

ASK THE EXPERTS

Does Significant Oversizing Matter in the Distal Descending Thoracic Aorta?

Experts discuss considerations for oversizing seal zones such as aortic pathology, distal and proximal landing zone diameters, and the use of tapered devices.

**WITH MELISSA L. KIRKWOOD, MD, FACS; SANTI TRIMARCHI, MD, PhD;
AND BRANT W. ULLERY, MD, FACS**



Melissa L. Kirkwood, MD, FACS

Associate Professor
Vascular and Endovascular Surgery
UT Southwestern Medical Center
Dallas, Texas
melissa.kirkwood@utsouthwestern.edu
Disclosures: None.

Successful thoracic endovascular aortic repair (TEVAR) requires complex decision-making and planning. Using CTA and three-dimensional reformatting, it is crucial to analyze the extent of aortic pathology, underlying mechanisms of disease, proximal and distal seal zones, coverage length, vessel tortuosity, angulation, and presence of intraluminal thrombus and/or wall calcification. Diameter measurements for seal zones are best obtained in a plane orthogonal to the centerline of flow. Traditional teaching recommends oversizing seal zones by 10% to 25%, but this should be modified based on the disease process and clinical circumstance. Aneurysmal patients typically benefit from more generous oversizing to maximize radial force at the seal zones. In areas of severe curvature, increased oversizing can achieve better inner curvature apposition. Stent graft sizing for aortic dissection patients is more conservative and varies based on the chronicity of the flap, with recommendations of

generally more oversizing for chronic dissections compared to acute dissections. In traumatic transection patients, the aorta is often smaller and less diseased, and best graft sizing ranges from no oversizing to only up to 10%. In every case, stent graft sizing should be sufficient to avoid stent graft migration or type I endoleaks.

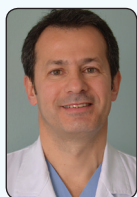
Further complicating stent graft sizing is that distal landing zone diameters are often smaller than proximal ones, and if sizing of the graft is done with only the proximal seal zone diameters in mind, then disproportionate graft oversizing in the distal descending thoracic aorta can result. Excessive oversizing can lead to graft folding, gutter formation with endoleak, and accelerated aneurysm degeneration. In aortic dissections, significant oversizing at the distal landing zone is thought to be a major factor in the development of stent graft–induced new entry (SINE). Distal SINE may cause retrograde false lumen flow and pressurization from new distal entry tears, resulting in potential aneurysmal degeneration. A histologic study of oversized TEVAR stent grafts placed in porcine models found a qualitative and organizational change in the structure of the aortic wall with increasing graft oversizing, with loss of elastic and muscle fibers, resulting in weak tissue.¹

The bottom line is that significant oversizing in the distal descending thoracic aorta does matter, and surgeons must play a cautious balancing act when sizing TEVAR stent grafts. Endografts with a tapered configuration are

very helpful in avoiding excessive distal oversizing. Available grafts can taper by 4 mm. Endografts tapered > 4 mm and custom-made devices would be beneficial when standard devices still result in significant distal oversizing. Unfortunately, such devices are not widely available and are currently considered investigational in most places. Alternatively, a bottom-up technique can also achieve the effect of tapering the stent graft size in the descending thoracic aorta. This technique involves first deploying a smaller stent graft distally, followed by a larger stent graft proximally. With appropriate preoperative planning both of these

methods are effective in reducing the oversize mismatch often seen between the proximal and distal landing zones. Understanding the aortic pathology being treated and choosing the correct recommended oversizing for that condition, while paying close attention to both the proximal and distal landing zones, will help minimize postoperative complications and achieve long-term stent graft durability after TEVAR.

1. Sincois IR, da Silva ES, Belczak SQ, et al. Histologic analysis of stent graft oversizing in the thoracic aorta. *J Vasc Surg.* 2013;58:1644-1651.



Santi Trimarchi, MD, PhD

Associate Professor of Vascular Surgery
Chair, Vascular Surgery Residency
Program
University of Milan
Head, Section of Vascular Surgery II
Director, Thoracic Aortic Research
Center
Policlinico San Donato IRCCS
Milan, Italy
santi.trimarchi@unimi.it
Disclosures: None.

