Percutaneous Vertebroplasty in Osteoporotic Vertebral Compression Fractures: Our initial experience

Ejaz Aslam, Tariq Muhammad, Salman Sharif
Department of Neurosurgery, Liaquat National Hospital, Karachi, Pakistan.

Abstract

Objective: To see the safety and efficacy of Percutaneous vertebroplasty in osteoporotic vertebral compression fractures.

Methods: This study was conducted at the Department of Neurosurgery, Liaquat National Hospital (LNH) Karachi, Pakistan. Patients with osteoporotic compression vertebral fractures, not responding to conservative treatment and having localized overlying tenderness and MRI evidence of high signal in the involved vertebral body, were included in the study. Visual Analogue Scale was used to measure the intensity of pain. Percutaneous vertebroplasty (PVP) was performed by injecting polymethylacrylate int eh diseased vertebral body. The patients were followed up for initially 4 and 24 hours. Later they had a check up at 2 weeks, one three, six and twelve months.

Results: Percutaneous vertebroplasty on twentyfour patients were included who underwent (LNH) from 2002 to 2006 Age range was from 65 to 85 years (mean age 75±3.3 years). Among 24 patients, 21 were females and 3 patients were male. Six patients had two levels osteoporotic compression vertebral fractures the rest, had compression at one level. Patients with radicular pain or signs of myelopathy, osteomyelitis of targeted vertebral body or overlying skin infection, severe compression of vertebral body or with retropulsed fragment into canal as evident by CT scan were excluded from the study. While patients who failed to respond to 6-12 weeks of conservative treatment, with localized overlying tenderness and MRI evident high signal in vertebral body involved, were included in the study. Visual analogue scale (VAS) was applied for the assessment of pain intensity. Follow-up was performed immediately, within 4 hours, after 24 hours, 2 weeks, 1 month, 3 months, 6 months and finally at one year.

Conclusion: Percutaneous vertebroplasty is a safe and useful procedure for the treatment of backache associated with osteoporotic vertebral compression fracture (JPMA 58:498;2008).

Introduction

Percutaneous vertebroplasty (PVP) is a therapeutic, interventional radiologic procedure that involves transpedicular injection of polymethylmethacrylate (PMMA) into a diseased vertebral body, commonly osteoporotic compression fractures, in an effort to relieve pain and provide stability. Osteoporotic compression fractures are an important public health concern, leading to significant morbidity, mortality and economic burden.[1] Immobility due to fracture pain is a common cause of morbidity in this population, making these individuals at risk for pneumonia, deep vein thrombosis, and pulmonary embolism.[2] In recent years Percutaneous Polymethylmethacrylate Vertebroplasty has become a common procedure for the treatment of pain and disability associated with osteoporotic vertebral compression fractures. The term vertebroplasty originally described an open surgical procedure that introduces bone graft or acrylic cement to mechanically augment weakened vertebral bodies.

The first image-guided percutaneous vertebral augmentation, or percutaneous vertebroplasty (PVP), was performed in France in 1984, and the first percutaneous vertebroplasty was performed in North America in 1993 and reported in 1997.[2] Later on PVP techniques were further refined largely on the basis of predominant European[3,4] and American[2,5] experiences.

Commonly available bone cement is polymethylmethacrylate (PMMA) with its good safety record as it has been used for augmentation of weakened or partially destroyed bone in orthopaedics for decades; and cadaveric vertebral bodies has shown a significant increase in the load-bearing ability of PMMA-injected vertebral bodies compared with controls.[6,7]

Percutancous vertebroplasty is widely practiced in developed countries. This study shows the promising results of the procedure in Pakistan.

Patients and Methods

The study was conducted on 24 patients at the

neurosurgery department of LNH from 2002 to 2006 (after informed consent). Six patients had two levels osteoporotic compression vertebral fractures while the rest had involvement at one level. Vertebral bodies involved were from D8 to L3.

Preprocedural workup included 6 to 12 weeks of conservative treatment that consisted of bed rest, analgesic use, and physical therapy. All patients with radicular pain or signs of myelopathy, osteomyelitis of targeted vertebral body or overlying skin infection, severe compression of vertebral body or with retropulsed fragment into canal as evident by CT scan were excluded. The patients who failed to respond to conservative treatment, with localized overlying tenderness and MRI evidence of high signal in vertebral body involved, were included in the study. Two patients had vertebral compression fractures (VCFs) at L2 and L3 with diffuse paraspinal pain that was radiating to both hip joints. They had negative localizing tenderness but MRI showed high signals at fracture sites, were also included in the study. Plain x-rays, Magnetic resonance imaging (MRI) and CT scan in very selective cases were the imaging tools. A screening MRI protocol was adopted to see the high signals in involved vertebral bodies. Visual analogue scale (VAS) was applied for the assessment of pain intensity, where 0 means no pain and 100 means pain of highest intensity.

