Close correlation of ASL MRI and Ultrasound derived Intracranial Blood Flow Velocities

M. Griebe[1], K. Szabo[1], M. Günther[1], R. R. Kern[1], F. Sallustio[1], M. G. Hennerici[1], A. Gass[1,2]

[1]Department of Neurology, Universitätsklinikum Mannheim, Mannheim, Germany, [2]Departments of Neurology and Neuroradiology, Universitätsspital Basel, Basel, Switzerland

Introduction: Arterial spin labelling (ASL) techniques have been shown to be useful in the assessment of cerebral haemodynamics. Possible applications include non-contrast agent perfusion measurements and a dynamic angiographic information (DynAngio). Using a Look-Locker approach, volumes are captured at different time intervals after labelling (inflow time TI), displaying the inflow of the labelled blood bolus in the large vessels at several time points, thus implying functional information in contrast to a pure anatomical conventional MR angiography. Here, we present our experience comparing the temporal MRI information from the calculation of blood flow velocities from DynAngio data to the transcranial Doppler (TCD) measurement in normal controls and patients with internal carotid artery (ICA) stenoses.

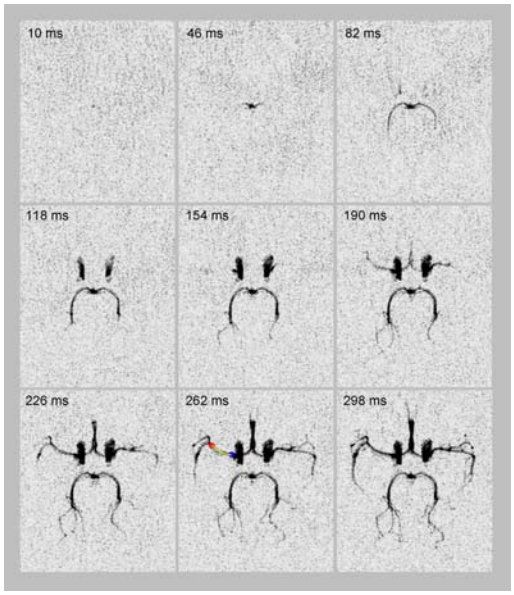
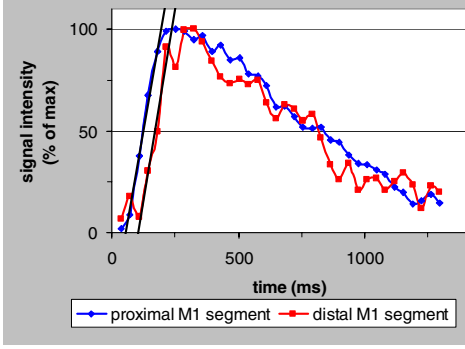


Fig 1: Dynamic MR-Angiography Inflow Signal



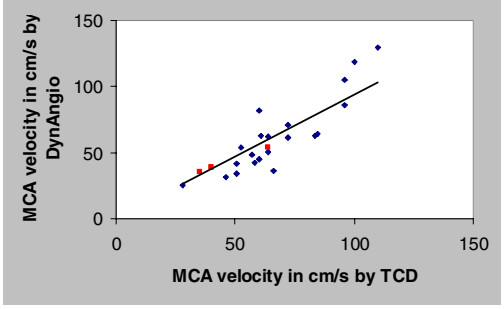
Methods: Eighteen middle cerebral arteries (MCAs) of nine normal control subjects (mean age 48.0 ± 17.7 years) and six MCAs of three patients with unilateral ICA stenosis (mean age 56.3 ± 10.0 years) were examined. For the DynAngio sequence, 36 different phases of inflow with a temporal resolution of 36 ms and an in-plane resolution of 0.52 mm were acquired on a clinical 1.5T scanner (Magnetom Sonata, Siemens, Erlangen, Germany) according to the protocol noted below. Blood flow velocity was calculated from the time lag of the inflow signals between regions of interest (ROIs) in projection to proximal and distal M1 segment and the distance between the ROIs *(see Fig.1)*.

These were compared to the mean blood flow velocities as detected by conventional TCD performing a linear regression and a comparison of means (paired Student's *t*-test).

The DynAngio sequence combines a FAIR inversion scheme with a segmented FLASH Look-Locker sampling strategy. This results in time resolved images of the inflow of blood into the arterial tree comparable to digital subtraction angiography (DSA). 36 different phases of inflow with a temporal resolution of 36 ms were acquired within 2 min 20 s. Measurement parameters were as follows: TR = 12 s / TE = 3.7 ms / 3 segments per phase per magnetization recovery / spatial resolution = 0.9x0.9 mm^2 / slab thickness = 60 mm / no ECG-triggering.

Results: In all patients and controls, the DynAngio technique showed the inflow of the labelled blood bolus in good quality. TCD measures and DynAngio calculated MCA velocities correlated closely for both control MCAs and ICA patients (r=0.89, p<0.0001; *see Fig.2*, red squares depicting MCAs at side of ICA stenosis, blue diamonds control MCAs). DynAngio calculated MCA velocities were slightly lower than TCD measures (60.0 ± 27.2 cm/s vs. 65.4 ± 20.8 cm/s, p=0.028).

Fig 2: Correlation of TCD and DynAngio flow velocities



Discussion / Conclusions: The DynAngio technique is useful in assessing intracranial haemodynamics of major arterial branches. It provides additional functional information compared to routine MRI sequences visualising accurately arterial blood inflow and the possibility to assess flow reduction. The calculated blood flow velocity values are very well in the range of well established ultrasound derived flow measurements despite a marginal underestimation.

Thus, the dynamic MR angiography combines and links the advantages of MR imaging techniques with those of functional tests as TCD.