Institute
of Experimental
Medicine, CAS

IEM CAS CONFERENCE

2023

PROGRAMME

09:00 – 09:10

INTRODUCTION

Ing. Miroslava Anděrová, CSc.
Director

09:10 – 09:40 (20 MIN. PRESENTATION + 10 MIN. DISCUSSION)

EXREGMED – HOW DID WE OBTAIN IT – A SHORT INTRODUCTION TO THE PROJECT, INCLUDING ITS STRENGTHS AND WEAKNESSES

doc. RNDr. Pavla Jendelová, Ph.D.
Department of Neuroregeneration

09:40 – 10:10

REGENERATION OF NERVOUS TISSUE AFTER INJURY

Mgr. Kristýna Árová, Ph.D.
Department of Neuroregeneration

10:10 – 10:40

TISSUE ENGINEERING OF VASCULAR GRAFTS: CELLS, SCAFFOLDS, TECHNOLOGIES

Yuriy Petrenko, PhD
Department of Neuroregeneration

10:40 – 11:00

COFFEE BREAK

11:00 – 11:30

ADDRESSING THE PROBLEM OF NEURODEGENERATION

Mgr. Martin Horák, Ph.D.
Department of Neurochemistry

11:30 – 12:00

WP3 – CELL-THERAPY OF RETINAL DEGENERATIVE DISEASES

prof. RNDr. Vladimír Holáň, DrSc.
Department of Nanotoxicology and Molecular Epidemiology

12:00 – 12:30

BIOACTIVE SCAFFOLDS FOR THE REGENERATION OF OSTEOCHONDRAL DEFECTS AND FOR WOUND HEALING

Mgr. Eva Filová, Ph.D.
Department of Tissue Engineering

12:30 – 12:50

MICROSCOPY SERVICE UNIT AND CZECH-BIOIMAGING – PRESENT AND FUTURE

Ing. Štěpán Kortus, Ph.D.
Microscopy Service Unit

12:50 – 13:00

DISCUSSION

ANNOTATION

EXREGMED – HOW DID WE OBTAIN IT

doc. RNDr. Pavla Jendelová, Ph.D.
Department of Neuroregeneration

The research agenda of the project is to create and develop an excellent research Centre, focused on R&D in the field of regenerative medicine therapeutic methods. The main research objectives are targeted at the restoration of tissues whose damage cannot yet be treated or whose regenerative capacity is significantly limited. These are mainly damage to the nervous tissue of the brain and spinal cord, including the problem of neurodegeneration and retinal degeneration, small-diameter blood vessel replacements, which are not yet available on the market (or in clinical practice), and last but not least the active healing of chronic wounds and osteochondral defects, which are also a serious problem of modern civilised society.

REGENERATION OF NERVOUS TISSUE AFTER INJURY

Mgr. Kristýna Kárová, Ph.D.
Department of Neuroregeneration

Making progress in reparation of complex biological systems requires complex approaches. Understanding their aspects in health and dynamic evolution of pathology is crucial for steps towards effective function restoration. A collaborative initiative led by the Department of Neuroregeneration has set out to tackle several domains in the problem of nervous tissue injury, which include intracellular mechanisms and signaling in the neural soma along with localized processes in the axon, notably the recycling system of autophagy that may underlie successful axon regrowth. Further, this project will address the extracellular space in the injured area that represents a target for modulation to eliminate regrowth “roadblocks” and increase a plasticity potential that could multiply synaptic connections. Nervous system injuries cause significant stress to the surviving neurons and as a whole the system would benefit from the deployment of neuroprotective strategies, which will continue to be developed and used to improve neural resilience and readiness for regeneration.

TISSUE ENGINEERING OF VASCULAR GRAFTS: CELLS, SCAFFOLDS, TECHNOLOGIES

Yuriy Petrenko, Ph.D.
Department of Neuroregeneration

The high demand of small diameter vascular grafts provides the motivation for the development of novel strategies, based on stem cell biology and tissue engineering. Currently, neither of the clinical approaches, such as autologous graft transplantation or using synthetic replacements can provide the sufficient clinical outcomes with low rates of complications. Therefore the development of tissue-engineered strategies, by combining the biomaterial and cellular components within the graft represents a great hope globally. In the presentation we will cover different aspects of vascular tissue engineering, including the search and development of biomaterial scaffolds, which would provide the sufficient mechanical properties, together with optimal cell repopulation. We will discuss the options and challenges for effective recellularization of the tissue-engineered grafts and the ways to generate the necessary cellular phenotypes by controlled stem cell differentiation. Finally, we will describe the use of bioreactor cultures for the generation of functional vascular grafts.

