3–5
December
2021

Szeged

XVII. MEETING OF NOBEL LAUREATES AND TALENTED STUDENTS

The program of the National Biomedical Foundation

The program elements of the conference are available at the venues and online as well at www.edu-sci.org.

NEMZETI TUDÓS AKADÉMIA
NATIONAL SCIENTISTS ACADEMY

VENUES

ACCOMMODATION, REGISTRATION

1. **Novotel Szeged ****** *(6721 Szeged, 1. Maros str.)*
2. **Art Hotel Szeged ****** *(6720 Szeged, 16. Somogyi str.)*

MENTOR LABORATORY VISITS

3. In the buildings of the **University of Szeged** *(Northern hospital garden)*, the
4. **University of Szeged Institute of Surgical Research** *(6724 Szeged, 1. Pulz str.)*, the
5. **University of Szeged Faculty of Biology** *(6726 Szeged, 52. Közép fasor)*, and the
6. **Biological Research Center, Szeged** *(6726 Szeged, 62. Temesvári ave.)*

OTHER PROGRAM ELEMENTS

7. **József Attila Department of Education and Information Center** *(6722 Szeged, 10. Ady sq.)*
   - Nobel Laureate Presentation
   - Szent-Györgyi Students meet Peter Doherty
   - Presentation of the Szent-Györgyi Students
   - Szent-Györgyi Pupils meet the Szent-Györgyi Students (round table discussions)
   - Press Conference
   - Presentation of the Szent-Györgyi Mentors
   - Plenary Session
   - Gala event
   - Dinner reception

PROGRAM

The broadcasting of the program for the online conference participants will start at 8.00 a.m. on Satudray 4 December 2021 (www.edu-sci.org).

((•)) Program elements available for online participants as well.

03 DECEMBER 2021. Friday

14.00–15.30 **ARRIVAL TO THE HOTELS, REGISTRATION**
Novotel Szeged, Art Hotel Szeged lobby

16.00–18.30 **SECONDARY SCHOOL PUPILS VISIT THE LABORATORIES OF THE SZENT-GYÖRGYI MENTORS**
(upon preliminary assignment)

19.00–20.30 **DINNER FOR THE HOTEL GUESTS**
Novotel Szeged, Art Hotel Szeged restaurant

04 DECEMBER 2021. Saturday

06.30–07.00 **BREAKFAST**
Novotel Szeged, Art Hotel Szeged

until 07.45 **ARRIVAL TO THE JÓZSEF ATTILA DEPARTMENT OF EDUCATION AND INFORMATION CENTER**

((•)) **08.00–08.10** **LAUDATION**
Congress Hall
Chairmen: András Varró, Péter Hegyi
Márta Széll: *Introduction of Peter Doherty*

08.10–09.00 **NOBEL LAUREATE PRESENTATION (ONLINE)**
Peter Doherty: *Long and the Short of COVID-19*

09.00–09.20 **LIVE ONLINE FREE DISCUSSION WITH PETER DOHERTY**

09.20–10.00 **COFFEE BREAK**
I-II. floor foyer, ground floor exhibition place

Parallel program:

09.20–09.40 **Closed discussion of Peter Doherty with the Szent-Györgyi Students** (online)
Grand Hall

10.00–11.00 **PRESENTATIONS OF THE SZENT-GYÖRGYI STUDENTS I.**
Congress Hall
Chairmen: Mária Deli, Zoltán Papp

10.00–10.15 **Zsófia Hernádi:** *Investigation of microvascular pericyte contractility in age-related ischemic brain pathologies*

10.15–10.30 **Gergő Bitay:** *Inhibition of the small-conductance Ca^{2+}-activated potassium channel slows the sinus rhythm under beta-adrenergic activation*

10.30–10.45 **Joanna Sandle:** *The role of Group I. mGluRs in interneuron plasticity in the human and rodent cortex*

10.45–11.00 **Endre Kocsis:** *Preparation and investigation of cytoprotective calonysterone-containing nanoparticles*

Parallel program:

10.00–11.00 **Round table discussions I.**
Szent-Györgyi Students meet the secondary school pupils
Basement, Auditorium I-II.

