Visualizing slow-flow endoleak after endovascular abdominal aortic aneurysm repair with the new blood pool agent Vasovist

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Introduction

Patients who underwent endovascular aortic aneurysm repair (EVAR) need to be enrolled in a life-long follow-up program to monitor aneurysm size and leakage of blood (endoleak) into the aneurysm sac as the long-term efficacy of EVAR is still unknown. The follow-up program in our institution consists of arterial and delayed phase CT angiography exams (CTA) post-operatively and yearly thereafter. The delayed phase is acquired 90 seconds after injection of contrast agent. Previous work showed that MRI has added value with respect to CTA in these patients. MRI is more sensitive to endoleak than CTA [1] and thanks to the superior soft-tissue contrast MRI visualizes thrombus organization inside the aneurysm sac, defined as the space between the endoprosthesis and the outer vessel wall [2].

Successfully treated abdominal aortic aneurysms are completely excluded from blood flow (no endoleak) and are expected to shrink. Shrinkage is defined as decrease in aortic diameter of more than 5 mm per year. Endoleak is an accepted etiology for aneurysms which fail to shrink. A clinical problem is formed by a large number of patients who exhibit stable or growing aneurysms without endoleak on CTA. The etiology of this phenomenon is unclear. Different causes have been proposed but were not yet visualized [3] e.g. graft porosity, slow-flow endoleak and fibrinolysis. We expect that in a number of these patients, endoleak hampering shrinkage of the aneurysm is present but invisible on CTA. Endoleaks are only visualized by CTA if leakage of a detectable amount of contrast agent occurs immediately after injection. This may not be the case with slow leakage, as in this case it will take a longer time before a detectable amount of contrast agent has leaked into the aneurysm sac. By that time, the contrast agent has already disappeared from the blood. Therefore, to visualize slow leakage contrast agents are needed that stay intravascular (blood pool agent) for a prolonged period of time. These agents allow for a longer delay between contrast fluid injection and imaging, potentially allowing the detection of slow flow endoleaks. Recently, one such agent, Vasovist (Schering AG, Berlin, Germany and EPIX Pharmaceuticals, Cambride, MA) was approved for clinical use. The purpose of this study was to visualize slow-flow endoleaks with Vasovist-enhanced MR-imaging in patients with aneurysms which do not shrink without evidence of endoleak on CTA.

Patients and methods

In the period between June and September 2006 nine consecutive patients taken from our regular EVAR follow-up program were included if they had (1) a stable or growing aneurysm, defined as increase in aneurysm diameter of more than 5 mm last year or change in aneurysm diameter of less than 5 mm last year, (2) no evidence of endoleak on arterial and delayed phase CT angiography, (3) a follow-up of more than 1 year, and (4) signed the informed consent form. Patients with MRI-incompatible endoprostheses and claustrophobia were excluded. Institutional review board approval was obtained.

Aneurysm diameters were measured by one observer on the two most recent follow-up CT angiography exams using digital calipers. These CT angiography exams were a year apart. 3 Patients had an Excluder endoprosthesis (Gore, Flagstaff, AZ, USA) 2 of which had the original Gore Excluder endoprosthesis, 1 patient had the new Excluder Low Permeability endoprosthesis, 5 patients had a Talent endoprosthesis (Medtronic Vascular), 1 patient had an EVT/Ancure (Guidant, Menlo Park, CA, USA) endoprosthesis. Median time after EVAR was 2.1 years (range 1.0 – 8.2 years). Median AAA diameter was 53.5 mm (range 40 – 61.5 mm), median time between CTA and MRA examination was 21 days (range 13 – 26 days with one exception where the CTA-MRA interval was 185 days).

Blood pool contrast agent Vasovist (gadofosveset trisodium) is a gadolinium based contrast agent which binds reversibly to human serum albumin, prolonging its intravascular time. Imaging with intravascular enhancement can take place within 60 minutes after injection [4]. We used Vasovist in the approved dosage of 0.03 mmol/kg. Vasovist was administered using a Medrad infusion pump at an injection speed of 1 ml/s, followed by a 30 seconds saline chaser with the same injection speed.

