



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Neurofisiologia del Movimento

1920-1-I0201D131-I0201D194M

Aims

The course provides the student with the essential knowledge concerning the functions of which the Physiotherapist is required to have a specific knowledge. It analyzes the mechanisms of the cell excitability, the interaction between excitable cells and the physiology of the motor and sensory systems.

The course provides the student with the essential knowledge concerning the functions of which the Physiotherapist is required to have a specific knowledge. It analyzes the mechanisms of the cell excitability, the interaction between excitable cells, cell motility and the physiology of the motor and sensory systems. A deep knowledge of the neuromotor control is aimed at understanding the most common physio-pathological clinical issues. The course, organized in a single semester, consists of lectures, exercises and seminars.

Contents

- Structure and function of the plasma membrane: ion channels, resting membrane potential
- Genesis and propagation of the action potential, the receptor potential, the synaptic transmission
- Responses mediated by sensory receptors – mode of action, intensity, localization and duration of the applied stimulus.
- Pain perception - nociceptors: anatomic distribution and function
- The motor system and the motor unit activation

- Postural control
- Control of the spinal cord by the upper motor neurons
- The modulation of movement by the basal ganglia
- The modulation of the movement by the cerebellum
- Eye movements and sensory motor integration

Detailed program

Cell excitability - plasma membrane. Permeability, diffusion, osmosis, active and passive transport through the membrane. Ionic channels. Electrochemical equilibrium and Nernst equation. Resting membrane potential. The Na⁺ / K⁺ pump. Passive electrical properties of the membrane. The action potential: genesis, ionic bases and properties. Conduction of the action potential in the myelinated and unmyelinated nerve fibers. Classification of nerve fibers. Elementary interactions between excitable cells. The synapse. General concepts on synaptic transmission. The neuromuscular junction. The central synapse. Electrical events in postsynaptic neurons. Neuronal integration of synaptic inputs: spatial and temporal integration. Neurotransmitters in the Central Nervous System.

The sarcomere: the contractile and the regulatory proteins. Excitation-contraction coupling: role of the Ca²⁺. Molecular basis of the muscle contraction. The mechanism of contraction. The isotonic and isometric contraction. Voltage-length and force-speed relationships. Muscle fibers classification. The motor units: force output by the frequency discharge and by recruitment of the motor units. The smooth muscle. Coupling between smooth muscle cells: unitary and multi-unitary muscle.

Sensory system: organization and general mechanisms. Sensory receptors: definition and classification of receptors. Signal transduction and coding. Appropriate stimulation. Adaptation. Receptive fields' dimensions: stimulus location, intensity, duration. Somatic sensitivity: touch, proprioception, pain. Ascending pathways of somatic sensitivity. Somatosensory cortex. Pain. Nociceptors: anatomic distribution, activation and sensitization mechanisms, somatic, deep and visceral nociceptors.

Maintaining equilibrium: the postural reflexes. Feedback and feedforward control mechanisms. Rhythmic movements and locomotion. The organization of the motor system. Cerebellum and Basal Ganglia: general information on the functional organization and their roles in the motor control. The anatomical organization of the cerebellum. Projections to the cerebellum. Projections from the cerebellum. The intrinsic circuits of the cerebellum. The cerebellar circuits and the coordination of the in progress movements. Consequences of most common cerebellar lesions. Projections to the basal ganglia. Projections from the basal ganglia to other brain regions. The intrinsic circuits of the basal ganglia, the role of dopamine. Movement disorders: hypokinesia and hyperkinesia. Medial and lateral systems in motor control. Motor functions of the spinal cord: spinal reflexes; muscle spindle and myotatic reflex; the reverse myotatic reflex; flexor reflexes, the supra-spinal control of the myotatic reflex; posture and its control. Vestibular and cervical reflexes. Eye movements and sensory motor integration. Cortical control of the movement. Motor areas of the cortex and their functional role, neurochemical mediators. Organization of

vegetative reflexes. Vegetative functions of the midbrain, medulla and pons. Nerve centers for visceral function control. Level of study: High or intermediate depending on the relevance of the topics.

Prerequisites

Required preliminary knowledge: Foundations of physics, biochemistry, histology and anatomy of the nervous system, anatomy of the musculoskeletal system.

Teaching form

Lectures, exercises and seminars

Textbook and teaching resource

Bossi et al., FISIOLOGIA UMANA ELEMENTI, edi-ermes

Belfiore et al., FISIOLOGIA UMANA FONDAMENTI, edi-ermes

DALE PURVE et al., Neuroscienze, Zanichelli

A.C. GUYTON & J.E. HALL, Fisiologia medica, Piccin W.J.

KLINKE, PAPE, KURTZ, SILBERNAGEL, Fisiologia, EdiSes

M. BERNE & M. N. LEVY Fisiologia, Un approccio integrato, Casa Editrice Ambrosiana

Semester

First semester

Assessment method

Written test: open questions aimed at assessing the understanding of the topics covered, in a context of clinical evaluation of the main physiological parameters with particular reference to the relationships and the interactions between the functions of the organs, apparatuses and systems

Office hours

By appointment, subject to communication to be sent to giulio.sancini@unimib.it
