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Endovascular Repair of Type A Aortic Dissection: Secondary Superselective Cannulation of the Innominate Artery

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Case Report

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Abstract

Objective

Type A aortic dissection (TAAD) is a life-threatening cardiovascular emergency with extremely high mortality. Emergency open surgery remains the standard treatment, but a subset of high-risk patients cannot tolerate conventional procedures. This case aimed to highlight the necessity of multiplanar fluoroscopic verification during fenestration cannulation in endovascular repair of TAAD.

Methods

A 76-year-old male was diagnosed with DeBakey type II(Stanford A) aortic dissection, accompanied by marked false lumen dilation and pericardial effusion, with an American Society of Anesthesiologists (ASA) class IV. After multidisciplinary discussion, total endovascular repair of the aortic arch with three supra-aortic branches was performed under local anesthesia using a physician-modified endograft (PMEG).

Results

During innominate artery reconstruction, the guidewire and bridging stent appeared to pass the fenestration successfully under lateral fluoroscopy alone, but the bridging stent was finally misplaced between the main stent-graft and the vessel wall. Under multiplanar fluoroscopic guidance, secondary superselective cannulation of the innominate artery fenestration and bridging stent implantation were completed smoothly. Six-month follow-up confirmed favorable aortic remodeling and patent branch vessels.

Conclusion

Single-angle fluoroscopy is prone to visual misinterpretation and may lead to false confirmation of successful fenestration cannulation. Multiplanar fluoroscopic verification is strongly recommended during selective fenestration cannulation to prevent technical failure and severe complications.

Introduction

TAAD is a life-threatening cardiovascular emergency, with a reported 24-hour mortality rate of up to 50% without urgent surgical intervention. Consequently, emergency open surgery is recommended for Stanford type A or DeBakey type I/II dissections.[1,2] Due to the anatomical complexity of the ascending aorta, the application of endovascular techniques in TAAD has long been limited, with only sporadic reports of thoracic endovascular aortic repair (TEVAR) in highly selected patients.[3]

In recent years, advances in endovascular devices and imaging guidance have enabled minimally invasive approaches to demonstrate potential survival benefits in TAAD patients who are at high surgical risk or unable to tolerate open surgery.[4,5]Patients with advanced age, ASA class IV, heart failure, and pericardial effusion constitute the absolute contraindication population for standard open surgery, which serves as the core clinical entry point of this case. Importantly, the present case fills the clinical warning gap regarding fenestration cannulation failure induced by single-angle fluoroscopic misinterpretation in endovascular repair of TAAD.

Herein, we report a case of TAAD treated with total endovascular reconstruction of the aortic arch and its three supra-aortic branches. This case highlights that single-angle fluoroscopy is prone to visual misinterpretation and may lead to false cannulation of the fenestration, with potentially catastrophic outcomes. This case report aims to emphasize the necessity of multiplanar fluoroscopy during fenestration cannulation for aortic arch reconstruction, thereby preventing severe complications caused by single-plane visual error. Multiplanar fluoroscopic verification and accurate three-dimensional orientation of the stent-graft are therefore crucial during selective fenestration cannulation.

Case Presentation

A 76-year-old male presented with one week of exertional chest tightness and dyspnea. He had stage 3 hypertension (very high risk) and was found to have moderate pericardial effusion with a high risk of impending cardiac tamponade. An elevated D-dimer level supported the diagnosis of acute aortic dissection. Computed tomography angiography (CTA) revealed DeBakey type II(Stanford A) aortic dissection (Fig. 1A), with a large primary entry tear and a low-density linear intimal flap on the anterior wall of the ascending aorta and arch (Fig. 1B). The maximum diameter of the ascending aorta was 68.1 mm (Fig. 1C), accompanied by pericardial effusion. Despite medical therapy including diuretics and antihypertensive agents, the patient's cardiac function and symptoms did not improve.

After multidisciplinary consultation involving cardiac surgery, cardiology, pulmonology, and anesthesiology, preoperative risk assessment demonstrated an ASA class IV and a Revised Cardiac Risk Index (RCRI) score of 2, indicating prohibitive risk for general anesthesia. Given the patient's condition and family preference, endovascular repair was performed under local anesthesia. The patient provided written informed consent for treatment and publication.

