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Successful application of angioembolization and thoracic endovascular aortic repair (TEVAR) in a retrograde type-A acute aortic dissection with polytrauma

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ABSTRACT

A 53-year-old man underwent thoracic endovascular aortic repair for persistent false lumen perfusion and limb salvage because of type A aortic dissection, severe lower-limb ischemia, and bleeding (mediastinal hematoma, bilateral lung contusion, liver injury, and splenic injury) caused by blunt trauma. We embolized the left supreme intercostal artery to control active mediastinal hemorrhage. Acute hemorrhage and leg ischemia were well controlled; however, residual blood flow in the false lumen persisted. We performed a Zone 2 thoracic endovascular aortic repair and discharged the patient on day 67. Thoracic endovascular aortic repair is a practical option for treating traumatic type A dissection.

Introduction

The standard treatment for type A acute aortic dissection (AAD) is a surgical approach that requires cardiopulmonary bypass (CPB) [1]. The influence of anticoagulants may worsen exsanguination in polytrauma cases, resulting in critical hemorrhage [2]. We report a case involving a type A AAD with polytrauma that was treated successfully. Thoracic endovascular aortic repair (TEVAR) and angioembolization (AE) were selected as acute-phase treatments.

The patient's consent to publish the case details and images was obtained.

Case report

A 53-year-old man was transferred to an outside hospital following a motorcycle crash. Computed tomography (CT) revealed an aortic injury and pneumothorax. The dissection progressed from the isthmus of the aorta (Fig. 1A) to the bilateral external iliac arteries. After endotracheal intubation and left chest drainage, he was transferred to our hospital with an aortic injury due to type B AAD.

Upon arrival at our hospital, he was sedated. His respiratory status was stable following endotracheal intubation and chest drainage (respiratory rate: 21/min, percutaneous oxygen saturation: 96%, oxygen ventilation: 100%). His systolic blood pressure was controlled

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below 120 mmHg by continuous administration of nicardipine (heart rate: 144/min, blood pressure: 113/69 mmHg). Initial blood examination revealed anemia and coagulopathy (hemoglobin 11.8 g/dl, platelet count $98 \times 10^3/\mu\text{l}$, PT-INR 1.84, APTT 68.8 s, fibrinogen 86 mg/dl, D-dimer 86.5 $\mu\text{g/ml}$). Mild progressive anemia was observed despite administering four units of packed red blood cells (PRBC) and 22 units of fresh frozen plasma.

Follow-up CT conducted after arrival at our hospital revealed that the false lumen of the aortic dissection retrogradely extended into the ascending aorta; i.e., the type B dissection developed into a type A dissection (Fig. 1B). The true lumen of the infrarenal aorta was severely compressed owing to expansion of the false lumen, resulting in progressive lower limb ischemia. The mediastinal hematoma increased and was accompanied by arterial extravasation. Aortic arch replacement, which requires CPB and full heparinization, is considered fatal in cases involving polytrauma with exsanguination. We selected thoracic endovascular aortic repair (TEVAR) for entry closure and limb salvage. To preserve the left vertebral artery, a stent-graft Conformable GORE TAG (CTAG, W. L. Gore & Associates, Flagstaff, AZ, USA) sized 31 mm \times 15 cm was placed in the aortic isthmus with Zone 3 landing (Fig. 2A). TEVAR sizing was achieved by measuring the aortic diameter, by performing CT outside the hospital; type-B dissection was noted. We avoided oversizing based on the characteristics of the aortic dissection, but not based on the aortic aneurysm. The perfusion of the lower limbs immediately improved. We embolized the supreme intercostal artery with metallic coils (Target Detachable Coils, Stryker, Kalamazoo, Michigan, USA) and N-butyl cyanoacrylate; the active arterial bleeding of the mediastinum was well controlled (Fig. 2B). After admission to the intensive care unit (ICU), his serum lactate level decreased gradually. Perfusion of the abdominal organs seemed to be well preserved. A detailed CT evaluation revealed remaining injuries: left frontal fractures, acute epidural hematoma, parietal traumatic subarachnoid hemorrhage, left maxillary fractures, bilateral clavicle fractures, mediastinal hematoma, left hemopneumothorax, bilateral lung contusion, liver injury (AAST grade I), splenic injury (AAST grade I), C7/Th1 fractures, and left radius/ulnar shaft fractures. The transfusion requirement for the first 24 h was 12 units of PRBC, 26 units of fresh frozen plasma, and 20 units of platelets

