

END-2451: NEONATAL/PEDIATRIC ELECTROENCEPHALOGRAPHY

Cuyahoga Community College

Viewing: END-2451 : Neonatal/Pediatric Electroencephalography

Board of Trustees:

March 2025

Academic Term:

Fall 2025

Subject Code

END - Electroneurodiagnostic

Course Number:

2451

Title:

Neonatal/Pediatric Electroencephalography

Catalog Description:

Discussion of neonatal and pediatric electroencephalography (EEG). Review the electrographic and clinical findings associated with neonatal and pediatric epilepsy syndromes and seizures. Discussion of longterm epilepsy monitoring, pediatric epilepsy surgery, and functional cortical mapping. Discussion of automatic seizure detection, artifact rejection, and trending software.

Credit Hour(s):

3

Lecture Hour(s):

3

Requisites

Prerequisite and Corequisite

END-1450 Intermediate Electroencephalography (EEG).

Outcomes

Course Outcome(s):

Apply knowledge of neonatal and pediatric (EEG) to perform monitoring in pediatric epilepsy monitoring units, routine, bedside, and intensive care unit (ICU) EEG testing of pediatric patients of various ages under supervision.

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):

1. Discuss and describe the American Clinical Neurophysiology Society (ACNS) Guideline 5: Minimum Technical Standards for Pediatric Electroencephalography.
2. Explain the activation procedures used in neonatal and pediatric EEG including the advantages and disadvantages of each.
3. Describe and discuss terminology related to pediatric and neonatal (EEG).
4. Describe and discuss the approach to visual analysis and interpretation of neonatal (EEG).
5. Describe and discuss the techniques of neonatal (EEG) recording.
6. Describe and discuss artifacts in the neonatal intensive care unit.
7. Describe and discuss elements of the normal neonatal (EEG).
8. Describe and discuss patterns of uncertain diagnostic significance relative to the neonatal (EEG).
9. Discuss abnormal EEG patterns through a classification of abnormalities, which will be related to all age groups.
10. Describe and discuss the (EEG) findings and clinical features of the different seizure types throughout neonatal, infant and adolescent period of life.
11. Describe and discuss imitators of epileptic seizures and their clinical correlations.
12. Describe and discuss the American Clinical Neurophysiology Society (ACNS) Guideline on Continuous Electroencephalography Monitoring in Neonates.

13. Perform head measurement for placement of electrodes according to the International 10-20 electrode placement and the modified 10-20 system of electrode place for neonatal electroencephalography recordings.
14. Demonstrate the different techniques of applying electrodes using collodion, paste, and electrode caps in the neonates and pediatric patients.
15. Describe and discuss how waveforms displays are affected by variations in instrumentation in the neonatal and pediatric patient.
16. Describe and discuss the definition of an epilepsy syndrome.
17. Define the descriptors of EEG activity: wave form, repetition, frequency, amplitude, distribution, phase, timing, persistence, and reactivity.
18. Describe and discuss pediatric epilepsy surgery, electrocorticography, and functional cortical mapping.
19. Describe and discuss the utility and functionality of automated seizure detection and trending.
20. Describe and discuss the American Clinical Neurophysiology Society standardized EEG terminology and categorization for the description of Continuous EEG Monitoring in Neonates.
21. Describe and discuss the 2017 International League Against Epilepsy (ILAE) Classification of Seizures, and compare and contrast it to the 1981 ILAE Classification scheme.
22. Describe and discuss the ILAE Classification of the Epilepsies: Position paper of the ILAE Commission for Classification and Terminology. Identify the epilepsy syndromes of the neonatal, infancy, and adolescent period of life.
23. Describe and discuss the ACNS's Standardized Critical Care EEG Terminology.
24. Discuss and describe pediatric appropriate care by EEG technologists.
25. Identify normal awake and sleep rhythms in an EEG to relate criteria specific to the neonatal and pediatric age groups.
26. Describe and discuss the effects of pain in the human neonate.

