Background and Objective

Care management of patients with Severe Intracranial Arterial Stenosis (SIAS) at risk of stroke events recurrence remains controversial. Thus, a better characterization of patients with SIAS might be helpful to better define therapeutic strategy. To estimate the risks of ischemic event, imaging of cerebrovascular reserve (CVR) has been proposed using BOLD fMRI to hypercapnic challenge\textsuperscript{1-3}. The objectives of the work were to provide 1) normal CVR values in 100 controls without SIAS using a laterality index approach; 2) to provide CVR results in patients referred for SIAS using BOLD fMRI during a hypercapnic challenge.\textsuperscript{1-3}

Subjects and Methods

21 patients (5 females; 61.3±19.0 years) with unilateral SIAS of internal carotid (n=9) or middle cerebral artery (MCA) (n=12) were examined using CVR fMRI BOLD contrast with a block-design hypercapnic challenge (CO\textsubscript{2} 8%) at 3T. Averaged end-tidal CO\textsubscript{2} pressure (EtCO\textsubscript{2}) was used as a physiological regressor for statistical analyses (SPM8). We conducted regions of interest (ROI) measures of %BOLD signal change/mmHg EtCO\textsubscript{2} on segmented gray matter of the MCA territories. We calculated a laterality index with CVR LIMCA=(Left_CVR\textsubscript{MCA}-Right_CVR\textsubscript{MCA})/(Left_CVR\textsubscript{MCA}+Right_CVR\textsubscript{MCA}). CBV, CBF, MTT were calculated using DSC.

CVR data were compared to those of 100 right-handed volunteers without SIAS (41 women; 47.5±21.6 years).

Results

In controls, mean CVR LIMCA was 0.02 with a slight predominance of the left MCA territory. The standard deviation was 0.03. Thus, 95% confidence interval was [−0.05;+0.07].

In patients, 9 out 21 had an abnormal |CVR LIMCA| ≥ 0.08, leaving 12 patients with a normal vascular reserve. CVR LIMCA was negatively correlated with CBV LIMCA (R=−0.64;p<0.01), negatively correlated with MTT LIMCA (R=−0.79; p<0.001), but not correlated with CBF.

Conclusion

In 100 volunteers without SIAS, the 95% confidence interval of LIMCA was [−0.05;+0.08]. In patients with SIAS, the autoregulation raises CBV and MTT to maintain CBF constant. This compensation is associated with a significant CVR decrease in about 40% of the patients.

CVR fMRI may be helpful to better manage patients with severe intracranial arterial stenosis.