Clinical efficacy of PVP and PKP in the treatment of OVCFs after bilateral resection of ovarian cancer

SHAOQIAN WANG*, HUI WANG* and LEI NIU

Department of Micro-Orthopaedics, The Second People's Hospital of Hefei, Hefei, Anhui 230011, P.R. China

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Abstract. The clinical efficacy of percutaneous vertebroplasty (PVP) and percutaneous kyphoplasty (PKP) in the treatment of osteoporotic vertebral compression fractures after bilateral resection of ovarian cancer was investigated. Eighty-six patients with osteoporotic vertebral compression fractures after bilateral resection of ovarian cancer admitted to the Second People's Hospital of Hefei from September, 2015 to August, 2016 were selected and randomly divided into control group (n=43) and observation group (n=43). The control group was treated with PVP, while the observation group received PKP. The operation time, fluoroscopy times, bone cement volume and leakage rate of patients in the two groups were recorded; the postoperative pain of patients was compared using Short-form McGill Pain Questionnaire; the changes in height of injured vertebra and Cobb angle of patients in two groups were compared; the efficacy of patients in the two groups was compared in accordance with Oswestry dysfunction index (ODI) and Japanese Orthopedic Association (JOA) low back pain scoring; and the quality of life was compared. The fluoroscopy times and bone cement leakage were significantly less in observation group than those in control group (P<0.05). After operation, the scores of ODI, MPQ and JOA in the two groups were significantly improved (P<0.05). The postoperative height of injured vertebra and the Cobb angle of patients in two groups were significantly different than those before the operation (P<0.05). The quality of life of patients in the observation group was higher than that in the control group one year after operation (P<0.05). In conclusion, PKP and PVP are effective in the treatment of osteoporotic vertebral compression fractures after bilateral resection of ovarian cancer; however, PKP is more conducive to lumbar stability and maintenance of intervertebral height thus greatly correcting the kyphosis, which is beneficial to improving the quality of life of patients.

Correspondence to: Dr Lei Niu, Department of Micro-Orthopaedics, The Second People's Hospital of Hefei, 246 Heping Road, Hefei, Anhui 230011, P.R. China
E-mail: m13365792992@163.com

*Contributed equally

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Introduction

Ovarian cancer is a common malignant tumor in women. In recent years, the incidence of ovarian cancer is increasing and shows younger trend, and its mortality is the highest among gynecological malignancies (1). Bilateral ovarian resection is an important therapy for ovarian cancer, but the operation will sharply decrease estrogen in patients, increase osteoclastogenesis and inhibit bone absorption, leading to the reduction of patients' bone density and resulting in osteoporosis (OP) (2). Fracture easily occurs in OP patients, and the spine bears most of the stress, so vertebral compression fractures are the most common, which is known as osteoporotic vertebral compression fractures (OVCFs) (3). The clinical symptoms of OVCF patients after bilateral ovarian resection are not typical at the initial stage. It is difficult to arouse the attention of patients, but it will lead to spinal deformity over time, and eventually bring great pain to the patients, which not only brings heavy financial burden to the family, but also directly affects the quality of life of patients, so it should be paid great attention (4). OVCFs are clinically administered by conservative treatment and surgical treatment; therein, percutaneous vertebroplasty (PVP) and percutaneous kyphoplasty (PKP), these two minimally invasive surgery modes, are mainly utilized at present, which display remarkable clinical efficacies, and the latter is developed on the basis of the former (5). In this study, patients with OVCFs after bilateral resection of ovarian cancer were treated with PVP and PKP, and the efficacy and safety of two surgical procedures were analyzed, so as to provide basis for the treatment of OVCFs, which is reported as follows.

Materials and methods

Clinical data. Eighty six patients with OVCFs after bilateral resection of ovarian cancer admitted to the Second People's Hospital of Hefei (Hefei, China) from September, 2015 to August, 2016 were selected. Inclusion criteria: i) Patients received bilateral resection of ovarian cancer; ii) OVCFs were diagnosed by X-ray examination; iii) bone density examination showed T <-2.5; and iv) patients signed the written informed consent. Exclusion criteria: i) Patients with severe osteomalacia or osteoporosis; and ii) patients with coagulation

Table I. Baseline data of patients in the groups.

