



## MEDICINE AND SURGERY

**Course: Clinical Neuroscience**

**Year (1<sup>st</sup>-2<sup>nd</sup>-3<sup>rd</sup>-4<sup>th</sup>-5<sup>th</sup>-6<sup>th</sup>): 5<sup>th</sup>**

**Period (1<sup>st</sup>-2<sup>nd</sup> semester – annual): 1<sup>st</sup>**

**Credits: 9**

### Objectives

*Knowledge in Clinical Neuroscience is expanding fast. We propose an integrated course aimed at translating from basic to clinical knowledge. This interdisciplinary course will bridge different subspecialties into an integrated and comprehensive program. By completion of the program, students will have adequate knowledge of the main neurological diseases, their pathophysiology and treatment.*

*The Neurology module will address the approach to a patient with symptoms of neurological impairment including symptoms of cognitive, motor, sensory and autonomic impairment, which indicate involvement of brain, spinal cord, nerves or muscles. The approach is symptom-based and patient-centered. The students will learn how a physician should investigate these symptoms and assess the patient's neurological status.*

*The Neuroanatomy and Neurophysiology modules integrate clinical neuroscience with their anatomical and physiological foundations. Integrated teaching aims to provide a clear understanding of different localization of functions and of pathophysiology of neurological disease. The Neuroradiology module reviews the role diagnostic and interventional radiology applied to neurological diseases. This module instructs on some of the basic aspects of neurologic imaging, including anatomy of the brain and spinal cord as shown by CT and MRI, and diagnosis of diseases and abnormalities of the central nervous system.*

*The Neurosurgery module provides an overview of the surgical management of neurological diseases. It integrates will diagnostic procedures and technological advancements.*

### Prerequisites

*The course is dedicated to 5<sup>th</sup> year medical students who already master the fundamental knowledge required to approach the integrated field of Clinical Neuroscience. This includes passing Head and Neck course.*

### Contents

**Presentation of the course. Introduction to Neurology (Albanese)**

Learning goals: Understand the relationship between clinical neurology and internal medicine;  
Understand the relationship between neurology, psychiatry and neuroscience; Understand the

clinical methodology in neurology; Describe the initial clinical approach to the patient with neurological problems; Describe the main categories of neurological diseases and their frequency.

**The neurological examination part 1: cranial nerves (Nobile-Orazio)**

Learning goals: Describe the symptoms due to impairment of cranial nerve; Learn the neurological examination of patients with cranial nerve impairment; Learn the main diseases causing cranial nerve impairment.

**The neurological examination part 2: motor and sensory (Nobile-Orazio)**

Learning goals: Describe the symptoms of motor and sensory pathways impairment; Describe the clinical assessment of motor impairment; Describe the clinical assessment of sensory impairment; Describe the symptoms due to cerebellar dysfunction; Describe the symptoms due to meningeal involvement; Describe the clinical assessment of cerebellar dysfunction and meningeal involvement.

**The neurological brainstem: “Locked-in” a small space (Barajon)**

Learning goals: Revise the macroscopic features of the brainstem; Revise the internal organization of the brainstem: tegmentum and base, position of nuclei and pathways; Revise the organization of the blood supply to the brainstem.

**Neurological syndromes (Albanese)**

Learning goals: Understand transient and permanent neurological syndromes; Understand the anatomical-clinical syndromes of the brain; Understand the anatomical-clinical syndromes of the spinal cord.

**The trembling patient: Parkinson’s disease and other parkinsonian syndromes (Albanese)**

Learning goals: Recognize the clinical presentations of parkinsonian syndromes; Learn diagnostic criteria for Parkinson’s disease and other parkinsonian syndromes; Review the different causes of parkinsonian syndromes; Learn how to manage a patient with Parkinson’s disease.

**The mechanisms of neuronal excitability and suffering (Fesce)**

Learning goals: Review excitatory/inhibitory balance and the pathogenesis of seizures and epilepsy; Review genetic and environmental causes of neuronal suffering and neurodegenerative disorders; Review calcium overload (excitotoxicity), ROS and oxidative damage, mitochondrial derangement and mitophagy, UPR, proteasome impairment; Review non-cell-autonomous factors (microglia, astroglia, neural stem cells).

