

A new inclusion technique through an upper partial sternotomy for complicated Stanford B-type aortic dissection with an aberrant right subclavian artery

A case report

Maoxun Huang, MD, Hulin Piao, MD, Bo Li, MD, Yong Wang, MD, Tiance Wang, MD, Zhicheng Zhu, MD, Dan Li, MD, Kexiang Liu, MD, PhD*

Abstract

Rationale: An aberrant right subclavian artery (ARSA), arising from the proximal descending aorta, is a common aortic arch anomaly, with an incidence of 0.5% to 2%. However, coexistence of dissection and an ARSA is extremely rare. We presented the first case of successful management of complicated Stanford B-type aortic dissection combined with an ARSA with a new inclusion technique and stent graft (SG) implantation through an upper partial sternotomy.

Patient concerns: A 39-year-old woman with a history of severe hypertension was admitted to our hospital because of sudden-onset chest and upper back pain.

Diagnoses: Aortic computed tomography angiography (CTA) demonstrated complicated Stanford B-type dissection with ARSA.

Interventions: A new inclusion technique and SG implantation through an upper partial sternotomy were performed for the patient, whose aortic arch branch vessels, including ARSA, were fully preserved.

Outcomes: The patient had an uneventful postoperative course without neurologic deficits, and no blood transfusion was required during the hospitalization. The false lumen completely disappeared on postoperative CTA.

Lessons: This new inclusion technique through an upper partial sternotomy is a safe and feasible treatment for complicated Stanford B-type aortic dissection with an ARSA with the primary tear located in the aortic arch.

Abbreviations: CTA = computed tomography angiography, ARSA = aberrant right subclavian artery, RCCA = right common carotid artery, LSA = left subclavian artery, LCCA = left common carotid artery, SG = stent graft, AA = ascending aorta.

Keywords: aberrant right subclavian artery, inclusion technique, upper partial sternotomy

1. Introduction

An ARSA, arising from the proximal descending aorta, is a common aortic arch anomaly, with an incidence of 0.5% to 2%. However, coexistence of dissection and an ARSA is extremely rare.^[1] If left untreated, it could lead to aortic rupture and death. Several methods have been used to manage this condition, including endovascular repair, open surgery, and a hybrid technique.^[2] Clinically, there is no standard treatment for

complicated Stanford type B aortic dissection with an ARSA owing to the limited number of reported cases, especially those with the primary tear located in the aortic arch; only 1 case was reported in literature.^[2] The patient underwent stented elephant trunk procedure and transposition of the ARSA to the right common carotid artery (RCCA) and the left subclavian artery (LSA) to the left common carotid artery (LCCA). For those with the primary tear located in the proximal descending aorta, endovascular repair or hybrid procedure is an available surgical method.^[3,4] We herein presented the first case of successful management of complicated Stanford B-type aortic dissection combined with an ARSA with a new inclusion technique and SG implantation through an upper partial sternotomy.

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Department of Cardiovascular Surgery, Second Hospital of Jilin University, Changchun, Jilin, China.

* Correspondence: Kexiang Liu, Department of Cardiovascular Surgery, Second Hospital of Jilin University, Changchun, Jilin 130041, China (e-mail: kxliu64@hotmail.com).

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2. Case presentation

This case report is a retrospective observation of a patient. Therefore, ethical approval was not needed. Informed written consent was obtained from the patient for publication of this case report and accompanying images. A 39-year-old woman with a history of severe hypertension was admitted to our hospital because of sudden-onset chest and upper back pain. Her CTA showed an ARSA located in the aortic arch posterolaterally, a tear site located distal to the LSA ostium, and a dissection extending to the left iliac common artery (Fig. 1A and B). Upon

