

## Hybrid Aortic Arch Surgery for Symptomatic Aberrant Right Subclavian Artery

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### DESCRIPTION

Treatment of aortic arch surgery is highly challenging and is characterized by a steadily increasing number of indications. It is characterized by the diversity of encountered diseases (Aneurysm, Dissection, Inflammatory, Degenerative diseases) but also the tremendous development of endovascular tools. And finally, the fact that aortic arch surgery is at the boundary of several specialties (Vascular surgery, Cardiac surgery, Interventional radiology). Over the last decades stent graft has become the mainstay of descending thoracic aorta treatment [1]. However, when supra-aortic trunks are involved, complete endovascular treatment becomes much more complex and hardly compatible with emergencies. On the other hand, open surgery, if technically feasible, may be deemed to invasive for comorbid patients. This is when hybrid surgery, with its bundle of tips and tricks, may be life saving. This is illustrated in this case of aberrant right subclavian artery with Kommerell diverticulum wherein debranching of supra-aortic trunks associated with stent graft coverage of the diverticulum avoided aortic arch surgery with cardiopulmonary bypass to favor a straightforward, much less invasive hybrid procedure [2]. Being thorough on hybrid surgery for aortic arch diseases is beyond the scope of this commentary, however, below is a list of situations in which hybrid treatment may play its card right in face of complex endovascular treatment and total open aortic arch surgery.

### Thoracic aortic arch aneurysms

Hybrid repair of thoracic aortic arch aneurysms reduces the invasiveness observed with total open reconstruction. The principle is to debranch the supra-aortic vessels and place a stent graft in the newly-created proximal landing zone. The drawbacks are the possibility of endoleaks, migration and retrograde dissection consecutive to the presence of the stent graft [3,4]. The decision is based on patient fitness, anatomy and extension of the aneurysm to the descending thoracic aorta. Hybrid treatment is usually divided into three categories [5]. In type I, a bypass originates from the ascending aorta which has an adequate landing zone to receive an endograft. Type II involves

replacement of the ascending aorta with a synthetic graft from which supra-aortic vessels are debranched and that allows a sufficient proximal landing zone. Type III is reserved for extensive lesion of the arch involving the descending aorta and consists in the frozen elephant trunk procedure.

### Thoraco-abdominal aortic aneurysms

In this category of aortic aneurysms, hybrid treatment usually refers to debranching of the visceral vessels. However, hybrid treatment may also refer to sequential treatment. Growing evidence suggest that, in favorable cases, a two-stage hybrid approach may reduce significantly mortality and spinal cord ischemia. (eg type IV thoraco-abdominal open surgery followed by TEVAR or the other way around) compared to total open surgery [6]. Chronic phase, in case of aneurysmal dilatation of the dissected aorta beyond 60 mm, if total open surgery is chosen, proximal aortic cross clamping may be difficult or even perilous necessitating complete circulatory arrest with deep hypothermia which invasiveness is considerable. Hybrid surgery should then be seriously considered. It consists in more or less extensive debranching of the supra-aortic vessels through cervicotomy, followed by endograft placement during the same procedure or in a two stage procedure. Alternatively, growing experience with the use of the frozen elephant trunk technique in this indication suggest encouraging results [7].

**Type B aortic dissection:** When intimal entry tear is located immediately distal to the Left Subclavian Artery (LSCA) origin, and if a treatment is indicated in the acute phase, a hybrid approach may be highly-beneficial for the patient. It involves surgical arch debranching of the LSCA or of both LSCA and left CCA in order to create an adequate proximal landing zone, followed by endovascular stent graft placement [8].

**Type A aortic dissection:** Open surgery remains the gold standard for acute type A aortic dissection, consisting in resection of the intimal tear and replacement of the ascending aorta (even hemi-arch if required) with a synthetic graft. Later on, in case of aortic arch enlargement or distal extension of the dissection, hybrid approach may be favored over total open redo surgery to avoid the need of artificially-induced circulatory

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arrest, hypothermia and cerebral protection measures. The former graft is used as inflow source for supra-aortic vessel debranching and represents an ideal proximal landing zone for a stent graft [9].

**Others:** Hybrid treatment may be offered in other situations, that, despite being rare, emphasize their usefulness. We here provide 2 examples:

- Aortic arch aneurysm without endovascular access from below. One patient was treated in our center for a large aortic arch aneurysm with a suitable proximal landing zone on the ascending aorta. Two severe 90° angulations of the descending thoracic aorta and the visceral aorta precluded insertion of an endograft from below. We thus performed debranching of the supra-aortic vessels from the ascending aorta through median sternotomy and an ancillary bypass was used for antegrade insertion of endograft from the ascending aorta and resulted in favorable outcome.
- Hybrid thoracoabdominal aortic aneurysm repair with simultaneous revascularization of supra-aortic vessels and visceral vessels from the ascending aorta followed by stent graft treatment [10].

## CONCLUSION

In conclusion, improving treatment of complex aortic diseases represents a formidable challenge. Surgeons have to help foster development of new research and techniques among which hybrid approach has an interesting role which exact extent remains to be determined. Hybrid treatment of aortic arch diseases offers an alternative therapeutic option to invasive open surgery and complex total endovascular treatment. This option should be considered in favorable situation. However it is often reserved to urgent situations or to patient deemed unfit for open surgery explaining in part why it is associated with relatively poor outcomes. Further studies are clearly needed to evaluate the exact place of these techniques.

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