NATIONAL ACADEMY OF SCIENTIST EDUCATION

YEARBOOK 2021/22

NEMZETI TUDÓSKÉPZŐ AKADÉMIA
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NATIONAL ACADEMY OF SCIENTIST EDUCATION

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Debrecen 113

Pécs 140

Szeged 170

THE MEMBERS OF THE NATIONAL BIOMEDICAL FOUNDATION BOARD OF TRUSTEES

ANDRÁS VARRÓ

CHAIRMAN OF THE BOARD OF TRUSTEES

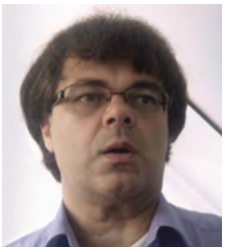
Professor of the Department of Pharmacology and Pharmacotherapy at the Albert Szent-György Medical School of the University of Szeged

PÉTER HEGYI

Professor at the Faculty of General Medicine of Semmelweis University and the University of Pécs

LÁSZLÓ DUX

Professor of the Institute of Biochemistry at the Albert Szent-Györgyi Medical School of the University of Szeged



ZOLTÁN GYENGE

Dean of the Faculty of Humanities and Social Sciences at the University of Szeged

LAJOS KEMÉNY

Professor and head of the Department of Dermatology and Allergology at the Albert Szent-Györgyi Medical School of the University of Szeged

ZOLTÁN KÓNYA

Vice-Rector for Scientific Affairs and Innovation at the University of Szeged

BÉLA MERKELY

Rector of Semmelweis University

FERENC NAGY

Director General of the Szeged Biological Research Centre Szeged

ZOLTÁN NUSSER

Director of the Institute of Experimental Medicine

ZSUZSANNA HELYES

Professor at the Medical School of the University of Pécs,
Chairman of the Szentágothai János Research Centre, Pécs

JÓZSEF TŐZSÉR

Vice-Rector responsible for health industry innovation and training development
at the University of Debrecen

LÁSZLÓ VÍGH

Research Professor of the Biological Research Centre Szeged

FORMER MEMBERS OF THE BOARD OF TRUSTEES

ISTVÁN LEPRÁN

as the dean's representative at the Faculty of Medicine of the University of Szeged (2013-2014)

LÁSZLÓ VÉCSEI

Dean of the Faculty of Medicine at the University of Szeged (2013-2014)

PÁL ORMOS

Director General of the Hungarian Academy of Sciences
Biological Research Centre Szeged (2013-2018)

FERENC BARI

Dean of the Faculty of Medicine at the University of Szeged (2014-2018)

GYÖRGY LÁZÁR

Dean of the Faculty of Medicine at the University of Szeged (2018-2021)

SZILVIA KRIZSÓ

Pulitzer Prize winning television journalist (2013-2021)

SCIENTIFIC SUPERVISORS OF THE NATIONAL BIOMEDICAL FOUNDATION

BERT SAKMANN

DIRECTOR GENERAL OF EDUCATION

Nobel Laureate cell physiologist, Max Planck Institute für Neurobiologie, München

ANDRÁS VARRÓ

STRATEGIC DIRECTOR

Professor of the Department of Pharmacology and Pharmacotherapy at the Albert Szent-György Medical School of the University of Szeged

PÉTER HEGYI

PROGRAM DIRECTOR,
DEVELOPER OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION (NASE) PROGRAM

Professor at the Faculty of General Medicine at Semmelweis University and the University of Pécs

UNIVERSITY EDUCATION PROGRAM

ZOLTÁN RAKONCZAY

DIRECTOR OF UNIVERSITY EDUCATION

Professor and head of the Institute of Pathophysiology at the Albert Szent-György Medical School of the University of Szeged

MÁRIA DELI

Scientific supervisor of the National Academy of Scientist Education at the Biological Research Centre Szeged Scientific Laboratory,
Director of the Institute of Biophysics, Biological Barriers Research Group at the Biological Research Centre Szeged

ÁDÁM DÉNES

Scientific supervisor of the National Academy of Scientist Education at the Institute of Experimental Medicine Scientific Laboratory,
Senior research fellow at the Institute of Experimental Medicine,
Director of the Neuroimmunology Research Group and the Cell Biology Centre

ZSUZSANNA HELYES

Scientific supervisor of the National Academy of Scientist Education at the University of Pécs Scientific Laboratory,
Professor at the Medical School of the University of Pécs,
Chairman of the Szentágothai János Research Centre

TAMÁS MARTINEK

Scientific supervisor of the National Academy of Scientist Education at the University of Szeged Scientific Laboratory,
Head of the Institute of Medical Chemistry at the Albert Szent-Györgyi Medical School of the University of Szeged

ATTILA MÓCSAI

Scientific supervisor of the National Academy of Scientist Education at the Semmelweis University Scientific Laboratory,
Professor of the Institute of Physiology at the Medical School of the Semmelweis University

ZOLTÁN PAPP

Scientific supervisor of the National Academy of Scientist Education at the University of Debrecen Scientific Laboratory,
Professor and head of the Institute of Clinical Physiology at the University of Debrecen,
Deputy Dean of Science at the University of Debrecen

SECONDARY SCHOOL EDUCATION PROGRAM

SÁNDOR BÁN

DIRECTOR OF SECONDARY SCHOOL EDUCATION

Senior teacher of biology at the Radnóti Miklós Experimental Grammar School, Szeged

ADRIEN LENGYEL

DIRECTOR OF SECONDARY SCHOOL EDUCATION

Teacher of biology and chemistry at the Calvinist Secondary School in Kecskemét

OPERATIVE MANAGEMENT

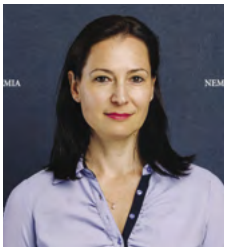
CONTACT: INFO@EDU-SCI.ORG WWW.EDU-SCI.ORG

ANITA TAKÁCS

MANAGING DIRECTOR

LUCA HERTELENDY-VARGA

FINANCIAL DIRECTOR



ÁGNES BITTERA

MARKETING AND EVENT MANAGER

LÁSZLÓNÉ FŐDI

FINANCIAL ASSISTANT

ZSUZSA PAPFALVI

UNIVERISTY EDUCATION COORDINATOR

ENIKŐ GULYÁS

SECONDARY SCHOOL EDUCATION COORDINATOR

JÓZSEF ANDÓCZI-BALOG

SOCIAL AND CULTURAL PROGRAM ORGANIZER

JÓZSEF TOLNAI

WEBSITE DEVELOPER

KLEBELSBERG SPONSORS

SCHOOL SUSTAINER:

GOVERNMENT
OF HUNGARY

SPONSORS:

Szeged

MCC
MATHIAS CORVINUS COLLEGIUM

RICHTER GEDEON

NEMZETI TUDÓSKÉPZŐ AKADÉMIA
NATIONAL ACADEMY OF SCIENTIST EDUCATION

SECONDARY SCHOOL PROGRAM

NATIONAL BASE SCHOOLS

RADNÓTI MIKLÓS EXPERIMENTAL GRAMMAR SCHOOL SZEGED

HEADMASTER: **DR. ANETT NAGY**

SZENT- GYÖRGYI SENIOR TEACHER: **ANDREA BORBOLA** *(See page 21)*

The Radnóti Miklós Experimental Grammar School of Szeged saw many profile changes throughout its 120 year old history. Originally named after Gábor Klauzál, it served as a boys' real school for Szeged's middle class. After the second World War a mixed education was introduced, adding the training of skilled workmanship next to the real school. The current general gymnasial profile – aiming to achieve scientific excellence – was gradually built up starting from 1957. The school's building is as old as the institute itself, historically decorated yet equipped with state of the art laboratories and ICT appliances. At the moment six different departments are operated: Mathematics-Physics, Chemistry, Biology, Mathematics, General Studies (with increased English or Spanish classes), Humanities and a talent care division focusing on students with underprivileged backgrounds.

The students achieve the best results in Mathematics and Sciences. The average grades of the final examinations and the number of students accepted to universities both mark efficiency of the education and talent care. It is also known that not many schools can exceed the 'Radnóti' when it comes to results at national and international competitions. While the faculty is proud of the students' achievements, they consider these competitions as a means of education, not as a main goal. During the preparation the students can learn confidence, persistency, self-knowledge and cooperation next to the professional knowledge. Hence the school's motto: 'Sapere aude' – 'Dare to know'.

The construction of the Specialized Laboratory for Scientific Education (TERMOSZ Laboratory) was finished in 2015. The laboratory is located at the school's area yet plays a central part in the renewal of scientific education collaborating with 18 other schools in the Szeged school district. The associates also help with the preparations and executions of international competitions, in addition they play a key role in the national biological talent care.

NÉMETH LÁSZLÓ SECONDARY AND GRAMMAR SCHOOL – HÓDMEZŐVÁSÁRHELY

HEADMASTER: **LÁSZLÓ ÁRVA**

SZENT- GYÖRGYI SENIOR TEACHER: **EDIT CSALÁNÉ BÖNGYIK** *(See page 22)*

Németh László Secondary and Grammar School was established in the 1980s to serve the Hódtó district of Hódmezővásárhely. Originally it was a minor elementary school, however it launched its gymnasial classes in 1995 which quickly helped to raise its ranks amongst the other high schools of the town. Besides the general gymnasial educational structure, the school also emphasizes language and IT (Information Technology) studies along with natural science.

It is an absolute advantage that the students can carry out their studies in one institute – the talent care and education starting from early age until their final examination. This counts as a unique feature in Hungary and it helps to maintain a smooth cooperation between the elementary and high school educators, helping out the long-term correction and design of the training plan. The students have proven themselves at several competitions and perform well on their final examinations – marking the good student-teacher collaboration.

The school's modern building provides a luminous, well established location and atmosphere to carry out high standard education. In addition, a botanical garden is being built which will be a green spot in the neighborhood.

The József Gyulai Scientific Workshop (József Gyulai Laboratory) was established in 2012, offering quality training with modern equipment. All the neighboring elementary students can use the laboratory under the supervision of its trained attendants.

SZTE PRIMARY AND SECONDARY GRAMMAR SCHOOL

HEADMASTER: **DR. JÁNOS DOBI**

SZENT-GYÖRGYI SENIOR TEACHER: **ISTVÁN CSIGÉR** *(See page 23)*

SZTE Primary and Secondary Grammar School can look back on a 66-year history. Its legal predecessor, the initially unnamed "New Grammar School", was established in 1955 as a practicing school of the Attila József University due to the increased number of teacher training and the increase in the number of high school students. It became known in the region - and nationally - as the Endre Ságvári High School from January 1956, then it operated as JATE, later under the name SZTE Endre Ságvári High School until 2015 when it received its current title due to forced name change and merger with the primary school of the same name.

Class types and class profiles gradually formed during the operation of the grammar school. French, English-Russian, mathematics-physics, and general curriculum classes operated for decades. The bilingual Hungarian-French training started in 1993, and in 2000 the board of teachers established the class structure that - with more or less changes - is still in place. Thus, pupils can choose between special mathematics and physics, Hungarian language and history, advanced biology developing natural science thinking, Hungarian-French bilingual, technical informatics and a general curriculum of six classes with English language orientation classes.

In the last 35-40 years, the competitive and cultural achievements of special mathematics, science subjects and humanities have rightly made it a recognized school in the region and the country.

The Szeged Regional Natural Science Laboratory for Pupils has been operating in the grammar school building since 2013, maintaining contacts with 18 partner schools for providing biology, physics, geography and chemistry laboratory classes.

Since 2015, the school and the laboratory have been the regional base institution of the secondary school program of the Szeged Scientists Academy and then, while maintaining this function, it has been operating as a national base school since June 2020.

REGIONAL BASE SCHOOLS

CALVINIST GRAMMAR SCHOOL OF KECSKEMÉT

Headmaster: Anna Durucz
Szent-Györgyi Senior Teacher:
Adrien Lengyel *(p. 19)*

DEÁK TÉRI LUTHERAN GYMNASIUM – GÖDÖLLŐ

Headmaster: Edit Gadóné Kézdy
Szent-Györgyi Senior Teacher:
Andrea Fazakas *(p. 27)*

ELTE BOLYAI JÁNOS PRACTICE PRIMARY AND SECONDARY GRAMMAR SCHOOL – SZOMBATHELY

Headmaster: Tibor Papp
Szent-Györgyi Senior Teacher:
József Baranyai *(p. 20)*

ELTE TREFORT ÁGOSTON SECONDARY GRAMMAR SCHOOL – BUDAPEST

Headmaster: Zoltán Csapodi
Szent-Györgyi Senior Teachers:
Norbert Faragó *(p. 26)*, László Kutrovácz *(p. 34)*

Photo: Gábor Magyar

FAZEKAS MIHALY PRIMARY AND SECONDARY GRAMMAR SCHOOL – BUDAPEST

Headmaster: dr. Zsolt Erős-Honti
Szent-Györgyi Senior Teachers:
dr. Zsolt Erős-Honti *(p.25)*,
Julianna Erős-Honti *(p. 24)*

FÖLDES FERENC HIGH SCHOOL – MISKOLC

Headmaster: Róbert Fazekas
Szent-Györgyi Senior Teacher:
Csilla Szentesi *(p. 37)*

GÖDÖLLŐ REFORMED SECONDARY SCHOOL

Headmaster: Árpádné Bajusz
Szent-Györgyi Senior Teacher:
Zsolt Horváth *(p. 29)*

LOVASSY LÁSZLÓ GRAMMAR SCHOOL – VESZPRÉM

Headmaster: Zoltán Schultz
Szent-Györgyi Senior Teacher:
Tünde dr. Szalainé Tóth *(p. 36)*

NAGY LAJOS GRAMMAR SCHOOL OF THE CISTERCIAN ORDER – PÉCS

Headmaster: Márta Bodáné Gálosi
Szent-Györgyi Senior Teacher: dr. Zsolt Nyisztor *(p. 35)*

NÉMETH LÁSZLÓ SECONDARY AND GRAMMAR SCHOOL – HÓDMEZŐVÁSÁRHELY

Headmaster: László Árva
Szent-Györgyi Senior Teacher:
Edit Csaláné Böngyik *(p. 22)*

PREMONSTRATENSIAN SCHOOL CENTER – GÖDÖLLŐ

Headmaster: Borbála Takácsné Elek
Szent-Györgyi Senior Teacher:
Zoltán Kerényi *(p. 31)*

RADNÓTI MIKLÓS EXPERIMENTAL GRAMMAR SCHOOL SZEGED

Headmaster: dr. Anett Nagy
Szent-Györgyi Senior Teacher:
Andrea Borbola *(p. 21)*

SZTE PRIMARY AND SECONDARY GRAMMAR SCHOOL – SZEGED

Headmaster: Dr. János Dobi
Szent-Györgyi Senior Teacher:
István Csigér *(p. 23)*

TÁNCSICS MIHÁLY SECONDARY GRAMMAR SCHOOL OF KAPOSVÁR

Headmaster: László Vámosi
Szent-Györgyi Senior Teachers:
Beatrix Bagi Kertész *(p. 33),* Róbert Kertész *(p. 32)*

TÓTH ÁRPÁD SECONDARY SCHOOL – DEBRECEN

Headmaster: Amália Fenyősné Kircsi
Szent-Györgyi Senior Teacher:
József Gőz *(p. 28)*

UNIVERSITY OF NYÍREGYHÁZA EÖTVÖS JÓZSEF PRACTICE PRIMARY SCHOOL AND HIGH SCHOOL

Headmaster: Dr. István Komáromi
Szent-Györgyi Senior Teacher: Szuhi Erika *(p. 38)*

VARGA KATALIN GRAMMAR SCHOOL SZOLNOK

Headmaster: László Molnár
Szent-Györgyi Senior Teacher:
Marianna Jeneiné Fekete *(p. 30)*

SZENT-GYÖRGYI SENIOR TEACHERS

"Those who affect children's imagination essentially influence their future existence as well."

József Eötvös

SÁNDOR BÁN

DIRECTOR OF SECONDARY SCHOOL EDUCATION

Radnóti Miklós Experimental Grammar School Szeged

Address: Tisza Lajos krt. 6-8., H-6720 Szeged, Hungary

TEACHING CAREER IN BRIEF

I started my career in 1993 at the Dugonics András Piarist Grammar School, Szeged, where I taught chemistry and biology, both as part of the regular curriculum and in advanced elective courses as well as special after-school lessons. In 1998–99, I played a leading role in designing and equipping the science section of the school's new building. I was also the head of the department of biology and chemistry for four years. Since 2002, I have taught in the special biology, chemistry and mathematics programs at the Radnóti Miklós Grammar School in Szeged, mostly in small groups. Between 2005 and 2012, I headed the biology department, which developed into the most successful high school biology workshop in the country during that period, based on advanced Matura examination and competition results. My colleagues and I have also established a state-of-the-art high school molecular biology laboratory. This facility has been made available to biology teachers from other schools for in-service trainings as well as to students for selection tests for international biology competitions. My colleagues and I have attended in-service trainings in molecular biology at the EMBL laboratories in Cambridge, Heidelberg and Monterotondo on a number of occasions. Since 2009, I have been the team leader of the Hungarian national teams at the International Biology Olympiad (IBO) and mentor to our national teams at the European Union Science Olympiad (EUSO). In 2010, I won the Rátz Lifetime Achievement Award. I am currently head of the EU-funded high school science laboratory.

PUBLICATIONS

Bán S. (1998). Gondolkodás a bizonytalanról: a valószínűségi és korrelatív gondolkodás fejlődése. [Thinking about the uncertain: developing probabilistic and correlative thinking]. In Csapó B. (Ed.): Az iskolai tudás. Budapest: Osiris Kiadó.

Bán S. (2010). A tanulás természetes jellemzőinek érvényesülése az iskolai biológiaoktatásban [Implementing natural features of learning in biology instruction]. Mester és Tanítvány 28: 48-56.

Bán S et al. (Eds.). (2003). From Vandal to Voter: Active Citizenship in Europe - Analysis and Methods. Szeged-Paris: KIFE.

SUCCESSFUL STUDENTS

Márton Szentirmai
Faculty of Medicine
University of Szeged, Szeged
- IBO 2011, silver medal
- EUSO 2010, gold medal
- IBO 2010, bronze medal

Petra Varga
Faculty of Medicine
University of Szeged, Szeged
- IBO 2016, silver medal
- EUSO 2015, gold medal
- iGEM 2014, Best Experimental Measurement Prize

Márk Harangozó
Faculty of Medicine
University of Szeged, Szeged
- EUSO 2015, silver medal
- iGEM 2014, Best Experimental Measurement Prize

Fatime Hawchar
Faculty of Medicine
University of Szeged, Szeged
- IBO 2011, bronze medal
- National Secondary School Competition (OKTV) Biology 4th place

Márton Pipicz
Faculty of Medicine
University of Szeged, Szeged
- Student research: Department of Anatomy, Faculty of Medicine, University of Szeged, Szeged
- 2011. Pro Scientia gold medal

ADRIEN LENGYEL

DIRECTOR OF SECONDARY SCHOOL EDUCATION

Calvinist Grammar School of Kecskemét

Address: Szabadság tér 3/a, H-6000 Kecskemét, Hungary

TEACHING CAREER IN BRIEF

Being a student at the József Attila University of Szeged, I concluded my studies as a Biology and Chemistry teacher. My first employment was at the Katona Secondary School at Kecskemét, then I changed to the Calvinistic Secondary School where I'm working up to this day. Upon launching the six-grade education program, my task was to develop the Chemistry curriculum, later I became the head of the teacher's team. We are frequent participants of the TUDOK (Annual Conference of National Scientific Students' Associations) with remarkable success. The achieved results truly enhanced my personal development. Along with a colleague, I'm organizing the Biology field trips which are quite popular amongst our students. I'm also an evaluating teacher at the advanced level final examinations. Throughout the years my main focus has been to modernize Biology education; especially reaching out for students who show interest in this field - for this achievement I received an award. Other significant professional steps were publishing textbooks and books assisting the preparation for final examinations (MAXIM publishing). These activities demand great devotion, lots of reading, consulting and many working hours, yet offer the best way for self-improvement in the dynamically changing subject of Biology. In addition, I handled full readership of a laboratory project and held advanced education to my colleagues. I find these activities both challenging and exciting. I have been working for the foundation since 2015, so our grammar school also became a basic school. The program is very attractive for students of regional high schools, today the active number covers more than a hundred students who are happy to attend our lectures and take part in laboratory classes, only here in the Kecskemét district. My work is to help as many talented students as possible find a place in our excellent universities, to take an active part in research and academic life. (I still have more research students than Szent-Györgyi.)

PUBLICATIONS

Cselekedeteink tüköre - / A szegedi orvosbiológiai kutatások jövőjéért / - cikk : **Lengyel Adrien** Print 2000 Nyomda 2020

Juhász K., **Vargáné L.A.** Theme Outlines for Biology Final Examination, Maxim Publishing, Szeged, 2017.

Juhász K., **Vargáné L.A.** 130 themes of Biology, Maxim Publishing, Szeged, 2017.

Juhász K., **Vargáné L.A.** Colourful thesmes of Biology, Maxim Publishing, Szeged, 2017.

Csigér, I., Juhász, K., **Vargáné Lengyel, A**. (2012). Biológia 12 (Biology 12). Szeged: Maxim Könyvkiadó

SUCCESSFUL STUDENTS

Andor Kenyeres
medical student at SZOTE
• OKTV Biology 2010, 35th place

Emese Klément
medical student at Semmelweis University
• OKTV Biology 2012, 30th place

Márk Svévis
doctor at the Honvéd Hospital Budapest
• ORKV Chemistry 2001, 1st place

JÓZSEF BARANYAI

ELTE Bolyai János Practice Primary and Secondary Grammar School

Address: Bolyai u. 11., H-9700 Szombathely, Hungary

TEACHING CAREER IN BRIEF

I completed my biology degree at the József Attila University (University of Szeged) in 1994. During my university years, I was a demonstrator at the Department of Zoology, and I stayed on as an assistant lecturer after receiving my degree. I have much to thank the excellent staff at the department (Drs. Róbert Gábriel, Éva Fekete and Katalin Halasi) for my professional development. They inspired me to become an outstanding student and assistant lecturer. Soon afterward, I was invited by János Iker to the newly established Bolyai Grammar School in Szombathely and have been teaching there since then for over 20 years. I am an advocate of problem-/inquiry-based learning, but also believe that there is not one single right method: one must always dynamically adjust to the problem at hand and tailor the methods accordingly. I have worked on a number of professional boards (Hungarian National Institute for Educational Research and Development (OKI/OFI) in curriculum development, dealing with the National Curriculum etc.). I am the head of our talent center, and I am proud of all the results of all my students. In 2011, I received the Rátz Lifetime Achievement Award, and in 2013 the Bonis Bona National Talent Award.

PUBLICATIONS

Baranyai J, Veres G. (2022). Biológia kompetencia fejlesztő feladatgyűjtemény

Baranyai J, Veres G. (2021). Biológia tankönyv 9-10.

Baranyai J, Szűcsné Kerti A. (2006). Biológia középszintű érettségi feladatgyűjtemény 10. [Intermediate biology Matura examination papers 10]. Budapest: Nemzeti Tankönyvkiadó.

Baranyai J, Szűcsné Kerti A. (2006). Biológia középszintű érettségi feladatgyűjtemény 11. [Intermediate biology Matura examination papers 11]. Budapest: Nemzeti Tankönyvkiadó.

Baranyai J, Szűcsné Kerti A. (2006). Biológia középszintű érettségi feladatgyűjtemény 12. [Intermediate biology Matura examination papers 12]. Budapest: Nemzeti Tankönyvkiadó.

SUCCESSFUL STUDENTS

Ramón Hegedüs
biophysics researcher – Barcelona
established own firm
- Intel International Science and Engineering Fair 2001, 1st prize

Péter Korcsmár
practising physician – Germany
- Bolyai Prize for Youth 2001

Krisztina Berek
intern – Second Department of Medicine and Cardiology Center, Szeged
- National Scientific and Innovation Contest for Youth 2004, 1st place

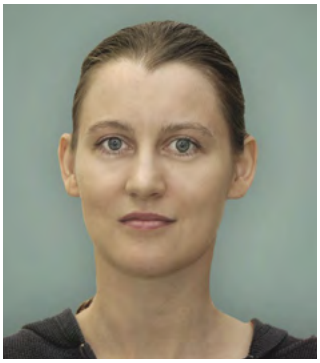
Péter Novinszky
physician – Szombathely
- IBO 2011, silver medal

Bence Hajnal
medical student
Semmelweis Medical University, Budapest
- IBO 2013, silver medal

Ádám Sánta
Biology student-SZTE
- OKTV 1. (2017)

Dominik Dobos
medical Student-SOTE
- 27th Youth Science and Innovation Talent Search Competition - 2nd Prize (2018)
- China Adolescent Science Technology and Innovation Contest - Macau, China - Second Main Prize, Biomedicine Category Special Prize (2019)

ANDREA BORBOLA



Radnóti Miklós Experimental Grammar School Szeged

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TEACHING CAREER IN BRIEF

I've been an associate at the TERMOSZ Laboratory since 2014, I consider it as a prime element in my life. During my high school years I had the opportunity of assisting at the Cell Biology and Evolutional Micropaleontology Laboratory of the University of Szeged, which helped me start my scientific work. Throughout my university studies I was co-authoring several English publications, participated in an Indian-Hungarian joint research and for years I was the technical editor of the Plant Cell Biology and Development (Szeged) issue. In addition I also acquired some successful applications (Pro Renovanda Cultura Hungariae Fund – 'Students for Science' foundation).

My interests shifted towards molecular biology - starting from 2001, I carried out my PhD studies at the Genetic Institute of the Biological Research Center (Hungarian Academy of Sciences); later on I worked there as a science assistant. Next to learning the basic molecular biology techniques and elaborating new methods I also participated in several conferences. At the moment I'm teaching Biology at the Radnóti Miklós Experimental Grammar School and tending to the TERMOSZ Laboratory.

PUBLICATIONS

Kiss E, Olah B, Kalo P, Morales M, Heckmann AB, **Borbola A**, Lozsa A, Kontar K, Middleton P, Downie JA, Oldroyd GED, Endre G: (2009) Lin, a novel type of u-box/wd40 protein, controls early infection by rhizobia in legumes. **PLANT PHYSIOLOGY 151**:1239-1249

Borbola A: (2004) Construction of a linkage map for Medicago truncatula RIL population and its comparative analysis with other Medicago genetic maps. **ACTA BIOLOGICA SZEGEDIENSIS 48:**51

Kedves M, Párdutz Á and **Borbola A**: (1998) Transmission electron microscopy of X-ray irradiated teliospores of Ustilago maydis. **GRANA 37:**29-34.

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Németh László Grammar School

Address: Németh László u. 16., H-6800 Hódmezővásárhely, Hungary

TEACHING CAREER IN BRIEF

I began teaching in the Commercial and hospitality secondary school of Hódmezővásárhely in 1998, parallel with my university studies and I have been working in the Németh László Grammar School since 2015. I have been teaching biology and chemistry and during my years in the vocational secondary school my students performed well at professional competitions. I have always felt fortunate to be a teacher, I am one of the few persons whose job is their hobby. I regularly attend professional trainings and always embrace varied pedagogical methods and educational forms. Recently, I have been committed to digital pedagogy. I was teaching complex nature for a long time, I also prepared a workbook for internal use with one of my colleagues. Thanks to this I became closer to the activities of the Öveges labs and also had the opportunity to participate in the elaboration of complex labotatory workbooks. I was also engaged for two years in a teacher training for renewing STEM thinking. I gladly contribute to project writing, I am proud of my two successful National Talent Projects. I held Visible Natural Science – Digital Teaching Practice course as a trainer of MDOE from 2018. In the spring of 2020, I was invited to develop professional recommendations in line with the new NAT. In December 2020, I won the Digital Educator Award in the Tempus competition. At present, I am teaching students committed to natural sciences at each grade above 8th and also the ones who wish to perform the advanced level biology final exam.

PUBLICATIONS

(2001) K. Hernádi, I. Pálinkó, **E. Böngyik**, I. Kiricsi, Biomimetic oxygen transfer by Co and Cu complexes immobilized in porous matrices, **Studies in Surface Science and Catalysis** (https://www.sciencedirect.com/science/article/abs/pii/S0167299101818607?fbclid=IwAR0Bjxq2VFVhqnFrsiEJZDJS3EVEmpI6j-lbyL5IuL2zC7RhBZwtu6ooSo8)

(2016) Mobileszközök az oktatásban konferencia, Okostelefonokkal a természettudományos oktatásban, Debreceni Egyetemi Kiadó, Veszprém 2016

SUCCESSFUL STUDENTS

Lemaitre Lucien
- Rajki Zsuzsa award
- Szent-Györgyi competition 6. prize
- 2022 - Talented student of the year

ISTVÁN CSIGÉR

SZTE Primary and Secondary Grammar School

Address: Szentháromság u. 2., H-6722 Szeged, Hungary

TEACHING CAREER IN BRIEF

I earned my degree at the József Attila University (University of Szeged) in 1985, which qualified me to teach biology and chemistry in secondary school. Right after I completed my studies, I started my career at the Vocational School for Forestry amd Water Resources Engineering and Management in Barcs, where I spent six years. I taught biology and chemistry to students in the forestry stream and chemistry and lab practice to students in the water resources engineering and management stream. In acknowledgement of my work, I received a Ministerial Commendation in 1989. In 1991, I came to my current workplace, the University of Szeged Grammar School and Primary School (previously the University of Szeged Ságvári Endre Grammar School) as a mentor teacher in biology. My basic job has been to teach biology and to train university students studying to become biology teachers (supervising student teaching and administering examinations to student teachers). I also work as the lead teacher for biology in the Szeged Regional Student Science Laboratory, established by our high school and by the University of Szeged, which supports it financially. Within the limits of reason, I endeavour to develop relationships with my high school and university students based on collegiality and respect, never compromising on quality work standards or the requirements of consistent and rigorous assessment. In acknowledgement of my teaching activities, I received the Golden Rostrum Commemorative Plaque in 2001. I first became involved in the Szeged Scientists Academy in 2012, which honored me with the title of Szent-Györgyi Teacher and then in 2016 with that of Szent-Györgyi Senior Teacher. I have endeavoured to aid the academy from the beginning to discover and cultivate young talent.

PUBLICATIONS

Csigér I, Juhász K, Vargáné Lengyel A. (2011). Biológia 11 [Biology 11]. Szeged: Maxim Könyvkiadó.

Csigér I, Juhász K, Vargáné Lengyel A. (2012). Biológia 12 [Biology 12]. Szeged: Maxim Könyvkiadó.

Csigér I, Németh E. (2005). Néhány szakmai észrevétel dr. Lénárd Gábor Biológia II. és Biológia III. Tankönyvéről [Some observations on Dr. Gábor Lénárd's Biology II and Biology III coursebooks]. A biológia tanítása 2. szám: 7-19

SUCCESSFUL STUDENTS

Tamás Kovács
forest engineer
• Kitaibel Pál Competition 1988, 4th place

Magdolna Gaál
dermatologist, associate professor
Dermotology Clinic,
Faculty of Medicine,
University of Szeged, Szeged

Attila Vass
ophthalmologist
Eye Clinic, Faculty of Medicine,
University of Szeged, Szeged

László Pecze
biologist
University of Fribourg, Switzerland
• National Secondary School Competition (OKTV) 1997, 17th place

JULIANNA ERŐS-HONTI

Fazekas Mihaly Primary and Secondary Grammar School

Address: Horváth Mihály tér 8., H-1082 Budapest, Hungary

TEACHING CAREER IN BRIEF

I completed my studies as a research biologist at Eötvös Loránd University, Budapest, with a concentration in evolutionary biology, systematics and ecology. Later, at the same institution, I studied in the Theoretical Ecology Program within the Doctoral School for Biology. In the meanwhile, I also earned a teaching degree. I conducted my research in the field of plant ecology, examining the distribution of grass species in the Dolomites. In my research work, I gained experience in planning research. I can thus assist students in carrying out independent research and writing articles. I taught biology at Fazekas Mihály Primary and Grammar School for 8 years. Here I gained experiences in nurturing excellence, preparing students for competitions, as well as in giving demonstrative lessons. Actually, I work in the ELTE Trefort Ágoston Grammar School, where I also mentor candidate teachers in addition to the above mentioned tasks. A great emphasis is placed on academic competitions at our school, for which we continuously prepare our students. I consider my most signficant tasks to be the special after-school lessons for nurturing excellence and the summer biology camps that I organise, in which our students can become acquainted with the mentality of the researcher and the diversity of the academic field. In addition to teaching, I have worked as an educational developer for the Hungarian National Institute for Educational Research and Development (OFI), and I also contribute to the work of the Matura examination, as assigned by the Office of Education.

PUBLICATIONS

Mihók B, Erős-Honti Zs, Gálhidy L, Bela Gy, Illyés E, Tinya F, **Erős-Honti J**, Molnár Á, Szabó R. (2006). A Borsodi-ártér természeti állapota a helyben élők és az ökológusok szemével - interdiszciplináris kutatás a hagyományos ökológiai tudásról [The natural state of the Borsod flood plain through the eyes of locals and ecologists: interdisciplinary research on traditional ecological knowledge]. TERM. VÉD. KÖZL. 12: 79-103.

Dobolyi K, **Erős-Honti J**, Botta-Dukát Z. (2008). Habitat preference of Linum dolomiticum (Linaceae) STUDIA. BOT. HUNG. 39: 135–144.

Dobolyi K, **Erős-Honti J**, Rédei T. (2010). Az Odvas-hegy flórája és vegetációja [The flora and vegetation of the Odvas Mountain]. In Molnár Cs, Molnár Zs, Varga A. (Eds.): „Hol az a táj szab az életnek teret, Mit az Isten csak jókedvében teremt." Válogatás az első tizenhárom MÉTA-túrafüzetből MTA-ÖBKI, Vácrátót, 2003-2009. pp. 191-199.

SUCCESSFUL STUDENTS

Balázs Striker
university student – Imperial College London
- National Secondary School Competition (OKTV) biology, category II, 2018. 2nd place
- Dr. Árokszállásy Zoltán National Biology and Environmental Protection Competition, category III, 2017. 1st place

Kinga Tomcsányi
university student – Semmelweis University
- National Secondary School Competition (OKTV) biology, category II, 2018. 4th place

Csaba Szilágyi
university student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) biology, category II, 2013, 2nd place

Eszter Székely
university student – chemistry
Faculty of Sciences,
Eötvös Loránd University, Budapest
- OKTV biology, category I, 2012, 6th place

Dániel Zahemszky
university student – biology
University of York
- Dr. Árokszállásy Zoltán National Biology and Environmental Protection Competition 2013, 5th–7th place

DR. ZSOLT ERŐS-HONTI

Fazekas Mihaly Primary and Secondary Grammar School

Address: Horváth Mihály tér 8., H-1082 Budapest, Hungary

TEACHING CAREER IN BRIEF

I am a research biologist with a PhD as well as having been trained as a specialized translator and secondary school biology teacher. For several years I had been working as an active reasercher at the Faculty of Horticultural Science, Szent István University. Ever since I received my teaching degree, I have been teaching biology to secondary school students (both in Hungarian and English). I participate in the nurturing excellence program at the school, preparing students for both domestic and international competitions, including the International Biology Olympiad. I also organise camps and prepare students for the Matura examination. I have developed teaching materials for public education, edited and published educational methodolgy coursebooks, and provided professional editing for materials used in public education. I participated in a Social Renewal Operational Program (TÁMOP) project dealing with the implementation of the framework curriculum in the Hungarian National Institute for Educational Research and Development (OFI), and I was also a member of a working group that harmonised the requirements of the Matura examinations with those of the framework curriculum. Since 2012, I have regularly completed assignments for the Office of Education. Currently, I am working as a biology teacher and vice principal at the Fazekas Mihály Primary and Grammar School of Budapest. As someone previously involved in higher education, it is my conviction that development and nurturing excellence should not be a process tied to particular educational phases. It should be an overarching effort. I am also convinced that success in the education system depends on effective communication between public and higher education.

PUBLICATIONS

Erős-Honti Zs. (2011). A kertészeti növények alaktana [Morphology of horticultural plants]. Egyetemi jegyzet. Budapest: BCE-KeTK.

Erős-Honti Zs. (2015). Az info-kommunikációs technológiák (IKT) alkalmazásának lehetőségei a kertészeti oktatás szakmódszertanában [Options for using Information and Communications Technology (ICT) in teaching horticulture]. In Szakmódszertani jegyzet az agrár-mérnöktanárok és -hallgatók számára (mezőgazdasági gépészet, mezőgazdaság, kertészet és parképítés) (Erős-Honti Zs, Nagy J). Budapest: BCE.

Jakucs E, **Erős-Honti Z**, Seress D, Kovács G M. (2015). Enhancing our understanding of anatomical diversity in Tomentella ectomycorrhizas: characterization of six new morphotypes. MYCORRHIZA 25(6): 419-429

NORBERT FARAGÓ

ELTE Trefort Ágoston Secondary Grammar School

Address: Trefort u. 8., H-1088 Budapest, Hungary

TEACHING CAREER IN BRIEF

I began my teaching career at the Terézváros Bilingual Primary and Grammar School in Budapest in 2001. I also taught biology and chemistry at a private grammar school concurrently. Since 2005, I have taught at the Trefort Ágoston School in Budapest, mostly biology. I have been a mentor teacher since 2006. In 2010, I received a certificate in mentoring candidate teachers. At school, I teach seventh- to twelfth-grade students as well as preparing the eleventh- and twelfth-grade students in advanced elective courses. Our students have achieved strong results at the Herman and Kitaibel competitions as well as at the National Secondary School Competition (OKTV) and the Árokszállásy biology and environmental protection competition. I regularly prepare students in groups for the advanced Matura examination. Since 2013, I have been head of the school's TÁMOP-funded science laboratory.

PUBLICATIONS

Faragó N., Szászné H J. (2013). Biológia lépésről lépésre [Biology step by step]. Budapest: Bölcselet Egyesület.

Czédulás K, **Faragó N,** Solymoss M, Szászné H J. (2013). Még egy lépés a biológia érettségihez [One more step toward the biology Matura examination]. Budapest: Bölcselet Egyesület.

SUCCESSFUL STUDENTS

Eszter Tóth
university student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) biology 2010, 2nd prize

György Varga
university student
Faculty of Sciences,
Eötvös Loránd University, Budapest
- Herman Competition 2010, 2nd prize - Árokszállásy Competition 2011, 1st prize EUSO XI, 2012, silver

Anna Uzonyi
university student
Technische Universität München
- Árokszállásy Competition 2014, 1st prize OKTV 2014, 1st prize
- IBO 2013, silver
- IBO 2014, silver

ANDREA FAZAKAS

Deák Téri Lutheran Gymnasium

Address: Sütő u. 1., H-1052 Budapest, Hungary

TEACHING CAREER IN BRIEF

I graduated with a secondary school teaching degree in biology and chemistry at József Attila University (University of Szeged) in 1988. I began teaching at the Deák Tér Lutheran Grammar School in Budapest in 1993. I quickly learned the importance of an encouraging school atmosphere in nurturing talented students. I developed Matura examinations for the Hungarian National Institute for Educational Research and Development (OFI) between 2003 and 2006. In 2004, I attended a Training for Trainers program to implement the two-tier Matura examination, and in 2004–05, I held talks on this new system for my colleagues. I have also participated in administering the advanced Matura examination since 2005. Meanwhile, in 2005, I passed a qualifying examination to become a mentor teacher at the Faculty of Sciences, Eötvös Loránd University, Budapest. I have always been happy to mentor future teachers. I have seen five of my candidates complete their teacher training. I received the BONIS BONA for the Nation's Talent Award in 2013 in acknowledgement of my efforts in preparing students for the National Secondary School Competition (OKTV). In 2015, I applied for the master teacher rank and received it the following year. I consider it important during my work to instil a passion for biology in my students and introduce them to the logic of the natural sciences. Various extracurricular events offer excellent opportunities in that regard. During the academic year, we usually take hiking trips, mainly in the Danube–Ipoly National Park (DINP). In addition, we also visit laboratories and attend lectures organised for students by the Hungarian Academy of Sciences. During the summer holidays, I take my students to one-week ecocamps. We have already visited the Kis-Balaton, Szatmár, Őrség and Lake Velence regions in and around Hungary as well as the North Hungarian Mountains.

PUBLICATIONS

Dr. Kisfaludy A, Dombóvári L, **Fazakas A,** Dr. Lóczy D. (2008). Természettudományi Enciklopédia [Encyclopaedia of science]. Budapest: Nemzeti Tankönyvkiadó.

SUCCESSFUL STUDENTS

Katalin Czöndör
researcher – assistant lecturer
Department of Physiology and Neurobiology,
Eötvös Loránd University, Budapest;
postdoc, University of Bordeaux
- L'Oréal-UNESCO for Women in Science International Prize 2014

Dóra Pálya
university student
Faculty of Medicine, Semmelweis University, Budapest
- National Secondary School Competition (OKTV) Biology 2015, 1st prize
- Curie Environmental Protection Competition 2014, 8th place
- Szentágothai Competition 2016, 1st prize

Orsolya Gresits
physician
Orthopedic Clinic,
Semmelweis University, Budapest
- OKTV Biology 2008, 11th place

Huba Szebik
university student – biology
Eötvös Loránd University, Budapest
- OKTV Biology 2013, 9th place
- OKTV Biology 2014, 31st place
- IBO national selection finals 2014

Bence Domokos
university student
Faculty of Medicine,
Semmelweis University, Budapest
- OKTV biology 2015, 11th place
- OKTV Biology 2016, 28th place
- Szentágothai Competition 2016, 5th place

JÓZSEF GŐZ

Tóth Árpád Secondary School

Address: Szombathi István u. 12., H-4024 Debrecen, Hungary

TEACHING CAREER IN BRIEF

I have been teaching biology and chemistry at the Tóth Árpád Grammar School in Debrecen since 2000. During my career, I have earned a qualification in specialized Hungarian–English translation as well as passing a mentor teaching examination and receiving the title of master teacher. At my job, in addition to teaching in the specialized biology program, I also joined the Arany János Nurturing Excellence Program, the International Baccalaureate Program and the Öveges Scientific Laboratory Program, as well as being involved in grant projects and in mentoring candidate teachers. In our school we are engaged in a specialized high school program for Biology and Chemistry that enjoys the longest history in the country. An integral part of this is nurturing excellence, developing projects, and preparing students for competitions and the Matura examinations. As a Matura examiner, I operate an online database which aids in the students' preparations for the examination with items on the written part presented in a system. My main area of interest and research is the methodology of teaching biology and, within that, digital innovation. In my work, I do my best to combine the facilities of ICT and the international environment with the traditional values embodied by my workplace and the domestic professional community. In 2018, I was awarded the Szent-Györgyi Trophy by the University of Szeged, and the MESTER-M award by the MOL Foundation. As a translator I participate in the Hungarian adaptation of science education materials of Khan Academy since 2021.

PUBLICATIONS

Dobróné Tóth M, Futóné Monori E, **Gőz J**, Revákné Markóczi I. (2015). Biológiatanítás az IKT és IBL világában [Biology teaching in a world of ICT and IBL]. Debrecen: Debreceni Egyetemi Kiadó

Gőz J. (2021): A Khan Academy egy középiskolai tanár szemével. **MAGYAR KÉMIKUSOK LAPJA 76(11)**: 343-344.

SUCCESSFUL STUDENTS

Anna Nagy
university student, Eötvös Loránd University, Budapest
- Kitaibel Pál Competition 2015, 1st prize

Barbara Hinnah
university student, Faculty of Medicine, University of Debrecen
- Szent-Györgyi Competition 2016, 2nd prize

Erika Bereczki
university student, Faculty of Medicine, University of Debrecen
- Szent-Györgyi Competition 2016, 2nd prize

Bálint Ugrin
university student, Eötvös Loránd University, Budapest
- Bugát Pál Competition 2017, 3rd prize

Bettina Bán
university student, University of Technology and Economics, Budapest
- Bugát Pál Competition 2017, 3rd prize

Benedek Szathmári
university student - University of Szeged, Faculty of Sciences
- Biology National Secondary School Competition 2020, 36th place
- Szent-Györgyi Competition 2019 1st place
- Árokszállás Competition 2020 5th place
- Árokszállás Competition 2019 7th place
- Árokszállás Competition 2018 4th place

Dóra Pintye
university student - University of Debrecen, Faculty of Medicine
- Árokszállás Competition 2019 21th place
- Árokszállás Competition 2018 12th place

ZSOLT HORVÁTH

Gödöllő Reformed Secondary School

Address: Szabadság tér 9., H-2100 Gödöllő, Hungary

TEACHING CAREER IN BRIEF

I received my teaching degree in biology and chemistry from the Kossuth Lajos University (University of Debrecen) in 1995 and have been working since then at the Reformed Church Grammar School in Gödöllő. During the first years of my career, I learned about the BISEL biological water quality assessment method, and in 2000 I participated in the Bioindication and Internet 2000 EU Leonardo in-service training for teachers in Belgium. Then in summer 2002, I organised the BISEL bioindication water quality assessment method 2 accredited in-service training. Between 2006 and 2008, I was asked to update high school biology coursebooks written by Gábor Lénárd and published by Nemzeti Tankönyvkiadó publishers. My tasks included editing (the Prizma series written by Mrs József Berger), preparing digital teaching materials (a CD-ROM with images, figures and experiments for the Lénárd biology coursebook series) and holding lectures (at the start-of-the-year Nemzeti Tankönyvkiadó conference). I have participated in designing biology competition items since 2008. Between 2011 and 2012, I edited digital teaching materials for chemistry and biology called Yenka and Sunflower, and I prepared a series of histological images for Mozaik Publishers. In 2015, I edited digital teaching materials entitled "The molecular cell biology of autolysis, apoptosis and cell regeneration", created by the Department of Anatomical, Cell and Developmental Biology, Eötvös Loránd University, and took part in a training for trainers on the advanced Matura examination in biology. As of 2016, my school (along with three other Hungarian high schools) has participated in a health protection program based on the TANTUdSZT contemporary teaching project, which won a teaching methodology competition announced by the Hungarian Academy of Sciences. In 2016, I had three articles published in the Eduvital column of Élet és Tudomány (Life and Science), a popular science weekly.

PUBLICATIONS

Horváth Zs. (2008). Képek, ábrák és kísérletgyűjtemény a Lénárd-féle biológia-tankönyvcsaládhoz [Images, figures and experiments for the Lénárd biology coursebook series]. Budapest: Nemzeti Tankönyvkiadó Zrt.

Horváth Zs. (2016). Fehérjebontás a sejtekben [Proteolysis in cells]. ÉLET ÉS TUDOMÁNY 71: 140-142.

Papp T, Szekeres Zs, Huoranszki Cs, **Horváth Zs.** (2016). Mindennapi kenyerünk 1-2 [Our daily bread 1–2]. ÉLET ÉS TUDOMÁNY 71: 468-470.

Horváth Zs. Biology assignments for those preparing for advanced level graduation and OKTV Mozaik Publisher, Szeged, 2019

Horváth Zs. Test maturity task sets 10 task sets with solutions and explanations Mozaik Publisher, Szeged, 2020

SUCCESSFUL STUDENTS

Éva Hamar
PhD student
Vegetable Crop Research Department, National Agricultural Research and Innovation Center

- National Secondary School Competition (OKTV) 2011, 7th place
- TUDOK National Finals: Medicine-biology section: special prize for best presentation

MARIANNA JENEINÉ FEKETE

Varga Katalin Grammar School

Address: Szabadság tér 6., H-5000 Szolnok, Hungary

TEACHING CAREER IN BRIEF

I obtained my first degree in biology at the Károly Eszterházy Teacher Training College in Eger in 1992, and then I graduated from the University of Debrecen in 2012 as a certified biology teacher (MSc). In the meantime, thanks to the University of Debrecen, I became a Master of Arts (MA) in English in 2010. Later, in 2018, I became a qualified teacher with a specialization in mentoring. I taught in several types of schools until 2008, when I became a teacher at the Katalin Varga Secondary School in Szolnok, where I teach English and biology in Hungarian and English at intermediate and advanced levels. I participate in graduation committees of middle- and advanced-level exams, both as a member and as chairman, for biology exams in English and Hungarian. As a master teacher, I have been working as a qualifier and supervisor since January 2022. From 2009 to 2019, I was one of the implementers of the student exchange program of BIOCAMP, which was organized twice a year in Szolnok and Brussels. We worked together with the teachers of European School in Brussels. Within the framework of the program, my colleagues and I developed an English-language students' task set for internal use, which was adapted to the theme of the given year: e.g. light, water. I became the deputy head of the laboratory set up thanks to the Öveges program in 2014, where, alongside our students, we hosted practical classes in the four science subjects in a total of 12 primary schools. I became responsible for setting up the biology department in the program. In addition to organizing the in-service training of primary school teachers, my task was to introduce them to the operation of the laboratory's ICT tools and e-lab diary. From 2016, I have been regularly visiting the programs of the Szeged and National Academy of Science with my students. I became a Szent-Györgyi Teacher because I could see that lab practise, lectures in English, and especially meetings with Nobel Prize-winning scientists bring scientific research closer to my students, bring the book-like curriculum to life, and strengthen their commitment to science. As a teacher, the most important thing for me is to help students find and achieve their goals.

PUBLICATIONS

Jeneiné Fekete M: Biology Workbook 12th grade (intermediate level), Szolnok, 2014

Jeneiné Fekete M: Teacher's Guide 12th grade (biology intermediate level), Szolnok, 2014

Jeneiné Fekete M: Biology Workbook 11-12. grade (advanced level), Szolnok, 2014

Jeneiné Fekete M: Teacher's Guide 11-12. grade (biology advanced level), Szolnok, 2014;

SUCCESSFUL STUDENTS

Réka Kránicz
Anaesthesiologist and intensive care resident (SZTE-ÁOK) Szolnok, Hetényi Géza Hospital
• OKTV Biology 2012.

Bence Borbély
Resident urologist (SZTE-ÁOK) Szolnok, Hetényi Géza Hospital and Clinic
• OKTV Biology 2012.

Noémi Suszterics-Fülöp
Anaesthesiologist and intensive care resident (SOTE-ÁOK) Dunaújváros, Szent Pantaleon Hospital
• Bugát Pál National Science Competition 2013. 1st place team member (biology)

István Nócs
Molecular Bionics Engineer BSc, Engineering Informatics MSc (SZTE-TTK)
• OKTV Biology 2014. I. category 31st place

Bence Varga
Resident Surgeon (DE-ÁOK - summa cum laude qualification)
Research Fellowship - Norton University (USA)
• OKTV Biology 2014.

Zsuzsanna Ladányi
Cardiovascular Resident (SOTE);
PhD student SOTE Doctoral School of Theoretical and Translational Medicine
• OKTV Biology 2016.

ZOLTÁN JÁNOS KERÉNYI

Premonstratensian School Center

Address: Takács Menyhért út 2., H-2100 Gödöllő, Hungary

TEACHING CAREER IN BRIEF

I graduated from József Attila University (University of Szeged) as both a biology teacher and a biologist with specialization in ecology. I started my teaching career in Dugonics András Piarist Grammar School in Szeged as an external teacher, then in 1998 I joined Premonstratensian St. Norbert Grammar School in Gödöllő. I was teaching in the regular curriculum for years, and I taught biology as an extracurricular activity to students applying to university and to enthusiasts as well. We launched a specialized program in biology and chemistry in 2014-15, and I played an active role in developing its content and structure as the lead of the working group. Since our school boasts a great many outstanding students, my teaching activity has become focused on working with young people with particular talent. In order to carry out this work with a truly professional manner, I attended a course at the University of Debrecen to become a talent development teacher (pedagogical professional examination), and completed 'Géniusz' in-service training as well ('Nurturing excellence among talented biology students'). One regular, preferred form of working with talented young people is the 'Path to Science' program where research teams of five students are formed to learn and improve their thinking through joint research activities on a particular subject. At the end of these projects the research teams present their results in a scientific presentation each year at ‚TUDOK' regional and national conferences. For my work in nurturing excellence, I have received Kontra György Award (2010), Bonis Bona Award (2013), Ministerial Certificate of Recognition (2016) and Pro Progressio Award (2018) so far.

PUBLICATIONS

Kerényi Z. (2004). Pilisjászfalu madárvilága [The bird world of Pilisjászfalu]. In Pilisjászfalu I. Pilisjászfalu: Pilisjászfaluért Közalapítvány.

Kerényi Z. (2011). A Gödöllői-dombság állatvilága [The animal world of the Gödöllő Hills]. In Szabó L. (Ed.): A Gödöllői-dombság természeti- és gazdaságföldrajzi viszonyai. Budapest: Agroinform Kiadó.

Kerényi Z, Ivók E. (2013). Nestsite characteristics of the European Bee-eater (Merops apiaster L.) in the Gödöllő Hills. ORNIS HUNGARICA 21(2): 23-32.

SUCCESSFUL STUDENTS

Bence Prehoda
university student, Faculty of Medicine, Semmelweis University, Budapest
- National Secondary School Competition (OKTV) Biology 2012, 4th place
- OKTV Biology 2013, 12th place
- IBO national selection, 3rd place

Flóra Takács
university student
University College London
- OKTV Biology 2014, 8th place
- IBO 2015, silver medal
- ICYS 2015, silver medal

Márton Csaba
university student, Faculty of Medicine, Semmelweis University, Budapest
- OKTV Biology 2015, 12th place
- TUDOK national finals 2015, grand prize
- KutDiák essay-writing competition 2014, 1st prize
- Avram Hershko Science Competition 2014. and 2015, 1st prize

István Krisztofer Tóth
Bartók Conservatory, Liszt Academy
- Hlavay József National Environmental Science Students Conference 2014, 1st prize
- TUDOK national finals 2015, grand prize

Gergely Csigi
university student, Faculty of Medicine, Semmelweis University, Budapest
- Hlavay József National Environmental Science Students Conference 2016, 1st prize
- OKTV Biology 2017, 21st place and 2018, 15th place
- International Conference of Young Scientist 2017, bronze medal, 2018, silver medal
- TUDOK national finals 2017, 2nd place

RÓBERT KERTÉSZ

Táncsics Mihály Secondary Grammar School of Kaposvár

Address: Bajcsy-Zsilinszky u. 17., H-7400 Kaposvár, Hungary

TEACHING CAREER IN BRIEF

I earned my secondary school teaching degree in biology and chemisry at the József Attila University (University of Szeged) in 1993. I started working at the Department of Botany there and then moved to Kaposvár in 1997. Since then, I have been teaching biology and chemistry in the regular and specialized curricular programs at my alma mater there, Táncsics Mihály Grammar School. Since the Research area of the two-tier Matura examinations, I have participated in the work of the advanced Matura examination boards, I have corrected advanced written Matura examinations and was even requested to oversee examination marking. I passed two specialized examinations (at the University of Szeged and the Budapest University of Technology and Economics) and have incorporated the knowledge I have thus acquired into my everyday practice. In 2014, I received the rank of master teacher, so I am now also called on to provide consultations, through which I endeavour to improve the position of my scientific subjects, which are continually being pushed into the background. During my work in secondary school, I have always laid great stress on nurturing excellence – I have prepared my students for various competions in both of my subjects. I consider it important to aid my students in strengthening their own innate interest and developing their own high professional standards.

PUBLICATIONS

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SUCCESSFUL STUDENTS

Ábel Perjés
research fellow
National Institute for Sports Medicine
• National Secondary School Competition (OKTV) Biology 2009, 9th place

András Horváth
research fellow
Institute of Enzymology, Hungarian Academy of Sciences, Budapest
• OKTV Biology 2002

Szabolcs József Vigvári
physician
Department of Emergency Medicine, University of Pécs
• OKTV Biology 2002

Szilveszter Ziegenheim
PhD student
University of Szeged
• OKTV Biology 2010

BEATRIX CSILLA BAGI KERTÉSZ

Táncsics Mihály Secondary Grammar School of Kaposvár

Address: Bajcsy-Zsilinszky u. 17., H-7400 Kaposvár, Hungary

TEACHING CAREER IN BRIEF

I earned my teaching degree in biology and chemistry at the József Attila University (University of Szeged) in 1993. I rounded out my degree with a postgraduate qualification in environmental protection in 1995. I taught at the Corvin Mátyás Vocational School in Hódmezővásárhely for four years, and I have been teaching in my current workplace at the Táncsics Mihály Grammar School in Kaposvár since 2001. Throughout my career, I have placed a major emphasis on nurturing excellence in my professional work. My students have achieved success at various competitions in chemistry, biology and environmental protection, many of them having gone on to study medicine, pharmacy,

biology and chemistry. I teach advanced elective courses in both my subject areas, and I was the form teacher for three of the groups in the school specializing in biology and chemistry as well as their teacher in those subjects. I have aided my students with a great deal of useful experience by regularly participating in the advanced Matura examinations in both of my subjects. I have always considered it important to learn about and apply an objective measurement of knowledge. I therefore did a specialized examination in teaching with a specialization in educational assessment at the University of Pécs in 2011. I feel responsible for the future of my academic subjects. My aim is for us to engage in a truly appealing science education in our schools at a high standard, an effort I strive to support as a consultant with a master teacher qualification. Finally, I think one needs sufficient professional humility and endurance to be successful in one's work, not only talent.

PUBLICATIONS

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SUCCESSFUL STUDENTS

Bence Bajzik
medical student – Faculty of Medicine, University of Pécs
- Árokszállásy 2011, 5th place
- OKTV Biology (II.) 2013, 34th place
- Fodor 2013, 2nd prize

Eszter Kovács
medical student – Faculty of Medicine, Semmelweis University, Budapest
- Árokszállásy 2017, 4th place
- OKTV Biology (II.) 2017, 7th place

Krisztina Bőhm
- Árokszállásy 2021, 3rd place
- Oláh 2021, 7th place

Zsombor Esküdt
- EUSO sc. 2020, 6th place

Botond Szikra
- Árokszállásy 2018, 3rd place, 2019, 1st place, 2020, 1st place, 2021, 4th place
- Fodor 2019, 3rd place, 2021, 1st place
- Irinyi 2019, 6th place
- Kitaibel 2019, 1st place
- Oláh 2021, 6th place
- OKTV Biology(II.) 2021, 9th place
- OKTV Chemistry (II.) 2021, 14th place
- IBO sc. 2021, 5th place
- Young Scientists Biology 2021, 8th place,
- Young Scientists Chemistry 9th place
- SZTA Excellent Student Award 2021.

Máté Szekér
- Irinyi 2018, 12th place, 2019, 8th place
- Oláh 2021, 3rd place
- Fodor 2021, 3rd place
- OKTV Biology(II.) 2020, 24th place, 2021, 14th place
- OKTV Chemistry (II.) 2020, 19th place, 2021, 15th place
- Young Scientists Biology 2021, 9th place
- IBO sc. 2021, 4th place

LÁSZLÓ KUTROVÁCZ

ELTE Trefort Ágoston Secondary Grammar School

Address: Trefort u. 8., H-1088 Budapest, Hungary

TEACHING CAREER IN BRIEF

I started my teaching career in autumn 2002 at the Eötvös Loránd University Trefort Ágoston School in Budapest, where I have worked ever since. I have trained candidate teachers as a mentor teacher in chemistry there for nine years, and I have been department head since 2011. As a form teacher, I will see my second group of students complete their Matura examinations. In 2010, I received the Trefort Ágoston Certificate of Recognition from the Eötvös Loránd University Senate. In the same year, I was certified as a mentor teacher with a specialization in nurturing excellence. My goal is to shed light on the beauty and importance of scientific connections and their close ties to our everyday lives. I lay a great deal of emphasis on mentoring talented students in special after-school lessons. Two of my students have reached the National Secondary School Competition (OKTV) finals in biology and two have done so in chemistry. One of my students became a member of the national team for the International Mendeleev Chemistry Olympiad. In 2018 I received the Lórrántfy Zsuzsanna Award from the ELTE Senate, and in 2019 I received the Bonis Bona Award from the Ministry of Human Resources.

PUBLICATIONS

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SUCCESSFUL STUDENTS

Borbála Bognár
psychologist
- National Secondary School Competition (OKTV) biology 2007,13th place

Susanne Prokop
medical researcher – KatonaLab – Momentum Laboratory of Molecular Neurobiology
- Irinyi János National Chemistry Competition 2008, 25th place
- National Secondary School Competition (OKTV) chemistry 2010, 30th place (could not participate in the finals)

Eszter Tóth
doctor
- National Secondary School Competition (OKTV) biology 2010, 2nd place

Anna Baumann
student
- National Secondary School Competition (OKTV) chemistry 2017, 25th place
- Dürer Chemistry Competition 2017, 1st place

Péter Kalapos
student
- Irinyi János National Chemistry Competition 2015, 10th place
- Oláh György National Chemistry Competition 2015, 2nd place
- National Secondary School Competition (OKTV) chemistry 2016, 13th; 2017, 7th place
- Dürer Chemistry Competition 2017, 1st place
- Baltic Chemistry Competition, 8th place
- Member of the Mengyelejev International Students Olympics Team
- International Chemistry Students Olympics 2017, silver medallion

DR. ZSOLT NYISZTOR

Nagy Lajos Grammar School of the Cistercian Order

Address: Széchenyi tér 11., H-7621 Pécs, Hungary

TEACHING CAREER IN BRIEF

I received my teaching degree in biology and chemistry at the University of Pécs. During my studies, I was engaged in an ecological study of barn owls, among other topics, as well as a molecular biology project involving the processing of samples collected in the field for taxonomic purposes. During this time, I also spent half a year in Italy as an ERASMUS student at the University of L'Aquila. In 2001, I began teaching at the Nagy Lajos Cistercian Grammar School in Pécs, where I have been a teacher ever since. I graduated from the Doctoral School of Biology and Sportbiology of University of Pécs in 2019. I studied the development of the mammalian retina. I would like to pass on to my students my enthusiasm for the sciences and the ability to wonder at the myriad beauty of the created world. I believe that Hungary should be represented among the scientific elite of the world through diligence and endurance. I consider it important for my students to leave high school not only strengthened in knowledge, but also in moral and spiritual values.

PUBLICATIONS

Nyisztor, Zs. (2015) Biológia munkafüzet 11-12. osztály [Biology workbook grades 11–12]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs. (2015) Biológia szaktanári segédlet 11. osztály [Biology teacher's guide grade 11]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs. (2015) Biológia szaktanári segédlet 12. osztály [Biology teacher's guide grade 12]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs., Dénes, V., Kovács-Valasek, A., Hideg O., Berta G., Gábriel R. (2018). Pituitary adenylate cyclase activating polypeptide (PACAP1-38) exerts both pro and anti-apoptotic effects on postnatal retinal development in rat. **Neuroscience** 385, 59-66.

Denes, V., Hideg, O., **Nyisztor, Zs.**, Lakk, M., Godri, Z., Berta, G., Geck, P., Gábriel, R. (2019). The neuroprotective peptide, PACAP1-38 contributes to horizontal cell development in postnatal rat retina. Investigative **Ophtalmology and Visual Science**.

SUCCESSFUL STUDENTS

Eszter Mária Végh
resident – Semmelweis University Heart Center, Budapest
- National Secondary School Competition (OKTV) biology, 12th place

Sándor Szabó
medical student – Faculty of Medicine, Semmelweis Medical University, Budapest
- OKTV Biology 2010, 14th place
- Árokszállásy Zoltán Biology Competition 2010, 20th place

Viktória Kornélia Takács
biologist – Department of Pathology, University of Pécs
- Kitabel Pál Biology Competition 2008, 23rd place
- OKTV biology 2010, 9th place
- TUDOK national finals 2010, grand prize

Dóra Kinga Kevey
medical student – Faculty of Medicine, University of Pécs
- TUDOK national finals 2013, grand prize
- OKTV biology 2013, 12th place
- Árokszállásy Zoltán Biology Competition
- 2014 national finals, 21st place

Bence Szélig
medical student – Faculty of Medicine, University of Pécs
- OKTV biology 2015, 11th place
- Árokszállásy Zoltán Biology Competition 2016, 7th place

Fanni Kóródi
student – Nagy Lajos Cistercian Grammar School in Pécs
- TUDOK national finals 2013, grand prize

TÜNDE DR. SZALAINÉ TÓTH

Lovassy László Grammar School

Address: Cserhát ltp. 11., H-8200 Veszprém, Hungary

TEACHING CAREER IN BRIEF

I have been an educator since 1982 and continue to derive great joy from my work to the present day. In addition to my daily teaching responsibilities, I have endeavoured to use and pass on my knowledge and experience at the school, municipal, county and national levels. I consider it a priority to nurture excellence: so far, 45 of my students have reached the final round of Hungary's highly respected National Secondary School Competition (OKTV) in biology, two of them won first place, two of them won second place, and 13 of them finished in the top ten. My students have achieved great success in numerous other prominent competitions for young scholars. As an acknowledgement of my work in nurturing excellence, I received the Rátz Life Achievement Award in 2014, the „Excellent Competition Preparator" title in 2017 and the MOL-Mester-M Award in 2018, as well as a Ministerial Certificate of Recognition. I have also been awarded the Ranolder Prize from the City of Veszprém and the Pro Talento Prize from the Veszprém County Institute of Education. I take part in organising county and national competitions as well as school events. I am a master teacher, consultant, board chair for the Matura examination and multiplier as well as participating in bringing grant projects to fruition. I was a form teacher for 19 years. I enjoy professional challenges, and I have worked as an educational developer in several projects for the Hungarian National Institute for Educational Research and Development (OFI). I have often published in Élet és Tudomány (Life and Science), a popular science weekly, in which studies by my students are also occasionally published. Since 2014, I have participated in the work of the National Teachers Chamber (NPK) as a national delegate, and I have been the national chair of the Man and Nature section of the Chamber since 2015.

PUBLICATIONS

Feith H, Melicher D, Máthé G, Gradvohl E, Füzi R, Darvay S, Hajdú Zs, Nagyné Horváth E, Soósné Kiss Zs, Bihariné Krekó I, Földvári-Nagy Lászlóné, Molnár E, **Szalainé Tóth T**, Urbán V, Kassay A, Falus A. (2016). Tapasztaltok és motiváltság: magyar középiskolások véleménye az egészségnevelő programokról [Experience and motivation: Hungarian high school students' views on health education programs]. ORVOSI HETILAP 2: 65-69.

Szalainé Tóth T. (2015). Megváltoztatható-e, ami génjeinkben meg van írva? [Can we change what is written in our genes?] ÉLET ÉS TUDOMÁNY 48: 1526-1528.

Szalainé Tóth T, Dr. Szűcsné Kerti A. (2017). Érettségi mintafeladatsorok biológiából (10 írásbeli emelt szintű feladatsor) [Sample Matura examinations in biology (10 advanced written examination papers)]. Szeged: Maxim Kiadó.

SUCCESSFUL STUDENTS

Lilla Kepes
physician, anaesthesiology resident
St. Anna-Virngrund-Klinik, Ellwangen, Germany
- National Secondary School Competition (OKTV) biology 2006, 1st place
  Kitaibel Pál Biology and Environmental Protection Competition 2003, 7th place
  Kitaibel Pál Biology and Environmental Protection Competition 2004, 4th place

Bence Szalai
postdoctoral medical researcher
Joint Research Center for Computational Biomedicine, RWTH Aachen Uniklinik, Germany
- OKTV biology 2001, 6th place
- OKTV biology 2000, 12th place
- Kitaibel Pál Biology and Environmental Protection Competition 1999, 3rd place

Norbert Hőgye
Medical doctor – Semmelweis University, General Medicine
- Biology National Secondary School Competition 2012, 2nd place
- Biology National Secondary School Competition 2011, 17th place

Attila Kékesi
University student, Eötvös Loránd University, biology-physics major
- Biology National Secondary School Competition 2017, 2nd place

Patrícia Stark
University student, Corvinus University
- Biology National Secondary School Competition 2016, 1st place
- 2017: Richter Gedeon Talentum Foundation scholarship

CSILLA SZENTESI

Földes Ferenc High School

Address: Kelemen Didák u. 5., H-3525 Miskolc, Hungary

TEACHING CAREER IN BRIEF

I completed my studies in biology and geography at the Kossuth Lajos University (University of Debrecen) in 1998. To this day, I have taught in my former high school, Földes Ferenc Grammar School in Miskolc. In 1998, I also completed a teaching degree in the field of environmental protection at the Eszterházy Károly College in Eger. In 2005, I passed an examination in public school management and teaching. In 1996, I joined the County Institute of Education, and I was appointed a municipal consultant in biology and environmental protection between 1998 and 2011. Since 2005, I have been a board chair for the advanced Matura examination in my subject areas and am also engaged in coordinating the corrections for the advanced written Matura examination. During my career, I have organised lectures and held practical in-service training for my colleagues in the county. I have participated in testing digital teaching materials, preparing task sheets and editing geography coursebooks as well as serving as a mentor teacher for a number of student teachers from the University of Debrecen.

As of 2015, I have also worked as a master teacher and an educational inspection and teacher certification expert. In 1997, my colleagues and I launched the Árokszállásy Biology and Environmental Protection Competition, of which I am the main organiser. My school has had a great natural sciences tradition. My work in preparing my students for the advanced Matura examination and in my capacity as a form teacher is a top priority for me. I prepare my students continuously, hold special after-school lessons, and organise fieldwork and lectures. I have received a number of certificates at national competitions through my students as well as a certificate of appreciation from the city. My greatest source of pride is my students' success and the happy smiles on their faces when they achieve their goals.

PUBLICATIONS

Szentesi Cs. (2014). Biológia munkafüzet és tanári segédlet 7.8.10. évfolyam [Biology workbook and teacher's guide for grades 7, 8 and 10]. Miskolc: Miskolc Megyei Jogú Város Önkormányzat

SUCCESSFUL STUDENTS

Bálint Lakatos
PhD student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) Biology 2010, 45th place

Lukács Lesinszki
demonstrator
Semmelweis Medical University, Budapest
- OKTV Biology 2014, 5th place
- Árokszállásy Competition 2014, 2nd prize

Ábel Major
student
Semmelweis Medical University, Budapest
- National Secondary School Competition (OKTV) Biology 2017, 10th place

Mátyás Sajgó
student
- National Secondary School Competition (OKTV) Biology 2017, 16th place

ERIKA SZUHI

University of Nyíregyháza
Eötvös József Practice Primary School And High School

Address: Ungvár sétány 12., H-4400 Nyíregyháza, Hungary

TEACHING CAREER IN BRIEF

I graduated as a teacher of biology and chemistry at the Bessenyei György Tanárképző Főiskola and then during my work I received a diploma as a secondary school teacher in chemistry at ELTE and biology at DE. In the meantime, I graduated as an environmental ecologist. In 1999 I started teaching at the Korányi Frigyes Gimnázium és Kollégium in Nagykálló. As a lecturer, I also worked at the local vocational high school and the vocational school, where I gained a lot of experience in the field of pedagogy. In September 2017, I started the school year at the a Nyíregyházi Egyetem Eötvös József Gyakorló Általános Iskola és Gimnáziumban, where I have been teaching ever since. I had to face new challenges in my workplace - primary school age, elevated biology education. From this year also elevated chemistry education. It's always a big responsibility, but the new challenges are inspiring to me. I have been an active member of both advanced written and oral graduation committees from the beginning. This requires continuous self-education, but this is the only way to become a good preparatory teacher. I consider it important that my students see not only the teacher in me, but the person who is helping them realize their dreams.

PUBLICATIONS

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SUCCESSFUL STUDENTS

Tibor Kondor
obstretrician gynecologist

Zsófia Tóth
urologist

Zsanett Horváth
surgeon

Dániel Czuczku
pharmacy student

Lajos Márton
dentist student
- Kabay János Biology competition 1. place 2020.
- Kabay János Biology competition 1. place 2021.

Orsolya Adamecz
student
- Béres József country biology competition 1. place
- Kabay János country biology competition 3. place

Dániel Szuhi
student
- Kontra József national chemistry competition 2. place

NEMZETI TUDÓSKÉPZŐ AKADÉMIA
NATIONAL ACADEMY OF SCIENTIST EDUCATION

UNIVERSITY PROGRAM

RESEARCH CENTRES

SEMMELWEIS UNIVERSITY, BUDAPEST

Semmelweis University is a more than 250 years old medically oriented research university and is the leading institution of higher education in the field of medicine and health sciences in Hungary and the Central European region. Its three main activities - education, research and innovation, and medicine - make it an internationally recognised centre of excellence. In Hungary, most doctors, dentists, pharmacists and midwives are graduates of Semmelweis, one of the most international universities in the world: a third of the more than 12,000 students are foreigners from 97 countries. It has the largest number of academy members in medicine and biomedical sciences and was the first in the country to perform many pioneering medical interventions. The university is one of the most successful Hungarian players in international rankings: it is among the top 300 universities in the world in the Times Higher Education (THE) 2022 world rankings, and among the best in the world in various subject areas. The university is one of the largest health care provider in Hungary, but it is also home to the largest number of research groups supported by the Hungarian Academy of Sciences and the National Research, Development and Innovation Office: there are around 300 university research groups, and their research is supported by 46 international and 263 domestic research projects. The University has 8 Doctoral Schools in different disciplines and more than 1,000 students are members of its Scientific Student Circle.

INSTITUTE OF EXPERIMENTAL MEDICINE, BUDAPEST

The Institute of Experimental Medicine (KOKI) was founded in 1952 to carry out high-quality research in the field of medicine. By the early 2000s, the Institute had developed into one of the leading neuroscience institutes of Central Europe. The focus of the Institute is basic and translational research to investigate the structural and functional principles of the nervous system. Key objectives include contribution to the universal knowledge of how the brain works, promoting the protection of human health, facilitating effective treatment of nervous system diseases and contribution to the development of modern research technologies in all areas of brain research. The KOKI has been successful in obtaining competitive funding including several European Research Council (ERC), Howard Hughes Medical Institute and Wellcome Trust grants, which have substantially contributed to the development of state-of-the-art technologies and unique core research facilities. Discoveries of research groups at the Institute have been published in several leading journals including Science, Nature, Nature Neuroscience or Neuron. The KOKI is also committed to education and training including its joint neuroscience PhD school with the Semmelweis University.

UNIVERSITY OF DEBRECEN

The University of Debrecen is more than four hundred and fifty years old, it is Hungary's oldest higher education institution operated continuously in the same city and as one of the largest educational centres of the country it is a central player in Hungarian higher education. It has outstanding educational, research, and innovation capacities in international comparison as well and based on these it plays a major role in the realization of objectives of national strategy. It is also one of the top 500 universities in the world. The student community of 30,000 can study in 14 faculties, in institutions of excellent scholarly standard. As a leading university it is known in Hungary as an intellectual centre providing the widest spectrum of educational programs while also closely cooperating with the private sector, the business sphere, and the local government.

UNIVERSITY OF PÉCS (UP)

The history of higher education in Pécs dates back to 1367, when King Louis the Great initiated the establishment of a university in the episcopal seat of Pécs. As a result of a multi-stage integration process, the UP was founded and has become one of the most renowned universities in the country, with a leading regional role. UP has 10 faculties and a research centre offering high-quality training across the whole spectrum of higher education. 18 professional colleges and 21 doctoral schools offering 300 courses to nearly 20,000 students. The UP puts efforts to ensure that it is not only the optimal choice as a starting point for talented researchers, but also as a great place to work. Its Clinical Centre is one of Hungary's largest healthcare providers. Its threefold activity encompasses medicine, education and scientific research. The large presence of Hungarian and foreign students and the Mediterranean atmosphere make Pécs a pleasant, lively and vibrant university town.

UNIVERSITY OF SZEGED

The University of Szeged is one of the leading universities of Hungary, committed to maintaining quality higher education.

The University was established by the integration of Attila József University, Albert Szent-Györgyi Medical University, Szeged College of Food Industry, Gyula Juhász Teacher Training College and the College of Agriculture in Hódmezővásárhely. The University of Szeged offers a wide range of educational opportunities for the students: hundreds of basic, master, doctoral and higher educational professional training programs, just like adult training and postgraduate specialist training courses. With its nearly 25,000 students and 7,000 employees (out of which 2,400 are academic researchers and teachers), the University of Szeged is one of the largest institutions of the Southern Great Plain region. Teaching and research are performed by the 12 Faculties while medical health care is the task of the Albert Szent-Györgyi Health Centre. The mission and aim of the University is to cultivate science and internationally competitive research work and to advance its research university nature.

BIOLOGICAL RESEARCH CENTRE

The Biological Research Centre (BRC) is an outstanding institution of the internationally acknowledged Hungarian biological research. It was founded in 1973. The 4 institutes of BRC - the Institutes of Biophysics, Biochemistry, Genetics and Plant Biology - employ about 260 scientists whose work is hall-marked by highly appreciated international scientific publications and patents. The research topics include several fields of molecular and cell biology from the industrial utilization of bacteria through controlled improvement of cultivated plants to the problems of human health and environmental protection. BRC is mainly a scientific basic research centre, but scientists of BRC play an initiative role in the foundation and promotion of biotechnological companies, as well as in educational duties. The successful activity and high-level scientific research pursued in BRC were also acknowledged by the European Molecular Biological Organization (EMBO) and in 2000 the European Union awarded the title of “Centre of Excellence“ to BRC. (http://www.brc.hu/about_brc.php)

INDIVIDUALS PARTICIPATING IN THE PROGRAM

ZOLTÁN RAKONCZAY

DIRECTOR OF UNIVERSITY EDUCATION

University of Szeged
Albert Szent-Györgyi Medical School
Department of Pathophysiology

Address: Semmelweis u. 1., H-6725 Szeged, Hungary

Zoltán Rakonczay is the professor and head of the Department of Pathophysiology at the Albert Szent-Györgyi Medical School (ASGMS), University of Szeged.

He graduated as a medical doctor in 1999, obtained his PhD degree in 2002, habilitated in 2010, and has been a doctor of the Hungarian Academy of Sciences since 2013.

Prof. Rakonczay considers talent management of students with scientific interest a high priority, he is the Chairman of the ASGMS Student Science Study Group Council and is the Secretary of the Medical and Health Sciences Professional Committees of the National Council of Student Research Societies.

His main research interests are the physiological and pathophysiological processes of the pancreas, with special emphasis on bicarbonate secretion and acute pancreatitis.

"If I go out into nature, into the unknown, to the fringes of knowledge, everything seems mixed up and contradictory, illogical, and incoherent. This is what research does; it smoothes out contradictions and makes things simple, logical, and coherent."

Albert Szent-Györgyi

BUDAPEST

ÁDÁM DÉNES

SCIENTIFIC SUPERVISOR OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION (INSTITUTE OF EXPERIMENTAL MEDICINE)

Institute of Experimental Medicine
Laboratory of Neuroimmunology

Address: Szigony u. 43., H-1083 Budapest, Hungary

Institute of Experimental Medicine

Adam Denes is a principal investigator at the Institute of Experimental Medicine (IEM), Budapest. He is heading the Laboratory of Neuroimmunology and the Cell Biology Center in the IEM.

Their research focuses on the role of inflammatory mechanisms and brain-immune interactions in common brain disorders, with particular attention on microglia, the main immune cells of the central nervous system.

ATTILA MÓCSAI

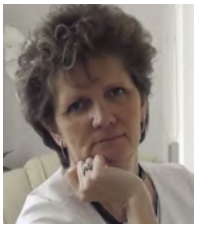
SCIENTIFIC SUPERVISOR OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION (SEMMELWEIS UNIVERSITY)

Semmelweis University
Faculty of Medicine
Department of Physiology

Address: Tűzoltó u. 37-47., H-1094 Budapest, Hungary

Attila Mócsai is a research physician and professor at the Department of Physiology of Semmelweis University. He gained his research experience at Semmelweis University and the University of California, San Francisco. He has been leading an independent research group at the Department of Physiology at Semmelweis University since 2002.

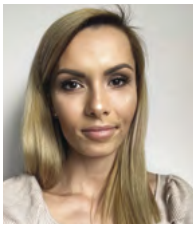
His areas of interest are inflammatory diseases and molecular mechanisms of bone resorption. He has been awarded grants from the European Research Council, the Wellcome Trust, and the Hungarian Momentum and Cutting Edge programmes. His 61 research students have won 74 awards at various university, national and international research student conferences.



TÜNDE SOPRONYI

Training Assistant of the National Academy of Scientist Education (Semmelweis University - Institute of Experimental Medicine)

E-mail: se@edu-sci.org



MARTINA HAJDU

Training Assistant of the National Academy of Scientist Education (Semmelweis University - Institute of Experimental Medicine)

E-mail: se@edu-sci.org

SZENT-GYÖRGYI MENTORS BUDAPEST

LÁSZLÓ ACSÁDY

Institute of Experimental Medicine
Thalamus Research Group

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

The main research focus of the Thalamus Research Group is to decipher the network mechanisms of the thalamocortical circuits that underlies higher order cognition as well as its pathological and alterations. To this end we utilize cell type specific investigations at morphological, physiological and behavioral levels to reveal how nucleus specific synaptic organization of thalamic circuits provides a framework for plastic behavioral and neuronal response to environmental challenges.

TECHNIQUES AVAILABLE IN THE LAB

Microscopy and image analysis: light microscopy, confocal, super-resolution and electron microscopy. Morphology: track tracing techniques, pre- and post-embedding immunocytochemistry. Physiology: measurement of extra- and intracellular activity, optogenetic methods, 2-photon microscopy. Behavioural analysis: manual and machine learning based behavioural analysis, correlated physiological and behavioural studies. Statistical and programming skills.

SELECTED PUBLICATIONS

Acsády, L. (2018) Heartless beat or beatless heart? **Nat Neurosci 21:** 649-651.

Acsády, L., Harris, K.D. (2017) Synaptic scaling in sleep. **Science 355:** 457-457.

Acsády, L. (2017) The thalamic paradox. **Nat Neurosci 20:** 901-902.

Fiath, R., Beregszaszi, P., Horvath, D., Wittner, L., Aarts, A.A., Ruther, P., Neves, H.P., Bokor, H., **Acsady, L.**, Ulbert, I. (2016) Large-scale recording of thalamocortical circuits: in vivo electrophysiology with the two-dimensional electronic depth control silicon probe. **Journal of Neurophysiology 116:** 2312-2330.

Halassa, M.M., **Acsády, L.** (2016) Thalamic Inhibition: Diverse Sources, Diverse Scales. **Trends in Neurosciences 39:** 680-693.

CSABA BARTA

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RESEARCH AREA

The main research field of our laboratory is psychogenetics. Within these we study the genetic and epigenetic background of a number of child psychiatric disorders, so called neurodevelopmental conditions (such as Tourette syndrome, attention deficit, hyperactivity disorder /ADHD/, obsessive-compulsive disorder /OCD/) using molecular biological techniques and bioinformatic analyses. The other main research area of our group is the genetic study of different addictions. We study genetic variation associated with both substance use and dependence, as well as behavioral addictions, such as internet use, gambling, gaming, etc.) The functional role of the studied genetic variants is investigated in cell cultures derived from neural tissue, and also in some animal models (C. elegans and rodents). Apart from the above we currently have genetic and epigenetic studies on infant behavior (regulational disorder), as well as the link between type 2 diabetes and certain insulin signaling related mental disorders.

TECHNIQUES AVAILABLE IN THE LAB

nucleic acid extraction (DNA, RNA)
conventional PCR and real-time PCR techniques, Open Array
epigenetic methods (DNA methylation microRNA)
tissue culture, reporter assays
bioinformatic analyses
occasionally C. elegans studies

SELECTED PUBLICATIONS

Cross-Disorder Group of the Psychiatric Genomics Consortium (a total of 606 authors, incl. **Barta C**). (2019) Genomic Relationships, Novel Loci, and Pleiotropic Mechanisms across Eight Psychiatric Disorders. **Cell 179:** 1469-1482. e11.

Pagliaroli, L., Vereczkei, A., Padmanabhuni, S.S., Tárnok Zs., Farkas, L., Nagy, P., Rizzo, R., Wolanczyk, T., Szymanska, U., Kapisyzi, M., Basha, E., Koumoula, A., Androutsos, C., Tsironi, V., Karagiannidis, I., Paschou P., and **Barta, C.** (2020) Association of genetic variation in the 3'UTR of LHX6, IMMP2L and AADAC with Tourette Syndrome. **Front Neurol 11:** 803.

Pagliaroli, L., Fothi, A., Nespoli, E., Liko, I., Veto, B., Devay, P., Szeri, F., Hengerer, B., **Barta, C.,** Aranyi, T. (2021) Riluzole Administration to Rats with Levodopa-Induced Dyskinesia Leads to Loss of DNA Methylation in Neuronal Genes. **Cells 10:** 1442.

Yang, Z., Wu, H., Lee, P.H., Tsetsos, F., Davis, L.K., Yu, D., Lee, S.H., Dalsgaard, S., Haavik, J., **Barta, C.,** Zayats, T., Eapen, V., Wray, N.R., Devlin, B., Daly, M., Neale, B., Børglum, A.D., Crowley, J.J., Scharf, J., Mathews, C.A., Faraone, S.V., Franke, B., Mattheisen, M., Smoller, J.W., Paschou, P. (2021) Investigating Shared Genetic Basis Across Tourette Syndrome and Comorbid Neurodevelopmental Disorders Along the Impulsivity-Compulsivity Spectrum. **Biol Psychiatry 90:** 317-327.

Vereczkei, A., **Barta, C.,** Magi, A., Farkas, J., Eisinger, A., Király, O., Belik, A., Griffiths, M.D., Szekely, A., Sasvári-Székely, M., Urbán, R., Potenza, M.N., Badgaiyan, R.D., Blum, K., Demetrovics, Z., Kotyuk, E. (2022) FOXN3 and GDNF Polymorphisms as Common Genetic Factors of Substance Use and Addictive Behaviors. **J Pers Med 12:** 690.

ZOLTÁN BENYÓ

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RESEARCH AREA

Physiology and pathophysiology of the cardiovascular system.
Regulation of the cerebral blood flow.
Signaling pathways of the endothelium and smooth muscle.
Physiological and pathophysiological functions of lipid mediators in the cardiovascular system.
Tumor angiogenesis and metastasis formation.
Physiological control and dysfunctions of the urinary bladder.

TECHNIQUES AVAILABLE IN THE LAB

Wire and pessure myography.
Langendorff heart system.
In vivo measurement of cardiovascular parameters and perfusion of the brain.
Telemetric blood pressure recording.
Cystometry.
Protein- and mRNA-based gene expression analysis.

SELECTED PUBLICATIONS

Borsodi, K., Balla, H., Molnár, P.J., Lénárt, Á., Kenessey, I., Horváth, A., Keszthelyi, A., Romics, M., Majoros, A., Nyirády, P., Offermanns, S., **Benyó, Z.** (2022) Signaling pathways mediating bradykinin-induced contraction in murine and human detrusor muscle. **Frontiers in Medicine 8:** 745638.

Thomas, M.J., Major, E., Benedek, A., Horváth, I., Máthé, D., Bergmann, R., Szász, A.M., Krenács, T., **Benyó, Z.** (2020) Suppression of metastatic melanoma growth in lung by modulated electro-hyperthermia monitored by a minimally invasive heat stress testing approach in mice. **Cancers 12:** 3872.

