



NATIONAL COMPETENCIES FOR PERFORMING INTRAOPERATIVE NEUROPHYSIOLOGIC MONITORING

PURPOSE

The American Society of Electroneurodiagnostic Technologists, Inc. presents this document to provide national criteria for evaluating competencies for performing intraoperative neurophysiologic monitoring.

These national competencies were established following analysis of survey data collected July thru August 2003, with tabulation completed by the ASET Executive Office. The ASET Board of Trustees approved this document October 27, 2003.

Basic knowledge and technical performance, as well as quality patient care and patient interaction, were considered. The technical components include those defined in the publication *Guidelines in EEG, Evoked Potentials and Polysomnography* 1994 authored by the American Clinical Neurophysiology Society; *Intraoperative EEG Guidelines* authored by ASET; and a draft document, *Practice Guidelines*, by the American Society of Neurophysiological Monitoring.

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STATEMENT OF COMPETENCIES

- The technologist observes operating room conduct by:
 - Following universal precautions;
 - Avoiding contamination of sterile drapes, personnel, instruments, etc.;
 - Passing sterile electrodes to the surgical personnel in an approved sterile manner;
 - Placing bloody or contaminated items in biohazard containers and sharps in a sharps container; and
 - Following hazardous material management guidelines.
- The technologist observes electrical and general safety precautions in connecting the patient to equipment by:
 - Using general safety precautions in handling of sharps, arranging cables and equipment to prevent injury; and
 - Maintaining equipment in good working order and performing maintenance checks at least twice per year.
- The technologist confers with the surgeon regarding structures at risk and modalities to be monitored and documents conversation(s).
- The technologist communicates IONM requirements to the anesthesia team and other OR personnel in a clear, definite and collegial manner and documents conversation(s).
- Before the patient enters the OR suite, and/or during intubation and prepping:
 - Collects patient history information (from patient, physician, OR staff and patient's chart as appropriate);
 - Sets up and calibrates equipment;
 - Applies electrodes (primary and backup) and secures placement;
 - Tests equipment and checks integrity of electrodes by checking and documenting impedances;
 - Arranges head box, cables and electrodes for minimization of artifacts, and to prevent electrodes from being dislodged, dried or contaminated with fluids; and
 - Obtains baseline recordings prior to incision (and after induction of anesthesia).
- During the procedure the technologist documents:
 - Surgical maneuvers and events;
 - Levels of inhaled anesthetics and dosage of IV anesthetics and use of muscle relaxants;

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- Blood pressure, temperature and other physiologic parameters as appropriate;
 - ALL WARNINGS TO ATTENDING SURGEON, SURGEON REPLIES AND CORRECTIVE ACTION TAKEN;
 - Communications with supervising physician or other clinical neurophysiologist with specialized training; and
 - Critical communications with anesthesia team or other OR personnel.
- The technologist reports and documents to the surgeon and/or supervising physician or other neurophysiologist with specialized training, any findings and significant changes according to policy and procedures.
 - If it is not clear, or not yet clear, whether an IONM change is significant, or due to technical, anesthetic or benign cause, the technologist:
 - Informs the surgeon of the change and of the probability that it may be significant according to documented policy and procedure alarm criteria; and
 - Notifies the surgeon that monitoring is momentarily interrupted for a technical reasons, (machine shutdowns, anesthetic levels too high, continuous use of electrocautery, artifact from C-arm, etc).
 - The technologist also includes the following documentation for the procedure:
 - All waveform tracings (printed and/or electronically archived). (If "waterfall" display is used, each waveform must be fully visible); and
 - Exact time, peak labels, latencies and amplitudes for all printed traces as dictated by lab or service policies.
 - At the end of the procedure, discards disposable supplies, especially sharps and contaminated items in an approved manner; cleans and disinfects equipment, cables, etc.
 - The technologist performing intraoperative neurophysiologic monitoring understands:
 - Blood pressure and other physiologic factors;
 - The surgical procedure being performed, including:
 - The structures at risk
 - The unique surgical instruments and the effect of their corrective force (Harrington Rods, Luque Wires, Miami Moss, etc)
 - The effect of corrective force exerted by spine instrumentation (Harrington Rods, Luque Wires, Miami Moss System, etc)
 - Critical periods during the surgery where monitoring is most crucial.
 - For Evoked potential and EMG recording, the anatomy of monitored pathways, including source of blood supply and electrode derivations and generators of EP components;
 - Pre-operative deficits, intraoperative injuries and possible post operative outcomes;
 - Waveform changes generated by:
 - Ischemia
 - Changes in blood pressure
 - Oxygen saturation
 - Temperature, core and limb
 - Changes in concentration of volatile agents (MAC)
 - Interactions between nitrous oxide and potent volatile anesthetics
 - Other unstable physiological factors such as changes in CO₂, Hemo/Hemato and metabolism rates.
 - The principles of modern anesthetic techniques:
 - How specific anesthetic agents affect central and peripheral nerve functioning
 - How specific anesthetics change ongoing EEG
 - How specific anesthetics change the latencies and amplitudes of evoked potentials
 - How the method of delivering anesthetics (inhalation, infusion, bolus injection, low flow inhalation) affects EEG and evoked potentials.
 - The operating room environment:
 - Operating room etiquette
 - The use of collodion, acetone or other flammable materials
 - Potentially bio-hazardous material
 - Sharp electrodes.
 - Electrical safety issues related to:
 - Types of recording and stimulating electrodes
 - Cautery units and return grounding pads
 - Other instruments that are connected to the patient
 - Multiple grounds
 - Use of new equipment in the OR (bio-med checks at individual hospitals).
 - The effects of other equipment (blood warmers, microscopes, etc.), on the quality of the intraoperative recording.

