Iatrogenic Ureteral Injury during Translumbar Embolization of a Type II Endoleak

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ABSTRACT

The persistence of flow within an aneurysm sac remains the so-called Achilles heel of endovascular aortic aneurysm repair. The management of type II endoleaks remains controversial, although aneurysm sac expansion is an accepted indication for intervention. The present case describes a patient with a type II endoleak following endovascular repair of an abdominal aortic aneurysm treated by translumbar embolization. The procedure was complicated by iatrogenic injury to the left ureter and nontarget embolization resulting in acute ureteral obstruction.

KEYWORDS: Endograft, type II endoleak, ureteral injury, translumbar embolization

Objectives: Upon completion of this article, the reader should be able to summarize the percutaneous management of type II endoleaks following endovascular aortic aneurysm repair.

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Endovascular placement of an aortic stent graft has become a popular technique for repair of abdominal aortic aneurysms. Unlike with conventional surgical aneurysm repair, there may continue to be blood flow within the aneurysm sac (endoleak) following endovascular repair. Endoleaks are classified based on the source of persistent blood flow.^{1,2} The most common subtype is type II: retrograde flow from patent aortic branch vessels. Type II endoleaks may result in continued aneurysm expansion, an accepted indication for intervention, generally embolization.^{3–6} However, the method of embolization remains controversial. We report a case in which a type II endoleak was treated with translumbar embolization using a liquid agent (n-butyl cyanoacrylate). The procedure was complicated by an iatrogenic injury to the ureter with acute ureteral obstruction from nontarget embolization.

CASE REPORT

A 74-year-old man was referred from an outside hospital for evaluation of an abdominal aortic aneurysm. At the time of surgery, the aneurysm sac measured 5 cm in diameter. He underwent placement of an AneuRx (Medtronic, Minneapolis, MN) stent graft, performed in the operating suite. Following stent-graft placement, abdominal aortogram demonstrated flow within a patent lumbar artery was identified (not shown) consistent with a type II endoleak. This was confirmed on a contrast-enhanced computed tomography (CT) scan performed 1 month later.

The patient was followed with surveillance CT scans. These continued to demonstrate persistent flow within the aneurysm sac via lumbar arteries. After the leak had persisted for 1 year, translumbar embolization was performed with direct injection of thrombin into the

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Case-Based Complications in Interventional Radiology: Lessons

Learned; Guest Editor, Sue Weeks, M.D.

Semin Intervent Radiol 2007;24:346–349. Copyright © 2007 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662.

DOI 10.1055/s-2007-985749. ISSN 0739-9529.

Figure 1 Single image from contrast-enhanced computed tomography scan demonstrates high-density material within the aneurysm sac (arrow) consistent with a type II endoleak.

aneurysm sac. This embolization, however, failed to eliminate the endoleak, but because the sac size was stable, the endoleak was not retreated at this time. The leak persisted (Fig. 1) and the aneurysm remained stable over the next 2 years until surveillance CT demonstrated interval enlargement of the aneurysm sac from a diameter of 5.0 cm to 5.6 cm.

With new aneurysm enlargement, it was decided to retreat the endoleak, again with translumbar embolization. The patient was positioned prone on the fluoroscopic table. Adhering to strict aseptic technique, so as not to introduce infection into the aneurysm sac, a skin site was localized and anesthetized with 1% Xylocaine (AstraZeneca, Wilmington, DE). From a left translumbar approach, a 21-gauge needle was inserted into the aneurysm sac. The needle was inserted at a level approximating that of the endoleak using bony landmarks and stent-graft markers as a guide. Once the aneurysm sac was entered, the needle was exchanged for a 4F catheter, and sac pressure was obtained. The sac pressure was nearly systemic, measuring 93/70 mm mercury and indicating the aneurysm sac was still exposed to arterial pressure. Contrast was injected into the aneurysm sac, but no lumbar arteries were opacified.

