

Spinal cord perfusion pressure measured with lumbar intrathecal catheters predicts neurological recovery in acute spinal cord injury

J. Squair; L. Bélanger; A. Tsang; L. Ritchie; JM Mac-Thiong; S Parent; S Christie; C Bailey; S Dhall; J Street; T Ailon; S Paquette; N Dea; C Fisher; M Dvorak; C West; B Kwon

Introduction

The current clinical practice guidelines for hemodynamic management of acute spinal cord injury (SCI) recommend that the mean arterial pressure be maintained between 85-90 mm Hg for the first seven days postinjury, with the use of vasopressors if necessary. A potentially important limitation with the present approach is the exclusive focus on mean arterial pressure, and not the spinal cord perfusion pressure. Our goal was to determine whether spinal cord perfusion pressure as measured with a lumbar intrathecal catheter is a more predictive measure of neurologic outcome than the conventionally measured mean arterial pressure.

Methods

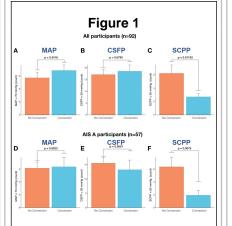
Ninety-two acute individuals with acute SCI were enrolled in this multi-center prospective observational clinical trial. Mean arterial pressure and cerebrospinal fluid pressure were monitored during the first week post-injury. Neurologic impairment was assessed at baseline and at six-months postinjury. We used logistic regression, systematic iterations of relative risk, and Cox proportional hazard models to examine hemodynamic patterns commensurate with neurologic outcome.

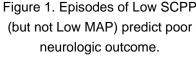
Results

We found that spinal cord perfusion pressure (OR=1.039, p=0.002) is independently associated with positive neurological recovery. The relative risk for not recovering neurological function continually increased as individuals were exposed to spinal cord perfusion pressure below 50 mmHg. Individuals who improved in neurological grade dropped below spinal cord perfusion pressure of 50 mmHg less times than those who did not improve (p=0.012). This effect was not observed for mean arterial pressure or cerebrospinal fluid pressure. Those who were exposed to spinal cord perfusion pressure below 50 mmHg were less likely to improve from their baseline neurologic impairment grade (p=0.0056).

Conclusions

We demonstrate that maintaining spinal cord perfusion pressure above 50 mmHg is a strong predictor of improved neurological recovery following SCI. This suggests spinal cord perfusion pressure (as measured with a standard lumbar intrathecal catheter) can provide useful information to guide the hemodynamic management of acute SCI patients.





The number of times (count) individuals drop below set cut-offs is shown for those who do not convert (orange) and those that

convert (blue). This was significantly different only for spinal cord perfusion pressure (panel A, SCPP), but not for either mean arterial pressure (panel B, MAP) or cerebrospinal fluid pressure cut-offs (panel C, CSFP). In essence, episodes of low SCPP (but not low MAP) predicted a poor neurologic outcome. This finding was consistent in a sub-analysis where only individuals with a baseline AIS score of "A" were considered (n = 57; panels D-F). Bar plots represent the mean and error bars the standard error. Note: CSFP cut-offs represent the number of times an individual exceeds the pressure value.

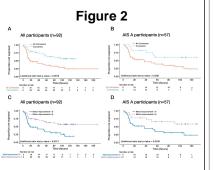


Figure 2. Low spinal cord perfusion pressure exposures occur primarily within the first day post-injury and significantly influence outcome. Kaplan-Meier plots of exposure status to low spinal cord perfusion pressure (below 50 mmHg) are shown for AIS conversion (panels A, B) or for total motor score improvement (panels C, D). Cox proportional hazard models revealed a statistically significant likelihood ratio test between those who

neurologically improved (i.e. conversion (p=0.0018) and total motor score improvement (p=0.0017) versus those that did not improve. In essence, exposure to low SCPP in the first 24 hours nearly halves the chances of neurologic recovery. This finding was consistent in a sub-analysis where only individuals with a baseline AIS score of "A" were considered (n = 57; panels B, D; p=0.0221, p=0.0230).

Learning Objectives

By the conclusion of this session, participants should be able to: 1) discuss the difference between spinal cord perfusion pressure monitoring and mean arterial pressure monitoring, 2) describe the importance of monitoring cerebrospinal fluid pressure, and 3) discuss the potential benefits of optimizing spinal cord perfusion pressure in the acute phase after SCI.

References

Kwon BK, Curt A, Belanger LM, Bernardo A, Chan D, Markez JA, Gorelik S, Slobogean GP, Umedaly H, Giffin M, Nikolakis MA, Street J, Boyd MC, Paquette S, Fisher CG, Dvorak MF. Intrathecal pressure monitoring and cerebrospinal fluid drainage in acute spinal cord injury: a prospective randomized trial. J Neurosurg Spine. 2009 Mar;10(3):181 -93. PubMed PMID: 19320576.

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