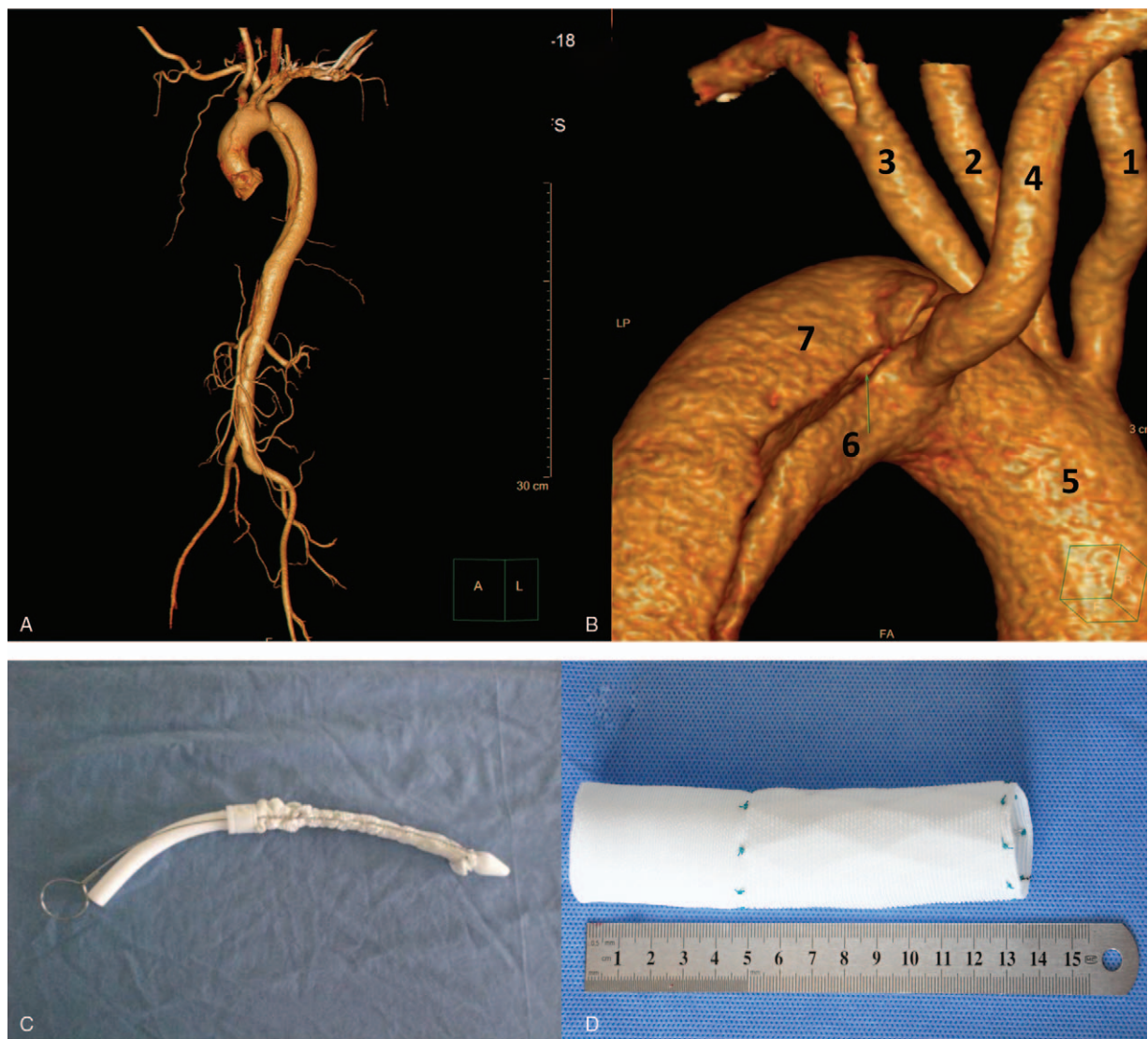


Figure 1. Preoperative computed tomographic angiogram (1: RCCA; 2: LCCA; 3: LSA; 4: ARSA; 5: AA; 6: true lumen; 7: false lumen) A: The dissection extends from the aortic arch to the left iliac common artery (anterior view); B: An ARSA located in the aortic arch posterolaterally, and the tear site is located distal to the LSA ostium (posterior view). Modified stent graft (SG): C: compacted; D: released.

admission, she was administered nicardipine intravenously to control hypertension, and beta-blockers to reduce cardiac contractility. After 2 weeks, CTA was repeated, showing similar results. Given that the proximal tear was large and the primary tear was located between the LSA and ARSA ostia, a surgical procedure was performed.

