Eur J Orthop Surg Traumatol
DOI 10.1007/s00590-015-1700-8

ORIGINAL ARTICLE • OSTEOPOROSIS - FRACTURES

ASA III osteoporotic fracture in 62 patients treated with vertebroplasty under local anesthesia

Tuluhan Yunus Emre[1] · H. Bahadır Gökcen[2] · Zafer Atbaşı[3] · Gülis Kavadar[4] · Meriç Enercan[5] · Cagatay Ozturk[2]

Received: 3 February 2015 / Accepted: 1 September 2015

Abstract Vertebroplasty is a minimally invasive procedure that may be performed under either local or general anesthesia. In this study, we aimed at assessing the outcomes of the vertebroplasty performed under local anesthesia in patients at high risk of general anesthesia. Vertebroplasty was performed under local anesthesia in the treatment of a total of 62 patients (68 vertebrae in total) with osteoporotic vertebral fractures between 2011 and 2013. None of the patients had a history of trauma. Patients who were classified as ASA III during the preoperative examinations were included in the study. VAS scores were evaluated before the surgery, on the first postoperative day, and in week 1 and in month 1 after the surgery. The average age was 77.5 years (age range 53–102). An average of 2 cc of cement was injected to 22 patients (35.5 %), and an average of 3 cc of cement was injected to 40 patients (64.5 %). The mean VAS scores were 7.52 (6–9) before the procedure, 3.55 (2–5) on the first day, 2.03 (0–4) in week 1 and 0.87 (0–2) in month 1 postoperatively. Asymptomatic cement embolism was detected in one patient. No other complications were observed in the study group. Vertebroplasty performed under local anesthesia is an effective and safe procedure in terms of pain control and early ambulation and is bereft of the complications associated with general anesthesia.

Keywords Vertebroplasty · Local anesthesia · ASA III · General anesthesia

✉ Tuluhan Yunus Emre
drtuluhan@yahoo.com

H. Bahadır Gökcen
bahadrgokcen@gmail.com

Zafer Atbaşı
zatbasi@yahoo.com

Gülis Kavadar
gulisd@hotmail.com

Meriç Enercan
enercan@yahoo.com

Cagatay Ozturk
cgtyztrk@yahoo.com

1 Orthopaedia and Traumatology Department, Memorial Hizmet Hospital, Halkalı Caddesi Yeşilköy Toplu Konut Sitesi A 31, Yeşilköy, Istanbul, Turkey

2 Orthopaedia and Traumatology Department, Florence Nightingale Bilim Üniversitesi, Istanbul, Turkey

3 Orthopaedia and Traumatology Department, Ankara Military Hospital, Ankara, Turkey

4 Physical Medicine and Rehabilitation Department, Medicine Hospital, Istanbul, Turkey

5 Orthopaedia and Traumatology Department, Istanbul Florence Nightingale İstanbul Omurga Center, Istanbul, Turkey

Introduction

Osteoporosis is a systemic disease that may result in fragility fractures due to loss of toughness and inherent quality of the bone structure. A gradual increase in the number of patients with osteoporosis has rendered the disease a major health concern. The most common sites of osteoporotic bone fractures are the spine, hip and wrist [1, 2]. Unlike osteoporotic fractures of the hip and wrist, osteoporotic fractures of the spine are not usually preceded by a fall or trauma. Thirty percent of the patients with osteoporotic spinal fractures present clinical symptoms [3, 4], while the rest of the fractures are randomly discovered during routine imaging. Untreated patients with osteoporosis may develop

Published online: 16 September 2015

irreversible spinal deformities. Spinal deformities are usually preceded by an initial increase in kyphosis, and progressive spinal cord compression may result in the degradation of the quality of life [5, 6].

Vertebroplasty was first described by Daramond et al. in 1985 [7]. The procedure is defined as the injection of polymethylmethacrylate (PMMA) into the vertebral body under radiological guidance to provide pain relief and structural support. In medical literature, vertebroplasty was first used in the treatment of symptomatic and aggressive vertebral angiomas [7, 8]. This procedure is also used in the treatment of the spinal fractures related to malignant tumors [9–14], as well as compression fractures of the spine [15–20]. However, the most common indication of vertebroplasty is the painful osteoporotic fractures of the spine [21].

