

Direct aneurysm sac catheterization and embolization of an enlarging internal iliac aneurysm using cone-beam CT

Monish Merchant, Rohan Shah, Scott Resnick

ABSTRACT

Since cone-beam computed tomography (CT) has been adapted for use with a C-arm system it has brought volumetric CT capabilities in the interventional suite. Although cone-beam CT image resolution is far inferior to that generated by traditional CT scanners, the system offers the ability to place an access needle into position under tomographic guidance and use the access to immediately begin a fluoroscopic procedure without moving the patient. We describe a case of a “jailed” enlarging internal iliac artery aneurysm secondary to abdominal aortic aneurysm repair, in which direct percutaneous puncture of the internal iliac artery aneurysm sac was performed under cone-beam CT guidance.

When planning for successful abdominal endovascular aneurysm repair (EVAR), it is important to evaluate if there are associated internal iliac artery (IIA) aneurysms and the potential for type II endoleaks via retrograde IIA flow. In cases of short, ectatic, or aneurysmal common iliac arteries, placement of the distal limb of the stent graft into the external iliac artery may be necessary to ensure safe graft limb positioning and an adequate seal. In situations such as this, where there is not an associated IIA aneurysm, standard therapy is to embolize the origin of the IIA prior to stent graft placement in order to prevent type II endoleaks (1).

The situation should be differentiated from the setting in which the IIA is not just a potential source of a type II endoleak, but is also aneurysmal. In this setting, embolization of the affected IIA origin is insufficient to protect the IIA aneurysm from retrograde perfusion and potential rupture (Fig. 1). This retrograde perfusion can lead to persistent aneurysm sac pressurization with subsequent aneurysm enlargement and increased risk of rupture. Furthermore, proximal embolization precludes future antegrade access into the aneurysm if an additional intervention is needed. The standard endovascular treatment of an isolated IIA aneurysm consists of embolic occlusion of all inflow and outflow branches (2). Hence, when an IIA aneurysm is associated with an abdominal aortic aneurysm (AAA), it should be treated in a similar manner prior to endograft placement (3).

We present a case of cone-beam computed tomography (CBCT) guided direct puncture of a “jailed” enlarging IIA aneurysm. The IIA aneurysm was not directly accessible through an antegrade endovascular approach secondary to prior IIA origin coil occlusion and stent graft exclusion of the IIA orifice.

Technique

This is a case of an 84-year-old male with history of AAA with concurrent aneurysmal dilation of the right common and internal iliac arteries. At an outside hospital the patient underwent an EVAR with extension of the iliac limb into the right external iliac artery. Computed tomography (CT) angiography approximately three months after EVAR showed that the right IIA aneurysm had enlarged 5 mm, now measuring 55 mm. An antegrade approach for treatment was not possible secondary to prior coil occlusion of the right IIA origin and extension of the iliac limb of the stent graft into the right external iliac artery.

CT angiography demonstrated partial enhancement of the right IIA aneurysm with probable retrograde flow through the right superior gluteal artery (Fig. 2). Our initial plan was to percutaneously puncture superi-

From the Department of Radiology (M.M. ✉ mmerchant1@gmail.com, R.S.), Advocate Illinois Masonic Medical Center, Chicago, Illinois, USA; the Department of Interventional Radiology (S.R.) Northwestern Memorial Hospital, Chicago, Illinois, USA.

Received 9 September 2014; revision requested 19 October 2014; revision received 31 October 2014; accepted 31 October 2014.

