

Endovascular Repair of an Ascending Aortic Pseudoaneurysm

Technical considerations of a common carotid artery approach in treating a challenging problem.

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Pseudoaneurysm of the ascending aorta is an uncommon and surgically challenging problem. Traditional operative repair of an ascending aortic pseudoaneurysm involves cardiopulmonary bypass with ascending aortic replacement under hypothermic circulatory arrest, all of which are associated with high operative morbidity and mortality. Although endovascular exclusion of an aortic pseudoaneurysm using an endograft may represent a less-invasive treatment option, such a treatment modality similarly possesses its own therapeutic challenges. Because the Food and Drug Administration (FDA) presently has not approved an endograft device for ascending aortic application, utilization of commercially approved devices, which are intended for abdominal aortic aneurysms, is associated with certain limitations. In addition, delivery of an endograft device to the

ascending aorta via conventional femoral artery access can be challenging. Moreover, the high blood flow in the ascending aorta may render precise endograft deployment difficult. We present a case of an iatrogenic ascending aortic pseudoaneurysm that occurred 4 years after coronary artery bypass grafting (CABG), which was successfully treated with endovascular exclusion by means of a left common carotid artery approach.



Figure 1. A CT scan of the chest demonstrating a large aortic pseudoaneurysm (double arrows) arising from the ascending aorta (single arrow). This symptomatic ascending aortic pseudoaneurysm has resulted in pulmonary artery compression (long arrow).

CASE PRESENTATION

A 78-year-old man developed progressive worsening of exertional dyspnea and chest pain 4 years after CABG. Computed tomography (CT) of the chest demonstrated an 8-cm X 12-cm ascending aortic pseudoaneurysm that was compressing the pulmonary arteries (Figure 1). An aortogram revealed a bovine arch and an ascending aortic pseudoaneurysm arising from an aortic cannulating site of his previous



Figure 2. An aortogram with early injection view (A) and delayed injection view (B) revealed a bovine arch and an ascending aortic pseudoaneurysm arising from an aortic cannulating site of previous CABG (single arrow). This pseudoaneurysm is 8 cm X 12 cm in size and extends to the inferior portion of the aortic arch (double arrows).

CABG (Figure 2). Because of his medical comorbidities, which included chronic obstructive pulmonary disease (COPD) and recent stroke, he was deemed a poor surgical candidate to undergo an open surgical repair of his ascending aortic pseudoaneurysm. The total length of his ascending aorta was approximately 6 cm, and the ascending aortic diameter was 30 mm based on CT scan measurement. The origin of this ascending aortic pseudoaneurysm was located in the mid-segment of the ascending aorta. Treatment strategy using an endovascular aortic cuff to seal the ascending aortic pseudoaneurysm via a left common carotid approach was planned (Figure 3).

The patient was taken to an operating suite equipped with a fluoroscopic imaging unit (OEC 9800, GE Medical System, Salt Lake City, UT). The procedure was performed under general anesthesia. A right femoral access was established using a 6-F introducer sheath (Boston Scientific Corporation, Natick, MA). The left common carotid artery was exposed via a neck incision along the anterior border of the sternocleidomastoid muscle. An ascending aortogram was performed via a 5-F pigtail catheter from the groin approach. A .035-inch Bentson guidewire (Boston Scientific) was placed in the ascending aorta via the right common carotid sheath, which was changed for a .035-inch Lunderquist Extra Stiff Wire Guide (Cook Medical, Bloomington, IN) under fluoroscopic guidance. Transesophageal echocardiography was used to aid the visualization the ascending aortic pseudoaneurysm. With a plan to exclude the ascending aortic

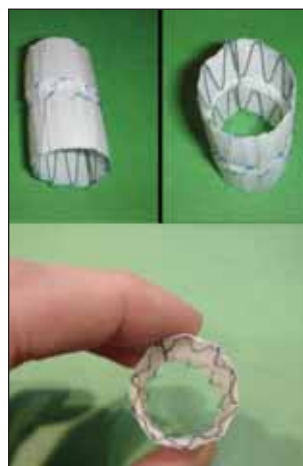


Figure 3. Endovascular treatment using Zenith aortic cuff devices was planned to exclude the ascending aortic pseudoaneurysm.

pseudoaneurysm using a Zenith aortic cuff, the nose cone of a Zenith aortic cuff (32 mm X 36 mm) (Cook Medical) was trimmed so the device could be properly delivered to the ascending aorta via a left common carotid artery approach (Figure 4). Three Zenith aortic cuffs were placed in the ascending aorta to successfully exclude the pseudoaneurysm, as demonstrated on the completion angiogram (Figure 5). The patient tolerated the procedure well without complications.

Follow-up CT scan showed successful pseudoaneurysm exclusion without endoleak (Figure 6).

