

Development and Pilot Results from a Large Animal Study to Measure Cerebrospinal Fluid Pressure before, during and after Spinal Cord Injury

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ABSTRACT

Introduction and Objective

The interactions between the spinal cord, cerebrospinal fluid (CSF), and dura during and immediately following spinal cord injury (SCI) are not well understood. This study aims to quantify CSF pressures experienced during injury, and to determine how CSF pressure varies cranially and caudally following acute SCI to evaluate CSF drainage for SCI treatment.

Methods

CSF pressure (CSFP) was measured at three spinal levels in anaesthetized pigs (N=6, 30-40kg), before, during and after a sustained SCI and subsequent decompression. Two multilevel laminectomies were performed, exposing the spinal cord in the thoracic and lumbar regions. Catheters (ϕ 1mm) were inserted several spinal levels above (CSFP-U) and below (CSFP-L) the injury site and connected to pressure transducers. A Fibre Bragg Grating pressure sensor (FBG, ϕ 0.4mm) was inserted approximately 1 cm cranial to the injury site. The SCI consisted of a 50g spherical weight dropped from 50 cm. After impact a further 100g was added statically to ensure subarachnoid occlusion. The pigs remained under anaesthesia, received analgesics and neuromuscular blockers throughout, and were euthanized post-procedure. This protocol was approved by the UBC Animal Care Committee (#A07-0363).

Summary of Results and Current Conclusions

In the three animals for which FBG data was obtained the pressure adjacent the injury increased in two and decreased in one (1475, 1890, -1775 mmHg). Two animals survived the entire procedure. CSFP-U was unchanged or increased after the injury (0, 0.64 mmHg), while CSFP-L increased (2.45, 1.76 mmHg). At 0.5 and 1 hours of sustained occlusion, CSFP-U decreased compared to immediately post-injury (0.5hr: -5.7, -0.57 mmHg; 1hr: -5.5, -0.36 mmHg). CSFP-L showed a similar trend (0.5hr: -1.8, -1.83 mmHg; 1hr: -2.5, -1.41 mmHg). Post-decompression CSFP-U was increased compared to pre-decompression (0.5hr: 1.76, 0.23 mmHg; 1hr: 0.98, 2.52 mmHg), while CSFP-L tended to decrease (0.5hr: -0.31, 0.17 mmHg; 1hr: -0.84, -1.86 mmHg). This study serves as baseline data and verification of our methods.