DESCRIPTION OF COURSE UNIT FOR DOCTORAL STUDIES AT VILNIUS UNIVERSITY

Scientific Area/eas, Field/ds of Science (codes)	Medical and Health Sciences (M 000): Medicine (M 001)			
Faculty, Institute, Department/Clinic	Faculty of Medicine Institute of Clinical Medicine Clinic of Neurology and Neurosurgery			
Course unit title (ECTS credits, hours)	**Ultrasound and Neurophysiological Investigations of the Nervous System** 7 credits (189 hours)			
Study method	**Lectures**	**Seminars**	**Consultations**	**Self-study**
Number of ECTS credits	**-**	-	1	6
Method of the assessment (in 10 point system)	Examination. Oral form. Five questions are provided.			

PURPOSE OF THE COURSE UNIT

To provide the doctoral student with knowledge of the basic principles of instrumental electrophysiological (electroencephalography, polysomnography, electromyography, electroneurography, evoked potentials) and ultrasound examinations (extracranial color-coded sonography, transcranial doplerography, transcranial color sonography), their significance in the diagnosis and treatment of diseases of the nervous system, scientific significance in clinical trials; to provide practical skills for performance of investigations; to learn to interpret the obtained test results.

THE MAIN TOPICS OF COURSE UNIT

1. ELECTROPHYSIOLOGICAL INVESTIGATION METHODS

Electroencephalography (EEG) and polysomnography (PSG). Epilepsiform and non-epileptic potentials. Placement of EEG electrodes, basic montages. Evaluation of artifacts. Recognition and evaluation of normal potentials. Identification and evaluation of pathological epilepsiform potentials. Recognition and evaluation of pathological non-epileptic potentials. Sleep stages and their characteristic EEG elements. EEG assessment and formulation of conclusions. Indications for PSG and multiple sleep latency test, principles of performance, basics of interpretation of results.

Electromyography (EMG), electroneurography (ENG) and evoked potentials. Indications and contraindications. Research unit equipment. Anatomical structure of peripheral nerves. Physiology and pathological changes in the spread of the neural impulse. Basic principles of sensory and motor nerve research. Motor unit and its structure. Changes in the structure of the motor unit due to musculoskeletal disorders. The denervation-reinforcement process and its EMG stages. Needle EMG, surface EMG, diagnostic value, indications. Special ENG methods: F waves, H reflex, Blink reflex. Somatosensory, visual and auditory evoked potentials, principles of methods, application, performance, normal and abnormal findings, diagnostic value. Studies of neuromuscular synapse. Rhythmic stimulation. Transcranial magnetic stimulation, principles of the study, indications, main findings. ENMG investigations in tunnel syndromes, significance of ENMG findings for the management. ENMG investigations in axonal and demyelinating polyneuropathies. ENMG investigations in major radiculopathies. ENMG diagnostic

criteria for motor neuron diseases. Significance of ENMG tests in myopathies, progressive muscular dystrophies and myositis. ENMG investigations in myotonic syndrome. Differential diagnosis of neurogenic and myogenic muscular atrophy. Diagnosis of nerve trauma and severity of nerve lesion. Impairment of the peripheral nervous system during critical conditions and value of ENMG for diagnosis. Interpretation of the results of ENMG. Importance of ENMG for research and clinical practice (diagnostics, management, monitoring and follow-up).

2. ULTRASOUND INVESTIGATION METHODS
Craniocervical vascular anatomy and physiology of cerebral circulation. Diagnosis and research methods of early atherosclerosis. Assessment of arterial stiffness. Evaluation of endothelial function. Evaluation of atherosclerosis in prevention programs and epidemiological studies. General principles of ultrasound diagnostics.
Extracranial color-coded sonography (ECCS).
ECCS technique, scanning planes and modes, analysis of hemodynamic parameters. Clinical application of the ECCS. Diagnosis of atherosclerotic lesions of the carotid arteries. Measurements of intimal-medial thickness. Ultrasound characterization of plaques. Ultrasound criteria for stenoses and occlusions. "Subclavian-steal" syndrome. Dissections of the carotid arteries and ultrasound diagnostics. Analysis of clinical cases. Inflammatory diseases of the blood vessels. Ultrasound evaluation of temporal arteritis. Innovative applications of ultrasound diagnostics.
Transcranial doplerography (TCD) and transcranial color sonography (TCCS).
Probe positions, anatomical landmarks, acoustic windows, vascular identification criteria. Hemodynamic parameters in TCD and TCCS studies. Intracranial stenosis, collateral blood flow. Ultrasound diagnosis of arteriovenous malformations and vasospasm. The role of ECCS, TCD and TCCS in acute cerebrovascular disorders. Diagnosis of patent foramen ovale and other shunting flow using contrast TCD. Monitoring of intracranial circulatory parameters during interventional procedures. Diagnosis and monitoring of microembolic signals during various conditions. Evaluation of cerebral vasoreactivity. Ultrasound examination of intracranial veins and venous sinuses. Anatomical features of the cerebral venous system. Normatives of velocities of venous flow. Venous sinus thrombosis. Transorbital color sonography. Evaluation of optic nerve and ocular arterial blood flow.

