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Vertebroplasty in the Inpatient Population

Andrew T. Trout, Leigh A. Gray, and David F. Kallmes

BACKGROUND AND PURPOSE: Vertebroplasty is frequently offered to patients hospitalized for refractory pain due to vertebral fractures, because it is assumed that the procedure will facilitate resolution of pain and a rapid hospital discharge. We report our experience with inpatient vertebroplasty, with attention to rapidity of discharge and relevant clinical parameters.

METHODS: We retrospectively reviewed the duration of hospitalization in patients admitted with primary diagnoses of back pain or vertebral fracture who were treated with vertebroplasty. We cataloged outcomes in the form of verbal pain scales (graded 0–10), in-hospital medication use (graded 0–6), and posthospitalization medication use. Outcomes were assessed at baseline and at 1 week, 1 month, 6 months, 1 year, and 2 years postvertebroplasty.

RESULTS: We identified 66 such patients who had a median total hospital stay of 6.0 days (range, 1–26 days). Median length of stay before and after vertebroplasty were 4.0 (range, 1–24 days) and 1.5 days (range, 0–7 days), respectively. Ten (15%) patients were discharged the day of vertebroplasty. By days 2 and 3, 33 (50%) and 48 (72.7%) of the 66 patients had been discharged. Patients who received vertebroplasty earlier in the course of hospitalization demonstrated greater decreases in medication strength by discharge ($P = .045$). There was significant improvement in all outcome measures by 1 week, with continued improvement at 1 and 6 months.

CONCLUSION: This study confirms that vertebroplasty facilitates a rapid hospital discharge as well as long-term improvement in patients admitted for refractory pain. Vertebroplasty administered earlier in hospitalization also leads to greater decreases in analgesic requirements.

Vertebral compression fractures pose a significant burden on our health care system. Between 8% and 50% of vertebral compression fractures presenting for medical care require acute inpatient hospital care (1–3). In the past, these patients were typically admitted for pain management with narcotic medications at an estimated expenditure of greater than \$540 million annually (4). With the success of vertebroplasty, this procedure has become the standard of care and is now routinely offered to patients hospitalized for refractory pain, often without regard to the chronicity of the fracture. This is based largely on the assumption that the procedure will facilitate resolution of pain and a rapid hospital discharge.

Unfortunately, despite the known success of vertebroplasty in a predominantly outpatient population, there exist no data regarding the efficacy of vertebroplasty in patients who required hospitalization for pain management. It is very likely that there are substantial differences between these two populations in terms of pain level and anesthesia requirements. In addition, these underlying differences would be expected to have a significant impact on outcomes following vertebroplasty. Despite these potential differences, there have been no specific examinations of the efficacy of vertebroplasty or the ability of vertebroplasty to shorten hospital stays and lead to rapid improvement in the inpatient population. We report our experience with inpatient vertebroplasty, with specific attention to rapidity of discharge and correlation to relevant clinical parameters.

Methods

We performed a retrospective review of 69 consecutive patients admitted between April 2000 and September 2004 with a primary diagnosis of back pain or vertebral compression fracture who were subsequently treated with vertebroplasty. Institutional review board approval was obtained for

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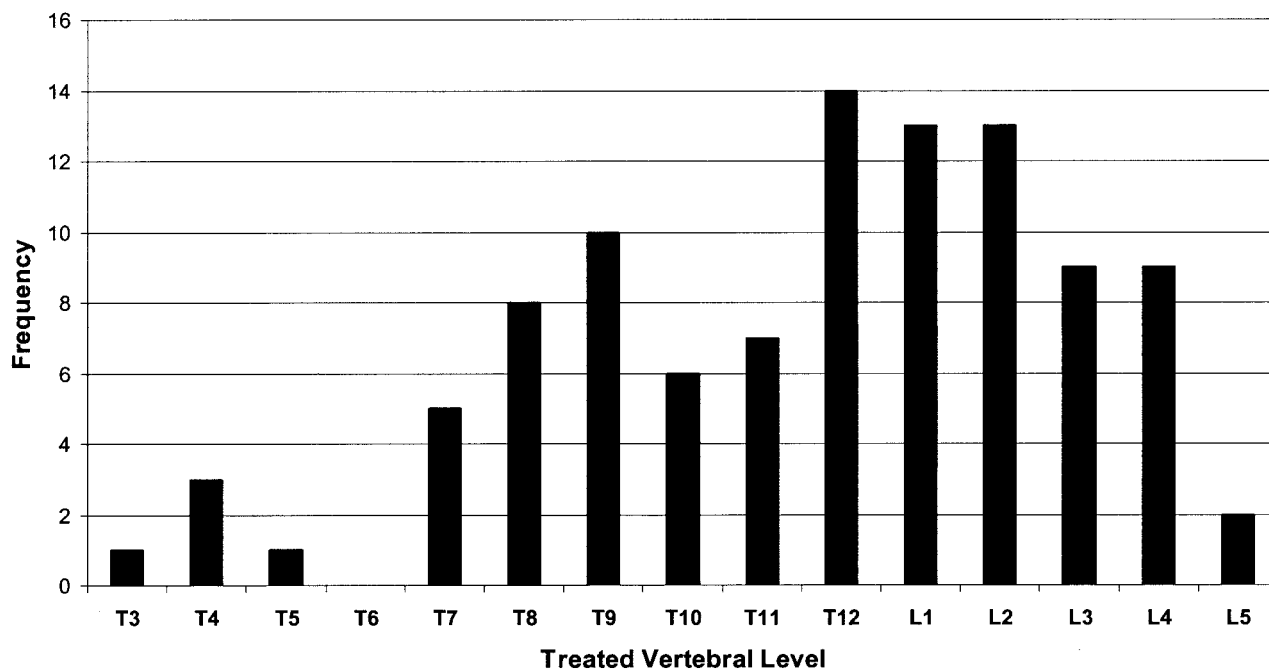


