Union Européenne des Medicins Specialistes

Core Curriculum for specialist training in Clinical Neurophysiology in Europe

Description of goals

Speciality Profile

The speciality of clinical neurophysiology involves the detection and evaluation of pathological changes of the central nervous system, peripheral nerves, skeletal muscles and certain sensory organs. A consultation in our field implies that the neurophysiologist designs and performs an investigation for covering, analysis and prognostic judgement of the disturbances which are causing the patients problems. To do so, an extensive knowledge of the field of neurology and related sciences is necessary. Mostly, classical electrophysiological methods are employed, but other techniques are increasingly used. Rapid advancements in technology, especially concerning digital signal analysis, constantly expand the diagnostic armamentarium and widen the indications for performing certain examinations. This places high demands on the specialist to continually assimilate knowledge of new methods and actively participate in method development.

Clinical neurophysiology is essentially a service discipline, providing diagnostic help mainly to other neurospecialities, e.g. neurology, neurosurgery and paediatric neurology, but also increasingly to hand surgery, general medicine, rheumatology, occupational medicine, orthopaedics, physiotherapy and rehabilitation, psychiatry and oto-rhino-laryngology.

The aims of this document are therefore to provide guidelines and to describe what is thought to be the necessary minimal level of knowledge for a specialist in clinical neurophysiology in 2008.

General Goals

Internal and External Collaboration

Central laboratories in clinical neurophysiology today tend to expand their consulting activities to satellite laboratories at county and local hospitals. This requires good knowledge of administration and leadership. The consulting physician must also be knowledgeable about telemedicine, since the rapid advancement of digital telecommunication is expanding the opportunities for rapid diagnostics and reporting via tele-transmitted signals.

Knowledge, Skills and Professional Attitude

The specialist education and training shall lead to sufficient knowledge of the anatomy and physiology of the nervous system, of the neurological diseases and their pathophysiological mechanisms, and of other diseases and injuries that alter the functions of the nervous system.

Diagnostic activity in clinical neurophysiology covers diseases and functional disorders in the central nervous system, peripheral nerves, certain sensory organs, the autonomic nervous system, the motor unit and striated skeletal muscle, sphincter muscles, and the urogenital organs. Apart from practical skills in neurophysiological examination methods and the handling of equipment, theoretic knowledge of measurement technology, electronics, signal analysis and telemedicine is required.

The interaction between clinical neurophysiologists and referring colleagues is important. Hence, the educational experience shall include practice in presentation during rounds and preparing interpretative reports.

Management training is an important part of the specialist training programme, and residents shall therefore:

· train their ability to make independent and well-founded decisions concerning issues involving medical ethics
· acquire knowledge about general healthcare policy goals and priorities
· be given opportunities to participate in departmental activities related to organizational planning, financial management, production control, and quality improvement
· acquire knowledge of and insight into the leadership role of the physician
· be encouraged to participate in research and development, and to refine their capabilities for

critically appraising the results from various methods and technologies
- increase their knowledge about the potential for preventing disease and injury, and participate in individual and general prevention activities
- develop their teaching skills by participating in the education and training of various categories of staff.

Supplementary Education and Training

Meeting the general goals for the speciality requires supplementary education and training in neurology and related disciplines. Supplementary education shall provide the resident with the knowledge and skills necessary to adequately assess anamnesis, symptoms, and clinical findings provided with a referral, and thereby be able to plan and carry out a relevant neurophysiological examination. The focus of supplementary education should be on training the resident's abilities to routinely carry out and evaluate anamnesis and neurological status of paediatric and adult patients.

Theoretical Education

The specialist training programme shall be paralleled by theoretical studies and other complementary educational activities, e.g. courses, conferences, etc. In collaboration with their tutors, residents shall plan literature studies and select courses intended to promote the development of competence, providing knowledge and skills that may otherwise be difficult to acquire within the framework of specialist training.

Quality Assurance

The speciality training shall be supervised. It is the responsibility of the chief medical officer (head of the department/clinic, or equivalent) to plan the specialist training programme with the resident so that specialist competency can be achieved within the stipulated time frame. Furthermore, it is the responsibility of the chief medical officer to ensure that the resident receives the supplementary education and training specified under the description of goals, and that complementary education/training is provided when the need for knowledge cannot be met within the normal framework of activities. The progress of residents shall be continuously assessed, and be checked against the individual's specialist training programme.

