

Ruptured Carotid Plaques as a Feature in Patients with Unstable Angina Pectoris

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INTRODUCTION:

Complex coronary plaque inflammation and rupture with subsequent formation of an intraluminal obstructive thrombus underlie UAP. The ability to identify persons with coronary plaque prone to rupture is of great value in stratifying the future risk for cardiovascular diseases and also for monitoring ongoing treatment. In the present study, by using multi-contrast high-resolution MRI we investigated prospectively whether carotid plaque characteristics can predict UAP.

MATERIALS AND METHODS:

Between October 2008 and April 2009, we prospectively studied 15 patients with UAP (13 men, 2 women, 65±8 years), and 20 with stable angina pectoris (SAP) (17 men, 3 women, 66±10 years). All patients underwent coronary angiography (UAP=15, SAP=9) or CT angiography (SAP=11), and significant coronary stenosis was diagnosed by detection of stenosis >50% in one or more major coronary arteries. Exclusion criteria were the prior carotid endarterectomy, carotid occlusion, prior neck irradiation, history of cerebrovascular disease intervention, and any contraindication for MRI. Each participant accepted a multi-contrast high-resolution carotid MRI scan on a 3.0-T MRI scanner (Signa Excite, General Electric Medical System, Wisconsin, USA). A bilateral 4-channel phased-array surface coil was used. A standardized protocol was used to obtain 4 different contrast MR images: (1) quadruple-inversion-recovery T1-weighted (QIR T1W); (2) proton density-weighted (PDW); (3) T2-weighted (T2W); and (4) 3D time-of-flight MR angiography (3D-TOF MRA). All images were obtained with the following parameters: field-of-view of 14 cm, matrix size of 256 × 256, slice thickness of 2 mm with no inter-slice gap. Each Carotid bifurcation was chosen as a reference, and 5 images were acquired above this bifurcation (proximal internal carotid) and 5 below (carotid bulb and distal common carotid). The total acquisition time was about 20~30 min. Images of each carotid artery were analyzed to obtain the maximal wall area (WA), total vessel area (TVA), wall thickness (WT), normalized wall index (NWI = WA/TVA), the minimal lumen area (LA), the percentage of each component (lipid-rich necrotic core, LRNC%; calcification%; intraplaque hemorrhage, IPH%) relative to the wall volume, and the presence or absence of fibrous cap rupture. Of the 35 original patients, 1 SAP was excluded due to image quality. The Student unpaired *t* test and Fisher's exact test were applied to estimate the difference in risk factors between UAP and SAP groups. Univariate binary logistic regression for variables of carotid arterial structure and carotid plaque characteristics was used to identify potential predictors of UAP. Multivariate logistic analysis was performed to assess independent predictors for patients with UAP. Calculations were performed with statistical software (version 15.0, SPSS).

RESULTS & DISCUSSION:

The clinical risk factors of atherosclerosis did not differ between the UAP and SAP groups. During univariate analysis, the maximal TVA and presence of fibrous cap rupture were potential predictors for patients with UAP (OR=1.030, p=0.005 and OR=14.316, p=0.015, respectively), while the calcification% was potential protective factors of UAP (OR=0.086, p=0.048). During multivariate analysis, however, the presence of fibrous cap rupture was the strongest independent predictor of UAP (OR=10.624, p=0.034) (Figure A, B), and the maximal TVA was a mild independent risk factor (OR= 1.027, p=0.016). Atherosclerosis is a systemic inflammatory disease [1]. Atherosclerotic plaque instability may not be confined to the coronary arteries but may also involve other arterial districts [2]. Our results suggest that fibrous cap rupture of carotid plaque being associated with an activated plaque inflammation is closely correlated with coronary plaque instability. The mild independent correlation of the maximal TVA with UAP may be due to a greater outward remodeling in vulnerable plaques.

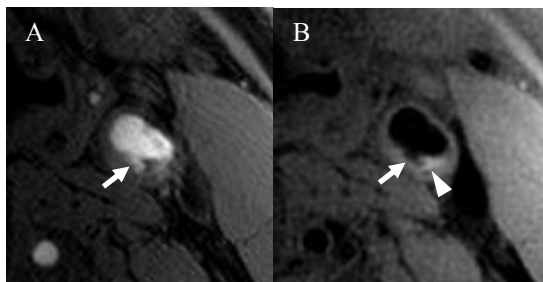
CONCLUSION:

The present study demonstrated a higher prevalence of ruptured carotid plaques in patients with UAP, compared with those with SAP. Moreover, the presence of ruptured carotid plaques was independently associated with UAP. With a multi-contrast high-resolution MRI, the ruptured carotid plaques may be a surrogate marker for identifying patients at high risk of UAP and may contribute to a better risk stratification of patients with coronary artery disease.

REFERENCES

1. Ross R. *Am Heart J* 1999; 138:S419-420.
2. Momiyama Y, Kato R, Fayad ZA, et al. *Arterioscler Thromb Vasc Biol* 2006;26:903-909.

Figure



A 66-year-old male patient had an unstable angina. (A) 3D-TOF MRA TOF image reveals a distinct fibrous cap rupture of left carotid bulb plaque (white arrow). (B) QIR T1W image reveals not only the fibrous cap rupture (white arrow), but also intraplaque hemorrhage (white arrowheads).