Dancs, P.T., Ruisanchez, E., Balogh, A., Panta, C.R., Miklós, Z., Nüsing, R.M., Aoki, J., Chun, J., Offermanns, S., Tigyi, G., **Benyó, Z.** (2017) LPA1 receptor-mediated thromboxane A2 release is responsible for lysophosphatidic acid-induced vascular smooth muscle contraction. FASEB **Journal 31:** 1547-1555.

Benyó, Z., Ruisanchez, E., Leszl-Ishiguro, M., Sándor, P., Pacher, P. (2016) Endocannabinoids in cerebrovascular regulation. **American Journal of Physiology - Heart and Circulatory Physiology, 310:** H785-H801.

Wirth, A., **Benyó, Z.,** Lukasova, M., Leutgeb, B., Wettschureck, N., Gorbey, S., Őrsy, P., Horváth, B., Maser-Gluth, C., Greiner, E., Lemmer, B., Schütz, G., Gutkind, S., Offermanns, S. (2008) G12/G13-LARG-mediated signalling in vascular smooth muscle is required for salt-induced hypertension. **Nature Medicine 14:** 64-68.

CSABA BÖDÖR

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RESEARCH AREA

Our research focuses on better understanding of the genomic background of the malignant diseases of the hematopoietic system, i. e. leukemias and lymphomas with a special focus on identification of biomarkers and development of technologies supporting a more precise diagnosis, risk stratification and application of targeted therapies in this disease group.

TECHNIQUES AVAILABLE IN THE LAB

State of the art molecular genetic technologies. Nucleic acid extraction, polymerase chain reaction, next-generation sequencing, gene expression analyses, genomic databases.

SELECTED PUBLICATIONS

Bödör, C., Kotmayer, L., László. T., Takács, F., Barna, G., Kiss, R., Sebestyén, E., Nagy, T., Hegyi, L.L., Mikala, G., Fekete, S., Farkas, P., Balogh, A., Masszi, T., Demeter, J., Weisinger, J., Alizadeh, H., Kajtár, B., Kohl, Z., Szász, R., Gergely, L., Gurbity Pálfi, T., Sulák. A., Kollár, B., Egyed, M., Plander, M., Rejtő, L., Szerafin, L., Ilonczai, P., Tamáska, P., Pettendi, P., Lévai, D., Schneider, T., Sebestyén, A., Csermely, P., Matolcsy, A., Mátrai, Z., Alpár, D. (2021) Screening and monitoring of the BTKC481S mutation in a real-world cohort of patients with relapsed/refractory chronic lymphocytic leukaemia during ibrutinib therapy. **British Journal of Haematology 194:** 355-364.

Nagy, Á., Bátai, B., Balogh, A., Illés, S., Mikala, G., Nagy, N., Kiss, L., Kotmayer, L., Matolcsy, A., Alpár, D., Masszi, T., Masszi, A., **Bödör, C.** (2020) Quantitative Analysis and Monitoring of EZH2 Mutations Using Liquid Biopsy in Follicular Lymphoma. **Genes 11:** 785.

Rendeiro, AF., Krausgruber, T., Fortelny, N., Zhao, F., Penz, T., Farlik, M., Schuster, L.C., Nemc, A., Tasnády, S., Réti, M., Mátrai, Z., Alpár, D., **Bödör, C.**, Schmidl, C., Bock, C. (2020) Chromatin mapping and single-cell immune profiling define the temporal dynamics of ibrutinib response in CLL. **Nature Communications 11:** 577.

Gángó, A., Alpár, D., Galik, B., Marosvári, D., Kiss, R., Fésüs, V., Aczél, D., Eyüpoglu, E., Nagy, N., Nagy, Á., Krizsán, S., Reiniger, L., Farkas, P., Kozma, A., Ádám, E., Tasnády, S., Réti, M., Matolcsy, A., Gyenesei, A., Mátrai, Z., **Bödör, C.** (2019) Dissection of subclonal evolution by temporal mutation profiling in chronic lymphocytic leukemia patients treated with ibrutinib. **International Journal of Cancer 146:** 85-93.

Kiss, R., Alpár, D., Gángó, A., Nagy, N., Eyupoglu, E., Aczél, D., Matolcsy, A., Csomor, J., Mátrai, Z., **Bödör, C.** (2018) Spatial clonal evolution leading to ibrutinib resistance and disease progression in chronic lymphocytic leukemia. **Haematologica 104:** 38-41.

CHRISTOS CHINOPOULOS

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RESEARCH AREA

Alterations in oncometabolism are substantiated by changes in protein expression 'rewiring' certain metabolic pathways, providing an excellent opportunity for cancer-specific therapeutic intervention. Identifying those proteins involved in bioenergetic pathways that are up- or downregulated in order to serve the needs of neoplasia, is crucial for beating cancer.

TECHNIQUES AVAILABLE IN THE LAB

Mitochondrial isolation
Mitochondrial respiration
Mitochondrial membrane potential estimation
Mitochondrial Q redox state estimation
Mitochondrial NAD/NADH ration estimation
Cell culturing
Epifluorescence imaging
Western blotting
Reverse Phase Protein Array

SELECTED PUBLICATIONS

Seyfried, T.N., Arismendi-Morillo, G., Mukherjee, P., **Chinopoulos, C.** (2020) On the Origin of ATP Synthesis in Cancer. **iScience 23:** 101761.

Chinopoulos, C. (2020) Acute sources of mitochondrial NAD+ during respiratory chain dysfunction. **Exp Neurol 327:** 113218.

Dobolyi, A., Bago, A., Palkovits, M., Nemeria, N.S., Jordan, F., Doczi, J., Ambrus, A., Adam-Vizi, V., **Chinopoulos, C.** (2020) Exclusive neuronal detection of KGDHC-specific subunits in the adult human brain cortex despite pancellular protein lysine succinylation. **Brain Struct Funct 225:** 639-667.

Chinopoulos, C. (2020) Quantification of mitochondrial DNA from peripheral tissues: Limitations in predicting the severity of neurometabolic disorders and proposal of a novel diagnostic test. **Mol Aspects Med 71:** 100834.

Chen, E., Kiebish, M.A., McDaniel, J., Niedzwiecka, K., Kucharczyk, R., Ravasz, D., Gao, F., Narain, N.R., Sarangarajan, R., Seyfried, T.N., Adam-Vizi, V., **Chinopoulos, C.** (2018) Perturbation of the yeast mitochondrial lipidome and associated membrane proteins following heterologous expression of Artemia-ANT. **Sci Rep 18:** 5915.

GÁBOR CZIRJÁK

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RESEARCH AREA

The main research area of our group is the study of the molecular regulatory mechanisms of potassium channels. The focus is on the background potassium channels (with two pore domains per subunit, K2P), but we also reported results on the function of voltage-gated Kv8.2 and lysosomal, unconventional TMEM175 channels. Significant results have been obtained in the detection of heterodimerization of subunits of the TASK and TREK subfamilies and in the study of the regulation of TASK and TRESK channels by signaling pathways. We are known for the first detection of the TASK-1 / TASK-3 heterodimer and the comprehensive description of the TRESK regulation by calcineurin-dependent dephosphorylation.

TECHNIQUES AVAILABLE IN THE LAB

Molecular biology - (e.g. RT-PCR, in vitro site-directed mutagenesis, subcloning with restriction enzymes, cRNA synthesis). Protein Expression in E. coli - production, purification and microinjection of GST- and His-tag fusion proteins. Maintenance of cell lines (e.g. HEK-293, COS-7), transfection. Basic confocal microscopy - detection of green fluorescent protein (GFP) protein labeling. Electrophysiology - two-electrode voltage clamp (TEVC), patch clamp (whole cell, excised patch methods). Detection of proteins and ion channel protein phosphorylation - immunoblot and Phos-tag SDS-PAGE methods.

SELECTED PUBLICATIONS

Czirják, G., Tóth, Z.E., Enyedi, P. (2004) The two-pore domain K^+ channel, TRESK, is activated by the cytoplasmic calcium signal through calcineurin. **Journal of Biological Chemistry 279:**18550-8.

Czirják, G., Enyedi, P. (2006) Targeting of calcineurin to an NFAT-like docking site is required for the calcium-dependent activation of the background K^+ channel, TRESK. **Journal of Biological Chemistry 281:**14677-82.

Enyedi, P., **Czirják, G.** (2010) Molecular background of leak K^+ currents: two-pore domain potassium channels. **Physiological Reviews 90:** 559-605.

Braun, G., Lengyel, M., Enyedi, P., **Czirják, G.** (2015) Differential sensitivity of TREK-1, TREK-2 and TRAAK background potassium channels to the polycationic dye ruthenium red. **British Journal of Pharmacology 172:**1728-38.

Pergel, E., Veres, I., Csigi, G.I., **Czirják, G.** (2021) Translocation of TMEM175 Lysosomal Potassium Channel to the Plasma Membrane by Dynasore Compounds. **International Journal of Molecular Sciences 22:**10515.

LÁSZLÓ CSANÁDY

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RESEARCH AREA

Ion channel structure-function. CFTR chloride ion channel. TRPM2 cation channel.

TECHNIQUES AVAILABLE IN THE LAB

Patch-clamp
Molecular biological techniques
Protein purification techniques
Enzyme kinetics measurements

SELECTED PUBLICATIONS

Mihályi, C., Iordanov, I., Töröcsik, B., **Csanády, L.** (2020) Simple binding of protein kinase A, prior to phosphorylation, allows CFTR anion channels to be opened by nucleotides. **Proc Natl Acad Sci USA 117:** 21740-21746.

Liu, F., Zhang, Z., **Csanády, L.**, Gadbsy, D.C., Chen, J. (2017) Molecular stucture of the human CFTR ion channel. **Cell 169:** 85-95.

Sorum, B., Czege, D., **Csanády, L.** (2015) Timing of CFTR Pore Opening and Structure of Its Transition State. **Cell 163:** 724-733.

Tóth, B., Iordanov, I., **Csanády, L.** (2014) Putative chanzyme activity of TRPM2 cation channel is unrelated to pore gating. **Proc Natl Acad Sci USA 111:** 16949-16954.

Tóth, B., **Csanády, L.** (2012) Pore collapse underlies irreversible inactivation of TRPM2 cation channel currents. **Proc Natl Acad Sci USA 109:** 13440-13445.

ÁDÁM DÉNES

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RESEARCH AREA

Adam Denes is heading the Laboratory of Neuroimmunology and the Cell Biology Centre in the Institute of Experimental Medicine. His main interest is neuroinflammation and brain-immune interactions in health and disease. Their research explored the mechanisms through which inflammation inside or outside the central nervous system contributes to different forms of brain injury. They have also studied the pathways through which immune processes are controlled by the nervous system. His research group has revealed the role of microglia, the main immune cells of the brain in regulating neuronal activity and injury and the pivotal role of microglia in modulating cerebral blood flow.

TECHNIQUES AVAILABLE IN THE LAB

The Laboratory of Neuroimmunology uses a broad range of molecular anatomy approaches (confocal microscopy, superresolution microscopy, electron microscopy, electron tomography, array tomography), in vivo two-photon microscopy, laser speckle contrast imaging, functional ultrasound imaging, in vivo models of inflammation and microglial manipulation as well as different ex vivo and cell biology approaches (e.g. flow cytometry, primary neuronal and glial cultures).

SELECTED PUBLICATIONS

Császár, E., Lénárt, N., Cserép, C., Környei, Z., Fekete, R., Pósfai, B., Balázsfi, D., Hangya, B., Schwarcz, A.D., Szabadits, E., Szöllősi, D., Szigeti, K., Máthé, D., West, B.L., Sviatkó, K., Brás, A.R., Mariani, J.C., Kliewer, A., Lenkei, Z., Hricisák, L., Benyó, Z., Baranyi, M., Sperlágh, B., Menyhárt, Á., Farkas, E., **Dénes, Á.** (2022) Microglia modulate blood flow, neurovascular coupling, and hypoperfusion via purinergic actions. **J Exp Med 219:** e20211071.

Cserép, C., Pósfai, B., **Dénes, Á.** (2021). Shaping neuronal fate: functional heterogeneity of direct microglia-neuron interactions. **Neuron 109:** 222-240.

Cserép, C., Pósfai, B., Lénárt, N., Fekete, R., László, Z.I., Lele, Z., Orsolits, B., Molnár, G., Heindl, S., Schwarcz, A.D., Ujvári, K., Környei, Z., Tóth, K., Szabadits, E., Sperlágh, B., Baranyi, M., Csiba, L., Hortobágyi, T., Maglóczky, Z., Martinecz, B., Szabó, G., Erdélyi, F., Szipőcs, R., Tamkun, M.M., Gesierich, B., Duering, M., Katona, I., Liesz, A., Tamás, G., **Dénes, Á.** (2020) Microglia monitor and protect neuronal function via specialized somatic purinergic junctions. **Science 367:** 528-537.

Fekete, R., Cserép, C., Lénárt, N., Tóth, K., Orsolits, B., Martinecz, B., Méhes, E., Szabó, B., Németh, V., Gönci, B., Sperlágh, B., Boldogkői, Z., Kittel, Á., Baranyi, M., Ferenczi, S., Kovács, K., Szalay, G., Rózsa, B., Webb, C., Kovacs, G.G., Hortobágyi, T., West, B.L., Környei, Z., **Dénes, Á.** (2018) Microglia control the spread of neurotropic virus infection via P2Y12 signalling and recruit monocytes through P2Y12-independent mechanisms. **Acta Neuropathol 136:** 461-482.

Szalay, G., Martinecz, B., Lénárt, N., Környei, Z., Orsolits, B., Judák, L., Császár, E., Fekete, R., West, B.L., Katona, G., Rózsa, B., **Dénes, Á.** (2016) Microglia protect against brain injury and their selective elimination dysregulates neuronal network activity after stroke. **Nat Commun 7:** 11499.

HENRIETTE FARKAS

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RESEARCH AREA

The Hungarian Angioedema Centre of Reference and Excellence (the member of the ACARE Network https://acare-network.com) at the Department of Internal Medicine and Haematology, Semmelweis University was established in 1998. Our centre is the founder and organizer of The International C1-Inhibitor deficiency and Angioedema Workshop which has taken place on 12 occasions since 1999 in Budapest, established the HAENETWORK project and Central Eastern European Angioedema Centre. Our research focuses on pathomechanism of angioedema, especially bradykinin mediated forms. Complement, molecular genetic and cell laboratories, patient registry, biobank provides the appropriate background for both clinical and basic research. We are investigating the function of plasma enzyme systems, white blood cells and endothelial cells involved in the development of angioedema, mainly in hereditary angioedema due to C1 inhibitor Deficiency. We have very good partnership and collaboration with colleagues from 44 countries.

TECHNIQUES AVAILABLE IN THE LAB

Our centre has both clinical and basic research facilities. These are based in part on the Angioedema Registry, which contains clinical and laboratory data on patients at diagnosis and follow-up. A biobank is also available in which patient serum, plasma (EDTA, citrate) samples are stored at minus 80 degrees Celsius. On the other hand, our genetic, complement and cellular laboratories are able to provide various methods (Sanguer sequencing, ELISA, umbilical cord endothelial cells) for research.

SELECTED PUBLICATIONS

Farkas, H. et al. (2017) International consensus on the diagnosis and management of pediatric patients with hereditary angioedema with C1 inhibitor deficiency. **Allergy 72:** 300-313.

Andrási, N., Veszeli, N., Kőhalmi, K.V., Csuka, D., Temesszentandrási, Gy., Varga L., **Farkas, H.** (2018) Idiopathic Nonhistaminergic Acquired Angioedema Versus Hereditary Angioedema. **J Allergy Clin Immunol Pract 6:** 1205-1208.

Farkas, H., Kőhalmi, K.V., Visy, B., Veszeli, N., Varga, L. (2020) Clinical Characteristics and Safety of Plasma-Derived C1-Inhibitor Therapy in Children and Adolescents with Hereditary Angioedema—A Long-Term Survey. **Journal of J Allergy Clin Immunol Pract 8:** 2379-2383.

Balla, Zs., Zsilinszky, Zs., Pólai, Zs., Andrasi, N., Kőhalmi, K.V., Csuka, D., Varga, L., **Farkas, H.** (2021) The Importance of Complement Testing in Acquired Angioedema Related to Angiotensin-Converting Enzyme Inhibitors. **J Allergy Clin Immunol Pract 9 :** 947-955.

Kajdácsi, E., Veszeli, N., Mező, B., Jandrasics, Z., Kőhalmi, K.V., Ferrara, A., Cervenak, L., Varga, L., **Farkas, H.** (2021) Pathways of Neutrophil Granulocyte Activation in Hereditary Angioedema with C1 Inhibitor Deficiency. **Clin Rev Allergy Immunol 60:** 383-395.

ANDREA FEKETE

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RESEARCH AREA

Open-angle glaucoma, diabetic keratopathy and corneal scarring are severe, non-retinal complications of diabetes. Their therapy is insufficient: POAG is treated by lowering intra-ocular pressure by medication or surgery; however, progression continues in many patients. Treatment of corneal dysfunction is largely symptomatic as well. Therefore preclinical research should aim at identifying disease mechanisms and novel antifibrotic therapies for both diseases. Renal ischemia/reperfusion injury-induced acute kidney injury develops in various clinical conditions and is the main cause of graft loss or delayed graft function following transplantation. Beside the shortage in donors, minimizing ischemia/reperfusion injury and thus improving long-term graft function remains a major and yet unsolved problem. Our aim is to characterize previously unknown molecular signaling mechanisms for the treatment of renal ischemia/reperfusion injury. By developing a new preservation solution containing Sigma-1 receptor agonists we could tackle the problem of donor shortage by optimizing the condition of expanded criteria donor grafts and extending maximum graft storage time. Idiopathic pulmonary fibrosis is the most common form of interstitial pulmonary diseases, with constantly growing incidence. The disease is associated with high mortality, as median survival after diagnosis is only 2-3 years. Main causes include environmental factors, infections and genetic factors. The latest studies suggest that fibrosis of the lungs is common among patients who recovered from the acute phase of a COVID-19 infection. Despite obvious clinical significance, the molecular mechanisms leading to fibrosis are largely unknown and currently there is no effective therapeutic agent which could prevent tissue fibrosis. Our aim is to identify the molecular pathways responsible for the protective effect of Sigma-1 receptor agonists, and thus to develop novel, effective therapies.

TECHNIQUES AVAILABLE IN THE LAB

In vitro models using cell lines as well as primer cells. Translational rodent models: diabetes, glaucoma, corneal scarring, kidney ischemia/reperfusion, kidney transplantation, bleomycin-induced pulmonary fibrosis, unilateral ureter obstruction etc. Molecular biology methods: Western blot, RT-qPCR, ELISA, CRISPR. Imaging: conventional histology, confocal-STED microscopy, functional MRI, mutiphoton microscopy.

SELECTED PUBLICATIONS

Hodrea, J., Saeed, A., Molnar, A., Fintha, A., Barczi, A., Wagner, L.J., Szabo, A.J., **Fekete, A.**, Balogh, D.B. (2022) SGLT2 inhibitor dapagliflozin prevents atherosclerotic and cardiac complications in experimental type 1 diabetes. **Plos One 17:** 2 Paper: e0263285.

Hosszu, A., Kaucsar, T., Seeliger, E., **Fekete, A.** (2021) Animal Models of Renal Pathophysiology and DiseaseIn. Pohlmann, Andreas (szerk.) **Preclinical MRI of the Kidney: Methods and Protocols New York, USA Springer (Boston) 720:** 27-44.

Balogh, D.B., Molnar, A., Hosszu, A., Lakat, T., Hodrea, J., Szabo, A.J., Lenart, L., **Fekete, A.** (2020) Antidepressant effect in diabetes-associated depression: a novel potential of RAAS inhibition. **Psychoneuroendocrinology 118:** 104705.

Lenart, L., Balogh, D.B., Lenart, N., Barczi, A., Hosszu, A., Farkas, T., Hodrea, J., Szabo, A.J., Szigeti, K., Denes, A., **Fekete, A.** (2019) Novel therapeutic potential of angiotensin receptor 1 blockade in a rat model of diabetes-associated depression parallels altered BDNF signalling. **Diabetologia 62:** 1501-1513.

Koszegi, S., Molnar, A., Lenart, L., Hodrea, J., Balogh, D.B., Lakat, T., Szkibinszkij, E., Hosszu, A., Sparding, N., Genovese, F., Wagner, L., Vannay, A., Szabo, A.J., **Fekete, A.** (2019) RAAS inhibitors directly reduce diabetes-induced renal fibrosis via growth factor inhibition. **J Physiol (london) 597:** 193-209.

CSABA FEKETE

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RESEARCH AREA

The main research goals of our laboratory are the elucidation of the central regulatory mechanisms controlling the hypothalamic-pituitary-thyroid axis and the examination of the neuronal circuits controlling the energy homeostasis.

TECHNIQUES AVAILABLE IN THE LAB

Immunocytochemistry, elektron microscopy, laser capture microdissection, metabolic characterization of rodents, patch-clamp electrophysiology, in situ hybridization, transcryptome analysis, antibody generation.

SELECTED PUBLICATIONS

Farkas, E., Varga, E., Kovács, B., Szilvásy-Szabó, A., Cote-Vélez, A., Péterfi, Z., Matziari, M., Tóth, M., Zelena, D., Mezriczky, Zs. et al. (2020) A glial-neuronal circuit in the median eminence regulates thyrotropin-releasing hormone-release via the endocannabinoid system. **Iscience 23:** 100921. 41 p.

Mohacsik, P., Erdelyi, F., Baranyi, M., Botz, B., Szabo, G., Toth, M., Haltrich, I., Helyes, Z., Sperlagh, B., Toth, Z. et al. (2018) A transgenic mouse model for detection of tissue-specific thyroid hormone action. **Endocrinology 159:** 1159-1171. 13 p.

Péterfi, Z., Farkas, I., Denis, R.G.P., Farkas, E., Uchigashima, M., Füzesi, T., Watanabe, M., Lechan, R.M., Liposits, Z., Luquet, S. et al. (2018) Endocannabinoid and nitric oxide systems of the hypothalamic paraventricular nucleus mediate effects of NPY on energy expenditure. **Molecular Metabolism 18:** 120-133.14 p.

Fekete, C., Lechan, R.M. (2014) Central Regulation of Pituitary-Thyroid Axis Under Physiological and Pathophysiological Conditions. **Endocrine Reviews 35:** 59-194. 36 p.

Kola, B., Farkas, I., Christ-Crain, M., Wittmann, G., Loll, F., Amin, F., Harvey-White, J., Liposits, Z., Kunos, G., Grossman, A.B. et al. (2008) The orexigenic effect of ghrelin is mediated through central activation of the endogenous cannabinoid system. **Plos One 3:** 3. Paper: e1797.

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RESEARCH AREA

Thyroid hormones (TH) are master regulators of cellular metabolism and proliferation and consequently exert a fundamental impact on brain development and function predominantly due to their impact on transcriptomic activity. The Laboratory aims to (i) identify and modulate cell-type specific molecular pathways responsible for the regulation of TH economy in the brain and coupled peripheries; (ii) translate these mechanisms to specific brain functions under physiological and pathophysiological conditions; (iii) develop transgenic approaches to assess and modulate cell-type specific TH action. They combine molecular, cell biological, anatomical and transgenic techniques to study regulation and consequences of TH signalling. (1) They study the molecular regulation of deiodinase enzymes mediating TH metabolism with special respect to the complex and tight regulation of type 2 deiodinase (D2) to identify molecular elements and protein-protein interactions allowing the rapid regulation of D2 activity along the ubiquitin/proteasome pathway and its role in the generation of tissue-specific hypothyroidism. The studies also target the regulation of the D2-encoding dio2 gene during hypothalamic response to inflammation, a phenomenon they described as a component of the pathogenesis of the nonthyroidal illness syndrome. (2) They investigate the mechanisms and biological consequences of D2 and type 3 deiodinase (D3) mediated neuro-glial coupling of TH metabolism and its impact on the hypothalamo-pituitary-thyroid axis and thyroid hormone signaling of the nervous system. (3) The Laboratory is involved in the generation of transgenic mouse models for cell-type specific modulation and assessment of TH signalling and also aims to identify human markers representing tissue TH economy. This resulted in the generation and patenting of the Thyroid Hormone Action Indicator (THAI) Mouse, allowing tissue-specific assessment of TH action in vivo.

TECHNIQUES AVAILABLE IN THE LAB

Recombinant DNA techniques, cell culturing, recombinant protein expression, transgenics, quantification of gene expression, detection of proteins and mRNA, microscopy, deiodination and biochemical assays, work with rodent models.

SELECTED PUBLICATIONS

Jo, S., Fonseca, T.L., Da Costa Bocco, B.M., Fernandes, G.W., McAninch, E.A., Bolin, A.P., Da Conceição, R.R., De Castro, J.P.W., Ignacio, D.L., Egri, P., Németh, D., Fekete, C., Bernardi, M.M., Leitch, V.D., Mannan, N.S., Curry, K.F., Butterfield, N.C., Bassett, J.H.D., Williams, G.R., **Gereben, B.,** Ribeiro, M.O., Bianco, A.C. (2019) Type 2 deiodinase polymorphism causes ER stress and hypothyroidism in the brain. **J Clin Invest 129:** 230-245.

Mohácsik, P., Erdélyi, F., Baranyi, M., Botz, B., Szabó, G., Tóth, M., Haltrich, I., Helyes, Zs., Sperlágh, B., Tóth, Zs., Sinkó, R., Lechan, R.M., Bianco, A.C., Fekete, Cs., **Gereben B.** (2018) A transgenic mouse model for detection of tissue-specific thyroid hormone action. **Endocrinology 159:** 1159–1171.

Kollár, A., Kvarta, Papp, Zs., Egri, P., **Gereben, B.** (2016) Different Types Of Luciferase Reporters Show Distinct Susceptibility To T3-Evoked Down-Regulation. **Thyroid 2016 26:** 179-82.

Gereben, B., McAninch, E.A., Riberio, M.O., Bianco, A.C. (2015) Scope and limitations of iodothyronine deiodinases in hypothyroidism. Nature Rev Endo 11: 642-52.

Dentice, M., Bandyopadhyay, A., **Gereben, B.,** Callebaut, I., Christoffolete, M.A., Kim, B.W., Nissim, S., Mornon, J.P., Zavacki, A.M., Zeold, A., Capelo, L.P., Curcio-Morelli, C., Ribeiro, R., Harney, J.W., Tabin, C.J., Bianco, A.C. (2005) The Hedgehog-inducible ubiquitin ligase subunit WSB-1 modulates thyroid hormone activation and PTHrP secretion in the developing growth plate. **Nature Cell Biology 7:** 698-705.

ANIKÓ GÖRBE

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RESEARCH AREA

In experimental cardiology models, several studies have already demonstrated that the reperfusion phase following cardiac oxygen deprivation activates processes that lead to further damage of myocardial tissue. However, there are protective mechanisms that can reduce the extent of damage. However, failures in clinical trials show that these mechanisms are not sufficiently effective in ischemic heart patients. Preclinical data suggest that co-morbidities such as hyperlipidemia, metabolic syndrome, diabetes mellitus-induced tissue changes and drug treatment of these diseases have a strong interfering effect. Furthermore, the presence of ischaemia/reperfusion injury and co-morbidities poses additional risks, as the hidden side effects of many drugs are only seen in such cases. Our research addresses the potential cardioprotective effects of microRNAs. The development of noncoding RNAs (such as microRNAs) as molecules of diagnostic and therapeutic value has in recent years brought them to the forefront of the pharmaceutical industry for the precision diagnosis and treatment of a number of diseases.

TECHNIQUES AVAILABLE IN THE LAB

- use of an in vitro simulated ischemia/reperfusion test system
- performing fluorescence and luminescence viability tests on myocardial cells
- construction of a primary rat cardiomyocyte model
- culture of cell lines, preparation of cell banks, frozen storage
- drug treatments in in vitro cell-based systems
- MMP zymography measurements to test the efficacy of matrix metalloproteinase enzyme inhibitors
- western blotting techniques for protein expression monitoring and identification
- qPCR technique to monitor and identify mRNA expression
- ELISA measurements for the identification of biomarkers

SELECTED PUBLICATIONS

Makkos A., Ágg B., Varga ZV., Giricz Z., Gyöngyösi M., Lukovic D., Schulz R., Barteková M., **Görbe A.**, Ferdinandy P. (2021) Molecular Network Approach Reveals Rictor as a Central Target of Cardiac ProtectomiRs. **Int J Mol Sci. 22:** 9539.

Bencsik, P., Gömöri, K., Szabados, T., Sántha, P., Helyes, Z., Jancsó, G., Ferdinandy, P., **Görbe, A.** (2020) Myocardial ischemia reperfusion injury and cardioprotection in the presence of sensory neuropathy: therapeutic options. **Br J Pharmacol 177:** 5336-5356.

Makkos, A., Ágg, B., Petrovich, B., Varga, Z.V., **Görbe, A.**, Ferdinandy, P. (2021) Systematic review and network analysis of microRNAs involved in cardioprotection against myocardial ischemia/reperfusion injury and infarction: Involvement of redox signalling. **Free Radic Biol Med 172:** 237-251.

Gömöri, K., Szabados, T., Kenyeres, É., Pipis, J., Földesi, .I, Siska, A., Dormán, G., Ferdinandy, P., **Görbe, A.**, Bencsik, P. (2020) Cardioprotective Effect of Novel Matrix Metalloproteinase Inhibitors. **Int J Mol Sci. 21:** E6990.

Pálóczi, J., Szántai, Á., Kobolák, J., Bock, I., Ruivo, E., Kiss, B., Gáspár, R., Pipis, J., Ocsovszki, I., Táncos, Z., Fehér, A., Dinnyés, A., Onódi, Z., Madonna, R., Ferdinandy, P., **Görbe, A.** (2020) Systematic analysis of different pluripotent stem cell-derived cardiac myocytes as potential testing model for cardiocytoprotection. **Vascul Pharmacol 133-134:** 106781.

BALÁZS HANGYA

Institute of Experimental Medicine

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RESEARCH AREA

We are interested in the neural basis of cognitive functions both in the normal and diseased brain. We are investigating how different neuron types of subcortical centres mediate cognitive processes such as attention, learning and memory. Cholinergic neurons have been associated with learning and other cognitive functions; however, their activity during behavior is unknown. Understanding how the activity of basal forebrain cholinergic neurons support learning as well as how their impairment leads to learning deficits can help understanding their role in neurodegenerative dementias. Intermingled with cholinergic neurons, the basal forebrain also contains cortically projecting long-range inhibitory neurons. To understand how the basal forebrain supports cognition, it is important to determine how cognitive functions associated with the basal forebrain are segregated among different cell types.

TECHNIQUES AVAILABLE IN THE LAB

Mouse experiments, animal handling, electrophysiology, fiber photometry, optogenetic manipulations, human EEG analysis.

SELECTED PUBLICATIONS

Hegedüs, P., Heckenast, J., **Hangya, B.** (2021) Differential recruitment of ventral pallidal e-types by behaviorally salient stimuli during Pavlovian conditioning. **iScience 24:** 102377.

Király, B., Balázsfi, D., Horváth, I., Solari, N., Sviatkó, K., Lengyel, K., Birtalan, E., Babos, M., Bagaméry, G., Máthé, D., Szigeti, K., **Hangya, B.** (2020) In Vivo Localization of Chronically Implanted Electrodes and Optic Fibers in Mice. **Nat Comm 11:** 4686.

Laszlovszky, T., Schlingloff, D., Hegedüs, P., Freund, T.F., Gulyás, A., Kepecs, A., **Hangya, B.** (2020) Distinct synchronization, cortical coupling and behavioral function of two basal forebrain cholinergic neuron types. **Nat Neurosci 23:** 992-1003.

Hangya, B., Ranade, S.P., Lorenc, M., Kepecs, A. (2015) Central cholinergic neurons are rapidly recruited by reinforcement feedback. **Cell 162:** 1155–1168.

Pi, H.J., **Hangya, B.**, Kvitsiani, D., Sanders, J.I., Huang, Z.J., Kepecs, A. (2013) Cortical interneurons that specialize in disinhibitory control. **Nature 503:** 521-524.

TAMÁS HEGEDŰS

Semmelweis University
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Department of Biophysics and Radiation Biology

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RESEARCH AREA

Our research focuses on transmembrane proteins, which are associated with many diseases and are the targets of most available drugs. We are investigating ABC proteins acting as multidrug transporters to protect cells from toxic substances. We use theoretical and computational methods to understand their mechanism of function and substrate recognition. We also investigate how cystic fibrosis causing mutations in the CFTR/ABCC7 chloride channel affect protein unfolding, dynamics and function. CFTR channel opening requires phosphorylation of its disordered regulatory region. In order to understand the associated regulatory processes, we determine the intramolecular interactions of the disordered region and design a protein to counteract these interactions to achieve activation. In a similar manner, we design a small protein that binds to the C-terminus of the SARS Cov-2 Envelope transmembrane protein, inhibiting its binding to the human Pals1 protein, thus the degradation of cell-cell contacts and the development of inflammation.

TECHNIQUES AVAILABLE IN THE LAB

Bioinformatics, 3D-bioinformatics, AlphaFold2, computational biology, molecular dynamics, High Performance Computing, Python, web application development, molecular biology, protein expression and purification, biochemistry, florescent microscopy, atomic force microscopy.

SELECTED PUBLICATIONS

Hegedűs, T., Geisler, M., Lukács, G.L., Farkas, B. (2022) Ins and Outs of AlphaFold2 Transmembrane Protein Structure Predictions. **Cell Mol Life Sci 79:** 73.

Nagy, T., Tóth, Á., Telbisz, Á., Sarkadi, B., Tordai, H., Tordai, A., **Hegedűs, T.** (2021) The Transport Pathway in the ABCG2 Protein and Its Regulation Revealed by Molecular Dynamics Simulations. **Cell Mol Life Sci 78:** 2329–2339.

Csizmadia, G., Erdős, G., Tordai, H., Padányi, R., Tosatto, S., Dosztányi, Z., **Hegedűs, T.** (2020) The MemMoRF Database for Recognizing Disordered Protein Regions Interacting with Cellular Membranes. **Nucleic Acids Res 49:** D355–D360.

Veit, G., Avramescu, R., Perdomo, D., Phuan, P., Bagdany, M., Apaja, P., Borot, F., Szollosi, D., Wu, Y., Finkbeiner, W., **Hegedus, T.,** Verkman, A., és Lukacs, G. (2014) Some Gating Potentiators, Including VX-770, Diminish ΔF508-CFTR Functional Expression. **Sci Transl Med 6:** 246ra97.

ESZTER MÁRIA HORVÁTH

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RESEARCH AREA

Oxidative stress is characterized by the imbalance between the release of oxygen and nitrogen-derived free radicals and oxidants and the body's antioxidant capacity. Accumulating free radicals and oxidants can damage cellular components, which play important role in the development and maintenance of several diseases. Our group examines these processes and their predictive value in physiological and pathophysiological conditions; in pregnancy and its complications, in inflammatory and in cardiovascular diseases.

TECHNIQUES AVAILABLE IN THE LAB

Histological techniques, immunohistochemistry, ELISA, Western blot, PCR, flow cytometry.

SELECTED PUBLICATIONS

Lajtai, K., Tarszabó, R., Bányai, B., Péterffy, B., Gerszi, D., Ruisanchez, É., Sziva, R. E., Korsós-Novák, Á., Benkő, R., Hadjadj, L., **Horváth, E. M.** et al. (2021) Effect of Vitamin D Status on Vascular Function of the Aorta in a Rat Model PCOS. **Oxid Med Cell Longev 2021:** 8865979.

Lajtai, K., Nagy, Cs.T., Tarszabó, R., Benkő, R., Hadjadj, L., Sziva, R.E., Gerszi, D., Bányai, B., Ferdinandy, P. Nádasy, Gy.L., **Horváth, E.M.** et al. (2019) Effects of Vitamin D Deficiency on Proliferation and Autophagy of Ovarian and Liver Tissues in a Rat Model of Polycystic Ovary Syndrome. **Biomolecules 9:** 471.

Horvath, E.M., Magenheim, R., Beres, N.J., Benko, R., Pek, T., Tabak, A.G., Szabo, C. (2018) Oxidative-Nitrative Stress and Poly (ADP-Ribose) Polymerase Activation 3 Years after Pregnancy. **Oxid Med Cell Longev 2018:** 1743253.

Barany, T., Simon, A., Szabo, G., Benko, R., Mezei, Zs., Molnar, L., Becker, D., Merkely, B., Zima, E., **Horvath, E.M.** (2017) Oxidative Stress-Related Parthanatos of Circulating Mononuclear Leukocytes in Heart Failure. **Oxid Med Cell Longev 2017:** 1249614.

Horváth, E.M., Magenheim, R., Kugler, E., Vácz, G., Szigethy, A., Lévárdi, F., Kollai, M., Szabo, C., Lacza, Z. (2009) Nitrative stress and poly (ADP-ribose) polymerase activation in healthy and gestational diabetic pregnancies. **Diabetologia 52:** 1935-1943.

ERIK HRABOVSZKY

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Reproductive Neurobiology Research Group

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RESEARCH AREA

Molecular, cellular and system biology research at the Laboratory of Reproductive Neurobiology aims to provide a deeper understanding of the central regulatory mechanisms of human reproduction. Hypothalamic secretion of gonadotropin-releasing hormone (GnRH) builds up during pubertal development. Secretory pulses of GnRH at every 30-90 minutes stimulate luteinizing and follicle stimulating hormone (LH and FSH) production in the anterior pituitary gland. These troph hormones, in turn, initiate and later maintain functions of the gonads (testes and ovaries). This laboratory combines anatomical, electrophysiological and molecular approaches to study i) the neuronal and hormonal control of pulsatile GnRH/LH secretion, ii) the mechanisms of the mid-cycle GnRH/LH surge which triggers ovulation in females, iii) the central effects of gonadal steroid hormones on neuroendocrine systems and on wider aspects of general neuronal functioning and iv) the molecular and cellular processes underlying reproductive senescence.

TECHNIQUES AVAILABLE IN THE LAB

Immunohistochemistry
In situ hybridisation
RNA-sequencing
Laser capture microdissection

SELECTED PUBLICATIONS

Hrabovszky, E., Shughrue, P.J., Merchenthaler, I., Hajszán, T., Liposits, Zs., Carpenter, C.D. and Petersen, S.L. (2000) Detection of estrogen receptor-β messenger ribonucleic acid and I [estrogen] binding sites in luteinizing hormone-releasing hormone neurons of the rat brain. **Endocrinology 141:** 3506-3509.

Hrabovszky, E., Ciofi, P., Vida, B., Horvath, M.C., Keller, É., Caraty, A., Bloom, S.R., Ghatei, M.A., Dhillo, W.S., Liposits, Z. and Kallo, I. (2010) The kisspeptin system of the human hypothalamus. Sexual dimorphism and relationship with gonadotropin-releasing hormone and neurokinin B neurons. **Eur. J. Neurosci 31:** 1984-1998.

Skrapits, K., Sárvári, M., Farkas, I., Göcz, B., Takács, S., Rumpler, É., Váczi, V., Vastagh, C., Rácz, G., Matolcsy, A., Solymosi, N., Póliska, S., Tóth, B., Erdélyi, F., Szabó, G., Culler, M.D., Allet, C., Cotellessa, L., Prévot, V., Giacobini, P. and **Hrabovszky E.** (2021) The cryptic gonadotropin-releasing hormone neuronal system of human basal ganglia. **Elife 10:** e67714.

Campbell, R.E., Coolen, L.M., Hoffman, G.E. and **Hrabovszky, E.** (2022) Highlights of neuroanatomical discoveries of the mammalian gonadotropin-releasing hormone system. **J Neuroendocrinol 34:** e13115.

Göcz, B., Rumpler, É., Sárvári, M., Skrapits, K., Takács, S., Farkas, I., Csillag, V., Trinh, S.H., Bardóczi, Z., Ruska, Y., Solymosi, N., Póliska, S., Szőke, Z., Bartoloni, L., Zouaghi, Y., Messina, A., Pitteloud, N., Anderson, R.C., Millar, R.P., Quinton, R., Manchishi, S.M., Colledge, W.H. and **Hrabovszky E.** (2022) Transcriptome profiling of kisspeptin neurons from the mouse arcuate nucleus reveals new mechanisms in estrogenic control of fertility. **Proc Natl Acad Sci U S A 119:** e2113749119.

PÉTER IGAZ

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RESEARCH AREA

Studies on endocrine tumors, especially adrenal and neuroendocrine tumors. In the focus, non-coding RNAs (especially microRNAs), their pathogenic roles and utility as biomarkers are examined. Both tissue and biofluid samples are used. As biomarkers, markers of malignancy and prognosis are searched for. The clinical relevance of these studies is underlined by the diagnostic difficulties related to the adrenal and neuroendocrine tumors both in histology and clinical diagnostics.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of nucleic acids (RNA, DNA)
Real-time PCR techniques
Next generation sequencings
Studies on protein expression (Western-blot)
Tissue culture
Database search
Article writing

SELECTED PUBLICATIONS

Turai, P.I., Herold, Z., Nyirő, G., Borka, K., Micsik, T., Tőke, J., Szücs, N., Tóth, M., Patócs, A., **Igaz, P.** (2022) Tissue miRNA Combinations for the Differential Diagnosis of Adrenocortical Carcinoma and Adenoma Established by Artificial Intelligence. **Cancers 14:** 895.

Decmann, A., Perge, P., Nyírő, G., Darvasi, O., Likó, I., Borka, K., Micsik, T., Tóth, Z., Bancos, I., Pezzani, R., Iacobone, M., Patócs, A., **Igaz, P.** (2018) MicroRNA expression profiling in adrenal myelolipoma. **J Clin Endocrinol Metab: 103:** 3522-3530.

Perge, P., Butz, H., Pezzani, R., Bancos, I., Nagy, Z., Pálóczi, K., Nyírő, G., Decmann, A., Pap, E., Luconi, M., Mannelli, M., Buzás, E.I., Tóth, M., Boscaro, M., Patócs, A., **Igaz, P.** (2017) Evaluation and diagnostic potential of circulating exosomal microRNAs in adrenocortical tumors. **Scientific Reports 7:** 5474.

Perge, P., Nagy, Z., Decmann, Á., Igaz, I., **Igaz, P.** (2017) Potential relevance of microRNAs in inter-species epigenetic communication, and implications for disease pathogenesis. RNA **Biology 14:** 391-401.

Szabó, P.M., Tamási, V., Molnár, V., Andrásfalvy, M., Tömböl, Z., Farkas, R., Kövesdi, K., Patócs, A., Tóth, M., Szalai, C., Falus, A., Rácz, K., **Igaz, P.** (2010) Meta-analysis of adrenocortical tumor genomics data: novel pathogenic pathways revealed. **Oncogene 29:** 3163-3172.

Tömböl, Z., Szabó, P.M., Molnár, V., Wiener, Z., Tölgyesi, G., Horányi, J., Riesz, P., Reismann, P., Patócs, A., Likó, I., Gaillard, R.C., Falus, A., Rácz, K., **Igaz, P.** (2009) Integrative molecular-bioinformatics study of human adrenocortical tumors: microRNA, tissue specific target prediction and pathway analysis. **Endocrine-Related Cancer 16:** 895-906.

ZOLTÁN PÉTER JAKUS

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RESEARCH AREA

The lymphatic system plays an essential role in regulating fluid balance, controlling immune cell migration and lipid absorption. Recently, other novel and unexpected functions of the system have been revealed. It is therefore critical that we understand the organ-specific functions of the lymphatic system. Our research group aims to study the organ-specific roles of the lymphatic system and lymphatic growth signaling pathways under physiological and pathological conditions using preclinical transgenic mouse models. In our experiments, we have developed a nucleoside-modified mRNA-based system that induces organ-specific lymphatic growth and reverses experimental lymphedema. We revealed that pulmonary lymphatic function and fetal breathing movements play a critical role in the preparation of the fetal lung for inflation at birth. In addition, our data suggest that the mechanical forces induced by lymphatic flow are critical factors in controlling the developmental program of meningeal lymphatics.

TECHNIQUES AVAILABLE IN THE LAB

Lymphatic growth, the molecular mechanisms controlling this process, and the physiological and pathophysiological role of lymphatic function will be studied in specific organs and tissues during the embryonic and postnatal periods in preclinical transgenic animal models. For our in vivo oriented experiments, imaging, histology, molecular biology and general laboratory techniques and methods are used.

SELECTED PUBLICATIONS

Szőke, D., Kovács, G., Kemecsei, É., Bálint, L., Szoták-Ajtay, K., Aradi, P., Styevkóné, Dinnyés, A., Mui, B.L., Tam, Y.K., Madden, T.D., Karikó, K., Kataru, R.P., Hope, M.J., Weissman, D., Mehrara, B.J., Pardi, N., **Jakus, Z.** (2021) Nucleoside-modified VEGFC mRNA induces organ-specific lymphatic growth and reverses experimental lymphedema. **Nat Commun 12:** 3460.

Bálint, L., Ocskay, Z., Deák, B.A., Aradi, P., **Jakus, Z.** (2020) Lymph Flow Induces the Postnatal Formation of Mature and Functional Meningeal Lymphatic Vessels. **Front Immunol 10:** 3043.

Szoták-Ajtay, K,. Szőke, D., Kovács, G., Andréka, J., Brenner, G.B., Giricz, Z., Penninger, J., Kahn, M.L., **Jakus, Z.** (2020) Reduced Prenatal Pulmonary Lymphatic Function Is Observed in Clp1 K/K Embryos With Impaired Motor Functions Including Fetal Breathing Movements in Preparation of the Developing Lung for Inflation at Birth. **Front Bioeng Biotechnol 8:** 136.

Bálint, L., **Jakus, Z.** (2021) Mechanosensation and Mechanotransduction by Lymphatic Endothelial Cells Act as Important Regulators of Lymphatic Development and Function. **Int J Mol Sci 22:** 3955.

Pawlak, J.B., Bálint, L., Lim, L., Ma, W., Davis, R.B., Benyó, Z., Soares, M.J., Oliver, G., Kahn, M.L., **Jakus, Z.,** Caron, K.M. (2019) Lymphatic mimicry in maternal endothelial cells promotes placental spiral artery remodeling. **J Clin Invest 129:** 4912-4921.

KRISZTINA KÁLDI

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RESEARCH AREA

The circadian time-keeping system enhances the adaptive ability of the organism by preparing it to the periodical changes in the environment, and on the other hand, allows temporal separation of otherwise conflicting biochemical activities. Endogenous time measuring is organized at the cellular level and almost all mammalian cells harbour self-sustained circadian oscillators. In mammals, the suprachiasmatic nucleus is considered as the master pacemaker, that drives and synchronizes peripheral oscillators by neuronal and humoral mechanisms. Circadian rhythm disturbances are associated with an increased risk of severe health problems, including cardiovascular diseases, metabolic syndrome, diabetes mellitus, various malignancies and psychiatric diseases such as mood disorders. In the modern society the risk for circadian misalignment is increasing due to the growing demand of shift work and intense exposure to artificial light during the late evening hours. Our research group is interested in a broad field of chronobiology research including the examination of molecular clock functions, studying circadian control of the immune system and exploring human behavioral rhythms.

TECHNIQUES AVAILABLE IN THE LAB

Genotyping and crossing of mouse strains, bone marrow transplantation in mice, isolation of human and mouse leukocytes, investigation of leukocyte functions, microscopic techniques, RNA isolation, analysis of gene expression with real-time PCR, culturing genetic modification of cell lines, flow cytometry, ELISA, genetic modification of Neurospora crassa, analysis of the conidiation rhythm, following promoter activity by in vivo luciferase assay, protein analysis with Western blot, examination of protein-protein interactions, analysis of the sleep rhythm in human.

SELECTED PUBLICATIONS

Sűdy, Á.R., Ella, K., Bódizs, R., **Káldi, K.** (2019) Association of Social Jetlag With Sleep Quality and Autonomic Cardiac Control During Sleep in Young Healthy Men. **Front Neurosci 13:**950.

Ella, K., Csépányi-Kömi, R., **Káldi, K.** (2016) Circadian regulation of human peripheral neutrophils. **Brain Behav Immun 57:**209-221.

Haraszti, R.Á., Ella, K., Gyöngyösi, N., Roenneberg, T., **Káldi, K.** (2014) Social jetlag negatively correlates with academic performance in undergraduates. **Chronobiol Int 31:**603-12.

Gyöngyösi, N., Nagy, D., Makara, K., Ella, K., **Káldi, K.** (2013) Reactive oxygen species can modulate circadian phase and period in Neurospora crassa. F**ree Radic Biol Med 58**: 134-143.

Malzahn, E., * Ciprianidis, S., * **Káldi, K.** (*joint first authors), Schafmeier, T., Brunner, M. (2010) Photoadaptation in Neurospora by Competitive Interaction of Activating and Inhibitory LOV Domains. **Cell 142:** 762-772.

ISTVÁN KATONA

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Molecular Neurobiology Research Group

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RESEARCH AREA

Synaptic junctions are major sites of communication in the brain, where chemical messenger molecules transmit information from presynaptic neurons to their postsynaptic partners. The efficacy of synaptic transmission is not constant in time and space. Instead, its plasticity is a fundamental phenomenon underlying information storage and adaptation to environmental stimuli. Although classical neurotransmitters (such as glutamate and GABA) have well characterized principal roles in mediating basal neurotransmission, emerging evidence has revealed that synapses exploit a wide array of additional messenger molecules integrated into sophisticated signaling pathways to accomplish their complex functions. Thus, the major objective of our laboratory is to identify new signaling systems regulating synaptic transmission and its plasticity. We aim to characterize the molecular architecture of these novel pathways and to elucidate their physiological roles. Ultimately, this activity is envisaged to help gain a better understanding of synaptic function and reveal new aspects of impaired synaptic activity in brain disorders.

TECHNIQUES AVAILABLE IN THE LAB

A broad array of molecular neurobiology techniques (DNA, RNA and protein isolation and measurement, PCR, cloning, in vitro mutagenesis, Western blot), as well as cell culture methods are used to characterize signaling molecule candidats by gain-of-function or loss-of-function models. Labeling or genetic manipulation of given neuronal populations is achieved by in utero electroporation. Anatomical and developmental experiments exploit the methods of in situ hybridization, RNAscope, immunohistochemistry, and the imaging is performed by confocal or STORM super-resolution microscopy.

SELECTED PUBLICATIONS

Prokop, S., Ábrányi-Balogh, P., Barti, B., Vámosi, M., Zöldi, M., Barna, L., Urbán, G.M., Tóth, A.D., Dudok, B., Egyed, A., Deng, H., Leggio, G.M., Hunyady, L., van der Stelt, M., Keserű, G.M., **Katona, I.** (2021) PharmacoSTORM nanoscale pharmacology reveals cariprazine binding on Islands of Calleja granule cells. **Nature Communications 12:** 6505.

László, Z., Lele, Z., Zöldi, M., Miczán, V., Mógor, F., Simon, G.M., Mackie, K., Kacskovics, I., Cravatt, B.F. and **Katona, I.** (2020) ABHD4-mediated developmental anoikis safeguards the embryonic brain. **Nature Communications 11:**1.

Frau, R.*, Miczan, V.*, Traccis, F., Aroni, S., Pongor, C.I., Saba, P., Serra, V., Sagheddu, C., Fanni, S., Congiu, M., Devoto, P., Cheer, J.F., **Katona, I.***, Melis, M.* (2019) Prenatal THC exposure produces a hyperdopaminergic phenotype rescued by pregnenolone. **Nature Neuroscience 22:** 1975–1985.

Barna, L., Dudok, B., Miczán, V., Horváth, A., László, Z.I., and **Katona, I.** (2016) Correlated confocal and super-resolution imaging by VividSTORM. **Nature Protocols 11:** 163-183.

Dudok, B., Barna, L., Ledri, M., Szabó, S.I., Szabadits, E., Pintér, B., Woodhams, S.G., Henstridge, C.M., Balla, GY., Nyilas, R., Varga, C., Lee, S.H., Matolcsi, M., Cervenak, J., Kacskovics, I., Watanabe, M., Sagheddu, C., Melis, M., Pistis, M., Soltesz, I. and **Katona, I.** (2015) Cell-specific STORM superresolution imaging reveals nanoscale organization of cannabinoid signaling. **Nature Neuroscience 18:** 75-86.

KRISZTINA KOVÁCS

Institute of Experimental Medicine

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

Neurobiology of stress. Regulation of the hypothalamo-pituitary-adrenocortical axis. The role of gut microbiome in the neuroendocrine regulation.

TECHNIQUES AVAILABLE IN THE LAB

Surgical techniques on laboratory rodents (mice, rats). Hormone measurements (RIA, ELISA); Histological techniques, immunocytochemistry, in situ hybridization, RNAscope; Molecular biology: RNA and protein isolation, real time PCR and Western blot.

SELECTED PUBLICATIONS

Xu, L., Füredi, N., Lutter, C., Geenen, B., Pétervári, E., Balaskó, M., Dénes, Á., **Kovács, K.J.**, Gaszner, B., Kozicz, T. (2022) Leptin coordinates efferent sympathetic outflow to the white adipose tissue through the midbrain centrally-projecting Edinger-Westphal nucleus in male rats. **Neuropharmacology 205:** 108898.

Kuti, D., Winkler, Zs., Horváth, K., Juhász, B., Paholcsek, M., Stágel, A., Gulyás, G., Czeglédi, L., Ferenczi, Sz., **Kovács, K.J.** (2020) Gastrointestinal (Non-systemic) Antibiotic Rifaximin Differentially Affects Chronic Stress-induced Changes in Colon Microbiome and Gut Permeability without Effect on Behavior. **Brain Behav Immun 804:** 218.228.

Winkler, Zs., Kuti, D., Polyák, Á., Juhász, B., Gulyás, K., Lénárt, N., Dénes, Á., Ferenczi, Sz., Kovács, K.J. (2019) Hypoglycemia-activated Hypothalamic Microglia Impairs Glucose Counterregulatory Responses. **Sci Rep 9:** 6224.

Winkler, Z., Kuti, D., Ferenczi, S., Gulyas, K., Polyak, A., **Kovacs, K.J.** (2017) Impaired microglia fractalkine signaling affects stress reaction and coping style in mice. **Behav Brain Res 334:** 119-128.

Ferenczi, S., Szegi, K., Winkler, Z., Barna, T., **Kovacs, K.J.** (2016) Oligomannan Prebiotic Attenuates Immunological, Clinical and Behavioral Symptoms in Mouse Model of Inflammatory Bowel Disease. **Sci Rep 6:** 34132.

ZSOLT LIPOSITS

Institute of Experimental Medicine
Endocrine Neurobiology Research Team

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

Neuronal and hormonal regulation of reproduction.

TECHNIQUES AVAILABLE IN THE LAB

Functional neuroanatomical techniques, molecular biological tools, patch-clamp electrophysiology.

SELECTED PUBLICATIONS

Balint, F., Csillag, V., Vastagh, C., **Liposits, Z.**, and Farkas, I. (2021) Insulin-like growth factor 1 (IGF-1) increases GABAergic neurotransmission to GnRH neurons via suppressing the retrograde tonic endocannabinoid signaling pathway in mice. **Neuroendocrinology 111:** 1219–1230.

Vastagh, C., Farkas, I., Scott, M.M., and **Liposits, Z.** (2021) Networking of glucagon-like peptide-1 axons with GnRH neurons in the basal forebrain of male mice revealed by 3DISCO-based immunocytochemistry and optogenetics. **Brain Structure & Function 226:** 105–120.

Bake, T., Le May, M.V., Edvardsson, C.E., Vogel, H., Bergström, U., Albers, M.N., Skibicka, K.P., Farkas, I., **Liposits, Z.** and Dickson, S.L. (2020) Ghrelin Receptor Stimulation of the Lateral Parabrachial Nucleus in Rats Increases Food Intake but not Food Motivation. **Obesity 28:** 1503–1511.

Leiszter, K., Galamb, O., Kalmár, A., Zsigrai, S., Valcz, G., Szigeti, K.A., Barták, B.K., Nagy, Z.B., Dank, M., **Liposits, Z.**, Igaz, P., Tulassay, Z. and Molnár, B. (2020) Az ösztrogének lehetséges szerepe a vastagbéldaganatok kialakulásában. **Orvosi Hetilap 161:** 532–543.

Balla, B., Sárvári, M., Kósa, J.P., Kocsis-Deák, B., Tobiás, B., Árvai, K., Takács, I., Podani, J., **Liposits, Z.** and Lakatos, P. (2019) Long-term selective estrogen receptor-beta agonist treatment modulates gene expression in bone and bone marrow of ovariectomized rats. **Journal of Steroid Biochemistry and Molecular Biology 188:** 185–194.

JUDIT MAKARA

Institute of Experimental Medicine
Neuronal Signaling Research Group

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

The focus of our research is to understand the principles of information processing by neurons. Nerve cells receive thousands of synaptic inputs onto their thin and long processes called dendrites and transform the integrated information to an output signal at the cell body. Processing of inputs takes place primarily in the dendrites that express a variety of voltage dependent ion channels, allowing them to perform diverse forms of nonlinear summation and input-output transformation. Furthermore, the fine regulation of ion channel function makes this processing dynamic. We use cutting edge microscopic and electrophysiological methods in brain slices and awake behaving rodents to elucidate the basic principles and regulation of dendritic function in neurons of the hippocampus (a brain region important for episodic memory) as well as the possible roles of these cellular information processing mechanisms in learning and memory guiding behaviour.

TECHNIQUES AVAILABLE IN THE LAB

In vitro patch-clamp electrophysiology in brain slices, two-photon microscopy in brain slice and in awake behaving animals.

SELECTED PUBLICATIONS

Magó, Á., Kis, N., Lükő, B, **Makara, J.K.** (2021) Distinct dendritic Ca2+ spike forms produce opposing input-output transformations in rat CA3 pyramidal cells. **eLife 10:** e74493.

Ujfalussy, B.B., **Makara, J.K.** (2020) Impact of functional synapse clusters on neuronal response selectivity. **Nature Communications 11:** 1413.

Magó, Á., Weber, J.P., Ujfalussy, B.B., **Makara, J.K.** (2020) Synaptic plasticity depends on the fine-scale input pattern in thin dendrites of CA1 pyramidal neurons. **J. Neuroscience 40:** 2593-2605.

Raus Balind, S., Magó, Á., Ahmadi, M., Kis, N., Varga-Németh, Z., Lőrincz, A., **Makara, J.K.** (2019) Diverse synaptic and dendritic mechanisms of complex spike burst generation in hippocampal CA3 pyramidal cells. **Nature Communications, 10:** 1859.

Harnett, M.T.*, **Makara, J.K.***, Spruston, N., Kath, W.L., Magee, J.C.† (2012) Synaptic amplification by dendritic spines enhances input cooperativity. **Nature, 491:** 599-602.
*shared first authors.

ÉVA MIKICS

Institute of Experimental Medicine
Laboratory of Translational Behavioural Neuroscience

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

Our lab conducts behavioral neuroscience research with a translational approach. We aim to better understand the neurobiological background of mental disorders using animal models in order to identify potential targets for novel treatment strategies. Our work is mainly focused on the long-term effects of early-life stress, i.e. how early adverse factors contribute to vulnerability for the development of specific mental disorders.

TECHNIQUES AVAILABLE IN THE LAB

Detailed behavioral studies in rodents: design, implementation and analysis of behavioral tests (analysis of emotional, cognitive, social and motor functions)
Optogenetic, chemogenetic and pharmacological manipulations
Fiber photometry
Immunohistochemistry
Confocal and super resolution microscopy
qPCR

SELECTED PUBLICATIONS

Bruzsik, B., Biro, L., Zelena, D., Sipos, E., Török, B., Sarosdi, K.R., Szebik, H., **Mikics#**, E., Toth#. M. #equal contribution (2022) Neurochemically distinct populations of the bed nucleus of stria terminalis modulate innate fear response to weak threat evoked by predator odor stimuli. **Neurobiol Stress 15:** 100415.

Bruzsik, B., Biro, L., Zelena, D., Sipos, E., Szebik, H., Sarosdi, K.R., Horvath, O., Farkas, I., Csillag, V., Finszter, C.K., **Mikics#**, E., and Toth#, M. #equal contribution, (2021) Somatostatin neurons of the bed nucleus of stria terminalis enhance associative fear memory consolidation in mice. **J Neurosci 41:** 1982–1995.

Miskolczi, C., Halász, J., and **Mikics, É.** (2019) Changes in neuroplasticity following early-life social adversities. **Pediatr Res 85:** 225–233.

Mikics*¬, E., Guirado*, R., Umemori, J., Toth, M., Biro, L., Miskolczi, C., Balazsfi, D., Zelena, D., Castren, E., Haller, J., and Karpova, N. *equal contribution (2018) Social Learning Requires Plasticity Enhanced by Fluoxetine Through Prefrontal Bdnf-TrkB Signaling to Limit Aggression Induced by Post-Weaning Social Isolation. **Neuropsychopharmacology 43:** 235–245.

Mikics, É., Kruk, M., and Haller, J. (2004) Genomic and non-genomic effects of glucocorticoids on aggressive behavior in male rats. **Psychoneuroendocrinology 29:** 618–635.

ATTILA MÓCSAI

Semmelweis University
Faculty of Medicine
Department of Physiology

Address: Tűzoltó u. 37-47., H-1094 Budapest, Hungary

RESEARCH AREA

The aim of our group is to understand the molecular mechanisms of various human diseases, laying down the foundations for new diagnostic and therapeutic approaches. Our experiments focus on the inflammatory processes that determine the pathomechanism of a large number of major human diseases. We investigate their molecular mechanisms using transgenic animal models, healthy and patient-derived human cells and tissues, state-of-the-art molecular biology and gene editing, as well as functional and imaging methods. We have close collaboration with several prominent international research groups. Our group is supported by several programmes of excellence, including the Frontline and Topical Excellence programmes, as well as the European Union's largest international rheumatology consortium.

TECHNIQUES AVAILABLE IN THE LAB

Transgenic technologies (knockout, knock-in, gene-addition mutants) in mammals
Autoimmune and inflammatory disease models
In vitro and in vivo genetic modelling of human diseases
Molecular biology and genetics
Immune cell analysis, culture, genetic modification
Whole-genome gene editing
High-throughput confocal microscopy

SELECTED PUBLICATIONS

Szilveszter, K.P., Vikár, S., Horváth, Á.I., Helyes, Z., Sárdy, M. and **Mócsai, A.** (2022) Phospholipase Cγ2 is essential for experimental models of epidermolysis bullosa acquisita. **J Invest Dermatol 142:** 1114-1125.

Futosi, K., Kása, O., Szilveszter, K.P. and **Mócsai, A.** (2021) Neutrophil phospholipase Cγ2 drives autoantibody-induced arthritis through the generation of the inflammatory microenvironment. **Arthritis Rheumatol 73:** 1614-1625.

Orosz, A., Walzog, B. and **Mócsai, A.** (2021) In vivo functions of mouse neutrophils derived from HoxB8-transduced conditionally immortalized myeloid progenitors. **J Immunol 206:** 432–445.

Németh, T., Sperandio, M. and **Mócsai, A.** (2020) Neutrophils as emerging therapeutic targets. **Nat Rev Drug Discov 19:** 253-275.

Csete, D., Simon, E., Alatshan, A., Aradi, P., Dobó-Nagy, C., Jakus, Z., Benkő, S., Győri, D.S. and **Mócsai, A.** (2019) Hematopoietic or osteoclast-specific deletion of Syk leads to increased bone mass in experimental mice. **Front Immunol 10:** 937.

NÁNDOR NAGY

Semmelweis University
Faculty of Medicine
Department of Anatomy, Histology and Embryology
Stem Cells and Experimental Embryology Laboratory

Address: Tűzoltó u. 58., H-1094 Budapest, Hungary

RESEARCH AREA

Our research is focusing on two broad areas. Firstly, our laboratory is interested in developmental mechanisms of enteric nervous system (ENS) formation. This work is aimed at understanding the development of the ENS in normal, abnormal, and evolutionary contexts. We do this by examining the role of the extracellular environment in the embryonic gut that regulate the mechanisms of neural crest derived stem cell differentiation during intestinal morphogenesis. Secondly, our laboratory focuses on mechanisms that underlie lymphoid organ formation. This work also uses the avian embryo as the model system, and addresses cellular (stem cell migration, differentiation), molecular (Foxn1, CXCR4, Shh, BMP4 expression), immunological (IBDV and bronchitis infection) and morphological (confocal, immune electron-microscopy) aspects of the primary and secondary lymphoid organ formation. Our aim is to discover how the avian lymphoid organs are built, and how immunosuppressive diseases affect its organization.

https://semmelweis.hu/stemcell/en/about-us/

TECHNIQUES AVAILABLE IN THE LAB

- embryomanipulation, chimeria constraction,microsurgery
- stem cell fate mapping in the developing embryo
- histology (lectin and immune)
- electron microscopy
- in situ hybridization to study the gene expression
- retroviral gene delivery, monoclonal antibody technique
- stem cell and organ cultures
- tissue and organ extracellular matrix scaffold
- epithelial and neural organoids.

SELECTED PUBLICATIONS

Nagy, N. (Corresponding author), Kovács, T., Stavely, R., Halasy, V., Soós, A., Szőcs, E., Hotta, R., Graham, H., Goldstein, A.M. (2021) Avian ceca are required for hindgut enteric nervous system development by inhibiting neuronal differentiation via non-canonical Wnt signaling and by promoting enteric neural crest cell proliferation. **Devepoment 148:** dev199825.

Dóra, D., Ferenczi, S., Stavely, R., Tóth, V.E., Varga, Z.V., Kovács, T., Bódi, I., Hotta, R., Kovács, K.J., Goldstein, A.M., and **Nagy, N.** (2021) Evidence of a Myenteric Plexus Barrier and Its Macrophage-Dependent Degradation During Murine Colitis: Implications in Enteric Neuroinflammation. **Cell Mol Gasrtoenterol Hepatol 12:** 1617-1641.

Nagy, N. (Corresponding author), Barad, C., Hotta, R., Bhave, S., Arciero, E., Dora, D., and Goldstein, A.M. (2018) Collagen 18 and agrin are secreted by neural crest cells to remodel their microenvironment and regulate their migration during enteric nervous system development. **Development 145:** dev160317.

Nagy, N. (Corresponding author), Barad, C., Graham, H.K., Hotta, R., Cheng, L.S., Fejszak, N., and Goldstein, A.M. (2016) Sonic hedgehog controls enteric nervous system development by patterning the extracellular matrix. **Development 143:** 264-275. IF: 5,843

Dóra, D., Fejszák, N., Goldstein, A.M., Minkó, K., **Nagy, N.** (2017). Ontogeny of ramified CD45 cells in chicken embryo and their contribution to bursal secretory dendritic cells. **Cell Tissue Res 368:** 353-370.

ZOLTÁN NUSSER

Institute of Experimental Medicine
Cellular Neurophysiology Research Group

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

The most fundamental function of nerve cells is the integration of their synaptic inputs to generate their propagating output signal, the action potential. The major aims of Dr Nusser's laboratory are to understand how identified presynaptic nerve cells release neurotransmitters; how the released transmitter molecules activate their postsynaptic receptors; and how the generated postsynaptic potentials are integrated to generate an action potential. The Laboratory of Cellular Neurophysiology focuses on the following major project areas using a variety of molecular, neuroanatomical, in vitro electrophysiological, in vitro and in vivo imaging and in silico modeling approaches: 1. Revealing the molecular, structural and functional heterogeneity of cortical excitatory and inhibitory synapses. Determine the molecular specializations underlying the functional and structural diversity of synapses, such as the probability and short-term plasticity of transmitter release, and the extent of postsynaptic receptor activation. 2. Creating a molecular map of the neuronal surface by determining the location and density of various voltage- and ligand-gated ion channel subunits in defined subcellular compartments of identified nerve cells. 3. Understanding the mechanisms underlying hippocampal network activity during behaviour.

TECHNIQUES AVAILABLE IN THE LAB

Molecular, neuroanatomical, in vitro electrophysiological, in vitro and in vivo two-photon imaging and in silico modeling approaches.

SELECTED PUBLICATIONS

Karlocai, M.R., Heredi, J., Benedek, T., Holderith, N., Lorincz, A. and **Nusser, Z.** (2021) Variability in the Munc13-1 content of excitatory release sites. **eLife 0:**e67468

Holderith, N., Heredi, J., Kis, V., and **Nusser, Z.** (2020) A high-resolution method for quantitative molecular analysis of functionally characterized synapses. **Cell Rep 32:** 107968.

Rebola, N., Reva, M., Kirizs, T., Szoboszlay, M., Lorincz, A., Moneron, G., **Nusser, Z.** and DiGregorio, D.A. (2019) Distinct nanoscale calcium channel and synaptic vesicle topographies contribute to the diversity of synaptic function. **Neuron 104:** 693-710.

Éltes, T., Kirizs, T., **Nusser, Z.** & Holderith, N. (2017) Target cell type-dependent differences in Ca^{2+} channel function underlie distinct release probabilities at hippocampal glutamatergic terminals. **J Neurosci 37:** 1910-1924.

Szoboszlay M., Lorincz, A., Lanore, F., Vervaeke, K., Silver, R. A. & **Nusser, Z.** (2016) Functional properties of dendritic gap junctions in cerebellar Golgi cells. **Neuron 90:** 1043-1056.

GÁBOR NYIRI

Institute of Experimental Medicine
Cerebral Cortex Research Group

Address: Szigony u. 43., H-1083 Budapest, Hungary

RESEARCH AREA

My research group focuses on the sub-cortical control of learning and memory processes. We study these questions from synaptic-level electron microscopy studies to viral neuronal tracing methods and behavioral-level studies.

TECHNIQUES AVAILABLE IN THE LAB

My research group uses a variety of neuroscience techniques including, but not limited to: immunohistochemistry, light and electron microscopy, RNAscope, brain surgery to explore and monitor neural pathways, optogenetics, chemogenetics, in vivo electrophysiology, fiber photometry, miniscope calcium imaging and a variety of behavioral techniques.

SELECTED PUBLICATIONS

Szőnyi, A., Sos, K.E., Nyilas, R., Schlingloff, D., Domonkos, A., Takács, V.T. Pósfai, B., Hegedüs, P., Priestley, J.B.J.B., Gundlach, A.L.A.L., Gulyás, A.I.A.I., Varga, V., Losonczy, A., Freund, T.F., **Nyiri, G.** (2019) Brainstem nucleus incertus controls contextual memory formation. **Science 364.**

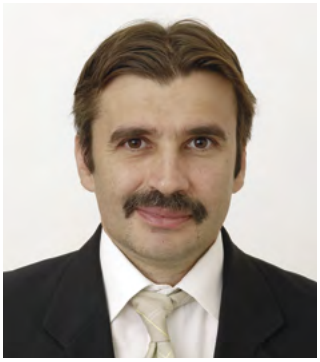
Szőnyi, A., Zichó, K., Barth, A.M., Gönczi, R.T.R.T., Schlingloff, D., Török, B., Sipos, E., Major, A., Bardóczi, Z., Sos, K.E.K.E., Gulyás, A.I.A.I., Varga, V., Zelena, D., Freund, T.F., **Nyiri, G.** (2019) A., Median raphe controls acquisition of negative experience in the mouse. **Science 366.**

Takács, V.T., Cserép, C., Schlingloff, D., Pósfai, B., Szőnyi, A., Sos, K.E.K.E., Környei, Z., Dénes, Á., Gulyás, A.I.A.I., Freund, T.F., Freund, T.F., **Nyiri, G.** (2018) Co-transmission of acetylcholine and GABA regulates hippocampal states. **Nat Commun. 9:** 2848.

Szabadits, E., Cserép, C., Szonyi, A., Fukazawa, Y., Shigemoto, R., Watanabe, M., Itohara, S., Freund, T.F.T.F., **Nyiri, G.** (2011) NMDA receptors in hippocampal GABAergic synapses and their role in nitric oxide signaling. **J Neurosci 31:** 5893–5904.

Szabadits, E., Cserép, C., Ludányi, A., Katona, I., Gracia-Llanes, J., Freund, T.F., **Nyiri, G.** (2007) Hippocampal GABAergic synapses possess the molecular machinery for retrograde nitric oxide signaling. **J Neurosci 27:** 8101–8111.

ATTILA PATÓCS



Semmelweis University
Faculty of Medicine
Department of Laboratory Medicine

Address: Nagyvárad tér 4., H-1089 Budapest, Hungary

RESEARCH AREA

genetics, oncogentics, genomics, endocrine tumors, hereditary cancer

TECHNIQUES AVAILABLE IN THE LAB

DNA and RNA isolation, PCR techniques, DNA sequencing, routine molecular biological methods

SELECTED PUBLICATIONS

Patocs, A., Zhang, L., Xu, Y., Weber, F., Caldes, T., Mutter, G.L., Platzer, P., Eng, C. (2007) Breast-Cancer Stromal Cells with TP53 Mutations and Nodal Metastases. **N Engl J Med 357:** 2543-2551.

Tretter, L., **Patocs, A.,** Chinopoulos, C. (2016) Succinate, an intermediate in metabolism, signal transduction, ROS, hypoxia, and tumorigenesis. **Biochim Biophys Acta1857:** 1086-1101.

Butz, H., Rácz, K., Hunyady, L., **Patócs, A.** (2012) Crosstalk between TGF-β signaling and the microRNA machinery. **Trends Pharmacol Sci 33:** 382-393.

Ni, Y., Zbuk, K.M., Sadler, T., **Patocs, A.,** Lobo, G., Edelman, E., Platzer, P., Orloff, M.S., Waite, K.A., Eng, C. (2008) Germline mutations and variants in the succinate dehydrogenase genes in Cowden and Cowden-like syndromes. **Am J Hum Genet 83:** 261-268.

Butz, H., Likó, I., Czirják, S., Igaz, P., Khan, M.M., Zivkovic, V., Bálint, K., Korbonits, M., Rácz, K., **Patócs, A.** (2010) Down-regulation of Wee1 kinase by a specific subset of microRNA in human sporadic pituitary adenomas. **J Clin Endocinol Metab 95:** E181-E191.

KAROLINA MILENA PIRCS

Semmelweis University
Faculty of Medicine
Department of Translational Medicine

Address: Üllői út 26., H-1085 Budapest, Hungary

RESEARCH AREA

I am interested in how alterations in autophagy contribute to healthy ageing and the pathophysiology of age-related, chronic neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease and Huntington's disease.

TECHNIQUES AVAILABLE IN THE LAB

Lentiviral vector production, direct neuronal reprogramming, nuclei sorting using FACS and ultracentrifugation.

SELECTED PUBLICATIONS

Pircs, K., Drouin-Ouellet, J., Horváth, V., Gil, J., Rezeli, M., Garza, R., Grassi, D.A., Sharma, Y., St-Amour, I., Harris, K., Jönsson, M.E., Johansson, P.A., Vuono, R., Fazal, S.V., Stoker, T., Hersbach, B.A., Sharma, K., Lagerwall, J., Lagerström, S., Storm, P., Hébert, S.S., Marko-Varga, Gy., Parmar, M., Barker, R.A., Jakobsson, J. (2021) Distinct subcellular autophagy impairments in induced neurons from Huntington's disease patients. **Brain** awab473 (online, ahead of print)

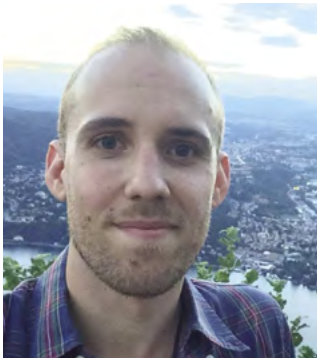
Brattas, P.L., Hersbach, B.A., Madsen, S., Petri, R., Jakobsson, J., **Pircs, K.** (2020) Impact of differential and time-dependent autophagy activation on therapeutic efficacy in a model of Huntington disease. **Autophagy 17:** 1316-1329.

Pircs, K., Petri, R., Madsen, S., Brattås, P.L., Vuono, R., Ottosson, R.D., St-Amour, I., Hersbach, A.B., Matusiak-Brückner, M., Hult, Lundh, S., Petersén, A., Déglon, N., Hébert, S.S., Parmar, M., Barker, A.R., Jakobsson, J. (2018) Huntingtin aggregation impairs autophagy leading to Argonaute-2 accumulation and global microRNA dysregulation. **Cell Rep 24:** 1397-1406.

Drouin-Ouellet, J., Lau, S., Brattas, P.L., Rylander, Ottosson, D., **Pircs, K.,** Grassi, D., Collins, M.L., Vuono, R., Sjöland, A.A., Westergren-Thorsson, G., Graff, C., Minthon, L., Toresson, H., Barker, A.R., Jakobsson, J., Parmar, M. (2017) REST suppression mediates neural conversion of adult human fibroblasts via microRNA dependent and independent pathways. **EMBO Mol Med 9:** 1117-1131.

Petri, R., **Pircs, K.,** Jönsson, M.E., Akerblom, M., Brattas, P.L., Klussendorf, T., Jakobsson, J. (2017) let-7 regulates radial migration of new-born neurons through positive regulation of autophagy. **EMBO J 36:** 1379-1391.

FRIGYES SÁMUEL RÁCZ



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Department of Physiology

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RESEARCH AREA

In our study we investigate the effects of aging on neurodynamics and various aspects of cognitive functioning. Our research focuses on the identification of neurophysiological biomarkers that can potentially predict age-related changes in cognition and help better understand their biological origin. Our project has two fundamental aspects. First, we develop new analythical and computational methods that can effectively capture nontrivial features of neural dynamics. These include, but are not limited to methods for assessing the fractal properties of dynamic functional connectivity among distinct brain regions, a subfield that only recently became the focus of interest in the field of neuroscience. Second, we collect and analyze data from our population of interest, specifically healthy (i.e., no history of any neuropsychiatric disorder or any severe general medical condition), elderly individuals. Results from the elderly group are contrasted with those obtained from healthy, young (age < 40 years) adults. We record cortical activity usin electroencephalography (EEG). Measurements are first performed in resting-state (i.e., not engaging in any specific mental activity), then EEG is recorded while subjects perform three different cognitive tasks. These all put different mental skills to test, such as pattern recognition, working memory or spatial orientation and learning. Following the EEG recordings, participants are further evaluated using the standardized and validated Cambridge Neuropsychological Test Automated Battery (CANTAB). This session includes seven further tasks, each testing various aspects of cognition that are most commonly affected in conditions related to age and pathologies eventually leading to dementia. Our research therefore not only focuses on how resting-state neural activity might predict performance related to different aspects of cognition, it is also equivalently important, how the brain adapts to increased mental challange/workload, and how this adaptation might be affected at a later age.

TECHNIQUES AVAILABLE IN THE LAB

Introduction to electroencephalography (EEG) and its neurophysiological origins, experience in conducting measurements with EEG
Introduction to analytical and evaluation methods frequently applied in cognitive neuroscience
Introduction to postgraduate level mathematics
Programming skills in Matlab and Python languages, introduction to the Matlab and Jupyter Notebook environments
Machine learning skills
Skills commonly applied in the fields of statistics and data science
Scientific writing skills
Presentation skills

SELECTED PUBLICATIONS

Mukli, P., Csipo, T., Lipecz, A., Stylianou, O., **Racz, F.S.**, Owens, C.D., Perry, J.W., Tarantini, S., Sorond, F.A., Kellawan, J.M. and Purebl, G., (2021) Sleep deprivation alters task-related changes in functional connectivity of the frontal cortex: A near-infrared spectroscopy study. **Brain and Behavior 11:** p.e02135.

Racz, F.S., Farkas, K., Stylianou, O., Kaposzta, Z., Czoch, A., Mukli, P., Csukly, G. and Eke, A. (2021) Separating scale-free and oscillatory components of neural activity in schizophrenia. **Brain and Behavior 11:** p.e02047.

Kaposzta, Z., Stylianou, O., Mukli, P., Eke, A. and **Racz, F.S.** (2021) Decreased connection density and modularity of functional brain networks during n-back working memory paradigm. **Brain and Behavior 11:** p.e01932.

Racz, F.S., Mukli, P., Nagy, Z. and Eke, A., (2018) Multifractal dynamics of resting-state functional connectivity in the prefrontal cortex. **Physiological measurement 39:** p.024003.

Racz, F.S., Mukli, P., Nagy, Z. and Eke, A. (2017) Increased prefrontal cortex connectivity during cognitive challenge assessed by fNIRS imaging. **Biomedical optics express 8:** 3842-3855.

BEÁTA SPERLÁGH

Institute of Experimental Medicine
Molecular Pharmacology Research Group

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RESEARCH AREA

ATP is one of the most versatile molecule in the living cells: it is well known as the universal "energy currency", and as a building block of DNA, but it is also an important signalling substance of intercellular communication. This latter function of ATP is mediated by ionotropic P2X and metabotropic P2Y receptors. The general scientific mission of my research is to understand the ATP mediated signalling in the normal and pathological nervous system; and thereby to identify new therapeutic targets for the treatment of CNS diseases. We employ multidisciplinary approaches to study purinergic mechanisms, including studies on the release and action of ATP, mapping and identification of purinergic receptors under physiological conditions and in animal models of various neurological and psychiatric disorders and clinical studies. The main focus of our current interest is to identify the role of P2X7 receptors and the coupled signalling pathways (NLRP3-IL-1beta) in animal models of autism, schizophrenia and mood disorders as well as that of the metabotropic P2Y12 receptors in the pathophysiology of pain and Parkinson's disease.

TECHNIQUES AVAILABLE IN THE LAB

Multiplex gene and protein expression analyses, light and electronmicroscopic immunhistochemistry, neurotransmitter release studies and other neurochemical techniques in vitro and in vivo, optogenetics, patch-clamp electrophysiology, two-photon microscopy, in vivo behavior studies in animal models of CNS disorders.

SELECTED PUBLICATIONS

Szabó, D., Tod, P., Gölöncsér, F., Román, V., Lendvai, B., Otrokocsi, L., **Sperlágh, B.** (2022) Maternal P2X7 receptor inhibition prevents autism-like phenotype in male mouse offspring through the NLRP3-IL-1β pathway. **Brain Behav Immun 101:** 318-332.

Iring, A., Tóth, A., Baranyi, M., Otrokocsi, L., Módis, L.V., Gölöncsér, F., Varga, B., Hortobágyi, T., Bereczki, D., Dénes, Á., **Sperlágh, B.** (2022) The dualistic role of the purinergic P2Y12-receptor in an in vivo model of Parkinson's disease: Signalling pathway and novel therapeutic targets. **Pharmacol Res 176:** 106045.

Gölöncsér, F., Baranyi, M., Iring, A., Hricisák, L., Otrokocsi, L., Benyó, Z., **Sperlágh, B.** (2021) Involvement of P2Y12 receptors in a nitroglycerin-induced model of migraine in male mice. **Br J Pharmacol 178:** 4626-4645.

Horváth, G., Otrokocsi, L., Beko, K., Baranyi, M., Kittel, Á., Fritz-Ruenes, P.A., **Sperlágh, B.** (2019) P2X7 Receptors Drive Poly(I:C) Induced Autism-like Behavior in Mice. **J Neurosci 39:** 2542-2561.

Bekő, K., Koványi, B., Gölöncsér, F., Horváth, G., Dénes, Á., Környei, Z., Botz, B., Helyes, Z., Müller, C.E., **Sperlágh, B.** (2017) Contribution of platelet P2Y12 receptors to chronic Complete Freund's adjuvant-induced inflammatory pain. **J Thromb Haemost 15:** 1223-1235.

JÁNOS SZABADICS

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RESEARCH AREA

The current theories of the broader hippocampal network explain its memory functions based on the firing of individual neurons. However, the cellular mechanisms that underlie these functions are elusive. We are interested in the functions that determine the activity of dentate gyrus granule cells (DG GC). DG GCs translate diverse inputs into highly different specific codes, which underlies the so-called pattern separation that allows us to distinguish similar events, objects. We focus on the principles that govern how single GCs extract information from the activity of single upstream neurons from the four major input pathways using direct patch clamp recordings and voltage-sensitive dye/protein imaging of single small axon terminals together with anatomical and computational approaches. The two perforant paths (PPs) that originate from the medial and lateral entorhinal cortices convey spatial context (such as the famous grid cell activity) or specific information content (for example certain objects). Inputs from hilar mossy cells distinguishes subtle differences and inputs from the hypothalamic supramammillary nucleus synchronizing GC activities during attention.

TECHNIQUES AVAILABLE IN THE LAB

Patch clamp electrophysiology, in vitro
Voltage imaging
Calcium imaging
Light microscopy
Neuronal simulations

SELECTED PUBLICATIONS

Oláh, V.J., Lukacsovich, D., Winterer, J., Arszovszki, A., Lőrincz, A., Nusser, Z., Földy, C., **Szabadics, J.** (2020) Functional specification of CCK+ interneurons by alternative isoforms of Kv4.3 auxiliary subunits. **eLife, 9:** e58515.

Neubrandt, M., Oláh, V.J., Brunner, J., Marosi, E., Soltesz, I., **Szabadics, J.** (2018) Single bursts of individual granule cells functionally rearrange feed-forward inhibition. J**. Neurosci. 38:** 1711-1724.

Neubrandt, M., Oláh, V.J., Brunner, J., **Szabadics, J.** (2017) Feedforward inhibition is randomly wired from individual granule cells onto CA3 pyramidal cells. **Hippocampus 27:** 1034-1039.

Brunner J, **Szabadics J** (2016) Analogue modulation of back-propagating action potentials enables dendritic hybrid signalling. **Nat Commun 7:** 13033.

Luo, W., Egger, M., Domonkos, A., Que, L., Lukacsovich, D., Cruz-Ochoa, N.A., Szőcs, S., Seng, C., Arszovszki, A., Sipos, E., Amrein, I., Winterer, J., Lukacsovich, T., **Szabadics, J.**, Wolfer, D.P., Varga, C., Földy, C. (2021) Recurrent rewiring of the adult hippocampal mossy fiber system by a single transcriptional regulator, Id2. **Proc Natl Acad Sci USA 118:** e2108239118.

KÁLMÁN TORY

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1st Department of Paediatrics

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RESEARCH AREA

The research group formerly identified the first variant with a trans-associated mutation-dependent pathogenicity in an autosomal recessive disorder (NPHS2 R229Q) [Tory et al, Nat Genet, 2014) and a novel gene of steroid-resistant nephrotic syndrome (DKC1). They demonstrated the role of rRNA-pseudouridylation in DKC1-associated nephrotic syndrome [Balogh et al, PNAS, 2020]. The group created a novel population-genetic algorithm to identify novel incompletely penetrant variants and interallelic interactions in autosomal recessive disorders [Mikó et al, Hum Mutat, 2021]. Function and interallelic interactions of the most frequently implicated protein in steroid-resistant nephrotic syndrome, podocin, as well as the function of novel genes are studied in cell culture experiments and on a Caenorhabditis elegans model.

TECHNIQUES AVAILABLE IN THE LAB

Cell culture experiments, vector construction, mutagenesis, PCR, rtPCR, qPCR, sequencing, expression, immunostaining, characterization of protein localization, maintenance, transformation, mutagenesis of Caenorhabditis elegans strains, fluorescence stereomicroscope, population-genetic calculations.

SELECTED PUBLICATIONS

Mikó, Á., Kaposi, A., Schnabel, K., Seidl, D., **Tory, K.** (2021) Identification of incompletely penetrant variants and interallelic interactions in autosomal recessive disorders by a population-genetic approach. **Hum Mutat 42:** 1473-87.