Specific Goals

To become a full specialist in clinical neurophysiology, five years of training is in principle required. Of these, 3- 4 years should be at a central department (laboratory) of Clinical Neurophysiology. Additional to this, at least 6 months of training in neurology is required. The remaining 6-18 months could be in neurology or a related speciality, as listed above. A PhD thesis within the field could result in a reduction of the time required to become a specialist by 6-12 months. The training should start with one year of basic training in medical technology and basic theoretical neurophysiology. The trainee should score at least 500 EEG in adults (normal and pathological) under the supervision of specialists. He/she should study the most common conditions requiring EMG and electro-neurography (see below) and also perform at least 500 of these investigations. Basic scientific training, including medical statistics should be provided. After this first year, the mentor and the department head should review the trainees´ progress and aptitude for the subject, and in an interview determine whether the training should proceed.

Furthermore, it is very important that the future specialist has an interest and understanding of scientific work and scientific approach to problems. It is therefore desirable that he/she writes at least one scientific report during the course of the training and is given opportunity to lecture, at least locally. He/she should also participate in annual national scientific meetings; and, during the course of the training, participate in at least in one international conference in clinical neurophysiology.

The head of the department of Clinical Neurophysiology where the training takes place is ultimately responsible for declaring the trainee a specialist. If he/she finds that the trainee lacks the required knowledge, as described below, an additional year of training could be allowed. If the needs are still not met, the trainee should not be recommended to the health care authorities for a specialist diploma.

A specialist exam is not mandatory in all UEMS countries, but should be provided for any trainee who demands it by the national specialist society.

In the following text, an endeavour has been made to describe tests and theory pertaining to the central nervous system and the peripheral nervous system separately, since many physicians working within the field in the “non-specialist” countries will only deal with one or

the other types of testing. However, it is our opinion that physicians wanting to become specialists should cover the whole field, thereby enabling them to work all over Europe. We also ultimately aim at making a specialist exam procedure, common to all countries belonging to the UEMS.

Central nervous system testing

The specialist in clinical neurophysiology shall

Have knowledge of

The international 10-20 and 10-10 systems for EEG recordings. Different forms of epilepsy, and their expressions in EEG. Encephalopaties. The normal development of EEG in different ages, including preterm babies.

A. ***Be able to independently perform/ score concerning EEG (Electroencephalography)****:*

- resting EEG, adults
- effects of hyperventilation and photostimulation.
- simultaneous video monitoring
- EEG in neonates and preterm babies
- neurophysiological diagnostics for total brain infarction/cerebral death
- EEG during sleep and sleep deprivation (epilepsy diagnostics)
- long-term recording by ambulatory equipment and/or telemetry
- Different EEG-patterns in coma
- Progression patterns of different forms of dementia.

Sleep:

- classify the different sleep stages according to Rechtschaffen and Kales (1968)
- Sleep patterns in infants
- awakenings and arousals
- respiratory events and periodic limb movements
- apnoeas, hypopneas, periodic limb movements and EOG (electro-oculogram) in polygraphic and polysomnographic recordings

- multiple sleep latency test (MSLT) with determination of sleep and REM onset times

Evoked potentials:

- VEP (Visual Evoked Potential), flash stimulation
- VEP, pattern stimulation
- SEP including subcortical response

These examinations listed above are performed routinely at all neurophysiological central laboratories. Residents shall achieve the knowledge and skills which enable them to independently perform these examinations and assess the results in relation to the patient's disease. Residents shall also be able to determine when a more experienced specialist should be consulted about unexpected results or results that are difficult to interpret.

B. *Have good knowledge of and some experience in performing/scoring*

- sphenoidal recording and recording with other special leads for EEG
- automatic frequency analysis of EEG
- topographic EEG analysis (mapping)
- continuous monitoring of brain function in intensive care units
- SEP after dermatome stimulation
- BAEP - brain stem auditory evoked potentials and auditory evoked potentials (AEP)
- Event-related and cognitive evoked potential tests (e.g., P300 test)
- electroretinography (ERG)
- determination of reaction time and use of computerized attention tests

All specialists are not expected to have an independent command of the above examination methods since they are used more or less frequently in central laboratories. Residents should, however, have extensive knowledge concerning the indications for which these methods are to be used, and during their continued training become increasingly independent in the performance and assessment of these examinations.

