RESEARCH ARTICLE

Clinical observation of percutaneous vertebroplasty in the treatment of osteoporotic vertebral compression fracture

Fei Feng,[1] Xin Zhong,[2] Lingli Luo,[3] Chao Shang,[4] Lin Huang,[5] Zhonghua Cheng[6]

Abstract

Objective: To investigate the clinical efficacy of percutaneous vertebroplasty (PVP) on osteoporotic vertebral compression fracture and relevant issues.

Methods: The data of 80 patients with osteoporotic vertebral compression fracture admitted to Orthopaedics Department, Huanggang Central Hospital from September 2013 to September 2015 was selected for analysis. The data selection was done from December 2018 to February 2019 Under local anaesthesia and C-arm X-ray fluoroscopy, percutaneous kyphoplasty was performed by puncturing into unilateral (or bilateral) pedicle(s) percutaneously and fixing with bone cement. The degree of lower back pain and the recovery of vertebral height in patients were observed and recorded before surgery, 24 hours and 3 months after surgery.

Results: All of the 80 patients had a successful surgery. After 24 hours of surgery, 47 (58.75%) patients had no lower back pain, 33 (41.25%) had mild dull pain locally; 74 (92.50%) patients were able to have out-of-bed activity on Day1 after surgery, and 6 (7.50%) patients were able to have out-of-bed activity on Day 3 after surgery. The visual analogue scale (VAS) score and percentage of injured vertebra height to original vertebra height 24 hours and 3 months after surgery were significantly better than those before surgery ($P<0.01$). The VAS score 3 months after surgery was significantly superior to the VAS score 24 hours after surgery ($P<0.01$). Compared with 24 hours after surgery, the injured vertebra height was lost 3 months after surgery, but it was not statistically significant ($P>0.05$). There were no complications, such as infection, haematoma, spinal nerve injury and bone cement toxicosis.

Conclusions: In the treatment of thoracolumbar osteoporotic vertebral compression fracture, PVP can effectively relieve pain, restore vertebral height partially and the efficacy is satisfactory.

Keywords: Percutaneous vertebroplasty, Fracture, Compression, Osteoporotic, Lumbar spine.
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Introduction

Osteoporosis is common in the elderly, especially in women. Osteoporotic fracture is a major problem for health care because it has a very high incidence of morbidity and mortality.[1] The cause of osteoporosis is still unclear, but the incidence of this disease increases in elderly women, especially those who often use corticosteroid and are postmenopausal.[2] Osteoporosis will cause vertebral body curvature, vertebral deformation, and fracture. Osteoporotic fracture is threatening the life of old people, and directly affecting their quality and standard of life. Patients with osteoporotic fracture usually will lose basic self-care ability, and suffer from flank pain.[3]

Usually osteoporotic fracture is managed by conservative treatments such as external bracing and rehabilitation. Recently, percutaneous vertebroplasty (PVP) has been used for the treatment of osteoporotic fracture because it is minimally invasive and has good efficacy. During PVP minimal invasive injection of bone cement into fractured vertebral body is performed to stabilize osteoporotic fracture and reduce associated flank pain, but there is still controversy on whether PVP is an effective treatment for osteoporotic fracture.[4-6] This study aimed to observe the clinical efficacy of PVP in the treatment of patients with osteoporotic fracture.

Materials and Methods

The data of 80 patients with osteoporotic vertebral compression fracture admitted to Orthopedics Department, Huanggang Central Hospital from September 2013 to September 2015 was selected for retrospective analysis. There were 17 males and 63 females, aged 64~83 years, with an average of 71±12 years. All the 80 patients had single vertebral fractures, varying from T11 to L3, and their clinical manifestations was dominated by different degrees of lower back pain and joint pain in the limbs. All patients underwent ultrasonic bone mineral density test, which indicated obvious osteoporosis. Before surgery, anterioposterior

[1,3-6]Department of Orthopaedics, Huanggang Central Hospital, Huanggang,
[2]Fuzhou Medical College of Nanchang University, Fuzhou, China.
Correspondence: Zhonghua Cheng. Email: 3527097566@qq.com

and lateral X-ray fluoroscopy, MRI and CT examinations were performed routinely. The X-ray films suggested the vertebra were compressed and flattened, while MRI revealed high signal intensity on T2-weighted images, and vertebral injury was confirmed. CT/MR allowed us to understand whether the posterior wall of vertebra was intact, whether the spinal canal was deformed and whether the nerve was compressed. Osteoporosis was diagnosed according to the diagnostic criteria of WHO (BMD<-2.5SD),[7] that is, if the measured bone density was 2.5 standard deviations below the average peak bone density for those of the same age and gender, one can be diagnosed as osteoporosis. Before surgery, all patients had obvious lower back pain, could not leave the bed or perform weight-bearing activities. Some patients had obvious kyphosis, and physical examination showed no neurological symptoms or signs. Those with tumour, heart failure, infection, mental disorder, severe lung disease and respiratory failure, incomplete posterior wall of vertebra, multiple vertebral compression fractures, old vertebral osteoporotic vertebral compression fracture and spinal nerve compression in CT/MRI examinations and those with abnormal clotting time, electrolyte, liver and kidney functions in laboratory tests were excluded.

