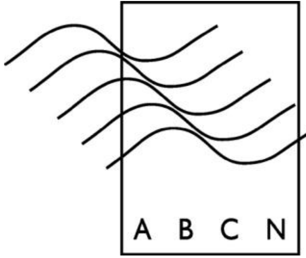

AMERICAN BOARD OF CLINICAL NEUROPHYSIOLOGY, INC.

Candidate Handbook

ABCN Executive Office
2509 W. Iles Ave., Suite 102
Springfield, IL 62704
Phone 217-726-7980
Fax 217-726-7989
abcn@att.net

www.abcn.org

TABLE OF CONTENTS

General information	3
Training Requirements	3
Application Procedures	3
Examination	
Part I	4
Content Outline	5
Reference List	7
Part II Tracks	9
Epilepsy Monitoring Track	10
Neurophysiologic Intraoperative Monitoring	12
Generalist Track	14
Length of Eligibility	16
Recertification	16

GENERAL INFORMATION

The American Board of Clinical Neurophysiology, Inc. (formerly The American Board of Qualification in Electroencephalography, Inc.) was founded in 1946 by Herbert Jasper, M.D. It is the oldest free standing Board for Medical Certification.

The purpose of the Board is to establish and improve standards of knowledge and proficiency in the professional practice of clinical neurophysiology. This is accomplished by examinations in the field of Clinical Neurophysiology of the Central Nervous System including Electroencephalography (EEG), Evoked Potentials (EP) and Polysomnography (PSG). The Board issues a certificate to eligible candidates who have satisfactorily completed both Parts I and II of the examination. The Board may grant one or more specialty or subspecialty designations upon successful completion of the examination process; General Clinical Neurophysiology, Epilepsy Monitoring, or Intraoperative Monitoring.

TRAINING REQUIREMENTS

An applicant who wishes to be examined by the Board must be a physician who has successfully completed residency training in Neurology, Neurosurgery or Psychiatry, preferably in an ACGME or RCPSC training program and is Board certified in one of those specialties. International candidates who are not in recognized U.S. training programs may make an application to ABCN and will be reviewed on a case by case basis. ABCN certificates of recognition will be issued to successful candidates. Successful candidates will not be awarded Diplomate status until evidence is presented of primary board certification.

In addition to the above, an applicant must have had a minimum of twelve months of training and supervised experience in clinical neurophysiology. At least six months of this training must have been in full-time clinical neurophysiology or its part-time equivalent following completion of residency. If not part of a fellowship program, training must be documented and include substantial and regularly supervised experience by an acknowledged Neurophysiologist, and other indications of continuing education in EEG and clinical neurophysiology, as indicated below.

The Board expects that training in EEG and clinical neurophysiology will include broad exposure to the scientific basis of clinical neurophysiology as well as relevant aspects of technique and instrumentation. Additional knowledge of sleep, intraoperative monitoring, EEG telemetry, and evoked potentials is required depending on the track chosen. All candidates are expected to have extensive experience interpreting EEGs, in all age groups and in a wide range of clinical disorders.

APPLICATION PROCEDURE

Official application forms may be obtained from the Executive Director and on line at the American Board of Clinical Neurophysiology Website www.abcn.org. The application process is complete only when the application fee, the application form and the required supporting documents from the candidate's training directors have been received by the Executive Office. Candidates who have trained in more than one location must have documentation from each program director. Because the Board asks the individual responsible for training to certify that the applicant has satisfactorily completed the program and is capable of independent record interpretation, endorsement should not be requested until near the end of training.

It is the responsibility of the applicant to obtain the necessary supporting documentation from sponsors using the forms provided with the application materials. Sponsors should send completed forms directly to the Executive Office. The Executive Director will notify the candidate when the application is complete. Application must be completed no later than two months preceding the date of the written examination.

Approval of the applicant for examination is determined on an individual basis by the Board upon review of the information submitted. Once an individual's application is approved by the Board, the applicant is considered an eligible candidate and must take the examination within 3 years after notification of eligibility.

Special testing arrangements may be made for special needs individuals submitting an application, examination fee, and a letter describing the nature of the disability and the special accommodations needed for testing. Requests for special testing for special needs must be received at least EIGHT weeks before both the written and oral examinations.

