

Critical Events Before Spinal Cord Injury in a Porcine Compression Model

Jesse Galina, BS¹; Vishal Sarwahi, MD¹; Aaron Atlas, BS¹; Sayyida Hasan, BS¹; Beverly Thornhill, MD²; Alan Legatt, MD, PhD³; Abhijit Pawar, MD²; Marina Moguevich, MD²; Terry Amaral, MD¹

¹Cohen Children's Medical Center, New Hyde Park, NY; ²Montefiore Medical Center, Bronx, NY; ³Montefiore Medical Center, New Hyde Park, NY

Recipient: Jesse Galina, BS

Purpose: Spinal cord injuries are one of the most devastating in spine surgery. Some cases of intraoperative neuromonitoring changes can occur as a secondary characteristic of spinal cord compression and a decrease in blood flow. Laser Doppler flowmetry has been well validated for measuring blood flow. The objective of this study is to identify measurable, critical events that occur before and during an evolving spinal cord injury.

Methods: After prone positioning and induction, multi-level laminectomies are performed in the midthoracic region. LDF electrodes were placed on the exposed dura in multiple areas to measure real-time spinal cord blood flow. Spinal cord injury was induced by incremental balloon inflation after being placed in the epidural space. After MEP loss (injury), several interventions were carried out: raising the systolic BP, expanding the intravascular volume with colloids, and IV lidocaine. After interventions, a wake-up test was performed, and a CT scan was done to measure the thoracic spinal canal volume. There were two groups based on timing of intervention. In Group A, medical interventions were administered before balloon deflation; in Group B, balloon deflated first.

Results: Seventeen pigs were studied, 14 of which survived and completed the experiment. Recordable SCBF changes (-13% - 13%) from baseline were seen

3-32 minutes before MEP loss in all pigs. For this reason, we considered 3 minutes to be the critical time before spinal cord injury. However, the 20% threshold interval was often reached before the 3-minute mark. Three minutes before MEP loss, change in SCBF was -24.9% and balloon pressure was 9 psi. The balloon volume was 0.63 cc. The spinal canal compromise three minutes before MEP signals loss was 69.3%, while SCBF 3 minutes before MEP loss was 71. This was a 24.85% change from baseline SCBF. In Group A, no pigs were moving their hind limbs. In Group B, 9/10 were found to be moving their hind legs.

Conclusion: Compression SCI is the end of a cascade involving increasing pressure, decreasing volume, and hypoperfusion. Rapid relief of compression leads to MEP return and function. SCBF monitoring can detect ischemia pre-injury, giving surgeons an opportunity for early intervention.

The Mission of the AAP Section on Orthopedics is to foster the health of children through the AAP by mentorship, education, advocacy, and research. The AAP Section on Orthopedics has also collaborated with POSNA in joint leadership meetings creating shared strategic plans. Through these shared visions and collaborations our organizations have collectively partnered with the 50,000 pediatricians within the AAP to advocate for injured and ill children throughout the world.