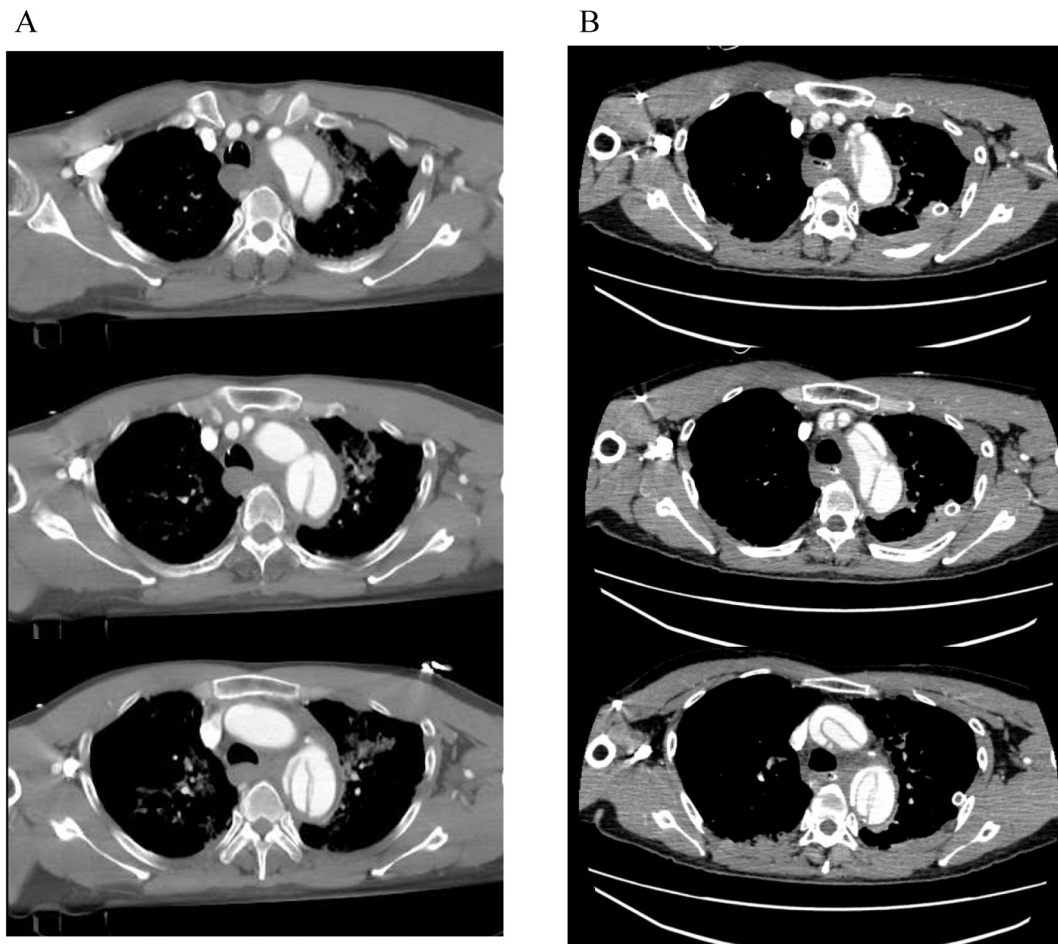


Fig. 1. Pre-treatment CT findings

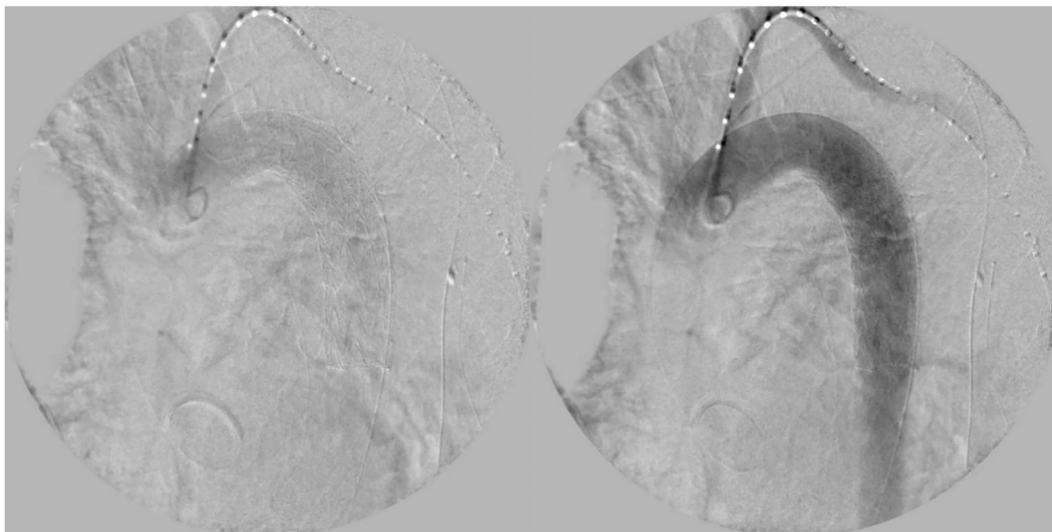
A. Initial CT angiography at the outside hospital

