latrogenic abdominal aortic pseudoaneurysm repaired by percutaneous image-guided translumbar embolization

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ABSTRACT

Aortic injury is a frequently encountered condition that can present as a life-threatening emergency. When this injury occurs in the retroperitoneal portion of the aorta, it can be difficult to diagnose and treat because of the location. Although surgical repair remains the mainstay of treatment, surgery might not be an option for some patients. We have presented a case of a 54-year-old nonoperative candidate who had experienced iatrogenic retroperitoneal abdominal aortic rupture with pseudoaneurysm formation. The patient was successfully treated with the novel use of a proven technique: direct percutaneous embolization of the pseudoaneurysm sac via a translumbar approach under image guidance. (J Vasc Surg Cases and Innovative Techniques 2021;7:35-9.)

Keywords: Aortic injury; Embolization; Pseudoaneurysm

Abdominal aortic injury is a frequently encountered and serious condition that can be secondary to direct injury to the vessel wall, stenotic atherosclerotic disease, or aneurysmal dilation and has the potential to quickly become a life-threatening emergency.^{1,2} latrogenic abdominal aortic injury can also occur from inadvertent perforation during surgery or after penetrating or blunt trauma and can also present as an emergency. Endograft placement is a common method of repair for this type of injury and functions by excluding the affected portion of the aortic wall from blood flow and systemic arterial blood pressure.² When the injury is limited to the retroperitoneum, the aortic injury and hematoma formation can be asymptomatic. This is because the smaller potential space of the retroperitoneum can occasionally provide a tamponade effect, allowing for hemodynamic stability.

Management of retroperitoneal hemorrhage can range from observation to surgical exploration and depends on multiple factors related to the patient's clinical status (eg, hemodynamic instability) and other coexisting injuries when associated with trauma.³ However, the site of hemorrhage can be difficult to identify during surgical exploration because of the difficulty in accessing the smaller

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space of the retroperitoneum. When successfully identified at surgery, this type of aortic injury can be managed with either open or endovascular repair.

Some patients with a retroperitoneal abdominal aortic pseudoaneurysm, however, will not be surgical candidates and will not experience a tamponade effect within the retroperitoneum. We have presented a novel approach in a patient who was not a surgical candidate to address this type of scenario via image-guided direct translumbar embolization of a pseudoaneurysm associated with an iatrogenic abdominal aortic pseudoaneurysm. The patient agreed to the publicaton of this report.

CASE REPORT

A 54-year-old woman had presented with bilateral lower extremity claudication with minimal effort that had worsened throughout a 24- to 36-hour period to include rest pain. She had a history of hypertension, coronary artery disease, previous percutaneous coronary intervention, breast cancer, and peripheral vascular disease with chronic total occlusion of her native bilateral common iliac arteries after aortobifemoral artery bypass grafting. The patient had undergone placement of the aortobifemoral artery bypass graft 14 days before presentation. The patient was evaluated in the emergency department by vascular surgery and the appropriate imaging studies were obtained. The imaging studies demonstrated partially occlusive thrombus of the proximal portions of both femoral limbs of the graft. Thus, the patient was admitted to the vascular surgery service for planned surgical thrombectomy.

The patient was brought to the operating room. Bilateral common femoral arteriotomies were performed. Also, using a 5F Fogarty graft thrombectomy catheter (Edwards Lifesciences, Irvine, Calif), mechanical thrombectomy of both femoral graft limbs was attempted but proved unsuccessful after multiple attempts. The interventional radiology (IR) team was, thus, consulted and soon after joined the vascular surgery team in the operating room. Aortograms were performed in the anteroposterior and left anterior oblique projections, showing persistent occlusion of both femoral

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Fig 1. Anteroposterior and steep left anterior oblique abdominal aortograms. **A**, A flush catheter was placed at the level of the renal arteries. The pseudoaneurysm was located at the posterolateral aspect of the midinfrarenal abdominal aorta (*wide arrow*). **B**, A partially occlusive thrombus can be seen within the aortic and femoral components of the aortobifemoral artery bypass graft (*thin arrows*) before placement of the kissing stents. The pseudoaneurysm was faintly identified just posterior and lateral to the left of the catheter (*wide arrow*). Note the normal faint enhancement of the vertebral bodies (*curved arrows*). Civen the patient's stable hemodynamic course throughout the case, the pseudoaneurysm was initially interpreted as a hypervascular lesion (eg, spinal hemangioma) or a focus of metastatic disease to the spine. Also, note the nonopacification of the previously placed stents within the native iliac arteries due to chronic occlusion.

graft limbs due to residual adherent thrombus (Fig 1, A and B). In addition, contrast media enhancement was noted outside the left lateral margin of the infrarenal abdominal aorta, well above the proximal anastomosis of the graft (Fig 1, A and B). Given the patient's stable hemodynamic status throughout the case, the finding was initially interpreted as a hypervascular lesion, such as a vertebral body hemangioma or a focus of metastatic disease. At this point, the recommendation was made by the interventional radiologist to place bilateral kissing self-expanding stents into the right and left femoral graft limbs. This was successfully accomplished using 10-mm \times 80-mm Lifestar self-expanding nitinol stents (Bard Peripheral Vascular, Inc, Tempe, Ariz), which were dilated with a 7-mm angioplasty balloon. Final angiographic imaging studies at the completion of the procedure demonstrated widely patent bilateral kissing femoral graft limb stents with normal opacification throughout the graft, without the evidence of residual thrombus. The postoperative evaluation demonstrated normal dorsalis pedis pulses and benign abdominal examination findings. Her clinical status remained unchanged throughout her immediate postoperative course.

