Percutaneous vertebroplasty in patients with osteoporotic vertebral body fractures

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Vertebroplasty is the percutaneous injection of polymethyl methacrylate (PMMA), also known as bone cement, into a symptomatic fractured vertebral body under fluoroscopic guidance. It is safe and can be a simple outpatient procedure. It was first described by Galibert et al in 1987¹ as a treatment method for certain spinal angiomas. This was followed in 1989 by a report from Kaemmerlen et al² who studied 20 patients with vertebral metastases. They injected in these metastases orthopedic cement by a percutaneous technique under local anesthesia. It was concluded that the best indication for use of the technique is the painful fractured vertebra without a periradicular tumor.² The procedure is readily available. In view of the high prevalence of osteoporosis and lack of well-established pain management protocols, it might be a useful technique for management of painful vertebral compression fractures. The objective of this study was to demonstrate the usefulness of this procedure in the pain management of patients with fractured vertebra.

PATIENTS AND METHODS

In 8 consecutive patients, 10 percutaneous vertebroplasties were performed in our institution during 12 months. Four male and 4 female patients underwent vertebroplasties to treat severe osteoporotic compression fractures, including 3 vertebral bodies at T12, 3 vertebral bodies at L1 and 4 vertebral bodies at L3. The duration of fractures was extremely variable, ranging from a few weeks to more than 6 months in one case. These patients had not responded to conservative treatment, which included many types of medications, including narcotics in one case.

Prior to percutaneous vertebroplasty all patients had a bone densitometry scan with the T score ranging from -2.4 to -2.8 with a median of -2.6 for the vertebral bones, confirming the diagnosis of osteoporosis. In addition all patients had either an MRI (6 patients, 75%), a bone scan (2 patients, 25%) or both (4 patients, 50%). The MRI confirmed bone marrow edema at the site of

the vertebral fracture and the bone scan showed high radiopharmaceutical uptake. Vertebroplasty was performed at only one level in 6 patients (75%), and at two levels in 2 patients, (25%) patients.

The indication for vertebroplasty was focal, intense, and intractable spinal pain without definite radicular signs and symptoms in 5 patients (62.5%), whereas vertebral body stabilization was done for 3 patients (37.5%). Retropulsed bone did prohibit the procedure because it allowed the PMMA to leak into the spinal canal. Exclusion criteria were bleeding disorders, and unstable fractures due to posterior element involvement. Severe vertebral body compression fractures were defined as vertebrae that had collapsed to less than one-third of their original height.

Percutaneous vertebroplasty was performed with strict sterile conditions with fluoroscopic guidance by using a biplane angiographic unit (Phillips Integris, Best, The Netherlands). The patients were placed prone on the fluoroscopy table for both thoracic and lumbar percutaneous vertebroplasty. The patient's blood pressure, electrocardiogram, and pulse oximetry were monitored continuously. Fentanyl (*Sublimaze*; Abbott Laboratories, North Chicago, IL) and midazolam (*Versed*; Roche, Pharmaceuticals, Manati, Puerto Rico) were administered intravenously for sedation and analgesia. The skin overlying the vertebral body to be injected was cleaned and draped. The skin, subcutaneous tissues, and periosteum over the pedicle to be punctured were anesthetized with 1% lidocaine hydrochloride (Abbott Laboratories, North Chicago, IL) and 0.25% bupivacaine hydrochloride (Abbott Laboratories, Abbott Laboratories, North Chicago, IL). After a small skin incision was made, an 11- or 13-gauge Murphy Back/Side Bevel - M1M (Cook, Bloomington, IN) biopsy trochar was advanced until its tip abutted the pedicle. With fluoroscopic guidance, the needle was pushed through the cortex, traversed the center of the pedicle, and was directed into the bone marrow of the vertebral body (Figures 1, 2). The stylet was removed from the trochar. The meth-

Figure 1. Plain radiograph of the spine of a 57-year-old male with primary osteoporosis and a history of trivial trauma, showing a fractured L3 vertebral body.

Figure 2. Sagittal T1-weighted image with fat saturation and intravenous gadolinium showing marked enhancement of the L3 vertebra (arrow).

ylmethacrylate powder (Vertefix Cook, Bloomington, IN) was mixed for a minute. The liquid methylmethacrylate monomer was then added to the powder and mixed into a toothpaste-like consistency.

The PMMA mixture was placed into at least four 1 cc disposable syringes. These were screwed to the Murphy needle and injected under strict continuous bi-plane fluoroscopic guidance until the PMMA reached the posterior quarter of the vertebral body or until it started to pass into the disc space and paravertebral tissues (Figure 3).