FIG 1. Graphic representation of the 101 vertebral levels treated in this inpatient population. The frequency of treated levels is bimodal with peaks near T8–T9 and L1.

this study. Three patients were excluded from the analysis because of the following confounding factors: additional surgery, osteogenesis imperfecta, and cement pulmonary embolus. These exclusions were made because the goal of this study was to define how vertebroplasty alone affects the duration of hospitalization, and these factors confounded this effect by extending the duration of hospitalization for unrelated tests and procedures.

Hospitalization and procedural data were gathered from electronic charts. We cataloged total length of hospital stay and duration of hospitalization before and after vertebroplasty. Outcomes data were collected in the form of verbal pain scales scored 0–10 for pain at rest and pain with activity. In addition, in-hospital medication use (graded 0–6) and posthospitalization medication use (relative to the prior time point: increased, same, decreased, none) were cataloged. All outcome measures were administered at baseline and at 1 week, 1 month, 6 months, 1 year, and 2 years postvertebroplasty.

Statistical Analysis

Spearman's ρ correlation coefficient was used for analysis of the correlation among the cataloged durations as well as between durations and outcome measures. Improvement in outcomes with time was analyzed with a paired t test comparison to the preceding time point for pain scales and by the Wilcoxon signed rank test for change in medication use. The Wilcoxon rank test and linear regression were used for analysis of the relationship between time periods, age and binary variables (sex, single vs multiple levels treated, thoracic vs lumbar cement placement).

Vertebroplasty Procedure

Vertebroplasties were performed by staff radiologists according to the methods outlined elsewhere (5). Specifically, patients were treated by using intravenous conscious sedation. Biplanar fluoroscopy was used in all cases. Local anesthesia was administered over the skin, subcutaneous tissues, muscular tissues, and periosteum of the targeted pedicle.

Transpediculate or parapedicular trajectories were used in all cases. After local anesthetic administration, 11-gauge biopsy needles (Cook, Inc., Bloomington, IN) were advanced into the central aspect of the vertebral bodies for unipediculate approaches, while placement of the needle was made into the midportion of the hemivertebra for bipedicate approaches.

The polymethylmethacrylate (PMMA) cement mixture was prepared under a vacuum hood. Approximately 30 g of PMMA powder (Codman Cranioplastic, Raynham, MA) was mixed with 12 g sterile barium sulfate (Cardinal Health; McGaw Park, IL) and 1 g gentamicin powder (Hawkins Inc., Minneapolis, MN). Liquid PMMA monomer was mixed with the powder mixture until the fluid reached a viscosity similar to that of cake glaze. The mixture was then loaded either into an injector device (Cook Inc.) or into 1-mL syringes and injected under continuous lateral and intermittent anteroposterior fluoroscopy. Cement injection was considered complete when the cement reached the posterior one-fourth of the vertebral body on the lateral projection. Injection was also terminated when epidural, venous, or transendplate extravasation was noted. Following needle removal, patients were left on strict bed rest for 1 hour and then discharged.

Results

We identified 66 patients (mean age, 77.6 years) who were hospitalized with refractory back pain and were subsequently treated at 101 vertebral levels (Fig 1). Twenty patients (30.3%) were men, and the vertebral fractures were due to osteoporosis in 64 patients and multiple myeloma in two. Complications were observed in 18 of the 66 patients (27.3%). Seven patients experienced cement extravasation into the paravertebral veins, three experienced extravasation into the epidural veins, and eight experienced disk space extravasation. None of these complications was symptomatic.