The patients took a prone position and were connected to an ECG monitor. Routine disinfection and draping were performed. After local anaesthesia with lidocaine (2%), puncture site was located with the aid of X-ray and 11~13 G bone was adopted as puncture needle, to ensure that the angle with the organism was on the sagittal section ranging from 15° to 2°. Before inserting needle, careful observation with lens in side position was carried out to ensure that operation would proceed on the periphery of bone wall. Contrast media omnipaque was injected into the spinal canal tendon and vessel inside the body and vertebra anterior veins when the needle tip was observed to reach the position of 1/3 of the pedicle of vertebral arch, and the needle in the normotopia reached the median line of the pedicle of vertebral arch. After bone cement was adjusted to be in the shape of toothpaste, it was injected into the body of patients with a syringe by spiral compression until the bone cement reached the posterior wall of vertebral body or the bolus injection resistance was large. If bone cement diffused on one side, it was injected from the vertebral arch on the other side to ensure that 2~6 ml bone cement was injected into the vertebral body on both sides. About 15 minutes after injection, patients were carefully examined for various vital signs, activities, and sensation of both lower extremities. All the patients had been injected with bone cement, 15 patients received vertebral arch puncture injection on one side, and others received on both sides. Failure of bone cement to go beyond and diffuse to the median line of vertebral body occurred on three patients, but the desired effect was achieved by repeated injection. After surgery, the patients were observed for another 10minutes. After the motion and sensation of lower limbs were examined for normalcy, breathing was stable, there was no skin rash, itch or other discomforts and the vital signs were stable, the patients were sent back to the ward. After surgery, the patients rested for 24 hours, and the vital signs, motion and sensation of lower limbs, defecation and urination functions were closely observed.

The visual analog scale (VAS) was employed to evaluate the change in the degree of pain before and after the surgery and represented by a number from 0 to10, with 0 indicating no pain and 10 indicating the most severe pain. The values in between stood for different degrees of pain.[8] Before and after surgery, routine X-ray examination and CT of injured vertebra were performed. The recovery of injured vertebra was assessed by calculating the changes in the heights of anterior, middle and posterior vertebra. Through a comparison and analysis of the above indices, the effectiveness of PVP in the treatment of thoracolumbar vertebral compression fracture was evaluated.

Statistical analysis: SPSS 17.0 statistical software package was used to analyze the data. The measurement data, VAS score and vertebral height, were expressed as mean ± SD. A paired t-test was used for intergroup comparison. $P<0.05$ was considered as statistically significant.

Results

All of the 80 patients in our study were successfully operated with no complication of incision infection, haematoma formation, bone cement poisoning or spinal nerve injury. On the next day, 47(58.75%) patients had no lower back pain at all, 33 (41.25%) had mild dull pain locally, but the symptoms were relieved 3-5 days later. Out-of-bed activity on Day1 after surgery was achieved by 74 (92.50%) patients whereas 6 (7.50%) patients were able to have out-of-bed activity on Day 3 after surgery. Routine X-ray examination was performed 24 hours after surgery which showed 7 (8.75%) cases to have bone cement leakage, including 2 cases in the paravertebral site, 5 cases in the intervertebral site, and none in posterior vertebra. None of them had nerve injury or spinal cord compression. The VAS score and percentage of injured vertebra height to original vertebra height 24 hours and 3 months after surgery were significantly better than those before surgery ($P<0.01$, Table-1). The VAS score 3 months after surgery was significantly superior to the VAS score

Table-1: Changes in the VAS Score and Vertebral Height before Surgery, 24 Hours and 3 Months after Surgery (mean ± SD, n=80).