Item	Control group (n=43)	Observation group (n=43)	t/χ^2 value	P-value
Age (years)	30-60	30-65		
Average age (years)	41.56±5.42	42.85±5.38	1.108	0.271
Bone density (T)	-2.93±0.46	-2.98±0.48	0.493	0.623
Body mass index (kg/m^2)	22.83±1.54	22.56±1.27	0.887	0.378
Fracture site (n, %)			0.206	0.902
Cervical vertebra	8 (18.60)	7 (16.28)		
Thoracic vertebra	18 (41.86)	17 (39.53)		
Lumbar vertebra	17 (39.53)	19 (44.19)		

disorders. The enrolled patients were divided into observation group (n=43) and control group (n=43) using a random number table. The differences in general data of patients between the groups were not statistically significant (P>0.05) (Table I). The study was approved by the Ethics Committee of the Second People's Hospital of Hefei. All patients have provided written informed consent for publication.

Preoperative preparation. Patients were comprehensively evaluated before surgery, and excluded due to surgical contraindications, and then appropriate timing of surgery was selected. Patients were administrated with antibiotics to prevent infection 2 h before operation, and fasting for 8 h and fasting with liquid for 6 h were required before operation.

Treatment. The control group was treated with PVP, of which patients were guided to take prone position, blocking up the chest and bilateral iliums, and blood pressure, electrocardiograph and blood oxygen were monitored. The affected vertebra was identified by C-arm machine, and then marked. Draping and disinfection were routinely prepared, the puncture was conducted outside the vertebral pedicle. Lidocaine infiltration (2%) was adopted for anesthesia, followed by transpedicular approach for puncture from the left side, until the correct position through observation using C-arm machine fluoroscopy. After the successful puncture, the inner core of puncture needle was extracted. Subsequently, 20 g bone cement powder [manufacturer: Heraeus Medical GmbH; registration no.: State Food and Drug Administration (Import) 2011; no. 3652798] was modulated well and slowly injected into the affected vertebra. When the bone cement in vertebra was diffused to the posterior margin of the vertebral body or bone cement leakage was found, injection was stopped. After surgery, patients were guided to have bed rest for 10 min, followed by compression and dressing with needle tract sterile materials after bone cement hardened completely.

The observation group received PKP. The positioning, puncture and other operations were the same as those in PVP. Before bone cement was modulated, the balloon dilatation catheter was placed at 1/3 the front of vertebral body. Under the monitoring by C-arm machine, the balloon was slowly dilated, followed by injection with contrast agent. The pressure of the balloon was less than 250 mmHg. When the height reset of the vertebral body was satisfactory, the contrast agent was stopped. The balloon was withdrawn as contrast agent was extracted, followed by injection of the modulated bone cement. The method was the same as that of PVP.

Postoperative processing and follow-up. Rest in supine position was required for patients after operation, and X-ray examination was carried out to observe the diffusion of bone cement and whether there was bone cement leakage. Antibiotic prophylaxis was administered to patients within 24 h, and out of bed activities with wearing a corset was performed after 24 h. Weight-bearing and lifting heavy weights were not allowed. Patients were followed-up for one year to observe the rehabilitation.

Evaluation methods. The operation conditions including operation time, fluoroscopy times, bone cement volume and leakage rate of patients in two groups were compared. During 12 months of the follow-up, Osteoporosis Quality of Life Scale (OQOLS) was utilized (6) to complete the scoring in accordance with grade 0-5-point method from disease (17 items), physiology (20 items), society (19 items), psychology (13 items) and degree of satisfaction (6 items). The score was positively correlated with quality of life.

