Training the Next Generation of Aortic Specialists

Future generations of aortic specialists will not only need to master endovascular techniques but also collectively work to preserve the open aortic skill set.

By Eric J. Finnesgard, MD, MS, and Andres Schanzer, MD

The landscape of vascular surgery and the management of aortic aneurysmal disease have changed considerably over the last 3 decades. Prior to the advent of endovascular techniques, open surgical repair was the sole means by which to manage aortic aneurysms that warranted repair. With the introduction of endovascular aneurysm repair (EVAR) in 1991, this paradigm rapidly changed.[1,2] EVAR subsequently became ubiquitous in vascular surgical practice and, at nearly all centers, replaced open repair as the preferred method of treating abdominal aortic aneurysms (AAAs). As a result, the majority of AAA repairs in the United States are now performed using endovascular techniques.[3] However, the meteoric rise of EVAR has coincided with a decline in experience and familiarity with open techniques, particularly as generations of vascular surgeons have retired.[4] This shift is cause for concern, as open repair continues to remain an essential tool in the management of aortic disease, particularly in the care of patients whose anatomy may be unsuitable for EVAR, those with connective tissue disorders or mycotic disease, and when stent graft explantation is required.[5]

The practice of EVAR has evolved since it was first introduced. Aortic stent grafts have benefitted from multiple decades of refinement, and lower-profile modular devices have become the norm. The conduct of EVAR has similarly changed with the adoption of entirely percutaneous techniques and increased utilization of fixed hybrid imaging systems, which have reduced radiation usage during endovascular aortic interventions.[6] Additionally, the scope of the technology has expanded as interventionalists have sought to apply it to more extensive aortic disease. The incorporation of fenestrations and branches (F/BEVAR) has enabled seal zones that extend well beyond the infrarenal aorta, allowing for exclusion of juxtarenal, suprarenal, thoracoabdominal, and aortic arch aortic aneurysms. Although these more complex repairs were initially performed only at a small number of specialized centers in the United States, many of these techniques have begun to see more widespread adoption as the commercial availability of fenestrated and branched devices has increased.[4]

The expansion of endovascular capabilities and the availability of comparable outcomes data have also spurred the adoption of an "endovascular-first" approach in the management of more extensive aortic aneurysms.[7] Providers are now beginning to have access to fenestrated and branched technologies that had historically been limited to a few United States centers. In the wake of the market introduction of the Gore Excluder thoracoabdominal multibranch endoprosthesis (TAMBE; Gore & Associates) in 2024, the list of commercially available fenestrated and branched endovascular devices is only anticipated to grow. Interventionalists and industry have also continued to push the limits of what can be achieved with endovascular techniques in the ascending and aortic arch regions; the lessons learned from these efforts will undoubtedly continue to reshape future practice. New alternative guidance technologies have also been introduced that seek to change how these complex interventions are performed and may one day eliminate their reliance on ionizing radiation altogether.

TRAINING OF THE NEXT GENERATION

New practitioners are entering the field at a time of continued evolution. Although this era promises excitement and innovation, it also presents new challenges. The modern-day aortic specialist must not only seek to master a growing array of endovascular techniques to manage a greater extent of aortic disease but also preserve expertise in open aortic repair—a task made more difficult by declining open aortic case volumes and

decreasing exposure of graduating trainees to open aortic surgery.[4,8] Those intent on developing a practice in this area will require a strong foundation of open and endovascular skills to build upon, but they must also seek out opportunities for dedicated training and mentorship in both open and complex endovascular aortic intervention. Such training should ideally include exposure to the full spectrum of aortic repair in high volume, participation in case planning and decision-making, experience with a broad array of aortic devices and endovascular techniques, and utilization of advanced imaging technologies.

