A 57-year-old man has 20-year history of hypertension presented with intermittent chronic pain in the chest area and shoulder blades over the last three months. Computed tomographic angiography (CTA) on admission revealed a chronic type B aortic dissection (TBAD) with an aberrant right subclavian artery (ARSA) crossed behind the trachea and bovine aortic arch (Figure 1B). The ARSA, that’s a Kommerell’s diverticulum (KD) (Figure 1A), originated from the posterior wall of the aortic arch nearly at the same level of the orifice of the left subclavian artery (LSA) based on a 3D reconstruction (Figure 1). The diameter of the ARSA was 2.2 cm at the orifice and 1.1 cm at the distal end.
5 cm from the site of origination. The right vertebral artery arose from the ARSA, and the primary tear was located at the side of greater curvature, 2 cm distal to the orifice of the LSA; the aortic dissection was retrograde to the margin of the LSA. The celiac artery and left renal artery originated from the false lumen, whereas the superior mesenteric artery and right renal artery arose from the true lumen. However, the dissection did not extend into the infra-renal abdominal aorta and bilateral common iliac arteries. The maximum diameter of the thoracic aortic dissection was 5.5 cm, which conformed to the surgical indications for reducing the risk of aortic rupture. Thoracic endovascular aortic repair (TEVAR) was the preferred surgical intervention for less invasive and preferred long-term outcomes.

The procedure was performed under general anesthesia in a hybrid operation room. Initially, a 5-F angiographic pigtail catheter with a calibration was inserted into the ascending aorta under fluoroscopic guidance via the left brachial artery, and angiography with Iodixanol contrast agent (GE Healthcare, Ireland) was performed to identify the proximal primary tear, the diameter at the relevant segments of the aorta, and ARSA consistent with the CTA measurement. Afterwards, 6-F and 14-F sheath were inserted percutaneously into the right brachial artery and femoral artery, respectively. A multifunctional catheter, combined with a guidewire, was introduced through the true lumen from the right brachial artery to the right femoral artery and it was exteriorized via a 14-F sheath in the femoral artery. Another pigtail catheter combined with a guidewire were introduced through the true lumen from the femoral artery to the ascending aorta and exchanged for a Lunderquist super stiff guidewire (William Cook Europe, Bjaeverskov, Denmark). The guidewire was removed and the traction wire on the side of the castor stent graft was threaded through a multifunctional catheter and exteriorized from the right brachial artery. A 363010-2003005 caster branch aortic stent graft (Microport Medical, Shanghai, China) was passed along the stiff guidewire and implanted into the ARSA, which overlapped 2 cm with the branch stent. Immediate aortography was performed and showed complete exclusion of the dissection with no endoleak and good branch stent patency.

After the patient was discharged, Aspirin (100 mg/per day) was given and no signs of discomfort were noted during follow-up. CTA was performed 12 months after TEVAR, which confirmed the patency of the ARSA (Figure 2A), no endoleak, thrombosis and shrinkage of the false lumen (Figure 2B).

ARSA is a common congenital variant of the aortic arch with the prevalence of 0.4%–2.0%, 60% of patients with an ARSA undergo aesuymal dilatation, known as KD, which may increase risk of rupture or dissection, as in the present case. There are rare cases of aortic dissection combined with KD, and the reason for this combination remains unknown. Karen, et al. believed that the medial degeneration or necrosis in the aortic wall of the KD was associated with the risk of aortic dissection and rupture from pathologic examination on resected specimens.

Owing to the deficiency of large series in published studies, there is no consensus on the optimal treatment strategy for TBAD with ARSA. TEVAR, compared to conventional open surgery, is the preferred choice for favorable outcomes according to recent articles, but it also faces challenges in maintaining perfusion to the right upper extremity and posterior cerebral circulation. Although several cases were free from ischemia in the right upper extremity and posterior cerebral circulation after ARSA occlusion without revascularization. However, just as covering LSA increased the risk of stroke, this phenomenon could also be seen in covering ARSA without reconstruction. To prevent this ischemia, reconstruction ARSA is necessary in some situations, such as dominant right vertebral artery, right arm arteriovenous fistula and abnormal origin of the right vertebral artery.

Several effective approaches have been performed to reconstruct ARSA, including subclavian to carotid transposition, anatomical external bypass, fenestration, parallel graft technique. Transposition was common in pediatric patients with KD who accepted KD resection and performed subclavian to carotid transposition simultaneously. For adult patients, reconstruction of the ARSA was conducted
more via cervical anatomical external bypass regardless of the operation procedures in graft replacement or hybrid endovascular repair. Furthermore, Gafoor, et al.\(^8\) reported a case with an ARSA aneurysm performed via totally endovascular repair reconstruction of the ARSA and LSA via fenestration procedure in high surgical risk patient. Silveira, et al.\(^11\) also reported that a customized branched device was deployed to perform a totally endovascular repair aberrant left subclavian artery with KD. In some emergency situations, parallel stent technique, a simplified endovascular procedure, has been applied to reconstruct an ARSA in patient suffering from TBAD.\(^5,10\)

To sum up, we introduced a new total endovascular procedure to treat a TBAD with ARSA by using a caster branch aortic stent-graft and in situ reconstruction of the ARSA. This device was the first domestic unibody branch aortic stent-graft and it has been approved by the Chinese Food and Drug Administration. The unibody design could also prevent proximal endoleak and long-term migration of the branch graft. Furthermore, the positive early results of caster branch aortic stent-graft-repaired TBAD and reconstructed LSA have been published.\(^12\) In this study, the caster device successfully repaired the TBAD and allowed for in situ reconstruction of the ARSA without covering other supra-arch branches. We believe that this total endovascular procedure is safe and feasible for this complex aortic arch pathology, keeping ARSA patency without risk of arm claudication and ischemic stroke. In the future, we hope that the caster branched device will be applied to more complex aortic arch pathologies and guarantee better long-term results.

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Figure 2. Postoperative computed tomographic angiography follow-up findings. Three-dimensional CTA scan shows (A) the patency of the ARSA (yellow arrow head); and (B) full thrombosis in the false lumen (green arrow head).
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