Kansas City

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Intra-Operative Neurophysiologic Monitoring (sensory-evoked potentials, motor-evoked potentials, EEG monitoring)

Policy Number: 7.01.58
Origination: 10/1988
Last Review: 5/2014
Next Review: 5/2015

Policy

Blue Cross and Blue Shield of Kansas City (Blue KC) will provide coverage for intra-operative neurophysiologic monitoring when it is determined to be medically necessary because the criteria shown below are met.

Note: These policy statements refer only to use of these techniques as part of intraoperative monitoring. Other clinical applications of these techniques, such as visual-evoked potentials and EMG, are not considered in this policy.

When Policy Topic is covered

Intraoperative monitoring, which includes somatosensory-evoked potentials, motor-evoked potentials using transcranial electrical stimulation, brainstem auditory-evoked potentials, EMG of cranial nerves, EEG, and electrocorticography (ECoG), may be considered **medically necessary** during spinal, intracranial, or vascular procedures.

When Policy Topic is not covered

Intra-operative monitoring of visual-evoked potentials is considered **investigational**.

Due to the lack of FDA approval, intraoperative monitoring of motor-evoked potentials using transcranial magnetic stimulation is considered **investigational**.

Intra-operative EMG and nerve conduction velocity monitoring during surgery on the peripheral nerves is considered **not medically necessary**. (See Considerations section for further discussion)

Considerations

Intra-operative monitoring typically is done in the operating room by a technician, with a physician as a remote backup. In some operating rooms there is a central physician monitoring room, where a physician may simultaneously monitor several cases.

Intra-operative monitoring is considered reimbursable as a separate service only when a licensed physician, other than the operating surgeon, performs the monitoring while in attendance in the operating room throughout the procedure.

Constant communication between surgeon, neurophysiologist, and anesthetist are required for safe and effective intraoperative neurophysiologic monitoring.

Implementation of a local policy on this technology may also involve discussions about credentialing of those providing the intraoperative monitoring services, as well as on-site versus remote real-time review and interpretation.

Coding for intraoperative monitoring uses time-based codes; they are not based on the number (single vs. multiple) of modalities used.

Description of Procedure or Service

Intraoperative neurophysiologic monitoring describes a variety of procedures that have been used to monitor the integrity of neural pathways during high-risk neurosurgical, orthopedic, and vascular surgeries. It involves the use of devices to record electrical signals produced by the nervous system in response to sensory or electrical stimulus.

Background

The principal goal of intraoperative monitoring is the identification of nervous system impairment in the hope that prompt intervention will prevent permanent deficits. Correctable factors at surgery include circulatory disturbance, excess compression from retraction, bony structures, or hematomas, or mechanical stretching. The technology is continuously evolving with refinements in equipment and analytic techniques including multimodal intraoperative monitoring in which more than one technique is used and recording in which several patients are monitored under the supervision of a physician who is outside the operating room.

The different methodologies of monitoring are described below:

Sensory-evoked Potentials

Sensory-evoked potential describes the responses of the sensory pathways to sensory or electrical stimuli. Intraoperative monitoring of sensory-evoked potentials is used to assess the functional integrity of central nervous system (CNS) pathways during operations that put the spinal cord or brain at risk for significant ischemia or traumatic injury. The basic principles of sensory-evoked potential monitoring involve identification of a neurological region at risk, selection and stimulation of a nerve that carries a signal through the at-risk region, and recording and interpretation of the signal at certain standardized points along the pathway. Monitoring of sensory-evoked potentials is commonly used during the following procedures: carotid endarterectomy, brain surgery involving vasculature, surgery with distraction compression or ischemia of the spinal cord and brainstem, and acoustic neuroma surgery. Sensory-evoked potentials can be further broken down into the following categories according to the type of simulation used:

- Somatosensory-evoked potentials (SSEPs) are electrical waves that are generated by the response of sensory neurons to stimulation. Peripheral nerves, such as the median, ulnar, or tibial nerves are typically stimulated, but in some situations the spinal cord may be stimulated directly. Recording is done either cortically or at the level of the spinal cord above the surgical procedure. Intraoperative monitoring of SSEPs is most commonly used during orthopedic or neurologic surgery to prompt intervention to reduce surgically induced morbidity and/or to monitor the level of anesthesia. One of the most common indications for SSEP monitoring is in patients undergoing corrective surgery for scoliosis. In this setting, SSEP monitors the status of the posterior column pathways and thus does not reflect ischemia in the anterior (motor) pathways. Several different techniques are commonly used, including stimulation of a relevant peripheral nerve with monitoring from the scalp, from interspinous ligament needle electrodes, or from catheter electrodes in the epidural space.
- Brainstem auditory-evoked potentials (BAEPs) are generated in response to auditory clicks and can define the functional status of the auditory nerve. Surgical resection of a cerebellopontine angle tumor, such as an acoustic neuroma, places the auditory nerves at risk, and BAEPs have been extensively used to monitor auditory function during these procedures.
- Visual-evoked potentials (VEPs) are used to track visual signals from the retina to the occipital cortex light flashes. VEP monitoring has been used for surgery on lesions near the optic chiasm. However, VEPs are very difficult to interpret due to their sensitivity to anesthesia, temperature, and blood pressure.