Methods of Evaluation:

1. Quizzes
2. Assignments
 - a. Analysis of pediatric EEG
 - b. Analysis of neonatal EEG
3. Participation
4. Final exam, including pediatric/neonatal EEG analysis

Course Content Outline:

1. The Normal Pediatric EEG
 - a. Terminology
 - i. Conceptional age (CA)
 - ii. Gestational age (GA)
 - iii. Pre-term
 - iv. Term
 - v. Infants
 - vi. Childhood
 - vii. Adolescence/adult
 - viii. Posterior-dominant rhythm (PDR) ranges for different ages
 - ix. Overall sleep stage breakdown
 1. N1, N2, N3, REM
 - x. Apgar scores
 - b. The Normal EEG
 - i. Infancy: 1 month to 1 year
 1. Awake/drowsy:
 - a. Hyperventilation (HV) and Photic
 2. Sleep (chart for sleep architecture vs ages):
 - ii. Toddler/early childhood: 1-3yrs
 1. Awake/drowsy
 2. Sleep
 - iii. 6-12 yrs
 1. Awake/drowsy
 2. Sleep
 - iv. Artifacts: common pediatric and neonatal artifact
 - v. Normal variants:
 1. Sleep stage identifiers: spindles, v waves, K-Complexes, REM
 2. Mu rhythm
 3. Lambda

4. Posterior slow waves of youth (PSWY)
5. Posterior slow wave transients with eye movements
6. Occipital slow transients
7. Slow/fast alpha variants
8. Wicket spikes
9. Mitten pattern
10. Hypnagogic hypersynchrony
11. Rhythmic midtemporal theta burst of drowsiness (RMTD)
12. 13/6hz positive spikes
13. Small sharp spikes (SSS) or benign epileptiform transients of sleep (BETS)
14. Phantom spike wave bursts
- vi. Activation procedures for pediatric patients overview
 1. HV responses: buildup. H-response
 2. Photoc stimulation responses:
 - a. Photoconvulsive response
 - b. H-Response
 3. sleep deprivation and sleep-activated epileptiform discharges
- vii. ACNS guidelines: "Minimum Technical Standards for Pediatric EEG"
2. Neonatal EEG
 - a. Introduction
 - b. Terminology
 - c. Approach to visual analysis and interpretation
 - i. CA
 - ii. Evidence of focal brain dysfunction
 - iii. Evidence of diffuse brain dysfunction
 - iv. Prognosis
 - d. Techniques of recording
 - i. Personnel
 - ii. Infant preparation
 - iii. Nursery environment
 - iv. Electrode placement
 - v. Polygraphic parameters
 - vi. Montage selection
 - vii. Recording protocols
 - e. Artifacts relative to the neonatal intensive care unit (NICU)
 - i. Environment
 - ii. Recording instrumentation
 - iii. Noncerebral physiologic potentials
 1. Alterations in electrical properties of scalp or skull
 2. Vital signs
 3. Movements
 - f. Elements of the normal neonatal EEG
 - i. Continuum of development
 1. Continuity
 2. Bilateral synchrony
 - ii. EEG developmental landmarks
 1. Neonatal cheatsheets
 2. Trace discontinu
 3. Delta brushes, beta-delta complexes
 4. Monorhythmic occipital delta activity
 5. Temporal theta and alpha bursts
 6. Trace alternant
 7. Frontal sharp waves (encoches frontales)
 8. Distinguishing between the waking and sleep EEG
 9. Reactivity to Stimulation
 10. Additional special waveforms and patterns
 - a. Bifrontal delta activity
 - b. Temporal sharp waves
 - iii. Summary of CA dependent findings

1. 24-26 weeks CA
2. 27-28 Weeks CA
3. 29-30 weeks CA
4. 31-32 weeks CA
5. 33-34 weeks CA
6. 35-36 weeks CA
7. 37-38 weeks CA

