Name of the subject: Mitochondrial dynamics

Teacher(s): Silvana Andric, PhD, professor

Status of the subject: Elective

Number of ECTS points: 15

Condition: -

Goal of the subject

Goal of this course is to acquire knowledge about the molecular mechanisms and signaling pathways and their interactions in the regulation and synchronization of mitochondrial biogenesis. Students should gain the ability in scientifically based interpretation of the experimental data from the field of regulation of mitochondrial biogenesis.

Outcome of the subject

At the end of this course students will be able to understand and describe the general features of the mitochondrial biogenesis, intracellular signaling properties and methods of network detection, transduction, transmission, propagation and amplification of information in order to achieve adequate control of mitochondrial biogenesis, as well as to acquire the capacity for analysis and discussion scientific papers in the field.

Content of the subject

Theoretical lectures

Functional morphology of mitochondria and overview of processes that maintain homeostasis of the mitochondria. Basic characteristics of mitochondrial biogenesis. Mitochondrial genome. Regulatory proteins involved in transcription of mitochondrial genes. Transcriptional regulators of mitochondrial proteins encoded by nuclear genes: the key role of NRF1 and NRF2. The key role of transcription in the regulatory cascade coactivator of mitochondrial biogenesis: PPAR coactivator1 (PGC1) family. Signaling pathways that activate PGC1. Network of signaling pathways and regulatory proteins on the relation mitochondria-nucleus. Molecular events that regulate mitochondrial biogenesis in extreme conditions (physical and psychological stress, cold, starvation, excessive physical exertion, illness). Regulation of mitochondrial biogenesis in the metabolic syndrome and aging.

Practical lectures

Each student will have an individual project assignment in the research related to the molecular events that regulate mitochondrial biogenesis. The degree of mitochondrial biogenesis will be determined by monitoring the number of mitochondria (MitoTrack assay), transcription analysis and analysis of expression and interaction of regulatory proteins. The various *in vivo* experimental models that mimic situation in human populations will be used.

Seminars. Short presentation of the specified topics connected with the subject of student's PhD thesis.

Journal Club. Presentation of the original peer-review scientific paper from the field.

Recommended literature

Miller BF & Hamilton KL (2012) *A perspective on the determination of mitochondrial biogenesis*. Am J Physiol Endo Met 302: E496–99.

Piantadosi CA & Suliman HB (2012) *Redox regulation of mitochondrial biogenesis*. www.sciencedirect.com/science/article/pii/S0891584912011392

O'Neill HM, Holloway GP & Steinberg GR (2012) *AMPK regulation of fatty acid metabolism and mitochondrial biogenesis: Implications for obesity*. Mol Cell Endo www.sciencedirect.com/science/article/pii/S0303720712003334

Herrmann JM, Longen S, Weckbecker D & Depuydt M (2012) Biogenesis of Mitochondrial Proteins www.springerlink.com/content/n1l0202h5043k532/

Medeiros DM (2008) Assessing Mitochondrial Biogenesis http://krex.k-state.edu/dspace/bitstream/handle/2097/1042/MedeirosMethods2008.pdf;jsessionid=60C921DE4C5258682936D254CF5C15C3?sequence=5

Leuenberger D, Curran SP & Koehler CM (2005) *Mitochondrial Biogenesis* in The Biogenesis of Cellular Organelles. Springer

Koehler CM & Bauer MF. (2004) *Mitochondrial Function and Biogenesis Series* in Topics in Current Genetics Vol.8. Springer

Review peer-review scientific paper from the field of mol. events & signaling path. in regulation of mitochondrial biogenesis.

Number of active classes	Theory: 5	Practice: 5

Methods of delivering lectures

Theoretical lectures – interactive lectures, consultation, and group discusion. *Student research work* – active participation in the planing and conducting the experiments, as well as analysis, interpretation and discussion of the results. *Seminar* – short presentation (10 – 15 minutes) connected with the subject of student's PhD thesis. *Journal Club* – Presentation of the original peer-review scientific paper from the field.

Evaluation of knowledge (maximum number of points 100)

Student research work – up to 30 points; Seminar – up to 10 points; Journal club – up to 10 points; Oral exam – up to 50 points.