

Prof. Jean-Pierre Becquemin, MD

The France-based vascular surgeon sheds light on ruptured aneurysm treatment, stent graft technology, and aortic centers of excellence.



How have your approaches to treating ruptured abdominal aortic aneurysms (AAAs) and thoracic aortic aneurysms changed in recent years? What is your current algorithm for open versus endovascular repair?

We started an endovascular program for ruptured aneurysms about 10 years ago. Before launching the program, we wanted to make sure that the basic requirements were up to the task. In our view, those included:

- resuscitator rooms for patients in an unstable condition
- duplex and CT imaging available without delay during the day and night
- a workstation with software that allows accurate preoperative measurements
- centerline alignment and three-dimensional reconstruction imaging available in the operating room,
- a well-equipped operating theater with C-arm imaging and a transparent mobile table, and/or an angiosuite equipped with the best quality imaging allowing three-dimensional reconstruction and fusion imaging

We wanted a room adjacent to the theater to store a large variety of catheters, wires, and stent grafts in every dimension and size, with easy access for the operating team.

Finally, a well-trained team including vascular anesthesiologists, two senior vascular surgeons, one trainee, and nurses familiar with endovascular procedures was crucial.

Obviously, we did not start out with all of these basic requirements, but over time and with an increase in the number of referred patients, we are almost there.

Our current algorithm of open versus endovascular aneurysm repair (EVAR) is the following: Patients (whether they are referred from other institutions or enter the hospital directly) usually undergo a CT scan, and we use these results to guide the treatment plan. Regardless of whether the condition is stable or unstable, if the CT scan shows that an endovascular approach is feasible, we go for it. If not, open surgery is chosen.

The main limitations of using an endovascular approach are the status of the iliac arteries (ie, too large, tortuous, or

diseased) or when the infrarenal neck is too short, large, or angulated to accommodate current stent grafts. Recently, we attempted to expand the indications to unfavorable anatomy by using a chimney or snorkel technique. In unstable patients, however, the use of endovascular clamping has also changed our strategy, and we use it in both open and endovascular repair. We recently published our technique's refinements and results, showing that we managed to reduce intraoperative mortality regardless of whether the patient was treated with open or endovascular repair.

Which technological advancements (either graft- or imaging-related) have improved your ability to effectively treat rupture?

As previously mentioned, to effectively treat rupture, an institutional policy that has all of the basic requirements available 24 hours a day is needed. The majority of current stent grafts can be used, provided that large graft sizes, limbs, or extensions are on the shelf. We sometimes mix the components of different companies in order to best fit the patient's anatomy. In terms of imaging, the latest-generation C-arm generally provides sufficient quality imaging; however, in patients with renal insufficiency or allergy to iodine, an operating room and angiosuite equipped with overlay and fusion imaging is a major benefit.

We generally prefer to use bifurcated grafts, which can be delivered percutaneously under local anesthesia. It cannot be ignored that contralateral limb catheterization may be an issue, especially in very large ruptured aneurysms. Surgeons must be ready to use a snorkel from the contralateral side or from the upper arm. When there are difficult anatomical particularities, however, aorto-uni-iliac grafts with femoral-femoral grafting may be a quicker option, but at the cost of a groin incision and its associated increased risk of infection. Finally, monitoring the pressure bladder is a useful adjunct tool for early detection and prevention of compartment syndrome. Resuscitation with fluid rather than vasopressive drugs and meshing the abdominal cavity with a VAC seem to be effective ways of reducing intestinal ischemia and the release of toxins into the general circulation, which are the major cause of postoperative pulmonary complications and hemodynamic disturbances.

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What has been learned about immediate and long-term health in the ruptured aorta after endovascular repair?

Although randomized controlled trials have so far failed to show a statistically significant benefit of endovascular repair over open surgery for ruptured AAAs, there is a trend toward reduced immediate mortality (approximately 37% for open repair vs 15%–25% for EVAR). Similarly to non-urgent EVAR, there is a reduced consumption of hospital resources with less transfusion and shorter intensive care unit and hospital stays. In surviving patients, there is also a trend toward better life expectancy, but more reinterventions are required, mostly to address endoleaks.

What are your observations regarding the durability of homemade versus manufacturer-provided branched stent grafts in your practice?

We have very few data about durability of homemade versus manufacturer-provided fenestrated or branched stent grafts. The pioneers in the technique at the Cleveland Clinic have showed very satisfying results with manufactured grafts. Bridge stents can kink, fracture, occlude, dislodge, and migrate, but these events are relatively rare. To prevent these complications, appropriate flaring of the aortic part of the bridge stent, and support of the covered

stent with a self-expandable stent is valuable. Durable results have been shown in 98% of target vessels after 10-year follow-up with the Zenith device (Cook Medical). The Anaconda fenestrated device (Vascutek, a Terumo company) also offers promising results; however, it does not have any long-term follow-up available so far. The Ventana system (Endologix, Inc.), which was very attractive in terms of its relative ease of insertion because of the preloaded renal catheter, has shown trouble due to a relative instability of the flexible aortic proximal component and renal stent fractures.

