Direct access of ascending aorta for endograft delivery in the descending thoracic aorta

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ABSTRACT

First-line therapy for aneurysm, dissection, or rupture of the descending thoracic aorta is now by the endovascular approach. Retrograde insertion of the endograft, through access from the femoral arteries, is the preferred approach. This case presents a new, innovative technique for delivery of an endoprosthesis into the descending thoracic aorta when hostile anatomy prevents delivery from the femoral arteries, iliac arteries, or infrarenal abdominal aorta in a patient not suitable for open repair. (J Vasc Surg Cases and Innovative Techniques 2020;6:63-6.)

Keywords: Thoracic aortic aneurysm; Alternative access sites for endovascular aortic repair; Hostile anatomy

First-line therapy for aneurysm, dissection, or rupture of the descending thoracic aorta is now by the endovascular approach. Retrograde insertion of the endograft, through access from the femoral arteries, is the preferred approach. However, when femoral access is prohibitive, alternative access becomes necessary. Described here is a patient with a symptomatic thoracic aortic aneurysm treated by endograft insertion through direct puncture of the ascending aorta. The patient provided written consent at the time of operation for her case and information to be used in research and publication.

CASE REPORT

A frail 80-year-old woman was transferred from an outside hospital with chest pain, shortness of breath, malaise, and lethargy. Her admission weight was 44.5 kg. Computed tomography angiography showed a saccular thoracic aortic aneurysm, measuring 6.2 × 8.3 cm, and a metachronous suprarenal abdominal aneurysm measuring 3.6 × 4.6 cm (Fig 1). The anatomy was not consistent with a type V thoracoabdominal aortic aneurysm. Her medical history was significant for myocardial infarction in 2013 treated with coronary stents, atrial fibrillation, chronic obstructive pulmonary disease on 2 L of continuous home oxygen, tobacco abuse (quit 6 years earlier, >35 pack-year history), congestive heart failure, systemic hypertension, and hyperlipidemia. She was aware of her thoracic aortic aneurysm, but it was previously asymptomatic and no treatment was pursued. After a cardiac source of the patient's chest pain was excluded by serial troponin measurements, electrocardiography, and transthoracic echocardiography (revealing an ejection fraction of 30% and no new wall motion abnormalities), treatment of the saccular descending thoracic aortic aneurysm was pursued. The authors were confident that her symptoms were secondary to the aneurysm, given significant improvement in her pain with strict blood pressure control (goal systolic blood pressure <120 mm Hg) and heart rate control (goal heart rate <80 beats/min) and exclusion of a cardiac source of the patient's pain.

In the hybrid operating suite, bilateral femoral artery exposures were performed. The femoral arteries were so severely calcified (Fig 2), however, that clamping was not possible. There was a small soft spot in the calcifications noted on the right side. A micropuncture needle was placed in a small soft spot on the right and was used to upsize to a 6F sheath. A micropuncture was also used to place a 5F sheath in the left femoral artery through the calcifications. Through the right 6F sheath, a 0.035-inch Bentson wire (Cook Medical, Bloomington, Ind) was passed into the thoracic aorta. Wire access to the thoracic aorta was also established through the left sheath. A Glide catheter (Terumo Interventional Systems, Somerset, NJ) was used to exchange the Bentson wire for an Amplatz wire (Cook Medical) on the right. Serial dilation was attempted to pass the needed sheath for endograft placement. An 18F dilator was passed into the common iliac artery on the right, where it met significant resistance. A 20F dilator was then attempted but would not pass into the common iliac artery, having met excessive resistance in the external iliac artery. It was clear that a 22F sheath, required for deployment of the Gore cTAG device (W. L. Gore & Associates, Flagstaff, Ariz), could not pass through the femoral or iliac arteries. Given the calcifications of the iliac arteries and abdominal aorta, graft deployment with iliac or abdominal aortic conduit creation was also not possible. This prompted evaluation of alternative access sites. Although the patient was not initially consented for limited thoracotomy, the patient's son/medical durable power of attorney was present at the hospital. Once retrograde access proved unsuccessful, consent was obtained from the medical durable power of attorney before performance of the exposure of the ascending aorta.