DISCUSSION

Common causes of aortic pseudoaneurysm include traumatic or mycotic etiologies. In our patient, however, we postulate that his pseudoaneurysm was an iatrogenic complication due to the cannulation of cardiopulmonary circuitry in his ascending aorta from the previ-

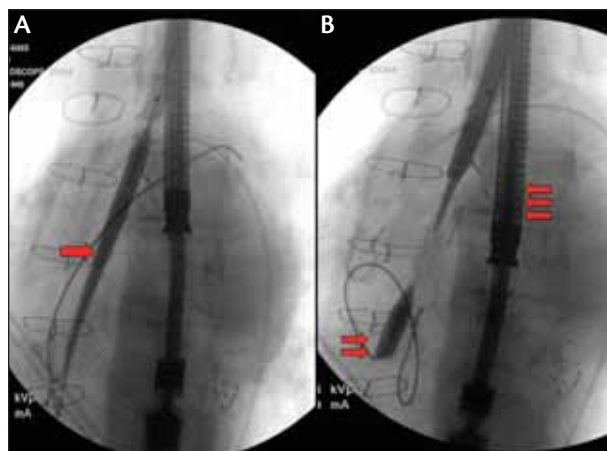


Figure 4. Delivery of a 32-mm X 36-mm Zenith aortic cuff device via a left common carotid artery without trimming of the nose cone (single arrow) would lead to inadequate device positioning in the ascending aorta (A). Once the device nose cone was trimmed (double arrows), the device was properly positioned to exclude the ascending aortic pseudoaneurysm (B). A transesophageal echocardiography probe is shown (triple arrows).



Figure 5. Completion angiography revealed successful exclusion of the ascending aortic pseudoaneurysm using the Zenith aortic cuff endograft.



Figure 6. A follow-up CT scan showed a well-positioned aortic endograft in the ascending aorta (single arrow) with successful pseudoaneurysm exclusion without endoleak (double arrows).

ous CABG procedure. In patients with acceptable operative risk, the surgical treatment of choice is mediastinotomy with direct aortic reconstruction. Such a treatment approach, however, poses a prohibitive risk in our patient due to his poor comorbid condition. As a result, an endovascular strategy was considered in the treatment of his symptomatic ascending aortic pseudoaneurysm. Because there is no FDA-approved device for ascending aortic placement, the only available endovascular option would be off-label use of aortic cuff endografts as a means of excluding his ascending aortic pseudoaneurysm. In planning for this endovascular procedure, three technical concerns were raised that deserved some consideration.

The first issue relates to which aortic cuff endograft should be used. The ascending aortic diameters proximal and distal to the pseudoaneurysm in our patient were 28 mm and 29 mm, respectively. Consequently, AneuRx (Medtronic Inc., Santa Rosa, CA), or Excluder (Gore & Associates, Flagstaff, AZ) aortic cuffs would not be adequate in our patient, because the maximum diameters of their aortic cuffs were 28 mm and 28.5 mm, respectively. As a result, the only suitable aortic cuff for our patient would be a Zenith aortic cuff device, which had a wide range of diameters (up to 36 mm). We chose a 32-mm aortic cuff in our patient, which was adequate for ascending aortic implantation.

The second technical consideration was to determine which artery should be accessed for endograft deployment because gaining access to the ascending thoracic aorta poses a particular challenge. Previous reports have documented the feasibility of creating an iliac conduit

through which an aortic cuff endograft is deployed to repair aneurysms of the descending thoracic aorta.¹⁻⁴ However, such an approach may not be applicable for ascending aortic endograft placement. Among all commercially available aortic cuff devices, which include the Excluder, AneuRx, and Zenith endografts, there are varying degrees of device shaft length, ranging from 55 cm to 65 cm. The short length of these device shafts was insufficient to be delivered to the ascending aorta in our patient, even if an iliac conduit was created to facilitate the delivery. Therefore, we had to consider deploying an aortic

cuff via an aortic branch vessel, such as a carotid or subclavian artery.

Rayan et al recently reported a case of deploying an Excluder aortic cuff via a left axillary artery cutdown, which successfully excluded a mycotic aneurysm of the ascending aorta.⁵ In this report, the authors delivered a 28.5-mm-diameter Excluder cuff in a bareback fashion over a stiff guidewire and deployed it in the ascending aorta. We believed that a subclavian or axillary artery approach would not have been a feasible option in our patient because his left internal mammary artery provided the only inflow to his previously bypassed coronary grafts. Deployment of an endovascular device via a left axillary or subclavian artery would create a temporary occlusion of the left internal mammary artery, which may have resulted in severe myocardial ischemia in our patient. Because of a bovine aortic arch in our patient, we postulated that deploying an aortic cuff endograft via his right carotid artery may lead to a transient occlusion of the left carotid artery because of the introducer sheath placement, due in part to the angle in which the left common carotid artery originated from the innominate artery. This would undoubtedly increase the risk of neurological complications. As a result, we chose the left common carotid artery to deliver the aortic endograft device because it was least likely to incur either cardiac or neurological sequelae.

A third technical consideration in our patient relates to device deployment. Because of the relative long nose cone of the Zenith endograft, the proximal 5 cm of the device nose cone had to be trimmed so that the aortic cuff could be properly positioned in the ascending

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aorta. To facilitate the device deployment, we created a transient cardiac arrest using intravenous adenosine, which significantly reduced the aortic pulsation and enhanced accurate deployment of the device. Several investigators have previously reported the beneficial effect of adenosine in inducing transient cardiac arrest when deploying an ascending aortic endograft.^{3,4,6,7}

CONCLUSION

We describe a case of a symptomatic ascending aortic pseudoaneurysm that was successfully treated using components of abdominal endografts via a left carotid artery approach. Because of the lack of approved endovascular devices for ascending aortic aneurysm repair, clinicians may have to rely on endograft components designed for abdominal aortic aneurysms to treat lesions in the ascending aorta. With careful planning of the treatment strategy, as well as appropriate patient selection, successful outcomes can be achieved using endovascular approach in treating ascending aortic pseudoaneurysms. ■

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