Somatosensory evoked potentials test

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Policy contains: Somatosensory evoked potentials test, evoked potentials, intraoperative, spinal cord, neuropathy, plexopathy.

This policy is a Sandhills Center Clinical Coverage Policy adopted from AmeriHealth Caritas of North Carolina. These clinical policies are used to assist with making coverage determinations. Sandhills Center's clinical policies are based on guidelines from established industry sources, such as the Centers for Medicare & Medicaid Services (CMS), state regulatory agencies, the American Medical Association (AMA), medical specialty professional societies, and peer-reviewed professional literature. These clinical policies along with other sources, such as plan benefits and state and federal laws and regulatory requirements, including any state- or plan-specific definition of "medically necessary," and the specific facts of the particular situation are considered by Sandhills Center when making coverage determinations. In the event of conflict between this clinical policy and plan benefits and/or state or federal laws and/or regulatory requirements, the plan benefits and/or state and federal laws and/or regulatory requirements shall control. Sandhills Center clinical policies are for informational purposes only and not intended as medical advice or to direct treatment. Physicians and other health care providers are solely responsible for the treatment decisions for their patients. Sandhills Center's clinical policies are reflective of evidence-based medicine at the time of review. As medical science evolves, Sandhills Center will update its clinical policies as necessary. Sandhills Center clinical policies are not guarantees of payment.

Coverage policy

Short latency somatosensory evoked potential testing is clinically proven and, therefore, medically necessary for diagnosis of any of the following indications (Centers for Medicare & Medicaid Services, 2019):

- Degenerative, nontraumatic spinal cord lesions (e.g., cervical spondylosis with myelopathy).
- Multiple sclerosis.
- Spinocerebellar degeneration.
- Myoclonus.
- Coma.
- Intraoperative monitoring.
- Subacute combined degeneration.
- Other diseases of myelin (e.g., adrenoleukodystrophy, adrenomyeloneuropathy, metachromatic leukodystrophy, and Pelizaeus-Merzbacher disease).
- Syringomyelia.
- Hereditary spastic paraplegia.

<u>Limitations</u>

All other uses of somatosensory evoked potentials testing are not medically necessary.

Note: Somatosensory evoked potentials studies are appropriate only when a detailed clinical history, neurologic examination, and appropriate diagnostic tests — such as imaging studies, electromyogram, and nerve conduction studies — make a lesion (or lesions) of the central somatosensory pathways a likely and reasonable differential diagnostic possibility.

Alternative covered services

Conventional nerve conduction studies or needle electromyography, as ordered, under care of a primary care physician or neurologist.

Background

Somatosensory evoked potentials are responses by the brain and spinal cord after exposure to sensory stimuli. These stimuli are generally elicited by electrical stimulation to the peripheral nerve; natural stimuli from pain or touch can also be used. Positive and negative potentials are observed after they have traveled along the somatosensory pathway. Various anatomical origins can assist in identifying the location of lesions (Yamada, 2014).

The somatosensory test for potentials involves placement of electrodes on the scalp and relevant areas of the body (e.g., arm, leg, lower back). A low-intensity electric shock is delivered through the electrodes, and the time it takes for the brain to respond is recorded. Stimulus is applied to the spinal cord, or parts of the nervous system where damage may exist. Results can indicate damage to a nerve pathway. Somatosensory evoked potentials testing is one of several types of neuromonitoring. Others include muscle motor evoked potentials, electroencephalogram, and brainstem auditory evoked potentials (Baker, 2020).

Somatosensory evoked potentials testing has been used in medical practice since the 1980s in the diagnosis and monitoring of various brain and nervous system disorders (Passmore, 2014). The technology has become a commonly used test of electrophysiological outcomes in areas such as spinal cord injury. A systematic review of 64 clinical trials showed that somatosensory evoked potentials were reported in 33%, trailing only electromyography activity (44%), and ahead of motor evoked potentials (33%), H-reflex (20%), reflex electromyography activity (11%), nerve conduction studies (9%), silent period (3%), contact heat evoked potentials (2%), and sympathetic skin response (2%) (Korupolu, 2019).

Findings

The American Academy of Neurology and American Clinical Neurophysiology Society's evidence-based guideline supports the use of somatosensory evoked potentials in spinal cord intraoperative monitoring as an effective predictor of surgical adverse outcomes, including paraparesis, paraplegia, and quadriplegia (Nuwer, 2012). The Society published a later guideline on an array of specifications, including the amplification, safety, filtering, calibration, replication, and interpretation of results of somatosensory evoked potentials testing (Legatt, 2016).

A guideline issued by the International Society of Intraoperative Neurophysiology also made recommendations on the indicated uses of somatosensory evoked potentials (MacDonald, 2019).

In October 2019, the Centers for Medicare & Medicaid Services issued a Local Coverage Determination specifying conditions for which somatosentory evoked potentials testing was indicated, along with limitations for use. Both are addressed in the coverage section of this policy (Centers for Medicare & Medicaid Services, 2019).

Few randomized trials exist comparing outcomes of patients who are versus who are not monitored intraoperatively for somatosensory evoked potentials (Baker, 2020). A study of 411 patients randomized to monitoring or no monitoring using somatosensory evoked potential monitoring during microsurgical clipping of unruptured middle cerebral artery aneurysms showed a significantly lower rate of ischemic complications in those with monitoring, 0.9% versus 5.6%. Authors state monitoring is an effective tool for prevention of ischemic complications (Byoun, 2016).

A systematic review (n = 5,607) of somatosensory evoked potentials monitoring during lumbar spine surgery found the procedure to be highly specific (97%) but moderately sensitive (44%) for detecting new post-operative neurological deficits (Chang, 2021).

