

PANEL DISCUSSION

What Will Define the Aortic Center of the Future?

Describing the necessary considerations, including interdisciplinary teamwork, device design collaboration, and more, for the creation of future aortic care centers.

With Bernardo C. Mendes, MD; Miranda Witheford, MD, PhD, FRCSC; Fiona Rohlfes, MD, PhD; and Salma El Batti, MD, PhD

**Bernardo C. Mendes, MD**

Assistant Professor of Surgery
Division of Vascular and Endovascular
Surgery
Mayo Clinic

Rochester, Minnesota

mendes.bernardo@mayo.edu

Disclosures: Principal Investigator of the Thoracoabdominal MultiBranch Endoprosthesis (TAMBE) trial for Gore & Associates; aortic regional advisory board member for Medtronic; all fees paid to Mayo Clinic.

Over the last 2 decades, there has been an increased interest in the creation of specialized aortic centers of excellence in tertiary care institutions worldwide. This results from increasing recognition that specialized teams are needed to address medical, genetics, imaging, open surgery, and endovascular issues in the care of these patients. There is no standardization of what constitutes an aortic center, but in general, the concept encompasses a dedicated team of individuals, a relatively large referral basis of aortic pathology, training capabilities, and research to continuously assess quality and outcomes.

Several aspects should be in place for the true aortic centers of the present and future to continue to pave the way toward better, less invasive, and durable aortic procedures. First is the foundation of commitment to clinical excellence in every aortic procedure, open or endovascular, from the aortic valve to the iliac bifurcation, with selection based on what is best for the individual patient. Unquestionably, a collaborative practice including anesthesiologists, intensivists, cardiologists, medical geneticists, rheumatologists, and vascular, endovascular, and cardiovascular surgeons is key. With increasing complexity, it is almost certain that we should be prepared to deal with new failure paradigms. Only with a team-based approach and partnership between specialties will we overcome these changes. The ideal infrastructure should be in place to provide optimal perioperative support and adequate preoperative and intraoperative imaging capabilities. There is a clear need for optimization (or perhaps elimination) of radiation exposure, and leading centers should be focused on these improvements for the protection of patients, operators, trainees, and staff.

Second, early access and participation in device trials will be important. Development of new device concepts, trial design, and collaborations between industry and experienced physicians are fundamental aspects of leading aortic centers. It is logical to assume that physicians in higher-volume centers should be part of every

relevant device trial so that achieved results can be a benchmark for comparison in the future once the technology has more widespread availability.

Aortic centers should play an important role in training the new generation of aortic surgeons through exposure to a wide range of pathology, devices, and procedures. There is no question that dedicated training will be increasingly needed for open and endovascular procedures that involve a higher level of complexity. As newer devices become available to the medical community, earlier exposure during feasibility and pivotal trial phases provides trainees with insights about planning, implantation, and postoperative care.



**Miranda Witheford, MD, PhD,
FRCSC**

Complex Aortic Team
Aortic and Vascular Surgery
Royal Free NHS Foundation Trust
London, United Kingdom
miranda.witheford@nhs.net

Disclosures: None.

Aortic surgery should be a personalized team endeavor. It is a team enterprise, not simply because aortic anatomy straddles different surgical disciplines but because aortic disease itself is complicated and unforgiving. It demands flexibility in consideration of management and surgical approaches that are best embraced by cardiac and vascular surgeons, with interventionalists and medical experts such as cardiologists, nephrologists, and diabetologists contributing to patient care.

We recognize from a robust body of literature that surgeon experience, but more importantly, institutional experience, has an impact on short-term patient outcomes after many types of aortic aneurysm repair.^{1,2} Although I may have performed what I considered to be the optimal aneurysm procedure on a medically optimized patient, it must be acknowledged that the impact of my knife is significantly bolstered by the effect of excellent ongoing perioperative and long-term medical care of the aortic patient. Increasingly, we have come to understand those comorbidities that portend poor long-term outcomes in aortic aneurysm patients (eg, infrarenal abdominal aortic aneurysm, severe chronic obstructive pulmonary disease, chronic renal insufficiency, congestive heart failure) and how these might be optimized pre- and postoperatively.³ The worsening of survival post endovascular aneurysm repair (EVAR) in patients lost to follow-up likely underlines a multifactorial interaction between patient engagement in their