RECOMMENDED LITERATURE SOURCES

1. R. Mameniškienė, R. Samaitienė. Elektroencefalografija. Vilniaus universiteto leidykla, 2018.
2. Schomer DL, Lopes da Silva FH. Niedermeyer's electroencephalography: basic principles, clinical applications, and related fields. 7th edition. Oxford University Press, 2018.
3. Gelisse P, Crespel A, Bureau M, et al. Atlas of electroencephalography: The epilepsies. EEG and epileptic syndromes. 2nd ed. John Libbey Eurotext, 2019.
4. Kane N, Acharya J, Benickzy S, et al. A revised glossary of terms most commonly used by clinical electroencephalographers and updated proposal for the report format of the EEG findings. Revision 2017. Clinical Neurophysiology Practice 2017; 2: 170-185.
5. Rundo JV, Downey R 3rd. Polysomnography. Handb Clin Neurol 2019; 160: 381-392.
6. Kimura J. Electrodiagnosis in diseases of nerve and muscle: principles and practice. 4th ed. Oxford University Press, 2013.
7. Weiss JM, Weis LD, Silver JK. Easy EMG. A quide to performing nerve conduction studies and electromyography. 3rd ed. Elsevier, 2021.
8. Evans AB. Clinical utility of evoked potentials. Medscape Reference, 2019. https://emedicine.medscape.com/article/1137451-overview.

9. Touboul P-J, Hennerici MG, Meairs S, et al. Mannheim carotid intima-media thickness and plaque consensus (2004–2006–2011). Cerebrovasc Dis 2012; 34: 290-296.
10. J. Valaikienė, D. Jatužis. Kaklo ir galvos kraujagyslių ultragarsinės diagnostikos metodika. Metodinė mokymo priemonė (atnaujintas ir papildytas leidimas). Vilniaus universiteto leidykla, 2018.
11. J. Valaikienė, D. Jatužis. Transorbitalinės spalvinės sonografijos klinikinis pritaikymas neurologijoje. Neurosonologijos seminarai 2017;21(71):5-9.
12. Kargiotis O, Safouris A, Magoufis G, et al. The role of neurosonology in the diagnosis and management of patients with carotid artery disease: a review. J Neuroimaging 2018; 28: 239-251.
13. Tsivgoulis G, Alexandrov AV. Ultrasound in neurology. Continuum (Minneap Minn) 2016;22(5, Neuroimaging):1655-1677.
14. AIUM–ACR–SPR–SRU practice parameter for the performance and interpretation of a diagnostic ultrasound examination of the extracranial head and neck. J Ultrasound Med 2018; 37: E6–E12.
15. D'Andrea A, Conte M, Cavallaro M, et al. Transcranial Doppler ultrasonography: From methodology to major clinical applications. World J Cardiol 2016; 8(7): 383–400.
16. Spence JD. Uses of ultrasound in stroke prevention. Cardiovasc Diagn Ther 2020; 10(4): 955-964.
17. Hakimi R, Alexandrov AV, Garami Z. Neuro-ultrasonography. Neurol Clin 2020; 38: 215-229.

CONSULTING LECTURERS

1. Coordinating lecturer: Dalius Jatužis (Prof. Dr.).
2. Rūta Mameniškienė (Prof. Dr.).
3. Jurgita Valaikienė (Assoc. Prof. Dr.).
4. Aušra Klimašauskienė (Assist. Prof. Dr.).

APPROVED:

By Council of Doctoral School of Medicine and Health Sciences at Vilnius University: 29th of September 2022

Chairperson of the Board: Prof. Janina Tutkuvienė