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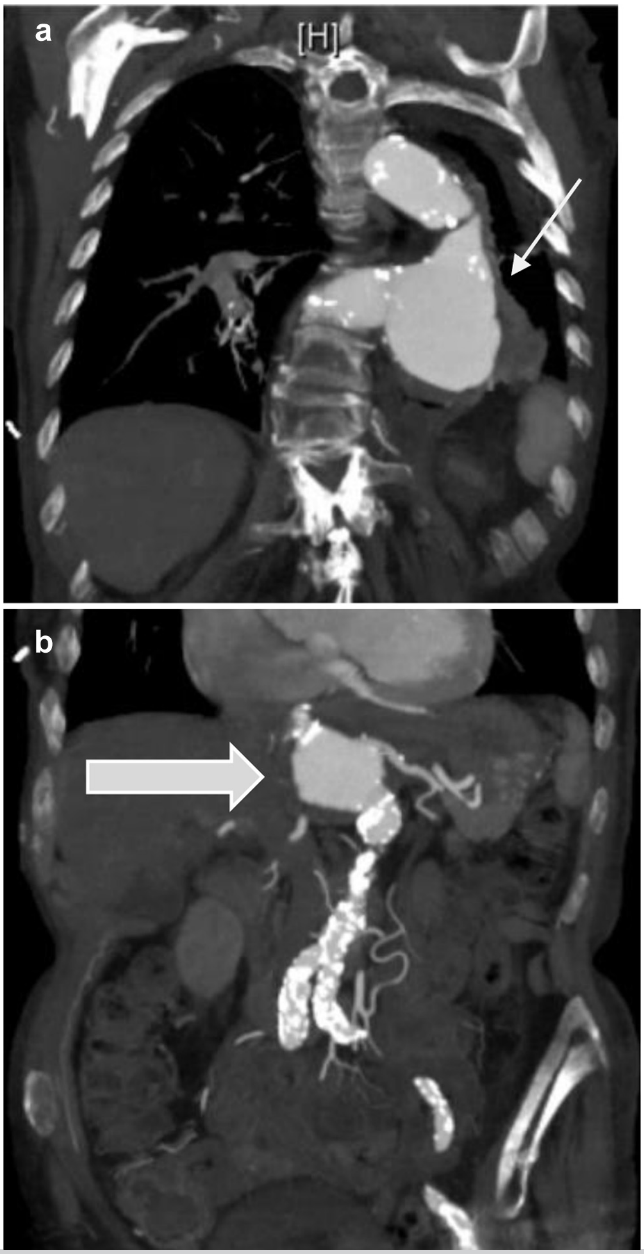

Fig 1. Preoperative computed tomography images showing **(A)** descending thoracic aortic aneurysm (*arrow*) and **(B)** suprarenal abdominal aortic aneurysm (*arrow*).

Fig 2. Preoperative images showing significant calcifications of the **(A)** right femoral artery (*arrow*), **(B)** left iliac and femoral arteries (*arrow*), and **(C)** aortoiliac arteries (*arrows*).

A right anterior minithoracotomy was then made with a 4-cm incision in the right third intercostal space. The right internal mammary vessels were clipped and divided. The pericardium was opened, exposing the ascending aorta. Two pledgeted purse-string sutures were placed, one outside the other, with 4-0 Prolene suture. A micropuncture needle was passed through the center of the inner purse-string suture and upsized to a 22F Gore DrySeal (Fig 3). Due to tortuosity of the aorta, a pure antegrade "push" of the endograft was considered less safe than a "pull" approach using the retrograde femoral sites. Thus, a snare was used to grasp the wire in the thoracic aorta and to bring it out the left 5F sheath. A long Glide catheter was then used to "floss" an Amplatz wire from the 22F sheath in the ascending aorta to the left femoral sheath to straighten the tortuosity and to allow passage of the endograft (Fig 3).

