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Case Report

Lumbar Artery Injury Related to Percutaneous Pedicle Screw Insertion

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A 75-year-old woman underwent L4-L5 lateral interbody fusion for L4-5 foraminal stenosis with the use of percutaneous pedicle screws. On the day after the surgery, she was in shock. Emergency contrast-enhanced CT showed active extravasation from the 4th lumbar artery with a transverse process fracture. A radiologist performed a successful transarterial embolization, and the patient then began walking training on the 4th day post-surgery. Close attention should be paid to the insertion of a percutaneous pedicle screw, as it may cause a lumbar artery injury; in such a case, transarterial embolization is the preferred treatment.

Key words: lumbar artery injury, percutaneous pedicle screw, transverse process fracture, hematoma

Percutaneous pedicle screws (PPSs) have the advantage of less invasiveness for patients, but their use entails a risk of vascular and nerve damage due to poor visibility. A lumbar artery (LA) injury is a life-threatening complication that requires prompt diagnosis and treatment. We report a case of postoperative hemorrhagic shock resulting from the LA injury caused by the tapping procedure for the insertion of a percutaneous pedicle screw with a transverse process fracture.

Clinical Presentation

A 75-year-old woman had developed numbness of the right leg that had started 3 years ago, and she underwent a fourth lumbar laminectomy 1 year before the present admission with a diagnosis of lumbar spinal canal stenosis in our department. However, the right lower limb pain recurred, and the patient visited our department again. She had L4 spondylolisthesis with right L4 radiculopathy due to L4-5 foraminal stenosis and instability. Under general anesthesia, she underwent an L4-5 lateral interbody fusion by the left retroperitoneal approach, and a cage was inserted into the L4-5 intervertebral space without any noticeable bleeding. Subsequently, with the patient in the prone position, we started the process of inserting a 6.5 mm × 40 mm PPS under fluoroscopy. At the tapping procedure on the left side of L4, the tapping device slipped from the entry point and caused gushing bleeding with a left L4 transverse process fracture even though the guide wire was thought to have been in the tapping device. Pressure using gauze seemed to stop the bleeding at that time, and the patient's vitals were stable. We incorrectly concluded that the bleeding had stopped, and we finished the surgery without further examination. The operation time was 2 hr and 23 min, and the blood loss was 128 mL at the end of the surgery.

Immediately after the operation, the patient had normal vital signs. However, on the next day she complained of nausea, respiratory distress, and cold sweating. She exhibited bradycardia and anemia; her systolic/diastolic blood pressure was 66/47 mmHg, and

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her hemoglobin had dropped from the preoperative level of 12.6 g/dL to 7.3 g/dL. An emergency contrast-enhanced CT examination revealed a large hematoma at the left psoas muscle with active extravasation from the 4th left LA (Fig. 1A, B).

A radiologist advanced a catheter into the LA and performed a selective angiogram and transarterial embolization (TAE) with a blood vessel embolus agent (n-butyl-2-cyanoacrylate, NBCA) (Fig. 2A, B). The patient required a total of 9 units (1,260 mL) of red blood cell transfusion in the first postoperative 3 days. The patient began walking training on the 4th day after surgery, and she was discharged from hospital on the 12th day after surgery. At the time of the last follow-up 4 years after surgery, she had normal lower limb muscle strength and her gait was normal.