3. Epileptic seizures and their classification and imitators of epileptic seizure
 - a. Epileptic seizures and their classification from epileptic syndromes and their treatment
 - i. Definitions:
 1. Epilepsy
 2. Epileptic seizures
 3. Ictal vs interictal
 4. Pharmacoresistant epilepsy stats
 5. Seizure
 6. Refractory/intractable
 7. Idiopathic vs cryptogenic vs symptomatic
 8. Paroxysmal
 9. Encephalopathy
 10. Epileptiform
 11. Epileptic or epileptiform encephalopathy
 12. Aura
 - ii. Classifications of epileptic seizures
 - iii. Seizure classification in the new ILAE Task Force reports
 - iv. Generalized seizures
 - v. Generalized tonic clonic seizures
 - vi. Generalized clonic seizures
 - vii. Generalized tonic seizures
 - viii. Epileptic spasms
 - ix. Myoclonus
 - x. Atonic seizures
 - xi. Typical absence seizures
 - xii. Atypical absence seizures
 - xiii. Focal epileptic seizures
 - xiv. Reflex epileptic seizures
 - b. Status Epilepticus (SE)
 - i. Generalized SE
 - ii. Focal SE
 - iii. Treatment of SE
 - c. Imitators of epileptic seizures
 - i. Syncopal attacks imitating seizures
 1. Neurally mediated syncope
 2. Cardiogenic syncope
 3. Syncopal attacks provoking epileptic seizures
 - ii. Psychogenic non-epileptic paroxysmal events (NEPEs) imitating epileptic seizures
 1. Convulsive psychogenic status epilepticus
 2. Non-epileptic paroxysmal movement disorders imitating epileptic seizures
 3. Non epileptic severe amnesic and confusional attacks imitating epileptic seizures
 4. NEPEs occurring during sleep and sleep disorders
 5. Migraine, migralepsy, basilar migraine with EEG occipital paroxysms, and diagnostic errors
 6. Cerebrovascular NEPEs imitating epileptic seizures
 7. Cerebrovascular NEPEs imitating epileptic seizures
 - d. Seizure first aid
 - i. Imitators of epileptic seizures
 - ii. Seizures: Annotating and Reporting
 - iii. Basic seizure first aid
 - iv. The seizure interview
 1. Outcomes

- e. Articles
 - i. ILAE Classification of the Epilepsies: Position paper of the ILAE Commission for Classification and Terminology
 - ii. 2017 International League Against Epilepsy (ILAE) Classification of Seizures
- 4. Neonatal epileptic, seizures and syndromes
 - a. Introduction
 - b. Neonatal seizures
 - c. Neonatal epilepsy syndromes
 - d. Main causes of neonatal syndromes
 - e. Epileptic encephalopathies in the neonatal period
 - f. Early myoclonic encephalopathy
 - i. Introduction
 - ii. Clinical manifestations
 - iii. EEG findings
 - iv. Prognosis
 - g. Ohtahara syndrome
 - i. Introduction
 - ii. Clinical manifestations
 - iii. EEG findings
 - iv. Prognosis
 - h. Idiopathic epileptic seizures and syndromes in infancy
 - i. Febrile seizures
 - i. Introduction
 - ii. Simple
 - iii. Complex
 - iv. EEG
 - v. Clinical Manifestations: Seizures
 - vi. Prognosis
 - j. Epilepsy with febrile seizures plus
 - k. Benign infantile seizures
 - l. Myoclonic epilepsy in infancy
 - m. Epileptic encephalopathies in infancy and early childhood
 - n. West syndrome
 - i. Introduction
 - ii. Clinical manifestations
 - iii. EEG findings
 - iv. Prognosis
 - o. Dravet syndrome
 - i. Introduction
 - ii. Clinical manifestations
 - iii. EEG findings
 - iv. Prognosis
 - p. Lennox-Gaustaut syndrome
 - i. Introduction
 - ii. Clinical manifestations
 - iii. EEG findings
 - iv. Prognosis
 - q. Landau-Kleffner syndrome
 - i. Introduction
 - ii. Clinical manifestations
 - iii. EEG findings
 - iv. Prognosis
 - r. Epilepsy with continuous spikes and waves during slow-wave sleep
 - i. Introduction
 - ii. Clinical manifestations
 - iii. EEG findings
 - iv. Prognosis
- 5. Childhood seizures, epilepsy, syndromes