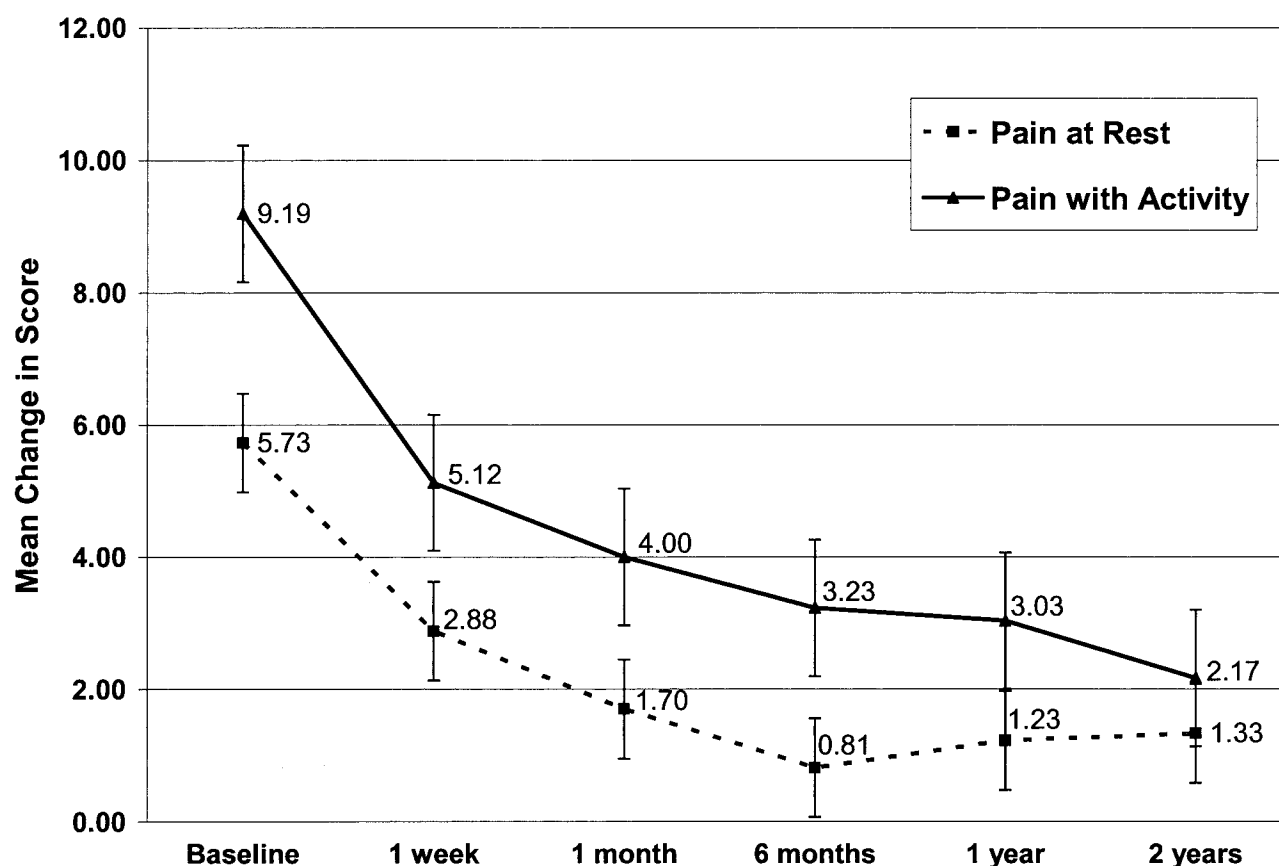


FIG 2. Graphic representation of mean pain scores throughout follow-up. There is significant improvement at 1 week, 1 month, and 6 months relative to the preceding time point. Improvement in pain scores persists to maximal follow-up (2 years).

Mean medication use throughout follow-up

	Baseline	1 week	1 month	6 months	1 year	2 years
N	66	59	62	44	34	18
Medication	0	-0.54	-0.85	-1.00	-1.28	-1.16
Use	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$

Note.—1 indicates increased; 0, same; -1, decreased; -2, no medications.

Rapidity of Discharge following Vertebroplasty

For the identified patients, the median total hospital stay was 6.0 days (range, 1–26 days). Median lengths of stay before and following vertebroplasty were 4.0 (range, 1–24 days) and 1.5 days (range, 0–7 days), respectively. Ten of the 66 patients were discharged the day of vertebroplasty. Thirty-three (50%) and 48 (72.7%) patients had been discharged by days 2 and 3, respectively. The remaining 16 patients had durations of hospitalization following vertebroplasty of between 4 and 7 days, with a median duration of 5 days.

