

Evaluation of Recurrent Carotid stenosis after Carotid Endarterectomy by In Vivo High Resolution MRI: A 48 months follow-up

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Introduction

Clinical trials have demonstrated the efficacy of carotid endarterectomy (CEA) in preventing stroke in patients with severe carotid stenosis [1]. But recurrent carotid stenosis (RCS), which is defined as greater than 50% diameter stenosis [2] after CEA, occurring months or years after the initial procedure resulting in recurrent symptoms or culminating in occlusion is the usual cause of late failure of this procedure. Pathological finding [3] suggested that intimal hyperplasia and recurrent atherosclerosis were two major causes for RCS. High-resolution MRI has shown to be capable of assessing the stenosis of carotid artery and evaluating the components of the carotid atherosclerotic plaque [4]. In this study, we assess the value of *in vivo* high resolution MRI in the evaluation of the long-term RCS rate and plaque morphology of carotid artery after CEA.

Methods

Twenty eight carotid arteries of 26 patients with 70% to 99% internal carotid artery stenosis were examined by high-resolution MR before and after CEA. All scans were performed on a 1.5T GE Signa scanner with a custom-designed phased-array coil. MR sequences 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]. The coverage is 12 sections with section thickness as 2mm in T1W, PDWI and T2WI but 1 mm in TOF. In-plane resolution is 0.25x0.25 mm². The follow-up time points include 3 months (as baseline) and each year after CEA. Lumen area of each cross-section are measured. The lumen restenosis rate is calculated as $(1 - \text{Minimal lumen area}_{\text{per year}} / \text{Minimal lumen area}_{\text{baseline}}) \times 100\%$. The appearance of plaque components (hemorrhage, lipid-rich necrotic core and calcification) are recorded.

Results

MR scans include 28 arteries at 3 months, 26 arteries at 12 months, 14 arteries at 24 months, 9 arteries at 36 months, 5 arteries at 48 months (Figure 1-4). Two of 28 carotid arteries were occluded after CEA within 3 months and the other 26 arteries were patent after 12~48 months follow-up. The average area restenosis rate is 11%, 18%, 33% and 40% for 12, 24, 36 and 48 months respectively. Only 1(3.9%) of 26 arteries categorized as RCS (>50% diameter stenosis or 75% area stenosis) after 36 month follow up. Hemorrhage, lipid-rich necrotic core and calcification have been detected in 3 and 2 arteries, respectively, after 36 months follow-up.

Conclusions

In vivo high resolution MRI is capable of following up RCS rate for the patients after CEA and of evaluating the plaque morphology of RCS. Therefore, in vivo high resolution MRI has the potential to provide valuable information about the risk of CEA patients.

References

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2. NASCET. NEJM 1991; 325: 445-453.
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4. Cai J, et al. Circulation 2002; 106: 1368-73

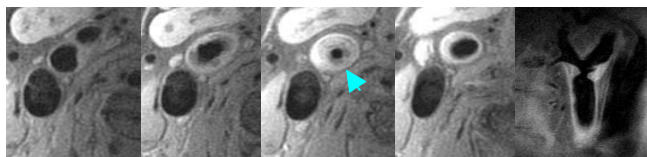


Figure 1: 72-years-old man before CEA, the atherosclerotic plaque (arrow) located at ICA and CCA on axial and oblique DIR T1WI MR images.

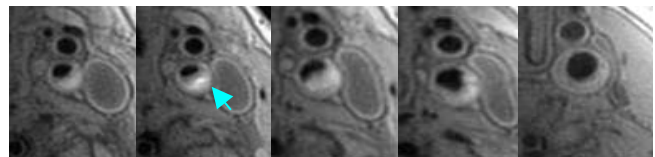


Figure3: 64-year-old man before CEA, the atherosclerosis plaque located at the ICA with hemorrhage (arrow) on DIR T1WI MR images.

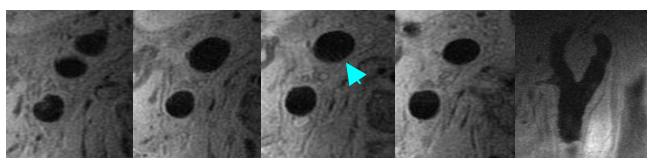


Figure 2: 3 months after CEA, the same patient as Figure 1, DIR T1WI image shows the lumen and the homogenous wall of the carotid artery (arrow).

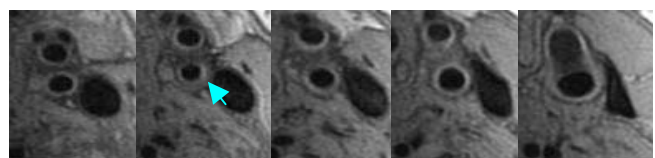


Figure 4: 4 years after CEA, the same patient as Figure 3, DIR T1WI image shows the wall of the ICA is thickening (arrow) with 30% diameter stenosis.