Case report

Endovascular aortic injury repair after thoracic pedicle screw placement

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ABSTRACT

Our objective was to describe the management and prevention of thoracic aortic injuries caused by a malposition of pedicle screws in corrective surgery of major spine deformities. Positioning pedicle screws in thoracic vertebrae by posterior approach exposes to the risk of injury of the elements placed ahead of the thoracic spine, as the descending thoracic aorta. This complication can result in a cataclysmic bleeding, needing urgent vascular care, but it can also be totally asymptomatic, resulting in the long run in a pseudoaneurysm, justifying the systematic removal of the hardware. We report the case of a 76-year-old woman who underwent spinal correction surgery for thoraco-lumbar degenerative kypho-scoliosis. Immediately after the surgery, a thoracic aortic injury caused by the left T7 pedicle screw was diagnosed. The patient underwent a two-step surgery. The first step was realized by vascular surgeons and aimed to secure the aortic wall by short endovascular aortic grafting. During the second step, spine surgeons removed the responsible screw by posterior approach. The patient was discharged in a rehabilitation center 7 days after the second surgery. When such a complication occurs, a co-management by vascular and spine surgeons is necessary to avoid major complications. Endovascular management of this kind of vascular injuries permits to avoid an open surgery that have a great rate of morbi-mortality in frail patients. Nowadays, technologies exist to prevent this kind of event and may improve the security when positioning pedicle screws.

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1. Introduction

Aortic injuries after spine surgery have been reported in the literature but most of the cases concerned anterior approaches. Anyway, placing pedicle screws in the thoracic spine exposes to the risk of major vascular injury, as it has been reported in the anatomical study of Vaccaro et al. [1]. This kind of injury during posterior approach has been reported by few authors [2–8]. Its rate remains unclear and is estimated to less than 0.05% but probably underreported [9]. We propose a closed management of this kind of lesion using endovascular procedure prior to screw removal.

2. Case report

A 76-year-old woman with a major history of complete atrioventricular block necessitating the implantation of a pacemaker, a Leyden factor II and osteoporosis underwent corrective spine surgery for degenerative thoraco-lumbar kypho-scoliosis (Fig. 1). The patient had no cardiovascular risk factor.

The surgery consisted in a posterior approach of the thoraco-lumbar spine. The deformity was corrected in sagittal and coronal plans by an asymmetric transpedicular osteotomy of L2 and L3 and arthrocometies of L1–L2, L2–L3 and L3–L4. The instrumentation consisted in two rods fixed by pedicle screws from T5 to iliac wings. The pedicle screws were placed free-hand under lateral fluoroscopic control. The procedure and the postoperative course were uneventful, outside an anaemia requiring the transfusion of two red cell units, which is not unusual after such a surgery.

The day after the surgery, the patient had a routine non-contrast-enhanced computed tomography that revealed the malposition of the left T7 pedicle screw. A contrast-enhanced CT scan was performed and showed a partial puncturing of the thoracic descending aortic posterior wall, without pseudoaneurysm, surrounding hematoma or leakage of contrast-medium (Fig. 2). After multidisciplinary staff, it was decided to treat the complication by a two-step combined surgery. During the first step,
the patient was in supine position. On the right common femoral artery, a percutaneous access was performed through a small stab incision with a pre-closure technique with a 10F Prostar XL device (Perclose, Abbott). At this time, the patient received 100 units/kg of heparin. After the two perclose 3-0 braided polyester sutures are deployed, the stent graft ESBE 28-80-PF (Cook) was inserted. After an angiogram performed through an additional left femoral arterial access, the stent graft was deployed accurately centered on the threatening screw (Fig. 3). When the procedure was completed, an angioseal 6F (cordis) was used to close the right femoral artery and the heparin was completely reversed with protamine.

Fig. 1. Preoperative antero-posterior and lateral full-spine radiographs. There is a major thoraco-lumbar degenerative scoliosis associated with a thoracic hyperkyphosis.

