Coming Soon: TEVAR in the Ascending Aorta?

The emergence of endovascular therapy in this challenging anatomy as an alternative to open repair.

BY MATT THOMPSON, MD, FRCS

Endovascular techniques have become more common in recent years[1] and have revolutionized the treatment of pathology affecting the descending thoracic aorta (TEVAR), with demonstrable reduction in both mortality and morbidity in conditions with diverse pathologies.[2] It may be argued that TEVAR is now the first-line therapy for patients with complicated acute type B dissections, descending thoracic aneurysms, and thoracic transactions.

With the success of TEVAR, new applications have been sought for this technology. One area of potential interest is the ascending aorta. Several pathologies may be candidates for endovascular treatment, including isolated ascending aortic aneurysms, cannulation-site false aneurysms, intramural hematoma, and some acute type A dissections. This article predominantly focuses on type A dissection.

TECHNICAL CHALLENGES IN THE ASCENDING AORTA

The anatomical and physiological challenges to endovascular therapy of the ascending aorta remain formidable. For instance, navigation of an endograft through the iliofemoral segment, the often-tortuous thoracic aorta, and the aortic arch is often difficult. In many cases, these access vessels will be narrow and tortuous, which may make delivery of the endograft problematic. In these cases, access may be achieved via axillary or subclavian routes and, conceivably, the apex of the left ventricle. These vessels have been successfully used for access in transcatheter aortic valve implantation.

Delivery of the endograft will require that the body of the endograft and its associated delivery system will need to be positioned in the left ventricle, with the attendant risk of valve disruption and ventricular perforation. There is also the need to use a delivery system that accommodates deployment into curved anatomy.

The proximal and distal landing zones are fraught with potential complications. The proximal landing zone will be necessarily close to the aortic valve and coronary arteries, whereas the distal zone will be in proximity to the innominate ostium. Furthermore, deployment of the endograft will need to take into consideration the hemodynamic forces in the ascending aorta. Clearly, cardiac output will need to be managed during deployment with rapid pacing or balloon inflow occlusion.

There are also challenges with conformability of the endograft in regard to the curvature of the ascending aorta and the sizing discrepancy between the proximal and distal ascending aorta. Finally, the fragility of the ascending aorta may pose difficulties, with the potential of retrograde type A dissection.

MORPHOLOGICAL SUITABILITY FOR ACUTE TYPE A DISSECTION

Despite these difficulties, endovascular development may offer a therapeutic modality for cases of surgically untreatable type A dissection. Selective studies have shown that up to 30% of patients with type A dissection are unable to undergo surgical treatment due to age or severe comorbidity.[3] The mortality in these cases is high (60%–80%), and endovascular therapy may be a possible alternative. Two recent studies have ascertained the suitability of type A dissection for treatment with an endovascular stent graft. In a study by Sobocinski et al,[4] 102

patients with acute type A aortic dissection were studied. Endovascular repair with a tubular stent graft was deemed feasible in 45 patients (with eight requiring a carotid-carotid bypass). An arch-branched endograft could have been used in 13 patients to exclude an entry tear located in the arch.

A similar study was performed by Moon et al at the Cleveland Clinic.[5] In this study of 162 patients, 77% of scans were suitable for analysis. The primary entry tear was visible in only 41% of the studies. Thirty-two percent of patients were deemed to be anatomically amenable to endovascular repair (absence of valvular involvement, appropriate length and diameter of proximal sealing regions, and avoidance of coronary ostia). The most common reason for an inability to perform endovascular repair was the absence of a proximal landing zone.

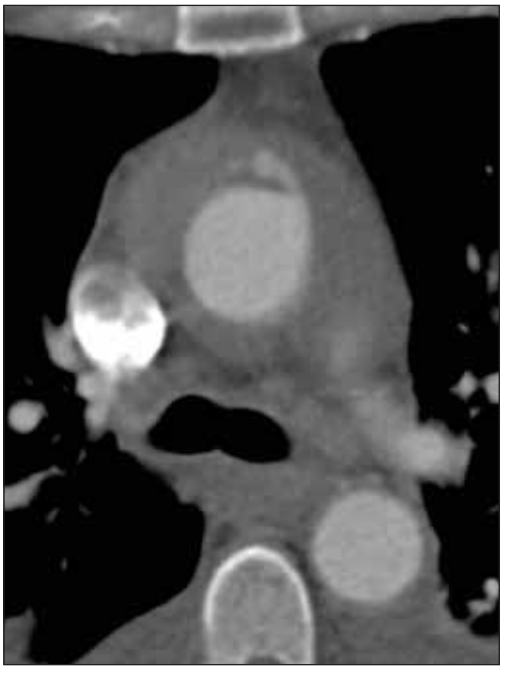

Figure 1. Axial computed tomographic (CT) angiogram showing an intimal tear in the mid-ascending aorta with extravasation of contrast.