PVP technique was exactly the same as described in European and American literature.[3-7] Under conscious sedation in prone position with vital signs monitoring, a unilateral pedicle was inserted with a trocar needle after localization with fluoroscopic guidance and proper instillation of local anaesthetic over the targeted pedicle. Three to ten ml of PMMA was injected and stopped if there was intradiscal, or epidural cement leakage. We did not perform vertebral venography, a procedure now no longer used.[2] With 3-4 hour postoperative bed rest, patients were allowed to get out of bed, if the pain was diminished significantly. Prospective follow-up was performed within 4 hours, after 24 hours, 2 weeks, one month, 3 months, 6 months and finally at one year (range: 9 to 15 months).

Results

The age range of the 24 patients studied was 65-85 years with a mean age of 75±3.3 years. There were 20 (83%) females and 4 (17%) males. In majority of fractures (n=19) there was no known precipitating event, whereas in 5 patients fall was the cause of fractures.

Eighteen (75%) patients were treated at single level and 6 (25%) patients at 2 levels. Irrespectie of the age, sex, region and number of levels treated, the volume of injected bone cement (PMMA), was divided into 3 groups according to their preoperative VAS pain score:

Group A- (13 patients): 78.48

Group B- (8 patients): 75.20

Group C- (3 patients): 72.45

The mean preoperative VAS score was 75.37±7.72

Postoperatiely witin 4 to 24 hours, mean VAS was 12.5±4.1 in Group A, 14.8±3.9 in Group B and 15±5.0 in Group C. So, overall mean postoperative VAS Score was 14.1±4.17 within first 24 hours, 11.16±3.76 at 2 weeks which further improved at follow up period (Table).

Table: Comparision of VAS scores before and after vertebroplasty.

Group treated	Mean VAS score					
	Before vertebroplasty	After vertebroplasty				
		4-24hrs	2 weeks	3months	6months	01 year
A 13	78.48±3.15	12.5±4.1	10.0±2.89	9.9±2.04	10.0±0	8.08±2.53
B 8	75.20±12.7	14.8±3.9	11.5±5.2	8.9±3.54	7.8±2.5	7.50±2.67
C 3	72.45±2.52	15±5.0	12.0±3.46	10.0±5.0	9.0±5.29	8.33±5.77
Overall=	75.37±7.72	14.1±4.17	11.16±3.76	9.60±2.92	8.94±2.31	7.84±2.92

Mean±SD

Two patients reported temporary radicular pain after the procedure, which was completely relieved with simple analgesics. One patient reported a worsening of the pain after procedure, with no obvious reason, but luckily he responded well to facet joint injection. Two patients presented with recurrence of pain at the same sites. With repeat vertebroplasty, the patients had an excellent pain relief. There was no infection, permanent neurologic injury and pulmonary embolism after the procedure.

Discussion

Overall pain relief in our case series on Visual Analogue Scale (preop-75.37±7.72; postop-7.84±2.92) was similar to other studies.[2,4,8-13]

The mechanism of action of PCV is not yet known. It may provide mechanical support to prevent further compression and prevent micromotions at fracture site, or it generates excessive heat with resultant thermal necrosis of intraosseous pain receptors.[14-19] Pain relief occurs irrespective of the volume of PMMA injected. This may indicate that either all the intraosseous pain receptors have not been burnt or the cement distribution was not sufficient to provide structural stability and thus repeat vetebroplasty has very good results as was in our two patients and the same is mentioned by Gaughen et al[20] as well.

Single pedicle insertion provides adequate access and significant volume of PMMA can be injected if the needle tip is directed properly to the centre of the vertebral body. Therefore we did not use bipedicular approach except in two cases with repeat vertebroplasty where the other pedicle was used. Kim et al and Tohmeh et al also did not find any difference in clinical outcome between unipedicular and bipedicular approaches.[14,21]

Bone scan imaging may be helpful when considering vertebroplasty therapy for patients suffering from multiple vertebral compression fractures of uncertain age or in patients with non-localizing pain patterns.[11] But in our cases, patients with non-localizing signs had still high signals at their fracture sites on MRI. This could be due to continuous acute on chronic microfractures in these non-healing fractures. Hence we did not need bone scanning.

The amount of cement required for good clinical outcome has never been systematically studied.[22] Testing of cadaveric spines suggests that up to 8ml of cement is required to achieve biomechanical integrity.[22] However, the risk of extraosseous extravasation of cement increases with increasing volumes of cement injected.[23] We have injected 3 to 10ml safely with equally good results.

One patient among our series reported a worsening of pain after the procedure who responded well to facet joint injection. This may be due to the presence of double pathology i.e., vertebral compression fracture along with facet arthropathy; hence alleviation of the bone pain unmasks the pain associated with facet joint arthropathy.

Conclusion

Percutaneous vertebroplasty with PMMA is a safe and useful procedure for the treatment of backache associated with osteoporotic vertebral compression fracture. But for proper future implementation, we need a prospective, randomized, controlled trial comparing PCV with conservative management to verify its safety and effectiveness.

We tried to perform a randomized controlled study but most of the patients from conservative group preferred to switch over to the surgical group after few weeks or months of conservative management.

