

## **Hybrid Repair of Late Onset Pseudoaneurysm After Previous Surgical Coarctation**

### **Repair**

Running title; *Hybrid Repair of Previous Coarctation*

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### **Competing interest**

There are no financial or other relations that could lead to a conflict of interest. There are not any non-financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript. Our study was presented as a poster presentation at the 26<sup>th</sup> Annual Meeting of the Asian Society for Cardiovascular and Thoracic Surgery (24 – 27, May 2018, Moscow, Russia). This clinical report has not been previously published or submitted elsewhere for publication and will not be sent to another journal until a decision is made concerning publication by The Journal of cardiac surgery. Ethical application for this study was approved by our center ethics committee.

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## **ABSTRACT**

Hybrid repairs for pseudoaneurysms after previous surgical coarctation repair are becoming a well-accepted and widespread method especially in patients with complex aortic disease. We report two cases which performed two different hybrid repair methods for pseudoaneurysm associated with previous aortic coarctation.

*Keywords: Aortic coarctation, Pseudoaneurysm, hybrid repair, Frozen elephant trunk*

## **Introduction**

Coarctation of the aorta is a congenital malformation that has long been considered completely correctable with appropriate surgery in childhood. However, with the aging of these patients, many late onset complications have been reported such as systemic hypertension, aneurysms, recurrent coarctation, and aortic valve dysfunction [1]. The late onset pseudoaneurysms after surgical repair observed in all various methods; such as subclavian flap angioplasty (17%), patch angioplasty (14%), tube graft repair (6%), or to end-to-end anastomosis (3%) [2]. Besides high preoperative peak systolic pressure gradients and bicuspid aortic valve are predictive risk factors for the development of postsurgical pseudoaneurysm [3].

Whatever the surgical technique used in first repair, re-do open surgical repair for pseudo-aneurysms has high mortality rates [4]. However, hybrid repair has been reported as safe and effective [3]. We report two different hybrid repairs of coarctation-associated aneurysm; left carotid-subclavian bypass with thoracic endovascular aortic repair (TEVAR) and

supra-coronary aortic replacement and aorta left subclavian bypass with Open Stentgrafting. (OSG) Ethical application for this study was approved by our center ethics committee.

## CASE REPORT 1

A 35-year-old man was admitted to cardiovascular surgery clinic with dyspnea and hoarseness which started 5-6 months ago and increasing rapidly in a few days. He had a history of aortic coarctation repair by patch angioplasty 18 years ago. A computed tomography angiogram (CT-A) signified the saccular pseudoaneurysm which sized 6.5x7.5 cm placed in the aortic arch and includes left subclavian artery. The aortic arch was 21 mm and the descending aorta distal to the aneurysm was measured as 23 mm. Control echocardiogram revealed a normal tricuspid aortic valve and preserved left ventricular ejection fraction of 65%. Since the suitable 2 cm proximal landing zone for endovascular repair could be provided with left carotid-subclavian bypass, the surgical team decided to perform a hybrid arch repair.

Extra anatomic bypass was performed as bilateral carotid-subclavian bypasses using 7 no Dacron grafts through supraclavicular incisions under general anesthesia and proximal left subclavian artery was surgically ligated proximal to the left vertebral artery ostium. Then, endovascular repair from the right common femoral artery as retrograde fashion to zone 2 was performed with a 26x26x200 mm TEVAR stent-graft (Bolton Medical (Sunrise, USA), Relay® Plus). Completion angiography confirmed the correct position of endograft without evidence of endoleak. Before discharged, control CT-A was performed after the session without wasting time but no significant endoleaks were noted. He was discharged without any postoperative complications and clinical problems. He had no problems in both imaging and the 1-year follow-up. (Figure 1)

## CASE REPORT 2

A 30-year-old man was admitted to our hospital with a back pain for 3 months. He had a history of aortic coarctation repair by aorto-aortic bypass with 20-mm vascular graft 14 years ago. A saccular aortic aneurysm which sized 6,2 x 7,2 cm placed in the descending aorta that was originated from next to the orifice of the left subclavian artery was detected in CT-A. Also, he had 46 mm in proximal site of ascending aorta. The echocardiogram revealed that the left ventricular ejection fraction was %65, bicuspid aortic valve was normofunctional and ascending aorta was 45 mm. Considering the anatomical features, age and surgical risks, we decided to perform open stent grafting with the repair of the ascending aorta.

Central catheter, bilateral upper extremity arterial monitorisation, near-infrared spectroscopy and cerebrospinal fluid pressure catheter were placed. While right subclavian artery was used for arterial cannulation, venous drainage was provided by using right atrium. Vent cannula was placed from upper-right pulmonary vein. Myocardial protection was ensured with blood cardioplegia. The aortic valve was bicuspid and normo-functional without any morphological pathology. Proximal aorta repair was performed with handmade one-branched graft (28 no + 10 mm Dacron graft) in cooling phase. When nasopharyngeal temperature was 26°C, aortic clamp was removed, and bilateral antegrade selective cerebral perfusion (flow rate=10-15 mL/kg/min) was started. Then open stent grafting performed using tapered Relay NBS plus stent graft (200 mm length with proximal and distal diameters of 20 mm and 24, respectively, Bolton Medical; Sunrise, USA) to the Zone-2 via pre-placed guidewire. Stentgraft was fixed to aorta wall via interrupted U sutures at proximal of left carotid artery. Afterwards, distal anastomosis was completed with hemiarch replacement and warming was initiated. Antegrade selective cerebral perfusion time was 77 minutes. The aorta-left subclavian artery bypass was performed using previously implanted 10 no Dacron graft.

