Doctoral School: **Biology Doctoral School**
Doctoral Program: Neuroscience and Human Biology

Subject code: **BIO/7/51**
Subject title: **Cellular neurophysiology lecture L**
Teacher and Neptun code: **Dr. Schlett Katalin (KDC2T1)**
Credits: 4
Class hours: 2 hours/week, lecture

Goal of the course

Presentation of neural and glial cells composing the nervous tissue. The lectures give a detailed overview about the cellular structure of neurons, including the structure and function of the plasma membrane. Structure of local networks, plasticity and regeneration phenomena and limiting structures of the nervous tissue are also discussed.

Contents of the course

- Overview of cell types in neural tissue. Characteristics of main cell types. Properties of neurons, significance of surface/mass ratio, postmytotic character, basis of similarity and difference compared to other tissues.
- Ontogenetic origin of cells composing the nervous tissue I. Neurogenesis in the central nervous system. Neuroepithelial stem cells and radial glia. Thickening and layer formation in the embryonal neocortex; radial and tangential cell migration. Lamination of the spinal cord. Determination of cellular fate.
- Ontogenetic origin of cells composing the nervous tissue II. Neurogenesis in the adult brain. Functional significance of neurogenesis in the subventricular zone and the subgranular zone. Diversification of main glial cell types, lineages and their regulation.
- Polarity of neurons. Development and determination of axonal and dendritic processes. Differentiation and regulation of intracellular transport processes. Process-specific role of motor proteins.
- Mosaic structure of the neuronal membrane I. Structure of the presynaptic terminal. Formation and functioning of the exocyst complex. Ca microdomains and their regulation.
- Mosaic structure of the neuronal membrane II. Structure, functioning and regulation of the postsynaptic terminal. Formation and functioning of the PSD complex. Regulation of the localization and interaction of scaffold proteins, adhesion receptors and ion channels.
- Mosaic structure of the neuronal membrane III. Structure of electrically excitable membranes. Formation and functioning of the axon initial segment. Formation and role of the myelin sheath.
- Mosaic structure of the neuronal membrane IV. Distribution, functioning and regulation of voltage-gated ion channels. Integrative functions of the neuron: spatial and temporal summation. Significance of ion channel distribution on the dendrite-cell body-axon axis, distal and proximal localization.
- Organization of neuronal networks. Significance and functioning of local neuronal networks. Basis of short-term synaptic plasticity.
- Neuronal plasticity. Cellular models, network experiments, in vivo paradigms. Different aspects of plasticity: potentiation and depression, synaptic and homeostatic processes.
- Glia-neuron interactions I. Glia-neuron interactions: interactions of metabolic functions.
- Glia-neuron interactions II. Glia-neuron interactions: relationship of circulatory regulation and metabolic regulation.
- Liquid spaces and limiting structures. Role of non-neuronal components in maintaining the homeostasis of nervous tissue. Special limiting strictures in the peripheral and central nervous system. The blood-brain barrier and the blood-liquor barrier. Transport processes across the limiting structures.
- Injury and regeneration capacity of the nervous tissue. Regeneration of central neurons and sprouting of processes. Regeneration possibilities of peripheral axons. Role of glial cells in neuronal regeneration.

Requirements

Oral exam, discussion about 2 topics.
Grade is determined by the grade received in oral exam.

Literature

Power point slides available in pdf format, circa 350 slides