THE EXAMINATION

The rationale for the examination is to test the knowledge of the candidate in clinical neurophysiology of the central nervous system, as it relates to disorders of the nervous system and to the field of general medicine. In addition, the Board will expect the candidate to demonstrate knowledge of the basic neurological sciences pertinent to an understanding of clinical neurophysiology and disorders of the nervous system.

THE BOARD

The Board consists of practicing physicians with expertise in central clinical neurophysiology and intraoperative monitoring.

AMERICAN BOARD OF CLINICAL NEUROPHYSIOLOGY

PART I EXAMINATION INFOMATION

The three-hour examination will be administered during an established two-week testing period at LaserGrade/PSI Computer Testing, Inc. The examination consists of 120 objective, multiple-choice questions. Admission to the examination requires submission of the application and application fee. Once accepted, the examination fee of $450 is due to ABCN.

LaserGrade/PSI has several hundred computer-based testing sites in the United States. Scheduling is done on a first-come, first-service basis. To find a testing center near you visit: www.lasergrade.com. Please note that hours and days of availability vary at different centers. You will not be able to schedule your examination appointment until you have received an Eligibility Notice from PTC.

If you do not receive an Eligibility Notice or other correspondence at least three weeks before the beginning of the two-week testing period, contact the Professional Testing Corporation by telephone at 212-356-0660.

If you need to cancel your examination appointment or reschedule to a different date within the testing period you must contact LaserGrade at 800-211-2754 no later than noon, Easter Standard Time of the second business day PRIOR to your scheduled appointment. There are no refunds for this examination. If you fail to arrive for your appointment or cancel without giving the required notice, you will forfeit your testing fee.

A candidate who fails the Part I examination may repeat the test within two years without filing a new application by advising the Executive Director and submitting a second examination fee no later than six weeks before the examination. If the candidate does not pass the examination within five years, a new

application, application fee, and examination fee must be filed with the Board. Eligibility requirements will be those in place at the time of the new application.

Part I Content Outline

I. Physiology and Instrumentation

- A. Physiology
  1. Anatomy of neural generation
  2. Mechanisms of EEG and evoked potential generation
  3. Pathophysiology of abnormal waveforms
  4. Basic mechanisms of epileptogenesis
- B. Instrumentation and Acquisition Procedures
  1. Basic electricity and electronics
  2. Amplifiers and their characteristics
  3. Calibration
  4. Filters
  5. Localization and polarity
  6. Artifacts
  7. Electrical safety
  8. Computers and principles of averaging
  9. Electrodes and their application
  10. Techniques of ECS determination
  11. Statistics
  12. Long term monitoring
  13. Instrumentation and safety in the operating room
  14. Principles of EEG digitalization

II. Clinical EEG

- A. Basic EEG Patterns From Prematurity to Senescence
  1. Maturational changes
     - a. Neonatal
     - b. Other age related changes
  2. Normal adult patterns-wake
  3. Normal variants
  4. Activation procedures
- B. Clinical Correlation
  1. Seizures
  2. Other paroxysmal and transient conditions
  3. Focal lesions
  4. Diffuse and multifocal encephalopathies
  5. Coma
  6. Brain death
  7. Drug and other treatment effects
  8. Patterns of uncertain significance
  9. Disorders affecting sleep patterns
  10. Periodic patterns
  11. Neonatal disorders
  12. Extended monitoring

C. Sleep
   1. Physiology
   2. Instrumentation
   3. Clinical

III. Clinical Evoked Potentials

A. Visual
   1. Stimulus and recording techniques
   2. Physiological parameters
   3. Standard parameters of stimulation and recording
   4. Criteria of abnormality
   5. Clinical correlation

B. Auditory
   1. Stimulus and recording techniques
   2. Physiological parameters
   3. Standard parameters of stimulation and recording
   4. Criteria of abnormality
   5. Clinical correlation

C. Somatosensory
   1. Stimulus and recording
   2. Physiological parameters
   3. Standard parameters of stimulation and recording
   4. Criteria of abnormality
   5. Clinical correlation

D. Event related
   1. Stimulus and recording techniques
   2. Physiological parameters
   3. Standard parameters of stimulation and recording
   4. Criteria of abnormality
   5. Clinical correlation