Balogh, E., Chandler, J.C., Varga, M., Tahoun, M.K., Menyhárd, D., Schay, G., Goncalves, T., Hamar, R., Légrádi, R., Szekeres, Á., Gribouval, O., Kleta, R., Stanescu, H., Bockenhauer, D., Kerti, A., Williams, H., Kinsler, V., Di, W.L., Curtis, D., Kolatsi-Joannou, M., Hammid, H., Szőcs, A., Perczel, K., Maka, E., Toldi, G., Sava, F., Arrondel, C., Kardos, M., Fintha, A., Hossain, A., D'Arco, F., Kaliakatsos, M., Koeglmeier, J., Mifsud, W., Mooseja, M., Faro, A., Jávorszky, E., Rudas, G.H., Saied, M., Marzouk, S., Kelen, K., Götze, J., Reusz, G., Tulassay, T., Dragon, F., Mollet, G., Motameny, S., Thiele, H., Dorval, G., Nürnberg, P., Perczel, A., Szabó, A.J., Long, D.A., Tomita, K., Antignac, C., Waters, A.M., **Tory, K.** (2020) Pseudouridylation defect due to DKC1 and NOP10 mutations cause nephrotic syndrome with cataracts, hearing impairment and enterocolitis. **Proc Natl Acad Sci USA 117:** 15137-47.

Mikó, Á.K., Menyhárd, D., Kaposi, A., Antignac, C., T**ory, K.** (2018) The mutation-dependent pathogenicity of NPHS2 R229Q: a guide for clinical assessment. **Hum Mutat 39:** 1854-60.

Stráner, P., Balogh, E., Schay, G., Arrondel, C., Mikó, Á., L'Auné, G., Benmerah, A., Perczel, A.K., Menyhárd, D., Antignac, C., Mollet, G., **Tory, K.** (2018) C-terminal oligomerization of podocin mediates interallelic interactions. **Biochim Biophys Acta Mol Basis Dis. 1864:** 2448-2457.

Tory, K., Menyhard, D.K., Woerner, S., Nevo, F., Gribouval, O., Kerti, A., Straner, P., Arrondel, C., Cong, E.H., Tulassay, T., Mollet, G., Perczel, A., Antignac, C. (2014) Mutation-dependent recessive inheritance of NPHS2-associated steroid-resistant nephrotic syndrome. **Nat Genet 46:** 299-304.

BALÁZS UJFALUSSY

Institute of Experimental Medicine
Biological Computation Research Group

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RESEARCH AREA

We are using mathematical models and computational analysis to study the neuronal basis of memory and navigation. Our goal is to understand how basic biophysical mechanisms in a specific neuronal system (the hippocampus) give rise to higher order cognitive processes. What is the effect of nonlinear dendritic processing of inputs on the dynamics of the network and thus how they influence the learning and recall of memories and ultimately the behavior of the animal? We answer similar questions using computational models in close collaborate with experimental colleagues. During the research, models are also used in a different way: during learning the neuronal network of the brain develops a model of the environment that the animal can use to interpret the incoming sensory information or to predict possible future consequences of its actions. Describing or analysing both of these models requires computational tools. We are looking for students passionate for understanding the nervous system but also interested in mathematics and programming.

TECHNIQUES AVAILABLE IN THE LAB

- simulation of detailed single neuron models in Neuron and Python
- data analysis and programming in python
- building and using probabilistic generative models
- analysing in vivo Ca-imaging and electrophysiology data
- analysis of behavioural experiments in mice
- programming virtual reality for animal experiments

SELECTED PUBLICATIONS

Ujfalussy, B.B., Orbán, G. (2021) Sampling motion trajectories during hippocampal theta sequences. **BioRxiv 2021.12.14.472575.**

Ujfalussy, B.B., Makara, J.K., (2020) Impact of functional synapse clusters on neuronal response selectivity. **Nature Comm 11:** 1-14.

Vágó, L., **Ujfalussy, B.B.** (2018) Robust and efficient coding with grid cells. **PLoS Computational Biology 14:** e1005922.

Ujfalussy, B.B., Makara, J.K., Lengyel, M., Branco, T. (2018) Global and multiplexed dendritic com- putations under in vivo-like conditions. **Neuron 100:** 579-592.

Ujfalussy, B.B., Branco, T., Makara J.K., Lengyel M. (2015) Dendritic nonlinearities are tuned for efficient spike-based computations in cortical circuits. **eLife 4:** e10056.

SZABOLCS VÁRBÍRÓ

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RESEARCH AREA

Our work group studied cardiovascular effects of female sexualsteroids in different animal models: its protective role in gender studies and in gender related cardiovascular sport adaptation studies. In pathophysiological models: cardiovascular adaptation in hypertension, menopause and polycystic ovary syndrome. In clinical studies we examine the connections of cardiovascular diseases with previous deliveries, spontaneous abortions - and its potential genetic and psychological background. During our experiments we use in vivo and in vitro observation methods: eg. treatment of vigil and anaesthetized animals - different surgical methods of experimental animals - isolation of vessels from different regions and vascular beds, the biomechanikcal and pharmacological reactivity of isolated vessels and also LAD network analysis with vascular phyciology methods and immunohystochemical analysis of hystological sections.

TECHNIQUES AVAILABLE IN THE LAB

Methods available: mapping, isolated vessels: rings and segments' studies with wire and pressure myography. Immunohystochemistry. Other methods: clinical database analysis, statistics.

SELECTED PUBLICATIONS

Várbíró, S., Takács, I., Tűű, L., Nas, K., Sziva, R.E., Hetthéssy, J.R., Török, M. (2022) Effects of Vitamin D on Fertility, Pregnancy and Polycystic Ovary Syndrome-A Review. **Nutrients 14:** 1649.

Sipos, M., Gerszi, D., Dalloul, H., Bányai, B., Sziva, R.E., Kollarics, R., Magyar, P., Török, M., Ács, N., Szekeres, M., Nádasy, G.L., Hadjadj, L., Horváth, E.M., **Várbíró, S.** (2021) Vitamin D Deficiency and Gender Alter Vasoconstrictor and Vasodilator Reactivity in Rat Carotid Artery. I**nt J Mol Sci 22:** 8029.

Merkely, P., Bakos, M., Bányai, B., Monori-Kiss, A., Horváth, E.M., Bognár, J., Benkő, R., Oláh, A., Radovits, T., Merkely, B., Ács, N., Nádasy, G.L., Török, M., **Várbíró, S.** (2021) Sex Differences in Exercise-Training-Related Functional and Morphological Adaptation of Rat Gracilis Muscle Arterioles. **Front Physiol 12:** 685664.

Török, M., Merkely, P., Monori-Kiss, A., Horváth, E.M., Sziva, R.E., Péterffy, B., Jósvai, A., Sayour, A.A., Oláh, A., Radovits, T., Merkely, B., Ács, N., Nádasy, G.L., **Várbíró, S.** (2021) Network analysis of the left anterior descending coronary arteries in swim-trained rats by an in situ video microscopic technique. **Biol Sex Differ 12:** 37.

Sziva, R.E., Fontányi, Z., Pál, É., Hadjadj, L., Monori-Kiss, A., Horváth, E.M., Benkő, R., Magyar, A., Heinzlmann, A., Benyó, Z., Nádasy, G.L., **Várbíró, S.** (2020) Vitamin D Deficiency Induces Elevated Oxidative and Biomechanical Damage in Coronary Arterioles in Male Rats. **Antioxidants (Basel) 9:** 997.

VIKOR VARGA

Institute of Experimental Medicine
Subcortical Modulation Research Group

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RESEARCH AREA

We live in an ever-changing world. Our survival and well-being depend on how we can adapt to it by momentarily readjusting our actions. In order to do so, we have to filter out unimportant inputs and store only relevant information. Then, based on the combination of freshly acquired information and our memories, we select an action plan matching the actual situation. Subcortical modulation, by influencing all stages of cortical information processing, is indispensable for the selection, storage and recall of information and for carrying out the optimal action. Disruption of subcortical modulation leads to severe psychiatric illnesses. Our lab aims to unravel the operational principles of subcortical modulation. We aim to decipher the modulatory signal (or code) and how it influences information processing in target cortical circuits. We are also interested in the feedback from the cortex to subcortical regions whereby we would be able to uncover how cortical circuits control their modulation.

TECHNIQUES AVAILABLE IN THE LAB

In vivo electrophysiology: juxtacellular and patch clamp recording, registration of large population of neurons by high channel count silicone probes in head-fixed and freely moving mice;
Manipulation of neuronal activity by optogenetics;
High temporal and spatial resolution behavior tracking;
Surgery: electrode implantation, injection of viral vectors and tracers;
Data analysis.

SELECTED PUBLICATIONS

Jelitai, M., Barth, A.M., Komlósi, F., Freund, T.F., **Varga, V.** (2021) Activity and coupling to hippocampal oscillations of median raphe GABAergic cells in awake mice. **Front Neural Circuits 15:** 784034.

Barth, A.M., Domonkos, A., Fernandez-Ruiz, A., Freund, T.F., **Varga, V.** (2018) Hippocampalnetwork dynamics during rearing episodes. **Cell Reports 23:** 1706-1715.

Domonkos, A., Ledri, L.N., Laszlovszky, T., Cserép, C., Borhegyi, Z., Papp, E., Nyiri, G., Freund, T.F., **Varga, V.** (2016) Divergent in vivo activity of serotonergic and non-serotonergic VGluT3-neurones in the median raphe region. **J Physiol (London) 594:** 3775-90.

Vandecasteele, M., **Varga, V.,** Berényi, A., Papp, E., Bartho, P., Venance, L., Freund, T.F., Buzsaki, G. (2014) Optogenetic activation of septal cholinergic neurons suppresses sharp wave ripples and enhances theta oscillations in the hippocampus. **Proc Natl Acad Sci USA 111:** 13535-13540.

Varga, V., Losonczy, A., Zemelman, B.V., Borhegyi, Z., Nyiri, G., Domonkos, A., Hangya, B.,Holderith, N., Magee, J.C., Freund, T.F. (2009) Fast synaptic subcortical control of hippocampalcircuits. **Science 326:** 449-453.

ZOLTÁN VARGA

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RESEARCH AREA

We are aiming to explore key inflammatory mechanisms of cardiovascular (heart failure and myocardial infarction) and oncological diseases by using translational animal models, cell cultures, and human samples. We place special emphasis on studying the interection of cancer and cardiovascular comorbidities, and investigating the potential pharmacological treatment of these conditions.

TECHNIQUES AVAILABLE IN THE LAB

immunoassays (Western blot, ELISA), qRT-PCR,
histological procedures (tissue processing, immunohistochemistry, immunofluorescent staining)
RNA in-situ hybridization, confocal microscopy, flow cytometry,
cell culture models, animal experiments

SELECTED PUBLICATIONS

Onódi, Z., Visnovitz, T., Kiss, B., Hambalkó, S., Koncz, A., Ágg, B., Váradi, B., Tóth, V.É., Nagy, R.N., Gergely, T.G., Gergő, D., Makkos, A., Pelyhe, C., Varga, N., Reé, D., Apáti, Á., Leszek, P., Kovács, T., Nagy, N., Ferdinandy, P., Buzás, E.I., Görbe, A., Giricz, Z., **Varga, Z.V.** (2021) Systematic transcriptomic and phenotypic characterization ofhuman and murine cardiac myocyte cell lines and primary cardiomyocytes reveals seriouslimitations and low resemblances to adult cardiac phenotype. **J Mol Cell Cardiol 165:** 19-30.

Onódi, Z., Ruppert, M., Kucsera, D., Sayour, A.A., Tóth, V.E., Koncsos, G., Novák, J., Brenner, G.B., Makkos, A., Baranyai, T., Giricz, Z., Görbe, A., Leszek, P., Gyöngyösi, M., Horváth, I.G., Schulz, R., Merkely, B., Ferdinandy, P., Radovits, T., **Varga, Z.V.** (2021) AIM2-driven inflammasomeactivation in heartfailure. **Cardiovasc Res 117:** 2639-2651.

van Esbroeck, A.C.M., **Varga, Z.V.,** Di, X., van Rooden, E.J., Tóth, V.E., Onódi, Z., Kuśmierczyk, M., Leszek, P., Ferdinandy, P., Hankemeier, T., van der Stelt, M., Pacher, P. (2020) Activity-based protein profilingof the human failing ischemic heart revealsalterations in hydrolase activities involving theendocannabinoid system. **Pharmacol Res 151:** 104578. [IF:5.57]

Varga, Z.V., Erdelyi, K., Paloczi, J., Cinar, R., Zsengeller, Z.K., Jourdan, T., Matyas, C., Balazs, N.T., Guillot, A., Xiang, X., Mehal, A., Hasko, G., Stillman, I.E., Rosen, S., Gao, B., Kunos, G., Pacher, P. (2018) Disruption of renal arginine metabolismpromotes kidney injury in hepatorenal syndrome. **Hepatology 68:** 1519-1533.

Valenta, I., **Varga, Z.V.,** Valentine, H., Cinar, R., Horti, A., Mathews, W.B., Dannals, R.F., Steele, K., Kunos, G., Wahl R.L., Pomper, M.G., Wong, D.F., Pacher, P., Schindler, T.H. (2018) Feasibility Evaluation of MyocardialCannabinoid Type 1 Receptor Imaging inObesity: A Translational Approach. **JACC CardiovascImaging 11:** 320-332.

ZOLTÁN ZÁDORI

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RESEARCH AREA

The gastrointestinal (GI) mucosa is constantly exposed to a wide variety of luminal aggressors, including gastric acid, pepsin, bile acids and bacterial components. In order to withstand these damaging factors and maintain the integrity of mucosal barrier, several physical and chemical defense mechanisms interact in a complex manner. Numerous conditions can lead to GI ulcers by directly damaging the epithelial cells and/or by disrupting the delicate balance between aggressive and defensive factors. Our previous studies focused mainly on the pathogenesis of gastric ulcers, whereas our recent projects aim to characterize the pathogenesis of small intestinal injury (enteropathy) caused by nonsteroidal anti-inflammatory drugs (NSAIDs) or by ischemia/reperfusion. One of our main interests is to analyze the NSAID-induced changes in intestinal bacteria and bile acids, and to identify the factors contributing to alterations of the microbiota. We also aim to identify novel therapeutic options for the treatment of enteropathy.

TECHNIQUES AVAILABLE IN THE LAB

A wide range of in vivo and in vitro techniques, including
- treatment of conscious animals (rats and mice),
- various surgical procedures on anesthetized animals and analysis of intestinal blood flow with laser speckle contrast analysis (LASCA),
- immunohistological analysis of tissue samples,
- western blotting, qPCR, ELISA and other molecular biological techniques.

SELECTED PUBLICATIONS

Hutka, B., Lázár, B., Tóth, A.S., Ágg, B., László, S.B., Makra, N., Ligeti, B., Scheich, B., Király, K., Al-Khrasani, M., Szabo, D., Ferdinandy, P., Gyires, K., **Zádori, Z.S.** (2021) The nonsteroidal anti-inflammatory drug ketorolac alters the small intestinal microbiota and bile acids without inducing intestinal damage or delaying peristalsis in the rat. **Frontiers In Pharmacology 12:** 664177.

Lázár, B., László, S.B., Hutka, B., Tóth, A.S., Mohammadzadeh, A., Berekméri, E., Ágg, B., Balogh, M., Sajtos, V., Király, K., Al-Khrasani, M., Földes, A., Varga, G., Makra, N., Ostorházi, E., Szabó, D., Ligeti, B., Kemény, Á., Helyes, Z., Ferdinandy, P., Gyires, K., **Zádori, Z.S.** (2021) A comprehensive time course and correlation analysis of indomethacin-induced inflammation, bile acid alterations and dysbiosis in the rat small intestine. **Biochemical Pharmacology 190:** 114590.

László, S.B, Lázár, B., Brenner, G.B., Makkos, A., Balogh, M., Al-Khrasani, M., Hutka, B., Mohammadzadeh, A., Kemény, Á., László, T., Scheich, B., Szabados, T., Kenyeres, É., Giricz, Z., Bencsik, P., Varga, Z.V., Novák, J., Helyes, Z., Ferdinandy, P., Gyires, K., **Zádori, Z.S.** (2020) Chronic treatment with rofecoxib but not ischemic preconditioning of the myocardium ameliorates early intestinal damage following cardiac ischemia/reperfusion injury in rats. **Biochemical Pharmacology 178:** 114099.

Lázár, B., Brenner, G.B., Makkos, A., Balogh, M., László, S.B., Al-Khrasani, M., Hutka, B., Bató, E., Ostorházi, E., Juhász, J., Kemény, Á., László, T., Tiszlavicz, L., Bihari, Z., Giricz, Z., Szabó, D., Helyes, Z., Ferdinandy, P., Gyires, K., **Zádori, Z.S.** (2019) Lack of small intestinal dysbiosis following long-term selective inhibition of cyclooxygenase-2 by rofecoxib in the rat. **Cells 8:** (3) 251.

Gyires, K., **Zadori, Z.S.** (2016) Role of cannabinoids in gastrointestinal mucosal defense and inflammation. **Current Neuropharmacology 14:** 935-951.

SZENT-GYÖRGYI JUNIOR MENTORS BUDAPEST

LÁSZLÓ BIRÓ

Institute of Experimental Medicine

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RESEARCH AREA

Exposure to acute stress can lead to the emergence of behavioral disturbances that place a heavy burden on both the individual and society. Previous research indicated that the paraventricular thalamic nucleus (PVT) is a brain area that plays a key role in the modulation of fear, anxiety, and increased arousal. Calretinin-expressing neurons in the paraventricular thalamus (PVT/CR+) exhibit significant activation under acute stress. In addition, PVT/CR+ cells send selective innervation to key stress-sensitive brain regions in the forebrain, suggesting a large-scale influence on brain function and behavior. In our research, we study the neurochemical identity, topography and the functional contribution of the ascending subcortical projections targeting the PVT/CR+ neurons in stress-induced behavioral disturbances.

TECHNIQUES AVAILABLE IN THE LAB

Using optogenetics, chemogenetics, in vivo electrophysiology (EEG and EMG recordings), and state-of-the-art neuroanatomical tools (viral tracing, immunohistochemistry, confocal microscopy, electron microscopy) we investigate the cellular and molecular mechanisms underlying acute stress-induced behavioral disturbances.

SELECTED PUBLICATIONS

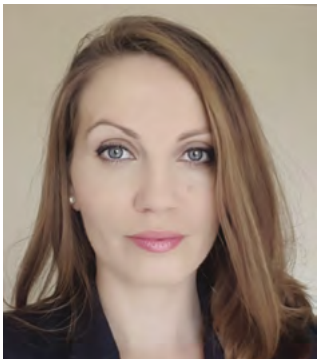
Bruzsik, B., **Biro, L.**, Zelena, D., Sipos, E., Szebik, H., Sarosdi, K.R., Horvath, O., Farkas, I., Csillag, V., Finszter, C.K., Mikics, E., Toth, M. (2021) Somatostatin neurons of the bed nucleus of stria terminalis enhance associative fear memory consolidation in mice. **Journal of Neuroscience 41:** 1982-1995.

Biro, L., Sipos, E., Bruzsik, B., Farkas, I., Zelena, D., Balazsfi, D., Toth, M., Haller, J. (2018) Task division within the prefrontal cortex: distinct neuron populations selectively control different aspects of aggressive behavior via the hypothalamus. **Journal of Neuroscience 38:** 4065-4075.

Mikics, E., Guirado, R., Umemori, J., Toth, M., **Biro, L.**, Miskolczi, C., Balazsfi, D., Zelena, D., Castren, E., Haller, J., Karpova, NN. (2018) Social Learning Requires Plasticity Enhanced by Fluoxetine Through Prefrontal Bdnf- TrkB Signaling to Limit Aggression Induced by Post-Weaning Social Isolation. **Neuropsychopharmacology. 43:**235-245.

Biro, L., Toth, M., Sipos, E., Bruzsik, B., Tulogdi, A., Tulogdi, A., Bendahan, S., Sandi, C., Haller, J. (2017). Structural and functional alterations in the prefrontal cortex after post-weaning social isolation: relationship with species-typical and deviant aggression. **Brain structure and function 222:** 1861-1875.

KRISZTINA ELLA



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RESEARCH AREA

The circadian time-keeping system enables the organism to anticipate the daily environmental changes and therefore is a crucial factor of adaptation. The endogenous rhythm is generated at the cellular level by a mechanism based on the action of interconnected transcription/translation feedback loops. The circadian system has a central pacemaker in the suprachiasmatic nucleus (SCN), which may coordinate and synchronize the peripheral oscillators present in other tissues through neuronal and humoral pathways. The main regulator of the SCN is light, but the peripheral clocks can also be modified by metabolic effects (e.g. food intake and its timing). Cellular clock function influences a wide range of physiological and pathological processes, e.g. both activity of the immune system and leukocyte migration have a characteristic circadian rhythm. Our investigations focus on the following questions: 1.) Which neural, humoral, hormonal and metabolic factors influence the circadian rhythm of immune functions? 2.) Which clock proteins control the effector functions of immune cells? 3.) What kind of individual differences can be detected in the clock function of the immune system? 4.) How does the circadian rhythm of the immune system change in different inflammatory and metabolic diseases and in sepsis? 5.) Is a cell's own molecular clock necessary for the control of rhythmic processes or is the operation of the central clock in the SCN sufficient? Understanding the regulation of the rhythmic immune system activity may help to identify therapeutic targets or design complementary therapeutic tools. For example, development of chronotherapeutic (time-dependent drug administration) strategies and design of individualised therapy for various inflammatory or other immune-related diseases could be possible.

TECHNIQUES AVAILABLE IN THE LAB

Genotyping and crossing of mouse strains, bone marrow transplantation in mice, isolation of human and murine leukocytes from blood and tissue samples, investigation of leukocyte functions, microscopic techniques, RNA isolation, analysis of gene expression with real-time PCR, culturing and genetic modification of cell lines, flow cytometry, ELISA, following promoter activity by in vivo luciferase assay, protein analysis with Western blot, examination of protein-protein interactions, analysis of the sleep rhythm in human.

SELECTED PUBLICATIONS

Sűdy, Á., **Ella, K.**, Bódizs, R., Káldi, K. (2019) Association of Social Jetlag With Sleep Quality and Autonomic Cardiac Control During Sleep in Young Healthy Men. **Front Neurosci 13:** 950.

Gyöngyösi, N., Szőke, A., **Ella, K.**, Káldi, K. (2017) The small G protein RAS2 is involved in the metabolic compensation of the circadian clock in the circadian model Neurospora crassa. **J Biol Chem 292:** 14929-14939.

Ella, K., Csépányi-Kömi, R., Káldi, K. (2016) Circadian regulation of human peripheral neutrophils. **Brain Behav Immun 57:** 209-221.

Haraszti, R., **Ella, K.**, Gyöngyösi, N., Roenneberg, T., Káldi, K. (2014) Social jetlag negatively correlates with academic performance in undergraduates. **Chronobiol Int 31:** 603-612.

Gyöngyösi, N., Nagy, D., Makara, K., **Ella, K.**, Káldi, K. (2013) Reactive oxygen species can modulate circadian phase and period in Neurospora crassa. **Free Radic Biol Med 58:** 134-143.

ANNA ZSUZSANNA FÖLDES

Semmelweis University
Faculty of Dentistry
Department of Oral Biology

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RESEARCH AREA

Present research field: Characterisation of stem cells of dental origin, studies on tissue regeneration-, differentiation capacity and immunomodulatory effects in vitro; studies on the structural and functional differentiation of the salivary gland and its secretion and transport processes. Development of a 3D cellular model of the ameloblast, studies on its structural and functional differentiation, secretion and transport processes. Covid research. previous research field: Functional neuroanatomy of the neuroendocrine hypothalamus, mapping of stress-related CNS networks; neurobiological effects of drug withdrawal, role and effects of histamine in the regulation of feeding (nutrition).

TECHNIQUES AVAILABLE IN THE LAB

Cell culture (primary cell culture), 3D cell culture (membrane, scaffold,organoid) molecular biology methods: real-time PCR, iPSC, in situ hybridisation, northern blot, PCR, gel shift assay, plasmid design, western blot, immunocytochemistry/ immunohistochemistry, short-circuit current measurement, experimental design, animal experiments (rat, mice), animal surgery (e.g. adrenalectomy, lesions), isotope labelling techniques.

SELECTED PUBLICATIONS

Földes, A., Reider, H., Varga, A., Nagy, K.S., Perczel-Kovach, K., Kis-Petik, K., DenBesten, P., Ballagi, A., Varga, G. (2021) Culturing and Scaling up Stem Cells of Dental Pulp Origin Using Microcarriers. **Polymers 13:** 3951.

Földes, A., Sang-Ngoen, T.*, Kádár, K., Rácz, R., Zsembery, Á., DenBesten, P., Steward, M.C., Varga, G. (2021) Three-Dimensional Culture of Ameloblast-Originated HAT-7 Cells for Functional Modeling of Defective Tooth Enamel Formation. **Front Phamracol 12:** 682654.

Földes, A., Kadar, K., Keremi, B., Zsembery, A., Gyires, K., Zádori, Z.S., Varga, G. (2016) Mesenchymal stem cells of dental origin - their potential for anti-inflammatory and regenerative actions in brain and gut damage. **Curr Neuropharmacol 14:** 914-934.

Fülöp, A.K., **Földes, A.*,** Buzás, E., Hegyi, K., Miklós, I.H., Romics, L., Kleiber, M., Nagy, A., Falus, A., Kovács, K.J. (2003) Hyperleptinemia, visceral adiposity, and decreased glucose tolerance in mice with a targeted disruption of the histidine decarboxylase gene. **Endocrinology 144:** 4306-4314.

Kovács, K.J., **Földes, A.,** Sawchenko, P.E. (2000) Glucocorticoid negative feedback selectively targets vasopressin transcription in parvocellular neurosecretory neurons. **J Neurosci 20:** 3843-3852.

ZSOLT LELE

Institute of Experimental Medicine
Molecular Neurobiology Research Group

Address: Szigony utca 43., H-1083 Budapest, Hungary

RESEARCH AREA

The Laboratory of Molecular Neurobiology has 3 major projects running currently. 1.) Development and novel application of the PharmacoSTORM superresolution microscopy. 2.) The role of endocannabinoid synthesizing enzymes in the development of the central nervous system. 3.) The role of cadherin cell adhesion molecules in cortical development. Of these, the second and the third projects are under my supervision. Endocannabinoids are endogenous molecules which bind to the same receptor which Δ^9-tetrahidrocannabinol, the main psychoactive component of marijuana targets. Currently there are two main endocannabinoids anandamide and 2-AG although there are several more or less uncharacterized lipids which may belong to this category. Synthesis of these signalling molecules can occur via many pathways, at least based on biochemical and in vitro cell culture experiments. Our main targets are the potential alternative synthesizing enzymes of anandamide, and we aim to characterize their role in the development of the CNS. The other project focuses on cadherins (Ca2+ -dependent adhesion molecules) and their role in cortical development. Of the more than 100 members of the cadherin superfamily our lab focuses on the classic (ie. β-catenin-binding) cadherin family. One of our main projects is actually at the crossing point of these projects where we recently described a novel protecting mechanism in the developing embryonic cortex which we termed developmental anoikis. Our main goal is currently to describe the molecular mechanisms behind this phenomenon.

TECHNIQUES AVAILABLE IN THE LAB

A wide spectrum of anatomical and molecular biology techniques can be mastered in our laboratory from basic cloning techniques to the use of state-of the art superresolution microscopes. These include but era not limited to PCR-based and classic cloning, site-directed mutagenesis, traditional chromogenic and fluorescent RNAScope in situ hybridization, immunohistochemistry, cell culture techniques, Western-blot, mousekeeping, breeding and genotyping techniques, in vivo gene transfer methods including in utero electroporation. Traditional and confocal light microscopy, STORM superresolution microscopy.

SELECTED PUBLICATIONS

László, Z.I., **Lele, Z.,** Zöldi, M., Miczán, V., Mógor, F., Simon, G.M., Mackie, K., Kacskovics, I., Cravatt, B.F., Katona. I. (2020) ABHD4-dependent developmental anoikis safeguards the embryonic brain. **Nat Commun 11:** 4363.

Cserep, C., Posfai, B., Lenart, N., Fekete, R., Laszlo, Z.I., **Lele, Z.,** Orsolits, B., Molnar, G., Heindl, S., Schwarcz, A.D. et al. (2020) Microglia monitor and protect neuronal function through specialized somatic purinergic junctions. **Science 367:** 528-537.

László, Z.I., Bercsényi, K., Mayer, M., Lefkovics, K., Szabó, G., Katona, I., **Lele, Z.** (2020) N-cadherin (Cdh2) Maintains Migration and Postmitotic Survival of Cortical Interneuron Precursors in a Cell-Type-Specific Manner. **Cereb Cortex 30:** 1318-1329.

Klinger-Gratz, P.P., Ralvenius, W.T., Neumann, E., Kato, A., Nyilas, R., **Lele, Z.,** Katona, I., Zeilhofer, H.U. (2018) Acetaminophen Relieves Inflammatory Pain through CB1 Cannabinoid Receptors in the Rostral Ventromedial Medulla. **J Neurosci 38:** 322-334.

Lefkovics, K., Mayer, M., Bercsenyi, K., Szabo, G., **Lele, Z.** (2012) Comparative analysis of type II classic cadherin mRNA distribution patterns in the developing and adult mouse somatosensory cortex and hippocampus suggests significant functional redundancy. **J Comp Neurol 520:** 1387-1405.

ANDREA LŐRINCZ

Institute of Experimental Medicine

Address: Szigony utca 43., H-1083 Budapest, Hungary

RESEARCH AREA

Human brain is composed of 100 billion neurons forming trillions of highly organized chemical synapses. The remarkably complex connectivity of neurons is believed to underlie our mental abilities. Still, the computational power of a neuronal circuit is not only influenced by the complex connectivity, but also depends on the functional diversity of synapses. It is generally believed that molecular heterogeneity of the pre- and postsynaptic cells can explain the diversity of synaptic strength. However, emerging evidence suggests that neurons equipped with the same set of molecules may form synapses with variable strength by altering the intrasynaptic density and / or intrasynaptic distribution pattern (i.e., nanotopology) of the same molecule. Unfortunately, little is known about the intrasynaptic distribution of synaptic proteins at the nanoscale level, as it requires high-resolution localization methods. To understand the molecular basis of synaptic heterogeneity we study the intrasynaptic distribution of relevant synaptic proteins in identified synapses of known efficacy in mouse hippocampus using highly sensitive and high-resolution electron microscopy and super-resolution microscopy.

TECHNIQUES AVAILABLE IN THE LAB

Pre- and postembedding immunogold and fluorescent immunohistochemistry, STED super-resolution microscopy, preparation of ultrathin sections, transmission electron microscopy, postembedding array tomography, SDS-digested freeze-fracture replica labelling, quantitative image analysis.

SELECTED PUBLICATIONS

Rebola, N., Reva, M., Kirizs, T., Szoboszlay, M., **Lőrincz, A.,** Moneron, G., Nusser, Z., DiGregorio, D.A. (2019) Distinct Nanoscale Calcium Channel and Synaptic Vesicle Topographies Contribute to the Diversity of Synaptic Function. **Neuron 104:** 693-710.

Szoboszlay, M.*, **Lőrincz, A.***, Lanore, F.*, Vervaeke, K., Silver, R.A., Nusser, Z. (2016) Functional Properties of Dendritic Gap Junctions in Cerebellar Golgi Cells. **Neuron 90:** 1043-56.

Holderith, N., **Lorincz, A.**, Katona, G., Rózsa, B., Kulik, A., Watanabe, M., Nusser, Z. (2012) Release probability of hippocampal glutamatergic terminals scales with the size of the active zone. **Nat Neurosci 15:** 988-97.

Lorincz, A. and Nusser, Z. (2010) Molecular identity of dendritic voltage-gated sodium channels. **Science 328:** 906-9.

Lorincz, A. and Nusser, Z. (2008) Cell-type dependent molecular composition of the axon initial segment. **J Neurosci 28:** 14329-40.

KRISZTINA NÉMETHNÉ FUTOSI

Semmelweis University
Faculty of Medicine
Department of Physiology

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RESEARCH AREA

Autoimmune and autoinflammatory diseases are characterized by the pathological overactivation of the immune system. In addition to acute flares, these inflammations in most cases show a chronic, progressive course and are associated with significant tissue damage, resulting in a significant deterioration in the quality of life of the affected patients. Our research group investigates the cellular and molecular mechanisms underlying the above inflammatory processes, which may contribute to a better understanding of the pathomechanism of these diseases and to identify new therapeutic targets. In our recent studies, we investigate the role of tyrosine kinase signaling pathways in the development of autoimmune arthritis, and in the urate crystal-mediated non-autoimmune gout by using genetic and pharmacological approaches. In recent years, we have identified a number of signaling molecules involved in the development of these inflammatory processes.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of hematopoietic cells of human and mouse origin (mainly neutrophils and monocytes), maintenance of macrophage cell cultures, measurement of in vitro neutrophil and macrophage cell responses (reactive oxygen intermedier production, cytokine and chemokine release, migration, phagocytosis, degranulation). In vivo animal models, processing of samples obtained from joint lavage. General laboratory techniques, Western blot, immunoprecipitation, flow cytometry, spectrophotometry, ELISA method, fluorescence video microscopy, cell migration and adhesion studies.

SELECTED PUBLICATIONS

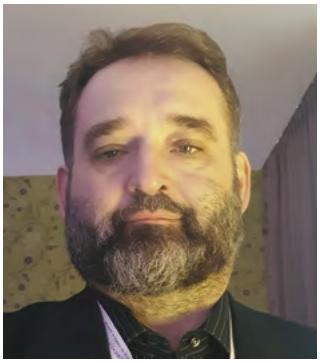
Futosi, K., Kása, O., Szilveszter, K., Mócsai, A. (2021) Neutrophil phospholipase Cγ2 drives autoantibody-induced arthritis through the generation of the inflammatory microenvironment. **Arthritis & Rheumatology 73:** 1614-1625.

Németh, T., **Futosi, K.**, Szilveszter, K., Vilinovszki, O., Kiss-Pápai, L., Mócsai, A. (2018) Lineage-specific analysis of Syk function in autoantibody-induced arthritis. **Frontiers in Immunology 9:** 555.

Németh T., **Futosi, K.**, Sitaru, C., Ruland, J., Mócsai, A. (2016) Neutrophil-specific deletion of the CARD9 gene expression regulator suppresses autoantibody-induced inflammation in vivo. **Nature Communications 7:** 11004.

Futosi, K., Németh, T., Pick, R., Vántus, T., Walzog, B., Mócsai, A. (2012) Dasatinib inhibits pro-inflammatory functions of mature human neutrophils. **Blood 119:** 4981-4991.

GÁBOR NYIRŐ



Semmelweis University, Faculty of Medicine
Department of Laboratory Medicine*
Department of Internal Medicine and Oncology**

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Korányi Sándor u. 2/A, H-1083 Budapest, Hungary**

RESEARCH AREA

Tumors originating from the human adrenal cortex can be divided in two groups, adrenocortical adenomas (ACA) wich are more frequent but benign and adrenocortical carcinomas (ACC) with bad prognosis but luckily also less frequent. Differenciating these two tumor types is difficult even for an experienced pathologist from postoperative tissue samples. Our research group is looking for specific molecular markers, so called microRNAs, that could help in these differentiations. The expression of microRNAs is tissue specific (thus tumor specific). They also have a role in the regulation of gene expression so their role can be regarded either tumor driver or tumor supressor. MicroRNAs are stable, they are present in (tumor)tissues, in the blood, and in other body fluids. This gives us a possibility to exploit them as minimal invasive biomarkers in diagnostics. MicroRNAs are present in neuroendocrine tumors of the gastrointestinal tract. We plan to investigate the diagnostic possibilities of microRNA expression in pancreas neuroendocrine tumors (pNET) in this project.

TECHNIQUES AVAILABLE IN THE LAB

Nucleic acid isolation methods for DNA, RNA, microRNA from a variety of samples (human tissue, tumor tissue, FFPE, blood, diverse body fluids). Differential expression analysis of mRNAs and microRNAs with reverse transcription quantitative PCR (RT-QPCR) method, relative quantitation.

Mutation analysis by sequencing (Sanger), QPCR (SNP analysis) or Illumina NGS methods for large scale sequencing. Differential expression analysis via NGS: mRNA based transcriptomics (RNASEQ) and microRNA profiling (miRNA-SEQ).

SELECTED PUBLICATIONS

Turai P.I., Herold, Z., **Nyirő, G.**, Borka, K., Micsik, T., Tőke, J., Szücs, N., Tóth, M., Patócs, A., Igaz, P. (2022) Tissue miRNA Combinations for the Differential Diagnosis of Adrenocortical Carcinoma and Adenoma Established by Artificial Intelligence. **Cancers Basel 11; 14:** 895.

Olah, C., Hahnen, C., Nagy, N., Musial, J., Varadi, M., **Nyiro, G.**, Gyorffy, B., Hadaschik, B., Rawitzer, J., Ting, S., Sjödahl, G., Hoffmann, M.J., Reis, H., Szarvas, T. (2021) A quantitative polymerase chain reaction based method for molecular subtype classification of urinary bladder cancer-Stromal gene expressions show higher prognostic values than intrinsic tumor genes. **Int J Cancer 1;150:** 856-867.

Turai, P.I., **Nyírő, G.**, Butz, H., Patócs, A., Igaz, P. (2021) MicroRNAs, Long Non-Coding RNAs, and Circular RNAs: Potential Biomarkers and Therapeutic Targets in Pheochromocytoma/Paraganglioma. **Cancers Basel 26;13:** 1522.

Saskői, É., Hujber, Z., **Nyírő, G.**, Likó, I., Mátyási, B., Petővári, G., Mészáros, K., Kovács, A.L., Patthy, L., Supekar, S., Fan, H., Sváb, G., Tretter, L., Sarkar, A., Nazir, A., Sebestyén, A., Patócs, A., Mehta, A., Takács-Vellai, K. (2020) The SDHB Arg230His mutation causing familial paraganglioma alters glycolysis in a new Caenorhabditis elegans model. **Dis Model Mech. 15;13:** dmm044925.

Szalay, B., Tátrai, E., **Nyírő, G.**, Vezér, T., Dura, G. (2012) Potential toxic effects of iron oxide nanoparticles in in vivo and in vitro experiments. **J Appl Toxicol 32:** 446-53.

DÓRA RAVASZ

Semmelweis University
Faculty of Medicine
Department of Biochemistry

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RESEARCH AREA

Energy is provided in the form of ATP by the mitochondrial respiratory chain in many cell types, as the oxidation of nutrients takes place partially in mitochondria, with the help of oxygen from the air. In case of oxygen deprivation or inhibition of the respiratory chain, the energy supply of the cell is disrupted, and instead of producing, mitochondria start to consume energy. An enzymatic reaction in the mitochondrial matrix can prevent this by generating ATP independently of the respiratory chain. Our research group has described several biochemical pathways which modulate the efficiency of this reaction. We also investigate metabolic pathways that can still fuel the respiratory chain when it is inhibited, by providing alternative entry points into the system, thus they are able to maintain ATP production to a certain level. Our aim is to characterize such ATP generating processes and the pathways required for their operation. These can not only help the survival of cells exposed to decreased oxygen supply, but they can also provide energy for tumor cells, often found in a hypoxic environment. Thus the enzymes involved are potential therapeutic targets in these tumors.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of mitochondria from different mouse tissues, maintenance of cell cultures, measurement of mitochondrial bioenergetic parameters (oxygen consumption, membrane potential, NADH level, redox state of quinone pool) in isolated and in situ mitochondria, enzyme activity assays, data evaluation.

SELECTED PUBLICATIONS

Pallag, G., Nazarian, S., **Ravasz, D.**, Bui, D., Komlódi, T., Doerrier, C., Gnaiger, E., Seyfried, T. N., Chinopoulos, C. (2022) Proline Oxidation Supports Mitochondrial ATP Production When Complex I Is Inhibited. **Int J Mol Sci 23:** 5111.

Ravasz, D., Kacso, G., Fodor, V., Horvath, K., Adam-Vizi, V., Chinopoulos, C. (2018) Reduction of 2-methoxy-1,4-naphtoquinone by mitochondrially-localized Nqo1 yielding NAD+ supports substrate-level phosphorylation during respiratory inhibition. **Biochim Biophys Acta 1859:** 909-924.

Ravasz, D., Kacso, G., Fodor, V., Horvath, K., Adam-Vizi, V., Chinopoulos, C. (2017) Catabolism of GABA, succinic semialdehyde or gamma-hydroxybutyrate through the GABA shunt impair mitochondrial substrate-level phosphorylation. **Neurochem Int 109:** 41-53.

Kacso, G., **Ravasz, D.**, Doczi, J., Nemeth, B., Madgar, O., Saada, A., Ilin, P., Miller, C.,Ostergaard, E., Iordanov, I., Adams, D., Vargedo, Z., Araki, M., Araki, K., Nakahara, M., Ito, H., Gal, A., Molnar, M.J., Nagy, Z., Patocs, A., Adam-Vizi, V., Chinopoulos, C. (2016) Two transgenic mouse models for beta-subunit components of succinate-CoA ligase yielding pleiotropic metabolic alterations. **Biochem J 473:** 3463-3485.

Németh, B., Doczi, J., Csete, D., Kacso, G., **Ravasz, D.**, Adams D., Kiss, G., Nagy, A.M., Horvath, G., Tretter, L., Mócsai, A., Csépányi-Kömi, R., Iordanov, I., Adam-Vizi, V., Chinopoulos, C. (2016) Abolition of mitochondrial substrate-level phosphorylation by itaconic acid produced by LPS-induced Irg1 expression in cells of murine macrophage lineage. **FASEB J 30:** 286-300.

KATALIN SKRAPITS

Institute of Experimental Medicine
Reproductive Neurobiology Research Group

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RESEARCH AREA

Molecular, cellular and system biology research at the Laboratory of Reproductive Neurobiology aims to provide a deeper understanding of the central regulatory mechanisms of human reproduction. Hypothalamic secretion of gonadotropin-releasing hormone (GnRH) builds up during pubertal development. Secretory pulses of GnRH at every 30-90 minutes stimulate luteinizing and follicle stimulating hormone (LH and FSH) production in the anterior pituitary gland. These troph hormones, in turn, initiate and later maintain functions of the gonads (testes and ovaries). This laboratory combines anatomical, electrophysiological and molecular approaches to study i) the neuronal and hormonal control of pulsatile GnRH/LH secretion, ii) the mechanisms of the mid-cycle GnRH/LH surge which triggers ovulation in females, iii) the central effects of gonadal steroid hormones on neuroendocrine systems and on wider aspects of general neuronal functioning and iv) the molecular and cellular processes underlying reproductive senescence. Techniques applied for single-cell research include traditional neuroanatomical approaches, slice electrophysiology and high-throughput and high-resolution molecular biology methods. In recent years, the laboratory preferentially uses human hypothalamic tissue samples in anatomical and molecular research. In view of the limited translational value of rodent models in reproductive biology, the Human Hypothalamus Research Unit became the most dynamically developing research unit with a broad focus on the role of the hypothalamus in neuroendocrine, metabolic and autonomic regulation. Studies of the Laboratory of Reproductive Neurobiology may lead to a better understanding of various human pathologies, such as different forms of central infertility, polycystic ovary syndrome (PCOS), ovarian cycle disturbances due to insufficient caloric intake (e.g. anorexia nervosa) or stress, abnormal pubertal development (e.g. precocious puberty, hypogonadotropic hypogonadism), and central nervous system dysfunctions caused by postmenopausal estrogen deficiency.

TECHNIQUES AVAILABLE IN THE LAB

Histological section preparation (rodent, human). Immunohistochemistry (peroxidase-based/immunofluorescent multiple-labeling). Light and confocal microscopy. Surgical techniques (gonadectomy, subcutaneous implantation of silastic capsules/osmotic minipumps). Laser capture microdissection. RNA sequencing.

SELECTED PUBLICATIONS

Göcz, B., Rumpler, É., Sárvári, M., **Skrapits, K.,** Takács, S., Farkas, I., Csillag, V., Trinh, S.H., Bardóczi, Z., Ruska, Y., Solymosi, N., Póliska, S., Szőke, Z., Bartoloni, L., Zouaghi, Y., Messina, A., Pitteloud, N., Anderson, R.C., Millar, R.P., Quinton, R., Manchishi, S.M., Colledge, W.H., Hrabovszky, E. (2022) Transcriptome profiling of kisspeptin neurons from the mouse arcuate nucleus reveals new mechanisms in estrogenic control of fertility. **Proc Natl Acad Sci USA 119:** e2113749119.

Skrapits, K., Sárvári, M., Farkas, I., Göcz, B., Takács, S., Rumpler, É., Váczi, V., Vastagh, C., Rácz, G., Matolcsy, A., Solymosi, N., Póliska, S., Tóth, B., Erdélyi, F., Szabó, G., Culler, M.D., Allet, C., Cotellessa, L., Prévot, V., Giacobini, P., Hrabovszky, E. (2021) The cryptic gonadotropin-releasing hormone neuronal system of human basal ganglia. **Elife 10:** e67714.

Rumpler, É., Takács, S., Göcz, B., Baska, F., Szenci, O., Horváth, A., Ciofi, P., Hrabovszky, E., **Skrapits, K.** (2020) Kisspeptin neurons in the infundibular nucleus of ovariectomized cats and dogs exhibit unique anatomical and neurochemical characteristics. **Front Neurosci 14:** 598707.

Hrabovszky, E., Takács, S., Göcz, B., **Skrapits, K.** (2019) New perspectives for anatomical and molecular studies of kisspeptin neurons in the aging human brain. **Neuroendocrinology 109:** 230-241.

Skrapits, K., Borsay, B.A., Herczeg, L., Ciofi, P., Liposits, Z. and Hrabovszky, E. (2015) Neuropeptide co-expression in hypothalamic kisspeptin neurons of laboratory animals and the human. **Front Neurosci 9:** 29.

SZENT-GYÖRGYI STUDENTS BUDAPEST

BENCE CZUMBEL

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Christos Chinopoulos

JUNIOR MENTOR:

Dóra Ravasz

SPECIALIZATION:

oncometabolism, mitochondriology

SECONDARY SCHOOL:

St. Norbert Premonstratensian Grammar School, Grammar School of Sacred Music, Secondary Art School and College

NAME OF TEACHER:

Zoltán Kerényi

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Hydrogen sulfide (H2S) was once considered to have only toxic properties, until it was discovered to be an endogenous signaling molecule. Mitochondria play an important role in its catabolism, in the reaction catalysed by sulfide-quinon-oxidoreductase, H2S is oxidized, coenzyme Q is reduced, thus it has a metabolic connection to the respiratory chain. Our research focuses on the effect of H2S on oxidative phosphorylation, especially if the respiratory chain works dysfunctionally (which we model by blocking different complexes of the respiratory chain and/or creating anoxic conditions).

AMBITIONS AND CAREER GOALS

My goal is to be a useful member of my research group and to gain scientific experince. As a second year medical student I have not made any definite plans regarding my future, I can see myself both as a researcher and a practicing physician, therefore, the most appealing option for me would be if my future work could somehow combine these two activities.

HONORS AND PRIZES

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PUBLICATIONS

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DORINA DEBRECZENI

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2003

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Gábor Czirják

JUNIOR MENTOR:

-

SPECIALIZATION:

molecular biology and electrophysiology

SECONDARY SCHOOL:

Bocskai István High School, Hajdúböszörmény

NAME OF TEACHER:

Erika Viziné Bencsik

LANGUAGES:

English/advanced
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

In my research, I investigate human TMEM175 lysosomal and TRESK two-pore potassium channels and their various mutations for their electrophysiological properties and regulatory mechanisms. The TMEM175 potassium channel plays an important role in regulating the K+ permeability of the lysosomal and endosomal membranes. This transmembrane protein has a special structure: it does not contain the P domain, which is the selectivity filter in all other known potassium channels. It is therefore questionable what is the reason for the high selectivity of TMEM175 for K+ over Na+. We also investigate the regulation of PKB, ion selectivity, and the effect of additional inhibitors (e.g., 4-aminopyridine) on TMEM175. One variant of TMEM175 (M393T) may be associated with an early onset of a neurodegenerative disease, Parkinson's disease, according to recent research. To understand this mechanism, it is particularly important to investigate the properties of the TMEM175 channel, as it may later be the target of drug treatments. K2P channels are common determinants of the regulated K + conductance of the plasma membrane, found in most animal and plant species, but are extremely structurally and functionally diverse. The TRESK K2P channel I examined is found in significant amounts in the sensory neuron subpopulations responsible for pain perception, affecting their excitability and the intensity of the response to painful stimuli. Some mutations in TRESK cause a rare form of hereditary migraine headache. In our research, we study general and direct regulatory mechanisms of the TRESK channel in heterologous systems that are likely to be independent of the cell-expressing cell type. Thus, a significant part of the mechanisms we describe provide a good basis for further studies to elucidate the role of the TRESK channel in pain perception.

AMBITIONS AND CAREER GOALS

I have been very curious and busy getting to know the complex living systems, the microscopic material world around us, and I can create something scientifically lasting. I believe that research provides an opportunity to develop a new way of thinking in addition to the material knowledge that can be acquired. One of my goals is to do research in addition to my medical work after completing my studies, as this way I may help more.

HONORS AND PRIZES

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PUBLICATIONS

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ZALÁN BALÁZS KÁPOSZTA

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Frigyes Sámuel Rácz

JUNIOR MENTOR:

-

SPECIALIZATION:

computational neuroscience

SECONDARY SCHOOL:

Városmajori High School

NAME OF TEACHER:

András Vizkievicz

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Studying physiological processes as a whole can help not only in understanding individual processes, but can also assist in understanding entire physiological systems. Such an approach serves as the fundamental basis for the modern translational medicine approach to healthcare, which utilizes evidence based methods, opposed to purely empirical discoveries. Such systems however show a high degree of dynamic fluctuation, pertaining to its role in maintaining physiological homeostasis in an ever changing environment, thus static methodologies in their analysis is quite limited. Accordingly, there is a need to develop algorithms that are able to: i) capture, in real time ii) multi-process, synchronized and iii) physiologically relevant data from various systems and iv) which can also efficiently assess the relationship between the aforementioned diverse processes. Our goal thus is to develop such a robust analysis method.

AMBITIONS AND CAREER GOALS

We aim to develop a robust analysis framework that is able to: i) capture, in real time ii) multi-process, synchronized and iii) physiologically relevant data from various systems and iv) which can also efficiently assess the relationship between the aforementioned diverse processes. Should be succeed in developing such an analytical paradigm, we shall have the tools required to analyze complex physiological systems.

HONORS AND PRIZES

2021 - People's Friendship University Moscow, XII. Internat. Scientific Conference, 1st place
2021 - Korányi Frigyes Dorm-college, XXV. Korányi Frigyes Scientific Forum, 2st place
2021 - Special Prize of the Hungarian Physiological Society
2021 - University of Szeged 35. National Students' Scientific Conference, 1st place
2021 - Semmelweis University Rector's Thesis Students' Scientific Association, 1st place
2021 - Semmelweis University Students' Scientific Association Students' Scientific Conference, 1st place
2020 - Semmelweis University Students' Scientific Association Students' Scientific Conference, 2nd place
2020 - Internat. Students' Scient. Association Internat. Students' Scient. Conf., 1st place

PUBLICATIONS

Kaposzta, Z., Czoch, A., Stylianou, O., Kim, K., Mukli, P., Eke, A., Racz, F.S. (2022) Real-Time Algorithm for Detrended Cross-Correlation Analysis of Long-Range Coupled Processes. **Frontiers in Physiology (IF = 4.57, Q1 (Scimago)):** https://www.frontiersin.org/articles/10.3389/fphys.2022.817268

Racz, F.S., Czoch, A., **Kaposzta, Z.,** Stylianou, O., Mukli, P., Eke, A. (2022) Multiple-Resampling Cross-Spectral Analysis: An Unbiased Tool for Estimating Fractal Connectivity With an Application to Neurophysiological Signals. **Frontiers in Physiology (IF = 4.57, Q1 (Scimago)):** https://www.frontiersin.org/articles/10.3389/fphys.2022.817239

KATA KÓTA

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

László Acsády

JUNIOR MENTOR:

László Biró

SPECIALIZATION:

thalamic research

SECONDARY SCHOOL:

Radnóti Miklós Experimental High School, Szeged

NAME OF TEACHER:

Ádám Zoltán Seres

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The thalamus is an especially important area in the brain, as it is the major source of inputs of the cerebral cortex, which is the top level information processor. Without the thalamus, the cortex has very little access to information from other areas of the brain. The cortex and the thalamus form a functional unit, and the disfunction of this thalamocortical system plays role in numerous neurological and psychiatric diseases. In spite of this, until recently thalamic research has been focused on a very narrow area, the relay of sensory inputs to the cortex, however all cortical areas are in connection with thalamic nuclei. Because of the lack of research, very little is known about the exact function of many thalamic nuclei so far. Our group aims to understand better this complex thalamocortical system.
A part of the group focuses on the inputs of one of the thalamic nuclei, the paraventricular nucleus (PVT). Via injecting viruses into definite areas of the brain of transgenic mice, we can visualize the axons ending in the PVT using a fluorescent or confocal microscope. This helps us determine the source of PVT inputs. Besides, we are also interested in exactly which areas of the PVT the axons from different souces end, and whether they are segregated or not. Based on this information, we can reveal the degree of integration of inputs from differnt sources in the PVT, which could help in understanding its exact function.

AMBITIONS AND CAREER GOALS

During my university years, I would like to aquire both theoretical and practical knowledge in order to become a good physician. It is equally important for me to join a scientific research group to learn about research work because and scietific techniques, because, I am convinced, this experience will be valuable later during my work.

HONORS AND PRIZES

–

PUBLICATIONS

–

LILI KOTMAYER

National Academy of Scientist Education, 6th year

Semmelweis University
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Csaba Bödör

JUNIOR MENTOR:

-

SPECIALIZATION:

molecular oncohematology

SECONDARY SCHOOL:

Eötvös Lóránd University, János Apáczai Csere Practical High School and College

NAME OF TEACHER:

Judit Bakonyi

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

As a member of the HCEMM-SE Molecular Oncohematology Research Group at the Department of Pathology and Experimental Cancer Research, Semmelweis University, my research aims to understand the molecular mechanisms underlying drug resistance in CLL and to identify the hereditary genetic variants in familial myeloid diseases. In doing so, my aim is to enable clinicians to make molecularly guided decisions and to use more targeted therapeutic options in the day-to-day care of patients based on the genetic background of oncohaematological diseases.

AMBITIONS AND CAREER GOALS

Apart from obtaining a PhD in medical sciences, my main aim within the framework of the MD-PhD program is to provide clinicians with valuable information about the genetic background of oncohaematological diseases that directly influences and drives therapeutic decisions. I believe that it is a great honour and a life-changing experience for a medical student to be involved in patient care during her undergraduate years.

HONORS AND PRIZES

2022 - Stephen W. Kuffler Research Foundation, Stephen W. Kuffler PhD Research Grant
2022 – European Hematology Association, Travel Grant for the EHA 2022 Hybrid Congress
2021 – National Council of Student Research Societies, Pro Scientia Gold Medal
2021 – Hungarian Healthcare Management Association, Medical Student of the Year
2021 – Dr. Genersich Antal Foundation, Genersich Antal Prize
2021 – National Council of Student Research Societies 35. National TDK Conference, 1st place
2021 – European Working Groups of Myelodysplastic Syndromes (EWOG-MDS), Travel Grant for the EWOG 9th International Symposium on MDS and SAA in Childhood
2020 - Kerpel-Fronius Ödön Talent Program, Kerpel Talent Prize

PUBLICATIONS

Kotmayer, L., Romero-Moya, D., Marin-Bejar, O., Kozyra, E., Català, A., Bigas, A., Wlodarski, M.W., Bödör, Cs., Giorgetti, A., (2022) GATA2 Deficiency and MDS/AML: Experimental Strategies for Disease Modelling and Future Therapeutic Prospects. **British Journal of Haematology:** https://doi.org/10.1111/bjh.18330

Kotmayer, L., Bödör, Cs. (2021) Az új generációs szekvenálás szerepe a klinikai onkológiában. **Klinikai Onkológia 8:** 103-114.

KARINA KOVÁCS

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Zoltán Nusser

JUNIOR MENTOR:

Andrea Lőrincz

SPECIALIZATION:

cellular neurophysiology

SECONDARY SCHOOL:

József Attila High School, Technical High School and College, Ózd

NAME OF TEACHER:

Jolán Heiling,
Veronika Novák (Tóth Árpád High School, Debrecen)

LANGUAGES:

English/advanced
Spanish/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Goals of the TDK work planned for the year: 1) Optimization of postembedding immunofluorescence reactions from mouse hippocampus for efficient labeling of synaptic molecules on semi-thin sections. 2) Investigation of the amount and intrasynaptic distribution of synaptic proteins in synapses identified by superresolution microscopy (STED, STORM). I would like to compile presentable material for the next school year and take it to a TDK conference.

AMBITIONS AND CAREER GOALS

Our goal is to investigate the intrasynaptic distribution of known efficacy proteins that determine synaptic function (eg Munc13-1, AMPA receptor, PSD-95, Cav2.1) with high-resolution immunolocalization methods in mouse cortical and hippocampal synapses.

HONORS AND PRIZES

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PUBLICATIONS

–

KORNÉL MOLNÁR

National Academy of Scientist Education, 3rd year

Semmelweis University
Faculty of Medicine, 3rd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Jakus Zoltán Péter

JUNIOR MENTOR:

-

SPECIALIZATION:

vascular biology

SECONDARY SCHOOL:

Szinyei Merse Pál High School, Budapest, District VI

NAME OF TEACHER:

István Takács

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Vaccines using messenger RNA (mRNA-LNP) technology packaged in lipid nanoparticles have recently attracted considerable scientific interest, as two vaccines against SARS-CoV-2 approved for emergency use are also based on this technology. However, processes in the immune response elicited by mRNA-LNP-based vaccines are still not fully understood. The aim of our research was to investigate the role of immune cells involved in the immune response induced by mRNA-LNP-based vaccines as well as the role of the lymphatic system in transgenic mouse models. To facilitate the success of our studies, a more detailed understanding of the processes elicited by mRNA-LNP-based vaccines may be offered in the future to increase the efficacy of these vaccines and to alleviate possible side effects.

AMBITIONS AND CAREER GOALS

My goal is to help people at the best of my ability during my future medical and research careers. To do this, it is essential to be up to date with the latest research findings in my field. The National Academy of Scienctist Education Training program is a great opportunity for me to start developing both my theoretical and practical knowledge to the highest possible level during my university years.

HONORS AND PRIZES

2022- Semmelweis University Students' Scientific Conference, 1st place

PUBLICATIONS

–

RÉKA ZSÓFIA SEBESTÉNY

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 3rd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Gábor Nyiri

JUNIOR MENTOR:

-

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

Frankfurt International School

NAME OF TEACHER:

Christopher Neumann

LANGUAGES:

English/advanced
German/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

As a student researcher I am investigating the cortical pathways and their role in memory formation. In the brain, spatial and episodic memory cues are encoded by different small subpopulations of principal hippocampal neurons called engram cells. My goal is to gain a deeper understanding of the formation of these cell assemblies and thus understand the precise function of memory formation and recall itself. Our results are expected to contribute to a better understanding of memory processes and could help the development of treatment for memory problems.

AMBITIONS AND CAREER GOALS

My primary goal in my research career is my own professional development. I would like to become as independent of a researcher as possible and be able to realise my own ideas to the fullest. I would like to further develop my skills in stereotaxic and optical fibre surgery as well as further my knowledge in the design of behavioural experiments. My long term goal would be to write and publish my own research results.

HONORS AND PRIZES

2022 - Semmelweis University Students' Scientific Conference, 1st place

PUBLICATIONS

–

HUNOR SEBŐK

National Academy of Scientist Education, 1st year

University of Veterinary Medicine, Budapest, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Gábor Nyiri

JUNIOR MENTOR:

-

SPECIALIZATION:

functional neuroanatomy

SECONDARY SCHOOL:

Piarist High School, Primary School and Kindergarten

NAME OF TEACHER:

Dr. Erzsébet Müllner,
Gábor Szabó,
Ákos Mjazovszky

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Different parts of the cerebral cortex, like the memory encoding hippocampus, are highly dependent on the excitatory and inhibitory pathways from deeper brain regions. Understanding how they work is essential to understanding their role in pathological conditions so that we can later treat these diseases by stimulating or inhibiting them. Both pharmacological and gene therapy would be possible for cell-specific treatment in the future. Our group has recently discovered a novel neural pathway provided by a basal forebrain cholinergic cell population that targets the hippocampus. Cholinergic cells have been implicated many times in a variety of neurodegenerative diseases, therefore examining this pathway may provide a promising opportunity to treat certain attention-related or anxiety-related diseases.

AMBITIONS AND CAREER GOALS

The complexity of nature and the underlying mechanisms of biological systems has always amazed me. The brain is one of the most complex systems in the world, thereby understanding it is exciting from many aspects. In addition to getting to know the brain, my goal is to learn and master as many modern techniques as possible. After the bachelor's and master's degrees, I would like to use these in my PhD studies as well.

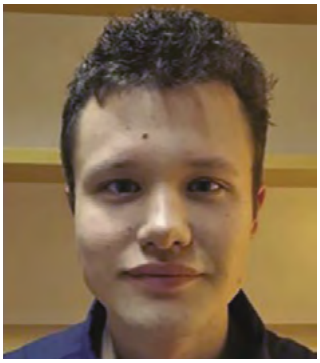
HONORS AND PRIZES

2021 - Conference of Scientific Students' Associations
2021 - National Conference of Scientific Students' Associations 1st place

PUBLICATIONS

–

BENDEGÚZ GÁBOR SRAMKÓ



National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Karolina Pircs

JUNIOR MENTOR:

Anna Zsuzsanna Földes

SPECIALIZATION:

neurobiology

SECONDARY SCHOOL:

Reformed High School, Tata

NAME OF TEACHER:

Erzsébet Éva Nagyné Kristó

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

His research will focus on the isolation and reprogramming of dental pulp stem cells (DPSCs). These neural crest derived mesenchymal stem cells shows an excellent potential for neuronal fate determintation. Therefore they may provide a new source of functionally active, direct reprogrammed neurons in vitro. Bendegúz will collaborate with the Semmelweis University Department of Oral Biology in order of the isolation and charachterisation of DPSCs.

AMBITIONS AND CAREER GOALS

I think I have a subjective relationship whit biology. To observe and describe a part of life makes me a special joy, a type of enthusiasm. To deal with biology means for me to deal with living systems, which are well describable, and between them, the scientist can observe a logical system, which is the evolution. Most of these proceedings, which are making organisms be able to change their morphological structure and therefore be able to adapt to the varying environment, are manifested firstly in the level of the genes of cells. That's why my interest takes a special look at cells, they are dynamic systems, which can change their metabolism in the order of adaptation. If they aren't able to do that, their function will change inadequately for their physiological job and it can lead to diseases. I think these reasons are enough for a following medical doctor to want to know the world of cells always better and better. The human species interested me always better than everything else in biology, but maybe it is not my only one reason to study medicine. I can't imagine more beautiful cognitive behaviour, than medicine, because it is not just a type of science, it is an altruist behaviour, that helps me to be a useful member of society. I want to be an experienced doctor in science and in humane.

HONORS AND PRIZES

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PUBLICATIONS

–

MÁTÉ MÁRK SZEKÉR

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2003

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Krisztina Káldi

JUNIOR MENTOR:

Krisztina Ella

SPECIALIZATION:

circadian rythm and metabolism

SECONDARY SCHOOL:

Táncsics Mihály High School, Kaposvár

NAME OF TEACHER:

Beatrix Kertészné Bagi

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The circadian rythm is a biologycal regulatory mechanism, that helps our body adapt to the changing environmental conditions throughout the day. The creation of this rythm requires a working endogenous clock, the so-called circadian clock. One of the more important regulators of the clock is the timing of food intake. Observation of epidemiologic, as well as animal experiments showed, that limiting food intake to a short time period of the day (time-restricted eating, TRE) has beneficial effects on the rythm of metabolic activities, and it can be an effective tool in preventing and treating obesity and type II diabetes. Our research group has found that in animal models TRE has a fundamental effect in the responsive capabilities of our immune system, and, overall has an anti-inflammatory effect. Our current experiments are aimed at finding out what is the connection between TRE, leukocyte function, which is determinded by bone marrow activity, and the rythm of adipose tissue function, which represents metabolic activity.

AMBITIONS AND CAREER GOALS

During my time in university, I would like to continue my scientific research within the NTA program, and I would also like to present said work in TDK conferences. While scientific work is important, I don't want to neglect my actual studies. When I'll be working as a doctor, i would still want to take part in scientific research, if I choose to not make research the main focus of my career.

HONORS AND PRIZES

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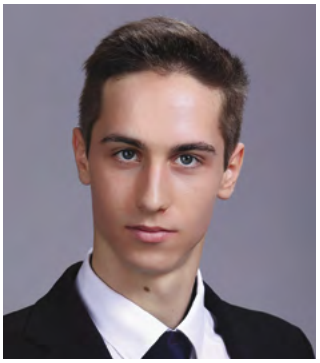
PUBLICATIONS

–

SOMA SZENTKIRÁLYI-TÓTH



National Academy of Scientist Education, 1st year

University of Veterinary Medicine, Budapest, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Erik Hrabovszky

JUNIOR MENTOR:

Katalin Skrapits

SPECIALIZATION:

reproductive neurobiology

SECONDARY SCHOOL:

Fényi Gyula Jesuit High School

NAME OF TEACHER:

Hajnalka Kosztelnikné Balázs

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Activity of hypothalamic gonadotropin-releasing hormone (GnRH) neurons, that comprise the highest level of the reproductive axis, is controlled by estradiol through the kisspeptin neuropeptide system. Kisspeptin neurons have been shown to be abundant in extrahypothalamic regions such as the putamen or the basal forebrain, where they control unknown functions. The goal of our research program is to shine light on the anatomical and molecular biological characteristics of these neuron populations. Based on prior evidence our research will pay special attention to studying the lateral part of the septum pellucidum.

AMBITIONS AND CAREER GOALS

Following my graduation from my current BSc. course I aim to continue my studies. I plan to acquire an MSc. and consequently a doctorate, during and following which working as a research fellow to gain experience. In my carreer, it is my goal to use the opportunity this scholarship offers to its maximum and contribute to a brighter future.

HONORS AND PRIZES

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PUBLICATIONS

–

BÁLINT KENDE SZEREDÁS

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Péter Igaz

JUNIOR MENTOR:

Gábor Nyirő

SPECIALIZATION:

(pancreatic) neuroendocrine tumors

SECONDARY SCHOOL:

Eötvös József High School

NAME OF TEACHER:

Berczelédi Réka,
Solymoss Miklós

LANGUAGES:

English/advanced
Italian/intermediate
German/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

A) 2 micro-RNA. We select two of the micro-RNAs used in the literature (hsa-mir-130b-3p and hsa-mir-96-5p), which have been shown to be differentially expressed in different stages of PAN-NETs. The expression of these two miRNAs is rising in a trend between the stages and they show significant expression change. The expression of the hsa-mir-96-5p is rising according to grade, while its target, the FoxO1 shows decreasing staining in the tumors. Expected scientific results: We can validate that the expression of these two miRNAs follows well the development of the tumor, and their expression is clearly equivalent to the grade rank. And does it have diagnostic value? B) We have the opportunity to examine and probably narrow (by type and grade) a panel of 8 miRNAs, which express in every GEP-NET grade based on previous studies. This has diagnostic value. We could examine the FoxO1 expression with qRT-PCR to confirm the microscopic image. Also, we could confirm the connection of miRNA-mRNA with a functional luciferase assay.

AMBITIONS AND CAREER GOALS

Ever since I was committed to biology and medicine, research has always seemed interesting to me. I loved to find out things and understand the background of processes. However, medicine has another part, which is at least as important, where we heal people. I would like to find a combination of these, where I can do both fairly and usefully. This program gives me the opportunity to get a taste of the world of research, even this early in my studies at the university. Due to this, til my graduation I will know, which area I would like to research, and I will have a knowledge base for my PhD work. In addition, probably I will see what proportion should I share my energy and time between medical practice and research.

HONORS AND PRIZES

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PUBLICATIONS

–

BOTOND SZIKRA

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

István Katona

JUNIOR MENTOR:

Zsolt Lele

SPECIALIZATION:

endocannabinoid system

SECONDARY SCHOOL:

Táncsics Mihály High School, Kaposvár

NAME OF TEACHER:

Beatrix Kertészné Bagi

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The endocannabinoid system may be involved in various neurodegenerative diseases, so understanding the endocannabinoid system could help comprehend these diseases.

AMBITIONS AND CAREER GOALS

In the future, am wish to finish my studies at the university. I do not know yet that after my graduation what am I going to do. Both residency and research intruiges me.

HONORS AND PRIZES

–

PUBLICATIONS

–

SIMON TUSNÁDY

National Academy of Scientist Education, 1st year

Semmelweis University
Faculty of Medicine, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Attila Mócsai

JUNIOR MENTOR:

Krisztina Némethné Futosi

SPECIALIZATION:

immunology

SECONDARY SCHOOL:

Bornemisza Péter High School, Primary School, Elementary Art School, Kindergarten and Sports School

NAME OF TEACHER:

Dr. Zsolt Erős-Honti,
Dr. Katalin Csókay

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Gout is a common arthritis characterized by recurrent severe inflammatory attacks of the joints, caused by monosodium urate (MSU) cyrstals deposition. Myeloid cells (neutrophils and macrophages) play an important role in the development of the disease, however, the molecular pathomechanism is not fully understood. In recent years, our research group has investigated the role of tyrosine kinase signaling pathways in autoantibody-induced inflammatory processes and has identified a number of essential signaling molecules. However, the role of tyrosine kinase pathways and PLCγ2 in the pathogenesis of gout, which is thought to be mediated by a different mechanism from the previously studied diseases, is unknown. Our aim is to investigate the role of PLCγ2 in MSU crystal-induced neutrophil activation and in an experimental model of gout. Better understanding the pathomechanism of gouty arthritis may contribute to the identification of novel therapeutic targets.

AMBITIONS AND CAREER GOALS

Both in my studies and research project, my main purpose is to gain as much knowledge as possible, to learn many practical techniques, and to obtain a complex and multidisciplinary perspective of science. In my opinion, these skills and experiences will have a great impact on my later scientific career.

HONORS AND PRIZES

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PUBLICATIONS

–

"Science is built on the premise that Nature answers intelligent questions intelligently; so if no answer exists, there must be something wrong with the question."

Albert Szent-Györgyi

DEBRECEN

ZOLTÁN PAPP

SCIENTIFIC SUPERVISOR OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION (UNIVERSITY OF DEBRECEN)

University of Debrecen
Faculty of Medicine
Department of Cardiology Division of Clinical Physiology

Address: Móricz Zsigmond krt. 22.,
H-4032 Debrecen, Hungary

Zoltán Papp is the professor and director of the Division of Clinical Physiology, Department of Cardiology at the Faculty of Medicine (FM) at the University of Debrecen (UD). He is also the Vice-Dean for scientific affairs at the FM UD.

He investigates the contractile function of the myocardium, the signalling systems of cardiomyocytes, the mechanisms of action of positive inotropic agents, and the pathomechanisms of acute and chronic heart failure.

KRISZTINA KASS

Training Assistant
of the National Academy of Scientist Education
(University of Debrecen)

E-mail: de@edu-sci.org

SZENT-GYÖRGYI MENTORS DEBRECEN

BÁLINT LÁSZLÓ BÁLINT

University of Debrecen
Faculty of Medicine
Department of Biochemistry and Molecular Biology

Address: Egyetem tér 1., H-4032 Debrecen, Hungary

RESEARCH AREA

Over the past decade, an extremely large amount of omics data has become publicly available. Data processing is ongoing, with suboptimal biomedical use. Our research group aims to find answers to unsolved clinical problems using the available data. Our main area of interest is the regulation of gene expression. Over the last few years, several oncologically relevant translocations have been shown to induce tumour cell proliferation by fusion of a cell-specific, highly active super-enhancer with an oncogene. Superenhancers can be identified by bioinformatic methods using chromatin-level markers. The key proteins involved in the function of superenhanes are now being mapped, and small molecules that inhibit their function are available. One such key protein is BRD4, a bromodomain protein with a role in the recognition of acetylated histone and thus the linking of enhancer and promoter regions. Several clinical trials are currently underway to test the efficacy of BRD4 inhibitors in malignancies. Our research aims to understand further details of how superenhancers work. We focus on breast cancer because a significant amount of multi-omics data is available. Significant basic research has already mapped several breast cancer cellular models at the molecular level and these data are freely available for further research. Complemented by the significant number of clinical genomics projects, there is a good chance to better understand the role of super-enhancers in tumorigenesis, stratification and identification of new treatment approaches.

TECHNIQUES AVAILABLE IN THE LAB

In our group, you can learn in vitro and in silico techniques. Our main interest is the study of gene expression and its regulation at the whole genome level in cellular systems. Therefore, students coming to us will learn cell culture techniques, the treatment, manipulation of cell lines, DNA and RNA isolation, quality control of nucleic acids, PCR and QPCR techniques. The entry stage of data analysis techniques is RNA sequencing data analysis on Galaxy platform, later on statistical data processing of genomic data and data visualization will be performed in R programming environment. The use of machine learning methods is the third stage of data analysis. All these techniques are aimed at dissemination of scientific results and publication, therefore students will also receive expert training in this area.

SELECTED PUBLICATIONS

Bojcsuk, D., Nagy, G., **Balint, B.L.** (2017) Inducible super-enhancers are organized based on canonical signal-specific transcription factor binding elements. **Nucleic Acids Research 45:** 3693-3706 Oxford University Press

Ozgyin, L., Horvath, A., Hevessy, Z., **Balint, B.L.** (2019) Extensive epigenetic and transcriptomic variability between genetically identical human B-lymphoblastoid cells with implications in pharmacogenomics research. **Scientific Reports 9:** 4889 Nature Publishing Group

Bojcsuk, D., Nagy, G., **Bálint, B.L.** (2020) Alternatively constructed estrogen receptor alpha-driven super-enhancers result in similar gene expression in breast and endometrial cell lines. **Int J Mol Sci 21:** 1630 Multidisciplinary Digital Publishing Institute

Erdős, E., **Bálint, B.L.** (2020) NR2F2 orphan nuclear receptor is involved in estrogen receptor alpha-mediated transcriptional regulation in luminal a breast cancer cells. **Int J Mol Sci 21:** 1910, Multidisciplinary Digital Publishing Institute

Gargya, P., **Bálint, B.L.** (2021) Histological Grade of Endometrioid Endometrial Cancer and Relapse Risk Can Be Predicted with Machine Learning from Gene Expression Data. **Cancers 13:** 4348 Multidisciplinary Digital Publishing Institute

PÉTER BAY

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RESEARCH AREA

The laboratory carries out exploratory and applied research in three main areas. We carry out investigations to understand the metabolic and non-oncological roles of PARP enzymes that were originally described as DNA repair proteins. The primary aim of these investigations is to facilitate the repurposing of clinically available, registered PARP inhibitors and to understand the role of these enzymes in cells. Oncological diseases are accompanied by changes to the composition of the bacterial communities (the microbiome) of the human body that is termed oncobiosis. The connections between tumors and the microbiome are bidirectional. Our aim is to understand the mechanisms through which neoplasias induce oncobiosis and those through which oncobiosis supports the growth and metastasis formation of tumors. We are developing diagnostic procedures in that field. Finally, in collaboration with the Department of Organic Chemistry at the University of Debrecen we are developing organic metal ion complexes with selective cytostatic property against tumors.

TECHNIQUES AVAILABLE IN THE LAB

The laboratory offers the possibility to learn, besides basic biochemistry and molecular biology techniques, oximetry and the characterization of the cellular energy sensor web. Furthermore, we employ metabolic and oncological animal models that can be absorbed. We work in close clinical collaboration, therefore, we offer a possibility to peek into organizing and conducting clinical studies.

SELECTED PUBLICATIONS

Kovács, T., Mikó E., Ujlaki, G., Yousef, H., Csontos, V., Uray K., **Bai, P.** (2021) The involvement of oncobiosis and bacterial metabolite signaling in metastasis formation in breast cancer. **Cancer and Metastasis 40:** 1223-1249.

Szántó, M., Gupte, R., Kraus, L.W., Pacher, P., **Bai, P.** (2021) PARPs in lipid metabolism and related diseases. **Progress in Lipid Research 84:** 101117.

Kacsir, I., Sipos, A., Bényei, A., Janka, E., Buglyó, P., Somsák, L., **Bai, P.***, Bokor É.* (2022) Reactive oxygen species production is responsible for antineoplastic activity of osmium, ruthenium, iridium and rhodium half-sandwich type complexes with bidentate glycosyl heterocyclic ligands in various cancer cell models. **International Journal of Molecular Medicine 23:** 813 *shared last authors

Curtin, N., Bányai, K., Thaventhiran, J., Le, Quesne, J., Helyes, Z., **Bai, P.** (2020) Repositioning PARP inhibitors for SARS-CoV-2 infection (COVID-19); a new multi-pronged therapy for ARDS? **British Journal of Pharmacology 177:** 3635-3645.

Mikó, E., Vida, A., Kovács, T., Ujlaki, Gy., Trencsényi, Gy., Márton,J., Sári, Zs., Kovács, P., Boratkó, A., Hujber, Z., Csonka, T., Antal-Szalmás, P., Watanabe, M., Gombos, I., Csoka, B., Kiss, B., Vígh, L., Szabó, J., Méhes, G., Sebestyén, A., Goedert, J.J., **Bai, P.** (2018) Lithocholic acid, a bacterial metabolite reduces breast cancer cell proliferation and aggressiveness. BBA – **Bioenergetics 1859:** 958-974.

SZILVIA BENKŐ

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RESEARCH AREA

Nod-like receptors are intracellular pattern recognition receptors that recognize pathogen- or danger-associated molecules and initiate cellular responses in order to protect the cell. Either directly (via inflammasome formation) or indirectly (via signal pathway), they regulate various cellular functions including pro-inflammatory cytokine secretion (like IL-1beta), cell division or cell death. NLRs function as potential therapeutic and diagnostic target since most of the already-characterized members of the family have been associated to some form of autoimmune-, autoinflammatory-, allergic- or cancer diseases. This is proven by the fact that many pharmaceutical company focuses on the molecular manipulation of NLRs by drug development. Despite of the intensive studies many questions are still open, including the cell specific function of NLRs and the molecular mechanisms that modify the functions. Our research team aims to study (1) the expression and the molecular mechanisms of the action in various macrophage subpopulations; (2) the role of skeletal muscle NLRs in the cytokine (myokine) production and insulin resistance.

TECHNIQUES AVAILABLE IN THE LAB

In vitro methods: isolation of monocytes from human blood and differentiation of macrophages subpopulations; differentiation of various mouse macrophages (eg. from bone marrow) or isolation of mouse macrophages (alveolar, peritoneal, brain); cultivation and treatment of primary cells and cell lines(human, mouse); RNA isolation, quantitative PCR; Western blot; ELISA; flow cytometry; microscopy; study of signaling pathways; staudy of metabolism; enzyme activity measurements. In vivo methods: mouse models of systemic and local inflammation; injection and isolation of murine Tibialis anterior muscle; stable and conditional knock-out mouse.

SELECTED PUBLICATIONS

Tóth, K., Lénárt, N., Berki,P., Fekete, R., Szabadits, E., Pósfai, B., Cserép, C, Alatshan, A., **Benkő, S.**, Kiss, D., Hübner, C.A., Gulyás, A., Kaila, K., Környei, Z., Dénes, Á.(2022) The NKCC1 ion transporter modulates microglial phenotype and inflammatory response to brain injury in a cell-autonomous manner. **PLoS Biol 27:** 3001526.

Kovács, E.,G., Alatshan, A., Budai, M.,M., Czimmerer, Z., Bíró, E., **Benkő, S.** (2021) Caffeine Has Different Immunomodulatory Effect on the Cytokine Expression and NLRP3 Inflammasome Function in Various Human Macrophage Subpopulations. **Nutrients 13:** 2409.

Szekanecz, Z., McInnes, I.,B., Schett, G., Szamosi, S., **Benkő, S.**, Szűcs, G. (2021) Autoinflammation and autoimmunity across rheumatic and musculoskeletal diseases. **Nat Rev Rheumatol 17:** 585-595.

Alatshan, A., Kovács, G.,E., Aladdin, A., Czimmerer, Z., Tar, K., **Benkő, S.** (2020) All-Trans Retinoic Acid Enhances both the Signaling for Priming and the Glycolysis for Activation of NLRP3 Inflammasome in Human Macrophage. **Cells 9:** 1591.

Czimmerer Z, Daniel B, Horvath A, Rückerl D, Nagy G, Kiss M, Peloquin M, Budai MM, Cuaranta-Monroy I, Simandi Z, Steiner L, Nagy B Jr, Poliska S, Banko C, Bacso Z, Schulman IG, Sauer S, Deleuze JF, Allen JE, **Benko S**, Nagy L. (2018) The Transcription Factor STAT6 Mediates Direct Repression of Inflammatory Enhancers and Limits Activation of Alternatively Polarized Macrophages. **Immunity 48:** 75-90.

ANIKÓ BORBÁS

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RESEARCH AREA

Our group is engaged in the field of synthetic carbohydrate, nucleoside and antibiotic chemistry. We focuse on the production of oligosaccharides of potential antithrombotic, antiviral and antitumor effects, the synthesis of thioglycoside mimetics of biorelevant carbohydrates, the development of new types of nucleic acid analogues and the chemical modification of glycopeptide antibiotics. In the last decade, we have designed and prepared heparin-like pentasaccharides with high anticoagulant activity, and important structure-activity relationships have been revealed in the field of heparinoid anticoagulants. We applied a biocompatible conjugation reaction, the photocatalytic thiol-ene coupling reaction on unsaturated carbohydrates, and prepared a number of biologically active (antiviral, enzyme-inhibiting) glycoconjugates. Significant progress has been made in the synthesis of glycopeptide-based semisynthetic antibacterial and antiviral compounds, as well as in the design and synthesis of new nucleoside analogs with antitumor activity. Our research has recently been extended to the study of NO- and H2S-donor nonsteroidal anti-inflammatory drugs. The biological activity of our compounds is evaluated in extensive domestic and international cooperation.

TECHNIQUES AVAILABLE IN THE LAB

Laboratory work in the field of synthetic organic chemistry, performing reactions (glycosylations, carbanion additions) requiring an inert atmosphere and / or absolute anhydrous conditions. Routine use of UV/visible-light-induced photochemical reactions in the presence of various initiators or catalysts. Synthesis of bodipy conjugates for fluorescence assays. Use of silica gel column chromatography, and gel filtration to purify oligosaccharides, oligonucleotides and glycopeptide derivatives. Application of methods for structure elucidation: recording and evaluation of NMR and MS spectra.

SELECTED PUBLICATIONS

Debreczeni, N., Bege, M., Herczeg, M., Bereczki, I., Batta, G., Herczegh, P., **Borbás, A**. (2021) Tightly linked morpholino-nucleoside chimeras: new, compact cationic oligonucleotide analogues. **Org Biomol Chem 19:** 8711–8721.

Bereczki, I., Papp, H., Kuczmog, A., Madai, M., Nagy, V., Agócs, A., Batta, G., Milánkovits, M., Ostorházi, E Mitrović, A., Kos, J., Zsigmond, Á., Hajdú, I., Lőrincz, Z., Bajusz, D., Keserű, G.M., Hodek, J., Weber, J., Jakab, F., Herczegh, P., **Borbás, A.** (2021) Natural apocarotenoids and their synthetic glycopeptide conjugates inhibit SARS-CoV-2 replication. **Pharmaceuticals 14:** 1111.

Szűcs, Z., Naesens, L., Stevaert, A., Ostorházi, E., Batta, G., Herczegh, P., **Borbás, A.** (2020) Reprogramming of the antibacterial drug vancomycin results in potent antiviral agents devoid of antibacterial activity, **Parmaceuticals 13:** 139.

Szőke, K., Czompa,A., Lekli, I., Szabados-Fürjesi, P., Herczeg, M., Csávás, M., **Borbás, A.**, Herczegh, P., Tósaki. A. (2019) A new vasoactive hybrid aspirin containing nitrogen monoxide-releasing molsidomine moiety. **Eur J Pharm Sci 131:** 159-166.

Szűcs, Z., Kelemen, V., Thai, S.L., Csávás, M., Rőth, E., Batta, G., Stevaert, A., Vanderlinden, E., Naesens, L., Herczegh, P., **Borbás, A.** (2018) Structure-activity relationship studies of lipophilic teicoplanin pseudoaglycon derivatives as new anti-influenza virus agents. **Eur J Med Chem 157:** 1017-1030.

Demeter, F., Gyöngyösi, T., Bereczky, Z., Kövér, K.E., Mihály Herczeg, M., **Borbás, A.** (2018) Replacement of the L-iduronic acid unit of the anticoagulant pentasaccharide idraparinux by a 6-deoxy-L-talopyranose – Synthesis and conformational analysis. **Scientific Reports 8:** 13736.

ENDRE KÁROLY KRISTÓF

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RESEARCH AREA

Primarily, we aim to identify the unique molecular regulators of browning in human adipose-derived stromal cells and differentiated adipocytes obtained from adipose tissues of distinct anatomical origins by analyzing the global gene expression pattern of these cells. To prove that the identified molecular elements directly regulate brown/beige differentiation or activation, the specific genes will be deleted or overexpressed. Based on the obtained gene expression data, we wish to determine the secreted cytokine and metabolite profiles of distinct human thermogenic adipose tissues and adipocytes by system biology approaches. We also intend to systematically investigate how human browning adipocytes switch off their thermogenic capacity and become dormant in response to the withdrawal of browning-inducers. Our research might open up better strategies for specific stimulation of beneficial fat browning or preventing entry into dormancy in humans, which aid weight reduction and decrease insulin resistance in obese individuals.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of nucleic acids, reverse transcription coupled quantitative polymerase chain reaction, single nucleotide polymorphism genotyping, functional genomics analysis of RNA-sequencing data, protein purification, immunoblotting, cultivation of cells, ELISA, functional cellular metabolic analysis (Seahorse XF96 extracellular flux assay), immunocytochemistry, laser-scanning cytometry.

SELECTED PUBLICATIONS

Kristóf, E., Doan-Xuan, Q.M., Bai, P., Bacso, Z., Fésüs, L. (2015) Laser-scanning cytometry can quantify human adipocyte browning and proves effectiveness of irisin. **Scientific Reports 5:** 12540.

Kristóf, E., Doan-Xuan, Q.M., Sárvári, A.K., Klusóczki, Á., Fischer-Posovszky, P., Wabitsch, M., Bacso, Z., Bai, P., Balajthy, Z., Fésüs L. (2016) Clozapine modifies the differentiation program of human adipocytes inducing browning. **Translational Psychiatry 6:** e963.

Klusóczki, Á., Veréb, Z., Vámos, A., Fischer-Posovszky, P., Wabitsch, M., Bacso, Z., Fésüs, L., **Kristóf E.** (2019) Differentiating SGBS adipocytes respond to PPARγ stimulation, irisin and BMP7 by functional browning and beige characteristics. **Scientific Reports 9:** 5823.