The preoperative and postoperative dysfunction of patients were scored using Oswestry dysfunction index (ODI) (7) according to 0-5-point method (0 point: No dysfunction; 5 points: Most obvious dysfunction) from individual ability, pain and personal comprehensive ability, three dimensions, a total of 9 items. The ODI value was positively correlated with the degree of dysfunction. The preoperative and postoperative low back pain of patients was scored in accordance with Japanese Orthopedic Association Scale (JOA) (8), a total of 29 points.

The joint pain of patients was assessed using Short-form McGill Pain Questionnaire (SF-MPQ) before operation and at postoperative 1, 6 and 12 months (9): Scoring from pain rating index (PRI), visual analogue scale (VAS) and present pain intensity (PPI). The points accumulated by these three parts were the final total score. The total score was positively correlated with degree of pain.

The changes in height of the affected vertebra were measured preoperatively and at 1 and 3 months after operation:

Table II. Comparisons of operation conditions in patients between two groups.

Group	Case	Operation time (min)	Bone cement volume (ml)	Fluoroscopy times (times)	Bone cement leakage (n, %)
Observation group	43	34.83±3.62	3.97±1.43	10.86±1.45	4 (9.30)
Control group	43	35.14±3.56	3.89±1.38	13.97±1.37	13 (30.23)
t/χ^2 value		0.400	0.264	10.223	4.692
P-value		0.690	0.792	<0.001	0.030

Table III. Comparisons of preoperative and postoperative ODI scores in patients between two groups.

Group	Case	Before operation	Postoperative 1 month	Postoperative 6 months	Postoperative 12 months	F-value	P-value
Observation group	43	30.89±3.26	11.47±3.63	5.75±2.26	4.12±2.23	47.648	<0.001
Control group	43	31.25±3.34	13.59±3.37	6.93±2.36	5.78±2.37	41.704	<0.001
t-value		0.506	2.807	2.368	3.345		
P-value		0.614	0.006	0.020	0.001		

Table IV. Comparisons of preoperative and postoperative ODI scores in patients between two groups.

Group	Case	Before operation	Postoperative 1 month	Postoperative 6 months	Postoperative 12 months	F-value	P-value
Observation group	43	2.82±0.35	4.57±0.36	4.57±0.35	6.25±0.36	19.624	<0.001
Control group	43	2.78±0.36	3.32±0.34	3.33±0.32	4.87±0.34	9.829	<0.001
t-value		0.522	16.553	17.146	18.275		
P-value		0.603	<0.001	<0.001	<0.001		

The anterior margin and middle height of the vertebral body on the X-ray lateral radiograph were measured, and the measured value was converted into the actual length according to the chip scale. The changes in vertebral kyphosis Cobb angle before and after operation were measured, which was obtained by measuring the corner of the up and down endplate vertical line of affected vertebra on the X-ray lateral radiograph.

Statistical analysis. Data were processed by SPSS 19.0 (SPSS Inc., Chicago, IL, USA) software. Measurement data were expressed as mean ± standard deviation and analyzed by t-test. Enumeration data were represented by rate and analyzed by Chi-square test. Rank-sum test was used for ranked data. P<0.05 was considered to indicate a statistically significant difference.

Results

Comparison of the operation and postoperative conditions in patients in the groups. There were no remarkable differences in operation time and bone cement volume in patients between the groups (P>0.05). The fluoroscopy times were significantly less in observation group than those in control group, and bone cement leakage in observation group was distinctly lower than that in control group (P<0.05) (Table II).

Comparison of preoperative and postoperative ODI scores in patients between two groups. The ODI scores of patients in two groups were significantly ameliorated at postoperative 1, 6 and 12 months, and the scores in observation group were remarkably superior to those in control group (P<0.05) (Table III).

Comparison of preoperative and postoperative JOA scores in patients between two groups. The JOA scores of patients in two groups were remarkably improved at postoperative 1, 6 and 12 months, and the scores in observation group were obviously superior to those in control group (P<0.05) (Table IV).

Comparison of postoperative MPQ scores in patients between two groups. The MPQ scores of patients in two groups were significantly ameliorated at postoperative 1, 6 and 12 months, and the scores in observation group were distinctly superior to those in control group (P<0.05) (Table V).

