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Original Article

Effects of PVP combined with Xianling Gubao capsules on osteoporotic vertebral compression fractures: JOA, VAS, and bone mineral density analysis

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Abstract: Objective: The aim of the current study was to analyze the effects of percutaneous vertebroplasty (PVP), combined with Xianling Gubao capsules, on Japanese Orthopedic Association scores (JOA), visual analogue scores (VAS), and bone density levels in patients with osteoporotic vertebral compression fractures (OVCF). Methods: One hundred and nine elderly patients with OVCF were retrospectively analyzed. They were divided into the control group (PVP + calcium and Alfacalcidol soft capsules) and observation group (PVP + Xianling Gubao capsules). VAS, JOA bone density, fracture healing status, and treatment safety scores, before and after treatment, were evaluated. Results: No significant differences were found in VAS scores and incidence of adverse reactions between the two groups after 6 months ($P>0.05$). However, JOA and bone mineral density scores of the observation group, after 6 months of treatment, were higher than those of the control group ($P<0.05$). Cobb angles and wedge angles of the injured vertebrae of the observation group were also smaller than those of the control group ($P<0.05$). Conclusion: OVCF treatment in elderly patients with PVP + Xianling Gubao capsules may improve lumbar spine function and bone density levels, promoting fracture healing without additional adverse reactions.

Keywords: Elderly, osteoporosis, vertebral compression fracture, Xianling Gubao capsules, PVP

Introduction

Osteoporosis is one of the most common metabolic bone diseases, leading to a generalized loss in bone mass. It promotes the degeneration of bone microstructure. It is manifested by reduced bone strength, increased bone fragility, and significant lower bone mineral density (BMD) levels [1, 2]. Changes in lifestyles and environment have given rise to the number of osteoporotic patients in China, as well as incidence rates of osteoporotic fractures [3]. In general, osteoporotic fractures mainly occur in the spine, hips, and distal radius [4].

Osteoporotic vertebral compression fractures (OVCF) attack the spine. These fractures are caused by calcium loss in the vertebrae, resulting in reduced strength and density levels of the vertebrae. In this case, multiple vertebral compression fractures may occur [5]. OVCF and its complications create a significant impact on patient quality of life, increasing patient suffering and increasing financial burdens [6]. Therefore, the discovery of methods to improve symptoms of patients with OVCF has become a key issue for medical workers [7]. Although conservative treatment is feasible for some patients with OVCF, treatment effects are not ideal and incidence rates of complications are high.

Percutaneous vertebroplasty (PVP) has been reported as a minimally invasive treatment, showing obvious rapid analgesic effects, compared with other traditional treatments. It is characterized by a fast recovery and low incidence of complications [8]. Although this surgical method is effective in treating OVCF, drug treatments are necessary after surgery, aiming to promote fracture healing [9]. Drugs, such as calcium and Alfacalcidol Soft capsules, are

usually administrated. However, the therapeutic effects need further improvement [10]. Traditional Chinese Medicine may be of value in anti-osteoporosis treatment. TCM maintains the matching of blood flow with ventilation, strengthened muscles and bones, nourished kidneys, spleen, and Qi. In the past, patients have been treated with surgical therapy alone in clinic. However, in the current study, Traditional Chinese Medicine therapy was combined after surgery. Traditional Chinese Medicine Xianling Gubao capsules were used for treatment of OVCF patients.

Methods and materials

Baseline data

Medical data of the 109 elderly patients with OVCF was collected, retrospectively. The patients were divided into two groups, according to the specific treatment method. Both groups received PVP. The control group (30 females and 24 males) received only calcium and Alfacalcidol Soft capsules after surgery. The observation group (32 females and 23 males) was additionally treated with Xianling Gubao capsules. Inclusion criteria: (1) Patients (60-80 years old) showed indications of surgery and received PVP; 2) Patients took the drugs prescribed in this study for more than 6 months; and 3) Informed consent was obtained. Exclusion criteria: 1) Patients with refractures during treatment; 2) Incomplete clinical data; combined with neuro-spinal injuries; and 3) Patients with old fractures, burst fractures, serious diseases affecting bone metabolism, and idiopathic or secondary osteoporosis. The present study was approved by the Medical Ethics Committee of the First Affiliated Hospital of Bengbu Medical College. Patients and/or caregivers provided the written informed consent.

Methods

After admission, patients in both groups were asked about their injury history, medical history, and symptoms. They underwent ECGs, chest radiography tests, biochemical examinations, CT examinations, MRI examinations, and X-ray examinations. Both groups of patients underwent PVP. First, the fracture site was determined by CT or X-ray examination. The patient was placed on the operating table in an appropriate position, aiming to maximize the recovery of the fractured vertebral body.

