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Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Thoracic aortic stent graft placement and simultaneous screw removal for a screw hitting the aorta

Seimei Go^{a,*}, Shingo Mochizuki^a, Kazunori Yamada^a, Shinya Takahashi^b

^a Akane-Foundation Tsuchiya General Hospital, Department of Cardiovascular Surgery, Japan

^b Hiroshima University, Department of Cardiovascular Surgery, Japan

ARTICLE INFO

Keywords:

Spinal screw
Vascular injury
TEVAR
Simultaneous operation

ABSTRACT

Vascular injury caused by spinal screw displacement is a rare complication of spinal fusion surgery. Here, we report a case with no perforation of the aortic wall, which we treated by means of simultaneous thoracic endovascular aorta repair (TEVAR) and screw removal.

An 82-year-old female underwent corrective spinal fixation. Postoperatively, a screw became displaced from the vertebrae and contacted the outer membrane of the descending aorta. To prevent rupture of the aorta, we performed stent graft placement from the right common femoral aorta. We left a flexion-resistant catheter in the left arm and moved the patient into an abdominal position with the left arm extended upward to enable immediate insertion of a guidewire and occlusion balloon if necessary. Then we removed the displaced screw with a drill. This safe and effective method can prevent possible aortic injuries secondary to displaced spinal screws.

The key to our method is the simultaneous performance of TEVAR and screw removal, made possible through patient repositioning.

Introduction

Vascular injury caused by spinal screw displacement is a rare complication of spinal fusion surgery. Even if the screw does not penetrate the aortic wall, delayed aortic injury may occur. To avoid chronic perforation or pseudoaneurysm formation, treatment may be necessary. Here, we report a case with no perforation of the aortic wall, which we treated by means of simultaneous thoracic endovascular aorta repair (TEVAR) and screw removal.

Case report

The patient is an 82-year-old female. Corrective spinal fixation was performed for scoliosis with spinal canal stenosis using the ARSENAL spinal fixation system (Alphatec Spine, Inc., Carlsbad, CA, USA). There was no bleeding from the screw hole at the time of screw implantation, and the patient did not have anemia or pain after the operation. However, follow-up radiography (Fig. 1A) and CT (Fig. 1B) showed that the screw intended for the left side of Th10 had become displaced from the vertebrae and was positioned just beside the descending aorta. The tip of the screw was pushing against the descending aortic wall and was suspected to be encroaching on the outer membrane of the descending aorta. No penetration of the arterial wall nor blood leakage was observed, but the screw

* Corresponding author at: Department of Cardiovascular Surgery, Akane-Foundation Tsuchiya General Hospital, Nakashimacho 3-30, Nakaku Hiroshima-city, Hiroshima, Japan.

E-mail address: go-hma@umin.ac.jp (S. Go).

<https://doi.org/10.1016/j.tcr.2021.100401>

Accepted 5 February 2021

Available online 9 February 2021

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would press against the aortic wall every time the aorta beat, and we expected that this would eventually cause rupture or pseudoaneurysm formation. We operated to prevent this outcome. Because of her advanced age, we selected TEVAR because it was less invasive than alternatives. Simultaneous screw removal was indicated because the residual screw could also have penetrated the stent graft. Because the displaced screw was the upper leftmost screw, we were able to remove it by cutting the metal rod without redoing the whole fixation procedure. We informed the risk of aorta perforation and the high mortality risk to the patient and she consented the operation.

Initially, we performed TEVAR with the patient in the supine position under general anesthesia. We accessed the aorta through the right common femoral artery under direct fluoroscopic guidance and administered heparin (5000 U) systemically. Aortography confirmed that the screw was pushing against the side of the aortic wall (Fig. 1C). Transesophageal echocardiography revealed that the screw pressed against the aortic wall every time the aorta beat (Fig. 2A). Because the diameter of the aorta was 25 mm, we chose a device with a diameter of 28 mm and a length of 10 cm (TAG conformable thoracic stent graft with active control system, Gore & Associates, Inc., Flagstaff, AZ, USA). We deployed the device slowly using the active control system. Fluoroscopy showed that the metal part of the stent graft was pressed against the screw and that there was no blood leakage. We touched up the upper and lower ends of the stent graft to prevent endoleakage. No touch-ups were performed where the screws hit. A 3Fr flexion-resistant catheter (Parent plus, Medikit Co., Tokyo, Japan) was placed from the left arm to the left common iliac artery and the guidewire was removed. In the unlikely event of bleeding during screw removal, the catheter would have allowed immediate insertion of a guidewire, followed by a 7Fr sheath for insertion of an occlusion balloon. The catheter placed in the left common iliac artery was sufficiently long to allow rapid insertion of the guidewire to the descending aorta, even if the catheter's position was displaced slightly by repositioning. Then, the sheath in the right femoral artery was removed and the incised part was closed.

