



Cerebral Vasospasm: what happens to Critical Closing Pressure?

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Introduction

The effect of cerebral vasospasm on critical closing pressure following subarachnoid haemorrhage has not been fully delineated. [1]

- Using a new methodology we sought to describe the behaviour of CrCP during CVS.
- As CrCP is the sum of intracranial pressure and vascular wall tension, we also explored its role in reflecting changes occurring in small vessels distal to CVS. [2]

CrCP = ICP + WT

Methods

This retrospective analysis included recordings from 98 aneurysmal SAH patients, 52 of whom were diagnosed with CVS through transcranial Doppler FV measurements. CrCP was calculated non-invasively using the cerebral impedance methodology. Measurements of ICP were available in 21 patients, and were used to validate non-invasive CrCP.

Critical Closing Pressure methods

$$CrCP = ABP - \frac{CPP}{\sqrt{(CVR \cdot Ca \cdot HR \cdot 2\pi)^2 + 1}}$$
 A

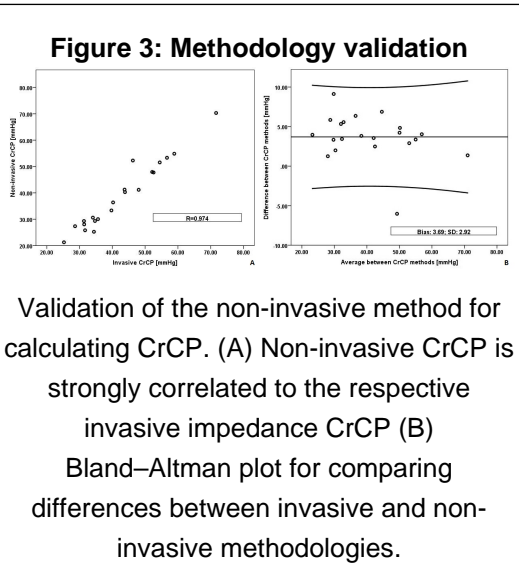
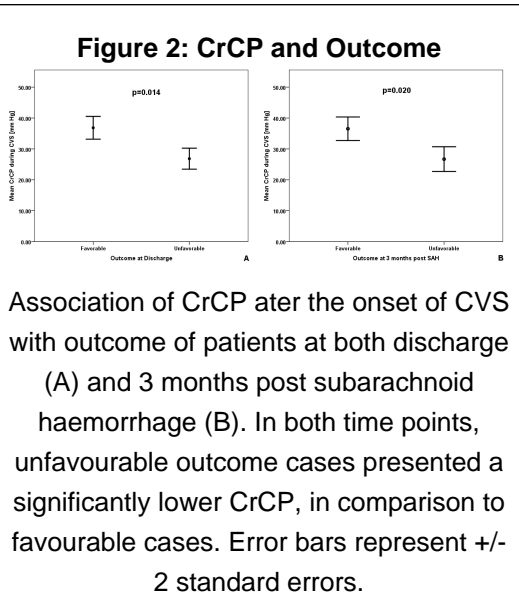
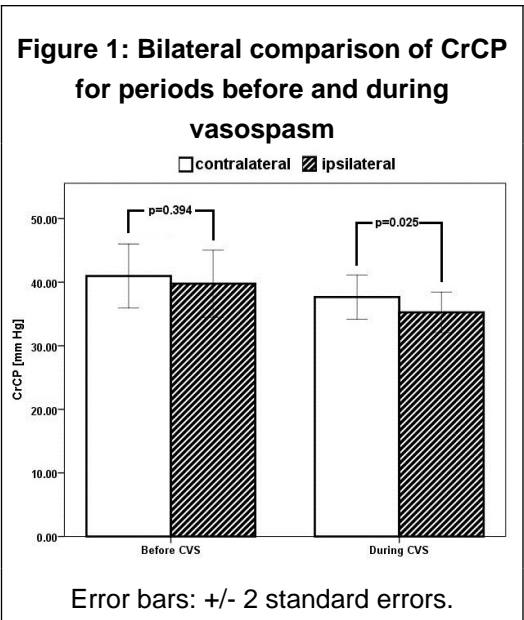
$$CrCP = ABP \cdot [1 - \frac{1}{\sqrt{(CVR \cdot Ca \cdot HR \cdot 2\pi)^2 + 1}}]$$
 B

Invasive (A) and non-invasive (B)

Results

I: The onset of CVS caused a significant decrease in CrCP (p=0.025) and induced asymmetry, with CrCP ipsilateral to CVS becoming significantly lower than contralateral (p=0.025). In contrast, no significant interhemispheric difference was found before CVS (*Figure 1*). ICP did not differ with presence of CVS (p=0.134).

II: CrCP was independently to FV associated with outcome, with unfavourable cases assessed at both discharge and at 3 months post SAH having a significantly lower CrCP after the onset of CVS (p=0.014 and p=0.020 respectively; *Figure 2*)



Conclusions

- CrCP became lower in presence of CVS and was associated with an unfavorable outcome.
- As ICP remained unchanged during CVS, reduced CrCP probably reflects a lower WT and dilated small vessels distal to CVS.

References

1. Soehle M et al. Critical Closing Pressure in Subarachnoid Hemorrhage: Effect of Cerebral Vasospasm and Limitations of a Transcranial Doppler-Derived Estimation. *Stroke* 2004; 35: 1393–1398.
2. Dewey RC et al. Experimental cerebral hemodynamics. Vasomotor tone, critical closing pressure, and vascular bed resistance. *J Neurosurg* 1974; 41: 597–606.
3. Varsos GV et al. Critical closing pressure determined with a model of cerebrovascular impedance. *J Cereb Blood Flow Metab Off J Int Soc Cereb Blood Flow Metab* 2013; 33: 235–243.

Abbreviations

ABP: arterial blood pressure; CPP: cerebral perfusion pressure; CrCP: critical closing pressure; CVS: cerebral vasospasm; FV: blood flow velocity HR: heart rate; ICP: intracranial pressure; SAH: subarachnoid haemorrhage; WT: vascular wall tension