Animal Physiology

Reparatory mechanisms at early stages of embryonic development

supervisor: MVDr. Dušan Fabian, DrSc. - Institute of Animal Physiology Slovak Academy of Sciences Košice

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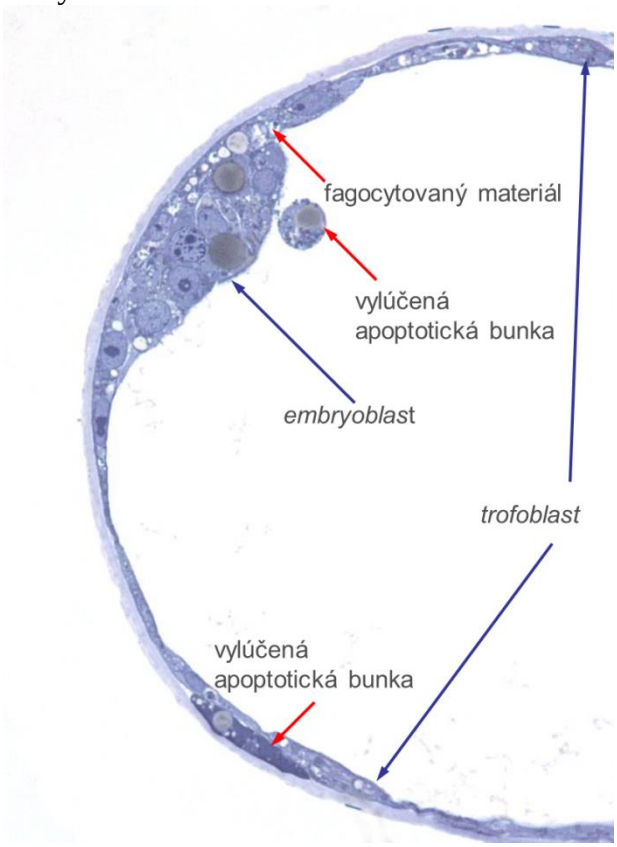
study form: full time



Annotation: The controlled elimination of damaged or useless cells is a physiological process occurring during the development of early embryo. Relatively high number of cells undergoing the process of self-destruction (apoptosis) was documented in populations of both embryonic lines: in embryoblast and trophoblast. Embryo is specific by the ability to remove dead cells in two ways: extrusion into embryonic cavities or phagocytosis by neighboring embryonic cells. Research will be focused on the study of phagocytotic abilities of embryonic cells and the identification of reason of high occurrence of extrusion (and following loss of organic material), which is – with the exception of epithelia –relatively rare phenomenon in the majority of organ systems. Experiments will be provided on animal model, using modern methods of morphological research and molecular biology.

Molecular mechanisms of preimplantation embryo responses to the factors of environment.

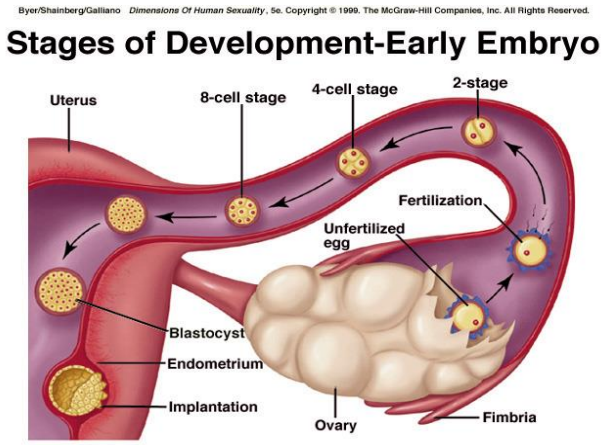
supervisor: RNDr. Štefan Čikoš, CSc. - Institute of Animal Physiology Slovak Academy of Sciences Košice

consultant: RNDr. Alexandra Špirková, PhD. – Institute of Animal Physiology Slovak Academy of Sciences Košice

study form: full time

Annotation: The preimplantation embryo (i.e. the embryo in the period from oocyte fertilization to implantation of blastocyst into uterus) can finish its development to the blastocyst stage relatively autonomously. On the other hand, recent data indicate that maternal environment influences significantly developmental potential of oocytes, quality of preimplantation embryos, implantation

success rate, and can also have long term consequences on the offspring health. Model of laboratory mouse (in vitro as well as in vivo approaches) will be used in experiments. Modern biochemical methods, molecular biology techniques as well as morphological methods will be used to analyze cell receptors and signaling pathways activated in early embryo cells.



Proteomic analysis of mitochondrial proteins in rat brain subjected to ischemic-reperfusion injury and after ischemic tolerance acquisition: MALDI-TOF/TOF study.

supervisor: MVDr. Miroslava Némethová, PhD. – Institute of Neurobiology Slovak Academy of Sciences Košice

study form: full time

Annotation: Ischemia-reperfusion injury leads to tissue oxidative stress enhancement and to neuronal death. A complex proteomic approach to identification of the differentially expressed proteins in the brain of rats after global ischemic stroke and ischemic tolerance acquisition is effective tool for mechanisms involved in oxidative stress and neuronal death pathways examination. This study will be aimed to comparative investigation of mitochondrial proteins involved in mechanisms underlying ischemia-reperfusion injury of the brain-influenced ROS production and the initiation of neuronal death and also to examining of protective pathways leading to ischemic tolerance acquisition after global cerebral ischemia.

