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CASE REPORT

Tuberculous Spondylitis and Paravertebral Abscess Formation Following Vertebroplasty: A Case Report and Review of the Literature

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Abstract: Tuberculous spondylitis following percutaneous vertebroplasty or kyphoplasty is rare. In this, we report a rare case of tuberculous spondylitis diagnosed after percutaneous vertebroplasty (PVP). A 69-year-old female sought came to our department with a history of chest and back pain from the last two months accompanied by weakness in both lower limbs. The patient underwent two vertebroplasty procedures at a local hospital within two years for compression fractures of the lumbar and thoracic spine. Due to continuous lower back pain following PVP surgery, along with the worsening back pain weakness in both lower limbs over the past 2 months, the patient presented to our hospital for the treatment. Radiological imaging showed long bone destruction in the L1, L2, and T12 vertebrae, accompanied by the formation of numerous paraspinal abscesses. The serum T-SPOT test yielded a positive result. A sample was taken from a paravertebral abscess for TB DNA testing (GeneXpert MTB/RIF assay) under the guidance of CT, which demonstrated the patient was infected with a non-drug-resistant strain of TB. The patient underwent surgical treatment via a combined anterior and posterior approach. The histological examination of the excised tissue revealed evidence of tuberculosis, characterized by granulomatous inflammation and sheet necrosis. After taking anti tuberculosis drugs for 12 months, the patient recovered without any sequelae. Spinal tuberculosis and osteoporotic vertebral compression fractures are similar in clinical and radiological aspects. Spinal surgeons should consider the entity of this disease to avoid misdiagnosis or complications. After diagnosis of spinal tuberculosis after vertebral augmentation surgery, early surgical intervention and anti-tuberculosis treatment should be carried out immediately.

Keywords: Tuberculous spondylitis, vertebroplasty

Introduction

Percutaneous vertebroplasty (PVP) or percutaneous kyphoplasty (PKP) are two widely used techniques worldwide for the treatment of osteoporotic vertebral compression fractures (OVCFs).[1,2] Although a large number of studies have confirmed that PVP/PKP is relatively safe and effective, some complications, including cement leakage, are still not uncommon. This can result in neurological dysfunction or even pulmonary embolism.[3] However, case reports of vertebral body infections following treatment with PVP/PKP are rare, with a prevalence rate of less than 1%.[4] In addition, the most commonly reported cases are purulent infection caused by bacteria.[5] We report a rare case of tuberculous spondylitis that was diagnosed after percutaneous vertebroplasty (PVP). We analyzed the causes of spinal tuberculosis infection and provided recommendations. Clinical doctors should be aware of this possibility and take it seriously to avoid misdiagnosis and mistreatment.

Case Presentation

A 69-year-old female patient presented with a six-month history of persistent low back pain following PVP, which had progressively worsened over the preceding two months, resulting in bilateral lower extremity weakness. She had a previous history of a compression fracture of the lumbar vertebra 1. Two years ago, which was treated with PVP surgery at a local hospital. One year after the surgery, another fracture of the lumbar vertebra 2 and thoracic vertebra 12 was treated with PVP surgery at

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a local hospital. The patient continued to experience lower back pain for a period of six months following the second surgical procedure, in addition to exhibiting weakness in the lower extremities for the final two months. The patient was subsequently admitted to our hospital for further examination and treatment.