**The patient with acute loss of consciousness and jerking: epilepsy (Nobile-Orazio)**

Learning goals: Describe the clinical presentation of a patient with acute loss of consciousness; Describe the main causes of acute loss of consciousness; Recognize the main seizure types, Learn what are the main forms and causes of epilepsy; Learn how to treat patients with epilepsy; Learn how to manage and treat patients with syncope.

Priority Presenting Problems Portfolio: Seizure, Loss of Consciousness

**The etiopathogenesis of neurodegenerative and neuroimmunological diseases (Fesce)**



Review the etiopathogenesis of: Parkinson, Huntington, Alzheimer, Amyotrophic Lateral Sclerosis, Multiple Sclerosis.

**The patient with loss of memory and cognitive impairment (Albanese)**

Learning goals: Describe the varied clinical presentations of a patient with cognitive impairment; Learn how to investigate a patient with cognitive impairment; Learn how to distinguish age-related cognitive decay from dementia; Review the different causes of dementia; Learn how to manage a patient with dementia.

**The confused patient: delirium (Albanese)**

Learning goals: Describe the clinical presentation of a patient with confusion and delirium; Learn what how to assess a patient with confusion and delirium; Describe the main causes of confusion and delirium; Learn how to treat patients with delirium.

Priority Presenting Problems Portfolio: Altered Mental Status, Substance Abuse

**Neurodegeneration or chronic vasculopathy? (Albanese)**

Learning goals: Learn the pathology and physiopathology of chronic cerebrovascular diseases; Differentiate between degenerative and vascular parkinsonism; Differentiate between degenerative and vascular dementia.

**Introduction to Neuroimaging; basic tips on how to read a brain CT and MRI (Politi)**

Learning goals: Recognize the main imaging features of brain CT; Recognize the main imaging features of brain MRI.

**Language physiology and aphasia (Fesce)**

Learning goals: Review the functions that sustain lexicon, semantics, comprehension, verbalization; Review Broca, Wernicke, conduction, transcortical motor and sensory aphasia; Review aphasia related to problems external to language areas.

**ARAS, physiopathology of emotions and the control of behavior (Fesce)**

Learning goals: Acquire a comprehensive perspective on the emotional and cognitive processes that contribute to regulate our cognitive and motor behavior.

This is a flipped class activity – the students will discuss this topic after having reviewed: the activating reticular ascending aminergic pathways and their roles in affecting emotional and cognitive processing, the sensory-motor, motivational, learning and executive circuits that control motor and cognitive behavior

**The patient with acute onset of neurological signs: stroke (Albanese)**

Learning goals: Describe the different clinical presentations of a patient with stroke; Review the main stroke syndromes; Recognize transient ischemic attacks; Describe the main causes leading to stroke.

Priority Presenting Problems Portfolio: Stroke

**Stroke management (Albanese)**



Learning goals: Describe the principal complication of stroke; Describe the prognosis of a patients with stroke; Describe the therapeutic approach to a patient with stroke; Describe the therapy in the acute phase of stroke; Describe the secondary prevention o stroke.

### **Imaging and endovascular treatment of ischemic stroke (Politi)**

Learning goals: Learn to recognize an acute ischemic stroke on CT and MRI images; Learn timing and indication of the different neuroimaging modalities in the management of a patient with acute ischemic stroke; Gain familiarity with CT angiography. Learn to recognize normal vasculature and vessel occlusions; Understand the differences between cytotoxic and vasogenic edema; Understand the fundamentals of endovascular thrombectomy; Learn how to depict brain chronic ischemic lesions on CT and MRI.

### **The patient with acute loss of consciousness: fainting and syncope (Albanese)**

Learning goals: Describe the clinical presentation of a patient with fainting and loss of consciousness; Describe the main causes of fainting and loss of consciousness; Learn what is the assessment of fainting and loss of consciousness; Learn how to treat patients with fainting and loss of consciousness; Learn how to manage and treat patients with fainting and loss of consciousness.

Priority Presenting Problems Portfolio: Transient Loss of Consciousness

### **The patient with pain in the head (Nobile-Orazio)**

Learning goals: Describe the clinical presentation of a patient with pain in the head; Learn what are the main causes of headache; Learn how to diagnose different types of headaches; Learn how to treat patients with headache.