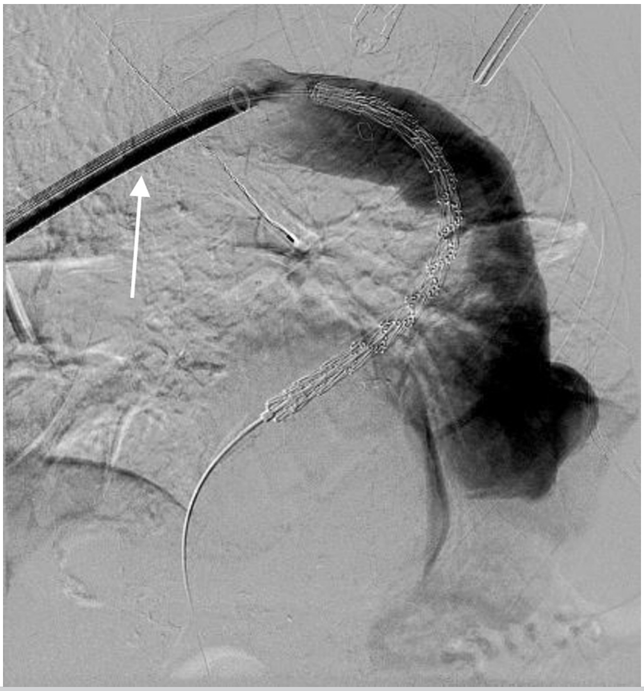

Fig 3. Placement of sheath from the ascending aorta, across the arch, and into the proximal descending thoracic aorta (indicated by *arrow*).

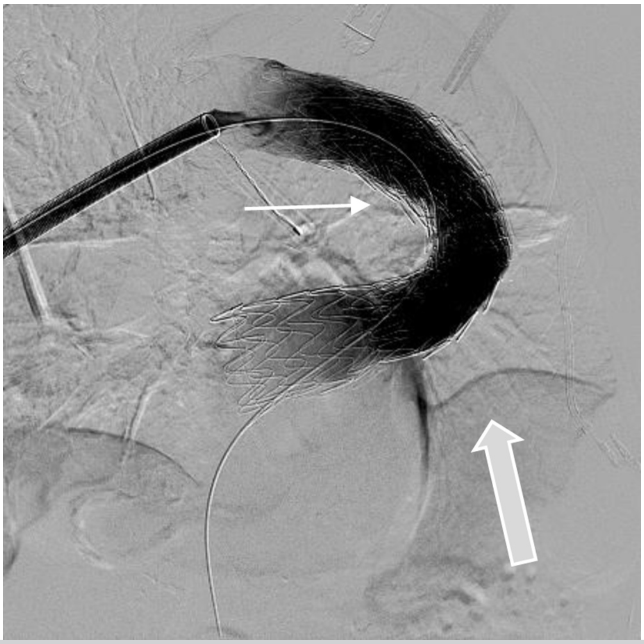

Fig 4. Completion angiography after proximal extension allowing complete exclusion of the thoracic aneurysm (*thin arrow*, flow lumen; *thick arrow*, aneurysm).

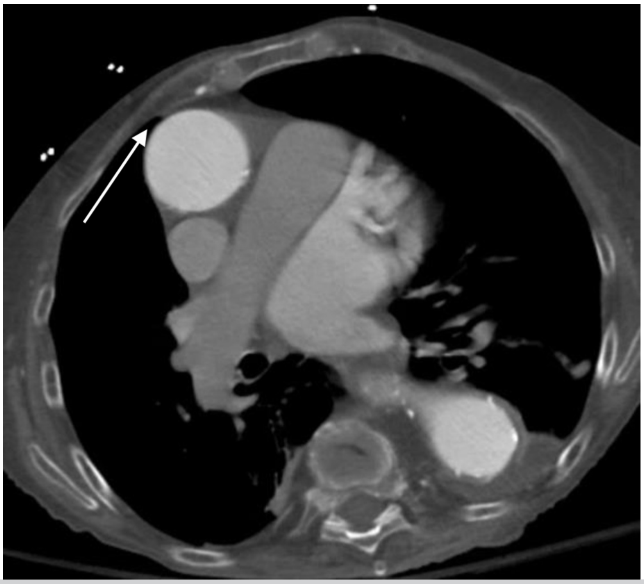

Fig 5. Anatomic appearance appropriate for direct puncture. Apposition of the ascending aorta to the anterior chest wall is noted by the *arrow*.

