

# Complex Coil Embolization of Multiple Type II Endoleaks

Liquid embolics, detachable coils, and plugs to repair an enlarging abdominal aortic aneurysm sac 5 years after EVAR.

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**A**n endoleak is radiographic or ultrasonic evidence of persistent blood flow outside the lumen of an endovascular graft but within the aneurysm sac. Endoleaks, regardless of size, can continue to transmit systemic pressure to the aneurysm sac. They are categorized into four distinct categories: (1) type I leaks, which are related to flow from poor proximal or distal sealing; (2) type II leaks, which are classified by retrograde filling of the aneurysm sac from collateral branch vessels coming off of the aneurysm sac, including lumbar arteries and the inferior mesenteric artery; (3) type III leaks, which are associated with either fabric tears or modular disconnections; and (4) type IV leaks, which are associated with graft porosity periprocedurally.

There is no debate that type I and type III endoleaks are associated with a continued risk of aneurysm rupture and require treatment. However, there is ongoing debate about how best to manage type II endoleaks, the most controversial type of leak in terms of evaluation, the need for treatment, and the methods of treatment. Typically, biannual evaluation with either duplex ultrasonography or computed tomographic angiography (CTA) is used for patients with persistent type II endoleaks, and reintervention is limited to patients with sac enlargement > 5 mm.

Although there is no difference in aneurysm-related death between patients with and without persistent endoleaks after endovascular aneurysm repair, those with a persistent endoleak (> 6 months) have had a significantly higher risk of aneurysm sac enlargement and a higher

risk of reintervention, and it was found to be a predictor of aneurysm rupture. Because of these findings, it has been suggested that patients with persistent type II endoleaks may warrant more frequent follow-up or a more aggressive approach to intervention.<sup>1-3</sup>

We report a case of a patient who was treated 5 years previously for repair of a 6.7-cm abdominal aortic aneurysm (AAA) but was lost to follow-up. Five years after the original repair, CTA revealed an enlarging aneurysm to 10 cm with multiple type II endoleaks from lumbar arteries and an internal iliac artery that had previously been coiled. Multiple agents, including liquid embolics, detachable coils, and plugs, were used to salvage the repair and exclude the aneurysm.

## CASE REPORT

The patient originally presented in March 2005 with a 6.7-cm AAA, a 2.8-cm left common iliac artery aneurysm, and a known right common iliac artery occlusion at the age of 82. Because of the right common iliac artery occlusion, we elected to treat the patient with a 32-mm Zenith Renu stent graft (Cook Medical, Bloomington, IN), which was extended into the left external iliac artery with 12-mm Zenith limbs. Before exclusion of the aneurysm, the left internal iliac artery was embolized with multiple Tornado coils (Cook Medical), which were placed from an ipsilateral approach into a nonaneurysmal left internal iliac artery. After exclusion of the aneurysm, femoral-femoral bypass grafting was performed with an 8-mm PTFE graft (Figure 1).



Figure 1. One-month CT angiogram after endovascular aneurysm repair of a 6.7-cm infrarenal aneurysm with a Renu device. There is no obvious endoleak seen on the CT angiogram.

The patient was discharged home on the 4th postoperative day without any complications. Other than the initial postoperative visit, the patient failed to make any clinic visits for routine surveillance because of travel restraints.

The patient continued to do well until 5 years later when he was worked up for evaluation of an asymptomatic stenosis of his left carotid artery. The carotid artery had a diameter loss of 50%. Noninvasive imaging of the infrarenal aneurysm was also performed, revealing enlargement of the aneurysm to 10 cm. As a result of the increase in the aneurysm size, CTA was performed, which revealed a maximum size of 12- X 11-cm diameter in the transverse and anteroposterior dimensions in the infrarenal aneurysm with bilateral internal iliac artery aneurysms. Type II endoleaks were filling the aneurysm from the lumbar arteries arising from the right and left internal iliac arteries (Figure 2).

Because of the increased size of the aneurysm and the multiple type II endoleaks, treatment options were discussed with the patient, including surgical conversion and coil embolization. Due to the patient's advanced age and overall health status, he declined open surgical repair and preferred attempts at coil embolization. Access to the right internal iliac artery was achieved from an ipsilateral approach with a 7-F sheath (Figure 3).

