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Novel imaging strategies in venous thromboembolism

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CHAPTER

Magnetic resonance direct thrombus imaging can distinguish between old and new thrombosis in the abdominal aorta: a Case Report

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ABSTRACT

A 43-year-old man with abdominal angina for several months showed a large suprarenal aneurysm with extensive circumferential wall thrombosis of the abdominal aorta on CT angiography, with complete occlusion of the right renal artery and critically stenosed left renal artery. He suffered from severe hypertension and renal failure. A percutaneous transluminal angioplasty (PTA) was planned. After complicated PTA leading to occlusion of the left renal artery, successful rescue revascularization surgery was performed. Hesitant to start anticoagulant treatment because of a high bleeding risk, magnetic direct thrombus imaging (MRDTI) to assess the age of the extensive arterial thrombosis was done. The MRDTI scan showed a low signal intensity of the aortic thrombus indicative of chronic thrombosis rather than acute thrombosis. Oral anticoagulant treatment was therefore not started. The patient recovered without major complications.

INTRODUCTION

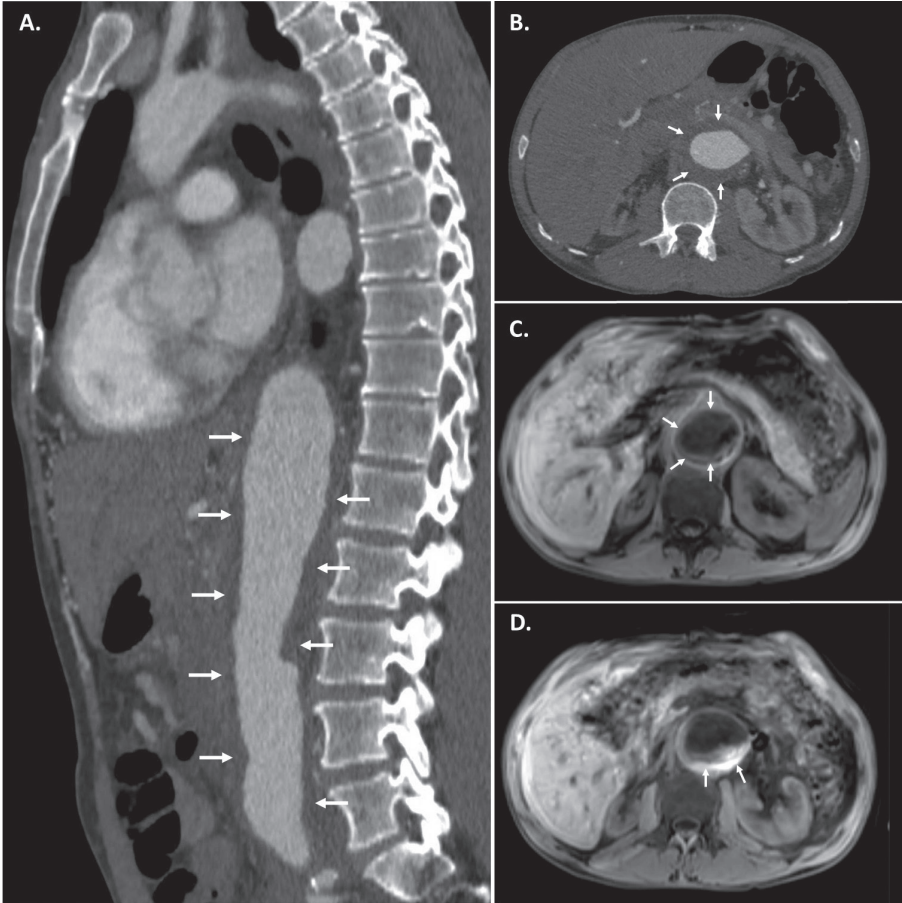
Aortic intraluminal thrombosis (ILT) commonly occurs in the presence of aortic pathology, such as aneurysmal disease, atherosclerotic plaque and/or dissection. Approximately 70-80% of patients with an abdominal aortic aneurysm (AAA) develop a non-occlusive aortic ILT.¹ Accurate diagnosis and treatment of ILT are of utmost importance to prevent serious complications such as (peripheral) arterial embolic occlusion with resultant ischemia.² To the best of our knowledge, we present the first report of a patient in whom the non-invasive magnetic resonance direct thrombus imaging (MRDTI) technique was used to determine whether an abdominal aortic thrombus was acute or chronic to guide antithrombotic management.

CASE DESCRIPTION

A 43-year-old man was referred to our hospital with abdominal discomfort for several months. He was a heavy smoker with 30 pack/years. His medical history included an ischemic stroke, helicobacter pylori gastritis and severe hypertension complicated by cardiac hypertrophy. He was prescribed chlorthalidone, barnidipine, lisinopril, nebivolol, clopidogrel, simvastatin and ranitidine. His family history was remarkable for multiple aortic aneurysms and coronary artery disease in his father, who died at a young age of a ruptured aneurysm. His mother had been treated for systemic hypertension. On physical examination he was hypertensive with a blood pressure of 211/130 mmHg and a heart rate of 55 bpm. During auscultation of the abdomen a murmur was recognized. Palpitation of the abdomen was not painful. Peripheral pulsations were present in both arms and legs. Neurologic examination was normal.