11.00–12.00 **PRESENTATIONS OF THE SZENT-GYÖRGYI STUDENTS II.**
Congress Hall
Chairmen: Zsuzsanna Tamasikné Helyes, Attila Mócsai
Repetition of Presentations of the Szent-Györgyi Students I.

Parallel program:

11.00–12.00 **Round table discussions II.**
Szent-Györgyi Students meet the secondary school pupils
Basement, Auditorium I-II
Repetition of Round table discussions I.

12.00–14.00 LUNCH
Hall

Parallel program for online participants:

12.00–12.15 **Presentation of the laboratory of Attila Hunyadi, Szent-Györgyi Mentor**

12.15–12.30 **Presentation of the laboratory of the Szent-Györgyi Mentors István Krizbai and Imola Wilhelm**

14.00–14.30 PRESS CONFERENCE
(upon prior registration)
Ground floor, videoconference room

14.30–15.50 PRESENTATIONS OF THE SZENT-GYÖRGYI MENTORS
Congress Hall
Chairmen: László Dux, Ádám Dénes

14.30–14.45 **Mária Deli:** *Why biological barriers are important?*

14.50–15.05 **Attila Gácser:** *Could fungi cause tumors?*

15.10–15.25 **Gábor Juhász:** *Analysis of lysosomal degradation pathways*

15.30–15.45 **Csaba Pál:** *The quest for antibiotics with limited resistance*

Each presentation is followed by a 5-minute-long discussion.

15.50–16.30 COFFEE BREAK
I-II. floor foyer, ground floor exhibition place

16.30–18.45 PLENARY SESSION
Congress Hall
Chairmen: András Varró, Péter Hegyi

16.30–16.50 **Péter Hegyi:**
Introduction of the National Scientists Academy

16.50–17.00 **Zoltán Rakonczay:** *Introduction of the university program of the National Scientists Academy*

17.00–18.30 **Introduction of the National Scientists Academy's scientific research institutions**

17.00–17.10 *University of Debrecen*
Zoltán Papp

17.15–17.25 *Institute of Experimental Medicine*
Ádám Dénes

17.30–17.40 *University of Pécs*
Zsuzsanna Helyes Tamasikné

17.45–17.55 *Semmelweis University*
Attila Mócsai

18.00–18.10 *Biological Research Center Szeged*
Mária Deli

18.15–18.25 *University of Szeged*
Tamás Martinek

18.30–18.45 **'Szent-Györgyi Student Excellence Award' Ceremony, presentation of the awardee**
Márton Czikkely: *Mapping of resistance-free bacterial-antibiotic combinations*

19.00–20.00 **GALA EVENT**
Hall

20.00–23.00 **GALA DINNER**
Hall

05 DECEMBER 2021. Sunday

08.00–09.30 **BREAKFAST, DEPARTURE**
Novotel Szeged, Art Hotel Szeged

LECTURE ABSTRACTS

In the sequence of performance

ZSÓFIA HERNÁDI

Investigation of microvascular pericyte contractility in age-related ischemic brain pathologies

Circulation of the brain plays an important role in preserving functionality of the aged nervous system. Among aging-associated pathologies of the central nervous system, stroke is one of the leading causes of death both in Hungary and worldwide. The most common type of stroke is ischemic stroke which is characterized by insufficient blood supply to the brain caused by blockage of vessels in the affected areas. This, in turn, leads to cell and tissue damage, resulting in neurological deficits and vascular dementia. It is well-known that during ischemia the neurovascular unit, including pericytes, become dysfunctional. This pathological condition induces contraction of microvascular pericytes, causing a lack of reperfusion, resulting in a greater ischemic damage.

Our research aims were to establish and optimize a microinfarct animal model to enable studying the direct effects of vessel blockage on microvascular pericytes with both *in vivo* and *ex vivo* methods, and to identify pericyte contraction-associated proteins and their expression levels in the microvasculature by using *ex vivo* immunofluorescent staining methods.

Our preliminary results indicate that microspheres when injected in the circulation successfully cause microocclusions which show typical regional distribution in the brain.

