Infrarenal aortic balloon-expandable stent graft deployment using the sheath control technique in a patient with hemorrhagic shock secondary to an aortoenteric fistula

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ABSTRACT

A 40-year-old man presented with hemorrhagic shock owing to an aortoduodenal fistula. Angiography demonstrated vasospasm of the right common femoral artery to 2 mm. Treatment using a balloon-expandable stent graft was chosen given the smaller sheath diameter requirement when compared to self-expandable aortic stent graft. Given the undersized 11 mm delivery balloon for the patient's aorta, a sheath control technique was utilized. The stent graft was partially expanded within the sheath and the delivery balloon was exchanged for a 16-mm balloon to complete expansion of the stent graft apposition to the aortic wall, bridging the patient to definitive surgical repair. (J Vasc Surg Cases and Innovative Techniques 2021;7:563-6.)

Keywords: Aortoenteric fistula; Balloon-expandable stent graft; Sheath control technique; Endoprosthesis; Balloon exchange

An acquired aortoenteric fistula (AEF) is a rare but a potentially fatal entity.[1] AEF are most commonly secondary to an underlying aortic aneurysm, but postradiation AEF have been described.[2] Endovascular repair of AEF has been reported, but small femoral artery diameter, as can be seen in the setting of hemorrhagic shock, may limit self-expanding stent graft options due to larger sheath requirements over a balloon expandable stent graft. This report describes a case of a radiation-induced AEF presenting with acute hemorrhage and associated femoral artery vasospasm, successfully treated with an undersized balloon-expandable stent graft using the sheath control technique.[3] Consent was obtained from the patient for publication of the present case report and corresponding images.

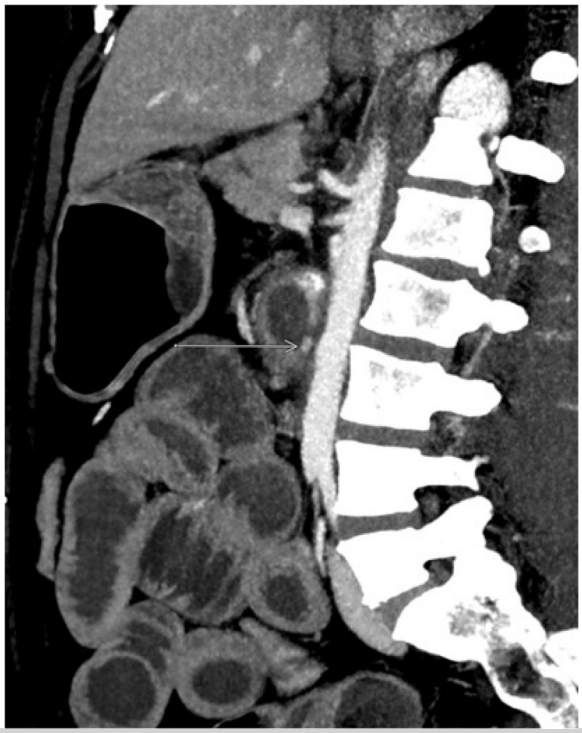

Fig 1. Sagittal plane of the descending aorta on a contrast enhanced computed tomography scan of the abdomen demonstrating contrast extravasation in the third portion of the duodenum (*arrow*) and a ventral lumen irregularity of the adjacent infrarenal abdominal aorta suggesting an AEF.

CASE REPORT

A 40-year-old man with a past medical history of right-sided renal Wilm's tumor after nephrectomy and adjuvant radiation

