Lower extremity compartment syndrome after elective percutaneous fenestrated endovascular repair of an abdominal aortic aneurysm

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Ischemic complications after fenestrated endovascular aortic aneurysm repair (FEVAR) can result in significant morbidity and mortality. We present a case of a 65-year-old man who underwent a FEVAR complicated by bilateral lower extremity compartment syndrome requiring four-compartment fasciotomies. This ischemic complication was likely caused by sheath occlusion because the patient had no evidence of arterial injury or distal plaque embolization. This case highlights the importance of careful postoperative monitoring after FEVAR, because the larger sheaths required can be occlusive and result in lower extremity ischemia, even for relatively short cases. (J Vasc Surg Cases and Innovative Techniques 2017;3:41-3.)

Endovascular aneurysm repair (EVAR) is a common procedure with an overall low complication rate. Most complications are related to the access site(s) and occur with a 9% to 16% incidence.[1,2] Percutaneous femoral access decreases that complication rate to 4% in some studies.[3] Ischemic complications are rare and generally the result of thromboembolization or arterial injury.[4] Recently, these have decreased with the development of lower-profile delivery systems and newer-generation devices.[5] Here we present a patient with lower extremity compartment syndrome (CS) after fenestrated EVAR (FEVAR). Patient consent was obtained for publication of this case.

CASE REPORT

The patient is a 65-year-old Caucasian man. Medical history includes former smoking, hypertension, hyperlipidemia, coronary artery disease with stent placement, oropharyngeal cancer treated with curative total laryngectomy with tracheostomy creation, and an asymptomatic abdominal aortic aneurysm diagnosed by positron emission tomography-computed tomography (CT) during cancer surveillance imaging. He denied intermittent claudication or other symptoms of peripheral arterial occlusive disease.

Physical examination findings were notable for the absence of a pulsatile midline abdominal mass and palpable dorsalis pedis and posterior tibial pulses bilaterally. A CT angiogram demonstrated a 5.2-cm fusiform juxtarenal abdominal aortic aneurysm with a short 4-mm proximal neck (Fig 1). Bilateral internal iliac arteries (IIAs) were patent but severely calcified, and the left IIA was critically stenosed. The common iliac arteries measured 8 mm bilaterally. The patient subsequently underwent a percutaneous FEVAR using a Zenith device (Cook, Bloomington, Ind) with iCAST stents (Atrium Medical Corp, Hudson, NH) in both renal arteries. These devices were delivered through 20F and 22F sheaths.

Total case time was 3 hours and 5 minutes, with a completion angiogram showing absence of endoleak and unchanged pelvic runoff, including severe stenosis at the origin of the left IIA (Fig 2). He remained hemodynamically stable throughout the case and did not require vasopressor support or blood transfusions. The patient was heparinized before cannulation, and activated clotting times were maintained at >250 seconds for the duration of the case.

He began experiencing bilateral calf pain 3 hours after surgery, which was treated initially with analgesics. The patient remained stable until ~5 hours postoperatively, when he experienced worsening leg pain with progression to pain and numbness in both feet. He had preservation of motor function during this time. The patient's left anterior and lateral compartments and right posterior compartments were tense. Pressures were measured at >30 mm Hg in all compartments. Extremities otherwise appeared well perfused, with palpable pedal pulses bilaterally. At this time creatine kinase (CK) levels were 20,510 U/L.

The patient then underwent emergency bilateral four-compartment fasciotomies, and the muscle appeared viable. Intraoperative biopsy specimens demonstrated myonecrosis and inflammatory infiltrate without evidence of cholesterol emboli. Subsequently, the patient remained stable, CK levels normalized, and his wounds were closed. A repeat CT scan showed no evidence of endoleak and a stable aneurysm sac. He was discharged to inpatient rehabilitation and made a full recovery.

DISCUSSION

Although FEVAR can be performed safely with low operative risks in properly selected patients, lower extremity ischemic complications should remain high on the differential diagnosis for patients with compromised or tenuous pelvic collaterals to the lower

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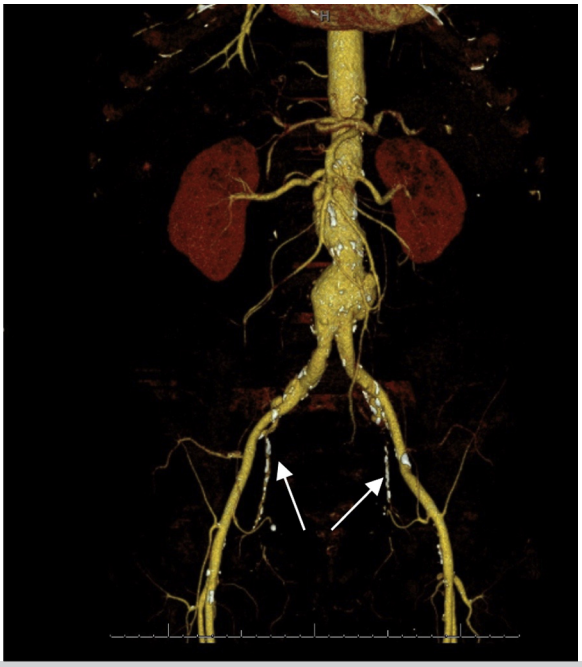

Fig 1. Preoperative computed tomography (CT) scan with three-dimensional reconstruction demonstrates 5.2-cm × 4.3-cm bilobed fusiform aneurysm along with calcified bilateral internal iliac arteries (IIAs; *arrows*).

