END-2300: NERVE CONDUCTION STUDIES

Cuyahoga Community College

Viewing: END-2300 : Nerve Conduction Studies

Board of Trustees:
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Academic Term:
Fall 2023

Subject Code
END - Electroneurodiagnostic

Course Number:
2300

Title:
Nerve Conduction Studies

Catalog Description:
Basic discussion of nerve conduction studies and electromyography. Emphasis on equipment, knowledge of placement stimulation sites, sources of error in nerve conduction studies, electronics, pathology (abnormal nerve conduction studies, anatomy as it pertains to entrapment sites and nerve conduction studies), waveforms identification and case presentation.

Credit Hour(s):
3

Lecture Hour(s):
2

Lab Hour(s):
2

Requisites

Prerequisite and Corequisite
END-1450 Intermediate Electroencephalography (EEG), and concurrent enrollment in END-2911 END Directed Practice II, or departmental approval.

Outcomes

Course Outcome(s):
Apply basic electrical safety as it relates to Nerve Conduction Studies and demonstrate instrumentation controls for stimulus, sweep, sensitivity, filters, averaging, and interference.

Objective(s):

a. Evaluate basic electrical safety for proper use of nerve conduction instrumentation.
b. Demonstrate proper machine grounding and patient grounding for Nerve Conduction Velocity (NCV) studies.
c. Evaluate the purpose and function of instrument stimulator controls (intensity, duration, rate).
d. Demonstrate the proper use of instrument stimulus controls.
e. Evaluate the purpose and function of instrument recording controls (sweep, sensitivity, filters, and averaging).
f. Demonstrate the use of instrument recording controls.

Course Outcome(s):
Demonstrate innervation using nerve conduction.

Objective(s):

a. Identify basic anatomy and physiology of peripheral nerves in the upper and lower extremities.
b. Identify the innervation patterns (sensory, motor, and mixed) for upper and lower extremities.
c. Demonstrate innervation patterns in upper and lower extremities using sensory and motor studies.

Course Outcome(s):

Explain all possible stimulus sites for each electrode placement.

Objective(s):

a. Demonstrate the basic Nerve Conduction Velocity (NCV) set-ups and recording electrode placements for sensory, motor and mixed nerves.
b. Identify the various stimulation sites for all the basic NCV set-ups (sensory, motor, and mixed).
c. Demonstrate the ability to modify stimulus sites based on anatomical differences, or anatomical anomalies.

Course Outcome(s):

Critique advantages and disadvantages of antidromic and orthodromic testing techniques.

Objective(s):

a. Explain the basic anatomy and physiology behind antidromic and orthodromic stimulation.
b. Explain and discuss advantages and disadvantages of antodromic and orthodromic stimulation techniques.
c. Demonstrate the techniques of conduction of antidromic and orthodromic studies on various peripheral nerves.

Course Outcome(s):

Evaluate the principles of measuring waveforms and distances used in routine nerve conduction studies.

Objective(s):

a. Discuss response latency, and differences in sensory, motor, and mixed studies.
b. Discuss amplitude measures for NCV studies (sensory, motor, and mixed nerves).
c. Discuss routine distances used for sensory, motor, and mixed studies.
d. Utilize machine controls for marking waveforms for sensory, motor, and mixed studies.
e. Demonstrate the ability to utilize the NCV instrument to conduct analysis of latency and amplitude measures for sensory, motor, and mixed studies.

Course Outcome(s):

Evaluate the pitfalls of nerve conduction studies including effect of temperature, gender, age, measurement, volume conduction, edema, and atrophy.

Objective(s):

a. Discuss the four wave components effected by low limb temperature.
b. Demonstrate ability to monitor low limb temperature during NCV studies.
c. Demonstarate techniques used to raise low limb temperature to adequate levels for proper NCV results.
d. Discuss age and gender differences noted in various NCV studies.
e. Describe volume conduction as it relates to recording and stimulating in NCV studies.
f. Recognize the effects of volume conduction in waveform morphology in NCV studies.
g. Discuss the effects of various tissue, nerve, and muscle pathologies causing technical difficulties in NCV studies.
h. Discuss the effects muscle atrophy has on NCV motor studies.

Course Outcome(s):

Evaluate specific neurophysiology terms pertinent to components and function of motor units and their pathway.

Objective(s):

a. Discuss Compound Muscle Action Potentials (CMAP) as it relates to NCV testing.
b. Discuss the neuromuscular junction, components, and various neurotransmitters involved in its function.
c. Discuss the differences and functions of upper and lower motor neurons.
d. Discuss the origins and innervations of motor nerves.

