

Minimally Invasive Endovascular Repair of Ascending Thoracic Aortic Aneurysm

with Use of Local Anesthesia and Conscious Sedation

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Ascending thoracic aortic aneurysm (ATAA) is typically treated surgically. No commercially available device has been specifically designed for endovascular ATAA repair, and currently, multiple anatomic and technical challenges affect its feasibility. Previously, such repairs have been performed with the patients under general anesthesia.

We describe a novel, minimally invasive approach to endovascular repair of ATAA, involving local anesthesia, conscious sedation, and 24-hour hospitalization. Two consecutive male patients (ages, 79 and 54 yr) who had comorbidities underwent percutaneous transfemoral endovascular ATAA repair with use of commercially available endografts. Patient 1 had a saccular aneurysm, and Patient 2 had a pseudoaneurysm consequent to recent surgical ATAA repair. The patients were discharged from the hospital 24 hours after technically successful, uncomplicated procedures. At 2 months, computed tomograms showed no endoleak or stent-graft migration. Our experience shows that minimally invasive endovascular ATAA repair is feasible for selected high-risk patients. We describe the procedure, access and closure devices, and challenges associated with this approach. (Tex Heart Inst J 2019;46(2):120-3)

Key words: Anesthesia, local; aortic aneurysm, thoracic/therapy; blood vessel prosthesis implantation/instrumentation; endovascular procedures/instrumentation/methods; equipment design; length of stay; patient selection; stents; treatment outcome

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Surgery is currently the standard treatment for ascending thoracic aortic aneurysm (ATAA). Endovascular ATAA repair can be feasible for patients who are poor surgical candidates; however, it is challenging because of anatomic complexities and current repair devices. We describe our novel, minimally invasive approach to endovascular ATAA repair—involving local anesthesia, conscious sedation, and short hospitalization—in 2 patients who were high-risk surgical candidates.

Case Reports

Patient 1

A 79-year-old man presented for repair of an enlarging saccular aneurysm of the ascending aorta. One month earlier, he had undergone cardioversion after cardiac arrest caused by ventricular fibrillation. During that admission, angiograms showed no coronary artery disease; however, an aortogram revealed a saccular ATAA (Fig. 1), and the patient was given an implantable cardioverter-defibrillator (ICD). Computed tomographic angiograms (CTA) showed that the aneurysm originated approximately 3 cm from the origin of the left coronary artery and ended 3 cm from the origin of the brachiocephalic artery.

Upon presentation, the patient had an S_4 gallop and a grade 2/6 aortic insufficiency murmur. His comorbid conditions included hypertension, hyperlipidemia, obesity, atrial fibrillation, and ventricular tachyarrhythmia. His medical history included subacute bacterial endocarditis with mitral valve annuloplasty and repair. Endovascular repair was recommended because of the high risk of surgery.

Patient 2

A 54-year-old man had undergone uneventful surgical repair of an ATAA through a median sternotomy with use of cardiopulmonary bypass, hypothermia, circulatory arrest, and a 28-mm Vascutek® Gelweave Valsalva™ gelatin-impregnated woven vascular graft (Terumo Cardiovascular Systems Corporation). On the 5th postoperative day,



Fig. 1 Patient 1. Aortogram shows a saccular ascending thoracic aortic aneurysm.

the patient had severe, persistent substernal chest pain after a coughing spell. Neither a physical examination nor a 12-lead electrocardiogram (ECG) revealed abnormalities. A chest CTA showed a large pseudoaneurysm (Fig. 2), assumed to have originated from where an 18G needle had been used to vent the ATAA graft at the end of the operation. Because of the high risk of repeat surgery and the patient's preference, endovascular repair was planned.

Endovascular Technique

Both patients underwent endovascular repair in our hybrid catheterization laboratory, under local anesthesia and conscious sedation.

