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Tightrope Technique for facilitating complex endovascular aortic repair in patients with severely angulated neck

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ABSTRACT

An 84-year-old presented with a large, symptomatic juxtarenal abdominal aortic aneurysm. Owing to severe angulation of the infrarenal neck, advancement of the distal bifurcated component caused dramatic lateral movement of the proximal physician-modified endovascular graft (PMEG) fenestrated device. This procedure risked aneurysm sac perforation and possible PMEG device displacement. To avoid this complication, the distal aspect of the PMEG device was tethered in place using endoscopic forceps to provide countertraction, similar to pulling a tightrope. This technique allowed for the uneventful placement of the distal bifurcated component without complication. This technique can overcome device placement challenges within an angulated aorta caused by large aneurysms. (J Vasc Surg Cases Innov Tech 2022;8:894-6.)

Keywords: AAA; PMEG; Tightrope technique; Infrarenal aortic angulation; Forceps providing countertraction

Complex abdominal aortic aneurysms (CAAA) including juxtarenal aneurysms can create technical challenges during repair.[1] Open aortic repair and fenestrated endovascular aortic repair (FEVAR) of CAAAs have a 30-day mortality rate of 4.0 % to 5.4% and 0.8%, respectively.[2,3] Even with proper planning and imaging, unexpected technical challenges can occur during a FEVAR CAAA repair. In this case, the patient had a large juxtarenal aneurysm with a severely angulated infrarenal neck, which made insertion of the distal bifurcated device a challenge. The severe aortic angulation allowed dramatic lateral displacement of the physician-modified endovascular graft (PMEG) with attempted insertion of the distal bifurcated endograft. This could have led to potential perforation of the aneurysm sac, and/or displacement of the PMEG device. This case report highlights a novel technique used to overcome this challenging anatomy during complex endovascular aortic repair using a transfemoral only approach.

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CASE REPORT

An 84-year-old man with multiple medical comorbidities presented to the emergency room with acute onset abdominal pain. Computed tomography angiography revealed a large fusiform 8.9 × 8.5-cm juxtarenal aortic aneurysm, a right common iliac artery aneurysm, and a left internal iliac artery aneurysm (Video 1). The patient was not a candidate for open aortic repair owing to his age and comorbidities and standard EVAR was not an option owing to the lack of infrarenal neck. Therefore, a ZFEN (Cook Medical, Bloomington, IN) PMEG with incorporation of the superior mesentery artery and bilateral renal artery fenestrations was determined to be his best option for repair. Consent for this report was obtained from the patient.

After successful deployment of the ZFEN PMEG proximal fenestrated device and placement of bridging mesentery and bilateral renal covered stents, the distal bifurcated ZFEN device was attempted to be advanced from the ipsilateral femoral access. Owing to the severe angulation of 80° to 90° in the infrarenal neck of the aneurysm, advancement of the distal bifurcated device resulted in dramatic lateral movement of the proximal ZFEN PMEG device within the aortic sac. An initial attempt to hold the distal segment of the PMEG device with a semicompliant, polyurethane CODA balloon catheter (Cook Incorporated) while advancing the ZFEN distal device over Lunderquist wire failed (Video 2). As an alternative, the distal end of the proximal PMEG device was grasped from the contralateral femoral access sheath with Raptor flexible wire endoscopic forceps (US Endoscopy, Mentor, OH) and held in place. Grasping the distal end of the fenestrated graft provided countertraction, similar to pulling a tightrope, which allowed the body of the bifurcated aortic graft to be advanced into the distal end of the proximal PMEG device smoothly and safely (Videos 3 and 4). This technique eliminated graft displacement, which could have led to aneurysm sac perforation and/or possible fenestrated graft migration.

Fig. Angiogram image of successful branched endovascular repair of the juxtarenal aortic artery aneurysm, right common iliac artery aneurysm, and left internal iliac artery aneurysm.

Proper overlap of the two devices was achieved and the ZFEN bifurcated device was deployed under fluoroscopic guidance showing successful placement. After deployment of the distal ZFEN bifurcated device attention was focused on the right common iliac and left internal iliac artery aneurysms.

