

# Utility of DSC-MRI indices as predictors of cerebral perfusion changes after carotid angioplasty with stenting

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## Introduction

Significant carotid stenosis increases the incidence of compromised cerebral hemodynamics. Carotid angioplasty with stent placement (CAS) is an optional treatment for significant carotid stenosis. Hyper-perfusion syndrome, including unilateral headache, seizures, and intracerebral hemorrhage (3), has been reported as a complication after CAS. In previous, there is a paper research the significant predictors of hyperperfusion phenomenon after CAS. Resting cerebral blood flow (CBF) and cerebral vasoreactivity (CVR) to acetazolamide challenge were quantitatively measured to evaluate cerebral hemodynamic reserve by using SPECT (2). To the best of our knowledge there was no MRI studies on this topic. This study aimed to assess hemodynamic status of patients with unilateral stenosis of internal carotid artery (ICA) using dynamic susceptibility contrast (DSC) MRI indices, including cerebral blood flow (CBF), time to peak (TTP), mean transit time (MTT) and Tmax (the time to maximum of the residue function obtained by deconvolution). In addition, this study investigated whether the perfusion changes after CAS in these patients were correlated with the compromised perfusion indices before CAS.

## Methods

Fifty-four patients with unilateral ICA stenosis and who underwent CAS (Left side stenosis : 29 patients, Right side stenosis: 25 patients) participated in this study. The CBF, TTP, MTT and Tmax were assessed by DSC-MRI before and one-week after CAS. DSC-MRI were acquired using a T2\*-weighted single-shot gradient-echo EPI sequence (TR/TE/FA = 1500ms/40ms/90 degrees, in-plane matrix = 128 × 128, slice thickness = 5mm, 20 slices, 60 dynamics ) at a 1.5T clinical scanner. The regions of interest (ROI) were manually placed in bilaterally symmetric regions of the MCA territory by an experienced neurologist. In addition, a ROI was also placed in the occipital white matter for reference. Perfusion images were analyzed by using the Perfusion Mismatch analyzer (PMA)(http://asist.umin.jp/index-e.htm). For each patient, an arterial input function was chosen from the MCA for the deconvolution calculation using the block-circulant singular value decomposition algorithm. The relative CBF obtained in each side of the MCA territory was then divided by the mean value of the occipital white matter ROI, and the ratio represented a normalized CBF (nCBF) value. The change in the nCBF of either side of the brain was then quantified by a CBF index : (nCBF after CAS) / (nCBF before CAS).

## Results

Figure 1 demonstrated relative CBF maps from a patient before (A) and after (B) CAS (CBF index = 1.4). Before CAS, the CBF on the stenotic (right) side was lower than that on the left side. After CAS, CBF on the right side increased and was higher than that on the left side. The pre-CAS nCBF, Tmax, TTP and MTT for the ipsilateral side of the stenosis and the normal side were listed in Table 1. For this patient group, the nCBF was marginally significant lower (p=0.07) and the Tmax and MTT were significantly longer (p=0.006 and p=0.035) in the stenotic side, when compared with the normal side. On the ipsilateral side of the stenosis, significant negative correlation was found between CBF index and nCBF (r = 0.482, p value = 0.0001\*\*), whereas significant positive correlations were found between CBF index and Tmax (r = 0.267, p value = 0.03\*), and between CBF index and MTT (r = 0.466, p value = 0.0002\*\*) Figure 2 demonstrated the correlation between CBF index and MTT. The patients were then divided into two groups with an CBF index = 1.2 (CBF index > 1.2, n=8; CBF index ≤ 1.2, n=46). Ipsilateral Tmax and MTT of the patients with CBF index > 1.2 were found significantly longer than those of the other group (Table 2). In addition, marginally significant difference was found in the nCBF.

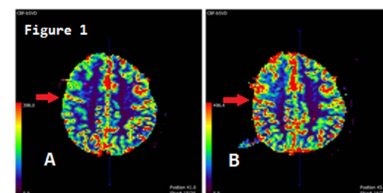


Table 1.

	Ipsilateral side	Normal side	p-value
nCBF	0.82±0.11	0.85±0.11	0.07
Tmax(s)	3±1.15	2.53±0.68	0.006*
TTP(s)	28.44±4.46	27.72±4.55	0.21
MTT(s)	5.58±0.91	5.29±0.69	0.035*

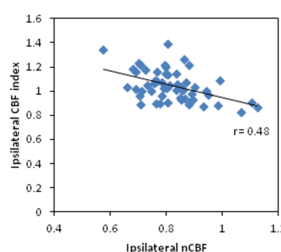


Table 2.

	CBF index > 1.2 (n=8)	CBF index ≤ 1.2 (n=46)	p-value
ipsilateral nCBF	0.77±0.09	0.83±0.11	0.06
ipsilateral Tmax(s)	3.67±1.82	2.89±0.92	0.04*
ipsilateral TTP(s)	30.13±3.42	28.14±4.58	0.13
ipsilateral MTT(s)	6.43±1.44	5.43±0.65	0.002**

## Conclusion

This study found compromised cerebral hemodynamics, in terms of CBF, Tmax and MTT, in patients with unilateral ICA stenosis. The perfusion changes after CAS were significantly correlated with the pre-CAS ipsilateral nCBF, Tmax and MTT. The pre-CAS ipsilateral Tmax and MTT were significantly longer for the hyper-perfusion group as comparing to the other patients.

## References

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