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CASE REPORT

An endovascular treatment of a thoracic aortic injury caused by a misplaced pedicle screw: Case report and review of the literature



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Aortic injuries are devastating complications after spinal surgery. We here would like to share our experience with a successful endovascular treatment of an iatrogenic thoracic aortic injury caused by misplaced pedicle screw after spinal surgery. A patient underwent posterior spinal surgery for L1 burst fracture was transferred to our department for instrumentation removal. An iatrogenic thoracic aortic injury at T11 level caused by a pedicle screw was recognized after routine CT scans. Complete screw extraction and instrumentation removal were performed after the placement of a thoracic aortic stent graft covering the injured region. The patient had an uneventful postoperative period and no complications were observed in the 1 and 12-month follow-up by contrast-enhanced CT scans. For the delayed thoracic aortic injuries which usually were usually shown on CT scans as pseudoaneurysm or penetration of the aorta, stent graft implantation would provide a preferred solution with high-effectiveness, low-invasiveness and fewer complications compared with conventional open surgery.

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Introduction

Iatrogenic vascular injuries after spinal surgery, although infrequent, are associated with life-threatening complications and a devastating mortality rate.¹ The most frequently occurring vascular lesions including arterial lacerations

accompanied with acute hemorrhage, pseudoaneurysm, thrombosis, and arteriovenous fistula.

Delayed aortic injuries are usually caused by pseudoaneurysm formation, or partial aorta wall penetration.^{2–9} The clinical symptoms of a delayed aortic injury are typically insidious or inexistant, making early diagnosis difficult.^{8,10} Conventionally, endovascular stent graft implantation for spinal intervention related thoracic aortic lesions are used as a preventive method for patients, rather than an established therapeutic option.⁶ In the present clinical case report, we present a successful endovascular procedure with stent graft to treat an uncommon thoracic aortic injury caused by a misplaced pedicle screw. Also, we conducted a thorough literature review of similar cases. We wish to share our experience of endovascular stent graft implantation for iatrogenic aortic injuries after spinal surgery with our colleagues.

Case report

A 24-year-old woman with a history of L1 burst fracture after a traffic accident underwent posterior spinal stabilization with the placement of spinal instrumentation (two longitudinal rods and six posteriorly placed pedicle screws

in T11, T12, and L2, two in each) at another hospital 17 months earlier. The procedure was well tolerated and the patient had an uneventful postoperative period. A computed tomography (CT) scan (Somatom Plus4 VolumeZoom; Siemens, Forchheim, Germany) revealed a malpositioned pedicle screw, which possibly caused partial penetration through the posterior wall of the thoracic aorta. The patient was therefore transferred to our department for evaluation of instrumentation removal and further treatment.

After transfer, routine examinations and laboratory tests indicated that the general condition of the patient appeared to be good and no symptom of hemodynamic instability was observed. Non-contrast-enhanced CT and contrast-enhanced CT scans demonstrated that the left sided pedicle screw at T11 level was half outside the 11th thoracic vertebra and had perforated the anterior cortex of the vertebra, causing an impingement on the posterior thoracic aortic wall by the tip (Figs. 1 and 2). Although there was no evidence of hematoma, pseudoaneurysm formation, or pleural effusion observed, it was clear that the malpositioned pedicle screw had caused an aortic lesion. However, it is difficult for us to discern by the radiologic evidence if the tip had perforated the posterior thoracic wall and penetrated into the lumen, or just