Course Outcome(s):

Evaluate specific neurophysiology terms pertinent to components and functions of sensory fibers and their pathways.

Objective(s):

a. Discuss Sensory Nerve Action Potentials (SNAP) as it relates to NCV testing.
b. Discuss the origins and innervations of sensory nerve.

Course Outcome(s):

Correlate important clinical symptoms and the appropriate nerve conduction study work-up for specific disorders.

Objective(s):

a. Discuss and describe clinical symptoms of various peripheral neuropathies.
b. Discuss NCV tests used, and results for sensory, motor and mixed studies seen in various peripheral neuropathies.
c. Discuss and describe clinical symptoms of various entrapment neuropathies.
d. Discuss NCV tests used, and results for sensory, motor and mixed studies seen in various entrapment neuropathies.
e. Discuss and describe clinical symptoms of various radiculopathies.
f. Discuss NCV tests used, and results for sensory, motor and mixed studies seen in various radiculopathies.
g. Discuss and describe clinical symptoms of various plexopathies.
h. Discuss NCV tests used, and results for sensory, motor and mixed studies seen in various plexopathies.
i. Discuss and describe clinical symptoms noted in various demyelinating disorders.
j. Discuss NCV tests used, and results for sensory, motor and mixed studies seen in demyelinating disorders.
k. Discuss and describe clinical symptoms noted in various axon disorders.
l. Discuss NCV tests used, and results for sensory, motor and mixed studies seen in axon disorders.
m. Discuss and describe clinical symptoms noted in various neuromuscular junction disorders.
n. Discuss NCV tests used, and results for sensory, motor and mixed studies seen neuromuscular junction disorders.

Course Outcome(s):

Evaluate and identify pathways related to the brachial and lumbo-sacral plexus.

Objective(s):

a. Discuss nerve roots of brachial plexus (BP).
b. Discuss the trunks, divisions and cords of the BP.
c. Discuss the peripheral nerves which originate in the BP.
d. Demonstrate the ability to label all components in a diagram of the BP.
e. Discuss nerve roots of lumbo-sacral plexus (LS).
f. Discuss the peripheral nerves which originate in the LS plexus.
g. Demonstrate the ability to label all components in a diagram of the LS plexus.

Methods of Evaluation:

a. Quizzes
b. Exams
c. Comprehensive final
d. Laboratory worksheets
e. Laboratory quizzes

f. Laboratory competencies
g. Laboratory comprehensive final

Course Content Outline:

a. Introduction to Electromyography (EMG) and Nerve Conduction Studies (NCS)
    i. Repetitive nerve stimulation test
        1. general concepts of repetitive nerve stimulation and single fiber tests
        2. techniques of repetitive nerve stimulation and single fiber tests
        3. anatomical guide and normal values for repetitive and single fiber tests
        4. repetitive nerve stimulation and single fiber EMG in various diseases
    ii. Single fiber electromyography
b. Instrumentation
    i. Instrument controls
        1. stimulus
            a. rate
            b. duration
            c. current or voltage
            d. stimulus artifact
        2. sweep
        3. sensitivity zero
        4. low and high frequency filters
        5. averaging
        6. interference
    ii. Review basic electricity and electrical safety
        1. equipment inspection
        2. current leakage
        3. electrically sensitive patients
        4. grounding
        5. Ohm's law
    iii. Electrodes
        1. stimulation
        2. electrodes when recording
            a. What happens when electrodes are reversed
            b. What is the minimum electrode separation recommended
c. Electrode placement and stimulus sites for nerve conduction studies
    i. Electrode placement for each nerve
    ii. Stimulation sites for each electrode placement and instrument setting for upper and lower nerve conductions
        1. five stimulation sites for the ulnar recording over the ADQM
        2. peroneal motor conduction study-EDB recording
        3. peroneal motor conduction study-tibialis anterior recording
        4. peroneal nerve sensory study-superficial peroneal antrdramic
        5. posterior tibial motor conduction study-abductor hallucis recording
        6. tibial h reflex-soleus recording
        7. tibial nerve f-wave
        8. sural nerve; sensory study antidromic
        9. saphenous nerve sensory antridromic
        10. femoral nerve motor study
        11. orthodromic sural sensory conduction
        12. antridromic sural sensory conduction
        13. median motor conduction study-apb recording
        14. median f-wave
        15. ulnar motor conduction study-fdi recording
        16. ulnar sensory study antidromic digits
        17. orthodromic superficial radial conduction
        18. antridromic superficial radial sensory conduction
        19. orthodromic median sensory conduction
        20. antidromic median sensory conduction
        21. orthodromic ulnar sensory conduction

