

Phase contrast flow quantification of Carotico-Vertebral blood flow at 3.0T in patients with Angiographically Normal Vessels

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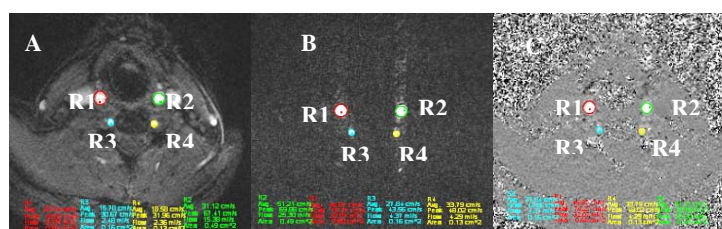
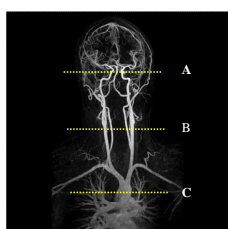
Purpose

To assess cerebral blood flow in individuals without anatomic carotid or vertebral-basilar stenosis and to determine its relationship with age and gender.

Materials and methods

Eighty consecutive adult patients (50 females and 30 males, mean age =55.3, age range=18-96) referred with neurological symptoms over eleven months period (October 2006- August 2007) and without caroticovertebral atherosclerotic disease on concurrent contrast-enhanced MRA of the head and neck, were prospectively evaluated with phase contrast(pc) flow quantification. Flow analysis was performed at three levels of carotid siphon, 2 cm below carotid bifurcation and ascending aorta. Average volume flow in the common carotid, vertebral, internal carotid, Basilar Arteries and aorta were measured for each subject using Argus flow analysis software (Siemens Medical Solutions). Values thus obtained were correlated with patients gender and age. In order to study the accuracy of the flow quantification from pcMRA, we measured the flow in a phantom. To ensure accuracy in vascular contouring, inter-observer variability was evaluated by comparing the results obtained with those of a second reader who repeated post-processing in 175 vessels in 25 patients.

Flow measurements were acquired at three different levels (A, B and C)



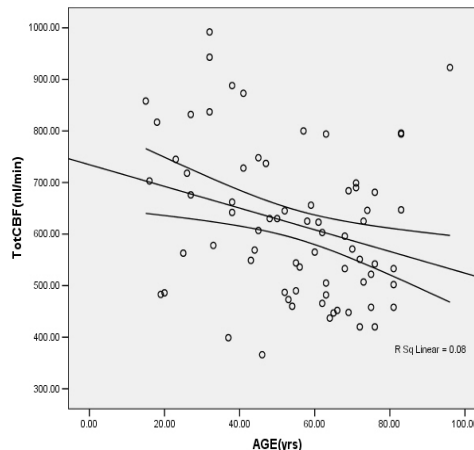
Velocity encoded phase contrast MRI of the neck

Results

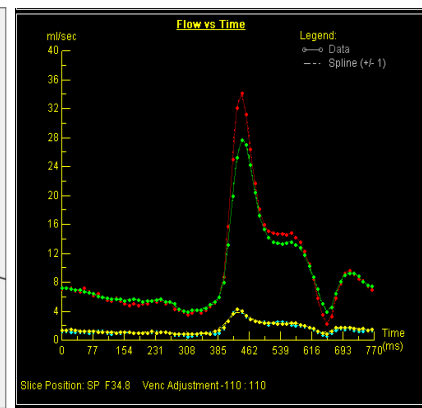
Mean common carotid flow in this patient population was determined to be 394.3±97.2 ml/min, vertebral arterial flow 91.2±40.6 ml/min, internal carotid flow 250.6±74.5 and basilar artery 150.8±49.8. Mean Total CBF was found to be 653.8±151.4 ml/min which was about 11.2±8.7% of cardiac output. No significant differences in total CBF were noted between the genders (p= 0.19). Finally, a weak negative correlation (r=-0.39) between subjects age and total cerebral blood flow was established. Anterior circulation blood flow, that is the sum of right and left internal carotid arterial blood flow, was found to be 76.7% of total cerebral blood flow and that of posterior circulation (basilar blood flow) 23.3%. Mean Flow within the external carotid arteries was calculated by measuring the difference between mean flow within the CCAs and ICAs. This was 164.1±96.5 ml/min, or 38.3% of mean CCA blood flow. This failed to correlate with subject age (r= 0.1, DF=65, p=0.2), however a significant difference was observed between the ECA blood flow of males, compared with that of females (M=193.7±95.6, F=132.6±80.9, p=0.008).

Conclusions

The findings of this study demonstrate that, in combination with MRA, 3.0 Tesla pcMRI is a practical method to measure total CBF. Knowledge of normal parameters is essential for contextual interpretation of the effect of vascular occlusive disease on cerebral perfusion. We provide such a range of values, and suggest that there is considerable variability in 'normal' cerebral blood flow in the absence of strong relationship with patient age or gender.



Total cerebral blood flow vs age



Average flow in R1, R2 (red and green lines), R3 and R4 (blue and yellow lines respectively) vs time.