Published online 8 April 2015.
DOI 10.5152/dir.2014.14332

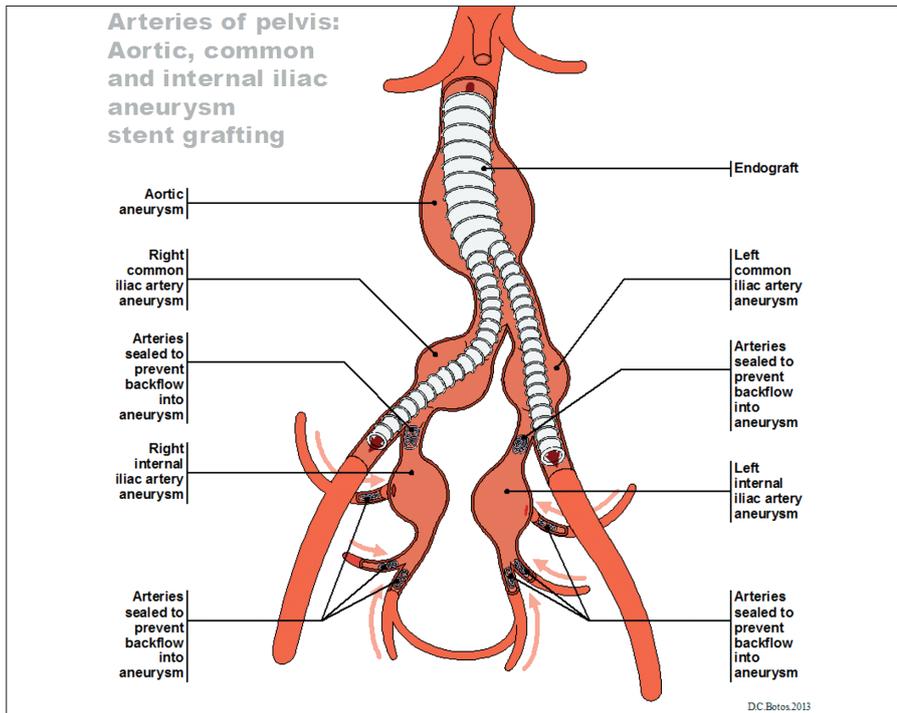


Figure 1. Illustration demonstrates endovascular aneurysm repair of an abdominal aortic aneurysm extending into the common iliac arteries and internal iliac arteries (IIA), with embolization of all inflow and outflow branches of the IIA to prevent enlargement of the IIA aneurysms. (Illustration by D.C. Botos)



Figure 2. Axial CT angiogram demonstrates large left internal iliac artery aneurysm with partial contrast opacification (*black arrow*) due to retrograde filling through a patent superior gluteal artery (*white arrow*).

or gluteal artery after using ultrasound guidance, but it was not sonographically visible through the gluteal musculature. Therefore, CBCT was used to percutaneously puncture the aneurysm sac. The patient was placed in the prone position and CBCT was acquired using the DynaCT (Siemens Medical Solutions) with a flat panel detector during administration of 100 mL intravenous contrast material. Three-dimensional reconstructions of the data set were used to plan the needle trajectory. The needle path graphic was then projected on the fluoroscopic image. Using this guidance, the patent portion of the partially thrombosed IIA aneurysm was directly punctured using an 18-gauge Chiba needle (Inrad). A 0.035-inch “J” tip guidewire (Bard Medical) was advanced into the aneurysm sac (Fig. 3). Arteriography through a 5 F angled diagnostic catheter confirmed persistent perfusion of the aneurysm sac via the superior gluteal artery (Fig. 4). The inflow superior gluteal artery was selectively catheterized using a Headliner 90 degree hydrophilic 0.018-inch guidewire (Terumo) and a Renegade STC microcatheter (Boston Scientific). Selective superior gluteal arteriography confirmed an intraluminal catheter position and retrograde perfusion of the aneurysm sac. The superior gluteal artery was embolized with multiple platinum microcoils until complete occlusion was achieved. The catheter was withdrawn into patent portion of the aneurysm sac. Repeat arteriography demonstrated complete exclusion of the IIA aneurysm sac with flow stasis and absence of other branch vasculature (Fig. 5). The catheter was removed and hemostasis obtained immediately. The patient tolerated the procedure well and was discharged home without complication later on the same day.

Discussion

AAA with a concomitant IIA aneurysm requires isolated treatment of the IIA aneurysm prior to EVAR. Embolization of the proximal internal iliac artery without associated embolization of the outflow branches has proven inadequate. Our case, along with others in the published literature, demonstrates that without distal control of an



Figure 3. Axial cone-beam CT image demonstrates the wire in the internal iliac artery aneurysm after percutaneous direct puncture with cone-beam CT guidance.

