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Treatment solution by Botta *et al.*

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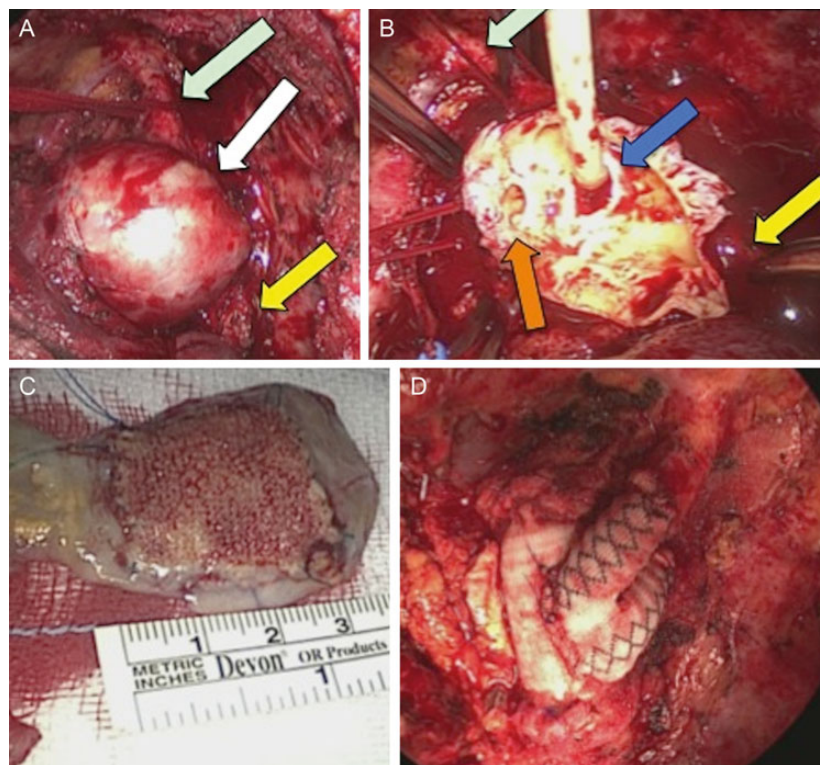
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Lifelong surveillance of repaired infantile CoA is mandatory because of possible recurrence, failure of surgical treatments and pseudoaneurysmal growth with an inherent risk of rupture and lethal outcome. Multiple technical options are nowadays available to treat a pseudoaneurysm of the aortic isthmus involving an

ARSA after previous repairs, including endovascular, conventional surgical and hybrid procedures. Despite a variety of options, several doubts can arise: would we go for an open or an endovascular approach? Is a single-stage correction or are multiple steps preferable? What is better: a first-time sternotomy or third redo left thoracotomy? Is partial or total arch repair required? What about cerebral protection? Should we close the extra-anatomical bypass or not? Many clinical features can influence the final decision: age, permanent paraplegia, previous operations and surgical accesses, the ARSA, a patent ascending-to-descending bypass, a gothic hypoplastic arch, uncertain landing zones, small but healthy femoral vessels, also keeping in mind the potential cost of the chosen procedure. We decided to treat this patient by conventional open surgery through a left thoracotomy at fifth intercostal space without cardiopulmonary bypass. Patient was positioned in the right semi-lateral decubitus. Intubation was performed by using a selective bronchial tube. Cerebral monitoring was obtained by means of continuous near-infrared spectroscopy (NIRS) and electro-encephalogram (EEG) registration. The pseudoaneurysm was isolated as well as the transverse arch and the descending thoracic aorta after careful lysis of dense pulmonary adhesions (Fig. 1A). The left carotid artery was clamped. After 2 min without NIRS and EEG changes, the left subclavian artery, the middle arch (between the carotid arteries) and the descending aorta were clamped. Perfusion of the lower body depended on the patent extra-anatomical bypass that was neither isolated nor ligated at the end of the procedure. The pseudoaneurysm was opened and a Foley catheter was inserted into the ARSA (Fig. 1B). A residual coarctation was evident close to the previous patch (Fig. 1C). Both the subclavian arteries were transected at the origin. The distal arch was enlarged by a transverse incision with exclusion of the residual coarctation. The proximal part (18 mm) of a bifurcated vascular graft (18/9 mm) was used to replace the pseudoaneurysm. The aortic clamp was moved from the arch to the prosthesis after proximal anastomosis, allowing bilateral cerebral perfusion. The remaining portion of the bifurcated graft (18/9 mm) was anastomized to the descending prosthesis using a partial clamp. The two legs were then connected in a termino-terminal fashion to the subclavian arteries (Fig. 1D). The patient was extubated after 8 h and discharged by ICU after 22 h. The postoperative course was uneventful despite a mild left pleural effusion. Discharge occurred after 8 days. Good clinical conditions were observed at 1-year follow-up.



