

ELECTRODIAGNOSTIC MEDICINE

OBJECTIVES – BEGINNER

Patient Care

Residents are expected to:

- Perform a comprehensive electrodiagnostic evaluation of each patient and to provide a concise diagnosis and plan for further treatment
- Describe the variety of conditions frequently encountered in electrodiagnostic medicine
- Determine a logical approach of testing for each individual condition
- Discuss the electrophysiology of common normal and abnormal findings encountered in Electromyography and Nerve conduction studies (EMG/NCS)
- Develop an extensive knowledge base of neuromuscular anatomy
- Familiarize oneself with the EMG/NCS machine and be able to troubleshoot common errors and problems encountered in EMG/NCS testing
- Identify patient and family concerns associated with the testing process as well as the results
- Define the patient safety issues with EMG/NCS including proper maintenance, inspection of the machine, and risk of blood borne pathogen exposure
- Obtain appropriate informed consent for the procedure
- Respect that the patient is experiencing an uncomfortable procedure
- Complete an Electrodiagnostic Medicine Proctored Clinical Exam (CEX)

Medical Knowledge

Residents are expected to:

Anatomy & Physiology:

- Define the components of the motor unit

- Draw the Brachial Plexus, including the terminal nerves
- List the nerve root level and peripheral nerve innervation of upper and lower extremity muscles
- Describe the nerve root and peripheral nerve innervation of the skin in both the upper and lower extremity
- Describe microanatomy of the axon-membrane and supporting structure
- Compare the structure of myelinated and unmyelinated nerves
- Identify the microanatomy of muscle, i.e., sarcomere, T-tubules, action, myosin, etc
- Describe nerve and muscle membrane physiology such as potential and permeability
- Compare impulse propagation in myelinated and unmyelinated nerves
- Describe muscle contraction in microscopic terms, i.e., actin-myosin binding, ratcheting effect, sarcomere shortening
- Describe the response of the peripheral nervous system to injury

Instrumentation:

- Describe the purpose of the EMG/NCV recording device
- Identify the relative contraindications to electrodiagnosis
- Identify the complications of electrodiagnosis
- List the components of the EMG machine and their purpose
- Discuss the concept of differential amplification and the purpose of G1 and G2 electrodes
- Define sensitivity and gain
- Describe the differences between monopolar and concentric needles in terms of recording area, noise and wave form characteristics
- List at least three ways to reduce stimulus artifact
- Give examples of high and low frequency responses commonly seen during Electrodiagnostic studies

- Discuss the effects of inadequate or excessive stimulus intensity
- List five causes of electrical interference and how to minimize them

Nerve conduction Studies (NCS):

- Adjust various “Parameters” to record sensory, motor nerve conduction and motor unit potentials
- Demonstrate the proper placement of recording, reference and ground electrodes; recognize proper stimulation sites; measure the latencies and calculate conduction velocities
- State the various physiological factors, which can influence the electrodiagnostic results, e.g., age, body temperature, volume conduction, electrical interferences, and measurement error
- Memorize normal values for distal latencies evoked response amplitudes and conduction velocities of different nerves
- Measure sensory latencies and amplitudes of median, ulnar, radial, superficial peroneal, dorsal ulnar cutaneous nerve, and medial antebrachial cutaneous nerves.
- Measure motor latencies, amplitude and conduction velocities of median, ulnar, radial, peroneal, tibial nerves, and musculocutaneous nerves
- Distinguish between the late responses (H, F, A) waves, their etiology and clinical significance
- Demonstrate the ability to perform H reflex and F wave studies and interpret the results.
- Differentiate between axon loss and conduction block
- Demonstrate the ability to perform and diagnose upper and lower extremity nerve entrapments and radiculopathies
- Differentiate axonal versus demyelinating type of peripheral neuropathies
- Demonstrate the ability to diagnose neuropraxia versus axonometric and neurotmetic nerve lesion in mononeuropathies

Needle Electromyography (EMG):

- Analyze a normal motor unit potential’s morphology (shape, size, and phases) and recruitment pattern on needle EMG exam

- Define the initial deflection, duration, amplitude, rate, rhythm, origin, and diagnostic significance of these potentials: miniature endplate potentials, end plate potentials, fibrillations, positive waves, fasciculations, myotonia, myokymia, complex repetitive discharges, pseudomyotonia, tremor and cramp discharges, 60 cycle interference and artifacts
- Explain the reason why fibrillations and positive sharp waves are commonly seen in myopathy
- Describe typical electromyographic findings in muscle disease
- Describe the electromyographic findings in neuropraxia, axonotmesis, and neuronotmesis over time in terms of spontaneous activity, recruitment, and motor unit action potential morphology
- Know key muscles for cervical and lumbar radiculopathy

Practice-Based Learning and Improvement

Residents are expected to:

- Review the literature for electrodiagnostic medicine “Best Practices” for neuromuscular disorders
- Disseminate these “Best Practices” to patients, consultants, and staff

Interpersonal and Communication Skills

Residents are expected to:

- Interact with patients in a sensitive manner
- Communicate on a given patient’s intellectual/educational level
- Produce concise, accurate documentation of the consultation, electrodiagnostic findings, and recommendations
- Complete all chart notes in a timely manner
- Participate in teaching discussions

Professionalism

Residents are expected to:

- Promote respect, dignity, and compassion for patients

- Accept responsibility for their own actions and decisions
- Demonstrate reliability and punctuality
- Understand and adhere to HIPPA regulations

System-Based Practice

Residents are expected to:

- Appreciate when electrodiagnostic medicine procedures are most appropriately rendered to maximize information gain and patient outcome
- Appreciate when electrodiagnostic medicine procedures are/are not cost-effective for the patient and health care system
- Understand where electrodiagnostic medicine testing “fits” in the continuum-of-care for persons with neurologic disorders

OBJECTIVES – ADVANCED

Patient Care

Residents are expected to:

- Review the objectives for the beginning rotation and to master what they have not learned
- Perform 4 to 6 Electrodiagnostic medicine evaluations per day with limited faculty supervision
- Determine a logical approach of testing for each individual condition
- Characterize the electrophysiology of common normal and abnormal findings encountered in EMG/NCS
- Build on their knowledge base of neuromuscular anatomy
- Troubleshoot common errors and problems encountered in EMG/NCS testing
- Identify patient and family concerns associated with the testing process as well as the results
- Learn the patient safety issues with EMG/NCS including proper maintenance, inspection of the machine, and risk of blood borne pathogen exposure
- Obtain appropriate informed consent for the procedure
- Respect that the patient is experiencing an uncomfortable procedure
- Communicate with tech support personnel when a machine is not functioning
- Review inpatient and outpatient Electrodiagnostic medicine consults to determine medical necessity, and the best time frame to perform the exam
- Develop enough speed to complete the exam in the allotted time frame

Medical Knowledge

Residents are expected to:

Anatomy & Physiology:

- Outline the events occurring at the neuromuscular junction

- Review the course and muscles supplied by the facial, phrenic, suprascapular, axillary, and spinal accessory nerves
- Review the anatomy of the lumbar and brachial plexus
- Discuss myopathic and neuropathic biopsy findings
- Describe anomalous innervation including the Martin-Gruber anastomosis and accessory deep peroneal nerve
- List the most common forms of muscular dystrophy, motor neuron diseases (e.g., Amyotrophic Lateral Sclerosis (ALS), Spinal Muscular Atrophy (SMA), hereditary motor/sensory neuropathies(HMSN), and myopathies and be familiar with their genetics, incidences, ages of onset, evaluation (to include electrodiagnostic studies), treatment options, and recommendations and prognosis
- Differentiate muscular dystrophy/congenital myopathy from kalemic and metabolic myopathies
- Describe the findings of stiff man syndrome and other diseases of continuous muscle activity
- Understand the anatomy of the blink reflex

Instrumentation:

- Describe the effect of changes in the high and low frequency filters on the sensory nerve action potential (SNAP) and compound muscle action potential (CMAP) latencies and amplitudes
- Describe the effect of changes in the high and low frequency filters on the motor unit action potential (MUAP)
- Describe the technical difficulties of performing Electrodiagnostic testing in the ICU setting

Nerve Conduction studies (NCS):

- Perform lateral femoral cutaneous, plantar, saphenous, spinal accessory, and suprascapular nerve studies
- Demonstrate the ability to evaluate Neuromuscular junction disorders with repetitive stimulation testing
- Evaluate and perform testing to diagnose patients with lumbar and brachial plexopathy

- Evaluate an inpatient with generalized weakness or difficulty weaning off the ventilator
- List the disease categories associated with axonal and demyelinating neuropathies
- Identify common reasons for utilizing Somatosensory Evoked Potentials (SSEP). State the limitations and the pathophysiology behind their generation. Have a basic understanding of interpretation.
- Interpret the blink reflex in a normal patient, and in a patient with trigeminal and facial nerve involvement
- Describe the sensitivity and specificity of the various studies to diagnose median neuropathy
- Describe the combined sensory index (CSI) for diagnosing median neuropathy

Electromyography(EMG):

- List the common forms of voluntary and spontaneous activity seen with muscle disease
- Be familiar with and apply the grading systems available for documenting the extent of spontaneous activity
- Describe the effects of muscle disease on MUAP morphology
- Give the differential diagnosis of an abnormal interference pattern
- Discuss single fiber electromyography (SFEMG) and its possible uses
- Define jitter and fiber density based on SFEMG usage
- Discuss when not to perform electromyography as part of the testing
- State the indications for anal sphincter EMG and how to perform the exam

Practice-Based Learning and Improvement

Residents are expected to:

- Review the American Association of Neuromuscular and Electrodiagnostic Medicine's (AANEM) Recommended Policy for Electrodiagnostic Medicine
- Review AANEM practice parameters for Electrodiagnostic studies in carpal tunnel syndrome, ulnar neuropathy at the elbow, and peroneal neuropathy

- Perform the minimum number of tests to establish an accurate diagnosis

Interpersonal and Communication Skills

Residents are expected to:

- Interact with patients in a sensitive manner
- Communicate on a given patient's intellectual/educational level
- Produce concise, accurate documentation of the consultation, electrodiagnostic findings, and recommendations
- Complete all chart notes in a timely manner
- Participate in teaching discussions

Professionalism

Residents are expected to:

- Promote respect, dignity, and compassion for patients
- Accept responsibility for own actions and decisions
- Demonstrate reliability and punctuality
- Understand and adhere to HIPPA regulations
- Serve as a role model for the more junior residents
- Supervise and teach residents who are just learning electrodiagnosis

System-Based Practice

Residents are expected to:

- Appreciate when electrodiagnostic medicine procedures are most appropriately rendered to maximize information gain and patient outcome
- Appreciate when electrodiagnostic medicine procedures are/are not cost-effective for the patient and health care system
- Understand where electrodiagnostic medicine testing "fits" in the continuum-of-care for persons with neurologic disorders