The procedure was performed under local anesthesia. Bilateral brachial arteries were accessed retrogradely with 11F sheaths. The right common femoral artery was accessed using the Seldinger technique, with two pre-closure devices deployed before insertion of a 10F sheath. The left common carotid artery was accessed with one pre-closure device and an 11F sheath. Based on precise preoperative CTA three-dimensional measurements of the distance between the entry tear and supra-aortic branches, true lumen diameter, and vessel tortuosity, a physician-modified endograft (PMEG) with pre-fenestrations (TAA4236B200, Ankura™, Lifetech, Shenzhen, China) was customized. Radiopaque rings were sutured around the fenestrations to enhance intraoperative visualization. The device was

delivered via the femoral artery into the ascending aorta, followed by deployment of a covered stent-graft (TAA3834B120). Angiography confirmed successful exclusion of the entry tear and restoration of true lumen flow. A guidewire and catheter were introduced through the right brachial sheath and appeared to successfully cannulate the innominate artery fenestration under single-plane lateral fluoroscopy alone (Fig. 2A). An FVL12060 bridging stent was advanced; however, during deployment, it was noted that the stent was malpositioned in the gap between the main aortic stent-graft and the aortic wall. The stent was withdrawn and fully deployed within the innominate artery (Fig. 2B). Subsequently, precise repositioning was performed under multiplanar (anteroposterior and lateral) fluoroscopic guidance. Secondary superselective cannulation of the innominate artery fenestration was achieved. After confirmation, an FVL14040 bridging stent was delivered via a through-and-through wire established between the right brachial and femoral arteries, successfully reconstructing the innominate artery. Using the same technique, an FVL10060 stent was placed in the left common carotid artery and an FVL14040 stent in the left subclavian artery, ensuring patency of all branches.

Final multiplanar angiography confirmed complete exclusion of the aortic entry tear, absence of endoleak, complete isolation of the dissection, and patent supra-aortic branches without stent migration or kinking (Fig. 2C). All access sites were closed with vascular closure devices and compression.

The patient received 3,500 units of Bemiparin sodium injection subcutaneously twice daily for anticoagulation therapy postoperatively. The patient was assigned Level II nursing care, underwent continuous ECG monitoring, had vital signs closely monitored, and had 24-hour fluid intake and output strictly recorded to maintain hemodynamic stability. The patient experienced no postoperative complications such as spinal cord ischemia, stroke, or thrombosis. Pericardial effusion decreased, cardiac function improved, and symptoms were significantly relieved. The patient was discharged on postoperative day 12. At six-month follow-up, the patient achieved optimal blood pressure control with standardized antihypertensive therapy. Patient remained completely asymptomatic, with no recurrence of chest tightness, dyspnea, or exertional intolerance. Cardiac function was significantly improved, with NYHA functional class restored to Class I, CTA demonstrated satisfactory remodeling of the ascending aorta (Fig. 3A), with all reconstructed branch vessels remaining patent and no evidence of stent migration or endoleak (Fig. 3B). The patient reported no discomfort.

Clinical evaluation (symptoms, blood pressure, cardiac function) and aortic CTA are scheduled at 1, 3, and 5 years postoperatively to monitor stent durability, aortic remodeling, branch patency, and late complications.

Discussion

Accurate alignment of fenestrations remains a central technical challenge in endovascular aortic repair, directly affecting procedural success and long-term outcomes.[6] In this case, reliance on single-plane lateral fluoroscopy caused visual misinterpretation, although the guidewire appeared to be successfully cannulated into the fenestration during the initial attempt, the lack of multiplanar fluoroscopic

verification resulted in significant spatial misalignment. This observation underscores the risk of severe visual misinterpretation when relying solely on single-plane fluoroscopy during complex endovascular procedures. Our experience suggests that even when initial misalignment occurs, safe and reliable vascular reconstruction can still be achieved through meticulous multiplanar imaging verification or adjunctive techniques such as balloon pre-dilation to confirm true fenestration access.

With the advancement of endovascular treatment for complex aortic diseases, multimodal imaging guidance has become increasingly important in TAAD interventions. Integration of transesophageal echocardiography (TEE), intracardiac echocardiography (ICE), intravascular ultrasound (IVUS), and angiography can provide comprehensive three-dimensional spatial information prior to stent deployment, significantly improving procedural accuracy while potentially reducing radiation exposure.[7–10] Future developments should focus on establishing standardized three-dimensional imaging assessment protocols to further optimize outcomes in complex endovascular aortic repair.

