UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Ocular Physiology

2627-1-E3006Q014-E3006Q01402

Aims

The Ocular Physiology module will treat the neural control of the ocular function and the central elaboration of the visual signal.
An adequate knowledge of eye physiology is essential for the comprehension of the subsequent courses on Eye Pathology, Psychology of perception and Contactology.

Contents

Sensory Systems.

Physiology of the eye and the retina.

Central elaboration of the visual signal.

Neural control of eye function and motility.

Epithelial transport, humour formation, lacrimation.

Development of the visual system.

Introduction to ocular pathology.

Detailed program

I) Sensory systems: general aspects.

Introduction to the sensory systems. Sensory coding: accessory structures, reception, transduction and receptor potential. Adaptation: general aspects and functional meaning (example of the Pacini body). Signal transduction in mechanoceptors, taste and olfactory receptors.

II) Auditory and vestibular system.

Parts of the ear. Cochlea, endo- and perilymph, hair cells, Corti organ, physiology of frequence analysis by the cochlea. Vestibular system: otolithic organs and semicircular channels, structure and physiological roles.

III) Eye structures and their nervous regulation.

Cornea e sclera. Structure and cornea functions. Physiology of the cornea epithelium, stroma and endothelium. Transport of respiratory gases, metabolites and regulation of hydration. Cornea trasparency and possible alterations. Main morphofunctional features of the sclera.

Tears. Composition of the lacrimal film. Lacrimal glands, conjunctival glands and Meibomian glands. Basal and reflex secretion. Neural control of secretion. Reduced quantity and altered quality of the lacrimal film: the dry eye syndrome.

Lens and iris. Morphofunctional aspects. Lens transparency. Metabolic exchanges. Accommodation, pupillary reflex and vergences. Regulation by the autonomous nervous system. Hints to some pathologies.

Circulation and nutrition. Uveal system and retinic circulation. Formation, composition and functions of the aqueous and vitreous humors. Intraocular pressure, normal conditions and circadian oscillations; regulation of aqueous production, glaucoma. Alterations of the vitreous body structure.

IV) Retinal Physiology and central elaboration of the visual signal

Summary of eye anatomy. General organization of the pigmented epithelium and the retina layers. Fovea and macula. Role of glial cells: astrocytes and Müller cells. Metabolism in the retina, blood perfusion and emato-retinal barrier. Metabolic compartmentation. Morphology of photoreceptors (external and internal segment, synapse). Photopigments and phototransduction. Regeneration of photopigment, exchanges through the pigmented epithelium and Müller cells. Dark current and effect of light. Transduction cascade, cGMP-activated channels, receptor potential, synaptic release. Rods and cones: main features and function, scotopic and photopic vision, color detection. Intraretinal elaboration, mechanisms of light adaptation, role of horizontal, bipolar, amacrine cells, integrative function of ganglion cells. Ganglion cell types, ON and OFF cells. Melanopsin-expressing cells, retinal-hypothalamic tract and suprachiasmatic nucleus in relation to the photoperiodic signal. Feature extraction from observed images and information processing: examples aof color vision and lateral inhibition to enhance contrast. Main central pathways of visual information transfer. Optic nerve. Lateral geniculate nucleus and the other subcortical stations involved in vision. Primary visual cortex. The constructive nature of sensory elaboration. Columnar organization of the visual cortex, hypercolumns. Simple and complex cells. Associative cortices. Dorsal and ventral pathways of the visual information transfer in the cerebral cortex.

V) Control of eye motility.

Vestibulo-ocular and optokinetic reflex. Nystagmus. Saccadic and pursuit movements, vergences.

VI) Eye development

Eye characteristics and functions at birth; modification from birth to maturation, variations in the optical constants; the physiological aging.

Prerequisites

Human and Eye Anatomy and Histology.
General Chemistry.

Teaching form

The lessons will be delivered in italian, in presence.
The couse will end with an interactive lesson (2 hours) during which the teacher will discuss and deepen the topics of the course, and she will answer questions and provide clarifications according to students' requests.

Textbook and teaching resource

Slides available on the E-learning platform.

Reference textbooks:
Levin et al. Adler's Physiology of the Eye. XI Edition. Saunders, 2011.
Peres, D'Angelo. Fisiologia. Edi-Ermes
Randall et al. Animal Physiology. Freeman.
Conti et al. Fisiologia Medica, Edi-Ermes, 2010.
Guyton, Hall. Fisiologia Medica, EDISES, 2002
Kandel et al., Principles of Neuroscience, CEA 2014.

For consulting:
Dowling, The Retina: an Approachable Part of the Brain. Harvard University Press, 2012.

Semester

II semester (from the second half of April until June)

Assessment method

There are no 'in itinere' tests.

The oral exam consists in a few questions aimed to verify the comprehension of the fundamental concepts of the course and to verify the communication skills.

The access to the exam is bound by passing the exam of General Physiology.

If requested, the exam will be in English.

The evaluation concerns the student's level of preparation and his/her communicative sklills.

Office hours

Appointment by e-mail.

Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | REDUCED INEQUALITIES