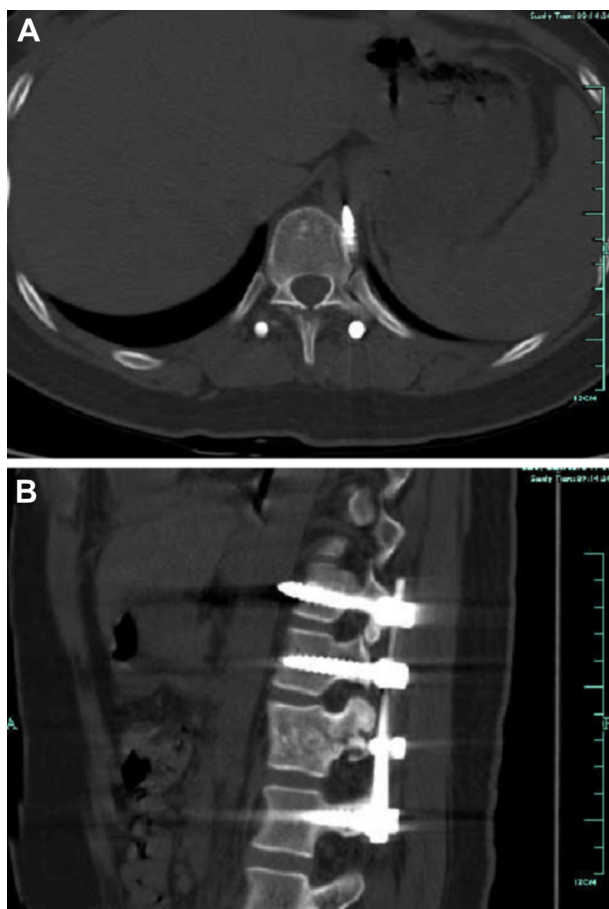


Figure 1 Noncontrast computed tomography scan demonstrates that the left T11 pedicle screw has caused an impingement on the posterior thoracic aortic wall.

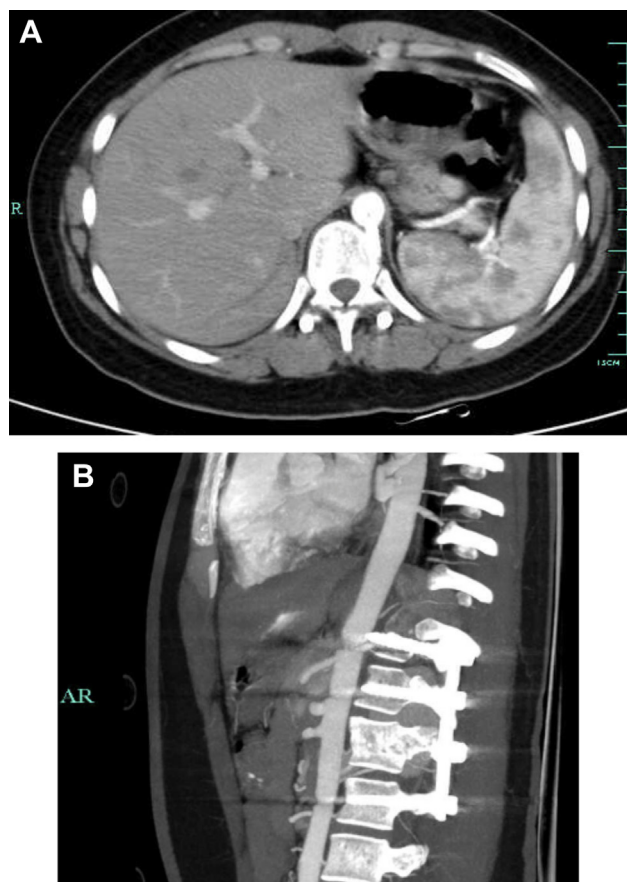


Figure 2 No evidence of hematoma, pseudoaneurysm formation or pleural effusion is observed in the contrast-enhanced computed tomography scan.

impinged on the aortic wall. We thus turned to vascular surgeons for help and they advised performing covered stent graft implantation during instrumentation removal.

5 Days later, the patient underwent endovascular covered stent graft implantation accompanied with spinal instrumentation removal in the vascular operation room under fluoroscopic control by a mobile C-arm machine (Diasonics OEC 9400 mobile C-Arm system, OEC-Diasonics, Salt Lake City, Utah, USA). CT angiography measurement of the injured segment had been performed prior to surgery to determine the size of the stent graft (20 mm × 80 mm). The

patient was fixed in a left lateral position after general anesthesia. Removal of two longitudinal rods and five correctly placed pedicle screws were performed firstly, leaving the malpositioned screw (the left T11 pedicle screw) unmanaged. After an inguinal cut down on the right femoral artery, a straight thoracic endovascular covered stent graft (Medtronic AVE, Santa Rosa, CA, USA) was then introduced via a transfemoral approach into the thoracic aorta and then remained unexpanded at the site of the malpositioned screw under direct fluoroscopic guidance (Fig. 3). We scrupulously removed two screw threads and a vascular surgeon simultaneously expanded the stent graft to cover the lesion (Fig. 4). Through the cooperation of two different medical teams, graft perforation caused by the screw tip was successfully avoided, and there was no evidence of extravasation of contrast medium.

After surgery, the patient recovered without complications and had an uneventful postoperative period. No evidence of endoleak, graft migration, or graft fracture was observed in 1-month follow-up contrast-enhanced CT scan (Fig. 5).

Discussion

Iatrogenic vascular injuries may occur in various orthopedic procedures such as lumbar discectomy, elective orthopedic joint procedures, or spinal stabilization procedures.^{11–13} After spinal surgery, thoracic aortic injuries may be caused by active bleeding resulting from acute lacerations during surgery or short postoperative period, or delayed pseudoaneurysms during the long-term postoperative period. For delayed aortic injuries, clinical symptoms are sometimes subtle, could be as simple as dorsal pains.

