INTRAOPERATIVE NEUROMONITORING

Policy Number: 0013
Effective Date: March 2019
Reviewed Date: June 2023
Next Review: June 2024
Clinician Reviewer: Kristophe Karami, DO, Neurosurgery

BACKGROUND

CLINICAL BACKGROUND

Intraoperative neurophysiologic monitoring (IONM) is a practice utilizing various procedures to evaluate the integrity of neural pathways during surgery. Techniques used in IONM include somatosensory evoked potentials (SSEP), motor evoked potentials (MEP), electroencephalography (EEG), and electromyography (EMG). By monitoring neural activity using these techniques, a neurophysiologist may be able to mitigate adverse effects by identifying and communicating changes to the surgical team.

POLICY AND CRITERIA

GENERAL CRITERIA

- Intraoperative neurophysiologic monitoring must be performed by either a licensed physician trained in clinical neurophysiology or a trained technologist who is practicing within the scope of his/her license/certification as defined by state law or appropriate authorities and is working under direct supervision of a physician trained in neurophysiology; AND

- Intraoperative neurophysiologic monitoring must be interpreted by a licensed physician trained in clinical neurophysiology, other than the operating surgeon, who is either in attendance in the operating suite or present by means of a real-time remote mechanism for neurophysiologic monitoring situations and is immediately available; AND

- Monitoring is conducted and interpreted real-time (either on-site or at a remote location) and continuously communicated to the surgical team; AND

- The physician performing or supervising monitoring must be monitoring no more than three cases simultaneously; AND

- Charges related to intraoperative monitoring will only be reimbursed when billed on a HCFA 1500 claim form for professional charges; AND

- Any charges related to intraoperative monitoring billed on a UB form are not reimbursable.

INDICATIONS

Intraoperative neuromonitoring may be indicated for a variety of spinal, intracranial, and vascular procedures. The specific type of monitoring indicated for each procedure varies, as outlined in the below criteria and summarized in the following tables. Pre-procedural baseline testing may be separately reported, but only once per operative session.

Somatosensory-evoked potentials with or without motor-evoked potentials

Intraoperative neuromonitoring using somatosensory-evoked potentials (SSEP), with or without motor-evoked potentials (using electrical stimulation), may be medically necessary during the following procedures:

- Spinal procedures
    - Dorsal rhizotomy
    - Correction of scoliosis
    - Correction of deformity involving traction on the spinal cord
    - Spinal cord tumor removal
    - Surgery due to traumatic injury to spinal cord
    - Surgery for arteriovenous (AV) malformation of spinal cord
- Intracranial procedures
    - Microvascular decompression of cranial nerves
    - Removal of acoustic neuroma, congenital auricular lesions, or cranial base lesions
    - Cholesteatoma, including mastoidotomy or mastoidectomy
    - Vestibular neurectomy for Meniere's
    - Removal of cranial nerve neuromas affecting any of the following nerves:
        - Abducens
        - Facial
        - Glossopharyngeal
        - Hypoglossal
        - Oculomotor
        - Recurrent laryngeal
        - Spinal accessory
        - Superior laryngeal
        - Trochlear
    - Deep brain stimulation
    - Endolymphatic shunting for Meniere's disease
    - Oval or round window graft
    - Removal of cavernous sinus tumors
    - Resection of brain tissue near primary motor cortex and requiring brain mapping
    - Resection of epileptogenic brain tissue or tumor
    - Other intracranial procedures (e.g., aneurysm repair, intracranial AVM)
- Non-cranial vascular procedures
    - Carotid artery surgery
    - Arteriography with test occlusion of carotid artery
    - Deep hypothermic circulatory arrest
    - Distal aortic procedures
    - Surgery of the aortic arch, its branch vessels, or thoracic aorta

Electroencephalographic monitoring

Intraoperative electroencephalographic (EEG) monitoring may be considered medically necessary for any of the following procedures

- Intracranial procedures
    - Microvascular decompression of cranial nerves
    - Removal of acoustic neuroma, congenital auricular lesions, or cranial base lesions
    - Cholesteatoma, including mastoidotomy or mastoidectomy
    - Vestibular neurectomy for Meniere's
    - Removal of cranial nerve neuromas affecting any of the following nerves:
        - Abducens
        - Facial
        - Glossopharyngeal
        - Hypoglossal
        - Oculomotor
        - Recurrent laryngeal
        - Spinal accessory
        - Superior laryngeal
        - Trochlear
    - Deep brain stimulation
    - Endolymphatic shunting for Meniere's disease
    - Oval or round window graft
    - Removal of cavernous sinus tumors
    - Resection of brain tissue near primary motor cortex and requiring brain mapping
    - Resection of epileptogenic brain tissue or tumor
    - Other intracranial procedures (e.g., aneurysm repair, intracranial AVM)
- Non-cranial vascular procedures
    - Carotid artery surgery
    - Arteriography with test occlusion of carotid artery