A C-arm X-ray machine was applied to locate the fracture segment. Next, local infiltration anesthesia was performed with lidocaine hydrochloride (Approval number: H37022839, Manufacturer: Shandong Hualu Pharmaceutical Co., Ltd., Specification: 5 mL: 0.1 g) at pedicles of the fractured vertebral body. The position of the needle was determined under fluoroscopy, which ceased at the anterior-middle junction of the vertebral body. A syringe (5 mL) was used to penetrate the vertebral body. Cement was slowly injected into the vertebral body via the contralateral pedicle. If the cement infiltrated or leaked out of the posterior edge of the injured vertebra, the injection was stopped. After the cement was completely hardened, the needle was pulled out.

The control group was given oral calcium (Calcic, H10950030, Wyeth Pharmaceutical Co., Ltd. Specification: 300 mg * 30 tablets), at 600 mg each time, 3 times a day. To promote calcium absorption, patients in the control group were also administrated Alfacalcidol Soft capsules (Approval number: H20074109, Manufacturer: China Resources Double-Crane Pharmaceutical Co., Ltd., Specification: 0.25 ug * 10 capsules * 2 pcs), 0.25 μg each time, 2 times a day for 6 months. The observation group was additionally prescribed Xianling Gubao capsules (Z20025337, Guizhou Tongjitang Pharmaceutical Co., Ltd. Specification: 0.5 g × 50 tablets), 1.5 g each time, twice a day for 6 months.

Outcome measurements

(1) VAS: VAS scores were evaluated before surgery and at 1 month, 3 months, and 6 months, respectively, after surgery. The degree of pain was expressed with a total of 11 numbers ranging from 0 to 10. Zero represents no pain and 10 represents the most severe pain. Pain levels were directly proportional to VAS scores [11]. Cronbach's alpha = 0.628; (2) JOA: JOA scores were used to evaluate the lumbar spine before treatment and at 6 months after surgery, including subjective symptoms, clinical signs, restricted daily activities, and bladder function. JOA scores ranged from 0 to 29 points, with higher scores indicating a healthier lumbar [12]. Cronbach's alpha = 0.775; (3) BMD: Dual-energy x-ray absorptiometry was used to determine BMD levels before treatment and at 6 months after surgery. Adjacent vertebral bodies of injured vertebrae were also measured; (4) Healing process of fracture: X-

Table 1. Baseline data [n (%)]/($\bar{x}$ ± s)

Index		Observation group (n = 55)	Control group (n = 54)	t/X^2	*P*
Gender	Male	23 (41.82)	24 (44.44)	0.077	0.782
	Female	32 (58.18)	30 (55.56)		
Age (year)		71.76±3.05	71.63±3.33	0.223	0.824
Osteoporosis					
I		20 (36.36)	19 (35.19)	0.015	0.888
II		19 (34.55)	18 (33.33)		
III		16 (29.09)	17 (31.48)		

Table 2. VAS comparison ($\bar{x}$ ± s, points)

Grouping	Prior surgery	1 moth after surgery	3 months after surgery	6 months after surgery
Observation (n = 55)	8.19±0.52	5.09±0.11#	2.28±0.58#	1.59±0.49#
Control (n = 54)	8.15±0.58	5.12±0.15#	2.32±0.51#	1.62±0.52#
t	0.379	1.192	0.382	0.310
P	0.705	0.236	0.703	0.757

Note: #indicates comparison with preoperative values, *P*<0.05.

Table 3. JOA comparison ($\bar{x}$ ± s, points)

Grouping	Prior surgery	6 months after surgery
Observation (n = 55)	11.45±2.18	19.58±3.15#,*
Control (n = 54)	11.52±2.12	24.52±3.08#
t	0.169	8.277
P	0.865	<0.001

Note: #indicates comparison with preoperative values, P<0.05; *indicates comparison with control group, P<0.05.

rays were used to detect Cobb angles, wedge angles, and heights of the anterior edge of the injured vertebra before and at 6 months after the surgery; (5) Safety: Adverse reactions between the two groups during medication were recorded.

Statistical analysis

Statistical analysis was performed using SPSS 22.0. Measurement data are expressed as mean ± standard deviation. Data that met normal distribution was tested using independent sample t-tests. Data that did not meet normal distribution was tested using Mann-Whitney U-tests. Comparisons within the group were examined by paired t-tests. Enumeration data are expressed as [n (%)]. Comparisons of enumeration data between the two groups were performed using X^2 tests. *P*<0.05 indicates statistical significance.

Results

Baseline data

No statistically significant differences were found between the two groups in terms of gender, average age, and degree of osteoporosis (*P*>0.05) (**Table 1**).

