END-2401: INTRAOPERATIVE MONITORING FOR ELECTRONEURODIAGNOSTIC TECHNOLOGISTS

Cuyahoga Community College

Viewing: END-2401 : Intraoperative Monitoring for Electroneurodiagnostic Technologists

Board of Trustees:
January 2023

Academic Term:
Fall 2023

Subject Code
END - Electroneurodiagnostic

Course Number:
2401

Title:
Intraoperative Monitoring for Electroneurodiagnostic Technologists

Catalog Description:
Introductory discussion of intraoperative monitoring of entire nervouse system structure and function integrity during surgical procedures. Types of recordings, technologists role, recording parameters, reasons for surgical monitoring, variables affecting monitoring, and critical parameters.

Credit Hour(s):
3

Lecture Hour(s):
3

Requisites

Prerequisite and Corequisite
END-1450 Intermediate Electroencephalography (EEG), and END-1500 Basic Evoked Potentials, and BIO-2341 Anatomy and Physiology II or concurrent enrollment.

Outcomes

Course Outcome(s):
Demonstrate knowledge of fundamentals of Intraoperative Monitoring (IOM):

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
a. Relay the basic science and instrumentation of intraoperative monitoring including use of differential amplifiers, filters and their effects, stimulus and averaging onset, signal averaging, artifact rejection.
b. Explain the role of the electroneurodiagnostic technologist in the operating room including licensure and certification requirements for performing procedures.
c. Demonstrate understanding of basic concepts of anesthesia and homeostatic factors and their effect on neurophysiologic signaling.
d. Review the anatomy pertaining to intraoperative monitoring of the brain, brain stem, cranial nerves, spinal column, spinal cord, and peripheral nerves.
e. Survey neurophysiological potentials and neurotransmitters.

Course Outcome(s):

Examine Somatosensory Evoked Potentials (SSEP) as an IOM modality.

Objective(s):

a. Review anatomy related to SSEP modality.
b. Review intraoperative utilization of SSEP.
c. Review recording concepts of SSEP and preoperative factors for electrode sites and applications, operation of equipment, site of stimulation, and stimulation issues.
d. Review criteria for establishing a baseline.
e. Review criteria for significant change/abnormality.
f. Relate effects of anesthesia and homeostatic changes on SSEP.

Course Outcome(s):

Examine Motor Evoked Potentials (MEP) as an IOM modality.

Objective(s):

a. Review anatomy related to MEP modality.
b. Review intraoperative utilization of MEP.
c. Review recording concepts of MEP and preoperative factors for electrode sites and applications, operation of equipment, site of stimulation, and stimulation issues.
d. Review contraindications to MEP.
e. Review criteria for establishing a baseline.
f. Review criteria for significant change/abnormality.

Course Outcome(s):

Examine Electromyography (EMG) as an IOM modality.

Objective(s):

a. Review anatomy related to EMG modality.
b. Review intraoperative utilization of EMG.
c. Review recording concepts of EMG and preoperative factors for electrode sites and applications, operation of equipment, site of stimulation, and stimulation issues.
d. Review criteria for significant change/abnormality.
e. Relate effects of anesthesia and homeostatic changes on EMG.

Course Outcome(s):

Examine Brainstem Auditory Evoked Potentials (BAEP) as an IOM modality.

Objective(s):

a. Review anatomy related to BAEP modality.
b. Review intraoperative utilization of BAEP.
c. Review recording concepts of BAEP and preoperative factors for electrode sites and applications, operation of equipment, site of stimulation, and stimulation issues.
d. Review criteria for establishing a baseline.
e. Review criteria for significant change/abnormality.
f. Relate effects of anesthesia and homeostatic changes on BAEP.

Course Outcome(s):

Examine Electroencephalography (EEG) as an IOM modality.

Objective(s):

a. Review anatomy related to EEG modality.
b. Review intraoperative utilization of EEG.

c. Review recording concepts of EEG and preoperative factors for electrode sites and applications, operation of equipment, site of stimulation, and stimulation issues.
d. Review criteria for establishing a baseline.
e. Review criteria for significant change/abnormality.
f. Relate effects of anesthesia and homeostatic changes on EEG.

