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The Spine Journal 12 (2012) 304–312

THE SPINE JOURNAL

Clinical Study

Hypovitaminosis D as a risk factor of subsequent vertebral fractures after kyphoplasty

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Received 14 April 2011; revised 30 November 2011; accepted 14 February 2012

Abstract

BACKGROUND CONTEXT: Over the past 20 years, methods of minimally invasive surgery have been developed for the treatment of vertebral compression fractures. Balloon kyphoplasty and vertebroplasty are associated with a recurrent fracture risk in the adjacent levels after the surgical procedure. In certain patient categories with impaired bone metabolism, the risk of subsequent fractures after kyphoplasty is increased.

PURPOSE: To determine the incidence of recurrent fractures after kyphoplasty and explore whether the status of bone metabolism and 25-hydroxyvitamin D (25(OH)D) levels affect the occurrence of these fractures.

STUDY DESIGN: Prospective longitudinal clinical study.

PATIENT SAMPLE: Forty female postmenopausal women with primary osteoporosis and acute symptomatic vertebral compression fractures.

OUTCOME MEASURES: Identification of new vertebral fractures and documentation of indicators of bone metabolism.

METHODS: A total of ninety-eight kyphoplasties were performed in 40 female patients. Balloon kyphoplasty was performed on all symptomatic acute vertebral compression fractures. Age, body mass index, history of tobacco use, number of initial vertebral fractures, intradiscal cement leakage, history of nonspinal fractures, use of antiosteoporotic medications, bone mineral density, bone turnover markers, and 25(OH)D levels were assessed. All participants were evaluated clinically and/or radiographically. Follow-up period was 18 months.

RESULTS: The mean population age was 70.6 years (range, 40–83 years). After initial kyphoplasty procedure, nine patients (11 levels) (22.5% of patients; 11.2% of levels) developed a postkyphoplasty vertebral compression fracture. Cement leakage was identified in seven patients (17.5%). The patients without recurrent fractures after kyphoplasty demonstrated higher levels of 25(OH)D (22.6 ± 5.51 vs. 14.39 ± 7.47; $p=.001$) and lower N-terminal cross-linked telopeptide values (17.11 ± 10.20 vs. 12.90 ± 4.05; $p=.067$) compared with the patients with recurrent fractures.

CONCLUSIONS: Bone metabolism and 25(OH)D levels seem to play a role in the occurrence of postkyphoplasty recurrent vertebral compression fractures.

Keywords: Kyphoplasty; Osteoporosis; Recurrent fractures; Bone metabolism; Hypovitaminosis D

FDA device/drug status: Not applicable.

Author disclosures: ***CPZ:*** Nothing to disclose. ***GPL:*** Nothing to disclose. ***NAP:*** Nothing to disclose. ***PEG:*** Nothing to disclose. ***AG:*** Nothing to disclose. ***SNC:*** Nothing to disclose. ***SGP:*** Nothing to disclose.

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doi:10.1016/j.spinee.2012.02.016

Introduction

Vertebral compression fractures are among the most common complications of osteoporosis with significant socioeconomic consequences. An estimated 750,000 new vertebral fractures occur in the United States every year [1], whereas the burden of health management exceeds $700 million [2].

The vertebral fractures affect the patient's overall health because of the direct and indirect effects on quality of life with increased morbidity and mortality [3–11]. Pain associated with vertebral fractures limits mobility of the patients and subsequently leads to depression and loss of self-independence [12–14].

The presence of one or more vertebral fractures increases the risk of a new vertebral fracture by five-fold, although the incidence of a new vertebral fracture in the following year is approximately 20% [15,16].

Despite medical approach [17], as many as one-third of patients with vertebral fractures continue to experience severe pain that can lead to further disability [18] that requires long-term care and hospitalization.

Over the past 20 years, methods of minimally invasive surgery have been developed, including vertebroplasty and kyphoplasty. The technique of vertebroplasty consists of fluoroscopically guided percutaneous insertion of a needle into the fractured vertebra and injection of polymethylmethacrylate cement. Kyphoplasty differs from vertebroplasty in that it involves the insertion of a balloon tamp [19]. The balloon tamp intends to reduce the deformity, to restore the vertebral body height while creating a cavity to be filled with polymethylmethacrylate. The complications of these techniques are bleeding, transitory increase in pain, cement leakage, spinal infection, rib fractures, symptomatic or asymptomatic pulmonary embolism, radiculopathy, and spinal cord compression from the extravagation of the cement. Balloon kyphoplasty and vertebroplasty are also associated with a recurrent fracture risk in the adjacent levels within a short period of time after the surgical procedure [19].

In recent years, there has been increasing interest regarding the incidence of recurrent vertebral fractures after each type of procedure and possible reasons for their occurrence. A number of variables, such as the number of levels treated, the age, the gender, the cement leakage, the role of intervertebral disc, the unipedicular or bipedicular kyphoplasty, the sagittal alignment, the amount or the type of cement injected, the bone mineral density measurements, and several other factors [20–29], have been evaluated by several studies in the development of the recurrent fractures and in the overall clinical outcome. At the present time, there are little and insufficient data concerning the evaluation of the metabolic profile of the patients who undergo kyphoplasty [30].

The present study was undertaken to evaluate the incidence of recurrent fractures after kyphoplasty and identify any association between these fractures and the metabolic risk factors.

EVIDENCE & METHODS

Context
Adjacent level fractures following vertebrolasty and kyphoplasty are common and can be problematic. In this study, the authors explore possible risk factors.

Contribution
In this relatively small prospective study that examined several potential risk factors for adjacent level fractures, only Hypovitaminosis D and cement leakage from the prior kyphoplasty were found to be risk factors.

Implication
The findings suggest that both technical and metabolic factors present risk. Importantly, both are somewhat controllable, either by vitamin supplementation or by technique modification.

—The Editors

Methods

A total of 98 kyphoplasties were performed in 40 women with an average age of 70.5 ± 8.5 years, with acute symptomatic vertebral compression fractures with stable or deteriorative pain for up to 12 weeks (Fig. 1). Patients with multiple myeloma, primary or metastatic malignancies, rheumatic diseases or corticosteroid use, liver or kidney disease, or transplantation were excluded from the study (Table 1).

A full medical history and physical examination at baseline were obtained. Body weight and height were obtained, and the body mass index was calculated. Patient's medications, fracture history, family history of osteoporosis, number of pregnancies, smoking, alcohol consumption, and age of menarche and menopause were recorded.

All patients underwent plain radiographs, magnetic resonance imaging (MRI), and bone scintigraphy. The criteria for diagnosis of vertebral fracture were deformation of the vertebral body according to Genant's grading system on plain radiographs, replacement of bone marrow with edema at the same level (T1-weighted and T2-weighted series with fat saturation) on MRI, and horizontally increased tracer uptake in a vertebral body on bone scintigraphy. If there was a discordance between the findings on MRI and bone scintigraphy, the patient was excluded from the study.

Bone mineral density was measured at the lumbar spine and femoral neck by using dual energy X-ray absorptiometry.

Kyphoplasty was performed through standard bilateral transpedicular approach under general anesthesia.

After surgery, biochemical analysis of bone turnover markers was performed for all the patients, to determine their bone metabolic profile and initiate or modify medical treatment, as needed.