European Spine Journal
https://doi.org/10.1007/s00586-019-06005-1

CASE REPORT

Delayed presentation of infected common iliac artery pseudoaneurysm caused by malpositioned pedicle screw after minimally invasive scoliosis surgery

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Received: 12 November 2018 / Accepted: 9 May 2019

Abstract

Purpose To report delayed onset common iliac artery perforation and infected pseudoaneurysm caused by malpositioned pedicle screw after minimally invasive scoliosis surgery (MISS).

Methods A 21-year-old female was referred to our hospital with a 1-week history of abrupt right-sided low back pain, lower abdominal pain, and fever with a history of MISS using cannulated pedicle screws 18 months earlier. Paravertebral arterial erosion with pseudoaneurysm and retroperitoneal and paraspinal abscess were suspected.

Results We performed resection of the pseudoaneurysm, vascular repair of right common iliac artery by angioplasty with a bovine patch and removal of implant. At 6 months after the last surgery, she had no limitations or problems in her daily activities with no recurrence of low back pain, abdominal pain, or fever as well as without loss of deformity.

Conclusions Our case showed that misplaced pedicle screws can cause potentially fatal complications, such as infected pseudoaneurysm, even in the late postoperative period.

Keywords Abscess · Common iliac artery · Fistula · Pseudoaneurysm · Malpositioned cannulated pedicle screw · Minimally invasive scoliosis surgery

Introduction

Pedicle screw instrumentation has been used to treat various complex spinal disorders, including spinal deformity correction [1]. However, damage to major vessels, including the aorta and iliac arteries, due to pedicle screw fixation has been reported [2–4]. Most acute major vessel injuries cause sudden hemodynamic instability, which may inadvertently lead to a life-threatening condition [5, 6]. More rarely, however, major vessel injuries after pedicle screw misplacement may be found with delayed symptom presentation or incidental findings in asymptomatic patients [7–10].

We experienced delayed onset common iliac artery perforation and infected pseudoaneurysm caused by a malpositioned pedicle screw after minimally invasive scoliosis surgery (MISS). Our report highlights that even posterior instrumentation surgery of the lower lumbar vertebra may cause major arterial injury in the late postoperative period, and a malpositioned cannulated screw could be a facilitating conduit to the spread of infection.

Materials and methods

A 21-year-old female was referred to our hospital with a 1-week history of abrupt right-sided low back pain, lower abdominal pain, and fever. About 18 months previously,

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IRB Status This study received the approval of the institutional review board of Korea University Guro Hospital (K2018-1903).

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Published online: 14 May 2019

she had undergone a minimally invasive scoliosis surgery (MISS) for the treatment of adolescent idiopathic scoliosis using a cannulated pedicle screw system from T4 to L4. Abdomino-pelvic computed tomography (AP-CT) revealed about 6.5 × 11 × 9 cm-sized collection of pre- and paravertebral fluid surrounding a rim-like enhancement around L3-5 level, containing more than two lobulated spaces filled with high-density-contrast material (maximum 4.1 cm in size, Fig. 1a) predominantly at the L4–5 level. In addition, a cystic lesion with a similar appearance was observed around the adjacent paraspinal muscle area, more than 3.3 × 5 × 10.5 cm, from T12 to Rt S1 level (Fig. 1b). Subsequent lumbar spine X-ray and CT revealed that the right L4 screw was positioned too far anteriorly with periscrew halo formation, adjacent vertebral body erosion, and detachment of the transverse process (Fig. 2). The medical records and postoperative radiographs of the hospital where the first operation was performed confirmed the surgical information: On medical record examination, there was no specific finding to cause infection on pre- and postoperative period except long operation time (about 10 h). On surgical procedures, deformity was corrected with MISS technique which

