ROLE OF MRI IN THE DIAGNOSIS OF AORTIC DISSECTION

Gabriel Meinhardt, Heiko Mahrholdt, Udo Sechtem

Division of Cardiology, Robert Bosch Medical Center, Stuttgart, Germany

MR imaging is increasingly becoming a first-line investigation for the evaluation of diseases of the aorta. Advantages of MRI include avoidance of ionizing radiation and the use of contrast agents, which are not nephrotoxic. Over the last years, major technological advances resulted in significant increases in acquisition speed.

Due to its large field of view MRI is well suited to visualize the thoracic and abdominal aorta. Additionally, many functional questions can be addressed that are important in patients with aortic disease such as regional and global ventricular function, the status of the heart valves, the condition of the pericardium and the presence of coronary artery disease. This chapter discusses the role of MRI in the work-up of patients with suspected aortic dissection. We also address the role of MRI in patients with other forms of acute aortic syndromes.

TECHNICAL CONSIDERATIONS

SPIN ECHO

With the use of spin-echo imaging rapidly flowing blood produces no signal, whereas slowly moving blood produces an increased intraluminal signal. Therefore, this type of sequences is often referred to as black blood. On spin-echo sequences, the intimal flap is a linear structure of intermediate signal intensity dividing the aortic lumen into two channels, both of which exhibit a
flow void. In black blood sequences, increases in intraluminal signal intensity can be caused by stagnant, retrograde, or turbulent blood flow or by poor ECG gating\(^2\). We use the HASTE sequence (half Fourier acquisition single shot fast spin echo) in patients with aortic syndromes to provide black blood MR images. The HASTE sequence is a very fast sequence, which only acquires half the usual number of lines in k-space. Transverse slices with a slice thickness of 6 mm covering the entire thorax and abdomen can thus be performed in a few seconds. The spatial resolution is, however, not as good as with the commonly used gradient-echo sequences.

Black blood techniques alone may be inadequate for the diagnosis of supraaortic branch vessel involvement\(^3\)-\(^5\).

**GRADIENT ECHO**

The intimal flap on gradient-echo sequences is visualized as a low-intensity linear structure dividing the aortic lumen into two channels, both of which exhibit high signal intensity if they contain flowing blood. Because gradient-echo sequences are flow sensitive, they are very useful to distinguish between slow flow and thrombus.

Cine gradient-echo imaging for the evaluation of aortic disease has been described first by Sonnabend in 1991\(^6\). Today, the standard gradient-echo pulse sequence is steady-state free precession (SSFP, TrueFISP) sequence\(^7\). SSFP produces high signal from blood and a good contrast to soft tissue without contrast material. In the case of aortic regurgitation, turbulence of flow leads to signal loss projecting from the aortic valve into the high-intensity blood pool in the left ventricle during diastole. With SSFP cine acquisition, it is possible to diagnose aortic regurgitation with high confidence. In a retrospective study, Pereles and coworkers examined the diagnostic accuracy of the SSFP portion alone of their comprehensive imaging protocol in patients with suspected aortic syndromes\(^8\). The comprehensive imaging protocol included transverse nonenhanced and contrast-enhanced gradient-echo T1-weighted fat-saturated two-dimensional acquisitions, sagittal oblique and coronal contrast-enhanced time-resolved MR angiography of the chest, contrast-enhanced high-spatial-resolution 3D MR angiography, transverse and coronal single-shot SSFP imaging of the chest and four breath-hold cine SSFP acquisitions. In 29 examinations, the SSFP portion alone was sufficient to diagnose the presence or absence of dissection or aneurysm of the aorta. The entire time required for this part of the protocol was less than 4 minutes. However, SSFP sequences are susceptible to magnetic field inhomogeneities and pulsatile flow, both of which may cause artifacts. Artifacts can occur in patients with sternotomy wires or surgical clips. Nevertheless, even in patients with a history of prior aortic graft repair SSFP yields diagnostic images in most cases\(^8\).