Because the feeding lumbar arteries could not be identified, it was elected only to embolize the aneurysm sac using a liquid agent. One milliliter of n-butyl cyanoacrylate (NBCA; Cordis, Miami Lakes, FL) was diluted with 4 mL Ethiodol (Savage Laboratories, Melville, NY) and injected into the aneurysm sac. After filling the aneurysm sac with glue, the catheter was withdrawn and a glue tail was formed sealing the puncture site of the aortic wall. At this point, fluoroscopy of the abdomen demonstrated a small amount of glue within the pelvis (Fig. 2A). A pelvic arteriogram was performed confirming that the glue was external to

Figure 2 (A) Spot fluoroscopic image following translumbar injection of n-butyl cyanoacrylate (NBCA) into the aneurysm sac (arrows) demonstrates a small amount of NBCA within the pelvis (curved arrow). (B) A standing column of contrast develops in the left ureter (arrows) to the level of the NBCA (curved arrow) confirming the location of the NBCA in the ureter.

the vascular system. A standing column of contrast formed within the ureter to the point of the glue (Fig. 2B), and moderate hydronephrosis of the left kidney developed suggesting that the glue had embolized to the distal ureter.

The left flank was then prepped with standard aseptic technique, and a lower pole calyx was accessed with a 21-gauge needle and fluoroscopy. Using an Accu-Stick transition dilator (Boston Scientific, Natick, MA), the needle was exchanged for a diagnostic catheter. An antegrade nephrostogram was performed demonstrating extravasation from the left ureter. In addition, there was obstruction of the distal left ureter from the nontarget embolization of the NBCA. Using a 5F Kumpe (Cook, Bloomington, IN) and 0.035-inch hydrophilic guidewire (GlideWire; Terumo, Tokyo, Japan), guidewire access to the bladder was achieved. A 3-mm angioplasty balloon was then used to push the glue into the bladder. An 8F 24-cm nephroureteral stent (Ultrathane; Cook, Bloomington, IN) was left in place.

The patient returned in 2 weeks for follow-up nephrostogram. At this time, there was no further extravasation from the site of ureteral injury and no evidence of obstruction of the distal ureter. The nephroureteral catheter was removed. The patient has now remained asymptomatic for 2 years and the aneurysm sac size has remained stable.

DISCUSSION

Type II endoleaks are reported to occur in 6 to 17% of cases.⁶ The natural history of this subtype of endoleak is uncertain: Many will seal spontaneously, leading to controversy over management.^{1,6,7} Animal models have shown elevated pressures within the aneurysm sac with type II endoleaks,⁸ and pressure transducers applied to catheters placed in enlarging aneurysm sacs with type II endoleaks have identified arterial waveforms.⁹ Type II leaks associated with elevated sac pressure may lead to aneurysm expansion and possibly rupture.⁷ Nonetheless, it remains controversial when to intervene. Work is currently underway to develop intrasac pressure transducers that may allow for more precise determination for which patients with type II endoleaks will require treatment.¹⁰ In the meantime, cross-sectional imaging is the most reliable method for determining which type II endoleaks require treatment. Although the specific parameters may vary, it is generally agreed that aneurysm expansion in the setting of a type II endoleak is a valid indication for embolization.^{7,11,12}

In addition to the topic of when to embolize, the method of embolization has also been a cause for discussion and undergone an evolution in recent years. Early on, type II endoleaks were primarily treated by transvascular branch vessel coil embolization.¹³ These procedures could be technically challenging,

and despite early successes, late failures were unfortunately common.¹⁴ The reason for these late failures is not certain, although the development of new collateral vessels supplying the aneurysm sac has been observed.¹⁵ Thus, with multiple inflow and outflow vessels, these endoleaks seem to behave in a similar manner to an arteriovenous malformation, and just as with a vascular malformation, successful embolization requires occlusion of the nidus (i.e., the aneurysm sac) for long-term success. This theory has been supported in a comparison between transvascular coil embolization and aneurysm sac embolization.¹⁵