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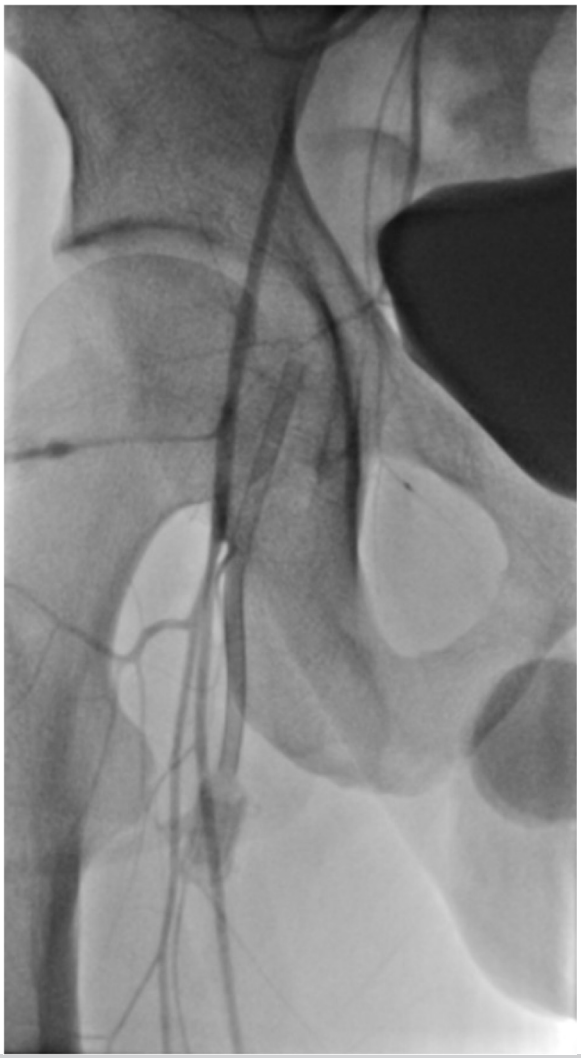

Fig 2. Right common femoral artery diameter of approximately 2 mm secondary to severe peripheral vasoconstriction in the setting of hemorrhagic shock.

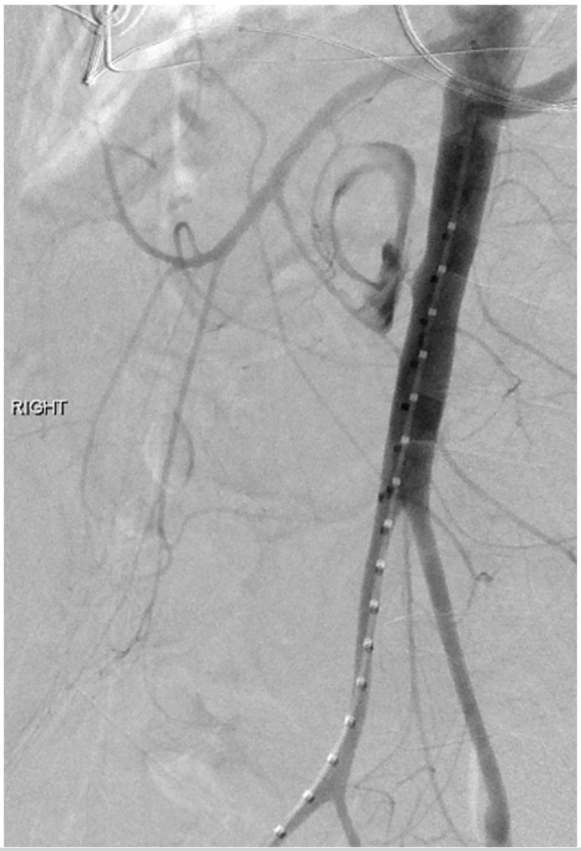

Fig 3. Abdominal aortogram demonstrating active contrast extravasation from the abdominal aorta to the third portion of the duodenum.

therapy at age 5 presented to the emergency department with hematemesis, melena, and bright red blood per rectum. Blood pressure and heart rate were 82/55 mm Hg and 120 bpm, respectively, at presentation. A nasogastric tube was placed, which returned 800 mL of bright red blood. He subsequently deteriorated requiring initiation of a massive transfusion protocol and intubation. Norepinephrine, epinephrine, and vasopressin were administered to maintain organ perfusion in the setting of a systolic blood pressure between 40 and 90 mm Hg.