Figure 2. Reconstruction of a CT angiogram after endovascular treatment of a type A dissection.

ENDOVASCULAR TREATMENT OF ACUTE TYPE A AORTIC DISSECTION

At present, the literature regarding endovascular therapy for ascending dissections is limited to case reports and case series but appears promising. In perhaps the biggest series to date, Ye et al[6] reported on a series of 45 patients with type A dissection. Many had a primary tear in the aortic arch and descending thoracic aorta, but 10 patients had a tear in the ascending aorta. The overall success rate of the cohort was 98%, with a mortality rate of 6.7%. There are a number of case reports in the literature that suggest that endovascular treatment of certain selected type A dissections is feasible. These cases are likely to involve patients who have been denied conventional surgery, but in the future, studies may define a cohort of patients who might benefit from endovascular repair as a primary treatment modality.

CLINICAL EXPERIENCE

Ascending aortic repair is only performed at our institution in patients who have no conventional surgical option. This has included therapy for cannulation-site aneurysms and a case of type A dissection.

In the last 2 years, a graft has been developed with Cook Medical (Bloomington, IN) for compassionate use in the ascending aorta. The nitinol-based stent graft has features that are specifically designed for use in this challenging anatomy:

- a delivery system capable of delivering the stent to the ascending aorta from a femoral route
- a tip capable of atraumatic entry to the left ventricle
- stable delivery with accurate placement
- length and diameter compatible with the ascending aorta
- at the time of writing, the system has been used in one compassionate case of type A dissection.[7]

CASE REPORT

A 68-year-old woman with a history of hypertension and current tobacco use was admitted with sudden-onset chest pain. Her chest x-ray, electrocardiography, serum troponin, and d-dimer tests were normal, but over the next 72 hours, she developed acute renal failure requiring hemofiltration, as well as pericardial and bilateral pleural effusions.

Four days after the patient's initial presentation, transthoracic echocardiography and CT pulmonary angiography revealed a significant type A intramural hematoma (Figure 1); contrast extravasation occurred in the ascending aorta due to an intimal tear with a hematoma in the aortic wall. The patient was unfit for open repair but consented to endovascular treatment with a custom-designed graft.

Under general anesthesia, the right brachial artery was

punctured percutaneously, and the left common femoral artery was exposed. Angiography identified the position of the coronary and innominate arteries. Via the common femoral artery, a 34-mm-diameter Zenith Ascend custom-made ascending aortic stent (Cook Medical) was positioned across the aortic valve over an extra-stiff guidewire (Lunderquist, Cook Medical). With overdrive pacing–induced hypotension, the stent was deployed in the ascending aorta. Angiography confirmed exclusion of the false lumen with patency of both coronary and innominate arteries (Figure 2). After surgery, the patient was extubated within 24 hours. A CT scan confirmed coverage of the aortic leak, and the patient made a successful recovery. Imaging at 9 months postoperatively confirmed adequate endograft position with no new adverse features.

FUTURE DIRECTIONS

Currently, the growth of endovascular experience in the ascending aorta is relatively slow due to the limited use of the technology in patients without a reasonable surgical option. Nevertheless, initial case reports are promising, and larger case series are beginning to appear. There are no data on mid- or long-term outcomes, and it will be important to observe whether endografts can survive in this challenging environment without causing serious postoperative complications. ■

Matt Thompson, MD, FRCS, is Professor of Vascular Surgery at St. George's Vascular Institute in London, United Kingdom. He has disclosed that he is a paid consultant to Abbott Vascular, Cook Medical, Endologix, Inc., Medtronic, Inc., and Trivascular, Inc. He also receives grant/research funding from Cook Medical and Medtronic, Inc. Professor Thompson may be reached at matt.thompson@stgeorges.nhs.uk.

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