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Intraoperative Neuromonitoring in Cervical Spine Surgery: Indications, Issues and New Developments

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Abstract

Cervical spine surgery is a complex procedure that carries potential risks for neurological damage due to the proximity of critical neural structures. To mitigate these risks, Intraoperative Neuromonitoring (IONM) has emerged as an invaluable tool. IONM involves real-time monitoring and assessment of neurological functions during surgery, providing surgeons with crucial information to make informed decisions and minimize postoperative complications. This article explores the indications and benefits of IONM in cervical spine surgery, highlights common issues and challenges associated with its implementation, and discusses recent advancements in the field.

Keywords: Intraoperative neuromonitoring • Cervical spine surgery • Cervical

Introduction

The implementation of IONM in cervical spine surgery is guided by specific indications. These include procedures involving extensive decompression, spinal fusion, correction of deformities, and tumour resection. IONM is particularly useful when the surgical approach involves the manipulation or retraction of neural structures, as it allows for the early detection of potential nerve damage, enabling timely interventions. Additionally, patients with pre-existing neurological deficits or risk factors, such as spinal cord compression or previous spinal surgery, benefit from IONM to minimize the risk of further neurological injury [1]. IONM offers several benefits in cervical spine surgery. Firstly, it provides real-time feedback to surgeons regarding the integrity and functionality of neural structures, allowing them to modify their approach if necessary. By identifying and addressing potential nerve injuries promptly, IONM contributes to better patient outcomes and reduced postoperative complications. Secondly, IONM helps differentiate between reversible and irreversible neural insults, aiding surgeons in making informed decisions during critical moments of the procedure. Moreover, IONM can assist in optimizing the placement of instrumentation, such as pedicle screws, by verifying their location and preventing neural compromise [2].

Literature Review

Despite its benefits, IONM also has limitations. False-positive and false-negative results are possible, requiring experienced professionals to interpret and integrate the information into the surgical plan accurately. Technical issues, such as electrode misplacement or interference, can impact the quality and reliability of monitoring. Furthermore, IONM does not completely eliminate the risk of neurological injury; it serves as an adjunct tool and should be used in conjunction with other surgical techniques and expertise [3]. Several challenges exist in the implementation of IONM in cervical spine surgery. One significant challenge is the lack of standardized protocols and guidelines for its utilization. Variations in monitoring techniques, equipment, and interpretation can lead to inconsistencies in practice. Standardization efforts are ongoing, aiming to establish evidence-based guidelines and promote uniformity in IONM procedures.

Discussion

Another challenge is the training and expertise required for IONM. The interpretation of monitoring data demands specialized knowledge and experience. Surgeons must collaborate closely with neurophysiologists and IONM teams to ensure accurate interpretation and effective communication during surgery [4,5]. Recent developments in technology have advanced the field of IONM. The integration of multimodal monitoring, including Somatosensory Evoked Potentials (SSEPs), Motor Evoked Potentials (MEPs), and Electromyography (EMG), has improved the sensitivity and specificity of IONM. This multimodal approach allows for comprehensive monitoring of various neural pathways simultaneously [6]. Additionally, advances in machine learning and artificial intelligence have the potential to enhance IONM. These technologies can aid in real-time data analysis, pattern recognition, and prediction of neurological outcomes, further assisting surgeons in decision-making during surgery.

Conclusion

Intraoperative neuromonitoring is a valuable tool in cervical spine surgery, enabling real-time assessment of neurological function and aiding in the prevention of postoperative complications. Its indications include procedures involving extensive decompression, fusion, deformity correction, and tumour resection. While IONM offers numerous benefits, challenges exist regarding standardization and the need for specialized training. Nevertheless, advancements in technology, such as multimodal monitoring and artificial intelligence, hold promise for further improving the efficacy of IONM. With continued research and collaboration between surgeons, neurophysiologists, and engineers, the future of IONM in cervical spine surgery looks promising.

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Conflict of Interest

None.

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