A multiphase contrast-enhanced computed tomography scan demonstrated a large clot in the third portion of the duodenum and a ventral lumen irregularity of the adjacent infrarenal abdominal aorta, raising suspicion for an AEF (Fig 1). It was determined through multidisciplinary discussion that the patient's labile clinical condition would not permit the safe use of both general anesthesia and open surgical repair. The patient was taken emergently to the interventional radiology suite where access of the right common femoral artery was obtained using a 21G needle and micropuncture set under ultrasound guidance. An arteriogram performed through the micropuncture sheath demonstrated severe peripheral vasospasm with a resultant right common femoral artery diameter of 2 mm (Fig 2). A 5F pigtail catheter through a 5F sheath was placed in the aortic lumen and an aortogram confirmed an aortoenteric fistula to the third portion of the duodenum with active extravasation (Fig 3). The 5F sheath was exchanged for an 8F $\times$ 55-cm sheath with significant resistance owing to the underlying vasospasm, and a temporary 16-mm balloon was deployed across the AEF to temporarily control hemorrhage. The decision was made to exclude the AEF with a balloon-expandable stent graft given the smaller sheath size requirement when compared with a self-expanding aortic endoprosthesis (the smallest available self expanding stent graft required a 12 Fr sheath). Vancomycin, caspofungin, and piperacillin-tazobactam were administered as antibiotic prophylaxis.

The patient's native aortic lumen measured 12 mm per angiography and 14 mm per a prior noncontrast renal stone computed tomography scan obtained during a remote emergency department visit. The largest balloon-expandable stent graft available in the hospital inventory was 11 $\times$ 59 mm (Gore VIABAHN VBX, W. L. Gore & Associates, Flagstaff, Ariz). Although this stent graft comes mounted on an 11-mm balloon, it can be post-dilated with a balloon exchange to a maximum diameter of 16 mm