Posterior spinal surgeries for surgical implantation procedures are increasingly performed in multifarious spinal

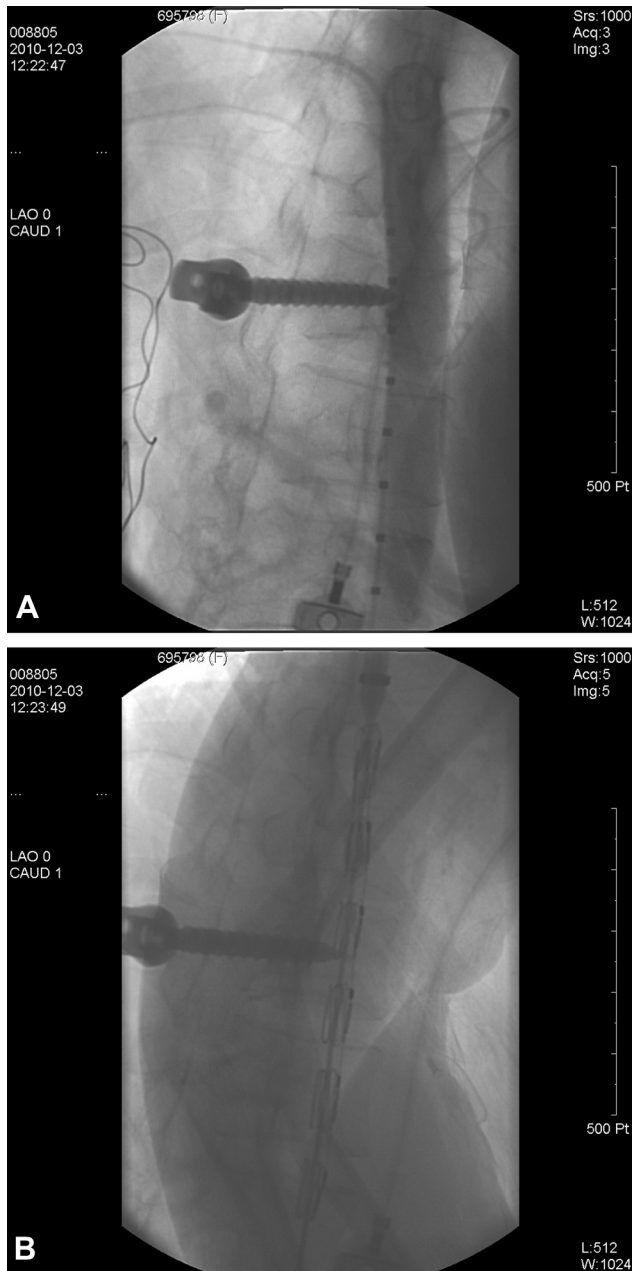


Figure 3 (A) Intraoperative fluoroscopy shows that the misplaced pedicle screw was left unmanaged prior to endovascular stent graft implantation. (B) Intraoperative fluoroscopy shows the stent graft remaining unexpanded at the site of the misplaced screw.

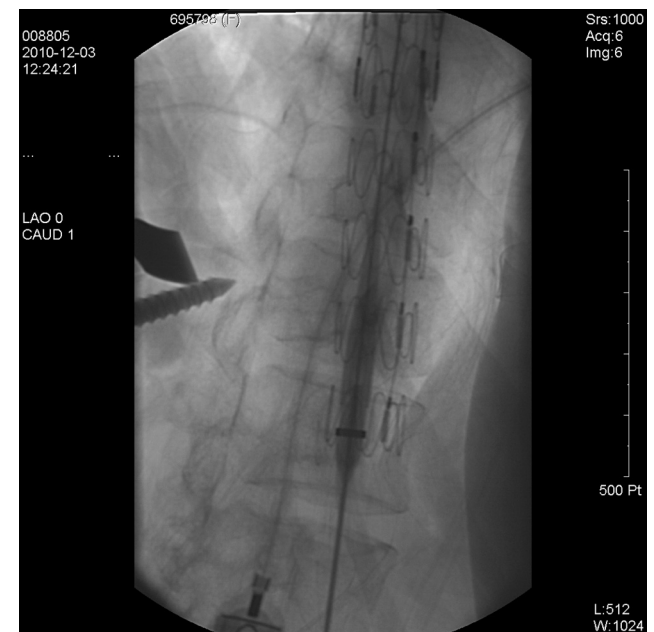


Figure 4 The screw is scrupulously removed by two screw threads and at the precise moment a vascular surgeon expanded the stent graft to cover the lesion.

