Ph.D. projects in progress

1.

Mentor: István Krizbai

Doctoral School: University of Szeged, Faculty of Science and Informatics, Doctoral School of Biology, University of Doctoral School of Theoretical Medicine

Ph.D. student: Mihály Kozma, Ádám Mészáros, Tamás Dudás

Title of the research topic: Role of the neurovascular unit in inflammatory processes of the central nervous system

Description of the research topic: A functionally intact neurovascular unit (NVU) is a prerequisite for the proper functioning of the central nervous system (CNS). The most important cellular components of the NVU are cerebral endothelial cells, pericytes and astrocytic endfeet, however, other cellular elements like microglia or neurons may also play a modulatory role. Our main aim is to understand the role of pericytes and endothelial cells in different CNS processes associated with inflammation (stroke, neurodegenerative disorders, aging). In vitro multicellular model systems and different biochemical and molecular biology and functional methods will be used to investigate the role of pattern recognition receptors and inflammasome activation in cellular components of the NVU. Advanced ex vivo (confocal microscopy, superresolution microscopy) and in vivo imaging systems (two photon microscopy) will be applied to monitor the neurovascular unit under different experimental conditions.

2.

Mentor: Imola Wilhelm

Doctoral School: University of Szeged, Faculty of Science and Informatics, Doctoral School of Biology, University of Szeged, Doctoral School of Theoretical Medicine

Ph.D. student: Kinga Mészáros-Molnár

Title of the research topic: Role of the blood-brain barrier and cerebral microenvironment in the formation of metastases of the central nervous system

Description of the research topic: Brain metastases of malignant tumors are life threatening pathologies with limited therapeutic options. Tumors giving CNS metastases with the highest frequencies are malignant melanoma, lung cancer and breast cancer (especially the triple negative subtype). Successful colonization of the CNS depends on the ability of tumor cells to migrate through the blood-brain barrier and to survive in the brain environment. In the present project, we will focus on signaling and proteolytic pathways, and intercellular communication routes,

including soluble factors, exosomes and membrane nanotubes. Different molecular biology, biochemistry and immunofluorescence techniques will be applied to elucidate mechanisms of interaction of metastasizing cancer cells with brain resident cells. In vivo, advanced microscopy techniques (two-photon and superresolution microscopy) will be used to monitor the process of transmigration and metastatic colonization of the brain.

3.

Mentor: Attila Elek Farkas

Doctoral School: University of Szeged, Faculty of Science and Informatics, Doctoral School of Biology

Ph.D. student: Lam Tri Duc (Vietnam)

Title of the research topic: Role of endothelial precursor cells in the regeneration of brain microvessels

Description of the research topic: Aging profoundly affects the brain capillary network as the decreased capillary density fails to maintain global blood flow despite compensatory increase in capillary diameters. At the same time, the number of senescent endothelial cells increase with age. These cells are incapable of proliferation and thus incapable of repairing damaged endothelium or form new vessels. Circulating endothelial precursor cells (EPC) are able to form new blood vessels in place of vessels lost to hypoxic injury in stroke and thus boost the regeneration of brain tissue. How EPCs integrate into existing blood vessels is not well understood. Therefore, we are going to study the integration dynamics and the intercellular communication during integration of circulating EPCs in old mice with senescent endothelium and in mice undergoing experimental ischemia. In our experiments we will use fluorescently labelled EPCs and advanced superresolution microscopy and intravital two-photon microscopy.