C. *Have been present during, or have theoretic knowledge of, management and performance of*

- corticography
- intracerebral EEG recordings incl. subdural leads
- investigations during deep brain stimulation
- amytal test during EEG (WADA-test)
- functional MRI
- magnetic encephalography (MEG)
- single photon emission computed tomography (SPECT)
- positron emission tomography (PET)
- Multiple Wake Test
- actigraphy for determination of sleep-wake patterns (diurnal rhythm)
- temperature recordings (core body and skin)
- high-density EEG- and evoked potential recordings (64 channels or more)
- digitized Source analysis in EEG

These examinations are performed less frequently and are not available at every central laboratory. The resident shall, however, acquire such knowledge of these examinations as to be able to judge when it is worthwhile to perform the examinations and where to turn if the method is not available in the home laboratory.

Peripheral nervous system testing

The specialist in clinical neurophysiology shall

have knowledge of:

different indications for electromyography (EMG) and electro-neurography (ENeG). He/she shall have adequate knowledge about the anatomic localization of different muscles as to be able to perform needle electromyography, and also the nerve location for stimulation and recording. He/she should also know the typical symptoms and findings in, e.g.,

- Different types of peripheral neuropathies in children and adults, e.g., Guillain-Barré syndrome and hereditary motor-sensory neuropathies.
- Neuromuscular disorders.

- Entrapment neuropathies.
- Toxic and metabolic neuropathies.
- Amyotrophic lateral sclerosis.
- Myasthenia gravis and myasthenic syndromes (transmission disorders).
- Myopathies and myositis.
- Myotonic dystrophies
- Reinnervation processes
- Critical illness neuropathy and myopathy
- Ganglionopathies

A. Be able to independently perform/ score concerning EMG and neurography

- Needle EMG of extremity muscles with scoring of interference patterns, and identification of different types of spontaneous activity.
- Needle EMG with quantitative and qualitative motor unit potential analysis, i.e, identification of potentials typical of neurogenic and myogenic lesions by means of manual methods and the most common automatic methods of EMG analysis

- Surface electrode EMG to analyse tremor, hyperkinesia, torticollis, etc in mobility disorders
- EMG of bulbar innervated musculature (muscles of the face, jaw, tongue, etc.)
- Nerve conduction velocity studies, motor and sensory
- Repetitive nervous stimulation, decrement analysis
- F-responses
- percutaneous magnet stimulation of motor cerebral cortex and spinal cord with recording of peripheral motor responses (MEP).
- quantitative measurement of sense of temperature (determination of thresholds for cold and heat)
- quantitative measurement of vibration thresholds

B. Have good knowledge of and some experience in performing/scoring

- Single fiber EMG with jitter analysis and assessment of fibre density
- EMG of anal sphincter musculature
- H-reflex
- blink reflex
- Treatment with Botuline toxin with EMG guidance
- Autonomic nervous system tests (RR-intervals, sympathetic skin response, etc)
- Needle neurography (e.g. to diagnose meralgia paresthetica, Mortons metatarsalgia, etc)
- Assessing pain thresholds by temperature sensory testing
- Long-term monitoring of MEP and SEP during surgery of spinal cord and brain stem

All specialists are not expected to have an independent command of the above examination methods since they are used more or less frequently in central laboratories. Residents should, however, have extensive knowledge concerning the indications for which these methods are to be used.

C. *Have been present during, or have theoretic knowledge of, management and performance of*

- larynx EMG
- phrenic stimulation - diaphragm EMG
- vesicle sphincter EMG
- monitoring of integrated EMG in relation to urodynamic investigation
- MUNE
- Macro-EMG
- Extra-ocular muscle EMG
- Muscle biopsies
- measurements of sensibility thresholds in sacral segments
- reflex- and latency measurements in sacral segments (bulbocavernosus reflex, pudendal latency)
- methods for measurement of muscle strength
- gait analysis, movement recordings

- microneurography and other methods of determination of conduction velocity in slowly conducting fibres
- Laser-evoked potentials

These examinations are performed less frequently, not at every central laboratory, and sometimes for scientific purposes only. The resident shall, however, acquire such knowledge of these examinations as to be able to judge when it is worthwhile to perform the examinations and where to turn if the method is not available in the home laboratory.