EMG (Electromyogram) Monitoring and Nerve Conduction Velocity Measurements

Electromyogram monitoring and nerve conduction velocity measurements can be performed in the operating room and may be used to assess the status of the peripheral nerves, e.g., to identify the extent of nerve damage prior to nerve grafting or during resection of tumors. In addition, these techniques may be used during procedures around the nerve roots and around peripheral nerves to assess the presence of excessive traction or other impairment. Surgery in the region of cranial nerves can be monitored by electrically stimulating the proximal (brain) end of the nerve and recording via EMG in the facial or neck muscles. Thus monitoring is done in the direction opposite that of sensory-evoked potentials, but the purpose is similar—to verify that the neural pathway is intact.

Motor-Evoked Potential Monitoring

Motor-evoked potentials (MEPs) are recorded from muscles following direct or transcranial electrical stimulation of motor cortex or by pulsed magnetic stimulation provided by a coil placed over the head. Peripheral motor responses (muscle activity) are recorded by electrodes placed on the skin at prescribed points along the motor pathways. Motor evoked potentials, especially when induced by magnetic stimulation, can be affected by anesthesia. The Digitimer electrical cortical stimulator received U.S. Food and Drug Administration (FDA) premarket approval in 2002. Devices for transcranial magnetic stimulation have not yet received approval from the FDA for this use.

Multimodal IONM, in which more than one technique is used, most commonly with SSEPs and MEPs, has also been described.

EEG (Electroencephalogram) Monitoring

Spontaneous EEG monitoring can also be recorded during surgery and can be subdivided as follows:

- EEG monitoring has been widely used to monitor cerebral ischemia secondary to carotid cross clamping during a carotid endarterectomy. EEG monitoring may identify those patients who would benefit from the use of a vascular shunt during the procedure to restore adequate cerebral perfusion. Conversely, shunts, which have an associated risk of iatrogenic complications, may be avoided in those patients in whom the EEG is normal. Carotid endarterectomy may be done with the patient under local anesthesia so that monitoring of cortical function can be directly assessed.
- Electrocorticography (ECoG) is the recording of the EEG directly from a surgically exposed cerebral cortex. CoG is typically used to define the sensory cortex and to map the critical limits of a surgical resection. ECoG recordings have been most frequently used to identify epileptogenic regions for resection. In these applications, ECoG does not constitute monitoring, per se.

Rationale

Literature searches of the MEDLINE database through March 2004 revealed that intraoperative monitoring is a widely accepted practice without a strong evidence-based support through controlled trials. In 2004, the Medical Policy Panel concluded that intraoperative neurophysiologic monitoring (IONM) has evolved into primarily a credentialing and reimbursement issue and determined that this policy would no longer be reviewed. In 2011, the policy was returned to active review, focusing on intraoperative-evoked potentials that had been considered investigational. The most recent literature update was performed through October 2012. Following is a summary of the key literature to date.

Intraoperative monitoring of neurologic function is a widely diffused practice, particularly during cervical and thoracic spinal surgery. There have been several references that have looked at the efficacy of this technology and the controversies surrounding its use. (1-4)

In 2010, Fehlings et al. published a systematic review of the evidence for improved outcomes from IONM for patients undergoing instrumented spine surgery. (5) The authors identified 32 articles that met their inclusion criteria. The overall strength of the evidence for unimodal somatosensory-evoked potentials (SSEPs) and motor-evoked potentials (MEPs) studies was very low. The review found a high level of evidence that multimodal IONM is sensitive and specific for detecting neurologic injury during spine surgery, with most studies reporting sensitivity and specificity above 90%. There was a low level of evidence that IONM reduces the rate of new or worsened perioperative neurologic deficits, based on 4 observational studies that compared patients with and without neuromonitoring. There was very low evidence that an intraoperative response to a neuromonitoring alert reduces the rate of perioperative neurologic deterioration, with only 1 comparative study identified.

