

AANEM POSITION STATEMENT

The Role of the Intraoperative Monitoring Team

Key Words: electrodiagnostic medicine • evoked potential • intraoperative monitoring • technologist

Intraoperative monitoring (IOM) techniques assess the motor and sensory systems during neurosurgical, orthopedic, vascular and other surgeries that may place the nervous system at risk. IOM can assess central sensory and motor pathways, peripheral and central auditory pathways, cranial nerves, motor and sensory spinal nerves and roots, brachial plexus, and peripheral motor and sensory nerves. Physicians and technologists, who are under the immediate supervision of trained physicians, have performed IOM for many years. Increasingly, orthopedic surgeons, neurosurgeons, otolaryngologists, head and neck surgeons, and vascular surgeons are requesting IOM to minimize neurological complications. IOM is being used in many types of surgeries, including surgery related to the spine, hip, spinal cord, brainstem, acoustic neuroma and other posterior fossa structures, epilepsy, cerebrovascular disease, plexus, peripheral nerve, parotid, head, neck, and a number of other less common surgeries.

The methods used for IOM vary with the type of surgery and the structures at risk. Methods of IOM include sensory evoked potentials, somatosensory evoked potentials, motor evoked potentials, brainstem auditory evoked potentials, visual evoked potentials, peripheral nerve action potentials, compound muscle action potentials, facial nerve monitoring, spinal cord monitoring, and non-diagnostic monitoring of electrical activity of muscle utilizing surface, subcutaneous, or fine wires. The need for neurological monitoring must be determined by the surgeon based on the risk to the individual patient. Surgeons and anesthesiologists who use IOM to assist in preventing neurologic

complications understand that IOM reduces the incidence, but does not eliminate the possibility of a postoperative neurological deficit. It is important that surgeons and anesthesiologists have a fundamental background of the neurophysiology of evoked-potential monitoring. During the monitoring procedure they may need to help solve problems that can arise from the type and depth of anesthesia as well as identify artifacts that are introduced by the stimulating or recording electrodes. The American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM) developed *The Role of the IOM Team* to address questions regarding performance of this aspect of electrodiagnostic medicine. The document was derived from a number of sources, including directives generated by the American Electroencephalographic Society (now the American Clinical Neurophysiology Society) in 1994.¹ IOM is distinct from clinical diagnostic needle electromyography and nerve conduction studies. While the electrode placement for IOM can be performed by a technologist under the supervision of a trained physician, diagnostic needle electromyography should be performed personally by a qualified physician. Diagnostic nerve conduction studies can be performed by a certified technologist under the general supervision of a physician, by a non-certified technologist under direct physician supervision, or can be performed personally by the physician.

Monitoring Systems

1. Any evoked potential system assembled "in-house" must be inspected and deemed to be safe before being utilized in the operating room. Evoked potential systems should comply with recent standards: a 100 μ A limit on total chassis leakage and a 10 μ A limit for isolated patient connections.
2. Both commercial and custom-made evoked potential systems must be inspected biannually by a qualified electronics specialist.
3. The monitoring team must designate a member of the team to be responsible for

performing necessary maintenance of the machine and ensuring the equipment is functioning properly.

Monitoring Techniques

1. Before any electrophysiological monitoring technique is offered to the surgical staff as a diagnostic tool, it is advisable that the recording be reliably reproduced in the operating room environment when findings are not critical to patient care. This allows the monitoring team to develop confidence in the technique's ability to reliably record electrophysiological waveforms continuously and its ability to interpret electrophysiologic changes induced by systemic factors. Recording should be repeated several times until the evoked-potential team becomes confident in the technique's ability to reliably record electrophysiologic waveforms continuously and its ability to interpret electrophysiologic changes induced by systemic and anesthetic factors.
2. In many cases, it is advisable to measure evoked potentials in a contralateral organ system (e.g., opposite brainstem auditory evoked potential, opposite arm or leg, or opposite facial nerve) in order to determine whether a change from baseline reflects a local or generalized process.

Monitoring Team

1. Appropriate IOM is best conducted using a team approach. The team should be composed of the surgeon, clinical neurophysiologist, monitoring technologist, and anesthesiologist. It is important that the surgeon and anesthesiologist have a fundamental background in the neurophysiology of evoked potentials monitoring. During the monitoring procedure they may need to help solve problems that may arise from artifacts introduced by anesthesia or stimulating or recording electrodes.

2. The monitoring team must have a sufficient knowledge and experience in intraoperative recording and electrodiagnostic technique to allow them to give immediate feedback to the surgical team and anesthesiologist about changes occur in the recorded waveforms.
3. Monitoring should commence by obtaining impedance measures prior to baselines before any surgical manipulation of the central or peripheral nervous system begins. Monitoring should continue until closing is underway in the surgical procedure. Monitoring may be terminated earlier or later if the surgeon indicates further monitoring is or is not needed. The monitoring technologist should complete a logbook on each patient. The logbook should document each of the following and any associated electrodiagnostic changes:
 - a. The time of surgical procedures.
 - b. The time of each surgical manipulation of the central or peripheral nervous system.
 - c. The names, doses and time of administration of anesthetics and drugs that may affect the central or peripheral nervous system or muscle.