ADDRESSING THE PROBLEM OF NEURODEGENERATION

Mgr. Martin Horák, Ph.D.
Department of Neurochemistry

Neurodegeneration is a complex pathological process in the central nervous system (CNS) accompanied by cognitive impairment that often leads to the development of Alzheimer's disease (AD) or Huntington's disease (HD). The aim of work package 2 (WP2) is to develop and preclinically test novel dually acting chemical derivatives affecting the cholinergic and/or glutamatergic system, in combination with the preparation of new nanomaterials for efficient transport of derivatives to the CNS and/or prolongation of their pharmacological effect.

Given the putative role of N-methyl-D-aspartate receptors (NMDARs) containing the GluN2B subunit (GluN2B-NMDAR) in the pathogenesis of neurodegeneration, a series of new chemical agents specifically inhibiting GluN2B-NMDARs will be prepared. This WP will also include the preparation of novel nanomaterials that will serve as carriers for these chemicals and will be engineered to both penetrate the CNS through the blood-brain barrier (BBB) and to release the chemicals gradually from the nanomaterial, preferably near the affected site in brain tissue (i.e. near the GluN2B-NMDAR). The new chemicals in combination with the nanomaterials will be subjected to detailed *in vitro* analysis to observe the effect on NMDAR and cholinesterase activity. Candidate chemical agents in combination with nanomaterials that show the most promising preclinical potential, including appropriate parameters on NMDAR activity, while retaining inhibitory cholinesterase activity, will be subjected to a thorough *in vivo* evaluation in relevant AD and HD mouse models to verify their realistic neuroprotective effect and/or pro-cognitive efficacy, both based on the dual nature of these agents combined with their optimized pharmacokinetic properties using innovative nanomaterials. Preclinical testing will be extended to testing in a large animal model closer to humans, namely HD minipigs, in case of efficacy in HD mouse models.

WP3 – CELL-THERAPY OF RETINAL DEGENERATIVE DISEASES

prof. RNDr. Vladimír Holáň, DrSc.
Department of Nanotoxicology and Molecular Epidemiology

Retinal degenerative diseases represent the main cause of decreased quality of vision and even blindness. In spite of extensive research, there are no effective protocols to treat these disorders. Since the main causes of these diseases are a local inflammatory reaction and a progressive loss of specialized retinal cells, cell-therapy appears to be the most perspective treatment approach. Therefore, theWP3 will be devoted to studies of the use of stem cell-based therapy for retinal degenerative diseases in two experimental models – a model of small laboratory animals and a model of large animals, a miniature pig. The research will be performed in two laboratories which have the experience with the experimental treatment of retinal diseases –i.e. at the Institute of Experimental Medicine CAS and the Institute of Animal Physiology and GeneticsCAS.

BIOACTIVE SCAFFOLDS FOR THE REGENERATION OF OSTEOCHONDRAL DEFECTS AND FOR WOUND HEALING

Mgr. Eva Filová, Ph.D.
Department of Tissue Engineering

Both critical-sized bone defects and cartilage defects do not heal spontaneously. The healing is enhanced with scaffolds which are functionalized with bioactive molecules, e.g. growth factors, peptides, small molecules, thrombocyte derivatives, exosomes from stem cells or plants. The effectivity and long-term effect of bioactive molecules can be improved using drug delivery systems, such as nanofibers, micro/nanoparticles, and liposomes.

Similarly, wound healing includes scaffolds, mainly nanofibers and hydrogels containing bioactive molecules supporting healing, e.g. growth factors, exosomes and/or antibiotic treatment.

The effectiveness of the scaffolds has to be proved in in vivo models of small and big animal models.

MICROSCOPY SERVICE UNIT AND CZECH-BIOIMAGING – PRESENT AND FUTURE

Ing. Štěpán Kortus, Ph.D.
Microscopy Service Unit

The Microscopy service unit of IEM CAS was formally established in 2022 and joined the Czech-Bioimaging infrastructure in 2023. We would like to summarize the operation and development of the department in these two years and outline our plans for the future. We will mention the intended investments for 2023 and the planned expansion of services. Furthermore, we would like to initiate a discussion and get feedback from you as users.

WE ARE LOOKING FORWARD TO YOUR PARTICIPATION