With our immunfluorescent stainings we found that besides alpha smooth muscle actin (αSMA), the protein that is mostly responsible for vessel diameter changes, other contractile proteins may have an important role in the complex pathomechanism of ischemia-induced pericyte contraction.

Results indicate that our microocclusion model is suitable to study the dysregulation of microvasculature in brain ischemia and facilitates the understanding of the underlying cellular mechanisms of pathological brain circulation.

GERGŐ BITAY

Inhibition of the small-conductance Ca^{2+}-activated potassium channel slows the sinus rhythm under beta-adrenergic activation

Introduction: Sinus node pacemaking is based on tight cooperation between the intracellular Ca^{2+} handling and surface membrane ion channels. An important player of this cooperation could be the small-conductance Ca^{2+}-activated K^+-channel. The

intracellular Ca^{2+} enables this channel to create a K^+ current, which may contribute to the formation of the action potential.

Aims of the research: Investigating the role of the small-conductance Ca^{2+}-activated K^+-channel in the automaticity of the sinus node.

Methods: After the removal of the rabbit heart (New Zealand rabbit), we measured the heart frequency with ECG by inserting electrodes to the heart. Ionic currents and action potentials were measured with the patch-clamp technique on individual rabbit sinus node cells.

Results: When 100 nM apamin (a selective inhibitor of small-conductance Ca^{2+}-activated K^+-channel) was applied, the hearts slowed down marginally under normal condition. This slowing effect significantly increased under beta-adrenergic stimulation when the intracellular Ca^{2+} was enhanced.

In isolated sinus node cells, an apamin-sensitive current was found when the Ca^{2+}_i was buffered to 500 nM, supporting the existence of the small-conductance Ca^{2+}-activated K^+ current.

100 nM apamin prolonged the cycle length of single-cell action potentials when the beta-adrenergic pathway was activated in spontaneously contracting cells.

Conclusions: Our data indicate that the small-conductance Ca^{2+}-activated K^+channels could contribute to the fine tuning of the sinus node action potential and pacemaking under beta-adrenergic activation.

JOANNA SANDLE

The role of Group I. mGluRs in interneuron plasticity in the human and rodent cortex

Synapses are the structures between neurons that allow for the passing on of impulses. Their ability to strengthen and weaken over time is what we refer to as synaptic plasticity, and it is a considered to be a foundation of learning and memory. With many veiled mechanisms underlying these processes we set out to investigate the role of Group I. metabotropic glutamate receptors (mGluR1 and 5) in excitatory synapses in human and rodent cortical interneurons.

For this we simultaneously recorded the membrane potential and the ion currents of connected neurons in cortical brain slice preparations from human and rodent brain using patch clamp technique.

Following pharmacological activation of mGluRs, in rodents we observed an increase in synaptic strength or no change, while in humans we found a more diverse plasticity outcome. Some connections went through potentiation, some depressed while others remained the same strength.

It is known that human cortical neurons differ in their biophysical, morphological properties, and have more numerous electrophysiologically and morphologically distinguishable cell types than rodents. Therefore, we presume that the observed difference is caused by the more diverse postsynaptic interneuron population – in the human brain- and the difference in their mGluR distribution.

Studying these receptors not only can help us to get a higher resolution picture of the neuronal events of learning and memory but as mGluRs play a role in certain neurodegenerative diseases it could also lead us to a better understanding of these conditions.

ENDRE KOCSIS

Preparation and investigation of cytoprotective calonysterone-containing nanoparticles

Ecdysteroids are structural analogues of an arthropod moulting hormone, ecdysone; and they have non-hormonal anabolic and cytoprotective activities in mammals. In this research, our focus was on an oxidized ecdysteroid derivative: calonysterone, which, according to our preliminary results, expresses a strong anti-inflammatory and antioxidant effect on the blood-brain-barrier endothelium. By certain semi-synthetic modifications enabled by the compound's structure, we are able to prepare self-assembling nanoparticles, that are expected to ensure the compound's controlled distribution, protection from decomposition, and targeted release on the blood-brain-barrier. During our work we have prepared squalenoylated calonysterone ester derivatives, which formed nanoparticles by spontaneous self-assembly upon administration to aqueous media. By appropriate modifications, we have successfully prepared stable and durable nanosuspensions.