Priority Presenting Problems Portfolio: Headache

### **The patient with headache and progressive neurological impairment: raised intracranial pressure (ICP) (Servadei, Pessina, Costa)**

Learning goals: Describe the physiology and pathophysiology of the mechanisms underlying ICP control; Learn causes of ICP dyscontrol; Learn the clinical presentation of ICP hypertension and hypotension; Learn how to treat patients with ICP disorders.

### **The patient with fever and acute neurological impairment (Nobile-Orazio)**

Learning goals: Describe the clinical presentation of a patient with fever and acute neurological impairment; Learn what is meningitis and encephalitis; Learn how to approach patient with suspected meningitis and encephalitis; Learn how to establish the diagnosis of patient with suspected meningitis and encephalitis; Learn how to treat patients with suspected meningitis and encephalitis.

Priority Presenting Problems Portfolio: Fever

### **The patient with relapsing neurological deficits: multiple sclerosis (Nobile-Orazio)**

Learning goals: Describe the clinical presentation of a young patient with relapsing neurological deficits; Learn what is multiple sclerosis; Learn how to diagnose multiple sclerosis; Learn how to treat patients with multiple sclerosis.

**The patient with abnormal movement and incoordination (Albanese)**

Learning goals: Describe the different hyperkinetic movement disorders; Learn how to diagnose a patient with hyperkinetic movement disorder; Learn how to manage patients with hyperkinetic movement disorders; Describe ataxias; Learn how to diagnose a patient with cerebellar ataxia

**The patient with progressive muscle weakness and atrophy: motor neuron disease (Albanese)**

Learning goals: Describe the clinical presentations of a patient with motor neuron disease; Learn how to assess a patient with progressive muscle weakness and atrophy; Learn how to diagnose amyotrophic lateral sclerosis; Learn how to manage the patient with amyotrophic lateral sclerosis.

**The patient with rapidly progressive palsy: polyradiculoneuritis (Nobile-Orazio)**

Learning goals: Describe the clinical presentation of a patient with rapidly progressive palsy; Learn how to evaluate a patient with rapidly progressive palsy; Learn the main causes of rapidly progressive palsy; Learn how to distinguish peripheral from central rapidly progressive palsy; Learn what is acute demyelinating inflammatory polyradiculoneuritis (Guillain-Barré syndrome); Learn what is acute myelitis; Learn how to diagnose and treat Guillain-Barré syndrome.

**The patient with pain and weakness in the limbs: neuropathy (Nobile-Orazio)**

Learning goals: Describe the clinical presentation of a patient with pain and weakness in the feet; Learn how to evaluate a patient with a suspected neuropathy; Learn what are the main causes of neuropathy; Learn how to distinguish the main causes of neuropathy; Learn what are the inflammatory neuropathies; Learn how to treat patients with neuropathy

**The weak and fatigable patient: neuromuscular disorders (Nobile-Orazio)**

Learning goals: Describe the clinical presentation of a patient with weakness or fatigability; Learn how to evaluate a patient with a suspected myasthenia gravis; Learn how to diagnose and treat a patient with myasthenia gravis; Learn how to evaluate a patient with a suspected myopathy; Learn what are the main causes of myopathy; Learn how to distinguish the main causes of myopathy; Learn how to treat a patient with myopathy.

**The patient with intracranial masses: brain tumors (Pessina)**

Learning goals: Describe the pathophysiology of intracranial tumor formation and expansion; Describe the clinical presentation of a patient with brain tumor; Learn how to diagnose brain tumors; Learn how to treat patients with brain tumors.

**Intracranial mass lesions (Politi)**

Learning goals: Learn how to distinguish intra- and extra-parenchymal mass lesions; Gain familiarity with imaging features of low and high-grade primary brain tumors; Learn how to identify complications arising from increased intracranial pressure; Understand the usefulness of advanced MRI techniques for tumor characterization and tumor grading; Understand the complexity of assessing brain tumor treatment response.

**The patient with head trauma (Servadei)**



Learning goals: Describe the clinical presentation of a patient with head trauma; Describe the direct effects of head trauma; Describe the secondary effects of head trauma; Describe the neuroradiological approach to a patient with head trauma; Describe the management of a patient with head trauma; Describe the complication of head trauma.

