

Clinical Study

Vertebroplasty and kyphoplasty: national outcomes and trends in utilization from 2005 through 2010

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Abstract

BACKGROUND CONTEXT: Vertebral compression fractures secondary to low bone mass are responsible for almost 130,000 inpatient admissions and 133,500 emergency department visits annually, totaling over \$5 billion of direct inpatient costs. Although most vertebral compression fractures heal within a few months with conservative therapy, a significant portion fail to improve with conservative treatment and require long-term care, conservative treatment, or both. Fractures that fail conservative therapy are treated with vertebral augmentation procedures (VAPs) such as vertebroplasty (VP) and kyphoplasty (KP). Two large randomized clinical trials published in 2009 questioned the efficacy of VP in treatment of VAPs.

PURPOSE: This study aimed to investigate trends in utilization of VP and KP between 2005 and 2010 to capture the impact of the 2009 literature on utilization of VAPs. The study also compares patient characteristics and perioperative outcomes between VP and KP to further delineate the risks of each procedure.

STUDY DESIGN: Retrospective analysis of national utilization rates, clinical outcomes, patient demographics, and patient comorbidities using a large national inpatient database.

PATIENT SAMPLE: A total of 63,459 inpatient admissions from 46 states and more than 1,000 different hospitals were included in the analysis.

OUTCOME MEASURES: Length of stay (LOS), total direct cost, mortality, postoperative complications.

METHODS: Data were obtained from the National Inpatient Sample database for the period between 2005 and 2010. National Inpatient Sample is the largest publicly available all payer inpatient database in the United States. Patients undergoing VP and KP were identified via corresponding the International Classification of Diseases, 9th Revision procedure codes. National utilization trends were estimated using weights supplied as part of the National Inpatient Sample dataset. Information on patient comorbidities and demographics was collected. A series of univariate and multivariate analyses were used to identify statistically significant differences in patient characteristics, clinical outcomes, as well as cost and LOS between patients undergoing VP versus KP.

RESULTS: A total of 307,050 inpatient VAPs were performed in the United States between 2005 and 2010. Of those procedures, 225,259 were KP and 81,790 were VP. Kyphoplasty utilization showed an increasing trend between 2005 and 2007, increasing from 27 to 33 procedures per 100,000 capita older than 40 years. During the same time period, VP utilization remained constant at approximately nine procedures per 100,000 capita older than 40 years. After 2007, utilization of

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

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both VP and KP decreased. The most precipitous decrease in VAP utilization occurred in 2009. Patients undergoing VP were on average older (76.7 vs. 77.8, $p < .0001$), more frequently women (74.48% vs. 73.15%, $p = .00083$), and black (1.77% vs. 1.55%, $p = .004059$). Patients undergoing VP had on average more comorbidities than those undergoing KP. Patients undergoing VP had a higher rate of postoperative anemia secondary to acute bleeding and higher rate of venous thromboembolic events. Those undergoing KP had a greater rate of cardiac complications; however, this difference was not statistically significant when taking into account patient age and comorbidity burden. Vertebroplasty was associated with higher mortality (0.93% vs. 0.60%, $p < .001$), longer LOS (6.78 vs. 5.05 days, $p < .0001$), and lower total cost (\$42,154 vs. \$46,101, $p < .0001$).

CONCLUSIONS: Overall, KP was associated with lower complication rates, shorter LOS, and a higher total direct cost compared with VP. Utilization rates showed a significant decrease since 2009 in both VP and KP, suggesting that both procedures were impacted by the two randomized controlled trials published in 2009 that suggested poor efficacy of VP. © 2015 Elsevier Inc. All rights reserved.

Keywords:

Kyphoplasty; Vertebroplasty; Vertebral augmentation procedures; Utilization; Vertebral compression fractures

Introduction

Osteoporosis is a major health concern facing physicians in the United States. By 2002 estimates, 44 million people older than 50 years were at risk of fractures secondary to low bone mass related to osteoporosis [1]. The prevalence of osteoporosis is increasing as the population ages [2–4]. Vertebral compression fractures (VCFs) are a common presentation of osteoporosis. Vertebral compression fractures secondary to low bone mass are responsible for almost 130,000 annual inpatient admissions and 133,500 emergency department visits annually [5,6]. The annual direct inpatient costs related to VCFs total almost \$5 billion, in addition to the substantial costs associated with outpatient treatments and indirect costs secondary to loss of function and inability to work [5]. Vertebral compression fractures are also associated with an increase in mortality [7].

Although most VCFs heal within a few months with conservative therapy, a significant portion fail to improve and require long-term care, surgical intervention, or both [8]. Fractures that fail conservative therapy are often treated with vertebral augmentation procedures (VAPs) such as vertebroplasty (VP) or kyphoplasty (KP).

Vertebroplasty involves the percutaneous injection of polymethylmethacrylate into the fractured vertebral body. Polymethylmethacrylate cement provides structural integrity to the vertebral body preventing further compression and potentially alleviating painful symptoms. Kyphoplasty is a modified VAP that involves creating a cavity in vertebral body by inflating a balloon before injection [9]. The additional balloon inflation step is intended to restore vertebral height and create a space for the polymethylmethacrylate, thereby reducing injection pressure [10,11].

A number of past case series and small trials suggested that VP is an effective treatment of VCFs [12–22]. The strongest evidence for the efficacy of VP came from a small nonblinded randomized trial of 34 patients [21]. Similarly, small studies have suggested that KP is an effective alternative to VP [23–25]. An open, randomized trial of KP was

published that supported its efficacy [26]. Weaknesses in methodology of these studies have brought efficacy of VAPs into question. Specifically, the lack of blinding in the trials and lack of a sham controls predispose the results of the trials to be impacted by placebo. The response to placebo has been noted to be more significant for invasive interventions [27].

Two double-blind randomized controlled trials (RCTs) investigating the efficacy of VP in the treatment of VCFs set out to provide strong evidence for the issue [28,29]. Both trials found no statistically significant difference in outcomes between VP and a sham procedure. These findings have led to questioning of the efficacy of VAPs, changes in recommendations by professional societies regarding the use of VP, and changes in reimbursement patterns for both procedures.

In a previous study, we investigated the trends in utilization of VAPs between 2005 and 2008 using inpatient and ambulatory state-specific databases from New York, New Jersey, and California [30]. The study noted a significantly greater use of KP comparing with VP and an overall trend of increasing utilization of VAPs. Other studies have noted similar increases in VAP use [31,32]. These studies were done before the publication of the two RCTs on the topic.

This study aimed to investigate trends in utilization of VP and KP using a large national administrative database to capture the impact of the 2009 literature on utilization of VAPs. The present study also compares patient characteristics and perioperative outcomes between VP and KP to further delineate the risks of each procedure.

Methods

Data were obtained from the National Inpatient Sample (NIS) database for the period between 2005 and 2010. National Inpatient Sample is an administrative database compiled by the Agency for Healthcare Research and Quality as part of the Healthcare Utilization Project [33]. This is the

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