We then moved the patient into an abdominal position with the left arm extended upward so that we could insert the guidewire and occlusion balloon immediately. We checked the position of the screw using fluoroscopy and made an incision directly above it. The metal rod running through the screw was drilled and broken off using a Midas Rex drill (Medtronic, Minneapolis, MN, USA) (Fig. 2B). We confirmed that the screw was free and carefully removed it. There was no apparent blood pressure fluctuation after removal, though arterial blood slowly flowed from the threaded screw hole. Aortography was performed from the sheath placed in the left arm, confirming that the bleeding was not from the aorta. Therefore, we concluded that no additional endovascular treatment was necessary. The extraction hole was filled with a hemostatic agent and pressure hemostasis was applied. After hemostasis was obtained, we closed the incision. The patient was returned to a supine position, the left arm sheath was removed, and protamine was administered. The total operative time was 175 min, of which 49 min were spent on body repositioning. The patient recovered without complications.

Comment

Aortic injury caused by spinal screw is a rare but serious complication. Various surgical and nonsurgical management techniques for such aortic injuries have been reported. Wagener [1] reported a case treated by open surgery with direct suturing of the aorta and screw-tip cutting. Fukuda [2] reported a case treated by open surgery with short graft replacement and screw-tip cutting. Hu [3] reported a case treated by TEVAR followed on the next day by screw removal.

The key to our method is the simultaneous performance of TEVAR and screw removal, made possible through patient repositioning. Although the screw contact area was covered with a stent graft, there was a risk that vibrations from the drill during screw removal

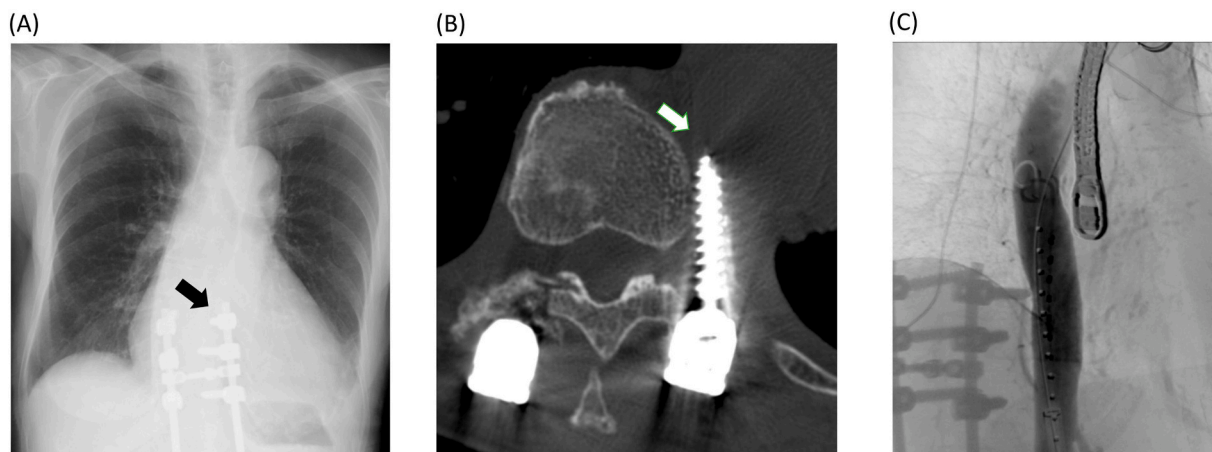


Fig. 1. (A) Follow-up radiography showed that the upper leftmost screw was displaced from the vertebrae (arrow: displaced screw). (B) CT showed that the tip of the screw was pushing against the descending aortic wall and was probably encroaching on the outer membrane of the descending aorta (arrow: outer membrane of the descending aorta). (C) Aortography showed that the screw was pushing against the side of the aortic wall.

