

Treatment of multiple osteoporotic vertebral compression fractures by percutaneous cement augmentation

Agnieszka Saracen · Zbigniew Kotwica

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Abstract

Purpose Vertebral compression fractures cause significant pain and some patients are debilitated by the pain due to the fracture. Conventional surgery carries a high risk and has a poor outcome. Vertebroplasty is a minimally invasive surgical procedure, which in vertebral fractures restores stability and diminishes pain. The aim of the study was to analyse the effectiveness and safety of vertebroplasty in multiple vertebral compression fractures with a 24-month follow-up.

Methods Vertebroplasty was performed in 160 patients with multiple osteoporotic compression fractures under local anaesthesia, using a unilateral transpedicular approach. The level of pain was assessed according to a 10-cm visual analogue scale. The patients were observed for 24 months after surgery. **Results** Vertebroplasty significantly diminished the level of pain in 90 % of patients, and half of them were free of pain within 12 hours after surgery. Only 4 % of the patients did not benefit from this type of treatment. During the 24-month follow-up these results changed only slightly, and after two years almost 80 % still benefited, while the number of unsatisfactory results changed from 6 to 9 %. No serious clinical complications were noted; in three patients new fractures appeared during the two year observation period.

Conclusions Vertebroplasty should be seriously taken into account as a primary method of treatment in patients with multiple osteoporotic vertebral compression fractures.

Keywords Vertebroplasty · Pain relief · Osteoporotic fracture · Vertebral column

A. Saracen · Z. Kotwica (✉)
Faculty of Health Sciences and Physical Education, Kazimierz
Pulaski University of Technology and Humanities in Radom,
Chrobrego 27, Radom 26 600, Poland
e-mail: zbigniew.kotwica@neostrada.pl

Introduction

The duration of life is still increasing which leads to the increased number of patients with osteoporotic fractures, proximal femur and vertebrae being the most often noted. Vertebral compression fractures cause significant pain and some patients are debilitated by the pain due to the fracture [1–3]. Conventional surgery carries a high risk and has a poor outcome and is reserved only to patients with significant neurological deficit [4, 5]. Vertebroplasty involves injecting liquid polymethyl methacrylate (PMMA) cement through a needle into the vertebral body, where it becomes hard, restoring stability and diminishing pain [2, 4, 6]. This method of treatment is relatively safe, causing minimal operative trauma, and the complications are rare [5], mainly caused by extravertebral leakage of the cement [5, 7] or osteitis [8]. In 2009, two randomised trials of vertebroplasty for acute osteoporotic spinal fractures did not find a beneficial effect of vertebroplasty as compared to conservative treatment [9, 10], with the same conclusion during a two year follow-up [11]. However, both trials had a small number of patients; the first one, from Australia [9], included 71 participants, 35 treated by vertebroplasty and 36 without cement augmentation, and the second one, from the Mayo Clinic [10], included 131 patients, 68 treated by vertebroplasty and 63 without surgery. The number of patients included in both trials puts into doubt the conclusion that vertebroplasty has no beneficial effect in osteoporotic fractures [12, 13].

Compression fractures can also be treated by kyphoplasty, in which an inflated balloon increases the height of the broken vertebra, correcting the kyphotic deformation [14–16]. Both methods—vertebroplasty and kyphoplasty—show similar clinical results [14–16]. Some authors suggest that an augmentation of one vertebra can increase the probability of new fracture development in adjacent vertebrae [17].

In osteoporosis we often face the problem of multiple fractures, and about 20 % of patients with one previously diagnosed compression fracture develop new ones [3, 17]. Some authors suggest even a prophylactic augmentation of decalcified vertebrae [3]. The development of fractures increases mortality [7]; it should also be noted that almost 4 % of fractures are due to neoplastic disease, suggesting the value of vertebral biopsy, which could be performed during this procedure [18]. It should also be noted that vertebroplasty also gives satisfactory results in the treatment of pathological fractures due to malignant tumours of the vertebrae [4]. In this paper we analysed the results of treatment of multiple osteoporotic vertebral compression fractures by vertebral cement augmentation.