Upon clinical examination upon admission, local tenderness and percussion pain in the back were observed, along with limited lumbar movement and extensive numbness in both lower limbs, accompanied by decreased muscle strength, which was rated at level 4. The results of routine blood tests indicated a white blood cell count of 4.82×10^9/L (within the normal range of 3.5–9.5 $\times$ 10^9/L), comprising 64.7% neutrophils (within the normal range of 40–75%), 21.6% lymphocytes (within the normal range of 20–50%), and 2.7% eosinophils (within the normal range of 0.4–8%). The erythrocyte sedimentation rate (ESR) was 120 mm/h (normal range: 0–20 mm/h), and the C-reactive protein (CRP) level was 34.15 mg/L (normal range: 0–10.0 mg/L). The serum T-SPOT test demonstrated that the earlier secreted antigen target-6 in the Antigen A group exhibited 26 spots (within the normal range of 0–6), while the culture filter protein-10 in the Antigen B group displayed 16 spots (within the normal range of 0–6). Consequently, the result of the serum T-SPOT test was determined to be positive. The results of the serum T-SPOT test indicated the presence of a Mycobacterium tuberculosis infection. All other test results were within the normal range, including those for tumour markers.

Computed tomography (CT) scans of the thoracic and lumbar vertebrae showed bone destruction and paraspinal abscess formation at T11, T12, L1 and L2. The surgical appearance of T12, L1 and 2 vertebral bodies showed that some bone cement had leaked into the paraspinal, spinal canal, lumbar muscle and right ascending lumbar vein. (Figure 1). Magnetic resonance imaging (MRI) showed changes after T12 and L1, 2 vertebral body shaping surgery, bone destruction and formation of paraspinal and lumbar muscle abscesses in T11, T12, L1 and L2 vertebral bodies. Compression and stenosis of the spinal canal in the T12-L2 segment suggest infectious lesions and possible tuberculosis. (Figure 2). No additional anomalies were identified on the CT scans of the thorax or abdomen. To obtain further diagnostic information, a CT-guided puncture was performed on the paravertebral abscess lesions for pathological examination. The results showed that bacterial and fungal cultures in the pus were negative, but the acid fast bacteria image experiment was positive. The GeneXpert MTB/RIF assay yielded positive results for the presence of TB DNA and negative results for rifampicin resistance, indicating that the patient was infected with a non-drug-resistant strain of TB.

Due to the potential risk of increased neurological deficits and worsening clinical symptoms, after 2 weeks of adjuvant therapy with isoniazid (300 mg/day), rifampicin (600 mg/day), pyrazinamide ((900mg/day)), and ethambutol (1500mg/day), we proceeded with the surgical treatment. The procedure included removal of anterior purulent lesions and necrotic bone, removal of leaked bone cement, spinal cord decompression, implantation of a titanium cage between the thoracic and lumbar regions (autogenous ribs), and posterior fixation with bone cement screw reinforcement T9-L4. Postoperative pathologic tests were also suggestive of tuberculosis infection. (Figure 3). Postoperatively, the patient continued to receive standardized anti-tuberculosis treatment. The patient had severe osteoporosis and received systematic anti-osteoporosis treatment after surgery. The post-operative CT showed that the dead bone and abscess had been cleared, and the position of the anterior titanium cage and posterior internal fixation was satisfactory. (Figure 4). Compared with the preoperative period, the patient's lower extremity numbness and muscle strength improved after surgery, and she was able to move normally with the assistance of thoracolumbar braces. At the one-year postoperative follow-up, the patient was observed to be ambulating without any complications.

Discussion

Many current studies have confirmed that PKP and PVP have good clinical efficacy in treating painful osteoporotic vertebral compression fractures and bone tumors.[6,7] Previous reports on its complications have mainly focused on the migration of bone cement to the venous system, neural foramen, and posterior spinal canal, as well as bone cement embolism.[8] Postoperative spinal infection has been documented in cases where immunosuppressive complications, such as diabetes and kidney transplantation, have been present.[5,9] Nevertheless, the occurrence of tuberculosis spondylitis with enhanced spine after percutaneous vertebroplasty (PVP) or PKP is an infrequently documented phenomenon. We set spinal tuberculosis and vertebroplasty as search terms and conducted a search in PUBMED, only finding 7 case reports.[10–16](Table 1). A total of 16 patients were involved in these reported cases. Two of these patients died, nine were cured and exhibited normal neurological function, and five exhibited residual symptoms of neurological damage.

