Case Report

Hybrid Endovascular Repair for an Arch Aneurysm Combined with Aberrant Right Subclavian Artery

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This report describes a hybrid endovascular approach to a 9.3-cm saccular aneurysm of the left sided aortic arch combined with an aberrant right subclavian artery. The two-step procedure consisted of a bilateral carotid-subclavian bypass, followed by an ascending aorta-bicarotid bypass and completed by an endovascular exclusion of the aneurysm by covering the whole aortic arch and its branches. The patient had no postoperative complications and was discharged 10 postoperative day. Hybrid procedures may be useful in complex aortic arch pathologies and may reduce postoperative complications in comparison with conventional open surgery.

Key words: aberrant right subclavian artery, TEVAR, hybrid surgery

Introduction

An aberrant right subclavian artery (ARSA) is the most common anomaly of the aortic arch. ARSA with left sided aortic arch occurs in 0.5%–2.0% of normal individuals.1) Since the 2000s, hybrid endovascular repair for thoracic aortic aneurysm has been reported and established. We present a successful hybrid repair of an arch aneurysm combined with an ARSA. The patient’s consent was obtained in this article writing.

Case Report

A 74-year-old asymptomatic man who had been under treatment for hypertension was referred to our hospital. Computed tomography showed a huge saccular aneurysm of aortic arch which was 93 mm in diameter combined with an ARSA in a left sided aortic arch (Fig. 1). The ARSA was not revealed aneurysmal change, and the ARSA arose as the fourth branch of the aortic arch and ran across the superior mediatinum posterior to the trachea and esophagus. Posterior cerebral circulation was normal, with both vertebral arteries patent.

To avoid an aortic graft replacement and cardiopulmonary bypass, the patient was offered a less invasive hybrid endovascular procedure. A landing zone distal to the right carotid artery origin was considered inadequate due to the short distance about 10 mm between the right carotid artery and the origin of the aneurysm. Therefore a more extended landing zone was chosen proximal to the right carotid artery. The procedure was concomitant with cervical debranching.

Under general anesthesia and in the supine position, the aortic arch aneurysm was exposed via median sternotomy. Because it was difficult to exteriorize left subclavian artery under median sternotomy, we gave up reconstruct left subclavian artery intrathoracically. Bilateral axillary arteries were exposed under clavicle and bilateral carotid arteries were exposed in neck incision. First we performed bilateral carotid-subclavian bypass using two 8 mm hybrid vascular grafts constructed of polyester and ePTFE named “FUSION” (MaquetVascularIntervention & Cardiac Surgery, Wayne, New Jersey, USA) which were rooted post clavicle. Second we performed cervical debranching. The ascending aorta was partially clamped to perform reconstruction of bilateral carotid artery using 12-mm × 8-mm × 8-mm InterGard knitted graft (InterVascular S.A., LaCiotat, France).

An 8F sheath was inserted through a cutdown on the right common femoral artery. A hydrophilic 0.035-inch guidewire (Terumo Medical Corp, Tokyo, Japan) was advanced into the ascending aorta, and we exchange a wire to a 0.035 inch Lunderquist double carved wire (CookEurope, Bjaeverskov, Denmark) through a pig-tail catheter. The left femoral artery was punctured, a 4F sheath was inserted, and pig-tail catheter was advanced...
into the ascending aorta for angiography. Through the right femoral access, a Conformable TAG endograft (TGU343415J; W.L. Gore & Associates, Flagstaff, Arizona, USA) was used for the distal landing zone 5 cm distal to the ARSA, followed by a second Conformable TAG (TGU404020J; W.L. Gore & Associates, USA) which was used for the proximal landing zone 1 cm distal to the carotid bypass, and the two endografts were sufficiently overlapped. We used a TRILOBE balloon (W.L. Gore & Associates, USA) to align the two grafts onto aortic wall. Then bilateral brachial arteries were punctured and 6F sheaths were inserted. From the brachial access we performed coil embolization of ARSA and LSA proximal to the vertebral artery using several Tornado embolization coils (COOK MEDICAL, Bloomington, Indiana, USA). A completion angiography showed the complete exclusion of the aneurysm without endoleaks. Wounds were closed with two chest draigns. No blood transfusion was required.

The patient had no postoperative complication and was discharged 10 postoperative day. The postoperative computed tomography angiography showed complete exclusion of the aneurysm without endoleaks and successful cervical debranching (Fig. 2).

**Discussion**

The ARSA arises as the last branch of the aortic arch and commonly it passes the superior mediastinum behind the
esophagus (80% of cases), although it passes between the esophagus and trachea (15% of cases) or anterior to the trachea (5% of cases).1,2) The ARSA alone presents rarely symptoms, typically dysphasia lusoria or dyspnea due to compression of the esophagus or trachea. There is little indication for surgery on an asymptomatic or nonaneurysmal ARSA (aneurysmal change of ARSA is so called Kommerell diverticulum).3) Although the patient of the present case had no indication for surgery on an ARSA, he had an indication for surgery on an arch aneurysm.

There are many reports published on ARSA with an aneurysm, particularly Kommerell diverticulum.4,5) However, an ARSA combined with an aortic aneurysm is rare.3) In a similar way, there are some reports describing hybrid endovascular repair of a Kommerell diverticulum,6,7) few reports describe hybrid endovascular repair of an ARSA combined with an aortic aneurysm. Cardiopulmonary bypass and hypothermic circulatory arrest must be used for conventional open surgery for an arch aneurysm, and there is the problem for secure cerebral perfusion in the case of aortic aneurysm with an ARSA.8) The hybrid procedure can avoid cardiopulmonary bypass, thus, this method may be useful in complex aortic arch pathologies and may reduce postoperative complications in comparison with conventional open surgery.

A previous report suggested that the ARSA should be reconstructed to prevent ischemic complications in the upper limbs or verteobasilar area.3) Furthermore, the ARSA has the possibility of future aneurysmal dilatation of the orifice and potential high risk for rupture.9) Thus, we performed right carotid-subclavian bypass and coil embolization of the ARSA proximal to the vertebral artery after TEVAR procedure to achieve complete thrombization of the ARSA.

We applied the past reported hybrid procedure for Kommerell diverticulum (involving elephant trunk with endovascular completion, frozen elephant trunk, or stent grafting with cervical debranching) to practical situation of this case.6,7) However we were compelled to do median sternotomy, we could achieve adequate proximal landing zone and anatomical reconstruction of carotid arteries without cardiopulmonary bypass and hypothermic circulatory arrest.

On another front, Gafoor S et al. reported a case of Kommerell diverticulum treated with a fully percutaneous procedure using a custom-made fenestrated endovascular graft under local anesthesia.10) Their procedure may be the minimum invasive method among every conceivable procedures at this time, however, the long term outcome is unclear as is the case with hybrid procedures. In addition, the custom-made fenestrated devices are not covered by insurance at present in Japan, our hybrid procedure has the potential to be a transient valuable alternative technique compared with open surgery.

**Conclusion**

This report describes a case of hybrid endovascular repair for an arch aneurysm combined with aberrant right subclavian artery, consisting of a total aortic debranching and endovascular aneurysm exclusion. Although long-term and careful follow-up must be needed, this method represents a valuable alternative and may help reduce complications and mortality in comparison with conventional open surgery.

**Disclosure Statement**

The authors declare no conflict of interest.

**References**