The Value of Carotid Plaque MRI in the Selection of choosing Stent-Treatment for Carotid Atherosclerosis Patients

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Introduction: Stent-treatment is a common option for carotid atherosclerosis patients[1], and the level of carotid stenosis, typically measured by digital subtraction angiography [DSA]), is the standard criteria to decide on stenting. There are, however, many patients who suffer repeated cerebral ischemia due to carotid atherosclerosis although their level of stenosis excludes them from stenting[2]. With the advent of carotid plaque MRI and its demonstrated ability to identify high risk features of plaques in addition to luminal stenosis[3,4], MRI has potential to provide a better evaluation method than DSA alone for carotid plaque treatment planning.

Purpose: To evaluate the efficiency of carotid plaque MRI in stent-treatment decision for patients with carotid atherosclerosis by comparing with DSA.

Materials and Methods: 27 patients who were found to have carotid plaque by ultrasound were enrolled in this study. A total of 17 symptomatic carotid arteries and 37 asymptomatic carotid arteries were evaluated by MRI and DSA, respectively. Carotid plaque MRI examination was acquired with 3.0T Philips Intera Achieva MR scanner and 8 channel surface coil. The parameters were as following[5]: 3D TOF: TR/TE 20/5ms, flip angle 20°; T1WI and CE-T1WI: quadruple inversion-recovery (QIR), black-blood, TSE, TR/TE 800/10ms; T2WI: Double IR (DIR),black blood, TSE, TR/TE 4800/50ms; PDWI: DIR TSE, TR/TE 4800/9ms; MP-RAGE: IR TFE, TR/TE 9.1/5.5ms, flip angle 15°; FOV 14cm x 14cm; acquisition matrix 256x256; in-plane resolution 0.55mmx0.55mm. The MR imaging centered at the peak of carotid bifurcation and the slice thickness was 2 mm. DSA was performed with GE Advantx LCN^{+}. Coronal and lateral views of carotid artery were taken. Images were evaluated for luminal stenosis and fibrous cap (FC) rupture by an experienced radiologist blinded to clinical history. The stent treatment decision was based on the common used criterion, which was luminal stenosis greater than 50% or ulcered plaque for symptomatic vessels, and stenosis greater than 70% or ulcered plaque for asymptomatic vessels. Intraplaque hemorrhage and calcification were also evaluated by MRI. Paired T-test and Fisher's exact test were used for the statistical analysis.

Results and discussion: There was no statistical difference between the degree of stenosis measured by MRI and DSA ($t=0.204$ for symptomatic group and 1.377 for asymptomatic group, and $p>0.05$ both). There were statistical differences in detecting FC rupture by MRI and DSA for both groups ($p<0.01$ both). For determining stent treatment for symptomatic vessels, 14 vessels according to MRI and 11 vessels according to DSA required stenting, and there was no statistical difference ($p>0.05$). For asymptomatic vessels, 16 vessels according to MRI and 4 vessels according to DSA required stenting, a significant statistic difference ($p<0.01$). The different efficiencies for MRI in treatment planning between the two groups is due to most of the symptomatic plaques being advanced cases where luminal stenosis was obvious, meaning presence of FC rupture did not affect the treatment decision. The luminal stenosis for asymptomatic carotids, however, was relatively slight and FC rupture weighted more in treatment planning. The prominence of MRI in FC rupture detection made it superior to DSA in treatment decisions for asymptomatic patients. Furthermore, MRI detected 19 regions of intraplaque hemorrhage and 25 regions of calcification in the plaque, which was helpful in surgical planning.

Conclusion: For symptomatic carotid atherosclerosis patients, MRI had no obvious advantage compared with DSA in stenting decision, but MRI can provide useful information about the plaque morphology which is helpful for treatment planning. While for asymptomatic patients, MRI is superior to DSA in determining stent treatment, especially for patients with carotid artery narrowing of less than 70% due to its ability to detect FC rupture.

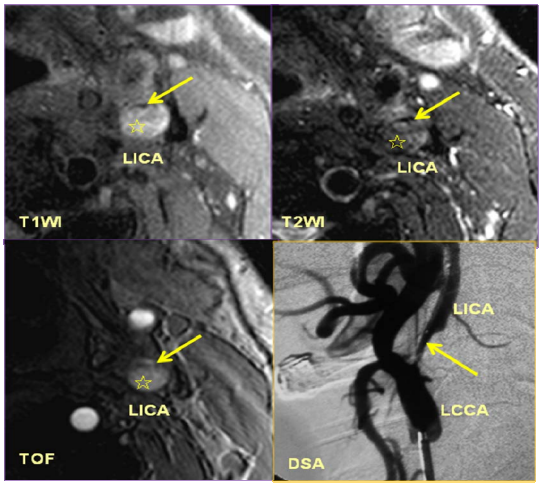

Figure 1 Stent treatment decision by MRI and DSA. Both examinations found severe stenosis of the left internal carotid artery (arrow). Furthermore, MRI detected FC rupture and intraplaque hemorrhage (star).

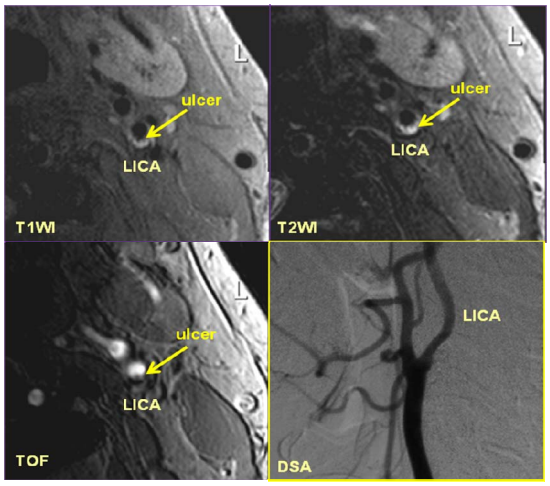

Figure 2 Stent treatment decision by MRI due to FC rupture detected by MRI. This patient would not be stented by DSA alone, since the stenosis of the left internal carotid artery was not obvious, and DSA could not detect the shallow FC rupture.

References:

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