Using a 4-F Glidecath angiographic catheter (Terumo Interventional Systems, Somerset, NJ) and a Progreat microcatheter (Terumo Interventional Systems), multiple

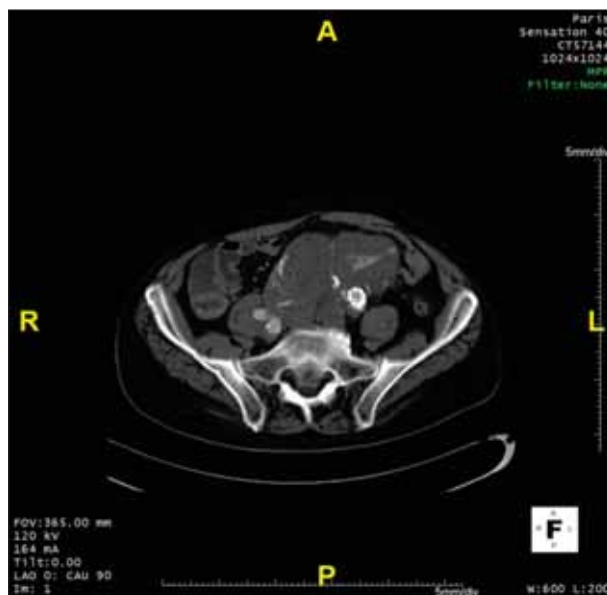
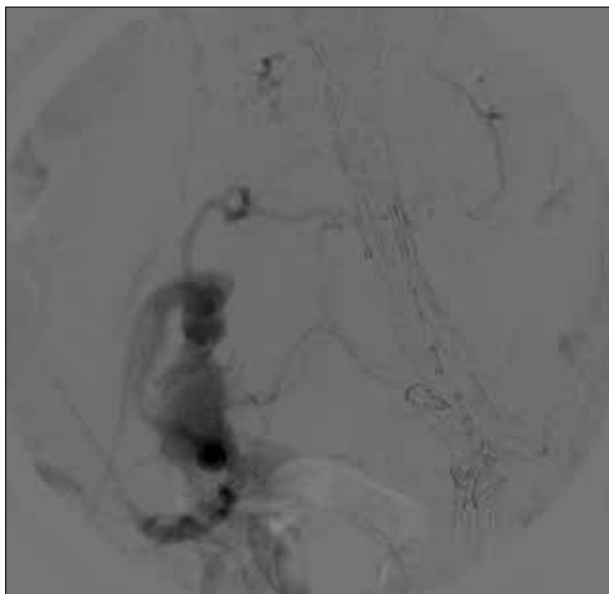


Figure 2. There are multiple type II endoleaks from lumbar vessels coming from the right and left internal iliac arteries. There was no evidence of a type I or type III endoleak, with excellent proximal and distal fixation of the graft.

lumbar arteries from the right internal iliac artery were accessed and coil embolized with 4-mm X 10-cm Azur detachable coils (Terumo Interventional Systems) (Figure 4). To achieve complete occlusion of the multiple branches of the lumbar vessels, Onyx (ev3 Inc., Plymouth, MN) was used as a liquid embolic, employing the "plug-and-push" technique. With this technique, Onyx 34 is used to form a plug; Onyx 18 is then used to push the Onyx 34 into smaller branches. Onyx flows like lava, and the Onyx 34 plug therefore stays soft while the outer core solidifies. Onyx 18 then pushes up and out from the core to fill the smaller branches. Using the Azur detachable coils and Onyx, the endoleak from the right side was completely obliterated (Figure 5), and the right external iliac artery was occluded with an Amplatzer vascular plug (AGA Medical, Plymouth, MN) (Figure 6). However, the previously coiled left internal iliac artery had become aneurysmal, and the coils were no longer occluding the retrograde flow to the aneurysm sac.