Laboratory results showed severe renal insufficiency with an estimated glomerular filtration rate (eGFR) of 14mL/min and a creatinine level of 418 μ mol/L. A CT angiography was performed showing a large suprarenal aortic aneurysm with diffuse circular atherosclerosis and extensive circumferential aortic wall thrombosis (**Figure 1A** and **1B**). The celiac trunk, superior mesenteric artery and right renal artery were occluded with an atrophic right kidney. The left renal artery was critically stenosed. The patient was subjected to PTA of the left renal artery, which was complicated by complete occlusion. To rescue the left kidney

Figure 1. CT images after IV iodinated contrast and MRDTI images without contrast agent. Figure 1A and 1B: Sagittal and axial CT image after IV contrast showing extensive wall thrombosis of the abdominal aorta (arrows) which cannot be distinguished from the aortic wall. Figure 1C: Axial MRDTI image showing chronic thrombosis (low signal intensity) in the aortic wall (arrows). Figure 1D: Axial MRDTI image showing high signal intensity representing recent thrombus in the aortic wall near the location of the PTA and rescue revascularization (arrows).



and treat abdominal angina a bifurcated Dacron bypass was made from the right external iliac to the left renal artery and common hepatic artery. Collateral flow via a well-developed gastroduodenal artery ensured adequate perfusion of the superior mesenteric arterial network. We hesitated initiating anticoagulant treatment because of a high bleeding risk due to the recent major surgery, severe hypertension and renal insufficiency. Therefore, a MRDTI scan was performed

to assess the age of the thrombus, which showed a low signal intensity of the aortic thrombus indicative of chronic rather than acute thrombosis (**Figure 1C**). A high signal intensity was only found in the aortic wall at the level of the left renal artery where the PTA had caused acute occlusion and bypass surgery had been performed (**Figure 1D**).

Because no acute thrombosis was identified, anticoagulant treatment was not started, and antiplatelet therapy continued. Abdominal ultrasonography after the bypass surgery showed open bypasses. The renal function gradually improved, and the patient could be discharged from hospital in good health. Genetic testing was performed because of the premature aortic thrombosis in presence of an AAA but was negative for connective tissue disorders or chromosomal syndromic thoracic aortic aneurysm. The patient was kept under close outpatient surveillance because of chronic persistent renal insufficiency with an eGFR of 60mL/min. In the first year after presentation, there were no thrombotic or bleeding complications.

DISCUSSION

Aortic ILT may lead to peripheral embolism resulting in occlusion of the distal arteries.³ Importantly, an acute aortic thrombosis (AAT) is a rare life-threatening event and may be caused by in-situ thrombosis of an atherosclerotic aorta, large saddle embolus to the aortic bifurcation or occlusion of previous surgical reconstruction.⁴ Prompt management is indicated in case of an AAT or an acute ischemic event caused by distal embolization⁴ and may be considered in an unstable thrombus.¹ However, current imaging modalities do not allow for accurate distinction between acute versus chronic thrombosis. It is therefore challenging to differentiate between stable and unstable thrombi.

MRDTI is a technique in which a thrombus can directly be visualized without the use of a potential toxic contrast agent. This method is based on the formation of methemoglobin in a fresh thrombus leading to shortening of the T1 signal on MRI.⁵ It has been shown to accurately diagnose a first deep vein thrombosis (DVT) and distinguish chronic thrombotic remains from acute recurrent DVT with a sensitivity of 95-100% and specificity of 100%.^{6,7} Current studies are evaluating its diagnostic accuracy for unusual site venous thromboembolism, including upper extremity DVT and splanchnic vein thrombosis (NTR 5738 and NTR 7061), where current imaging tests often cannot provide a definite diagnosis.

MRDTI may prove useful to overcome diagnostic challenges in the arterial system too, but the technique has not been extensively studied in this setting. In a preliminary study, 14 patients with acute limb ischemia were evaluated with MR angiography and MRDTI. MRDTI showed a positive signal in 11 (79%) patients. In 6 patients MRDTI findings were discrepant in thrombus length and occlusion compared to MR angiography. Since recanalization with thrombolysis in these 6 patients was not achieved, it was suggested that the discrepancy reflected a difference between chronic arterial disease and superimposed acute thrombosis.⁸ MRDTI was also suggested to be useful in identifying complicated plaques in the carotid arteries and upper thoracic aorta in patients with cerebral vascular disease.^{9,10} MRDTI has not yet been evaluated as a tool to guide anticoagulant treatment in abdominal aortic thrombosis. Because of the associated morbidity and mortality of complicated aortic ILT, accurate diagnosis of an unstable thrombus or differentiation between acute versus chronic thrombosis remains very relevant for selected patients.

We present the case of a patient who was diagnosed with AAA and extensive wall thrombosis in whom acute and unstable thrombosis could be excluded with MRDTI. MRDTI may therefore be a valuable additional imaging test to establish a definitive diagnosis and treatment in patients with abdominal aortic thrombosis with or without co-existing aortic pathology. More diagnostic studies are needed to support our findings.

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