References

1. Kayanja MM, Togava D, Lieberman IH. Biomechanical changes after the augmentation of experimental osteoporotic vertebral compression fractures in the cadaveric thoracic spine. Spine J 2005;5:55-63.
2. Jensen ME, Evans AJ, Mathis JM, Kallmes DF, Cloft HJ, Dion JE. Percutaneous polymethylmethacrylate vertebroplasty in the treatment of osteoporotic vertebral compression fractures: Technical aspects. AJNR Am J Neuroradiol 1997; 18:1897-1904.
3. Cotten A, Boutry N, Cortet B, Assaker R, Demondion X, Le Blond D, et al. Percutaneous vertebroplasty: State of the art. RadioGraphics 1998; 18:311-20.
4. Gangi A, Kastler BA, Dietemann JL. Percutaneous vertebroplasty guided by a combination of CT and fluoroscopy. AJNR Am J Neuroradiol 1994; 15:83-86.
5. Jensen ME, Dion JE. Percutaneous vertebroplasty in the treatment of osteoporotic compression fractures. Neuroimaging Clin N Am 2000; 10:547-68.
6. Harrington KD, Sim FH, Enis JE, Johnston JO, Diok HM, Gristina AG. Methylmethacrylate as an adjunct in internal fixation of pathological fractures: Experience with three hundred and seventy-five cases. J Bone Joint Surg Am 1976; 58: 1047-55.
7. Belkoff SM, Maroney M, Fenton DC, Mathis JM. An in vitro biomechanical evaluation of bone cements used in percutaneous vertebroplasty. Bone1999; 25 (2 suppl.): 23S-6S.
8. Barr JD, Barr MS, Lemley TJ, Mc Cann RM. Percutaneous vertebroplasty for pain relief and spinal stabilization. Spine 2000; 25:923-8.
9. Grados F, Depriester C, Cayrolle G, Hardy N, Deramond H, Fardellone P. Long-term observations of vertebral osteoporotic fractures treated by percutaneous vertebroplasty. Rheumatology (Oxford) 2000; 39 :1410-4.
10. Martin JB, Jean B, Sugui K, San Millan, Ruiz D, Piotin M, Murphy K, et al. Vertebroplasty: Clinical experience and follow-up results. Bone 1999; 25:11-5.
11. Maynard AS, Jensen ME, Schweickert PA, Marx WF, Short JG, Kallmes DF. Value of bone scan imaging in predicting pain relief from percutaneous vertebroplasty in osteoporotic vertebral fractures. AJNR Am J Neuroradiol 2000; 21 :1807-12.
12. Mathis JM, Barr JD, Belkoff SM, Barr MS, Jensen ME, Deramond H. Percutaneous vertebroplasty: A developing standard of care for vertebral compression fractures. AJNR Am J Neuroradiol 2001; 22:373-81.
13. Weill A, Chiras J, Simon JM, Rose M, SolaMartinez T, Enkaoua E. Spinal metastases: Indications for and results of percutaneous injection of acrylic surgical cement. Radiology 1996; 99:241-7.
14. Kim AK, Jensen ME, Dion JE, Schweickert PA, Kaufmann TJ, Kallmes DF. Unilateral transpedicular precutaneous vertebroplasty: Initial experience. Radiology 2002; 222: 737-41.
15. Bostrom MP, Lane JM. Future directions: Augmentation of osteoporotic vertebral bodies. Spine 1997; 22 (24 Suppl): 38S-42S.
16. San Millan Ruiz D, Burkhardt K, Jean B, et al. Pathology findings with acrylic implants. Bone 1999; 25:85-90.
17. Jefferiss CD, Lee AJC, Ling RS. Thermal aspects of self-curing polymethylmethacrylate. J Bone Joint Surg Br 1975; 57: 511-8.
18. Deramond H, Wright NT, Belkoff SM. Temperature elevation caused by bone cement polymerization during vertebroplasty. Bone 1999; (25 Suppl): 17-21.
19. De Vrind HH, Wondergem J, Haveman J. Hyperthermia-induced damage to rat sciatic nerve assessed in vivo with functional methods and with electrophysiology. J Neurosci Methods 1992; 45: 65-74.

20. Gaughen Jr, Jensen ME, Schweickert PA, Marx WF, Kallmes DF. The therapeutic benefit of repeat percutaneous vertebroplasty at previously treated vertebral levels. AJNR Am J Neuroradiol 2002; 23: 1657-61.

21. Tohmeh AG, Mathis JM, Fenton DC, Levine AM, Belkoff SM. Biomechanical efficacy of unipedicular versus bipedicular vertebroplasty for the management of osteoporotic compression fractures. Spine 1999; 24:1772-6.

22. Kallmes DF, Jensen ME. Percutaneous Vertebroplasty Radiology 2003; 229: 27-36

23. Belkoff SM, Mathis JM, Jasper LE, Deramond H. The biomechanics of vertebroplasty: The effect of cement volume on mechanical behavior. Spine 2001; 26:1537-41.