Electromyographic monitoring

Intraoperative electromyographic (EMG) monitoring may be considered medically necessary when monitoring is during any of the following procedures:

- Dorsal rhizotomy
- Microvascular decompression of cranial nerves
- Removal of acoustic neuroma, congenital auricular lesions, or cranial base lesions
- Cholesteatoma, including mastoidotomy or mastoidectomy
- Vestibular neurectomy for Meniere's
- Removal of cranial nerve neuromas affecting any of the following nerves:
    - Abducens
    - Facial
    - Glossopharyngeal
    - Hypoglossal
    - Oculomotor

- Recurrent laryngeal
- Spinal accessory
- Superior laryngeal
- Trochlear

SPINAL PROCEDURES	SSEP (with or without MEP) 95925,95926, 95927,95938 With MEP – 95928, 95929, 95939	EEG 95822 95955	EMG 95860 95861 95867 95868 95870
Dorsal rhizotomy	☑		☑
Correction of scoliosis	☑		
Correction of deformity involving traction on the spinal cord	☑		
Spinal cord tumor removal	☑		
Surgery due to traumatic injury to spinal cord	☑		
Surgery for AV malformation of spinal cord	☑		

NON-CRANIAL VASCULAR PROCEDURES	SSEP (with or without MEP) 95925,95926, 95927,95938 With MEP – 95928, 95929, 95939	EEG 95822 95955	EMG 95860 95861 95867 95868 95870
Carotid artery surgery	☑	☑	
Arteriography w/ test occlusion of carotid artery	☑	☑	
Deep hypothermic circulatory arrest	☑		
Distal aortic procedures (due to risk of ischemia to spinal cord)	☑		
Surgery of aortic arch, its branch vessels, or thoracic aorta	☑		

INTRACRANIAL PROCEDURES*	SSEP (with or without MEP) 95925,95926, 95927,95938 With MEP – 95928, 95929, 95939	EEG 95822 95955	EMG 95860 95861 95867 95868 95870
Microvascular decompression of cranial nerves	☑	☑	☑
Removal of acoustic neuroma, congenital auricular lesions, cranial base lesions	☑	☑	☑
Cholesteatoma, including mastoidotomy or mastoidectomy	☑	☑	☑
Vestibular neurectomy for Meniere's	☑	☑	☑
Removal of cranial nerve neuromas affecting any of following nerves: *Abducens* *Facial* *Glossopharyngeal* *Hypoglossal* *Oculomotor* *Recurrent laryngeal* *Spinal accessory* *Superior laryngeal* *Trochlear*	☑	☑	☑
Deep brain stimulation	☑	☑	
Endolymphatic shunt for Meniere's disease	☑	☑	
Oval or round window graft	☑	☑	
Removal of cavernous sinus tumors	☑	☑	
Resection of brain tissue near primary motor cortex and requiring brain mapping	☑	☑	
Resection of epileptogenic brain tissue or tumor	☑	☑	
Other intracranial vascular procedures (e.g. aneurysm repair, intracranial AV malformation)	☑	☑	

*Intraoperative brainstem auditory evoked response monitoring may also be appropriate for intracranial procedures in which auditory function is at risk, such as acoustic neuroma resection or brainstem tumor resection.

EXPERIMENTAL AND INVESTIGATIONAL

IONM is considered experimental/investigational for all indications not meeting the above criteria. Examples of procedures for which there is insufficient evidence to establish net benefit of IONM include, but are not limited to, the following:

- Routine lumbar or cervical laminectomies and fusions
- Spinal cord stimulator implantation
- Thyroid or parathyroid surgery
- Cochlear implantation
- Vagal nerve stimulator implantation
- Spinal injections
- Hip replacement
- Parotid gland surgery

Intraoperative monitoring of visual evoked potentials is experimental and investigational for all indications.

Intraoperative monitoring of motor evoked potentials using transcranial magnetic stimulation is experimental and investigational for all indications.

Nerve conduction studies for intraoperative monitoring purposes are considered experimental and investigational for all indications.

RATIONALE

EVIDENCE BASIS

There is moderate strength of evidence that IONM may identify patients at greater risk of adverse outcomes due to neurological injury among individuals undergoing certain spinal procedures. For surgeries that risk damaging the spinal cord (e.g., scoliosis correction, spinal cord tumor removal), the effectiveness of IONM has been assumed. As such, the evidence base for comparative studies is minimal. However, multiple retrospective and prospective cohort studies indicate that IONM may accurately identify those with postoperative neurological deficits. Less clear is whether knowledge of injury, intraoperatively, can lead to intervention which prevents or reverses said neurological deficits.