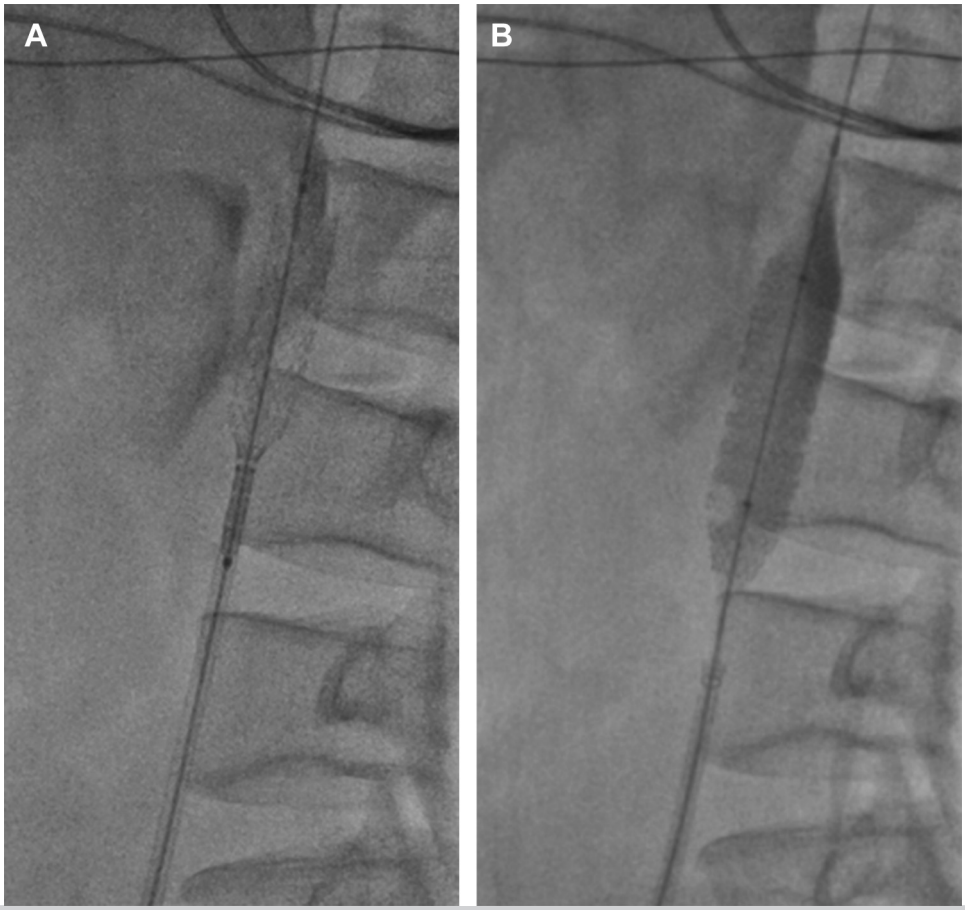

Fig 4. (A) Partially deployed Gore VBX balloon-expandable endoprosthesis in the abdominal aorta unopposed to the endothelium with one-third remaining within the sheath. **(B)** Final Gore VBX balloon-expandable endoprosthesis diameter of 16 mm completely expanded after 11-mm balloon exchange for the 16-mm balloon.

after deployment. To prevent distal migration of the undersized stent graft during the balloon exchange, the sheath control technique—previously described for the attenuation of transjugular intrahepatic portosystemic shunts—was used.[3] After deflation of the temproary 16-mm balloon, the stent graft was centered over the AEF and partially deployed with approximately one-third remaining in the sheath (Fig 4, *A*). The deployment balloon was removed and exchanged with a 16-mm balloon that was used to expand the stent graft and secure cranial apposition to the aortic wall while the sheath was retracted off the remaining stent graft, which was then inflated to its maximal diameter as per the manufacturer instructions for use (Fig 4, *B*). A final aortogram demonstrated exclusion of the aortoenteric fistula and the patient responded with improved hemodynamics.

The patient recovered for 3 days in the intensive care unit and underwent definitive surgical repair on day four with an open resection of the diseased aorta and replacement with a rifampin soaked 14-mm straight Dacron graft. Omentum was used to cover the graft to avoid future AEF formation. The patient had an uneventful recovery and was discharged 6 days after surgery on antibiotic prophylaxis with amoxicillin-clavulanate twice daily. A repeat contrast-enhanced computed tomography angiogram of the abdomen and pelvis one month after discharge demonstrated an unremarkable aortic repair and normal femoral arteries.

DISCUSSION

This case illustrates a technique to allow the placement of a balloon-expandable aortic stent graft in the setting of small diameter iliofemoral arteries. A similar sized self-expanding stent graft was not used given the severe iliofemoral vasoconstriction and the requirement for a larger sheath.[4-6]

A potential point of failure of the sheath control technique is stent displacement secondary to the winged tip of a previously deployed balloon. This risk was mitigated using a previously undeployed balloon while performing balloon exchange. The constrained portion of the partially deployed stent graft within the sheath provides sufficient clearance to withraw the initial delivery balooon while using a syringe to back aspirate. The authors recommend between 30% and 50% of the stent remain within the sheath during balloon exchange. Less than 30% may result in "watermelon seeding" of

the stent graft out of the sheath before full apposition against the vessel lumen.

Another consideration in this case is the use of a supra-inguinal iliac exposure to access a larger vessel. A device such as a 16 × 16 mm stent graft (Medtronic ENDURANT II, Minneapolis, Minn) could have been used to avoid a potential aortic wall injury from excessive balloon tension, however, the patient was moments away from cardiopulmonary arrest and both treatment delay and general anesthesia were avoided by using the reported approach. Although a large diameter balloon-expandable endoprosthesis delivered via a 14F sheath has been used successfully for the repair of traumatic aortic injuries, the sheath control technique provided a useful alternative deployment strategy in the setting of both the equipment and anatomic limitations described in this report.[3,7]

CONCLUSIONS

The sheath control technique allows for the deployment of initially undersized balloon-expandable stent grafts in the aorta with a smaller sheath diameter than a comparably sized self-expanding stent graft.

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