A certain degree of mismatch between normal aortic physiology and the mechanics of a nonbiological device (ie, a stent graft) is unavoidable. To achieve a durable coupling of stent graft to aorta, stent graft sizing should be optimized for the particular environment where it is deployed, taking the individual patient's anatomy and physiology into account. In the distal descending thoracic aorta, inappropriate sizing can result in failure, including type Ib endoleak. Late (> 30 days) type Ib endoleak is not uncommon after TEVAR (estimated between 1% and 6.7%) and is likely underreported. When a distal endoleak is detected, this is usually a reason for reintervention. Distal SINE is another complication, especially in patients treated for dissection or intramural hematoma. Although the clini-

cal significance of SINE has not been fully elucidated yet, it can also be an indication for reintervention. Together, these distal stent graft–related complications add to the morbidity after TEVAR, some of which could be prevented with the right degree of oversizing.

Other than the quality of the aortic wall in the distal landing zone, aortic tortuosity and distensibility are the most obvious factors that influence stent graft sealing. In case of the distal descending thoracic aorta, not much has been published about these factors, but especially in patients with aneurysm, there can be significant tortuosity of the distal aorta. Moreover, there is increasing interest in the effects of aortic elongation over time on the durability of endovascular repair. The optimal degree of oversizing should be adapted to these factors (eg, tortuosity, distensibility, elongation), but there is a wide variation between individuals.

Until a truly individualized optimal degree of oversizing can be determined, 10% to 20% oversizing is the norm, also in the distal aorta. However, to prevent type Ib endoleaks, a greater degree of oversizing might be desirable, especially in case of a tortuous distal aorta, although there is a potential risk of stent graft infolding. Finally, a stent graft length that may seem slightly excessive may actually be required in a more tortuous distal thoracic aorta where a lot of stent graft length can be “lost” during deployment.

Oversizing in the distal descending thoracic aorta probably matters; therefore, more research is needed to find the optimal degree of oversizing for the individual patient.



Brant W. Ullery, MD, FACS

Vascular and Endovascular Surgery
Providence Heart and Vascular
Institute
Portland, Oregon
brant.ullery@providence.org
Disclosures: None.

Conventional TEVAR for aneurysmal disease is generally performed with the understanding that adequate fixation of self-expanding thoracic aortic endografts requires oversizing of 10% to 20% relative to the diameter of the adjacent normal arterial segment. However, discrepant aortic diameters between proximal and distal landing zones may be present in those with thoracic aortic aneurysms and other thoracic aortic pathologies. In these cases, the thoracic aortic endograft is most

commonly sized relative to the larger of the two aortic diameters. Given that the proximal aorta is frequently associated with the larger diameter, the distal landing zone in the descending thoracic aorta could foreseeably be oversized well beyond the upper range noted in the device-specific instructions for use when a single uniform-diameter thoracic aortic stent graft is utilized.

Excessive oversizing of thoracic aortic endografts can lead to infolding/collapse of the device, stent fatigue, intimal-medial injury, type I endoleak, and thromboembolic phenomenon resulting from luminal flow disturbances. A growing body of literature has cited significant distal oversizing as an independent risk factor for multiple adverse clinical events in patients undergoing TEVAR for treatment of thoracic aortic dissection, including development of distal SINE tears,¹ but few reports have explored this topic in patients treated for aneurysmal disease. However, Alberta et al showed that aortic diameters increase after TEVAR in patients treated for thoracic aneurysms and found a strong correlation between the percentage of oversizing and change in the distal neck diameter.²

As such, I do believe that excessive oversizing in TEVAR does matter distally regardless of the underlying aortic pathology, including among those with aneurysmal disease. Avoidance of excessive oversizing in the distal landing zone can be accomplished by following the device-specific sizing guidelines set forth by the manufacturer, utilizing tapered devices, or by incorporating the “shingling” technique to facilitate stepwise upsizing of the thoracic endografts distally to proximally. It is also important to note that aortic diameters may vary according to intravascular volume status, cardiac output, respiratory mechanics, and elasticity of the vessel wall. Intraoperative adjuncts (eg, intravascular ultrasound, transesophageal echocardiography) can aid in optimizing device sizing in equivocal cases. ■

1. Pantaleo A, Jafrancesco G, Buia F, et al. Distal stent graft-induced new entry: an emerging complication of endovascular treatment in aortic dissection. *Ann Thorac Surg*. 2016;102:527-533.

2. Alberta HB, Secor JL, Smits TC et al. Comparison of thoracic aortic diameter changes after endograft placement in patients with traumatic and aneurysmal disease. *J Vasc Surg*. 2014;59:1241-1246.