Materials and methods

A total of 160 consecutive patients were included in the study. There were 153 women and seven men, 58–91 years old. All presented with severe back pain, with no neurological deficit. Severity of pain was evaluated by the patient with the use of a 10-cm visual analogue scale (VAS). Radiological studies revealed in all of them multiple osteoporotic vertebral compression fractures, from two up to six fractured vertebrae. Table 1 shows the age and the number of fractures in the group of patients analysed.

The highest fractures were located at T3 and the lowest at L5. From a total number of 594 fractures, 422 (71 %) were thoracic and 172 (39 %) lumbar. All of the fractured vertebrae were augmented with an acrylic cement (PMMA). Surgical procedures were performed under local anaesthesia, and a unilateral transpedicular approach was used (Fig. 1).

The cement volume was 1.0–2.5 ml. In thoracic fractures the volume used was lower, from 1.0 to 2.0 ml, and in the lumbar area from 2.0 to 2.5 ml. During one procedure only two vertebrae were augmented, but never the adjacent ones. In patients with three or more fractures, the first procedure was performed in the

Table 1 Number of fractures according to patients' age

Patient's age (in years)	Number of fractures					Total
	2	3	4	5	6	
<60	3	2	1	0	0	6
61–65	2	8	7	10	1	28
66–70	2	8	9	3	0	22
71–75	4	18	14	3	1	40
76–80	2	8	17	9	2	38
81–85	0	6	8	4	0	18
86–90	0	4	2	0	0	6
>90	1	1	0	0	0	2
Total	14	55	58	29	4	160



Fig. 1 Vertebroplasty of compressed T8 vertebra. Vertebral body of T7 had been augmented previously. T6 vertebra is also fractured

most painful area. As a rule, before augmentation the biopsy material was taken for microscopic examination.

If the number of fractures in the patient exceeded two, the next surgical procedures were performed every two weeks (Fig. 2). The follow-up was at least 24 months for all patients.

Results

Before surgery the patients assessed the severity of pain from 6.5 cm up to 9.5 cm on a 10-cm VAS; the average was 8.2 cm. Twelve hours after the first surgery a significant relief of pain



Fig. 2 Four adjacent vertebrae augmented during two consecutive surgical procedures. The result of treatment was perfect, and the patient was totally free of pain for the next 12 months

was noted in almost 90 % of patients, and only 4 % of patients reported no benefit from surgery. Pain on the VAS was assessed from 1.0 cm up to 9.0 cm, but the average diminished to 3.2 cm. The examination on the 30th day revealed the same results; of 160 patients, 82 (51 %) were free of pain, in 62 (39 %) significant relief of pain was noted, ten (6 %) reported slight improvement and in six (4 %) the level of pain did not change. During this examination the patients had all the fractures augmented. One year after the last surgical procedure, 71 (44 %) patients were free of pain, 56 (35 %) had little pain, 24 (15 %) felt significant pain, but less than before surgery, and the last nine (6 %) had the same level of pain as before vertebroplasty. The average value on the VAS was 3.4 cm. Similar results were also noted two years after augmentation, with a VAS value of 3.6 cm. The results of treatment are shown in Table 2.

Of 160 patients, during 24 months of follow-up, new fractures appeared in three, and in one of them in a vertebra adjacent to the previously augmented one. No clinical complications were noted; however, control X-ray showed extravertebral cement leakage in 83 (14 %) of 594 augmented vertebrae. In four patients cement was also noted in paravertebral veins (Fig. 3). In not one patient was neoplastic tissue found in biopsy material.