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- In addition, the technologist maintains and improves knowledge and skills by:
 - Participating in hospital in-service programs, especially post-operative review of monitored surgical cases;
 - Reading books and journal articles;
 - Attending professional meetings and seminars;
 - Providing education to staff members; and
 - Participating in research activities.
- During the intraoperative EEG, the technologist will:
 - Select montage(s) appropriate for surgical procedure being performed;
 - Select the appropriate instrumentation settings;
 - Recognize, document and correct all artifact;
 - Monitor respiration, EKG, EMG and eye movements, if appropriate;
 - Establish a preoperative post-anesthetic baseline prior to incision and re-establish that baseline if necessary; and
 - Alert appropriate individuals of significant changes so that immediate intervention can occur to prevent irreversible neurological damage.
- During intraoperative EP monitoring, the technologist will:
 - Discuss anesthetic recommendations for monitoring, in a definitive but cordial manner, with anesthesia staff;
 - Ensure that the averager and stimulators are correctly synchronized;
 - Ensure that all stimulators are correctly delivering expected stimuli to the selected side;
 - Choose the appropriate stimulus rate and adjusts as needed to reduce time-locked artifacts;
 - Establish and document that stimulating parameters are within safe limits;
 - Recognize, document and correct all artifacts;
 - Establish baseline values prior to induction of anesthesia and positioning of the patient, if appropriate (as in cases of unstable cervical spine);
 - Reestablish baselines as needed or as anesthetic regimen changes;
 - Monitor continuously during manipulation; document evoked potential tracings at frequent intervals as directed by policy and procedure manuals;
 - Alert appropriate individuals of important changes so that immediate intervention can occur to prevent irreversible neurological damage; and
 - Document warnings to surgeon and surgeon's response, as well as any corrective action and/or recovery, following established criteria.
- The technologist records technically adequate SSEP data by:
 - Maintaining stimulating electrode impedance EQUAL and BELOW 5000 Ohms to assure proper stimulation and to decrease stimulus artifact;
 - Using a montage that records obligate peak responses from peripheral nerve, spinal cord, sub-cortical structures and the cerebral cortex as appropriate. (For example: sub-cortical responses can be used for monitoring spinal cord function, but cortical responses would be required in monitoring an aneurysm clipping);
 - Recording from electrodes overlying the scalp surface, peripheral sites and from electrodes placed in the spinous process or epidural spaces, as appropriate;
 - Marking waveforms and calculating the absolute latencies, amplitudes and inter-peak intervals at baseline and throughout the monitoring procedure;
 - Recording from additional electrode derivations in case of technical problems in order to allow continuous recording; and
 - Delivering unilateral alternating stimulation of left and right-sided nerves or on special occasions from bilateral stimulation (e.g., infants).
- The technologist assists the interpreting physician or other clinical neurophysiologist with specialized training in accurate localization of sensorimotor cortex by:
 - Obtaining relevant patient history;
 - Obtaining a pre-incision baseline with surface electrodes to confirm function of the somatosensory pathway and approximate latency of the N20 peak;
 - Selecting appropriate time-base, sensitivity and band pass settings;
 - Selecting the appropriate stimulation site (normally, contra-lateral median nerve);
 - Recording from cotton wick, stainless steel, platinum or carbon ball electrodes or stainless steel or platinum electrodes embedded in inert Teflon or silicone sheet placed by the surgeon;
 - Preparing stimulus site to reduce stimulating electrode impedance;
 - Monitoring sub-cortical peripheral nerve site to verify stimulus effect;
 - Using a montage that records direct cortical responses and produces a "phase reversal";
 - Obtaining adequate resolution of the obligate components;
 - Recording from multiple cortical sites in order to obtain adequate localization; and