A systematic review concluded that IONM is sensitive and specific for detecting neurological complications during spinal surgery.[1] That review included 14 prospective cohort studies addressing a variety of spinal indications. Across all included studies, IONM was not associated with any serious harms. Authors concluded that IONM can be a valuable tool during spinal surgery when the spinal cord or nerve roots are at risk.[1]

IONM has also been proposed as potentially valuable during thyroid surgery as a means to prevent injury to the recurrent laryngeal nerve. A systematic review evaluated 17 studies

comparing thyroid surgery with and without IONM.[2] Using pooled data from those studies, authors found no statistically significant difference in recurrent laryngeal nerve palsy (RLNP) between those who had undergone thyroid surgery with or without IONM.[2] Another systematic review reported a slightly lower incidence of RLNP among those who had thyroid surgery with IONM, but this difference was not statistically significant.[3]

The American Association of Neurological Surgeons (AANS) and the Congress of Neurological Surgeons (CNS) released an updated position statement on IONM in January 2018. The AANS/CNS concluded that IONM is a reliable diagnostic tool for assessment of spinal cord integrity during surgery, but that there is insufficient evidence of a therapeutic benefit of IONM during spinal surgery.[4] In 2014, an analysis of all spine surgeries performed from 2007-2011 that were included in the Nationwide Inpatient Sample database that included 443,194 spine procedures in which 31,680 cases utilized IONM.[5] Iatrogenic neurological injury was rare, occurring in less than 1% with no difference in cases where IONM was used.[5] A 2015 analysis of a University of Texas Health Science's Center department's spine surgeries completed before and after adoption of a departmental policy limiting IONM use to intradural procedures and those for spinal deformity correction found that while utilization of IONM dropped from 38% of spinal cases to 7%, there was no change in incidence of neurological injury.[6] In fact, the only observed cases of injury occurred in cases utilizing IONM where the monitoring did not alert the surgeon to the injury.[6]

In 2017, "Guidelines for the Use of Electrophysiological Monitoring for Surgery of the Human Spinal Column and Spinal Cord" was approved by both the American Association for Neurological Surgeons and the Congress of Neurological Surgeons.[7] This Guideline was based on review of relevant published literature from 1966-2017. This guideline found that IONM "has not been shown to be successful in reducing the rate or perioperative neurological deterioration or to improve neurological outcome during spinal surgery procedures." The authors later conclude that because use of IONM during spinal surgery has not been correlated with improvements in neurological outcome that its expense does not appear justified.[7]

In a systematic review on IONM for cervical degenerative myelopathy and radiculopathy, authors concluded that altering of the surgical plan or intraoperative steroid administration based upon IONM monitoring was not shown to decrease the incidence of neurological injury. However, the review concluded that IONM may be sensitive for assessing neurological injury for diagnostic information.

The American Association of Neuromuscular and Electrodiagnostic Medicine (AANEM) released a position statement in 2014 supporting the use of intraoperative SSEP for certain spinal surgeries, particularly those with increased risk for nerve root or spinal cord injury (including complex, extensive, or lengthy procedures). Authors also stated that intraoperative SSEP was not indicated for routine lumbar or cervical root decompression.

In 2012, the American Academy of Neurology (AAN) and the American Clinical Neurophysiology Society (ACNS) identified 11 studies as part of their evidence-based guidelines process, from which they concluded the IONM is safe and effective for identifying increased risk of adverse outcomes, including paraparesis, paraplegia, and quadriplegia during spinal surgery.[8]

A 2019 Cochrane systematic review performed a comprehensive review and meta-analysis on the use of IONM for adults undergoing thyroid surgery.[9] In that review, authors found no definitive evidence that IONM was superior to visual identification of the recurrent inferior

laryngeal nerve during thyroid surgery. Measured outcomes included permanent RILN palsy (Relative Risk 0.77, 95% CI 0.33-1.77, p=NS), transient RILN palsy (RR 0.62, 95% CI 0.35-1.08, p=NS), and transient hypoparathyroidism (RR 1.25, 95% CI 0.45-3.47, p=NS). There were no significant differences in operative time.[9]

A 2021 Hayes Health Technology Assessment on IONM to detect and prevent surgical manipulations that could cause nerve damage during lumbar spinal discectomy alone or discectomy plus fusion identified 5 studies that evaluated IONM for detection of new neurological deficits and 11 studies that evaluated IONM for intraoperative guidance to prevent new neurological studies.[10] Hayes concludes that the overall body of evidence is very low in quality and not sufficient to make conclusions about the efficacy and safety of IONM for detection and prevention of new neurological deficits in patients undergoing lumbar discectomy or fusion.[10]