The body-floss technique is helpful for more control of the device in advancing it antegrade through the thoracic aorta as it allows tension to be applied to the wire. This straightens the system, giving more pushability to the device. It is the authors' opinion that barring anatomic barriers to the floss technique, this should be applied in any circumstance in which antegrade delivery of the device from the ascending aorta is being attempted. Intravascular ultrasound was then used to mark the proximal and distal aspects of the thoracic aneurysm, and angiography was performed to confirm device position before deployment of the 34-mm × 15-cm graft. Initial deployment resulted in a small amount of bird-beaking of the proximal aspect of the graft, so proximal extension was performed with a 34-mm × 10-cm graft (Fig 4). The sheath was removed under direct visualization, and the two purse-string sutures were tied with good hemostasis. The small chest and groin incisions were then closed in layers. The patient had an uneventful recovery and was discharged on postoperative day 6. The patient's postoperative course was prolonged secondary to a bump in her creatinine concentration postoperatively from 1.64 mg/dL at admission to 1.74 mg/dL postoperatively. At discharge, it had normalized to 1.11 mg/dL. Her appetite was slow to return, but the patient was eating the majority of her calories and on supplemental protein shakes before discharge. The patient remained intubated until postoperative day 2. Her respiratory status after extubation was not significantly worsened; she had been weaned during the course of 3 days after extubation to her baseline oxygen requirements. The patient's peripheral pulse examination findings remained unchanged from preoperatively with weakly (1+) palpable femoral pulses and nonpalpable pedal pulses but clear Doppler signals in the dorsalis pedis and posterior tibial arteries bilaterally. The authors' recommendation was for follow-up in 3 months for repeated computed tomography angiography of the chest, abdomen, and pelvis. Unfortunately, the patient was from out of state and desired follow-up in her local community. The procedure was performed on February 20, 2019, and to the authors' knowledge, the patient is still alive as of the publication of this manuscript.

DISCUSSION

Retrograde deployment of the thoracic aortic endograft through femoral artery access is possible in most patients to treat disease of the descending thoracic aorta.[1] When the femoral arteries are hostile, however, alternative access must be sought. Hostile anatomy for the retrograde access and deployment of endografts includes significant proximal iliac artery occlusive disease, small iliofemoral arteries, significant iliofemoral calcific disease, severe tortuosity of the iliofemoral system, and any combination of these anatomic variations. The first alternative for delivery is the iliac arteries. Traditionally, this has been accomplished by retroperitoneal open iliac conduit creation.[2,3] The continued expansion of endovascular techniques allowed the development of the internal endoconduit as an alternative to the open iliac approach when the iliac arteries are hostile but access to the femoral arteries is reasonable.[4,5] This technique requires angioplasty and stent placement to allow the delivery sheath to pass through the diseased iliac arteries. Direct puncture of the abdominal aorta for delivery of thoracic endografts has also been described.[2] In the patient described here, access vessels would not allow passage of an 18F outer diameter (OD) dilator, approximately 6.7 mm OD. The sheath required for the 34-mm cTAG is a 22F inner diameter, which has an OD of 8.2 mm. For reliable delivery of the device, the authors would prefer a 9-mm covered stent, which was thought to be too high risk for rupture of the iliofemoral system in a frail patient who may not tolerate significant blood loss that can accompany endoconduit technique. The Gore cTAG was chosen for this case secondary to device availability and the surgeon's comfort. This device requires a 22F inner diameter delivery system for deployment. Alternative systems include the RelayPlus (Bolton Medical, Sunrise, Fla), which also has a 22F OD delivery system for a 34-mm-diameter device. The smallest on market is the Navion (Medtronic, Santa Rosa, Calif), which would have required a 20F OD but was not available at the time of the procedure in the facility.

As surgeons have gained experience, and devices have become lower profile, alternative access sites have been proposed for endovascular aortic intervention in patients with hostile femoral or iliac arteries. These include the axillary artery,[6] the carotid artery,[7-9] the aortic arch,[10,11] and even a transapical approach.[12] Diethrich et al[13] were among the first to describe the antegrade deployment of a thoracic endograft from the ascending aorta. However, their description was in combination with open ascending aortic replacement and arch debranching through median sternotomy. The case described herein differs as it was performed through a limited anterior thoracotomy without violation of the parietal pleura or pericardium, without median sternotomy for open exposure of the arch or associated branch vessels or performance of an aortic arch debranching for placement of the endograft proximal to the origin of the left subclavian artery.

CONCLUSIONS

In patients with suitable anatomy, direct access of the proximal ascending thoracic aorta is yet another alternative that may be considered. The ascending aorta and aortic arch must have minimal atherosclerosis or calcific deposits (Fig 5). The minithoracotomy in the right third intercostal space can be done without a rib spreader (a Weitlaner retractor was sufficient), without opening the pleural space (no pleural tube was necessary) and without difficulty in accessing the ascending aorta for purse-string suture placement.

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