Time	VAS Score	Percentage of the Height of Anterior Vertebra (%)	Percentage of the Height of Middle Vertebra (%)
Before surgery	8.8±1.2	57.22±10.41	64.36±10.03
24 hours after surgery	3.2±1.3a	87.16±12.35a	86.25±13.32a
3 months after surgery	2.4±1.1bc	86.74±11.73bc	85.31±12.54bc

a indicates comparison between before surgery and 24 hours after surgery, P<0.01; b indicates comparison between before surgery and 3 months after surgery, P<0.01; c indicates comparison between 24 hours after surgery and 3 months after surgery, P<0.05 for VAS score, and P>0.05 for vertebral height.

24 hours after surgery (P<0.01, Table-1).

Discussion

As a common and frequently-occurring degenerative disorder, osteoporosis is more likely to occur in the elderly. The most severe complication of osteoporosis is fragile fracture, and the predilection site is thoracolumbar vertebra.[9] The traditional therapeutic method for osteoporotic vertebral compression fracture is to strictly lie on a hard bed for 2~3 months. The injured vertebra is propped up with a soft pillow to correct the vertebral deformity, associated with pain alleviating drugs, inhibit bone resorption and strengthen bone. The treatment often lasts long and the patients suffer great pain.[10] Open surgical treatment, in general, is not easily accepted by patients, due to its large surgical trauma, wide dissection scope and relatively high surgical risk. While PVP is a kind of minimally invasive spine surgery technique to increase the strength and stability of vertebra, prevent collapse and relieve pain by puncturing percutaneously and injecting bone cement into the diseased vertebra via pedicular or extrapedicular approaches. At present, it is an ideal regimen for osteoporotic vertebral compression fracture. The results of our study showed that 24 hours after surgery, 58.75% of the 80 patients had no lower back pain at all and 41.25% had significantly improved. Moreover, with the extension of observation period, the degree of lower back pain of patients gradually decreased and the vertebral height significantly recovered than before surgery. Only 1~2 incisions with a diameter of about 0.4cm were required, and all patients were able to have out-of-bed activities 1~3 days after surgery, indicating that PVP can effectively alleviate lower back pain induced by fracture, shorten the duration of bed rest compared with traditional conservative therapy and improve the mobility and quality of life of patients, which supports the advantages of PKP, that is, small trauma, quick recovery and reliable efficacy.

Concerning the pain-killing mechanism of PVP, a current research consensus is that it is related to the injection of bone cement into vertebra. It is believed that after bone cement is solidified, it will fix the fracture, stabilize the vertebra and play the role of internal fixation. But on the other hand, the heat released during the polymerization of the bone cement can lead to thermal coagulation and necrosis of nerve tissues, causing cytotoxicity, which can damage nerve endings.[11] Meanwhile, some scholars observed that when PVP is used to treat osteoporotic vertebral compression fracture, there is no significant correlation between the relief degree of patients' lower back pain and the amount of bone cement injected during surgery, which implies that too much of bone cement should not be used if the patient has severe pain.[12] At present, there is no strict regulation on the amount of bone cement injected, but we should stop before going too far, for the more bone cement injected, the higher the risk of leakage. In the present study, bone cement leakage was observed in 7 cases (8.75%), including 2 cases in the paravertebral site, 5 cases in the intervertebral site, and 0 cases in posterior vertebra, but none of them had nerve injury or spinal cord compression.

In addition, clinically when most elderly patients see a doctor, they are found to have multiple flattened and collapsed vertebral segments in the X-ray examination. At this point, attention should be paid to distinguish between fresh and old fractures. The author hereby suggests that "injured vertebra" should be identified according to the patient's symptoms, signs and MRI examination before surgery, which can be located by obvious spinous process tenderness and percussion sensitivity in the vertebra during physical examination. An injured vertebra cannot be considered as the vertebra that caused pain unless the X-ray shows wedge-shaped changes in that vertebra, and MRI examination indicates bleeding and edema signals induced by fracture inside that vertebra. The key to successful treatment of osteoporotic vertebral compression fracture is to determine "injured vertebra" before surgery and treat that injured vertebra in a targeted way. On the other hand, we also notice that with the extension of observation period, compared with 24 hours after surgery, there is secondary loss of vertebral height 3 months after surgery. For this phenomenon, some

scholars argue that it might be attributed to the progress of the natural course of osteoporosis and the failure to fully fill bone cement into the fracture site with and insufficient strength of vertebra.[13] Thus, the treatment of osteoporotic vertebral compression fracture should stop short at simple relief of pain, but aim at treating osteoporosis and preventing re-fracture.

Conclusion:

PVP is an effective treatment for thoracolumbar osteoporotic vertebral compression fracture. PVP can effectively relieve pain, restore vertebral height partially and is simple to perform.

All the eighty patients included in this study had a very successful outcome.

Disclaimer: None.

Conflict of Interest: There are no conflicts of interest.

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