IV. Sleep

A. Technical, polysomnography
   1. Selection of appropriate recorded variables
      a. Neonates and children
      b. Adults
   2. Recording parameters for different variables
   3. Recording respiration
   4. Artifacts

B. Physiology
   1. Sleep stage criteria
      a. Neonates and children
      b. Adults
   2. Patterns of drowsiness and sleep
      a. Neonates
      b. Children, adults, elderly
   3. Sleep indices criteria
   4. Normal sleep architecture
   5. Normal EEG patterns of drowsiness in children, adults and elderly

6. Circadian rhythms and sleep
7. Neural and neurochemical control of sleep patterns
8. Effects of sleep deprivation, sleep needs

C. Clinical aspects
1. Effect on epileptiform activity and seizures
   a. Neonates and children
   b. Adults
2. Common parasomnias
3. Effects of drugs on sleep architecture
4. Criteria of abnormal sleep architecture
5. Disorders of excessive somnolence
   a. Polysomnographic testing in diagnosis
   b. Multiple sleep latency testing in diagnosis
6. Disorders of initiation and maintenance of sleep
7. Abnormalities of sleep in CNS disease
8. Indications for sleep monitoring

V. Intraoperative Monitoring

A. SEP monitoring for spinal cord, brainstem and cerebral surgery
B. BAEP monitoring techniques for eighth nerve and brainstem surgery
C. EEG monitoring for cerebral surgery
D. Motor evoked potential monitoring for spinal cord surgery
E. Cranial nerve monitoring
F. Criteria for decision making
G. Influence of anesthetic agents

VI. Epilepsy

A. Applications and limitations of ambulatory EEG monitoring
B. Applications and limitations of video/EEG monitoring
C. Recognition of ictal patterns
D. Correlation of EEG patterns with clinical syndromes
E. Intracranial recording

REFERENCES

The latest editions of the following references may be of some help in preparing for the ABCN examination. This list does not attempt to include all acceptable references, nor is it suggested that the exam is necessarily based on these references.

Abou-Khalil, B., Misulis, K.E., Atlas of EEG and Seizure Semiology. Butterworth-Heinemann, 2005.

American Clinical Neurophysiology Society Guidelines www.acns.org.

Aminoff, M.J. (ed.) Electrodiagnosis in Clinical Neurology, 5th ed. Churchill Livingstone, 2005.

Bloome, WT., Kalibara., M., Young.,GB. Atlas of Adult Electroencephalography, 2nd Edition. Lippincott, Williams & Wilkins, 2002.

Brenner, R.P. EEG on DVD – Adult: An Interactive Reading Session. Demos, 2007.

Butkov, N, Lee-Chiong, T. (eds) Fundamentals of Sleep Technology. Kluwer/Lippincott Williams & Wilkins, 2007.

Chiappa K. Evoked Potentials in Clinical Medicine, 3rd ed. Raven Press. 1997.

Chokroverty S. (ed) Sleep Disorders Medicine: Basic Science, Technical Considerations and Clinical Aspects, 3rd Edition. 2005.

Ebersole, J.S. and Pedley, T.A. (eds.) Current Practice of Clinical Electroencephalography, 3rd Edition. Lippincott Williams & Wilkins. 2003.

Fisch, B.J. Fisch & Spehlmann's EEG Primer: Basic Principles of Digital and Analog EEG, 3rd Revised and Enlarged Edition. Elsevier. 1999.

Geyer, J.D., Payne, T., Carney, P.R., Aldrich, M. Atlas of Digital Polysomnography. Lippincott, Williams & Wilkins. 2000.

Goldensohn E.S. (ed) et al Goldensohn's EEG Interpretation: Problems of Overreading and Underreading, 2nd Edition. Futura. 1999.

Husain, A. (ed). A Practical Approach to Neurophysiologic Intraoperative Monitoring. Demos: New York, 2008.

Iber, C., Ancoli-Israel S., Chesson, A.L., Jr, Quan, S.F. for the American Academy of Sleep Medicine. The AASM Manual for the Scoring of Sleep and Associated Events. AASM. 2007.

Kartush, J.M. and Bouchard, K. R. Neuromonitoring in Otology and Head and Neck Surgery. Raven Press. 1992.