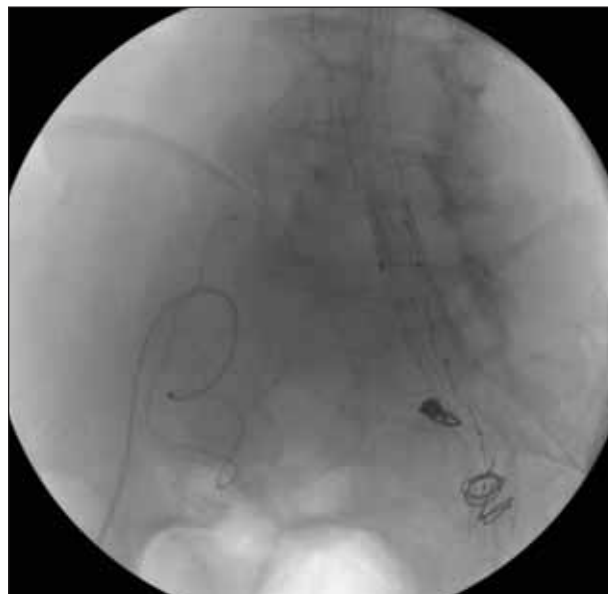
The left hemiabdomen was prepped and draped in the usual sterile fashion, and under ultrasound guidance, an AccuStick system (Boston Scientific Corporation, Natick, MA) was advanced with a single stick through the anterior wall of the large AAA sac. The tip of the needle was navigated into a large, high-flow channel within the left aspect of the AAA that communicated with the left common iliac limb of the aneurysm sac. The coaxial dilator was advanced over a 0.018-inch wire,



**Figure 3.** Cannulation of the ipsilateral right internal iliac artery shows multiple lumbar vessels filling the aneurysmal sac. There was no evidence of a type I or III endoleak at the time the arteriogram was obtained.

which was left in place to be used as a security wire. A long, 6-F vascular sheath was deployed into the aneurysm sac. A 0.035-inch wire and Kumpe catheter (Cook Medical) were used to navigate through a nest of indwelling coils within the endoleak channel, and the Kumpe catheter tip was positioned within the inferior-most aspect of the endoleak channel. The wire was then removed, and gentle contrast injection revealed multiple arteries communicating with the endoleak channel, including what appeared to be the left iliolumbar artery and a few small, unnamed branches arising from the anterior division of the left hypogastric arterial system.

After selecting the largest of the arterial branches, coil embolization with four 4-mm Azur coils was performed within the branch artery and inferior aspect of the endoleak channel. Next, a Progreat catheter was positioned within the inferior aspect of the channel, and serial instillation of the liquid embolic material, Onyx, was used to fill virtually the entire endoleak channel and some of the very small, unnamed branch arteries. Doppler ultrasound evaluation of the previously seen type II endoleak revealed flow within the left common iliac limb of the endograft but complete cessation of endoleak flow from the left internal iliac artery. Two additional 4-mm Azur coils were deployed along the anterior peripheral aspect of the AAA sac at the location of the puncture.



**Figure 4.** A 4-F Glidecath angiographic catheter and Progreat microcatheter were used for superselection of the small lumbar branch vessels filling the aneurysm sac from the right internal iliac artery.

## DISCUSSION

Persistent type II endoleaks remain a common problem after endovascular aneurysm repair. They result in continued pressurization of the aneurysm sac and can be associated with aneurysm enlargement. Most type II endoleaks are innocuous, and often, intervention is not required. However, they do require continued surveillance, and secondary intervention is necessary when associated with aneurysm growth to limit aneurysm enlargement and delayed aortic rupture.

Some interventionists have attempted to decrease the risk of postoperative type II endoleaks by attempting the prophylactic occlusion of the inferior mesenteric and lumbar arteries. Although this approach appears to have some merit with direct access to the collateral vessels, the efficacy and clinical benefit remain controversial. Most interventionists agree that the most reasonable time to intervene on type II endoleaks is in cases of increasing aneurysm size or if the endoleak does not resolve within 6 months.<sup>1</sup>

Silverberg et al reviewed type II endoleaks occurring in 965 patients after endovascular aneurysm repair (EVAR) at a single institution over an 8-year period. Sixteen percent of patients (n = 154) had a type II endoleak after EVAR. Mean follow-up was 22 months, and 36% of the type II endoleaks resolved spontaneously within 15 months. Nineteen patients with type II endoleaks were treated for sac enlargement of > 5 mm. No patients with

type II endoleaks experienced rupture or required conversion to open repair during their follow-up. The investigators concluded that type II endoleaks have a relatively benign course and can be followed for a prolonged period in the absence of sac expansion. However, when type II endoleaks require treatment, further controversy remains as to the appropriate method of intervention.<sup>2</sup>

