Case Report

SPINE RESEARCH

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A case of progressive decrease in muscle strength of the lower limbs caused by intradural cement leakage after vertebroplasty

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Abstract:

Here's a report on bone cement leakage. Our review of the literature revealed that cases of bone cement leakage are commonly reported, but intradural leakage of bone cement is rare. Here, we present a delayed case of L2 and L3 radiculopathy secondary to bone cement leakage from percutaneous vertebroplasty (PVP). This case exhibited extensive intravertebral and intradural cement leakage, with only a slight decrease in lower extremity strength and lateral thigh pain in the immediate postoperative period. In this case, we describe a rare occurrence of substantial postoperative PVP with intradural leakage. In terms of treatment, early surgical decompression and cement removal should be performed in patients with significant symptomatic cement leakage.

Abbreviations: ODI = oswestry disability index, OVCFs = osteoporotic vertebral compression fractures, PVP = percutaneous vertebroplasty, PKP = percutaneous kyphoplasty, VCF = vertebral compression fracture.

Keywords: bone cement, intradural leakage, osteoporosis, osteoporotic vertebral compression fractures, percutaneous vertebroplasty

1. Introduction

Osteoporosis, the most common metabolic bone disease, is characterized by low bone mineral density and reduced bone strength, resulting in an increased risk of fractures.[1] The incidence of osteoporotic vertebral compression fractures (OVCFs) has been increasing in the past few decades, with numbers expected to rise from 3.5 million in 2010 to 4.5 million in 2025.[2] Although there are no substantial conclusions on the superiority of cementoplasty over conservative management for OVCFs, it is well accepted that conservative treatments are not indicated for every condition, and cementoplasty is appropriate in certain circumstances. Moreover, conservative treatments have inevitable limitations such as residual pain, malunion, prolonged bed rest, and consequent complications. Thus, cementoplasty is strongly recommended for patients with intense pain, severe kyphosis, or substantial functional limitations.[3]

Here, we present a delayed case of L2 and L3 radiculopathy secondary to bone cement leakage from percutaneous vertebroplasty (PVP). This case exhibited extensive intravertebral and intradural cement leakage, with only a slight decrease in lower extremity strength and lateral thigh pain in the immediate postoperative period.

2. Case report

A 52-year-old woman presented to our department with the chief complaint of low back pain persisting for more than 7 years, accompanied by pain and numbness in the right lower limb lasting for more than 2 years, worsening over the past 6 months. On taking the patient's history, the patient was diagnosed with a compression fracture of the T12 vertebrae after a fall 7 years ago that resulted in thoracic back pain. Preoperative X-ray showed a compression fracture of the T12 vertebral body with a slight wedge deformity, and percutaneous vertebroplasty of the T12 was performed in a local hospital, with significant pain relief and no neurologic abnormality after the operation. Subsequently, the patient fell again and was diagnosed with L2 and L3 vertebral compression fractures, and again underwent L2 and L3 percutaneous vertebroplasty locally (Fig. 1). Immediately after surgery, the patient felt pain in the right lateral thigh and numbness below the left knee. After being bedridden for 3 days, the patient transitioned to being mobile at ground level, followed by rehabilitation acupuncture treatment. Despite

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this intervention, the patient reported insignificant relief and no dysfunction in urinary and fecal functions.

Two years after their last surgery, the patient was admitted to the hospital for relevant examinations. Due to having previously undergone PVP surgery on 3 vertebrae, they could only undergo a bone mineral density test at the femoral neck, yielding a value of 0.656 g/cm^2. With a *T* value of –2.8, the patient was diagnosed with severe osteoporosis, and the imaging results are described later.

During their physical examination, the patient exhibited marked pain in the right lateral thigh, sensory hypersensitivity, inability to lie on the right side, and numbness below the left knee up to the plantar aspect of the foot. Sensation in the anus and perineal area was normal, and the muscle strength in the right lower limb was graded as 4. The muscle strength of the left lower limb was grade 4+, bilateral ankle dorsiflexion muscle strength was normal, knee tendon reflexes were hyperactive, anal reflexes were present, and Achilles tendon reflexes were not abnormal.