Figure 1 Computed tomography (CT) scans (thoracic and lumbar spine). Bone destruction and paraspinal abscess formation in the T11, T12, L1 and L2 vertebrae. The surgical appearance of the T12, L1 and 2 vertebrae showed that some of the bone cement had leaked into the paraspinal area, spinal canal, lumbar musculature and right ascending lumbar vein. (**A**). Sagittal; (**B**). Coronal; (**C** and **D**). Transversal.

Only one patient was treated with anti-tuberculosis drugs alone, and the results were satisfactory. As evidenced by these cases, this is a devastating infection that frequently necessitates significant surgical intervention to stabilise the spine and preserve nerve function. The overall prognosis is dependent on early diagnosis and timely surgical intervention. Here, We report a case of a patient with post-PVP infection who was diagnosed with multiple tuberculous spondylitis.

Early imaging examinations for spinal tuberculosis may not be typical, and patients may also have no symptoms of tuberculosis poisoning. Therefore, relying solely on imaging examination results is indeed difficult to distinguish from OVCFs and is prone to misdiagnosis.[17,18] At the same time, in the absence of symptoms of tuberculosis poisoning and other systemic manifestations, doctors are not alert to spinal tuberculosis, and do not fully understand the diversity of spinal tuberculosis lesions. Reliance on a single imaging result leads to limited diagnostic evaluation. The main symptom of early spinal tuberculosis may only be local pain.[19] Patients often seek medical attention due to "pain", and doctors use imaging examinations such as X-rays, CT, MRI, etc. Imaging examinations show OVCFs imaging manifestations such as wedge-shaped changes in the vertebral body and bone marrow edema signals. In addition, doctors with elderly patients tend to habitually diagnose OVCFs, neglecting detailed inquiries about their medical history and missing necessary medical examinations for tuberculosis diagnosis. Vertebroplasty is a minimally invasive surgery under local anesthesia,