Tóth, B.B., Arianti, R., Shaw, A., Vámos, A., Veréb, Z., Póliska, S., Győry, F., Bacso, Z., Fésüs, L., **Kristóf, E.** (2020) FTO intronic SNP strongly influences human neck adipocyte browning determined by tissue and PPARγ specific regulation: a transcriptome analysis. **Cells 9:** 987.

Shaw, A., Tóth, B.B., Király, R., Arianti, R., Csomós, I., Póliska, S., Vámos, A., Korponay-Szabó, I.R., Bacso, Z., Győry, F., Fésüs, L., **Kristóf, E.** (2021) Irisin stimulates the release of CXCL1 from differentiating human subcutaneous and deep-neck derived adipocytes via upregulation of NFκB pathway. **Frontiers in Cell and Developmental Biology 9:** 737872.

Vámos, A., Shaw, A., Varga, K., Csomós, I., Mocsár, G., Balajthy, Z., Lányi, C., Bacso, Z., Szatmári-Tóth, M., **Kristóf, E.** (2022) Mitophagy mediates the beige to white transition of human primary subcutaneous adipocytes ex vivo. **Pharmaceuticals (Basel) 15:** 363.

CSABA MATTA

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RESEARCH AREA

Traditional therapies for the treatment of osteoarthritis, which affects a large proportion of the population worldwide, have limited effectiveness, owing to limited regeneration of articular cartilage. Therefore, cartilage regeneration remains a major challenge, due in part to the lack of detailed knowledge of the molecular processes that regulate cartilage formation. For this reason, a number of biological therapies are currently being developed for which a more complete understanding of cartilage differentiation is essential. Our research group is interested in the biology of cartilage tissue, with particular emphasis on its formation (chondrogenesis). We aim to understand the cell surface proteome (surfaceome) of developing cartilage cells with the hope of identifying new biomarkers. We also aim to gain a better understanding of the biological clock in differentiating chondrocytes and to synchronise these clocks with mechanical stimuli. A more precise mapping of chondrogenic pathways could contribute to the development of more efficient cartilage regeneration procedures.

TECHNIQUES AVAILABLE IN THE LAB

Students interested in our research may get a better understanding of primary cartilage formation (chondrogenesis), as well as the molecular processes of healthy and osteoarthritic cartilage. We use cutting-edge methodology in our laboratory, including:
- in vitro cell and tissue culturing;
- primary chondrifying cell cultures established from embryonic limb buds;
- gene expression studies by RT-qPCR and next generation sequencing (NGS);
- protein expression studies;
- cell surface protein (surfaceome) analysis using high-throughput mass spectrometry

SELECTED PUBLICATIONS

Matta, C., Lewis, R., Fellows, C., Diszhazi, G., Almassy, J., Miosge, N., Dixon, J., Uribe, M. C., May, S., Poliska, S., Barrett-Jolley, R., Fodor, J., Szentesi, P., Hajdú, T., Keller-Pinter, A., Henslee, E., Labeed, F. H., Hughes, M. P., & Mobasheri, A. (2021) Transcriptome-based screening of ion channels and transporters in a migratory chondroprogenitor cell line isolated from late-stage osteoarthritic cartilage. **Journal of cellular physiology 236:** 7421–7439.

Alagha, M. A., Vágó, J., Katona, É., Takács, R., van der Veen, D., Zákány, R., & **Matta, C.** (2021) A Synchronized Circadian Clock Enhances Early Chondrogenesis. **Cartilage 13:** 53S–67S.

Matta, C., Juhász, T., Fodor, J., Hajdú, T., Katona, É., Szűcs-Somogyi, C., Takács, R., Vágó, J., Oláh, T., Bartók, Á., Varga, Z., Panyi, G., Csernoch, L., & Zákány, R. (2019) N-methyl-D-aspartate (NMDA) receptor expression and function is required for early chondrogenesis. **Cell communication and signaling 17:** 166.

Matta, C., Boocock, D. J., Fellows, C. R., Miosge, N., Dixon, J. E., Liddell, S., Smith, J., & Mobasheri, A. (2019) Molecular phenotyping of the surfaceome of migratory chondroprogenitors and mesenchymal stem cells using biotinylation, glycocapture and quantitative LC-MS/MS proteomic analysis. **Scientific reports 9:** 9018.

Matta, C., Fellows, C. R., Quasnichka, H., Williams, A., Jeremiasse, B., Allaway, D., & Mobasheri, A. (2021). Clusterin secretion is attenuated by the proinflammatory cytokines interleukin-1β and tumor necrosis factor-α in models of cartilage degradation. **Journal of orthopaedic research: official publication of the Orthopaedic Research Society 39:** 1017–1029.

NORBERT NÉMETH

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RESEARCH AREA

Hemorheological, microcirculatory and histomorphological investigations of tissue/organ ischemia-reperfusion related to surgical interventions, with comparative analysis of the detectable injuries and their preventive/therapeutic possibilities. Complex investigation of the pathomechanism of sepsis with special regard to the hemodynamic and microcirculatory changes. Examination of regeneration of micro-vascular anastomoses, setting the optimal geometry of anastomoses and shunts with the usage of agents having a positive effect on the maturation processes.

TECHNIQUES AVAILABLE IN THE LAB

Experimental surgical and microsurgical methods and basic concepts. Microsurgical techniques. Hemorheological laboratory techniques (capillary viscosimetry, conventional and osmotic gradient ektacytometry, light transmission and -reflection aggregometry), special intravital video-microscopy (incident darkfield, IDF, CytoCam), hemo-dynamical measurement methods.

SELECTED PUBLICATIONS

Varga, Á., Mátrai, Á., Baráth, B., Deák, Á., Horváth, L., **Németh, N.** (2022) Interspecies diversity of osmotic gradient deformability of red blood cells in human and seven vertebrate animal species. **Cells 11:** 1-15.

Németh, N., Pető, K., Magyar, Z., Klárik, Z., Varga, G., Oltean, M., Mantas, A., Czigány, Z., Tolba, R. (2021) Hemorheological and microcirculatory factors in liver ischemia-reperfusion injury - An update on pathophysiology, molecular mechanisms and protective strategies. **Int. J. Mol. Sci. 22:** 1-24.

Szabó, B., Fazekas, L., Ghanem, S., Godó, Z., Madar, J., Apró, A., **Németh, N.** (2020) Biomechanical comparison of microvascular anastomoses prepared by various suturing techniques. I**njury-Int. J. Care Inj. 51:** 2866-2873.

Berhés, M., **Németh, N.**, Pető, K., Deák, Á., Hajdu, E., Molnár, Á., Árkosy, P., Szabó, J., Fülesdi, B. (2019) Hemodynamic consequences of intravenously given E. coli suspension: observations in a fulminant sepsis model in pigs, a descriptive case-control study. **Eur. J. Med. Res. 24:** 1-6.

Mester, A., Magyar, Z., Molnár, Á., Somogyi, V., Tánczos, B., Pető, K., **Németh, N.** (2018) Age- and gender-related hemorheological alterations in intestinal ischemia-reperfusion in the rat. **J. Surg. Res. 225:** 68-75.

Ghanem, S., Tánczos, B., Deák, Á., Bidiga, L., **Németh, N.** (2018) Carotid-jugular fistula model to study systemic effects and fistula-related microcirculatory changes. **J. Vasc. Res. 55:** 268-277.

ATTILA OLÁH

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RESEARCH AREA

Complex cannabinoid signaling contributes to the regulation of a number of (patho)physiological processes in human skin. These include, but are not limited to, local inflammatory processes, sebum production, pigmentation, hair growth, or differentiation of epidermal keratinocytes. Dysregulation of these processes play an important role in the pathogenesis of highly prevalent diseases (e.g., acne, hair growth disorders, atopic dermatitis, etc.). Thus, together with national and international collaborators, and industrial partners, our team aims to explore the putative therapeutic potential of the cannabinoid signaling in the above diseases. We mostly use molecular and cellular physiology approaches. In addition to the "endogenous" cannabinoids produced in our body, we also study the effects of plant-derived cannabinoids and "cannabinoid-like" compounds, as well as signaling systems that are related to the cannabinoid signaling (e.g., purinergic signaling, TRP channels, etc.). Moreover, we plan to pay special attention to the interactions between the cannabinoid signaling and the extracellular vesicle-mediated intercellular communication.

TECHNIQUES AVAILABLE IN THE LAB

In our experiments, we investigate cell lines, primary human cells, reconstructed 3D skin equivalents, as well as various organ cultures (e.g., hair follicle, full-thickness human skin). Among others, changes in viability, proliferation, lipid production, intracellular ion homeostasis, gene expression (Q-PCR, western blot, immunolabeling), and mediator production (ELISA) are monitored. We influence gene expression by various methods (e.g., siRNA-mediated selective gene silencing), while in the case of genomic and lipidomic studies, we rely on the expertise of our collaborators.

SELECTED PUBLICATIONS

Oláh, A., Tóth, B.I., Borbíró, I., Sugawara, K., Szöllősi, A.G., Czifra, G., Pál, B., Ambrus, L., Kloepper, J., Camera, E., Ludovici, M., Picardo, M., Voets, T., Zouboulis, C.C., Paus, R., Bíró, T. (2014) Cannabidiol exerts sebostatic and antiinflammatory effects on human sebocytes. **J Clin Invest 124:** 3713-3724.

Oláh, A., Markovics, A., Szabó-Papp, J., Szabó, P.T., Stott, C., Zouboulis, C.C., Bíró, T. (2016) Differential effectiveness of selected non-psychotropic phytocannabinoids on human sebocyte functions implicates their introduction in dry / seborrheic skin and acne treatment. **Exp Dermatol 25:** 701-707.

Szántó, M.[#], **Oláh, A.**[#], Szöllősi, A.G., Tóth, K.F., Páyer, E., Czakó, N., Pór, Á., Kovács, I., Zouboulis, C.C., Kemény, L., Bíró, T., Tóth, B.I. (2019) Activation of TRPV3 inhibits lipogenesis and stimulates production of inflammatory mediators in human sebocytes – a putative contributor to dry skin dermatoses. **J Invest Dermatol 139:** 250-253. [#]Shared first authorship.

Tóth, K.F., Ádám, D., Bíró, T.[#], **Oláh, A.**[#,&] (2019) Cannabinoid signaling in the skin: Therapeutic potential of the "c(ut) annabinoid" system. **Molecules 24:** 918. [#]Shared last authorship. [&]Corresponding author.

Szabó, I.L., Lisztes, E., Béke, G., Tóth, K.F., Paus, R., **Oláh, A.**[#,&], Bíró, T.[#,&] (2020) The phytocannabinoid, ( )-cannabidiol, operates as a complex, differential modulator of human hair growth: Anti-inflammatory submicromolar versus hair growth inhibitory micromolar effects. **J. Invest. Dermatol 140:** 484-488. [#]Shared last authorship. [&]Shared corresponding author.

Markovics, A., Angyal, Á., Tóth, K.F., Ádám, D., Pénzes, Zs., Magi, J., Pór, Á., Kovács, I., Törőcsik, D., Zouboulis, C.C., Bíró, T.[#], **Oláh, A.**[#,&] (2020) GPR119 is a potent regulator of human sebocyte biology. **J Invest Dermatol 140:** 1909-1918.e8. [#]Shared last authorship. [&]Corresponding author.

ZOLTÁN PAPP

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RESEARCH AREA

The cellular myocardial physiology laboratory, established in 2001 and unique in Hungary, provides the opportunity to study the mechanical properties of single myocardial cells obtained from human or experimental animal models of cardiovascular diseases. With the help of our sensitive mechanical measuring system, we can determine the contractile parameters of individual myocardial cells isolated from deep-frozen or even biopsy-derived myocardial tissues. Thus, the Ca2+-dependent isometric force generation of contractile proteins can be measured directly at the cellular level, and direct conclusions can be drawn about the kinetic characteristics of the actin-myosin cycle. In addition to cellular studies, the small size of the preparation (single isolated myocardial cell) allows the characterization of the composition of contractile proteins under control conditions and following enzymatic modifications (e.g., phosphorylation, degradation) or the induction of different model conditions. Thus, our experimental system is suitable for mapping cellular and subcellular changes during altered myocardial contractility in various human and experimental disease states.

TECHNIQUES AVAILABLE IN THE LAB

Preparation of laboratory solutions, myocardial cell isolation, performance of mechanical measurements on isolated myocardial cells, evaluation of measurement data, muscle biochemical methods.

SELECTED PUBLICATIONS

Bódi, B., Oláh, A., Mártha, L., Tóth, A., Radovits, T., Merkely, B., **Papp, Z.** (2021) Exercise-induced alterations of myocardial sarcomere dynamics are associated with hypophosphorylation of cardiac troponin I. R**eviews in Cardiovascular Medicine 22:** 1079-1085.

Bódi, B., Kovács, Á., Gulyás, H., Mártha, L., Tóth, A., Mátyás, C., Barta, B., Oláh, A., Merkely, B., Radovits, T., **Papp, Z.** (2021) Long-Term PDE-5A Inhibition Improves Myofilament Function in Left and Right Ventricular Cardiomyocytes through Partially Different Mechanisms in Diabetic Rat Hearts. **Antioxidants 10:** 1-13.

Bódi, B., Pilz, P., Mártha, L., Lang, M., Hamza, O., Fagyas, M., Szabó, P., Abraham, D., Tóth, A., Podesser, B., Kiss, A., **Papp, Z.** (2021) Alterations in ACE and ACE2 Activities and Cardiomyocyte Signaling Underlie Improved Myocardial Function in a Rat Model of Repeated Remote Ischemic Conditioning. **Int J Mol Sci 22:** 1-17.

Alvarado, G., Tóth, A., Csősz, É., Kalló, G., Dankó, K., Csernátony, Z., Smith, A., Gram, M., Akerström, B., Édes, I., Balla, G., **Papp, Z.**, Balla, J. (2020) Heme-Induced Oxidation of Cysteine Groups of Myofilament Proteins Leads to Contractile Dysfunction of Permeabilized Human Skeletal Muscle Fibres. **Int J Mol Sci 21:** 1-17.

Ruppert, M., Bódi, B., Korkmaz-Icöz, S., Loganathan, S., Jiang, W., Lehmann, L., Oláh, A., Barta, B., Sayour, A., Merkely, B., Karck, M., **Papp, Z.**, Szabó, G., Radovits, T. (2019) Myofilament Ca2+ sensitivity correlates with left ventricular contractility during the progression of pressure overload-induced left ventricular myocardial hypertrophy in rats. **J Mol Cell Cardio 129:** 208-218.

VALTER PÉTER PFLIEGLER

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RESEARCH AREA

The domestication of Saccharomyces yeasts, their macro- and microevolution, especially in the case of clades infecting and colonizing humans, with the use of genomics and experimental evolution.

TECHNIQUES AVAILABLE IN THE LAB

Genomics, Illumina, Oxford Nanopre, experimentla evolution, phenotyping, virulence factors.

SELECTED PUBLICATIONS

Imre, A., Kovács, R., Pázmándi, K., Nemes, D., Jakab, Á., Fekete, T., Rácz, H. V., Dóczi, I., Bácskay, I., Gácser, A., Kovács, K., Majoros, L., Farkas, Z., Pócsi, I., **Pfliegler, P. W.** (2021) Virulence factors and in-host selection on phenotypes in infectious probiotic yeast isolates (Saccharomyces 'boulardii'). **Journal of Fungi 7:** 746.

Rácz, H.V., Mukhtar, F., Imre, A., Rádai, Z., Gombert, A.K., Rátonyi, T., Nagy, J., Pócsi, I., **Pfliegler, W.P.** (2021) How to characterize a strain? Clonal heterogeneity in industrial Saccharomyces influences both phenotypes and heterogeneity in phenotypes. **Yeast 38:** 453-470.

Imre, A., Rácz, H.V., Antunovics, Zs., Rádai, Z., Kovács, R., Lopandic, K., Pócsi, I., **Pfliegler, W. P.** (2019): A new, rapid multiplex PCR method identifies frequent probiotic origin among clinical Saccharomyces isolates. **Microbiological Research 277:** 126298.

Pfliegler, W. P., Boros, E., Pázmándi, K., Jakab, Á., Zsuga, I., Kovács, R., Urbán, E., Antunovics, Zs., Bácsi, A., Sipiczki, M., Majoros, L., Pócsi, I. (2017) Commercial strain-derived clinical Saccharomyces cerevisiae can evolve new phenotypes without higher pathogenicity. **Molecular Nutrition & Food Research 61:** 1601099.

ATTILA TÓTH

University of Debrecen
Faculty of Medicine
Department of Cardiology Division of Clinical Physiology

Address: Móricz Zsigmond krt. 22.,
H-4032 Debrecen, Hungary

RESEARCH AREA

We deal with three areas of research in our laboratory. (1) High blood pressure affects one in three adults, but the cause is unknown in 90% of cases. The diameter of the blood vessels determines the tissue blood supply and blood pressure. We investigate the mechanisms of regulation of the vascular diameter, with particular reference to mechanisms that depend on temperature-dependent receptors and angiotensin peptides. (2) Heart failure is a high-mortality disease that is unfortunately common in Hungary. In our research, we investigate the mechanisms leading to heart failure and the mechanisms of action of new experimental drugs. (3) Cardiovascular disease is the leading cause of death. With proper medication, survival can be significantly improved. Nevertheless, less than half of patients are taking their medications properly. In addition, setting the right dose of drug is difficult and time consuming. In our research, we develop methods that are suitable for measuring the biochemical efficacy of drugs. This may make it possible to determine the optimal dose for a given patient after a simple blood draw.

TECHNIQUES AVAILABLE IN THE LAB

(1) Vascular measurements: artery isolation; cannulation or wire fixation; then measurement of vascular function by diameter change (based on a microscopic image) or determination of contractile force.

(2) Examination of myocardial contractility: simultaneous measurement of the contraction and intracellular Ca2 + concentration of isolated myocardial cells; monitoring of myocardial function in anesthetized animals by echocardiography.

(3) Biomarker research: enzyme activity measurements; separation techniques; ELISA technique; application and programming of a large chemical laboratory analyser (automatic measurements).

SELECTED PUBLICATIONS

Fagyas, M., Bánhegyi, V., Úri, K., Enyedi, A., Lizanecz, E., Mányiné Siket, I., Mártha, L., Fülöp, G., Radovits, T., Pólos, M., Merkely, B., Kovács, Á., Szilvássy, Z., Ungvári, Z., Édes, I., Csanádi, Z., Boczán, J., Takács, I., Szabó, G., Balla, J., Balla, G., Seferović, P., Papp, Z., **Tóth, A.** (2021) Changes in the SARS-CoV-2 cellular receptor ACE2 levels in cardiovascular patients: a potential biomarker for the stratification of COVID-19 patients. **GeroScience** [Epub ahead of print]

Bánhegyi, V., Enyedi, A., Fülöp, G., Oláh, A., Mányiné Siket, I., Váradi, C., Bottyán, K., Lódi, M., Csongrádi, A., Umar, M., Fagyas, M., Czuriga, D., Édes, I., Pólos, M., Merkely, B., Csanádi, Z., Papp, Z., Szabó, G., Radovits, T., Takács, I., **Tóth, A.** (2021) Human Tissue Angiotensin Converting Enzyme (ACE) Activity Is Regulated by Genetic Polymorphisms, Posttranslational Modifications, Endogenous Inhibitors and Secretion in the Serum, Lungs and Heart. **Cells 10:** 1708

Fagyas, M., Kertész, A., Mányiné Siket, I., Bánhegyi, V., Kracskó, B., Szegedi, A., Szokol, M., Vajda, G., Rácz, I., Gulyás, H., Szkibák, N., Rácz, V., Csanádi, Z., Papp, Z., T**óth, A.**, Sipka, S. (2021) Level of the SARS-CoV-2 receptor ACE2 activity is highly elevated in old-aged patients with aortic stenosis: implications for ACE2 as a biomarker for the severity of COVID-19. **GeroScience 43:** 19-29.

Fülöp, G., Oláh, A., Csípő, T., Kovács, Á., Pórszász, R., Veress, R., Horváth, B., Nagy, L., Bódi, B., Fagyas, M., Helgadottir, S., Bánhegyi, V., Juhász, B., Bombicz, M., Priksz, D., Nánási, P., Merkely, B., Édes, I., Csanádi, Z., Papp, Z., Radovits, T., **Tóth, A.** (2021) Omecamtiv mecarbil evokes diastolic dysfunction and leads to periodic electromechanical alternans. **Basic Res Cardiol 116:** 24

Tóth, A., Fagyas, M., Papp, Z., Édes, I.: **Dilution based inhibition assay.** [szabadalom]

DÁNIEL TÖRŐCSIK

University of Debrecen
Faculty of Medicine
Department of Dermatology

Address: Nagyerdei krt. 98., H-4032 Debrecen, Hungary

RESEARCH AREA

The Group is a great opportunity for all who are interested in everyday skin problems such as acne and want to have a knowledge that can be translated into the real world. Our aim is to provide a knowledge that the participant could benefit from not only throughout the university years but also in post-doctoral fellowships. Moreover, we offer an exciting field of research for anyone who is interested in dermatology or in the cosmetic industry. In the nearly 10 years that we spent with research on how sebocytes moisturize the skin and how their altered lipid production leads to the development of acne. We also revealed that the changing sebaceous gland density at different parts of the body could be behind the site-specific appearance of some inflammatory skin diseases. Based on these findings we are currently investigating how sebocyte derived lipids could be therapeutically applied not only to treat dry skin but also inflammatory diseases.

TECHNIQUES AVAILABLE IN THE LAB

State of the art research techniques covering a wide spectrum of genetic studies, protein work and enrolment of patients suffering from acne, with a special focus on:
- studying acne involved skin
- in vitro cell cultures
- studying skin inflammation in mice
- genetic studies (eg. RNAseq, RT-Q-PCR, CRISPR gene modification)
- analysis of histological specimens

SELECTED PUBLICATIONS

TTörőcsik, D., Fazekas, F., Póliska, S., Gregus, A., Janka E.A., Dull, K., Szegedi, A., Zouboulis, C.C., Kovács, D. (2021) Epidermal Growth Factor Modulates Palmitic Acid-Induced Inflammatory and Lipid Signaling Pathways in SZ95 Sebocytes. **Front Immunol 12:** 600017.

Dull, K., Fazekas, F., Deák, D., Kovács, D., Póliska, S., Szegedi, A., Zouboulis, C.C., **Törőcsik, D.** (2021) miR-146a modulates TLR1/2 and 4 induced inflammation and links it with proliferation and lipid production via the indirect regulation of GNG7 in human SZ95 sebocytes. **Sci Rep 11:** 21510

Szentkereszty-Kovács, Z., Fiatal, S., Janka, E.A., Kovács, D., Szegedi, A., Remenyik, É., **Törőcsik, D.** (2021) Leptin Receptor (rs1137101) and Brain-Derived Neurotrophic Factor (rs925946) Gene Variants Are Associated with Obesity in the Early- but Not in the Late-Onset Population of Hungarian Psoriatic Patients. **Life 11:** 1086.

Szentkereszty-Kovács, Z., Gáspár, K., Szegedi, A., Kemény, L., Kovács, D., **Törőcsik, D.** (2021) Alcohol in Psoriasis-From Bench to Bedside. **Int J Mol Sci 22:** 4987.

Dull, K., Fazekas, F., **Törőcsik, D.** (2021) Factor XIII-A in Diseases: Role Beyond Blood Coagulation. **Int J Mol Sci 22:** 1459.

GYÖRGY VEREB

University of Debrecen
Faculty of Medicine
Department of Biophysics and Cell Biology

Address: Egyetem tér 1., H-4032 Debrecen, Hungary

RESEARCH AREA

Developing and optimizing novel therapies against solid tumors and autoimmune diseases based on genetically reprogrammed immune cells, particularly using chimeric antigen receptors (CAR) and chimeric autoantigen receptors (CAAR) in T and NK cells. As a mechanistic background, the molecular assembly and function of immune synapses recruited by various CARs that contain versatile costimulatory domains and/or drive additional signaling pathways through other ectopic genes or RNA interference is also being explored.

Exploitation for diagnosis, prognosis, or therapeutic targeting of the interactions of receptor tyrosine kinases and integrins. Developing microscopic and other spectroscopic/cytometric methods for the quantitative analysis of molecular interactions and signaling processes in situ in cells and tissues with a view to migrate these methods to histopathology diagnostics.

Understanding the molecular dynamics of the corneal limbal stem cell niche, defining non-invasive in vivo imaging modalities that correlate with age or disease-related limbal stem cell deficiency (LSCD) and creating improved methodologies for regenerating corneas with LSCD (in cooperation with the Department of Ophthalmology, University of Debrecen).

TECHNIQUES AVAILABLE IN THE LAB

Basic cell and molecular biology techniques: cell culture (cell lines, ex vivo explants, spheroids), immunofluorescence labeling, flow cytometry and cell sorting, viability / proliferation assays, Western blotting, cloning, transfection, viral transduction. Cryosectioning, immunohistochemistry, digital pathology. Microscopy techniques: fluorescence, confocal, AiryScan, fluctuation microscopy (FCS, FCCS), fluorescence lifetime imaging (time and frequency domain), Förster resonance energy transfer (FRET), digital image processing and analysis. Preclinical tumor models and small animal imaging (luminescence, CT).

SELECTED PUBLICATIONS

Csaplár, M., Szöllősi, J., Gottschalk, S., **Vereb, G***., Szöőr, Á*. (2021) Cytolytic Activity of CAR T Cells and Maintenance of Their CD4+ Subset Is Critical for Optimal Antitumor Activity in Preclinical Solid Tumor Models. **Cancers 13:** 1-19.

Szöőr, Á., Tóth, G., Zsebik, B., Szabó, V., Eshhar, Z., Abken, H., **Vereb, G.** (2020) Trastuzumab Derived HER2-specific CARs for the Treatment of Trastuzumab-Resistant Breast Cancer: CAR T Cells Penetrate and Eradicate Tumors That Are Not Accessible to Antibodies. **Cancer Lett 484:** 1-8.

Tóth, G., Szöőr, Á., Simon, L., Yarden, Y., Szöllősi, J., **Vereb, G.** (2016) The combination of trastuzumab and pertuzumab administered at approved doses may delay development of trastuzumab resistance by additively enhancing antibody-dependent cell-mediated cytotoxicity. **mAbs 8:** 1361-1370.

Petrás, M., Lajtos, T., Friedländer, E., Klekner, Á., Pintye, É., Feuerstein, B., Szöllősi, J., **Vereb, G.** (2013) Molecular interactions of ErbB1 (EGFR) and integrin-β1 in astrocytoma frozen sections predict clinical outcome and correlate with Akt-mediated in vitro radioresistance. **Neuro-Oncology 15:** 1027-1040.

Takács, L., Tóth, E., Losonczy, G., Szántó, A., Bahr-Ivacevic, T., Benes, V., Berta, A., **Vereb, G.** (2011) Differentially Expressed Genes Associated with Human Limbal Epithelial Phenotypes: New Molecules That Potentially Facilitate Selection of Stem Cell-Enriched Populations. Invest. **Ophthalmol Vis Sci 52:** 1252-1260.

Roszik, J., Szöllősi, J., **Vereb, G.** (2008) AccPbFRET: an ImageJ plugin for semi-automatic, fully corrected analysis of acceptor photobleaching FRET images. **BMC Bioinformatics 9:** 346.

LÁSZLÓ VIRÁG

University of Debrecen
Faculty of Medicine
Department of Medical Chemistry

Address: Egyetem tér 1., H-4032 Debrecen, Hungary

RESEARCH AREA

The main profile of our research group is to investigate the relationship between oxidative stress and poly-ADP-ribosylation of proteins in different cellular systems and animal models. A common feature of living organisms is the generation of various free radicals and other reactive intermediates from the oxygen consumed during cellular respiration. These oxygen derivatives may have an important cellular regulatory role, but in pathological conditions, such as inflammation, ischemia-reperfusion injuryn (e.g. in myocardial infarction or stroke), their overproduction cannot be counteracted by the antioxidant system and they cause tissue damage. In addition to the peroxidation of lipids and the oxidation of proteins, oxidative damage also leads to DNA breaks, which are mainly recognized by the enzyme poly(ADP-ribose) polymerase-1 (PARP1), which marks DNA breaks with NAD-derived ADP-ribose polymers to initiate DNA repair. Through its role in DNA damage sensing, the enzyme is a survival factor, but when DNA damage is irreparably severe, PARP1 overactivation triggers a poly(ADP-ribose)-dependent cell death pathway termed parthanathos. In addition to this dual role in cell death, PARP1 also has several functions independent of DNA breakage e.g. in transcriptional regulation. ADP-ribosylation by the 17-members of the PARP enzyme family regulates almost all cellular functions. Our research group is working on diverse and multifaceted research projects, including the study of redox balance and the role of PARP enzymes in tissue macrophages, therapeutic resistance of tumor cells, cell death models, inflammatory processes and tumor-host interactions. An integral part of our research program is the identification of molecules with high-throughput screening that interfere with the above processes.

TECHNIQUES AVAILABLE IN THE LAB

The techniques we use cover almost the entire spectrum of biochemistry, cell and molecular biology and pharmacology. Morphological and functional assays for the characterization of cell death, confocal microscopy, gene inactivation, stem cell cultures, tumor cell-immune cell (e.g. natural killer cell, macrophage) cocultures, 3D cell cultures are all part of our repertoire. We are working on reprogramming macrophages and designing and expressing chimera antigen receptors on macrophages to exploit the anti-tumor effects of these cells. We also screen compound libraries to identify potential drug candidates using HTS (high-throughput screening) and imaging-based HCS (high-content screening) technologies.

SELECTED PUBLICATIONS

Garcia,Soriano, F*.,**Virág, L*.,** Jagtap, P., Szabó. E., Mabley, JG., Liaudet, L., Marton, A., Hoyt, DG., Murthy, KG.,Salzman, AL., Southan, GJ., Szabó, C. (2001) Diabetic endothelial dysfunction: the role of poly(ADP-ribose)polymerase activation. **Nat Med. 7:** 108-13.(*shared first authors)

Erdély,i K., Bai, P., Kovács, I., Szabó, E., Mocsár, G., Kakuk, A., Szabó, C., Gergely, P., **Virág, L.** (2009) Dual role ofpoly (ADP-ribose) glycohydrolase in the regulation of cell death in oxidatively stressed A549 cells. **FASEB J 23:** 3553-63.

Géhl, Z., Bakondi, E., Resch, M.D., Hegedűs, C., Kovács, K., Lakatos, P., Szabó, A., Nagy,Z., **Virág, L.** (2016) Diabetes-induced oxidative stress in the vitreous humor. **Redox Biol 9:** 100-103.

Kiss, A., Ráduly, A.P., Regdon, Z., Polgár, Z., Tarapcsák, S., Sturniolo, I., El-Hamoly, T., **Virág, L*.,** Hegedűs, C*. (2020) Targeting Nuclear NAD+ Synthesis Inhibits DNA Repair, Impairs Metabolic Adaptation and IncreasesChemosensitivity of U-2OS Osteosarcoma Cells. **Cancers 12:** 1180. (*shared corresponding authors)

Regdon, Z., Demény, M.A., Kovács, K., Hajnády, Z., Nagy-Pénzes, M., Bakondi, E., Kiss, A., Hegedűs, C., **Virág, L.** (2021) High-content screening identifies inhibitors of oxidative stress-induced parthanatos: cytoprotective andanti-inflammatory effects of ciclopirox. **Br J Pharmacol 178:** 1095-1113.

SZENT-GYÖRGYI
JUNIOR MENTORS
DEBRECEN

MÁTÉ ÁGOSTON DEMÉNY

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RESEARCH AREA

Regulation of signaling pathways is largely achieved by dynamic chemical modification of proteins. The focus of our research lies on protein modifications through ADP-ribosylation during interaction between tumors and the immune system. As of present, one in six deaths worldwide is still due to malignant tumors. Today's medicine is pinning its best hopes on targeted molecular therapy and immunotherapy to fight cancer. An effective immune response can, indeed, eradicate malignant cells and curb metastasis. However, tumors have a number of processes that inhibit immune cell function. One of the most abundant cells in the tumor stroma are macrophages (Mφ), phagocytes that are part of the innate immune system and also play an important role in directing the adaptive immune response. Paradoxically, their presence in the tumor is usually associated with a poor prognosis, as their interaction with tumor cells results in the acquisition of a phenotype that enhances tumor vascularisation, cancer cell proliferation and resistance to chemotherapy. Both others' and our own preliminary results suggest that protein ADP-ribosylation events are involved in this reprogramming of Mφs. In the laboratory, we are using proteomic methods to identify ADP-ribosylome changes in Mφs as they switch phenotype in association with tumor cells. We are using 2D and 3D tumor cell-Mφ co-culture models to study this. We aim to identify the signaling proteins, transcription factors, metabolic enzymes that undergo modification and the ADP-ribosyltransferase enzymes responsible for their modification. We envision that targeted interference with the identified signaling pathways by manipulating ADP-ribosylation will alter the behavior of tumor Mφs in a favorable direction, which may provide the basis for new cancer therapies.

TECHNIQUES AVAILABLE IN THE LAB

Conventional 2D and 3D spheroid cell culture. Gene transfer by lentiviral transduction. Gene silencing, genome editing in cell lines using Crispr/Cas9 methodology. Flowcytometry. Respirometry and metabolic analysis. Recombinant DNA techniques, mutagenesis, PCR, RT-qPCR. Recombinant protein expression and protein purification. Immunofluorescence, immunohistochemistry. Confocal microscopy, microirradiation, FRAP. High-content automated microscopy.

SELECTED PUBLICATIONS

Guti, E., Regdon, Z., Sturniolo, I., Kiss, A., Kovács, K., **Demény, M.**, Szöőr, Á., Vereb, G., Szöllősi, J., Hegedűs, C., Polgár, Z., Virág, L. (2022) The multitargeted receptor tyrosine kinase inhibitor sunitinib induces resistance of HER2 positive breast cancer cells to trastuzumab-mediated ADCC. **Cancer Immunol Immunother** doi: 10.1007/s00262-022-03146-z. Online ahead of print.

Demény, M,.A., Virág, L. (2021) The PARP Enzyme Family and the Hallmarks of Cancer Part 1. Cell Intrinsic Hallmarks. **Cancers 13:** 2042.

Demény, M,.A., Virág, L. (2021)The PARP Enzyme Family and the Hallmarks of Cancer Part 2: Hallmarks Related to Cancer Host Interactions. **Cancers 13:** 2057.

Regdon, Z., **Demény, M,.A.,** Kovács, K., Hajnády, Z., Nagy-Pénzes, M., Bakondi, E., Kiss, A., Hegedűs, C., Virág, L. (2021) High-content screening identifies inhibitors of oxidative stress-induced parthanatos: cytoprotective and anti-inflammatory effects of ciclopirox. **Br J Pharmacol 178:** 1095-1113.

Sharma, R.*, **Demény, M.***, Ambrus, V., Király,, S.B., Kurtán, T., Gatti-Lafranconi, P., Fuxreiter, M. (2019) Specific and Fuzzy Interactions Cooperate in Modulating Protein Half-Life. **J Mol Biol 431:** 1700-1707.

CSABA HEGEDŰS

University of Debrecen
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RESEARCH AREA

The ability of tumors to form metastases is one of the biggest challenges for physicians. Metastases often appear on vital organs, which can cause the death of patients in a short time. Our research may provide new perspectives in inhibiting metastasis formation. NMNAT enzymes are key players in cellular NAD synthesis. In addition to their cellular energy role, by supporting NAD-demanding enzymes (PARP, SIRT) in cells, they can influence processes such as DNA defect repair, gene expression, and regulation of cell division. NMNAT-1 KO osteosarcoma cells were generated by our research group, they show significantly reduced NAD levels compared to wild-type cells. Other enzymes in NAD + synthesis have already been identified as positive regulators of tumor cell invasion and migration. Drugs that further reduce cellular NAD levels, in combination with the absence of NMNAT1, are expected to be effective tools in inhibiting tumor cell invasion, which is the basis for metastasis formation.

TECHNIQUES AVAILABLE IN THE LAB

High throuhput screening
High content analysis
Immunofluorescence
Western blot
Quantitative real-time PCR
NAD measurement
ATP measurement

SELECTED PUBLICATIONS

Kiss, A., Csikos, C., Regdon,. Z., Polgár, Z., Virág, L.[#], **Hegedűs, C.**[#] (2021) NMNAT1 Is a Survival Factor in Actinomycin D-Induced Osteosarcoma Cell Death. **Int J Mol Sci 22:** 8869

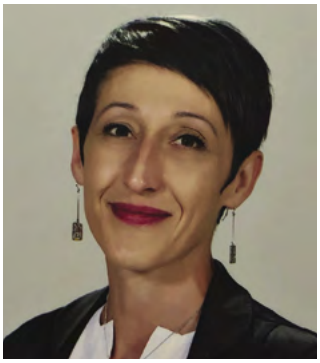
Kiss, A., Ráduly, A.,P., Regdon, Z., Polgár, Z., Tarapcsák, S., Sturniolo, I., El-Hamoly, T., Virág, L.[#], **Hegedűs, C.**[#] (2020) Targeting Nuclear NAD+ Synthesis Inhibits DNA Repair, Impairs Metabolic Adaptation and Increases Chemosensitivity of U-2OS Osteosarcoma Cells. **Cancers (Basel) 12:** 1180.

El-Hamoly, T., Hajnády, Z., Nagy-Pénzes, M., Bakondi, E., Regdon, Z., Demény, .,A., Kovács, K., **Hegedűs, C.**, Abd, El-Rahman, S.,S,, Szabó, É., Maléth, J., Hegyi, P., Virág. L. (2021) Poly(ADP-Ribose) Polymerase 1 Promotes Inflammation and Fibrosis in a Mouse Model of Chronic Pancreatitis. I**nt J Mol Sci 22:** 3593.

Regdon, Z., Demény, M.,A., Kovács, K., Hajnády, Z., Nagy-Pénzes, M., Bakondi, E., Kiss, A., **Hegedűs, C.**, Virág, L. (2021) High-content screening identifies inhibitors of oxidative stress-induced parthanatos: cytoprotective and anti-inflammatory effects of ciclopirox. **Br J Pharmacol 178:** 1095-1113.

Bakondi, E., Singh, S.,B., Hajnády, Z., Nagy-Pénzes, M., Regdon, Z., Kovács, K., **Hegedűs, C.**, Madácsy, T., Maléth, J,, Hegyi, P., Demény, M.,Á., Nagy, T., Kéki, S., Szabó, É., Virág, L. (2019) Spilanthol Inhibits Inflammatory Transcription Factors and iNOS Expression in Macrophages and Exerts Anti-inflammatory Effects in Dermatitis and Pancreatitis. **Int J Mol Sci 20:** 4308.

KATALIN KOVÁCS



University of Debrecen
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Department of Medical Chemistry

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RESEARCH AREA

Development of high throughput screening methods and molecular library screening to identify compounds that influence autophagy and other biological processes. Molecule library screening allows the investigation of existing drugs for new therapeutic purposes (drug repurposing). Our goal is to detect compounds that boost cancer cell elimination. The student will perform Antibody-Dependent Cell-Mediated Cytotoxicity (ADCC) assays. ADCC involves bridging target cells (e.g. virus-infected or cancer cells) and effector cells [e.g. natural killer (NK) cells or macrophages] with an antibody. The latter binds specifically to a cell surface antigen on the target cell while the constant region (Fc fragment) binds to the Fc receptor on the effector cells. We plan to set up assays for the quantification of cancer cell killing by NK cells and to perform high-content screening to identify ADCC enhancing drug candidates from drug libraries.

TECHNIQUES AVAILABLE IN THE LAB

Cell culture, working with co-cultures, viability assays, cytotoxicity assays, image analysis with different software, immunofluorescence, detection of proteins with Western blotting, confocal microscopy, flow cytometry, quantitative PCR.

SELECTED PUBLICATIONS

Guti, E., Regdon, Z., Sturniolo, I., Kiss, A., **Kovács, K.**, Demény, M., Szöőr, Á., Vereb, G., Szöllősi, J., Hegedűs, C., Polgár, Z., Virág, L. (2022) The multitargeted receptor tyrosine kinase inhibitor sunitinib induces resistance of HER2 positive breast cancer cells to trastuzumab-mediated ADCC. **Cancer Immunol Immunother**

Regdon, Z., Robaszkiewicz, A., **Kovács, K.,** Rygielska, Ż., Hegedűs, C., Bodoor, K., Szabó, É., Virág, L. (2019) LPS protects macrophages from AIF-independent parthanatos by downregulation of PARP1 expression, induction of SOD2 expression, and a metabolic shift to aerobic glycolysis. **Free Radic Biol Med 131:** 184-196.

Kovács, K., Erdélyi, K., Hegedus, Cs., Lakatos, P., Regdon, Zs., Bai, P., Haskó, Gy., Szabó, É., Virág, L. (2012) Poly(ADP-ribosyl)ation is a survival mechanism in cigarette smoke-induced and hydrogen peroxide-mediated cell death. **Free Radic Biol Med 53:** 1680-8.

SZENT-GYÖRGYI STUDENTS DEBRECEN

ÁKOS MÁTÉ BEDE

National Academy of Scientist Education, 1st year

University of Debrecen,
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

László Virág

JUNIOR MENTOR:

Katalin Kovács

SPECIALIZATION:

Immunopharmacology

SECONDARY SCHOOL:

Ady Endre Secondary School, Oradea

NAME OF TEACHER:

Annamária Hanesz

LANGUAGES:

English/advanced
Romanian/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Antibody-Dependent Cell-Mediated Cytotoxicity (ADCC) involves bridging target cells (e.g. virus-infected or cancer cells) and effector cells [e.g. natural killer (NK) cells or macrophages] with an antibody. The latter binds specifically to a cell surface antigen on the target cell while the constant region (Fc fragment) binds to the Fc receptor on the effector cells. ADCC is one of the key mechanisms by which cell-based cancer therapies fight the tumor. However, these mechanisms easily burn out and boosting ADCC activity would provide therapeutic benefit in oncology. We plan to set up assays for the quantification of cancer cell killing by NK cells and to perform high-content screening to identify ADCC enhancing drug candidates from drug libraries.

AMBITIONS AND CAREER GOALS

Throughout my university education I strive to acquire deep theoretical and practical medical knowledge. My goal after graduating medical school is getting a Phd degree. I wish to become a scientist-physician, working to improve people's lives in a clinical setting as well as by conducting biomedical research.

HONORS AND PRIZES

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PUBLICATIONS

–

CSABA CSIKOS

National Academy of Scientist Education, 5th year

University of Debrecen,
Faculty of Medicine, 5th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Péter Bay

JUNIOR MENTOR:

Csaba Hegedűs

SPECIALIZATION:

Biochemistry

SECONDARY SCHOOL:

University of Debrecen,
Kossuth Lajos Practical High School and Primary School

NAME OF TEACHER:

Zsolt Krakonperger,
Edit Futóné Monori,
Klára Ölveti,
Edina Molnár

LANGUAGES:

english

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

NMNAT1 is an enzyme localized in the nucleus and it plays an important role in several biochemical processes. We are investigating the effect of NMNAT1 on the migration of tumor cells. We set up an in vitro wound healing assay with which we can examine the proliferation and migration of the cells at the same time. With this method, we may be able to find new therapeutic approches that can improve the survival rate of malignant diseases.

AMBITIONS AND CAREER GOALS

I would like to become a physician who fulfills both their professional duties and their humanitarian requirements. For this, I find it important to acquire lots of knowledge and many skills while being a medical student. Joining a research project also contributes to achieving my future goals in many ways.

HONORS AND PRIZES

–

PUBLICATIONS

–

PÉTER GARGYA

National Academy of Scientist Education, 6th year

University of Debrecen,
Faculty of Medicine, 6th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Bálint László Bálint

JUNIOR MENTOR:

-

SPECIALIZATION:

bioinformatics

SECONDARY SCHOOL:

Fazekas Mihály High School, Debrecen

NAME OF TEACHER:

Ágnes Barta

LANGUAGES:

English

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Amplification of some biomarker genes from a fine-needle aspiration sample may be suitable for developing a rapid test that can differentiate between malignant and benign lesions based on gene expression, complementing the current screening methods with an independent, highly-sensitive test. By using bioinformatics analysis and machine learning algorithms, our goal is to find the genes whose expressions are best for differentiating between healthy and tumor tissue samples, making them the most promising targets for further laboratory work.

AMBITIONS AND CAREER GOALS

Before graduating, I would like to publish another first author paper. After graduating, I would like to be a full-time doctor, meanwhile I get a PhD title as soon as possible. In the long run, I plan to combine clinical practicing with doing scientific research.

HONORS AND PRIZES

2022 - Annual Student Research Conference: Genetics, genomics section: 1st prize
2021 - National Student Research Conference: Bioinformatics section: 1st prize
2021 - Annual Student Research Conference: Biophysics, cell-biology, bioinformatics section: honorary award
2020 - Annual Student Research Conference: Genetics, genomics section: 3rd prize

PUBLICATIONS

Gargya, P., Bálint, B.L. Histological Grade of Endometrioid Endometrial Cancer and Relapse Risk Can Be Predicted with Machine Learning from Gene Expression Data. **Cancers 2021, 13**, 4348.

MIKLÓS LOVAS

National Academy of Scientist Education, 1st year

University of Debrecen,
Faculty of Pharmacy, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Anikó Borbás

JUNIOR MENTOR:

-

SPECIALIZATION:

pharmaceutical chemistry

SECONDARY SCHOOL:

Tóth Árpád High School

NAME OF TEACHER:

Veronika Novák

LANGUAGES:

English/advanced
Spanish/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Hydrogen sulfide is widely regarded as a toxic, foul-smelling chemical, but studies have identified it as the third gasotransmitter molecule. It has been found that it plays roles in various physiological processes, and has cardioprotective, pro-apoptotic and anti-inflammatory properties. In my research project I aim to synthesize compounds that can release hydrogen-sulfide upon enzymatic hydrolysis, and study the cardioprotective properties of these compounds in ischemic rat hearts.

AMBITIONS AND CAREER GOALS

After graduating, I intend to take part in PhD education, participate in research, and also get to know different areas of pharmacy. I would like to do all this at least partly abroad, building international relations that help me grow professionally, and help building my career.

HONORS AND PRIZES

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PUBLICATIONS

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BEÁTA VÁRKONYI

National Academy of Scientist Education, 1st year

University of Debrecen,
Faculty of Medicine, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

László Virág

JUNIOR MENTOR:

Máté Demény

SPECIALIZATION:

Cell biology

SECONDARY SCHOOL:

University of Debrecen, Kossuth Lajos Practical High School and Primary School

NAME OF TEACHER:

Dr. Edit Róza Futóné Monori, Edina Lovas-Kiss, Dr. Adrienn Krakompergerné Aros

LANGUAGES:

English
German
French

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

My research focuses on the interaction between tumour cells and macrophages. Using a co-culture system of breast cancer cells and macrophages, I investigate the role of PARP enzyme family members in the process by which the tumour reprograms tumour-associated macrophages into a tumour cell growth promoting phenotype. I plan to study the role of the post-translational protein modification process called ADP-ribosylation catalyzed by PARP enzymes, in the tumour cell-induced metabolic, transcriptional and signalling processes of macrophages. The aim and expected outcome of the research is to identify ADP-ribosylation-regulated proteins in macrophages that may be targets for reprogramming efforts towards a tumour-killing immune cell phenotype.

AMBITIONS AND CAREER GOALS

I intend to learn the research approach during my university years and then apply it in the clinic. I would like to gain experience abroad as well, which I plan to apply to my work here in Hungary. My aim is to learn as much as possible about the literature, to keep up to date with it and thus to gain a more complete picture of the challenges and achievements of the medical profession. I plan to obtain a PhD after graduating from medical school and to continue the research work I have already started.

HONORS AND PRIZES

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PUBLICATIONS

–

"Raising a good problem, asking a good question is already half the work."

Albert Szent-Györgyi

PÉCS

ZSUZSANNA HELYES

SCIENTIFIC SUPERVISOR OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION (UNIVERSITY OF PÉCS)

University of Pécs
Szentágothai Research Centre

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PÉCSI TUDOMÁNYEGYETEM
UNIVERSITY OF PÉCS

Zsuzsanna Helyes is a neuropharmacologist, professor, specialist at clinical laboratory diagnostics and clinical pharmacology. She graduated from the Medical University of Pécs in 1995 with a general medical degree, obtained her PhD in 1999, habilitation in 2007, doctorate of the Hungarian Academy of Sciences in 2011. She was elected to be a corresponding member of the Hungarian Academy of Sciences in 2019. Currently, she is a professor at the Department of Pharmacology and Pharmacotherapy at the Medical School of the University of Pécs and the president of the Szentágothai János Research Centre.

Her research interests focus on the role of capsaicin-sensitive sensory neurons, neuropeptides and their receptors, and neuro-immune interactions in pain, inflammation and tumour-related diseases. Her aim is to identify novel analgesic and anti-inflammatory drug targets, and to develop drug candidates.

ERIKA PINTÉR

DEPUTY SCIENTIFIC SUPERVISOR OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION (UNIVERSITY OF PÉCS)

University of Pécs
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Department of Pharmacology and Pharmacotherapy

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PÉCSI TUDOMÁNYEGYETEM
UNIVERSITY OF PÉCS

Erika Pintér has been the head of the Department of Pharmacology and Pharmacotherapy at the Faculty of Medical School of the University of Pécs since 2013. She graduated as a general practitioner in 1985 and as a clinical pharmacologist in 1991. She defended her doctoral thesis and obtained her Ph.D. degree in 1996. She habilitated in 2003.

Scientific field interests: Neuro-immuno-pharmacology, inflammation, the role of the capsaicin-sensitive sensory nerve endings in the regulation of microcirculation and neurogenic inflammation, immuno-modulatory effect of neurogenic inflammation, anti-inflammatory effect of somatostatin and its analogues, biological effects of hydrogen-sulfide.

RITA LÍVIA BALÁZS

Training Assistant
of the National Academy of Scientist Education
(University of Pécs)

E-mail: pte@edu-sci.org

SZENT-GYÖRGYI MENTORS PÉCS

TAMÁS ATLASZ

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RESEARCH AREA

Retinal diseases are among the leading causes of blindness. Therefore, any experimental approach that leads to a better understanding of the molecular background of these diseases, as well as the testing of groups of molecules that can reduce or potentially prevent damage, is a priority research activity. Our research focuses on the study of two posterior segment diseases of the eye (glaucoma and diabetic retinopathy) which are leading causes in the development of blindness. Our goal is to develop a new effective treatment strategy for the previously mentioned ophthalmic diseases by using different neuroprotective pharmacons, with each having distinct target points that reduce the development of the disease.

TECHNIQUES AVAILABLE IN THE LAB

In our ophthalmic research, we use state-of-the-art technology in rodents in vivo, such as optical coherence tomography (OCT). OCT is suitable for comprehensive examination of the posterior and anterior segments of the eye. It also allows us to measure intraocular pressure, examine the fundus with funduscopy, and analyze vision via the electroretinographic method. Additionally, our laboratory routinely uses histological, immunohistochemical, and molecular biological methods (western blot, ELISA, apoptosis, and cytokine array kit).

SELECTED PUBLICATIONS

Patko, E., Szabo, E., Toth, D., Tornoczky, T., Bosnyak, I., Vaczy A., **Atlasz, T.**, Reglodi, D. (2022) Distribution of PACAP and PAC1 Receptor in the Human Eye, **J Mol Neurosci**

Kvarik, T., Reglodi, D., Werling, D., Vaczy, A., Kovari, P., Szabo, E., Kovacs, K., Hashimoto, H., Ertl, T., Gyarmati, J., **Atlasz, T.** (2021) The Protective Effects of Endogenous PACAP in Oxygen-Induced Retinopathy, **J Mol Neurosci 71:** 2546–2557.

Szabó, E., Patkó, E., Váczy, A., Molitor, D., Csutak, A., Tóth, G., Reglődi, D., **Atlasz, T.** (2021) Retinoprotective Effects of PACAP Eye Drops in Microbead-Induced Glaucoma Model in Rats, **Int J Mol Sci 22:** 16.

Kovacs, K., Vaczy, A., Fekete, K., Kovari, P., **Atlasz, T.**, Reglodi, D., Gabriel, R., Gallyas, F., Sumegi, B. (2019) PARP Inhibitor Protects Against Chronic Hypoxia/Reoxygenation-Induced Retinal Injury by Regulation of MAPKs, HIF1α, Nrf2, and NFκB. **IOVS 60:** 1478–1490.

Atlasz, T., Werling, D., Song, S., Szabo, E., Vaczy, A., Kovari, P., Tamas, A., Reglodi, D., Yu, R. (2019) Retinoprotective Effects of TAT-Bound Vasoactive Intestinal Peptide and Pituitary Adenylate Cyclase Activating Polypeptide. **J Mol Neurosci 68:** 397-407.

BOLDIZSÁR CZÉH

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Structural Neurobiology Research Group

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RESEARCH AREA

The physiological stress response is essential for our everyday survival, but traumatic or chronic stress represents a strong risk factor for the development of various mental and somatic disorders. The aim of our research is to investigate the functional and structural changes in the brain caused by stress. Such studies help us to understand the pathophysiology of mental disorders such as depression.

We perform clinical studies and we work also with animal models of neuropsychiatric disorders. We employ different imaging methods to examine the cellular alterations that develop under stress. Structural and functional changes in the brain are examined by magnetic resonance imaging (MRI). This method is suitable for determining the volume of different brain structures and for providing information on the microstructure of white matter structures. Functional MRI investigations are suitable for examining brain areas which are specifically activated during cognitive and emotional tasks. The in vivo imaging experiments are complemented by postmortem histological studies, in which we study morphological changes of the cells and neural networks using different microscopic methods.

TECHNIQUES AVAILABLE IN THE LAB

Neuroimaging studies: Principles of magnetic resonance imaging (MRI) in humans and experimental animals. Structural MRI studies: volume measurements of gray and white matter structures, analysis of diffusion tensor images, tractography. Functional MRI studies: BOLD responses related to emotional and cognitive tasks, analysis of resting state functional MRI.

Classic histochemistry methods, immunohistochemistry procedures, light microscopy, fluorescence and confocal microscopy, transmission electron microscopy. 3D neuronal reconstruction and stereological cell counting with Neurolucida systems.

SELECTED PUBLICATIONS

Nagy, S. A., Kürtös, Z., Németh, N., Perlaki, G., Csernela, E., Lakner, F. E., Dóczi, T., **Czéh, B.**, Simon, M. (2021) Childhood maltreatment results in altered deactivation of reward processing circuits in depressed patients: A functional magnetic resonance imaging study of a facial emotion recognition task. **Neurobiol Stress 15:** 100399.

Nagy, S. A., Vranesics, A., Varga, Z., Csabai, D., Bruszt, N., Bali, Z. K., Perlaki, G., Hernádi, I., Berente, Z., Miseta, A., Dóczi, T., **Czéh, B.** (2020) Stress-Induced Microstructural Alterations Correlate With the Cognitive Performance of Rats: A Longitudinal in vivo Diffusion Tensor Imaging Study. **Front Neurosci 14:** 474.

Simon, M., Németh, N., Gálber, M., Lakner, E., Csernela, E., Tényi, T., **Czéh, B.** (2019) Childhood Adversity Impairs Theory of Mind Abilities in Adult Patients With Major Depressive Disorder. **Front Psychiatry 10:** 867.

Czéh, B., Müller-Keuker, J. I., Rygula, R., Abumaria, N., Hiemke, C., Domenici, E., Fuchs, E. (2007) Chronic social stress inhibits cell proliferation in the adult medial prefrontal cortex: hemispheric asymmetry and reversal by fluoxetine treatment. **Neuropsychopharmacology 32:** 1490–1503.

Coe, C. L., Kramer, M., **Czéh, B.**, Gould, E., Reeves, A. J., Kirschbaum, C., Fuchs, E. (2003) Prenatal stress diminishes neurogenesis in the dentate gyrus of juvenile rhesus monkeys. **BiolPsychiatry 54:** 1025–1034.

Czéh, B., Michaelis, T., Watanabe, T., Frahm, J., de Biurrun, G., van Kampen, M., Bartolomucci, A., Fuchs, E. (2001) Stress-induced changes in cerebral metabolites, hippocampal volume, and cell proliferation are prevented by antidepressant treatment with tianeptine. **Proc Natl Acad Sci USA 98:** 12796–12801.

ANDRÁS GARAMI

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RESEARCH AREA

Normal body temperature – which is essential for life – is maintained by various thermoregulatory mechanisms. Thermoregulatory disorders are present in many pathological conditions, e.g., febrile diseases, systemic inflammation (sepsis), organ dysfunctions (e.g., pancreatitis), heat stroke, and hypothermia. It is of utmost importance to discover the pathophysiological processes in the thermoregulatory disorders. More and more influencing factors are identified, such as the pH status and transient receptor potential channels. In our research, we aim at identifying the neural substrates and molecular mediators involved in the thermoregulatory processes mainly in different animal models, but to some extent also in human studies. Our findings can further advance the knowledge of bodily homeostasis, moreover, they can open new directions in clinical practice, most of all intensive therapy, and other sciences. Successful development of drugs designed specifically to target body temperature, could pave the road to pharmacologically controlled temperature management, thereby advancing the therapeutic approaches in clinical conditions with thermoregulatory disorders.

TECHNIQUES AVAILABLE IN THE LAB

Various surgeries in rodents (e.g., brain cannula, i.p. and i.v. catheter implantations, vagotomy, cecal ligation, implantation of abdominal radiotransmitter and osmotic minipump). Thermocouple thermometry (core and skin temperature measurement in incubator chamber). Biotelemetry (investigation of circadian rhythm in rodents). Thermal imaging (skin and core temperature measurement in small animals and humans). Food intake, body composition, and nocifensive reaction measurements. Techniques of blood collection and tissue harvesting, as well as, sample storing for molecular biology experiments.

SELECTED PUBLICATIONS

Keringer, P., Furedi N., Gaszner, B., Miko, A., Pakai, E., Fekete, K., Olah, E., Kelava, L., Romanovsky, A. A., Rumbus, Z., **Garami, A.** (2022). The hyperthermic effect of central cholecystokinin is mediated by the cyclooxygenase-2 pathway. **Am J Physiol Endocrinol Metab 322:** E10–E23.

Olah, E., Rumbus, Z., Kormos, V., Tekus, V., Pakai, E., Wilson, H. V., Fekete, K., Solymar, M., Kelava, L., Keringer, P., Gaszner, B., Whiteman, M., Keeble, J., Pinter, E., **Garami, A.** (2021). The hypothermic effect of hydrogen sulfide is mediated by the transient receptor potential ankyrin-1 channel in mice. **Pharmaceuticals (Basel, Switzerland) 14:** 992.

Garami, A., Shimansky, Y. P., Rumbus, Z., Vizin, R., Farkas, N., Hegyi, J., Szakacs, Z., Solymar, M., Csenkey, A., Chiche, D. A., Kapil, R., Kyle, D. J., Van, Horn W. D., Hegyi, P., Romanovsky, A. A. (2020). Hyperthermia induced by transient receptor potential vanilloid-1 (TRPV1) antagonists in human clinical trials: Insights from mathematical modeling and meta-analysis. **Pharmacol Ther 208:** 107474.

Pakai, E., Tekus, V., Zsiboras, Cs., Rumbus, Z., Olah, E., Keringer, P., Khidhir, N., Matics, R., Deres, L., Ordog, K., Szentes, N., Pohoczky, K., Kemeny, A., Hegyi, P., Pinter, E., **Garami, A.** (2018) The neurokinin-1 receptor contributes to the early phase of lipopolysaccharide-induced fever via stimulation of peripheral cyclooxygenase-2 protein expression in mice. **Front Immunol 9:** 166.

Garami, A., Steiner, AA., Romanovsky, A. A. (2018) Fever and hypothermia in systemic inflammation. In: Thermoregulation, Part I: From Basic Neuroscience to Clinical Neurology. **Handb Clin Neurol** Oxford, UK: **Elsevier 157:** 565-597.

ZSUZSANNA HELYES

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Szentágothai Research Centre

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RESEARCH AREA

Mapping the complex mechanisms underlying chronic arthritic pain. A significant proportion of people with rheumatoid arthritis are 'difficult to treat' patients, falling into the categories of non-inflammatory and persistent inflammation. Chronic pain is the main symptom in both cases, with autoimmune, neuroinflammatory and neuropathic processes underlying central and peripheral mechanisms. As conventional analgesics are often ineffective, our aim is to understand the mechanisms of sensitisations responsible for chronic pain and to identify the key mediators and pathways involved. In mouse models of arthritis, we perform complex functional and analytical as well as morphological studies of the central nervous system (glial cell-neuron interactions, neuroinflammation). RNA isolated from peripheral blood mononuclear cells and dorsal root ganglia will be subjected to transcriptomic measurements and from plasma to metabolomic measurements, which will be evaluated using bioinformatic methods. Pain levels will be correlated with other inflammatory and immunological parameters, as well as anxiety and mood changes. Brain functional imaging studies will be performed to map changes in the activation pattern of the "pain matrix".

TECHNIQUES AVAILABLE IN THE LAB

Functional studies in mouse models of arthritis (inflammatory parameters, nociception, anxiety, behavioural testing), blood and tissue sampling, peripheral blood mononuclear cell isolation, RNA isolation, transcriptomic and metabolomic data analysis, participation in bioinformatics analyses, histopathological methods (joint, spinal cord, brain section, immunostaining), microscopic methods, brain imaging, statistical evaluation.

SELECTED PUBLICATIONS

Helyes, Z., Tékus, V., Szentes, N., Pohóczky, K., Botz, B., Kiss, T., Kemény, Á., Környei, Z., Tóth, K., Lénárt, N., Ábrahám, H., Pinteaux, E., Francis, S., Sensi, S., Dénes, Á., Goebel A. (2019) Transfer of complex regional pain syndrome to mice via human autoantibodies is mediated by interleukin-1-induced mechanisms. **Proc Natl Acad Sci USA 116:** 13067-13076.

Kecskés, A., Pohóczky, K., Kecskés, M., Varga, ZV., Kormos, V., Szőke, É., Henn-Mike, N., Fehér, M., Kun, J., Gyenesei, A., Renner, É., Palkovits, M., Ferdinandy, P., Ábrahám, IM., Gaszner, B., **Helyes Z.** (2020) Characterization of Neurons Expressing the Novel Analgesic Drug Target Somatostatin Receptor 4 in Mouse and Human Brains. **Int J Mol Sci. 21:** 7788.

Horváth, Á., Tékus, V., Bencze, N., Szentes, N., Scheich, B., Bölcskei, K., Szőke, É., Mócsai, A., Tóth-Sarudy, É., Mátyus, P., Pintér, E., **Helyes, Z.** (2018) Analgesic effects of the novel semicarbazide-sensitive amine oxidase inhibitor SZV 1287 in mouse pain models with neuropathic mechanisms: Involvement of transient receptor potential vanilloid 1 and ankyrin 1 receptors. **Pharmacol Res. 131:** 231-243.

Botz, B., Kriszta, G., Bölcskei, K., Horváth, ÁI., Mócsai, A., **Helyes, Z.** (2021) Capsaicin-Sensitive Peptidergic Sensory Nerves Are Anti-Inflammatory Gatekeepers in the Hyperacute Phase of a Mouse Rheumatoid Arthritis Model. **Int J Mol Sci. 22:** 1682.

Szentes, N., Tékus, V., Mohos, V., Borbély, É., **Helyes, Z.** (2019) Exploratory and locomotor activity, learning and memory functions in somatostatin receptor subtype 4 gene-deficient mice in relation to aging and sex. **Geroscience 41:** 631-641.

ISTVÁN HERNÁDI

University of Pécs
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Institute of Biology

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RESEARCH AREA

Investigating the neurocognitive underpinnings of ageing and neurocognitive impairment in rodents: identification of preclinical drug development strategies and development of combined cognitive enhancer therapies. The main objective of the project is to understand and model the processes underlying brain ageing and neurocognitive disorders (dementias) in rodents and to study cellular and behavioural processes in a coordinated manner in the same model. The research is carried out in two locations: our cellular biology (electrophysiology) laboratory is located at the Faculty Sciences and our small animal behavioural pharmacology laboratory is located at the Szentágothai Research Centre (SzRC). Our preclinical animal models include e.g. pharmacologically induced amnesia, natural ageing, repetitive mild traumatic brain injury and genetic (DREADD) models. Behavioural changes are investigated in state-of-the-art test packages. Our results are further utilized in both basic and applied drug discovery research. Our main long-term goal is to unravel the yet unknown mechanisms underlying neurocognitive diseases and to identify biomarkers that may later play a crucial role in the diagnosis and treatment of cognitive disorders and in the development of new drug candidates.

TECHNIQUES AVAILABLE IN THE LAB

Faculty of Sciences: in vivo extracellular neurophysiological and cellular neurochemical studies (microiontophoresis), stereotaxic surgery, microinjections, optogenetic and chemogenetic studies (DREADD technique). Szentagothai Research Centre, rodent behaviour laboratory and core facility. Behavioural pharmacology studies in rodents: Neurological tests, open field test, elevated cross-maze and zero maze tests, forced swim test, food preference tests, spatial memory tasks (T-maze, Morris Water Maze), computer-controlled operant behavioural tests (psychomotor vigilance and decision-making tasks) reversible inactivations, systemic/central application of bioactive compounds and drug candidates, drug development in rodent models of psychiatric and neurocognitive disorders.

SELECTED PUBLICATIONS

Bruszt N., Bali Z.K., Tadepalli S.A., Nagy L.V., **Hernádi I.** (2021) Potentiation of cognitive enhancer effects of Alzheimer's disease medication memantine by alpha7 nicotinic acetylcholine receptor agonist PHA-543613 in the Morris water maze task. **Psychopharmacology (Berl) 238:** 3273–3281.

Nagy L.V., Bali Z.K., Kapus G., Pelsőczi P., Farkas B., Lendvai B., Lévay G., **Hernádi I.** (2021) Converging Evidence on D-Amino Acid Oxidase–Dependent Enhancement of Hippocampal Firing Activity and Passive Avoidance Learning in Rats. **Int J Neuropsychopharmacol 24:** 434.

Bali Z.K., Nagy L.V., **Hernádi I.** (2017) Alpha7 nicotinic acetylcholine receptors play a predominant role in the cholinergic potentiation of N-methyl-D-aspartate evoked firing responses of hippocampal CA1 pyramidal cells. **Front Cell Neurosci 11:** 271.

Grabenhorst F., **Hernádi I.**, Schultz W. (2016) Primate amygdala neurons evaluate the progress of self-defined economic choice sequences. **Elife 12:** e18731.

Hernádi I., Grabenhorst F., Schultz W. (2015) Planning activity for internally generated reward goals in monkey amygdala neurons. **Nat Neurosci 18:** 461-469.

Stefanics G., Hangya B., **Hernádi I.**, Winkler I., Lakatos P., Ulbert I. (2010) Phase entrainment of human delta oscillations can mediate the effects of expectation on reaction speed. **J Neurosci 30:** 13578-13585.

CSABA HETÉNYI

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RESEARCH AREA

Development and application of computer-aided drug design A key step in the early stages of drug design is the design of potent drug molecules. This process is now mostly carried out using computer (pharmaco-informatics) methods, which are capable of handling both large amounts of structural data and complex energy calculations. The pharmacoinformatics toolbox will be used in both target-based and ligand-based design and will be extended with new procedures in the course of the PhD work. The methods will be tested and applied in curricular areas of pharmacology such as pain management, regulation of signalling, antiviral and epigenetic-based therapies. Computational analysis of target-drug interactions: Computational docking is an indispensable tool in drug design and is widely used by pharmaceutical companies. This project focuses on the prediction of the structure and energy of drug-target interactions by computer docking. The capabilities and limitations of the method will be investigated.

TECHNIQUES AVAILABLE IN THE LAB

Computational molecular modeling, statistical methods of quantitative structure-activity relationships, programming in C, shell scripting.

SELECTED PUBLICATIONS

Zsidó, B.Z., Börzsei, R., Pintér, E., **Hetényi, C.** (2021) Prerequisite Binding Modes Determine the Dynamics of Action of Covalent Agonists of Ion Channel TRPA1. **Pharmaceuticals 14:** 988

Zsidó, B.Z., **Hetényi, C.** (2021) The role of water in ligand binding. **Curr Opin Struct Biol 67:** 1-8

Zsidó, B.Z., Börzsei, R., Szél, V., **Hetényi, C.** (2021) Determination of Ligand Binding Modes in Hydrated Viral Ion Channels to Foster Drug Design and Repositioning. **J Chem Inf Model 61:** 4011-4022

Zsidó, B.Z., **Hetényi, C.** (2020) Molecular Structure, Binding Affinity, and Biological Activity in the Epigenome. **Int J Mol Sci 21:** 4134

Horváth, I., Jeszenői, N., Bálint, M., Paragi, G, **Hetényi, C.** (2019) A fragmenting protocol with explicit hydration for calculation of binding enthalpies of targetligand complexes at a quantum mechanical level. **Int J Mol Sci 20:** 4384

FERENC JAKAB

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RESEARCH AREA

Description and molecular characterisation of new viral pathogens. Emerging infectious diseases pose an extremely serious and complex challenge to humanity, but especially to the globalised world order and economy. Over the past decades, several epidemics have emerged in human populations, many of them mediated by wild animals. Two thirds of the pathogens thus emerged originate from wild animals. A striking example is the current pandemic SARS-2 coronavirus, which originates from an as yet unknown animal, but evolutionarily from bats. If we know of naturally occurring viruses with similar potential, we can use their detailed natural history to take clear and effective preventive action to avert, or at least reduce, the likelihood of their emergence in human populations. We aim at the identification of such pathogens and the development of innovative capacities for their rapid, modern and efficient testing. New viruses detected or discovered from the animal populations studied, in addition to further investigation of natural processes, transmission properties and innovative detection capacity development, may also be directly useful in other basic research lines (e.g. drug development). The National Laboratory of Virology has decades of experience in the sampling and complex virological analysis of naturally occurring zoonotic viruses.

TECHNIQUES AVAILABLE IN THE LAB

A diverse set of molecular virology techniques can be mastered within the National Laboratory of Virology. The Laboratory has well-equipped BSL-2 and BSL-4 facilities. Different PCR assays, for instance, droplet-digital PCR, real-time PCR, nested PCR and traditional PCR are routinely used in the laboratory. Top-notch next-generation sequencing (Nanopore sequencing) and data analysis also take place in the laboratory. Maintaining and working with different cell lines in sterile conditions are also a necessity for the different projects within the laboratory. Working in the BSL-4 laboratory requires training that is organised by the head of the National Laboratory of Virology.

SELECTED PUBLICATIONS

Bajusz, D., Wade, WS., Satała, G., Bojarski, AJ., Ilaš, J., Ebner, J., Grebien, F., Papp, H., **Jakab, F.**, Douangamath, A., Fearon, D., von Delft, F., Schuller, M., Ahel, I., Wakefield, A., Vajda, S., Gerencsér, J., Pallai, P., Keserű, GM. (2021) Exploring protein hotspots by optimized fragment pharmacophores. **Nat Commun 12:** 3201.

Földes, F., Madai, M., Papp, H., Kemenesi, G., Zana, B., Geiger, L., Gombos, K., Somogyi, B., Bock-Marquette, I., **Jakab, F.** (2020) Small Interfering RNAs Are Highly Effective Inhibitors of Crimean-Congo Hemorrhagic Fever Virus Replication In Vitro. **Molecules 25:** 5771.

Zana, B., Erdélyi, K., Nagy, A., Mezei, E., Nagy, O., Takács, M., Bakonyi, T., Forgách, P., Korbacska-Kutasi, O., Fehér, O., Malik, P., Ursu, K., Kertész, P., Kepner, A., Martina, M., Süli, T., Lanszki, Z., Tóth, GE., Kuczmog, A., Somogyi, B., **Jakab, F.**, Kemenesi, G. (2018) Multi-Approach Investigation Regarding the West Nile Virus Situation in Hungary. **Viruses 12:** 123.

Földes, F., Madai, M., Németh, V., Zana, B., Papp, H., Kemenesi, G., Bock-Marquette, I., Horváth, G., Herczeg, R., **Jakab, F.** (2019) Serologic survey of the Crimean-Congo haemorrhagic fever virus infection among wild rodents in Hungary. **Ticks Tick Borne Dis 10:** 101258.

Kemenesi, G., Kurucz, K., Dallos, B., Zana, B., Földes, F., Boldogh, S., Görföl, T., Carroll, MW., **Jakab, F.** (2019) Re-emergence of Lloviu virus in Miniopterus schreibersii bats, Hungary, 2016. **Emerg Microbes Infect 7:** 66.

GÁBOR KEMENESI

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Institute of Biology

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RESEARCH AREA

Research on emerging and re-emerging infectious diseases with high biosafety level (BSL3 and BSL4) as part of the OneHealth concept. Discovery, characterization and complex understanding of new viruses, assessment of their zoonotic ability (ability to jump from animal to human).

TECHNIQUES AVAILABLE IN THE LAB

Molecular biological diagnostic methods, viral genome sequencing, basics of biosafety, in vitro isolation experiments (virus propagation), evolutionary phylogenetic analyzes (origin research).

SELECTED PUBLICATIONS

Kemenesi, G., Tóth, E G., Mayora-Neto, M., Scott, S., Temperton, N., Wright, E., Mühlberger, E., Adam J. Hume, Ellen L. Suder, Zana, B., Boldogh A, S., Görföl, T., Estók, P., Lanszki, Zs., Somogyi, A B., Nagy, Á., Pereszlényi, I Cs., Dudás, Cs., Földes, F., Kurucz, K., Madai, M., Zeghbib, S., Maes, P., Vanmechelen, B., Jakab, F. (2022) Isolation of infectious Lloviu virus from Schreiber's bats in Hungary. **Nat Commun 13:** 1706.

Lanszki, Zs., Tóth E. G., Schütz, É., Zeghbib, S., Rusvai, Zs., Jakab, F., **Kemenesi, G.** (2022) Complete genomic sequencing of canine distemper virus with nanopore technology during an epizootic event. **Sci Rep 12:** 4116.

Hume, J A., Heiden, B., Olejnik, J., Suder, L E., Ross, S., Scoon, A W., Bullitt, E., Ericsson, M., White, R M., Turcinovic, J., Thao, T N T., Hekman, M R., Kaserman, E J., Huang, J., Alysandratos, K D., Toth, E G., Jakab, F., Kotton, N., Wilson, A A., Emili, A., Thiel, V., Connor, H J., **Kemenesei, G.**, Cifuentes, D., Mühlberger, E. (2022) Recombinant Lloviu virus as a tool to study viral replication and host responses **PLoS Pathog.**

Kemenesi, G., Tóth, E G., Bajusz, D., Keserű, M Gy., Terhes, G., Burián, K., Zeghbib, S., Somogyi B A., Jakab, F. (2021) Effect of An 84-bp Deletion of the Receptor-Binding Domain on the ACE2 Binding Affinity of the SARS-CoV-2 Spike Protein: An In Silico Analysis **Genes 12:** 194.

Kemenesi, G., Zeghbib, S., Somogyi A B., Tóth, G E., Bányai, K., Solymosi, N., Szabó, M P., Szabó, I., Bálint, Á., Urbán, P., Herczeg, R., Gyenesei, A., Nagy, Á., Pereszlényi, Cs I., Babinszky, Cs G., Dudás, G., Terhes, G., Zöldi, V., Lovas, R., Tenczer, Sz., Kornya, L., Jakab, F. (2020) Multiple SARS-CoV-2 Introductions Shaped the Early Outbreak in Central Eastern Europe: Comparing Hungarian Data to a Worldwide Sequence Data-Matrix. **Viruses 12:** 1401.

SÁNDOR KUNSÁGI-MÁTÉ

University of Pécs
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RESEARCH AREA

The determinant role of the weak molecular interactions in the transport of bioactive molecules is associated either to their moderated adsorption onto the macromolecule's surface or also to the solubility of bioactive molecules moderated by the formation of inclusion complexes. The latter process offers too the selective and sensitive detection of bioactive molecules. Further the stereo-chemical and structural facts, the weak molecular interactions and the resulted chemical equilibria are also affected by the temperature and the molecular environment. During the last few years we described the effect of the bulk properties of the molecular environment onto the stabilities of the above mentioned inclusion complexes and also the effect of the solvent water structures have been investigated accordingly in our lab. Some cases the antioxidant, scavenging effect has been investigated regarding to the target-specific therapeutic applications. Our overall goal is to perform investigations to determine the effect of the molecular packing in the stability of drugs, to clarify the role of micro-solvation and to describe the related overall mechanisms.

TECHNIQUES AVAILABLE IN THE LAB

Investigation (measurement and data-evaluation) of weak molecular interactions by fluorescence (steady-state, anisotropy, lifetime, anisotropy decay, solvent-relaxation) methods. Protein dynamics by scanning and isotherm calorimetry. Vibrational analysis by Raman-spectroscopy, surface and tip-enhanced Raman spectroscopy. Theoretical molecular modelling by the HyperChem and Gaussian codes using personal and supercomputers.

SELECTED PUBLICATIONS

Preisz, Zs., **Kunsági-Máté, S.** (2021) Effect of methotrexate and its photodegradation products on the temperature induced denaturation of human serum albumin. **Spectrochim Acta A 245:**118898.

Kovács, F., Yan, H., Li, H., **Kunsági-Máté, S.** (2021) Temperature-Induced Change of Water Structure in Aqueous Solutions of Some Kosmotropic and Chaotropic Salts. **Int J Mol Sci 22:** 12896.

Preisz, Zs., Hartvig, N., Bognár, B., Kálai, T., **Kunsági-Máté, S.** (2021) Comparative EPR Study on the Scavenging Effect of Methotrexate with the Isomers of Its Photoswitchable Derivative. **Pharmaceuticals 14:** 665.

Preisz, Zs., Nagymihály, Z., Lemli, B., Kollár, L., **Kunsági-Máté, S.** (2020) Weak interaction of the antimetabolite drug methotrexate with a cavitand derivative. **Int J Mol Sci 21:** 4345.

Kovács, F., **Kunsági-Máté, S.** (2020) Change of liquid water structure under the presence of phosphate anion during changing its kosmotropic character to chaotropic along its deprotonation route. **Chem Phys Lett 756:** 137827.

KRISZTIÁN KVELL

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RESEARCH AREA

Anti-tumour effect of exercise-derived microRNAs: Regular exercise is known to protect against the development of many chronic diseases, including cancer. Our research has mapped the health protective effects of microRNAs at the molecular level. Levels of several micro-RNAs that protect against the development of tumours, including lung tumours, are elevated, based on our own data and literature. These micro-RNAs have a long-term preventive effect, but in the short term they may have an adjuvant oncotherapeutic, i.e. additional anti-tumour effect. Investigation of the toxic effects of the SARS2 viral spike protein: COVID-19 disease, caused by SARS-CoV-2, affects many tissues and organs. Although it has become known as a respiratory disease, it actually attacks the kidneys, heart/circulatory system, digestive system and central nervous system as well. Some articles have raised the toxicity of Spike protein and its degradation products in aqueous solution on cells. Our working hypothesis is that Spike protein and its degradation products released from SARS-CoV-2 viruses during infection of epithelial cells exert toxic effects. We test this working hypothesis in a conventional 2D, conventional 3D cell culture system.

TECHNIQUES AVAILABLE IN THE LAB

- PCR types (conventional PCR, qPCR, digital PCR)
- Gene expression studies (Taqman Array)
- RNA interference, CRISPR
- Transient and stable genetic manipulation

SELECTED PUBLICATIONS

Garai, K., Adam, Z., Herczeg, R., Banfai, K., Gyebrovszki, A., Gyenesei, A., Pongracz, JE., Wilhelm, M., **Kvell, K.** (2021) Physical Activity as a Preventive Lifestyle Intervention Acts Through Specific Exosomal miRNA Species-Evidence From Human Short- and Long-Term Pilot Studies. **Front Physiol 12:** 658218.

Garai, K., Adam, Z., Herczeg, R., Katai, E., Nagy, T., Pal, S., Gyenesei, A., Pongracz, JE., Wilhelm, M., **Kvell K.** (2019) Artificial Neural Network Correlation and Biostatistics Evaluation of Physiological and Molecular Parameters in Healthy Young Individuals Performing Regular Exercise. **Front Physiol 10:** 1242.

Banfai, K., Ernszt, D., Pap, A., Bai, P., Garai, K., Belharazem, D., Pongracz, JE., **Kvell, K.** (2019) „Beige" Cross Talk Between the Immune System and Metabolism. **Front Endocrinol (Lausanne) 10:** 369

Banfai, K., Garai, K., Ernszt, D., Pongracz, JE., **Kvell, K.** (2019) Transgenic Exosomes for Thymus Regeneration. **Front Immunol 10:** 862

Ernszt, D., Banfai, K., Kellermayer, Z., Pap, A., Lord, JM., Pongracz, JE., **Kvell, K.** (2017) PPARgamma Deficiency Counteracts Thymic Senescence. **Front Immunol 8:** 1515.

EDINA LEMPEL

University of Pécs
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Department of Dentistry
Oral and Maxillofacial Surgery

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RESEARCH AREA

Physical and biocompatibility investigations of rapid polymerized and pre-heated resin composites. According to the manufacturer's recommendation, the adequate curing of the rapid polymerized resin composites can be achieved in 3 seconds with a suitable curing unit up to 4 mm in layer thickness. However, both the layer thickness and the short exposure time could be a barrier to the proper monomer-polymer conversion. Additionally, internal stress can develop due to shrinkage of the polymerizing material, which can cause gaps at the filling/tooth interface. Insufficient polymerization may result in unreacted monomer release in the oral cavity or may diffuse to the pulp through the tubular dentin. The monomers' toxic effects are well known, although details are still being researched to this day. However, this chemical effect might be supplemented by a thermal effect, arises from both the energy, delivered by the curing unit and from the heat generated during the exothermic polymerization of the resin composite. It may cause further cell damage to pulpal cells if it exceeds the 5.5 °C threshold in the pulp. This thermal effect is even more significant in the cases of pre-heated resin composites, which are preferred because of their good adaptation ability and mechanical properties.

During our investigations, we would test the gap formation caused by the polymerization shrinkage using micro-CT; we would measure the intrapulpal manifestation of the heat generated during the polymerization; and we would examine the effects of physical and chemical stimuli on cells histomorphometric and immunohistochemical changes) on 3D pulpal tissue model.

TECHNIQUES AVAILABLE IN THE LAB

Intrapulpal thermal registration
Micro-CT imaging, reconstruction, evaluation
Histomorphometric and immunhistochemical studies

SELECTED PUBLICATIONS

Lempel, E., Szalma, J. (2022) Effect of spray air settings of speed-increasing contra-angle handpieces on intrapulpal temperatures, drilling times, and coolant spray pattern. **Clin Oral Investig 26:** 523-533.

Kincses, D., Böddi, K., Őri, Zs., Lovász, B. V., Jeges, S., Szalma, J., Kunsági-Máté, S., **Lempel, E.** (2021) Pre-heating effect on monomer elution and degree of conversion of contemporary and thermoviscous bulk-fill resin-based dental composites. **Polymers (Basel) 13:** 3599.

Lempel, E., Őri, Zs., Kincses, D., Lovász, B. V., Kunsági-Máté, S., Szalma, J. (2021) Degree of conversion and in vitro temperature rise of pulp chamber during polymerization of flowable and sculptable conventional, bulk-fill and short-fibre reinforced resin composites. **Dental Mater 7:** 983–997.

Lempel, E., Lovász, B. V., Bihari, E., Krajczár, K., Jeges, S., Tóth, Á., Szalma, J. (2019) Long-term clinical evaluation of direct resin composite restorations in vital vs. endodontically treated posterior teeth – Retrospective study up to 13 years. **Dent Mater 35:** 1308-1318.

Lempel, E., Őri, Zs., Szalma, J., Lovász, B. V., Kiss, A., Tóth, Á., Kunsági-Máté, S. (2019) Effect of exposure time and pre-heating on the conversion degree of conventional, bulk-fill, fiber reinforced and polyacid-modified resin composites. **Dent Mater 35:** 217-228.

Lempel, E., Lovász, B. V., Meszarics, R., Jeges, S., Tóth, Á., Szalma, J. (2017) Direct resin composite restorations for fractured maxillary teeth and diastema closure: A 7 years retrospective evaluation of survival and influencing factors. **Dent Mater 33:** 467-476.

ERIKA PINTÉR

University of Pécs
Medical School
Department of Pharmacology and Pharmacotherapy

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RESEARCH AREA

Scientific interests: neuro-immuno-pharmacology, inflammation The role of capsaicin-sensitive sensory nerve endings in the regulation of microcirculation and neurogenic inflammation. Immunomodulatory effects of neurogenic inflammation. Anti-inflammatory effects of somatostatin and its analogues. Biological effects of hydrogen sulphide.

TECHNIQUES AVAILABLE IN THE LAB

In vivo pain, inflammation, behaviour tests in mice, rats. ELISA, RIA, PCR, RNA probe, immunohistochemistry, histology. Pharmacogenetics. In silico pharmacology, in vivo imaging techniques.

SELECTED PUBLICATIONS

Saghy, E., Sipos, E., Acs, P., Bolcskei, K., Pohoczky, K., Kemeny, A., Sandor, Z., Szoke, E., Setalo Jr. G., Komoly, S., **Pinter, E.** (2016) TRPA1 deficiency is protective in cuprizone-induced demyelination-A new target against oligodendrocyte apoptosis. **Glia 64:** 2166-2180.

Kemény, A., Kodji, X., Horváth, Sz., Komlódi, R., Szőke, E., Sándor, Z., Perkecz, A., Gyömörei, Cs., Sétáló, Gy., Kelemen, B., Biro, T., Toth, B., **Pinter, E.**, Gyulai, R. (2018) TRPA1 acts in a protective manner in imiquimod-induced psoriasiform dermatitis in mice. **J Invest Dermatol 138:** 1774-1784.

Bátai, István Z., Pápainé Sár, C., Horváth, Á., Borbély, É., Bölcskei, K., Kemény, Á., Sándor, Z., Nemes, B., Helyes, Zs., Perkecz, A., Mócsai, A., Pozsgai, G., **Pintér, E.** TRPA1 Ion Channel Determines Beneficial and Detrimental Effects of GYY4137 in Murine Serum-Transfer Arthritis. (2019) **Front Pharmacol 10:** 964.

Kriszta, G., Nemes, B., Sándor, Z., Ács, P., Komoly, S., Berente, Z., Bölcskei, K., **Pintér, E.** (2020) Investigation of Cuprizone-Induced Demyelination in mGFAP-Driven Conditional Transient Receptor Potential Ankyrin 1 (TRPA1) Receptor Knockout Mice. **Cells 9:** 81

Kántás, B., Szőke, É., Börzsei, R., Bánhegyi, P., Asghar, J., Hudhud, L., Steib, A., Hunyady, Á., Horváth, Á., Kecskés, A., Borbély, É., Hetényi, Cs., Petfő, G., **Pintér, E.** (2021) In Silico, In Vitro and In Vivo Pharmacodynamic Characterization of Novel Analgesic Drug Candidate Somatostatin SST4 Receptor Agonists **Front Pharmacol 11:** 601887

MIKLÓS POÓR

University of Pécs
Faculty of Pharmacy
Department of Pharmacology

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RESEARCH AREA

I. Interaction of mycotoxins with biomolecules and with potential mycotoxin binders: Toxicokinetic studies, investigation of combinative effects, and experiments with potential mycotoxin binders (for toxin extraction, decontamination, and/or detoxification purposes). II. Interaction of natural polyphenols and their metabolites with drugs: Certain dietary supplements contain extremely high doses of polyphenols; in this project, the interaction of these polyphenols and their metabolites are examined with important proteins from the pharmacokinetic point of view (e.g., serum albumin, biotransformation enzymes, drug transporters).