The recent experience we have with homemade grafts is very satisfying so far, and we see no reasons it should be otherwise. The grafts are an exact replica of the Cook devices, with the same sizing, planning, customization, and material. For the visceral component, we tend to use the TX2 (Cook Medical), Valiant (Medtronic), and more recently, Zenith Alpha (Cook Medical). We always reinforce the rings around the fenestrations, sew the reducing ties, and use the same bridge stents. We have not seen any occlusion or migrations so far.

One disadvantage of the surgeon-made graft is that it is customized in the operating room, which takes between 2 and 3 hours while the patient is prepared. The occupation time of the operating room is then enormously increased. We reserve this technique for urgent cases. We still have

limited experience with off-the-shelf grafts; however, they do not fit all anatomies, and we strongly believe that surgeons need to know how to customize their own graft in case it is ever a necessity. This way, the endovascular approach has the same versatility as open surgery. One further advantage of the surgeon-modified graft is that it prevents any misunderstanding of the graft configuration, which can be the case when a third person customizes the graft.

What are your opinions on the future role of aortic centers of excellence? What are the keys to success with this model and the challenges it faces?

It is a health care and a political issue. In a way, many vascular trainees are currently well trained to safely perform EVAR in standard patients. The grafts have greatly improved; they are easier to implant and more durable. To remain competent, however, practitioners have to treat a minimum number of AAAs each year. That number remains to be determined—is it 10, 30, 50? In large recruiting centers, the temptation can be to expand EVAR indications to less favorable anatomy. We all know the negative impact of using stent grafts outside the instructions for use on the rate of endoleak, migration, and ultimately, rupture.

Aortic centers of excellence are means of treating patients in a safer way. Large recruitments allow a better selection in terms of patients' needs, graft availability, and the mandatory high-quality imaging and training, postoperative surveillance, and follow up. Urgent cases, which are the most difficult to treat, obviously benefit from specialized, well-equipped centers. Complicated cases can be safely treated with a multidisciplinary approach including radiologists, cardiac surgeons, and vascular surgeons if needed. New technology can be safely tested and evaluated. High volume facilitates research and evaluation of stent grafts, strategy, and training. Open, as well as endovascular, repair can be taught efficiently to trainees.

Oncologic centers and stroke centers have proved to enhance the quality of care. Why would aortic centers not achieve this? The challenges it faces are (1) accessibility, especially for urgent cases, which is an issue when travel distances are long or when the facilities are too small; and (2) the blockage of smaller centers that will be denied access to innovation and less revenue for both the institutions and physicians. Countries such as Great Britain have succeeded in this organization, which so far seems to have dramatically improved the standard of care for AAAs in the country.

Do you believe that the rate and nature of innovation in endovascular aortic repair is slowing, keeping pace, or increasing? What factors might affect this?

The inventiveness of human beings is without limits. It is amazing to go from having one stent graft in 1990 to now having many on the market. Insufficiencies of the first device generations have been solved. The grafts are now more durable, have a lower profile, are more flexible, and have better fixation, preventing migration and thus, AAA rupture. The remaining problem of type II endoleak (the benignity of which is debated) is being solved by the Nellix (Endologix, Inc.) endovascular aneurysm sealing concept. Short- or no-necked aneurysms were a contraindication to EVAR for years, but can currently be treated with fenestrated and branched EVAR. Hypogastric arteries can be preserved with branched grafts, chimney grafting, or other tricks. Finally, the last frontier, the arch, is being crossed with aortic branched grafts, chimneys, and snorkels. Prototypes are almost ready to be delivered on the market, where no measurement will be necessary with one device fits all.

The more we learn, the more we advance toward better technology. It is obviously a market-driven factor, which, so far, increasingly benefits AAA patients due to expanded indications thanks to new graft designs. The question is, for how long? I have no answers to that question. The number of AAAs detected per year is stable and is even declining in some countries—mostly the northern European states, probably due to a healthier lifestyle, including cessation of smoking, and drugs such as statins. That may slow companies' interests in promoting research and development in this field. However, other aortic pathologies, such as dissections, need better devices in order to be efficiently treated. The ascending aorta (both aneurysms and dissections) has a bright future, and there is a lot of room for innovation.

If you were to recommend one recent article for every aortic specialist to read, which would it be?

Many articles and conferences (including our own in Paris, France [www.CACVS.org]) are of value. The latest issue of the Rutherford's Vascular Surgery textbook is to be commended. I also recommend two excellent reviews: "Aortic Dilatation in Patients With Bicuspid Aortic Valve" (*N Engl J Med.* 2014;370:1920–1929.) and "Thoracic Aortic Aneurysm and Dissection" (*J Am Coll Cardiol.* 2014;64:1725–1739.).

My final advice would be: Stay tuned. So many things happen every day, and some of them may change your practice. ■

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