ADAPTATION OF CEREBRAL PRESSURE-VELOCITY HEMODYNAMIC CHANGES OF NEUROVASCULAR COUPLING TO ORTHOSTATIC CHALLENGE

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ABSTRACT
Regional evoked cerebral blood flow increase due to a cortical activation by a task, also known as neurovascular coupling, can be evaluated with transcranial Doppler. We investigated the behaviour of different cerebral blood pressure-velocity models during neurovascular coupling. In our study, a 2-parameter model including resistance-area product (RAP) and critical closing pressure (CrCP) showed better discrimination of cerebral vasomotor changes than the classical cerebrovascular resistance index.

INTRODUCTION
Regional evoked cerebral blood flow increase due to a cortical activation by a task, also known as neurovascular coupling (NVC) (Iadecola, 1993 and 2007), can be evaluated with functional transcranial Doppler (TCD) (Aaslid, 1989; Paulson, 1990; Tiecks, 1998). Another cerebrovascular regulatory mechanism, the cerebral autoregulation, adapts cerebral blood flow to changes in blood pressure, that can occur namely changing the orthostatic condition. NVC, analysed by a control system approach (Rosengarten, 2001), was shown to be unaffected by orthostatic challenge (Azevedo, 2007), but data is lacking regarding the mechanism of this interplay and the behaviour of other cerebrovascular reactivity parameters. We investigated the changes in different pressure-velocity models during functional TCD, under different orthostatic conditions.

Thirteen healthy volunteers performed a reading test stimulation task in sitting, supine and head-up tilt (HUT) positions. CBF velocity was monitored with TCD in the posterior cerebral artery (Rosengarten, 2001), and blood pressure was monitored with Finapres. Cerebrovascular resistance index (CV Ri) was compared to a two-parameter model including resistance-area product (RAP) and critical closing pressure (CrCP) (Panerai, 2003; Moody, 2005), in the maximal and in the stable phases of flow response to visual stimulation.

RESULTS AND CONCLUSIONS
As expected, all cerebrovascular resistance parameters decreased with visual stimulation, but the magnitude of their variation in each orthostatic condition was not similar. From supine to HUT, CrCP variation decreased (both maximal and stable phase p=0.001). CV Ri variation increased from sitting to HUT positions (maximal p=0.039; stable phase p=0.033). RAP variation to visual stimulation did not change between the three positions (maximal p=0.077; stable phase p=0.188).
A 2-parameter model of vascular resistance provided better discrimination of the effects of posture on NVC, as shown by the adaptive changes in CrCP with orthostatic challenge, in comparison with the classical use of CVRi. These findings suggest that although NVC seemed unaffected by orthostatic challenge, the behaviour of the complex vasoregulative mechanisms varies in different orthostatic conditions. Refining these mechanisms can potentially be of diagnostic or prognostic value.

Fig.1 - averaged normalized mean BFV (A), CVRi (B), RAP(C) and CrCP (D) of PCA [and mean BFV of MCA as a control (A)] changes before and during 40s of reading task (gray bar at bottom in supine (continuous line), sitting (dashed line) and tilt (dotted line) positions. For clarity, only the largest ±SE is represented at the point of occurrence. (First 10 seconds of resting phase not shown only for graphical proposal).

REFERENCES