Comparison of changes in height of the injured vertebra before and after operation in patients between two groups. The changes in observation group were remarkably better than those in control group at postoperative 1 and 3 months, and the differences were statistically significant (P<0.05) (Table VI).

Table V. Comparison of postoperative MPQ scores in patients between two groups.

Group	Case	Before operation	Postoperative 1 month	Postoperative 6 months	Postoperative 12 months	F-value	P-value
Observation group	43	56.95±3.15	36.85±3.16	18.56±3.18	9.16±3.15	57.638	<0.001
Control group	43	57.16±3.26	48.06±3.24	24.63±3.22	16.28±3.14	51.527	<0.001
t-value		0.304	16.242	8.795	10.497		
P-value		0.762	<0.001	<0.001	<0.001		

Table VI. Comparisons of changes in height of the injured vertebra before and after operation in patients between two groups.

Group	Case	Before operation	Postoperative 1 month	Postoperative 3 months	F-value	P-value
Observation group	43	22.62±2.34	25.56±2.37	29.24±2.47	13.518	<0.001
Control group	43	22.74±2.36	24.34±2.38	25.89±2.43	8.521	<0.001
t-value		0.237	2.382	6.340		
P-value		0.813	0.019	<0.001		

Table VII. Comparisons of changes in Cobb angle before and after operation in patients between two groups.

Group	Case	Before operation	Postoperative 1 month	Postoperative 3 months	F-value	P-value
Observation group	43	22.25±1.37	20.76±1.05	17.34±0.76	11.818	<0.001
Control group	43	22.31±1.38	18.32±1.03	13.49±0.84	9.706	<0.001
t-value		0.202	10.878	22.287		
P-value		0.840	<0.001	<0.001		

Comparisons of changes in Cobb angle before and after operation in patients between two groups. The changes in observation group were remarkably better than those in control group at postoperative 1 and 3 months, and the differences were statistically significant (P<0.05) (Table VII).

Comparison of quality of life in patients between two groups during one year of follow-up after operation. The quality of life scores at various dimensions were significantly higher in observation group than those in control group (P<0.05) (Table VIII).

Discussion

Osteoporosis (OP) may occur after bilateral resection of ovarian cancer in women due to its hormone-dependent manner in patients, and estrogen will decrease greatly after operation. Generally, the human skeleton is estrogen-dependent. Normally, estrogen effectively inhibits the differentiation and activation of osteoclasts, thus reducing the occurrence of bone loss, and maintains a dynamic balance between bone absorption and formation, thereby reducing the occurrence of fractures (10,11). The rapid decrease of estrogen caused by bilateral resection of ovarian cancer accelerates the proliferation and differentiation of osteoclast precursors, and increases osteoclast activity, which leads to greater bone absorption than bone formation, thus inducing OP (12). In addition to the effect by estrogen, it is also correlated with the way of postoperative exercise, diet and psychological factors. The lumbar vertebra is the most stressed part of the human spine; due to the loss of bone tissue, destruction of bone tissue microstructure and thinning of cortical bone, once patients are affected by turning back, carrying heavy weights, moving objects or other violence activities, thoracolumbar spine is more prone to fracture (13).

With the application of minimally invasive technique in the Department of Orthopedics, PVP has been widely used in clinical practice of orthopedics, PKP has also been applied in clinic, and both are proved to be effective methods for the treatment of osteoporotic compression fractures; there are similarities and differences between them (14). The results of the study showed that there were no remarkable differences in operation time and bone cement volume in patients between two groups (P>0.05); the fluoroscopy times were significantly less in observation group than those in control group, and bone cement leakage in observation group was distinctly lower than that in control group (P<0.05). This is because the use of minimally invasive techniques for bone cement infusion into

Table VIII. Comparison of quality of life in patients between two groups.