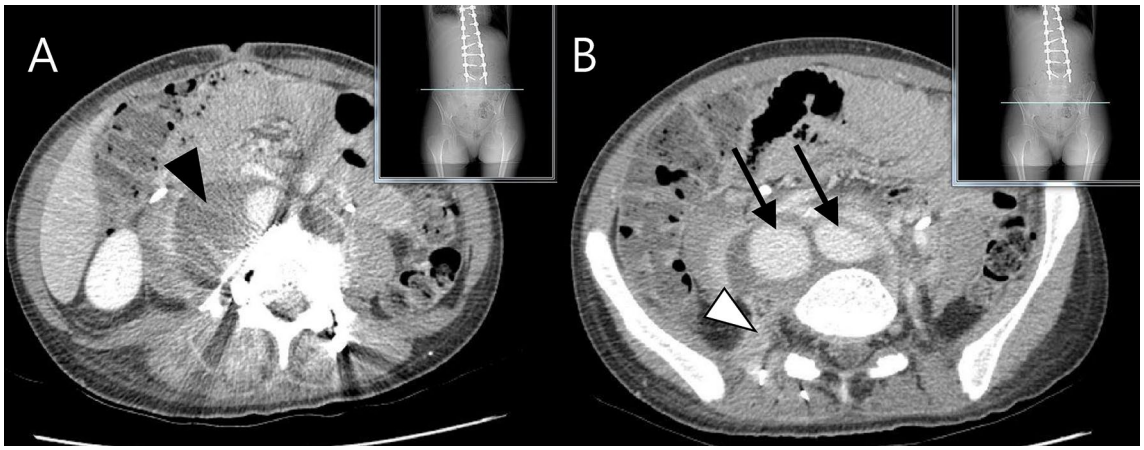

Fig. 1 Abdomino-pelvic computed tomography (AP-CT) revealed a collection of pre- and paravertebral fluid collection (black arrowhead) surrounding a rim-like enhancement around the L3–5 level, containing more than two lobulated spaces filled with high-density-contrast material (black arrow, **a**), predominantly at the L4–5 level. In addition, a cystic lesion with a similar appearance was observed around the adjacent paraspinal muscle area, from T12 to Rt S1 level (white arrowhead, **b**)

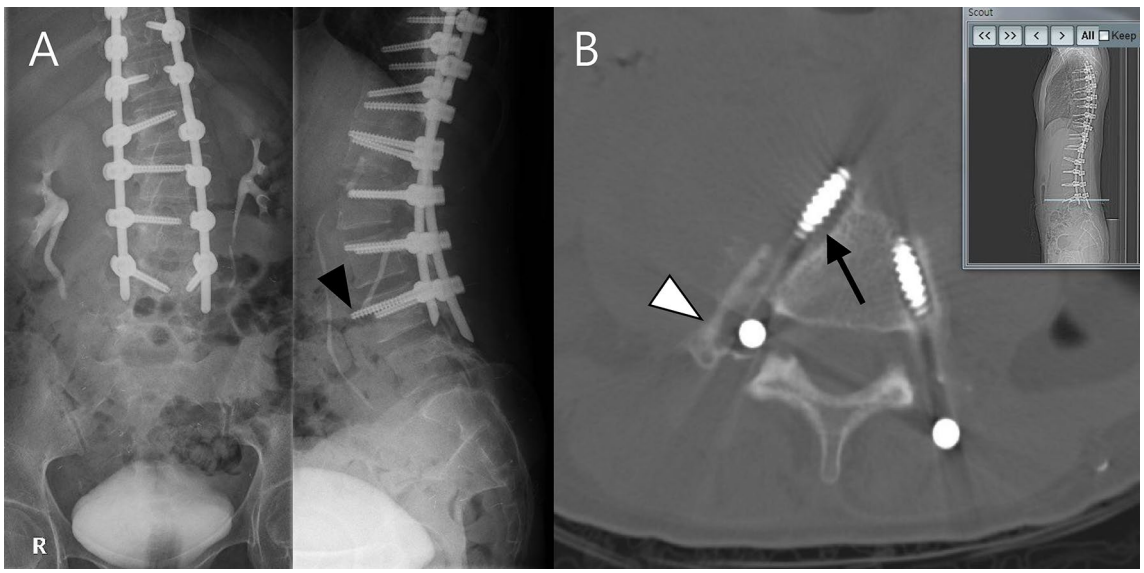

Fig. 2 Lumbar spine X-ray and CT revealed that the right L4 pedicle screw (black arrowhead) was positioned to far anteriorly, with periscrew halo formation (black arrow), adjacent vertebral body erosion, and detachment of the transverse process (white arrowhead)

was made up with free-handed cumulated poly-axial pedicle screw insertion through 2–4 skin incisions each of size 3 cm, pre-contoured rod insertion, thoracoplasty using the same skin incision, arthrodesis by facetal fusion and correction using rod translation and rotation maneuvers [11]. On immediate postoperative radiography at first operation, right L4 pedicle screw malposition was seen without a screw halo.