Acquisition All MRI scans were performed on a Philips Achieva 1.5-T scanner (Philips Medical Systems, Best, The Netherlands). A wrap-around body coil was used as receive coil. Patients were scanned using a dedicated MRI-protocol, designed for follow up after EVAR [1]. For endoleak detection our protocol contains pre- and postcontrast T1-weighted spin echo images. Scan parameters were TR/TE/α 580 ms/15 ms/90°, slice thickness 3.0 mm, FOV 270x385 mm2, acquisition matrix 256 x 256, 60 slices. NSA=1. Acquisition time was 5 minutes 27 seconds. A regional saturation slab was placed on the abdominal fat to prevent ghosting artifacts due to breathing. Postcontrast images were acquired 3 minutes and 30 – 70 minutes after injection.

Data collection Two observers independently evaluated the MR scans and classified them into the following categories: endoleak, possibly endoleak, and no endoleak. Early and late postcontrast images were both compared to precontrast images. Leakage was defined as high signal intensity on the postcontrast image outside the lumen inside the aneurysm sac not present on the precontrast image. In case of doubt, consensus was reached after consultation of a third observer. Observers were blinded to patient's identity and other imaging studies performed.

Results

Results of late postcontrast T1-weighted images are given, early postcontrast images in brackets:

Endoleak was seen in 5(0) patients. Possible endoleak was seen in 2(3). No endoleak was seen in 2(6). All possible endoleaks on early postcontrast images were labeled endoleaks on the late images. In the two patients with the original Excluder endoprosthesis graft porosity was visible (Figure 2). These patients were 2 resp. 3 years after EVAR. The origin of the other 3 endoleaks was not visible. Figure 1 and 2 show early and delayed CTA and MR-images of the same patient. Note that vasa vasorum were visible in 4(3) patients. These tiny vessels were more pronounced on the late phase images (Figure 2b,c) and could not be distinguished on CTA-images.

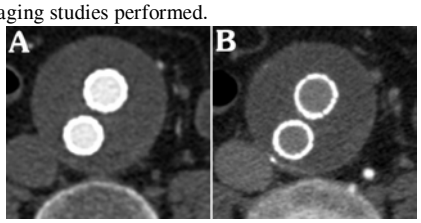

Figure 1 *CT angiography image a) arterial phase, b) late phase (2 minutes after injection), images of same patient as Figure 2. No endoleak is visible.*

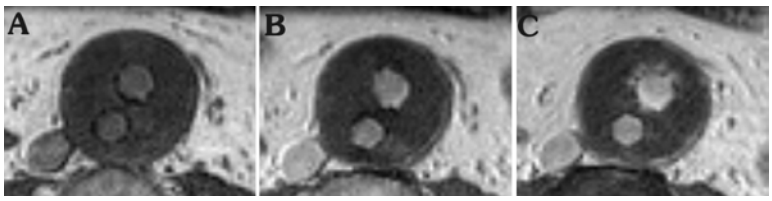

Figure 2 *Transverse T1-weighted spin echo images a) pre-contrast b) post-contrast 3 minutes after injection c) late phase 70 minutes after injection. c) shows an endoleak which seems to originate from a porous graft.*

Discussion

Our study showed that MRI with the use of the blood pool agent Vasovist including late phase imaging revealed endoleaks in about 50% of patients who had a stable or growing aneurysm without evidence of endoleak on arterial and delayed phase CT angiography exams. These additional endoleaks were visible on the late phase images. Because no blood pool agents exist for CTA, MRI with Vasovist is currently the only non-invasive technique for visualizing slow-flow endoleaks. To our knowledge, for the first time graft porosity of the original Excluder endoprosthesis was depicted, which had already been addressed by the manufacturer by changing the graft fabric to a less porous alternative. This new contrast agent improved our understanding of aneurysms which do not shrink after treatment. This knowledge can lead to new treatment strategies for these patients. Further research is necessary to unravel this problem completely.

References

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