Comparison of VAS scores in both groups

Differences in VAS scores were not significant before surgery (*P*>0.05). VAS at 1 month, 3 months, and 6 months, postoperatively, were significantly lower than those before surgery in both groups (*P*<0.05). No significant differences were found in VAS scores between the two groups at 1 month, 3 months, and 6 months after surgery (*P*>0.05) (**Table 2**).

Comparison of JOA scores in both groups

There were no statistically significant differences in JOA scores before surgery (*P*>0.05). Compared with preoperative scores, JOA scores were significantly increased at 6 months postoperatively in the two groups (*P*<0.05). Increases in the observation group were higher than those of the control group (*P*<0.05) (**Table 3**).

Comparison of BMD levels in both groups

No significant differences were found in BMD levels between the two groups before surgery (P>0.05). Compared with levels before surgery, BMD levels of the two groups increased significantly at 6 months after surgery (*P*<0.05). Increases of the observation group were higher than those of the control group (*P*<0.05) (**Table 4**).

Comparison of fracture healing indices in both groups

Cobb angles before surgery in the observation and control group were (19.85±5.02) and (19.82±4.98), with no significant differences

Table 4. BMD comparison ($\bar{x} \pm s$, g/cm^2)

Grouping	Prior surgery	6 months after surgery
Observation (n = 55)	0.61±0.02	0.85±0.15#,*
Control (n = 54)	0.62±0.05	0.72±0.11#
t	1.347	5.686
P	0.180	<0.001

Note: #indicates comparison with preoperative values, P<0.05; *indicates comparison with control group, P<0.05.

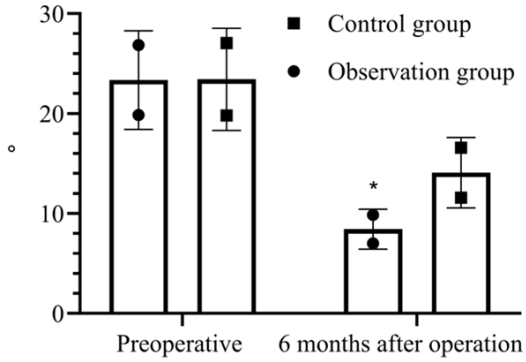

Figure 1. Comparison of Cobb angles between the two groups. There were no significant differences before surgery *P*>0.05; Observation group showed smaller Cobb angles at 6 months after surgery than the control group, *P*<0.05. *indicates comparison with the control group, *P*<0.05.

noted (t = 0.031, *P*>0.05). At 6 months after surgery, the Cobb angle of the observation group (7.02±2.96) was smaller than that of the control group (11.59±5.02) (t = 5.802, *P*<0.05) (**Figure 1**).

Preoperative vertebral wedge angles in the observation and control group were (18.25±3.12) and (18.29±3.09), with no significant differences noted (t = 0.067, *P*>0.05). At 6 months after surgery, the vertebral wedge angle of the observation group (4.52±0.18)° was smaller than that of the control group (8.56±1.28) (t = 23.177, *P*<0.05) (**Figure 2**).

Heights of the anterior edge of the injured vertebrae were (21.69±1.05) mm (observation group) and (21.72±1.03) mm (control group), showing no significant difference between the two groups (t = 0.151, *P*>0.05). At 6 months after surgery, heights of the anterior edge of the injured vertebra were (23.98±1.35) mm (observation group) and (22.05±1.29) mm (control group), showing significant differences (t = 7.629, *P*<0.05) (**Figure 3**).

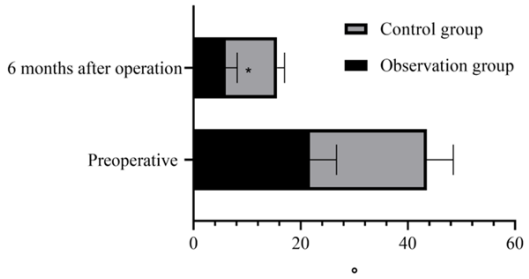

Figure 2. Comparison of wedge angles of injured vertebra between the two groups. There were no significant differences before surgery *P*>0.05; Observation group showed smaller wedge angles 6 months after surgery than the control group, *P*<0.05. *indicates comparison with the control group, *P*<0.05.

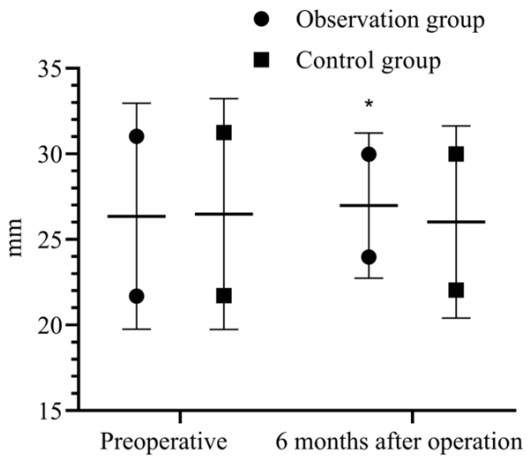

Figure 3. Comparison of heights of the anterior edge of the injured vertebra in the two groups. *P*>0.05 before surgery and *P*<0.05 at 6 months after surgery. *indicates comparison with the control group, *P*<0.05.