In 2012, the American Academy of Neurology (AAN) and the American Clinical Neurophysiology Society examined the evidence on whether intraoperative SSEPs and MEPs predict adverse surgical outcomes. (6) Outcomes of patients with evoked potential (EP) changes were compared with those of patients without EP changes. In order to reduce bias, the only outcomes assessed were new paraparesis, paraplegia, and quadriplegia. Twelve studies met inclusion criteria and were reviewed. Results of the 4 Class I diagnostic studies showed that 16-40% of patients who had an EP change during IONM had paraparesis, paraplegia, or quadriplegia. There were no adverse events in patients without an EP change. The evidence review did not identify any studies that evaluated these outcomes in patients with IONM compared to patients without IONM. The review did identify one prospective study that found a significant positive relationship between the decision to monitor and better motor outcome.

Multimodal IONM

Authors of a study from a U.S. center reviewed records of 1,121 patients with scoliosis treated at 4 pediatric spine centers between 2000 and 2004 and monitored with a multimodality technique. (7) Thirty-eight had recordings that met criteria for signal change. Of these, 17 showed suppression of the amplitude of transcranial electrical MEPs in excess of 65% without evidence of changes in SSEPs. In 9 of the 38 patients, the signal change was related to hypotension and was corrected with augmentation of the blood pressure. In the remaining 29 patients, the alert was related directly to a surgical maneuver (segmental vessel clamping and posterior instrumentation and correction). Nine of the 26 patients with an instrumentation-related alert woke with a transient motor and/or sensory deficit. Seven of these 9 patients presented solely with a motor deficit, which was detected by monitoring of MEPs in all cases. Two patients had only sensory symptoms. Sensory-evoked potentials (SEPs) failed to identify a motor deficit in 4 of the 7 patients and, when changes in SEPs occurred, they lagged behind changes in transcranial electric MEPs by an average of approximately 5 minutes.

Visual-evoked Potentials (VEPs)

Several articles from Asia describe potentially useful methods of utilizing intraoperative VEPs to assess the integrity of visual pathway structures, including optic nerves, in order to detect visual impairment before it is irreversible. (8, 9) More research is required to identify the role and utility of intraoperative VEPs.

Summary

Intraoperative neurophysiologic monitoring (IONM) describes a variety of procedures that have been used to monitor the integrity of neural pathways during high-risk neurosurgical, orthopedic, and vascular surgeries. At the present time, it appears that monitoring of somatosensory-evoked potentials (SSEPs) and motor-evoked potentials (MEPs), particularly for spine surgery and open abdominal aorta aneurysm repairs, has broad acceptance though the evidence base consists mainly of observational studies. Therefore, intraoperative monitoring, which includes somatosensory-evoked potentials, motor-evoked potentials using transcranial electrical stimulation, brainstem auditory-evoked potentials, electromyogram (EMG) of cranial nerves, electroencephalogram (EEG), and electrocorticography (ECoG), may be considered medically necessary during spinal, intracranial, or vascular procedures. More research is required to identify the role and utility of intraoperative visual-evoked potentials (VEPs); this is considered investigational. Due to the lack of U.S. Food and Drug Administration (FDA) approval, intraoperative monitoring of motor-evoked potentials using transcranial magnetic stimulation is considered investigational. Intraoperative EMG and nerve conduction velocity monitoring during surgery on the peripheral nerves is considered not medically necessary.

It should be noted that there is ongoing controversy about the utility of IONM in some surgical procedures. Most of the literature is from Europe and the United Kingdom, and, while many papers report the sensitivity and specificity of MEPs for predicting post-surgical neurological deficits, few papers report intraoperative interventions undertaken in response to information from monitoring. In a review, Malhotra and Shaffrey note that although MEP monitoring is considered to be safe, relative contraindications include epilepsy, cortical lesion, skull defect, proconvulsant medication, cardiac pacing, and implantable device. (10)

Practice Guidelines and Position Statements

The American Electroencephalographic Society (now the American Clinical Neurophysiology Society) published guidelines in 1984 and 1994 on the intraoperative monitoring of SEPs. (11, 12) Included were standards for IOMN of auditory-evoked potentials, facial nerve responses, and SSEPs. At the time of the 1994 guidelines, it was considered too early to develop guidelines on monitoring of motor function by stimulation of the spinal cord or motor cortex.

