Percutaneous balloon kyphoplasty, a good minimally invasive surgical option for osteoporotic thoracolumbar compression fracture

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Introduction

Osteoporosis is a systemic skeletal disease characterized by low bone density and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture. Vertebral compression fracture is the leading cause of morbidity and disability in the elderly. Acute pain due to vertebral compression fracture may subside over period of weeks or months however it is not uncommon that chronic pain is seen in number of cases leading to significant disability. Chronic pain may be due to incomplete healing with progressive vertebral collapse, spinal deformity leading to altered spinal kinematics or development of pseudoarthrosis at the involved level. This often leads to decreased quality of life and depression.

Shift of the center of gravity anteriorly due to kyphotic deformity puts more stress on apex of kyphosis promoting further angulation and additional fractures. The kyphotic deformity is well associated with functional status, risk of further fracture, neurological manifestation, mental health, and pulmonary function, which can contribute to increased mortality rate.

The conservative treatment which includes analgesics, bed rest, corset or spinal brace and rehabilitation is the mainstay of treatment of vertebral compression fracture. However, with the advent of minimally invasive surgical technique including vertebroplasty and kyphoplasty, it provides quicker relief from pain and improvement in physical functional status compared to medical treatment. In addition, being less traumatic and less risk for elderly patients these are also considered good option than open procedures which is limited to cases with spinal instability and/or neurological deficit.

Considering limitation of medical treatment and furthermore immobilization leading to bone demineralization and muscle deconditioning predisposes it to future fracture, two minimally invasive approaches balloon kyphoplasty and vertebroplasty were developed for management of symptomatic vertebral compression fracture.

The first description by Galibert et al. (1987),...
Vertebroplasty involves percutaneous injection of polymethylmethacrylate into the body of the vertebra. In balloon kyphoplasty, with the use of a tamp (balloon) before injection of polymethylmethacrylate using transpedicular or extrapedicular approach creates a cavity compressing cancellous bone and if possible renews the vertebral endplates. The purpose of this study was to evaluate the efficacy and safety of balloon kyphoplasty in the treatment of symptomatic vertebral compression fractures.

Materials and Methods

Thirty patients with symptomatic osteoporotic vertebral compression fractures between January 2014 to December 2017 who underwent balloon kyphoplasty in Bangabandhu Sheikh Mujib Medical University and other private hospitals around Dhaka were included in the study. Active infection, neurological deficit, and uncorrected therapeutic anticoagulation were exclusion criteria for the surgical procedures. There were 8 males (26.7%) and 22 females (73.3%) with mean age of 72.5 years (range 60-85 years).

Surgical technique

Patient positioned prone and under general anesthesia. The proper positioning and bolster support improves chance of correcting kyphosis. Transpedicular approach is used for lumbar vertebrae and extrapedicular approach in thoracic spine as pedicle has smaller diameter and less medially angulated pedicle. In transpedicular approach trochar tip is introduced at the outer aspect of the pedicle under fluoroscopic guidance and passing through centre of the pedicle. At the posterior vertebral cortical margin it should be just within the medial border of the pedicle outline on PA view under c-arm. The trocar is then exchanged with cannula over a guidewire and working instrument is advanced 3 mm from the anterior border of the body of vertebra. In thoracic vertebra, the needle starting point is craniolateral towards the costovertebral joint and is advanced along the neck of the rib or transverse process. And lateral pedicle wall is reached and passed through upper and outer circumference of the pedicle. Only after posterior vertebral wall has been passed on lateral view should the needle tip cross the medial pedicle wall on PA view. Adherence to these landmarks is essential to avoid spinal perforation. A brief illustration with image is given in Figure 1 and Figure 2.

Cobb angle was measured from superior endplate
Table I

<table>
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<th></th>
<th>Mean</th>
<th>Pre-operative</th>
<th>Immediate post-operative</th>
<th>Final follow-up</th>
<th>p value</th>
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<td>Visual analog scale</td>
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<td>2.3</td>
<td>2.4</td>
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<tr>
<td>Kyphotic angle</td>
<td>16.4</td>
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<td>Anterior vertebral height</td>
<td>51</td>
<td>75.5</td>
<td>71.2</td>
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<td>Oswestry disability index</td>
<td>71.5</td>
<td>26.0</td>
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Figure 3: Lateral radiograph showing cement and affected vertebra at 1 year follow-up

Discussion

This study shows results of balloon kyphoplasty in treatment of osteoporotic vertebral compression fracture. In our series of 30 cases, the majority were female (73.3%) similar to other study. Measure of clinical outcome for pain, mean VAS score was 8.1 ± 0.9 preoperatively which improved to 2.4 ± 0.3 at final follow-up which shows p value less than 0.05 by paired t-test and is statistically significant. This can improve sagittal profile, which decreases compensating activity of the muscles. The ODI score also shows significant improvement after surgery, which improved from 71.4 ± 3.4 to 26.0 ± 4.8 at one day and 21.2 ± 5.5 at final follow-up. Mean kyphotic angle was improved from 16.4 ± 3.5 to 5.6 ± 1.7 postoperatively and 8.4 ± 1.6 at final follow-up. The significant increment in mean anterior vertebral height was observed i.e., from 51 ± 7.3% before surgery to 75.5 ± 7.4% at one day after surgery and 71.2 ± 3.2% at the last follow-up. The result shows functional improvement in VAS score and ODI score which is similar to other studies.

Our study showed a rapid decrease in pain, with a significant improvement in VAS score postoperatively.

Our study shows an improvement in sagittal alignment of spine and vertebral body height was achieved in most of the patients. A mean correction of 8.07° was achieved in local kyphosis which is similar to the 8.8° in another study. The cement leakage was 9% following kyphoplasty and 41% after vertebroplasty in other clinical studies. In our series, it was reported in one case (3.3%) which shows better results. The study shows no neurological complications, no infection and no symptomatic pulmonary embolism. Thus, percutaneous kyphoplasty showed low complication rates with good outcome.

Conclusion

Percutaneous balloon kyphoplasty for treatment of symptomatic osteoporotic vertebral compression fracture is a good option with better pain relief, quality of life and with low complication rates.

References