To approach aneurysm sac for embolization, either a transvascular or a translumbar route may be used. Both may be effective, but the translumbar route is typically easier. Although rarely performed today, the safety of diagnostic translumbar aortography is well established; the reported incidence of complications is 2.69%.¹⁶ This compares favorably with the incidence of complications for transfemoral and transaxillary aortography, which are reported to be 1.73% and 3.29%, respectively. As for major complications, Szilagyi et al reported an incidence of only 0.05% in translumbar aortography.¹⁷ These complications were mostly related to hemorrhage or pneumothorax; there was one incidence of paraplegia and no ureteral injuries. By combining data from two separate reviews, no ureteral injuries were reported in 18,668 translumbar aortograms.^{16,17} This does suggest that the incidence of ureteral injury is indeed very low. However, because this complication likely often goes unrecognized and, therefore, unreported, the true incidence is not certain.

Translumbar access to the sac may be performed using a variety of imaging modalities, including ultrasound, fluoroscopy, and CT. Of these options, ultrasound is the least frequently used. The major limitation is that ultrasound often requires a transperitoneal approach, introducing the risk of traversing viscera or mesenteric vessels.¹⁸ In addition, visualization may be limited in obese patients or patients with a large amount of bowel gas. More commonly, the aneurysm sac is approached through the retroperitoneum using fluoroscopy or CT for guidance. With either modality, the aim is to access the sac near the level of the endoleak. This may require approaching the sac from either the right or left side and using anatomical landmarks and stent-graft markers as a guide. Using a right-sided approach occasionally means traversing the inferior vena cava (IVC), which has been shown to be safe.¹⁹ In this particular case, the aneurysm sac was accessed using fluoroscopy and anatomical landmarks from a left translumbar approach. This did avoid traversing the IVC but resulted in an iatrogenic injury to the left ureter. This injury was compounded when a small volume of NBCA embolized into the distal ureter, resulting in acute left-sided renal obstruction: It was this second complication that led to

the recognition of the ureteral injury and allowed for prompt management.

The unique concern in this case is the significance of the NBCA that has embolized to the distal ureter. Although this did cause acute obstruction, it did not result in any long-term clinical sequela. There has been little study of the degree that NBCA may adhere to the ureteral mucosa, but animal models have shown that NBCA does have adhesive properties in the ureter even greater than that of sutures.²⁰ Therefore, the potential exists that nontarget embolization of NBCA to the ureter could have resulted in long-term ureteral obstruction if it had adhered to the mucosal surface. In this instance, however, the glue was most likely already polymerized and, therefore, resulted in an acute ureteral occlusion without permanently adhering to the ureteral mucosa.

When reviewing a complication such as this, it is important to examine how it could have been avoided. Although the use of fluoroscopic imaging for guidance to access the aneurysm sac is a well-established technique,^{3,5} it does not permit visualization of intervening structures, such as the ureter. If CT guidance had been used, both the iatrogenic injury and nontarget embolization to the left ureter could have been avoided while targeting the site of endoleak more precisely. Despite these advantages, the use of CT may also have its limitations. In our department, the CT scanner is located in a different part of the hospital than the interventional radiology suite. Therefore, once access to the sac has been achieved, the patient must be transferred to a fluoroscopy table with either the needle or a guidewire left in place. In addition to being cumbersome, this introduces the risk of loss of access and infection during transport. Other departments have overcome this dilemma by using a combination fluoroscopy and CT unit.²¹ Unfortunately, these are not yet widely available.

In summary, this case illustrates a potential complication of translumbar access to an aneurysm sac for type II endoleak embolization using only fluoroscopy for imaging guidance: iatrogenic ureteral injury with nontarget embolization of NCBA to the distal ureter. Although this resulted in no long-term injury, it does bolster the argument for using CT guidance when accessing the aneurysm sac for this type of procedure.