In 2009 the American Clinical Neurophysiology Society published recommended standards for intraoperative neurophysiologic monitoring. (13) Guideline 11A includes the following statement.
The monitoring team should be under the direct supervision of a physician with training and experience in NIOM. The monitoring physician should be licensed in the state and privileged to interpret neurophysiologic testing in the hospital in which the surgery is being performed. He/she is responsible for real-time interpretation of NIOM data. The monitoring physician should be present in the operating room or have access to NIOM data in real-time from a remote location and be in communication with the staff in the operating room. There are many methods of remote monitoring however any method used must conform to local and national protected health information guidelines. The monitoring physician must be available to be in the operating room, and the specifics of this availability (i.e., types of surgeries) should be decided by the hospital credentialing committee. In order to devote the needed attention, it is recommended that the monitoring physician interpret no more than three cases concurrently.

The American Academy of Neurology (AAN) published an assessment of IONM in 1990 with an evidence-based guideline update in 2012 by the AAN and the American Clinical Neurophysiology Society. (6, 14) The 1990 assessment indicates that monitoring requires a team approach with a well-trained physician-neurophysiologist to provide or supervise monitoring. EEG monitoring is used during carotid endarterectomy or for other similar situations in which cerebral blood flow is at high risk. Electrocorticography from surgically exposed cortex can help to define the optimal limits of a surgical resection or identify regions of greatest impairment, while sensory cortex SSEPs can help to localize the central fissure and motor cortex. Auditory-evoked potentials, along with cranial nerve monitoring can be used during posterior fossa neurosurgical procedures. Spinal cord SSEPs are frequently used to monitor the spinal cord during orthopedic or neurosurgical procedures around the spinal cord, or cross-clamping of the thoracic aorta. EMG monitoring during procedures around the roots and peripheral nerves can be used to warn of excessive traction or other impairment of motor nerves. At the time of the 1990 assessment, MEPs were considered investigational by many neurophysiologists. The 2012 update, which was endorsed by the American Association of Neuromuscular and Electrodiagnostic Medicine, concluded that the available evidence supports IONM using SSEPs or MEPs when conducted under the supervision of a clinical neurophysiologist experienced with IONM. Evidence was insufficient to evaluate IOMN when conducted by technicians alone or by an automated device.

The American Society of Neurophysiological Monitoring provides position statements on intraoperative monitory with auditory evoked potentials, electromyography, somatosensory evoked potentials, and electroencephalography. (15)

In 1999, the International Organisation of Societies for Electrophysiological Technology (OSET) published guidelines for performing EEG and evoked potential monitoring during surgery. (16) Included in the guidelines are recommended standards for surgical monitoring personnel, technique and standards of safety, along with standards for monitoring SSEPs, auditory-evoked potentials, and EEG. The guidelines indicate that neuromonitoring may be useful during surgery that may affect spinal cord function (deformity correction, traumatic spinal fracture repair, tethered cord release, spinal cord mass removal), brainstem function (posterior fossa mass removal), brain function (carotid endarterectomy, aneurysm repair), and peripheral nerve function (pelvic fracture surgery). Brainstem auditory-evoked potentials can be utilized during neurosurgical procedures that involve the pons and the lower midbrain, and EEG monitoring can be useful for monitoring the brain when surgical procedures may potentially compromise blood perfusion to the brain or involve the cerebral cortex. EEG monitoring is described for carotid endarterectomy, intracranial aneurysm surgery, cardiac bypass surgery, electrocorticography, and the Wada test.

In 1993, the International Federation of Clinical Neurophysiology (IFCN) published a report on neuromonitoring during surgery. (17) The stated goals of neuromonitoring are the identification of new neurologic impairment early enough to allow prompt correction of the cause, prompt identification of new systemic impairment, to help a surgeon to identify uncertain or unrecognized tissue, identify the location of a lesion, provide reassurance to the surgeon during the course of an operation, and for high-risk patients. The report describes standard procedures for electrocorticography, EEG, auditory- and somatosensory-evoked potentials (SSEPs), and MEPs.

Medicare National Coverage

Electroencephalographic (EEG) monitoring "may be covered routinely in carotid endarterectomies and in other neurological procedures where cerebral perfusion could be reduced. Such other procedures might include aneurysm surgery where hypotensive anesthesia is used or other cerebral vascular procedures where cerebral blood flow may be interrupted". (18) Coverage determinations for other modalities were not identified.

