MAGNETIC RESONANCE PWI-DERIVED COLLATERAL FLOW INDEX IS A PREDICTOR OF MCA-M1 RECANALIZATION AFTER IV THROMBOLYSIS : NEW INSIGHT USING THE BAYESIAN METHOD

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Target audience: Neuroradiologists involved in acute stroke management

Purpose : Recently, an index of collateral flow that is predictive of the rate of recanalization of MCA-M1 occlusions in patients treated with IV Thrombolysis (IVT) has been described (1). This index, named the normalized Collateral Circulation Deficit (nCCD), is based on Tmax maps at different time points (calculated using a block-circulant SVD). To confirm that the nCCD index determined using cSVD is significantly correlated with the speed of the supplying flow inside the MCA territory, we performed a Bayesian estimation of hemodynamic parameters in a cohort of patients with an acute MCA-M1 occlusion. The Bayesian method (BM) (2) is a rigorous probabilistic estimation of hemodynamic parameters. From a quantitative point of view, this method outperforms deconvolution methods (standard, block-circulant or oscillating Singular Value Deconvolution (SVD)).

Methods: Twenty-six patients with an acute MCA-M1 occlusion were included in the study. MR perfusion images were postprocessed using a development version of OleaSphere^{TM} (Olea Medical, La Ciotat, France). The nCCD index was calculated as already described(1). The estimation of other hemodynamic parameters (CBF, CBV, MTT, TTP, arterial-tissue delay (ATD)) was performed using the BM. This method allowed to increase temporal resolution from 1.9 sec. to 0.5 sec(2). The speed of retrograde filling of the MCA territory was measured from the high resolution TTP map. The correlations between the nCCD index value and the relative CBF and the volume of tissue with increased ATD were also analyzed.

Results : The nCCD index is significantly correlated with the speed of the supplying flow (SSF) (figure 1; SSF=18.9+6.7*Log (nCCD); adjusted r^2=0.45 ; p=0.0001) and the relative CBF inside the hypoperfused MCA territory (figure 2; rCBF=0.9–0.002*nCCD; adjusted r^2=0.46 ; p<0.0001). Moreover, the nCCD index is highly correlated with the volume of tissue with increased ATD (volume of severely increased ATD=2.17+0.21 *nCCD ; adjusted r^2 =0.72 ; p<0.0001) accurately measured by the BM(2).

Figure 1:

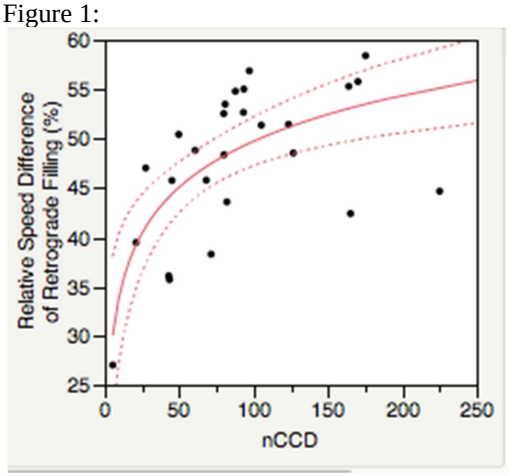
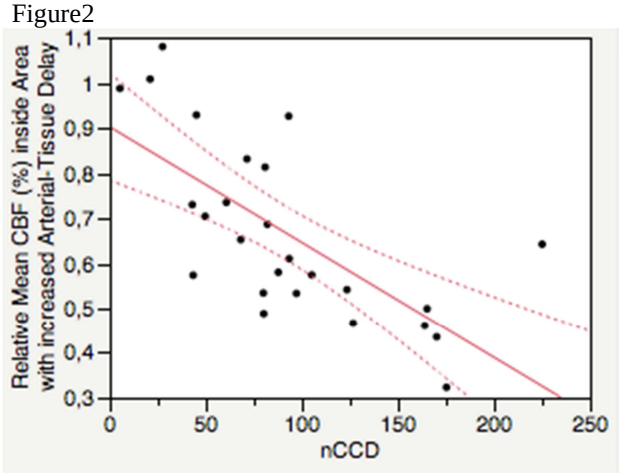


Figure2



Discussion : The accuracy of the Bayesian method allowed to confirm the tight link between the nCCD index and the retrograde filling of hypoperfused MCA territory *via* collaterals. Moreover, the temporal tracking of the contrast agent in the brain blood flow using this Bayesian-based high temporal resolution makes the visualization of the retrograde filling of hypoperfused areas *via* collaterals possible. Besides, it also allows to accurately and non invasively determine the speed of such supplying flow, a paramount criteria for the standard grading of collateral flow using angiography.

Conclusion : The Bayesian post-processing of MR perfusion images allows an accurate measurement of hemodynamic parameters and a non invasinve grading of the collateral flow in acute ischemic stroke patients. This method could help to improve the selection of patients with MCA-M1 occlusion for endovascular therapy, since the better the collateral flow, the better the results of this invasive therapy.

References :

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