TECHNIQUES AVAILABLE IN THE LAB

UV-Vis and fluorescence spectroscopy, HPLC, in vitro enzyme assays, cell experiments, pharmacokinetic/toxicokinetic animal experiments.

SELECTED PUBLICATIONS

Poór, M., Faisal, Z., Zand, A., Bencsik, T., Lemli, B., Kunsági-Máté, S., Szente, L. (2018) Removal of zearalenone and zearalenols from aqueous solutions using insoluble beta-cyclodextrin bead polymer. **Toxins 10:** 216.

Mohos, V., Pánovics, A., Fliszár-Nyúl, E., Schilli, G., Hetényi, C., Mladěnka, P., Needs, P.W., Kroon, P.A., Pethő, G., **Poór, M.** (2019) Inhibitory effects of quercetin and its human and microbial metabolites on xanthine oxidase enzyme. **Int J Mol Sci 20:** 2681.

Faisal, Z., Garai, E., Csepregi, R., Bakos, K., Fliszár-Nyúl, E., Szente, L., Balázs, A., Cserháti, M., Kőszegi, T., Urbányi, B., Csenki, Z., **Poór, M.** (2020) Protective effects of beta-cyclodextrins vs. zearalenone-induced toxicity in HeLa cells and Tg(vtg1:mCherry) zebrafish embryos. **Chemosphere 240:** 124948.

Mohos, V., Fliszár-Nyúl, E., Ungvári, O., Bakos, É., Kuffa, K., Bencsik, T., Zsidó, B.Z., Hetényi, C., Telbisz, Á., Özvegy-Laczka, C., **Poór, M.** (2020) Effects of chrysin and its major conjugated metabolites chrysin-7-sulfate and chrysin-7-glucuronide on cytochrome P450 enzymes, and on OATP, P-gp, BCRP and MRP2 transporters. **Drug Metab and Dispos 48:** 1064-1073.

Fliszár-Nyúl, E., Szabó, Á., Szente, L., **Poór, M.** (2020) Extraction of mycotoxin alternariol from red wine and from tomato juice with beta-cyclodextrin bead polymer. **J Mol Liq 319:** 114180.

Csenki, Z., Garai, E., Faisal, Z., Csepregi, R., Garai, K., Kánainé Sipos D., Szabó, I., Kőszegi, T., Czéh, Á., Czömpöly, T., Kvell, K., **Poór, M.** (2021) The individual and combined effects of ochratoxin A with citrinin and their metabolites (ochratoxin B, ochratoxin C, and dihydrocitrinone) on 2D/3D cell cultures, and zebrafish embryo models. **Food Chem Toxicol 158:** 112674.

DÓRA REGLŐDI

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Medical School
Department of Anatomy

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RESEARCH AREA

Investigating the effects of PACAP. Pituitary adenylate cyclase activating polypeptide (PACAP) is an anti-apoptotic, anti-inflammatory and antioxidant neuropeptide with neuroprotective and general cytoprotective effects that have been demonstrated in a number of experiments. Our group has been working for more than 15 years on mapping the physiological effects of PACAP and its protective role in in vitro and in vivo models of various pathological conditions. In the absence of endogenous PACAP, knockout (KO) mice are highly susceptible to adverse effects. Early signs of ageing are also observed due to increased oxidative stress, inflammation and apoptosis associated with the deficiency state. Our preliminary observations show increased neuronal degeneration in the brains of KO mice. In the absence of PACAP, we have described systemic tissue amyloidosis associated with aging, in addition to retinal degeneration. Our results so far suggest that the absence of PACAP accelerates several degenerative processes and leads to premature ageing. Our human, translational studies investigate PACAP expression/levels in different human tissues and biological fluids and we investigate correlations between pathological conditions and alterations in PACAP levels. These may be important for the future biomarker use of PACAP as a diagnostic and/or prognostic tool. Results can also shed light on biological functions of PACAP in the human body.

TECHNIQUES AVAILABLE IN THE LAB

Histology, immunohistology, ELISA measurements, clinical sampling, data analysis. Animal models: anaesthesia, operations, treatments, sample taking, handling of animals, ethical permissions.

SELECTED PUBLICATIONS

Kiss, P., Banki, E., Gaszner, B., Nagy, D., Helyes, Zs., Pal, E., Reman, Gy., Toth, G., Tamas, A., **Reglodi, D.** (2021) Protective effects of PACAP in a rat model of diabetic neuropathy. **Int J Mol Sci 22:** 10691

Toth, D., Tamas, A., **Reglodi, D.** (2020) The neuroprotective and biomarker potential of PACAP in human traumatic brain injury. **Int J Mol Sci 21:** 827

Toth, D., Szabo, E., Tamas, A., Juhasz, T., Horvath, G., Fabian, E., Opper, B., Szabo, D., Maugeri, G., D'Amico, AG., D'Agata, V., Vicena, V., **Reglodi, D.** (2020) Protective effects of PACAP in peripheral organs. **Front Endocrinol 11:** 377

Reglodi, D., Jungling, A., Longuespée, R., Kriegsmann, J., Casadonte, R., Kriegsmann, M., Juhasz, T., Bardosi, A., Tamas, A., Fulop, BD., Kovacs, K., Nagy, Zs., Sparks, J., Miseta, A., Mazzucchelli, G., Hashimoto, H., Bardosi, A. (2018) Accelerated pre-senile systemic amyloidosis in PACAP knockout mice – a protective role of PACAP in age-related degenerative processes. **J Pathol 245:** 478-490

Reglodi, D., Atlasz, T., Szabo, E., Jungling, A., Tamas, A., Juhasz, T., Fulop, BD., Bardosi, A. (2018) PACAP deficiency as a model of aging. **Geroscience 40:** 437-452

ÉVA SZŐKE

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Department of Pharmacology and Pharmacotherapy

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RESEARCH AREA

Pain sensation is mediated by the nocisensor Transient Receptor Potential ion channels such as the Vanilloid 1 (TRPV1) and the TRP ankyrin 1 (TRPA1). Previous discoveries on TRP channels described important structural and functional properties of these proteins, but very little is known about the function, importance and modulation opportunities of the lipid rafts surrounding them in the plasma membrane. We recently discovered that lipid raft disruption by depletion of various constituents, by methyl β-cyclodextrin (MCD), sphingomyelinase (SMase), myriocin and our carboxi-steroid compound reduced TRP activation on sensory neurons and transfected cells. We examine the potential analgesic effect of MCD, SMase, myriocin or our carboxi-steroid compound in topical dermatological formulation in in vivo mouse models. The lipid raft disruptor myriocin had an antitumor activity in a murine melanoma model. We examine the potential dual effect (antitumor and analgesic activity) of myriocin in our mouse osteosarcoma model.

TECHNIQUES AVAILABLE IN THE LAB

Methods and models: in vitro neuronal culture preparation, fluorescent intracellular calcium imaging, radioactive calcium-uptake experiment, fluorescence spectroscopy, cell viability assay complex in vivo nociception experiments: capsaicin-induced chemonociception; resiniferatoxin-evoked neurogenic inflammation, thermal and mechanical hyperalgesia; acute nocifensive behaviour model; bone cancer pain model; investigation of mechanonociception, thermonociception, spontaneous pain and in vivo imaging by micro-CT.

SELECTED PUBLICATIONS

Szőke É, Börzsei R, Tóth DM, Lengl O, Helyes Z, Sándor Z, Szolcsányi J (2010) Effect of lipid raft disruption on TRPV1 receptor activation of trigeminal sensory neurons and transfected cell line. **Eur J Pharmacol 628:** 67-74.

Sághy É, **Szőke É**, Payrits M, Helyes Zs, Börzsei R, Erostyák J, Jánosi TZ, Sétáló Gy Jr, Szolcsányi J (2015) Evidence for the role of lipid rafts and sphingomyelin in Ca2+-gating of Transient Receptor Potential channels in trigeminal sensory neurons and peripheral nerve terminals, **Pharmacol Res 100:** 101-116.

Payrits M, Horváth Á, Biró-Sütő T, Erostyák J, Makkai G, Sághy É, Pohóczky K, Kecskés A, Kecskés M, Szolcsányi J, Helyes Z, **Szőke É.** (2020) Resolvin D1 and D2 Inhibit Transient Receptor Potential Vanilloid 1 and Ankyrin 1 Ion Channel Activation on Sensory Neurons via Lipid Raft Modification. **Int J Mol Sci 21:** 5019.

Horváth Á, Biró-Sütő T, Kántás B, Payrits M, Skoda-Földes R, Szánti-Pintér E, Helyes Z, **Szőke É** (2020) Antinociceptive Effects of Lipid Raft Disruptors, a Novel Carboxamido-Steroid and Methyl β-Cyclodextrin, in Mice by Inhibiting Transient Receptor Potential Vanilloid 1 and Ankyrin 1 Channel Activation. **Front Physiol 11:** 559109.

Horváth Á, Payrits M, Steib A, Kántás B, Biró-Sütő T, Erostyák J, Makkai G, Sághy É, Helyes Z, **Szőke É.** (2021) Analgesic effects of lipid raft disruption by sphingomyelinase and myriocin via Transient Receptor Potential Vanilloid 1 and Transient Receptor Potential Ankyrin 1 ion channel modulation. **Front Pharmacol 11:** 593319.

DÓRA TÍMEA ZELENA

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RESEARCH AREA

Effect of the lipid component of mRNA vaccines on the menstrual cycle. Observations from women and clinicians alike suggest that during the COVID-19 pandemic, the incidence of menstrual cycle problems increased, especially after vaccination with the new mRNA vaccines. However, it remains to be seen whether there is indeed a link between COVID-19 mRNA vaccination and menstrual disorders and, if so, whether the effect of the vaccine on the menstrual cycle is short- or long-term. We plan to investigate this question using three approaches. Our human questionnaire study, which is collecting data on menstrual problems following mRNA vaccination among women aged 18 to 65 years at the time of the pandemic, is already underway. In our in vivo experiments, we would like to observe whether the estrus cycle or fertility of female mice is altered by mRNA vaccination or treatment with lipid droplets. Finally, we want to test in vitro whether lipid droplets modify the function of normal human endometrial cells.

TECHNIQUES AVAILABLE IN THE LAB

Animal examionations, small animal operations (ovariectomy, stereotaxic surgrey etc.), behavioural examinatiopns (elevated plus maze, forced swim test, Morris Watermaze, conditioned fear test etc.), opto- and pharmacogenetic, fibre photometry, human and animal tissue collection, processing, other molecular biological methods (PCR, Western blot, RNAscope), cell culture, superresolution microscopy.

SELECTED PUBLICATIONS

Fazekas, CL., Bellardie, M., Török, B., Sipos, E., Tóth, B., Baranyi, M., Sperlágh, B., Dobos-Kovács, M., Chaillou, E., **Zelena, D**. (2021) Pharmacogenetic excitation of the median raphe region affects social and depressive-like behavior and core body temperature in male mice. **Life Sci 286:** 120037.

Török, B., Fazekas, CL., Szabó, A., **Zelena, D.** (2021) Epigenetic Modulation of Vasopressin Expression in Health and Disease. **Int J Mol Sci 22:** 9415.

Chaves, T., Fazekas, CL., Horváth, K., Correia, P., Szabó, A., Török, B., Bánrévi, K., **Zelena, D.** (2021) Stress Adaptation and the Brainstem with Focus on Corticotropin-Releasing Hormone. **Int J Mol Sci 22:** 9090.

Szőnyi A, Zichó K, Barth AM, Gönczi RT, Schlingloff D, Török B, Sipos E, Major A, Bardóczi Z, Sos KE, Gulyás AI, Varga V, **Zelena D.**, Freund TF, Nyiri G. (2019) Median raphe controls acquisition of negative experience in the mouse. **Science 366:** 8746.

Hevesi, Z., **Zelena, D.**, Romanov, RA., Hanics, J., Ignácz, A., Zambon, A., Pollak, DD., Lendvai, D., Schlett, K., Palkovits, M., Harkany, T., Hökfelt, TGM., Alpár, A. (2021) Secretagogin marks amygdaloid PKCδ interneurons and modulates NMDA receptor availability. **PNAS 118:** e1921123118.

SZENT-GYÖRGYI JUNIOR MENTORS PÉCS

ZSOLT KRSITÓF BALI

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Translational Neuroscience Research Group

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RESEARCH AREA

Investigating the neurocognitive underpinnings of ageing and neurocognitive impairment in rodents: identification of preclinical drug development strategies and development of combined cognitive enhancer therapies. The main objective of the project is to understand and model the processes underlying brain ageing and neurocognitive disorders (dementias) in rodents and to study cellular and behavioural processes in a coordinated manner in the same model. The research is carried out in two locations: our cellular biology (electrophysiology) laboratory is located at the Faculty of Natural Sciences (Faculty of Science) and our small animal behavioural pharmacology laboratory is located at the Szentágothai Research Centre (SZKK). Our preclinical animal models include e.g. pharmacologically induced amnesia, natural ageing, repetitive mild traumatic brain injury and genetic (DREADD) models. Behavioural changes are investigated in state-of-the-art test packeges. Our results are further utilized in both basic and applied drug discovery research. Our main long-term goal is to unravel the as yet unknown mechanisms underlying neurocognitive diseases and to identify biomarkers that may later play a crucial role in the diagnosis and treatment of cognitive disorders and in the development of new drug candidates.

TECHNIQUES AVAILABLE IN THE LAB

Szentagothai Research Centre: rodent behaviour laboratory and core facility: Behavioural pharmacology studies in rodents: neurological tests, open field test, elevated zero maze test, spatial memory tasks (T-maze test, Morris Water Maze), operant behavioural tests (e.g., psychomotor vigilance tasks), systemic application of pharmacological compounds, drug development in rodent models of psychiatric and neurocognitive disorders.

SELECTED PUBLICATIONS

Bruszt, N., **Bali, ZK.** Tadepalli, SA., Nagy, LV., Hernádi, I. (2021) Potentiation of cognitive enhancer effects of Alzheimer's disease medication memantine by alpha7 nicotinic acetylcholine receptor agonist PHA-543613 in the Morris water maze task. **Psychopharmacology 238:** 3273-3281

Nagy, LV., **Bali, ZK.**, Kapus, G., Pelsőczi, P., Farkas, B., Lendvai, B., Lévay, G., Hernádi, I. (2021) Converging evidence on D-amino acid oxidase-dependent enhancement of hippocampal firing activity and passive avoidance learning in rats. **Int J Neuropsychopharmacol 24(5):** 434-445

Tadepalli, SA., **Bali, ZK.**, Bruszt, N., Nagy, LV., Amrein, K., Fazekas, B., Büki, A., Czeiter, E., Hernádi, I. (2020) Long-term cognitive impairment without diffuse axonal injury following repetitive mild traumatic brain injury in rats. **Behav Brain Res 378:** 112268

Bali, ZK., Bruszt, N., Tadepalli, SA., Csurgyók, R., Nagy, LV., Tompa, M., Hernádi I. (2019) Cognitive enhancer effects of low memantine doses are facilitated by an alpha7 nicotinic acetylcholine receptor agonist in scopolamine-induced amnesia in rats. **Front Pharmacol 10:** 73

Bali, ZK., Nagy, LV., Hernádi, I. (2017) Alpha7 nicotinic acetylcholine receptors play a predominant role in the cholinergic potentiation of N-methyl-D-aspartate evoked firing responses of hippocampal CA1 pyramidal cells. **Front Cell Neurosci 11:** 271

KLAUDIA BARABÁS

University of Pécs
Medical School
Institute of Physiology

Address: Szigeti út 12., H-7624 Pécs, Hungary

RESEARCH AREA

Observations from both women and clinicians suggest that during the COVID-19 pandemic there was an increased incidence of menstrual cycle problems, especially after vaccination with the new mRNA technology vaccines. However, it remains to be seen whether there is indeed a link between COVID-19 mRNA vaccination and menstrual disorders and, if so, whether the effect of the vaccine on the menstrual cycle is short- or long-term. We plan to investigate this question using three approaches. Our human questionnaire study, which is collecting data on menstrual problems following mRNA vaccination among women aged 18 to 65 years at the time of the pandemic, is already underway. In our in vivo experiments, we would like to observe whether the estrus cycle or fertility of female mice is altered by mRNA vaccination or treatment with lipid droplets. Finally, we want to test in vitro whether lipid droplets modify the function of normal human endometrial cells.

TECHNIQUES AVAILABLE IN THE LAB

Immunocytochemistry, immunohistochemistry, cell culture, Western blot, confocal, TIRF, STORM, STED microscopy, surgical techniques, molecular biology techniques.

SELECTED PUBLICATIONS

Barabás, K., Kobolák, J., Godó, S., Kovács, T., Ernszt, D., Kecskés, M., Varga, Cs., Jánosi, TZ., Fujiwara, T., Kusumi, A., Téglási, A., Dinnyés, A., Ábrahám, IM. (2021) Live-Cell Imaging of Single Neurotrophin Receptor Molecules on Human Neurons in Alzheimer's Disease. **Int J Mol Sci 22:** 529.

Godó, S., **Barabás, K.**, Lengyel, F., Ernszt, D., Kovács, T., Kecskés, M., Varga, Cs., Jánosi, TZ., Makkai, G., Kovács, G., Orsolits, B., Fujiwara, T., Kusumi, A., Ábrahám, IM. (2021) Single-Molecule Imaging Reveals Rapid Estradiol Action on the Surface Movement of AMPA Receptors in Live Neurons. **Front Cell Dev Biol 9:** 708715.

Barabás, K., Edina, Szabó-Meleg., Ábrahám, IM. (2020) Effect of Inflammation on Female Gonadotropin-Releasing Hormone (GnRH) Neurons: Mechanisms and Consequences. **Int J Mol Sci 21:** 529.

Barabás, K., Barad, Zs., Dénes, Á., Bhattarai, JP., Han, SK., Kiss, E., Sármay, G., Ábrahám, IM. (2018) The Role of Interleukin-10 in Mediating the Effect of Immune Challenge on Mouse Gonadotropin-Releasing Hormone Neurons In Vivo. **ENEURO 5:** 0211-18.

Barabás, K., Godó, S., Lengyel, F., Ernszt, D., Pál, J., Ábrahám, IM. (2018) Rapid non-classical effects of steroids on the membrane receptor dynamics and downstream signaling in neurons. **Horm Behav:** 30090-4.

ANDREA TAMÁS

University of Pécs
Medical School
Department of Anatomy

Address: Szigeti út 12., H-7624 Pécs, Hungary

RESEARCH AREA

Examination of the effects of PACAP. Pituitary adenylate cyclase activating polypeptide (PACAP) is an anti-apoptotic, anti-inflammatory and antioxidant neuropeptide with neuroprotective and general cytoprotective effects demonstrated in numerous experiments. Our group has been working for more than 20 years on mapping the physiological effects of PACAP and its protective role using in vitro and in vivo models of various pathological conditions. In the absence of endogenous PACAP, PACAP-deficient (KO) mice are highly susceptible to harmful effects. Early signs of ageing are also observed in KO mice due to increased oxidative stress, inflammation and apoptosis. Our preliminary observations show increased neuronal degeneration in the brains of KO mice. In the absence of PACAP, we have described systemic tissue amyloidosis associated with aging, in addition to retinal degeneration. Our results so far suggest that the absence of PACAP accelerates several degenerative processes and leads to premature ageing. Our human, translational studies examine the changes of PACAP expression in different human tissues and biological fluids and we investigate correlations between pathological conditions and alterations in PACAP levels. These may be important for the future biomarker use of PACAP as a diagnostic and/or prognostic tool. Results can also shed light on biological functions of PACAP in the human body.

TECHNIQUES AVAILABLE IN THE LAB

Histology, immunohistology, ELISA measurements, clinical sampling, data analysis. Animal models: anaesthesia, operations, treatments, sample taking, handling of animals, ethical permissions.

SELECTED PUBLICATIONS

Szabo, D., Sarszegi, Zs., Polgar, B., Saghy, E., Reglodi, D., Toth, T., Onodi, Zs., Leszek, P., Varga, Z.V., Helyes, Zs., Kemeny, A., Ferdinandy, P., **Tamas, A.** (2022) PACAP-38 and PAC1 Receptor Alterations in Plasma and Cardiac Tissue Samples of Heart Failure Patients. **Int J Mol Sci 23:** 3715

Pham, D., Polgar, B., Toth, T., Jungling, A., Kovacs, N., Balas, I., Pal, E., Szabo, D., Fulop, B.D., Reglodi, D., Szanto, Z., Herczeg, R., Gyenesei, A., **Tamas, A.** (2022) Examination of pituitary adenylate cyclase-activating polypeptide in Parkinson's disease focusing on correlations with motor symptoms. **Geroscience 44:** 785-803.

Jungling, A., Reglodi, D., Maasz, G., Zrinyi, Z., Schmidt, J., Rivnyak, A., Horvath, G., Pirger, Zs., **Tamas, A.** (2021) Alterations of Nigral Dopamine Levels in Parkinson's Disease after Environmental Enrichment and PACAP Treatment in Aging Rats. **Life 11:** 35

Szabo, D., Sarszegi, Zs., Polgar, B., Saghy, E., Nemeth, A., Reglodi, D., Makkos, A., Gorbe, A., Helyes, Zs., Ferdinandy, P., Herczeg, R., Gyenesei, A., Cziraki, A, **Tamas, A.** (2021) PACAP-38 in Acute ST-Segment Elevation Myocardial Infarction in Humans and Pigs: A Translational Study. **Int J Mol Sci 22:** 2883

Fulop, DB., Humli, V., Szepesy, J., Ott, V., Reglodi, D., Gaszner, B., Nemeth, A., Szirmai, A., Tamas, L., Hashimoto, H., Zelles, T., **Tamas, A.** (2019) Hearing impairment and associated morphological changes in pituitary adenylate cyclase activating polypeptide (PACAP)-deficient mice. **Sci Rep 9:** 14598.

ALEXANDRA VÁCZY

University of Pécs
Medical School
Department of Anatomy

Address: Szigeti út 12., H-7624 Pécs, Hungary

RESEARCH AREA

Retinal diseases are among the leading causes of blindness. Therefore, any experimental approach that leads to a better understanding of the molecular background of these diseases, as well as the testing of groups of molecules that can reduce or potentially prevent damage, is a priority research activity. Our research focuses on the study of two posterior segment diseases of the eye (glaucoma and diabetic retinopathy) which are leading causes in the development of blindness. Our goal is to develop a new effective treatment strategy for the previously mentioned ophthalmic diseases by using different neuroprotective pharmacons, with each having distinct target points that reduce the development of the disease.

TECHNIQUES AVAILABLE IN THE LAB

In our ophthalmic research, we use state-of-the-art technology in rodents in vivo, such as optical coherence tomography (OCT). OCT is suitable for comprehensive examination of the posterior and anterior segments of the eye. It also allows us to measure intraocular pressure, examine the fundus with funduscopy, and analyze vision via the electroretinographic method. Additionally, our laboratory routinely uses histological, immunohistochemical, and molecular biological methods (western blot, ELISA, apoptosis, and cytokine array kit).

SELECTED PUBLICATIONS

Patko, E., Szabo, E., Toth, D., Tornoczky, T., Bosnyak, I., **Vaczy A.**, Atlasz, T., Reglodi, D. (2022) Distribution of PACAP and PAC1 Receptor in the Human Eye, **J Mol Neurosci**

Kvarik, T., Reglodi, D., Werling, D., **Vaczy, A.**, Kovari, P., Szabo, E., Kovacs, K., Hashimoto, H., Ertl, T., Gyarmati, J., Atlasz, T. (2021) The Protective Effects of Endogenous PACAP in Oxygen-Induced Retinopathy, **J Mol Neurosci 71:** 2546–2557.

Szabó, E., Patkó, E., **Váczy, A.**, Molitor, D., Csutak, A., Tóth, G., Reglődi, D., Atlasz, T. (2021) Retinoprotective Effects of PACAP Eye Drops in Microbead-Induced Glaucoma Model in Rats, **Int J Mol Sci 22:** 16.

Kovacs, K., **Vaczy, A.**, Fekete, K., Kovari, P., Atlasz, T., Reglodi, D., Gabriel, R., Gallyas, F., Sumegi, B. (2019) PARP Inhibitor Protects Against Chronic Hypoxia/Reoxygenation-Induced Retinal Injury by Regulation of MAPKs, HIF1α, Nrf2, and NFκB. **IOVS 60:** 1478–1490.

Vaczy, A., Kovari, P., Kovacs, K., Farkas, K., Szabo, E., Kvarik, T., Kocsis, B., Fulop, B., Atlasz, T., Reglodi, D. (2018) Protective role of endogenous PACAP in inflammation-induced retinal degeneration. **Curr Pharm Des 24:** 3534–3542.

Vaczy, A., Reglodi, D., Somoskeoy, T., Kovacs, K., Lokos, E., Szabo, E., Tamas, A., Atlasz, T. (2016) The Protective Role of PAC1-Receptor Agonist Maxadilan in BCCAO-Induced Retinal Degeneration. **J Mol Neurosci 60:** 186–194.

SZENT-GYÖRGYI STUDENTS
PÉCS

ANGELIKA BODÓ

National Academy of Scientist Education, 1st year

University of Pécs,
Medical School, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

István Hernádi

JUNIOR MENTOR:

Zsolt Kristóf Bali

SPECIALIZATION:

neurobiology

SECONDARY SCHOOL:

Türr István High School and College

NAME OF TEACHER:

Gábor Fekete,
Csilla Bostai

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Examination of ageing and neurocognitive disorders in rodents: identification of preclinical drug development strategies and development of combined performance-enhancing therapies. In neuroscience recently, pharmacological studies are increasingly being replaced by so-called chemogenetic methods, which have the advantage of allowing selective, spatially and temporally defined manipulation of the brain area of interest. In our experiments, we aim to develop such a translational model in rodents and non-human primates using DREADD (Drug Receptors Excusively Activated by Designer Drugs) technology that reliably represents congitive impairment related to certain human pathologies, thus providing a significant role both in basic research and in the preclinical investigation of new drug candidates that enhance cognitive performance.

AMBITIONS AND CAREER GOALS

My goal is to develop, through continuous learning and experience, the knowledge base that I will later use to help advance medicine. This is why I would like to pursue a career in research after my medical degree, as I am driven by curiosity and a desire to learn, and I believe that future doctors will need to use innovative diagnostic and therapeutic methods to help their patients. I am particularly keen to promote efforts to treat the now incurable but increasingly problematic neurodegenerative diseases of the soul, such as Alzheimer's, which are a growing problem in our ageing society, and I hope that one day I will find a way to restore the hope of a long, happy and quality life for those affected.

HONORS AND PRIZES

2020 - University of Pécs, Medical School, Romhányi Görgy College membership
2020 - Türr István Secondary School, Cum Laude Medal
2019 - National Secondary School Study Competition, Biology I. category: 1st place
2016, 2017, 2018 - Dr. Árokszállásy Zoltán Biology Competition: 4th place in category I, 2nd place in category II
2018 - 3rd Semmelweis Health Competition: national final
2017 - participation in the Association of Hungarian Talent Support Organisations tutor programme

PUBLICATIONS

–

LAJOS KARAKAI

National Academy of Scientist Education, 1st year

University of Pécs,
Medical School, 1st year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Éva Szőke

JUNIOR MENTOR:

-

SPECIALIZATION:

neuropharmacology

SECONDARY SCHOOL:

Budapest-Fasori Lutheran High School

NAME OF TEACHER:

János Bátovszky

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Investigation of modification of lipid rafts for analgesic and antitumor effects. We investigate the functional relationship between Transient Receptor Potential (TRP) ion channels and lipid rafts in different mouse models of acute pain and in a complex mouse osteosarcoma tumor model. Lipid rafts are specific microdomain of the cell membrane that can be disrupt through their cholesterol or sphingolipid content, thereby affecting the function of different receptors. In the acute pain model we investigate the effect of lipid raft disruption on the TRP Melastatin 3 (TRPM3) and TRP Melastatin 8 (TRPM8) ion channel , and in the chronic tumor pain model on the TRP Vanilloid 1 (TRPV1) and TRP Ankyrin 1 (TRPA1) ion channel activity, respectively.

AMBITIONS AND CAREER GOALS

Self-development in many areas of life is a close goal of mine. Of these, with a particular focus on science, where I can delve deeper into the background and learn new and exciting methods. My long-term goals are still vague, but I can see that whatever I do, I will dive into it with great enthusiasm.

HONORS AND PRIZES

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PUBLICATIONS

–

LILI MARGARET SCHWIETERS

National Academy of Scientist Education, 1st year

University of Pécs,
Medical School, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Dóra Reglődi

JUNIOR MENTOR:

Andrea Tamás

SPECIALIZATION:

neurosciences,
neuroendocrinology

SECONDARY SCHOOL:

Városmajori High School

NAME OF TEACHER:

András Vizkievicz

LANGUAGES:

English/advanced
Italian/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

My research area is determining potential changes in PACAP polypeptide concentration levels in different bodily fluids of patients going through pathological pregnancies, such as preeclampsia or diabetes. The importance of these changes could lie in the possibility of using these changes – among other factors – during prognosis, diagnosis or treatment of these pathologies. Given that PACAP possesses general anti-apoptotic, anti-inflammatory and anti-oxidant properties, both the decrease and increase could indicate a deviation from the desired scenario. The aforementioned importance of visualizing the concentration this polypeptide - both in physiological and pathological situations - can also be regarded as our primary goal during this research. The conclusions drawn from examining the concentration levels of PACAP will guide us to the further steps, presumably regarding potential uses of this polypeptide.

AMBITIONS AND CAREER GOALS

My goal is to bridge the gap between research and practice, by providing essential information to clinicians regarding a topic, which I find exhilarating. Diving into a problem and understanding the mechanism lying behind the visible phenomenon allows me to take the liberty of thinking about possible solutions for the problem, with which I could contribute to the patients' options for treatment in given disorders. On the other hand, hearing out the concerns and opinions of clinicians is a crucial point in developing a powerful method for the future. Due to my flexibility, communication skills and willpower, I am convinced my ability to interconnect my research area with clinicians' everyday lives will be immensely beneficial for both communities. In part, I have already been working toward the realization of this goal, since the role I took on in my current research project is to connect the Obstetrics- and Gynecology Clinic with the Anatomy Department by organizing and carrying out the sample-taking procedures.

HONORS AND PRIZES

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PUBLICATIONS

–

ENIKŐ TARI

National Academy of Scientist Education, 1st year

University of Pécs,
Faculty of Sciences, Biology, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Tamás Atlasz

JUNIOR MENTOR:

Alexandra Váczy

SPECIALIZATION:

ophthalmology

SECONDARY SCHOOL:

Nagy Lajos High School and College of the Cistercian Order

NAME OF TEACHER:

Zsolt Nyisztor,
Eszter Dénes,
Éva Csikyné Radnai

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

It is estimated that the number of people blind from glaucoma in 2020 globally is 11.1 million, which makes it the second most common cause of blindness worldwide. Glaucoma is a group of optic disorders with the common attribute that they lead to the apoptosis of retinal ganglion cells. This disease develops because of the blockage of the aqueous humor drainage system leading to intraocular hypertension. Glaucoma has several subtypes, but the most common one is primary open-angle glaucoma. Pituitary adenylate cyclase activating polypeptide (PACAP) belongs to the vasoactive intestinal peptide (VIP)/glucagon/growth hormone releasing factor/secretin superfamily. It has two active forms PACAP1-27 and PACAP1-38 and both of them are naturally found in the retina. PACAP exerts its effects through three different G-protein coupled receptors: VPAC1, VPAC2 and PAC1. While VPAC1 and VPAC2 receptors show similar affinity for VIP and PACAP, PAC1 is a specific receptor to PACAP. PACAP can be easily hydrolyzed by dipeptidyl-peptidase IV (DPP IV). The cyclopeptide synthesized from the cyclization of PACAP1–5 has been revealed as an activator of PAC1 and DDP IV hydrolyzation is more difficult due to the cyclization. Therefore, cyclized PACAP1-5 can be potentially suitable for the study of PAC1 receptor signaling as a potential pharmacon candidate in the field of ophthalmic diseases.

AMBITIONS AND CAREER GOALS

The use of PACAP1-5 and other PACAP analogs may provide an opportunity to specifically investigate signalling pathways of PAC1 receptor. Our aim is to better understand the mechanism of PACAP and the PAC1 receptor which it may form the basis of a future therapeutic option in common retinal diseases such as glaucoma. In addition, treatment as eye drops is an easy-to-use, non-invasive method and may be suitable for clinical use.

HONORS AND PRIZES

–

PUBLICATIONS

–

KATA VÁRADI

National Academy of Scientist Education, 1st year

University of Pécs,
Medical School, 1st year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Dóra Tímea Zelena

JUNIOR MENTOR:

Klaudia Barabás

SPECIALIZATION:

neuroscience,
neuroendocrinology

SECONDARY SCHOOL:

Illyés Gyula High School, Vocational High School and Technical School, Budaörs

NAME OF TEACHER:

Ágota Gruberné Szilágyi

LANGUAGES:

English/advanced
French/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Observations from women and clinicians alike suggest that during the COVID-19 pandemic, the incidence of menstrual cycle problems increased, especially after vaccination with the new mRNA vaccines. One of the aims of my research is to get a clearer picture of the scientific answers: is there really a link between COVID-19 mRNA vaccination and menstrual disorders? If so, is the effect of the vaccine on the menstrual cycle short - or long term? Is there a change in the estrogen receptor composition of the cells of the female reproductive organs?

AMBITIONS AND CAREER GOALS

„The science of today is the magic of yesterday, and the magic of today can easily be the science of tomorrow". And with the right skills, knowledge and tools, yesterday's discovery can become tomorrow's discovery. My goal as a research physician is to get a closer look at the workings of man as an extremely complex - and incredibly precise - biological system. I believe that by unravelling the precise molecular mechanisms of the ‚human machine', I can contribute to the advancement of medicine and to a better understanding of our fellow human beings. I would like to make discoveries that can be passed on to future generations in the form of general knowledge, and from which they can generate insights themselves.

HONORS AND PRIZES

2022 - Honorary Award, Budaörsi Illyés Gyula High School
2021 - Innovation Award, Budaörsi Illyés Gyula High School

PUBLICATIONS

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"Discovery is seeing what everybody else has seen, and thinking what nobody else has thought."

Albert Szent-Györgyi

SZEGED

MÁRIA DELI

SCIENTIFIC SUPERVISOR OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION
(BIOLOGICAL RESEARCH CENTRE SZEGED)

Biological Research Centre
Institute of Biophysics
Biological Barriers Research Group

Address: Temesvári krt. 62., H-6726 Szeged, Hungary

Maria A. Deli is the head of the Biological Barriers Research Group in the Institute of Biophysics of the Biological Research Centre Szeged.

Her research interests include culture models of the blood-brain barrier and epithelial barriers; barrier models in microfluidic devices; organ-on-chip models; protection of biological barriers in diseases; effect of natural products on biological barriers; drug delivery with targeted nanoparticles; cell interactions with new nanomaterials; role of glycocalyx in barrier functions.

TAMÁS MARTINEK

SCIENTIFIC SUPERVISOR OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION (UNIVERSITY OF SZEGED)

University of Szeged
Albert Szent-Györgyi Medical School
Department of Medical Chemistry

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Tamás Martinek is the professor and head of the Department of Medical Chemistry at the Albert Szent-Györgyi Medical School of the University of Szeged.

He is active in the field biomimetic self-organizing systems and their applications in drug discovery. His research focuses on antimicrobial foldamers, modulation of protein-protein interactions, and the development of peptides inducing cell penetration.

LINDA BORKÚTI

Training Assistant
of the National Academy of Scientist Education
(University of Szeged - Biological Research Centre Szeged)

E-mail: szte@edu-sci.org

SZENT-GYÖRGYI MENTORS SZEGED

RITA AMBRUS

University of Szeged
Faculty of Pharmacy
Institute of Pharmaceutical Technology and Regulatory Affairs

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RESEARCH AREA

Modern pharmaceutical technology is focused on formulations that are targeted to the exact site at the appropriate time, with maximum efficiency and with reduced side-effects. Nanoparticle engineering has been developed and reported for pharmaceutical applications. In this approach, poorly water-soluble compounds are formulated as nanometer-sized (< 1000 nm) drug particles. Nanoparticulate technology offers increased bioavailability, improved absorption, and the potential for drug targeting. The main question of our work how we can use and apply the prepared nanosized systems (as predispersions) in drug formulation (to reach local or systemic effect) to get effective therapies in different diseases. Therefore we should find cost-effective production by new technological processes containing the most important technological and material parameters. The aim is to reach a local and systemic effect with alternative, mainly pulmonary / nasal drug administration. There is a great need for the development of pulmonary and nasal generic formulations, as the protection of currently marketed formulations is about to expire. From a therapeutic point of view, the treatment of local asthma and Chronic Obstuctive Pulmonary Disease (COPD) / remains the main indications for inhalation therapy. However, inhalation formulations for the treatment of e.g. diabetes or schizophrenia are already available as to have systemic treatment. Many new types of nasal products were developed for systemic drug delivery are already on the market. However, the development of nasal delivery systems for the treatment of central nervous system diseases that provide rapid and effective brain pharmacon concentrations for drugs that utilize the nasal route could be a new area of research.

TECHNIQUES AVAILABLE IN THE LAB

We use a wide variety of technological procedures: comilling, high-pressure homogenization, laser fragmentation, high-intensity ultrasound, solvent-antisolvent precipitation, nano-spray-drying, freeze-drying, coating, preparation of nanocapsule and nanofibers. Characterization of micrometric and physicochemical properties (size, morphology), structure (XRPD, FTIR, DSC), compatibility, stability, in vitro, ex vivo, in silico and in vivo properties as investigation methods could be found. According to the Pharmacopoeia drug release and absorption can be studied in intestinal media (gastric juice, intestinal fluid, lung media, and nasal fluids). It can be predicted (Impactor, horizontal cells) e.g. the extent of lung deposition or diffusion through human nasal mucosa.

SELECTED PUBLICATIONS

Party, P., Bartos, Cs., Farkas, Á., Szabó-Révész, P., **Ambrus, R.** (2021) Formulation and In Vitro and In Silico Characterization of "Nano-in-Micro" Dry Powder Inhalers Containing Meloxicam. **Pharmaceutics 13:** 2 Paper: 211.

Gieszinger, P., Stefania, Csaba, N., Garcia-Fuentes, M., Prasanna, M., Gáspár, R., Sztojkov-Ivanov, A., Ducza, E., Márki, Á., Janáky, T., Kecskeméti, G., Katona, G., Szabó-Révész, P., **Ambrus, R.** (2020) Preparation and characterization of lamotrigine containing nanocapsules for nasal administration. **Eur J Pharm Biopharm 153:** pp. 177-186.

Alshweiat, A., Csóka, I., Tömösi, F., Janáky, T., Kovács, A., Gáspár, R., Sztojkov-Ivanov, A., Ducza, E., Márki, Á., Szabó-Révész, P., **Ambrus, R.** (2020) Nasal delivery of nanosuspension-based mucoadhesive formulation with improved bioavailability of loratadine: preparation, characterization, and in vivo evaluation **Int J Pharm 579:** Paper: 119166.

Ambrus R., Alshweiat A., Csóka I. Ovari G., Esmail A., Radacsi N. (2019) 3D-printed electrospinning setup for the preparation of loratadine nanofibers with enhanced physicochemical properties **Int J Pharm 567:** Paper: 118455.

Ambrus, R., Benke, E., Farkas, Á., Balásházy, I., Szabó-Révész P. (2018) Novel dry powder inhaler formulation containing antibiotic using combined technology to improve aerodynamic properties **Eur J Pharm Sci 123:** pp. 20-27.

ISTVÁN BACZKÓ

University of Szeged
Albert Szent-Györgyi Medical School,
Department of Pharmacology and Pharmacotherapy

Cím: Dóm tér 12., H-6720 Szeged, Hungary

RESEARCH AREA

Cardiovascular diseases lead mortality statistics worldwide. Congestive heart failure and atrial fibrillation are major contributors to cardiovascular mortality and morbidity, in addition, their prevalence is constantly increasing. The two conditions often co-exist, further increasing mortality in these patients. Despite significant improvements in their treatment in the last two decades, congestive heart failure and atrial fibrillation remain significant health care problems. Our laboratory aims at the identification of common and separate elements of electrical remodeling (changes in the expression of transmembrane ion channels and transporters in response to these conditions) in heart failure and atrial fibrillation that can serve as novel therapeutic targets with the help of different animal models of atrial fibrillation established in our laboratory with continuous clinical collaboration. Furthermore, new compounds acting on identified molecular targets are also tested in our atrial fibrillation models. Another important goal of our work is to study the mechanisms responsible for increased arrhythmia susceptibility in models of congestive heart failure, with special attention to elements of electrical remodeling. In addition, our laboratory also focuses on the unmet need for improved preclinical models for better prediction and prevention of proarrhythmic adverse effects of drugs in development in order to improve cardiovascular safety of novel compounds entering the market. In this regard, in the last 5 years, for the first time in the world, we have participated in the creation of several transgenic rabbit models of long QT syndromes.

TECHNIQUES AVAILABLE IN THE LAB

In vivo cardiac electrophysiology methods, including pacemaker implantation and radiofrequency catheter ablation for heart failure and atrial fibrillation models. *In vivo* electrocardiography, echocardiography and setups for advanced hemodynamic studies. *In vivo* models for antiarrhythmic and proarrhythmic studies. *In vitro* techiques include Langendorff-perfused isolated heart, conventional microelectrode technique, patch-clamp technique in native cardiomyocytes and in cellular expression systems. Adenoviral gene transfer, PCR and other standard molecular biological techniques.

SELECTED PUBLICATIONS

Castiglione, A., Hornyik, T., Wülfers, E.M., Giammarino, L., Eder, I., Jowais, J.J., Rieder, M., Perez-Feliz, S., Koren, G., Bősze, Z., Varró, A., Zehender, M., Brunner, M., Bode, C., Liin, S.I., Larsson, H.P., **Baczkó, I.**, Odening, K.E. (2021) Docosahexaenoic acid normalizes QT interval in LQT2 transgenic rabbit models in a genotype-specific fashion. **Europace 24:** 511-522.

Varró, A., Tomek, J., Nagy, N., Virág, L., Passini, E., Rodriguez, B., **Baczkó, I.** (2021) Cardiac transmembrane ion channels and action potentials: cellular physiology and arrhythmogenic behavior. **Physiol Rev 101:** 1083-1176.

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FERENC BARI

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RESEARCH AREA

Adequate and continuous blood supply of the brain requires a very precise regulatory mechanism. Investing the properties of the cerebral microcirculation opens a unique way for understanding the details (components, dynamics) of blood flow regulation in both the healthy and the injured brain. We have been studying the major characteristics of the neurovascular coupling (enhanced neuronal activity is followed by changes in the local blood perfusion) for more than 20 years. We have obtained considerable knowledge on the nature of excitatory amino acid release and the concomitant changes in local microcirculation. We have intensively studied the vascular consequences of hypoxic-ischemic injuries and tested various, potentially neuroprotective strategies. We study cerebral microcirculation in various animal models. Our major approach is using optical methods (intravital microscopy, laser Doppler flowmetry, laser speckle contrast analysis [LASCA]). In addition, we perform *ex vivo* studies in order to characterize morphological alterations and changes in protein expression in the injured brain. Recently, we have been working on new neuroprotective approaches.

During the last years our research interest involves the question how medical informatics could help in stroke prevention and treatment of stroke victims.

TECHNIQUES AVAILABLE IN THE LAB

Intravital microscopy, laser Doppler flowmetry, laser speckle contrast image analysis, brain electrophysiology,monitoring of vital functions of anesthetized animals, data evaluation and analysis.

SELECTED PUBLICATIONS

Clark, D., Tuor, U.I., Thompson, R., Institoris, A., Kulynych, A., Zhang, X., Kinniburgh, D.W., **Bari, F.,** Busija, D.W., Barber, P.A. (2012) Protection against recurrent stroke with resveratrol: endothelial protection. **PLOS One 7:** e47792.

Domoki, F., Zölei, D., Oláh, O., Tóth-Szűki, V., Hopp, B., **Bari, F.,** Smausz, T. (2012) Evaluation of Laser-speckle contrast image analysis techniques inthe cortical microcirculation of piglets. **Microvasc Res 83:** 311-7.

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Mracsko, E., Hugyecz, M., Institoris, A., Farkas, E., **Bari, F.** (2010) Changes in prooxidant and antioxidant enzyme levels during cerebral hypoperfusion in rats. **Brain Res 1321:** 13-9.

Lenti, L., Domoki, F., Gáspár, T., Snipes, J.A., **Bari, F.**, Busija, D.W. (2009) N-methyl-D-aspartate induces cortical hyperemia through cortical spreading depression-dependent and independent mechanisms in rats. **Microcirculation 16:** 629-39.

ZSUZSANNA BATA-CSÖRGŐ

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RESEARCH AREA

Psoriasis is the most common inflammatory skin disease among Caucasians. Our research focus is on the pathomechanism of this disease. The disease is polygenic with complex pathology therefore our work has different aspects: immunology, epidermal and dermal biology, regulation of cell proliferation and differentiation and extracellular matrix biology. We are engaged in classical theory driven research, but also use large scale studies. The research group is closely related to the clinic that makes it possible to use human tissues and cells for some of our work, which enhances the clinical relevance of our results. Some of our work is more basic research, we investigate normal and pathological functions of keratinocytes, fibroblasts and melanocytes.

TECHNIQUES AVAILABLE IN THE LAB

Separation and culture of various cells, immunostaining techniques on tissues and on cells, flow cytometry methods, cell cycle analysis, Western blot, RT-PCR, proteomic techniques.

SELECTED PUBLICATIONS

Gál, B., Dulic, S., Kiss, M., Groma, G., Kovács, L., Kemény, L., **Bata-Csörgő, Z.** (2017) Increased circulating anti-α6-integrin autoantibodies in psoriasis and psoriatic arthritis but not in rheumatoid arthritis. **J Dermatol 44:** 370-374

Göblös, A., Danis, J., Vas, K., **Bata-Csörgő, Z.**, Kemény, L., Széll, M. (2016) Keratinocytes express functional CARD18, a negative regulator of inflammasome activation, and its altered expression in psoriasis may contribute to disease pathogenesis. **Mol Immunol 73:** 10-18.

Gubán, B., Vas, K., Balog, Z., Manczinger, M., Bebes, A., Groma, G., Széll, M., Kemény, L., **Bata-Csörgő, Z.** (2016) Abnormal regulation of fibronectin production by fibroblasts in psoriasis. **Br J Dermatol 174:** 533-41.

Belső, N., Széll, M., Pivarcsi, A., Kis, K., Kormos, B., Kenderessy, A.S., Dobozy, A., Kemény, L., **Bata-Csörgõ, Z.** (2008) Differential expression of D-type cyclins in HaCaT keratinocytes and in psoriasis. **J Invest Dermatol 128:** 634-42.

Bata-Csorgo, Z., Hammerberg, C., Voorhees, J.J., Cooper, K.D. (1995) Kinetics and regulation of human keratinocyte stem cell growth in short-term primary *ex vivo* culture. Cooperative growth factors from psoriatic lesional T lymphocytes stimulate proliferation among psoriatic uninvolved, but not normal, stem keratinocytes. **J Clin Invest 95:** 317-27.

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PÉTER BENCSIK

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RESEARCH AREA

Our research group, which has been operating for more than 25 years, investigates the tissue and cellular biochemical basis of myocardial stress adaptation and attempts to identify new drug targets for the development of cardioprotective drugs together with national and foreign pharmaceutical industrial partners. We focus primarily on matrix metalloproteinase-2 (MMP-2) and its possible substrate molecules, which enzyme is also found in the intra- and extracellular compartments of the heart. In the preclinical phases of drug development, we investigate the inhibitory effect of potential drug candidate molecules on MMP-2. In addition, in close collaboration with the Institute of Pharmacology at Semmelweis University, we investigate the role and expression changes of microRNAs during acute myocardial infarction. We synthesized microRNAs, which showed significant change during myocardial ischemia/reperfusion injury and test their potential cardioprotective effect by administration of these so called protectomiRs in a mouse model of acute myocardial infarction. With both of the above-mentioned therapeutic options, our aim is to develop cardioprotective drugs or therapeutic formulations that can have a positive effect on cardiac muscle even in the presence of cardiovascular risk factors, comorbidities, and already authorized and widely used other pharmacological treatments (e.g. antihyperlipidemic or antihypertensive drugs). Moreover, our ultimate goal is to achieve prolonged cardioprotection by the use of the above drug candidate molecules to improve cardiac function and to prevent or decelerate the development and progression of post-infarction heart failure.

TECHNIQUES AVAILABLE IN THE LAB

The techniques available in our research group are based on *in vivo* animal experiments. We use basic and microsurgical techniques to develop acute myocardial infarction and post-infarction as well as volume overload-induced heart failure in mice and rats. To better visualize and understand microsurgical techniques, we use a stereomicroscope, which displays the image seen in the ocular on a large monitor. These models are characterized by echocardiography and measurement of hemodynamic parameters by pressure-volume catheterization. Simulated infarction and viability assays on cardiac myocyte cultures as well as enzymological and protein determination methods are included in our laboratory's repertoire.

SELECTED PUBLICATIONS

Gömöri, K., Szabados, T., Kenyeres, É., Pipis, J., Földesi, I., Siska, A., Dormán, G., Ferdinandy, P., **Bencsik, P.** (2020) Cardioprotective effect of novel matrix metalloproteinase inhibitors. **Int J Mol Sci. 21:** 6990.

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Bencsik, P., Kupai, K., Gorbe, A., Kenyeres, E., Varga, Z.V., Paloczi, J., Gaspar, R., Kovacs, L., Weber, L., Takacs, F., Hajdu, I., Fabo, G., Cseh, S., Barna, L., Csont, T., Csonka, C., Dorman, G., Ferdinandy, P. (2018) Development of Matrix Metalloproteinase-2 Inhibitors for Cardioprotection. **Front Pharmacol 9:** 296.

Kiss, K., Csonka, C., Pálóczi, J., Pipis, J., Görbe, A., Kocsis, G.F., Murlasits, Z., Sárközy, M., Szűcs, G., Holmes, C.P., Pan, Y., Bhandari, A., Csont, T., Shamloo, M., Woodburn, K.W., Ferdinandy, P.*, **Bencsik, P.** (2016) Novel, selective EPO receptor ligands lacking erythropoietic activity reduce infarct size in acute myocardial infarction in rats. **Pharmacol Res 113:** 62-70.

ANTAL BERÉNYI

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RESEARCH AREA

Recent technical development gave a new momentum to experiments studying the brain, although the extremely complex structure of the nervous system still supplies the researchers with an endless inventory of open questions. In our research we investigate the possible therapeutic effects of Transcranial Electrical Stimulation (TES) on epileptic seizures. Particularly, we plan to develop a focused stimulation protocol both in time and space to interact only with the desired brain areas within an appropriate time-frame. To determine the appropriate focal points of stimulation, we investigate the internal dynamics of neural networks involved in seizure generation. We do this by performing a throughout analysis of networks on microscopic and mesoscopic scale with extremely high spatial and temporal resolution. The same approach is used to focus on the role of hippocampus and related circuitries in memory formation and spatial navigation. We pay special interest to the role of sensory information in this field.

Our long-term vision is to develop a closed-loop, implantable seizure suppressor device that continuously monitors the patterns of brain activity, and delivers electrical pulses in order to terminate any occurring seizures. We are hoping to translate our laboratory-stage experimental results into clinical trials within a few years.

TECHNIQUES AVAILABLE IN THE LAB

Extra- and juxtacellular recording techniques, transcranial electrical stimulation, freely moving animal models to study the correlation of behavior and neuronal activity patterns, basic histology and immunohistochemistry, double transgenic animal models for optogenetical research, analog and digital electronics development, microcontroller programming, signal processing algorithms, advanced data mining techniques, Matlab and Labview programming languages, non-supervised pattern recognition algorithms.

SELECTED PUBLICATIONS

Oliva, A., Fernández-Ruiz, A, Buzsáki, G., **Berényi, A.** (2016) Role of Hippocampal CA2 Region in Triggering Sharp-Wave Ripples. **Neuron 91:** 1342-55.

Agarwal, G., Stevenson, I.H., **Berényi, A.**, Mizuseki, K., Buzsáki, G., Sommer FT. (2014) Spatially distributed local fields in the hippocampus encode rat position. **Science 344:** 626-30.

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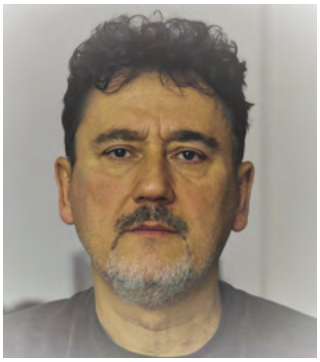
ZSOLT ENDRE BOLDOGKŐI



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RESEARCH AREA

The main projects of our research group: 1. Genetic regulation in various viral families: We have been assembling the transcriptome atlases of various viruses using short- and long-read sequencing technologies. We have currently been investigating the following viruses: herpes simplex virus, pseudorabies virus, varicella-zoster virus, human cytomegalovirus, Epstein-Barr virus, vaccinia virus, influenza virus, a baculovirus, an endogenous retrovirus, a circovirus, various RNA viruses, etc. Additionally, we have been examining how the transcriptions as well as the transcription and the DNA replication are interrelated with each other. We have put forward two hypotheses for assuming a genome-wide interplay among the transcription and replication machineries, which are the Transcription Interference Network (TIN) hypothesis and the Transcription and replication Network (TRIN) hypothesis, respectively. 2. Generation of intelligent viral vectors for brain research: Application of genetically modified pseudorabies virus for tansneuronal tract-tracing, as well as analysis of neural activity using optical methods. 3. Examination of the genetic basis of major depression and suicide: high-coverage whole-exome analysis of depression. 4. Various microbiome research projects since 2019 have been launched.

TECHNIQUES AVAILABLE IN THE LAB

1. Long-read and short-read sequencing: Illumina next generation sequencing; Oxford Nanopore Technologies and Pacific Bioscience third-generation sequencing platforms. We have tested various methods using these platforms, including Cap-selection, direct RNA sequencing, targeted sequencing, etc. 2. Molecular cloning: application of restriction endonucleases and CRISPR-Cas9 technology, recombinant virus technology, etc. 3. PCR and real-time RT PCR: These techniques are used for quantitative analysis of gene expression. 4. Microscopy: light microscopy, as well as, confocal and fluorescence microscopy.

SELECTED PUBLICATIONS

Tombácz, D., Prazsák, I., Szűcs, A., Dénes, B., Snyder, M., **Boldogkői, Z.** (2018) Analysis of the transcriptome of Vaccinia virus using long-read sequencing techniques. **GigaScience 7:** 139.

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RESEARCH AREA

Transcription of eukaryotic genes is a multistep process that involves a large number of functionally different proteins and requires the ordered assembly of giant multiprotein complexes. In recent years the important role of chromatin structure in transcription regulation has been recognized and new directions in transcription research have been initiated. It is hoped that a better understanding of the roles of functionally distinct classes of transcription regulatory proteins and chromatin modifiers will provide keys to decipher why and how can these drive development and can be de-regulated in diseases like cancer. In joint laboratories located at the BRC and at the Biochemistry and Molecular Biology Department of SzU we use combined approaches to characterize proteins which modify chromatin structure. In one area of research we focus our studies on histone proteins used only under specific conditions for example at the very early stage of embryonic development. For these studies we use Drosophila model, as this permits us to combine genetic and cell- and molecular biology methods. Another research approaches we study gene expression changes in cancer cells. For this we use clinical samples and are primarily interested in identifying the genetic alterations that contribute tumor formation.

TECHNIQUES AVAILABLE IN THE LAB

The techniques we use regularly to study different aspects of gene expression consist of a very broad range of genetic, biochemical, cell biology and molecular biology methods. That means daily use of techniques of genetic engineering including the classic ways of DNA manipulations and cloning and also the latest methods of targeted genome editing, chromatin immunoprecipitation and next generation sequencing. In addition to DNA we work extensively with proteins and use diverse methods for purify proteins from different sources and analyze protein–protein interactions.

SELECTED PUBLICATIONS

Majoros, H.; Ujfaludi, Zs.; Borsos, B.N.; Hudacsek, V.V.; Nagy, Z.; Coin, F.; Buzas, K.; Kovács, I.; Bíró, T.; **Boros, I.M.** (2019) et al. SerpinB2 is involved in cellular response upon UV irradiation. **Scientific Reports 9:** 2753.

Ujfaludi, Zs.; Tuzesi, A.; Majoros, H.; Rothler, B.; Pankotai, T.; **Boros, I.M.** (2018) Coordinated activation of a cluster of MMP genes in response to UVB radiation. **Scientific Reports 8:** 2660.

Borsos, B.N.; Huliak, I.; Majoros, H.; Ujfaludi, Z.; Gyenis, A.; Pukler, P.; **Boros, I.M.**; Pankotai, T. (2017) Human p53 interacts with the elongating RNAPII complex and is required for the release of actinomycin D induced transcription blockage. **Scientific Reports 7:** 40960.

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Borsos, B.N.; Pankotai, T.; Kovacs, D.; Popescu, C.; Pahi, Z.; **Boros, I.M.** (2015) Acetylations of Ftz-F1 and histone H4K5 are required for the fine-tuning of ecdysone biosynthesis during Drosophila metamorphosis. **Developmental Biology 404:** 80-7.

Vedelek, B.; Blastyak, A.; **Boros, I.M.** (2015) Cross-Species Interaction between Rapidly Evolving Telomere-Specific Drosophila Proteins. **Plos One 10:** e0142771.

Gyenis, A.; Umlauf, D.; Ujfaludi, Z.; **Boros, I.M.**; Ye, T.; Tora, L. (2014) UVB Induces a Genome-Wide Acting Negative Regulatory Mechanism That Operates at the Level of Transcription Initiation in Human Cells. **Plos Genetics 10:** e1004483.

Sike, A.; Nagy, E.; Vedelek, B.; Pusztai, D.; Szerémy, P.; Venetianer, A.; **Boros, I.M.** (2014) mRNA Levels of Related Abcb Genes Change Opposite to Each Other upon Histone Deacetylase Inhibition in Drug- Resistant Rat Hepatoma Cells. **Plos One 9:** e84915.

Villanyi, Z.; Ribaud, V.; Kassem, S.; Panasenko, O.O.; Pahi, Z.; Gupta, I.; Steinmetz, L.; **Boros, I.M.**; Collart, M.A. (2014) The not5 subunit of the ccr4-not complex connects transcription and translation. **Plos Genetics 10:** e1004569.

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RESEARCH AREA

Surgical research can bring together many clinical disciplines and interests, ranging from cardiovascular biology to gastroenterology. The ischemia-reperfusion (I/R)-induced cellular hypoxia - reoxygenation, and subcellular oxidoreductive stress are major determinants of mortality and morbidity in many areas of clinical practice, such as sepsis or shock situations, and investigations targeting the I/R-caused microcirculatory dysfunction are essential for development of treatment strategies for several clinical pathologies. From a general perspective, it is worth pointing out that any intervention protecting microcirculation is likely to result in protection of tissue function and structure. In this scheme we have characterized the anti-inflammatory potential of membrane-forming phospholipids in I/R-induced antigenindependent inflammation, and the observation that methane formation from phosphatidylcholine metabolites occurs in ischemic systems opened up new avenues for future research. Currently we examine the possible biological roles of endogenous methane formation and whether methane - or potentially methane-releasing agents influence IR-induced microcirculatory dysfunctions and modulate the outcome of inflammation.

TECHNIQUES AVAILABLE IN THE LAB

Fundamental surgical techniques with complete hemodynamic monitoring and distinct imaging possibilities, such as intravital fluorescence microscopy and orthogonal polarization spectral imaging for *in vivo* microcirculatory analysis. Confocal laser scanning endomicroscopy for *in vivo* gastrointestinal histology. Detection of whole body methane emission by photoacoustic spectroscopy. Highresolution respirometry for mitochondrial studies.

SELECTED PUBLICATIONS

Strifler, G., Tuboly, E., Szél, E., Kaszonyi, E., Cao, C., Kaszaki, J., Mészáros, A., **Boros, M.**, Hartmann, P. (2016) Inhaled Methane limits the mitochondrial electron transport chain dysfunction during experimental liver ischemia-reperfusion injury. **Plos One 11:** e0146363.

Boros, M., Tuboly, E., Meszaros, A., Amann, A. (2015) The role of methane in mammalian physiology-is it a gasotransmitter? **J Breath Res 9:** 014001.

Tuboly, E., Szabó, A., Garab, D., Bartha, G., Janovszky, Á., Erős, G., Szabó, A., Mohácsi, Á., Szabó, G., Kaszaki, J., Ghyczy, M., **Boros, M.** (2013) Methane biogenesis during sodium azideinduced chemical hypoxia in rats. **Am J Physiol Cell Physiol 304:** C207-214.

Boros, M., Ghyczy, M., Érces, D., Varga, G., Tőkés, T., Kupai, K., Torday, C., Kaszaki, J. (2012) The anti-inflammatory effects of methane. **Crit Care Med 40:** 1269-1278.

Ghyczy, M., Torday, C., **Boros, M.** (2003) Simultaneous generation of methane, carbon dioxide, and carbon monoxide from choline and ascorbic acid: a defensive mechanism against reductive stress? **FASEB J 17:** 1124-1126.

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RESEARCH AREA

Duplication of the genetic material is essential for every living organism. In our laboratory, located at the Institute of Genetics in the Biological Research Centre, we examine the replication of eukaryotic cells. The replicative protein complex works with high speed and high fidelity, but several circumstances can interfere with this process. These could be different damage or structural barriers formed on the template DNA strand. The focus of our research interest is the replication of stable secondary structures, which formation is induced by the endogenous nucleotide sequence of the DNA. There are several types of the stable secondary structures, but our laboratory examines the replication of G-quadruplex (G4) structures. Computational analysis identified that there are more than 700,000 G4 motifs in our genome. Thus, the replication of the G4 in cells is challenging. G4 is a tetramer structure formed by stacking of guanine quartets on single-stranded nucleic acid (DNA or RNA) via Hoogsteen's base pairing. The most well examined form of G4 structures are the telomeres, which ensure the stability of the chromosome ends. Our work focuses on the replication of intrachromosomal G4 structures. Since G4 structures are very stable in physiological conditions, they can block the movement of the replicative machinery, which could lead to genome instability. On this basis, it is expected that the amount of G4-forming sequences is reduced during evolution, but the opposite is true. In E. coli and C. elegans the amount of G4-forming sequences in the genome is 0.42% and 0.89%, respectively, but in human cells 4.17% of the genome can form G4 structures that highlights the important function of G4s in the nuclear processes. Recently it has been described, that G4 structures can regulate the gene expression, the initiation of replication, the recombination and the epigenetic code. Therefore, fast end precise replication of G4 structures is essential, otherwise important nuclear functions might be damaged. For the efficient replication special DNA helicases and regulatory proteins are needed, which can synchronize the action of G4 unwinding DNA helicases and the replication apparat. In our laboratory we examine the function of these regulatory proteins.

TECHNIQUES AVAILABLE IN THE LAB

Yeast and Caenorhabditis elegans genetic methods Construction of deletion and overexpression mutants, killing curve, genome stability assay), recombinant DNA techniques (DNA isolation and RNA isolation, PCR, cloning, Southern blot), protein purification, characterization of purified proteins, enzyme reactions, characterization of the functional domains of the proteins, Western blot, techniques used for human cell cultures and microscopy.

SELECTED PUBLICATIONS

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TAMÁS CSONT

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RESEARCH AREA

Cardiovascular diseases and especially acute myocardial infarction are among the leading causes of death worldwide. Although prevention and the therapy of myocardial infarction have been significantly improved in the last decades, mortality is still unacceptably high. Therefore, development of new therapies aiming to attenuate infarct size is very relevant. Thus, our research group investigates the molecular mechanisms of infarction as well as the adaptive responses of the myocardium to ischemic stress (pre- and postconditioning) to develop novel potential therapies for the treatment of myocardial infarction. Since the risk of myocardial infarction is increased by the presence of several co-morbidities and risk factors including high cholesterol level, diabetes, obesity, hypertension, smoking, lack of exercise, kidney failure, etc., we also look at the effects of certain risk factors on the myocardium as well as on adaptive mechanisms of the heart.

TECHNIQUES AVAILABLE IN THE LAB

Induction and treatment of disease models (e.g. diabetes, hypercholesterolemia) in experimental animals, echo-cardiographic assessment of cardiac morphology and function, surgical interventions to induce disease models (myocardial infarction, heart failure, kidney failure, etc.), isolated heart perfusion, determination of infarct size, induction and maintenance of cell culture, viability assays, transfection, general biochemical methods to determine metabolites, proteins and nucleic acids (spectroscopy, western blot, ELISA, flow cytometry, histochemistry, PCR, etc.).

SELECTED PUBLICATIONS

Sárközy, M., Szűcs, G., Fekete, V., Pipicz, M., Éder, K., Gáspár, R., Sója, A., Pipis, J., Ferdinandy, P., Csonka, C., **Csont, T.** (2016) Transcriptomic alterations in the heart of non-obese type 2 diabetic Goto-Kakizaki rats. **Cardiovasc Diabetol 15:** 110.

Pipicz, M., Varga, Z.V., Kupai, K., Gáspár, R., Kocsis, G.F., Csonka, C., **Csont, T.** (2015) Rapid ventricular pacing-induced postconditioning attenuates reperfusion injury: effects on peroxynitrite, RISK and SAFE pathways. **Br J Pharmacol 172:** 3472-83.

Varga, Z.V., Kupai, K., Szűcs, G., Gáspár, R., Pálóczi, J., Faragó, N., Zvara, A., Puskás, L.G., Rázga, Z., Tiszlavicz, L., Bencsik, P., Görbe, A., Csonka, C., Ferdinandy, P., **Csont, T.** (2013) MicroRNA-25-dependent up-regulation of NADPH oxidase 4 (NOX4) mediates hypercholesterolemia-induced oxidative/nitrative stress and subsequent dysfunction in the heart. **J Mol Cell Cardiol 62:** 111-21.

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Csont, T., Görbe, A., Bereczki, E., Szunyog, A., Aypar, E., Tóth, M.E., Varga, Z.V., Csonka, C., Fülöp, F., Sántha, M., Ferdinandy, P. (2010) Biglycan protects cardiomyocytes against hypoxia/reoxygenation injury: role of nitric oxide. **J Mol Cell Cardiol 48:** 649-52.

MÁRIA DELI

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RESEARCH AREA

Organisms are protected by biological barriers from harmful effects. These barriers also impede drug penetration. Our lab investigates methods to increase drug delivery on culture models of the blood-brain, nasal, corneal, respiratory and intestinal barriers. The pathways examined are (i) reversible opening of tight intercellular junctions by peptides or small molecules; (ii) targeting solute carriers at barriers for drug delivery by nanoparticles. Cellular toxicity of active ingredients and pharmacautical excipients are measured by a real-time impedance-based method. Double and triple co-culture models are used for experiments, and a microfluidic integrated chip has been developed in a collaborative project. Our other major research interest is the examination of blood-brain barrier injury and dysfunctions in different diseases, like Alzheimer's disease, acute pancreatitis and diabetes. The goal of these experiments is to reveal the effect of disease pathogenic factors on blood-brain barrier functions and to identify protective molecules. The protection of brain endothelial cells and the improvement of BBB functions in pathological conditions, the exploration of new approaches for drug transport/targeting to brain may have therapeutic potential in the treatment of central nervous system diseases.

TECHNIQUES AVAILABLE IN THE LAB

Mammalian cell culture; primary cultures from brain and brain microvessels; models of biological barriers by double and triple co-cultures; cell culture models in microfluidic chips; electric resistance measurements of cell layers; permeability of drugs across culture models; immunohistochemistry; phase contrast, fluorescent and confocal microscopy; ELISA; measurement of nitric oxide and reactive oxygen species production in cells; colorimetric and impedance-based toxicity tests.

SELECTED PUBLICATIONS

Mészáros, M., Porkoláb, G., Kiss, L., Pilbat, A.M., Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülper, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., **Deli, M.A.**, Veszelka, S. (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the blood-brain barrier. **Eur J Pharm Sci 123:** 228-240.

Veszelka, S., Tóth, A., Walter, F.R., Tóth, A.E., Gróf, I., Mészáros, M., Bocsik, A., Hellinger, É., Vastag, M., Rákhely, G., **Deli, M.A.** (2018) Comparison of a rat primary cell-based blood-brain barrier model with epithelial and brain endothelial cell lines: gene expression and drug transport. **Front Mol Neurosci 11:** 166.

Walter, F.R., Valkai, S., Kincses, A., Petneházi, A., Czeller, T., Veszelka, S., Ormos, P., **Deli, M.A.,** Dér, A. (2016) Versatile lab-on-a-chip tool for modeling biological barriers. **Sens Actuators B Chem 222:** 1209-1219.

Bocsik, A., Walter, F.R., Gyebrovszki, A., Fülöp, L., Blasig, I., Dabrowski, S., Ötvös, F., Tóth, A., Rákhely, G., Veszelka, S., Vastag, M., Szabó-Révész, P., **Deli, M.A.** (2016) Reversible opening of intercellular junctions of intestinal epithelial and brain endothelial cells with tight junction modulator peptides. **J Pharm Sci 105:** 754-765.

Veszelka, S., Tóth, A.E., Walter, F.R., Datki, Z., Mózes, E., Fülöp, L., Bozsó, Z., Hellinger, E., Vastag, M., Orsolits, B., Környei, Z., Penke, B., **Deli, M.A.** (2013) Docosahexaenoic acid reduces amyloid-β induced toxicity in cells of the neurovascular unit. **J Alzheimers Dis 36:** 487-501.

ANDRÁS DÉR

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RESEARCH AREA

Bioelectronics has a double meaning in scientific literature. On the one hand, as a branch of basic biophysical sciences, it deals with electric phenomena appearing on any organization level of living systems. On the other hand, as a recently developed discipline of information technological science, it explores the potential of biological materials for application in molecular electronics. These two areas of research are in close interaction not only with each other, but also with other disciplines of basic applied sciences. Our main goal is to develop novel methods on integrated micro- and nanotechnological platforms for the investigation of light-induced processes in biological membranes, and utilize them in both branches of bioelectronic science. The most important scientific problems to be solved are, on the one hand, concerned with the investigation of electric properties of single cells and cellular interfaces, while on the other hand with the application of photochromic proteins in optoelectronics and photonics. Besides its impact on basic biophysical science, our research is expected to have utilizations in various branches of applied bioelectronics.

TECHNIQUES AVAILABLE IN THE LAB

Photoelectric measuring techniques, absorption kinetics, polarisation methods, electro-optics, photolithography, laser-assisted microstructure building, surface coating techniques, TIRF-microscopy, MATLAB programing, LabVIEW programing.

SELECTED PUBLICATIONS

Dér, A., Kelemen, L., Fábián, L., Taneva, S.G., Fodor, E., Páli, T., Cupane, A., Cacace, M.G., Ramsden, J.J. (2007) Interfacial Water Structure Controls Protein Conformation. **J Phys Chem B 111:** 5344-5350.

Ormos, P., Fábián L., Oroszi L., Ramsden, J.J., Wolff, E.K., **Dér, A.** (2002) Protein-based integrated optical switching and modulation. **Appl Phys Lett 80:** 4060-4062.

Dér, A., Keszthelyi, L. (eds.) (2001) Bioelectronic Applications of Photochromic Pigments, IOS Press **NATO Science Series**, Vol. 335.

Dér, A., Keszthelyi, L. (2001) Charge motion during the photocycle of bacteriorhodopsin. **Biochemistry (M) 66:** 1234-1248.

Dér, A., Oroszi, L., Kulcsár, Á., Zimányi, L., Tóth-Boconádi, R., Keszthelyi, L., Stoeckenius, W., Ormos, P. (1999) Interpretation of spatial charge displacements in bacteriorhodopsin in terms of structural changes during the photocycle. **Proc Natl Acad Sci USA 96:** 2776-2781.

LÁSZLÓ DUX

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RESEARCH AREA

The Biochemitsry Department follows the traditions of the school of Albert Szent-Györgyi in muscle research. Former achievements in the area, as the discovery of actin, the characterization of actin-miosin-ATP involvement in muscle contraction, crystallization of the calcium pump enyzme in muscle paved the way until now. Recent re search interest is focused on the development, differentiation and regeneration of muscle tissues at the molecular level. Neural and humoral factors, as well as extracellular matrix components involved in these processes are under study. Another main field our of research and development activities is the standardization, quality assurance of diagnostic methods in clinical biochemistry and molecular biology. The development and application of reference materials for the area.

TECHNIQUES AVAILABLE IN THE LAB

Qualitative and quantitave protein and nucleic acid analytical methods, cell and tissue culture, histo chemistry and immunohistochemistry, morphometry, flow cytometry, characterization of molecular regulatory systems.

SELECTED PUBLICATIONS

Becsky, D., Gyulai-Nagy, S., Balind, A., Horvath, P., **Dux, L.**, Keller-Pinter, A. (2020) Myoblast Migration and Directional Persistence Affected by Syndecan-4-Mediated Tiam-1 Expression and Distribution. **Int J Mol Sci 21:** 823.

Sztretye, M., Dienes, B., Gönczi, M., Czirják, T., Csernoch, L., **Dux, L.**, Szentesi, P., Keller-Pintér, A. (2019) Astaxanthin, a potential mitochondrial targeted antioxidant treatment in diseases and with aging. **Oxid Med Cell Longev 2019:** 3849692.

Szentesi, P., Csernoch, L., **Dux, L.**, Keller-Pinter, A. (2019) Changes in redox signaling in skeletal muscle during aging. **Oxid Med Cell Longev 2019:** 4617801.

Keller-Pinter, A., Szabo, K., Kocsis, T., Deak, F., Ocsovszki, I., Zvara, A., Puskas, L., Szilak, L., **Dux, L.** (2018) Syndecan-4 influences mammalian myoblast proliferation by modulating myostatin signalling and G1/S transition. **FEBS Lett 592:** 3139-3151.

Kocsis, T., Trencsényi, Gy., Szabó, K., Baán, J. A., Müller, G., Mendler, L., Garai, I., Reinauer, H., Deák, F., **Dux, L.**, Keller-Pintér, A. (2017) Myostatin propeptide mutation of the hypermuscular Compact mice decreases the formation of myostatin and improves insulin sensitivity. **Am J Physiol Endocrinol Metab 312:** E150-E160.

ATTILA GÁCSER

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RESEARCH AREA

Infectious diseases are one the leading causes of mortality worldwide, killing millions of people every year. While bacteria and viruses cause the majority of deadly infections, notably the number of fungal diseases is increasing at an alarming rate. In fact, it is estimated that nearly as many people die annually from invasive fungal infections as from the greatly feared tuberculosis (1.4 million) or malaria (1.2 million). Our research program focuses on the most common human fungal pathogens, the opportunistic Candida species with special focus on C. parapsilosis. We investigate the basic mechanisms of fungal pathogenesis and host immunity, and we aim to improve diagnosis and identify novel biomarkers of infection. Recently, we also investigate the role of the human "mycobiome" in health and disease development and progression.

TECHNIQUES AVAILABLE IN THE LAB

In vitro infection models using phagocytes (murine and human cell lines, primer immune cells). Measurement of fungal cell phagocytosis with Flow Cytometry or microscopy, cytokines-chemokines with ELISA, host damage with LDH-assay. Quantitative imaging using FlowSight. In vivo infection models using wild type and transgenic mice. Colony formig unit measurements from different organs, histological analysis, immune cell preparation from infected animals. Basic and advanced molecular techniques, qRTPCR, Western blot, Southern blot, CRISPR/Cas9 technology, GATEWAY-cloning system.

SELECTED PUBLICATIONS

Tóth, A., Zajta, E., Csonka, K., Vágvölgyi, C., Netea, M.G., **Gácser, A.** (2017) Specific pathways mediating inflammasome activation by Candida parapsilosis. **Sci Rep 7:** 43129.

Pryszcz, L.P., Nemeth, T., Saus, E., Ksiezopolska, E., Hegedusova, E., Nosek, J., Wolfe, K.H., **Gácser, A*.**, Gabaldon, T.* (2015) The Genomic Aftermath of Hybridization in the Opportunistic Pathogen Candida metapsilosis. **PLOS Genetics 11:** e1005626.

Tóth, R., Alonso, M.F., Bain, J.M., Vágvölgyi, C., Erwig, L-P., **Gácser, A.** (2015) Different Candida parapsilosis clinical isolates and lipase deficient strain trigger an altered cellular immune response. **Front Microbiol 6:** 1102.

Toth, A., Csonka, K., Jacobs, C., Vagvolgyi, C., Nosanchuk, J.D., Netea, M.G., **Gácser, A.** (2013) Candida albicans and Candida parapsilosis Induce Different T-Cell Responses in Human Peripheral Blood Mononuclear Cells. **J Infect Dis 208:** 690-698.

Lázár-Molnár, E.*, **Gácser, A.***, Freeman, G.J., Almo, S.C., Nathenson, S.G., Nosanchuk, J.D. (2008) The PD-1/PD-L costimulatory pathway critically affects host resistance to the pathogenic fungus Histoplasma capsulatum. **Proc Natl Acad Sci USA 105:** 2658-2663.

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RESEARCH AREA

In experimental cardiology models, several studies have already demonstrated that the reperfusion phase following cardiac oxygen deprivation activates processes that lead to further damage of myocardial tissue. However, there are endogenic protective mechanisms that can reduce the extent of damage. The beneficial effects of ischemic pre-, post- and remote conditioning as well as pharmacological pre- and post-conditioning have been demonstrated in vivo and ex vivo in animal models. However, failures in clinical trials show that these mechanisms are not sufficiently effective in ischemic heart patients. Preclinical data suggest that co-morbidities such as hyperlipidemia, metabolic syndrome, diabetes mellitus-induced tissue changes and drug treatment of these diseases have a strong interfering effect. The most cost-effective way to study intracellular mechanisms is to use in vitro cardiomyocyte models. Furthermore, the presence of ischaemia/reperfusion injury and co-morbidities poses additional risks, as the hidden side effects of many drugs are only seen in such cases. Our research addresses the potential cardioprotective effects of microRNAs. The development of noncoding RNAs (such as microRNAs) as molecules of diagnostic and therapeutic value has in recent years brought them to the forefront of the pharmaceutical industry for the precision diagnosis and treatment of a number of diseases. In particular, to further investigate the role of mammalian metalloproteinase (MMP) enzymes in cardiac remodelling, the research group is developing MMP inhibitor molecules, which are being tested at several levels: in silico molecular design in collaboration with a chemistry group, in vitro pretesting, screening, ex vivo and in vivo testing.

TECHNIQUES AVAILABLE IN THE LAB

• use of an in vitro simulated ischemia/reperfusion test system • performing fluorescence and luminescence viability tests on isolated myocardial cells and cardiac cell lines • construction of a primary rat cardiomyocyte model • culture of cell lines, preparation of cell banks, frozen storage • drug treatments in in vitro cell-based systems • MMP zymography measurements to test the efficacy of matrix metalloproteinase enzyme inhibitors • western blotting techniques for protein expression monitoring and identification • qPCR technique to monitor and identify mRNA expression • ELISA measurements for the identification of biomarkers.

SELECTED PUBLICATIONS

Makkos A., Ágg B., Varga ZV., Giricz Z., Gyöngyösi M., Lukovic D., Schulz R., Barteková M., **Görbe A.**, Ferdinandy P. (2021) Molecular Network Approach Reveals Rictor as a Central Target of Cardiac ProtectomiRs. **Int J Mol Sci. 22:** 9539.

Bencsik, P., Gömöri, K., Szabados, T., Sántha, P., Helyes, Z., Jancsó, G., Ferdinandy, P., **Görbe, A.** (2020) Myocardial ischemia reperfusion injury and cardioprotection in the presence of sensory neuropathy: therapeutic options. **Br J Pharmacol 177:** 5336-5356.

Makkos, A., Ágg, B., Petrovich, B., Varga, Z.V., **Görbe, A.**, Ferdinandy, P. (2021) Systematic review and network analysis of microRNAs involved in cardioprotection against myocardial ischemia/reperfusion injury and infarction: Involvement of redox signalling. **Free Radic Biol Med 172:** 237-251.

Gömöri, K., Szabados, T., Kenyeres, É., Pipis, J., Földesi, .I, Siska, A., Dormán, G., Ferdinandy, P., **Görbe, A.**, Bencsik, P. (2020) Cardioprotective Effect of Novel Matrix Metalloproteinase Inhibitors. **Int J Mol Sci. 21:** E6990.

Pálóczi, J., Szántai, Á., Kobolák, J., Bock, I., Ruivo, E., Kiss, B., Gáspár, R., Pipis, J., Ocsovszki, I., Táncos, Z., Fehér, A., Dinnyés, A., Onódi, Z., Madonna, R., Ferdinandy, P., **Görbe, A.** (2020) Systematic analysis of different pluripotent stem cell-derived cardiac myocytes as potential testing model for cardiocytoprotection. **Vascul Pharmacol 133-134:** 106781.

LAJOS HARACSKA

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RESEARCH AREA

Stalling of the DNA replication machinery, which occurs as a consequence of encountering unrepaired DNA damage, is a challenge for cells. To rescue the stalled replication fork, different DNA damage bypass mechanisms have evolved that promote replication through DNA lesions. In humans, increased error-prone bypass of DNA lesions causes increased mutagenesis and, as a consequence, a rise in the incidence of cancers. Error-free bypass processes, by contrast, keep mutagenesis low and reduce the frequency of cancers. Our research laboratory is interested in the driving forces and molecular mechanisms of mutagenesis and carcinogenesis. In particular, we investigate the following questions: What are the common roots of evolution and carcinogenesis? What are the molecular mechanisms of chromosomal rearrangements and the formation of point mutations? Why do we observe increased genome instability during carcinogenesis? What is the role of the recently described DNA repair genes in cancer suppression? Why do mutations in certain genes predispose to cancer? Which genes are commonly mutated in cancer, and how do these mutations contribute to tumour development and drug resistance? We investigate these challenging problems using human tissue culture-based reporter systems, next-generation DNA sequencing and purified proteins in reconstituted reaction pathways. Our research provides more insight into the molecular events of genome instability, carcinogenesis and has the potential to identify new tumour markers and drug targets as well as to improve personal cancer treatment.

TECHNIQUES AVAILABLE IN THE LAB

Next-generation DNA sequencing, PCR, qPCR, protein microarray, human tissue culture-based reporter assays such as cell survival, mutagenesis, homologous recombination and various tests, confocal microscopy-based techniques such as protein localization, DNA replication and chromosomal rearrangements, protein overexpression and purification, immunological assays, biochemical enzyme assays, and yeast genetic methods.

SELECTED PUBLICATIONS

Mórocz, M., Zsigmond, E., Tóth, R., Enyedi, M.Z., Pintér, L., **Haracska, L.** (2017) DNA-dependent protease activity of human Spartan facilitates replication of DNA-protein crosslink-containing DNA. **Nucleic Acids Res 45:** 3172-3188.

Chen, J., Ai, Y., Wang, J., **Haracska, L.**, Zhuang, Z. (2010) Chemically ubiquitylated PCNA as a probe for eukaryotic translesion DNA synthesis. **Nature Chem Biol 6:** 270-2.

Blastyák, A., Pintér, L., Unk, I., Prakash, L., Prakash, S., **Haracska, L.** (2007). Yeast Rad5 protein required for postreplication repair has a DNA helicase activity specific for replication fork regression. **Molecular Cell 28:** 167-75.

Johnson, R.E., Washington, M.T., **Haracska, L.**, Prakash, S., Prakash, L. (2000) Eukaryotic polymerases ι and ζ act sequentially to bypass DNA lesions. **Nature 406:** 1015-1019.

Haracska, L., Yu, S.L., Johnson, R.E., Prakash, L., Prakash, S. (2000) Efficient and accurate replication in the presence of 7,8-dihydro-8-oxoguanine by DNA polymerase η. **Nat Gen 25:** 458-461.

PETRA HARTMANN

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RESEARCH AREA

Antibiotics and non-steroidal anti-inflammatory drugs (NSAIDs) have a potential influence on eukaryotic cells through affecting mitochondrial functions, the oxidative phosphorylation and mitochondrial reactive oxygen free radicals formation. Both drug classes are commonly used in acute and chronic inflammatory and non-inflammatory diseases of the gastrointestinal (GI) tract, where mitochondrial dysfunction can also occur. Our research group investigates the potential role of mitochondrial dysfunction in the inflamed and non-inflamed states of the digestive tract in experimental and clinical settings. We also aim at investigating the effect of drugs being commonly administered in these diseases. We perform a comprehensive analysis of in vitro doseresponse effect of antibiotics and NSAIDs using highresolution respirometry (HRR) in clinical and experimental tissue samples. In parallel, simultaneous manifestations of intramitochondrial and microcirculatory dysfunctions are monitored in a colitis model with particular interest in mucosal barrier functions and composition of the microbiome; these are examined in the presence and absence of various treatment combinations (antibiotics, antibiotics and NSAIDs, respectively).

TECHNIQUES AVAILABLE IN THE LAB

Processing of human samples and samples from in vivo animal models (mitochondria, epithelial cell and platelet isolation, tissue homogenates from punch biopsies). Basic laboratory techniques (measurements of enzyme activities, spectrophotometry, ELISA). Measurement of mitochondrial respiration, hydrogen-peroxyde production and membrane potential using high-resolution respirometry and its fluorescent moduls (Oxygraph2k). Microcirculatory measurements with orthogonal polarization spectral imaging and laser-Doppler.

SELECTED PUBLICATIONS

Benke, K., Jász, D.K., Szilágyi, Á.L., Baráth, B., Tuboly, E., Márton, A.R., Varga, P., Mohácsi, Á., Szabó, A., Széll, Z., Ruppert, M., Radovits, T., Szabó, G., Merkely, B., **Hartmann, P.**, Boros M. (2021) Methane supplementation improves graft function in experimental heart transplantation. **J Heart Lung Transplant 40:** 183-192.

Jász, D.K,, Szilágyi, Á.L., Tuboly, E., Baráth, B., Márton, A.R., Varga, P., Varga, G., Érces, D., Mohácsi, Á., Szabó, A., Bozó, R., Gömöri, K., Görbe, A., Boros, M., **Hartmann, P.** (2021) Reduction in hypoxia-reoxygenation-induced myocardial mitochondrial damage with exogenous methane. **J Cell Mol Med 25:** 5113-5123.