There is no substitute for experience with aortic intervention. Interventionalists must accrue considerable expertise to achieve proficiency. This has been a consistent finding in studies of the relationship between experience and patient outcomes with both open repair and complex EVAR.[9-13] New providers should seek to begin building this experience as early in their career as possible with dedicated exposure to both open and endovascular aortic interventions. However, with the decline in the volume of open aortic repair, particularly open TAAA repair, this experience is overall becoming more difficult to obtain. In response to the growing deficit in expertise, there has been a movement toward regionalizing open aortic repair to improve outcomes, but the need for formalized training in these techniques has thus far gone unmet. The field is now rapidly approaching an inflection point where accredited open aortic fellowships with an emphasis on training in open TAAA repair are needed to subvert a future scarcity of expertise necessary to care for patients with connective tissue disorders, mycotic disease, and need for graft explant. Short of a deliberate and effective change to training paradigms, a time is rapidly approaching where the skill set required to appropriately manage these conditions with open repair will no longer exist. In its absence, endovascular techniques will increasingly be used in circumstances where they cannot provide durable or appropriate solutions. Although the widespread adoption of complex endovascular techniques represents a significant achievement for the field, we cannot afford for this progress to come at the loss of open surgical skills.

Each patient and aortic intervention is unique, presenting its own distinct challenges and potential for complication. Providers must carefully select patients for a given intervention and, importantly, also recognize when not to intervene. Rigorous case planning is similarly critical to the flow and outcome of an aortic procedure, particularly with complex EVAR. For instance, staging some interventions may reduce risk, while a poor case plan can significantly raise the difficulty of an already challenging intervention. Trainees should seek immersion in the planning process to learn how patient anatomy or intervention/device constraints influence decision-making. Perhaps equally important is participation in intraprocedural troubleshooting when cases do not go as planned. Given the complexity and high stakes of aortic interventions, the misdeployment of a device or injury to a target vessel can pose a significant challenge for the interventionalist to overcome. Such problems must be promptly recognized and methodically worked to identify a potential solution. To this end, providers must be familiar with salvage techniques for their chosen intervention, such as externalizing an endoconduit or creating a laser fenestration during complex EVAR.

Practitioners must accumulate knowledge of the devices and technologies they plan to use in their own practice as well as those in use within the field at large. For example, to effectively treat a patient who develops a type Ia endoleak after EVAR, an interventionalist planning an endovascular repair must have a clear understanding of how their planned intervention and chosen device will interact with the indwelling stent graft. This knowledge is gained from both staying current with the state of the art and obtaining hands-on experience with a wide array of devices and techniques. Although new providers should ultimately focus on mastery of a more limited set of techniques and devices, exposure to a variety of alternatives can help avoid development of a siloed practice and the limitations it can impose.

Aortic interventions share a close relationship with advanced imaging technologies, both inside and outside the operating room. Fixed hybrid and fusion imaging systems, now considered standard of care in complex EVAR, significantly reduce ionizing radiation use in endovascular procedures.[6] Providers must make every effort to learn the subtleties of these systems and prioritize the reduction of radiation use, which poses significant long-term risk to patients as well as to staff whose lifetime accumulated dosage can grow large. New adjunctive guidance systems, such as the LumiGuide (Philips) or IOPS (Centerline Biomedical) platforms, are also poised to further reduce reliance on fluoroscopy during EVAR as they become further integrated into practice in the years to come.[14,15] Providers should seek to build familiarity with these rapidly evolving technologies and critically evaluate how they may be used to elevate the standard of care. Outside of the operating room, diagnostic imaging studies and centerline imaging software continue to play an essential part in aortic practice. Interventionalists should work to improve the accuracy and precision of measurements they take with these instruments, which are crucial to correct device selection and design in complex aortic interventions.

CONCLUSION

The practice of aortic surgery has changed considerably over the past 3 decades. The shift toward an "endovascular-first" mentality in the management of aortic disease has coincided with a diminishment in open aortic expertise, and the field continues to grapple with the ramifications of this change. The next generation of aortic surgeons must be trained to master and expand upon what can be accomplished with EVAR and to preserve and cultivate the open aortic skill set. As the field moves to further regionalize aortic care, accredited open aortic fellowships that prioritize training in open TAAA repair are needed. ■

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Eric J. Finnesgard, MD, MS
Division of Vascular & Endovascular Surgery
UMass Chan Medical School
Worcester, Massachusetts
eric.finnesgard@umassmemorial.org
Disclosures: None.

Andres Schanzer, MD
Division of Vascular & Endovascular Surgery
UMass Chan Medical School
Worcester, Massachusetts
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