The communicating type B aortic dissection was found after blunt trauma.

B. The second CT angiography at our hospital

The false lumen had extended into the ascending aorta at the second scan.

A



B

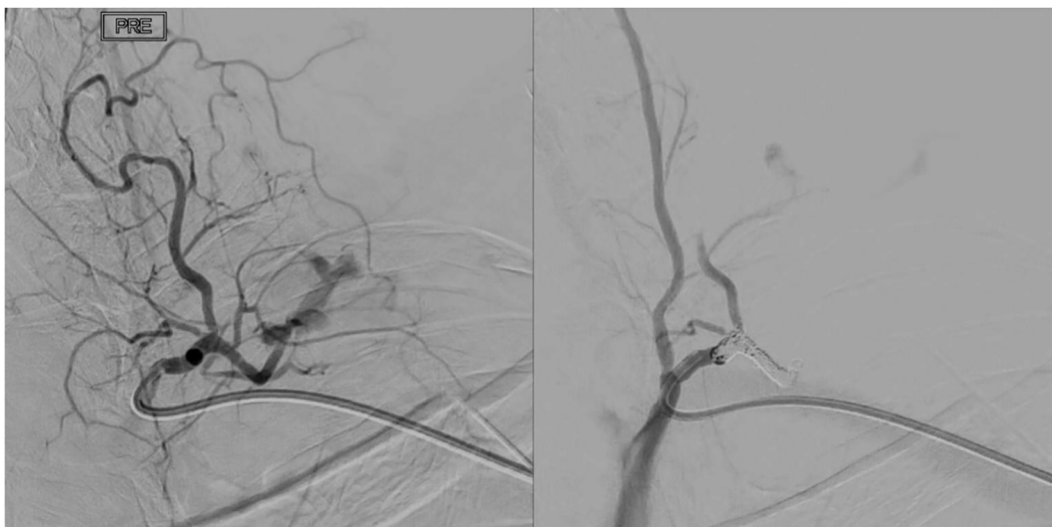


Fig. 2. The images captured during the emergent endovascular procedures

A. The initial emergent TEVAR

The stent graft was placed in Zone 3 of the aortic arch. The true lumen was secured after thoracic endovascular aortic repair.

B. Angioembolization of a branch of the supreme intercostal artery

The left supreme intercostal artery was embolized with metallic coils and N-butyl cyanoacrylate. The extravasation disappeared after embolization.

(in the Japanese transfusion unit, one unit of platelets is made from 200 ml of donor blood). The injury severity score was 29: Head abbreviated injury scale (AIS) of 3, face AIS of 2, neck AIS of 2, chest AIS of 4, abdomen AIS of 2, and pelvis or lower extremities AIS of 0. The Revised Trauma Score was 7.84 and the probability of survival was 0.97.

He was extubated on the 11th day and was discharged from the ICU on the 17th day. Contrast-enhanced CT on the 2nd day after admission showed a thrombosed false lumen of the ascending aorta. However, the residual blood flow in the false lumen from the left subclavian artery extended into the false lumen of the aortic arch. On the 25th day, Zone 2 landing TEVAR (CTAG, 34 mm × 15 cm) was added to the left subclavian artery, and angioembolization with metallic coils at the proximal part of the left vertebral artery was performed to block the blood flow in the false lumen (Fig. 3). Contrast-enhanced CT on the 52nd hospital day confirmed thrombosis in the false lumen of the ascending aorta and aortic arch (Fig. 4). Minor higher cerebral dysfunction persisted, but his daily living activities improved. The patient was transferred to a rehabilitation hospital.