A systematic review of 48 studies showed abnormal morphology in somatosensory evoked potentials and brainstem auditory evoked potentials in patients with premanifest spinocerebellar ataxia. Only hyporeflexia and abnormalities of somatosensory evoked potentials showed correlations with the time to ataxia onset, and thus are potential predictors (Kim, 2021).

A systematic review of 94 studies (n = 30,200) of comatose adults who had suffered cardiac arrest assessed various tests within seven days from return of spontaneous circulation to predict poor neurological outcome (death, vegetative state, or severe disability at discharge). Short-latency somatosensory evoked potentials was one test with a 0% false positive rate for poor outcome (Sandroni, 2020).

A systematic review of 21 studies compared the ability of various methods to detect postoperative injury in the resection of intramedullary spinal cord tumors. Sensitivity and specificity for motor-evoked potential (90% and 82%) was slightly higher than those for somatosensory evoked potentials (85% and 72%) (Azad, 2018).

A systematic review (Liu, 2017) evaluated the intraoperative warning criteria for monitoring evoked potential. Current guidelines recommend a decrease in somatosensory evoked potentials amplitude by 50% and motor evoked potentials amplitude by 50% to 100% as warning signals for injury to the ascending sensory and descending motor pathways. Of significance, 0.1% to 4.1% of monitored patients in the review suffered postoperative neurologic deficit despite apparently normal intraoperative recordings. The authors argue that until a threshold that predicts spinal cord injury can be accurately determined, it remains difficult to define the clinical utility of intraoperative neurophysiologic monitoring.

A systematic review (Thirumala, 2017) sought to determine the efficacy of intraoperative transcranial motor evoked potential in patients (n = 2,102) undergoing surgery for scoliosis, and found an observed incidence of neurologic deficits of 1.38% (29/2,102). The diagnostic odds ratio indicated that it is 250 times more likely to observe significant motor evoked potentials changes intraoperatively in patients who experience a new-onset motor deficit immediately after scoliosis surgery.

A systematic review (Thirumala, 2016a) studied the predictive value of combined multimodality somatosensory evoked potential and transcranial motor evoked potential monitoring in detecting impending neurological injury during surgery for idiopathic scoliosis. Seven studies (n = 2,052) established that the incidence of neurologic deficit in this cohort was 0.93%. The pooled sensitivity and specificity were 82.6% and 94.4%. The authors reported that patients who experience a new neurologic deficit discovered postoperatively are 106.16 times more likely to have had an somatosensory and/or transcranial motor evoked potentials change during corrective procedures, and that these results demonstrate that combined multimodality somatosensory and transcranial motor evoked potentials monitoring are advantageous in this clinical setting.

A contemporary meta-analysis (Tanaka, 2016) found motor evoked potentials monitoring intra-operatively to be high in sensitivity and specificity at predicting postoperative paraplegia in patients undergoing thoracic or thoracoabdominal aortic aneurysm surgery.

A systematic review (Thirumala, 2016b) considered the ability of intraoperative somatosensory evoked potentials to predict perioperative neurologic outcome in patients undergoing spinal deformity surgery to correct adolescent idiopathic scoliosis. Fifteen studies (n = 4,763) documented new postoperative neurologic deficits in 1.11% of the sample population. Among this population (n = 53), 75.5% showed significant somatosensory evoked potentials changes; specificity averaged 98%). The authors concluded that somatosensory evoked potentials is a highly sensitive and specific test, and that patients with iatrogenic spinal cord injury resulting in new neurologic deficits were 340 times more likely to have changes in somatosensory evoked potentials compared to those without any new deficits.

A systematic review (Thirumala, 2016c) sought to determine whether intraoperative changes in somatosensory evoked potentials during cerebral aneurysm clipping are predictive of perioperative stroke. A total of 14 articles (n = 2,015) found somatosensory evoked potentials demonstrated a strong mean specificity of 84.5%. However, there was significantly less sensitivity (56.8%) for predicting stroke. A diagnostic odds ratio of 7.772 suggested that the odds of observing a change among those with a postoperative neurologic deficit were seven to eight times greater than those without a neurologic deficit.

A systematic review (Thirumala, 2016d) studied somatosensory evoked potentials, transcranial motor evoked potentials, and electromyography as monitoring activities in anterior cervical procedures for cervical spondylotic myelopathy. The authors identified a total of only two studies (n = 173) that met inclusion criteria for the review. In both studies, procedures done without monitoring found worsening myelopathy and/or quadriplegia in 2.71% of patients without monitoring and in 0.91% of patients with monitoring. The authors opined that insufficient evidence exists to make recommendations regarding the use of different monitoring modalities to reduce neurologic complications during anterior cervical procedures.

A systematic literature review of 14 studies (n = 732) assessed the predictive ability of somatosensory evoked potentials in children with coma after acute brain injury. The presence of potentials strongly predicted favorable outcomes, as did absence of unfavorable outcomes (Carrai, 2010).

References

On July 21, 2021, we searched PubMed and the databases of the Cochrane Library, the U.K. National Health Services Centre for Reviews and Dissemination, the Agency for Healthcare Research and Quality, and the Centers for Medicare & Medicaid Services. Search terms were “evoked potentials,” “intraoperative,” “spinal cord,” neuropathy,” plexopathy.” We included the best available evidence according to established evidence hierarchies (typically systematic reviews, meta-analyses, and full economic analyses, where available) and professional guidelines based on such evidence and clinical expertise.

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Policy updates

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6/2014: Policy references updated.

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