Methods of Evaluation:

a. Quizzes
b. Exams
c. Comprehensive final
d. Case study
e. Worksheets

Course Content Outline:

a. Introduction to IOM
    i. Purpose of IOM
    ii. Types of surgeries
    iii. Neurophysiologic parameters
    iv. IOM advantages
    v. Types of recording
    vi. Consequences of surgical intervention
        1. Neurophysiologic signals as a measure in IOM
    vii. Neuronal anatomy and physiology
        1. Neuron-cell anatomy
        2. Action potential
        3. Synapse
        4. Neuromuscular junction
b. In the Operating Room
    i. Aseptic technique
    ii. Scrubbed personnel
    iii. Non-scrubbed personnel
    iv. Sterile field
    v. OR personnel
        1. Surgical team
            a. Attending surgeon
            b. Resident surgeon
        2. Anesthesia team
            a. Anesthesiologist
            b. Anesthesia resident, assistant, CRNA
        3. Nursing team
            a. Circulating nurse
            b. Scrub nurse/ Scrub tech
        4. IOM team
            a. IOM technologist
c. Anesthesia and Homeostasis
d. General anesthesia
    i. Basic concept
    ii. 4 Components of balanced anesthesia
    iii. Administration of anesthesia
        1. Volatile (inhalational) agents
            a. Properties
            b. Minimal Alveolar Concentration (MAC)
        2. Intravenous (injectable) agents
            a. Continuous infusion vs. bolus concept
            b. Sedation/ Amnesia agents

i. Hypnotics/ Anesthetics
ii. Barbiturates
iii. Benzodiazepines
3. Analgesia agents
a. Opiates
4. Neuromuscular blocker agents
a. Slow vs. fast acting neuromuscular blockers
iv. Homeostasis alterations
1. Temperature
a. Hypothermia definition
b. Effects of hypothermia on neurophysiologic signaling
c. Protective properties of hypothermia
2. Blood pressure
a. Relation to perfusion and oxygenation
b. BP control in the operating room
c. Effects of hypotension on neurophysiologic signaling
3. Oxygenation
a. Effects of hypoperfusion and oxygenation on neurophysiologic signaling
i. Ischemia
ii. Infarct

e. Somatosensory Evoked Potentials (SSEP)
i. Anatomy and Physiology
1. Vertebral column
a. Vertebra
2. Spinal cord
a. Spinal nerves
3. SSEP pathway
a. Dorsal Column-Medial Lemniscus tract
4. Primary Somatosensory Cortex-Homunculus
5. Blood supply
a. Cerebral
b. Spinal cord
ii. Utilization
1. Intraoperative use of SSEP to monitor blood perfusion to brain, spinal cord, and peripheral nerves
2. Intraoperative use of SSEP to monitor structural and functional integrity of the spinal cord, nerve roots, and peripheral nerves
3. Intraoperative use of SSEP to identify cortical structures
iii. Stimulation concept
1. Generation of signal
a. Traditional
b. Alternate placement
2. Stimulation parameters
iv. Recording/Acquisition concept
1. Recording procedure-choice of peripheral nerve
2. Recording electrode placement
3. Recording montages
4. Signal generators
5. Alternate electrode placement
6. Obligate waveforms
v. Explanation/Analysis of acquired data
1. Concept of baseline/ acceptable baseline
2. Concept of No Change
3. Change
a. Global vs. Localized
b. Gradual vs. Sudden
c. Criteria for change
d. Artifact considerations
e. Localization of change
vi. Anesthesia/Homeostasis effects

1. Effects of inhalation agents on SSEP
2. Effects of intravenous agents on SSEP
3. Effects of hypothermia on SSEP
4. Effects of hypotension/hypoperfusion on SSEP

f. Motor Evoked Potentials (MEP)
   i. Anatomy and Physiology
      1. Motor pathway (Descending Corticospinal Tract)
         a. Upper motor neuron
         b. Lower motor neuron
      2. Blood supply (Descending Corticospinal Tracts)
         a. Spinal cord
   ii. Utilization
      1. Spine surgery
      2. Correction of abnormalities of thoracic arteries
      3. Correction of abnormalities of cerebral arteries
      4. TcMEP/DcMEP/D-wave
   iii. Stimulation concept
      1. Stimulus site-general
      2. Stimulus type
         a. Magnetic
         b. Electrical
      3. Stimulating electrode placement (TcMEP, DcMEP, D-wave)
         a. Anode
         b. Cathode
      4. Stimulation technique/ parameters (TcMEP, DcMEP, D-wave)
      5. TcMEP electrical stimulation contraindications
   iv. Recording/Acquisition concept
      1. Myogenic responses (TcMEP, DcMEP)
      2. Neurogenic responses (D-wave)
   v. Explanation/Analysis of acquired data
      1. Myogenic responses
      2. Neurogenic responses
   vi. Anesthesia/Homeostasis effects
      1. Effects of inhalation agents on TcMEP/myogenic MEP
      2. Effects of intravenous agents on TcMEP/myogenic MEP
         a. Concept of TIVA
         b. Neuromuscular blockers
      3. Effects of anesthesia on D-wave/ neurogenic MEP
      4. Effects of hypoperfusion on MEP