Although conventional treatment of spinal fractures includes bed rest and analgesics, several studies on the management of painful osteoporotic fractures of the spine in medical literature have demonstrated the efficacy of vertebroplasty in relieving pain [22–26]. Even though it is a percutaneous procedure, the use of general anesthesia may be associated with certain risks since osteoporotic vertebral fractures affect elderly population. The benefits of minimally invasive procedures are shorter hospital stay, enhanced patient safety and lower postoperative morbidity than open surgical procedures. Similar to those in other surgical procedures, a comprehensive preoperative evaluation should be carried out to determine whether the procedure requires general anesthesia [27–29]. The preoperative evaluation of the patients is carried out according to the American Society of Anesthesiologists (ASA) Physical Status Classification System. The purpose of this grading system is simply to assess the degree of a patient's "sickness" or "physical state" in order to decide on the mode of anesthesia or whether to conduct the surgery. The description of patients' preoperative physical status is retained for record keeping, communication between colleagues and creating a uniform system for statistical analysis [30].

Aim of this study is to evaluate the efficacy of percutaneous vertebroplasty in relieving pain when performed under local anesthesia on senior patients with a high risk of general anesthesia.

Patients and methods

Sixty-two patients (a total of 68 vertebrae) with symptoms for less than 3 months who were diagnosed with a symptomatic osteoporotic spinal fracture between September 2010 and December 2013 were included in the study. None of the patients had a history of trauma. ASA III patients were enrolled in the study, and during the preoperative preparations, they underwent a vertebroplasty procedure under local anesthesia. "The ASA score is a subjective assessment of a patient's overall health that is based on five classes (I–V): (I) Patient is a completely healthy fit patient. (II) Patient has mild systemic disease. (III) Patient has severe systemic disease that is not incapacitating. (IV) Patient has incapacitating disease that is a constant threat to life. (V) A moribund patient who is not expected to live 24 h with or without surgery. E. Emergency surgery, E is placed after the Roman numeral. Since inception it has been revised on several occasions and an 'E' suffix was included denoting an emergency case. Being simple and widely understood, ASA score also has been used in policy making, performance evaluation as an easy tool for audit, resource allocation, reimbursement of anesthesia services and frequently is cited in clinical research as well" [30].

The patients were evaluated on the basis of VAS scores before the surgery, on the first postoperative day, and in week 1 and in month 1 after the surgery.

Vertebroplasty technique

Vertebroplasty may be performed under sterile conditions with the patient under local anesthesia with sedation or under general anesthesia. Either extrapedicular or transpedicular approach may be used to access the vertebral body for cement injection. In our study, we performed the vertebroplasty procedure under local anesthesia with mild sedation due to the higher ASA grades of our patients. Cement was injected into the vertebral body via transpedicular route in all of the patients. The procedure was performed in the prone position with thoraco-pelvic supports. After prepping and draping the surgery field in a sterile fashion, the entry sites were determined under the guidance of a C-arm fluoroscope (Fig. 1). The entry sites were anesthetized using local anesthetic (bupivacaine hydrochloride), and a 0.5 cm skin incision was made. Under the guidance of a C-arm fluoroscope (anterior–posterior and lateral views), a guide wire was used to access the fractured vertebral body through the pedicles (Fig. 2). Kirschner wires were advanced over the guidewire, and the position of the entry sites over the pedicle and vertebral body was verified. A second guide wire was advanced over the Kirschner wires, and the K-wires were removed. Meanwhile, the cement (PMMA) was prepared in another sterile field. After attaining an injectable form, the cement was injected into the fractured vertebral body through the guidewire under the C-arm fluoroscopic guidance. The guide wires were removed, and the procedure was completed following primary skin closure by sutures. The patient was turned from prone to supine position, and repeated X-rays were taken. Patients were mobilized at postoperative sixth hour.