Priority Presenting Problems Portfolio: Trauma

### **The patient with brain hemorrhage** (Servadei, Pessina, Costa)

Learning goals: Describe the clinical presentation of a patient with different types of brain hemorrhage; Learn the diagnostic workout; Learn the surgical indications in these patients; Learn which are the main causes of brain hemorrhage; Learn the different surgical approaches; Learn the clinical outcomes of surgery of the brain hemorrhagic patients.

### **Head trauma and spontaneous intracranial hemorrhages** (Politi)

Learning goals: Learn how to recognize an acute intracranial hemorrhage on CT and MRI images; Being able to distinguish intraparenchymal hemorrhage from subarachnoid hemorrhage, and subdural hematoma from epidural hematoma; Understand the complication of intracranial hemorrhages and learn how to depict them; Discriminate between a skull fracture and a suture on CT images; Understand the basics of endovascular treatment options for brain aneurysms, arteriovenous malformations and dural arteriovenous fistulae.

### **The patient with spinal diseases** (Costa)

Learning goals: Describe the clinical presentation of a patients with limb weakness and pain; Learn the diagnostic workout; Learn the surgical indications in these patients; Learn which are the main causes of surgery in the spine; Learn the different surgical approaches; Learn the clinical outcomes of surgery of the spine.

### **Demyelinating disorders – Spine degenerative changes** (Politi)

Learning goals: Gain familiarity with the imaging features of the different demyelinating disorders; Understand the relevance of neuroimaging in assessing disease progression in demyelinating diseases; Gain familiarity with the imaging features of the different demyelinating disorders; Learn to recognize intervertebral disc bulging, protrusion and extrusion; Learn to depict spinal canal and neuroforaminal stenosis.

### **The patient with hydrocephalus** (Servadei, Albanese)

Learning goals: Describe the clinical presentation of a patients with hydrocephalus and learn the differential diagnosis with other dementia patients; Learn the diagnostic workout; Learn the surgical indications in these patients; Learn which are the main causes of hydrocephalus; Learn the different surgical approaches; Learn the clinical outcomes of surgery.

### **Collaborative learning: Headache** (Barajon, Fesce, Albanese, Pessina)

Learning goals: Describe the possible neuroanatomical sources of pain in the head region; Classify the various clinical forms of headache and migraine; Understand the role of the trigeminal ganglion and the trigeminovascular system in the pathogenesis of migraine; Review the pharmacological



treatments for headache and migraine; Organize and integrate reasoning on headache, its causes, pathophysiology, clinical presentations, diagnostic and therapeutic approaches

#### **Wrap-up and conclusions** (Albanese)

Learning goals: Identify and solve difficulties in learning clinical neurosciences; Review interdisciplinary and bridging topics; Test learning through examples

#### **Teaching methods**

*Lectures, clinical case discussions, teamwork. Lecture materials are provided to students.*

#### **Verification of learning**

*Written tests will assess the student's overall preparation and skills. The test will encompass 45 multiple-choice or open questions (25 Neurology, 5 each for Neurosurgery, Neuroanatomy, Neurophysiology and Neuroimaging). The threshold for passing the test is  $\geq 60\%$  of correct answers in each module. Students may also pass the exam if they fail to reach the  $\geq 60\%$  threshold in one module only (except Neurology) and have at least 80% of correct answers in all the other modules.*

#### **Texts**

- *Adams & Victor's Principles of Neurology, 11th edition, by Allan Ropper, Martin Samuels, Joshua P. Klein, Sashank Prasad – McGraw-Hill Education 2019*
- *Merritt's Neurology, 14<sup>th</sup> edition, by Elan D. Louis, Stephan A. Mayer, Lewis P. Rowland – Wolters Kluwer 2015*
- *Neuroanatomy through clinical cases, 3<sup>rd</sup> edition, by Hal Blumenfeld – Sinauer Associates 2021*
- *Learning Radiology, Recognizing the Basics, 4<sup>th</sup> edition, by William Herring – Elsevier 2021*
- *Neuroradiology: The Requisites, 4<sup>th</sup> Edition, by Rohini Nadgir, David Yousem – Elsevier 2016*
- *Handbook of Neurosurgery, 9<sup>th</sup> Edition, by Mark S. Greenberg – Thieme Medical Publishers 2019*