The conventional SG Cronus (Microport Medical Co. Ltd, Shanghai, China) has a 10 mm long stent-free vascular graft at the proximal end. Our modified SG consists of a 10 cm self-expandable metallic SG and a 5 cm Dacron stent-free vascular graft at the proximal end which is enough to place inside aortic arch for inclusion repair (Fig. 1C and D).

A cooling blanket was applied to the patient's back after induction of general anesthesia. The patient underwent an upper J mini-sternotomy (up to the right 4th intercostal space). Cardiopulmonary bypass was initiated via cannulation of the RCCA, right femoral artery and vein, and superior vena cava. Left heart venting was achieved through a right superior pulmonary vein cannulation. The ascending aorta (AA) was

cross-clamped, and cold blood cardioplegia was infused through the aortic root. Circulatory arrest was initiated when the rectal temperature reached 28°C. After transverse incision of the aortic arch wall, antegrade selective cerebral perfusion was started via the RCCA and LCCA cannulation. Since the ARSA was too deep, a balloon catheter was inserted into the ARSA to block it. The 2 cm long tear was located distal to the LSA ostium and above the ARSA (Fig. 2A and B). The incision was closed using 4-0 Prolene mattress sutures with felt (Fig. 2C and D). A 26 mm diameter SG was advanced into the true lumen of the descending aorta and was released once the proximal side of the SG was distal to the lower side of ARSA orifice. Then, the stent-free vascular graft was pulled back into the aortic arch and trimmed into an elliptical shape to avoid blocking the ARSA ostium. Subsequently, the vascular graft was sutured with aortic wall at the lower margin of the ARSA orifice using a 5-0 Prolene double-armed suture to fix the vascular graft into the aortic wall. Thereafter, 1 needle of the abovementioned suture string was picked to suture on the lower side of the trimmed vascular graft to the posterior aortic wall,