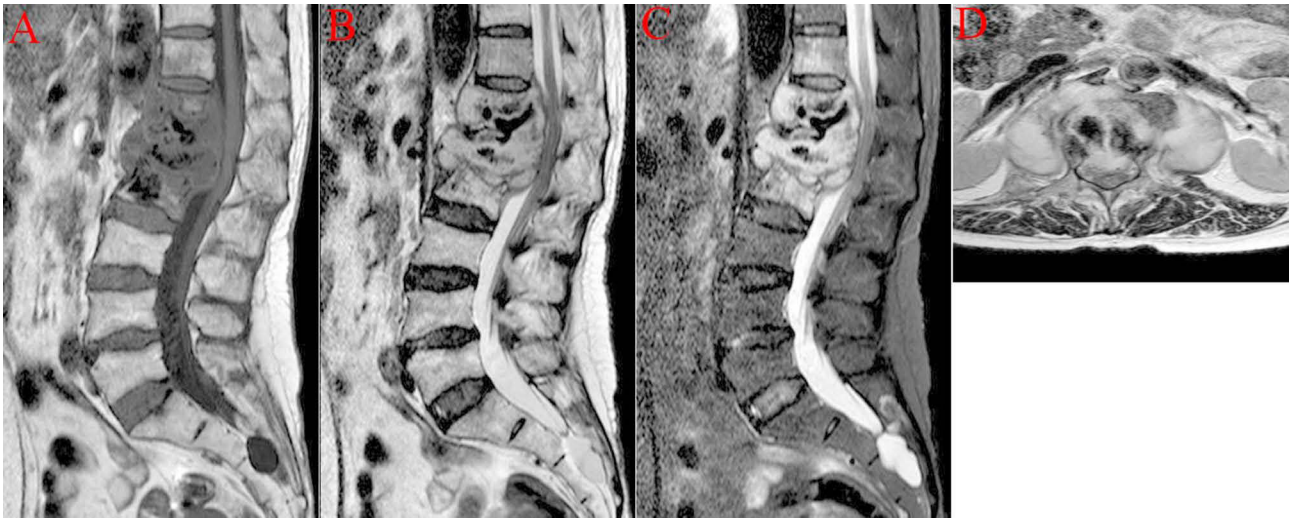

Figure 2 Magnetic resonance imaging (MRI) (thoracic and lumbar vertebra). Bone destruction and formation of paraspinal and lumbar muscle abscesses in T11, T12, L1 and L2 vertebral bodies, and compression and stenosis of the spinal canal in the T12-L2 segment. ((**A**) sagittal T1-weighted; (**B**) sagittal T2-weighted; (C) sagittal fat-suppressed T2-weighted; (**D**) transversal fat-suppressed T2-weighted).

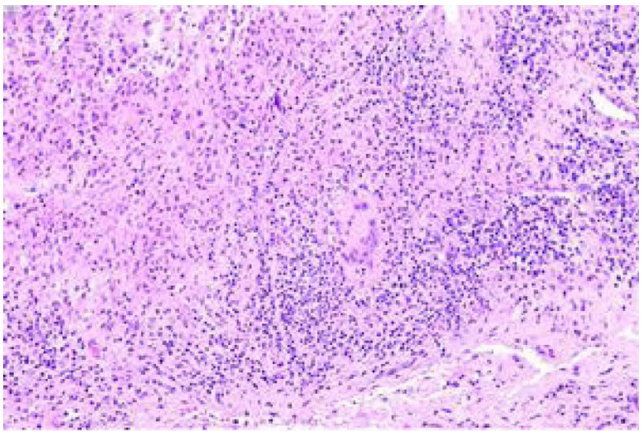

Figure 3 The result of pathology of puncture biopsy-sample. Granulomatous inflammation with foci of necrosis under the microscope, suggestive of tuberculous infection. (hematoxylin-eosin staining).

and patients have a short hospital stay. Generally, patients are discharged on the third postoperative day with no need for further inpatient observation.

In our reported case, the patient underwent two PVP surgeries within two years at a local hospital. After the first PVP surgery on the lumbar vertebrae 1, bone edema occurred again in the thoracic vertebrae 12 and lumbar vertebrae 2. The progression of the condition did not receive the attention of the doctor, and we believe there may be a misdiagnosis. At present, the causes of tuberculosis infection after PVP and PKP surgery still need further research. In addition to the initial misdiagnosis of tuberculosis as compression fractures, research has indicated a potential correlation between pulmonary tuberculosis and the subsequent development of spinal tuberculosis following PVP/PKP.[10,20] In the case of active pulmonary tuberculosis, the most likely mechanism is the spread of blood from the lungs to the vertebrae. In addition, the trauma caused by local bone cement surgical puncture makes the area more susceptible to infection.[21] The existing inactive tuberculosis focus or macrophages from the primary infection site migrate to the injury site, causing spinal infection. The case we reported has no active pulmonary tuberculosis, and the patient had no history of tuberculosis. It is hypothesised that the local reactivation theory may provide an explanation for the pathogenesis.