Horváth, T., Jász, D.K., Baráth, B., Poles, M.Z., Boros, M., **Hartmann, P.** (2021) Mitochondrial Consequences of Organ Preservation Techniques During Liver Transplantation. **Int J Mol Sci 22:** 2816.

Strifler, G., Tuboly, E., Görbe, A., Boros, M., Pécz, D., **Hartmann, P.** (2016) Inhaled Methane limits the mitochondrial electron transport chain dysfunction during experimental liver ischemia-reperfusion injury. **PLoS One 11:** e0146363.

Strifler, G., Tuboly, E., Szél, E., Kaszonyi, E., Cao, C., Kaszaki, J., Mészáros, A., Boros, M., **Hartmann, P.** (2016) Targeting mitochondrial dysfunction with L-alpha glycerylphosphorylcholine. **PLoS One 11:** e0166682.

PÉTER HEGYI

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RESEARCH AREA

Epithelial cells form a sheet-like contiguous layer that covers both the external and internal free surfaces of the body, e.g. the surface of skin or inner surface of hollow organs such as in the gastrointestinal tract (GIT). The epithelial cells in the GIT secrete over 10 liters of digestive fluid daily into the lumen - and after digestion - absorb the fluid and nutrients from the lumen. Derangement of this secretory process can lead to severe disorders such as cystic fibrosis or secretory diarrhoea. One of our main research interests is to understand the physiology and pathophysiology of secretory mechanisms. Most recently we have shown that epithelial fluid and ion secretion plays a crucial role in acute pancreatitis which is one of the most severe inflammatory diseases of the GI tract. Therefore, repairing the damaged secretion may lead to a new specific therapeutic way in acute pancreatitis. Besides our interest in the pancreas we work on understanding the oesophageal, gastric and colonic fluid and ion transport mechanisms.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of epithelial cells from human and animal, culturing of cells, measurement of fluid secretion using video-technique, measurement of intracellular ion (H^+, Ca^{2+}) concentrations using fluorescence imaging microscopy, western blotting, working with DNA and RNA, measurement of mitochondrial damage using confocal microscopy, *in vivo* experimental animal models.

SELECTED PUBLICATIONS

Maléth, J., Balázs, A., Pallagi, P., Balla, Z., Kui, B., Katona, M., Judák, L., Németh, I., Kemény, L.V., Rakonczay Jr., Z., Venglovecz, V., Földesi, I., Pető, Z., Somorácz, Á., Borka, K., Perdomo, D., Lukacs, G.L., Gray, M.A,, Monterisi, S., Zaccolo, M., Sendler, M., Mayerle, J., Kühn, JP., Lerch, M.M., Sahin-Tóth, M., **Hegyi, P.** (2015) Alcohol disrupts levels and function of the cystic fibrosis transmembrane conductance regulator to promote development of pancreatitis. **Gastroenterology 148:** 427-39.

Pallagi, P., Venglovecz, V., Rakonczay, Z., Borka, K., Korompay, A., Ozsvári, B., Judák, L., Sahin-Tóth, M., Geisz, A., Schnúr, A., Maléth, J., Takács, T., Gray, M.A., Argent, B.E., Mayerle, J., Lerch, M.M., Wittmann, T., **Hegyi, P.** (2011) Trypsin reduces pancreatic ductal bicarbonate secretion by inhibiting CFTR Cl- channels and luminal anion exchangers. **Gastroenterology 141:** 2228-2239.

Hegyi, P., Pandol, S., Venglovecz, V., Rakonczay, Z. (2011) The acinar-ductal tango in the pathogenesis of acute pancreatitis. **Gut 60:** 544-52.

Maléth, J., Venglovecz, V., Rázga, Z., Tiszlavicz, L., Rakonczay, Z., **Hegyi, P.** (2011) Non-conjugated chenodeoxycholate induces severe mitochondrial damage and inhibits bicarbonate transport in pancreatic duct cells. **Gut 60:** 136-8.

Venglovecz, V., Rakonczay, Z., Ozsvári, B., Takács, T., Lonovics, J., Varró, A., Gray, M.A., Argent, B.E., **Hegyi, P.** (2008) Effects of bile acids on pancreatic ductal bicarbonate secretion in guinea pig. **Gut 57:** 1102-12.

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RESEARCH AREA

Natural products play an important role in drug discovery because of their unmatched structural diversity, amazing, and often complex structures. The aim of our group is to perform purposeful research by rational selection of plant extracts and compounds to be isolated, in order to obtain efficiently new secondary plant metabolites, which are perspective for drug discovery. Literature data, ethnomedicinal knowledge, results of screen investigations and metabolomic approaches are considered for selection of plant species. Compounds are isolated from the very complex multi-component extracts exhibiting efficacy in the used tests, with the aid of different chromatographic methods by guidance of bioassay. The structures of the purified compounds are determined by means of spectroscopic methods (NMR and MS). The biological activity is usually investigated in collaborations.

TECHNIQUES AVAILABLE IN THE LAB

Solid-solid and solid-liquid extraction techniques, evaporators; chromatographic techniques (OCC, GC, VLC, CPC, Flash, SE, SFC, MPLC, HPLC) coupled with UV-Vis, PDA, light scattering and MS detectors; ESIMS, HRMS, 1D and 2D NMR for structure elucidation; microplate reader, bioassays for antimicrobial, antitumor, ion channel activity in collaboration.

SELECTED PUBLICATIONS

Ványolós, A., Dékány, M., Kovács, B.t, Krámos, B., Bérdi, P., Zupkó, I., **Hohmann, J.**, Béni Z. (2016) Gymnopeptides A and B, cyclic octadecapeptides from the mushroom Gymnopus fusipes. **Org Lett 18:** 2688-2691.

Vasas, A., Forgo, P., Orvos, P., Tálosi, L., Csorba, A., Pinke, G., **Hohmann, J**. (2016) Myrsinane, premyrsinane, and cyclomyrsinane diterpenes from Euphorbia falcata as potassium ion channel inhibitors with selective G protein-activated inwardly rectifying ion channel (GIRK) blocking effects. **J Nat Prod 79:** 1990-2004.

Hajdu, Z., Nicolussi, S., Rau, M., Lorantfy, L., Forgo, P., **Hohmann, J.**, Csupor, D., Gertsch, J. (2014) Identification of endocannabinoid system-modulating N-alkylamides from Heliopsis helianthoides var. scabra and Lepidium meyenii. **J Nat Prod 77:** 1663-1669.

Vasas, A., Rédei, D., Csupor, D., Molnar, J., **Hohmann, J.** (2012) Diterpenes from European Euphorbia species serving as prototypes for natural-product-based drug discovery. **Eur J Org Chem 2012:** 5115-5130.

Hohmann, J., Molnár, J., Rédei, D., Evanics, F., Forgo, P., Kálmán, A., Argay, G., Szabó, P. (2002) Discovery and biological evaluation of a new family of potent modulators of multidrug resistance: reversal of multidrug resistance of mouse lymphoma cells by new natural jatrophane diterpenoids isolated from Euphorbia species. **J Med Chem 45:** 2425-2431.

PÉTER HORVÁTH

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RESEARCH AREA

Recent advances in light microscopy have changed the way biological research is conducted. The ability to acquire massive amounts of image data has given rise to new fields such as high content screening (HCS) or 3D imaging, which promise to open new doors both for basic research and drug discovery. However, with such massive amounts of data comes a need for automatic analysis tools. Our research concentrates on how human knowledge can be best integrated into intelligent computer algorithms for automated microscopy. To reach this goal, we have interest in image processing that is concerned with extracting biologically relevant quantitative information in 3-4-5D imaging and multi-parametric machine learning analysis that is necessary to make sense of this information. Recently, machine learning algorithms have become a popular solution for analyzing large single cell-based imaging scenarios. We concentrate on improving the state-of-the-art by detecting unusual patterns corresponding to unknown phenotypes.

TECHNIQUES AVAILABLE IN THE LAB

Various microscopy and computational techniqes are available in the BIOMAG laboratory. These include high-content screening, confocal, laser microdissection, light-sheet, point scanning confocal microscopy; and various image analysis and machine learning approaces and software and hardware infrastructure.

SELECTED PUBLICATIONS

Pfisterer, S., Gateva, G., **Horvath, P.**, Pirhonen, J., Salo, V., Karhinen, L., Varjosalo, M., Ryhänen, S., Lappalainen, P., Ikonen, E. (2017) Role for formin-like 1-dependent acto-myosin assembly in lipid droplet dynamics and lipid storage. **Nat Commun 8:** 14858.

Horvath, P., Aulner, N., Bickle, M., Davies, A., Del Nery, E., Ebner, D., Montoya, M., Ostling, P., Pietiainen, V., Price, L., Shorte, S., Turcatti, G., von Schantz, C., Carragher, N. (2016) Screening out irrelevant cell-based models of disease. **Nat Rev Drug Discov 15:** 751–769.

Molnar, Cs., Jermyn, I., Kato, Z., Rahkama, V., Ostling, P., Mikkonen, P., Pietiainen, V., **Horvath, P.** (2016) Accurate morphology preserving segmentation of overlapping cells based on active contours. **Sci Rep 6:** 32412.

Piccinini, F., Kiss, A., **Horvath, P**. (2015) CellTracker (not only) for dummies. **Bioinformatics 32:** 955-957.

Smith, K., Li, Y., Piccinini, F., Csucs, G., Balazs, C., Bevilacqua, A., **Horvath, P.** (2015) CIDRE: an illumination-correction method for optical microscopy. **Nat Methods 12:** 404–406.

Banerjee, I., Miyake, Y., Nobs, S. P., Schneider, C., **Horvath, P.**, Kopf, M., Matthias, P., Helenius, A., Yamauchi, Y. (2014) Influenza A virus uses the aggresome processing machinery for host cell entry. **Science 346:** 473-7.

ATTILA HUNYADI

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RESEARCH AREA

Cancer is a leading cause of morbidity and mortality worldwide, and it is expected that annual cancer cases will rise from 14 million in 2012 to around 22 million within the next two decades. Resistance is a major factor promoting failure of chemotherapy and there is an urgent need for new therapeutic strategies. By following a natural product inspired drug discovery strategy, our group focuses on novel chemical approaches to fight cancer and particularly multi-drug resistant cancer. In this endeavor, we aim at the preparation of nature-inspired chemical scaffolds that can act as chemo-sensitizers on resistant tumor cells, hence can be used as non-toxic adjuvants in combination with chemotherapeutics. A broad scale of interesting natural products is utilized as starting materials, e.g. well-known antioxidants, insect hormones utilized as anabolic food supplements, etc. Thanks to this and to our intensive international collaboration, an inspiring multidisciplinary working environment awaits the candidates to join our team.

TECHNIQUES AVAILABLE IN THE LAB

Extraction and preparation of herbal constituents, as well as simple chemical reactions for their structural modification, a wide array of separation techniques used in natural product chemistry, including analytical and preparative HPLC, supercritical fluid HPLC (SFC), centrifugal partition chromatography (CPC), rotational planar chromatography, TLC and column chromatography, structure elucidation by spectroscopic techniques (NMR, MS, UV-VIS).

SELECTED PUBLICATIONS

Fási, L., Di Meo, F., Kuo, C.Y., Stojkovic Buric, S., Martins, A., Kúsz, N., Béni, Z., Dékány, M., Balogh, G.T., Pesic, M., Wang, H.C., Trouillas, P., **Hunyadi, A.** (2019) Antioxidant-inspired drug discovery: antitumor metabolite is formed in situ from a hydroxycinnamic acid derivative upon free radical scavenging. **J Med Chem 62:** 1657-1668.

Hunyadi, A. (2019) The mechanism(s) of action of antioxidants: from scavenging reactive oxygen/nitrogen species to redox signaling and the generation of bioactive secondary metabolites. **Med Res Rev 39:** 2505-2533.

Vágvölgyi, M., Martins, A., Kulmány, Á., Zupkó, I., Gáti, T., Simon, A., Tóth, G., **Hunyadi, A.** (2018) Nitrogen-containing ecdysteroid derivatives vs. multi-drug resistance in cancer: Preparation and antitumor activity of oximes, oxime ethers and a lactam. **Eur J Med Chem 144:** 730-739.

Hunyadi, A., Herke, I., Lengyel, K., Báthori, M., Kele, Z., Simon, A., Tóth, G., Szendrei, K. (2016) Ecdysteroid containing food supplements from Cyanotis arachnoidea on the European market: evidence for spinach product counterfeiting. **Sci Rep 6:** 37322.

Csábi, J., Hsieh, T.J., Hasanpour, F., Martins, A., Kele, Z., Gáti, T., Simon, A., Tóth, G., **Hunyadi, A.** (2015) Oxidized Metabolites of 20-Hydroxyecdysone and their Activity on Skeletal Muscle Cells: Preparation of a Pair of Desmotropes with Opposite Bioactivities. **J Nat Prod 78:** 2339-2345.

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RESEARCH AREA

Autophagy is a fundamental catabolic pathway in eukaryotic cells. During the main route, portions of cytosol and organelles are captured into double-membrane autophagosomes, which then fuse with lysosomes to deliver their cargo for degradation and reuse. Our group is studying the role and mechanisms of autophagy mainly using the popular animal model Drosophila. We are also working on related trafficking pathways including endocytosis and crinophagy (secretory granule degradation). In recent years, we have started experiments to understand the regulation of lysosomal function.

TECHNIQUES AVAILABLE IN THE LAB

Genetic manipulation of Drosophila and cultured human cells: gene knockouts, transgenic reporter constructs, mosaic analysis. Confocal microscopy, autophagic degradation and endocytic uptake and degradation assays. Transmission electron microscopy. Western blots, immunoprecipitations, proteomic analysis (done by the core facility). Cell culture facilities, yeast twohybrid, molecular cloning, RT-PCR and qPCR. Purification of recombinant proteins, biochemical binding and structural assays, antibody production.

SELECTED PUBLICATIONS

Lőrincz, P., Kenéz, L.A., Tóth, S., Kiss, V., Varga, Á., Csizmadia, T., Simon-Vecsei, Z., **Juhász, G.** (2019) Vps8 overexpression inhibits HOPS-dependent trafficking routes by out-competing Vps41/Lt. **Elife 8:** e45631.

Csizmadia, T., Lőrincz, P., Hegedűs, K., Széplaki, S., Lőw, P., **Juhász, G.** (2018) Molecular mechanisms of developmentally programmed crinophagy in Drosophila. **J Cell Biol 217:** 361-374.

Katheder, NS., Khezri, R., O'Farrell, F., Schultz, S.W., Jain, A., Rahman, M.M., Schink, K.O., Theodossiou, T.A., Johansen, T., **Juhász, G.**, Bilder, D., Brech, A., Stenmark, H., Rusten, T.E. (2017) Microenvironmental autophagy promotes tumour growth. **Nature 541:** 417-420.

Lorincz, P., Lakatos, Z., Varga, A., Maruzs, T., Simon-Vecsei, Z., Darula, Z., Benko, P., Csordas, G., Lippai, M., Ando, I., Hegedus, K., Medzihradszky, K., Takats, S., **Juhasz, G.** (2016) MiniCORVET is a Vps8-containing hemocyte- and nephrocyte-specific early endosomal tether in Drosophila. **Elife 5:** e14226.

Takats, S., Nagy, P., Varga, A., Pircs, K., Karpati, M., Varga, K., Kovacs, A.L., Hegedus, K., **Juhasz, G.** (2013) Autophagosomal Syntaxin17-dependent lysosomal degradation maintains neuronal function in Drosophila. **J Cell Biol 201:** 531-539.

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RESEARCH AREA

Sepsis remains one of the leading causes of death in the intensive care units which necessitates the development of new diagnostic tools and novel, more efficient therapeutic possibilities. The basic problem in sepsis is the discrepancy between oxygen delivery and oxygen consumption which can lead to irreversible oxygen extraction deficit and energy shortage. The cornerstone of acute care should be to prevent, assess and treat oxygen debt globally. We propose that causative factors and signs of oxygen deficit have to be examined together on microcirculatory, cellular (endothelial) and subcellular (mitochondrial) levels in different shock-affected organs (e.g. the intestine and lung) by employing sufficiently long-term, clinically relevant experimental models. With this theoretical background, the major goal of our study is to find optimal, clinically applicable manoeuvres for microcirculatory recruitment and mitochondrial resuscitation to minimize the energy deficit of organs during the septic response.

TECHNIQUES AVAILABLE IN THE LAB

Our research laboratories are equipped with instruments to identify macro- and microcirculatory changes (hemodynamic computerized data-acquisition and analysis systems, laser-Doppler flowmetry, fluorescence-based intravital microscopy, orthogonal polarisation spectral imaging). Fluorescence confocal laser scanning endomicroscopy technique offers the possibility of acquiring precise *in vivo* data for histological analysis. A high resolution respirometer is available for examination of mitochondrial function (activities of the components of electron transport chain) and additional laboratory facilities (ELISA) to study inflammatory biomarkers. Animal house and fully-equipped operating theatres are available for surgical intervention of small (rats) and larger animals (minipigs).

SELECTED PUBLICATIONS

Poles, M.Z., Bódi, N., Bagyánszki, M., Fekete, É., Mészáros, A.T., Varga, G., Szűcs S., Nászai, A., Kiss, L., Kozlov, A.V., Boros, M., **Kaszaki, J.** (2018) Reduction of nitrosative stress by methane: Neuroprotection through xanthine oxidoreductase inhibition in a rat model of mesenteric ischemia- reperfusion. **Free Radic Biol Med 120:** 160-169.

Érces, D., Nógrády, M., Varga, G., Szűcs, S., Mészáros, A.T., Fischer-Szatmári, T., Cao, C., Okada, N., Okada, H., Boros, M., **Kaszaki, J.** (2016) Complement C5a inhibition improves late hemodynamic and inflammatory changes in a rat model of nonocclusive mesenteric ischemia. **Surgery 159:** 960-971.

Érces, D., Nógrády, M., Nagy, E., Varga, G., Vass, A., Süveges, G., Imai, M., Okada, N., Okada, H., Boros, M., **Kaszaki, J.** (2013) Complement c5a antagonist treatment improves the acute circulatory and inflammatory consequences of experimental cardiac tamponade. **Crit Care Med 41:** 344-351.

Boros, M., Ghyczy, M., Érces, D., Varga, G., Tőkés, T., Kupai, K., Torday, Cs., **Kaszaki, J.** (2012) The anti-inflammatory effects of methane. **Crit Care Med 40:** 1269-1278.

Kaszaki, J., Érces, D., Varga, G., Szabó, A., Vécsei, L., Boros, M. (2012) Kynurenines and intestinal neurotransmission – the role of N-methyl-D-aspartate receptors. **J Neural Transm 119:** 211-223.

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RESEARCH AREA

Skeletal muscle is a highly dynamic tissue that can undergo successful regeneration upon injury, and change in size in response to exercise, aging or due to diseases (e.g. cancer cachexia, immobilization, or denervation). The muscle stem cells, satellite cells are stimulated by local damage to proliferate extensively and form myoblasts that will subsequently migrate, differentiate and fuse to form muscle fibers. Our research aims are to study (i) the signaling pathways and mechanisms in myoblast migration, differentiation, and fusion (ii) the role of exosomes in cell migration, (iii) the biology of satellite cells. Moreover, we investigate the molecular mechanisms regulating skeletal muscle mass, and we aimed to find new nanotechnological approaches for the local treatment of muscle atrophy. Skeletal muscle has an important role in whole-body metabolism, it accounts for 40% of adult human body weight, and about 90% of insulin-stimulated glucose uptake occurs in skeletal muscle. The vesicular transport of GLUT4 glucose transporters is impaired in cases of insulin resistance and type-2 diabetes mellitus leading to decreased glucose uptake of skeletal muscle and increased blood glucose level. Our further aim is to study this mechanism and to find new signaling pathways regulating glucose uptake of skeletal muscle. Our work is mainly basic research and we have strong scientific collaborations with clinicians.

TECHNIQUES AVAILABLE IN THE LAB

Mammalian tissue culture techniques, in vivo animal models, primary cell isolation, single myofiber and satellite cell isolation, immunocytochemistry, immunohistochemistry, fluorescent microscopy techniques, image analysis, analysis of cell migration, flow cytometry, cell cycle analysis, cell proliferation assays, spectrophotometry (measurement of enzyme activities, metabolites), PCR, co-immunoprecipitation, GTP-ase activity assays, Western blotting, glucose tolerance test, insulin tolerance test.

SELECTED PUBLICATIONS

Szabo, K., Varga, D., Vegh, AG., Liu, N., Xiao, X., Xu, L., Dux, L., Erdelyi, M., Rovo, L., **Keller-Pinter, A.** (2022) Syndecan-4 affects myogenesis via Rac1-mediated actin remodeling and exhibits copy-number amplification and increased expression in human rhabdomyosarcoma tumors. **Cell Mol Life Sci 79:** 122.

Becsky, D., Szabo, K., Gyulai-Nagy, S., Gajdos, T., Bartos, Z., Balind, A., Dux, L., Horvath, P., Erdelyi, M., Homolya, L., **Keller-Pinter, A.** (2020) Syndecan-4 Modulates Cell Polarity and Migration by Influencing Centrosome Positioning and Intracellular Calcium Distribution. **Front Cell Dev Biol 15:** 575227.

Becsky, D., Gyulai-Nagy, S., Balind, A., Horvath, P., Dux, L., **Keller-Pinter, A**. (2020) Myoblast Migration and Directional Persistence Affected by Syndecan-4-Mediated Tiam-1 Expression and Distribution. **Int J Mol Sci 21:** 823.

Keller-Pinter, A., Szabo, K., Kocsis, T., Deak, F., Ocsovszki, I., Zvara, A., Puskas, L., Szilak, L., Dux, L. (2018) Syndecan-4 influences mammalian myoblast proliferation by modulating myostatin signalling and G1/S transition. **FEBS Lett 592:** 3139-3151.

Kocsis, T., Trencsenyi, G., Szabo, K., Baán, J.A., Müller, G., Mendler, L., Garai, I., Reinauer, H., Deak, F., Dux, L., **Keller-Pintér, A.** (2016) Myostatin propeptide mutation of the hypermuscular Compact mice decreases the formation of myostatin and improves insulin sensitivity. **Am J Physiol Endocrinol Metab 312:** E150-E160.

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RESEARCH AREA

Trillions of bacteria, fungi and viruses colonize the skin surface, collectively comprising the skin microbiome. There is a continous interaction in between the microbas and the different cells in the skin. Recent data suggest, that the skin commensal bacteria play an important role in providing a protection against more harmful bacteria, and in the regulation of skin immune system. Commensal bacteria can activate the different cells in the skin to produce inflammatory mediators. However, it is not known, how the skin cells can differentiate in between commensal and pathogenic bacterias? How do we tolerate the great number of bacteria without inducing inflammation in the skin? In special circumstances, the commensal flora has been suggested to play a role in the induction or in the maintenace of chronic inflammatory skin diseases, such as acne, rosacea or psoriasis. Important member of the skin's commensal flora is the bacterium called *Propionibacterium acnes (P. acnes)*. Even though it resides in the pilosebaceous unit of the skin, under certain circumstances it may also play an important role in the pathogenesis of acne, the most common inflammatory skin disease. We investigate how and when this commensal microbe turns pathogenic and how this bacterium influences the skin immune system.

TECHNIQUES AVAILABLE IN THE LAB

Various cell separation techniques, cell culturing methods, flow cytometry, immune-staining techniques of tissues and cells, protein, mRNS detection, cell cycle analysis, cell proliferation measurements.

SELECTED PUBLICATIONS

Buzas, K., Marton, A., Vizler, C., Gyukity-Sebestyen, E., Harmati, M., Nagy, K., Zvara, A., Katona, R.L., Tubak, V., Endresz, V., Németh, I., Olah, J., Vigh, L., Biro, T., **Kemeny, L.** (2016) Bacterial sepsis increases survival in metastatic melanoma: Chlamydophila pneumoniae induces macrophage polarization and tumor regression. **J Invest Dermatol 136:** 862-865.

Tax, G., Urbán, E., Palotás, Zs., **Kemény, L.**, Szabó, K. (2016) Propionic acid produced by Propionibacterium acnes strains contribute to their pathogenicity. **Acta Derm Venereol 93:** 43-49.

Manczinger, M., **Kemény, L.** (2013) Novel factors in the pathogenesis of psoriasis and potential drug candidates are found with systems biology approach. **Plos One 8:** e80751.

Szabó, K., **Kemény, L.** (2011) Studying the genetic predisposing factors in the pathogenesis of acne vulgaris. **Human Immunol 72:** 766–773.

Kinyó, A., Kiss-László, Z., Hambalkó, S., Bebes, A., Kiss, M., Széll, M., Bata-Csörgő, Z., Nagy, F., **Kemény, L.** (2010) COP1 contributes to UVB-induced signaling in human keratinocytes. **J Invest Dermatol 130:** 541–545.

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RESEARCH AREA

One of the best method to acquire data about brain structure and function is magnetic resonance imaging (MRI). The structure can be measured at different levels: the volume of the brain, gray and white matter and the subcortical structures can be estimated from structural scans, and microscopic information about the tissue integration can be gathered from diffusion weighted MRI images. Brain regions activating during certain tasks can be identified with MR sequences sensitive for the blood oxygen content. And the very same functional MRI acquisition can be utilised to detect the resting activity fluctuations in the brain. The synchronous activity fluctuations of remote brain regions identifies functional networks. The time-dependent changes of these connections mark out brain states. In our research group we investigate the alterations of brain structure and function in various neurological disorders. Headache disorders: Our studies pointed out that the pathomechanism in migraineurs experiencing aura symptoms before the headache is very different from those patients who has no aura symptom. The microstructure of the white matter shows marked differences in the two subtype of the disease that is correlated with the resting activity fluctuation of the white matter. Multiple sclerosis: We showed that the disintegration of the periventricular white matter has a close relationship with the cortical atrophy. Our results called attention to the fact that various forms of clinical disability and cognitive disfunction is defined by different set of MRI measured parameters. Stroke: Our investigations showed that the resting activity fluctuation of the hypoperfused brain is delayed as compared to the homologous contralateral normal side. Furthermore we showed that the functional hyperaemia is delayed in stroke patients. Our newest results indicated that the functional connectivity of the contralesional motor cortex is altered that is a function of functional recovery.

TECHNIQUES AVAILABLE IN THE LAB

Theory of the MRI measurements. Human neuro-physiological techniques: EEG, evoked potentials, transcranial magnetic and direct current stimulations. Structural MRI investigations: Brain volumetry, processing of diffusion tensor images, tractography. Functional MRI investigations: Detection of task-related brain activation patterns, evaluation of resting state fMRI data, independent component analysis, dynamic functional connectivity. Basic programming skills: Matlab, Python, bash. Statistical approaches: conventional modell based approaches, permutation, bootsrapping. Neurological examination of patients. Neuroradiological evaluation of MRI images.

SELECTED PUBLICATIONS

Faragó, P., Tóth, E., Kocsis, K., Kincses, B, Veréb, D., Király, A., Bozsik, B., Tajti, J., Párdutz, Á., Szok, D., Vécsei, L., Szabó, N., **Kincses, Z.T.** (2019) Altered Resting State Functional Activity and Microstructure of the White Matter in Migraine With **Aura. Front Neurol 10:** 1039.

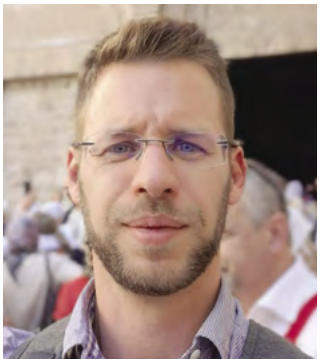
Kincses, B., Hérák, BJ., Szabó, N., Bozsik, B., Faragó, P., Király, A., Veréb, D., Tóth, E., Kocsis, K., Bencsik, K., Vécsei, L., **Kincses, Z.T**. (2019) Gray Matter Atrophy to Explain Subclinical Oculomotor Deficit in Multiple Sclerosis. **Front Neurol 10:** 589.

Kocsis, K., Csete, G., Erdei, Z., Király, A., Szabó, N., Vécsei, L., **Kincses, Z.T**. (2019) Lateralisation of the white matter microstructure associated with the hemispheric spatial attention dominance. **PLoS One 14: e**0216032.

Tóth, E., Faragó, P., Király, A., Szabó, N., Veréb, D., Kocsis, K., Kincses, B., Sandi, D., Bencsik, K., Vécsei, L., **Kincses, Z.T**. (2019) The Contribution of Various MRI Parameters to Clinical and Cognitive Disability in Multiple Sclerosis. **Front Neurol 9:** 1172.

Veréb, D., Szabó, N., Tuka, B., Tajti, J., Király, A., Faragó, P., Kocsis, K., Tóth, E., Kincses, B., Bagoly, T., Helyes, Z., Vécsei, L., **Kincses, Z.T**. (2018) Correlation of neurochemical and imaging markers in migraine: PACAP38 and DTI measures. **Neurology 91:** e1166-e1174.

BÁLINT KINTSES



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RESEARCH AREA

The human body is a complex ecosystems consisting of the host and its associated microbiota made up of hundreds of beneficial commensal and disease causing pathogenic and opportunistic pathogenic bacterial species. As modern human lifestyles keep changing the ecological environment of the human microbiota at an unprecedented pace, these bacteria respond to these changes with continuous adaptation. A well known consequence of this process is the global antibiotic resistance crisis which is responsible for over 700,000 deaths annually, primarily driven by the emergence of multi-drug resistant opportunistic pathogenic bacteria. In our laboratory, we develop novel technologies in the field of synthetic biology, genomics and genome engineering for two complementary goals. First, to understand the evolutionary dynamics of antibiotic resistance development, and second, to develop novel therapeutic approaches designed to selectively target multi-drug resistant pathogenic bacteria. Beyond asking fundamental scientific questions, we are interested in the utilisation and commercialisation of our inventions.

TECHNIQUES AVAILABLE IN THE LAB

Functional genomics and functional metagenomics, bacterial genome engineering, phage biology and phage engineering, directed evolution, molecular biology and DNA cloning techniques, classic and state-of-the-art microbiology techniques, working with biology safety level 2 pathogenic bacteria, 16S rRNA sequencing of the gut microbiome, next-generation sequencing techniques, data analysis and bioinformatics in R.

SELECTED PUBLICATIONS

Kintses, B., Kumar, P., Jangir, PK,, Fekete, G., Számel, M., Méhi, O., Spohn, R., Daruka, L,, Martins, A., Hosseinnia, A., Gagarinova, A., Kim, S., Phanse, S., Csörgö, B., Györkei, A., Ari, E., Lázár, V., Faragó, A., Bodai, L., Nagy, I., Babu, M., Pál, C., Papp, B. (2019) Chemical-genetic profiling reveals cross-resistance and collateral sensitivity between antimicrobial peptides. **Nat Commun 10:** 5731.

Kintses, B., Méhi, O., Ari, E., Számel, M., Györkei, Á., Jangir, PK., Nagy, I., Pál, F., Fekete, G., Tengölics, R., Nyerges, Á., Likó, I., Bálint, A., Molnár, T., Bálint, B., Vásárhelyi, BM., Bustamante, M., Papp, B., Pál, C. (2019) Phylogenetic barriers to horizontal transfer of antimicrobial peptide resistance genes in the human gut microbiota. **Nature Microbiology 4:** 447-458.

Nyerges, Á., Csörgő, B., Draskovits, G., **Kintses, B.**, Szili, P., Ferenc, G., Révész, T., Ari, E., Nagy, I., Bálint, B., Vásárhelyi, BM., Bihari, P., Számel, M., Balogh, D., Papp, H., Kalapis, D., Papp, B., Pál, C. (2018) Directed evolution of multiple genomic loci allows the prediction of antibiotic resistance. **Proc Natl Acad Sci U S A 115:** E5726-E5735.

Colin, PY., **Kintses, B.**, Gielen, F., Miton, C., Fischer, G., Mahomed, M., Hyvonen, M., Morgavi, DP., Janssen, DB., Hollfelder, F. (2015) Ultrahigh-throughput Discovery of Promiscuous Enzymes by Picodroplet Functional Metagenomics. **Nature Communications 6:** 10008.

Notebaart, RA., Szappanos, B., **Kintses, B.***, Pál, F., Györkei, Á., Bogos, B., Lázár, V., Spohn, R., Csörgő, B., Wagner, A., Ruppin, E., Pál, C., Papp, B. (2014) Network-level architecture and the evolutionary potential of underground metabolism. **Proc Natl Acad Sci U S A** 111: 11762-7.

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RESEARCH AREA

The general strategy to treat cancer relies largely on traditional chemotherapy using small molecular drugs. Although conventional chemotherapy has a decent success rate it frequently causes severe side effects and can even result in the evolution of multidrug resistant cancer phenotypes. Nanoparticle based treatment of solid tumors is regarded as a novel, attractive strategy to improve cancer therapy, since approximately 10-200 nm sized materials are selectively accumulated in tumor tissues due to the passive targeting effect, where many of them, especially metallic particles can exert direct anti-cancer activity. Owing to their large surface area nanomaterials can also serve as controllable delivery platforms of various cytotoxic drugs for active tumor targeting. Our research group investigates the cellular and molecular events behind the anti-cancer activity of different types of metal nanoparticles in *in vitro* and *in vivo* animal model systems.

TECHNIQUES AVAILABLE IN THE LAB

Standard cell and tissue culture techniques, *in vitro* model systems, co-cultures, testing drugs and nanomaterials, toxicity screens, cell migration and invasion assays, biochemical and molecular biology methods, ELISA, Western blot analysis, RT-qPCR, next generation sequencing, fluorescent and confocal microscopy, histological analysis, immunocytochemistry, reporter systems, gene silencing.

SELECTED PUBLICATIONS

Gopisetty, M.K., Kovács, D., Igaz, N., Rónavári, A., Bélteky, P., Rázga, Z., Venglovecz, V., Csoboz, B., Boros, I.M., Kónya, Z., **Kiricsi, M.** (2019) Endoplasmic reticulum stress: major player in size-dependent inhibition of P - glycoprotein by silver nanoparticles in multidrug-resistant breast cancer cells. **J Nanobiotechnol 17:** 9.

Huliák, I., Bodai, L., Czepán, M., Kovács, D., Szabó, A., Tiszlavicz, L., Lázár, G., Rakonczay, Z. Jr, Hegyi, P., Boros, I.M., **Kiricsi, M.** (2019) Genetic, epigenetic and transcriptional comparison of esophagus tumor-associated and adjacent normal myofibroblasts. **Oncology Rep 41:** 839-852.

Igaz, N., Kovács, D., Rázga, Z., Kónya, Z., Boros, I.M., **Kiricsi, M.** (2016) Modulating chromatin structure and DNA accessibility by deacetylase inhibition enhances the anticancer activity of silver nanoparticles. **Colloids Surf B Biointerfaces 146:** 670-7.

Kovács, D., Igaz, N., Keskeny, C., Bélteky, P., Tóth, T., Gáspár, R., Madarász, D., Rázga, Z., Kónya, Z., Boros, I.M., **Kiricsi, M.** (2016) Silver nanoparticles defeat p53-positive and p53-negative osteosarcoma cells by triggering mitochondrial stress and apoptosis. **Sci Rep 6:** 27902.

Kovács, D., Szőke, K., Igaz, N., Spengler, G., Molnár, J., Tóth, T., Madarász, D., Rázga, Z., Kónya, Z., Boros, I.M., **Kiricsi, M.** (2016) Silver nanoparticles modulate ABC transporter activity and enhance chemotherapy in multidrug resistant cancer. **Nanomedicine 12:** 601-10.

ISTVÁN KRIZBAI

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RESEARCH AREA

The central nervous system is one of the most complex and meantime the most sensitive part of our organism. For its proper function the central nervous system needs a steady state environment which is largely provided by the neurovascular unit. In this respect changes in functions of the neurovascular unit have important consequences in causing or aggravating a large number of neurological diseases. The main goal of our research is to understand the molecular mechanisms underlying the function of the neurovascular unit under physiological and pathological conditions. For this purpose, we use different *in vitro* models and *in vivo* two-photon microscopy. On the one side, we investigate the role of neurovascular unit in the formation of brain metastases and the mechanisms of migration of tumour cells into the brain. On the other hand, we investigate how cellular components of the neurovascular unit (brain endothelial cells, pericytes, astrocytes) communicate with each other in neurological disorders associated with aging and with inflammatory processes.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of different cell types from mammalian brain, cell culture, *in vitro* model systems including disease models, barrier permeability studies, biochemical and molecular biology methods, ELISA, fluorescence and confocal microscopy, *in vivo* two-photon and superresolution (STED) microscopy.

SELECTED PUBLICATIONS

Haskó, J., Fazakas, C., Molnár, K., Mészáros, Á., Patai, R., Szabó, G., Erdélyi, F., Nyúl-Tóth, Á., Győri, F., Kozma, M., Farkas, A.E., **Krizbai, I.A.***, Wilhelm, I.*. (2019) Response of the neurovascular unit to brain metastatic breast cancer cells. **Acta Neuropathol Commun 7:** 133. *corresponding authors

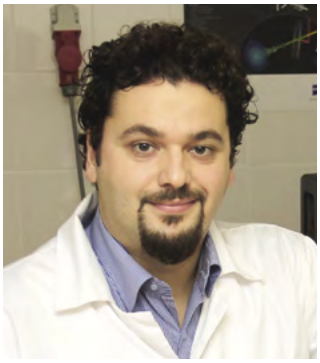
Wilhelm, I., Fazakas, C., Molnár, K., Végh, A.G., Haskó, J., **Krizbai, I.A.** (2018) Foe or friend? Janus- faces of the neurovascular unit in the formation of brain metastases. **J Cereb Blood Flow Metab 38:** 563-587.

Nyúl-Tóth, Á., Kozma, M., Nagyőszi, P., Nagy, K., Fazakas, C., Haskó, J., Molnár, K., Farkas, A.E., Végh, A.G., Váró, G., Galajda, P., Wilhelm, I., **Krizbai, I.A.** (2017) Expression of pattern recognition receptors and activation of the non-canonical inflammasome pathway in brain pericytes. **Brain Behav Immun 64:** 220-231.

Nyúl-Tóth, Á., Suciu, M., Molnár, J., Fazakas, C., Haskó, J., Herman, H., Farkas, A.E., Kaszaki, J., Hermenean, A., Wilhelm, I., **Krizbai, I.A.** (2016) Differences in the molecular structure of the blood-brain barrier in the cerebral cortex and white matter: an in silico, in vitro and ex vivo study. **Am J Physiol Heart Circ Physiol 310:** H1702-14.

Nagyőszi, P., Nyúl-Tóth, Á., Fazakas, C., Wilhelm, I., Kozma, M., Molnár J., Haskó, J., **Krizbai, I.A.** (2015) Regulation of NODlike receptors and inflammasome activation in cerebral endothelial cells. **J Neurochem 135:** 551-64.

JÓZSEF MALÉTH



University of Szeged
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First Department of Medicine

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RESEARCH AREA

Epithelial cells are essential orchestrators of organ physiology by determining fluid and volume homeostasis and secreting many biologically active compounds (including enzymes and mucins). Furthermore impaired epithelial function is associated with a plethora of severe and potentially lethal diseases, such as cystic fibrosis, or acute pancreatitis, whereas malignant epithelial transformation leads to different forms of cancer. Thus, epithelial functions are extensively regulated, but the details of these regulatory pathways are not well understood. I believe that the detailed understanding of complex epithelial functions will lead to better treatment of lethal diseases therefore in my research projects I focus on the physiological and pathophysiological roles of pancreatic epithelial cells.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of pancreatic acinar and ductal cells, pancreatic organoid cultures, cell culture techniques, confocal microscopy, fluorescent microscopy (intracellular pH, Ca^{2+} concentration measurements), immunofluorescent staining, cell transfection, plasmid purification, transformation, fluorescence resonance energy transfer (FRET) measurements, measurement of pancreatic ductal fluid secretion, Western blot analysis, qPCR, induction of acute pancreatitis in animals, measurement of enzyme (amylase, trypsin, myeloperoxidase, lactate dehydrogenase) activities, histological analysis.

SELECTED PUBLICATIONS

Maléth, J., Balla, Z., Kui, B., Balázs, A., Katona, M., Judák, L., Németh, I., Pallagi, P., Kemény, L.V., Rakonczay, Jr., Z., Venglovecz, V., Földesi, I., Pető, Z., Somorácz, Á., Borka, K., Perdomo, D., Lukacs, G.L., Gray, M.A., Monterisi, S., Zaccolo, M., Sendler, M., Mayerle, J., Kühn, J.P., Lerch, M.M., Sahin-Tóth, M., Hegyi, P. (2015) Alcohol Disrupts Levels and Function of the Cystic Fibrosis Transmembrane Conductance Regulator to Promote Development of Pancreatitis. **Gastroenterology 148:** 427-39.e16.

Maléth, J., Choi, S., Muallem, S., Ahuja, M. (2014) Translocation Between PI(4,5)P2-Poor and PI(4,5)P2-Rich Microdomains During Store Depletion Determines STIM1 Conformation and Orai1 Gating. **Nat Commun 17:** 5843.

Jha, A., Ahuja, M., **Maléth, J.**, Moreno, C.M., Yuan, J.P., Kim, M.S., Muallem, S. (2013) The STIM1 CTID domain determines access of SARAF to SOAR to regulate Orai1 channel function. **J Cell Biol 202:** 71-9.

Pallagi, P., Venglovecz, V., Rakonczay, Jr., Z., Borka, K, Korompay, A., Ózsvári, B., Judák, L., Sahin-Tóth, M., Geisz, A., Schnúr, A., **Maléth, J.**, Takács, T., Gray, M.A., Argent, B.E., Mayerle, J., Lerch, M.M., Wittman, T., Hegyi, P. (2011) Trypsin reduces pancreatic ductal bicarbonate secretion by inhibiting CFTR Cl^- channels and luminal anion exchangers. **Gastroenterology 141:** 2228–2239.e6.

Maléth, J., Venglovecz, V., Rázga, Zs., Tiszlavicz, L., Rakonczay, Jr., Z., Hegyi, P. (2011) The non-conjugated chenodeoxycholate induces severe mitochondrial damage and inhibits bicarbonate transport in pancreatic duct cells. **Gut 60:** 136-8.

MÁTÉ MANCZINGER

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Institute of Biochemistry

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Department of Dermatology and Allergology

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RESEARCH AREA

How does our immune system distinguish between billions of molecules? What are the main determinants of immune recognition? What factors explain that certain people are more likely to get infections or cancer, while others are protected from these diseases? My research group aims to answer these questions. We focus on the adaptive immune system, which recognizes specific molecular motifs of pathogens, cancer and our self-cells. While this system is extremely completed, it is controlled by some less complicated laws, which we intend to characterize in detail. For example, while one would expect that the immune system is more likely to recognize molecular motifs that are highly dissimilar to our self-molecules, we showed that overly high dissimilarity hinders immune recognition. Moreover, adaptive immune recognition is largely influenced by diverse genetic factors resulting in variable susceptibility to infections, cancer and autoimmune diseases. If you would like to take part in untangling the complexity of adaptive immune recognition, don't hesitate to join us!

TECHNIQUES AVAILABLE IN THE LAB

Data science; Modern statistical methods; Programming; Big data analysis; Advanced data visualization; Machine learning

SELECTED PUBLICATIONS

Koncz, B., Balogh, G. M., Papp, B. T., Asztalos, L., Kemény, L., & **Manczinger, M.** (2021). Self-mediated positive selection of T cells sets an obstacle to the recognition of nonself. P**roceedings of the National Academy of Sciences 118:** e2100542118.

Manczinger, M., Koncz, B., Balogh, G. M., Papp, B. T., Asztalos, L., Kemény, L., Papp, B. & Pál, C. (2021). Negative trade-off between neoantigen repertoire breadth and the specificity of HLA-I molecules shapes antitumor immunity. **Nature Cancer 2:** 950-961.

Manczinger, M., Boross, G., Kemény, L., Müller, V., Lenz, T. L., Papp, B., & Pál, C. (2019). Pathogen diversity drives the evolution of generalist MHC-II alleles in human populations. **PLoS biology 17:** e3000131.

Manczinger, M., Kemény, L. (2018). Peptide presentation by HLA-DQ molecules is associated with the development of immune tolerance. **PeerJ 6:** e5118.

TAMÁS MARTINEK

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RESEARCH AREA

The aim of our research group is to create new macromolecules from unnatural building blocks (foldamers), of which 3D structure can be predicted and programmed. Manipulating protein-protein, protein-membrane and protein-carbohydrate interactions by these chemically well defined substances is a great challenge and holds promise. While small molecule drugs can not effectively decouple macromolecule interactions in general because of their geometry, the right sized and often used antibodies have many disadvantages. We utilize foldamers as artifical self-organizing protein mimetics to modulate protein interactions, to develop diagnostic tools and novel antibacterial materials.

TECHNIQUES AVAILABLE IN THE LAB

Foldamers are synthetised chemically by using automated methods and the desing heavily relies on computer modelling. Their structure is analyzed by HPLC-MS. To analyze protein-ligand interactions, NMR spectrometry is deployed with a special emphasis on protein NMR methods including 3D structure refinement and the analysis of protein dynamics. Proteins are produced via bacterial expression systems. We analyze protein – ligand interactions with the help of isothermal titration calorimetry and various fluorescent techniques. Biological activity of the compounds are tested in cell-based assays.

SELECTED PUBLICATIONS

Bhaumik K.N., Hetényi, A., Olajos, G., Martins, A., Spohn, R., Németh, L., Jojárt, B., Szili, P., Dunai, A., Jangir, P.K., Daruka, L., Földesi, I., Kata D., Pál, Cs., **Martinek, T.A.** (2022) Rationally designed foldameric adjuvants enhance antibiotic efficacy via promoting membrane hyperpolarization. **Molecular Systems Design & Engineering 7:** 21-33.

Imre, N., Hetényi A., Szabó, E., Bodnár, B., Szkalisity, A., Gróf, I., Bocsik, A., Deli M.A., Horváth, P., Czibula, Á., Monostori, É., **Martinek T.A.** (2020) Routing Nanomolar Protein Cargoes to Lipid Raft-Mediated/Caveolar Endocytosis through a Ganglioside GM1-Specific Recognition Tag. **Advanced Science 7:** 1902621.

Hegedus, Z., Makra, I., Imre, N., Hetényi, A., Mándity, I.M., Monostori, É., **Martinek, T.A.** (2016) Foldameric probes for membrane interactions by induced β-sheet folding. **Chemical Communications 52:** 1819.

Hegedus, Z., Weber, E., Kriston-Pal, E., Makra, I., Czibula, A., Monostori, E., **Martinek, T.A.** (2013) Foldameric alpha/beta-Peptide Analogs of the beta-Sheet-Forming Antiangiogenic Anginex: Structure and Bioactivity. **Journal of the American Chemical Society 135:** 16578-16584.

Berlicki, Ł., Pilsl L., Wéber, E., Mándity, I.M., Cabrele, C., **Martinek, T.A.,** Fülöp, F., Reiser, O. (2012) Unique α,β- and α,α,β,β-peptide foldamers based on cis-β-aminocyclopentanecarboxylic acid. **Angewandte Chemie International Edition 51:** 2208-2212.

LAJOS MÁTÉS

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RESEARCH AREA

Cancer is the leading cause of death in the developed world. According to estimates from the International Agency for Research on Cancer, there were 8.2 million cancer deaths in 2012 worldwide. Cancer research began as early as at the end of the 19th century, indicating the social efforts to control this devastating disease. In recent years, the tremendous advances reached in molecular biology and genomics has given further impetus to the development of this field. Among other things, the recently developed high-throughput sequencing technology platforms have generated massive amounts of genetic variation data from a huge number of cancer samples. The collected data support the concept that cancer is a disease of our genome, because in the majority of tumors tens or even hundreds of thousands of mutations have been detected. These data also show that the spontaneous mutation rate observed in normal cells is not sufficient to account for the high number of mutations found in cancers. The key feature of cancer cells, allowing them to rapidly evolve more and more new mutations, is the instability of their genetic material.

The long-term objective of our laboratory is to explore genetic alterations fuelling malignant transformation by undermining the stability of the genome.

TECHNIQUES AVAILABLE IN THE LAB

Basic molecular biological methods, involving isolation manipulation and analysis of DNA, RNA and proteins, standard mammalian tissue culture techniques, basic mouse colony management techniques, gene knockout and gene knockdown techniques, advanced gene delivery methods used in tissue culture and in animal models.

SELECTED PUBLICATIONS

Kopasz A.G., Pusztai D.Z., Karkas R., Hudoba L., Abdullah K.S.A., Imre G., Pankotai-Bodó G., Migh E., Nagy A., Kriston A., Germán P., Bakné Drubi A., Molnár A., Fekete I., Dani V.É., Ocsovszki I., Puskás L.G., Horváth P., Sükösd F., **Mátés L.** (2022) A versatile transposon-based technology to generate loss- and gain-of-function phenotypes in the mouse liver. **BMC Biology 20:** 74

Katter, K., Geurts, A.M., Hoffmann, O., **Mátés, L.,** Landa, V., Hiripi, L., Moreno, C., Lazar, J., Bashir, S., Zideke, V., Popova, E., Jerchowc, B., Beckerc, K., Devarajc, A., Walterj, I., Grzybowksib, M., Corbettb, M., Filhol, A.R., Hodgesb, M.R., Baderc, M., Ivics, Z., Jacob, H.J., Pravenec, M., Bősze, Z., Rülicke, T., Izsvák, Z. (2013) Transposon-mediated Transgenesis, Transgenic Rescue, and Tissue-specific Gene Expression in Rodents and Rabbit. **FASEB J 27:** 930-941.

Xue, X., Huang, X., Nodland, S.E., **Mátés, L.,** Ma, L., Izsvak, Z., Ivics, Z., LeBien, T.W., McIvor, R.S., Wagner, J.E., Zhou, X. (2009) Stable gene transfer and expression in cord blood-derived CD34+ hematopoietic stem and progenitor cells by a hyperactive Sleeping Beauty transposon system. **Blood 114:** 1319-1330.

Mátés, L., Chuah, M.K., Belay, E., Jerchow, B., Manoj, N., Acosta-Sanchez, A., Grzela, D.P., Schmitt, A., Becker, K., Matrai, J., Ma, L., Samara-Kuko, E., Gysemans, C., Pryputniewicz, D., Miskey, C., Fletcher, B., VandenDriessche, T., Ivics, Z., Izsvak, Z. (2009) Molecular evolution of a novel hyperactive Sleeping Beauty transposase enables robust stable gene transfer in vertebrates. **Nature Genet 41:** 753-761.

Ivics, Z., Li, M.A., **Mátés, L**., Boeke, J.D., Nagy, A., Bradley, A., and Izsvak, Z. (2009) Transposon-mediated genome manipulation in vertebrates. **Nat Methods 6:** 415-422.

JÓZSEF MIHÁLY

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Developmental Genetics Unit

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RESEARCH AREA

Coordinated regulation of the actin and microtubule cytoskeleton is known to play a pivotal role in the growth and proper navigation of neuronal axons and dendrites that are necessary to the formation of a functional nervous system. One of our major scientific interests is to gain a better understanding of the molecular mechanisms of axonal growth and guidance by uncovering the role of the growth cone cytoskeleton regulatory proteins. In addition, we are interested in the mechanisms of myofibrillogenesis. Myofibrils are composed of repeated sarcomeres that are extremely highly ordered macromolecular assemblies where structural organization is intimately linked to their functionality as contractile units. Recently, we developed a powerful nanoscopic approach that allowed us to determine the position of 27 muscle proteins with a quasi-molecular localization precision, and by means of template based protein structure modelling, we assembled a refined I-band and H-zone model with an unparalleled scope and resolution. We aim to combine this method with genetic approaches to investigate the molecular mechanisms of sarcomere assembly during muscle development. Our studies are of potential biomedical relevance as they may help to develop more efficient neuronal regeneration methods, and to understand sarcomere assembly and function in healthy and disease conditions.

TECHNIQUES AVAILABLE IN THE LAB

Classical and molecular Drosophila genetics, molecular biology, cell biology, cytoskeleton analysis, immunohistochemistry, the basic methods of biochemistry, confocal and super-resolution microscopy, behavioral tests, live imaging, digital image analysis.

SELECTED PUBLICATIONS

Szikora, S., Gajdos, T., Novák, T., Farkas, D., Földi, I., Lenart, P., Erdélyi, M., **Mihály, J.** (2020) Nanoscopy reveals the layered organization of the sarcomeric H-zone and I-band complexes. **J Cell Biol 219:** e201907026

Szikora, S., Földi, I., Tóth, K., Migh, E., Vig, A., Bugyi, B., Maléth, J., Hegyi, P., Kaltenecker, P., Sanchez-Soriano, N., **Mihály, J.** (2017) The formin DAAM is required for coordination of the actin and microtubule cytoskeleton in axonal growth cones. **J Cell Sci 130:** 2506-2519.

Nelson, K.S., Khan, Z., Molnár, I., **Mihály, J.,** Kaschube, M., Beitel, GJ. (2012) Drosophila Src regulates anisotropic apical surface growth to control epithelial tube size. **Nat Cell Biol 14:** 518-525.

Matusek, T., Gombos, R., Szécsényi, A., Sánchez-Soriano, N., Czibula, A., Pataki, C., Gedai, A., Prokop, A., Raskó, I., **Mihály, J.** (2008) Formin proteins of the DAAM subfamily play a role during axon growth. **J. Neurosci 28:** 13310-13319.

Boutros, M., **Mihaly, J.**, Bouwmeester, T., Mlodzik, M. (2000) Signaling specificity by Frizzled receptors in Drosophila. **Science 288:** 1825-1828.

LÁSZLÓ NAGY

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RESEARCH AREA

We are interested in the general principles of genomes evolution, that of the evolution of organismal complexity, fungal development and their biotechnological applications. Fungi are the most ubiquitous microbes in modern biotechnology which, despite centuries of research, offer huge unharnessed potentials. Our research focuses on gene regulatory networks underlying fungal morphogenesis and the degradation of complex plant polysaccharides (e.g. lignocellulose). Complex plant polysaccharides, such as lignin and cellulose, are the most abundant repositories of sequestered carbon on Earth. Fungi can most efficiently reintroduce this sequestered carbon into the carbon cycle, contributing a key step to ecosystem functioning worldwide. However, the genes and gene regulatory networks that underlie the fungal decomposition of complex plant biomass are unknown. Gene regulatory networks are finely tuned circuits that regulate precise spatial and temporal expression of genes. We use modern -omics, genetic, phylogenetic and bioinformatic approaches to uncover the evolutionary origins and genetic bases of fungal morphogenesis, multicellularity and to translate basic research results into biotechnological applications.

TECHNIQUES AVAILABLE IN THE LAB

Students applying to our research group can learn diverse techniques in the field of bioinformatics, modern high-throughput -omics, molecular and microbiology. We employ a wide repertoire of molecular biology methods, including polymerase chain reaction (PCR), gene knockout, CRISPR. Cas9, vector construction, protein and gene expression visualisation and various microscopy techniques. Of '-omics' methods, we employ genomics, genome-sequencing, transcriptome sequencing and perform bioinformatic analyses of data gerenated by these approaches. We employ state of the art long-read technologies (NanoPore). We use diverse bioinformatic pipelines for data-analysis, phylogenetic reconstruction, molecular clock, comparative genomic questions as well as develop novel algorithms and routines.

SELECTED PUBLICATIONS

Varga, T., et al., **Nagy, G.L.** (2019) Megaphylogeny resolves global patterns of mushroom evolution. **Nat Ecol Evol 3:** 668-678.

Krizsán, K., et al., **Nagy, G.L.** (2019) A transcriptomic atlas of mushroom development highlights an independent origin of complex multicellularity. **Proc Natl Acad Sci USA 116:** 7409-7418.

Kiss, E., Hegedus, B., Varga, T., Merenyi, Z., Koszo, T., Balint, B., Prasanna, A.N., Krizsan K., Riquelme, M., Takeshita, N., **Nagy, L.G.** (2019) Comparative genomics reveals the origin of fungal hyphae and multicellularity. **Nat Commun 10:** 4080.

Nagy, G.L., Kovács, G.M., Krizsán, K. (2018) Complex multicellularity in fungi: evolutionary convergence, single origin, or both? **Biol Rev Camb Philos Soc 93:** 1778-1794.

Sipos, G., et al., **Nagy, G.L.** (2017) Genome expansion and lineage-specific genetic innovations in the forest pathogenic fungi Armillaria. **Nat Ecol Evol 1:** 1931-1941.

NORBERT NAGY

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RESEARCH AREA

The cardiac electrophysiology investigates the electrical changes of the heart, including both the physiological and pathological functions as well as novel pharmacological interventions. The cardiovascular diseases, and especially the arrhythmias are leading cause of mortality. The arrhythmias have a complex underlying mechanism where the intracellular Ca2+ handling plays a critical role. Therefore, the main aim of our laboratory is the investigation of the physiological function of the cardiac Ca2+ handling, its role in different arrhythmias, and development of new pharmacological interventions. A novel antiarrhythmic strategy could be the selective inhibition of the cardiac Na+/Ca2+ exchanger that may decrease the excessive Ca2+ load of the cell, additionally may have positive inotropic effect. The sinus-node as a primary rhythm generator of the heart has an extremely complex electrophysiological mechanism, at the same time, it could be involved in several types of arrhythmias. Our further aim is the investigation of the Ca2+ handling in sinus-node cells under normal as well as during pathological condition (e.g.: metabolic syndrome). It is well-known that physical activity is healthy and significantly contributes to the normal physiology of the cardiovascular system. Still, several times sudden cardiac death of competitive athletes was observed where organic disease of the heart was not found. The underlying mechanism of sudden death could be the abrupt disturbance of the normal electrophysiological function of heart, however the arrhythmia mechanism is unknown. Therefore, further aim of our Institute is to develop a reliable "athlete's heart" animal model that provides data regarding the electrophysiological changes during physical activity. Our group investigates the alterations of the Ca2+ handling in the athlete's heart.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of cardiac myocytes from rabbit and canine heart. Measurement of action potentials from cardiac tissue and isolated cells with standard microelectrode and patch-clamp technique. Combined ionic current and Ca movement measurement by patch-clamp technique associated with fluorescent optical method from isolated ventricular and sinus node cells. Optical mapping of membrane potential and intracellular Ca movements in isolated rabbit heart. Analysis and interpretation of the data.

SELECTED PUBLICATIONS

Tóth, N., Szlovák, J., Kohajda, Z., Bitay, G., Veress, R., Horváth, B., Papp, J.G., Varró, A., **Nagy, N.** (2021) The development of L-type Ca^{2+} current mediated alternans does not depend on the restitution slope in canine ventricular myocardium. **Sci Rep 11:** 16652.

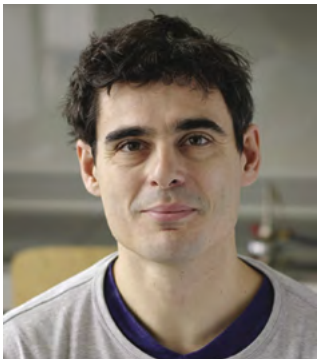
Szlovák J., Tomek, J., Zhou, X., Tóth, N., Veress, R., Horváth, B., Szentandrássy, N., Levijoki, J., Papp, J.G., Herring, N., Varró, A., Eisner, D.A., Rodriguez, B., **Nagy, N.** (2021) Blockade of sodium-calcium exchanger via ORM-10962 attenuates cardiac alternans. **J Mol Cell Cardiol 153:** 111-122.

Gazdag, P., Oravecz, K., Acsai, K., Demeter-Haludka, V., Ördög, B., Szlovák, J., Kohajda, Z., Polyák, A., Barta, B.A., Oláh, A., Radovits, T., Merkely, B., Papp, J.G., Baczkó, I., Varró, A., **Nagy, N.** & Prorok, J. (2020) Increased Ca^{2+} content of the sarcoplasmic reticulum provides arrhythmogenic trigger source in swimming-induced rat athlete's heart model. **Sci Rep 10:** 19596.

Varró, A., Tomek, J, **Nagy, N.**, Virag, L., Passini, E., Rodriguez, B., Baczkó, I. (2020) Cardiac Transmembrane Ion Channels and Action Potentials: Cellular Physiology and Arrhythmogenic Behavior. **Physiol Rev 101: 1083-1176.**

Kohajda Z., Tóth N., Szlovák J., Loewe A., Bitay G., Gazdag P., Prorok, J., Jost, N., Levijoki, J., Pollesello, P., Papp, J.G., Varró, A., **Nagy, N.** (2020) Novel Na^{+}/Ca^{2+} Exchanger Inhibitor ORM-10962 Supports Coupled Function of Funny-Current and Na^{+}/Ca^{2+} Exchanger in Pacemaking of Rabbit Sinus Node Tissue. **Front Pharmacol 10:** 1632.

CSABA PÁL



Biological Research Centre
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Synthetic and Systems Biology Unit

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RESEARCH AREA

We focus on bacterial pathogens and the problem of antibiotic resistance. We found that multidrug resistance mutations in bacteria simultaneously enhance sensitivity to other unrelated antibiotics (collateral sensitivity). This finding has led to the design of new antibiotic cocktails. Using bacterial genome engineering, we aim to develop novel resistance-free antibiotics. Finally, we study the evolution of adaptive immune system in response to pathogens and cancer.

More details: *http://www.brc.hu/sysbiol*

TECHNIQUES AVAILABLE IN THE LAB

Bacterial genome engineering, laboratory evolution, systems biology, bioinformatics.

SELECTED PUBLICATIONS

Kintses, B., Méhi, O., Ari, E., Számel, M., Györkei, Á., Jangir, PK., Nagy, I., Pál, F., Fekete, G., Tengölics, R., Nyerges, Á., Likó, I., Bálint, A., Molnár, T., Bálint, B., Vásárhelyi, BM., Bustamante, M., Papp, B., **Pal, C.** (2019) Phylogenetic barriers to horizontal transfer of antimicrobial peptide resistance genes in the human gut microbiota. **Nature Microbiology 4:** 447–458.

Lázár, V., Martins, A., Spohn, R., Daruka, L., Grézal, G., Fekete, G., Számel, M., Jangir, P.K., Kintses, B., Csörgő, B., Nyerges, Á, Györkei, Á., Kincses, A., Dér, A., Walter ,F.R., Deli, M.A., Urbán, E., Hegedűs, Z., Olajos G., Méhi, O., Bálint, B., Nagy, I., Martinek, T. A., PappB., **Pal C.** (2018) Antibiotic-resistant bacteria show widespread collateral sensitivity to antimicrobial peptides. **Nature Microbiology 3**: 718–731.

Pal, C., Papp, B., Pósfai, G (2014) The dawn of evolutionary genome engineering. **Nature Reviews Genetics 15:** 504-512.

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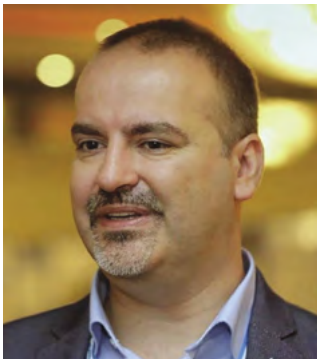
Pal, C., Papp, B., Lercher, MJ., Csermely, P., Oliver, SG., Laurence, D. Hurst. (2006) Chance and necessity in the evolution of minimal metabolic networks. **Nature 440:** 667-670.

TIBOR PANKOTAI



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RESEARCH AREA

Faithful repair of DNA double-strand breaks (DSBs) is indispensable since improper repair can lead to genome instability and subsequently to tumorigenesis. DSBs can be repaired through different pathways, and the balance between the choice of them must be tightly regulated to preserve genome integrity. DNA damage can be considered as a harmful stressor in which various biochemical pathways are activated, ensuring the proper DNA repair and cell survival. The main focus of the project is to map the signalling circuit induced by DNA damage and to understand how the malfunctional DNA repair can initiate tumorigenesis. In our experimental setup, we will use state-of-the-art biochemical technologies and genomic mapping in a human cell culture model system, and we combine these with single-cell data using super-resolution STORM microscopy. Additionally, with our experimental data, we can verify the existence and the means of DNA damage-induced cell signalization circuits and reveal the potential mechanisms of cellular communication. Although as a primary goal, the project aimed to unveil a basic research clue, identifying key steps in the repair process can help us to recognize new anti-cancer therapeutic targets, thereby also contributing to the development of novel drugs in tumor therapy.

TECHNIQUES AVAILABLE IN THE LAB

Nucleic acid-based techniques: nucleic acid isolation, mutations and gene expression measurements by PCR and quantitative PCR technics. Genomic applications: short read-based Illumina sequencing and bioinformatics data processing. Protein detection: Western blot, immunoprecipitation, chromatin immunoprecipitation. Microscopy: Immunohistochemistry, confocal and super-resolution STORM microscopy. Test models: Frozen and paraffin-embedded sections of mammalian in vitro cell cultures, tumor-derived primary cell cultures.

SELECTED PUBLICATIONS

Khanam T, Muñoz I, Weiland F, Carroll T, Morgan M, Borsos BN, Pantazi V, Slean M, Novak M, Toth R, Appleton P, **Pankotai T**, Zhou H, Rouse J. (2021) CDKL5 kinase controls transcription-coupled responses to DNA damage. **EMBO J 4:** e108271.

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BALÁZS PAPP

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RESEARCH AREA

Metabolism is central to life as it provides the building blocks and energy for all biological processes. While its fundamental tasks are highly conserved across all life forms, there are substantial differences in the details of how metabolism works across species and individuals. Humans are no exception. Any two of us show large metabolic differences and many diseases are known to involve changes in metabolism. However, not all metabolic differences are harmful and identifying those that impact human health is of paramount importance for medicine. Our laboratory uses computational approaches to study the variation of metabolism both within human populations and between different species. Our goal is to uncover the signatures of natural selection acting on human metabolism and thereby increase our understanding of healthy and diseased states.

For more details, see *www.brc.hu/sysbiol/*.

TECHNIQUES AVAILABLE IN THE LAB

Basic bioinformatics and chemoinformatics methods, phylogenetics and comparative genomics methods, computational metabolomics, experimental metabolomics, R statistical programming language, Matlab programming language, Perl programming language, statistical methods, machine learning.

SELECTED PUBLICATIONS

Zampieri, M.*, Szappanos, B.*, Buchieri, M.V., Trauner, A., Piazza, I., Picotti, P., Gagneux, S., Borrell, S., Gicquel, B., Lelievre, J., **Papp, B.**, Sauer, U. (2018) High-throughput metabolomic analysis predicts mode of action of uncharacterized antimicrobial compounds. S**cience Translational Medicine 10:** eaal3973.

Notebaart, R.A., Szappanos, B., Kintses, B., Pál, F., Györkei, A., Bogos, B., Lázár, V., Spohn, R., Csörgő, B., Wagner, A., Ruppin, E., Pál, C., **Papp, B.** (2014) Network-level architecture and the evolutionary potential of underground metabolism. **Proc Natl Acad Sci U S A 111:** 11762-11767.

Szappanos, B., Kovács, K., Szamecz, B., Honti, F., Costanzo, F., Baryshnikova, A., Gelius-Dietrich, G., Lercher, M.J., Jelasity, M., Myers, C.L., Andrews, B.J., Boone, C., Oliver, S.G., Pál, C., **Papp, B.** (2011) An integrated approach to characterize genetic interaction networks in yeast metabolism. **Nature Genetics 43:** 656-62.

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FERENC PETÁK

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RESEARCH AREA

The cardiopulmonary research laboratory performs scientific activities in various fields of cardiopulmonary physiology and pathophysiology by using translational animal models of lung diseases and performing assessments in clinical environment. A research area is focusing on the involvement of the pulmonary hemodynamics and lung vasculature in various respiratory diseases. We clarify the mechanisms responsible for the lung function deteriorations with a particular focus on the cardiopulmonary interactions. Further research focuses on the characterization of the pulmonary consequences of general anesthesia in various animal models and in clinical environment. Improvement of patient monitoring is essential for the optimization of patient management in anesthesia and intensive care settings. Analyses of the expired gases has great importance in respiratory patient monitoring. Thus we analyze the within-breath dynamics of CO_2 exhalation by using capnography to gain insights into the ventilation-perfusion matching. Further research focuses on the pulmonary manifestations of type-2 diabetes mellitus (T2DM) that presents major public health concerns. We characterize the changes in airway function and clarify the deteriorations in the viscoelastic properties of the pulmonary parenchyma, which may be a consequence of lung volume loss, interstitial edema, proliferation, and the effect of advanced glycation endproducts and their interaction with receptors.

TECHNIQUES AVAILABLE IN THE LAB

Measurement methodologies for the assessment of lung mechanics in animal models and in clinical environment involving spontaneously breathing subjects and anaesthetized mechanically ventilated patients. • Techniques for circulatory and respiratory monitoring. • Models of airway hyperresponsiveness. • Inhalation of airborne nanoparticles: exposition and measurement methods. • Analyses of expired gases, evaluation of the dynamics of expired CO_2 concentration with capnography, oxygraphy. • Assessment of pulmonary consequences of diabetes mellitus in animal models and patients. • Near infrared spectroscopy for the assessment of cerebral tissue oxygen saturation. • Assessment of perioperative hemostasis.

SELECTED PUBLICATIONS

Fodor, G.H., Bayat, S., Babik, B., Habre, W., **Petak, F.** (2018) Reversing Cholinergic Bronchoconstriction by Common Inotropic Agents: A Randomized Experimental Trial on Isolated Perfused Rat Lungs. **Anesth Analg 129:** 745-752.

Babik, B., Balogh, A.L., Sudy, R., Ivankovitsne-Kiss, O., Fodor, G.H., **Petak, F.** (2017) Levosimendan prevents bronchoconstriction and adverse respiratory tissue mechanical changes in rabbits. **Am J Physiol Lung Cell Mol Physiol. 313:** L950-L956.

Petak, F., Fodor, G.H., Babik, B., Habre, W. (2016) Airway mechanics and lung tissue viscoelasticity: effects of altered blood hematocrit in the pulmonary circulation. **J Appl Physiol 121:** 261-7.

Filep, Á., Fodor, G.H., Kun-Szabó, F., Tiszlavicz, L., Rázga, Z., Bozsó, G., Bozóki, Z., Szabó, G., **Petak, F.** (2016) Exposure to urban PM1 in rats: development of bronchial inflammation and airway hyperresponsiveness. **Respir Res 17:** 26.

Fodor, G.H., Babik, B., Czövek, D., Doras, C., Balogh, Á.L., Bayat, S., Habre, W., **Petak, F.** (2016) Fluid replacement and respiratory function: comparison of whole blood with colloid and crystalloid: A randomised animal study. **Eur J Anaesthesiol 33:** 34-41.

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RESEARCH AREA

Acute pancreatitis is a sudden inflammation of the pancreas which can have mild or severe course. Unfortunately, the latter form still has an unacceptably high mortality. The reason for this is, at least in part, due to the facts that the pathomechanism of acute pancreatitis is unclear and we have no specific treatment of the disease. The main aims of our group are to investigate the roles of various inflammatory factors, mitochondria and the recently identified pancreatic ductal cells in the development of acute pancreatitis. Our hope is to eventually open up new therapeutic possibilities in acute pancreatitis.

TECHNIQUES AVAILABLE IN THE LAB

Induction of acute pancreatitis in animals, isolation of pancreatic acinar and ductal cells, measurement of enzyme (amylase, trypsin, myeloperoxidase, lacatate dehydrogenase) activities, confocal microscopy, histological analysis, ELISA, microspectrofluorimetry (intracellular H^+, Ca^{2+} concentration), microperfusion of pancreatic ducts, measurement of pancreatic ductal fluid secretion, Western blot analysis, RT-PCR.

SELECTED PUBLICATIONS

Biczó, G., Végh, E.T., Shalbueva, N., Mareninova, O.A., Elperin, J., Lotshaw, E., Gretler, S., Lugea, A., Malla, S.R., Dawson, D., Ruchala, P., Whitelegge, J., French, S.W., Wen, L., Husain, S.Z., Gorelick, F.S., Hegyi, P., **Rakonczay Jr., Z.**, Gukovsky, I., Gukovskaya, A.S. (2018) Mitochondrial dysfunction, through impaired autophagy, leads to endoplasmic reticulum stress, deregulated lipid metabolism, and pancreatitis in animal models. **Gastroenterology 154:** 689-703.

Pallagi, P., Hegyi, P., **Rakonczay Jr., Z.** (2015) The physiology and pathophysiology of pancreatic ductal secretion: the background for clinicians. **Pancreas 44:** 1211-1233.

Pallagi, P., Balla, Z., Singh, A.K., Dósa, S., Iványi, B., Kukor, Z., Tóth, A., Riederer, B., Liu, Y.J., Engelhardt, R., Jármay, K., Szabó, A., Janovszky, Á., Perides, G., Venglovecz, V., Maléth, J., Wittmann, T., Takács, T., Gray, M.A., Gácser, A., Hegyi, P., Seidler, U., **Rakonczay Jr., Z.** (2014) The role of pancreatic ductal secretion in protection against acute pancreatitis in mice. **Crit Care Med 42:** e177-88.

Biczó, G., Hegyi, P., Dósa, S., Shalbuyeva, N., Berczi, S., Sinervirta, R., Hracskó, Z., Siska, A., Kukor, Z., Jármay, K., Venglovecz, V., Varga, I.S., Iványi, B., Alhonen, L., Wittmann, T., Gukovskaya, A., Takács, T., **Rakonczay Jr., Z.** (2011) The crucial role of early mitochondrial injury in L-lysine-induced acute pancreatitis. **Antioxid Redox Signal 15:** 2669-81.

Rakonczay Jr., Z., Hegyi P., Takács T., McCarroll J., Saluja A.K. (2008) The role of NF-κB activation in the pathogenesis of acute pancreatitis. **Gut 57:** 259-267.

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RESEARCH AREA

Diastolic dysfunction and left ventricular hypertrophy are characteristic features of chronic heart failure in the early phases. With the progression of cardiac fibrosis, systolic dysfunction also develops leading to the late phases of chronic heart failure. Common causes of chronic heart failure are arterial hypertension, chronic kidney disease (CKD), metabolic syndrome, oncologic treatments such as chemotherapy and/or radiotherapy-induced cardiotoxicity forms. Our aim is to investigate and compare the molecular mechanisms of heart failure forms developed as a consequence of different underlying diseases. The identification of the early predictors and prevention of hypertrophy and fibrosis by the administration of protective agents are relevant research perspectives both experimentally and clinically. In our experiments, we investigate the heart function and morphology, the molecular changes in the cardiac microRNA/mRNA profiles and downstream targets as well as the circulating marker molecules, and we test new agents for the prevention of heart failure. Moreover, the hypertrophic heart is more prone to ischemia. In industrialized countries, acute myocardial infarction is the leading cause of mortality. Therefore, the ischemic adaptation of the hypertrophic and fibrotic heart is also the focus in our disease models.

TECHNIQUES AVAILABLE IN THE LAB

Induction and treatment of disease models (e.g. chronic kidney disease induced by 5/6 nephrectomy, metabolic syndrome, radiation-induced heart disease, chemotherapy-induced cardiotoxicity, etc.) in experimental animals (rats and mice), assessment of cardiac function and morphology by transthoracic echocardiography, drug administration via different routes (per os gavage, ip., iv.), blood sampling, oral glucose tolerance test, Langendorff heart perfusion, induction of acute myocardial infarction, ischemic conditioning techniques, determination of infarct size, histological analysis, general biochemical and molecular biology methods (colorimetric assays, qRT-PCR, ELISA, Western blot) to determine metabolites, microRNA, mRNA, proteins and enzyme activities, etc.

SELECTED PUBLICATIONS

Kovács, M.G., Kovács, Z.Z.A., Varga, Z., Szűcs, G., Freiwan, M., Farkas, K., Kővári, B., Cserni, G., Kriston, A., Kovács, F., Horváth, P., Földesi, I., Csont, T., Kahán, Z., **Sárközy, M.** (2021) Investigation of the Antihypertrophic and Antifibrotic Effects of Losartan in a Rat Model of Radiation-Induced Heart Disease. **Int J Mol Sci 22:** 12963.

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Sárközy, M., Márványkövi, F.M., Szűcs, G., Kovács, Z.Z.A., Szabó, M.R., Gáspár, R., Siska, A., Kővári, B., Cserni, G., Földesi, I., Csont, T. (2021) Ischemic preconditioning protects the heart against ischemia-reperfusion injury in chronic kidney disease in both males and females. **Biol Sex Differ 12:** 49.

Sárközy, M., Gáspár, R., Zvara, Á., Kiscsatári, L., Varga, Z., Kővári, B., Kovács, M.G., Szűcs, G., Fábián, G., Diószegi, P., Cserni, G., Puskás, L.G., Thum, T., Kahán, Z., Csont, T., Bátkai, S. (2019) Selective Heart Irradiation Induces Cardiac Overexpression of the Pro-hypertrophic miR-212. **Front Oncol 9:** 598.

Sárközy, M., Gáspár, R., Zvara, Á., Siska, A., Kővári, B., Szűcs, G., Márványkövi, F., Kovács, M.G., Diószegi, P., Bodai, L., Zsindely, N., Pipicz, M., Gömöri, K., Kiss, K., Bencsik, P., Cserni, G., Puskás, L.G., Földesi, I., Thum, T., Bátkai, S., Csont, T. (2019) Chronic kidney disease induces left ventricular overexpression of the pro-hypertrophic microRNA-212. **Sci Rep 9:** 1302.

ÁRON SZABÓ

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RESEARCH AREA

Key to the long-term survival of the nervous system is its resilience towards unwanted environmental effects coupled to plasticity and regeneration following adverse events. Nerve injuries, traumatic spinal cord and brain injury, neurodegenerative diseases, viral infections, and certain chemotherapeutic agents all compromise the integrity of the nervous system. Injury, for example, results in short-term cell death and degeneration of neurites in the vicinity of the injury, which in turn may lead to inflammation and neurodegeneration that can last for years, damaging other cells. Debris and dead cells that form after injury are cleared by glial cells, which make up half of the nervous system. Without removal of debris by microglia, which represent the major phagocyte population in the brain, secondary damage may be much more sustained and severe than with normal phagocytic activity. Therefore, it is important to understand the regulation of glial phagocytosis after nerve injuries. Our working group studies glial phagocytic processes and membrane-limited degradation pathways involved in lysosomal degradation of extracellular cargoes such as axonal debris and internal cell constituents such as regulatory proteins, in the nervous system of Drosophila melanogaster or fruit fly. The ensheathing and wrapping glia of Drosophila have similar phagocytic function to microglia and use a similar phagocytic receptor as mammalian glia. The genetic toolkit and neural complexity of Drosophila allows us to obtain results that are relevant in vivo, more rapidly in contrast to those obtained in cell cultures and that are potentially translatable to mammals.

TECHNIQUES AVAILABLE IN THE LAB

The following techniques can be mastered in our laboratory without the need for exclusiveness. It is typical that experiments usually suggest new lines of research that calls for introduction of new techniques. Techniques: • fluorescent confocal and structured illumination microscopy • image analysis of images obtained from microscopy • recombinant DNA techniques • Drosophila genetics, transgenesis • RNA and protein biochemistry • Examination of Drosophila behaviour - such as sleep, locomotor activity • lifespan experiments • transcriptomics and proteomics sample preparation.

SELECTED PUBLICATIONS

Szabó, Á.*, Papin, C. *, Cornu, D., Chélot, E., Lipinszki ,Z., Udvardy, A., Redeker, V., Mayor, U., Rouyer, F. (2018) Ubiquitylation Dynamics of the Clock Cell Proteome and TIMELESS during a Circadian Cycle. **Cell Reports 23:** 2273-2282.

Alexopoulou, Z., Lang, J., Perrett, R.M., Elschami, M., Hurry, M.E., Kim, H.T., Mazaraki, D., **Szabó, Á.**, Kessler, B.M., Goldberg, A.L., Ansorge, O., Fulga, T.A., Tofaris, G.K. (2016) Deubiquitinase Usp8 regulates α-synuclein clearance and modifies its toxicity in Lewy body disease. **PNAS 113:** E4688-97.

Szabó, Á., Tofaris, G.K. (2019) Monitoring α-Synuclein Proteotoxicity in Drosophila Models. **Methods Mol Biol 1948:** 199-208.

Bhattacharjee, A. *, **Szabó, Á.***, Csizmadia, T., Laczkó-Dobos, H., Juhász , G. (2019) Understanding the importance of autophagy in human diseases using Drosophila. **J Genet Genomics 46:** 157-169.

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RESEARCH AREA

The genome programs of the past decades have provided an enormous amount of information about the human genome and how this information is translated to the "language of life". This knowledge is essential for understanding the pathogenesis of human diseases at the molecular level and, in fact, is currently being used to develop novel diagnostics and therapeutic modalities. Our workgroup identifi es novel pathogenic mutations that result in rare monogenic human diseases. By performing functional analyses of these mutations, we attempt to understand how their mode of action leads to human disease. In another project, we investigate the genetics and molecular susceptibility factors of multifactorial human skin diseases, with a primary focus on psoriasis. We are also engaged in the investigation of non-coding RNAs. In particular, we analyze the role of the PRINS mRNA-like non-coding RNA, which was previously identifi ed by our workgroup, in cellular stress responses and in various human diseases. In the last few years our research group has joined the Hungarian Brain Research Program (NAP Project) and as the member of the clinical branch we are engaged in the identification of genetic factors in neurodegenerative human diseases. This work has already yielded several new results for the field.

TECHNIQUES AVAILABLE IN THE LAB

After identifying mutations using the polymerase chain reaction (PCR) and sequencing methods, various bioinformatics tools are used for sequence analysis. For our functional analyses, we employ *in vitro* DNA and cloning techniques as well as specifi c gene-silencing methods. Gene and protein expression is assessed using real-time reverse transcriptase PCR, western blot analysis, immunohistochemistry and immunocytochemistry. In the last few years we have introduced next generation sequencing (NGS) into our laboratory and we apply it routinly in our research work. Data provided by NGS are analized by various bioinformatics tools.

SELECTED PUBLICATIONS

Tripolszki, K., Csányi, B., Nagy, D., Ratti, A., Tiloca, C., Silani, V., Kereszty, É., Török, N., Vécsei, L., Engelhardt, J.I., Klivényi, P.(5), Nagy, N., **Széll, M.** (2017) Genetic analysis of the SOD1 and C9ORF72 genes in Hungarian patients with amyotrophic lateral sclerosis. **Neurobiol Aging 53**: 195.e1-195.e5

Szell, M., Danis, J., Bata-Csorgo, Z., Kemeny, L. (2016) PRINS, a primate-specific long non-coding RNA, plays a role in the keratinocyte stress response and psoriasis pathogenesis. **Pflugers Archiv 468:** 935-943.

Szell, M., Bata-Csorgo, Z., Kemeny, L. (2008) The enigmatic world of mRNA-like ncRNAs: Their role in human evolution and in human diseases. Semin **Cancer Biol 18:** 141-148.

Sonkoly, E., Bata-Csorgo, Z., Pivarcsi, A., Polyanka, H., Kenderessy, Szabo, A., Molnar, G., Szentpali, K., Bari, L., Megyeri, K., Mandi, Y., Dobozy, A., Kemeny, L., **Szell, M.** (2005) Identifi cation and characterization of a novel, psoriasis susceptibility-related noncoding RNA gene, PRINS. **J Biol Chem 280:** 24159-24167.

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GÁBOR TAMÁS

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RESEARCH AREA

Our research is characterized by a combination of technically challenging electrophysiology, molecular biology, imaging and anatomy in pursuit of the function of cell types and their synapses in the human and rodent cerebral cortex. We discovered the cellular source (neurogliaform cells) of slow, GABAB receptor mediated inhibition in the cerebral cortex. Subsequently, we discovered the mechanism of this slow inhibition as single neuron driven nonsynaptic or volume transmission of the neurotransmitter GABA. In addition, our experiments assigned a new, excitatory role to axo-axonic cells, which were considered as the most specific inhibitory neurons of the cortex. Our commitment to cutting edge methodology recently resulted in recordings from identified interneurons in completely unaesthetized, freely behaving rodents and identified the first ripple-like oscillatory events in the neocortex and their cellular structure. We initiated a research program in 2004 for multiple patch clamp recordings in slices taken from the human cerebral cortex leading to the first recordings of human synaptic interactions and showing the existence of Hebbian networks in the human cerebral cortex.

TECHNIQUES AVAILABLE IN THE LAB

In vivo juxtacellular recordings from neurons of the cerebral cortex in freely behaving rodents, *in vivo* patch clamp electrophysiology, human *in vitro* brain slice patch clamp electrophysiology, *in vivo* and *in vitro* multiphoton imaging (acustooptical and resonant scanning), CARS microscopy in brain slices, transmission electron microscopy, 3D neuron reconstruction with Neurolucida, single digital PCR, single and oligocellular next generation sequencing.

SELECTED PUBLICATIONS

Averkin, R., Szemenyei, V., Borde, S., **Tamas, G.** (2016) Identified cellular correlates of neocortical ripple and high-gamma oscillations during spindles of natural sleep. **Neuron 92:** 916-92.

Molnar, G., Rozsa, M., Baka, J., Holderith, N., Barzo, P., Nusser, Z., **Tamas, G.** (2016) Human pyramidal to interneuron synapses are mediated by multi-vesicular release and multiple docked vesicles. **eLife 5:** e18167.

Olah, S., Fule, M., Komlosi, G., Varga, C., Baldi, R., Barzo, P. **Tamas, G.** (2009) Regulation of cortical microcircuits by unitary GABA-mediated volume transmission. **Nature 461:** 1278-81.

Szabadics, J., Varga, C., Molnar, G., Olah, S., Barzo, P., **Tamas, G.** (2006) Excitatory effect of GABAergic axo-axonic cells in cortical microcircuits. **Science 311:** 233-5.

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RESEARCH AREA

Genome integrity is crucial for all living organisms. If damaged DNA is not promptly repaired, the mutations ultimately lead to the development of cancer. Defective repair can also cause immunodeficiency, neurodegenerative disorders and premature ageing. The range of DNA lesions require diverse signaling and repair pathways to shape the DNA damage response. This involves changes in nuclear dynamics including alterations in chromatin structure, nucleocytoplasmic transport and protein activities. ADP-ribosylation is one of the earliest post-translational modifications appearing upon DNA damage. Its effects are numerous. One of its functions is to relax chromatin at the sites of DNA damage, facilitating the access of DNA repair processes to the lesions. Our findings indicate that nuclear dynamics, mRNA metabolism and chromosome organization strongly depend on nuclear ADP-ribosylation reactions and their crosstalk with other signaling pathways. Its deregulation impairs DNA repair and is implicated in cancer. At the bedside, the inhibition of ADP-ribosylation by drugs is used to treat cancer with certain gene mutations. Our research goal is to characterize novel molecular mechanisms that regulate the DNA damage response, including nucleocytoplasmic transport, mRNA metabolism and chromatin architecture. We study novel cancer relevant mutations that are sensitive to ADP-ribosylation inhibitors, which could be potentially used to treat tumors carrying such mutations. Furthermore, we investigate the molecular basis of a novel DNA damage-induced nuclear export mechanism that regulates ADP-ribose metabolism.

TECHNIQUES AVAILABLE IN THE LAB

Molecular biology techniques for DNA, RNA and protein production, isolation and measurement, PCR, qPCR, cloning, sequencing, *in vitro* mutagenesis, Western blot, immunohistochemistry, cell culture methods, cell-based reporter assays to measure DNA repair, ADP-ribosylation, chromatin structure or protein-protein interaction, confocal microscopy, live cell imaging of fluorescently tagged proteins, knocking out or silencing genes in human cells, CRISPR-based whole genome knockout screening.