22. antidromic ulnar sensory conduction
23. median palmar sensory conduction
24. ulnar palmar sensory Conduction
25. blink reflex
26. radial nerve motor study
27. radial nerve sensory antidromic dorsum of hand

iii. Antidromic and orthodromic testing techniques as they apply to individual nerves
1. Indications
2. Contra-indications

iv. Anomalous innervations

d. Specific neurophysiology and neuroanatomy terms/placements pertaining to components and functions of motor unit and sensory fibers and their pathways

i. Excitation of the nerve
1. stimulus (subthreshold, threshold, supramaximal)
2. depolarization, repolarization
3. afferent, efferent
4. saltatory conduction
5. refractory period
6. membrane permeability
7. schwann cell
8. conduction velocity
9. conduction velocity in myelinated and unmylenated nerve fibers
10. conduction velocity and axon diameter
11. conduction velocity and intermode length

ii. Neuromuscular junction
1. nerve terminal
2. vesicles
3. facilitation
4. pseudofacilitation
5. exhaustion
6. repetitive stimulation
7. acetylcholine
8. muscle receptor
9. decrement
10. tetancy
11. increment

iii. Late responses
1. anodal block
2. h-reflex
3. reflex arc
4. f-wave
5. a-wave
6. excitability

iv. Nerve lesions
1. demyelination
2. reinnervation
3. sprouting
4. local block
5. anonotemesis
6. neurapraxia
7. neurotmesis
8. axonal damage
9. wallerian degeneration
10. temporal dipersion
11. mixed lesionsp
12. preganaglionic
13. postganglionic
14. phase cancellation

e. Clinical symptoms and the appropriate nerve conductions study work-up for the diseases and trauma affecting the peripheral nervous system
   i. Polyneuropathies
      1. acquired generalized, such as:
      2. alcoholic, diabetic, uremic/renal, etc.
      3. Guillian-Barre syndrome
   ii. Inherited generalized, such as
      1. Charcot-Marie tooth disease
      2. Dejerines Sottas disease
      3. Friedreich's Ataxia
   iii. Radiculopathies
      1. cervical
         a. spondylosis
         b. herniated disc
      2. thoracic
      3. lumbar
      4. sacral
      5. cauda equina
      6. polyradiculopathy
      7. double drush
   iv. Plexopathies
      1. brachial plexus
      2. cervical rib and thoracic outlet syndrome
      3. lumbrosacral plexus
   v. Motor neuron disease
      1. anterior horn cell disease
      2. amyotrophic lateral sclerosis
      3. poliomyelitis
      4. syringomyelia
      5. spinal muscle atrophy
   vi. Neuromuscular junction disorders
      1. myasthenia gravis
      2. myasthenic syndrome, Eaton-Lambert syndrome
      3. botulism
   vii. Myopathies
      1. muscular dystrophy
      2. steroid myopathy
      3. polysositis

Resources

American Society of Electroneurodiagnostic Technologists. (2017) *Nerve Conduction Studies for the Technologist (3rd ed.)*, ASET.

American Society of Electroneurodiagnostic Technologists. (1997) *Nerve Conduction Studies A to Z*, ASET.

Kimura, J. (2013) *Electrodiagnosis In Diseases Of Nerve And Muscle (4th ed.)*, New York, NY: Oxford Press.

Neal, P.G. & Katirji, B. (2011) *Nerve Conduction Studies Practical Guide and Diagnostic Protocols*, Rochester, MN: AANEM: American Association of Nueromuscular & Electrodiagnoistic Medicine.

Preston, D.C., & Shapiro, B.E. (2013) *Electromyography and Neuromuscular Disorders Clinical-Electrophysiologic Correlations (3rd ed.)*, New York, NY: Elsevier Saunders.

Russo, M., Kelly, J.J. (2011) *Essentials of Nerve Conduction Studies*, Charleston, SC: MJ Renas, LLC.

Weis, Lyn D., M.D., Jay M. Weiss, M.D., and Julie K. Silver, M.D. *Easy EMG: A Guide to Performing Nerve Conduction Studies and Electromyography*. 3rd ed. Elsevier, 2022.

Resources Other

a. ASET The Neurodiagnostic Society. 2022. https://www.aset.org/
b. American Clinical Neurophysiology Society. 2022. https://www.acns.org/
c. The Nerve Conduction Association. 2022. https://www.aaet.info/

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