Artery Dissection and Arterial Thrombus Aging
The Role of Noninvasive Magnetic Resonance Imaging

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Magnetic resonance imaging (MRI) has the potential to study atherosclerotic lesions noninvasively, and it is considered a valid method for the detection of deep venous thrombosis. An organized/old thrombus is considered one of the most thrombogenic substrates. Therefore, noninvasive detection and differentiation between recent and old arterial thrombi is an important goal for diagnostic imaging. Aortic dissection was detected in a rabbit model of atherosclerosis after balloon injury using MR angiography and black-blood cross-sectional images (Figure 1). A low-intensity signal area compatible with slow flow and/or fresh thrombus was seen in the false lumen. Sequential MR indicated a progressive decrease of the residual blood flow in the false lumen, and the MR signal intensity of the surrounding thrombus increased (Figure 2). The correlation of the histopathological analysis of the corresponding arterial segments with the MR signal obtained using T1-weighted black-blood sequencing allowed us to differentiate the matrix (hypointense MR signal) from various stages of hemoglobin-degrading products (Figures 3E and 3F). Methemoglobin-rich areas corresponded to the hyperintense MR signal, and hemosiderin-rich areas corresponded to the isointense MR signal. This case provides evidence of the potential of noninvasive MR for the detection of fresh thrombus. In addition, by using an adequate MRI sequence (ie, T1-weighted), MR may further characterize the age of the thrombus.

Detection of thrombotic material in the arterial circulation and the exact definition of its age remain a crucial clinical challenge for noninvasive diagnosis. Noninvasive MRI is a very promising tool and should be validated for the human circulation.

Figure 1. Left, Time-of-flight (TOF) MR angiography of the abdominal aorta, without contrast medium, indicates the presence of an aortic dissection (arrow). Right, Black-blood axial MRI (proton density–weighted; PDW) shows patent true (TL) and false lumen (FL) and highlights the dissection membrane (DM). This axial image corresponds to the largest diameter of the false lumen (level of the arrow on left).

Figure 2. Black-blood axial MRIs were matched at different time points. All MRIs were acquired with the same MR parameters (ie, fast spin-echo, axial proton density-weighted). Note the shift from hypointense to hyperintense signal through time inside the false lumen (arrows). A, Dissection diagnosis (baseline). B, 2 weeks later, residual blood flow was still present in the false lumen, and the surrounding thrombus appeared more apparent. C, At 8 weeks, the false lumen was completely occluded and showed a dramatic change in MR signal.
Figure 3. T1-weighted (T1W) MRIs of 2 contiguous sections (D1 and D2) and corresponding histological staining (combined Mason’s elastin [CME], E1 and E2). F1, Detail of the methemoglobin-rich area (red-brown), highlighted in E1, corresponding to hyperintense MR signal (red arrow, D1). F2, Detail of the hemosiderin-rich area (yellow), highlighted in E2, corresponding to isointense MR signal (yellow arrow, D2). Magnification is shown above stains.
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