While maintaining the endoscopic grasper in place, a Gore Iliac Branch Endoprosthesis (IBE) (W. L. Gore & Associates, Flagstaff, AZ) was placed in the ipsilateral right common iliac and extended into the right external iliac artery. An Oscor conformable sheath was used to canulate the internal iliac gate (Oscor, Palm Harbor, Fl) from the ipsilateral approach. Two Gore VBX stents (W. L. Gore & Associates) were placed within the right internal iliac extending into the IBE, which preserved flow to the right internal iliac artery. A Cook bridging iliac graft (Cook Incorporated) was used to seal the right common iliac, extending from the ipsilateral limb into the IBE. At this point, the distal aspect of the PMEG device was released and the forceps were then removed after ipsilateral limb treatment was complete. Next, the left internal iliac anterior and posterior branches were coil embolized and a 20-mm Amplatzer II vascular plug (Abbott, Santa Clara, CA) was used to occlude the proximal left internal iliac artery. After the vascular plug, the left common iliac limb was placed and positioned with proper overlap within the left external iliac artery, extending distal to the origin of the left internal iliac artery (Fig). A completion aortogram was than obtained confirming successful exclusion of the aneurysms with widely patent stented fenestrations and iliac limbs and no endoleak. The case was then successfully concluded, and the patient was discharged home one day following surgery. At 30-days of follow-up, the patient had no vascular complaints and a computed tomography angiography showed slight aneurysm regression with no signs of endoleak. Sadly, the patient subsequently developed metastatic prostate cancer and died before his routine 6-month follow-up visit.

DISCUSSION

Paravisceral aortic angulation has been recognized as a significant limitation to FEVAR owing to alignment difficulty of fenestrations and target arteries.[4] In our case, infrarenal angulation further complicated FEVAR by allowing dramatic lateral displacement of the proximal PMEG fenestrated device with attempted advancement of the distal bifurcated device. The tightrope technique allowed us to overcome this difficulty by tethering the distal portion of the proximal component.

The use of a single bifurcated PMEG device may have also decreased these risks; however, we may have seen similar device displacement with advancement of the iliac limbs as well. Another alternative solution to prevent displacement of device in angulated anatomy is placement of a flossing through and through wire.[5] We perform complex endovascular aortic repair from a transfemoral access only approach with conformable sheaths used for selection of the fenestrations and delivery of the bridging stents. The flossing technique would require an additional brachial or axillary access and introduction of an additional stiff wire and sheath across the patient's aortic arch. Converting to the transbrachial or transaxillary access would have added significant operative time and the inherent risks associated with this approach, namely, bleeding and/or thrombosis at the access site and reported stroke risk.[6] The flossing technique may be preferred for operators who continue to use transbrachial or transaxillary access routinely to perform complex endovascular aortic repair. However, with more widespread adoption of transfemoral access only and the use of conformable sheaths to facilitate this approach, the tightrope technique may be preferrable because it successfully avoids additional access and the associated inherent risks.[6]

Potential risks of this technique would include grasping of unintentional targets including aortic wall or aneurysm sac thrombus. These risks were minimized by maintaining wire access through the device and positioning the contralateral sheath just outside of the distal end of the endograft, thereby minimizing travel of the open grasper. Deformation of the bridging stents was avoided by using only enough downward traction to prevent the lateral movement of the distal end of the device and allow forward advancement of the distal bifurcated device. Excessive downward force with the grasper could potentially deform the visceral balloon-expandable stents and should be avoided. Graft perforation resulting in a type III endoleak could also be a potential concern. This risk was addressed by only grasping the very distal end of the proximal fenestrated device with the forceps jaws. Even if a defect in the graft material would have been created with the tips of the grasper jaws, this area of the device would be excluded from vascular flow once the distal bifurcated device was successfully placed with appropriate overlap. Thus, eliminating the potential for a type III endoleak. We performed a completion aortogram and noncontrast cone beam computed tomography scan at the completion of the case to visualize the bridging stents and visceral flow.

Intravascular use of endoscopic forceps has been previously described to facilitate retrieval of inferior vena cava filters and intravascular foreign bodies.[7] To our knowledge, this case report represents the first description of a novel intravascular use of endovascular forceps.

Intensive preoperative imaging and planning to obtain the three-dimensional characteristics and dimensions of the aortic branches and aneurysm are required in CAAA repair.[8] However, proper preparation does not guarantee a successful outcome, and ingenuity is sometimes required to obtain excellent technical outcomes. The tightrope technique allowed us to overcome an unforeseen technical obstacle during FEVAR and ultimately led to a successful repair of a CAAA while using our standard transfemoral only approach.

CONCLUSIONS

This case report demonstrates how the tightrope technique can overcome device placement challenges within a severely angulated aorta caused by a large juxtarenal aneurysm. This maneuver can be considered as an alternative to the through and through flossing wire technique to limit endograft displacement in severely angulated anatomy, especially when a transfemoral access only approach is used for complex endovascular aortic repair.

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