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- Printing out a hard copy of simultaneous or sequentially recorded SSEP's for the purpose of studying the amplitude gradient and polarity of the responses in relation to the location of the gyri.
- The technologist obtains a technically adequate TCeMEP by:
 - Choosing the appropriate stimulation sites by measuring the head using the international 10/20 system of electrode placement;
 - Applying stimulating electrodes that are below 5 K ohms and balanced;
 - Choosing the appropriate muscles to be monitored based on the surgical procedure being performed;
 - Securely applying recording electrodes that are below 5 K ohms and balanced to ensure proper recording of the muscle activity;
 - Ensuring the proper anesthetic regime for protocol being used, i.e., maximal or threshold level stimulation;
 - Choosing the appropriate stimulation parameters including, intensity, duration and frequency of stimulation delivery;
 - Recognizing appropriate alarm criterion; and
 - Checking for pre-existing medical conditions and H&P (i.e., indwelling devices such as pace-makers and stimulators, seizure disorder, stroke, significant head injury, intra-cranial metal objects such as aneurysm clips and metal plating devices, previous spinal instrumentation and motor deficits).
- The technologist records technically adequate BAEP data by:
 - Documenting any existing hearing loss or condition of ear structures;
 - Using molded ear speakers or insert transducers to avoid contamination of the surgical field;
 - Using waterproof adhesive tape, Tegaderm and/or bone wax to protect the ear speaker and ear canal from blood or fluids;
 - Choosing the appropriate montage, time-base, number of stimuli, sensitivity and band pass settings;
 - Using alternating click polarity to minimize stimulus artifact, or rarefaction or condensation clicks to obtain best response as appropriate;
 - Using an appropriate stimulus intensity;
 - Using an appropriate stimulus rate to resolve the most important BAEP components and maintaining the same rate throughout;
 - Obtaining adequate resolution of obligate component(s) waves I, III and V;
 - Measuring and calculating the absolute latencies, amplitudes and inter-peak intervals of obligate peaks at base-line and throughout monitoring and adjusting the base-lines as necessary due to anesthetic and other physiologic changes;
 - Masking the contra-lateral ear with appropriate intensity, when applicable;
 - Continuously monitoring the ear ipsi-lateral to surgical intervention (contra-lateral ear monitoring is also appropriate for large posterior fossa tumors, or as a control); and
 - Notifying the appropriate personnel in the event of changes not related to physiologic or anesthetic effects.
- For certain posterior fossa procedures, the technologist records direct nerve action potentials from the 8th cranial nerve simultaneously with the BAEPs by:
 - Providing the surgeon with a sterile direct nerve electrode for placement on the exposed 8th nerve;
 - Using the same auditory clicks to stimulate the ipsi-lateral ear at the same intensity and stimulus rate as that used with the BAEPs;
 - Using a montage referencing the direct nerve electrode to the ipsi-lateral ear;
 - Selecting appropriate time base and recording sensitivity to record these high amplitude responses; and
 - Reporting significant changes in morphology, latency and amplitude of these responses.
- The technologist obtains a technically adequate motor cranial nerve recording by:
 - Selecting appropriate recording parameters and montage for EMG;
 - Applying needle, sticky pads or hook wire recording electrodes to the appropriate muscles to record spontaneous and evoked EMG responses from the specific nerves. Impedance and recording function must be tested prior to prepping and draping;
 - Ensuring the neuromuscular blockade is not employed;
 - Monitoring the ongoing EMG through a loud speaker which provides continuous auditory feedback to the surgical team;
 - Providing a sterile stimulating probe when needed;
 - Selecting appropriate current intensity and duration to produce a moderate muscle twitch of the muscles from the cranial nerve being stimulated being cognizant of patient safety issues;
 - Recording spontaneous free-running EMG, signal-triggered EMG and evoked CMAP's; and
 - Informing the attending surgeon of spontaneous activity, mechanical stimulation of the nerve and results of nerve stimulation; documenting surgical events, warning to surgeon, etc., as covered in previous sections.

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