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ORIGINAL ARTICLE

Therapeutic effects analysis of percutaneous kyphoplasty for osteoporotic vertebral compression fractures: A multicentre study

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Summary *Background:* Percutaneous kyphoplasty (PKP), a minimally invasive treatment, has been widely used for osteoporotic vertebral compression fractures (OVCFs).
Objective: To retrospectively analyse the therapeutic effects of PKP using a series of key techniques in a multicentre study.
Methods: From May 2000 to December 2016, PKP was performed using a series of key techniques (puncture, reduction, and perfusion techniques) for the treatment of 4532 OVCF patients. The pain visual analog scale (VAS) and the Oswestry Disability Index (ODI) questionnaire prior to the operation, at postoperative Day 2, and at the last follow-up were analysed by paired t-test analysis. The leakage of bone cement was evaluated by postoperative radiography and/or computed tomography. Four-year survival was calculated at the last follow-up.
Results: The average follow-up was 63 months (1–116 months). The VAS score decreased from 8.9 (preoperative) to 2.3 (2 days postoperative) to 1.9 (last follow-up). The ODI score of the patients decreased from 86.7 (preoperative) to 31.6 (2 days postoperative) to 25.3 (last

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follow-up). Both VAS score and ODI score improved significantly. The bone cement leakage rate was 3.5%, with no clinical symptoms. The 4-year survival rate was 77.5%.
Conclusion: This study suggests that PKP with key techniques would be an effective technique to treat OVCF with less risk and better therapeutic effect. Such diagnostic methods and surgical techniques lead to the development and progress of treatment for OVCF.

The translational potential of this article: PKP with key techniques would be an effective technique to treat and lead to the development and progress of treatment for OVCF.

Introduction

According to estimated data from the World Health Organization, the population of the elderly over 60 years old around the world was 900 million in 2015 and may reach 2 billion by 2050 [1—4]. Osteoporosis and osteoporotic fractures have become global concerns along with this increasing population, affecting the quality of life and incurring a high economic burden to the patients, as well as society. Currently, more than 8.9 million patients suffer from osteoporotic fractures annually all over the world, 40% of which are osteoporotic vertebral compression fractures (OVCFs) [4,5]. Most patients with OVCF (>75%) had only minor injuries (such as coughing and sneezing) or no definite trauma. A small number (<25%) of cases are caused by trauma, such as falls. Thereafter, patients with fractures often experience only thoracic/lumbar back pain, with no obvious swelling or deformity. The majority of patients can reluctantly stand and may be able to slightly walk. Therefore, patients often consider it to be a lumbar sprain; thus, they do not pay sufficient attention to it, and do not go to the hospital for treatment. Even if patients are still experiencing chest/back pain after resting in bed, they usually do not go to the department of orthopaedics for treatment. Thus, the misdiagnosis rate is high. The results of a retrospective study in the UK showed that the misdiagnosis rate of OVCF was as high as 82% in all patients who underwent chest radiography for chest pain [6]. Thus, the actual incidence rate of OVCF is much higher than the current rate from hospital statistics.

For elderly patients with OVCF, bed rest and other conservative treatments often lead to further loss of bone mass, worse osteoporosis, development of hypostatic pneumonia, bedsores, urinary tract infection, and other complications. Additionally, they can reduce the patients' quality of life, and even endanger their lives. The mortality rate of OVCF is as high as 49.4% within 4 years [7—9]. Percutaneous kyphoplasty (PKP) has been widely accepted and adopted because of its satisfactory clinical efficacy and ability to quickly relieve the patient's thoracic/lumbar back pain and improve the patient's quality of life. This study was conducted from May 2000 to December 2016 in three hospitals, including The First Affiliated Hospital of Soochow University, The First Affiliated Hospital of Sun Yat-sen University and The First Affiliated Hospital of Nanjing Medical University. The clinical efficacy of PKP in the treatment of patients with OVCF was analysed retrospectively, and the therapeutic effect of PKP was also evaluated to provide clinical references.

Materials and methods

Patients

The clinical study was approved by the Ethics Committee of The First Affiliated Hospital of Soochow University, The First Hospital of Sun Yat-sen University and The First Affiliated Hospital of Nanjing Medical University, and written informed consents were obtained from all participants. A total of 4532 patients with OVCF treated by PKP in three hospitals between May 2000 and December 2016 were included in the study, including 1036 men and 3496 women, with an average age of 69.1 years (range, 50—99 years). All patients were examined using radiography, computed tomography (CT), and magnetic resonance imaging (MRI) prior to operation. Painful vertebrae in each patient were identified preoperatively by chief complaint (local back pain), physical examination (percussion pain at local vertebral spinal process), and MRI (low signal intensity on T1-weighted imaging, high or equal signal intensity on T2-weighted imaging, and high signal intensity on fat suppression sequence imaging) [10]. The bone mineral density of the lumbar spine was measured with dual-energy X-ray absorptiometry. The T-score was −2.6 to −4.1 (average, −3.4). All patients underwent a radiographic examination of the spine after operation and during follow-up.

Operation procedures using key techniques

The procedure was performed under general anaesthesia. The C-arm X-ray was used to capture standard anteroposterior and lateral images for the operative vertebral bodies, and safety puncture techniques for the vertebral bodies (baseline positioning, puncture point positioning, puncture direction adjustment, and step-by-step insertion) were also used. The bilateral/unilateral pedicle and vertebral pedicle puncture approach were used to reach the front of the posterior margin of the vertebral bodies (about 3 mm); guide wires, expansion cannula, and working cannula were then sequentially inserted. Inflatable balloons were placed into the vertebral body through a working cannula. They were then inflated under fluoroscopic guidance. A series of bone cement perfusion techniques (time-window determination of injection, incremental temperature cement delivery, real-time perfusion pressure detection, and secondary cement preparation based perfusion and blocking) was used; the

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