- a. Idiopathic epileptic seizures and syndromes in childhood
 - i. Febrile seizures
 - 1. Introduction
 - 2. Simple
 - 3. Complex
 - 4. EEG
 - 5. Clinical manifestations: seizures
 - 6. Prognosis
- b. Severe neocortical epileptic syndromes in infancy and childhood
 - i. Rasmussen syndrome
 - 1. Introduction
 - 2. Clinical manifestations
 - 3. EET
 - 4. Prognosis
- c. Benign childhood focal seizures and related epileptic syndromes
 - i. Introduction
 - ii. Benign childhood epilepsy with centrotemporal spikes
 - 1. Introduction
 - 2. Clinical manifestations
 - 3. EEG
 - 4. Prognosis
 - iii. Panayiotopoulos syndrome
 - 1. Introduction
 - 2. Clinical manifestations
 - 3. EEG
 - 4. Prognosis
- d. Idiopathic generalized epilepsies
 - i. Introduction
 - ii. Epilepsy with Myoclonic-Astatic seizures (Doose syndrome)
 - 1. Introduction
 - 2. Clinical manifestation
 - 3. EEG
 - 4. Prognosis
 - iii. Childhood absence epilepsy
 - 1. Introduction
 - 2. Clinical manifestations
 - 3. EEG
 - 4. Prognosis
 - iv. Juvenile myoclonic epilepsy (JME)
 - 1. Introduction
 - 2. Clinical manifestations
 - 3. EEG
 - 4. Prognosis
- e. Familial (autosomal dominant) focal epilepsies
 - i. Introduction
 - ii. Autosomal dominant nocturnal frontal lobe epilepsy
 - 1. Introduction
 - 2. Clinical manifestations
 - 3. EEG
 - 4. Prognosis
- f. Symptomatic and cryptogenic focal epilepsies
 - i. Introduction
 - ii. Mesial temporal lobe epilepsy with hippocampal sclerosis (MTLE-HS)
 - iii.
 - 1. Introduction
 - 2. Clinical manifestations
 - 3. EEG
 - 4. Prognosis
 - iv. Frontal lobe epilepsies

1. Introduction
2. Clinical manifestations
3. EEG
4. Prognosis
- g. Reflex seizures and reflex epilepsies
 - i. Jeavons syndrome
 1. Introduction
 2. Clinical manifestations
 3. EEG
 4. Prognosis
 - ii. Startle seizures
 1. Introduction
 2. Clinical manifestations
 3. EEG
 4. Prognosis
6. Pediatric epilepsy surgery, electrocorticography, functional cortical mapping.
 - a. History of epilepsy surgery
 - b. Epilepsy treatment: response rates to antiepileptic drug (AED) therapy
 - c. General principles of the presurgical evaluation.
 - d. Seizure freedom rates from different types of epilepsy surgery
 - e. Phase 1 and Phase 2 epilepsy surgery workup
 - f. Electrocorticography
 - i. Introduction
 - ii. The controversial role of intraoperative electrocorticography (ECoG) in epilepsy
 - iii. Indications
 - iv. Methodology
 - v. Interpretation
 - g. Functional cortical mapping
 - i. Introduction
 - ii. Surgical preparation
 - iii. Sensorimotor mapping
 - iv. Language mapping
 - v. Cortical mapping threshold variability
 - vi. ECoG during functional mapping
 - vii. Anesthesia considerations
 - viii. Functional magnetic resonance imaging (MRI)
 - ix. Positron emission tomography (PET)
 - x. Single-photon emission computed tomography (SPECT): interictal and ictal

Resources

Chee, MW.L. *WaveGuide, an EEG Atlas- On CD-ROM*. Lippincott-Raven, 1998.

Cooper, R., Osselton, J. W., Shaw, J.C. *EEG Technology*. 3rd ed. Boston: Butterworth, 1980.

Ebersole, John, Aatif M. Husain, and Douglas R. Nordi Jr. . *Current Practices of Clinical Electroencephalography*. 5th ed. Philadelphia, PA: Wolters Kluwer Health, 2023.

Jasper, H. *Report of the Committee on Methods of Clinical Exam in EEG*. *Electroencephalography Clinical Neurophysiology* 10:370-375, 1958.