Patient 1. We gained percutaneous access to Patient 1's right and left common femoral arteries by using a micropuncture kit (Cook Medical Inc.) and the standard Seldinger technique. Next, we placed 6F sheaths in both femoral arteries. We used a 10F Prostar® XL Percutaneous Vascular Surgical System (Abbott Vascular) to preclose the right access site, and a Perclose ProGlide® Suture-Mediated Closure System (Abbott Vascular) to preclose the left access site. Under fluoroscopic guidance, we introduced a 5F marker pigtail catheter (Cook Medical) through the left femoral artery into the thoracic aorta and then advanced the catheter into the right coronary sinus. Digital imaging was aided by a 50-cc contrast injection to determine the aneurysm's location and anatomic relationship with the brachiocephalic and coronary arteries.

After gaining access to the left common femoral vein, we advanced a 7F, 75-cm Mullins sheath (Cook

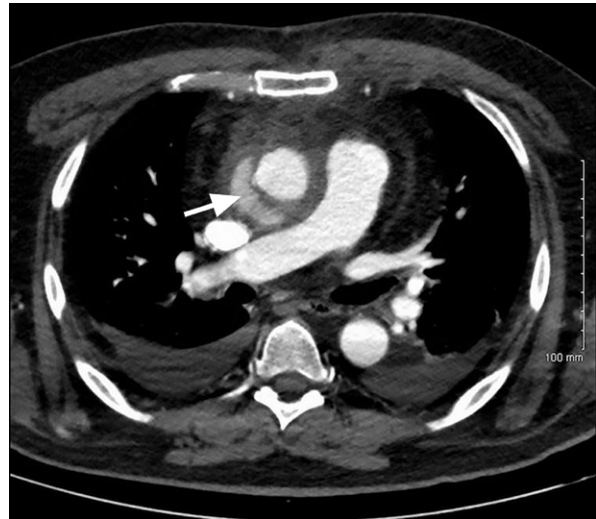


Fig. 2 Patient 2. Computed tomographic angiogram shows a pseudoaneurysm (arrow) that developed after surgical repair of an ascending thoracic aortic aneurysm.

Medical) over a 0.035-in guidewire to the right ventricle under fluoroscopic guidance. We introduced a 5F balloon-tipped pacemaker catheter (Bard Medical Division, part of Becton, Dickinson and Company) through the sheath and advanced it to the right ventricular apex to enable rapid ventricular pacing during stent-graft deployment. The pacemaker was connected and tested. We temporarily turned off the patient's ICD and advanced a 5F pigtail catheter to the ascending aorta through the left femoral artery, to enable imaging.

We introduced a 0.035-in J guidewire (Cook Medical) and a Judkins right 4 catheter (Cardinal Health, Inc.) through the right femoral artery access site and crossed the aortic valve without difficulty. The J guidewire was exchanged for a 0.035-in Lunderquist Extra Stiff wire (Cook Medical), which we positioned inside the left ventricular (LV) cavity. We placed a 22F sheath (Medtronic Inc.) in the right femoral artery and advanced a 44 × 80-mm Valiant™ stent-graft (Medtronic) to the ascending aorta. After angiographic imaging with use of the pigtail catheter, we induced ventricular pacing at a rate of 180 beats/min and deployed the stent-graft. The rapid pacing was intended to reduce cardiac output and to minimize pulsatility and movement of the endograft during deployment. The operator took care to keep distance between the stent-graft and the coronary artery ostia and brachiocephalic artery.

When angiograms showed substantial endograft foreshortening and a small endoleak, we advanced another 44 × 80-mm Valiant stent-graft and deployed it in the ascending aorta, using the same precautions as those for the first (Fig. 3). A completion angiogram confirmed exclusion of the aneurysm from the arterial flow and showed patent brachiocephalic and coronary arteries (Fig. 4).

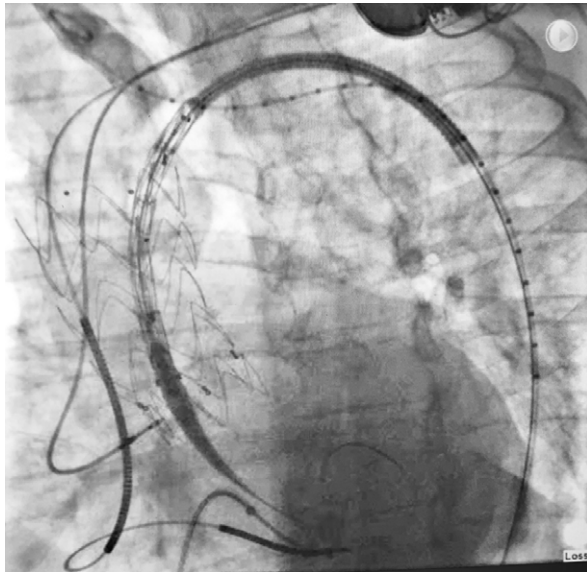


Fig. 3 Patient 1. Fluoroscopic image shows the second Valiant graft after deployment.

