

The Relationship between the Carotid Atherosclerotic Plaque and Cerebral Perfusion-Weighted Imaging: Preliminary Results

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Introduction

Patients with severe stenosis of the ICA are at risk for future ischemic infarcts in the brain [1]. The patterns of cerebral PWI in patients with ICA stenosis are complex. It is related to the formation of collateral artery, the stenosis rate of the ICA and the development of the circle of Willis [2]. In this study, we evaluate the appearance of the cerebral PWI between the stable and the unstable carotid atherosclerotic plaque for the patients with severe ICA stenosis, and analyze the relationship between the carotid atherosclerotic plaque and cerebral PWI.

Material and Methods

118 patients were imaged with a custom-designed phased-array carotid coil in a 1.5T GE Signa Scanner. MR sequences of carotid artery included double inversion recovery (DIR) FSE T1WI (TR/TI/TE: 800/650/9ms), PDWI (TR/TE: 3000/20ms), T2WI (TR/TE: 3000/40ms) and 3D time of flight (TOF) [TR/TE: 23/3.6ms]. Among them, 30 patients with unilateral ICA stenosis ranging from 70% to 99% were selected to have cerebral PWI. The ICA stenosis diagnosis is according to NASCENT criteria by MRA of carotid artery [3]. The T1WI (TR/TE=2416/14ms), T2WI (TR/TE=4660/111ms) and PWI of brain were performed. A multislice GRE-EPI sequence (TR/TE=1200/75ms, 9 slice, FOV240cm, matrix 128×128, slice thickness 5mm, 40 images per slice) was used for PWI hemodynamic mapping. After an initial baseline period of 8 images per slice, contrast agent (Magvist, Schering, Germany) was injected at a flow rate of 4ml/sec. On the MTT, relative cerebral blood flow (rCBF) and relative cerebral blood volume (rCBV) maps, the region of interest (ROI) was placed on the frontal lobe, parietal lobe, centrum semiovale, anterior and posterior WS. The MTT, rCBF and rCBV ratio of the patients were calculated as stenosis side versus contralateral side. Based on the status of the fibrous cap, with/without hemorrhage, superficial calcification and large lipid core of the carotid plaque, the patients were divided the carotid plaque into stable and unstable plaque group. The cerebral PWI of these two groups were compared.

Results

The MTT ratios of the anterior cortical WS and posterior cortical WS were prolonged significantly in the unstable group (n=17) compared with the stable group (n=13) (p=0.042, t=1.561 and p=0.038, t=1.227), but the rCBF and rCBV ratios showed no significant differences. There were no significantly differences for the MTT, rCBF and rCBV ratios of the frontal lobe, parietal lobe and centrum semiovale between the stable and unstable group. (Table 1, Figure 1 and 2).

Conclusions

The stability of the carotid atherosclerotic plaque has close relationship with the perfusion of relative cortical watershed region, and MTT is the most sensitive parameter to detect the unilateral hypoperfusion. This needs be studied in the future with histology.

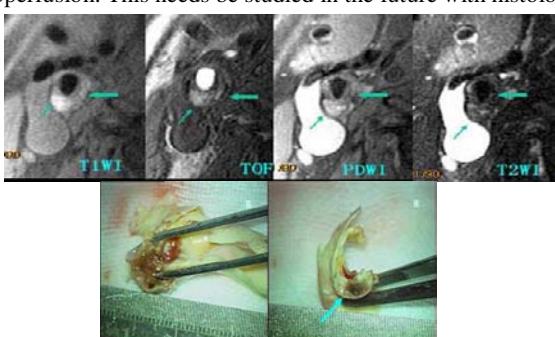


Figure 1: 71-years-old man with 70% right ICA stenosis, the hemorrhage in the right carotid artery plaque (arrow) was revealed on the high resolution MRI and specimen of carotid artery atherosclerosis plaque.

location	Stable group	Unstable group	p value	t value
Frontal lobe	1.04±0.11	1.12±0.31	0.315>0.05	0.843
Parietal lobe	1.03±0.12	1.05±0.16	0.593>0.05	0.378
Centrum semiovale	1.08±0.12	1.18±0.46	0.151>0.05	0.781
Anterior cortical WS	1.06±0.12	1.28±0.54	0.044<0.05	1.411
Posterior cortical WS	1.10±0.13	1.20±0.39	0.038<0.05	1.093

Table 1: Statistical table shows the results of MTT ratio compared stable with unstable group

References

1. Grubb RL, et al. JAMA 1998; 280:1055-1060.
2. Isabelle Momjian-Mayor, et al. Stroke, 2005, 36:567-572...
3. North American Symptomatic Carotid Endarterectomy Trial. Methods, patient characteristics, and progress. Stroke 1991; 22:711-720.

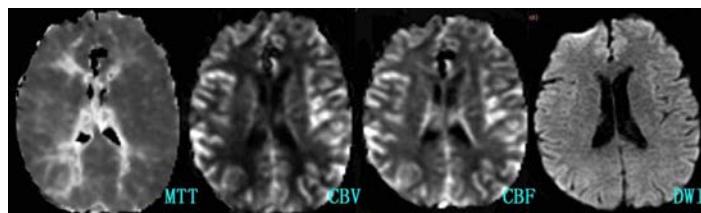


Figure 2: The acquisition of a transverse section position through the body of lateral ventricle in the same patient. MTT of right anterior and posterior cortical watershed were prolonging compared with the left side.