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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.

Molnar, G., Farago, N., Kocsis, A.K., Rozsa, M., Lovas, S., Boldog, E., Baldi, R., Csajbok, E., Gardi, J., Puskas, L.G. , Tamas, G. (2014) GABAergic neurogliaform cells represent local sources of insulin in the cerebral cortex. **J Neurosci 34:** 1133-1137.

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.