Krass, G.L. and Fisher. R.S. The Johns Hopkins Atlas of Digital EEG: An Interactive Guide. Johns Hopkins Press, 2007.

Kryger., M.H., Roth.T., Dement, W. Principles and Practice of Sleep Medicine, 4thEdition. W. B. Saunders. 2005.

Misulis, K.E., Essentials of Clinical Neurophysiology, 2nd Edition. Butterworth-Heinemann. 1997.

Mizrahi, E.M., Hrachovy, R.A., Kellaway, P. Atlas of Neonatal Electronencephalography, 5th ed. Urban and Schwarzenberg, 2004.

Moller, A. Intraoperative Neurophysiologic Monitoring. Harwood Academic Publishers. 2005.

Nuwer, M.R. (Ed.) Intraoperative Monitoring of Neural Function: Handbook of Clinical Neurophysiology. Elsiver, 2008.

Neidermeyer, E., Da Silva, Fernando. Electroencephalography: Basic Principles, Clinical Applications and Related Fields, 5th edition. Lippincott, Williams & Wilkins. 2005.

Noachtar, S., Wyllie, E. Electroencephalographic Atlas of Epileptiform Abnormalities in the Treatment of Epilepsy: Practice & Principles. 4th Edition., 2006: 183-214.

Pressman, M.R. Primer of Polysomnogram Interpretation. Butterworth-Heinemann. 2002.

Rosenow, F., Luders, O.H. (eds.) Presurgical Assessment of the Epilepsies with Clinical Neurophysiology and Functional Imaging Handbook of Clinical Neurophysiology, Volum 3, Elsevier, 2004.

Russell, G.B., Rodichok. L.D. (eds.) Primer of Intraoperative Neurophysiologic Monitoring. Butterworth-Heinemann, 2005.

Stern, JM.,, Engel, J. Jr. Atlas of EEG Patterns. Lippincott, Williams & Wilkins, 2004

Tatum, W.O., Husain, A.M. Benbadis, S.R., Kaplan, P.W., Handbook of EEG Interpretation. Demos, 2007.

Wyllie, E., Gupta, A., Lachhwani, D.K. (eds.) The Treatment of Epilepsy: Principles and Practice, 4th Ed. Lippincott, Williams & Wilkins, 2006.

Yamada, T., Meng, E. Practical Guide for Clinical Neurophysiologic Testing, Lippincott, Williams & Wilkins, 2009.

Zouridakis, G. & Panpanicolaou, A. A Concise Guide to Intraoperative Monitoring. Lewis, 2000.

AMERICAN BOARD OF CLINICAL NEUROPHYSIOLOGY

PART II EXAMINATION

The Part II three-hour examination will be administered during an established two-week testing period at LaserGrade/PSI Computer Testing, Inc.

The examination consists of approximately 100 objective, multiple-choice questions. Candidates will have three hours to complete the track selected. Acceptance to the examination requires submission of a Part II application and $450 exam fee per track.

The candidate must select at least one of three tracks for the completion of Part II. These three tracks include Epilepsy Monitoring, Neruophysiologic Intraoperative Monitoring and General Clinical Neurophysiol

Track II
Epilepsy Monitoring
Content Outline

The Epilepsy Monitoring Track will contain more case-based items and will incorporate video segments.

A. Correlation of interictal EEG with seizure type **10%**
   1. Partial onset
   2. Secondarily generalized
   3. Primary generalized
      a. Convulsive
      b. Nonconvulsive

B. Identification of various patterns of ictal onset, propagation, and resolution along with their localizing significance in scalp recordings **25%**
   1. Focal onset seizure
   2. Generalized convulsive seizure
   3. Generalized nonconvulsive seizure
   4. Syndromes
      a. Hypsarrhythmia – electrodecremental seizures
      b Lennox Gastaut syndrome
      c. Electrical SE during slow sleep
      d. Landau-Kleffner syndrome
   5. Recognition of non-ictal events & patterns
      a. Artifacts
      b. Nonepileptic paroxysmal patterns
   6. Technical aspects
      a. Appropriate recording montages
      b. Activation techniques
      c. Other approaches that may assist in event interpretation

