

Clinical Study

Percutaneous vertebroplasty for patients with metastatic compression fractures of the thoracolumbar spine: clinical and radiological factors affecting functional outcomes

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Abstract

BACKGROUND CONTEXT: Vertebroplasty (VP), including balloon kyphoplasty (BKP), has long been accepted as a minimally invasive surgical intervention for the stabilization of painful vertebral compression fractures. In metastatic compression fracture (MCF), cancer often invades the paravertebral structure and involves the posterior column of the vertebrae.

PURPOSE: In the present study, we first analyzed how clinical features of MCF affect functional outcomes after VP. Second, we evaluated whether BKP is more beneficial than simple VP (SVP) in MCF.

STUDY DESIGN/SETTING: This is a retrospective observational study.

PATIENT SAMPLE: Three hundred forty-two patients who underwent VP for painful MCF from solid cancer were included. We excluded MCF from hematopoietic cancer, such as leukemia or multiple myeloma.

OUTCOME MEASURES: Pain improvement was evaluated using the visual analog scale (VAS; range: 0–10), and if the VAS score decreased by at least three points the treatment was considered effective. Postoperative change in Karnofsky performance status (KPS) and drug requirement for pain control were also measured as functional outcomes.

METHODS: An institutional database at the National Cancer Center of Korea was searched to identify all patients who underwent VP for painful MCF between March 2002 and September 2013. Demographic data, as well as preoperative and postoperative clinical factors, were collected from patients' medical records. Radiological features, including paravertebral extension of tumors and the extent of three-column involvement, were reviewed from pretreatment magnetic resonance imaging (MRIs). These clinical and radiological factors were then analyzed for their influence on functional outcomes.

RESULTS: The mean preoperative VAS score was 5.8; this improved to a mean of 2.7 after VP. Effective improvement in VAS score (≥ 3) was achieved in 206 patients (60%). Patients with radiculopathy, as well as those with involvement of (1) the posterior column or (2) more than four out of six columns, presented with significantly higher pretreatment VAS scores and experienced more effective improvement after treatment ($p < .05$). Two hundred thirty-eight patients (70%) underwent SVP, whereas the remaining 104 patients underwent BKP. The pretreatment degree of compression was significantly higher in BKP (mean: 47%) than in SVP patients (mean: 30%) ($p < .001$). However, preoperative VAS scores were not significantly different between the two groups, and the resultant VAS score improvement was also not significantly different. Although BKP patients reported to have a greater chance of more than 3 mL of cement injection ($p = .01$), the mean amount of

FDA device/drug status: Not applicable.

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cement injected was not different between the two groups. Patients with other bone metastases showed a significantly poorer KPS improvement rate ($p=.015$). Patients having moderately or slowly growing cancer according to the Tomita classification had a greater chance of reduced drug requirements 1 month after the procedure ($p=.004$).

CONCLUSIONS: Paravertebral extension and posterior column involvement of MCF did not preclude pain improvement after VP. Balloon kyphoplasty for MCF failed to show enhanced pain improvement relative to SVP. Metastatic compression fracture patients with other bone metastases or rapidly growing tumors had a lower chance of performance improvement and reduced drug requirements, respectively. © 2016 Elsevier Inc. All rights reserved.

Keywords: Compression fracture; Kyphoplasty; Metastasis; Minimally invasive surgical procedures; Patient outcome; Vertebroplasty

Introduction

The spine is one of the most common locations of metastases in patients with systemic malignancy. The incidence of spinal metastasis has increased due to extended patient survival and early diagnosis with advanced neuroimaging, such as magnetic resonance imaging (MRI) [1,2]. Treatment is important because spinal metastasis frequently results in debilitating pain and immobility. Surgical intervention is indicated for patients with neurologic deficits from metastatic spinal cord compression; it could provide both relatively prompt restoration of neurologic function and immediate stabilization of the spine [3,4]. Fortunately, the most common presenting symptom of spinal metastases is limited to pain (85%–96% of patients), and osteolytic spinal metastases without neurologic compromise can be treated successfully with percutaneous vertebroplasty (VP) at the cost of short hospital stay or outpatient base [5]. Vertebroplasty could provide effective pain relief and immediate stabilization for painful metastatic compression fractures (MCF) and durable local control combined with radiotherapy to the involved vertebrae [6–10]. Although the reported rate of pain improvement in MCF after VP is as high as 50%–95%, the factors influencing the effectiveness of VP for MCF have not been evaluated thoroughly [7,10–17].

In addition to the motion-related pain from vertebral instability, patients with MCF complain constant pain from the paravertebral involvement of the tumor or radiculopathy when the nerve root is compressed, and unlike patients with osteoporotic compression fracture (OCF), patients with MCF usually have associated systemic disease, including visceral metastases and other, non-spinal bone metastases, both of which can superimpose upon the pain from MCF. Furthermore, the speed of progression and the type of primary cancer can affect pain resolution after VP [9,18].

Gadolinium-enhanced MRI is a standard diagnostic neuroimaging technique for MCF. It differentiates MCF from benign OCF with findings such as a pattern of marrow involvement, multiple-level involvement, pedicle involvement, paravertebral extension of the tumor, and posterior vertebral expansion [19,20]. However, the clinical significance of these radiological features has not yet been studied, necessitating further study on how VP might affect symptom improvement.

In OCF, vertebral augmentation by balloon kyphoplasty (BKP) restores the loss of vertebral height and corrects kyphotic deformities, providing a more natural stabilization than simple VP (SVP). Some studies also suggested more effective pain relief by BKP [14,21–23]. However, in MCF, tumors frequently invade the vertebrae asymmetrically and sometimes occur as a chronic process, provoking reactive change. These two caveats raised the following questions: (1) Can BKP achieve better vertebral augmentation than SVP in MCF? (2) If it does, will the better augmentation result in the better pain improvement, as it does in OCF?

In this retrospective study, we measured the efficacy of VP through changes in visual analog scale (VAS) scores, as well as Karnofsky performance status (KPS) and change in drug requirements as indicators of pain and functional impairment, respectively. We evaluated how clinical and radiological factors unique to MCF affect these outcomes after VP. In addition, we evaluated whether BKP is more effective than SVP in patients with MCF, and identified patients who can benefit from BKP in such cases.

Materials and methods

Eligibility criteria

From March 2002 to September 2013, authors from the National Cancer Center of Korea performed 553 VP rounds in 467 cancer patients with vertebral compression fracture. For patients who underwent multiple-round VP via separated operations, only the first round was analyzed. Vertebroplasty was performed on patients with intractable back pain caused by a pathologic fracture and with no evidence of neurologic deficit from epidural compression. We excluded patients with previous spinal surgeries, including VP, those with OCF, and those with compression fractures of the spine in which the primary cancer was hematopoietic, such as multiple myeloma and leukemia, which tend to show a similar nature and distribution of marrow involvement (predominantly the anterior and middle columns of the vertebrae) as OCF. Consequently, our results include a total of 342 patients who received VP for painful thoracolumbar MCF without neurologic deficit.

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