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INTERVENTIONAL RADIOLOGY

TECHNICAL NOTE

Proximal iliac limb extension and embolization: a new technique of complete endovascular management of an unfavorably sited type III endoleak

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ABSTRACT

Type III endoleak is an uncommon but life-threatening complication of endovascular aortic repair, and such leaks at certain sites can be challenging to treat through an endovascular route. A 77-year-old man presented with severe abdominal pain and was found to have an abdominal aortic aneurysm with contained rupture due to an unfavorably cited type IIIb endoleak. He was successfully treated with an endovascular approach using bilateral iliac limb proximal extension combined with embolization of endoleak sac, endoleak site and the feeding recess, preserving flow through both the iliac limbs obviating the need for an additional femorofemoral bypass. The patient improved clinically and had a favorable long-term follow-up profile.

Endoleak is the most common complication of endovascular aortic repair requiring re-intervention (1). There are five types of endoleak; type III is a less common but the most dangerous variety (2, 3). Endovascular repair is preferred over surgical repair and different treatment options exist depending on the site of endoleak (4). Because of its location, a type IIIb endoleak from a defect in the graft at or close to the endograft bifurcation cannot be treated by simple relining with an aortic extender cuff or an iliac limb, and is usually endovascularly treated by insertion of an aorto-uni-iliac stent graft along with occlusion of contralateral limb and a surgical femorofemoral bypass; the other option being insertion of a bifurcated stent graft if there is sufficient length between renal artery origin and endograft bifurcation (1, 4, 5). We describe the first case of a successfully treated unfavorable type IIIb endoleak using proximal extension of iliac limbs, endoleak sac and feeding recess embolization.

Technique

A 77-year-old male presented to the accident and emergency department with a 5 hour history of sudden onset severe abdominal pain radiating to the back. He was conscious; his blood pressure was 100/65 mmHg, and pulse rate was 96 beats per minute. He had an endovascular repair of an 11.5 cm sized abdominal aortic aneurysm 6 years ago with an Endurant bifurcated stent graft (Medtronic Endovascular) performed in a different hospital. He had annual follow-up CT scans; the latest at that time was from six months earlier where the graft position was optimal, aneurysm had shrunken to 9 cm in diameter, and there was no endoleak.

A CT aortogram showed enlargement of abdominal aortic aneurysm to 13.5 cm in diameter, contained rupture in its anterosuperior aspect, and an endoleak in its posterior part at the level of stent graft bifurcation (Fig. 1). No discrete communication with either the graft lumen or an adjacent lumbar artery could be seen. Considering possibilities of type II and III endoleaks, the patient was taken for an angiogram under general anesthesia with an aim to either embolize or perform an open surgery. Digital subtraction angiogram using right femoral access confirmed a type III endoleak through a defect in the posterior wall of the stent graft main body approximately 4 mm above its bifurcation (Fig. 2a). After a quick multidisciplinary discussion between interventional radiology and vascular surgery colleagues, endovascular percutaneous treatment with proximal limb extension and posterior recess embolization was decided.

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Figure 1. Preoperative axial CT image shows an abdominal aortic aneurysm *(asterisk)* with contained rupture *(white arrows)*, and an endoleak in its posterior aspect *(black arrow)* close to the endograft bifurcation *(white arrowhead)*.

