Unmet Needs in…
Infrarenal Anatomy

Experts consider outward forces exerted by currently available EVAR devices, hostile anatomy leading to inadequate seal, and endoleaks resulting in sac expansion and reintervention.

With Javairiah Fatima, MD, FACS, RPVI, DFSVS, and Nuno V. Dias, MD, PhD

Javairiah Fatima, MD, FACS, RPVI, DFSVS
Associate Professor of Surgery
Co-Director of the Complex Aortic Center
MedStar Heart and Vascular Institute
MedStar Health, Georgetown University
Washington, DC
javairiah.fatima@medstar.net
Disclosures: None.

Infrarenal abdominal aortic aneurysm (AAA) devices have been on the market since 1992 and have undergone multiple iterations since their original market release to address the needs and anatomic demands of infrarenal AAAs. Current devices are lower-profile modular devices, with increased conformability to accommodate significant angulations and improved trackability to navigate even the most hostile access vessels.

To ensure the highest standard of care and provide the greatest value, the goal of treatment must be for the index procedure to be the right operation for each patient. This approach allows one to strategize and be prepared with easy treatment in the event of device failure or disease progression.

Despite these advances, a significant number of endovascular aneurysm repairs (EVARs) continue to fail. It is important to understand that EVAR failures are multimodal; they can be device related, but very importantly, they often are due to disease progression and can be attributed to short-sightedness in not accounting for disease progression during the planning phase. The self-expanding nature of most available EVAR devices results in exertion of radial force, and this remains an accelerating factor of such progression. This process can be further exacerbated in patients with short, wide, and hostile necks, who would ideally be best served with a fenestrated/branched device up front to allow for sealing in healthy and parallel aorta. An in-depth understanding of the pathophysiology of AAAs and continued research in the form of clinical trials to ascertain their behavior with endovascular treatment and long-term outcomes are critical to laying the groundwork for further innovation.

One of the biggest challenges that we have learned is with sac management. Sac shrinkage and subsequent positive aortic remodeling remain the most important factors in determining success of EVAR. Failure of aortic sac after EVAR is associated with higher long-term mortality, independent of reinterventions or endoleaks. Yet, sac regression occurs in only about 40% to 50% of all EVARs; this remains the Achilles heel of EVAR. Endeavors to construct endografts with built-in sac obliteration systems have been met with failure, and attempts of introducing various materials into the excluded sac such as liquid embolics, glue, coils, and other materials have not quite been successful in increasing the rate of sac shrinkage either, leaving this void in the success of EVAR.

As we continue to address these challenges, we ought to acknowledge that we have made significant advances in the last 3 decades that have transformed our outlook on the management of infrarenal AAAs. The strong partnership of physicians and industry has been instrumental in continually improving technology and strategizing to allow for innovation, which remains the holy grail of endovascular management of aortic disease.

Nuno V. Dias, MD, PhD
Professor (Adj) of Vascular Surgery
Vascular Center Malmö
Skåne University Hospital
Department of Clinical Sciences
Malmö, Lund University
Malmö, Sweden
nuno.dias@med.lu.se
Disclosures: Intellectual property holder and research collaboration with Cook Medical; research collaboration with Gore & Associates and Medtronic.

EVAR has become the first option for repair of infrarenal AAAs. Results of EVAR in this anatomic area have improved with time and different endograft iterations that have addressed many of the initial limitations. For that reason, there is not a single challenge or unmet need in infrarenal anatomy that needs to be addressed. However, there are still some issues that require further improvements or consolidation in the long term.

- **Long-term dilatation of the proximal sealing zone.** This has been a limitation with most of the endografts used for infrarenal EVAR. The degree to which this is related to the outward force applied by the self-expanding stents, oversized compared to the nominal aortic diameter, has long been debated. Some data have suggested that restricting the outward force may improve the results, but this is very limited information and more long-term data are needed. Moreover, and more importantly, the expansion of the sealing zone only becomes significant in a subgroup of patients, suggesting that there are other factors that have not been explored, such as patterns of disease progression and biological factors.
- **Extremely angulated proximal sealing zones.** The presence of long and parallel aortic walls in the sealing zone has been identified as a determinant of good outcome because it maximizes the seal provided by the aorta-endograft interface. However, the presence of severe angulations not only potentially endangers this seal but also makes accurate intraoperative deployment of the graft more difficult. Endografts with redesigned proximal stents and modified delivery systems have shown promising results, although long-term data are still lacking. Moreover, the absence of a suprarenal fixation may make these grafts more prone to migration given that angulation increases the forces acting on the graft. Grafts with suprarenal fixation also have been suggested as a possible alternative, but again there is some increased risk of suboptimal apposition to the sealing zone and long-term failure.
- **Sealing zones with large diameter or conical shape.** This has often been shown to lead to the development of endoleaks when large grafts are used. As a result, alternatives that rely on sealing beyond the branches adjacent to those segments have gained popularity. However, this increases the complexity of the procedure. Strategies that would allow for a long-term seal in large and/or conical segments are still needed, particularly in cases where the anatomy of the renovisceral segment or hypogastric arteries is not ideal for more complex solutions, such as in the presence of multiple accessory renal arteries or hypogastric artery aneurysms.
- **Iliofemoral access.** Large-bore delivery systems limit the direct applicability of EVAR in patients with occlusive disease or small-diameter arteries. Therefore, decreasing the profile of the delivery systems was the focus of device development for years. This, combined with the development of other techniques such as endoconduits and/or lithotripsy, has increased the applicability of EVAR. However, a further decrease in profile would still be needed, without risking material fatigue of the fabrics and/or stents as has happened at times when lowering the profile.
- **Type II endoleaks.** This type of endoleak affects a minority of patients but is still associated with a lower probability of the sac shrinking and, at times, a tendency for expansion. Importantly, reinterventions are often challenging, particularly those addressing lumbar artery–related endoleaks. In that case, the risk of failure and/or recurrence is not negligible. Attempts have been made to have integrated solutions in the endograft that would prevent the occurrence of these endoleaks, the most popular of which recently has been endovascular aneurysm sealing. Unfortunately, the results were disappointing; the device is unavailable, and enhanced surveillance programs have been recommended for patients already treated with this technology. The current alternative is the use of intraoperative adjunctive procedures such as side branch or sac embolization. These have been proposed to lead to favorable outcomes at least in patients at a high risk for type II endoleak development. However, they are time consuming, costly, and not widely used.

If further enhancements of the endovascular technology manage to address the aforementioned issues, the applicability of EVAR will become even higher without compromising—and perhaps even improving—the results. This may lessen the need for follow-up programs as well as the concerns with offering this type of repair to young and fit patients. ■