Finally, for aortic centers to transcend frontiers and have an exponential impact, it is paramount that there is a true academic commitment to research with the goals of better understanding processes of aortic disease, identifying superior modalities of treatment for specific patient populations, and constantly improving clinical outcomes. This can be accomplished with recurrent analysis of results and always being able to change and adapt. It is needless to say that fulfilling the highest standards in clinical practice, device design, innovation, research, and training will be limited to only a few centers worldwide—but it is clear that the impact of a successful aortic center in such format can be seen far beyond its borders.

overall medical care and the availability of opportunities for health professionals to ameliorate extra-aortic and aortic-related medical problems.⁴ How the management of medical comorbidities and long-term patient care is affected by surgeon or hospital volume (ie, the entirety of the experience of the “aortic center”) has not been fully examined and deserves further attention.^{5,6}

However, I would argue that personalized aortic medicine—the new generation of aortic care—needs to travel beyond a reflexive optimization/assessment of comorbidities pre- and postintervention. Evidence-based modeling of the combined effect of patient comorbidities and preoperative anatomy on long-term aortic aneurysm exclusion and aortic remodeling should be used for surgical decision-making, individualized postoperative surveillance, and medical management. This process equally applies to arenas of aortic disease other than aneurysms, notably to the management of aortic dissection and other acute aortic syndromes. Data delineating these anatomic, medical, and institutional relationships in aortic disease remains elusive. An example of this disconnect is with infrarenal and complex EVAR. The newer, broader surgical endovascular armamentarium has been poorly contextualized within models predicting long-term endograft durability based on preoperative anatomic and medical attributes. To bridge this divide, we need an individualized understanding of patient and graft interactions. This process will only be facilitated by innovative predictive imaging in the operating room (OR) as well as during follow-up. Optimally, predictive imaging should allow early detection, but preferably preimplantation prediction, of possible graft failure.

Attaining this understanding relies on robust surveillance coupled with an assessment of and mechanisms for tracking poor radiographic and clinical outcomes. Crucially, this is a time-dependent iterative assessment because a poor aortic outcome is far-removed from the initial intervention, and because it is not only techno-

logic migration that influences patient outcomes but equally migration of surgeon judgment. This implies that the aortic center of the future is uniquely positioned as the central coordination point for aortic patient care, research, engagement, and equally, self-reflection, reappraisal, and innovation.

1. Esce A, Medhekar A, Fleming F, et al. Increasing surgeon volume correlates with patient survival following open abdominal aortic aneurysm repair. *J Vasc Surg.* 2019;70:762-767. doi: 10.1016/j.jvs.2018.11.027

2. Landon BE, O'Malley AJ, Giles K, et al. Volume-outcome relationships and abdominal aortic aneurysm repair. *Circulation.* 2010;122:1290-1297. doi: 10.1161/CIRCULATIONAHA.110.949172

3. Mori M, Shioda K, Wang X, et al. Perioperative risk profiles and volume-outcome relationships in proximal thoracic aortic surgery. *Ann Thorac Surg.* 2018;106:1095-1104. doi: 10.1016/j.athoracsur.2018.05.081

4. Hicks CW, Zarkowsky DS, Bostock IC, et al. Endovascular aneurysm repair patients who are lost to follow-up have worse outcomes. *J Vasc Surg.* 2017;65:1625-1635. doi: 10.1016/j.jvs.2016.10.106

5. Davis FM, Albright J, Battaglia M, et al. Fenestrated repair improves perioperative outcomes but lacks a hospital volume association for complex abdominal aortic aneurysms. *J Vasc Surg.* 2021;73:417-425.e1. doi: 10.1016/j.jvs.2020.05.039

6. Scali ST, Giles KA, Kubilis P, et al. Impact of hospital volume on patient safety indicators and failure to rescue following open aortic aneurysm repair. *J Vasc Surg.* 2020;71:1135-1146.e4. doi: 10.1016/j.jvs.2019.06.194



Fiona Rohlfes, MD, PhD

German Aortic Center Hamburg
Department of Vascular Medicine
University Heart & Vascular Center
University Hospital Hamburg-
Eppendorf
Hamburg, Germany
f.rohlfes@uke.de
Disclosures: None.

