

Detection of cerebral hypoperfusion in patients with unilateral Severe Internal Carotid Artery Stenosis by Arterial Spin labeling MR Imaging: Comparison with Dynamic Contrast Perfusion MR Image

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Introduction

Patients with symptomatic severe stenosis of the internal carotid artery (ICA) [1] are at risk for future ischemic infarcts in the brain. Pathologically, reduced cerebral blood flow (CBF) indicates hemodynamic cerebral impairment [2]. Arterial spin labelling (ASL) is a developing magnetic resonance imaging (MRI) technique that enables measurement of CBF in a non-invasive manner [3]. In this study, we assess the value of the ALS MRI in the evaluation of the hypoperfusion of the cerebral tissue in the patients with severe ICA stenosis by compared with dynamic contrast perfusion MRI (PWI).

Material and Methods

ASL and PWI of brain from 9 patients with ICA stenosis $\geq 70\%$ in one side and 6 volunteers with normal ICA were performed on a 1.5T GE Twinspeed scanner with 8-channel head coil. The ICA stenosis diagnosis is according to North American Symptomatic Carotid Endarterectomy Trial criteria by contrasted MR angiography of carotid artery [1]. At baseline, T1WI (T1flair sequence TR/TE=2416/14ms), T2WI (FSE sequence TR/TE=4660/111ms) and PWI were performed. A multislice GRE-EPI sequence (TR/TE=1200/75ms, 9 slice, FOV240cm, matrix 128x128, slice thickness 5mm, 40 images per slice) was used for PWI. Contrast agent (Magnevist, Schering, Germany) was injected at a flow rate of 4ml/sec, 0.1mmol/kg. ASL images were acquired with the Fairest pulse sequence [4] and the parameters were TI=1200ms, TE=17ms, 3 continuous slices, matrix 64x64, 48 images per slice. Maps of CBF, CBV and MTT were created using MGH software [5]. In the section above the ventricles, the region of interest (ROI) was placed on the gray matter. ROI size range from 15~17cm². The CBF, MTT and ASL ratio of the patients were calculated as stenosis side/contralateral side. The CBF, MTT and ASL ratio of the volunteers were calculated as right side/left side.

Results

The value of CBF, MTT and ASL were measured at the same middle cerebral artery territories. Compared to the volunteers, CBF ratio of patients with ICA stenosis was decreased whereas the MTT ratio was increased compared to the volunteers (independent-sample t-test). There was a high level of agreement between CBF ratio and ASL ratio (paired-sample t-test). (Table 1, Figure 1).

Conclusion

CBF, MTT and ALS were decreased in affected middle cerebral artery territories in patients with ipsilateral ICA severe stenosis compared to the contralateral region and there was a high level of agreement between CBF ratio and ASL ratio. Therefore, ALS MR imaging is capable of detecting the cerebral hemodynamic change in patients with unilateral ICA stenosis in noninvasive manner.

References

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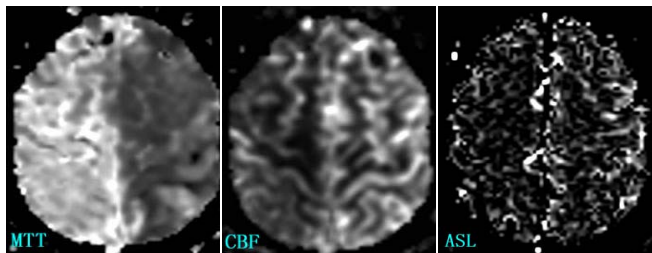


Figure 1: 55-years-old man with 80% right ICA stenosis. At the transverse location level with the centrum semiovale, MTT of right middle artery territory was prolonged, CBF and ASL were decreased comparing with the left side.

	Group	Mean	Std. Deviation	Std. Error Mean	t	p
MTTRatio*	Stenosis	1.4383	.39046	.13015	2.537	0.023<
	Volunteer	1.0197	.06094	.02488		
CBFRatio*	Stenosis	.7636	.20167	.06722	-2.638	0.020 <
	Volunteer	1.0001	.10059	.04106		
ASLRatio*	Stenosis	.6997	.26590	.08863	-2.294	0.039 <
	Volunteer	.9762	.15098	.06164		
Pair CBF ratio& ASLRatio**		.8582	.20306	.05243	1.944	0.072 >
		.8103	.26114	.06743		

Table 1: The results of MTT ratio, CBF ratio and ASL ratio comparison.

* Comparison between the patients with ICA stenosis and volunteers.

** Comparison of CBF ratio with ASL ratio in the same individuals.