Without any postoperative complications and clinical problems, the patient was discharged. At 1 and 2-year follow-up visits, CT-A scans showed complete aneurysm exclusion and the patient was fully asymptomatic. (Figure 2)

## COMMENT

Late-term aortic pseudoaneurysm formation after surgical repair of aortic coarctation has been reported for all repair methods including patch aortoplasty, end-to-end anastomosis and prosthetic graft replacement. [2]. Pseudoaneurysm structure has a high risk of spontaneous rupture rate 31% and rupture related mortality is high consequently [4]. Redo open surgical repair has a high risk of bleeding, pulmonary complications and renal complications with high mortality [5]. Hybrid treatment can be the solution for the difficult cases including concomitant cardiac diseases and complications of re-thoracotomy.

In both cases, there are technical considerations for our choice of endovascular repair in different hybrid procedures; the length of the segment to be covered, the length of the suitable proximal landing zone and the mismatch in the proximal and distal landing zones.

The first case is a standard hybrid arch repair and a suitable proximal landing zone was created by performing an extra-anatomic bypass such as left carotid-subclavian bypass. However, Bolton Relay Plus stent-graft was specifically chosen to overcome the tortuosity of aortic arch since it is more flexible after exiting the outer primary sheath.

In the second case, a median sternotomy was required for 2 reasons: (1) the management of 4.6 cm ascending aorta of a young patient with bicuspid aortic valve and coarctation and (2) the need to create an adequate landing zone for standard TEVAR in young patients, which can only be achieved with a left carotid-subclavian bypass at a maximum of 1.1 mm, so debranching is required. Furthermore, the surgical team decided to apply supra-coronary replacement, aortoleft subclavian bypass and open stent grafting for pseudoaneurysm treatment, since OSG

has the advantage of providing fixation of the proximal side of the stent-graft even with a 1 cm suturing space.

In addition, there was a mismatch in the aortic diameter before and after the pseudoaneurysm. Both Proximalization of the stent-graft landing zone with the aorta-left subclavian bypass and placement of the tapered Relay Plus TEVAR stent graft in antegrade fashion, thereby solving the mismatch problem. The longest diameter of the standard frozen elephant trunk hybrid grafts available in the market is 150 mm long. In order to properly cover the lesion, we employed a 200 mm long stent-graft in the OSG procedure.

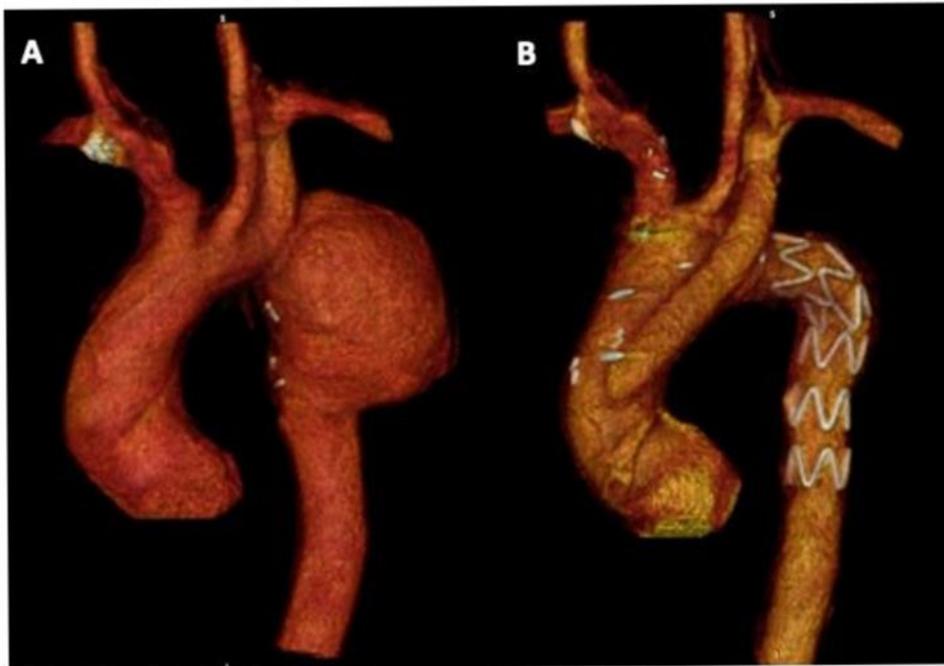
Our report shows that hybrid repair is encouraging solutions for pseudo-aneurysms following open surgery for aortic coarctation. Moreover, no matter how complex aortic pathology is, hybrid repair can be used safely with appropriate device preferences and detailed preoperative planning.

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## Figure Legends

**Figure 1;** Case 1. Volume rendering and 3D reconstruction **A)** before and **B)** 1 year after left carotid-subclavian bypass with thoracic endovascular aortic repair.



**Figure 2;** Case 2. Volume rendering and 3D reconstruction of show a pseudoaneurysm **A)** before and **B)** 2 year after supra-coronary aorta replacement, aorto-left subclavian bypass with open stent grafting.