CODES

CPT/HCPCS	Description
General neuromonitoring	
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)
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)
Somatosensory-evoked potentials (SSEP)	
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
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
Motor evoked potentials (MEP)	
95928	Central motor evoked potential study (transcranial motor stimulation); upper limbs
95929	Central motor evoked potential study (transcranial motor stimulation); lower limbs

95939	Central motor evoked potential study (transcranial motor stimulation); in upper and lower limbs
Brainstem auditory evoked potentials (BAEP)	
92585	Auditory evoked potentials for evoked response audiometry and/or testing of the central nervous system; comprehensive
92586	Auditory evoked potentials for evoked response audiometry and/or testing of the central nervous system; limited
Electroencephalography	
95822	Electroencephalogram (EEG); recording in coma or sleep only
95955	Electroencephalogram (EEG) during non-intracranial surgery (e.g., carotid surgery)
Electromyography	
95860	Needle electromyography; 1 extremity with or without related paraspinal areas
95861	Needle electromyography; 2 extremities with or without related paraspinal areas
95867	Needle electromyography; cranial nerve supplied muscle(s), unilateral
95868	Needle electromyography; cranial nerve supplied muscles, bilateral
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
Experimental and Investigational for Intraoperative Monitoring Use	
95907-95913	Nerve conduction studies
95930	Visual evoked potential (VEP) testing central nervous system, checkerboard or flash
95937	Neuromuscular junction testing (repetitive stimulation, paired stimuli), each nerve, any 1 method

NOTE: CPTs 95925 and 95926 should not be billed during the same procedure if both upper and lower limbs are monitored; instead, CPT 95938 should be used. CPT 95938 should not be coded in conjunction with either 95925 or 95926. Similarly, 95928 and 95929 should not be billed together; instead 95939 should be used if both upper and lower limbs are monitored.

References

1. Fehlings MG, Brodke DS, Norvell DC, Dettori JR. The evidence for intraoperative neurophysiological monitoring in spine surgery: does it make a difference? *Spine (Phila Pa 1976)*. Apr 20 2010;35(9 Suppl):S37-46. doi:10.1097/BRS.0b013e3181d8338e
2. Malik R, Linos D. Intraoperative Neuromonitoring in Thyroid Surgery: A Systematic Review. *World J Surg*. Aug 2016;40(8):2051-8. doi:10.1007/s00268-016-3594-y
3. Yang S, Zhou L, Lu Z, Ma B, Ji Q, Wang Y. Systematic review with meta-analysis of intraoperative neuromonitoring during thyroidectomy. *International Journal of Surgery*. 2017/03/01/ 2017;39:104-113. doi:https://doi.org/10.1016/j.ijsu.2017.01.086
4. AANS, CNS. AANS/CNS Joint Section on Disorders of the Spine and Peripheral Nerves Updated Position Statement: Intraoperative Electrophysiological Monitoring.

5. James WS, Rughani AI, Dumont TM. A socioeconomic analysis of intraoperative neurophysiological monitoring during spine surgery: national use, regional variation, and patient outcomes. *Neurosurg Focus*. Nov 2014;37(5):E10. doi:10.3171/2014.8.Focus14449
6. Hawksworth SA, Andrade NS, Son CT, Bartanusz V, Jimenez DF. Conservative Policy for Intraoperative Neuromonitoring in Spinal Surgery. *Neurosurgery*. Aug 2015;62 Suppl 1:190-3. doi:10.1227/neu.0000000000000799
7. Hadley MN, Shank CD, Rozzelle CJ, Walters BC. Guidelines for the Use of Electrophysiological Monitoring for Surgery of the Human Spinal Column and Spinal Cord. *Neurosurgery*. Nov 1 2017;81(5):713-732. doi:10.1093/neuros/nyx466
8. Nuwer MR, Emerson RG, Galloway G, et al. Evidence-based guideline update: Intraoperative spinal monitoring with somatosensory and transcranial electrical motor evoked potentials. *Neurology*. 2012;78(8):585. doi:10.1212/WNL.0b013e318247fa0e
9. Cirocchi R, Arezzo A, D'Andrea V, et al. Intraoperative neuromonitoring versus visual nerve identification for prevention of recurrent laryngeal nerve injury in adults undergoing thyroid surgery. *Cochrane Database of Systematic Reviews*. 2019;(1)doi:10.1002/14651858.CD012483.pub2
10. Hayes. *Intraoperative Neuromonitoring for Lumbar Spinal Fusion and Discectomy*. 2021. *Health Technology Assessment*.