Effect of Rosuvastatin Therapy on the Adventitial Perfusion of Carotid Plaque with Intraplaque Hemorrhage: A Dynamic Contrast-enhanced MR Imaging Study

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Introduction

Markers of inflammation by the dynamic contrast-enhanced (DCE) MRI may be fastest response of the beneficial therapy in vivo.[1] However, the correlation in the plaque with intraplaque hemorrhage (IPH) has not been well studied.

Objectives

To evaluate whether the intensive lipid therapy could reduce the vasa vasorum perfusion and improve plaque composition with IPH by MRI.

Method

Study Population: Between March 2009 and March 2012, the prospective study, Rosuvastatin Evaluation of Atherosclerotic Chinese Patients (REACH Study, NCT 00885872), recruited 32 subjects with advanced lesions (≥3 mm thickness without >50% calcification), matched MRI scans and acceptable image quality. All subjects received rosuvastatin 5~20 mg/d to lower low-density lipoprotein cholesterol levels to < 80 mg/dl over the 24-month follow-up period. **MR Imaging Protocol:** Carotid high-resolution (HR) MRI and DCE-MRI were underwent at baseline and 3, 12, 24 months at a 3.0T whole body scanner (GE) with a 4-channel phased-array carotid surface coil. A standardized protocol was used to acquire T1-weighted, T2-weighted black-blood images and 3D-TOF bright-blood angiographic images. DCE-MRI using double inversion recovery technique was performed on six selected axial slices chosen from T1-weighted image set at 15 times separated by a repetition interval of 16 seconds. The acquisition of the forth time was coincident with the initiation of the intravenous injection of 0.2 mmol/kg gadolinium-based contrast agent at a rate of 2 ml/sec through a power injector. After the DCE-MRI scanning, the T1-weighted sequence was repeated to achieve the contrast-enhanced images. [2] **Data analysis:** Plaque composition was analyzed using CASCADE (IBMarker Company). The DCE-MR imaging analysis was performed using the population arterial input function and Patlak model [3] to calculate kinetic parameters V_p and K^{trans} for each pixel based on its temporal changes in intensity on the ≥3 mm thick slice. The analysis of perfusion was performed with blinding to the composition.

Results

Among the 32 subjects, there were 2 cases showed IPH at baseline. After 12 and 24 months of treatment, there was an obvious reduction in mean adventitial V_p (0.134 ± 0.090 [standard deviation] to 0.061 ± 0.036, 0.046 ± 0.024. Fig. 1), but no statistically significant trend between baseline and 3 months (0.126 ± 0.073. Fig. 1). The HRMRI indicated that there was no obvious change in composition of IPH during 24-month treatment (Fig. 2).

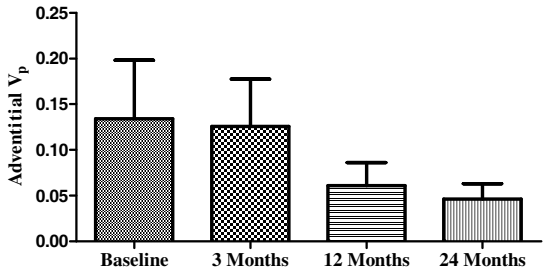

Figure 1: Adventitial V_p changes at baseline and 3, 12, 24 months with IPH

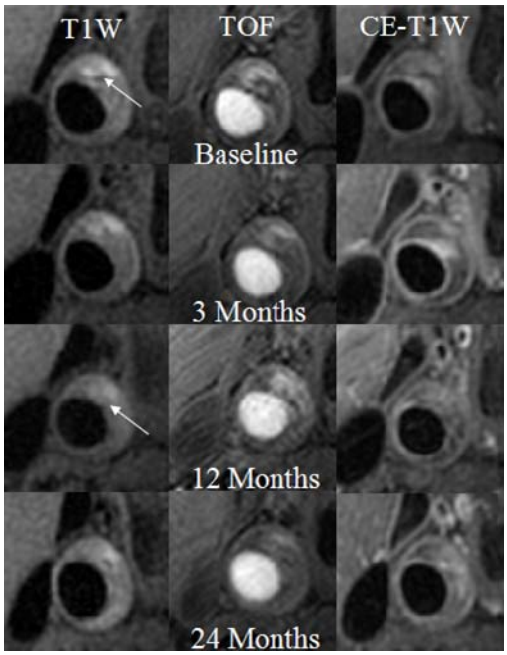

Figure 2. HRMRI example of irreversible IPH and time points.

Discussion and Conclusions

In conclusion, evaluation of effects of lipid-lowering therapy on atherosclerotic plaques with IPH should be focused on inflammatory activity rather than composition and plaque burden. IPH may be irreversible content within the first one year after treatment. Kinetic parameters of DCE-MRI are the valuable biomarker for evaluating the evolution of the carotid plaque in vivo, noninvasively.

References

1. Zhao XQ, et al. Clin Lipidol 2012;7:329. 2. Dong L, et al. Radiology 2011;260:224. 3. Gaens ME, et al. Radiology 2013;266:271.