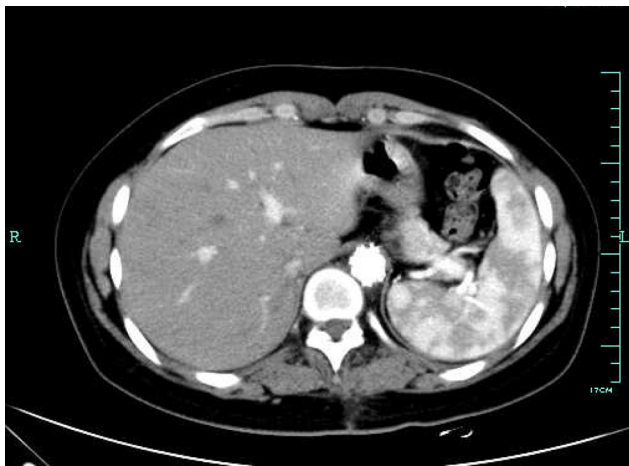


Figure 5 One month later, the stent graft is observed to be in good condition by contrast-enhanced computed tomography.

disorders. Due to the difficulty of the posterior approach and the method of screw implantation, misplacement of pedicle screws is difficult to avoid even under fluoroscopic assistance. As reported in postoperative CT scanning studies of instrumentation in scoliosis, the incidence of misplacement of pedicle screws in spinal surgeries ranges

from 4% to 25%.^{14–17} There is no standard to decide whether the removal is necessary when the malpositioned pedicle screw has a breach of the vertebra. However, considering the aortic pulsation and the migration of the screw resulting from osteoporosis or sometimes infection, pedicle screws abutting on the aorta may gradually penetrate the aorta wall and cause pseudoaneurysm or hemorrhage.

Endovascular treatment is the common therapy for delayed iatrogenic thoracic injuries.^{2,5,8} The first attempt of endovascular stent graft implantation was made on a suspected thoracic aortic injury caused by a malpositioned pedicle screw.⁸ We have therefore reviewed and compared the similar cases of nonsurgical treatment for thoracic aortic injury after spinal surgery (Table 1).^{2,4,6,8}

The technique of stent graft is generally adopted in the treatment for delayed aortic injuries as it is minimally invasive with considerably fewer complications of post-operative pulmonary failure and lower paraplegia rates.^{5,6,8,18,19} Endovascular stent graft is a preferable choice for patients with increased risks of aortic injuries in spinal surgeries, or patients with multiple traumas that are unlikely to be performed with open surgeries.^{6,20,21}

Overall, we demonstrated an uncommon thoracic aortic injury caused by a malpositioned pedicle screw after spinal surgery, and a successful procedure to remove the screw

Table 1 Nonsurgical treatment for thoracic aortic injuries after spinal surgery.

Study	Disease	Initial surgery	Time	Diagnosis	Treatment	Result
Minor (2004) ⁸	Scoliosis	Posterior thoracic spinal instrumentation	1.0 mo	Incidental CT finding	Stent graft and removal	Uneventful
Been (2006) ²	Scoliosis	Anterior Zielk procedure	20 yr	Pseudoaneurysm and shortness of breath	Stent graft	Uneventful
Kopp (2007) ⁶	Unstable traumatic fracture	Dorsal vertebral stabilization	Immediate postoperative	Previous aortic laceration/primary intraoperative hemorrhage	Preventive stent graft and secondary spinal reintervention	Uneventful
	Metastatic breast cancer	Vertebral stabilization	Intraoperative	intraoperative hemorrhage	Preventive stent graft and spinal reosteosyntheses	Uneventful
Kim (2010) ¹	Burst fracture	Screw fixation	4.5 mo	Pseudoaneurysm	Stent graft	Uneventful
Hu (2010) ⁴	Spondylitis	Posterior thoracic spinal instrumentation	8 mo	Incidental postoperative CT finding	Preventive stent graft and removal	Uneventful
Lopera (2010) ²²	N/A	Thoracic spine fracture fixation	3.0 mo	Chest pain	Stent graft	Uneventful
	N/A	Lumbar spine fracture fixation	1 d	Incidental postoperative CT finding	Screw replaced	Uneventful
	N/A	Thoracic spine fracture fixation	3 mo	Incidental CT finding	None	Uneventful
Our patient	L1 fracture	L1 fracture fixation	17 mo	Incidental CT finding	Stent graft and removal	Uneventful

CT = computed tomography; N/A = not available.

with the application of endovascular stent graft implantation. The results suggest that, for delayed aortic injury, endovascular stent graft implantation could be an effective and feasible management to prevent sudden rupture of the injured aorta and a therapeutic option of the lesion in orthopedic surgery.

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