Percutaneous vertebroplasty was performed under local anesthesia on 62 patients with osteoporotic vertebral fracture

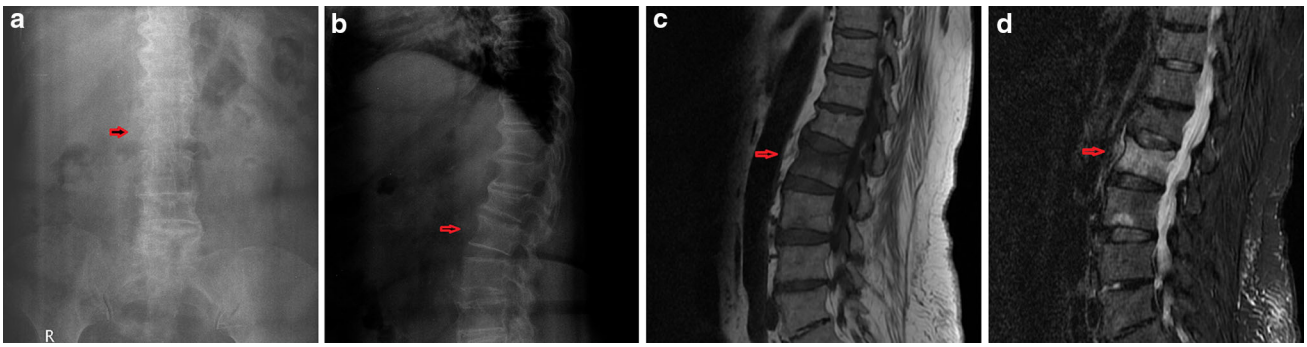

Fig. 1 **a–d** Preoperative anteroposterior and lateral X-ray and T1-weighted and STIR-weighted MR images of the patients

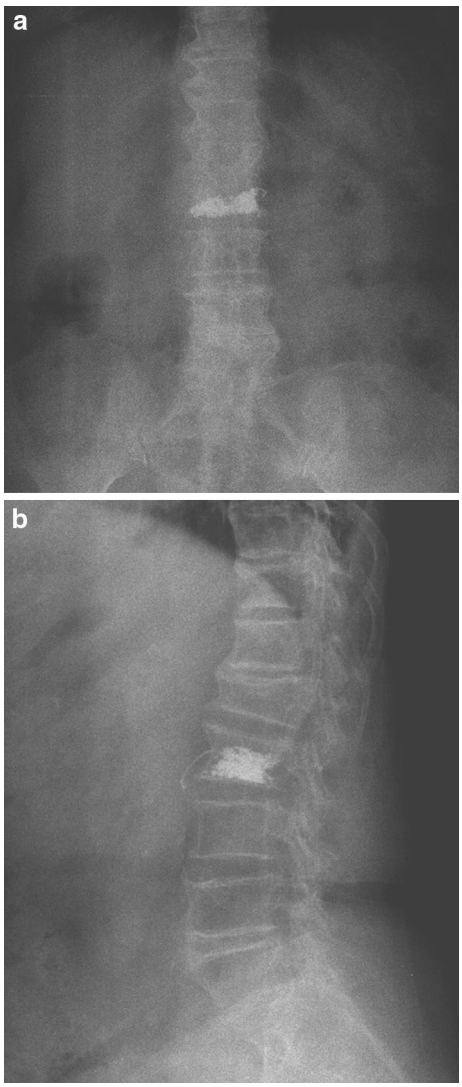

Fig. 2 **a**, **b** Postoperative anteroposterior and lateral X-ray images of the patients