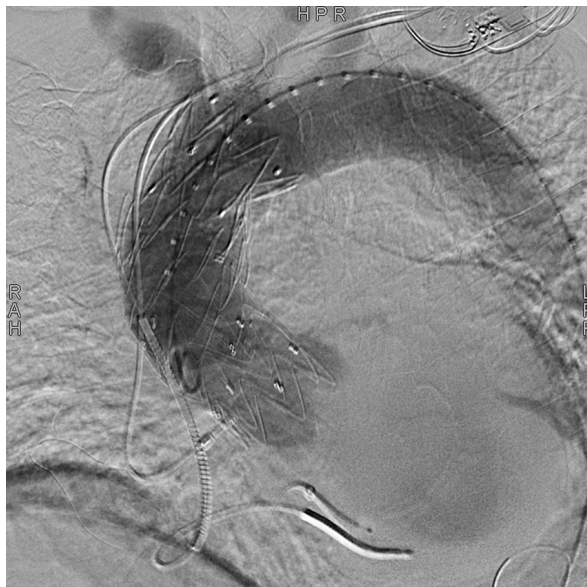


Fig. 4 Patient 1. Completion angiogram shows the excluded aneurysm and patent brachiocephalic and coronary arteries.

Patient 2. We applied the same interventional technique to repair Patient 2's large pseudoaneurysm but deployed a 32 × 80-mm Zenith® TX2® Low Profile TAA Endovascular Graft (Cook Medical). This procedure excluded the pseudoaneurysm with no endoleak (Fig. 5). To reduce risks of dissection and other complications, we avoided excessive graft oversizing and did not dilate the balloon after deployment.

Both patients were monitored on the interventional floor. They were given a regular diet 2 hours postprocedurally and were helped to walk after 4 hours. Their

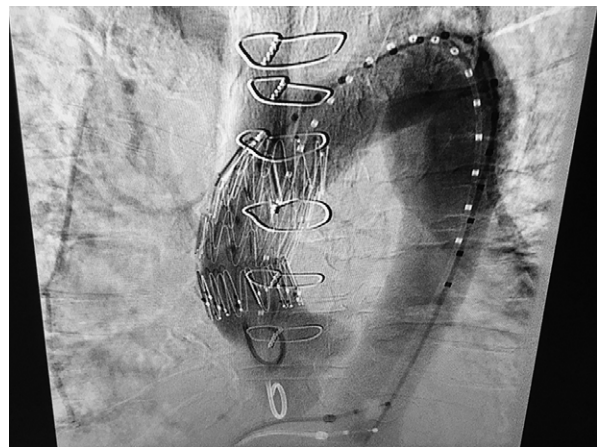


Fig. 5 Patient 2. Angiogram shows the excluded pseudoaneurysm and no endoleak.

hospital courses were uneventful, and both were discharged from the hospital in 24 hours. Neither had a complicated postoperative course. At 2 months, CTAs showed adequate stent-graft positioning, no migration or endoleak, and successful exclusion (Figs. 6 and 7).

Discussion

We think that these are the first 2 cases of endovascular ATAA repair with use of a percutaneous femoral artery approach, local anesthesia, and conscious sedation.

Conventional surgical treatment for ATAA—involving sternotomy, cardiopulmonary bypass, deep hypothermia, and circulatory arrest with cerebral perfusion—is associated with high morbidity and mortality rates in patients who have multiple comorbidities. For this reason, Patient 1 was a poor surgical candidate; moreover, sternotomy was risky because his ATAA was in the mid-anterior ascending thoracic aorta, abutting the sternum.¹ Patient 2 was at high risk from repeat surgery.

