Timing of Femoral Nerve Injuries in LLIF. Using TMAP with an Event Based Protocol

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INTRODUCTION:

Lateral lumbar interbody fusion (LLIF) carries a significant risk of femoral nerve injury, particularly at L4-5, where neural structures are close to the transpsoas corridor. While neuromonitoring techniques such as triggered electromyography and somatosensory evoked potentials are widely used, they lack the real-time sensitivity and specificity necessary for reliably detecting nerve compromise. The absence of real-time neuromonitoring data in LLIF has limited the understanding of when and how femoral nerve injuries occur, leaving surgeons without a clear strategy to mitigate these injuries intraoperatively. This study aims to bridge this gap by correlating intraoperative Transabdominal Muscle Action Potential (TMAP) neuromonitoring changes with specific procedural steps.

METHODS:

A retrospective analysis was conducted on consecutive patients who underwent single-position prone LLIF from 2020 to 2024. Patients with lateral implants placed in the femoral nerve distribution (L2-5) were included. TMAP was utilized intraoperatively at predefined procedural steps to monitor nerve integrity. TMAP changes were correlated with postoperative quadriceps motor deficits to determine the timing of injury. Sensitivity, specificity, and predictive thresholds of TMAP were also analyzed.

RESULTS:

One hundred sixty-one patients (average age 67.9 ± 9.8 years, BMI 30.7 ± 5.6 kg/m²) were included, 63.4% were female and 82.6% underwent LLIF at L4-5. Postoperative quadriceps weakness (≤3/5 strength) occurred in four patients (2.5%), with no significant difference in retractor times between injured and uninjured patients. Uninterrupted TMAP monitoring was achieved in all cases. TMAP detected all injuries intraoperatively, demonstrating 100% sensitivity at the 150 mA alert threshold, though specificity remained low (38.9%). Alternative threshold analysis identified an optimal TMAP threshold of 400-500 mA, significantly improving specificity to 83.4-89.8% while maintaining 100% sensitivity. The event-based protocol revealed that injuries were linked to specific procedural steps, with the docking phase posing the highest risk for femoral nerve injury.

DISCUSSION AND CONCLUSION:

This study provides new insights into femoral nerve injuries in LLIF, demonstrating that nerve compromise is more strongly associated with specific procedural steps rather than prolonged retractor time. TMAP, integrated with an event-based protocol, enabled real-time identification of nerve compromise, revealing that direct mechanical trauma was the primary mechanism of femoral nerve injury in LLIF.