C. Recognition of clinical manifestations of various seizure types, and their appropriate classification **20%**
   1. Simple partial
   2. Complex partial
      a. Automatisms
      b. Lateralizing signs
      c. Localizing signs
   3. Secondarily generalized
      a. Lateralizing signs
      b. Localizing signs
   4. Primary generalized
      a. Convulsive
      b. Absence
   5. Myoclonic
   6. Atonic

D. Identification and localization of neonatal seizures **6%**
   1. Interictal EEG patterns
   2. Ictal EEG patterns
      a. Focal
      b. Multifocal
   3. Clinical manifestations

E. Recognition of behavioral features suggestive of non-epileptic events **15%**
   1. Psychogenic

2. Arrhythmia
3. Parasomnia
4. Other

F. Planning and Interpretation of Intracranial Monitoring **12%**

1. Indications for intracranial monitoring
2. Choice of intracranial electrodes
   a. Subdural strips
   b. Grids
   c. Depth electrodes
3. Interictal epileptiform activity
4. Ictal activity
   a. Identification of seizure onset
   b. Localization

G. Evaluation of patients for epilepsy surgery **12%**

1. EEG findings leading to
   a. Temporal lobectomy
   b. Corpus callosotomy
   c. Multiple subpial transection
2. EEG and the intracarotid amobarbital test (Wada)
3. Intraoperative electrocorticography
   a. Uses
   b. Limitations

Track II
Neurophysiologic Intraoperative Monitoring
Content Outline

The NIOM Track will contain more complex multiple-choice questions focused on all aspects of Neurophysiologic Monitoring. Candidates will have three hours to complete 120 items.

A. Basic NIOM techniques **25%**

1. SEP
2. MEP
3. BAEP
4. EEG
5. ECoG
6. EMG/NCS
7. VEP
8. Others

B. Anatomy and physiology **15%**

1. Cerebral cortex
2. Subcortical structures
3. Brainstem and cerebellum
4. Ascending and descending pathways
5. Cranial nerves
6. Spinal cord
7. Peripheral nerves, neuromuscular junction, muscles
8. Vascular anatomy
9. Head and neck
10. Spine and other bones
11. Cellular physiology
12. Others

C. Surgical procedures and NIOM (to include surgical technique and NIOM questions) **25%**

1. Vertebral column surgery
2. Spinal cord surgery
3. Lumbosacral surgery
4. Tethered cord surgery
5. Peripheral nerve surgery
6. CPA surgery
7. Vascular surgery
8. Cardiac and aortic surgery
9. Epilepsy surgery
10. Brain tumor surgery
11. Posterior fossa decompression surgery
12. Selective dorsal rhizotomy
13. Pain surgery
14. Movement disorders surgery
15. Cranial nerve surgery
16. Pelvic floor surgery
17. Hip surgery
18. ENT surgery
19. Other surgery

D. Anesthetic considerations **15%**

1. SEP

2. MEP
3. BAEP
4. EEG
5. ECoG
6. EMG/NCS
7. VEP
8. Anesthesia not modality related
9. Others

E. Operating room procedures **5%**

1. Sterilization techniques
2. OR equipment
3. Anesthesia equipment
4. Aseptic techniques/sterile field
5. Imaging
6. Communication

F. Equipment/Networking issues **10%**

1. Electrodes
2. NIOM machines (incl. amplifiers, filters, averaging, electrical issues, etc)
3. Networking, remote access
4. Other/Ancillary equipment

G. Ethical and medicolegal issues **5%**

1. ACNS guidelines
2. AANEM guidelines
3. AAN guidelines
4. Medicare rules for interpretation
5. Real time review issues
6. Other

Track II
Generalist
Content Outline

The **Generalist Track** will include short segments of neurophysiologic studies (EEG, evoked potentials, etc.), with one or more multiple-choice questions for each sample. Additional multiple choice questions will cover technical aspects of recording and clinical correlation.