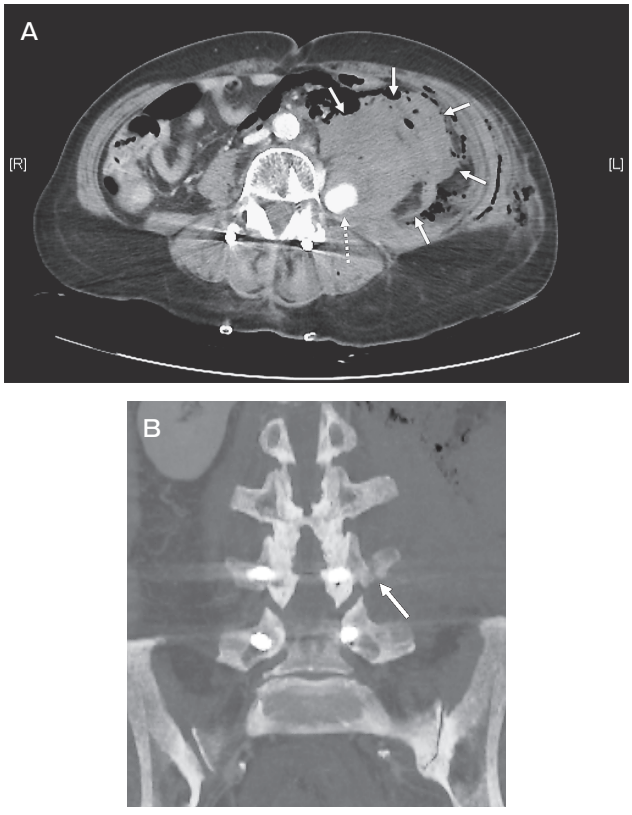

Fig. 1 **A**, Enhanced CT showing extravasation from the left 4th lumbar artery (white broken arrow) and a large retroperitoneal hematoma (white arrow); **B**, CT showing the left 4th transverse process fracture (white arrow).

Discussion

The use of PPSs was first reported by Foley *et al.* [1], and the PPS technique has spread widely because it is less invasive and convenient. An advantage of the use of PPSs is that unlike the previous open method, no step is necessary to confirm the transverse process by the naked eye. Instead, the surgeon uses a finger to identify the entry point between the transverse process and the facet joint in order to insert a Jamshidi needle into that point under fluoroscopy [2, 3], which encourages the surgeon to keep the fluoroscopy time short. These

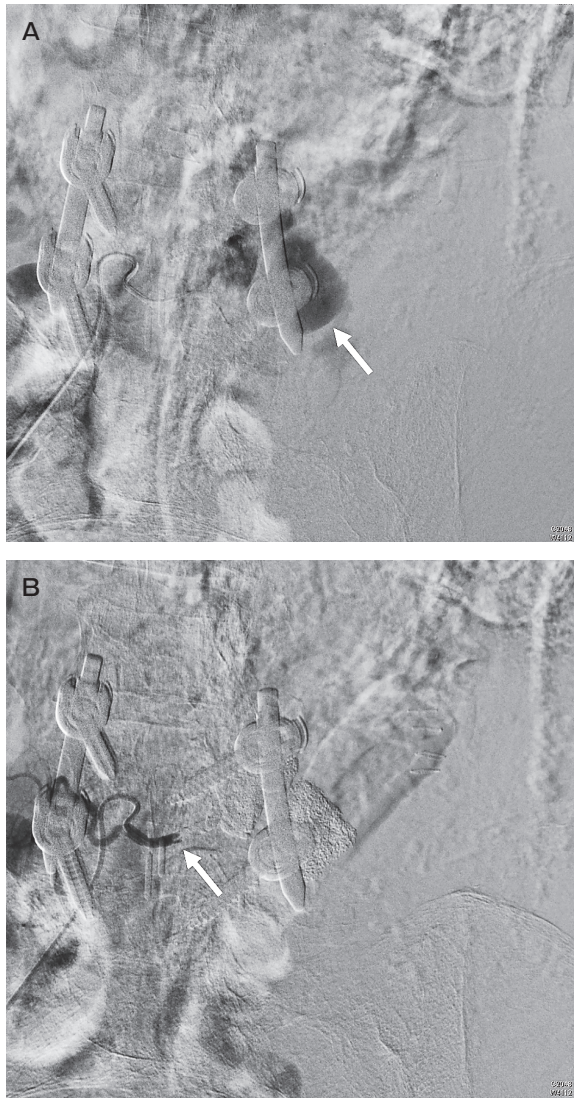

Fig. 2 **A**, Angiography showing the extravasation from the left 4th LA (white arrow); **B**, Angiography obtained after coil embolization reveals no leakage of the contrast medium (white arrow).

aspects of the PPS technique require skill and may pose a risk of LA injury.