**Figure 1:** Intraoperative view. In (A), the white arrow shows the isthmus pseudoaneurysm while the green and yellow arrows show the left subclavian artery and the descending thoracic aorta, respectively (also in B). In (B), a Foley catheter is inserted into the right aberrant subclavian artery (blue arrow) while the orange arrow shows a residual coarctation. (C) The patch previously used for aortoplasty. The straight part (18 mm) of a bifurcated graft (18/9 mm) was used to replace the pseudoaneurysm. Proximal and distal anastomoses were reinforced with external Teflon felt. The bifurcated segment was used to perform the reimplantation of both subclavian arteries as shown by the final result in (D).

## CONCLUSION

Patients with aortic coarctation can require multiple surgical procedures. Lifelong surveillance is mandatory during long-term follow-up. Recurrence of coarctation or pseudoaneurysmal evolution, particularly when associated with hypoplastic aortic arch, requires a definitive operation. A careful planning should be tailored to the single patient according to clinical and imaging features. Although multiple technical options can be adopted, conventional open redo surgery still represents an effective, durable and less expansive option.

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## Treatment solution by reader

**Endovascular treatment of aortic isthmus pseudoaneurysm involving a right aberrant subclavian artery long after multiple coarctation repairs following cervical debranching**

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Transfer of left carotid and both subclavian arteries to the right carotid artery followed by TEVAR seemed less invasive than a re-do surgery with circulatory arrest for the particular patient [1]. A temporary bypass between the right and left external

carotid arteries provides excellent cerebral protection during debranching procedure [2, 3].

The operation can be performed with regional or general anaesthesia. Bilateral common, internal and external carotid arteries are exposed through cervical incisions. The right and left subclavian arteries are dissected with supraclavicular incisions. A Y-graft is created with 8-mm ringed PTFE grafts for the debranching of the left carotid and left subclavian arteries and passed through tunnels for their destinations. Following heparinization the right subclavian artery is ligated proximal to the vertebral artery and a separate 8-mm ringed PTFE graft is anastomosed end to end to the right subclavian artery. A cross-over bypass is performed between the external carotid arteries with a 6-mm PTFE graft. The right carotid artery is clamped and the right subclavian artery debranching graft is anastomosed end to side to the right lateral surface of the right common carotid artery. The proximal end of the Y-graft is anastomosed end to side to the left lateral surface of the right common carotid artery. The clamps on the right carotid artery are removed. The left carotid artery is ligated and the short leg of the Y-graft is anastomosed end to end to the left common carotid artery. At that stage the cross-bypass between the external carotid arteries is no more needed and simply removed. The left subclavian artery is ligated proximal to the vertebral artery and the long leg of the Y-graft is anastomosed end to end to the left subclavian artery. Then, a stent graft deployed through the femoral access, or a temporary 10-mm graft anastomosed to the abdominal aorta [4] and placed beyond the right carotid artery, successfully excludes the pseudoaneurysm.

**Conflict of interest:** none declared.

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