Percutaneous endovascular ATAA repair is associated with anatomic challenges, including origin of the aortic arch vessels, hemodynamic forces, respiratory motion, inner aortic curvature angulation, and proximity to the coronary arteries and aortic valve. Technical challenges arise when physicians attempt to treat pathologic conditions of the ascending aorta as they would treat abdominal aortic or descending thoracic aortic aneurysms. In most patients, the current delivery systems for treating abdominal aortic aneurysms are too short to reach the ascending aorta from the femoral artery for ATAA repair.²⁻⁴ In addition, the delivery systems for thoracic endovascular aortic repair (TEVAR) have large profiles and long nose cones that must be placed in the LV cavity, increasing the risk of LV perforation. No commercially available device is designed specifically for endovascular ATAA repair. Therefore, our approach ne-



Fig. 6 Patient 1. After 2 months, computed tomogram (3-dimensional reconstruction) shows no endoleak or device migration.

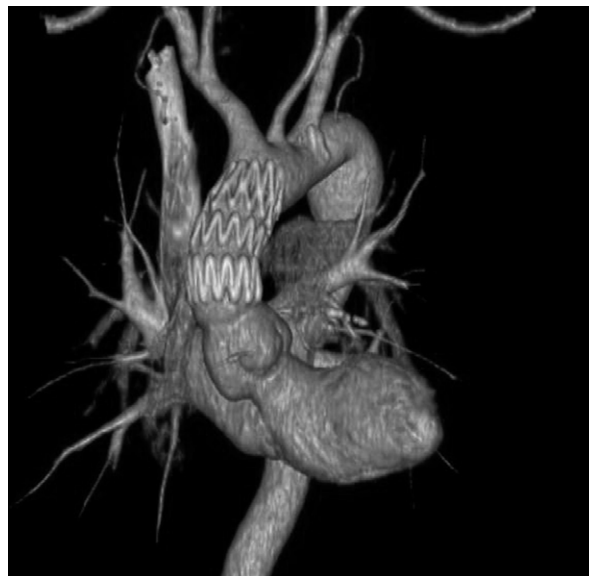


Fig. 7 Patient 2. After 2 months, computed tomogram with volume-rendering shows adequate graft positioning and no endoleak or device migration.

cessitates an adequate landing zone above the coronary arteries to avoid occluding them. Any involvement of the arch branches or sinus of Valsalva would be a contraindication to using our approach.

Results of several small studies have shown the feasibility of the endovascular approach for treating pathologic conditions of the ascending aorta.²⁻⁴ Preventza and colleagues² used various devices off-label in 7 patients. At a median follow-up period of 14.4 months (range, 5.5–22.6 mo), the survival rate was 66.6% with no aorta-related deaths. Vallabhajosyula and colleagues³ reported no hospital or 30-day deaths among 6 patients who had endovascular repairs. Yin and associates⁴ used transcatheter means to repair ascending aortic aneu-

rysms in 3 patients who were high-risk surgical candidates.

All prior operators have placed patients under general anesthesia before endovascular ATAA repair. Our experience shows that using TEVAR, local anesthesia, and conscious sedation in select cases can enable safe, accurate endograft placement and rapid recovery. This TEVAR approach is the same that we use for transcatheter aortic valve replacement (TAVR).

Using local rather than general anesthesia during endovascular aortic aneurysm repair can produce superior outcomes and lower costs. Advantages include simplicity, hemodynamic stability, and less consumption of resources.⁵ For minimal invasiveness, we used the Prostar XL closure device for the large-bore femoral sheaths, to achieve hemostasis. Haas and colleagues⁶ showed the safety of this procedure, and others have confirmed it.

To increase safety, we used right ventricular pacing to reduce the effect of hemodynamic forces during endograft deployment. This technique is often implemented in TAVR to prevent device movement by reducing systolic blood pressure to less than 50 mmHg.

Our patients recovered rapidly. Pending design improvements in endograft delivery systems, we consider our technique to be a feasible, minimally invasive alternative for selected high-risk surgical candidates who need ATAA repair.

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