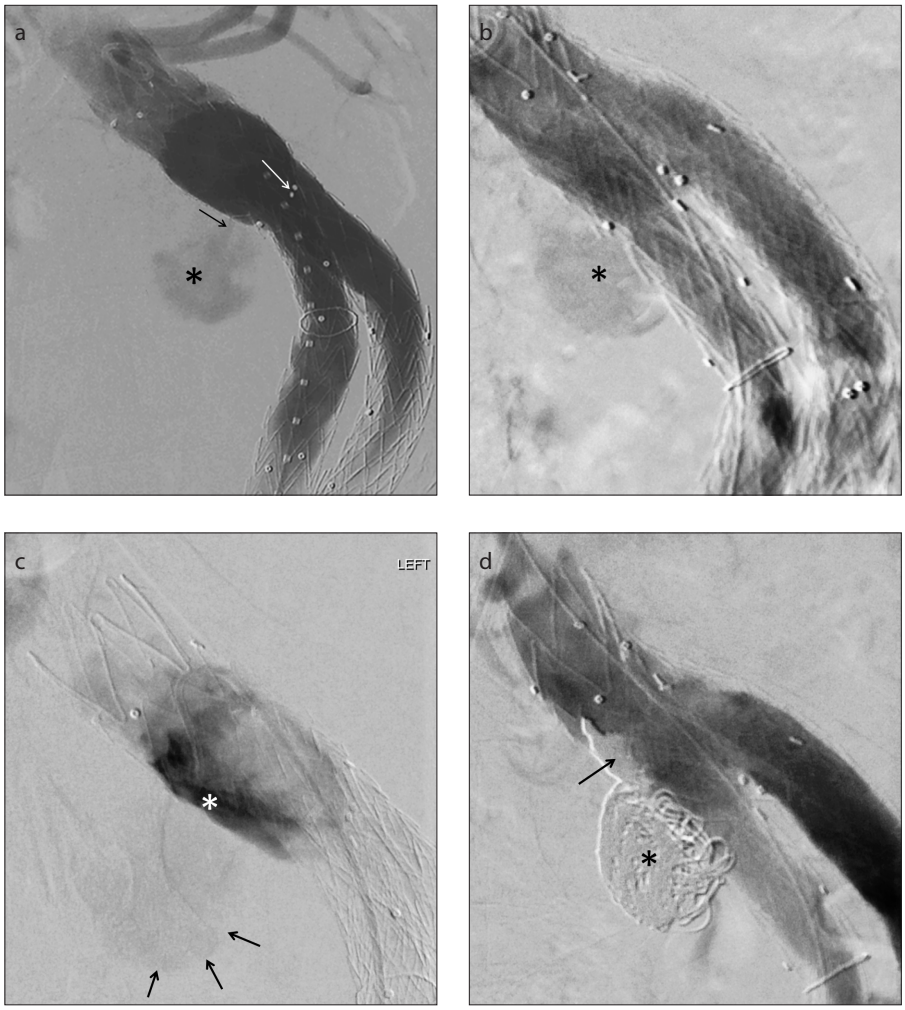

Figure 2. a–d. Intraoperative digital subtraction angiogram images. Initial diagnostic aortogram in anteroposterior projection **(a)** confirms a type IIIb endoleak *(asterisk)* with a jet of contrast *(black arrow)* close to the bifurcation of the stent graft main body *(white arrow)*. Aortogram in steep left anterior oblique (LAO) projection after proximal deployment of iliac limbs **(b)** shows a persistent endoleak *(asterisk)*. Angiogram in anteroposterior projection and cranial angulation **(c)** after cannulating the posterior recess between stent grafts *(asterisk)* confirms catheter position and shows the persistent endoleak *(black arrows)*. Postprocedure aortogram in steep LAO projection shows coil mass in the endoleak sac *(asterisk)*, Onyx cast in the posterior recess *(arrow)*, no residual endoleak, and patent bilateral iliac limbs.

Through bilateral percutaneous femoral access, 14 F DrySeal Flex introducer sheaths (W.L. Gore and Associates Inc.) were introduced after preparing the puncture sites with two Perclose ProGlide sutures (Abbott Vascular) on either side. Two 16–18 ×115 mm Gore Excluder (W.L. Gore and Associates Inc.) stent grafts were deployed one on either side with their proximal ends approximately 2 cm above the endoleak site. Post deployment angiography showed a persistent endoleak through the posterior recess between the deployed iliac limbs and the leaking stent graft main body (Fig. 2b). Angiogram performed using a reverse hook catheter (MHK2) placed in the posterior recess confirmed the leak being fed by this recess (Fig. 2c). A Progreat microcatheter (Terumo Corp.) was coaxially introduced through the reverse hook catheter, and with minimal manipulation, the endoleak cavity could be cannulated through the stent graft defect. The endoleak cavity was partially embolized with multiple Ruby coils (Penumbra). Onyx 18 (Medtronic) was then injected through the microcatheter into the neck of the endoleak close to the defect, graft defect and part of the posterior recess. Postprocedure angiogram showed patent iliac limbs and no endoleak (Fig. 2d). The femoral puncture sites were closed by tightening the pre-deployed Perclose ProGlide suture knots. The patient had significant reduction in abdominal pain after the procedure and complete relief in one week. There was no recurrence of symptoms; follow-up yearly CT scans and trimonthly ultrasound Doppler examinations showed resolution of contained rupture, progressive reduction in size of aneurysm to 11.7 cm, patent stent grafts and absent endoleak over a period of three years (Fig. 3).

Main points

- Type IIIb endoleak is treated through endovascular route by establishing continuity of fabric by relining the site of leak with stent grafts.
- Leak at or close to the endograft bifurcation is challenging and most often is treated by aorto-uni-iliac stent graft with contralateral iliac limb plugging and a femorofemoral bypass.
- Extension of iliac limbs proximally with endoleak embolization might be a simpler, feasible and safe option to treat such an endoleak without requiring a femorofemoral bypass.