REFERENCES

1. Tolia AJ, Landis R, Lamparello P, et al. Type II endoleaks after endovascular repair of abdominal aortic aneurysms: natural history. *Radiology* 2005;235:683–686
2. Veith FJ, Baum RA, Ohki T, et al. Nature and significance of endoleaks and endotension: summary of opinions expressed at an international conference. *J Vasc Surg* 2002;35:1029–1035
3. Baum RA, Cope C, Fairman RM, et al. Translumbar embolization of type 2 endoleaks after endovascular repair of abdominal aortic aneurysms. *J Vasc Interv Radiol* 2001;12:111–116
4. Haulon S, Tyazi A, Willoteaux S, et al. Embolization of type II endoleaks after aortic stent-graft implantation: technique and immediate results. *J Vasc Surg* 2001;34:600–605
5. Stavropoulos SW, Kim H, Clark TWI, et al. Embolization of type 2 endoleaks after endovascular repair of abdominal aortic aneurysms with use of cyanoacrylate with or without coils. *J Vasc Interv Radiol* 2005;16:857–861
6. Gelfand DV, White GH, Wilson SE. Clinical significance of type II endoleak after endovascular repair of abdominal aortic aneurysm. *Ann Vasc Surg* 2006;20:69–74
7. Rhee SJ, Ohki T, Veith FJ, et al. Current status of management of type II endoleaks after endovascular repair of abdominal aortic aneurysms. *Ann Vasc Surg* 2003;17:335–344
8. Mousa A, Dayal R, Bernheim J, et al. A canine model to study the significance and hemodynamics of type II endoleaks. *J Surg Res* 2005;123:275–283
9. Baum RA, Carpenter JP, Cope C, et al. Aneurysm sac pressure measurements after endovascular repair of abdominal aortic aneurysms. *J Vasc Surg* 2001;33:32–41
10. Milner R, Ruurda JP, Blankensteijn JD. Durability and validity of a remote, miniaturized pressure sensor in an animal model of abdominal aortic aneurysm. *J Endovasc Ther* 2004;11:372–377
11. van Marrewijk CJ, Fransen G, Laheij RJF, et al. Is a type II endoleak after EVAR a harbinger of risk? Causes and outcome of open conversion and aneurysm rupture during follow-up. *Eur J Vasc Endovasc Surg* 2004;27:128–137
12. van Marrewijk C, Buth J, Harris PL, et al. Significance of endoleaks after endovascular repair of abdominal aortic aneurysms: the EUROSTAR experience. *J Vasc Surg* 2002;35:461–473
13. Baum RA, Carpenter JP, Tuite CM, et al. Diagnosis and treatment of inferior mesenteric arterial endoleaks after endovascular repair of abdominal aortic aneurysms. *Radiology* 2000;215:409–413
14. Solis MM, Ayerdi J, Babcock GA, et al. Mechanism of failure in the treatment of type II endoleak with percutaneous coil embolization. *J Vasc Surg* 2002;36:485–491
15. Baum RA, Carpenter JP, Golden MA, et al. Treatment of type 2 endoleaks after endovascular repair of abdominal aortic aneurysms: comparison of transarterial and translumbar techniques. *J Vasc Surg* 2002;35:23–29
16. Hessel SJ, Adams DF, Abrams HL. Complications of angiography. *Radiology* 1981;138:273–281
17. Szilagyi DE, Smith RF, Elliot JP, et al. Translumbar aortography: a study of its safety and usefulness. *Arch Surg* 1977;112:399–408
18. Boks SS, Andhyiswara T, de Smet AA, et al. Ultrasound-guided percutaneous transabdominal treatment of a type 2 endoleak. *Cardiovasc Intervent Radiol* 2005;28:526–529
19. Stavropoulos SW, Carpenter JP, Fairman RM, et al. Inferior vena cava traversal for translumbar endoleak embolization after endovascular abdominal aortic aneurysm repair. *J Vasc Interv Radiol* 2003;14:1191–1194
20. McNally-Heintzelman KM, Riley JN, Heintzelman DL. Scaffold-enhanced albumin and n-butyl-cyanoacrylate adhesives for tissue repair: ex vivo evaluation in a porcine model. *Biomed Sci Instrum* 2003;39:312–317
21. Binkert CA, Alencar H, Singh J, et al. Translumbar type II endoleak repair using angiographic CT. *J Vasc Interv Radiol* 2006;17:1349–1353