Clinical Outcomes

To date, 66 patients have reached the 1-week end-point, 65 have reached 1 month, 44 have reached 6

months, 39 have reached 1 year, and 21 have reached the 2-year end-point. Follow-up pain scores were available for 62 patients (94%) at baseline, 58 patients (88%) at 1 week, 59 patients (91%) at 1 month, 33 patients (75%) at 6 months, 31 patients (79%) at 1 year, and 18 patients (86%) at 2 years. There was significant and rapid improvement in pain measures that persisted through maximal follow-up (Fig 2). Specifically, we observed significant improvement in rest and activity pain by 1 week ($P < .0001$ for both) with continued significant improvement at 1 month ($P = .02$ for both) and 6 months ($P = .05$ for rest pain; $P = .03$ for activity pain) relative to the preceding time points. Medication-use data were available on similar numbers of patients at each time point as those listed for pain measures, above. Mean medica-

tion use significantly decreased between all follow-up time points (Table).

Correlation of Duration of Hospital Stay with Clinical Outcomes

We also attempted to determine whether long hospitalizations would affect outcomes following vertebroplasty, in light of the fact that these patients may have either developed tolerance to medication or may have been more debilitated than those who were only hospitalized briefly before vertebroplasty. Duration of hospitalization between admission and vertebroplasty was significantly correlated with the change in medication strength between admission and discharge ($P = .045$). That is, patients who were treated with vertebroplasty earlier in their hospital course had greater decreases in the strength of their medication by discharge. The number of days between vertebroplasty and discharge was significantly correlated with the medication strength on admission ($P < .01$). That is, patients who were admitted for treatment with stronger medications such as parenteral or transdermal narcotics required longer hospital stays after vertebroplasty. Duration between admission and vertebroplasty, duration following vertebroplasty, and total length of hospitalization were not significantly associated with age, sex, number of levels treated, or thoracic versus lumbar treatment.

Discussion

Patients who are hospitalized for refractory back pain are increasingly being treated with vertebroplasty as a first-line therapy. This practice is largely the result of the demonstrated success of vertebroplasty in the outpatient population. Patients who require inpatient management of their pain may, however, represent a different population than outpatients treated with vertebroplasty. These patients may have more severe fractures, they may differ from outpatients in their perception of, or tolerance to, pain, or they may have become tolerant to the medications used to treat their pain. Each of these issues might influence the perceived efficacy of vertebroplasty. Because vertebroplasty in the inpatient setting has not been previously studied, we report our outcomes following vertebroplasty in a strictly inpatient population.

The current study demonstrates that vertebroplasty is highly effective in the inpatient population. Patients experience significant and rapid reduction in pain that persists for at least 2 years. In addition, patients experience continuing reduction in their medication requirements throughout follow-up. Perhaps more important, this study confirms that vertebroplasty facilitates a rapid discharge in most patients hospitalized for refractory back pain. These results support routine use of vertebroplasty in patients hospitalized

for refractory back pain due to vertebral compression fractures.

Epidemiologic investigations that have studied the length of hospitalization for vertebral fractures describe a mean duration of hospitalization of 6–10 days (1, 6). The median total hospitalization of 6.0 days in our population of patients treated with vertebroplasty is similar to these benchmarks. On average, however, 4 days passed before the patients in our study were treated with vertebroplasty. Following vertebroplasty, the median stay was only an additional 1.5 days, which suggests significant and rapid improvement in pain and medication requirements. The short course of hospitalization following vertebroplasty, combined with our finding that vertebroplasty administered earlier in hospitalization leads to greater decreases in the strength of analgesics required, demonstrate the value of this procedure in an inpatient population. It is our assertion that, in light of the demonstrated benefits of vertebroplasty, the procedure should be offered earlier in the course of hospitalization for refractory back pain.

This investigation was both retrospective in nature and lacked a control group. It would be valuable to compare these results to a strictly inpatient control group in an effort to describe the underlying differences in this population and thereby more accurately describe the treatment effects. Lack of a control group is not unique to this study. The vertebroplasty literature as a whole is lacking in randomized and placebo controlled studies. Ultimately, these are the type of data that are needed to demonstrate the value of vertebroplasty in both the inpatient and outpatient settings (7).

Another limitation of this study is that we were unable to control for patient comorbidities and the effects these might have had on duration of hospitalization. Though coincident pathologic processes likely increased the duration of hospitalization, we were still able to show rapid discharge and significant improvement following vertebroplasty, which indicates that a large effect exists.

Conclusion

We have clearly demonstrated the benefits of vertebroplasty in terms of pain relief and reduction in medication use for the unique population of patients who are hospitalized for refractory pain. In addition, these data demonstrate the utility of vertebroplasty in facilitating a rapid discharge from the hospital.

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