Discussion

Type III endoleak arises from endograft device structural failure, and is classified into two types: the more common type IIIa comprises leakage between or separation of modular components of the stent graft, and the less frequent type IIIb comprises leakage from disruption in stent graft fabric (1, 3, 4). Among the different endoleaks, types I and III result in direct communication of aneurysm sac with aortic pressure, are associated with higher risk of aneurysm rupture, are hence considered dangerous,

Figure 3. Three-year follow-up unenhanced axial CT image shows reduction in size of aortic aneurysm *(asterisk)*, resolution of contained rupture, and beam hardening artifact from coils and onyx in the endoleak sac and posterior recess *(white arrow)*.

and need to be treated urgently (1–3). Type III endoleak is more dangerous than type I since it is associated with a sudden increase in intra-aneurysmal pressure and a measurable increase in aneurysm size (2, 3, 6). Multiphasic CT scan has the highest sensitivity to detect an endoleak, but categorizing them into either type II or type III, which have very different management options, is difficult. Catheter angiography is the best imaging technique to determine the type of endoleak and characterize the site of a type III endoleak (1, 2, 6).

Endovascular treatment is favored over surgical repair for type III endoleaks (1, 4). Type IIIa endoleak is treated with reconnection of graft components using bridging stent grafts, or ballooning overlapping stent graft components to obliterate a leak between them. Type IIIb endoleak is treated by relining the device across the site of graft defect with another stent graft of appropriate size. Embolization of the endoleak sac in isolation is not considered appropriate for type IIIb endoleaks (2). Sufficient landing zone is needed both proximal and distal to the site of a type IIIb endoleak for achieving an adequate seal, which is difficult to achieve with leaks at or very close to the endograft bifurcation using a simple aortic extender or an iliac limb. Placement of a bifurcated stent graft within the leaking endograft is the best option for such leaks since it provides a seal and preserves blood flow in both iliac limbs, avoiding an additional femorofemoral bypass. This, however, needs a sufficient length (of at least 7 cm considering a 4 cm main body covered segment and a 3 cm contralateral limb) between renal artery origin and bifurcation of the leaking endograft to deploy the contralateral limb of a bifurcated main body above the bifurcation—such a length is not available with most of the currently used stent grafts which have 4 to 5 cm long covered segment of main body (4). Because of this, these unfavorably situated leaks are usually treated with placement of an aorto-uni-iliac stent graft combined with contralateral iliac limb occlusion and a femorofemoral bypass (1, 4).

The case described had a leak very close to the main body bifurcation and showed signs of contained rupture necessitating an emergency repair. The distance between renal artery origin and endograft bifurcation was 43 mm—not suitable for any bifurcated grafts available on the shelf. An aorto-uni-iliac device was not available at that time. We used a novel technique to adequately embolize and seal the endoleak without requirement of an additional femorofemoral bypass surgery. Our aim was to embolize the aneurysm sac using a combination of coils and onyx liquid embolic agent, and extend the liquid embolic agent across the defect into the stent graft to seal the defect completely, while avoiding a distal embolization by proximal deployment of bilateral iliac limbs. Favorable outcome has been observed over a 3-year postprocedure period.

Proximal extension of the iliac limbs in isolation through femoral route would not line the entire circumference of the endograft main body because of their size, and would result in two blind ending passages orthogonal to the iliac limbs feeding the endoleak. In the case described, the diameters of the main body above its bifurcation measured 24.6 and 29.8 mm in orthogonal axes, and all the available iliac limbs were 16 mm in their proximal diameter. To completely cover the cross-section of the main body without any residual blind passages, the minimum diameter of iliac limbs required would be 21.5 mm. This could potentially be performed with bilateral flared iliac limbs using the upside down Gore Excluder limb technique (7). Another potential completely endovascular yet undescribed method of treating such unfavorable type IIIb endoleaks could be relining the whole aortic stent graft with Altura Endograft (Lombard medical Ltd) (8). Discussion of these devices and techniques is beyond the scope of this technical note.

In conclusion, type IIIb endoleak can be a challenge if the graft defect is close to or at the endograft bifurcation and percutaneous treatment usually involves sacrifice of an iliac limb and a femorofemoral bypass. Proximal iliac limb extension with endoleak sac and feeding recess embolization can be a simpler, feasible and safe option to treat such an endoleak.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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