Clinical Neurophysiologists

1. A trained clinical neurophysiologist (MD or DO) must be a member of the IOM team. The clinical neurophysiologist should have completed additional training in neurophysiologic monitoring. This training can be obtained during a fellowship or through sufficient continuing medical education and experience with a trained clinical neurophysiologist to assure competence in the recognition of the changes in neurophysiologic measures that can occur during surgical procedures. Board certification in the field of clinical neurophysiology is strongly

recommended and can be obtained from the American Board of Electrodiagnostic Medicine (ABEM), the American Board of Psychiatry & Neurology subspecialty certification in Clinical Neurophysiology (ABPN-CN), or the American Board of Clinical Neurophysiology-IOM (ABCN-IOM). More information about training in electrodiagnostic medicine is available in the AANEM Policy Statement *Who is Qualified to Practice Electrodiagnostic Medicine?*

2. The clinical problem being monitored determines whether the clinical neurophysiologist may be: (1) in the operating room; (2) in the same building; (3) monitoring real-time recordings from a remote site when a monitoring technologist is continuously present in the operating room; or (4) at a location from which the operating room is accessible in minutes to view the recording procedure.
3. The number of procedures that the clinical neurophysiology physician responsible for the monitoring can oversee is determined by the nature of the procedure(s) monitored. Those with more frequent changes require closer oversight. The physician work value for the monitoring CPT® code (95920) was derived assuming a certain number of cases may be monitored simultaneously. Claims for 95920 should not be submitted in excess of 3 simultaneous cases. However, it may be necessary for more than 3 cases to be monitored on some occasions. The team should have additional physicians available to monitor these additional cases. While monitoring multiple cases, a single case may develop problems requiring one-on-one attention. On such an occasion, the team must have contingency plans in place to turn over monitoring of other cases to another clinical neurophysiology physician.

Monitoring Technologists

1. The role of the monitoring technologist is to assist the surgical team. As such, the monitoring technologist should be under the direct supervision of a clinical neurophysiologist (MD or DO) who has training in electrophysiologic monitoring and the fundamentals of clinical neurophysiology.
2. The monitoring technologist must have a minimum of 3 to 5 years of training and experience in routine electrophysiologic testing and a minimum of 1 year of experience of clinical neurophysiologic monitoring in the operating room under the qualified supervision of a physician. This training should include the monitoring of at least 100 surgical procedures.
3. The monitoring technologist must have a solid background in electrical safety and its relevance to patients in the operating room.
4. The monitoring technologist must have a knowledge base in the pharmacologic, physiologic, and pathophysiologic influences that may change or distort electrodiagnostic waveforms.
5. The monitoring technologist must have a solid background in the influence of filter settings on the amplitude, duration, and latency of electrophysiologic potentials.
6. The monitoring technologist must understand basic neuroanatomy and neurophysiology, the location of evoked-potential generators and the pathways between generators, medical terminology, evoked-potential correlates of specific neurologic, neurosurgical, vascular, orthopedic, audiologic and visual disorders, and a grasp of the pathologic and non-pathologic factors affecting electrophysiologic potentials, electrical hazards, and normative data for evoked potentials.
7. The monitoring technologist must have knowledge of electronics and its application to neurophysiology. The

monitoring technologist should understand and be able to:

- a. interpret artifact rejection and signal-to-noise ratio,
 - b. identify whether a waveform is physiologic or non-physiologic,
 - c. identify the source of an artifact,
 - d. estimate the frequency in hertz of rhythmic artifacts,
 - e. understand proper patient grounding, and
 - f. understand the concept of enhancement of the signal-to-noise ratio by increasing the number of averaged potentials.
8. The monitoring technologist must have sufficient educational background in each IOM procedures in which the technologist participates. These procedures may include stimulation and recording of:
- a. sensory evoked potentials,
 - b. motor evoked potentials,
 - c. auditory evoked potentials,
 - d. visual evoked potentials,
 - e. somatosensory evoked potentials,
 - f. cranial nerves, particularly the facial nerve,
 - g. peripheral nerves including nerve roots, spinal nerves, and plexus,
 - h. electromyographic recordings.
9. The monitoring technologist must maintain and improve interpretive skills by reviewing surgical monitoring records with the clinical neurophysiologist on a regular basis.

References

- ¹ American Electroencephalographic Society. Guideline Eleven: Guidelines for intraoperative monitoring of sensory evoked potentials. *J Clin Neurophysiol* 1994; 11:77-87.

Approved September 16, 2008 by the AANEM Board of Directors.