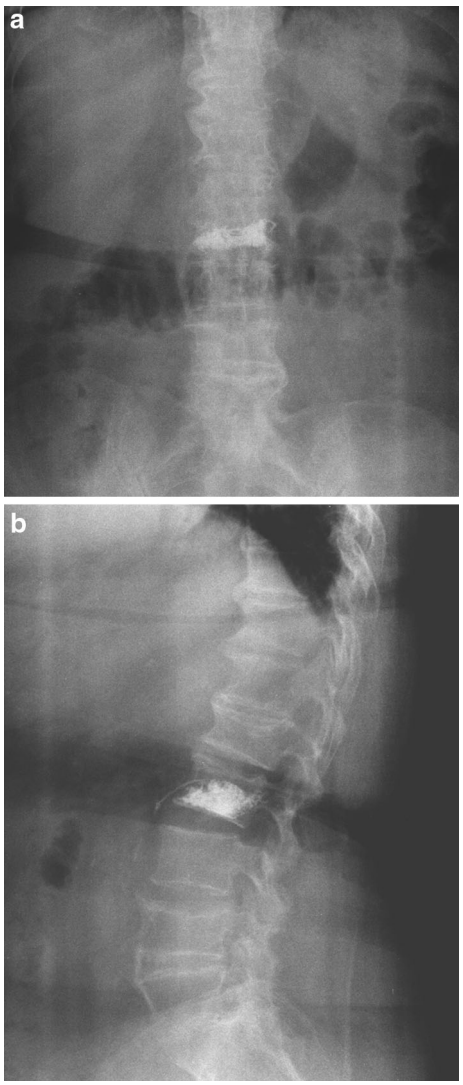

Fig. 3 **a**, **b** Postoperative 1 year follow-up anteroposterior and lateral X-ray images

using the vertebroplasty technique defined above. None of the patients had a history of a major trauma. All of the patients had a back pain unresponsive to bed rest and analgesic medications. Forty-four patients were diagnosed with spinal fractures at the time of admission to the outpatient clinic. The remaining 18 patients were evaluated in the

Table 1 Demographic and clinical characteristics of the patients

	Mean	SD	Minimum–maximum
Age (years)	77.15	10.99	53–102
Follow-up duration (months)	11.74	1.36	8–14
Hospital stay duration (h)	14.16	5.69	6–28
Diagnosis to vertebroplasty duration (days)	13.2	10.08	2–90

emergency room where they were admitted due to a fall at home. The patients were diagnosed by physical examination, whole spine X-ray and MRI scans. The assessments of the patients were performed using Huskisson's visual analog scale (VAS; 0 mm = no pain, 100 = severe pain), before the procedure, on the first day postoperatively, in week 1 and in month 1 after the surgery. Whole spine X-rays were taken in the supine position after the surgery in the operating room, in standing position during the follow-up visits of the first day, month 1, month 6 and year 1 after the surgery (Fig. 3). This study is approved by the local ethics committee. Written informed consent was obtained from the patients.

Statistical analysis

SPSS software version 15.0 was used for descriptive statistics. Student's *t* test and Pearson's correlation test were used to analyze the VAS scores of the patients before the surgery on day 1, week 1 and month 1 after the surgery.

Results

Sixty-two patients classified as ASA III were included in the study based on their ASA scores after the evaluation by the physicians from the Department of Anesthesiology and Reanimation. The mean age of 62 patients (20 M, 42 F) who underwent percutaneous vertebroplasty was 77.5 years (53–102 years). The mean time form the diagnosis to vertebroplasty was 13.2 days (2–90 days), and the mean hospital stay was 14.16 h (6–28 h). The mean follow-up duration was 11.74 months (8–14 months). Demographic and clinical characteristics of the patients are summarized in Table 1. The locations of the 68 osteoporotic vertebral fractures in 62 patients were as follows: 2 thoracic (T) 9 fractures (3 %), 12 T11 fractures (18 %), 20 T12 fractures (29 %), 28 lumbar (L) 1 fractures (41 %) and 6 L2 fractures (9 %) (Table 2). During the procedure, the average amount of the cement injected into the vertebral body was 2 cc in 22 vertebrae (32.3 %) and 3 cc in 46 vertebrae (67.6 %). The mean VAS scores of the patients were 7.52 (6–9) before the procedure, 3.55 (2–5) on day 1 postoperatively, 2.03 (0–4) at week 1 postoperatively and 0.87 (0–2) at month 1 postoperatively. A case of cement embolism was observed during the postoperative period (1.6 %).