A. Electroencephalography **45%**
1. Physiology of normal and abnormal waveforms
2. Instrumentation and acquisition procedures (include quantitative EEG)
3. Normal patterns of various ages in wake, drowsy, and sleep states
4. Neonatal normal and abnormal patterns
5. Activating procedures (hyperventilation, photic stimulation)
6. Drug effects
7. Focal abnormalities
8. Diffuse abnormalities
9. Coma and brain death
10. Epileptiform abnormalities
11. Benign EEG variants and patterns of unknown significance
12. Artifacts

B. Epilepsy Monitoring **15%**
1. Correlate interictal EEG with seizure type / epilepsy syndrome
2. Localization and propagation of epileptogenic foci (children, adults)
3. Correlation of behavioral and electrographic changes
4. Identify and localize neonatal seizures
5. Nonepileptic events (physiologic and psychogenic)
6. Plan and interpret intracranial monitoring
7. Evaluate patients for epilepsy surgery

C. Evoked Potentials **15%**
1. Visual evoked potentials (pattern reversal)
2. Brain stem auditory evoked potentials
3. Short latency somatosensory evoked potentials
    a. Stimulus and recording techniques
    b. Criteria for identification of major waveform components
    c. Criteria for normal and abnormal evoked potentials for adults and children
    d. Presumed generator sources of major waveform components
    e. Clinical significance of various evoked potential abnormalities
    f. Technical and non-pathologic factors that influence evoked potentials and affect interpretation

D. Sleep **15%**
1. Recognition of sleep stages
2. Identification of examples showing the effects of age, physiological and environmental variables, and disease on sleep architecture
3. Interpretation of multiple sleep latency studies
4. Identification of polysomnographic findings in sleep-related disorders
5. Montages, special instrumentation and other technological aspects of sleep studies

E. Intraoperative Monitoring **10%**
1. SEP monitoring for spinal cord, brainstem and cerebral surgery
2. BAEP monitoring techniques for eighth nerve and brainstem surgery
3. EEG monitoring for cerebral surgery

4. Motor evoked potential monitoring for spinal cord surgery
5. Cranial nerve monitoring
6. Criteria for decision making

LENGTH OF ELIGIBILITY

It is expected that both Part I and Part II examinations must be satisfactorily completed within five years after notification of approval of the application. Failure to do so requires that a new application and fee be submitted. A candidate who fails either Part must be reexamined and complete the exam process within five years. Candidates are strongly advised to seek further education before re-examination. There is no limit to the number of times a candidate may attempt the examination within the five year period.

NOTIFICATION OF RESULTS

ABCN will release results only to the candidate. Notification is done by mail. Certificates are sent to successful candidates within two months of the examination. Names of new Diplomates and Certificates are announced on the ABCN website and shared with the American Society of Clinical Neurophysiology. Occasionally the ABCN database may be published. Contact information will not be included.

CERTIFICATION AND RECERTIFICATION

Candidates will be certified by the Board when they have passed both Part I and Part II examinations. Those successfully completing the Epilepsy Monitoring Track will be certified in Central Clinical Neurophysiology "with special competency in Epilepsy Monitoring". Those successfully completing the Intraoperative Monitoring Tack will be certified "with special competency in Intraoperative Monitoring". Those successfully completing the General Clinical Neurophysiology Track will be certified "in Central Clinical Neurophysiology". Certificates are time-limited and certificants and diplomates are subject to recertification by written examination at the end of ten years. Diplomate status is offered to successful candidates who have provided documentation of primary certification in Neurology by the American Board of Psychiatry and Neurology or the American Osteopathic Board of Neurology and Psychiatry.

Any certificate issued by the Board shall be subject to revocation any time the Board shall determine in its sole discretion that the diplomate to whom the certificate was issued either was not properly qualified to receive it or has since become disqualified because the medical license of the diplomate is withdrawn or suspended for cause. Individuals whose certificate has been revoked by the Board will be entitled to appeal the Board's action by submitting new evidence to the Board. Any such appeal process must be initiated in writing by the diplomate. If this is done, The Board will consider the new evidence and then take final action. Once this procedure is completed, the Board's decision will be final and not contestable. Upon reinstatement of the license, certification will be reinstated upon petition by the physician.

It is the responsibility of the diplomate to keep the Executive Office informed of changes in name and address and licensure status as soon as the change is made.

VERIFICATION OF CREDENTIALS

A database of ABCN Diplomates and Certificates is maintained in the ABCN Executive Office. Requests to verify credentials should be directed to the Office. Verbal and written verifications are provided upon request.

The American Board of Clinical Neurophysiology, Inc. does not discriminate on the basis of age, sex, race, religion, national origin, marital status, or handicapping condition.