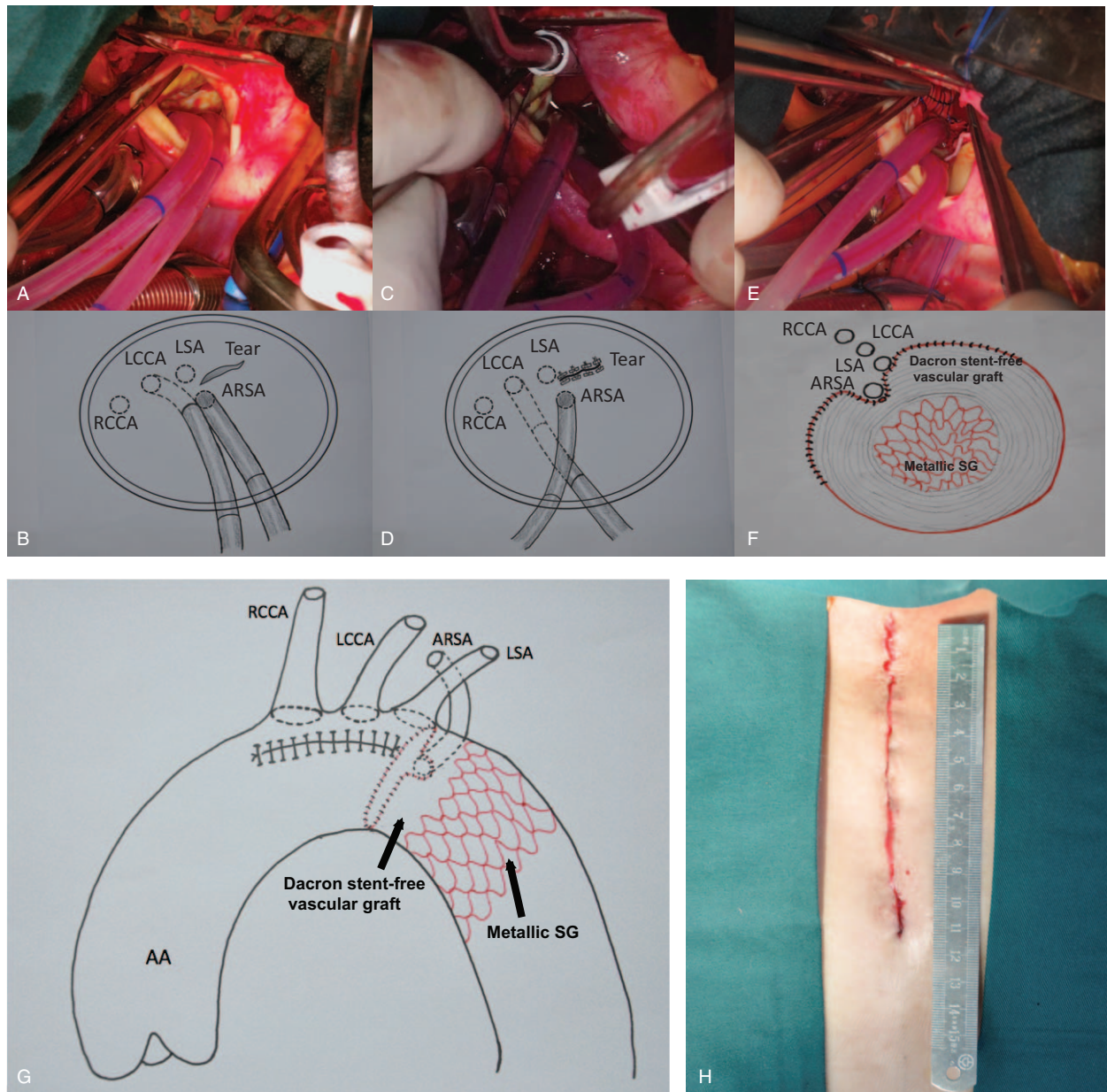


Figure 2. Intraoperative pictures (1: superior vena cava; 2: ARSA; 3: LCCA; 4: RCCA; 5: AA): A: The black arrow represents the primary tear; C: Suturing the tear using 4-0 Prolene mattress sutures with felt; E: The neo-aortic arch: stent graft (SG) is inserted into the true lumen of the distal aorta, trimmed into an elliptical shape, and the trimmed vascular graft is sutured to the aortic wall. Schematic diagram: B, D, and F: correspond to A, C, and E; G: The neo-aortic arch from the anterior view; H: skin incision.

with a continuous suture passing through the vascular graft and aortic wall as deep as possible. The other needle of the suture string was used to suture the upper side of the trimmed vascular graft with the anterior aortic wall (Fig. 2E and F). Suturing started from inside of the aortic wall to outside, then back to inside, through all layers of the aortic wall and vascular graft. After the aortic arch incision was closed (Fig. 2G), the surgical procedure was performed in the usual manner. The skin incision was only 11 cm long (Fig. 2H). The circulatory arrest, cross-clamping, and cardiopulmonary bypass times were 28, 34, and 73 minutes, respectively. The drainage during the first 24 hours was only 125 mL, and no blood transfusion was required during the hospitalization.

The postoperative course was uneventful without neurologic deficits. The false lumen completely disappeared on postoperative CTA at the 16-month follow-up. (Fig. 3A and B).