Fig. 2. Contrast-enhanced CT scan. The left T7 pedicle screw is responsible of a partial punching of the thoracic descending aortic posterior wall.
Then the patient was turned in prone position and spine surgeons removed the screw responsible of the aortic injury by a paramedian 2 cm incision. The procedure was well supported. A follow-up contrast-enhanced CT scan showed the correct positioning of the aortic endograft and the absence of blood leakage around the aortic injury (Figs. 4 and 5). The patient was watched 24 hours in vascular intensive care and was then discharged in the neurosurgical unit. The patient was then transferred to a rehabilitation center on the 7th day.

3. Discussion

Regarding to the thickness of the thoracic vertebra pedicles, the placement of screws is more difficult than in lumbar spine. In addition, the rotation of the vertebral bodies in major deformities makes the placement of the screws even more complex. These elements explain that the malposition of thoracic pedicle screws in major deformities is estimated to 25% [10,11]. This malposition is particularly hard to diagnose intraoperatively in patients with osteopenia and osteoporosis because of the poor quality of the cortical bone.

Even in patients with major scoliosis, the aorta remains extremely close to the vertebral column [12]. Moreover, it has been shown that the aorta is placed more laterally in these patients, thus increasing the risk of vascular injury when misplacing pedicle screws [13].

Partial punching of the aortic wall by pedicle screw can result in an immediate major bleeding, needing urgent vascular care [7], but it can also be totally asymptomatic. In our report, the aortic injury was diagnosed by a routine CT scan, but the patient had no pain and no biologic or clinical signs of bleeding. However, the contact between hardware and pulsating aorta can result in the long run in the formation of aortic pseudoaneurysm, a complication that can be life-threatening. This evolution explains the necessity of the removal of the hardware when an aortic injury is diagnosed, even if the patient is asymptomatic [5,6,14].

In a recent review, paraplegia following endovascular treatment of thoracic aortic injuries appears to occur at a rate of 3.9% and the authors listed as the two main indications for the use of cerebrospinal drains the anticipated stent graft coverage of T9 to T12 and the coverage of a long segment of thoracic aorta (>20 cm) [15]. In this case, we did not use prophylactic cerebrospinal drains. Indeed, we used an 80-mm length thoracic stent graft, which allowed a safe distal anchorage with around 30 mm of distal aortic neck without coverage of T9.

The treatment of vascular injuries due to spinal instrumentation must be co-managed by vascular and spine surgeons, to prevent from catastrophic bleeding when removing the hardware. In the case reported by Matsuaki et al. [16], a patient undergoing anterior fusion of thoracic vertebrae presented an aortic injury, treated by left thoracotomy, cardiopulmonary by-pass and replacement of an 8-cm thoracic aortic segment. Nowadays, the use of endovascular procedures avoiding open surgery results in a clear decrease of the morbidity associated with thoracic vascular surgery that has been estimated to more than 50% [17,18]. The endovascular grafting is now the reference for the treatment of traumatic aneurysm of the thoracic aorta [19,20]. In our case, the aortic endograft enabled to secure the aortic wall partial punching from bleeding when removing the screw. In addition, endovascular treatment of aortic injury permitted to reduce the length of the graft to its minimum that is to say at the area facing the screw, decreasing the risk of paraplegia and ischemic stroke [21].

To prevent this kind of event, technologies to increase accuracy in screw position now exist. Among these technologies, the intraoperative 3-dimensional imaging (O-arm) seems to be
efficient. In a study published by Sembrano [22], screw malposition was diagnosed by O-arm intraoperatively in 18% of cases. The use of this kind of intraoperative imaging could be the solution for patients with major deformities.

4. Conclusion

We reported the case of a rare life-threatening complication of the posterior spine instrumentation. In this case, a co-management by vascular and spine surgeons permitted to treat the complication safely. The use of endovascular grafting avoided a major thoracic surgery with a high-risk of cardiorespiratory complications. Finally, the use of modern technologies as intraoperative CT scan could be the solution to avoid screw malposition in corrective surgery for major spine deformities.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