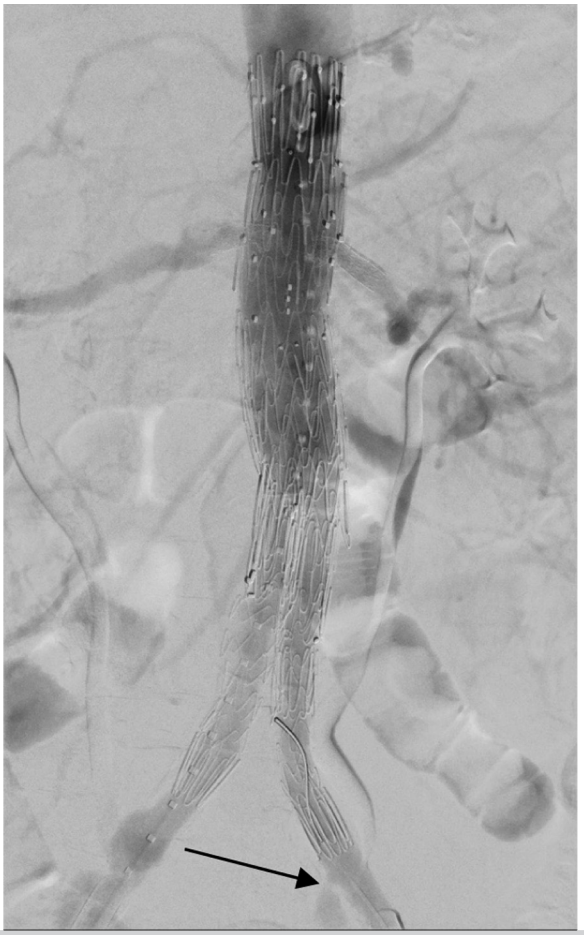

Fig 2. Intraoperative completion angiogram demonstrates patency of bilateral renal and femoral arteries, without evidence of endoleak. Again, the origin of the left internal iliac artery (IIA) is shown to be stenosed but patent (*arrow*).

extremities. Lower extremity CS, although rare, can occur after prolonged endovascular cases due to atheroemboli or injury related to low-flow ischemia and reperfusion, or both. This has been reported in the cardiac literature for cardiopulmonary bypass (CPB); however, to our knowledge, this is a rare occurrence after endovascular repair of aortic pathology.[6] Jan te Kolste et al[7] report 16 cases of CPB complicated by postoperative lower extremity CS. Etiologies in this series included sheath occlusion, intra-aortic balloon pump placement, low mean arterial flow with pressures of 50 to 85 mm Hg during CPB, the proinflammatory state induced by blood circulating through the bypass machine, leg bleeding from endoscopic great saphenous vein harvest, and decreased venous return with increased compartment pressures caused by positioning (abduction and external rotation) during great saphenous vein harvest.[7]

Similarly, our patient also had significant sheath occlusion in both femoral arteries. Despite the mural thrombus in the aorta, there was no evidence of atheroembolization on the muscle biopsy specimen at the time of fasciotomy. Moreover, our patient retained intact pedal pulses throughout and did not sustain an access site injury. The most likely etiology for CS in our patient was the occlusion of his iliofemoral arteries by the large sheaths and subsequent reperfusion injury to the distal muscle. This was exacerbated by poor pelvic collaterals and diseased hypogastric arteries, despite a relatively short sheath occlusion time of 3 hours.

For longer endovascular cases, Kalder et al[8] have proposed a shunting procedure to maintain lower extremity perfusion in the setting of femoral artery cannulation with large-profile (20F-22F) sheaths. Briefly, bilateral femoral arteries are cannulated with 7F sheaths in an antegrade fashion, distal to the large sheaths. A modified three-way stopcock is then used to connect the side ports of large and small sheaths to one another, thus creating a shunt to the lower extremity. Using this technique, they report a median lower limb perfusion rate of 102 mL/min, with only a modest rise in CK and no subsequent CS. This technique may not be limited to surgical groin cutdowns. Percutaneous antegrade catheters have recently been used to maintain distal perfusion in a similar fashion in patients undergoing extracorporeal membrane oxygenation.[9]

Indeed, such shunting techniques may be beneficial and serve to protect against lower extremity ischemia, especially during longer cases or in the setting of compromised pelvic collaterals, as in our patient.

Notably, the study by Kalder et al[8] reported a median operative time of 293 minutes, whereas our case was of considerably shorter duration (185 minutes). We believe that the heavily diseased pelvic collaterals and IIA critical stenoses exacerbated ischemia to the lower extremity despite relatively shorter sheath occlusion time.

Finally, this case highlights the importance of close postoperative monitoring for signs of lower extremity CS when pelvic collaterals are absent or diseased and large >20F sheaths are required. Our patient, in particular, may have benefited from balloon angioplasty of the left IIA stenosis to improve pelvic collaterals to the lower extremity. In addition, intraoperative shunting in patients undergoing prolonged procedures with large sheaths should be considered. Misdiagnosis of CS or delaying the diagnosis can lead to significant morbidity and mortality because irreversible damage ensues with compartment pressures >30 mm Hg for 6 to 8 hours.[10] Therefore, rapid return to the operating room for four-compartment fasciotomies should take place early to prevent permanent tissue damage or other sequelae.

CONCLUSIONS

Although the incidence of lower extremity ischemic complications after EVAR has decreased, FEVAR requires larger sheath sizes and, therefore, renewed vigilance for such ischemic complications. Preoperative assessment of important collaterals to the lower extremities (ie, IIA), attention to intraoperative details (ie, length of case and hypotension), and recognition of postoperative signs and symptoms of CS (ie, leg pain and swelling despite present pulses) are critical to ensure prompt diagnosis and treatment of this important ischemic complication after FEVAR.

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