



Editorial

Hybrid procedures for complex thoracoabdominal aortic aneurysms

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Although surgical repair of thoracic (TAA) and thoracoabdominal aortic aneurysms (TAAA) is an effective therapeutic option with excellent long-term results, it is also a potentially problematic procedure, owing both to the technical difficulties of aortic reconstruction and to the stress suffered by patients, who are often elderly and afflicted by multiple comorbidities [1]. Also, despite progress in operative techniques in recent years, anatomically challenging aneurysms involving visceral and renal arteries are still associated with high mortality and significant spinal-cord complications [2]. As a result, morbidity and mortality rates are still rather high, especially in patients at high risk for conventional surgical repair [1, 3].

Total endovascular aneurysm repair by branched stent-graft technology is proposed as an approach to very sick patients; nevertheless, the availability of this technology is currently limited to a handful of institutions [4, 5], and the safety, effectiveness, and durability of these techniques have yet to be fully assessed. While development of branched and fenestrated endografts has not reached a point where speed, availability and cost allow wider usage, transitional solutions are being trialed. The chimney technique is an example of a transitional technique that solves speed and availability issues, but brings additional clinical complications at much higher expense [6]. Hybrid repair consists of open surgical extra-anatomical bypasses providing a suitable landing zone and simultaneous or staged thoracic endovascular exclusion of the aneurysm; it is less invasive than open surgery in the treatment of complex aortic pathology, as it avoids thoracotomy, single-lung ventilation, aortic cross-clamping and extracorporeal perfusion [4, 7–11] and partially solves the speed, availability and cost problem. Therefore, hybrid TAAA repair is particularly advantageous in cases of previous descending thoracic aortic repair in which a revision left-sided thoracotomy may be associated with major bleeding, increased

rate of postoperative respiratory and organ failure, longer distal aortic perfusion time, longer total aortic clamping time, longer operative time, and reduced long-term survival [4, 7]. Furthermore, in few selected cases, such as patients with a frozen chest, a hybrid TAAA repair may be the only surgical treatment alternative for large pulmonary iatrogenic injuries [4], or may be a solution to reduce the paraplegia risk of extensive aortic coverage, as hybrid techniques occlude less of the spinal circulation [1] or collateral network [12].

Hybrid repair may also have some advantages over conventional open TAAA repair in cases of previous ascending aortic or arch repair, in which pericardial or proximal aortic adhesions may increase the technical challenges and risk of major bleeding at the site of inflow cannulation if a left heart bypass from the left atrium, pulmonary vein or distal aortic arch is required [4, 8]. Current thoracic or abdominal tube grafts in hybrid TAAA repairs offer optimal graft landing zones for endografts and ideal inflow sites for visceral bypasses [8].

The main disadvantage of two-stage treatment is the risk of aneurysmal rupture in the interval between the two interventions [2], but with reduced rates of paraplegia [1, 8] and invasiveness [3]. One-stage procedures provide improved graft patency and allow immediate verification of integrity [2]. The one-stage strategy has several additional advantages, one of which is related to the problem of endograft access site. An iliac or aortic approach is required in most cases, and after the retrograde visceral reconstruction, the one-stage procedure makes the femoral artery, iliac axis or infrarenal aorta promptly available for endograft insertion. The hybrid approach also provides the option of placing a wire around the aortic landing zone as a radiologic marker for one- or two-staged approaches, as well as enables direct visualization of the vascularization of abdominal organs during endograft deployment in single-stage procedures [8].

The long-term results of hybrid repair are yet another matter of concern. The safety and durability of retrograde bypass grafting in hybrid repair seems encouraging [3, 4]. Given the necessary extra-anatomic routing of visceral retrograde grafts, the overall late patency results (94% at 5 years) are favorable, with renal branch occlusion observed in 8–9.6% [8, 13].

In larger published series, despite high technical success rates (97.3–100%), perioperative death has occurred in 2.3–34.2% of cases [2, 8]; paraplegia in 3.2–12.8%; renal failure in 9.6–28.9%; bowel ischemia in 17.1%; pancreatitis in 9.6%; and endoleak in 3.2–5.2%. Aneurysm was the factor best associated with low identification of the artery of Adamkiewicz [1], whether due to the aneurysm itself or to occlusion of the vessel after aneurysm exclusion. The latter is one of the factors that explains the still-high rate of paraplegia (up to 16%, as shown in

Abbreviations: TAA, thoracic aortic aneurysm; TAAA, thoracoabdominal aortic aneurysm.

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Table 1

Results of hybrid repair for thoracoabdominal aortic aneurysms (modified from Rosset et al. [2]).

Author	Year	N	30-day mortality (%)	Paraplegia (%)	Follow-up	Patency (%)
Lee et al.	2007	17	24	0	8	96
Böckler et al.	2008	28	14	16	22	89
Chiesa et al.	2009	31	19	3	11.9	93
Quiñones-Baldrich et al.	2009	20	0	7	16.6	100
Kuratani et al.	2010	86	2	0	88.5	99
Cochennec et al.	2011	81	12	10	17	94
Hughes et al.	2012	47	9	0	19.3	97
Rosset et al.	2013	76	34	12	30	99
Di Marco et al.	2018	17	13	0	23.3	–
Overall		403	14	6	26.3	92

Table 1). Late complications included visceral graft occlusion (6.8%), endoleak (3.2%), migration (3.2%), dysphagia and regurgitation (3.2%), suggesting development of secondary achalasia [4].

Visceral aortic patch dilatation or aneurysm after conventional TAAA repair is not uncommon. It may lead to aortic rupture, and is particularly frequent in patients with connective tissue disorders, dissecting aneurysm, or prior thoracic or AAA repair. Management of this complication can be open, hybrid, or endovascular [4, 14, 15].

Hybrid treatment is appealing in high-risk patients, with pulmonary or cardiac comorbidities, or those who have undergone prior aortic surgery, especially in cases of recurrent TAAA [4, 9]. Based on a mortality rate of >30% in patients undergoing conventional open TAAA repair, some authors encourage the use of hybrid TAAA repair in preference to conventional surgery. The hybrid technique is not easy to perform, but is widely available. Careful and limited selection of patients for hybrid treatment is suggested, as it can be useful in very special cases of aneurysms involving the visceral and renal arteries when conventional surgery cannot be considered. Most of these cases have similar indications for fenestrated and branched endografts, but processing time and cost can be much higher. It is generally accepted that different services have distinct resources at their disposal, as well as singular limitations. I understand the hybrid approach as currently the best transitional technique available, although it is far from perfect and carries many complications. It will probably fall into disuse in the not-so-distant future, but still has its place – and plenty of room for improvement.

Declarations of interest

None.

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