A visual analog scale (VAS) was used to assess the efficacy of pain management regimens in patients with acute post vertebroplasty pain. The VAS is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum. The patient was asked prior to and 1 day after the procedure to rate the pain on a scale of 1 to 10, with 10 being extremely painful and 1 being no pain. Statistical significance was tested using paired sample correlations. A *P* value less than 0.05 on a 2-tailed test was considered significant.

RESULTS

The mean volume of PMMA injected was 3.0 mL (range, 2-4 mL). A single pedicle was injected in all 10 vertebroplasties. Radiographic complications included PMMA leakage into the adjacent disc in 3 of 10 injections and the paravertebral soft tissues in 1 patient. Venous leakage occurred in 2 patients. A tiny epidural leak occurred in 1 injection. There were no major radiographic complications, and no patient required follow-up surgery. Pain was reduced from 10 to 2 on the 10-point VAS in 6 of 8 patients (75%) while there was no change in 2 patients (25%). The mean pain score prior to vertebroplasty was 7.6 (range, 4-10). The mean pain score 1 day post procedure was 1.25 (range, 0.8 to 2) ($P < .05$).

DISCUSSION

Indications for vertebroplasty include pain relief, stabilization, destructive metastases, extensive bone lysis in multiple myeloma, weakened vertebra in vertebral body, haemangioma and osteoporotic vertebral collapse. Contraindications include coagulopathy, and severe collapse. In the article by Weill et al,³ in which 37 patients with metastases underwent 52 vertebroplasties, the authors stated that lesions were treatable unless the vertebrae had collapsed to less than one-third of the original height. In their opinion, vertebroplasty was technically difficult if less than one-third of the height was preserved. Other authors⁴⁻⁵ also agreed that the reduction

Figure 3. Lateral plane fluoroscopic image demonstrating needle tip in the body of the vertebra after it has been advanced percutaneously. Arrow points to the infusion of PMMA.

to one-third of vertebral body height constituted severe vertebral compression and was considered a relative contraindication to the procedure. The opinion of Weill et al was that this is not a strong contraindication and may be attempted with great caution, which is in agreement with the article by Peh et al.⁶ All patients in our series received vertebroplasties for osteoporotic vertebral body compression fractures.

Osteoporosis is recognized as a prevalent disease in Saudi Arabia. In the study by El-Desouki,⁷ 39.5% of the subjects had osteoporosis, with a mean bone mineral density of 0.767 ± 0.11 and a T-score of -3.4 SD. When the 830 subjects were analyzed by age, 42.3% were normal, 33.4% had osteopenia and 24.3% had osteoporosis in the age range of 50-59 years, while 11% were normal, 27% had osteopenia and 62% had osteoporosis in the

age range of 60-69 years. In the older age group (70-79 years) only 4.6% had a normal BMD, 21.5% had osteopenia and 73.8% had osteoporosis.

Osteoporotic compression fractures have many quality of life issues. Elderly patients have a shortened life expectancy, mobility and reserve. A fracture in this age group can lead to deconditioning as this may lead to difficulty in mobilization to the previous level of activity and can result in deep vein thrombosis. In addition, osteoporotic fractures can lead to spinal cord compression, progressive deformity and pulmonary compromise. The goal in these patients is to restore "normal" activities of daily living; minimize pain and other morbidity and lower analgesic requirements. Pain relief is expected after a mean of 24 hours after the procedure.⁵ Marked or complete pain relief was demonstrated in more than 90% of patients with osteoporotic compression fractures^{8,9} and haemangioma.⁴ The results of our study are similar to that in the Western literature. However, other studies have followed patients up to a year, which this study did not, but this is the only study on this subject in Saudi Arabia to the author's knowledge.

Complications of the procedure include cement leakage, which may go into the intervertebral disc¹⁰ and which can increase the risk of a new fracture of an adjacent vertebral body. A substantial number of patients with osteoporosis develop new fractures after undergoing percutaneous vertebroplasty; two-thirds of these new fractures occur in vertebrae adjacent to those previously treated.¹¹ The incidence of minor passage of cement into the perivertebral veins is 16.6%, including one case in which a minute amount of cement reached the inferior vena cava (0.5%).¹²

In summary, percutaneous vertebroplasty is a useful technique for management of painful vertebral compression fractures. It provides pain relief and vertebral stabilization in the majority of patients. I believe that it is safe and effective and should be offered as a management option.

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