However, 10 days later, the patient had presented with worsening abdominal pain that radiated to the back. Because of the continued steady worsening of her pain, contrastmedium-enhanced computed tomography of the abdomen and pelvis was obtained. The imaging study demonstrated a pseudoaneurysm of the posterior abdominal aortic wall at the level of the inferior mesenteric artery, just above the aortic component of the graft, with ensuing retroperitoneal pseudoaneurysm formation (Fig 2, A-C). The patient was again evaluated by vascular surgery, and an urgent operative repair of her aorta was scheduled. However, the preoperative evaluation revealed a decrease in her cardiac ejection fraction to 46% (previously 59% ~1 week previously). Given this acute finding and the patient's known comorbidities, an urgent preoperative cardiologic consultation was obtained for surgical clearance in preparation for the anticipated repair. Given the acuity of the finding, the patient could not be cleared immediately for surgery by the cardiology team. In addition, her native infrarenal abdominal aorta, which measured ~1 cm in diameter, was too small in caliber, with a short length between the renal arteries and the top of the bilateral kissing femoral graft limb stents, to accommodate an aortic cuff, the only repair option in stock at the time. Therefore, IR was urgently consulted for additional treatment options.

The patient was evaluated by IR and, after the patient provided written informed consent, she was taken to the IR suite for diagnostic angiography. With the patient in the prone position, direct translumbar percutaneous access into the Journal of Vascular Surgery Cases and Innovative Techniques Volume 7, Number 1



Fig 2. Axial and sagittal contrast-enhanced imaging studies of the abdomen demonstrating the pseudoaneurysm originating from the aorta. **A**, A tear can be seen at the posterior wall of the aorta (*thin arrow*), allowing communication with the pseudoaneurysm sac (*wide arrow*). Note the small diameter of the aorta at this level (*curved arrow*), which precluded placement of an aortic cuff. **B**, The pseudoaneurysm sac extended superiorly to the level of the celiac trunk. **C**, A single axial slice more superiorly to the level of the superior mesenteric artery demonstrating the extent of size of the sac (*thin arrow*). Note the normal caliber aorta at this level (*wide arrow*).

retroaortic pseudoaneurysm was obtained using a 21-guage, diamond-tip AccuStick II Introducer Needle (Boston Scientific, Marlborough, Mass) under fluoroscopic imaging guidance via a left translumbar approach (Fig 3, A). Pulsatile blood flow was obtained from the access needle, consistent with an arterial source. Opacification with contrast media during angiography again demonstrated the pseudoaneurysm (Fig 3, B). After multiple exchanges, a 4F, angled Kumpe Catheter (Cook Medical, Bloomington, Ind) with a coaxial 2.8F Lantern Delivery Microcatheter (Penumbra, Inc, Alameda, Calif) were advanced into the pseudoaneurysm sac. Through the microcatheter, a combination of six platinum Helix EV3 Concerto microcoils (Medtronic PLC, Dublin, Ireland) and four Interlock coils (Boston Scientific) were deployed into the pseudoaneurysm under fluoroscopic guidance, resulting in persistent, but decreased, flow of contrast media in the sac (Fig 4, A). The decision was then made to inject a mixture of Gelfoam (Pfizer Pharmaceuticals, New York, NY) and thrombin to achieve complete stasis through the sac. Contrast media. Gelfoam, and thrombin were mixed in a 10-mL syringe to form a slurry, which was then slowly injected into the pseudoaneurysm sac under fluoroscopic imaging guidance to avoid reflux into the abdominal aorta through the neck of the pseudoaneurysm. The completion angiogram demonstrated complete cessation of arterial flow within the pseudoaneurysm, as evidenced by stasis of the injected contrast media (Fig 4, B and C). Hemostasis was further achieved with manual compression. The patient tolerated the procedure well, with stable vital signs throughout the procedure, and experienced no procedure-related complications. Follow-up computed tomography imaging at 7 days, 20 days, and 12 months after the procedure demonstrated progressive shrinkage of the occluded abdominal aortic pseudoaneurysm sac (Fig 5).

DISCUSSION

The present case has demonstrated the ability to directly and quickly embolize a retroperitoneal abdominal aortic pseudoaneurysm via a direct, translumbar approach. Because the retroperitoneum has much less potential to expand with increasing volume and pressure, unlike the peritoneal space, we postulated that the success of this technique was, in part, due to the tamponade effect achievable in the retroperitoneal space. This "direct-stick" technique is not new and has been proved effective in treating endoleaks.⁴⁻⁶ We drew on that technique and used it in a novel method for retroperitoneal aortic pseudoaneurysm repair.