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Billing Coding/Physician Documentation Information

92585	Auditory evoked potentials for evoked response audiometry and/or testing of the central nervous system; comprehensive
95822	Electroencephalogram (EEG); recording in coma or sleep only
95829	Electrocorticogram at surgery (separate procedure)
95860	Needle electromyography; 1 extremity with or without related paraspinal areas
95861	Needle electromyography; 2 extremities with or without related paraspinal areas
95863	Needle electromyography; 3 extremities with or without related paraspinal areas
95864	Needle electromyography; 4 extremities with or without related paraspinal areas
95865	Needle electromyography; larynx
95866	Needle electromyography; hemidiaphragm
95867	Needle electromyography; cranial nerve supplied muscle(s), unilateral
95868	Needle electromyography; cranial nerve supplied muscles, bilateral
95869	Needle electromyography; thoracic paraspinal muscles (excluding T1 or T12)
95870	Needle electromyography; limited study of muscles in 1 extremity or non-limb (axial) muscles (unilateral or bilateral), other than thoracic paraspinal, cranial nerve supplied muscles, or sphincters
95867	Needle electromyography; cranial nerve supplied muscles, unilateral
95868	Cranial nerve supplied muscles, bilateral
95907	Nerve conduction studies; 1-2 studies
95908	Nerve conduction studies; 3-4 studies
95909	Nerve conduction studies; 5-6 studies
95910	Nerve conduction studies; 7-8 studies
95911	Nerve conduction studies; 9-10 studies
95912	Nerve conduction studies; 11-12 studies
95913	Nerve conduction studies; 13 or more studies
95925	Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in upper limbs
95926	Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in lower limbs
95927	Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in the trunk or head
95928	Central motor evoked potential study (transcranial motor stimulation); upper limbs
95929	Central motor evoked potential study (transcranial motor stimulation); lower limbs
95930	Visual evoked potential (VEP) testing central nervous system, checkerboard or flash
95933	Orbicularis oculi (blink) reflex, by electrodiagnostic testing

95937 Neuromuscular junction testing (repetitive stimulation, paired stimuli), each nerve, any 1 method
95938 Short-latency somatosensory evoked potential study, stimulation of any/all peripheral nerves or skin sites, recording from the central nervous system; in upper and lower limbs
95939 Central motor evoked potential study (transcranial motor stimulation); in upper and lower limbs
95940 Continuous intraoperative neurophysiology monitoring in the operating room, one on one monitoring requiring personal attendance, each 15 minutes (List separately in addition to code for primary procedure)
95941 Continuous intraoperative neurophysiology monitoring, from outside the operating room (remote or nearby) or for monitoring of more than one case while in the operating room, per hour (List separately in addition to code for primary procedure)
95955 Electroencephalograph during non-cranial surgery (eg. carotid surgery)
G0453 Continuous intraoperative neurophysiology monitoring, from outside the operating room (remote or nearby), per patient, (attention directed exclusively to one patient) each 15 minutes (list in addition to primary procedure)

Codes 95040 and 95941 would be reported in conjunction with the code(s) for the testing performed i.e., 92585, 95822, 95860-95870, 95907-95913, and 95925-95939.

Additional Policy Key Words

N/A

Policy Implementation/Update Information

10/1/88	New policy.
5/1/00	No policy statement changes.
5/1/01	Policy statement revised to include monitoring of motor evoked potentials within the brain and visual-evoked potentials as investigational. Monitoring of peripheral nerves during surgery is considered part of the total procedure.
5/1/02	No policy statement changes.
5/1/03	No policy statement changes.
5/1/04	No policy statement changes.
5/1/05	No policy statement changes.
5/1/06	No policy statement changes.
5/1/07	No policy statement changes.
5/1/08	No policy statement changes.
5/1/09	No policy statement changes.
5/1/10	No policy statement changes.
5/1/11	No policy statement changes.
9/1/11	Policy statements changed to indicate motor-evoked potentials using transcranial electrical stimulation may be considered medically necessary and motor-evoked potential using transcranial magnetic stimulation is investigational, other policy statements unchanged.
5/1/12	No policy statement changes.
5/1/13	No policy statement changes.
5/1/14	Added a statement in the Policy Guidelines about the associated nerve testing codes that would be reported with codes 95940 and 95941.

State and Federal mandates and health plan contract language, including specific provisions/exclusions, take precedence over Medical Policy and must be considered first in determining eligibility for coverage. The medical policies contained herein are for informational purposes. The medical policies do not constitute medical advice or medical care. Treating health care providers are independent contractors and are neither employees nor agents Blue KC and are solely responsible for diagnosis, treatment and medical advice. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, photocopying, or otherwise, without permission from Blue KC.