MARIA DELI

Why biological barriers are important?

Organisms are protected by biological barriers from harmful effects. These barriers also impede drug penetration. The Biological Barriers Research Group investigates methods to increase drug delivery using culture models of the blood-brain, cornea, respiratory and intestinal barriers. The major pathway examined is the targeting of receptors and transporters at barriers by peptides or small molecules to elevate drug delivery by nanocarriers. The models are made by co-culture of two or three cell types and are investigated in microfluidic integrated chip devices, too. Our other major research interest is the examination of blood-brain barrier injury and dysfunction in different diseases, like Alzheimer's or Parkinsin's disease. The goal of these experiments is to reveal the effect of disease pathogenic factors on 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. In our experiments in addition to cell culture, we use microfluidic chip devices, electric measurements, drug permeability assays, different microscopy techniques and molecular biological methods. The research work is supported by a large, project-based international network of cooperation partners from Japan, France, Austria, Germany, Switzerland, Italy, Luxembourg, Taiwan and the USA.

ATTILA GÁCSER

Could fungi cause tumors?

Microbes such as bacteria, viruses and fungi are present at various surfaces of the human body. These are collectively known as the 'microbiota'. In a healthy human environment, these microbial co-tenants live in a balanced relationship with host cells. However, if either side undergoes alterations, the balanced relationship gets disrupted, resulting in disease development. The main objective of our research group is to investigate the components of the oral fungal microbiota and the effects of these species on tumors. Previous clinical observations revealed that as a side effect, fungal infections often occur during the treatment of oral squamous cell carcinomas, and these are primarily caused by *Candida* species. It has been suggested that fungal cells may have a direct effect on tumor progression and their metastatic potential. However, no experimental evidence could support this hypothesis. The aim of the research group is to investigate the nature of tumor-fungus interactions, to explore the molecular background behind the fungal stimuli's effect on metastasis development, and to apply the obtained information for the later development of a more effective antifungal, antitumor therapy.

GÁBOR JUHÁSZ

Analysis of lysosomal degradation pathways

Lysosomes represent the main degradation center in eukaryotic cells. This intracellular organelle breaks down obsolete or non-functional biological macromolecules (proteins, lipids, carbohydrates, nucleic acids) and complete organelles (such as mitochondria and endoplasmic reticulum) using its hydrolase enzymes that are active at an acidic pH, to produce building blocks to be recycled to the cytosol and used in biosynthetic and energy production processes.

The materials to be degraded can reach lysosomes in multiple ways: cargo from the cytoplasm is delivered by autophagy, cargo from the plasma membrane or from outside of the cell travels via endocytosis or phagocytosis, and the cargo of secretory granules (containing material produced for the extracellular space such as hormones) reaches lysosomes by crinophagy. In our research, we study the functional importance and molecular mechanisms of these degradation and recycling pathways in Drosophila and cultured human cells. Our methods include modern molecular genetics (such as targeted gene editing), cell biology (such as superresolution microscopy), biochemistry and biophysics (such as the interaction of purified recombinant proteins with artificial liposomes). In my talk, I will introduce the shared and pathway-specific factors involved in vesicle fusions (tethering complexes, SNARE proteins and small GTPases), the loss of which prevents proper delivery of cargos to lysosomes that is implicated in various diseases.

CSABA PÁL

The quest for antibiotics with limited resistance

Antibiotic resistance is a pressing issue in modern healthcare, but paradoxically, several major pharmaceutical companies have abandoned their antibiotic development programs. Developing new antibiotics is not only a painfully slow and costly process, but it is also a risky investment due to the early rise of resistance. Are antibiotics currently in clinical development any better than the ones used on a daily basis? It is of paramount importance to assess resistance in the laboratory at an early stage of development, but most standard technologies are inadequate. Therefore, it is common that companies waste considerable resources on less promising antibiotic candidates that are prone to resistance formation during clinical trials. We have recently developed a novel genome engineering technology (termed DIvERGE) that allows testing the evolution of resistance in the laboratory at unprecedented speed, accuracy, and scale. This technology offers a unique opportunity for pharmaceutical companies to identify new antibiotics with limited resistance from a large set of compounds at a very early stage of the antibacterial drug-discovery process.