Clinically, paravertebral arterial erosion with pseudoaneurysm and retroperitoneal and paraspinal abscess were suspected, and surgical treatment was inevitable. Our operating strategy was an interdisciplinary single-session two-step approach, with a vascular surgery team. The first step of surgery was retroperitoneal exploration through the anterior midline abdominal incision. Intraoperatively, a 3-mm perforation at the posterior wall of the right common iliac artery (just below the aortic bifurcation) and pseudoaneurysm behind the artery with surrounding abscess were identified (Fig. 3). After drainage of the abscess, vascular repair of the right common iliac artery was performed with a bovine patch angioplasty. Common iliac artery perforation was treated with primary suture repair. The second step included removal of the right-sided instrument and paravertebral abscess drainage. There was dark-black mucoid fluid with abundant granulation tissues around the right-sided implant at T12–L5 level. Also, a fistula from the right L4 pedicle screw insertion site to the cavity to the retroperitoneal abscess was identified. Left-sided instrumentation was not removed because there was no evidence or sign of infection.

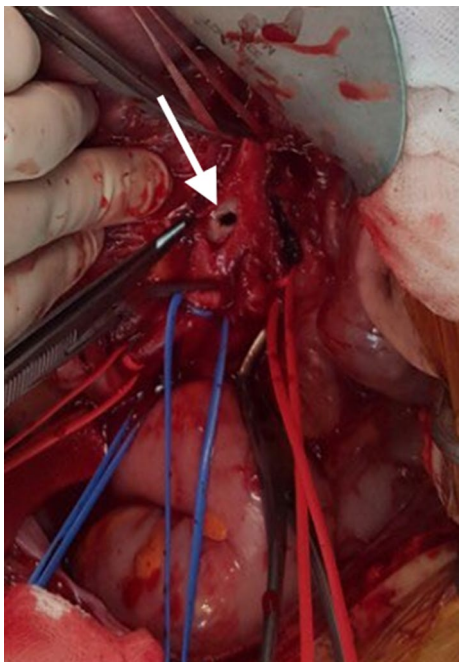

Fig. 3 A 3-mm-sized perforation at the posterior wall of the right common iliac artery, just below the aortic bifurcation (white arrow) was identified and was connected to the fistula from the pedicle screw insertion site

Postoperatively, methicillin-resistant Staphylococcus aureus (MRSA) was identified in the tissue culture from the abscess from the operation field and the patient was treated with intravenous ciprofloxacin according to the antibiotics susceptibility results. At postoperative day seven, the patient recovered to ambulation without any assistance and was discharged without pain or fever. At the 6-month follow-up after the last surgery, she had no limitations or problems in her daily activities with no recurrence of low back pain, abdominal pain, or fever. On the standing whole spine radiograph taken at the last follow-up that was 6 months later after last operation, there was no progression of the residual deformity despite removal of the right-sided instrumentation (Fig. 4).

Discussion

The rate of pedicle screw misplacement varies from 5 to 41% for the lumbar spine, depending on underlying pathology, surgical technique used, and site of screw fixation [12, 13]. The pedicles of the lumbar spine are larger than the pedicles of the thoracic spine. Therefore, the risk of screw misplacement is lower in the lumbar spine than in the thoracic region [14, 15]. Nevertheless, complications caused by pedicle misplacement of the lumbar spine have been reported consistently.

Major vascular injury is one of the most fatal complications of malpositioned pedicle screws. The overall reported incidence of major vascular injury during spine surgery is less than 0.01% [16, 17]. Major vessel injury can remain undiscovered even in follow-up and can become symptomatic in the late postoperative period. The patient may be asymptomatic for months or years after the initial operation. Delayed presentation is most commonly combined with pseudoaneurysm and arteriovenous fistula [18, 19]. Parker et al. reported the incidence of vascular encroachment (a pedicle screw that was touching or deforming the wall of a major vessel) as 0.22% among 6816 consecutive pedicle screws in the thoracic and lumbosacral spine [20]. Foxx et al. reported that 33 of 680 inserted screws were in contact with a major vessel on routine postoperative imaging after a mean follow-up of 44 months, including the aorta (four cases), the iliac artery (seven cases), and the iliac veins (22 cases), but there were no symptoms or sequelae such as pseudoaneurysms, erosions, or deaths [2].

