EDITORIAL

Treatment of Thoracoabdominal Aortic Aneurysms in 2019: Endovascular or open repair as first line treatment?

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In the last decade, three options have emerged to treat thoracoabdominal aortic aneurysms (TAAA): (i) open repair, (ii) endovascular repair with the use of fenestrated/branched stent-grafts (F/BEVAR), and (iii) hybrid repair consisting of visceral debranching in conjunction with endovascular aneurysm exclusion with standard stent-grafts. Open repair has been considered the first line treatment for appropriate-risk patients and has benefitted with the development of adjunctive techniques such as left-left heart bypass and neuromonitoring.[1,2] Endovascular approach has expanded the treatment options, especially in patients "unfit for open repair".[3-5] Hybrid repair enjoyed great interest about 10 years ago, but results were disappointing and now seems to play a marginal role in some patients unfit for open repair and with unsuitable anatomy for endovascular repair.[6,7] Marc Schermerhorn in our opinion correctly summarized the current status of all techniques in following quote: *"The described hierarchy of treatment preferences is mostly artificial, based on the historical reliability of open repair and the investigational nature of endovascular techniques."*[8]

Ideally, a randomized controlled trial (RCT) would provide a higher degree of evidence to answer the question whether open or endovascular repair should nowadays be considered as the 1st line treatment for most TAAAs. Such an RCT is currently not available, and will unfortunately probably never become available given the inherent difficulties regarding timing (quick evolution of endovascular techniques, different level of operative skills, experience, logistics in participating centres) and inclusion criteria (only patients deemed suitable for both techniques). Despite the lack of RCTs, there are contemporary data originating mainly from observational studies that are useful to compare open with endovascular treatment of TAAA.

In a propensity matched comparison with 341 patients, two Italian groups demonstrated an early benefit of endovascular repair with reduced perioperative respiratory morbidity compared to open repair. Mid-term survival and reintervention rates between the two methods were equal.[9] A recent analysis of the nationwide German DRG data with a total of 2607 patients showed that endovascular repair was increasingly used over time (from 6% in 2005 to 76% in 2014) and is currently the 1st line treatment for TAAA in Germany.[10] Endovascular TAAA repair with F/BEVAR was associated with a significant reduction of in-hospital mortality [risk reduction (RR) 0.35, 0.24-0.51, p<0.001]. A meta-analysis of eight studies comparing endovascular (831 patients) vs open repair (2231 patients) of TAAA showed significantly lower 30-day mortality (RR: 0.63; p < 0.01), spinal cord ischemia (RR: 0.65; p = 0.05), incidence of dialysis (RR: 0.44; p = 0.01) and length of hospital stay (mean difference, 4.4 days; p < 0.01) for endovascular repair.[11] Similarly, Locham et al. in a comparative study of 879 patients (481 endovascular repair vs 398 open repair) showed a significant reduction of 30-day mortality (5% vs 15%, p<0.001) and morbidity (2-3 fold reduction for all major complications) for endovascular repair.[12] One could therefore cautiously conclude that endovascular TAAA repair provides a significant early advantage over open TAAA repair.

Searching for long-term results reveals that durability of open TAAA repair is not well-documented.[1] The long-term patency of branch grafts to the visceral and renal arteries after open TAAA repair is actually unknown. The largest available series of patients with long-term angiographic follow-up of branch grafts after open TAAA repair was published only recently, in 2017 by Kouchoukos et al. including a total of 33 patients with a follow-up of more than 5 years.[13]

Durability of branches after endovascular TAAA repair has been documented in multiple series[14-16], with the longer term outcomes being reported by the group of the Cleveland Clinic. Mastracci et al. showed in a cohort of 650 patients with follow-up duration up to 9 years that branches in F/BEVAR are durable and rarely the cause of patient death (0.46% during the whole follow-up period).[16] Most importantly, the same group showed excellent overall efficacy for F/BEVAR in the long-term, as reflected by a freedom from aortic related mortality of 98% at 8 years.[15] Similar outcomes are also seen in our series, with aortic related mortality <1% at 5 years in our updated experience with more than 350 patients treated up to now. Reinterventions mainly for branches are required in almost 20% of the patients after 5 years, but most of these reinterventions can be completed successfully by endovascular means with minimal morbidity and zero mortality. Nev-

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ertheless, we also concluded that one should be critical with patient selection, especially those at highest risk (ASA IV), as in these patients both early and late (unrelated) mortality are significantly higher.[17]

Financial costs also merit evaluation. Clearly, material costs for F/BEVAR significantly exceed those of open repair. But if one calculates the total costs and resources (materials, hospitalization including intensive care unit costs, blood transfusion costs), F/BEVAR may in the end be more cost effective than open repair. As Locham et al. recently demonstrated, F/BEVAR was almost 8,000 US dollars cheaper than open repair (mean total cost 36.612 US dollars for endovascular vs 44,355 US dollars for open, p=0.004).[12] This difference was driven by higher morbidity and longer hospitalization after open repair.

Putting all of the above together, it appears that endovascular repair of TAAA is associated with reduced perioperative mortality and morbidity and lower overall costs compared to open repair, while mid-term durability remains good provided adequate individualized surveillance. If one adds the patient's preference, which is most commonly in favor of a minimal invasive treatment, it seems reasonable to consider endovascular repair as the first line treatment for most patients with TAAAs. This statement should exclude patients with connective tissue disease and maybe some other younger patients. This treatment shift has not been officially adopted by the current guidelines yet, but F/BEVAR to treat TAAA is clearly the real-life "first choice" in many countries nowadays.

Such a shift towards "endovascular first" has resulted in growing endovascular experience in many centers worldwide. But at the same time this leads unavoidably to decreasing experience in open TAAA repair. Certainly, the number of surgeons who can perform the traditional open TAAA operation with good results is decreasing and will decrease further in the future. And this may not be without consequences especially for cases that open repair is needed to correct failures of endovascular repair.

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