Conclusion

Single-angle fluoroscopic assessment has substantial limitations in complex endovascular aortic arch repair, as it easily causes spatial misjudgment and a false impression of successful fenestration cannulation, which may result in catastrophic technical errors and clinical adverse events. For supra-aortic branch reconstruction using fenestration techniques, multiplanar fluoroscopic verification combined with real-time three-dimensional imaging assessment can effectively ensure accurate fenestration alignment, improve procedural safety and success rate. This case provides a key clinical reminder that multiplanar imaging guidance should be routinely adopted in endovascular repair of high-risk TAAD to avoid intraoperative misoperation and optimize short- and long-term outcomes.

Declarations

Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of The First Hospital of Lanzhou University [LDYYLL2025-293].

Consent to participate

The patient provided written informed consent for publication.

Consent for Publication

Written informed consent for publication was obtained from all patients whose images or clinical information are included in this article.

Declaration of Conflicting Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contribution

Zuyue Huang wrote the main manuscript text. Xiaojun Shu, Yingxin Tan, and Yonglong Wang prepared Figures 1-3. All authors reviewed the manuscript.

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Figures

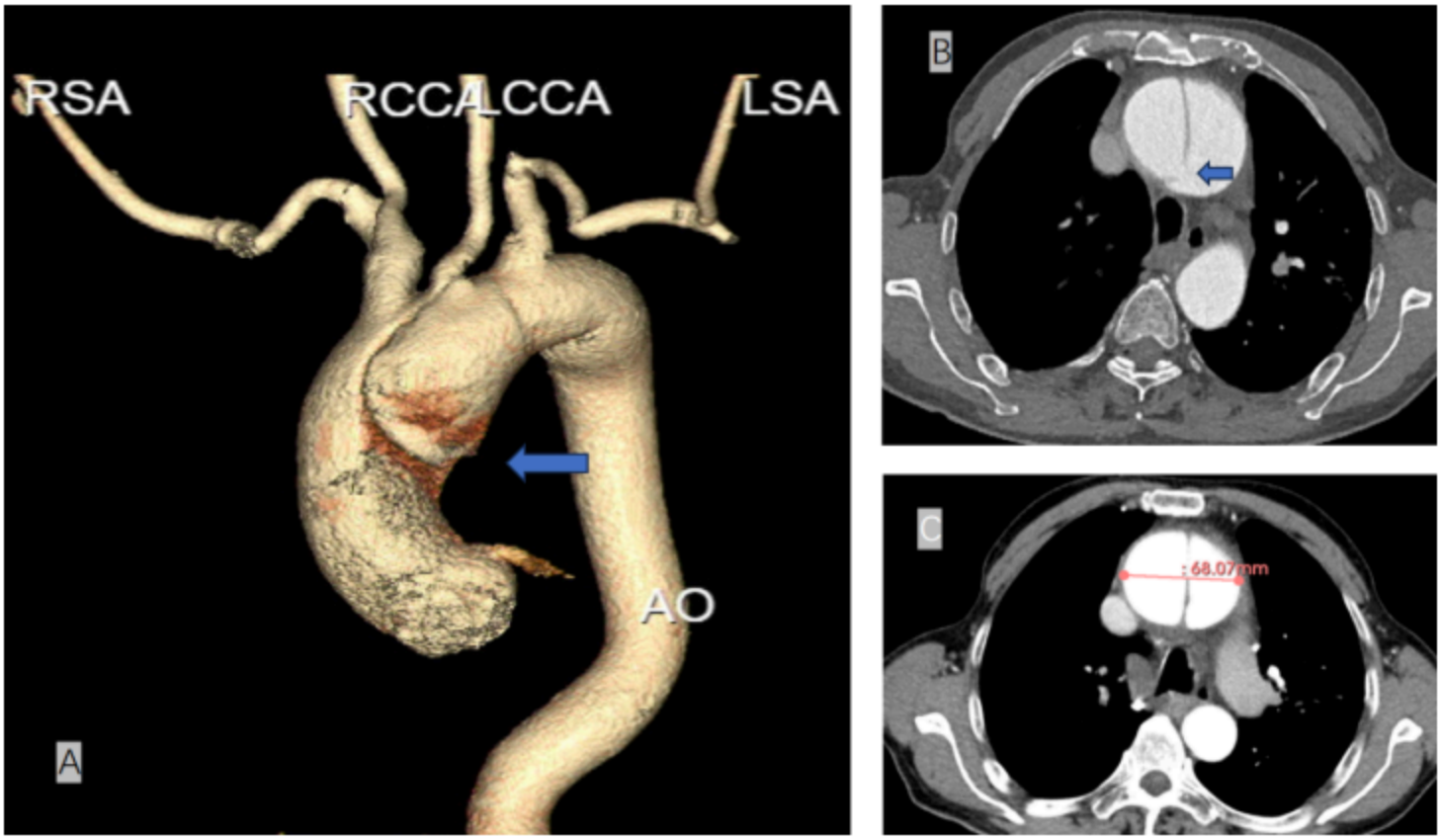


Figure 1

CTA demonstrating DeBakey type II aortic dissection（A）, Large entry tear and low-density linear intimal flap on the anterior wall of the ascending aorta(B), Ascending aortic diameter measuring 68.07 mm(C).

