Unmet Needs in…
Ascending and Arch Disease

Experts weigh in on prioritizing early diagnosis, addressing downstream complications, identifying areas of concern, and the future of treatment in ascending and arch disease.

With Tilo Kölbel, MD, PhD, and Joseph Bavaria, MD

Tilo Kölbel, MD, PhD
German Aortic Center Hamburg
Department of Vascular Medicine
University Heart & Vascular Center
Hamburg, Germany
tilokoelbel@googlemail.com
Disclosures: Consultant, proctor, intellectual property, research, and travel grants with Cook Medical; consultant and intellectual property with Terumo Aortic; owns shares with Mokita Medical.

Treatment of ascending aorta and aortic arch disease is moving into the focus of endovascular aortic repair. Over the past 20 years, new endovascular techniques have proven to benefit most patients with aortic aneurysms and aortic dissection and provide better outcomes for patients with lesions of the thoracic and abdominal aorta. This trend is also increasingly reflected in guideline recommendations of vascular and cardiovascular societies, and the ascending aorta and aortic arch are the last strongholds of open surgery that are now increasingly challenged.

Despite this triumphal march of a less invasive technology, some areas of concern persist, and these concerns are aggravated in the more proximal segments of the thoracic aorta:

- **Loss of compliance.** Current open and endovascular grafts that replace aortic segments increase aortic stiffness due to the loss of compliance. Depending on the position and length of the aortic repair, the Windkessel effect becomes impaired and has an impact on organ perfusion and cardiac function. Increase in left ventricular afterload leads to high blood pressure, chronic left ventricular dysfunction, and impaired diastolic organ perfusion. Long-term sequelae of this systematic disturbance of the arterial system are increasingly studied and will hopefully trigger the development of more physiologic endografts that include compliance features. Without an improved endograft design that better mimics the mechanical properties of the native aorta, endovascular repair techniques may fail to become the standard of care for young patients with a longer life expectancy.
- **Apposition.** Endografts and their delivery systems were originally designed to land in straight aortic segments of the abdominal and thoracic aorta. When the aorta has tortuous segments due to aortic elongation, even severe curves can be traversed with endografts, but proximal and distal landing is advisable in straight parallel aortic segments to achieve seal. When landing in the aortic arch and the ascending aorta, proximal landing frequently must be achieved in curved aortic segments with the risk of suboptimal sealing stent orientation, bird-beaking, and a compromised proximal seal. Conformability of endografts for the ascending aorta and the aortic arch is frequently insufficient, and additional deployment steps to secure a perpendicular sealing stent placement are required and should be integrated in future delivery systems.
- **Stroke and neurologic damage.** The risk of stroke during standard thoracic endovascular aortic repair (TEVAR) is 3% to 5% and up to 40% in complex procedures using fenestrated and branched stent grafts in the aortic arch. These numbers do not even include so-called asymptomatic neurologic damage represented by silent brain infarctions,

which are present after TEVAR in most patients. The risk of stroke depends on the landing zone and is highest for the ascending aorta and the aortic arch while the pathomechanism includes solid and gaseous emboli, hemodynamic compromise, and hemorrhage. Embolization to the carotid and vertebral arteries can even occur when solid or gaseous materials are released far distally to the left subclavian artery due to retrograde diastolic flow. Future endovascular stent grafts for the aortic arch and ascending aorta must be completely air-free when deployed to minimize cerebral embolization. Other protective measures such as filter devices, temporary clamping, or balloon inflation may further help reduce neurologic damage to a minimum.

Joseph Bavaria, MD
Vice Chief, Cardiovascular Surgery
Penn Medicine
Philadelphia, Pennsylvania
joseph.bavaria@uphs.upenn.edu
Disclosures: Principal Investigator for Gore & Associates, Terumo Aortic, and Medtronic; consultant to Gore & Associates; speakers bureau for Terumo Aortic.

The biggest unmet need in ascending and arch disease today is summed up by the fact that acute type A dissection (DeBakey type I) is a total aortic catastrophe in all domains, in all segments, and in space and time.

We know that aortic dissection is more common than previously assumed. Many patients die before diagnosis, are classified as sudden death due to unknown cause or myocardial infarction, or are simply not counted in the "incidence" statistics. In our emergency department entry points, we must "think aorta" when patients come in with complex or "nonclassic" chest pain. Rapid diagnosis for these patients with a CT scan as early as possible is crucial before cardiovascular collapse starts to become end stage. Survival is directly proportional to earlier diagnosis in this catastrophic aortic presentation.

We must develop strategies to address the ubiquitous downstream complications of aortic death, thoracic aneurysm formation, and reintervention by stabilizing the thoracic aorta within the first 90 days after the index type A dissection proximal aortic reconstructive procedure. This concept is crucial if we want to improve mid- and late-term survival. We can do it; we just need to think about it.

The most effective means of accomplishing this goal is to perform index procedures for type A dissection that will allow for relatively easy distal TEVAR solutions to the celiac artery. This includes creating appropriate proximal TEVAR landing zones in the arch at zones 1 and 2.

In type A dissection, it's all related. This is our biggest challenge and unmet need in proximal aortic surgery today, with the most impact on survival. ■