SELECTED PUBLICATIONS

Smith, R., Sellou, H., Chapuis, C., Huet, S., **Timinszky, G.** (2018) CHD3 and CHD4 recruitment and chromatin remodeling activity at DNA breaks is promoted by early poly(ADP-ribose)-dependent chromatin relaxation. **Nucleic Acids Research 46:** 6087.

Singh, H.R., Nardozza, A.P., Möller, I.R., Knobloch, G., Kistemaker, H.A.V., Hassler, M., Harrer, N., Blessing, C., Eustermann, S., Kotthoff, C., Huet, S., Mueller-Planitz, F., Filippov, D.V., **Timinszky, G.**, Rand, K.D., Ladurner, A.G. (2017) A Poly-ADP-Ribose Trigger Releases the Auto-Inhibition of a Chromatin Remodeling Oncogene. **Molecular Cell 68:** 860.

Golia, B., Moeller, G.K., Jankevicius, G., Schmidt, A., Hegele, A., Preißer, J., Tran, M.L., Imhof, A., **Timinszky, G.** (2017) ATM induces MacroD2 nuclear export upon DNA damage. **Nucleic Acids Research. 45:** 244.

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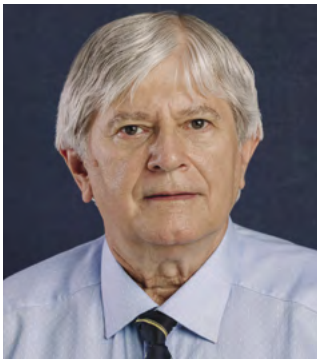
Jankevicius, G., Hassler, M., Golia, B., Rybin, V., Zacharias, M., **Timinszky, G.**, Ladurner, A.G. (2013) A family of macrodomain proteins reverses cellular mono-ADP-ribosylation. **Nature Structural & Molecular Biology 20:** 508.

ANDRÁS VARRÓ



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RESEARCH AREA

Sudden cardiac death is among the leading causes of mortality worldwide. Therefore to better understand the mechanisms of sudden cardiac death and consequently to introduce effective preventive measures represent extremely important issues in the field of public health care. Sudden cardiac death may occur due to cardiac ischaemia, adverse reaction following drug treatment is associated with diseases like heart failure, congenital diseases or can develop in top athletes due to excessive exercise and/or doping. These cases can manifest due to electrophysiological malfunctions of the heart as a consequence of disturbances in cardiac transmembrane ion channel function including various types of potassium channels. Our research team focuses on investigations on the physiology and pathophysiology of these ion channels including pharmacological modulation and possible prevention of cardiac arrhythmias in general, achieving international attention worldwide.

TECHNIQUES AVAILABLE IN THE LAB

Basic cardiac electrophysiological and molecular biological methods, such as *in vivo* arrhythmia models, cellular action potential measurements, patch-clamp techniques, epifluorescent Ca^{2+} signal detection, gene transfer, PCR and Western Blot techniques.

SELECTED PUBLICATIONS

Jost, N., Virág, L., Comtois, P., Ördög, Ö., Szűts, V., Seprényi, Gy., Bitay, M., Kohajda, Zs., Koncz, I., Nagy, N., Szél, T., Magyar, J., Kovács, M., Puskás, LG., Lengyel, Cs., Wettwer, E., Ravens, U., Nánási, PP., Papp, JGy., **Varró, A.**, Nattel, S. (2013) Ionic mechanisms limiting cardiac repolarization-reserve in humans compared to dogs. **J Physiol 591:** 4189-4206.

Jost, N., Nagy, N., Corici, C., Kohajda, Zs., Horváth, A., Acsai, K., Biliczki, P., Levijoki, J., Pollesello, P., Koskelainen, T., Otsomaa, L., Tóth, A., Papp, J.Gy., **Varró, A.**, Virág, L. (2013) ORM-10103, a novel specific inhibitor of the sodium/calcium exchanger, decreases early and delayed afterdepolarization in the canine heart. **Brit J Pharmacol 170:** 768-778.

Nagy, N., Acsai, K., Kormos, A., Sebők, Zs., Farkas, A.S., Jost, N., Nánási, P.P., Papp, J.Gy., **Varró, A.**, Tóth, A. (2013) [Ca2+] i-induced augmentation of the inward rectifier potassium current (IK1) in canine and human ventricular myocardium. **Pflügers Arch Eur J Physiol 465:** 1621-35.

Jost, N., Virág, L., Bitay, M., Takács, J., Lengyel, Cs., Biliczki, P., Nagy, Zs., Bogáts, G., Lathrop, D.A., Papp, J.Gy., **Varró, A.** (2005) Restricting excessive cardiac action potential and QT prolongation: a vital role for IKs in human ventricular muscle. **Circulation 112:** 1392-1399.

Varró, A., Baláti, B., Iost, N., Takács, J., Virág, L., Lathrop, D.A., Lengyel, C., Tálosi, L., Papp, J.Gy. (2000) The role of IKs in dog ventricular muscle and Purkinje fibre repolarisation. **J Physiol (London) 523:** 67-81.

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RESEARCH AREA

Pharmaceutical treatment of most disorders of the central nervous system, including neurodegenerative diseases and brain tumors, is restricted due to the poor penetration of drugs across the *blood-brain barrier*, the major entry route for therapeutic compounds to the central nervous system. The great majority of neuropharmaceutical candidates, hydrophilic molecules, biopharmaceuticals, and efflux transporter ligands have a low permeability across the blood-brain barrier. Biocompatible and biodegradable drug targeting systems, so-called *nanocarriers* hold a great promise. Nanovesicles which can encorporate drug cargos and present on their surfaces ligands for blood-brain barrier endogenous nutrient transporters achieve increased specificity and efficacy for drug delivery across the blood-brain barrier. Combination of such ligands is a novel and innovative idea which could contribute to develop systems for better treatment of central nervous system diseases.

TECHNIQUES AVAILABLE IN THE LAB

In vitro cell culture works, isolation of brain endothelial cells (rat/mouse), toxicity measurements (MTT/LDH tests, double cell nuclei staining, real-time cell monitoring assay), resistance measurement, cell uptake and blood-brain barrier transport experiments, immunohistochemistry, confocal microscopy, scanning electron microscopy, spectrofluorometer measurements. Preparation of nanoparticles, zeta potential and size measurements.

SELECTED PUBLICATIONS

Veszelka, S., Mészáros, M., Porkoláb, G., Szecskó, A., Kondor, N., Ferenc, G., Polgár, T.F., Katona, G., Kóta, Z., Kelemen, L., Páli, T., Vigh, JP., Walter, FR., Bolognin, S., Schwamborn, J.C., Jan, J.S., Deli, M.A. (2021) A Triple Combination of Targeting Ligands Increases the Penetration of Nanoparticles across a Blood-Brain Barrier Culture Model. **Pharmaceutics 14:** 86.

Fekete, T., Mészáros, M., Szegletes, Z., Vizsnyiczai, G., Zimányi, L., Deli, M.A., **Veszelka, S.***, Kelemen, L.* (2021) Optically Manipulated Microtools to Measure Adhesion of the Nanoparticle-Targeting Ligand Glutathione to Brain Endothelial Cells. **ACS Appl Mater Interfaces 13:** 39018-39029.

Topal, G.R., Mészáros, M., Porkoláb, G., Szecskó, A., Polgár, T.F., Siklós, L., Deli, M.A., **Veszelka, S.***, Bozkir, A.* (2020) ApoE-Targeting Increases the Transfer of Solid Lipid Nanoparticles with Donepezil Cargo across a Culture Model of the Blood-Brain Barrier. **Pharmaceutics 13:** 38.

Porkoláb, G., Mészáros, M., Tóth, A., Szecskó, A., Harazin, A., Szegletes, Z., Ferenc, G., Blastyák, A., Mátés, L., Rákhely, G., Deli, M.A., **Veszelka, S.** (2020) Combination of Alanine and Glutathione as Targeting Ligands of Nanoparticles Enhances Cargo Delivery into the Cells of the Neurovascular Unit. **Pharmaceutics 12:** 635.

Mészáros, M., Porkoláb, G., Kiss, L., Pilbat, A.M, Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülper, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., Deli, M.A., **Veszelka, S.** (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the bloodbrain barrier. **Eur J Pharm Sci 123:** 228-240.

LÁSZLÓ VÉCSEI

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RESEARCH AREA

Our main research interest is the experimental and clinical investigation of the pathomechanism and possible therapeutic targets of neurological diseases. With the aid of MR imaging and electrophysiological recordings we search for the characteristic features of multiple sclerosis, Alzheimer's disease, Parkinson's disease and given headache disorders. From cerebrospinal fluid and from blood samples we determine biomarkers, which could help the diagnosis confirmation and provide details about the course of the diseases. In genetic studies, we investigate the genetic background of multiple sclerosis and Parkinson's' disease. The foundation of these experiments is our Biobank of human tissue samples, which we collect continuously. In our animal models we examine the molecular background of neurological disorders, particularly the protective effects of kynurenic acid derivatives. The kynurenine system is our main research target, which is involved in the patho-mechanism of numerous neurological disorders due to the modulatory effects on glutamatergic neurotransmission. In previous experiments, these molecules were effective in the experimental models of headache, Huntington's disease, epilepsy and stroke. Our aim is to further elucidate the mechanisms of effect and potential therapeutic value of this molecules.

TECHNIQUES AVAILABLE IN THE LAB

MR imaging and data processing, clinical electro-physiological recordings, transcranial direct/alternating current stimulation, RNA and DNA isolation, different PCR and ELISA methods, immunohistochemistry, Western blotting, behavioral experiments on animals, HPLC.

SELECTED PUBLICATIONS

Vécsei, L., Szalárdy, L., Fülöp, F., Toldi J. (2013) Kynurenines in the CNS: recent advances and new questions. **Nat Rev Drug Discov 12:** 64-82.

Szpisjak, L., Zadori, D., Klivenyi, P., **Vecsei, L.** (2019) Clinical characteristics and possible drug targets in autosomal dominant spinocerebellar ataxias. **CNS Neurol Disord Drug Targets 18:** 279-293.

Fakan, B., Szalardy, L., **Vecsei, L.** (2019) Exploiting the Therapeutic potential of Endogenous Immunomodulatory Systems in Multiple Sclerosis-Special Focus on the Peroxisome Proliferator-Activated receptors (PPARs) and the Kynurenines. **Int J Mol Sci 20:** 426.

Boros, FA., Klivényi, P., Toldi, J., **Vécsei, L.** (2019) Indoleamine 2,3-dioxygenase as a novel therapeutic target for Huntington's disease. **Expert Opin Ther Targets 23:** 39-51.

Veréb, D., Szabó, N., Tuka, B., Tajti, J., Király, A., Faragó, P., Kocsis, K., Tóth, E., Kincses, B., Bagoly, T., Helyes, Z., **Vécsei, L.**, Kincses, ZT. (2018) Correlation of neurochemical and imaging markers in migraine: PACAP38 and DTI measures. **Neurology 91:** 1166-1174.

Vécsei, L., Lukács, M., Tajti, J., Fülöp, F., Toldi, J., Edvinsson, L. (2018) The therapeutic impact of new migraine discoveries. **Curr Med Chem 26:** 6261-6281.

Boros, FA., Bohár, Z., **Vécsei, L.** (2018) Genetic alterations affecting the genes encoding the enzymes of the kynurenine pathway and their association with human diseases. **Mutat Res 776:** 32-45.

Hertelendy, P., Toldi, J., Fülöp, F., **Vécsei, L.** (2018) Ischemic Stroke and Kynurenines: Medicinal Chemistry Aspects. **Curr Med Chem 25:** 5945- 5957.

Edvinsson, L., Tajti, J., Szalárdy, L., **Vécsei, L.** (2018) PACAP and its role in primary headaches. **J Headache Pain 19:** 21.

Zádori, D., Veres, G., Szalárdy, L., Klivényi, P., **Vécsei, L.** (2018) Alzheimer's Disease: Recent Concepts ont he Relation of Mitochondrial Disturbances, Excitotoxicity, Neuroinflammation, and Kynurenines. **J Alzheimers Dis 62:** 523-547.

Körtési, T., Tuka, B., Tajti, J., Bagoly, T., Fülöp, F., Helyes, Z., **Vécsei, L.** (2018) Kynurenic Acid Inhibits the Electrical Stimulation Induced Elevated Pituitary Adenylate CyclaseActivating Polypeptide Expression in the TNC. **Front Neurol 8:** 745.

Annus, Á., Bencsik, K., Obál, I., Kincses, ZT., Tiszlavicz, L., Höftberger, R., **Vécsei, L.** (2018) Paraneoplastic neuromyelitis optica spectrum disorder: A case report and review of the literature. **J Clin Neurosci 48:** 7-10.

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RESEARCH AREA

As a "central dogma" earlier it was suggested that stress-induced protein denaturation serves as a major stress-sensing machinery, which triggers the expression of the molecular chaperone heat shock proteins (HSPs). We have introduced a new but not exclusive cellular "membrane thermosensor" model, which predicts the existence of membrane-associated stress sensing and signaling mechanisms. It proposes that changes in the physical state and composition of lipid molecular species with the concomitant destabilization/reorganization of membrane microdomains ("rafts") can serve also as "molecular switches" to operate "cellular thermometers". Using mammalian cells and the fission yeast *(S.pombe)* as models we intend to elucidate the mechanism of membrane-associated stress sensors, signaling pathways and the interplay and networking of potential cellular stress survival strategies. Since HSPs play a fundamental role in the pathology of several human diseases, understanding the mechanism whereby mammalian cells can elicit a stress response may also be of paramount importance for the design of novel drug molecules.

TECHNIQUES AVAILABLE IN THE LAB

Classical biochemical and molecular biology methods. Membrane biophysics: spectroscopy, Langmuir monolayers, ultrasensitive fluorescence microscopy, single molecule tracking, image analysis. Lipidomic analysis: chromatographic and mass spectrometry techniques. Multidimensional data analysis, statistical methods.

SELECTED PUBLICATIONS

Escribá, P.V., Busquets, X., Inokuchi, J.I., Balogh, G., Török, Z., Horváth, I., Harwood, J.L., **Vigh, L.** (2015) Membrane lipid therapy: Modulation of the cell membrane composition and structure as a molecular base for drug discovery and new disease treatment. **Prog Lipid Res 59:** 38-53.

Nagy, E., Balogi, Z., Gombos, I., Akerfelt, M., Björkbom, A., Balogh, G., Török, Z., Maslyanko, A., Fiszer-Kierzkowska, A., Lisowska, K., Slotte, P.J., Sistonen, L., Horváth, I., **Vigh, L.** (2007) Hyperfluidization-coupled membrane microdomain reorganization is linked to activation of the heat shock response in a murine melanoma cell line. **Proc Natl Acad Sci USA 104:** 7945-7950.

Vigh, L., Horváth, I., Maresca, B., Harwood, J.L. (2007) Can the stress protein response be controlled by ‚membrane-lipid therapy'? **Trends Biochem Sci 32:** 357-363.

Török, Z., Tsvetkova, N.M., Balogh, G., Horváth, I., Nagy, E., Pénzes, Z., Hargitai, J., Bensaude, O., Csermely, P., Crowe, J.H., Maresca, B., **Vigh, L.** (2003) Heat shock protein coinducers with no effect on protein denaturation specifically modulate the membrane lipid phase. **Proc Natl Acad Sci USA 100:** 3131-3136.

Vigh, L., Literáti, P.N., Horváth, I., Török, Z., Balogh, G., Glatz, A., Kovács, E., Boros, I., Ferdinándy, P., Farkas, B., Jaszlits, L., Jednákovits, A., Korányi, L., Maresca, B. (1997) Bimoclomol: a nontoxic, hydroxylamine derivative with stress protein-inducing activity and cytoprotective effects. **Nat Med 3:** 1150-1154.

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RESEARCH AREA

Homeostasis and proper functioning of the central nervous system are largely determined by the coordinated action of cells of the neurovascular unit. Formed by microvascular endothelial cells, pericytes, glial cells and neurons, the neurovascular unit controls the traffic of solutes and cells between the circulation and the brain (blood-brain barrier function) and regulates cerebral blood flow in response to local neural activity (neurovascular coupling). The neurovascular unit is involved in several pathologies of the brain, including cerebral metastases and small vessel ischemic disease. Recently, we have shown that a poorly characterized cell type, namely cerebral pericytes possess significant pro-metastatic features, especially in triple negative breast cancer. In addition, we observed constriction of capillaries in the vicinity of metastatic cells and also cerebral microinfarcts, which seems to be mediated by pericytes. Therefore, on the one hand, we aim to evaluate the role of capillary pericytes in the regulation of blood supply, which is a highly debated scientific question. On the other hand, we focus on the effects of cancer cells on pericytes and other cells of the brain, to understand the mechanisms of tumour cell-induced shaping of the metastatic niche.

TECHNIQUES AVAILABLE IN THE LAB

Classical biochemistry and molecular biology techniques (real-time PCR, western-blot), isolation of primary cells, culture of cerebral and tumour cells, construction of complex in vitro models, gene silencing, impedance measurements, measurement of transendothelial electrical resistance and permeability, exosome isolation, transgenic animal models, injection of tumour cells into the carotid artery, preparation of cranial window, immunofluorescence and confocal microscopy, advanced microscopy (two-photon, superresolution).

SELECTED PUBLICATIONS

Molnár, K., Mészáros, Á., Fazakas, C., Kozma, M., Győri, F., Reisz, Z., Tiszlavicz, L., Farkas, A.E., Nyúl-Tóth, Á., Haskó, J., Krizbai, I.A., **Wilhelm, I.** (2020) Pericyte-secreted IGF2 promotes breast cancer brain metastasis formation. **Mol Oncol 14:** 2040-2057.

Haskó, J., Fazakas, C., Molnár, K., Mészáros, Á., Patai, R., Szabó, G., Erdélyi, F., Nyúl-Tóth, Á., Győri, F., Kozma, M., Farkas, A.E., Krizbai, I.A., **Wilhelm, I.** (2019) Response of the neurovascular unit to brain metastatic breast cancer cells. **Acta Neuropathol Commun 7:** 133.

Herman, H., Fazakas, C., Haskó, J., Molnár, K., Mészáros, Á., Nyúl-Tóth, Á., Szabó G, Erdélyi, F., Ardelean, A., Hermenean, A., Krizbai, I.A., **Wilhelm, I.** (2019) Paracellular and transcellular migration of metastatic cells through the cerebral endothelium. **J Cell Mol Med 23:** 2619-31.

Wilhelm, I., Fazakas, C., Molnár, K., Végh, A.G., Haskó, J., Krizbai, I.A. (2018) Foe or friend? Janus-faces of the neurovascular unit in the formation of brain metastases. **J Cereb Blood Flow Metab 38:** 563-587.

Molnár, J., Fazakas, C., Haskó, J., Sipos, O., Nagy, K., Nyúl-Tóth, Á., Farkas, A.E., Végh, A.G., Váró, G., Galajda, P., Krizbai, I.A., **Wilhelm, I.** (2016) Transmigration characteristics of breast cancer and melanoma cells through the brain endothelium: role of Rac and PI3K. **Cell Adh Migr 10:** 269-81.

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RESEARCH AREA

Proteins are polypeptide chains characterized by unique amino acid sequences (primary structures) and specific secondary and tertiary three dimensional structures. They are the key players in many biophysical, biochemical and physiological processes. (Nota bene, many intrinsically disordered proteins have recently been discovered whose functional form lacks any defined 3D structure…). In many cases the presence of non-amino-acid cofactors is also essential for the protein's function. Typical examples are the proteins excited by visible light (e.g. in visual perception and light sensing), or certain electron transport – so called redox – proteins, such as the cytochromes, that are also colored. In our research group we study such "colorful" proteins, their properties, function, physiological roles, taking advantage of the fact that the structural changes accompanying their function can usually be followed by measuring their color changes using static or kinetic (rapid time-resolved) absorption spectroscopy. The colored (possessing chromophores) or the redox proteins may exhibit interesting or useful properties not only in their natural physiological environment but also in very different artificial environments. One can envisage biophotonics or bioelectronics applications from the appropriate interfacing of certain proteins with photonic crystals or semiconductor materials. Hence we also study the interactions of porous silicon based photonic crystals (periodic structures commensurate with the wavelength of light) and select proteins.

TECHNIQUES AVAILABLE IN THE LAB

Expression and purification of proteins, static and kinetic spectroscopies, electrochemical technique (voltammetry), preparation and functionalization of porous silicon photonic samples, control of pulsed laser laboratory, Matlab programming language.

SELECTED PUBLICATIONS

Hajdu, K., Gergely, C., Martin, M., Cloitre, T., **Zimányi, L.,** Tenger, K., Khoroshyy, P., Palestino, G., Agarwal, V., Hernádi, K., Németh, Z., Nagy, L. (2012) Porous silicon / photosynthetic reaction center hybrid nanostructure. **Langmuir 28:** 11866-11873.

Levantino, M., Cupane, A., **Zimányi, L.**, Ormos, P. (2004) Different relaxations in myoglobin after photolysis. **Proc Natl Acad Sci USA 101:** 14402-14407.

Zimányi, L., Kulcsár, Á., Lanyi, J.K., Sears, D.F., Saltiel, J. (1999) Singular value decomposition with self-modeling applied to determine bacteriorhodopsin intermediate spectra: Analysis of simulated data. **Proc Natl Acad Sci USA 96:** 4408-4413.

Zimányi, L., Kulcsár, Á., Lanyi, J.K., Sears, D.F., Saltiel, J. (1999) Intermediate spectra and photocycle kinetics of the Asp96 ->Asn mutant bacteriorhodopsin determined by singular value decomposition with self-modeling. **Proc Natl Acad Sci USA 96:** 4414-4419.

Dér, A., Oroszi, L., Kulcsár, Á., **Zimányi, L.**, Tóth-Boconádi, R., Keszthelyi, L., Stoeckenius, W., Ormos, P. (1999) Interpretation of the spatial charge displacements in bacteriorhodopsin in terms of structural changes during the photocycle. **Proc Natl Acad Sci USA 96:** 2776-2781.

ISTVÁN ZUPKÓ

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RESEARCH AREA

In spite of the impressive achievements in the treatment possibilities of malignant disorders, cancers still have leading roles in mortality statistics worldwide indicating the need for novel anticancer agents. Natural products and their analogs are inexhaustible source of drugs candidates. The main aims of our group are to identify potential lead molecules by screening isolated and synthetic compounds for their anticancer properties. *In vitro* cell culture based studies are performed in order to characterize the cancer selectivity and the mechanism of the action of the most promising hits.

TECHNIQUES AVAILABLE IN THE LAB

Determination of antiproliferative action against cancer cells, cell cycle analysis by flow cytometry, fluorescent microscopy, tubulin polymerization assay, apoptosis detection (measurement of activities of caspases), cell-based assays for hormonal activity, Western blot analysis, RT-PCR.

SELECTED PUBLICATIONS

Bózsity, N., Minorics, R., Szabó, J., Mernyák, E., Schneider, G., Wölfling, J., Wang, H.C., Wu, C.C., Ocsovszki, I., **Zupkó, I.** (2017) Mechanism of antiproliferative action of a new d-secoestrone-triazole derivative in cervical cancer cells and its effect on cancer cell motility. **J Steroid Biochem Mol Biol 165:** 247-57.

Molnár, J., Szebeni, J.G., Csupor-Löffler, B., Hajdú, Z., Szekeres, T., Saiko, P., Ocsovszki, I., Puskás, G.L., Hohmann, J., **Zupkó, I.** (2016) Investigation of the antiproliferative properties of natural sesquiterpenes from Artemisia asiatica and Onopordum acanthium on HL-60 cells *in vitro*. **Int J Mol Sci 17:** 83.

Molnár, J., Frank, É., Minorics, R., Kádár, Z., Ocsovszki, I., Schönecker, B., Wölfling, J., **Zupkó, I.** (2015) A click approach to novel D-ring-substituted 16α-triazolylestrone derivatives and characterization of their antiproliferative properties. **PLOS ONE 10:** e0118104.

Mernyák, E., Kovács, I., Minorics, R., Sere, P., Czégány, D., Sinka, I., Wölfling, J., Schneider, G., Újfaludi, Z., Boros, I., Ocsovszki, I., Varga, M., **Zupkó, I.** (2015) Synthesis of trans-16-triazolyl-13α-methyl-17-estradiol diastereomers and the effects of structural modifications on their *in vitro* antiproliferative activities. **J Steroid Biochem Mol Biol 150:** 123-34.

Minorics, R., Bózsity, N., Molnár, J., Wölfling, J., Mernyák, E., Schneider, G., Ocsovszki, I., **Zupkó, I.** (2015) A molecular understanding of d-homoestrone-induced G2/M cell cycle arrest in HeLa human cervical carcinoma cells. **J Cell Mol Med 19:** 2365-74.

SZENT-GYÖRGYI JUNIOR MENTORS SZEGED

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RESEARCH AREA

Psoriasis is a common, chronic inflammatory, immune-mediated skin disease characterized by red, scaly patches. The psoriatic involved skin is mainly characterized by hyperproliferation of epidermal keratinocytes and infiltration of immune cells. Although nowadays the number of therapeutic options is increasing, however, there is currently no solution to prevent the recurrence of symptoms after the suspension of the therapy.

The disease is characterized by the fact that the involved skin areas are well separated from the clinically uninvolved, healthy-looking skin areas. Furthermore, even a number of cellular and extracellular abnormalities are present in the uninvolved skin areas. However, the main characteristic mechanisms of involved skin such as hyperproliferation of epidermal keratinocytes and infiltration of immune cells, are not observed in uninvolved skin. Our previous studies suggest that abnormalities of the uninvolved skin on one hand can predispose to the development of symptoms, on the one hand, alterations of the uninvolved skin can be protective factors and mechanisms as well. These alterations can contribute to the special balanced, so-called pre-psoriatic condition. Studying these protective mechanisms is a novel approach in psoriasis research. Recurrence of the psoriatic lesions may potentially be prevented by a better understanding of the changes that can maintain the uninvolved state.

TECHNIQUES AVAILABLE IN THE LAB

Processing of punch biopsies from healthy individuals and from involved and uninvolved skin areas of psoriatic patients: *ex vivo* tissue culture, isolation and culture of primary cells (keratinocytes, fibroblasts), cell biological examinations (e.g. BrdU cell proliferation assay, MTT assay, in vitro wound healing assay). Furthermore, preparation and processing of tissue sections, acquisition of immunofluorescence staining techniques using tissue and cell culture samples. Perform protein-level studies by protein array and Western blot methods and gene expression studies by PCR and sequencing methods.

SELECTED PUBLICATIONS

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Kelemen, E.*, **Bozó, R.***, Groma, G., Bata-Csörgő, Zs., Kemény, L., Danis, J., Széll, M. (2021) The psoriatic non-lesional skin: a battlefield of constant fight between susceptibility and protective factors. **J Invest Deramtol 141:** 2785-2790.

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RESEARCH AREA

In the recent decades it became achievable to obtain better and better quality multichannel, multidimensional images of tissues and cells even on the subcellular or protein levels thanks to the advanced microscopy techniques. With the advancement of high-throughput methods generating hundreds or thousand images from a single sample is no longer a dream. This not only pushes the limits of data storage capacity, but also encourages researchers to develop newer and newer image analysis methods, as the goal is to interpret data as quickly and efficiently as possible with minimal amount of human intervention. With the rise of automation, we can answer questions we never could before: which is the most promising drug candidate, which proteins play a role in complex processes such as cell division or tumor formation. The research of our group focuses on how we can help answer biological questions by efficiently analyzing thousands of microscopic images using intelligent computational algorithms with applying state-of-the-art machine learning techniques. We pay particular attention to the analysis of individual cells to identify morphological features using imaging information that allows for the discovery of previously hidden phenotypes.

TECHNIQUES AVAILABLE IN THE LAB

Our group (BIOMAG) offers the possibility to learn the following techniques: high-throughput fluorescence and confocal microscopy, light-sheet microscopy, laser microdissection, various image analysis and machine learning methods with the necessary software and hardware background, statistical analysis of results, access to the software developed by the group. In addition, it is possible to learn about different sample preparation techniques: cell culturing, immunostaining, tissue preparation and staining.

SELECTED PUBLICATIONS

Miczán, V., Kelemen, K., Glavinics, J.R., László, Z.I., Barti, B., Kenesei, K., Kisfali, M., Katona, I. (2021) NECAB1 and NECAB2 are consensus calcium-binding proteins of the CB1 -positive interneuron population in the mouse forebrain. **Cereb Cortex 31:** 1786.

László*, Z.I., Lele*, Z., Zöldi, M., **Miczán, V.**, Mógor, F., Simon, G.M., Mackie, K., Kacskovics, I., Cravatt, B.F., Katona, I. (2020) ABHD4-dependent developmental anoikis safeguards the embryonic brain. **Nat Commun 11:** 1.

ÁRPÁD CSERNETICS

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RESEARCH AREA

Transition from simple to complex multicellularity was a giant evolutionary innovation in the history of life. Mushroom-forming fungi are ideal model organisms of complex multicellularity: they start their lifecycle as unicellular spores thus developing multicellular filaments followed by formation of a complex fruiting body structures with various fungal tissues in the sexual cycle. Complex multicellularity appeared multiple times independently (convergent origins) in the fungal kingdom via unique mechanisms. In contrast, yeasts are secondarily simplified organisms with multicellular ancestors. They spend most of their life cycle as unicellular organisms but retain the genes for multicellular complexity. The potential for yeast-like growth (i.e. genetic toolkit) evolved early in fungal evolution but the transitions to yeast-like lifestyle happened much later multiple times and yeast-like growth became dominant independently in distantly related clades. To gain deeper insight into such evolutionary innovations we examine genome-evolution, differences in gene expression and reconstruct gene regulatory networks with comparative genomics and -transcriptomics and lab experiments. Investigating the genetic and molecular background of fungal plant cell wall degradation is also among our research interests. Lignocellulose decomposition is one of the most industrially exploited fungal traits (e.g. in bioethanol production). Our goal is to reconstruct gene regulatory networks that underlie plant biomass degrading fungal extracellular enzyme biosynthesis.

TECHNIQUES AVAILABLE IN THE LAB

Coprinopsis cinerea is our primary model system, however, several members of Basidiomycota and Ascomycota are also involved in these experiments. In addition to basic microbiological techniques, we also use state-of-the-art methods of genetics, molecular biology and bioinformatics. Of those I would like to highlight the followings: cultivation of fungi and induction of fruiting body formation, microscopy imaging techniques, DNA and RNA isolation, genome- and transcriptome (RNA-Seq) sequencing and data-analysis, protein-DNA interaction assays (identification of DNA binding sites of transcription factors with Chip-Seq, DAP-Seq and CUT&RUN), gene cloning, CRISPR/Cas9-based genome editing, heterologous protein expression, protein purification and Western-blot, phylogenetic reconstruction.

SELECTED PUBLICATIONS

Nagy, L.G., Varga, T., **Csernetics, Á.**, Virágh, M. (2020) Fungi took a unique evolutionary route to multicellularity: Seven key challenges for fungal multicellular life. **Fungal Biol Rev 34:** 151-169.

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Homa, M., Galgóczy, L., Manikandan, P., Narendran, V., Sinka, R., **Csernetics, Á.**, Vágvölgyi, Cs., Kredics, L., Papp, T. (2018) South Indian isolates of the Fusarium solani species complex from clinical and environmental samples: identification, antifungal susceptibilities, and virulence. **Front Microbiol 9:** 1052.

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RESEARCH AREA

Investigation of peptide carriers on culture models of biological barriers

Targeted delivery of protein drugs into cells and through biological barriers to achieve a more effective therapeutic effect is an area of intensive research. Several strategies exist already for delivery to the intracellular space, however the drugs that enter by endocytosis are unable to be effective due to entrapment in vesicles or degradation by lysosomes. We are investigating carriers that can be conjugated to a peptide or protein drug to enter cells and avoid lysosomal degradation. The aim of the research is to investigate these peptide carriers in culture models of different biological barriers for the delivery of large biomolecules. In this work, comparative study of several peptide carriers are performed on the culture model of endothelial and epithelial barriers, such as the blood-brain barrier, cornea-, lung-, and intestinal epithelium. In our experiments, we characterize the viability, integrity, and morphological changes of intercellular junctions of the cell layers. We study the intracellular localization of peptide carriers as well as their penetration through cell layers. Furthermore, passage of fluorescent proteins loaded into peptide-targeted nanoparticles through barrier models is tested. The expected results may contribute to the development of new types of carrier systems for the delivery of drugs or biopharmaceuticals across biological barriers, which may contribute to a better cure for diseases.

TECHNIQUES AVAILABLE IN THE LAB

Sterile lab work; In vitro cell culture works; isolation of primary cultures from brain and brain microvessels; double and triple co-culture models of biological barriers; experiments with brain organoids; cell culture models in microfluidic chips; electric resistance measurements of cell layers; cellular uptake and permeability assays; permeability of drugs across culture models; immunohistochemistry; phase contrast, fluorescent and confocal microscopy; spectrofluorometry; toxicity measurements (MTT/LDH tests, double cell nuclei staining, impedance based real-time cell monitoring assay).

SELECTED PUBLICATIONS

Bocsik, A., **Gróf, I.**, Kiss, L., Ötvös, F., Zsíros, O., Daruka, L., Fülöp, L., Vastag, M., Kittel, Á., Imre, N., Martinek, T.A., Pál, C., Szabó-Révész, P., Deli, M.A. (2019) Dual Action of the PN159/KLAL/MAP Peptide: Increase of Drug Penetration across Caco-2 Intestinal Barrier Model by Modulation of Tight Junctions and Plasma Membrane Permeability. **Pharmaceutics 11:** 73.

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Katona, G., Sipos, B., Budai-Szűcs, M., Balogh, G.T., Veszelka, S., **Gróf, I.**, Deli, M.A., Volk, B., Szabó-Révész, P., Csóka, I. (2021) Development of In Situ Gelling Meloxicam-Human Serum Albumin Nanoparticle Formulation for Nose-to-Brain Application. **Pharmaceutics 13:** 646.

NÓRA IGAZ

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RESEARCH AREA

Metal nanoparticles have a great potential in cancer treatment due to a broad spectrum of anti-cancer activities. Nano-sized materials are able to accumulate in the tumor tissue owing to the fenestrated endothel of the tumor blood vessels. Moreover, the large specific surface of nanoparticles can be functionalized with tumor-specific ligands to achieve active tumor targeting. Among metal nanomaterials, silver and gold nanoparticles are the most promising entities for oncotherapeutic applications. Silver nanoparticles induce apoptosis in tumor cells by triggering the production of reactive oxygen species, whereas gold nanoparticles potentiate the efficacy of ionizing radiation, thus possess radiosensitizing activity on tumor cells. Metal nanoparticles are also excellent combinational partners of chemotherapeutic agents and of different treatment modalities. Besides the tumor-targeting activity of nanoparticles, nano-sized materials can be used to modulate the cancer promoting activity of other cell types such as cancer-associated fibroblasts and tumor-associated macrophages in the tumor microenvironment, thus we examine how metal nanoparticles affect the paracrine cross-talk between cells in the tumor tissue in order to attenuate tumor progression, invasion and dissemination.

TECHNIQUES AVAILABLE IN THE LAB

Maintaining *in vitro* human cell cultures, detection of cell proliferation, *in vitro* toxicity measurements, detection of cell migration by scratch assay, invasion assays, gelatin zymography, Western blot analysis, conventional PCR, Real-time PCR, immunocytochemistry, fluorescence microscopy, isolation of primary cells, toxicity measurements on 3D cell cultures, clonogenic assay to detect the colonyforming capabilities of tumor cells.

SELECTED PUBLICATIONS

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Szerencsés, B., **Igaz, N.**, Tóbiás, Á., Prucsi, Zs., Rónavári, A., Bélteky, P., Madarász, D., Papp, Cs., Makra, I., Vágvölgyi, Cs., Kónya Z, Pfeiffer, I., Kiricsi, M. (2020) Size-dependent activity of silver nanoparticles on the morphological switch and biofilm formation of opportunistic pathogenic yeasts. **BMC Microbiol 20:** 176.

Gopisetty, M. K., Kovács, D., **Igaz, N.**, Rónavári, A., Bélteky, P., Rázga, Zs., Venglovecz, V., Csoboz, B., Boros, I., Kónya, Z., Kiricsi, M. (2019) Endoplasmic reticulum stress: major player in size-dependent inhibition of P-glycoprotein by silver nanoparticles in multidrug-resistant breast cancer cells. **J Nanobiotechnology 17:** 9.

Rónavári, A., Kovács, D., **Igaz, N.**, Vágvölgyi, Cs., Boros, I., Kónya, Z., Pfeiffer, I., Kiricsi, M., (2017) Biological activity of green-synthesized silver nanoparticles depends on the applied natural extracts: a comprehensive study. **Int J Nanomedicine 12:** 871-883.

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RESEARCH AREA

1) *In vitro* measurements. The transplanted organ (graft) undergoes warm and cold ischemic periods during surgical removal from the donor and the cell damage during storage is further exacerbated by reperfusion injury during the reestablishment of the circulation. During ischemia the oxidative phosphorylation is inhibited due to lack of oxygen and the Ca^{2+} overload results in a reduction of the efficiency of the mitochondrial electron transport and the formation of reactive free radicals. In the clinical practice static and dynamic preservation techniques are used and our goal is to increase the efficiency of transplant solutions by using biological active gases which may contribute to better graft survival and improved recovery of function. Methane (CH_4) is widely considered to be biologically inert, but many recent studies have shown that exogenous CH_4 affects cell pathways involved in oxidative and nitrosative stress responses. To date, the effect of CH_4 on the outcome of organ transplantation and graft damage has not been studied, and the effect of CH_4 on graft survival or other postoperative effects is unknown. 2) *In vivo* measurements Behavioural studies provide important information for modelling various human neurological pathologies, various forms of cognitive impairment, including postoperative sepsis-associated encephalopathy and for testing the efficacy of therapies in the experimental phase. One group includes methods and tests that examine the animal's spontaneous, self-produced behavior. The other large group consists of methods for studying learning / memory. Our laboratory has widely accepted non-invasive, repeatable, "real-time" data tools for testing the cognitive functions of rodents. Spatial memory, spontaneous discovery activity, coordination, sense of balance, anxiety, and depression are examined using a variety of tests.

TECHNIQUES AVAILABLE IN THE LAB

Participation in animal experimental work, acquisition of surgical techniques (surgical and microsurgical techniques) in anesthetized rats. Professional application of the use and evaluation of behavioral test methods and the drawing of conclusions. Functional testing of isolated organs *in vitro* (in an organ bath). *Ex vivo* monitoring and analysis of cell and mitochondrial respiration using a high-resolution respirometer. Measurement of the activity of several inflammatory biochemical markers and enzymes. Methods of data processing, statistical analysis of data.

SELECTED PUBLICATIONS

Horváth, T., Jász, D.K., Baráth, B., Poles, M.Z., Boros, M., Hartmann, P. (2021) Mitochondrial Consequences of Organ Preservation Techniques During Liver Transplantation. **Int J Mol Sci 22:** 2816.

Horváth, T., Hanák, L., Hegyi, P., Butt, E., Solymár, M., Szűcs, Á., Varga, O., Thien, B.Q., Szakács, Zs., Csonka, E. et al. (2020) Hydroxyapatite-coated implants provide better fixation in total knee arthroplasty. A meta-analysis of randomized controlled trials. **PLoS One 15:** e0232378.

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Horváth, T., Vezér, T., Kozma, G., Papp, A.(2018) Functional neurotoxicity and tissue metal levels in rats exposed subacutely to titanium dioxide nanoparticles via the airways. **Clinical Neuroscience 71:** 35-42.

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RESEARCH AREA

Functional and morphological changes within mitochondria and their altered interaction with other organelles are suggested to play a critical role in the pathogenesis of various diseases associated with life-threatening organ dysfunction. Some of them, such as sepsis and ischaemia/reperfusion-induced injury (I/R) have more recently become an intensively developing field of basic research. Our main purpose is to investigate the underlying mitochondrial and cellular mechanisms involved in the corresponding animal model of diseases.

TECHNIQUES AVAILABLE IN THE LAB

Preparation of intact mitochondria/tissue homogenates from various tissues/organs of laboratory animals (e.g., liver, small intestine, kidney and brain), evaluation of cellular respiratory function and states using high-resolution respirometry (OROBOROS O2k), simultaneous monitoring of changes in mitochondrial membrane potential (safranin fluorescence), mitochondrial reactive oxygen species (HRP/Amplex UltraRed assay) and calcium-flux (Calcium Green-5N fluorescence). Assesement of oxidative and nitrosative stress markers.

SELECTED PUBLICATIONS

Juhász, L., Rutai, A., Fejes, R.,Tallósy, S.P., Poles, M.Z., Szabó, A., Szatmári, I., Fülöp, F., Vécsei, L., Boros, M., Kaszaki, J. (2020) Divergent effects of the N-methyl-D-aspartate receptor antagonist kynurenic acid and the synthetic analog SZR-72 on microcirculatory and mitochondrial dysfunction in experimental sepsis. **Front Med 7:** 566582.

Nászai, A., Terhes, E., Kaszaki, J., Boros, M., **Juhász, L.** (2019) Ca(2+)N it be measured? Detection of extramitochondrial calcium movement with high-resolution fluorespirometry. **Sci Rep 9:** 19229.

Poles, M.Z., **Juhász, L.**, Boros, M. (2019) Methane and inflammation - A review (Fight fire with fire). I**ntensive Care Med Exp 7:** 68.

Juhász, L., Kiss, A., Nyeső, E., Kovács, M., Seprényi, G., Kaszaki, J., Végh, Á. (2011) Is there a trigger role of peroxynitrite in the anti-arrhythmic effect of ischaemic preconditioning and peroxynitrite infusion? **Eur J Pharmacol 667:** 306-313.

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RESEARCH AREA

Organelles of eukaryotic cells represent an intricate network the members of which are connected with each other either via vesicular transport processes or permanent physical contacts. Significance of the latter type of organellar communication (the so-called membrane contact sites) has only been recognized in the last decade. The complex, dynamic endomembrane system plays a pivotal role in normal cell physiology and its proper function requires the concerted action of several proteins. Main research focus of our group is the investigation of genes and proteins involved in vesicular trafficking routes chanelling to the lysosomes, the central degradative organelles of cells. Members of the Sorting nexin (Snx) protein family play important roles in numerous points of the endolysosomal system. All Snx proteins contain the lipid-binding PX-domain that enables them to associate with organellar membranes where they utilize other protein domains to take part in versatile molecular events. However, exact cellular functions of many Snx proteins are currently unknown, and importantly, some of these proteins are involved in the pathogenesis of human diseases. Most of the Sorting nexins are evolutionarily conserved, offering the possibility to investigate their functions in model organisms. We use various fruitfly tissues to study the molecular functions of the less well-characterized Snx proteins in the endolysosomal system. Our current focus is on the investigation of the function of Snx25, a known membrane contact site protein, which is involved in a human hereditary neurodegenerative disease. Our results show that the mutation of the fruitfly counterpart of this gene leads to severe defects in the endosomal maturation process of the highly endocytic larval nephrocytes. However, the exact mechanism of this phenomenon is currently not known.

TECHNIQUES AVAILABLE IN THE LAB

To explore Sorting nexin functions in the endolysosomal system, we primarily use light-microscopy techniques (fluorescent immunohistochemistry and other labeling methods). In our research we exploit the genetic and cell biology toolkit of the fruitfly (*Drosophila melanogaster*), the model organism with a history of more than a hundred years. Beside larval nephrocytes, we use other fruitfly tissues (e.g. larval fat body and salivary gland) as well to analyze the endolysosomal network. Routine molecular biology approaches (cloning and protein detection methodsbetc.) are also used mainly in order to generate new genetic tools (mutant and transgenic animals).

SELECTED PUBLICATIONS

Kiss, V., Jipa, A., Varga, K., Takáts, S., **Maruzs, T.**, Lőrincz, P., ... & Tóth, D. (2019). Drosophila Atg9 regulates the actin cytoskeleton via interactions with profilin and Ena. **Cell Death & Differentiation**, 1-16.

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Maruzs, T., Lőrincz, P., Szatmári, Z., Széplaki, S., Sándor, Z., Lakatos, Z., ... & Sass, M. (2015). Retromer ensures the degradation of autophagic cargo by maintaining lysosome function in Drosophila. **Traffic 16:** 1088-1107.

Lőrincz, P., Lakatos, Z., **Maruzs, T.**, Szatmári, Z., Kis, V., & Sass, M. (2014). Atg6/UVRAG/Vps34-containing lipid kinase complex is required for receptor downregulation through endolysosomal degradation and epithelial polarity during Drosophila wing development. **BioMed Res Int 2014:** 851349

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RESEARCH AREA

The pharmaceutical treatment of central nervous system disorders is far from satisfactory due to the poor penetration of drugs to the brain tissue. The blood-brain barrier is the major obstacle to prevent potential neuropharmaceuticals to reach their targets. Nanosized drug carriers, or nanoparticles are in the focus of research efforts to develop successful drug delivery systems for the central nervous system. Drug loading to nanoparticles alone is not enough for successful delivery of drugs to the brain. In order to elevate the permeability of nanocarriers across the blood-brain barrier a specific targeting is needed. Influx transport systems are highly expressed on the cerebral endothelium in contrast to blood vessel endothelial cells of other organs. Nanoparticles targeted by the ligands of these transporters may better dock to the luminal surface of brain microvascular endothelial cells resulting in better cellular uptake into the cells and penetration of the cargo across the blood-brain barrier.

Blood-brain barrier dysfunction and inflammation play central role in the pathomechanism of many central nervous system disorders. Protection of the blood-brain barrier, the inhibition of causal factors of the brain microvascular breakdown offers an innovative therapeutic target of brain diseases. Several studies confirm that long-term treatment with non-steroidal anti-inflammatory drugs such as ibuprofen reduces the risk of Alzheimer's disease by the inhibition of inflammatory cascades. The serious peripheral side effects of long-term administration of ibuprofen limits its clinical applicability. Formulation of ibuprofen with targeted nanocarriers increases the brain specific penetration of the drug and at the same time reduces treatment doses and peripheral side-effects. The expected new results contribute to the development of new targeted nanocarrier systems for better brain delivery of drugs and to prevent and treat the diseases of central nervous system.

TECHNIQUES AVAILABLE IN THE LAB

Preparation of nanoparticles and their characterization by zeta potential, size, encapsulation efficiency measurements. In vitro mammalian cell culture, isolation of primary brain endothelial cells, models of biological barriers by double and triple co-cultures. Cellular toxicity measurements (MTT/LDH tests, double cell nuclei staining, real-time cell monitoring assay), electrical resistance measurements on barrier models, cell uptake and blood-brain barrier transport experiments for drugs and nanoparticles, immunohistochemistry, confocal microscopy, scanning electron microscopy, spectrofluorometry measurements.

SELECTED PUBLICATIONS

Veszelka, S., **Mészáros, M.**, Porkoláb, G., Szecskó, A., Kondor, N., Ferenc, G., Polgár, T.F., Katona, G., Kóta, Z., Kelemen, L., Páli, T., Vigh, J.P., Walter, F.R., Bolognin, S., Schwamborn, J.C., Jan, J.S., Deli, M.A. (2022) A triple combination of targeting ligands increases the penetration of nanoparticles across a blood-brain barrier culture model. **Pharmaceutics 14:** 86.

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Porkoláb, G., **Mészáros, M.**, Tóth, A., Szecskó, A., Harazin, A., Szegletes, Z., Ferenc, G., Blastyák, A., Mátés, L., Rákhely, G., Deli, M.A., Veszelka, S. (2020) Combination of Alanine and Glutathione as Targeting Ligands of Nanoparticles Enhances Cargo Delivery into the Cells of the Neurovascular Unit. **Pharmaceutics 12:** 635.

Mészáros, M., Porkoláb, G., Kiss, L., Pilbat, A.M., Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülper, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., Deli, M.A., Veszelka, S. (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the blood-brain barrier. **Eur J Pharm Sci 123:** 228-240.

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RESEARCH AREA

Since the beginning of modern neuroscience it is a primary desire to understand the human cerebral cortex. How neurons build up networks and how they are able to serve higher brain functions such as cognition, complex perception, decision-making or language is still a mystery yet to be solved. The research of human brain mainly approached with noninvasive low resolution brain-imaging technologies or scalp electrode based techniques. We still are missing the information on the intricate organization of human neuronal networks. To date substantial data have been acquired from animal models investigating the physiological mechanisms. However, research on human neural circuits are more challenging due to lack of suitable tissue. Human neurons are not "scaled-up" versions of rodent or primate neurons, but have unique structural and functional properties. Our results, apart from deepening our understanding of basic features and mechanisms neuronal circuits and connections, can also provide a basis for development of proper therapies for neurodegenerations.

TECHNIQUES AVAILABLE IN THE LAB

We are using cutting edge neurophysiological and imaging techniques e.g. in vivo patch clamp electrophysiology, human *in vitro* brain slice patch clamp electrophysiology, *in vivo* and i*n vitro* multiphoton imaging (acustooptical and resonant scanning), CARS microscopy in brain slices, transmission electron microscopy, 3D neuron reconstruction with Neurolucida, image processing, coding and statistics.

SELECTED PUBLICATIONS

Cserep, C., Posfai, B., Lenart, N., Fekete, R., Laszlo, Z.I., Lele, Z., Orsolits, B., **Molnar, G.**, Heindl, S., Schwarcz, A.D., Ujvari, K., Kornyei, Z., Toth, K., Szabadits, E., Sperlagh, B., Baranyi, M., Csiba, L., Hortobagyi, T., Magloczky, Z., Martinecz, B., Szabo, G., Erdelyi, F., Szipocs, R., Tamkun, M.M., Gesierich, B., Duering, M., Katona, I., Liesz, A., Tamas, G., Denes, A. (2020) Microglia monitor and protect neuronal function through specialized somatic purinergic junctions. **Science 367:** 528-537.

Molnar, G., Rozsa, M., Baka, J., Holderith, N., Barzo, P., Nusser, Z., Tamas, G. (2016) Human pyramidal to inteiencerneuron synapses are mediated by multi-vesicular release and multiple docked vesicles. **eLife:** e18167.

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Molnar, G., Olah, S., Komlosi, G., Fule, M., Szabadics, J., Varga, C., Barzo, P., Tamas, G. (2008) Complex events initiated by individual spikes in the human cerebral cortex. **PLoS Biol 6:** e222.

Szabadics, J., Varga, C., **Molnar, G.**, Olah, S., Barzo, P., Tamas, G. (2006) Excitatory effect of GABAergic axo-axonic cells in cortical microcircuits. **Science 311:** 233-5.

MARGIT PÁL

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RESEARCH AREA

Our research group's aim is to identify the genomic causes of rare genetic disorders. Rare disease affects a small percentage of the population; its prevalence is less than 1:2000. However, taking all rare diseases together, many individuals and families are affected. To date, there are more thousands of known rare disease. They cause a large health burden to the individuals and families. 80% of rare diseases have genetic component and they are very diverse. Our research group mainly focuses on genodermatoses, neurodegenerative diseases, cardiovascular diseases, rare inheritable eye diseases, inherited hearing loss and congenital developmental abnormalities. Our findings help to understand the genetic background of rare genetic disorders and to expand human mutational databases related to human inherited diseases. This knowledge is essential for understanding the pathogenesis of human diseases at the molecular level and it can be also useful to develop novel diagnostics and therapeutic modalities. Our results may provide a good basis to develop Hungarian population-specific test panels in different inherited diseases.

TECHNIQUES AVAILABLE IN THE LAB

We apply a wide range of laboratory methods, including classical and new ones. The regularly used methods are the following: polymerase chain reaction (PCR) and sequencing methods combined with various bioinformatics tools for sequence analysis. DNA extraction from blood and tissue samples, DNA quantitation, primer design, different PCR techniques such as standard, Repeat-Primed PCR, Real-Time PCR, Digital Droplet PCR, agarose gel electrophoresis, Sanger sequencing and amplicon fragment length analysis, next generation sequencing (gene panel and whole exome sequencing) and bioinformatics analysis of these data. We use clinical and mutational databases and *in silico* variant predictions for variant interpretation and also provide genotype-phenotype comparison.

SELECTED PUBLICATIONS

Rusz, O., **Pal, M.**, Szilagyi, E., Rovo, L., Varga, Z., Tomisa, B., Fabian, G., Kovacs, L., Nagy, O., Mozes, P., Reisz, Z., Tiszlavicz, L., Deak, P., Kahan, Zs. (2017) The Expression of Checkpoint and DNA Repair Genes in Head and Neck Cancer as Possible Predictive Factors. **Pathol Oncol Res 23:** 253-264.

Kovács, L., Nagy, Á., **Pál, M.**, Deák, P. (2020) Usp14 is required for spermatogenesis and ubiquitin stress responses in Drosophila melanogaster. J Cell Sci 133: 2.

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Pal, M., Nagy, O., Menesi, D., Udvardy, A., Deak, P. (2007) Structurally Related Tpr Subunits Contribute Differently to The Function of The Anaphase-promoting Complex in Drosophila Melanogaster. **J Cell Sci 120:** 3238-3248.

MÁRTON PIPICZ

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RESEARCH AREA

Despite improving therapeutic options, cardiovascular diseases including myocardial infarction remain the leading cause of death. Research aiming to reduce heart damage is therefore of great importance. The heart has its own adaptive response to the cardiac injury. Various procedures can enhance this response and result in cardioprotection by reducing the injury. In addition to classical pre- and postconditioning techniques, our research group investigates pharmacological and non-pharmacological cardioprotective approaches and molecular mechanisms to alleviate cardiac injury. Certain metabolic diseases (e.g. hypercholesterolemia, diabetes) increase the risk of myocardial infarction, directly impair cardiac function and interfere with the heart's adaptive response to myocardial infarction. Our research focuses on the adverse effects of metabolic diseases as cardiovascular risk factors on cardiac function and adaptive response. We comprehensively analyse molecular changes with genomic and proteomic approaches, then we elucidate them in detail by focused studies. We also conduct experiments regarding pharmacological and non-pharmacological interventions to affect these undesirable molecular changes and to mitigate adverse cardiac effects.

TECHNIQUES AVAILABLE IN THE LAB

Induction, maintenance and treatment of cell cultures, simulated ischemia/reperfusion protocol and determination of cell death. Isolated heart preparation, heart perfusion according to Langendorff and Neely, induction of global and regional ischemia, ex vivo heart function measurement, determination of myocardial infarction with biochemical assays and tissue staining techniques. In vivo echocardiography, blood pressure measurement, cardiac catheterization. Induction and pharmacological treatment of diabetes and hypercholesterolemia in experimental rats and mice. General biochemical methods to determine metabolites, proteins and nucleic acids (colorimetry, Western blot, ELISA, PCR, immunocytochemistry, etc.).

SELECTED PUBLICATIONS

Pipicz, M., Kocsis, G.F., Sarvary-Arantes, L., Bencsik, P., Varga, Z.V., Ferdinandy, P., Csont, T. (2017) Low-dose endotoxin induces late preconditioning, increases peroxynitrite formation, and activates STAT3 in the rat heart. **Molecules 22:** 433.

Varga, Z.V., **Pipicz, M.**, Baán, J.A., Baranyai, T., Koncsos, G., Leszek, P., Kuśmierczyk, M., Sánchez-Cabo, F., García-Pavía, P., Brenner, G.J., Giricz, Z., Csont, T., Mendler, L., Lara-Pezzi, E., Pacher, P., Ferdinandy, P. (2017) Alternative splicing of nox4 in the failing human heart. **Front Physiol 8:** 935.

Pipicz, M., Demján, V., Sárközy, M., Csont, T. (2018) Effects of cardiovascular risk factors on cardiac STAT3. **Int J Mol Sci 19:** 3572.

Szabó, M.R., Gáspár, R., **Pipicz, M.**, Zsindely, N., Diószegi, P., Sárközy, M., Bodai, L., Csont, T. (2020) Hypercholesterolemia Interferes with Induction of miR-125b-1-3p in Preconditioned Hearts. **Int J Mol Sci 21:** 3744

Demján, V., Sója, A., Kiss, T., Fejes, A., Gausz, F. D., Szűcs, G., Siska, A., Földesi, I., Tengölics, R., Darula, Z., Csupor, D., **Pipicz, M.**, & Csont, T. (2021) Stellaria media tea protects against diabetes-induced cardiac dysfunction in rats without affecting glucose tolerance. **J Tradit Complement Med 12:** 250-259.

BALÁZS SZAPPANOS

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RESEARCH AREA

The recent emergence of the field of systems biology brought a new era in the research of evolution. The novel methods and largescale datasets enable the systematic exploration of the elements of biological systems and the interactions between them. Our group is particularly interested in studying the evolution of metabolism. By measuring the intracellular metabolite levels, that is, the metabolome in different yeasts we can assess how fast metabolism evolves and what are the driving forces behind its evolution. We are also studying the evolution of the metabolic network, that is, how can organisms gain novel enzymes and biochemical pathways to better adapt to the environmental conditions. We utilize this knowledge for strain design by discovering genetic modifications that can boost the microbial production of chemicals with industrial importance.

TECHNIQUES AVAILABLE IN THE LAB

Metabolic network modelling, phylogenetic and comparative genomics methods, bioinformatic analysis of metabolomic and transcriptomic data, statistics and machine learning. Programming in R, Python, Perl and Matlab languages.

SELECTED PUBLICATIONS

Zampieri, M., **Szappanos, B.**, Buchieri, M.V., Trauner, A., Piazza, I., Picotti, P., Gagneux, S., Borrell, S., Gicquel, B., Lelievre, J., Papp, B., Sauer, U. (2018) High-throughput metabolomic analysis predicts mode of action of uncharacterized antimicrobial compounds. **Sci Transl Med 10:** eaal3973.

Szappanos, B., Fritzemeier, J., Csörgő, B., Lázár, V., Lu, X., Fekete, G., Bálint, B., Herczeg, R., Nagy, I., Notebaart, R.A., et al. (2016) Adaptive evolution of complex innovations through stepwise metabolic niche expansion. **Nat Commun 7:** 11607.

Notebaart, R.A., **Szappanos, B.**, Kintses, B., Pál, F., Györkei, A., Bogos, B., Lázár, V., Spohn, R., Csörgő, B., Wagner, A., Ruppin, E., Pál, C., Papp, B. (2014) Network-level architecture and the evolutionary potential of underground metabolism. **Proc Natl Acad Sci U S A 111:** 11762-11767.

Szappanos, B., Kovács, K., Szamecz, B., Honti, F., Costanzo, F., Baryshnikova, A., Gelius-Dietrich, G., Lercher, M.J., Jelasity, M., Myers, C.L., Andrews, B.J., Boone, C., Oliver, S.G., Pál, C., Papp, B. (2011) An integrated approach to characterize genetic interaction networks in yeast metabolism. **Nat Genet 43:** 656-62.

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RESEARCH AREA

Sarcomeres, the basic contractile units of muscles, are composed of three major filament systems: a filamentous actin based thin-filament array, the myosin motor protein based thick filaments, and a titin based elastic filament system. Grounded on classic electron microscopy studies, the sarcomere is defined as a repeating unit of the myofibril bordered by two Z-disks, which serve as anchoring sites for the oppositely oriented thin-filaments of the neighboring units. The midline of the sarcomere is referred as to the M-line flanked by the H-zone corresponding to the central thin filament-free area and to the head-less area of the bipolar thick filaments. The sarcomeres are extremely highly ordered macromolecular assemblies where structural organization is intimately linked to the functionality of these contractile units. Therefore, precise structural description of the sarcomeres is critical to better understand the mechanisms of muscle development and maintenance. We previously established a single-molecule localization microscopy based approach, which can deliver localization maps of multiprotein complexes with very high precision, virtually attaining single protein size resolution. By combining the tools of Drosophila genetics with nanoscopy, we plan to better understand the molecular mechanisms of sarcomere assembly and growth during development.

TECHNIQUES AVAILABLE IN THE LAB

Classical and molecular Drosophila genetics, molecular biology, cell biology, cytoskeleton analysis, immunohistochemistry, the basic methods of biochemistry, confocal and superresolution microscopy, behavioral tests, live imaging, digital image analysis.

SELECTED PUBLICATIONS

Szikora, S., Gajdos, T., Novák, T., Farkas, D., Földi, I., Lenart, P., Erdélyi, M., Mihály, J. (2020) Nanoscopy reveals the layered organization of the sarcomeric H-zone and I-band complexes. **J Cell Biol 219:** e201907026.

Gajdos, T., Cserteg, Z., **Szikora, S.**, Novak, T., Kovacs, B. B. H., Szabo, G., Mihaly, J., and Erdelyi, M. (2019) mmSTORM: Multimodal localization based super-resolution microscopy. **Sci Rep 9:** 798.

Migh, E., Gotz, T., Foldi, I., **Szikora, S.**, Gombos, R., Darula, Z., Medzihradszky, K., Maleth, J., Hegyi, P., Sigrist, S., Mihaly, J. (2018) Microtubule organization in presynaptic boutons relies on the formin **Daam Development 145: dev**158519.

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Teréz Vig, A., Földi, I., **Szikora, S.**, Migh, E., Gombos, R., Ágnes Tóth, M., Huber, T., Pintér, R., Csaba Talián, G., Mihály, J., Bugyi, B. (2017) The activities of the c-terminal regions of the formin protein disheveled-associated activator of morphogenesis (daam) in actin dynamics. **J Biol Chem 292:** 13566–13583.

DÓRA TOMBÁCZ

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RESEARCH AREA

Genomics is the study of the structure and function of genome. The genome sequences of many organisms have now been determined. It has also been described that the mammalian genomes contain approximately 22,000 protein-coding genes, however, they only represent about 1% of the genomes. It has also been demonstrated, that almost the entire genome is transcriptionally active at both DNA strands. More and more results show that the non-protein coding RNAs have a very important role on the regulation of gene expression, on various post-transcriptional processes and on the translation. Our research projects focus on the analysis of various viruses (e. g., Herpes simplex virus, Varicella Zoster virus, Vaccinia virus, etc.). We examine the gene expression profiles and transcriptional complexity of these viruses, and also use them as model organisms for the study of our Transcriptional Interference Network (TIN) hypothesis, which propose a novel layer of genetic regulation, and is based on the interactions between the gene activities via the mechanisms of transcriptional read-through between convergent, divergent and parallel gene pairs. For these, we apply state-of-the-art sequencing and bioinformatics techniques, as well as other cutting edge technologies such as the CrispR-Cas9/dCas9 techniques, with which we generate genetically modified viruses or inducible gene expression. Our group also has bacterial-fungal- and human genomics projects (analysis of the genetic background of major depression, Alzheimer's Disease) by applying exome-, transcriptome-, methyl- and ChIP-seq techniques.

TECHNIQUES AVAILABLE IN THE LAB

We apply a wide variety of standard molecular biological methods and the most modern genomic approaches: DNA and RNA purification, propagation and maintaining various cell cultures, propagation of viruses, molecular cloning (homologous recombination and CrispR technique), PCR, quantitative (q)PCR, digital (d)PCR, Northern- and Western-blot, fluorescent and confocal microscopy. Next- and third generation sequencing (Illumina MiSeq, Oxford Nanopore MinION): genome-, transcriptome-, small RNA sequencing, analysis of epigenetic changes, preparation of sequencing libraries, bioinformatics and statistics. Pacific Biosciences RSII and Sequel data analysis and bioinformatics.

SELECTED PUBLICATIONS

Boldogkői, Z., Moldován. N., Balázs. Z., Snyder, M., **Tombácz, D.** (2019) Long-Read Sequencing - A Powerful Tool in Viral Transcriptome Research. **Trends Microbiol 27:** 578-592.

Tombácz, D., Prazsák, I., Szűcs, A., Dénes, B., Snyder, M., Boldogkői, Z. (2018) Dynamic transcriptome profiling dataset of vaccinia virus obtained from long-read sequencing techniques. **Gigascience 7:** giy139.

Tombácz, D., Sharon, D., Szűcs, A., Moldován, N., Snyder, M., Boldogkői, Z. (2018) Transcriptome-wide survey of pseudorabies virus using next- and third-generation sequencing platforms. **Sci Data 5:** 180119.

Tombácz, D., Maróti, Z., Kalmár, T., Csabai, Z., Balázs, Z., Takahashi, S., Palkovits, M., Snyder, M., Boldogkői Z. (2017) High-Coverage Whole-Exome Sequencing Identifies Candidate Genes for Suicide in Victims with Major Depressive Disorder. **Sci Rep 7:** 7106.

Boldogkői, Z., Balint. K., Awatramani. G.B., Balya, D., Busskamp,V., Viney, T.J., Lagali, P.S., Duebel, J., Pásti, E., **Tombácz, D.**, Tóth, J.S., Takács, I.F., Scherf, B.G., Roska, B. (2009) Genetically timed, activity-sensor and rainbow transsynaptic viral tools. **Nat Methods 6(2)**: 127-30.

RENÁTA TÓTH

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RESEARCH AREA

Besides the bacterial flora, several fungal species are also long-term occupants of the oral microbiota. Among these, *Candida* are the most abundant species. Although the role of the human bacteriota and virome is well characterized, less is known about the composition of the mycobiota, let alone its role in the host. Therefore, one purpose of our project is to examine how do normal oral epithelial cells respond to the presence of commensal *Candida* species. We aim to explore their recognition, the corresponding signal transduction mechanisms and potential effector functions in the presence of various fungal stimuli. Since the last decade, numerous studies report alterations in the diversity of the oral microflora of immunocompromised and cancer patients (e.g. with oral squamous cell carcinoma), allowing the overgrowth of opportunistic pathogenic species (such as *C. albicans* and *C. parapsilosis*). Besides the increased probability of oral candidiasis in these patients, the abnormally altered microbiota might also influence the underlying diseases' progression. In addition to investigating the immune response regulatory effect of normal oral epithelial cells, we further aim to examine the potentially altered immunomodulatory effects of oral squamous cell carcinoma cells and to explore signaling routes that might be associated with tumor progression following fungal stimuli.

TECHNIQUES AVAILABLE IN THE LAB

Establishment/ optimization/ handling of *in vitro* co-infection models to examine fungal infections, using human monocytic, epithelial and murine cell lines and primary cells; phagocytosis and killing experiments; RNA preparation; real-time PCR; ELISA; flow cytometry; metabolic activity; cell adhesion and host cell killing (LDH) assays, live cell imaging. Next-generation sequencing, RNA-seq, micro RNA investigations.

SELECTED PUBLICATIONS

Toth, R., Nosek, J., Mora-Montes, H., Gabaldon, T., Bliss, J.M., Nosanchuk J.D., Turner, S.A., Butler, G., Vagvolgyi, Cs., Gacser, A. (2019) The emergence of Candida parapsilosis: from genes to the bedside. **Clin Microbiol Rev 32:** e00111-18.

Toth, R., Cabral, V., Thuer, E., Bohner, F., Nemeth, T., Papp, Cs., Nimrichter, L., Molnar, G., Vagvolgyi, Cs., Gabaldon, T., Nosanchuk, J.D., Gacser, A. (2018) Investigation of Candida parapsilosis virulence regulatory factors during hostpathogen interaction. **Sci Rep 8:** 1346.

Toth, R., Toth, A., Vagvolgyi, Cs., Gacser, A. (2017) Candida parapsilosis secreted lipase as an important virulence factor. **Curr Protein Pept Sci 18:** 1043-1049.

Nagy, L.G., **Toth, R.**, Kiss, E., Slot, J., Gacser, A., Kovacs, G.M. (2017) Six Key Traits of Fungi: Their evolutionary origins and genetic bases. **Microbiol Spectr 5.**

Toth, R., Toth, A., Papp, Cs., Jankovics, F., Vagvolgyi, Cs., Alonso, M.F., Bain, J.M., Erwig, L.P., Gacser, A. (2014) Kinetic studies of Candida parapsilosis phagocytosis by macrophages and detection of intracellular survival mechanisms. **Front Microbiol 5: 633.**

MÁTÉ VÁGVÖLGYI

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RESEARCH AREA

Bioactive natural compounds and their semi-synthetic derivatives represent a highly promising treasury of potential new drugs. Two particularly interesting naturally occurring, pharmacologically active compound groups are ecdysteroids and protoflavonoids.

Ecdysteroids are present both in flora and fauna. In mammals, they are non-toxic compounds that can exert numerous beneficial non-hormonal bioactivities, such as anabolic and adaptogenic effects. Besides, our research group has discovered the particular property of notably less polar ecdysteroid derivatives to sensitize the drug resistance of both multi-drug resistant (MDR) and non-MDR cancer cells towards various chemotherapeutics.

The pharmacological potential of protoflavonoids is also wide-ranging. They are intensively studied for their antitumor effects, which stem from their representatives' cytotoxic nature and their inhibitory effect on specific DNA damage response mechanisms (ATR-dependent signaling), through which they can enhance, e.g., the activity of cisplatin. Besides, considerable evidence has been revealed in recent years (e.g., inhibition of xanthine oxidase enzyme, antiviral activities) suggesting that the pharmacology of protoflavonoids might exceed their antitumor potential.

The focus of our research efforts is on the structural optimization of compounds of the outlined groups with therapeutic potential, according to which semi-synthetic modifications are made on the molecules, which may result in the improvement of their chemical-physical parameters, the enhancement of their biological effects and/or the reduction of their potential disadvantageous side effects.

TECHNIQUES AVAILABLE IN THE LAB

Versatile organic synthetic techniques and drug functionalization methods that enhance the *in vivo* efficacy of the compounds (e.g., the preparation of self-assembled nanoparticles of bioactive agents) can be studied in our laboratory. An extensive array of instrumental chromatographic techniques is available for the qualitative analysis and purification of products: high performance liquid chromatography (HPLC), supercritical fluid chromatography (SFC), flash chromatography, rotation planar chromatography, and centrifugal partition chromatography (CPC). In addition to the above, we provide an opportunity to learn about methods used for the structure elucidation of molecules (mass spectrometry, nuclear magnetic resonance spectroscopy).

SELECTED PUBLICATIONS

Vágvölgyi, M., Bélteky, P., Bogdán, D., Nové, M., Spengler, G., Latif, A.D., Zupkó, I., Gáti, T., Tóth, G., Kónya, Z., Hunyadi, A. (2020) Squalenoylated Nanoparticle Pro-Drugs of Adjuvant Antitumor 11α-Hydroxyecdysteroid 2,3-Acetonides Act as Cytoprotective Agents Against Doxorubicin and Paclitaxel. **Front Pharmacol 11:** 552088.

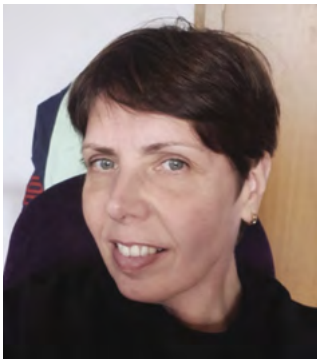
Vágvölgyi, M., Girst, G., Kúsz, N., Ötvös, S.B., Fülöp, F., Hohmann, J., Servais, J-Y., Seguin-Devaux, C., Chang, F-R., Chen, M.S., Chang, L-K., Hunyadi, A. (2019) Less Cytotoxic Protoflavones as Antiviral Agents: Protoapigenone 1′-O-isopropyl ether Shows Improved Selectivity Against the Epstein–Barr Virus Lytic Cycle. **Int J Mol Sci 20:** 6269.

Fumagalli, G., Giorgi, G., **Vágvölgyi, M.**, Colombo, E., Christodoulou, M.S., Collico, V., Prosperi, D., Dosio, F., Hunyadi, A., Montopoli, M., Hyeraci, M., Silvani, A., Lesma, G., Dalla Via, L., Passarella, D. (2018) Heteronanoparticles by Self-Assembly of Ecdysteroid and Doxorubicin Conjugates To Overcome Cancer Resistance. **ACS Med Chem Lett 9:** 468-471.

Vágvölgyi, M., Martins, A., Kulmány, A., Zupkó, I., Gáti, T., Simon, A., Tóth, G., Hunyadi, A. (2018) Nitrogen-containing ecdysteroid derivatives vs. multi-drug resistance in cancer: Preparation and antitumor activity of oximes, oxime ethers and a lactam. **Eur J Med Chem 144:** 730-739.

Vágvölgyi, M., Girst, G., Kuo, C-Y., Wang, H-C., Fülöp, F., Hunyadi, A. (2018) Synthesis of Nontoxic Protoflavone Derivatives through Selective ContinuousFlow Hydrogenation of the Flavonoid B-Ring. **Chempluschem 83:** 72-76.

GABRIELLA VARGA



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RESEARCH AREA

The extracorporeal circulation (ECC) can be lifesaving in conditions, accompanied by severe acute respiratory or circulatory failure, but the ECC related complications limit the application of the technique, and this reduces the group of patients who can benefit from the ECC treatment. Moreover, the complications frequently affect vital organs (kidney, brain, heart) and as a result long lasting aftercare can be necessary or in case of the most severe cases, it might even cause the death of the patient. Our main purpose is to develop and establish animal models, which will be suitable to the examination of inflammatory processes that play critical role in the pathomechanism of the ECC related complications. The other aim is to develop an innovative treatment method, the trans-oxygenator methane administration to moderate ECC associated complications.

TECHNIQUES AVAILABLE IN THE LAB

Learn about small and large animal models of extracorporeal circulation. Participation in animal experimental work, learn about surgical techniques, macro and microhemodynamic measurements. Methods of data processing, statistical analysis of data. Active participation in human studies of the research team.

SELECTED PUBLICATIONS

Szűcs, S., Bari, G., Ugocsai, M., Lashkarivand, R.A., Lajkó, N., Mohácsi, A., Szabó, A., Kaszaki, J., Boros, M., Érces, D., **Varga, G.** (2019) Detection of Intestinal Tissue Perfusion by RealTime Breath Methane Analysis in Rat and Pig Models of Mesenteric Circulatory Distress. **Crit Care Med 47:** e403-e411.

Bari, G., Érces, D., **Varga, G.**, Szűcs, Sz., Varga, Z., Bogáts, G., Boros, M. (2019) Methane inhalation reduces the systemic inflammatory response in a large animal model of extracorporeal circulation. **Eur J Cardiothorac Surg 56:** 135-142.

Poles, M.Z., Bódi, N., Bagyánszki, M., Fekete, É., Mészáros, A.T., **Varga, G.**, Szűcs, Sz., Nászai, A., Kiss, L., Kozlov, A.V., Boros, M., Kaszaki, J. (2018) Reduction of nitrosative stress by methane: Neuroprotection through xanthine oxidoreductase inhibition in a rat model of mesenteric ischemia-reperfusion. **Free Radic Biol Med 120:** 160-169.

Mészáros, A.T., Büki, T., Fazekas, B., Tuboly, E., Horváth, K., Poles, M.Z., Szucs, S., **Varga, G.**, Kaszaki, J., Boros, M. (2017) Inhalation of methane preserves the epithelial barrier during ischemia and reperfusion in the rat small intestine. **Surgery 161:** 1696-1709.

Boros, M., Ghyczy, M., Erces, D., **Varga, G.**, Tokes, T., Kupai, K., Torday, C., Kaszaki, J. (2012) The anti-inflammatory effects of methane. **Crit Care Med 40:** 1269-1278.

BALÁZS VEDELEK

University of Szeged
Faculty of Science and Informatics
Department of Biochemistry and Molecular Biology

Address: Közép fasor 52., H-6726 Szeged, Hungary

RESEARCH AREA

Telomeres are nucleoprotein complexes responsible for the protection of chromosome integrity. Telomeres hide the ends of the chromosomes from DNA repair mechanism to prevent chromosome fusions. Telomeres also buffer the 'end replication problem' by the telomerase enzyme, which can elongate the chromosomes ends. In human somatic cells the telomerase is inactive; the chromosomes are continuously shortening, which results in the senescence of the cells. In tumours however the telomerase is reactivated and provides the possibility of unlimited cell divisions. In our lab we study the mechanisms behind telomerase gene activation in tumours.

TECHNIQUES AVAILABLE IN THE LAB

DNA isolation from different biological samples (bacteria, FFPE tumour samples, urine), agarose gel electrophoresis, cloning methods, enzymatic DNA manipulation techniques, culturing of bacterial or mammalian cells, reporter assay, chromatin immunprecipitation, PCR based techniques (primer design, high fidelity PCR, nested PCR, PCR mutagenesis, KASP, qPCR), heterologous protein expression and protein purification, PAGE, macromolecule interaction studies (gel filtration, immunprecipitation, MST).

SELECTED PUBLICATIONS

Sike, A., Nagy, E., **Vedelek, B.**, et al. (2014) mRNA Levels of Related Abcb Genes Change Opposite to Each Other upon Histone Deacetylase Inhibition in Drug-Resistant Rat Hepatoma Cells. **PLosOne 9:** e84915.

Vedelek, B., Blastyák, A., Boros, I.M. (2015) Cross-Species Interaction between Rapidly Evolving Telomere-Specific Drosophila Proteins. **PLosOne 10:** e0142771.

Pahi, Z., Borsos, B.N., **Vedelek, B.**, et al. (2017) TAF10 and TAF10b partially redundant roles during Drosophila melanogaster morphogenesis. **Transcription 8:** 297-306.

Henn, L., Szabó, A., Imre, L., Román, Á., Ábrahám, A., **Vedelek, B.,** Nánási, P., Boros, I.M. (2020) Alternative linker histone permits fast paced nuclear divisions in early Drosophila embryo. **Nucleic Acids Research, 48:** 9007–9018.

V**edelek, B.**, Maddali, A.K., Davenova, N., Vedelek. V., Boros, I.M. (2020) TERT promoter alterations could provide a solution for Peto's paradox in rodents. **Sci Rep 10:** 20815

Vedelek, B., Kovács, Á., Boros, I.M. (2021) Evolutionary mode for the functional preservation of fast-evolving Drosophila telomere capping proteins. **Open Biol.11:** 210261

DÁNIEL VERÉB

University of Szeged
Albert Szent-Györgyi Medical School
Department of Radiology

Address: Semmelweis u. 6., H-6725 Szeged, Hungary

RESEARCH AREA

Neuroimaging methods are powerful non-invasive tools increasingly deployed to understand the structure and function of the human brain. Structural methods include the quantitative assessment of regional and global grey matter volumes that can be used to monitor cortical atrophy, as well as plastic changes in local grey matter density and geometry. Another popular technique is diffusion tensor imaging, where diffusion-weighted sequences and voxel wise diffusion tensor models are used to describe white matter microstructure and connectivity. Diffusion tensor data can also be used to reconstruct white matter pathways via tractography. The most popular functional method is functional MRI, which exploits hemodynamic changes associated with neural function to investigate task-related and resting state fluctuations in the measured blood oxygen level dependent signal. Analytic techniques that can be used to process functional magnetic resonance imaging data are expanding continuously and include methods that yield information about the network-like functional architecture of the brain, e.g. methods based on functional connectivity, graph theory or spatial statistics.

TECHNIQUES AVAILABLE IN THE LAB

Voxel based morphometry, subcortical volumetry (FSL FIRST), vertex analysis (FSL FIRST), tract based spatial statistics, probabilistic and deterministic tractography, structural connectivity, statistical parametric mapping, analysis of task-based functional MRI data (FSL FEAT, SPM12), psychophysiological interaction analysis, dynamic causal modeling, independent component analysis (FSL MELODIC), dual regression based connectivity analysis, graph theoretical measures, functional cortical gradients.

SELECTED PUBLICATIONS

Vereb, D., Szabo, N., Tuka, B., Tajti, J., Kiraly, A., Farago, P., … Kincses, Z. (2018) Correlation of neurochemical and imaging markers in migraine. PACAP38 and DTI measures. **Neurology 91:** e1166–e1174.

Veréb, D., Szabó, N., Tuka, B., Tajti, J., Király, A., Faragó, P., … Kincses, Z. T. (2020) Temporal instability of salience network activity in migraine with aura. **Pain 161:** 856-864.

Veréb, D., Tóth, E., Bozsik, B., Király, A., Szabó, N., Kincses, B., … Kincses, Z. T. (2021) Altered brain network function during attention-modulated visual processing in multiple sclerosis. **Mult Scler J 27:** 1341-1349.

Szabo, N., Farago, P., Kiraly, A., **Vereb, D.**, Csete, G., Toth, E., … Kincses, Z. (2018) Evidence for Plastic Processes in Migraine with Aura: A Diffusion Weighted MRI Study. **Front Neuroanat 11:** 138.

Toth, E., Farago, P., Kiraly, A., Szabo, N., **Vereb, D.**, Kocsis, K., … Kincses, Z. T. (2019) The Contribution of Various MRI Parameters to Clinical and Cognitive Disability in Multiple Sclerosis. **Front Neurol 9:** 1172

ZOLTÁN JÁNOS VERÉB

University of Szeged
Albert Szent-Györgyi Medical School
Department of Dermatology and Allergology
Regenerative Medicine and Cellular Pharmacology Research Laboratory

Address: Korányi fasor 6., H-6720 Szeged, Hungary

RESEARCH AREA

Stem cells present in the human adult body play a crucial role in the maintaining of homeostasis, and in the regeneration of tissues and organs. The loss or alteration of their function have been shown to have an important role in the pathomechanism of certain diseases. Mesenchymal stem cells (MSCs) can be isolated from many tissues and organs, and can be differentiated under appropriate conditions towards osteoblasts, fat cells, chondrocytes, myoblasts, fibroblasts, epithelium and other tissues as well. The MSC is capable of controlling humoral and cellular immune responses to prevent inflammation, tissue and organ rejection. They have an extremely important role in inducing local immunosuppression, in which both T cells and dendritic cells are affected by MSC. Due to their immunosuppressive capacity and their high potential for differentiation they became the most researched objects of regenerative medicine. As cell therapy product MSC able to regenerate the damaged tissues or organs and inhibit inflammatory processes. Our research mainly focuses on the role of mesenchymal stem cells in tissue regeneration, and immunomodulation under healthy and pathological conditions According this knowledge we create artificial tissues, tissue engineered products using 3D bioprinting from stem cells and bioscaffolds. We characterize the biochemical and immunological properties of these bioprinted tissues as well. We also investigate how MSC can participate in tumor formation and metastasis.

TECHNIQUES AVAILABLE IN THE LAB

Isolation of stem cells and progenitor cells from various tissues, *in vitro* and *ex vivo* cultivation of isolated cells. Phenotype analysis of cells is performed by immunocytochemistry and flow cytometry. Gene expression studies using PCR and high throughput gene arrays. Measurement of *in vitro* differentiation assays, wound healing and migration tests by high content screening microscopy. Detection of proteins, secreted factors by Western blots, ELISA and protein arrays. Three-dimensional cell cultures and 3D bioprinting.

SELECTED PUBLICATIONS

Klusóczki, Á., **Veréb, Z.**, Vámos, A., Fischer-Posovszky, P., Wabitsch, M., Bacso, Z., Fésüs, L., Kristóf, E. (2019) Differentiating SGBS adipocytes respond to PPARγ stimulation, irisin and BMP7 by functional browning and beige characteristics. **Sci Rep 9:** 5823.

Veréb, Z., Póliska, S., Albert, R., Olstad, OK., Boratkó, A., Csortos, C., Moe, MC., Facskó, A., Petrovski G. (2016) Role of Human Corneal Stroma-Derived Mesenchymal-Like Stem Cells in Corneal Immunity and Wound Healing. **Sci Rep 6:** 26227.

Veréb, Z., Albert, R., Póliska, S., Olstad, OK., Akhtar, S., Moe, MC., Petrovski, G. (2013) Comparison of upstream regulators in human ex vivo cultured cornea limbal epithelial stem cells and differentiated corneal epithelial cells. **BMC Genomics 14:** 900.

Veréb, Z., Lumi, X., Andjelic, S., Globocnik-Petrovic, M., Urbancic, M., Hawlina, M., Facskó, A., Petrovski, G. (2013) Functional and molecular characterization of ex vivo cultured epiretinal membrane cells from human proliferative diabetic retinopathy. **Biomed Res Int 2013:** 492376.

Varga, N., **Veréb, Z.**, Rajnavölgyi, E., Német, K., Uher, F., Sarkadi, B., Apáti, A. (2011) Mesenchymal stem cell like (MSCl) cells generated from human embryonic stem cells support pluripotent cell growth. **Biochem Biophys Res Commun 14:** 474-80.

EDIT WÉBER

University of Szeged
Albert Szent-Györgyi Medical School
Department of Medical Chemistry

Address: Dóm tér 8., H-6720 Szeged, Hungary

RESEARCH AREA

Protein-protein interactions play an important role in a number of therapeutically relevant pathophysiological processes. These interactions include large protein surfaces; hence their modulation is challenging. While small-molecule drugs cannot effectively decouple macromolecule interactions in general because of their small size, the right sized and often used antibodies have many disadvantages. Thus, proteomimetic compounds and innovative drug development strategies are required. The aim of our research group is to create new proteomimetic macromolecules from unnatural building blocks (foldamers), of which 3D structure can be predicted and programmed. Manipulating protein functions by these chemically well-defined substances is a great challenge and holds promise. We utilize foldamers as artificial self-organizing proteomimetics to modulate protein-protein interactions or to develop diagnostic tools. Our targets are proteins that have a key role in tumour development and progression. We aim to design foldamers that can bind to our target proteins and are able to inhibit their interactions, thereby modulating their function. Our goal is to construct new foldamers which can inhibit tumour growth in cells.

TECHNIQUES AVAILABLE IN THE LAB

Target proteins are produced via bacterial expression systems. Foldamers are synthetized chemically. To detect and analyze protein-ligand interactions, various techniques are applied: pull-down methods with HPLC-MS analysis, protein mass spectrometry, NMR spectrometry methods, isothermal titration calorimetry and various fluorescent techniques. Structure-based drug design. Foldamer structure design relies on computer modelling. In order to determine the binding site of the foldamers and to characterize the structure of the protein-ligand complexes, NMR spectroscopy is deployed with a special emphasis on protein NMR methods.

SELECTED PUBLICATIONS

Tököli, A., Mag, B., Bartus, É., **Wéber, E.**, Szakonyi, G., Simon, M. A; Czibula, Á., Monostori, É., Nyitray, L., Martinek, T.A. (2020) Proteomimetic surface fragments distinguish targets by function. **Chem Sci 11:** 10390.

Fenteany, G., Gaur, P., Hegedűs, L., Dudás, K., Kiss, E., **Wéber, E.**, Hackler, L., Martinek, T.A., Puskás, L., Haracska, L. (2019) Multilevel structure–activity pro ling reveals multiple green tea compound families that each modulate ubiquitin-activating enzyme and ubiquitination by a distinct mechanism. **Sci Rep 9:** 12801.

Fenteany, G., Gaur, P., Hegedűs, L., Dudás, K., Kiss, E., **Wéber, E.**, Hackler, L., Martinek, T.A., Puskás, L., Haracska, L. (2019) Multilevel structure–activity pro ling reveals multiple green tea compound families that each modulate ubiquitin-activating enzyme and ubiquitination by a distinct mechanism. **Sci Rep 9:** 12801.