In this case, the patient presented a sudden symptom about 18 months after MISS. MISS for the treatment of AIS has multiple potential benefits such as less blood loss, shorter hospital stay, earlier mobilization, and relatively less pain, but minimally invasive approach usually needs longer

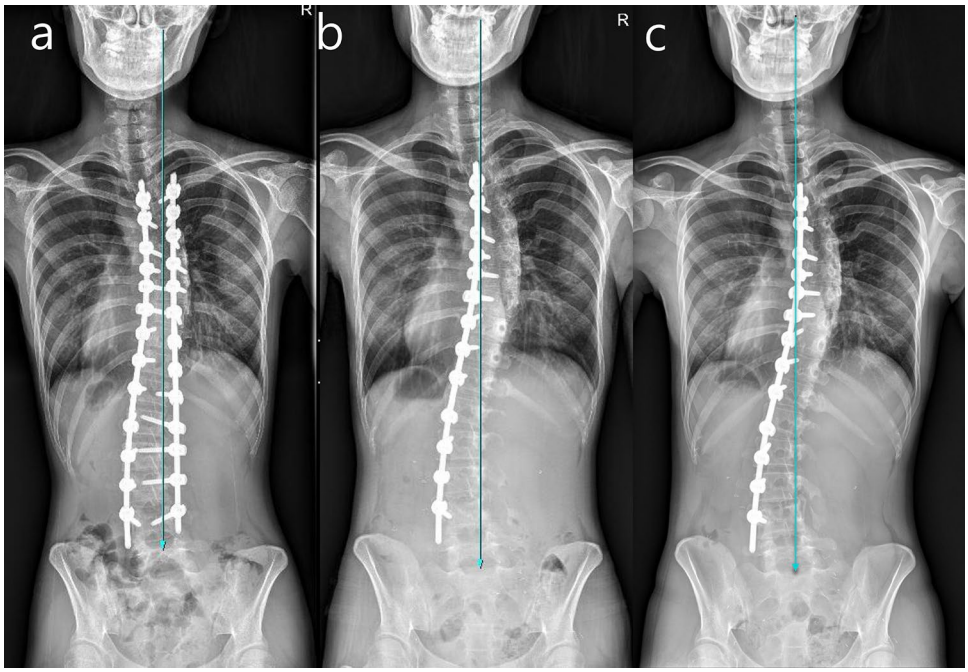

Fig. 4 **a** Standing radiograph at 2 months after initial corrective surgery. Despite removal of right-sided instrumentation (**b**), there was no progression of the residual deformity during the six-month follow-up after the last surgery (**c**)

median operative time and has more potential to make radiologic complications, such as screw loosening or malposition [21–23]. The initial entry point of the misplaced screw was targeted too laterally, and the screw tip was placed too far anteriorly. At this time, the screw tip may have been in contact with the common iliac artery. Screw halo formation, adjacent vertebral body erosion, and detachment of the transverse process indicate that the pedicle screw was not securely fixed to the vertebra. This poor bone-screw anchorage might give less fixation power and finally result in continuous and repetitive motion around the misplaced screw. Scoliosis is one of the most commonly encountered spinal deformities to influence the location of the aorta relative to the vertebral body [24]. Vertebral rotation and angular alterations in scoliosis patients may increase the risk of major vessel injury [14]. In addition, because the misplaced screw was located at the lowest instrumented vertebrae (LIV) of the pedicle screw construct, repetitive toggling motion associated with lumbar spine motion might have occurred on the misplaced screw. This toggling motion of the screw tip was presumed to have caused chronic erosive damage to the adjacent iliac artery and would have contributed to subsequent delayed pseudoaneurysm formation.

In our case, the patient had an infected pseudoaneurysm with abscess formation. Based on a fever episode, complicated infection was presumed to have initiated 1 week before the visit. Paradoxically, the development of this infectious condition helped early detection of late vascular complications in this case. The cause of sudden bacterial infection is presumed to be a hematogenous infection complicated with hematoma around the vessel. In addition, the cannulated pedicle screw used as an instrument for MISS would have contributed to cause increased bleeding and/or spread of infection to the paravertebral muscle layer from the retroperitoneal space where the abscess first occurred.

Our repair strategy for damaged common iliac artery was performed with an open surgical approach, resection of the pseudoaneurysm and an angioplasty with bovine patch. Thanks to effective antibiotic use and relatively young age of the patients, early recovery was achieved without any complications. However, direct repair of the chronic perforation of that vessel seems to be dangerous, especially in the complicated infectious condition. Transient insertion of the vascular stent may also be considered a good alternative technique to consider until the time of infection control.

In summary, we report a rare case of delayed vascular complication following MISS due to malpositioned lumbar pedicle screw, and the cannulated screw could be a facilitating conduit for the spread of infection. Our case showed that misplaced pedicle screws can cause potentially fatal complications even in the late postoperative period, such as infected pseudoaneurysm. In addition, the pedicle screw inserted in the LIV must be inserted in the correct position with sufficient holding strength to prevent delayed complication.

Compliance with ethical standards

Conflict of interest None of the authors has any potential conflict of interest.

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