The conservative treatment options for abdominal aortic pseudoaneurysms of this type can be used in clinically stable and asymptomatic patients because of the potential for self-tamponade by the surrounding retroperitoneal soft tissues. In patients with more brisk bleeding in whom tamponade cannot be achieved, minimally invasive surgical repair can be attempted via an endovascular approach, with more invasive open repair performed when the former is not an option. However, in patients such as the present patient who are unable to undergo surgical treatment or patients who continue to demonstrate clinical evidence of hemodynamic decline, this approach provides an additional treatment option. However, other options exist for the repair of aortic pseudoaneurysms of this type in addition to that used in the present patient, and those options should be of primary consideration for more straightforward cases. These include an aortic cuff, the Viabahn endoprosthesis (W. L. Gore and Associates, Inc, Newark, Del), or Atrium Advanta V12 covered



Fig 3. A, A 21-guage needle (*arrow*) was used to achieve direct translumbar percutaneous access into the retroaortic pseudoaneurysm under fluoroscopic imaging guidance via a left translumbar approach. **B**, Through an access sheath, contrast media injection confirmed placement in the pseudoaneurysm sac. **C**, A microcatheter was advanced further into the pseudoaneurysm sac, and the contrast media elaborated the superior extent of the sac.



Fig 4. A, Digital subtraction angiogram after coil embolization showing near-complete stasis of the contrast media within the pseudoaneurysm sac. **B**, Unsubtracted digital acquisition angiogram following injection of Gelfoam and thrombin slurry showing complete stasis with no flow within the completely occluded pseudoaneurysm. No blood could be aspirated through the access sheath at completion of the procedure, further confirming occlusion.

stent (Getinge AB, Wayne, NJ), to name a few. For the present patient, the only available possibility was an aortic cuff, because this was the only device in stock at the time. However, the diminutive caliber of her distal aorta (10 mm) and the short distance between the renal arteries and the top of the bilateral kissing

femoral limb stents did not allow for accommodation of an aortic cuff.

One limitation of the present single case was that we could not determine the optimal size of an abdominal aortic perforation or pseudoaneurysm to be treated using this technique. The aortic tear in



Fig 5. Serial computed tomography imaging of the pseudoaneurysm sac at 7 days **(A)**, 20 days **(B)**, and 12 months **(C)** demonstrating the continued decrease in the size of the sac, with near complete resolution at 12 months.

the present patient was relatively small, with the size of the pseudoaneurysm neck measuring ~5 mm in the greatest dimension, a property we hypothesized would allow for the success of this technique during preprocedure planning. Given the varying potential sizes of retroperitoneal aortic tears resulting in a pseudoaneurysm or hematoma, direct-stick translumbar image-guided embolization might not be appropriate for larger tears, owing to the theoretical risk of inadvertent embolization of the abdominal aortic lumen. However, this technique might prove successful in extreme circumstances and for patients with a pseudoaneurysm neck size similar to, or smaller than, that in the present patient. We do not propose that this technique should replace the current standards, because most patients with an abdominal aortic pseudoaneurysm should undergo open or endovascular repair. However, in situations in which these options are not feasible (eg, in the case of patients who should not undergo surgery or with limited supply) or in emergency situations in which those treatments are not readily available, this approach can certainly be considered.

CONCLUSIONS

Patients with an abdominal aortic pseudoaneurysm should undergo open or endovascular repair. For cases

involving nonoperative patients or when endovascular repair is not amenable, translumbar direct-stick imageguided percutaneous embolization of the pseudoaneurysm sac can be considered.

REFERENCES

- Hoornweg L, Storm-Versloot M, Ubbink D, Koelemay MJW, Legemate DA, Balm R. Meta-analysis on mortality of ruptured abdominal aortic aneurysms. Eur J Vasc Endovasc Surg 2008;35:558-70.
- 2. Hirsch A, Haskal Z, Hertzer N, Bakal CW, Creager MA, Halperin JL, et al. Practice guidelines for the management of patients with peripheral arterial disease. Circulation 2006;113:463-654.
- 3. Feliciano D. Management of traumatic retroperitoneal hematoma. Ann Surg 1990;211:109.
- Uthoff H, Katzen BT, Gandhi R, Pena C, Benenati J, Geisbush P. Direct percutaneous sac injection for postoperative endoleak treatment after endovascular aortic aneurysm repair. J Vasc Surg 2012;56:965-72.
- 5. Chen J, Stavropoulos SW. Management of endoleaks. Semin Intervent Radiol 2015;32:259-64.
- Choi SY, Won JY, Lee DY, Choi D, Shim WH, Lee KH. Percutaneous transabdominal approach for the treatment of endoleaks after endovascular repair of infrarenal abdominal aortic aneurysm. Korean J Radiol 2010;11:107-14.

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