To prevent injury of the LA, the surgeon should examine not only the length and diameter of the pedicle screw but also the shape of the transverse process and facet joint; the patient's bone mineral density should be determined before the surgery. In addition, CT-based and fluoro-based navigation techniques have been reported to exhibit higher accuracy in pedicle screw placement compared to the free-hand technique and the use of fluoroscopy [4], and the use of those navigation techniques may help reduce unwanted complications. In our patient's case, based on the situation during the surgery, we think that the tapping device slipped and caused the LA injury without it being noticed that the guide wire was about to come off. Care should thus be taken to not pull a guide wire out or to insert it too deeply, especially in the cases of patients with osteoporosis. Even with the risk of radiation exposure, it is necessary to properly confirm this using fluoroscopy. A long Kocher clamp can be used to hold instruments that maintain a distance from the X-ray tube [5]; alternatively, radiation-protective gloves can be used [6].

LA injuries caused by pedicle screws are rare, and there are only 4 reported cases [7-9]. Two of the 4 cases were due to screw tapping [7, 8], and the other 2 cases involved malposition of the pedicle screw [7, 9]. Several anatomical studies describe the courses of LA branches over the anterior aspect of the base of the transverse process [10, 11], which suggests that pedicle screws outside the pedicle or fracture of the transverse process can easily damage these branches.

On the other hand, to the best of our knowledge, there are no reports about a transverse process fracture caused by a percutaneous or conventional pedicle screw. Regarding transverse process fracture and LA injury, Oh *et al.* reported that an injury to the LA was caused by a L3 transverse process fracture during drilling decortications in a case of L3-L4 posterolateral fusion [12]. They speculated that the LA was injured at the anterior side of the transverse process. Looking at LA injuries caused by a transverse process fracture in other than iatrogenic cases, an LA injury combined with a transverse process fracture after a fall was reported [13]. Based on these reports, if a transverse process fracture has occurred, we should keep in mind the possibility of a LA injury.

In the present patient's case, there were no findings of massive bleeding after the lateral lumbar interbody fusion, but we observed gushing bleeding at the PPS tapping procedure. The PPS procedure was thus considered to be the cause of bleeding but not the lateral lumbar interbody fusion. In addition, the blood loss during this surgery was 128 mL and the patient's vital signs were normal throughout the surgery; we did not perform abdominal enhanced CT immediately after the surgery, which was the reason the patient developed shock the next day. A systematic review described a total of 26 patients with iatrogenic LA injury, and the diagnoses of 19 of the patients were delayed from 1 day to 6 months (average 22 ± 44 days) [14].

Ntourantonis *et al.* described a delayed and fatal bleeding of the LA despite the lack of visible intraoperative bleeding and an uneventful postoperative period as in our patient's case; their patient died on the seventh postoperative day [15]. It can expected to be more difficult to confirm the bleeding site in an LA injury caused by PPS than in open surgery. We suspect that the bleeding in our patient's case was continuing and gradual after the surgery, but the hematoma was covered with the strong psoas major and minor muscles. An important reflection point is that a single CT examination, several complete blood count tests, or frequent blood pressure monitoring after surgery could have avoided this emergency. This case, although rare, teaches us that even when bleeding seems to have stopped, we should never overlook the possibility of persistent bleeding from an invisible site.

Our patient was successfully treated by TAE. When we recognize persistent bleeding from an injured LA during or after surgery, TAE is considered to be safest and most effective method for LA bleeding. In a systematic review, 20 of 20 patients with LA injury were successfully treated by TAE [14]. In our experience, it is very important to collaborate with a radiologist who is skilled at intervention techniques involving TAE before PPS insertion or lateral interbody fusion surgery.

Conclusion

Close attention is necessary for a PPS insertion, as it may cause an injury to the LA. Once an LA injury has occurred, transarterial embolization is the preferred treatment.

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