Translumbar type II endoleak embolization using real-time needle guidance and fluoroscopy overlay on pre-treatment CTA

H. Kobeiter
J. Mayer
P. Desgranges
J.P. Becquemin
A. Rahmouni
A.G. Radaelli

Department of Radiology and Vascular Surgery, Henri Mondor University Hospital, Creteil, France.

Interventional X-ray, Philips Healthcare, Best, the Netherlands.

Clinical applications

Type II endoleaks consist of persistent retrograde perfusion of the aneurysm sac after Endovascular Aneurysm Repair (EVAR) through unoccluded collateral arteries [1]. Translumbar embolization is an efficient therapeutic option in the case of sac enlargement in abdominal aortic aneurysm (AAA) [2]. This technique requires precise puncture of the sac within the endoleak location while avoiding damage to healthy organs and to the endograft.

The choice of image guidance technique can be challenging. Endoleaks are optimally visualized with cross-sectional imaging such as computed tomography (CT) while needle control is better achieved with real-time imaging such as fluoroscopy. Live C-arm fluoroscopy overlay on pre-acquired CT angiography represents the new generation of imaging technology, offering the guiding capabilities of fluoroscopy with the contrast resolution of CTA. When combined with needle guidance software such as XperGuide (Philips Healthcare, Best, the Netherlands) [3], it can provide a clear target during needle advancement and avoid additional injection of iodinated contrast to visualize the endoleak.

We report on our experience in the clinical use of this technique in the treatment of type II endoleaks.

Materials and methods

An 81-year-old male was referred to our department for a type II endoleak following EVAR, with a sac enlargement larger than 10 mm. The endoleak was located on the posterior wall and originated from the lumbar arteries. It was clearly visible on CT angiography and its location was difficult to access intra-arterially due to a severe stenosis of both internal iliac arteries.

We decided to plan the intervention with the XperGuide software and verify the feasibility of a translumbar approach by drawing the puncture path on the diagnostic CTA image, because this optimally shows shape and volume of the targeted endoleak (Figure 2a). In general, we recommend the use of delayed phase CTA, although in this specific case we used the arterial phase because it still offered a good depiction of the endoleak and a better spatial resolution in the sagittal and coronal planes, which are used to guide needle puncture.

During intervention, the patient was placed in the prone position. Although needle planning can be performed before intervention, the predetermined optimal path should always be verified after image fusion with an intra-operative low dose cone-beam CT scan (XperCT, Philips Healthcare, the Netherlands) without...
To fill the endoleak and possibly get reflux into the collaterals. Technical success was assessed by absence of blood reflux in the needle. The patient was then observed for 24 hours before being discharged.

**Results**

Translumbar embolization of type II endoleaks under real-time needle guidance with overlay of fluoroscopy on pre-treatment CTA was feasible and technically successful. The total procedure time was 40 minutes and we used a total of 5 cc of iodinated contrast throughout the intervention. This technique allowed for puncturing the endoleak accurately and without damage to the endograft while avoiding bony structures and vital organs during needle advancement.

Accurate needle positioning was further documented by acquiring an XperCT image and fusing it with the pre-acquired CTA (Figure 3a). The distance between final tip position and contrast agent as organ shift or patient torsion may have occurred between the CT room and the interventional suite. This has the additional advantage of allowing the pre-acquired CTA to be registered with the live fluoroscopy image. Consequently, we could use the CT data as background overlay during fluoroscopy-guided needle puncture, and guide the needle towards the endoleak with greater confidence (Figure 2b).

The relation between the 2D fluoroscopy and the CTA is maintained during C-arm movements (angulations and rotations), table panning, changes in source-image distance, and modifications in image size.

The puncture was performed under local anesthesia through a 20 G needle, and success was confirmed by blood reflux and endoleak visualization after direct injection of 5 cc of contrast agent. Embolization was then performed with Onyx 18 liquid embolic agent (eV3 Neurovascular, Irvine, California, USA) in order
target of the planned needle path was 6 mm. A final XperCT image was acquired to document the shape and size of the embolic agent, its position with respect to the endograft, and the complete coverage of the endoleak (Figure 3b). The patient experienced no pain during the intervention.

Discussion

Selection of the best image guidance modality for translumbar embolization of type II endoleaks can be challenging. CT-guidance is efficient [4, 5] but may be limited and does not offer real-time control. Fluoroscopy provides real-time guidance but requires multiple incidences [2] and does not show the abdominal organs. Real-time overlay of fluoroscopy and cone-beam CT offers real-time control, and combines an easier access to the patient via fluoroscopy with the volumetric information and contrast resolution of cone-beam CT [6, 7], but requires either intra-arterial or intravenous injection of up to 100 cc of iodinated contrast for direct visualization of the endoleak.

Most patients undergo a CTA examination during diagnostic work-up and the possibility of reusing a pre-acquired CTA data set rather than a new contrast-enhanced cone-beam CT scan makes it possible to avoid a new contrast agent injection (apart from the 5 cc injected into the sac to confirm endoleak puncture) and reduce radiation exposure. We use a low-dose cone-beam CT protocol without contrast agent to acquire the volume necessary for image co-registration.

The reduction of iodinated contrast administration is particularly important in patients with abdominal aortic aneurysms, who represent an older population more prone to renal function impairment. According to our experience, the registration between CTA and non-contrast XperCT works well and the matching between CT and fluoroscopy is accurate in clinical practice. The patient lies supine for CTA and prone for embolization. This means that some organs move under the influence of gravity. However, the resulting mismatches induced during registration did not significantly influence the procedures, because the bone landmarks, the aorta and the endograft do not move significantly relative to each other from prone to supine. The mismatches essentially involved the anterior abdominal wall and the gut.

In conclusion, our experience shows the potential of image fusion and cone-beam CT needle guidance in translumbar embolization of type II endoleaks. Currently, this is our preferred technique for the percutaneous management of type II endoleaks. We hope that this preliminary experience and the analysis of larger cohort of patients will further support the use of this technique for patients requiring translumbar embolization of type II endoleaks.