The aortic center of the future represents a highly specialized place with dedicated physicians to treat all aortic pathology at a high frequency 24/7. It should offer treatment options to patients with the most challenging disease; so-called complex procedures should be considered regular operations and be done in a standardized workflow. An open group of surgeons, interventionalists, cardiovascular physicians, and anesthesiologists should be available, understanding themselves as one team to discuss aspects of the disease from different views and generate a plan including multiple-step procedures. To advance technologies, close cooperation with companies during procedures could be useful.

Hybrid ORs are crucial, with a dedicated staff including endovascular specialists or technicians to supervise the availability of materials, interact with companies on optimized delivery pathways (also in emergencies), and support in procedure-relevant technical features such

as overlay preparation. Radiation protection should also play an important role, potentially supported by expert physicists, to offer a safe environment for staff and patients in endovascular procedures. As follow-up is the key to good long-term results, there would be a need for regular outpatient clinics or other facilitated surveillance methods in those patients who are immobile. Surveillance of the patient should be considered “part of the treatment.” To advance technology and learn about diseases, research with dedicated research staff to maintain databases in an up-to-date fashion allows for further understanding of aortic pathology and innovation in therapy options.

Next to regular beds, a dedicated aortic center should be equipped with (at any time available) intensive care unit beds and CT scanners close to the OR and emergency room to facilitate transport. A quick information technology system to scan images and do stent graft planning with dedicated software is crucial inside the OR. Additionally, the establishment of a reliable referring system is mandatory and maybe (a global pandemic notwithstanding) with an international airport nearby.

A good aortic center should attract patients and physicians with quality and agreeable working conditions; it should allow younger generations to grow into this field and become new experts. Nevertheless, besides all these considerations, there remains a question about the budget. A good knowledge of business administration can be useful.



Salma El Batti, MD, PhD

Assistant Professor
Vascular Surgery Department
Hôpital Européen Georges Pompidou
Université de Paris
Paris, France
salma.el-batti@aphp.fr
Disclosures: None.

Aortic diseases represent a fascinating intellectual and technical challenge. Like all centers of excellence, an aortic center should constantly be on the lookout for the best quality of care. In my opinion, to accomplish this, four goals have to be reached in the future.

The first should be to gather a multidisciplinary and multiskilled team. Considering that aortic diseases are mostly the result of a global condition, potentially involving several segments of the vessel with knock-on effects on the entire body, aortic patients should be cared for by a network of aortic specialists. This aortic network

should include cardiac surgeons, vascular and endovascular surgeons, cardiologists, vascular specialists, and anesthesiologists. The network should also be extended to pre- and rehabilitation centers. Treatment indications have to be proposed with all available options, including endovascular, open, or robotic surgery techniques. Constant questioning about what's the best decision for each patient must discard dogmas of the past and pressure from device industry lobbying. Moreover, a regular assessment of the clinical practice is required to ensure the best quality of care.

Next, research is another essential aspect to invest in. The clinical team should be involved and work together with a local research unit. Usual fundamental research programs on aneurysmal degeneration or arterial dissection, mechanical arterial behavior with endovascular devices, or epidemiologic studies are, of course, still relevant. However, artificial intelligence in imaging for diagnosis, procedure planning and simulation, early detection of complications, and follow-up is the next step. To this

end, a strong collaboration with engineers seems mandatory to develop the imaging systems of the future for endovascular as well as open complex surgery.

The third major dimension of an aortic center should be the attractiveness for young specialists. Strong involvement in teaching and mentoring of young trainees would be the best investment to maintain the high-performance level requested to deal with aortic diseases. In return, they would bring a fresh eye on old concepts, maintaining a challenge toward innovation.

Finally, the present era of necessary social distance reminds us how much sharing is crucial. Thus, it seems archaic to consider such centers of excellence separated from each other. Sharing experience, knowledge, skills, data, processes, and protocols between centers would be a major asset to improve outcomes in aortic disease management and scientific production. The concept of an aortic network in one institution should be extended to a national and international level to overtake the unproductive competition. ■