MR Imaging of Carotid Plaque: Correlation between Contrast-enhancement and Inflammation at Histopathology

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Purpose: Ischemic neurological events are more frequently related to carotid plaque instability than to stenosis degree (1). Moreover, a large number of patients with severe carotid artery stenosis are asymptomatic (2). The majority of ruptured plaques contains a lipid rich core covered by a thin cap of fibrous tissue and are infiltrated by macrophages (3). Plaque contrast enhancement in magnetic resonance may be correlated to inflammation. Our aim was to assess the correlation between carotid vessel wall enhancement at MR imaging and plaque inflammation at histopathology.

Methods and materials: IRB approval and written informed consent were obtained. Twenty-eight patients (aged 68±9 years) scheduled for thromboendarterectomy prospectively underwent 1.5-T MR imaging (Sonata, Siemens). Phased array head, neck and cervical spine coils were used in the following protocol:

1) unenhanced axial 3D T1-weighted gradient-echo sequence centered on carotid bifurcation;
2) standard 3D coronal carotid MR angiography with 0.1 mmol/kg of gadobenate dimeglumine (Gd-BOPTA, MultiHance, Bracco, Italy);
3) gradient-echo sequence as in point 1, three minutes after contrast injection.

Images obtained at point 1 were digitally subtracted from those obtained at point 3, as already described (4). On axial native and subtracted images, vessel wall enhancement was assigned a three-point score (0, absent; 1, focal; 2, extended). Stenosis degree was calculated on standard MR angiography according to NASCET criteria. At histopathology, inflammatory cell infiltration was graded using a three-point score (0, absent or minimal; 1, focal; 2, extended), used as a standard of reference. Weighted Cohen k was used.

Results: Six MR studies were discarded due to patient movements. Out of the remaining 22 patients, the vessel wall enhancement was graded as absent in 13, focal in 6, and extended in 3. Inflammatory cell infiltration was graded as absent or minimal in 13, focal in 7, and extended in 2. An example is shown in Figure 1. Weighted Cohen k resulted 0.57 (moderate agreement). The diagnostic performance at dichotomous analysis is reported in Table 1. Considering all the 28 MR angiographies, stenosis degree was moderate in 7 and severe in 21. Stenosis degree did not show any correlation either with inflammatory cell infiltration (p=1.000, n=28) or with vessel wall enhancement (p=0.747, n=22).

Conclusion: Carotid vessel wall enhancement using 0.1 mmol/kg of gadobenate dimeglumine is a good marker of plaque inflammation. This finding, not correlated with stenosis degree, could be used as an independent indicator of plaque instability.

References