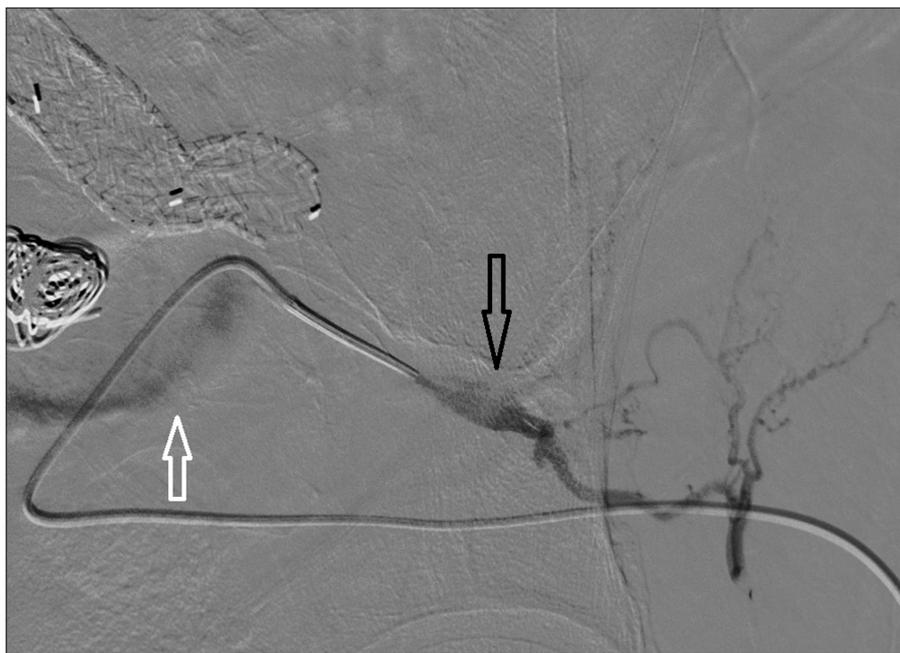


Figure 4. Selective superior gluteal artery angiography (*black arrow*) shows retrograde flow of contrast material into the internal iliac artery aneurysm sac (*white arrow*).

IIA aneurysm, the sac may grow and rupture after a long delay (3–5). The potential for retrograde flow through the patent outflow branches increases the probability of continued sac pressuriza-

tion and risk of rupture. IIA aneurysms associated with an AAA should be treated in an identical fashion to an isolated IIA aneurysm.

IIA aneurysms are clinically signifi-

cant because of their anatomic position deep in the pelvis, making them difficult to detect if they remain asymptomatic. Treatment is advocated when sac diameter is greater than 3–3.5 cm or if symptomatic (6). For many years the mainstay treatment was open surgical repair, which consisted of ligation of the IIA alone or endoaneurysmorrhaphy. Due to the restricted access to aneurysms lying deep in the pelvis and difficulties with achieving hemostatic control of numerous pelvic vessels, the associated mortality with surgical repair is high (7). Endovascular treatment has emerged as an alternative, less invasive therapeutic tool. The advantages of using an endovascular approach are associated with the minimally invasive nature of the procedure. There is minimal blood loss, operative surgical trauma, and cardiovascular compromise (6).

Endovascular treatment of an IIA aneurysm, whether isolated or in association with an AAA, consists of embolic (coil or plug) occlusion of the inflow artery and of all the outflow vessels (2). Recently, innovative techniques have been described involving branched endografts, which preserve blood flow through the IIA aneurysm, to avoid secondary complications such as buttock claudication, sexual dysfunction, and more serious pelvic ischemic complications (colorectal ischemia, nerve injury, gluteal necrosis) (8).

In our patient, prior EVAR and IIA aneurysm origin coil occlusion rendered an antegrade catheterization of the enlarging IIA aneurysm unattainable. In this situation an alternative approach must be pursued. Abderhalden et al. (3) recently reported two cases of growing IIA aneurysm without antegrade transarterial access. They successfully gained access to the outflow arteries by catheterizing collateral pathways linking the femoral artery to the internal iliac artery circulation. However, this approach requires adequate time for the collaterals to develop after occlusion of the internal iliac artery. Given the recent IIA occlusion in our patient, and the ongoing aneurysm growth, this approach was not feasible. CT-guided percutaneous or transosseous direct aneurysm puncture to gain access to the feeding arteries or aneurysm sac alone has also been described (9, 10). Other



Figure 5. Postembolization angiogram demonstrates complete occlusion of the superior gluteal artery. Of note, the embolization coils placed at the inflow of the internal iliac artery are visualized (black arrow).

reported approaches for embolization of such partially excluded aneurysms are percutaneous ultrasound-guided access or surgical exposure of the superior gluteal artery. Open ligation is rarely used and only indicated when all other approaches have failed (11).

In our case a sonographic approach was not available and direct puncture of the IIA aneurysm sac using CT guidance was considered. Prior authors have noted that the major disadvantage to this approach is the possibility of needle dislodgment while transferring the patient between the angi-suite and the CT scanner (10). For this reason we chose CBCT guidance which can be performed in the angiography suite using modern C-arm flat-panel fluoroscopy systems.