Discussion

Percutaneous vertebroplasty is widely used for the treatment of osteoporotic compressed fractures of the vertebrae [2–4, 9, 10]. Some randomised trials put into doubt the efficiency of vertebroplasty in osteoporotic fractures [9–11], but many more publications show significant relief of pain after performing this procedure [2, 4, 5, 14, 16, 17]. With multiple fractures some authors suggest an increase in the number of new fractures after performing vertebroplasty [3, 17], especially in vertebrae adjacent to the augmented ones [3, 17]. In our patients we did not note the development of new fractures during the two year follow-up; it occurred in three patients only. However, before surgery, we decided not to perform the procedure on two adjacent vertebrae at the same time; the time interval between augmentations was two weeks. The pain



Fig. 3 Sagittal computed tomography: reconstruction of the thoracic and lumbar vertebral column with five augmented vertebrae. At L1 level an extravertebral leakage with filling of paravertebral veins is seen. Two years before the first vertebroplasty the patient was treated surgically—T8–T11 laminectomy was performed—because of extradural spinal cavernous angioma

relief was significant and was noted 12 hours after the surgical procedure. Thirty days after surgery 50 % of patients were free of pain, and 90 % presented with significant improvement. One and two years after surgery the results were only slightly worse; almost 80 % of patients were highly satisfied with the procedure. It is quite difficult to explain why some authors [9, 10] have not accomplished any positive results of vertebroplasty in osteoporotic fractures, both in short- and long-term follow-up, while a lot of others have found [2, 4, 5, 14, 16, 17], similar to us, a significant relief of pain. The first, previously mentioned reason can be a very limited number of patients in both studies [9, 10]. Other reasons can result from improper selection of patients as well as improper surgical technique used during the procedure. Since 2009, when both controversial articles were published [9, 10], a significant number of papers have showed effectiveness

Table 2 Results of treatment during 2 years of follow-up

Follow-up result of treatment	12 hours	30th day	1 year	2 years
Free of pain	82 (51 %)	82 (51 %)	71 (44 %)	70 (44 %)
Significant relief of pain	62 (39 %)	62 (39 %)	56 (35 %)	57 (35 %)
Slightly better	10 (6 %)	10 (6 %)	24 (15 %)	19 (12 %)
No change	6 (4 %)	6 (4 %)	9 (6 %)	14 (9 %)
Worsening	0	0	0	0
Total	160 (100 %)	160 (100 %)	160 (100 %)	160 (100 %)

of vertebroplasty, not only in osteoporotic, but also in neoplastic and traumatic cases [4–6, 15, 16], and practically no reliable publication confirmed the results from Australia and the Mayo Clinic.

The unilateral transpedicular approach appeared to be effective which makes the procedure safer than a bilateral approach and can diminish the number of complications. The most dangerous complication of vertebroplasty is extravertebral leakage, especially into the spinal canal. However, in osteoporotic fractures the posterior wall of the vertebra is usually stable, and proper position of the needle and careful observation of cement distribution during the surgical procedure make it possible to avoid this complication. Leakage of PMMA into paravertebral veins occurs quite often, but with the use of a limited amount of cement the area of embolised veins is limited and in general does not exceed above veins of the affected vertebra. Pulmonary embolism with PMMA is potentially highly dangerous, but if the safety measures mentioned above (small amount of PMMA and careful real-time inspection of cement leakage) are heeded, this complication can be easily avoided. In our series of patients, extravertebral leakage was noted in 14 % of patients, mainly to draining veins of the fractured vertebra, and no clinical symptoms of this complication were noted.

Conclusion

Transcutaneous vertebroplasty is effective in the treatment of multiple osteoporotic vertebral compression fractures and more than 80 % of patients are highly satisfied with this kind of treatment. In our subjects, augmentation did not increase the number of new fractures. For pain reduction it is not necessary to perform a bilateral approach to the fractured vertebra; the unilateral transpedicular approach appeared to be effective. Despite the extravertebral leakage, which occurred in 14 % of cases, no clinically significant complications were noted.

Conflict of interest The authors declare that they have no conflict of interest.

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