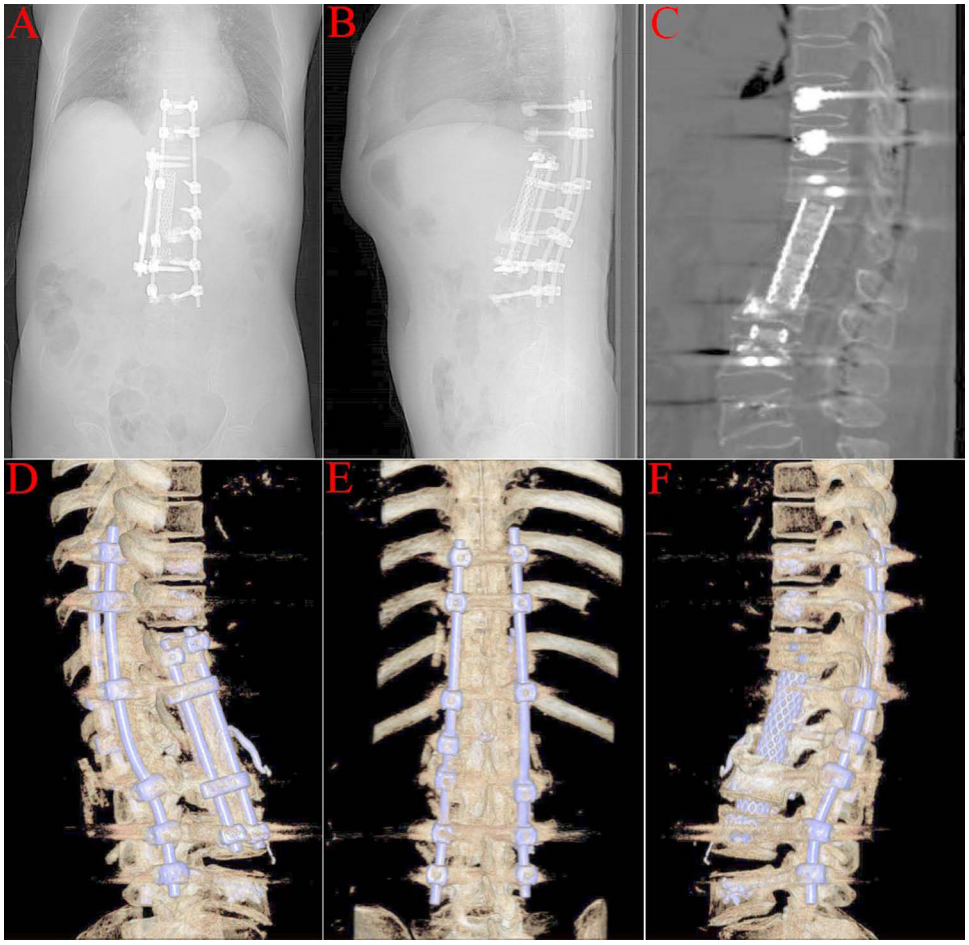

Figure 4 Computed tomography (CT) (thoracic vertebra). The position of the anterior titanium cage and posterior internal fixation was satisfactory. (**A** and **B**). DR, positive and lateral positioning images; (**C**). Sagittal reconstruction; (**D–F**). 3D reconstruction.

How to avoid misdiagnosis of spinal tuberculosis as compression fractures? Clinical doctors should first pay attention to medical history inquiries, including the time of onset, triggering factors, nature and duration of pain, as well as accompanying symptoms, treatment history, etc. Pay attention to some sensitive indicators for screening tuberculosis infection, such as the serum T-SPOT test. The serum T-SPOT test, also known as the serological examination, has been demonstrated to exhibit a sensitivity and specificity of over 90%. Furthermore, it is a more time-efficient method than microbiological and histological examination of specimens.[22] However, microbiological and histological examination of specimens remains the gold standard for diagnosis. In our case, we performed T-SPOT testing and abscess puncture for microbiological and histological examination,

Table 1 Summary of Previous Cases of Active Tuberculous Spondylitis After PVP or PKP

Published Time(year)	Study	Age/ Sex	P-TB	Treated Levels	Infected Levels	Mode of Therapy	Outcome
2006	Bouvresse et al[16]	69/M	No	T12–L5 PVP	L5	Surgery, antituberculous medications	Cured, normal walking
2010	Ivo et al[12]	70/M	Yes	L1 PKP	L1	Surgery, antituberculous medications	Died
2012	Kim et al[15]	76/F	No	T12, L1 PKP	T12, L1	Surgery, antituberculous medications	Cured, normal walking
2015	Zou et al[10]	68/F	Yes	L2 PVP	L1, L2, L3	Antituberculous medications	Cured, normal walking
		67/F	Yes	L3 PKP	L2, L3	Surgery, antituberculous medications	Cured, normal walking
2016	Ge et al[14]	61/F	No	L1 PKP	T9–L1	Surgery, antituberculous medications	Cured, normal walking
2018	Sun et al[13]	54/F	Yes	L3 PKP	L2, L3	Surgery, antituberculous medications	Cured, normal walking

(*Continued*)

Table 1 (Continued).