3. Discussion

The common aortic arch branching vessels consist of the brachiocephalic trunk, LCCA, and LSA. ARSA, arising directly from the descending thoracic aorta, is a congenital variant of the aortic arch. It was first described by Hunauld in 1735 and with an incidence of 0.5% to 2%.^[5] Patients with ARSA are usually asymptomatic, but it carries the risk of aneurysmal dilatation and dissection. However, coexistence of dissection and an ARSA is



Figure 3. Postoperative computed tomography: A, anterior view; B, posterior view.

extremely rare. An ARSA significantly increases the surgical difficulty and adds risks to the surgical treatment of type B dissection. Conventional open surgery for this anomaly involves replacement of the affected aorta proximal to the origin of the ARSA with preservation of the ARSA and repair of the diseased aortic lesion after revascularization of the ARSA via a median sternotomy.

In our case, the primary tear was located in the aortic arch. To perform endovascular treatment, the ARSA and LSA should be occluded to achieve a sufficient anchorage zone and transposition or the bypass procedure is necessary. However, endoleak may occur and the grafts may be non-patent, affecting the long-term survival of patients. Therefore, we designed a new open surgery that included the inclusion technique and SG implantation through an upper partial sternotomy to manage this condition. We selected the appropriate SG according to the diameter of proximal descending aorta. Then pulled back the stent-free vascular graft into the aortic arch and trimmed into an elliptical shape to avoid blocking the ARSA ostium. Subsequently, sutured the vascular graft with the aortic wall. The whole procedure was carried out endoluminally, extensive disassociation can be avoided. So, our method will be less invasive and chances of nerve injury during disassociation will be significantly reduced. In addition, our procedure can be repaired in a one-stage procedure, and we do not need to perform bypass procedure, thereby simplifying distal anastomosis, avoiding potential graft-related complications, and reducing intraoperative bleeding.

A minimally invasive procedure has been reported for aortic valve or aortic root replacement.^[6] In addition, El-Sayed Ahmad A and associates reported that the minimally invasive approach for aortic arch surgery employing the frozen elephant trunk technique showed benefits like improved postoperative stability of the sternum, cosmetic results, less pain, and reduced bleeding

complications, transfusion requirements compared to conventional surgery. Furthermore, this minimally invasive procedure does not add to the complexity of the surgery, and the operative times are comparable with conventional full sternotomy.^[7] In our case, we performed a minimally invasive procedure through an upper partial sternotomy (up to the right 4th intercostal space) to treat aortic dissection and achieved satisfactory results. The patient was mobilized on postoperative day 3, and no blood transfusion was required during the hospitalization.

We believe that this new incision technique through an upper partial sternotomy is a safe and feasible treatment for complicated Stanford B-type aortic dissection with an ARSA with the primary tear located in the aortic arch.

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Author contributions

Conceptualization: Mao Xun Huang, Hu Lin Piao, Zhi Cheng Zhu, Dan Li, Kexiang Liu.

Data curation: Mao Xun Huang, Hu Lin Piao, Dan Li, Kexiang Liu.

Formal analysis: Mao Xun Huang, Hu Lin Piao, Yong Wang, Kexiang Liu.

Investigation: Mao Xun Huang, Bo Li, Yong Wang, Zhi Cheng Zhu.

Methodology: Mao Xun Huang, Yong Wang, Zhi Cheng Zhu, Kexiang Liu.

Project administration: Mao Xun Huang, Yong Wang, Tian Ce Wang, Zhi Cheng Zhu, Kexiang Liu.

Resources: Mao Xun Huang, Yong Wang, Tian Ce Wang, Zhi Cheng Zhu, Kexiang Liu.

Software: Mao Xun Huang, Tian Ce Wang.

Supervision: Mao Xun Huang, Bo Li, Tian Ce Wang, Kexiang Liu.

Validation: Bo Li, Tian Ce Wang, Kexiang Liu.

Visualization: Mao Xun Huang, Tian Ce Wang, Kexiang Liu.

Writing – original draft: Mao Xun Huang, Kexiang Liu.

Writing – review & editing: Mao Xun Huang, Kexiang Liu.

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