Most investigators would agree that translumbar rather than transarterial embolization is more effective. Gorlitzer et al evaluated 84 consecutive patients for type II endoleaks after EVAR. Of these, five patients required treatment for type II endoleaks. All five patients had failed transarterial coil embolization. Translumbar coil embolization was effective in 80% of the patients for resolving the type II endoleak.<sup>3</sup> After transarterial coil embolization of type II endoleaks, persistence has been reported to be as high as 60%. The high failure rate of transarterial coil embolization is associated with persistence of flow through the coils and development of retiform anastomosis around the coiled vessel. Because our main treatment for type II endoleaks is translumbar, this case used both a transarterial as well as a transabdominal approach to the multiple type II endoleaks present.<sup>4</sup>

Utilizing a transarterial approach for the right internal iliac artery, microcatheters and detachable coils were used to access the multiple branches. To avoid the risk of persistence of flow through the coils, Azur coils, which combine a platinum coil and an expandable hydrogel polymer, were deployed. In concert, these elements provide a uniquely stable and permanent platform for blood stasis, thrombus organization, and neointima formation. Azur's hydrogel coating undergoes limited expansion within the first 3 minutes and fully expands within 20 minutes. The result is greater filling and mechanical stability with fewer coils—nearly five times more filling volume for the 0.018-inch coil and four times more filling volume for the 0.035-inch coil versus platinum coils of the same size.

The microcatheter and smaller coils allow for easy trackability and placement within small vessels. The use of the liquid embolic Onyx allowed for embolization of the smaller branches throughout the nidus of the multiple branches, ensuring complete cessation of flow into the aneurysm sac from the right ilio-lumbar system. No access into the left ilio-lumbar system was available, so a transabdominal approach was utilized. Complete occlusion of the left internal iliac system was achieved using these two systems.

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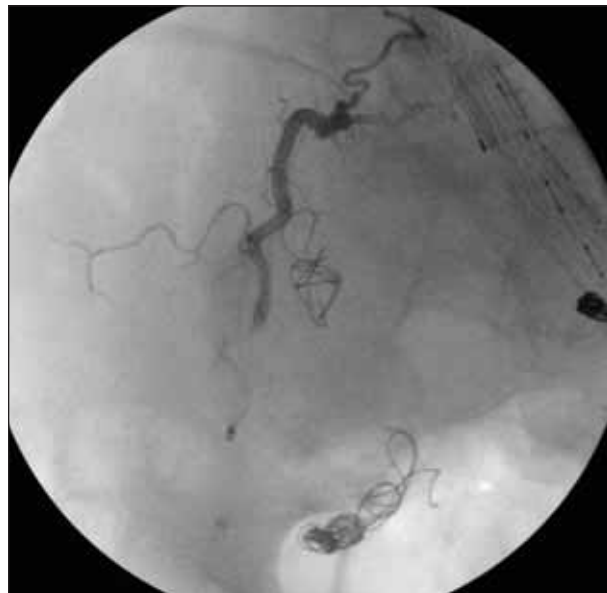
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**Figure 5.** Onyx and multiple Azur detachable coils were used to completely occlude the multiple branch vessels filling the aneurysm sac. Onyx forms a radiopaque cast along the distal branches while the Azur detachable coils are placed both proximally and distally to completely occlude the lumbar vessels filling the aneurysm sac.



**Figure 6.** Complete exclusion of the right external iliac, internal iliac, and multiple lumbar arteries using Azur detachable coils, Onyx liquid embolic, and finally an Amplatzer plug in the right external iliac artery

## CONCLUSION

The modality and appropriate indications for treating type II endoleaks after EVAR remain controversial. The translumbar approach, based on small case series, appears to be the preferred choice and is the first choice in our experience. It appears to be safe and well-tolerated, and the immediate and short-term follow-up are encouraging. Although transarterial embolization does not seem to be as successful, it was used in this case to reach the multiple lumbar arteries utilizing both coils and Onyx. Use of these newer coils with the addition of Onyx may achieve improved results over older technologies.

Based on review of the literature, the majority of type II endoleaks can probably be treated with expectant management and surveillance. However, in those associated with sac enlargement or persistence over 12 months without sac enlargement, intervention is most likely warranted based on the patient's current health status. ■

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