Published Time(year)	Study	Age/ Sex	P-TB	Treated Levels	Infected Levels	Mode of Therapy	Outcome
2019	Lai et al[11]	75/F	Yes	T9 PVP	T9, T10	Surgery, antituberculous medications	Died
		79/F	Yes	T11, T12 PVP	T11, T12	Surgery, antituberculous medications	Cured, walker support
		66/M	No	L4 PVP	L3, L4, L5	Surgery, antituberculous medications	Cured, normal walking
		79/F	No	L1 PVP	T12, L1, L2	Surgery, antituberculous medications	Cured, normal walking
		70/F	Yes	T9, T10 PVP	T9, T10	Surgery, antituberculous medications	Cured, on wheel chair
		74/F	Yes	L1 PVP	T12, L1	Surgery, antituberculous medications	Cured, walker support
		71/F	No	L1 PVP	L1	Surgery, antituberculous medications	Cured, walker support
		72/F	No	L4 PVP	L3, L4, L5	Surgery, antituberculous medications	Cured, walker support
		70/F	Yes	T8, T9 PVP	T8, T9	Surgery, antituberculous medications	Cured, on wheel chair
	Current study	69/F	No	T12, L1, L2 PVP	T11, T12, L1 and L2	Surgery, antituberculous medications	Cured, normal walking

Abbreviations: M, male; F, female; PVP, percutaneous vertebroplasty; PKP, percutaneous kyphoplasty. P-TB: Pulmonary tuberculosis.

both of which confirmed spinal tuberculosis infection. After two weeks of standardized anti tuberculosis treatment, we implemented a combination of anterior and posterior surgical approaches.

The main purpose of the operation was to remove the bone cement, thoroughly remove the tuberculosis focus, reduce the load of tuberculosis, help control tuberculosis, rebuild the stability of the spine, reduce pain, and improve the quality of life.[23] For the removal of tuberculosis focus, the most thorough way is to remove the focus under direct vision through anterior surgery. The focus was completely removed, which made it easier to remove the bone cement. Removing bone cement first is not easy without removing the focus because there would have been a risk of damaging surrounding tissue during the removal process. Elderly patients have varying degrees of osteoporosis. Intervertebral bone grafting following lesion removal combined with posterior internal fixation enhances the stability of the surgical outcome.[24] In our case, standardized anti tuberculosis treatment was performed after surgery, along with systematic anti osteoporosis treatment to promote bone fusion, increase bone strength, and promote stability of the implant.

Conclusion

In summary, we present a rare case of spinal tuberculosis infection following PVP surgery. Therefore, clinical doctors should be aware of this possibility and take it seriously to avoid misdiagnosis and mistreatment. Early diagnosis is crucial. Standardized anti-tuberculosis treatment and surgical treatment can lead to favorable clinical outcomes.

Abbreviations

MRI, magnetic resonance imaging; CT, computed tomography; PVP, percutaneous vertebroplasty; PKP, percutaneous kyphoplasty; OVCFs, osteoporotic vertebral compression fractures.

Data Sharing Statement

The data employed and analyzed in the present study are available from the corresponding author upon reasonable request. All data files referenced in this manuscript are available for consultation.

Ethics Approval

The study was approved by the Medical Ethics Committee of Yichang Central People's Hospital. The Medical Department of Yichang Central People's Hospital has granted permission for the publication of case details.

Informed Consent Statement

All published medical histories and photographs have been signed with informed consent from the patient.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no competing interests.

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