Table 2 Locations of the osteoporotic vertebral fractures

	Frequency	Percent
D9	2	3
D11	12	18
D12	20	29
L1	28	41
L2	6	9

L lumbar vertebrae, *D* dorsal vertebrae

Discussion

Advanced surgical technique and possibilities gave a popularity to the vertebroplasty in the treatment of painful osteoporotic vertebral fractures. In medical literature, there are many studies advocating the efficacy of this procedure [22–24, 26, 31] both in pain control and on the quality of life by means of shortening the time to return to daily activities. The etiology of pain following a vertebral compression fracture is likely to be multifactorial, and the mechanism of pain relief after vertebroplasty is still unknown. Cement-mediated stabilization of microfractures and thermal or chemical damage to nerve endings are potential mechanisms that may explain the pain amelioration after vertebroplasty [32–34]. In our study, the mean VAS score, which was used for pain assessment, was reduced from 7.52 to 3.55 on the first postoperative day. The most significant reduction in VAS score was observed at the month 1 follow-up visit. The mean score was reduced to 0.87. The values measured at the week 1 visit were found to be lower in comparison with the values measured at the day 1 visit.

The benefits of all minimally invasive surgical procedures are well known. However, these procedures also require a comprehensive preoperative evaluation similar to other surgical procedures [27–29]. Although vertebroplasty has a lower surgical risk, the senior patients carry a high risk of presenting with complications related to both the procedure itself and substantial anesthetic risk associated with multiple comorbidities [35–37]. Several retrospective studies have demonstrated a correlation between ASA classification and perioperative mortality [38–42] and have suggested its usefulness as a predictor of patient outcome. Prospective studies correlating ASA classification with

both perioperative mortality and morbidity have suffered either from small patients [39] or from focusing only on anesthetic complications [43, 44]. Wolters et al. [45] published that absolute mortality rates of 0.1 % for ASA I, 0.7 % for ASA II, 3.5 % for ASA III, 18.3 % for ASA IV and 93.3 % for ASA V were based on all deaths in hospital after surgery. Forrest et al. [46] showed that ASA classes III and IV were major predictors for severe cardiorespiratory outcome in a study which included only patients for elective surgery. The higher ASA grade of the patients in our study led us to avoid general anesthesia, and we performed the procedure under local anesthesia.

Fields et al. [47] evaluated the short-term complications in hip fracture surgery and reported that patients having hip fracture surgery under spinal anesthesia had lower unadjusted frequency of deep vein thrombosis and urinary tract infection and also had a shorter mean duration of surgery than patients under general anesthesia. Similarly, Pugely et al. [48] detected a small but significant increase in the risk of complications in knee arthroplasty subjects operated under general anesthesia compared to those operated under spinal anesthesia and that the difference was more pronounced in patients with multiple comorbidities.

Vertebroplasty can be performed under either local or general anesthesia [27, 28, 49]; Caglı et al. [50] performed vertebroplasty under local anesthesia to avoid the potential complications of general anesthesia in a review of 91 vertebroplasty and kyphoplasty cases and reported no medical complications. We also preferred local anesthesia due to a mean patient age of 77.5 years and higher ASA scores in our study group and observed no procedure-related medical complications in the postoperative period.

Although the advantages of vertebroplasty are well described, there are still some complications associated with this intervention which include cement embolism, neurological deficits, discitis, dural tears and cement leakage. Cement leakage is a well-known complication of vertebroplasty [35]. In our study, only one case of cement leakage was observed. In a study conducted by Lee et al. [51], embolisms unrelated to cement application were reported as a medical complication of the vertebroplasty procedure and this complication was closely related to the medical state of the patient.

There are some strength and limitations associated with our study. We were able to assemble a specific patient group with only osteoporotic and symptomatic vertebral fractures who were classified as ASA III. Major limitations include a relatively shorted follow-up period and the absence of standard clinical outcome measurements. In conclusion, the significance of osteoporosis is gradually increasing, and osteoporotic vertebral fractures may severely impact the quality of life of the patients. Concomitant systemic disorders of the patients may render the treatment rather difficult by increasing the risks of general anesthesia. We believe that as a minimally invasive procedure, percutaneous vertebroplasty performed under local anesthesia is an effective method for pain relief in patients at high risk of general anesthesia.

Compliance with ethical standards

Conflict of interest None.

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