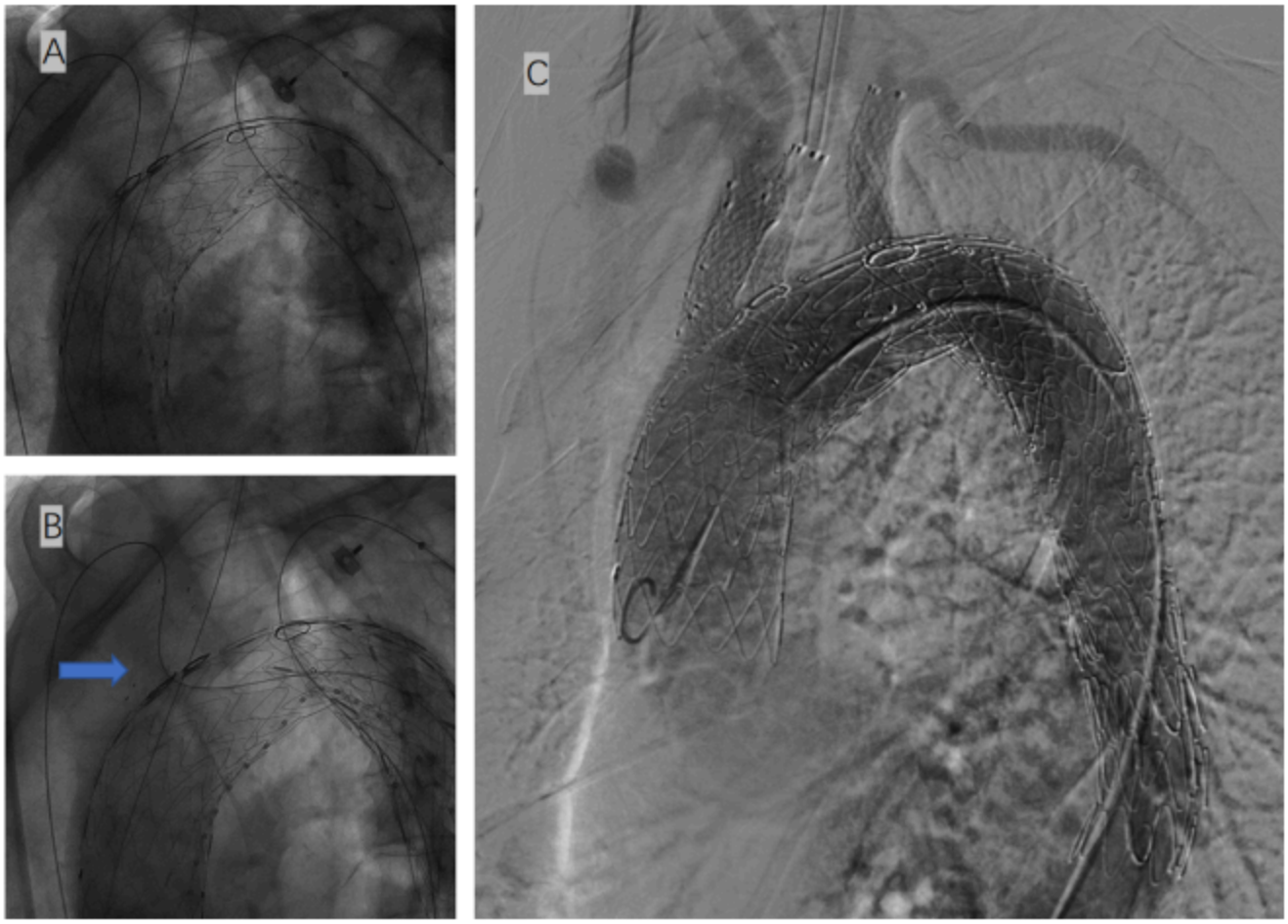


Figure 2

Guidewire positioned centrally within the fenestration under fluoroscopy(A), Mild stent displacement after full deployment, indicating failure to enter the fenestration,Single-plane lateral fluoroscopy presented a false appearance of successful