Group	Case	Disease	Physiology	Society	Psychology	Degree of satisfaction
Observation group	43	63.82±3.34	53.56±3.35	54.26±3.56	28.24±3.36	38.26±3.26
Control group	43	52.78±3.32	45.34±3.36	46.79±3.44	21.89±3.34	30.69±3.25
t-value		15.372	11.361	9.895	8.789	10.784
P-value		<0.001	<0.001	<0.001	<0.001	<0.001

the injured vertebra, and there is no distinct difference in bone cement volume; however, the balloon needs to be expanded before cement modulation in PKP, and bone cement infusion is required to be more direct and accurate, so as to reduce the fluoroscopy times and the permeability rate of bone cement in the late stage (15).

OVCFs have a profound impact on patients with spinal kyphosis and lumbar back pain; if not treated in time, patients will suffer persistent pain, needing treatment with analgesic drugs daily to maintain normal life; not only does it increase the financial burden, but it also has a serious impact on the physical and mental health and the quality of life (16). The results of this study show that there were no significant differences in preoperative ODI, MPQ and JOA scores between the two groups (P>0.05), and after operation, the scores of ODI, MPQ and JOA in the two groups were significantly improved, which were more obvious in the observation group than those in the control group (P<0.05). This is because patients do not take bed rest, and a sharp pain is felt even when turning over or being touched; when people suffer from OVCFs, spinal kyphosis will occur, which leads to loss of normal curvature and changes in spinal endurance, thus enhancing compression force of injured vertebra and more obvious pain; the nerve involvement of lesions will cause neurological dysfunction, and OP itself can also incur pain in patients (17). After treatment with PVP and PKP, the concretion of bone cement blocks the blood of the diseased part of the vertebra, thereby reducing the pressure at the fracture site and enhancing the stability of the fracture site; in addition, the chemical reaction during the coagulation process produces heat, which destroys the nerve endings around the fracture and reduces the nerve irritation caused by the movement of the fracture site, thereby achieving analgesic effects (18). Through balloon dilatation, PKP can compress the spongy bone around the fracture, so that bone trabecula becomes relatively dense, so as to effectively alleviate dysfunction, and it also can effectively reduce the leakage of bone cement, thus reducing the paraspinal muscle tissue damage and decreasing postoperative local pain.

The results of this study indicated that the height of the injured vertebra and the Cobb angle of patients in two groups were significantly different from those before the operation (P<0.05), and the change in observation group was more distinct from those in control group (P>0.05). This is because after PVP and PKP treatment, the diffusion of bone cement at bone fracture will reinforce the bone strength of the injured vertebra and can reset the vertebral compression fracture, thus restoring part of the injured vertebra height; with the height of the injured vertebra restored, the Cobb angle also recovered (19). Through the balloon dilatation, the viscosity bone cement perfusion under low pressure in PKP treatment is higher, and the local mechanical effect of bone cement increases; balloon dilation also can effectively support the collapse, which shows a significant effect of reset, thus recovering the height of injured vertebra to the utmost and remarkably correcting spinal kyphosis (20). Through the treatment of PVP and PKP, the local tissue burden is increased, the pain of patients is alleviated effectively, and the kyphosis is also corrected, so that the patients return to normal activities and their quality of life is effectively improved.

In summary, PKP and PVP are effective in the treatment of osteoporotic vertebral compression fractures after bilateral resection of ovarian cancer, but compared with PVP, PKP can effectively relieve the pain in patients, recover the height of injured vertebra and correct spinal kyphosis, and the incidence of bone cement leakage is also lower. However, due to the limited sample size, data bias is unavoidable, and long-term efficacy still needs to be further observed.

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Availability of data and material

The datasets analyzed during the current study are not publicly available due to the protection of patient privacy but are available from the corresponding author on reasonable request.

Authors' contributions

SW and HW collected the patient clinical information and analyzed the data. SW wrote the manuscript and LN revised and edited the manuscript. LN evaluated and analyzed the operation conditions. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Ethics Committee of The Second People's Hospital of Hefei (Hefei, China). All patients have provided written informed consent for publication.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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