Journal of Clinical Neurophysiology vol. 3, Supplement 1. *American Electroencephalographic Society Guidelines in EEG and Evoked Potentials*. Raven Press, 1986.

Spehlmann, R. *EEG Primer*. New York: Elsevier Biomedical Press, 1985.

Tyner, F. S., Knott, J. R., Mayer, W. B. *Fundamentals of EEG Technology, Clinical Correlates*. Raven Press, 1989.

Fenichel, Gerald. *Clinical Pediatric Neurology: A Signs and Symptoms Approach*. 6th ed. Saunders/Elsevier, 2009.

Sheldon, Spire, Levy. *Pediatric Sleep Medicine*. W. B. Saunders Company, 1993.

Stockard-Pope, Werner, Bickford. *Atlas of Neonatal Electroencephalography*. 2nd ed. New York, 1992.

"Neonatal EEG"

"Pediatric EEG"

Yamada, Thoru, MD and Elizabeth Meng BA R. EEG/EP T. *Practical Guide for Clinical Neurophysiologic Testing*. 2nd Edition. 2018.

Tsuchida, Tammy N., et al. "American Clinical Neurophysiology Society Standardized EEG Terminology and Categorization for the Description of Continuous EEG Monitoring in Neonates: Report of the American Clinical Neurophysiology Society Critical Care Monitoring Committee." *Journal of Clinical Neurophysiology*#: Official Publication of the American Electroencephalographic Society. vol. 30, no. 2, Apr. 2013, pp. 161–73. EBSCOhost, <https://doi.org/10.1097/WNP.0b013e3182872b24>.

Shellhaas, Renée A., et al. "The American Clinical Neurophysiology Society's Guideline on Continuous Electroencephalography Monitoring in Neonates." *Journal of Clinical Neurophysiology*#: Official Publication of the American Electroencephalographic Society. vol. 28, no. 6, Dec. 2011, pp. 611–17. EBSCOhost, <https://doi.org/10.1097/WNP.0b013e31823e96d7>.

Jordan, James W. "Semiology: Witness to a Seizure – What to Note and How to Report." *American Journal of Electroneurodiagnostic Technology*. vol. 47, no. 4, Dec. 2007, pp. 264–82. EBSCOhost, <https://doi.org/10.1111/epi.13671>.

Fisher, Robert S., et al. "Instruction Manual for the ILAE 2017 Operational Classification of Seizure Types". *Epilepsia*, vol. 58, no. 4, Apr. 2017, pp. 531–42. EBSCOhost, <https://doi.org/10.1111/epi.13671>.

Resources Other

1. *The Neurodiagnostic Journal* by the ASET; 4 issues annually; which reflects most recent changes and updates in the field. 2024. <https://www.aset.org/the-neurodiagnostic-journal/>
2. Tsuchida, T. N., Wusthoff, C. J., Shellhaas, R. A., Abend, N. S., Hahn, C. D., Sullivan, J. E., Nguyen, S., Weinstein, S., Scher, M. S., Riviello, J. J., & Clancy, R. R. (2013). American clinical neurophysiology society standardized EEG terminology and categorization for the description of continuous EEG monitoring in neonates. *Journal of American Clinical Neurophysiology Society*, 30(2), 161–173. <https://doi.org/10.1097/wnp.0b013e3182872b24>
3. Shellhaas, R. A., Chang, T., Tsuchida, T., Scher, M. S., Riviello, J. J., Abend, N. S., Nguyen, S., Wusthoff, C. J., & Clancy, R. R. (2011). The American Clinical Neurophysiology Society's guideline on Continuous Electroencephalography monitoring in neonates. *Journal of American Clinical Neurophysiology Society*, 28(6), 611–617. <https://doi.org/10.1097/wnp.0b013e31823e96d7>

4. Jordan J. W. (2007). Semiology: witness to a seizure—what to note and how to report. *American journal of electroneurodiagnostic technology*, 47(4), 264–282.
5. Fisher RS, Cross JH, D'Souza C, et al. Instruction manual for the ILAE 2017 operational classification of seizure types. *Epilepsia*. 2017;58(4):531-542. doi:10.1111/epi.13671

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