cannulation, lacking anteroposterior spatial information.(B), Patent supra-aortic branches with no stent kinking or migration(C).

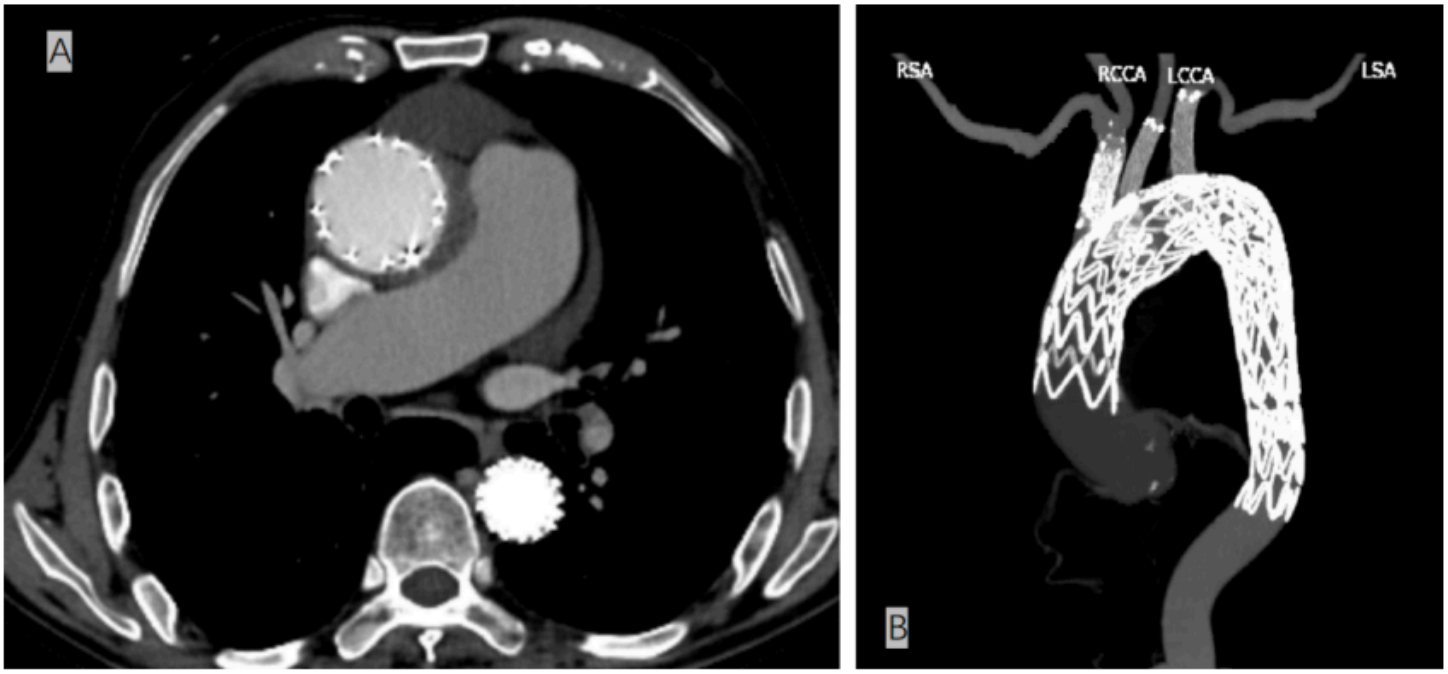


Figure 3

Favorable remodeling of the ascending aorta(A), All reconstructed vessels remained patent with no stent migration or endoleak(B).