Models for studying nerve fiber regeneration *in vitro*.

supervisor: MVDr. Ivo Vanický, PhD. - Institute of Neurobiology Slovak Academy of Sciences Košice

study form: full time

Annotation: The aim of this work is to establish an *in vitro* model for studying regeneration of nerve fibers after injury. Peripheral nerve fibers have the ability to regenerate after damage, but its success is often limited. The conditions that are limiting the growth of regenerating fibers are not fully understood, and their studying *in vivo* is dificult. The role of the student will be to establish a recently published *in vitro* model based on organotypic cultures prepared from spinal cord sections. The tissue culture is maintained in *in vitro* conditions, and allows direct observation of regeneration of damaged axons. This work will include the collection of tissues from newborn animals, preparation of sections of the spinal cord, and its long-term incubation in the tissue culture laboratory.

Quantitative analysis of bone microstructure in basal birds and their ancestors: implications to thermoregulation and paleogenomics

supervisor: doc. RNDr. Martin Kundrát, PhD. – CIB Košice

study form: full time

Annotation: Deinonychosaurian theropods (dromaeosaurids and troodontids) and basal birds are evolutionary intermediates tracking the dinosaur-modern bird transition. The critical significance of *Archaeopteryx* in the origin of flying dinosaurs has become recently controversial including the flying capacity, the avian physiology and the pivotal position of *Archaeopteryx* as the oldest known bird. The supervisors´ recent synchrotron-based findings on the 8th specimen of *Archaeopteryx* provide enhanced qualitative grounds for comprehensive revisions of the aforementioned evolutionary and phylogenetic controversies. The Daiting specimen shows that *Archaeopteryx* acquired numerous flight supporting characters, had highly vascularized bones, and reinstates the avialan position of the genus *Archaeopteryx*. These cumulating inconsistencies constitute a driving force for critical reassessment and revaluation of biological characters of 'transitional' taxa. Methodologically, the supervisors´ research also demonstrates importance of high-resolution synchrotron imaging for completion of our previous understanding that rested almost entirely on external 2D observations. In particular, the inner bone properties and their bearing for illumination of the early history of the flying and thermoregulation have remained underexplored for two reasons: 1) technological limits for imaging microstructure in fossils on the order of 1 micron, and 2) restricted access to precious closely guarded specimens bones of which can be invasively sampled; the extraction of such samples is necessary for approaching cellular level in imaging of fossilized tissues. This project therefore aims to undertake a pioneering investigation in quantitative imaging of dinosaur bone microstructure at cellular level. The research design has all signatures for making historical breakthrough in the study of microstructure innovations that may correlate with evolution of active flight, endothermy, and genome size reduction in dinosaurs and their avian descendants.

Aims:

1. to reconstruct quantitative 3D models of cortical bone microstructure of selected non-avian maniraptoran dinosaurs, early and more derived avialans;
2. to understand how bone microstructure respond to the evolutionary novelty when forelimbs and hindlimbs lost the same functionality; this functional dissociation led to revolutionary adaptation of the forelimbs into the wings which were subsequently co-opted for a coordinated flapping;
3. to test hypothesis A: If active flight requires high metabolic rates and these are congruent with elaborated shape and the number of osteocyte lacunae, then endothermic properties of primitive birds and their close relatives may be quantitatively assessed through high-resolution imaging of the microstructures; the applicant will analyze if these parameters show correlations with the total size and ontogenetic stage of the specimens;
4. to test hypothesis B: Does the size of osteocyte lacunae in taxa that map out the morphological transition from dinosaurs to birds vary in the same individual? The applicant shall verify suggestions by Organ et al. (2007 Nature 446: 180-184) that deinonychosaurians had smaller genome than basal avialans (estimations calculated from 2D parameters of fossilized osteocytes);
5. to formulate evolutionary scenario that refers to which cortical microstructures appeared before versus after the origin of flight.

Modulation of immune response by probiotic bacteria in colorectal carcinogenesis

supervisor: doc. RNDr. Monika Kassayová, CSc.

study form: full time

Annotation: Slovakia is one of the five countries in the world with the highest incidence and mortality of colorectal cancer. Modulation of intestinal flora by regular consumption of probiotic bacteria appears to be an effective strategy of colorectal cancer prevention. Probiotics may influence local (intestinal) or systemic immune reponse of the host. These changes can play a key role in the intestinal malignant transformation. The mechanisms of probiotic action, however, are not sufficiently investigated yet and strongly depend on the probiotic strain used. Therefore, the detailed testing of probiotic preparations is essential. The aim of the work is to study properties of

the combination of Lactobacillus plantarum and Lactobacillus salivarius strains in the form of a new probiotic product designed for fermentation of human foods. Effects of lactobacilli will be evaluated using in vitro models of immunocompetent cells, enterocytes and colorectal cancer cells as well as in vivo using chemically induced colorectal carcinogenesis in rats. Changes in cytokine production and tumour microenvironment will be studied.