Comparison of adverse reactions in both groups

During treatment, only minor adverse reactions occurred. Incidence of adverse reactions was 7.41% in the control group and 9.09% in the observation group. Incidence rates of adverse reactions showed no significant differences between the two groups (X^2 = 0.102, *P*>0.05) (**Table 5**).

Discussion

Osteoporosis is most common in the elderly, characterized by deterioration of the fine structure of bone tissue and a reduction of bone mass [13]. Patients with osteoporosis have a higher risk of fractures. Vertebral compression

Table 5. Comparison of adverse reactions [n (%)]

Group	Dizzy	Nausea	Anorexia	Abdominal distension	Total incidence
Control (n = 54)	1 (1.85)	1 (1.85)	1 (1.85)	1 (1.85)	4 (7.41)
Observation (n = 55)	1 (1.82)	2 (3.64)	1 (1.82)	1 (1.82)	5 (9.09)
X^2					0.102
P					0.749

fractures are the most frequent type. They are closely related to bone mass and physical conditions of the patients. These factors have a significant impact on quality of life levels [14, 15]. The principle of OVCF treatment is to inhibit bone resorption, promote bone formation, and reduce incidence of fractures [16].

Traditionally, conservative treatment has been adopted, but with a longer course of treatment. Patients need to stay in bed for a longer time after surgery. Thus, risks of bedsores and thrombosis are significantly increased. Advances in medical technology have brought about PVP. This method may reconstruct the vertebral body and quickly relieve patient pain, with low incidence of complications [17, 18]. Although the effects of PVP on OVCF are ideal, postoperative anti-osteoporosis treatment is equally vital.

Currently, the best anti-osteoporosis treatment after PVP has not reach a consensus [19]. Calcium is one of the trace elements necessary for bone formation, widely recognized as a suitable supplement [20]. Alfacalcidol Soft capsules are mainly used to treat postmenopausal osteoporosis, which can increase vertebral bone density and reduce risks of fractures [21]. It this study, Xianling Gubao capsules were additionally administrated to treat OVCF. Results showed that the observation group exhibited higher bone mineral density, lower Cobb angles, and lower vertebral wedge angles than the control group, suggesting that Xianling Gubao capsules may further promote fracture healing and improve bone density. The main active ingredients of Xianling Gubao capsules contain extracts from six herbs, including Herba epimedii, Radix dipsaci, Radix salvia miltiorrhiza, Rhizoma anemarrhenae, Fructus Psoraleae, and Radix Rehmanniae.

Herba epimedii could warm the kidney and liver meridians. It has the functions of expelling wind and dehumidifying and invigorating the kidneys. It can be effective in treating diseases, such as weakness of the bones and muscles and lassitude in loins and legs. Modern pharmacological studies have shown that Herba epimedii contains flavonoids, which can exert estrogen-like effects. Combined with estrogen receptors on the surface of osteoblasts, it has shown good anti-osteoporosis effects, effectively promoting bone formation. Radix Dipsaci is a kidney tonifying herbal medicine. It could tonify the blood to prevent miscarriage, strengthen the muscles and bones, and tonify the liver and kidneys. These may ease arthralgia aggravated by colds. Fructus Psoraleae may reinforce kidney yang [22], while Radix salvia miltiorrhiza can promote blood flow to regulate menstruation and improve body circulation. Rhizoma anemarrhenae has the effects of refreshing and moistening, clearing away heat and purging fire. Radix Rehmanniae replenishes the essence and the marrow, replenishing blood and nourishing yin [23]. These ingredients together could strengthen tendons and bones, promote blood circulation, and nourish the liver and kidneys. It can maintain metabolic balance, promote osteoblast proliferation and differentiation, inhibit osteoclast resorption, and increase bone mineral content and bone density. Present results showed no statistically significant differences in incidence of adverse reactions in the two groups (P>0.05), further confirming the safety of Xianling Gubao capsules.

In summary, OVCF treatment in the elderly with Xianling Gubao capsules is beneficial. This treatment may restore the lumbar spine, bone density levels, and bone metabolism, promoting fracture healing with safety.

However, the current study included fewer subjects and did not conduct long-term follow-ups. These improvements will be necessary in future studies to confirm present results.

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lumbar osteoporotic compression fracture model with different compression degree.

Disclosure of conflict of interest

None.

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