CBCT has brought volumetric CT capabilities into the interventional suite offering a substantial improvement over conventional single-planar digital subtraction angiography and fluoroscopy. The use of CBCT has been described in complicated vascular and nonvascular procedures. It allows the visualization of the vascular distribution of arterial territories and corresponding areas of tissue perfusion in the region of interest. Some described vascular appli-

cations of CBCT include use during hepatic arterial interventions, portal vein embolizations, and treatment of vascular anomalies. CBCT has also been used during challenging spinal, enterostomy, and biliary interventions (12). Specific tools on CBCT allow real-time fluoroscopic needle guidance. The needle tract can be planned on the three-dimensional data set and then this path can be projected during fluoroscopy, which allows visualization of the entry point as well as the progression of the needle to the point of interest.

The two most significant technical limitations of CBCT are image quality and set-up time. Compared to multi-detector CT, the wider collimation in CBCT leads to increased scatter radiation and degradation of image quality with a decreased contrast-to-noise ratio. Also there is decreased temporal resolution which increases motion artifact.

In conclusion, when planning endovascular treatment of an AAA with an associated IIA aneurysm it is vital that the outflow branches of the affected IIA be occluded in addition to the inflow artery. In the case we presented this was not done and the IIA aneurysm continued to enlarge secondary to retrograde flow from the outflow branch-

es. An antegrade approach to treatment was not possible due to previous EVAR so the aneurysm sac was directly punctured and successfully treated with the use of CBCT. Three-dimensional images acquired by CBCT allowed precise placement of our needle and avoided potential complications.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Ryer EJ, Garvin RP, Webb TP, Franklin DP, Elmore JR. Comparison of outcomes with coils versus vascular plug embolization of the internal iliac artery for endovascular aortoiliac aneurysm repair. *J Vasc Surg* 2012; 56:1239–1245. [CrossRef]
2. Cynamon J, Prabhaker P, Twersky T. Techniques for hypogastric artery embolization. *Tech Vasc Interv Radiol* 2001; 4:236–242. [CrossRef]
3. Abderhalden S, Rancic Z, Lachat ML, Pfammatter T. Retrograde hypogastric artery embolization to treat iliac artery aneurysms growing after aortoiliac repair. *J Vasc Interv Radiol* 2012; 23:873–877. [CrossRef]
4. Sahgal A, Veith FJ, Lipsitz E, et al. Diameter changes in isolated iliac artery aneurysms 1 to 6 years after endovascular graft repair. *J Vasc Surg* 2001; 33:289–284. [CrossRef]
5. Deb B, Benjamin M, Comerota AJ. Delayed rupture of an internal iliac artery aneurysm following proximal ligation for abdominal aortic aneurysm repair. *Ann Vasc Surg* 1992; 6:537–540. [CrossRef]
6. Antoniou GA, Nassef AH, Antoniou SA, Loh CY, Turner DR, Beard JD. Endovascular treatment of isolated internal iliac artery aneurysms. *Vascular* 2011; 19:291–300. [CrossRef]
7. Brings HA, Murray JD, Light JT, Hemp JR, Ranbarger KR. Internal iliac artery aneurysm following aortic reconstruction. *Ann Vasc Surg* 1996; 10:59–62. [CrossRef]
8. Riesenman PJ, Ricotta JJ 2nd, Veeraswamy RK. Preservation of hypogastric artery blood flow during endovascular aneurysm repair of an abdominal aortic aneurysm with bilateral common and internal iliac artery involvement: utilization of off-the-shelf stent-graft components. *Ann Vasc Surg* 2012; 26:109. [CrossRef]
9. Gemmete JJ, Arabi M, Cwikiel WB. Percutaneous transosseous embolization of internal iliac artery aneurysm type II endoleak: report of two cases. *Cardiovasc Intervent Radiol* 2011; 34:S122–125. [CrossRef]
10. Heye S, Vaninbroux J, Daenens K, Houthoofd S, Maleux G. Embolization of an internal iliac artery aneurysm after image-guided direct puncture. *Cardiovasc Intervent Radiol* 2012; 35:807–814. [CrossRef]
11. Patel SD, Perera A, Law N, Mandumula S. Case report. A novel approach to the management of a ruptured Type II endoleak following endovascular repair of an internal iliac artery aneurysm. *Br J Radiol* 2011; 84:240–242. [CrossRef]
12. Wallace M, Kuo M, Glaiherma, C, Binkert C, Orth R, Soulez G. Three-dimensional C-arm cone-beam CT: applications in the interventional suite. *J Vasc Interv Radiol* 2008; 19:799–813. [CrossRef]