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Scoliosis and Intraoperative Neurophysiological Monitoring: Benefits of Using Multimodality IONM During Complex Spine Surgeries - Part 2.

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The Crucial Role of Somatosensory Evoked Potentials (SSEPs)

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INTRODUCTION

Somatosensory Evoked Potentials (SSEP) is a crucial component of intraoperative neurophysiological monitoring (IONM), specifically designed to assess the nervous system's sensory or ascending/afferent pathways. These pathways transmit sensory signals from the extremities to the brain via the spinal cord and brainstem. SSEPs play a vital role in monitoring the optimal functional condition of these pathways during complex surgeries, thereby mitigating the risk of potential damage to the patient.

The somatosensory evoked potentials (SSEP) focus on the somatosensory aspect of the nervous system, offering numerous benefits beyond intraoperative monitoring. It plays a crucial role in diagnosing and researching diseases that affect the spinal cord and the brain. SSEP is widely used to detect diseases and injuries involving the spinal cord and neuromuscular and demyelinating disorders. Additionally, SSEPs provide surgeons with real-time feedback during procedures, reducing the risk of patients experiencing long-term neurological deficits and evaluating vascular aspects such as blood flow to the surgical area.

To fully appreciate the multitude of benefits offered by SSEPs, it is imperative to have a thorough understanding of the operational mechanisms of this IONM modality. During a surgical procedure, stimulating electrodes are precisely positioned on the extremities, such as the nerves in the ankles or hands. In contrast, recording electrodes are meticulously placed on the scalp following a specific international head

measurement system. These electrodes assess the duration it takes for an input to travel from an extremity to the brain (from a stimulating electrode in the peripheral nervous system to a recording electrode in the central nervous system). Detecting any existing or potential future injuries to the neural tissue in the surgical area of interest is paramount. For instance, anomalies in the time it takes for an input from the ankle to reach the brain, such as slowness or a decrease in size, could signify an abnormality demanding immediate attention.

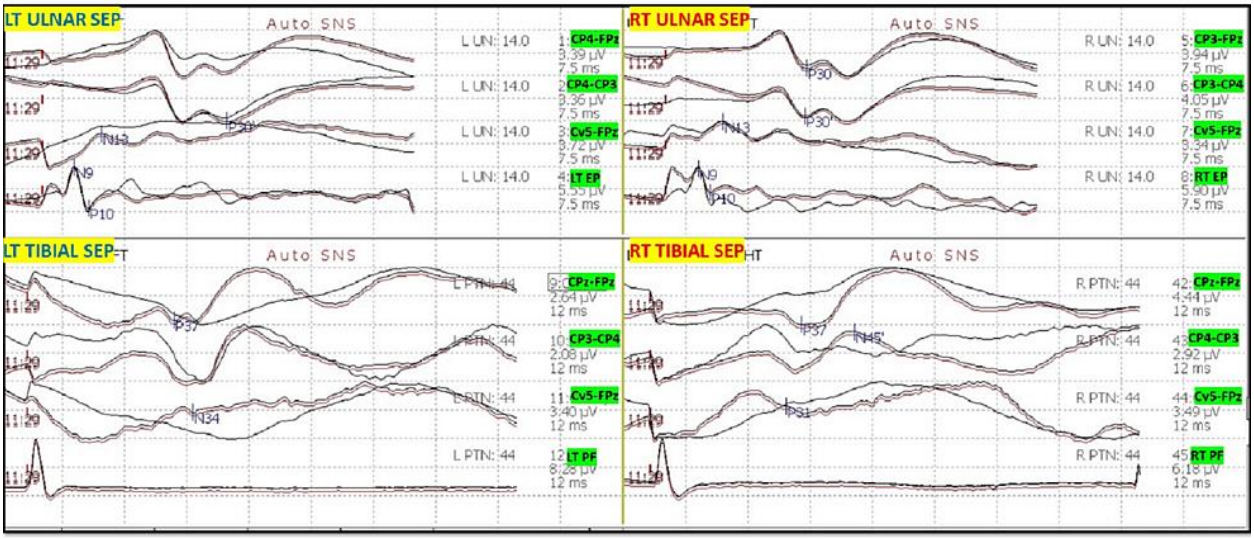

Figure 1. Baseline Somatosensory Evoked Potentials (SSEP). Reliable and reproducible SSEP were recorded at the baselines from ulnar nerves in the upper extremity and posterior tibial nerves in the lower extremities. LT: Left, RT: Right. EP: Erb's Point, PF: Popliteal Fossa (*Reprinted with permission from Jahangiri FR et al.* 2022).

Regarding surgical procedures involving spinal diseases such as scoliosis, SSEPs play a fundamental role in evaluating the state of the disease intraoperatively by minimizing any further damage and risks that could lead to severe post-operative side effects. For instance, in the paper - *Syringomyelia, A Potential Risk Factor in Scoliosis Surgery by Noordeen et al. (1994),* it is mentioned how Syringomyelia, which is a CSF (cerebrospinal fluid)-filled cyst within the spinal canal and spinal cord and is considered as a common disorder caused by Scoliosis, represents an even greater risk for scoliosis corrective surgical procedures. This neurological problem also represents a danger on its own since the cyst, also known as the syrinx, increases with time and thus could end up compressing vital neural tissue in the surrounding area. Thus, using SSEPs in this type of scoliosis case is highly recommended. Furthermore, it also showed how decreases in SSEP intraoperative signals were directly correlated to higher postoperative risks. Additionally, spinal distraction, the force exerted manually on a spinal area of interest, is also linked to a higher risk of spinal injuries in patients with scoliosis. The data also showed that decreased spinal distraction positively

affected SSEPs' intraoperative responses, thus increasing the possibility of higher positive postoperative outcomes in patients suffering from scoliosis-syringomyelia problems.

It's crucial for a patient with Scoliosis, a severe spinal deformity that can lead to loss of neural activity if left untreated, to undergo surgical treatment as soon as possible. Therefore, it is essential to understand the significance of IONM modalities such as SSEPs and motor evoked potentials (MEPs) and their transformative impact on complex corrective spinal surgeries.

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