At the patient's firm request, a third decompression surgery was performed, which was carried out under neurophysiological monitoring throughout the procedure. Imaging revealed cement leakage into the dura mater along the direction of the puncture needle, with large amounts of cement remaining in the epidural and intradural and intervertebral foramina of L2/L3 (Fig. 2).

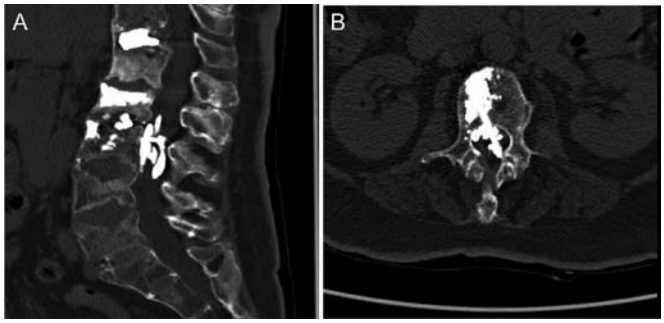

Figure 2. Preoperative sagittal (A) and transverse (B) computed tomography scans show that the bone cement penetrated the spinal canal along the puncture channel, occupying almost the entire L2/3 level of the spinal canal, with noticeable spinal cord compression.

Due to the findings described earlier, after completing the examination, L2–L4 laminectomy + intradural cement removal was performed to maximize the removal of the intradural and intracanal bone cement for decompression.

During surgery, the incision of the dura revealed multiple pieces of free bone cement adhering and compressing at the level of the L2–L3 vertebral body, with large amounts of scattered sclerotic bone cement observed in the dura mater bilaterally as well as in the intervertebral foramina of L2–L4 (Figs. 3 and 4).

Immediately after the operation, the patient's pain in the right lower limb significantly decreased, and they regained the ability to lie on their right side, with muscle strength of grade 4. The patient was also able to get out of bed independently while wearing a waist cuff. Postoperative X-ray images showed that most of cement had been removed (Fig. 5). It was determined that the patient's new neurologic deficit after the second vertebroplasty was caused by intracanalicular cement leakage. At the last follow-up visit, 28 months after the previous surgery, the muscle

Figure 1. Frontal (A) and lateral (B) views of an entire spine radiograph showing well-filled bone cement in T12, with substantial cement infiltration into the posterior margins of the L2 and L3 vertebral bodies posteriorly.

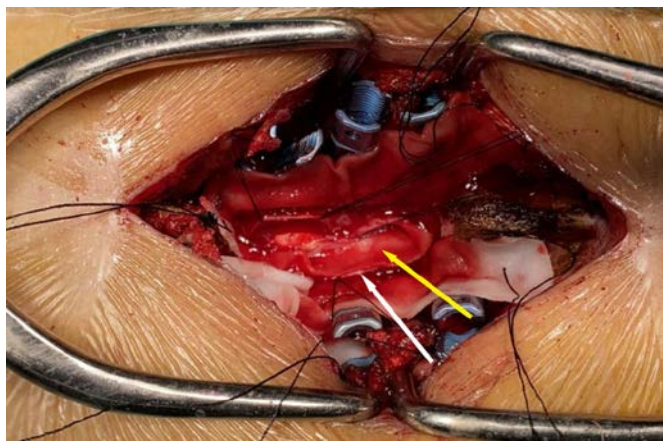

Figure 3. Intraoperative visualization of the presence of a large amount of cement debris within the dura, with severe spinal cord compression (yellow arrows indicate the incised dura, white arrows indicate the cement leaking into the dura).