g. Electromyography (EMG)
   i. Anatomy and Physiology
      1. Spinal nerves
      2. Cranial nerves
      3. EMG activity-physiology
   ii. Utilization
      1. Spontaneous EMG
         a. Protection of neural structures
      2. Triggered EMG
         a. Identification and verification of integrity of neural tissues
         b. Verification of integrity and placement of pedicles and pedicle screws
   iii. Stimulation concept
      1. Spontaneous EMG
      2. Triggered EMG
         a. Surgeon guided stimulator
         b. Parameters for direct nerve/ pedicle screw stimulation
   iv. Recording/Acquisition concept
      1. Muscles/spinal nerve root levels
         a. Cervical
         b. Lumbar
         c. Sacral

v. Explanation/Analysis of acquired data
    1. Presence/absence of response
    2. Latency/amplitude significance
    3. Cranial nerves-motor component
    4. Spontaneous EMG
        a. Irritation of neural tissue
    5. Triggered EMG
        a. Verification of neural tissue
vi. Anesthesia/Homeostasis effects
    1. Effects of Neuromuscular blockers on EMG

h. Brainstem Auditory Evoked Potentials (BAEP)
i. Anatomy and Physiology
    1. Vestibulocochlear Cranial Nerve-CN VIII
    2. BAEP pathway
ii. Utilization
    1. Posterior Fossa surgery
iii. Stimulation concept
    1. Generation of signal
        a. Clicks/ ear inserts
            i. Condensation
            ii. Rarefaction
iv. Recording/Acquisition concept
    1. BAEP montage
    2. Masking noise
v. Explanation/Analysis of acquired data
    1. Criteria for a change
        a. Absolute latency
        b. Interpeak latencies
        c. Wave V amplitude
    2. Artifact considerations
vi. Anesthesia/Homeostasis effects
    1. Effects of hypothermia on BAEP

i. Electroencephalogram (EEG)
i. Anatomy and Physiology
    1. Pyramidal cells of cortex
ii. Utilization
    1. Risk to cortex-ischemia
        a. Carotid endarterectomy
        b. Cerebral aneurysm (AVM) clipping
iii. Stimulation concept
    1. Spontaneous activity
iv. Recording/ Acquisition concept
    1. Concepts review (prerequisite to course)
v. Explanation/ Analysis of acquired data
    1. Criteria for a change
        a. Loss of fast frequencies
        b. Increased slowing
        c. Suppression of signal
vi. Anesthesia/ Homeostasis effects
    1. Effects of Inhalation agents on EEG
    2. Effects of Intravenous agents on EEG
    3. Effects of hypotension/hypoperfusion/ ischemia on EEG

Resources

Deletis, V., Shils, J., Sala, F., Seidel, K. (2020) *Neurophysiology in Neurosurgery: A Modern Approach*, San Diego, CA: Academic Press.

Zouridakis, G. Papanicolaou, A. (2001) *A concise guide to Intraoperative Monitoring,*Boca Raton: CRC PRess.

Russell, G. Rodichok, L. (1995) *Primer of Intraoperative Neurophysiologic Monitoring,*Boston: Butterworth-Heinemann.

Simon MD, M. (2018) *Intraoperative Neurophysiology*, New York: Demos Medical Publishing.

Husain MD, A. (2014) *A Practical Approach to Neurophysiologic Intraoperative Monitoring*, New York: Demos Medical Publishing.

Møller, A. (2011) *Intraoperative Neurophysiological Monitoring,*New York: Springer.

Jahangiri, F. (2012) *Surgical Neurophysiology,*Unknown.

Loftus, C., Biller, J, Baron, E. *Intraoperative neuromonitoring.* New York: McGraw-Hill Education, 2014.

Jahangiri, Faisal. (2021) *Mapping of the Brain*, Columbia, SC: Global Innervation LLC.

Resources Other

a. www.aset.org
b. www.asnm.org
c. *American Journal of Electroneurodiagnostic Technology (AJET)* by the ASET; 4 issues annually; which reflects most recent changes and updates in the field.

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