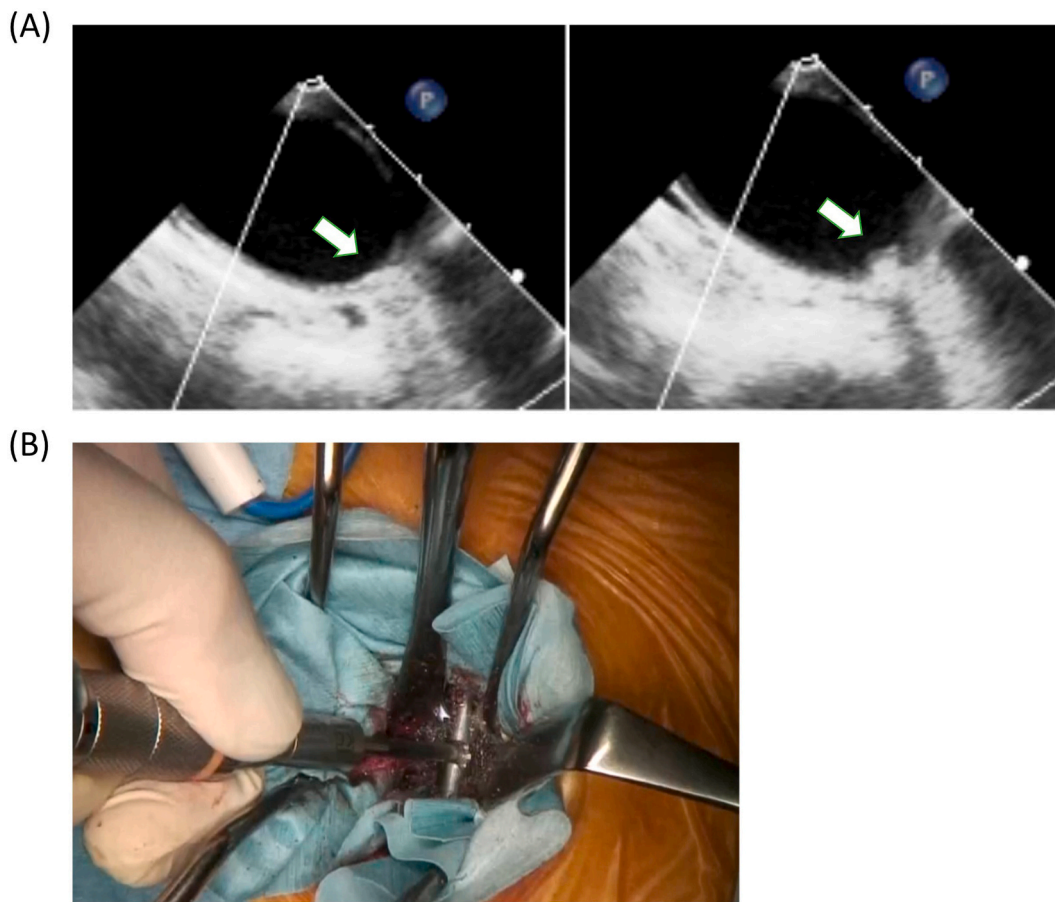


Fig. 2. (A) Transesophageal echocardiography of the descending aorta prior to our operation. The arrows in the two panels point to the same place. Each time the aorta beat, the tip of the screw was pressing against and retreating from the arterial wall.

(B) The metal rod running through the screw was drilled and broken off. With this technique, steps must be taken to mitigate the risk of vibration transmission from the drill to the screw during screw removal.

would be transmitted to the screw, which would then puncture the stent graft. The screw removal has to be performed in the abdominal position, however, it is difficult to perform endovascular treatment in this position. To prepare for this possibility, we kept a catheter in the left arm at the time of screw removal. In the unlikely event of bleeding during screw removal, this catheter would have allowed us to immediately insert a guidewire, which we would then replace with a 7Fr sheath, allowing us to insert an occlusion balloon. The occlusion balloon will suppress the bleeding point and gain time to return the patient to the supine position for endovascular treatment. Care must be taken to ensure that the catheter in the left arm does not accidentally fall out while the patient is being repositioned. Furthermore, we had to perform screw removal without using antagonizing heparin ($ACT > 150$) to prevent thrombus because it was difficult to straighten the arm with the patient in the abdominal position. This required us to be particularly careful to stop the bleeding while performing screw removal.

Here we present a successfully treated case of spinal screw displacement. Although the long-term outcome has not yet been determined, simultaneous TEVAR and screw removal may be a safe and effective method of preventing possible aortic injury secondary to displaced spinal screw.

Meeting which the work was presented

None.

Funding

None.

Declaration of competing interest

None.

References

- [1] B. Wegener, C. Birkenmaier, A. Fottner, V. Jansson, H.R. Dürr, Delayed perforation of the aorta by a thoracic pedicle screw, *Eur Spine J.* 17 (2008) 351–354.
- [2] W. Fukuda, C. Aoki, K. Daitoku, S. Taniguchi, I. Fukuda, Screw in the aorta: minimally invasive graft replacement for chronic aortic erosion by spinal instrument, *Ann Thorac Cardiovasc Surg.* 19 (2013) 320–322.
- [3] H.T. Hu, J.H. Shin, J.Y. Hwang, Y.J. Cho, G.Y. Ko, H.K. Yoon, Thoracic aortic stent-graft placement for safe removal of a malpositioned pedicle screw, *Cardiovasc Intervent Radiol.* 33 (2010) 1040–1043.