Discussion

Blunt thoracic aortic injury (BAI) is rare but remains a leading cause of trauma deaths. In a previous observational study, it accounted for 0.3% of all trauma admissions. In the above study, 4% of patients died on arrival, and 19% died during triage [3]. A surgical approach requiring CPB can be applied only in limited cases because BAI is often associated with active bleeding from multiple injuries [2]. A previous case report demonstrated the clinical course of a patient with retrograde type A aortic dissection who underwent delayed total aortic arch replacement with CPB [4]. This report showed successful outcomes through delayed surgery after confirming that hemostasis had occurred at other injury sites. Current guidelines recommend delayed repair with adequate blood pressure control to reduce the mortality rate when the hemorrhagic situation is conducive [5]. However, death mainly occurs during the early days of admission (0, 1, and 2 days). The risk of dying while waiting for intervention cannot be overlooked [3].

Our case involved a retrograde type A aortic dissection with entry at the isthmus. The false lumen in the ascending aorta was open, and the lower legs experienced ischemic changes due to obstruction of the true lumen. The supreme intercostal artery injury was actively bleeding into the mediastinum, and the hemorrhagic shock was not due to the aortic injury. Moreover, we diagnosed leg ischemia, which required urgent treatment based on physical findings and CT images. Immediate TEVAR to close the entry at the isthmus and angioembolization to control the mediastinal hemorrhage enabled emergent aortic repair, bleeding control, and limb salvage.

TEVAR is an effective and safe treatment for type B aortic dissection [6]. It has also been recognized as a treatment for blunt aortic injury in the descending aorta [5,7]. Several studies have reported retrograde type A aortic dissection after stent-graft placement as a severe complication, especially in cases involving an entry at the distal aortic arch [8–10]. In our case, the dissection entry was at the isthmus of the aorta, a typical injury site for blunt aortic injury. Subsequently, the false lumen extended into the ascending aorta. Even after the closure of the entry by TEVAR, we carefully monitored the patient. CT was performed to detect the residual blood flow into the false lumen of the aortic arch. We performed additional TEVAR and angioembolization of the left subclavian artery because the false lumen was still open. Endovascular therapy is an additional treatment option.

Conclusions

We successfully treated a patient with type A AAD with polytrauma using TEVAR and angioembolization. Active bleeding from polytrauma limits available options for the treatment of the aorta. TEVAR may be a promising treatment option even in type A dissection accompanied by active bleeding in cases with blunt polytrauma.

Declaration of competing interest

Yosuke Matsumura was a Clinical Advisory Board Member at Tokai Medical Products, which is not related to this study. Other authors declare no conflicts of interest. The authors received no financial support for the research.

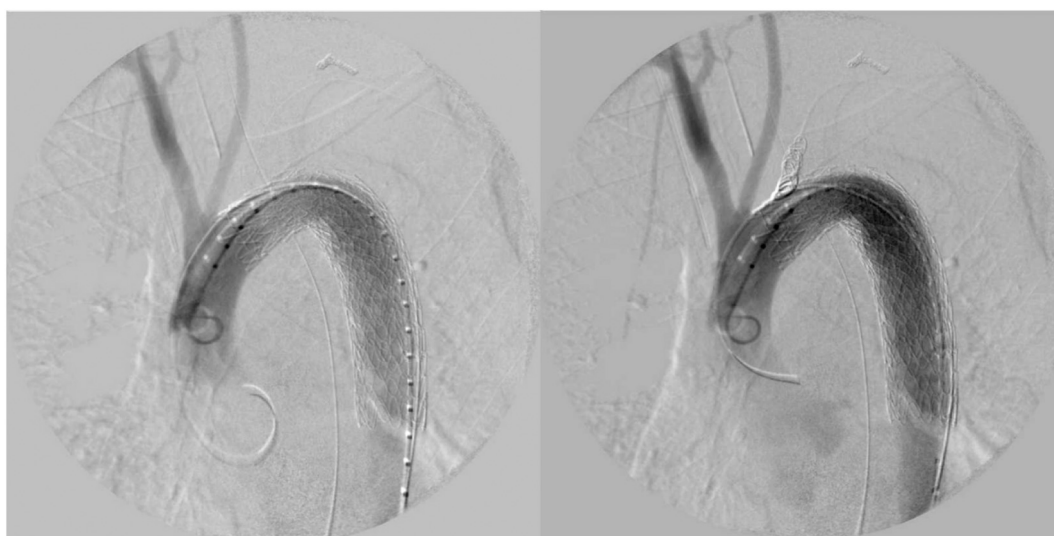


Fig. 3. Images captured during the additional TEVAR and subclavian artery embolization. The stent graft was placed in Zone 2 of the aortic arch (left). The left subclavian artery was embolized with metallic coils (right).

