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Neurological Outcomes Following Spinal Tumour Procedures and Intraoperative Neurophysiological Monitoring: A Single Institution Experience

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Abstract

Our research on the use of multimodal intraoperative neurophysiological monitoring (IONM) during intradural spinal tumor surgery will be presented in this abstract. The intraspinal tumor surgery that was performed at the Vajira Center of Excellence in Neurosurgery was the subject of this cohort's retrospective review; from 2005 to 2020. For IONM with alarm criteria, transcranial motor evoked potentials, somatosensory evoked potentials, and free run electromyography were utilized. Reviews of the patient's records included measurements of neurological outcomes both before and after surgery; Frankel Grading, McCormick Score, Karnofsky Performance Status (KPS) Scale, American Spinal Injury Association (ASIA) Grading, and The Japanese Orthopedic Association (JOA) Score at 1, 6, 12, and 24 months after surgery 104 patients were operated on in total. IONM was used in 77.4% of the operations. 70.2 and 16.7% of tumors were found in the intradural extramedullary (IDEM) space, respectively. All follow-up time in the IONM group showed a statistically significant improvement (p-value 0.050) between preoperative and postoperative neurological outcomes. Alarm IONM had a sensitivity of 66.7 percent and a specificity of 88.7 percent, respectively, for predicting early worsening of the neurological outcome following surgery. Surgery for IDEM spinal cord tumors is linked to a favorable neurological outcome (OR 0.187, 95% CI 0.05–0.71); p-value of 0.014 The use of IONM in intradural spinal tumor surgery resulted in a statistically significant improvement in neurological outcomes and a decrease in neurological deficits following the procedure. With fair sensitivity and high specificity, IONM can identify neurological deficits and poor outcomes following surgery. In particular, using IONM in IDEM results in better neurological outcomes after surgery.

Keywords: Intradural spinal tumor • Intraoperative neurophysiological monitoring • Neurological outcomes

Introduction

Approximately 15% of neurogenic tumors are intraspinal. Primary intraspinal tumors are those that originate in intraspinal tissues; secondary intraspinal tumors are those that originate in tissues that extend beyond the intraspinal origin or that have metastasized long distances to spinal tissues. Surgical decompression, with or without instrumentation, is the treatment of choice for patients who present with symptoms or notice that there is evidence of tumor growth. The "gold standard" for most intraspinal tumors is total resection. On the other hand, total resection is not safe whenever tumors are adjacent to significant structural elements [1,2]

Description

The removal of a spinal cord lesion always carries the possibility of neurological damage after surgery. Nerve root deficits have a postoperative complication rate of 6–8%, and myelopathy has a rate of 3–12%.Today, technological advancements have significantly improved intraoperative neurophysiological monitoring (IONM) during spinal surgery. The benefit of IONM has been reported in deformity spinal surgery. IONM shows high sensitivity and specificity in deformity correction spinal surgery, preventing postoperative neurological complications. The goal of the IONM is to prevent irreversible neural injury by using the appropriate IONM modalities that alert, rather than predict, a neurological complication. In this, IONM is using electrophysiological recordings such as motor evoked potential (MEP), somatosensory [3,4].

In this study, the neurological outcomes of intradural spinal tumor surgeries with and without IONM were compared. In order to demonstrate the ability of IONM to predict postoperative neurological outcome and neurological recovery in intradural spinal tumors, we conduct a retrospective study. The study's retrospective design only provides original information from a setting with limited resources, making it worthy of consideration. During the first few years of this study, our academic hospital performed surgical removal of the tumor prior to the IONM era. We used IONM for every operation during the IONM era. Multimodal IONM included transcranial MEP, SSEP, and continuous EMG in all patients. Transcranial stimulation of the right and left primary motor cortex produced MEP. Two pairs of electrodes are positioned on each hand to monitor the muscles of the upper extremities (deltoid, biceps brachii, brachioradialis abductor digiti minimi, abductor pollicis brevis). Eight electrode pairs are positioned on four bilateral muscle groups for the lower extremities (right and left: biceps femoris, vastus medialis, anterior tibialis, and medial gastrocnemius). The peroneal nerve at the tibial nerve in the popliteal fossa in the lower extremities and the posterior tibial nerve at the foot served as alternate stimulation sites for SSEP. After positioning, baseline signals were recorded as part of the monitoring procedure. SSEP and EMG baseline signals were continuously monitored, while MEP signals were obtained prior to and following tumor decompression, prior to closure, and whenever the surgeon requested it [5].

MEP was developed to better characterize the integrity of the corticospinal tracts. In the 1970s, SSEP were developed as an indirect method of monitoring the ventral corticospinal tracts through dorsal column integrity. However, several studies reported its limitation regarding postoperative neurological deficit in normal SSEP. EMG is a real-time monitoring of nerve root function, particularly during instrumentation and manipulation during surgery. Due to the

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effectiveness of replacing the limitations of individual monitoring, multimodality neurophysiological monitoring has become a standard procedure for a variety of spinal procedures. In addition, it was useful for predicting postoperative neurological deficit and recovery. Spinal deformity surgery has utilized a combination of MEP and SSEP monitoring. In particular, the addition of free running EMG and triggered EMG can improve the efficiency with which nerve root injuries can be detected. Correlations between IONM changes and postoperative neurological outcomes indicate that alarm IONM contributed to postoperative neurological poor outcome or neurological deficit. It may assist in detecting early neural injury at a reversible stage, preventing poor postoperative outcomes. On the other hand, intraoperative recovery of the IONM modality can indicate a favorable postoperative outcome. In addition, it aids in improving the assessment of neural function, thereby guiding intraoperative decision-making regarding what should be done at that time for the management of alarm IONM in that position. In order to determine the relationship between IONM use and neurological outcomes after surgery, we used a variety of measurements, including the KPS Scale, the Frenkel Grade, the JOA Score, the ASIA Score, and McCormick Score [6-9].

Conclusion

All measurements improved over the 24 months following surgery in both groups, but only the IONM group saw a statistically significant improvement. Additionally, there was a statistically significant distinction in the improvement of the neurological postoperative outcome between the IONM and non-IONM groups. In addition, all measurements decreased in the non-IONM group one month after surgery; however, neurological outcomes improved following treatment, but not by a statistically significant amount. Minor surgical injuries to the neural integrity, such as intraoperative manipulation or neural tissue contusion during tumor dissection, are probably to blame for this. In intradural spinal tumor surgery, we presume that the routine use of multimodality IONM resulted in a decrease in neurological deficit and improved postoperative neurological outcome.

Acknowledgement

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Conflict of Interest

None.

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