Bartus, É., Hegedüs, Z., **Wéber, E.**, Csipak, B., Szakonyi, G., Martinek, T.A. (2017) De Novo Modular Development of a Foldameric Protein-Protein Interaction Inhibitor for Separate Hot Spots: A Dynamic Covalent Assembly Approach. **Chemistryopen 6:** 236-241.

HeténYi, A., Németh, L., **Wéber, E.**, Szakonyi, G., Winter, Z., Jósvay, K., Bartus, É., Oláh, Z., Martinek, T.A. (2016) Competitive inhibition of TRPV1 – calmodulin interaction by vanilloids. **FEBS Lett 590:** 2768.

SZENT-GYÖRGYI STUDENTS SZEGED

BARBARA AMBRUS

National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2003

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Zsuzsanna Bata-Csörgő

JUNIOR MENTOR:

Renáta Bozó

SPECIALIZATION:

dermatology, psoriasis

SECONDARY SCHOOL:

ELTE Apáczai Csere János Secondary School

NAME OF TEACHER:

Judit Bakonyi

LANGUAGES:

English/advanced
Italian/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Psoriasis vulgaris is an immune-mediated, multifactorial, chronic skin disease, which is primarily caused be the hyperproliferation of keratinocytes and the infiltration of immune cells. There are several therapies with a short-term effect but there is no available treatment strategy which could entirely prevent the recureence/spread of the disease. Psoriasis is characterized by well-demarcated, scaly plaques and uninvolved, healthy-looking skin, referred to as non-lesional (NL) skin. There is now strong evidence that non-lesional (NL) psoriatic skin, despite its normal appearance, represents an intermediate state between healthy and lesional skin. Extracellular matrix could play an important role in maintaining skin in NL condition, and the molecular changes in NL skin is a completely new approach. Thereby the aim of my research is to examine the changes of extracellular matrix and its regulating mechanisms in NL skin, which could be responsible for maintaining the NL phenotype. Proteases and protease inhibitors are known to play role in the regulation of extracellular matrix components, therefore our aim is to compare the expression of proteases and protease inhibitors in lesional, non-lesional and healthy skin.

AMBITIONS AND CAREER GOALS

As a member of the National Academy of Scientist Education I have the opportunity to experience all the aspects of laboratory work, along with its laborious and pleasurable side, and provides a strong background for my future career as a doctor or a researcher, both academically and socially. My long-term goal is not just to partecipate in a clinical research, but to come up with own ideas, which humankind could directly benefit from.

HONORS AND PRIZES

2019 - SZTE Szent-Györgyi Competition, IV. place
2020 - XIII. Dürer Competition, chemistry K+ section I. place
2020 - Dr. Árokszállásy Zoltán Competition: III. category 16. place
2020 - European Union Science Olympaid final round 5. place
2020 - KÖKÉL English translation competition 3. place
2020 - National Conference of Reseraching Students (TUDOK) Molecular and microbiology section special award
2020 - Richter scholarship
2021 - New National Excellence Programme scholarship
2021 - National Secondary School Academic Competition (OKTV) Italian Language I. category 16. place
2021 - International Chemistry Tournament (IChTo), bronze medal

PUBLICATIONS

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GERGŐ ZALÁN BIRÓ

National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Tamás Csont

JUNIOR MENTOR:

Márton Pipicz

SPECIALIZATION:

Biochemistry,
myocardial function

SECONDARY SCHOOL:

Teleki Blanka High School,
Székesfehérvár

NAME OF TEACHER:

Zsuzsanna Perák,
Erika Molnár,
Ildikó Kiss
Ágnes Hegyi

LANGUAGES:

English/intermediate
German/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Cardiovascular diseases are still the leading causes of death today. Obesity and its associated, or isolated metabolic disorders (eg. hypercholesterolemia, diabetes) have a negative effect on heart function and increase the risk of myocardial infarction and reduce the heart's ability to adapt to heart attack. Some findings indicate that the environmental effects on the mother can also cause alterations in the offspring, such as abnormal heart function, which may be due to epigenetic changes. However, the effects of maternal high blood cholesterol on the hearts of adult offspring have not been studied to date. One of the aims of our research group is to investigate the cardiac function of the offspring of such mothers and the adaptation of the heart to infarction in animal experiments. Furthermore, we investigate whether hypercholesterolemia causes epigenetic changes in the heart that may be associated with adverse cardiac effects, whether these are inheritable, and if so, whether they can be reversed by medication or lifestyle interventions. We hope that our research will contribute to a detailed understanding of the cardiac effects of maternal metabolic abnormalities in the offspring and to the development of treatment possibilities.

AMBITIONS AND CAREER GOALS

I would like to serve society as a specialist worthy of the title of Doctor of Medicine, both in terms of expertise and humanity. In addition to research, I am also attracted to clinical medicine, so I wish to combine the two fields during my career.

HONORS AND PRIZES

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PUBLICATIONS

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GERGŐ BITAY

National Academy of Scientist Education, 3rd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Norbert Nagy

JUNIOR MENTOR:

-

SPECIALIZATION:

electrophysiology, farmacology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Béla Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Our research group specialises is researching the electrophysiological and pharmacological properties of the heart. We mainly focus on the spontaneous activity of the heart, Ca^{2+} - homeostasis; sudden cardiac arrest related research on athletic heart syndrome models. In our laboratory we conduct research on rabbit and dog models, both on tissue samples (conventional microelectrode technique) and on individual cells (patch-clamp). My main research involves the spontaneous activity of the sinus node: Ca^{2+} - homeostasis, sodium-calcium exchanger, small-conductance calcium-activated potassium (SK) channels. SK channels have a significant role in neurons, and due to the fact that they create a direct connection between the intracellular calcium handling and the repolarisation of the cell membrane, their role in the cardiac tissue could also be important. However, there is no consensus in the literature on the extent of their contribution to cardiac repolarisation. Because both the Ca^{2+} - homeostasis and the repolarisation are related to arrhytmias, SK channels could potentially have a major role pathophysiologically and farmacologically.

AMBITIONS AND CAREER GOALS

My ambition is to become a successful doctor and to continue with research. Furthermore, my goals are to earn a PhD and other degrees. The amount of knowledge given to us by the programme, the publications and the scientific conferences all contribute to achieve these goals.

HONORS AND PRIZES

2019 - XXXIV. OTDK, Medical and Health Section, Theoretical Medicine - Electrophysiology: Special Award
2018 - SZTE ÁOK TDK: Best presentation in the secondary-school section
2017/2018 - Biology OKTV 14th place
2017 - SZTE Szent-Györgyi Competition 3rd place

PUBLICATIONS

Kohajda, Zs., Tóth, N., Szlovák, J., Loewe, A., **Bitay, G.**, Gazdag, P., Prorok, J., Jost, N., Levijoki, J., Pollesello, P., Papp, J.Gy., Varró, A., Nagy, N. (2020) Novel Na+/Ca2+ Exchanger Inhibitor ORM-10962 Supports Coupled Function of Funny-Current and Na+/Ca2+ Exchanger in Pacemaking of Rabbit Sinus Node Tissue. **Front in Pharmacol 10:** 1632.

Tóth, N., Szlovák, J., Kohajda, Zs., **Bitay, G.**, Veress, R., Horváth, B., Papp, J. Gy., Varró, A., Nagy, N. (2021) The development of L-type Ca 2+ current mediated alternans does not depend on the restitution slope in canine ventricular myocardium. **Sci Rep 11:** 16652.

Bitay, G., Tóth, N., Déri, Sz., Szlovák, J., Kohajda, Zs., Varró, A., Nagy, N. (2022) The Inhibition of the Small-Conductance CA2+ -Activated Potassium Channels Decreases the Sinus Node Pacemaking during Beta-Adrenergic Activation. **Pharmaceuticals 15:** 313.

CSENGE BOCZ

National Academy of Scientist Education, 2nd year

University of Szeged,
Faculty of Pharmacy, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mónika Kiricsi

JUNIOR MENTOR:

Nóra Igaz

SPECIALIZATION:

nanoparticles,
tumor stroma

SECONDARY SCHOOL:

Petőfi Sándor Secondary School, Bonyhád

NAME OF TEACHER:

Andrea Nagy, Csaba Péter

LANGUAGES:

English/advanced
German/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Nowadays many people are affected by some kind of cancerous disease. Tumorcells are able to change their microenviroment, thereby creating the ideal conditions to multiply, migrate and become malignant. In this process stromal cells have a major role. These are altered functioned, cancer associated fibroblasts and immune cells. Targeting these cells is a potential therapeutic method. Nanoparticles can be used in the treatment of tumors, and they have several beneficial impacts, in contrast with the traditional cytotoxik molecules. In our research group we examine the anti-tumor effects of metal nanoparticles on stromal cells. Our goal is to get a better understanding of the communication between the cancer cells and their microenviroment, and recon the cellular and molecular events behind this process. This could provide relevant information in the fields of cancer research, and give the opportunity to develop new diagnostic techniques and treatments.

AMBITIONS AND CAREER GOALS

During my studies I would like to acquire the skills that will be really useful in my future work. I find it important to deepen my knowledge, and get a first-hand experience about what it is like to work in a laboratory and be part of a research group. My primary goal is to become a researcher and take part in the developement of novel therapeutic strategies.

HONORS AND PRIZES

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PUBLICATIONS

–

BÁLINT LÁSZLÓ CZAKÓ

National Academy of Scientist Education, 2nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 2nd year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

József Kaszaki

JUNIOR MENTOR

László Juhász

SPECIALIZATION:

circulatory physiology and pathophysiology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Sepsis is a potentially life-threatening multiorgan failure, an uncontrolled, self-harming response of the body to inflammation. This disease is one of the biggest challenges in intensive clinical care, so it is extremely important to develop new organ-protective therapies. In our study, we examined the damage of vital organs, and its underlying mitochondrial function impairment in untreated and methane-inhaled rats with peritonitis induced sepsis. Methane is a biologically active, anti-inflammatory gas that, due to its apolar nature, can pass through membrane systems without hindrance, thus it can offer a promising targeted therapy in sepsis. In our sepsis model, we examine the extent of circulatory and inflammatory parameters, mitochondrial function, and organ damage, which features are expected to improve with methane treatment.

AMBITIONS AND CAREER GOALS

My ambition is to master techniques and gain knowledge while working in the laboratory and to be able to exploit those skills when becoming a doctor. The program and the organised events provide an excellent opportunity to acquire insight into the life of a researcher and to lay down the foundations for my future research career.

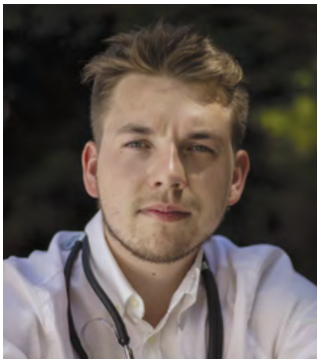
HONORS AND PRIZES

2019 - European Union Science Olympiad (EUSO): silver medal
2019 - International Genetically Engineered Machine (iGEM): bronze medal
2020 - Chemistry OKTV: 15th place
2020 - Biology OKTV: 6th place
2020 - International Biology Olympiad (IBO): bronze medal
2021 - University of Szeged: Scientific Students' Association Conference (TDK) – 3rd place in the physiology, pathophysiology 2. section
2021 - University of Szeged: Scientific Students' Association Conference (TDK) – 1st place in the pharmacology section

PUBLICATIONS

Poles, M., Z., Nászai, A., Gulácsi, L., **Czakó, B.**, L., Gál, G., K., Glenz, J. R., Dookhun, D., Rutai, A., Tallósy, Sz., P., Szabó, A., Lőrinczi, B., Szatmári, I., Fülöp, F., Vécsei, L., Boros, M., Juhász, L. and Kaszaki, J. (2021) Kynurenic Acid and Its Synthetic Derivatives Protect Against Sepsis-Associated Neutrophil Activation and Brain Mitochondrial Dysfunction in Rats. **Front Immunol 12:** 717157.

MÁRTON SIMON CZIKKELY



National Academy of Scientist Education, 5th year

University of Szeged,
Albert Szent-Györgyi Medical School, 5th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Csaba Pál

JUNIOR MENTOR:

-

SPECIALIZATION:

genetic engineering, experimental evolutionary biology, antibiotic resistance

SECONDARY SCHOOL:

Városmajori High School

NAME OF TEACHER:

Anna Jánossyné Solt

LANGUAGES:

English/advanced
Spanish/advanced
German/intermediate
Latin/intermediate
Persian/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Pathogens seem invariably to attempt to survive the immune system of the invaded host or the pressures of applied therapies. During this accommodation process, DNA-level changes and mutations occur in the cells. These invisible, but important evolutionary processes lead to one of our biggest clinical challenges: antimicrobial resistance. Thanks to scientific advances of recent decades, it has become possible to manipulate the DNA in a precise manner, which enables a rapid and targeted examination of these very mutations. This approach offers a breakthrough in the investigation of antimicrobial resistance. A technique developed in the laboratory of my mentor, Csaba Pál, makes the rapid examination and manipulation of evolution possible with unprecedented accuracy. In our current work, we use this technique also to predict the most important resistance processes against antibiotics under development.

AMBITIONS AND CAREER GOALS

My aim is to help the fight against antibiotic resistance – a major crisis in medicine – trough the examination of its evolution in clinically important pathogens.

HONORS AND PRIZES

2021 - Szent-Györgyi Student of the Year
2021 - Ivan Krisztinicz Award
2021 - University of Szeged: Scientific Students' Associations Conference (TDK)
1. prize in Cell Biology-Microbiology-Molecular Biology section
2020/21, 2021/22- National Higher Educational Scholarship
2020 - University of Szeged: Scientific Students' Associations Conference (TDK)
1. prize in Cell Biology-Microbiology section
2019 - Stephen W. Kuffler Research Scholarship
2019 - University of Szeged: Scientific Students' Associations Conference (TDK)
2. prize in Biochemistry-Microbiology section
2018 - University of Szeged: Scientific Students' Associations Conference (TDK)
1. prize in Genetics and Molecular Biology Section
2018/19, 2019/20, 2020/21, 2021/2022 - ÚNKP
2018/19, 2019/20, 2020/21 - Municipality of Szeged: University Scholarship

PUBLICATIONS

Wannier, T. M., Nyerges, A., Kuchwara, H. M., **Czikkely, M.,** Pál, C., Church G. M., et. al. (2020) Improved bacterial recombineering by parallelized protein discovery. **Proc Natl Acad Sci U S A 117:** 13689-13698.

Szili, P.§, .Draskovits§, G., Révész, T.§, **Czikkely, M.,** Pál*, Á. Nyerges, Á.,* et al. (2019) Rapid evolution of reduced susceptibility against a balanced dual-targeting antibiotic through stepping-stone mutations. **Antimicrob Agents Chemother 63:** 00207-19.

ZSOMBOR ESKÜDT

National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2003

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Áron Szabó

JUNIOR MENTOR:

-

SPECIALIZATION:

Drosophila genetics,
glial degradation

SECONDARY SCHOOL:

Táncsics Mihály High School, Kaposvár

NAME OF TEACHER:

Beatrix Kertészné Bagi

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

One of greatest medical challenge today is the effective cure of people suffering from a neurodegenerative disease. For most of these diseases there is no therapy yet. In order to develop therapies it is important to understand which enzymes play a role in autophagic processes after nerve injury. These enzymes are evolutionary conserved, so this processes can be excellently examined in fruit flies (Drosophila melanogaster). In our model animal we can see which factors are important in STAT mediated autophagy. Our long time goal is the understanding of glial activation and to have a better view on the early transcriptional response after injury.

AMBITIONS AND CAREER GOALS

As a medical student my goal is to do research that can be well translated into human medicine. I hope that the experience gathered in the lab will make me able to work as a researcher even after graduation. Currently my most important goal is to make the best and most comprehensive article possible, out of my research topic.

HONORS AND PRIZES

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PUBLICATIONS

–

SZUZINA FAZEKAS

National Academy of Scientist Education, 6th year

University of Szeged,
Albert Szent-Györgyi Medical School, 6th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Anikó Keller-Pintér

JUNIOR MENTOR:

-

SPECIALIZATION:

skeletal muscle regeneration, cell migration, exosomes

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Ádám Zoltán Seres
Tamás Mező
Gábor Ábrahám
István Tigyi

LANGUAGES:

English/advanced
Spanish/intermediate
Russian/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

I have always been interested in Natural Sciences, I knew from the start that I wanted to do research later. I have always been amazed by the complexity and mystery of the human body: understanding how it works from the smallest parts to the whole is one of the most interesting questions I know.
The Szent-Györgyi Research Program gave me an opportunity to join the skeletal muscle adaptation research group of the Department of Biochemistry. The institute follows the muscle research traditions of the Szent-Györgyi school. The aim is to understand the molecular mechanisms of the skeletal muscle regeneration and adaptation, and our findings could have clinical applicability later.

AMBITIONS AND CAREER GOALS

During my medical career my primary aim is to become a good doctor and meet the highest scientific expectations. While researching, I am eager to use my obtained knowledge and also widen my scientific perspective. I believe it is desirable to begin the scientists' and doctors' lifelong learning as early as possible.

HONORS AND PRIZES

2021 - National Scientific Students' Associations Conference (OTDK), Special prize
2020 - Scientific Students' Associations Conference (TDK), Szeged, 2nd prize
2019 - National Scientific Students' Associations Conference (OTDK), Special prize
2019 - Scientific Students' Associations Conference (TDK), Szeged, 1st prize
2018 - XXV. Scientific Students' Associations Conference (TDK), Targu Mures, Special award
2018 - Korányi Frigyes Scientific Forum, 1st prize
2017 - Scientific Student Conference, Szeged, 1st prize
2016 - OKTV Biology, 37th place

PUBLICATIONS

Becsky, D., Szabo, K., **Gyulai-Nagy, S.**, Gajdos, T., Bartos, Z., Balind, A., Dux, L., Horvath, P., Erdelyi, M., Homolya, L., Keller-Pinter, A. (2020): Syndecan-4 Modulates Cell Polarity and Migration by Influencing Centrosome Positioning and Intracellular Calcium Distribution. **Front Cell Dev Biol 8:** 575227.

Becsky, D.*, **Gyulai-Nagy, S.***, Balind, A., Horvath, P., Dux, L., Keller-Pinter, A. (2020): Myoblast Migration and Directional Persistence Affected by Syndecan-4-Mediated Tiam-1 Expression and Distribution. I**nt J Mol Sci 21:** 823. *társ-elsőszerzők

Keller-Pinter, A., **Gyulai-Nagy, S.**, Becsky, D., Dux , L., Rovo, L. (2021) Syndecan-4 in Tumor Cell Motility. **Cancers 13:** 3322.

BÁLINT ENDRE FEKETE

National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2003

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Bálint Kintses

JUNIOR MENTOR:

-

SPECIALIZATION:

synthetic biology,
genome engineering

SECONDARY SCHOOL:

Bolyai János High School,
Kecskemét

NAME OF TEACHER:

István Németh, Éva Kothenczné Kemény, József Laczkó

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The emergence of antibiotic resistant pathogens is a growing threat in the global healthcare. The conventional treatments based on antibiotics are losing their efficacy. An alternative solution could be the use of bacteriophages (also phages). The host range (which bacteria can a phage infect) is determined by the proteins located on the tail end of the phage. The goal of the research is designing phages with specific tail proteins by the means of synthetic biology, so that the phage will only recognize the disease causing bacteria exclusively. To prevent the prevalence of resistance against the bacteriophage we can change these proteins while keeping the desirable properties.

AMBITIONS AND CAREER GOALS

During the Szent-Györgyi Program I got my chance to start my scientific work during my university studies. I find this instance of encounter of synthetic and microbiology rather fascinating. My goal is to be able to continue my scientific work after finishing my studies, even alongside of practising medicine.

HONORS AND PRIZES

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PUBLICATIONS

–

ANNA TÁCIA FÜLÖP

National Academy of Scientist Education, 3rd year

University of Szeged,
Faculty of Science and Informatics,
Molecular Bionics Engineer Program, 3rd year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Máté Manczinger

JUNIOR MENTOR:

-

SPECIALIZATION:

immunology,
bioinformatics, bionics

SECONDARY SCHOOL:

Fazekas Mihaly Primary and Secondary Grammar School, Budapest

NAME OF TEACHER:

Zsolt Erős-Honti

LANGUAGES:

English/advanced
French/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

HLA molecules are essential in immune recognition, because they present short peptides to T cells. HLA-encoding genes are the most variable ones in the human genome. Using bioinformatics, we investigate the possible relationships between the peptide binding properties of different HLA variants and certain diseases (e.g. different tumours). We also aim to explain the molecular background of these associations.

AMBITIONS AND CAREER GOALS

After the current Bachelor's degree, I would like to continue my Master's degree and then to obtain a PhD degree. After graduating, I would like to join an international research team at a Hungarian university or research institute.

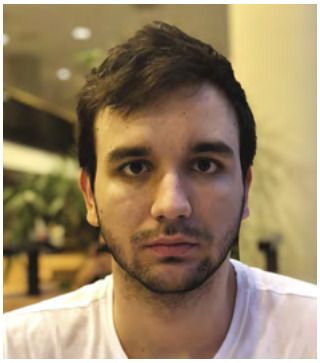
HONORS AND PRIZES

2019 - OKTV Biology, 1st prize
2019 - Dr. Árokszállásy Zoltán Biology Competition, 1st prize
2018 - OKTV Biology, 2nd prize
2018 - International Linguistics Olympiad, Prague, contestant

PUBLICATIONS

–

ÁKOS HARANGOZÓ



National Academy of Scientist Education, 4th year

University of Szeged,
Albert Szent-Györgyi Medical School, 4th year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Zsolt Endre Boldogkői

JUNIOR MENTOR:

Dóra Tombácz

SPECIALIZATION:

genomics and
gene technology

SECONDARY SCHOOL:

Radnóti Miklós
Experimental Grammar
School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

With modern sequencing technologies we are able to make structural and functional examination of living organisms and viruses, thus we can understand better the role of the present genes and non-coding sequences and their effect on each other. The main focus of our research group includes the genomic analysis of various human and non-human pathogenic viruses by using state of the art genome- and transcriptome sequencing methods (long- and short-read sequencing approaches). The gained genomic data is processed with the help of bioinformatical programs. Also we generate genetically modified viruses by using the CrispR-cas9/dCas9 - which is a state of the art genome editing technology capable of making very precise changes - methods for the evaluation of the effect of the gene modification on the global transcriptome.
Our major goal is to describe the static and dynamic transcriptome profiles of these viruses, and to apply them as model organisms for the study of the Transcriptional Interference Network (TIN) hypothesis proposed by our group.

AMBITIONS AND CAREER GOALS

As a medical doctor I want perform medical practice and research side by side, for which this program gives the best bases. My goal with my research is to gain theoretical knowledge and practical experience which will help me in my career which hopefully will lead me to be able to help others. During my career besides finishing medical university, I also want to reach academic degree in which the Szent-Györgyi program provides help.

HONORS AND PRIZES

2016 - EUSO Tartu, silver medal
2017 - EUSO Copenhagen, golden medal
2017/2018 - Biology OKTV II. category, 30th place
2016/2017 - Biology OKTV II. category, 18th place

PUBLICATIONS

–

MÁRK HARANGOZÓ

National Academy of Scientist Education, 6th year

University of Szeged,
Albert Szent-Györgyi Medical School, 6th year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Antal Berényi

JUNIOR MENTOR:

-

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/advanced
French/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Anxiety and depression are responsible for one of the largest societal and individual burdens amongst neuropsychiatric disorders, and in many cases drug treatments cannot maintain an asymptomatic state. Former investigations have shown that the mechanism of the transformation of concrete fear reactions into generalized anxiety is similar to that of learning, although the exact neuronal mechanisms in the background are still unknown. Successful animal experiments and clinical investigations have proven that depression and anxiety can be made asymptomatic by means of electrical stimulation. This effect is rather diffuse, though. The aim of my work is to explore the neuronal networks and cell-type specific chokepoints which are responsible for the efficacy of electrical therapies.
In our experiments we use different transgenic animal models in which cell-type specific optoproteins are expressed, making their selective excitation or inhibition feasible. Fear reactions are evoked by using lege artis electrical footshock, and we attempt to prevent their generalization into anxiety with optical stimulation. The efficacy of the stimulation is evaluated by measuring the level of anxiety after re-exposure to a similar environment with standard psychophysiological methods (e.g. freezing). The long-term goal of my work is to develop non-pharmaceutical methods to treat drug-resistant anxiety and post-traumatic stress disorder.

AMBITIONS AND CAREER GOALS

After obtaining my medical degree, I would like to become an internationally recognized physician and researcher. Naturally, I intend to earn a PhD and a postdoctoral degree, too. In order to acquire some professional experience, I hope to be able to work abroad as a member of an international team, possibly in the US or the UK.

HONORS AND PRIZES

2015 - EUSO, silver medal (as the member of the Hungarian team)
2014 - iGEM HS division, Best Experimental Measurement (as the member of team HUNGENIOUS)

PUBLICATIONS

Takeuchi, Y., **Harangozó, M.**, Pedraza, L., Földi, T., Kozák, G., Li, Q., Berényi, A. (2020) Closed-loop stimulation of the medial septum terminates epileptic seizures. B**rain 144:** 885-908.

ANNA HEGYI

National Academy of Scientist Education, 2nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mária Deli

JUNIOR MENTOR:

Ilona Gróf

SPECIALIZATION:

cell biology, pharmacology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

In several diseases the targeted delivery of large protein cargo at therapeutically relevant concentrations is difficult due to their poor penetration across biological barriers. These barriers protect organisms from damaging agents and create homeostasis for physiological functions. The Biological Barriers Research group has an expertise in modelling and studying the epithelium of the intestinal or respiratory systems and the endothelium of blood vessels. The goal of our team is to investigate different peptide constructs to enhance the penetration of high molecular weight drugs across different biological barriers using co-culture models. In these experiments, we study the viability of the cells, the integrity and the barrier functions of the cell layers, the morphological changes of tight junction proteins and the penetration of fluorescently labeled peptide constructs. In our latest studies, we got promising results with a pentapeptide sequence which can deliver large proteins into different cell types via endocytosis. Our aim is to achieve specific targeting of biological barriers with a short, easily applied and nontoxic peptide tag which can not only facilitate the endocytosis of the protein cargo in a carrier/receptor triggered manner but also act as a shuttle for biopharmaceutics.

AMBITIONS AND CAREER GOALS

In my research, I would investigate methods by which I can broaden my knowledge about drug delivery trough barriers, thereby contributing to more effective treatment of various diseases. I consider it important to be able to align scientific research with clinical practice throughout my career because I believe both are essential areas for my future results.

HONORS AND PRIZES

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PUBLICATIONS

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ZSÓFIA RITA HERNÁDI

National Academy of Scientist Education, 3rd year

University of Szeged,
Faculty of Pharmacy, 3rd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

István Krizbai

JUNIOR MENTOR:

-

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

Nagy Lajos Grammar School of the Cistercian Order

NAME OF TEACHER:

Zsolt Nyisztor

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

For the physiological functioning of the central nervous system it is inevitable to maintain a constant internal environment in which the so-called neurovascular unit plays a pivotal role. Damage to this defence system can lead to the development of or can aggravate various serious diseases affecting the central nervous system. Pericytes have been attributed a prominent role in the pathophysiology of age-related brain pathologies including ischemic stroke, particularly in the production of abnormal vasoconstriction, which may impede the maintenance of normal cerebral circulation.
As there is currently no clear evidence that pericytes are responsible for pathological vasoconstriction, in the research group we set out to investigate the structural changes and molecular mechanisms that may be involved in this process using in vivo two-photon microscopy imaging and ex vivo techniques. Our expected results may shed new light on the active role of blood-brain barrier elements, particularly the pericytes, in the pathomechanism of age related brain diseases, and may lead to the discovery of new therapeutic targets in the future.

AMBITIONS AND CAREER GOALS

As a Pharmacy student, I feel that the Szent-Györgyi program offers a unique opportunity to master both research and pharmacy skills. After graduating from the University, I would like to join a doctoral school and obtain a PhD while also working as a scholarship holder at famous foreign laboratories. Finally, I would like to use my experience in independent research projects as a neuroscientist.

HONORS AND PRIZES

2021- XXXV. National Scientific Student's Associations Conference (OTDK) - Physiology-Pathophysiology Section – 2nd Prize
2020 - Scientific Student's Associations Conference (TDK) Szeged – Special Prize
2019/2020 - New National Excellence Programme (UNKP) scholarship
2019 - National Research Student Conference (TUDOK), Health Science Section, First Prize
2019 - Conference of Scientific Students' Associations (TDK) Medical School of the University of Pécs, High School Section, First Prize; Audience award

PUBLICATIONS

Mészáros, Á., Molnár, K., Nógrádi, B, **Hernádi, Z.** Nyúl-Tóth, Á., Wilhelm, I., Krizbai, I. A. (2020) Neurovascular Inflammaging in Health and Disease. **Cells 9:**1614.

Kozma, M., Mészáros, Á., Nyúl-Tóth, Á., Molnár, K., Costea, L., **Hernádi, Z.**, Fazakas, Cs., E Farkas, A., Wilhelm, I., Krizbai, I., A. (2021) Cerebral Pericytes and Endothelial Cells Communicate through Inflammasome-Dependent Signals. **Int J Mol Sci 22:** 6122.

MÁRTON HORVÁTH

National Academy of Scientist Education, 5th year

University of Szeged,
Faculty of Science and Informatics,
Molecular Bionics Engineer, MSc 1st year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Attila Gácser

JUNIOR MENTOR:

Renáta Tóth

SPECIALIZATION:

microbiology

SECONDARY SCHOOL:

Bilingual Secondary Grammar School of Balatonalmadi

NAME OF TEACHER:

Anna Várkuti

LANGUAGES:

English/advanced
German/intermediate
Italian/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Throughout the last few decades, invasive fungal infection has been posing a growing threat to patients with a suppressed immune status in hospital environments. Species from the genus *Candida* are frequently isolated from such infections, and among them it is *Candida* parapsilosis that threatens neonates most and is thus in the centre of our attention. In our research we aim to better understand the interaction between fungal cells and the host by investigating immune responses. We intend to examine pathogen recognition and potentially activated signal transduction pathways in a healthy mucosal environment during *C. parapsilosis* interaction by using various approaches. These include the investigation of the role of pattern recognition receptors (PRRs) in the immunological recognition of *C. parapsilosis* as well as the activated signal transduction pathways, which lead to the development of immunological tolerance. Our further ambitions include finding yet undiscovered mechanism involved in the discrimination between elimination and tolerogenic responses induced by fungal species as we hypothesize that these mechanisms might contribute to the progression of other, non-microbial diseases as well.

AMBITIONS AND CAREER GOALS

During my scientific career I aspire to acquire a deeper insight into immunology in order to fully understand the bases of fundamental immune responses, for which the understanding of host-pathogen interactions is absolutely necessary. As a member of the Candida research group, my long-term goal is to contribute to the expansion of our current knowledge on commensal and pathogen microbe-induced immune responses.

HONORS AND PRIZES

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PUBLICATIONS

Horváth, M., Nagy, G., Zsindely, N., Bodai, L., Horváth, P., Vágvölgyi, Cs., Nosanchuk, J. D., Tóth, R., Gácser, A. (2021) Oral Epithelial Cells Distinguish between Candida Species with High or Low Pathogenic Potential through MicroRNA Regulation. **mSystems 6:** e00163-21.

GÁBOR JUHÁSZ

National Academy of Scientist Education, 3rd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Gábor Juhász

JUNIOR MENTOR:

Tamás Maruzs

SPECIALIZATION:

endosomal system, membrane contact sites, drosophila genetics

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Béla Gál

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The existence of membrane contact sites, i.e. permanent physical contacts between organelles of eukaryotic cells has been known for a long time, however, understanding their functions has just begun during the last decade. The most well-characterized function of these contacts is enabling lipid transport between the contacting organelles. Interestingly, recent studies shed light on the direct role of such contacts in the endosomal system as well. During our work, we aim to investigate the function of Snx25, a known membrane contact site protein, which is involved in a human hereditary neurodegenerative disease, a distinctive type of spinocerebellar ataxia. Our results show that the mutation of the fruit fly (Drosophila melanogaster) counterpart of this gene leads to severe defects in the endosomal maturation process of the highly endocytic larval nephrocytes. As the exact mechanism of this phenomenon is currently not known, we aim to decipher the role of the Drosophila Snx25 protein in endosomal maturation using genetics and light-microscopy and our self-maintained fruit fly stocks' nephrocytes as an experimental model system.

AMBITIONS AND CAREER GOALS

My primary aim is to match the medical and scientific work. In my opinion through knowledge in all natural sciences, especially in regards to modern biology is essential to understand and discover the most effective therapies. In the near future I would like to work in the fields of genetics and cell biology. Later I intend to continue this work during my PhD study, and my task in inland and foreign laboratories in addition to my medical studies.

HONORS AND PRIZES

2019 - National Biology Competition: 11th place
2019 - National Chemistry Competition: 13th place
2018 - Dr. Árokszállásy Zoltán Biology Competition: 9th place
2018 - National Biology Competition: 14th place
2017 - Szent-Györgyi Albert Competition: 3rd place

PUBLICATIONS

–

FLÓRA KAPTÁS

National Academy of Scientist Education, 2nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Péter Horváth

JUNIOR MENTOR:

Vivien Csapóné dr. Miczán

SPECIALIZATION:

bioinformatics

SECONDARY SCHOOL:

Bányai Júlia Secondary School, Kecskemét

NAME OF TEACHER:

Zsuzsanna Korsósné Jávorka

LANGUAGES:

English/intermediate
German/basic

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Thanks to the automation and acceleration of imaging, such new techniques have been created over the past decades which opened new doors in the field of biological research. This has increased the need for automated analytical methods. The aim is the extraction of biologically relevant information from pictorial data and the interpretation of them with machines. After cardiovascular diseases, the leading causes of death are the cancer diseases. Because of these, it is important to understand the cellular functioning of tumors and their effects on cell growth. Our goal is to detect cell division and its steps in tumor tissue with the help of deep learning and then to develop an effective pipeline for this task. Further on our goal is as well the extension of this to more tumor types in general.

AMBITIONS AND CAREER GOALS

During my studies and research, my primary goal is to become a good doctor and to learn more practical and theoretical knowledge which can be helpful later. I would like to take advantage of all the opportunities so that I can help many people in the future during my medical practice. This program also provides excellent opportunities for my goals.

HONORS AND PRIZES

2020 - XIII. National Dürer Competition, Category K, 3rd place
2019 - 19th National Conference of Researching Students Tender, International Finals, Category National Instruments and Informatics
2019 - Robot Race, National 2nd place
2018 - VII. Student Symposium, 1st place
2018 - Hlavay József National Environmental Science and Engineering Student Conference, 1st place
2016 - National Robot Programmer Competition, 3rd place

PUBLICATIONS

–

ENDRE KOCSIS

National Academy of Scientist Education, 4th year

University of Szeged
Albert Szent-Györgyi Medical School, 4th year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Attila Hunyadi

JUNIOR MENTOR:

Máté Vágvölgyi

SPECIALIZATION:

pharmacognosy

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

According to WHO, one in every 6 people's death (a total of 9,6 million deaths in 2018) is due to cancer, making it the second leading cause of death globally. In most cases, the cause of faliure in pharmacotherapy is originated in the tumor's apace development of resistance against cytotoxic agents, which is also called as multidrug resistance (MDR). This issue is unsolved to the present day, which calls for an urgent need for a radically new approach in enhancing our strategies. Ecdysteroids are analogs of ecdysone, a moulting hormone of arthropods, that are non-toxic and bioactive in mammals. Some of their less polar derivatives combined with a certain chemotherapeutic agent have a strong chemo-sensitizing effect on both drug susceptible and MDR cancer cell lines. The main goals of our research are the identification and semisynthetic chemical modification of new and promising lead molecules (e.g. production of fluorine substituated derivatives and their self-assembling nanostructures), as well as defining their pharmacological potential.

AMBITIONS AND CAREER GOALS

As a medical student I would like to represent the level of quality this profession requires both in my academic studies, and in my research. Apart from improving my cooperating and problem solving ability, research also provides me with an important support in leading me in the scientific literature, which sufficiently supplements my academic knowledge with comprehensive and up-to-date information. I also hope that our work can lead to results that can emerge as useful help in therapy.

HONORS AND PRIZES

2021 - XXXV. National Scientific Students' Associations Conference, 1st prize
2020 - Annual Scientific Students' Associations Conference, University of Szeged, Faculty of Pharmacy, 1st prize
2019 - Annual Scientific Students' Associations Conference, University of Szeged, Faculty of Pharmacy, Special Prize
2017/18 - National High-School Competition in biology, 36th place

PUBLICATIONS

–

ANNA GEORGINA KOPASZ

National Academy of Scientist Education, 6th year

University of Szeged,
Faculty of Science and Informatics,
Biology MSc 2nd year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Lajos Mátés

JUNIOR MENTOR:

-

SPECIALIZATION:

cancer biology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Nowadays cancer is the leading cause of death in economically developed countries. The contraction of cancer can be considered as an evolutionary process within our bodies. The tumor genome sequence data collected so far show that there are tens or even hundreds of thousands of mutations in each tumor sample, and the spontaneous mutation rate observed in normal cells is not sufficient to account for the high number of mutations found in cancers. However, it is this very instability of their genetic material that may allow cancer cells to generate an enormous number of mutations. The long-term objective of our laboratory is to explore genetic alterations fueling malignant transformation by undermining the stability of the genome.

AMBITIONS AND CAREER GOALS

After obtaining my MSc degree, I plan to continue my studies and my research work as a PhD student. By earning my PhD degree, I would like to master a broad range of molecular biological techniques and their biological bases. As a postdoctoral researcher, I hope I will have the chance to spend some years abroad before I can establish my own research group.

HONORS AND PRIZES

2021 – SZTE Talent of the Year Scholarship
2021 - Forum for Young RNA Investigators – Best Presenter Award
2021 - SZTE József Sófi Foundation scholarship, biology MSc category, 1st prize
2020 - 4th National Conference of Young Biotechnologists, Best Presenter Award of the Animal Biotechnology Section, and the Special prize of the Committee on Agricultural Biotechnology of the MTA Section of Agricultural Sciences
2020 - XXIII. Spring Wind Conference, Interdisciplinary Medical Sciences Section, 1st prize
2020 - Annual Scientific Students' Associations Conference, 1st prize
2019 - Annual Scientific Students' Associations Conference, special prize

PUBLICATIONS

Kopasz, A. G. (2021), Optimization of RNA interference-based gene silencing using a well-balanced bidirectional promoter in a somatic transgenic mouse model, Young Investigators RNA Forum, presentation and abstract.

Kopasz, A. G. (2020), Establishement of an RNA interference based gene silencing system in a somatically transgenic mouse model, IV National Conference of Young Biotechnologists, presentation and abstract.

Kopasz, A. G., Pusztai, D. Z., Karkas, R., Hudoba, L., Abdullah, K., Imre, G., Pankotai-Bodó, G., Migh, E., Nagy, A., Kriston, A., Germán, P., Drubi, A. B., Molnár, A., Fekete, I., Dani, V. É., Ocsovszki, I., Puskás, L. G., Horváth, P., Sükösd, F., Mátés, L. (2022) A versatile transposon-based technology to generate loss- and gain-of-function phenotypes in the mouse liver. **BMC Biology 20:** 74.

ÁKOS KOVÁCS

National Academy of Scientist Education, 4th year

University of Szeged,
Albert Szent-Györgyi Medical School, 4th year

YEAR OF BIRTH:

1999

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Imre Miklós Boros

JUNIOR MENTOR:

Balázs Vedelek

SPECIALIZATION:

molecularbiology, genetics

SECONDARY SCHOOL:

Temesvári Pelbárt Franciscan HighSchool, Esztergom

NAME OF TEACHER:

Andrea Keppel Erdős
Katalin Szontagh

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Early recognition is one of the most important factors in successful treatment of cancer, which ideally can be achieved through non-invasive or minimally invasive way. In case of bladder cancer, tumour cells appear in the urine, from which DNA could be purified and analysed to detect mutations specific to cancer. Mutation hotspots are in oncogenes and among them in the promoter of the telomerase reverse transcriptase, which is responsible for DNA elongation at the ends of chromosomes. The telomerase is active in embryonic cells but inactive in somatic cells, therefore the telomeres of the latter are progressively shortening, with each cell division, until they are critically shortened, that results senescence. In tumours, however the telomerase is often re-activated, therefore these cells become immortalised, so they can endlessly divide. In most cases telomerase reactivation is due to mutations at hotspots in its promoter. Our aim is to study telomerase promoter mutations in order to get answers for the following questions: Under what circumstances do the mutations appear? At which stage of carcinogenesis / tumour progression do telomerase promoter mutations appear? Is there any correlation with mutation types, appearance and bladder cancer subtypes? How do the mutations affect the course of the disease? Our long-term goal is to develop a PCR-based, simple and cost-efficient rapid test to detect the presence of potentially cancerous cells from urine targeting telomerase promoter mutation and other tumour markers.

AMBITIONS AND CAREER GOALS

I would like to improve my knowledge continously in order to become as good researcher and physician as I can. With my work I hope to contribute to the advance of society that I consider the most important goal one can aim at.

HONORS AND PRIZES

2021 - University of Szeged: Scientific Students' Associations Conference (TDK) 3. prize in Cell Biology-Microbiology-Molecular Biology section

PUBLICATIONS

Vedelek, B., **Kovács, Á.**, Boros, I. M. (2021) Evolutionary mode for the functional preservation of fast-evolving Drosophila telomere capping proteins. **Open Biol 11:** 210261.

DORINA KOVÁCS

National Academy of Scientist Education, 2nd year

University of Szeged,
Faculty of Dentistry, 2nd year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Bálint Kintses

JUNIOR MENTOR:

-

SPECIALIZATION:

antibiotic resistance

SECONDARY SCHOOL:

Grammar School Senta

NAME OF TEACHER:

Mónika Rózsa Sípos

LANGUAGES:

German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Testing resistance evolution with predictive screens is an imperative step of antibiotic development. These screens help to choose the lead molecules for further drug development which are less prone to resistance evolution, and thus may remain effective for years. In the laboratory of my mentor, Bálint Kintses, I'm able to join the development of a platform that accurately predicts which resistance genes will be acquired by disease-causing bacteria via horizontal gene transfer to eradicate the efficacy of a future antibiotic. We would achieve this strategic aim by testing resistance evolution in an experimental system resembling the real-life clinical environment, unlike the current technologies that use oversimplified experimental conditions. The goal is to provide a unique toolset that supports the development of promising antibiotic candidates which may remain effective for years once on the market.

AMBITIONS AND CAREER GOALS

I want to develop my theoretical and practical knowledge by taking advantage of the opportunities offered by the Szent-Györgyi program, and by learning the most possible from my Mentor. My goal is to arrange this acquired competence in the scientific research, thereby being able to cooperate in solving major scientific questions.

HONORS AND PRIZES

2020 - Student of the generation, Grammar School Senta

PUBLICATIONS

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MÁRTON ATTILA KOVÁCS

National Academy of Scientist Education, 3rd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Zsigmond Tamás Kincses

JUNIOR MENTOR:

Dániel Veréb

SPECIALIZATION:

diagnostic imaging, functional MRI

SECONDARY SCHOOL:

Andrássy Gyula Grammar School, Békéscsaba

NAME OF TEACHER:

Klára Stefanik

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

I have been interested in medicine since high school, and have always been keen on the workings of the human body, especially the human brain. Parallel with my university studies, the Szent-Györgyi Program provided an opportunity to participate in research on this topic. By joining the interdisciplinary work of the Neuroimaging Research Group, I have the opportunity to learn about the use of imaging methods in various neurological conditions. The main profile of the lab is using magnetic resonance imaging (MRI) as a biomarker to track the course of disease and to identify underlying pathological processes, employing modern image analysis and statistical methodology. In our current project, we use functional magnetic resonance imaging (fMRI) to characterize hemispheric lateralization via network-based analysis techniques.

AMBITIONS AND CAREER GOALS

During my university studies, I would like to acquire as wide a range of medicine and multidisciplinary knowledge as possible by engaging in as many international scientific projects as possible, where I can acquire practical skills. After finishing my studies, I would like to apply my knowledge both in research and clinical work.

HONORS AND PRIZES

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PUBLICATIONS

Veréb, D., **Kovács, M. A.**, Kocsis, K., Tóth, E., Bocsik, B., Király, A., Kincses, B., Faragó, P., Fricska-Nagy, Zs., Bencsik, K., Klivényi, P., Kincses, Zs., T., Szabó, N. (2021) Functional Connectivity Lateralisation Shift of Resting State Networks is Linked to Visuospatial Memory and White Matter Microstructure in Relapsing–Remitting Multiple Sclerosis. **Brain Topogr 35:** 268-275.

CSABA KOZMA

National Academy of Scientist Education, 3rd year

University of Szeged,
Faculty of Science and Informatics, Biology, 3rd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

József Mihály

JUNIOR MENTOR:

Szilárd Szikora

SPECIALIZATION:

molecular cell biology

SECONDARY SCHOOL:

Petőfi Sándor Secondary School, Bonyhád

NAME OF TEACHER:

Csaba Péter

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Sarcomeres are the basic contractile units of muscles. They are composed of three major filament systems: the filamentous actin based thin filament array, the myosin based thick filaments and the titin based elastic filament system. The structure of sarcomeres has been well characterized, leading to quasi-atomic models of thin and thick filaments. However, the exact spatial arrangement of many of the major muscle proteins remained unknown. In addition, several key aspects of microfilament array formation and dynamics are not yet clarified. Our research group used a Single Molecular Localization Microscopy system to collect imagines of Drosophila melanogaster flight muscle sarcomeres, which are highly similar to the striated muscles of vertebrates. Our group also created a nanoscopic protein localization atlas, which includes 22 muscle proteins. Our studies were so far focused on the muscles of 1 day old adult specimens, however, to obtain developmental insights, it is necessary to examine both earlier and later developmental time points, in order to map the distribution of proteins during the actively elongating phases of sarcomere development, as well as in mature or ageing muscles. Our aim is to better understand how sarcomeres are organized and get assembled during sarcomerogenesis; to determine the position of novel muscle proteins; to test the predictions of our new I-band and H-zone model and to probe the evolutionary conservation of the fruity fly protein distribution data in mouse myofibrils. These pieces of information are indispensable in order to understand the details of sarcomere assembly and function in healthy and in disease conditions.

AMBITIONS AND CAREER GOALS

During my research, I would like to acquire as much methodological and theoretical knowledge as possible, which can be helpful in my further work. I find it important to have a greater insight into the research work during my university years, which will help me make decisions about my long-term plans. After graduating with my MSc degree, I would like to get a PhD degree and then work as a researcher.

HONORS AND PRIZES

2019 - 30th International Biology Olympiad, Hungary, Gold Medal
2019 - Biology OKTV category II, 2nd place
2018 - Biology OKTV category I, 1st place
2018 - SZTE Szent-Györgyi Competition, 1st place
2018 - Richter Gedeon Talent Scholarship
2017 - 15th European Union Science Olympiad, Denmark, Silver Medal
2016 - 13th International Junior Science Olympiad, Indonesia, Silver Medal

PUBLICATIONS

Szikora, Sz., Görög, P., **Kozma, Cs.**; Mihály, J. (2021) Drosophila Models Rediscovered with Super-Resolution Microscopy. **Cells 10:** 1924.

BARNABÁS ÁKOS LAKOS

National Academy of Scientist Education, 2nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Antal Berenyi

JUNIOR MENTOR:

-

SPECIALIZATION:

Neuroscience

SECONDARY SCHOOL:

SZTE Primary and Secondary Grammar School

NAME OF TEACHER:

István Csigér

LANGUAGES:

English/advanced
French/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The sharp wave ripple (SWR) oscillations of the hippocampus play a crucial role in the synchronization of healthy brain activities, and in the development of pathological activities. Stimulus tied to the SWRs is shown to influence the development of certain brain disorders (e.g., various forms of anxiety), and may play a role in the treatment of epileptic seizures. Existing studies detected SWRs and delivered stimuli to deep brain areas through penetrating electrodes, limiting human therapeutic applicability.
The aim of our work is to find cortical activity patterns detectable by non-invasive EEG scalp electrodes, which can effectively substitute the hippocampal SWRs in stimulus timing. To achieve this goal, besides of analyzing the signals of specific electrodes (e.g., sleep-spindles, or slow waves) we will also search for distributive patterns in the high-resolution space time representation of the signals of multiple electrodes using the methods of modern data-science and 'big-data' analysis.
We will also explore if the novel transcranial electrical stimulation method (ISP - intersectional short pulse stimulation) developed and patented by our research group can target the desired deep brain target areas and become an alternative to invasive deep brain stimulation electrodes.
We will also search for cortical targets as alternatives to the already identified deep brain targets, making stimulation easier. A possible candidate is the stimulation of the ventromedial prefrontal cortex (or the infralimbic cortex in rodents) instead of the deep brain reward systems (e.g., ventral tegmental area), which can be an important clinical target in the treatment of anxiety-based disorders and posttraumatic stress disorder (PTSD).

AMBITIONS AND CAREER GOALS

During my university years I want to be a useful member of my research group. In two years, I will be responsible for a subtask of the project including the animal experimentation and analysis. After receiving my degree, I want to continue my education in a PhD program. My long-term goal is to become an internationally respected member of the scientific community.

HONORS AND PRIZES

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PUBLICATIONS

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ADÉL LÜVI

National Academy of Scientist Education, 1st year

University of Szeged,
Faculty of Science and Informatics, Biology, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Imola Wilhelm

JUNIOR MENTOR:

-

SPECIALIZATION:

tumour biology

SECONDARY SCHOOL:

Czuczor Gergely Benedictine High School and College, Győr

NAME OF TEACHER:

Tamás Kleininger

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

One of the most important roles of the neurovascular unit – which is built up by cerebral endothelial cells, pericytes, glial cells, and neurons – is to form the blood-brain barrier. In order to form brain metastases, tumour cells – originating principally from malignant melanoma, breast carcinoma and lung cancer – have to migrate through the blood-brain barrier, the main function of which is to prevent the penetration of toxic substances to the brain. Therefore, metastatic cells which are able to extravasate into the brain are protected from therapeutic drugs by the blood-brain barrier itself. This is the main reason why brain metastases have an extremely poor prognosis. According to our group's results, not only brain endothelial cells, but pericytes can also increase survival of the tumour cells. Currently, we are investigating whether pericytes protect tumour cells against chemotherapeutic drugs. However, not only pericytes influence the tumour cells, but this is a mutual interaction. In our experiments, we want to test how brain metastatic breast cancer cells communicate with pericytes and what changes are induced by tumour cells in pericytes to contribute to the formation of the metastatic niche. Understanding of these mechanisms may contribute to the development of novel therapeutic methods.

AMBITIONS AND CAREER GOALS

During my research work, my ambition is to contribute to the understanding of brain metastases and therefore, to help people suffering from this tumour disease. In the following years, I want to learn new methods, to improve my scientific skills, and to be a useful member of our research group with the final goal of being able to use this acquired knowledge later in my own projects.

HONORS AND PRIZES

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PUBLICATIONS

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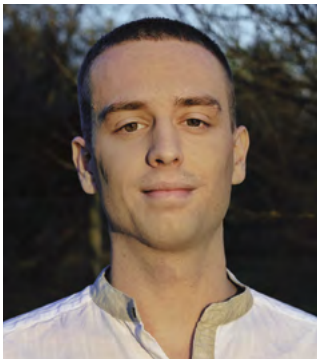
ISTVÁN GELLÉRT MAGYARY



National Academy of Scientist Education, 1st year

University of Szeged,
Faculty of Science and Informatics, Biology, 1st year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Balázs Papp

JUNIOR MENTOR:

Balázs Szappanos

SPECIALIZATION:

systems biology, metabolomics, bioinformatics

SECONDARY SCHOOL:

Táncsics Mihály Secondary School, Kaposvár

NAME OF TEACHER:

Róbert Kertész

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Recent advances in technology made metabolomics an integral part of systems biology research. Despite the surge in popularity in metabolomics, the processes governing the evolution of metabolite levels are still largely unknown. One of our lab's focuses has been the emerging field of evolutionary metabolomics, i.e. the evolution of metabolite concentrations. These previous analyses have focused on the between-species differences of metabolite concentrations with the help of data from multiple mammalian and yeast species. Among the findings were the discovery of simple molecular traits that govern the extent of evolutionary conservation. One such principle is that metabolites involved in human diseases have highly conserved concentrations between species, indicating that evolution permits less changes in metabolites that have a high health impact. Building on these findings, I will study the principles driving metabolome variation within human populations. Specifically, I will test whether the same factors govern the evolution of metabolite concentrations across species as within human populations. For my research I use a dataset of hundreds of serum metabolites from a healthy human population. Ultimately, the results will give new insights into why some metabolites are more variable between individuals than others and may inform the discovery of new biomarkers.

AMBITIONS AND CAREER GOALS

My career goal is to conduct research in the research field of personalised omics as a bioinformatician, a subfield of systems biology where the long-term goal is to help improve people's quality of life with the help of new discoveries and contribute to the early diagnoses of pathological processes. Throughout my studies I also plan on acquiring knowledge in statistics and data science and participating in relevant networking events.

HONORS AND PRIZES

2018 - „Ifjú természettudós" Dr. Keszthelyi Lajos' prize

PUBLICATIONS

-

GÁBOR MOHÁCSI

National Academy of Scientist Education, 3nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 2nd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

András Varró

JUNIOR MENTOR:

-

SPECIALIZATION:

neurophysiology

SECONDARY SCHOOL:

Lutheran Grammar School
Aszód

NAME OF TEACHER:

Bernadett Könczöl
Rita Csörgei

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Our aim is to understand of the mechanisms underlying cortical information processing. The two distinct type of processes are excitation and inhibition. The efferent and afferent connections of inhibitory neurons are precise and diverse. We conduct experiments in order to determine the physiologycal significance of the distinct cells. We are recording from identified interneurons in completely unaesthetized freely behaving rodents.The neurogliaform cells play an important role in neuronal inhibiton.

AMBITIONS AND CAREER GOALS

After obtaining my degree I would like to earn a PhD, as well. As a researcher I hope that I can find answers to some important questions. My dream is to develop new methods, which can be applied in clinical environments.

HONORS AND PRIZES

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PUBLICATIONS

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FERENC ISTVÁN NAGY

National Academy of Scientist Education, 6th year

University of Szeged,
Faculty of Science and Informatics,
Teacher Education in Biology and Chemistry, 6th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mónika Kiricsi

JUNIOR MENTOR:

-

SPECIALIZATION:

Molecular biology

SECONDARY SCHOOL:

Sandor Petofi Evangelical School of Bonyhad

NAME OF TEACHER:

Péter Kecskés-Kiss,
István Nagy

LANGUAGES:

English/advanced

BACKGROUND, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Cancer is among the leading causes of death. Along with surgery and radiotherapy, chemotherapy is the most frequent treatment approach. Unfortunately, cancer cells often become insensitive to antineoplastic drugs and develop multidrug resistance, which significantly decreases not only the efficiency of chemotherapy but patient survival rates as well. Various molecular mechanisms can ultimately lead to multidrug resistance. One of them is the overexpression of molecular pumps residing in the plasma membrane of tumor cells. With the help of these pumps, cancer cells can get rid of chemotherapy agents fairly quickly, thereby avoiding the cytotoxic action of these chemicals. Research is ongoing all around the world, to find selective inhibitors of these pumps to enhance the efficiency of various types of chemotherapeutic agents and thus to save countless human lives. Our research group is currently examining a large variety of nanoparticles and synthetic steroid derivatives as potential selective efflux pump inhibitors. We conduct our experiments *in vitro* using cancerous and non-cancerous cells lines, nevertheless, if a given agent or combination of drugs seems promising, we test the candidate molecules *in vivo* too, using animal models.

AMBITIONS AND CAREER GOALS

First, I would like to greatly increase my knowledge during my undergraduate and PhD studies at the University of Szeged. Then, I would like to apply for Postdoctoral positions abroad. After becoming a more experienced researcher, I would like to found my lab. Throughout my life, I would like to greatly contribute to the development of humankind.

HONORS AND PRIZES

2017, 2019, 2020, 2021 - National Higher Education Scholarship
2019, 2020, 2021 - New National Excellence Program
2021 - XXXV. National Scientific Students' Associations Conference, Biology, Molecular and cell biology – II. place

PUBLICATIONS

Gopisetty, M.K., Adamecz, D.I., **Nagy, F.I.**, Baji, Á., Lathira, V., Szabó, M.R., Gáspár, R., Csont, T., Frank, É., Kiricsi, M. (2021) Androstano-arylpyrimidines: Novel small molecule inhibitors of MDR1 for sensitizing multidrug-resistant breast cancer cells. **Eur J Pharm Sci 156:** 105587.

ZSÓFIA FLÓRA NAGY

National Academy of Scientist Education, 6th year

University of Szeged,
Albert Szent-Györgyi Medical School, 6th year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Márta Széll

JUNIOR MENTOR:

Margit Pál

SPECIALIZATION:

genetics

SECONDARY SCHOOL:

Városmajori Secondary School, Budapest

NAME OF TEACHER:

Anna Solt Jánossyné

LANGUAGES:

English/advanced
German/advanced
Latin/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Amiotrophic lateral sclerosis (ALS) is a neurodegenerative disorder which cannot be cured efficiently up to this day. ALS significantly decreases the quality of life of the patient and leads to death 3-5 years after the diagnosis. There are two forms of this disorder: familial and sporadic. Through sequencing the genome of patients scientists have been able to detect genetic variants that might be responsible for the development of ALS. The aim of our research is to further investigate the genetic background of amyotrophic lateral sclerosis through the genetic analysis of Hungarian patients affected by ALS. The knowledge of the genetic background of ALS could provide an opportunity to develop efficient diagnostic techniques and personalized therapy.

AMBITIONS AND CAREER GOALS

After finishing medical school, I would like to get my PhD degree. I intend to work overseas or somewhere in Europe, and I wish to pursue a carrier in research as a full-time scientist.

HONORS AND PRIZES

2021/2022 - National Higher Education Scholarship
2021 - Completing the Writing in the Sciences course with honours offered by Stanford University
2021- Annual Student Research Conference, Cell biology, Microbiology, Molecular Biology 2nd section, 1st prize
2021 - XXXV. National Student Research Conference (NSRC), Genetics, Genomics section: 2nd prize
2020 - Annual Student Research Conference (ASRC), Genetics Molecular Biology section, 2nd prize
2020 - 27th Student Research Conference in Targu Mures: special prize
2020 - 7th Lublin International Medical Congress, Neurology and Neurosurgery session: II. prize

PUBLICATIONS

Tripolszki, K., Danis, J., Padhi, A.K., Gomes, J., Bozó, R., **Nagy, Z.F.**, Nagy, D., Klivényi, P., Engelhardt, J.I., Széll, M. (2019) Angiogenin mutations in Hungarian patients with amyotrophic lateral sclerosis: Clinical, genetic, computational, and functional analyses. **Brain Behav 9:** 01293.

Tripolszki, K., Gampawar, P., Schmidt, H., **Nagy, Z.F.**, Nagy, D., Klivényi, P., Engelhardt, J.I., Széll, M. (2019) Comprehensive Genetic Analysis of a Hungarian Amyotrophic Lateral Sclerosis Cohort. **Front Genet 10:** 732.

Nagy, Zs. F., Pál, M., Salamon, A., Zodanu, G., K., E., Füstös, D., Klivényi, P., Széll, M. (2022) Re-analysis of the Hungarian amyotrophic lateral sclerosis population and evaluation of novel ALS genetic risk variants, **Neurobiol Aging 116:** 1-11.

BENCE NAGYMIHÁLY

National Academy of Scientist Education, 2nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Tamás Martinek

JUNIOR MENTOR:

Edit Wéber

SPECIALIZATION:

Molecular biology, protein analysis techniques

SECONDARY SCHOOL:

Miklós Radnóti Experimental School, Szeged

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Protein-protein interactions play a role in a number of pathophysiological processes, the manipulation of which can be therapeutically beneficial. Targeting extensive protein surfaces, however, is difficult with small molecules. For this purpose, artificial agents with higher interaction surface area, e.g. protein mimetics are required. Artificial self-assembling polymers (foldamers) can inhibit protein-protein interactions. The advantages of foldamers are that they have a designable and stable secondary structure, have a larger surface area than small molecule drugs, are resistant to proteases and are less immunogenic than antibodies. We are focusing on PCNA and on Rad6 proteins. PCNA is essential for DNA replication, however, its ubiquitination promotes error-prone DNA replication and allows cancer cells to survive. Rad6 plays a role in the ubiquitination of PCNA. Our goal is to inhibit PCNA ubiquitination with foldamers by blocking the key protein-protein interactions of PCNA and Rad6. We construct the foldamers by linking small-sized, protein surface mimetic building blocks, and innovative optimisation methods, such us dissipative systems are applied. Our compounds could serve as novel anti-tumour agents.

AMBITIONS AND CAREER GOALS

During my work and studies, my aim is to acquire as much theoretical and practical knowledge as possible, so that I can later become an active participant not only in the clinical field, but also in the scientific field. The opportunities provided by the National Academy of Scientist Education will enable me to acquire scientific knowledge on which I can build and guarantee my development in the future. I would like to adopt the concepts and perspectives I have learned here, so that I can later, in my individual work, come up with my own unique ideas to influence the development of the field and use my knowledge to help people beyond the sickbed.

HONORS AND PRIZES

2017 - EUSO: silver medal
2019 - iGEM HS division: bronze medal
2020; 2019; 2018 - Dr. Árokszállásy Zoltán Biology Competition 2nd; 5th; 7th place
2020 - IBO qualifying competition: 5th place
2020 - Bánkúti-prize
2020 - Biology OKTV II. category: 37th place

PUBLICATIONS

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EMESE KINCSŐ PÁLI

National Academy of Scientist Education, 2nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Szilvia Veszelka

JUNIOR MENTOR:

Mária Mészáros

SPECIALIZATION:

cell biology, pharmacology

SECONDARY SCHOOL:

Újpesti Könyves Kálmán Grammar School

NAME OF TEACHER:

Szulágyiné dr. Segesdi Katalin

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Cyclodextrins are versatile sugar molecules that can act both as medicines and as nanocarriers of other active ingredients. Cyclodextrins interact with lipid membranes and can selectively remove lipids from cell membranes. Some cyclodextrins are used as therapeutic drugs, while others are currently tested in clinical studies to treat human neurological diseases, including Alzheimer's disease. It is still a question whether cyclodextrins are able to cross the blood-brain barrier, the gatekeeper and protector of the central nervous system, which blocks the entry of the majority of drug molecules. The Biological Barriers Research group has an expertise in modelling and studying the blood-brain barrier. Our goal is to test different unmodified and modified cyclodextrin molecules on human cell based models of blood-brain barrier. With the help of fluorescent tags we will measure the interaction of cyclodextrins with the cells of the blood-brain barrier, namely, brain endothelial cells, pericytes and astrocytes. We will determine cellular toxicity, the entry of the cyclodextrines to the cells and using a complex model with three cell types the crossing of cyclodextrin across the barrier. These studies will help to determine if cyclodextrins need to cross the blood-brain barrier to act directly on the neuronal cells, or they can exert therapeutic effects without entering the central nervous system. Our results will help in the future therapeutic application of modified cyclodextrins in diseases.

AMBITIONS AND CAREER GOALS

In the course of my work, it is especially essential for me to accomplish activities that are useful and beneficial for society, and I have the opportunity to do so in the Biological Barriers Research Group. Drug delivery research not only has a great future ahead, but its success also promises to make human lives easier. My personal intentions include actively participating in Hungarian scientific life both as a doctor and a researcher. The possibilities provided by the Szeged Scientist Academy open unique gates to reach my goals.

HONORS AND PRIZES

2021 - Annual Scientific Students' Associations Conference, University of Szeged Albert Szent-Györgyi Medical School 3. prize in Cell Biology-Microbiology-Molecular Biology section

PUBLICATIONS

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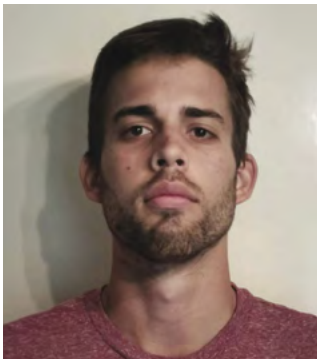
DOMONKOS JÁNOS PERÉNYI



National Academy of Scientist Education, 2nd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

1998

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Petra Hartmann

JUNIOR MENTOR:

Tamara Illésné Horváth

SPECIALIZATION:

mitochondrial respirational activity

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School

NAME OF TEACHER:

Sándor Bán

LANGUAGES:

German/intermediate
English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The main goal of the usage of profilactic antibiotics is to prevent infections that could occur in connection with surgical interventions. Several studies have proved, that properly applied antibiotical profilaxis plays an important role in the prevention of wound-infections. However, the effect of antibiotics is not confined only to the bacterias. Depending on the concentration of the agent and the duration of the treatment, it can cause different deformities in the tissues and cells, leading to various side-effects. Effects causing mitochondrial disfunction have been proved in cases of several antibiotics, that were followed with increased reactive oxigen species (ROS) production, after which tissue-damage can emerge. To find a proper solution for these problems, we started to experience with some antibiotics that not have been used before. During our research we use the third generational ceftriaxone and the poorly absorbed rifaximine. The goal of our research is to examine the effects of these antibiotics on the mitochondrial respirational activity, and on the coupling of electron transport chain.

AMBITIONS AND CAREER GOALS

Practicing medicine always walked hand in hand with research. That is why I think it is utterly important, to take part in it during my years at the university, and get a broader perspective in disciplines. I see the scholarship of SZTA a one of a kind opportunity to develop myself, from which I hope I can make the most out of.

HONORS AND PRIZES

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PUBLICATIONS

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BENCE PÓSA

National Academy of Scientist Education, 3rd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Péter Bencsik

JUNIOR MENTOR:

-

SPECIALIZATION:

Pharmacology of the Cardiovascular system

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Cardiovascular diseases are the leading cause of death in industrialised societies. The function of the heart is diverse, but the most prominent is the pump function, which is circulateing blood through the vascular system. To perform this pumping function, the heart also requires oxygenated blood, which it receives from its own private‚coronary' circulation. Impairment of this coronary circulation results in ischaemia and death of the heart muscle, and thus impairment of pump function. MicroRNAs are RNA sequences that account for only 1% of the genome, but significantly affect the expression of other genes. In our study, we investigate the effects of myocardial ischemia, abnormal enlargement (hypertrophy) and other diseases affecting other organs (e.g. colitis) on the microRNA profile of the heart. Our aim is to identify pharmacological compounds that mimic (miRNA mimic) or inhibit (antagomiR) microRNAs, which influence the expression of microRNAs that mitigate myocardial damage and the genes/proteins they regulate, and thus have cardioprotective potential by influencing a number of processes.

AMBITIONS AND CAREER GOALS

After graduating from medical school, I would like to continue my work primarily as a clinician, but also do research. My goals are to obtain a PhD and to be actively involved in teaching and educational organisation. I believe that even as a student, we should not only treat our present patients, but also help and support our fellow doctors and students, so that we can move closer to a viable and humane professional future.

HONORS AND PRIZES

2021 - SZTE SZAOK-FOK-GYTK-ETSZK TDK conference, Pathology, Morphology, Image Diagnostics 3. section, „Variability of Diffusion parameters in Multiple Sclerosis", III. place

PUBLICATIONS

–

JOANNA GRACE SANDLE

National Academy of Scientist Education, 3rd year

University of Szeged,
Faculty of Science and Informatics, Biology, 3rd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Gábor Tamás

JUNIOR MENTOR:

Gábor Molnár

SPECIALIZATION:

neurobiology, electrophysiology

SECONDARY SCHOOL:

ELTE Bolyai János Primary and Secondary Grammar School

NAME OF TEACHER:

Katalin Horváth
József Baranyai

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The way we percieve and process information and inputs from our environment is unique to us, humans and still most of the mechanisms which enable us to perform complex and abstract thinking are yet to be discovered. In Tamás Gábor's Research Group for Cortical Microcircuits we seek to unveil the underlying elementary mechanisms of this process on the level of synapses and neural microcircuits and the functions of different cell types in rodent and human cortical cortex. We have the excellent opportunity to compare the functions of the commonly used model animals' brain with ours by performing in vitro patch clamp in non-pathological human brain slices among other electrophysiological techniques. Our primary focus is on the role of inhibitory interneurons in such networks.

AMBITIONS AND CAREER GOALS

I endeavour to exploit the opportunities offered by Szent-Györgyi programme, broaden my understanding and learn new methods. It is of great importance to me to keep up with the developments and findings of neuroscience, and to acquire up-to-date, applicable knowledge not only in the fields of neurobiology and electrophysiology but also in borderline sciences. I want to become a useful member of a research group and be able to contribute to the development of my field of expertise.

HONORS AND PRIZES

2018 - OKTV, biology 26th place
2019 - OKTV, biology 29th place
2022 - Annual Scientific Students Association, University of Szeged, Faculty of Science and Informatics, Biology - neuroscience, cell section - 1st place

PUBLICATIONS

Iacone, Y., Morais, T. P., David, F., Delicata, F., **Sandle, J.,** Raffai, T., Parri, H. R., Weisser, J. J., Bundgaard, C., Klewe, I. V., Tamás, G., Thomsen, M. S., Crunelli, V., Lőrincz, M. L. (2021) Systemic administration of ivabradine, a hyperpolarization-activated cyclic nucleotide-gated channel inhibitor, blocks spontaneous absence seizures. **Epilepsia 62:** 1729-1743.

GERGŐ DÁVID SVORENJ

National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2003

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Attila Gácser

JUNIOR MENTOR:

Renáta Tóth

SPECIALIZATION:

microbiology, immunology

SECONDARY SCHOOL:

Németh László High School, Budapest

NAME OF TEACHER:

Péter Zagyi

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

My research topic is based on recent observations, that inform us about the fact that besides the growing number of fungal infections, caused by Candida species, they also contribute to the progression of certain diseases. One such disease is oral squamous cell carcinoma. It has been shown that the presence of certain Candida species, such as C. albicans, the migration and potentially invasive properties of tumor cells increase following the tumor-microbe contact. The current aim of the research group, and my project as well, is to further investigate this phenomenon and to examine what molecular processes could be responsible for this effect. Identification of such processes will lead to better understanding of the complexity of microbe-tumor interactions, and may contribute to health care advancements. Understanding of these mechanisms may contribute to the development of novel therapeutic methods.

AMBITIONS AND CAREER GOALS

My ultimate aim is to achieve proper fundamentals regarding my research field, as well as to gain in-depth insights and deep knowledge into the research field of immunology and microbiology. My long-term plans enhance after every single goal achieved, the sky is the only limit. My current aim is to join the scientific community, acquire all of the basic skills needed for fundamental research, participate in a project, learn how to interpret the results and how to insert them in the current standing of the research topic.

HONORS AND PRIZES

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PUBLICATIONS

–

DÓRA JULIANNA SZABÓ

National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

László Dux

JUNIOR MENTOR:

-

SPECIALIZATION:

Skeletal muscle

SECONDARY SCHOOL:

ELTE Bolyai János Practising Primary and Secondary School, Szombathely

NAME OF TEACHER:

József Baranyai,
Bence Farkas Szabó

LANGUAGES:

English/advanced
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Skeletal muscle demonstrates a high degree of regenerative capacity repeating the embryonic myogenic program. The empairment of this program is the cause of numerous illnesses. One of them, is the rhabdomyosarcoma, which is the most common sarcoma in childhood. Our research team works on understanding the physiological and pathological molecular background of this regeneration program. At present, syndecan-4 is observed the most, which is a transmembrane protein, that contributes to several mechanisms, like cell adhesion and migration, cell proliferation or cytokinesis, therefore tumorigenesis. By unfolding the role of syndecan-4, we could get closer to understanding the illnesses regarding the skeletal muscle, and also to their successful treatment.

AMBITIONS AND CAREER GOALS

As a Szent-Györgyi student, I have the opportunity to get an insight into the world of researches, improve in a motivating environment and broaden my knowledge, as well as challenge myself day by day. After finishing medical school, I would like to do my PhD, then work as a biomedical researcher.

HONORS AND PRIZES

2021 - Biology OKTV 32nd place
2021 - Ifjú Tudósok, biology 9th place
2019 - Tehetségek Magyarországa scholarship

PUBLICATIONS

–

BENEDEK SZATHMÁRI

National Academy of Scientist Education, 2nd year

University of Szeged,
Faculty of Science and Informatics, Biology, 2nd year

YEAR OF BIRTH:

2001

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

László Nagy

JUNIOR MENTOR:

Árpád Csernetics

SPECIALIZATION:

fungal genomics

SECONDARY SCHOOL:

Tóth Árpád Secondary Grammar School, Debrecen

NAME OF TEACHER:

József Gőz

LANGUAGES:

English/advanced
Latin/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Fungal evolution, the investigation of which is challenging but also interesting due to great amount of convergence, is still burdened by countless unanswered questions. Our research group investigates the evolutionary biology and developmental genetics of fungi, focusing on the origin of complex multicellularity that, in contrast with other branches of the tree of life, appeared eight times independently in this clade. One of my projects is connected to the mentioned topic: I knock out genes responsible for basidium and fruiting body formation. Our aim here is to understand the origin of other fruiting body cells present around basidia better. There were also lots of simplifications in the course of fungal evolution. The group of unicellular yeasts with a reduced morphology provided some 'workstocks' for the industry, however, we know unworthily little about their evolution. I hope that with my other project, during which I investigate the density-dependent behaviour (quorum sensing) of spores of a mould species, I can also contribute to the creation of a gap-filling evolutionary concept regarding yeasts.

AMBITIONS AND CAREER GOALS

'Nothing in biology makes sense except in the light of evolution' I cannot agree more with this statement of Theodosius Dobzhansky, and my aim is to understand this overall concept. I think achieving this goal does not only require studying, but also the investigation of important problems and interesting phenomena, as well, during which one can pose, and even answer questions no one has before. Creating a complex scientific world-view built upon scepticism is crucial for me. I would like to become a broad-minded researcher with creative thoughts.

HONORS AND PRIZES

2020/21; 2019/20 - Richter Gedeon Talentum Scholarship
2020; 2019; 2018 - Árokszállásy Zoltán Biology Competition 5th; 7th; 4th
2020 - Biology OKTV 37th
2020 - Chemistry OKTV 17th
2020; 2019 - Latin OKTV 9th; 2nd
2020; 2019 - 'Eminence of Debrecen' Award
2020 - Most Successful Student of Tóth Árpád Secondary Grammar School
2019 - Albert Szent-Györgyi Competition 1st
2019; 2017 - Horváth István Károly Latin Competition 3rd; 1st
2019 - International Cicero Competition – participation
2018 - Curie Chemistry Competition 9th

PUBLICATIONS

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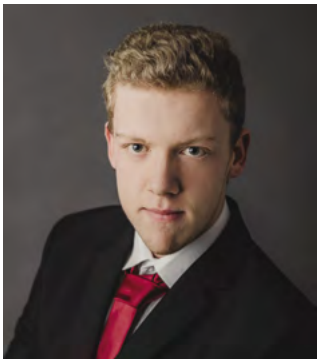
NORMAN NOEL TANNER



National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Anikó Keller-Pintér

JUNIOR MENTOR:

-

SPECIALIZATION:

Biochemistry

SECONDARY SCHOOL:

Petőfi Sándor Evangelical High School and College, Bonyhád

NAME OF TEACHER:

Csaba Péter

LANGUAGES:

English/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Cell migration is absolutely necessary in the formation of the tissues, in differentiation and in regeneration. Besides that the cell migration is also an important factor in the metastasis of tumour cells. Syndecan-4 is a transmembrane protein which has a crucial role in the process that lead to efficient cell migration. The syndecan-4 is able to bind growth factors as a receptor to begin important signal transduction processes that are necessary to the cell migration. The main purpose of our research is to get a deeper understanding of the cell migration and the role of the syndecan-4 protein in this process in muscle regeneration and in rhabdomyosarcoma.

AMBITIONS AND CAREER GOALS

My greatest objective is to become a good doctor with a wide knowledge in medicine and science. To achieve that, during my university years I would like to get scientific knowledge alongside the clinical knowledge. I hope that I can use these experiences in my clinical carrier and also in research.

HONORS AND PRIZES

2021 - Biology OKTV 3. place
2021 - "Ifjú Tudósok" Scientific Secondary School Contest National 5. place
2021 - Lotz János award golden degree
2020 - Biology OKTV 10. place
2020 - Richter Gedeon scholarship
2020 - Völgység Talentuma award
2020 - Hungarian Sientific and Innovation Talent Scout competition honour prize
2018 - SZTE Szent-Györgyi academic competition 1. place

PUBLICATIONS

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ISTVÁN TÓTH

National Academy of Scientist Education, 1st year

University of Szeged,
Albert Szent-Györgyi Medical School, 1st year

YEAR OF BIRTH:

2002

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

István Krizbai

JUNIOR MENTOR:

-

SPECIALIZATION:

neuroscience

SECONDARY SCHOOL:

ELTE Bolyai János Practising Primary and Secondary School

NAME OF TEACHER:

Bence Farkas Szabó

LANGUAGES:

English/intermediate
German/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Research in recent years supported the idea that both aging and a significant part of age-related diseases of the central nervous system are due to the inadequate functionality of the neurovascular unit that coordinates the interaction between the cerebral circulation and the functioning of the central nervous system. The physiological functioning of the nervous system requires a precisely regulated microenvironment, which is maintained by the aforementioned neurovascular unit through its two main functions (formation of the brain-blood barrier and neurovascular coupling). The main purpose of our research is to understand the functioning of the neurovascular unit more precisely in aging and age-related diseases of the brain. We plan to focus on pericytes and cerebral endothelial cells. In addition, using endothelial precursor cells we are looking for regenerative mechanisms that could provide an opportunity to maintain the functionality of neurovascular unity, thus contributing to the prevention of cognitive disabilities in elderly people.

AMBITIONS AND CAREER GOALS

During my undergraduate studies, I want to become a useful member of the research team. After completing my medical studies, I would like to get a PhD and gain experience abroad to gain as much knowledge as possible, which I can later use in my own research to become an internationally recognized researcher and help the development of science.

HONORS AND PRIZES

2020 - Chemisty OKTV - 29. place
2021 - Chemistry OKTV - 30. place

PUBLICATIONS

_

NOÉMI VIDA

National Academy of Scientist Education, 3rd year

University of Szeged,
Albert Szent-Györgyi Medical School, 3rd year

YEAR OF BIRTH:

2000

FORMER SZENT-GYÖRGYI PUPIL:

yes

SZENT-GYÖRGYI MENTOR:

Mihály Boros

JUNIOR MENTOR:

Gabriella Varga

SPECIALIZATION:

diseases of systemic circulation

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Extra corporal circulation (ECC) is commonly used during several type of heart surgeries and intensive care. During extracorporal membrane oxigenization (ECMO) or cardiopulmonary bypass (CPB) the lungs are excluded from the circulation and the blood is introduced to a considerable amount of heparin. Furthermore the blood contact with the foreign surface of the CPB circuit causes an immediate inflammatory response similar to the septic systemic inflammatory response (SIRS) in which humoral and cellular factors play an essential role. The contact activation leads to intrinsic activation of the coagulation cascade and further activation of pro-inflammatory cascades, triggering a wide variety of cellular systems. If these cascade activations are dysregulated due to prolonged ECC time and further metabolic changes, significant tissue and organ damage can occur in sensitive organs such as the kidneys and intestines. *In vivo* animal models are used to explore the mechanisms behind these reactions, therefore in the Institute for Surgical Research, University of Szeged, a clinically relevant large animal model is used to monitor inflammatory responses during ECC. Our aim is to investigate the exact mechanism behind the ECC-induced inflammatory reactions along with the development of novel therapeutic strategies to reduce post-ECC inflammatory damage.

AMBITIONS AND CAREER GOALS

As a medical student clinical knowledge and skills are exeptionally important, however I find keeping up with scientific research and integrating them into practice is just as cruical. By working in this laboratory, I would like to deepen my knowledge in the pathophysiology of post-surgical inflammatory response and obtain surgical skills, which I will benefit from later as a practicioner.

HONORS AND PRIZES

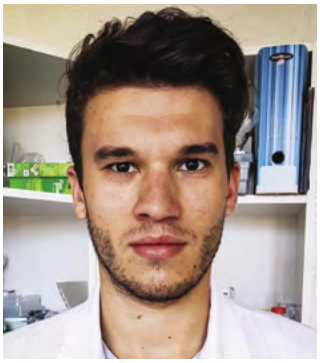
2020 - Scientific Students' Associations Conference (TDK) Szeged, 1st prize in Physiology, Patophysiology and Morphology
2019 - XXXIV. National Student Scientific Conference - Surgical Researcher Prize
2019 - Hungarian Research Student Association Conference, Conference of Life Sciences in the Carpathian Region - Grand Prize
2019 - Dr. Árokszállásy Zoltán National Biology Competition, 17th place
2017 - Dr. Árokszállásy Zoltán National Biology Competition, 13-14th place

PUBLICATIONS

Bársony, A., **Vida, N.,** Gajda, Á., Rutai, A., Mohácsi, Á., Szabó, A., Boros, M., Varga, G., Érces, D. (2020) Methane Exhalation Can Monitor the Microcirculatory Changes of the Intestinal Mucosa in a Large Animal Model of Hemorrhage and Fluid Resuscitation. **Front Med (Lausanne) 7:** 567260.

Varga, P., **Vida, N.,** Hartmann, P., Szabó, A., Mohácsi, Á., Szabó, G., Boros, M., Tuboly, E. (2019) Methanogenic potential of consumable organosulfur administration: *in vitro* and *in vivo* evidences **PLOS One 15:** e0236578.

DÁNIEL LÁSZLÓ VIDÁCS



National Academy of Scientist Education, 5th year

University of Szeged,
Albert Szent-Györgyi Medical School, 6th year

YEAR OF BIRTH:

1997

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Zsuzsanna Bata-Csörgő

JUNIOR MENTOR:

Zoltán János Veréb

SPECIALIZATION:

dermatology

SECONDARY SCHOOL:

Radnóti Miklós Experimental Grammar School, Szeged

NAME OF TEACHER:

Viktória Gál

LANGUAGES:

English/advanced
Spanish/intermediate

IMPORTANCE, AIMS AND POSSIBLE OUTCOME OF RESEARCH

Psoriasis is a multifactorial skin disease affecting about 2-3% of the population worldwide although it is more prevalent in the Caucasian race. The most common form is the plaque type psoriasis, called Psoriasis vulgaris. Psoriatic lesional tissue is characterized by epidermal hyperplasia, abnormal keratinocyte differentiation, intensified and abnormal angiogenesis and inflammatory cell infiltration. The research focus of my group in our laboratory is the pathomechanism of psoriasis. I am involved in investigating the contribution of the extracellular matrix (ECM) components to the development of psoriatic skin pathology. We aim to examine the regulation of ECM genes by using Real-time RT-PCR technology and the expression of ECM proteins with immunocytochemistry and Flow cytometry in a 3D skin model.

AMBITIONS AND CAREER GOALS

By working in this laboratory, I want to learn basic techniques in biomedical research so that later on I can contribute finding new methods in the therapy of inflammatory skin diseases. There are several medicines that cure psoriasis, but many of them are merely symptomatic therapies. A better understanding of the pathomechanisms may lead to more relevant therapies with longer lasting results.

HONORS AND PRIZES

–

PUBLICATIONS

Vidács, D. L., Veréb, Z., Bozó, R., Flink, L. B., Polyánka, H., Németh, I. B., Póliska, S., Papp, B. T., Manczinger, M., Gáspár, R., Mirdamadi, S., Kemény, L., Bata-Csörgő, Zs. (2021) Phenotypic plasticity of melanocytes derived from human adult skin. **Pigment Cell Melanoma Res 35:** 38-51.

Bozó, R., Danis, J., Flink, L., B., **Vidács, D. L.**, Kemény, L., Bata-Csörgő, Zs. (2021) Stress-Related Regulation Is Abnormal in the Psoriatic Uninvolved Skin. **Life (Basel) 11:** 599.

SZENT-GYÖRGYI

PHD. STUDENT

SZEGED

GERGŐ PORKOLÁB

National Academy of Scientist Education, 2nd Ph.D. year

University of Szeged,
Doctoral School of Biology, 2nd year

YEAR OF BIRTH:

1996

FORMER SZENT-GYÖRGYI PUPIL:

no

SZENT-GYÖRGYI MENTOR:

Mária Deli

RESEARCH INTERESTS:

cell biology, blood-brain barrier

UNIVERSITY DEGREE:

MSc in Biology

AS A SZENT-GYÖRGYI STUDENT:

Former Szent-Györgyi mentor: Mária Deli
Former Szent-Györgyi junior mentor: Szilvia Veszelka

SECONDARY SCHOOL:

Tömörkény István Secondary School

NAME OF TEACHER:

Ildikó Vadászné Horváth

LANGUAGES:

English/advanced

BACKGROUND, AIMS AND POSSIBLE OUTCOME OF RESEARCH

The main goal of our research is to develop a novel drug delivery system that is capable of transporting therapeutics across the blood-brain barrier (BBB). We load the drugs into nanoparticles, which are targeted to the BBB by special molecules on their surfaces. These targeting molecules are recognised by the BBB and the drug-loaded nanoparticles – like „molecular Trojan horses – are able to enter the brain. We are also interested in developing novel, human cell-based models that enable us to investigate the interactions of nanoparticles with the BBB, as well as the healthy and diseased brain.

AMBITIONS AND CAREER GOALS

As a researcher, I would like to focus on and find solutions to relevant basic scientific problems that can potentially improve people's lives in the future.

HONORS AND PRIZES

2020 - New National Excellence Program scholarship for the academic year of 2020/21
2020 - Excellent Student of the Faculty Prize, Faculty of Science and Informatics, University of Szeged
2020 - SZTE József Sófi Foundation Scholarship, „Whole University" category – grand prize
2019 - Student of the Year Prize, National Scientists Academy
2019 - New National Excellence Program scholarship for the academic year of 2019/20
2019 - Stephen W. Kuffler Research Fellowship
2019 - SZTE József Sófi Foundation Scholarship, Biology MSc category – 1st prize

PUBLICATIONS

Topal, G.R, Mészáros, M., **Porkoláb, G.**, Szecskó, A., Polgár, T.F, Siklós, L., Deli, M.A, Veszelka, S., Bozkir, A. (2020) ApoE-Targeting Increases the Transfer of Solid Lipid Nanoparticles with Donepezil Cargo across a Culture Model of the Blood-Brain Barrier. **Pharmaceutics 13:** 38.

Porkoláb, G., Mészáros, M., Tóth, A., Szecskó, A., Harazin, A., Szegletes, Z., Ferenc, G., Blastyák, A., Mátés, L., Rákhely, G., Deli, M.A., Veszelka, S. (2020) Combination of Alanine and Glutathione as Targeting Ligands of Nanoparticles Enhances Cargo Delivery into the Cells of the Neurovascular Unit. **Pharmaceutics 12:** 635.

Mészáros, M., **Porkoláb, G.**, Kiss, L., Pilbat, A.M., Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülper, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., Deli, MA., Veszelka, S. (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the blood-brain barrier. **Eur J Pharm Sci 123:** 228-240.

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