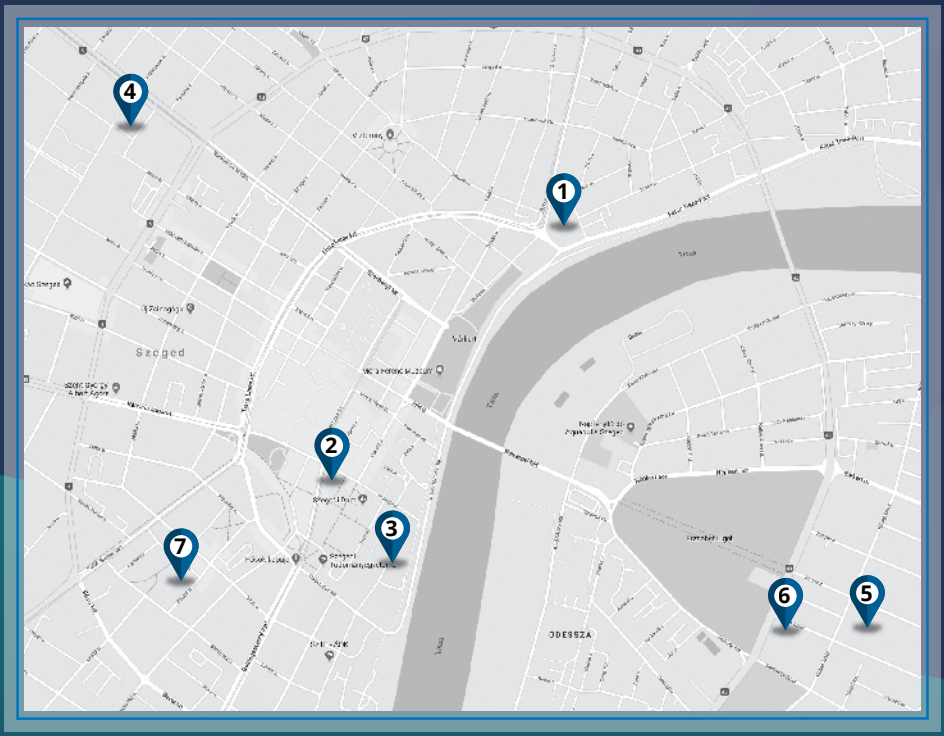
MÁRTON CZIKKELY

Mapping of resistance-free bacterial-antibiotic combinations

The rapid spread of multiple antibiotic-resistant pathogens by 2050 will lead to a global health problem. During my work, I examine whether antibiotics recently launched on the market can be effective in the long run or whether resistance to them can easily develop. Based on the results, I make suggestions on what new antibiotics to use against a given bacterial infection to reduce the chances of developing resistance.

In general, the development of resistance in the laboratory is rapid for many species-antibiotic pairs. The level of the developed resistance is very high in many cases exceeding the maximum concentration that can be reached in the blood plasma of the particular antibiotic. However, some species-antibiotic combinations have been shown to be effective because resistance has not or only very rarely developed.

These new antibiotics will not solve the antibiotic crisis, as resistance to them develops at a similar rate as to the antibiotics currently in use. However, our results also show that the development of resistance is highly dependent on the genetic background of the initially susceptible bacterium. This raises the possibility of new pathogen-specific antibiotic therapies.



1. Novotel Szeged ****
2. Art Hotel Szeged****
3. University of Szeged
   Northern hospital garden
4. University of Szeged
   Institute of Surgical Research
5. University of Szeged Faculty of Biology
6. Biological Research Center
7. József Attila Department of Education and
   Information Center

Institutions participating in the
implementation of the professional program
of the National Scientists Academy

SZTE UNIVERSITY OF SZEGED

SEMMELWEIS UNIVERSITY

UNIVERSITY of DEBRECEN

Institute of Experimental Medicine

BRC

PÉCSI TUDOMÁNYEGYETEM
UNIVERSITY OF PÉCS

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