Editorial

Intraoperative Neuromonitoring (IONM)

Dr. Farqad B. Hamdan, MBChB, MSc, PhD
Professor of Clinical Neurophysiology,
College of Medicine, Al-Nahrain University

What is IONM?

Intraoperative neuromonitoring (IONM) is the observation of a patient's nervous system (NS) during operative and other invasive procedures to assist the surgeon with avoiding patient injuries and to prevent a permanent neurological deficit[1].

IONM personnel use a neurodiagnostic device to send electricity up the spinal cord in the form of somatosensory evoked potentials (SSEPs) or down the spinal cord via transcranial electrical motor evoked potentials (TCeMEPs). Personnel use electromyography (EMG) to monitor nerves to determine if they are being unintentionally manipulated; stimulate tissue to determine if it is a nerve or not; and test pedicle screws to help assess their proper placement in the patient[2]. Personnel also can use IONM (i.e., SSEPs, electroencephalography [EEG]) to confirm adequate blood perfusion for specific procedures[3].

A rudimentary form of IONM was first used in neurosurgery in the late nineteenth century [4]. In 1939, this technique was used to measure and record brain activity via EEG for the treatment of epilepsy[5]. In the 1980s, an electrophysiological system that recorded SSEPs was introduced in spinal procedures for scoliosis [6]. Since then, advances in technology and new techniques have expanded the role of IONM beyond neurological and orthopedic surgery to include otorhinolaryngology surgery[7], vascular surgery[8], and interventional radiology[9].

What is the purpose of IONM?

The purpose of IONM is to protect the NS. The real-time information of IONM can often prevent neurological injury (damage to the brain, spinal cord, or nerves). When neurological injury does occur, the immediate feedback from IONM allows the surgeon, anesthesiologist and nurses to quickly respond to minimize long-term post-operative damage[1]. IONM provides an additional layer of safety for both the patient and the surgeon. Introduction of IONM has reduced the risk of debilitating deficits such as muscle weakness, paralysis, hearing loss, and other loss of normal body functions[10].

How does IONM work?

Typically, IONM works through measuring and creating electrical impulses and determining their effect on the NS. To gather this information, electrodes are attached to the wrist, ankles, scalp, and sometimes to specific muscle groups, depending on the type of surgery. The electrodes record the response of NS to electrical stimulus and can indicate changes in the functioning of NS. If there are significant changes, the clinician will immediately alert the surgeon and, if necessary, appropriate intervention is initiated[1].

What are the benefits of IONM?

IONM provides critical information about the neurological system to the surgeon during surgery to protect the patient and to increase the chance of a positive surgical outcome. IONM risks are so minimal.

What procedures typically have IONM services?

The use of IONM is very individual, depending on the type of surgery, what is at risk, and the surgeon's preference. IONM participate most in the following [10]:

1. Neurosurgical: including craniotiomies for tumor removal, spinal cord neoplasms, diskectomies, laminectomies, aneurysms, microvascular decompression, intra/extramedullay spinal cord tumors,

peripheral nerve injury, brachial plexus nerve injury, selective dorsal rhizotomies, AVM, posterior fossa decompression for Arnold Chiari Malformations.

2. Otolaryngology: including acoustic neuroma / vestibular schwanoma.
3. Orthopedics: including scoliosis, spinal laminectomies and fusion, spinal diskectomies, acetabular fractures and revision, stenosis, spondylilosthesis, hip lengthening & replacements.

Depending on the procedure, a variety of tests can be used to measure the NS function such as motor evoked potentials (EPs), somatosensory EPs, brainstem auditory EPs or corticobulbar motor EPs, and free-running electromyography.

REFERENCES:

1. New to IONM? The American Society of Neurophysiological Monitoring. https ://www.asnm.org/page/NewIONM. Accessed Oct. 9, 2020.
2. Kim SM, Kim SH, Seo DW, et al. Intraoperative neurophysiologic monitoring: basic principles and recent update. J Korean Med Sci. 2013; 28(9):1261-1269.
3. Roth M, Rakers L. Intraoperative neuromonitoring: principles and considerations for perioperative nurses. Aorn J. 2019; 110(1):11-26.
4. Horsley V. Brain-surgery. Br Med J. 1886; 2:670-675.
5. Engel J Jr. Historical perspectives. In: Engel J Jr, ed. Surgical Treatment of the Epilepsies. 2nd ed. New York, NY: Raven Press; 1993: 695-705.
6. Whittle IR, Johnston IH, Besser M, et al. Intra-operative spinal cord monitoring during surgery for scoliosis using somatosensory evoked potentials. Aust N Z J Surg. 1984; 54(6):553-557.
7. Christoforides C, Papandrikos I, Polyzois G, et al. Two-stage thyroidectomy in the era of intraoperative neuromonitoring. Gland Surg. 2017; 6(5):453-463
8. Sridharan ND, Thirumala P, Chaer R, et al. Predictors of cross-clamp-induced intraoperative monitoring changes during carotid endarterectomy using both electroencephalography and somatosensory evoked potentials. J Vasc Surg. 2018; 67(1):191-198.
9. Kurup AN, Morris JM, Boon AJ, et al. Motor evoked potential monitoring during cryoablation of musculoskeletal tumors. J Vasc Interv Radiol. 2014; 25(11):1657□1664.
10. What is intraoperative monitoring. http://stsiom.com/patient-information/patient-faqs/. Accessed Oct. 8, 20020.