Figure 4. Partially cleaned bone cement fragments.

strength of both lower limbs had essentially returned to normal, with occasional complaints of lumbar pain, and the surgical sensation of the right thigh had returned to normal. During that time, the patient consistently adhered to an anti-osteoporosis medication regimen.

3. Discussion

OVCFs stand as one of the most common fragility fractures, significantly impacting the quality of life of older individuals.[4] Cement leakage is a common complication of OVCFs, with a reported incidence of 4.8% to 39%. However, the majority of cement leakage cases are asymptomatic. Nevertheless, cement leakage can lead to complications such as paraplegia, pulmonary embolism, and even cardiovascular distress.[5] One study reported that the cement leakage rate was highest in unilateral PVP patients, attributed to the increased angle of puncture.[6] In these cases, a large amount of bone cement is injected, increasing the pressure on the diseased vertebrae, resulting in bone cement leakage. However, identifying leakage via fluoroscopy or X-ray poses challenges due to complexity and interobserver variability in agreement. Consequently, a computed tomography (CT) scan emerges as the preferred method for precise assessment of the cement extravasation rate. This imaging modality could also aid in determining whether postoperative clinical symptoms are linked to cement leakage.[7] Given the apparent frequency of cement leakage, proactive measures to prevent its occurrence are imperative. Preoperative identification and assessment of risk factors can significantly mitigate the likelihood of cement leakage.

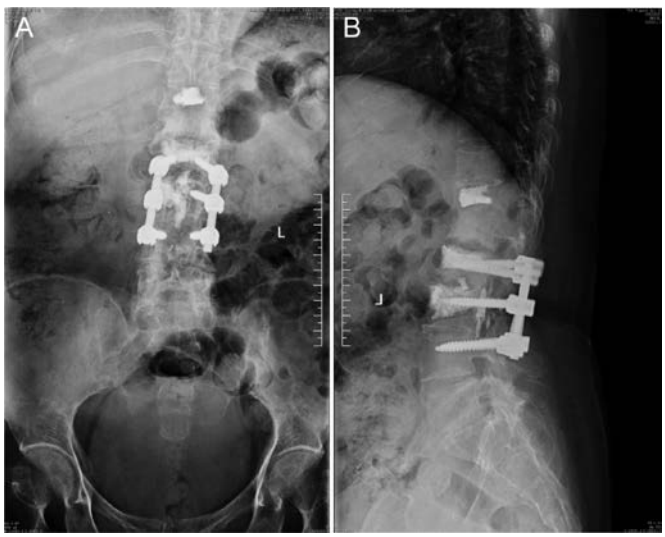

Figure 5. Postoperative X-ray images captured from the frontal (A) and lateral (B) views, illustrating the substantial removal of cement.

In this case, we describe a rare occurrence of substantial postoperative PVP with intradural leakage. Notably, if cement leakage occurs, termination of the procedure is recommended.[8] For inexperienced young orthopedic surgeons, imaging studies such as CT, magnetic resonance imaging, and X-rays should be performed before surgery to identify factors affecting cement leakage, such as damage to the pedicle wall, vertebral body fracture, and the puncture angle. Additionally, imaging can assist in formulating a reasonable surgical plan, which can help prevent serious sequelae. Moreover, postoperative CT examination can further confirm cement distribution, and routine postoperative follow-ups should be performed in patients for at least 1 year. In terms of treatment, early surgical decompression and cement removal should be performed in patients with significant symptomatic cement leakage.

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Ethical statement

Ethics approval was obtained from the the First Affiliated Hospital of Zhengzhou University (No. L2020-Q213-002).

Conflicts of interest

The authors have no conflicts of interest to disclose.

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Data availability

Not applicable.

Author contributions

CFS and LYL have equal contributions to this manuscript. CFS, LYL, HWK, and GWS drafted the manuscript. CFS, SFC, ZKL, and MHW prepared figures. HJL

edited the final manuscript. All authors have reviewed and approved the final submitted manuscript.

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