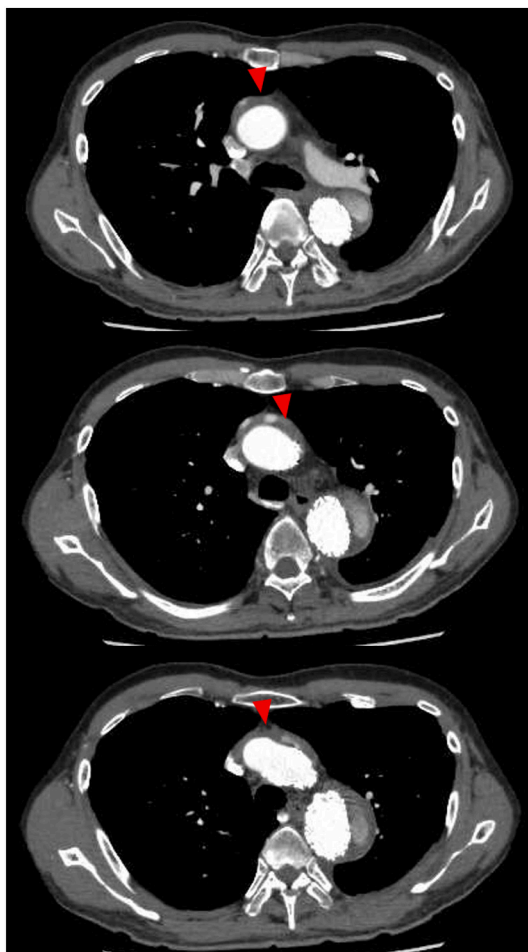


Fig. 4. Post-treatment CT findings

The false lumen (red arrowheads) was thrombosed in the post-treatment CT image on hospital day 52.

References

- [1] P.G. Hagan, C.A. Nienaber, E.M. Isselbacher, et al., The international registry of acute aortic dissection (IRAD): new insights into an old disease, *JAMA* 283 (2000) 897–903.
- [2] J.W. Pate, T.C. Fabian, W.A. Walker, Acute traumatic rupture of the aortic isthmus: repair with cardiopulmonary bypass, *Ann Thorac Surg* 59 (1995) 90–98, discussion 98–99.
- [3] Z.M. Arthurs, B.W. Starnes, V.Y. Sohn, et al., Functional and survival outcomes in traumatic blunt thoracic aortic injuries: an analysis of the National Trauma Databank, *J. Vasc. Surg.* 49 (2009) 988–994.
- [4] K. Tsukioka, T. Kono, K. Takahashi, et al., A case of traumatic retrograde type a aortic dissection accompanied by multiorgan injuries, *Ann. Vasc. Dis.* 11 (2018) 138–142.
- [5] N. Fox, D. Schwartz, J.H. Salazar, et al., Evaluation and management of blunt traumatic aortic injury: a practice management guideline from the eastern Association for the Surgery of trauma, *J. Trauma Acute Care Surg.* 78 (2015) 136–146.
- [6] R. Fattori, T.T. Tsai, T. Myrmet, S. Trimarchi, J.V. Cooper, Complicated acute type B dissection: is surgery still the best option?: a report from the International Registry of Acute Aortic Dissection, *JACC Cardiovasc Interv* 1 (2008) 395–402.
- [7] D. Demetriades, G.C. Velmahos, T.M. Scalea, et al., Operative repair or endovascular stent graft in blunt traumatic thoracic aortic injuries: results of an American Association for the Surgery of Trauma Multicenter Study, *J Trauma* 64 (2008) 561–570, discussion 570–561.
- [8] C. Shu, T. Wang, Q.M. Li, et al., Thoracic endovascular aortic repair for retrograde type A aortic dissection with an entry tear in the descending aorta, *J Vasc Interv Radiol* 23 (2012) 453–460, e451.
- [9] Y. Chen, S. Zhang, L. Liu, et al., Retrograde type a aortic dissection after thoracic endovascular aortic repair: a systematic review and meta-analysis, *J. Am. Heart Assoc.* 6 (2017).
- [10] A.M.A. Al-Kalei, Z. Wu, H. Zhang, Influence of primary intimal tear location in type b aortic dissection as a factor portending retrograde type a aortic dissection after endovascular repair, *J. Vasc. Interv. Radiol.* 29 (833–840) (2018), e832.