

Original Research Article

Role of vertebroplasty in osteoporotic compression fracture

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	International Archives of Integrated Medicine, Vol. 4, Issue 10, October, 2017.	
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	Available online at http://iaimjournal.com/	
	ISSN: 2394-0026 (P)	ISSN: 2394-0034 (O)
	Received on: 08-10-2017	Accepted on: 14-10-2017
	Source of support: Nil	Conflict of interest: None declared.
How to cite this article: Suryakant Purohit, Himanshu Jain, Sonal Garg, Nitin Kumar Singh. Role of vertebroplasty in osteoporotic compression fracture. IAIM, 2017; 4(10): 203-208.		

Abstract

Majority of osteoporotic vertebral compression fracture present with back pain and some of them with spinal deformity. Percutaneous vertebroplasty not only addresses pain relief but also the correction of spinal deformity with least post-operative morbidity. 72 patients with osteoporotic compression fracture and spinal deformity with chronic invalidating pain treated with percutaneous vertebroplasty were followed for 2.8 years with an average of 1.3 years. 47% showed excellent, 13% showed good and 40% showed fair result on vas score. There was good improvement in stature in 43%, fair in 40% and 17% showed no improvement.

Key words

Vertebroplasty, Osteoporotic compression fracture, Spinal deformity.

Introduction

Majority of Osteoporotic Vertebral Compression Fracture takes place either spontaneously or after minor trauma, presents commonly in elderly patients primarily in female as: wedge, biconcave or crushed fracture.

Back pain in Osteoporotic Vertebral Compression Fracture may present as acute and excruciating, chronic and persistent [1, 2]. One third to three fourth [3] of such patients may develops chronic invalidating pain. The cause may be attributed to pseudoarthrosis or osteoporotic spinal Deformity. Traditional conservative method of osteoporotic vertebral

compression fracture has included bed rest, oral and parenteral analgesic, muscle relaxant, external bracing and physiotherapy [4]. Calcitonin may have variable analgesic effect in osteoporotic vertebral compression fracture [5]. Majority of these patients responds favourably to traditional treatment, but this therapy can't address deformity. Because of elderly age of patients presence of concomitant disorder and fragile state of osteoporotic bone open surgical vertebroplasty is often not possible.

Percutaneous vertebroplasty literally means augmentation of vertebral body through skin which was introduced and designed for management of osteolytic tumors [6-9] (firstly used in hemangiomas C₂ vertebra) and later was successfully applied for osteoporotic vertebral compression fracture [10-12]. Primary aim of Percutaneous vertebroplasty is to reduce pain caused by vertebral fracture. Osteoporotic vertebral compression fracture consist of numerous micro fractures that stimulates nerves of periosteum during vertebral body movements (pseudarthrosis).

The mechanism of Pain relief in Percutaneous vertebroplasty is not clear and there are probably three possible mechanisms: 1. Mechanical vertebrae effect of injected bone cement, 2. Thermal destruction of nerve ending due to high temperature reached during vertebroplasty of injected cement and 3. Chemical destruction of nerve ending due to composition of cement. It is shown in previous studies that Percutaneous vertebroplasty is more efficacious in mobile vertebral fractures as compare to fixed vertebral fractures.

PMMA has been shown to restore strength and stiffness in vertebral bodies in post-mortem studies with proven safety records since 1960 [13].

This study was conducted by modifying the cement injecting procedure to make it more safe and without any complication.

Materials and methods

Patients were selected with following criteria:

- Osteoporotic vertebral compression fracture not responding to conservative therapy for more than six weeks
- Vertebral compression fracture with at least 15% anterior height loss
- Presence of bone marrow edema in collapsed vertebral body on MRI
- Avascular necrosis of vertebral body (cleft phenomenon)
- Progressive increasing pain ,disability and radiological worsening documented on follow up

All these patients were assessed clinically by vertebrae tenderness over affected vertebrae. Clinical examination was done by keeping following things in back of mind:

- Pain attributed to the fractured vertebrae level. Local bony tenderness over spine was observed.
- Detailed neurological examination; sensory and motor changes, radiculopathies.
- **Laboratory tests:** Blood investigations for complete blood cell counts, diabetes control, coagulation indices. Appropriate additional tests were done for primary disease, if any, causing the vertebral compression fracture.

The following investigations were done to evaluate the physical status of patient and the pre and post-operative results. The results were assessed both by clinical evaluation and vertebroplasty.

- **X-rays:** X-rays of the spine in AP and lateral views. Preferably standing lateral view in flexion and extension (flexion and extension were done by active movement with utmost care) were taken.
- **CT scan:** The CT scanning with 3D, sagittal and coronal reconstructions are helpful in assessing the complex vertebral fractures, they were done in selected cases. Thin reconstructed

section shows the fracture and the integrity of the posterior vertebral wall.

- **MRI:** This is one of the single investigation in the evaluation of the Vertebral compression fracture. It has shown to be positive prognostic sign when bone marrow oedema or endplate oedema is seen. This is helpful to assess all the involved fracture level, define the intervertebral clefts, and aid in giving information about pathological fractures. High density signals of T₂ weighted or short-tau Inversion Recovery (STIR) sequences signify intra-osseous oedema. Involvement of the pedicle or soft tissue or in epidural space may indicate malignancy or infection. Signal changes in vertebral body are predictive of high positive outcome with vertebroplasty. STIR sequence is most sensitive in identifying acute fractures. Imaging modality of choice is MRI of spine as it is: Highly sensitive and Increased signals in T₂ sequence show acute fracture = oedema = increased signal T₁ STIR T₂ [14, 15].

High intensity signal on STIR MRI have shown 100% association with osteoporotic vertebral compression fracture correction predictor for the vertebral body fracture correction [16].

Procedure

Percutaneous vertebroplasty was performed under local anesthesia sometimes with sedation. Patient was positioned prone with bollester under both sides, the chest and pelvis in order to increase anterior widening of vertebrae then with full antiseptic precautions and under fluoroscopic guidance affected vertebrae was marked and through a small incision a 11 or 13 Gauge vertebroplasty needle with trocar and cannula (or leur lock bone biopsy needle) was inserted through pedicle, the tip of vertebroplasty needle must be in center of vertebrae that was confirmed by C-arm. The tip of the cannula is advanced to a point approximately 1 cm posterior to the anterior vertebral body as assessed laterally.

Because the vertebral body is not rectangular but rather curved, leaving a safe gap between these two points is needed to ensure the anterior cortex is not breached. The contralateral pedicle is cannulated in a similar fashion. Bilateral cannulation is favored due to increased chance of adequate and safe cement injection. Then the normal saline is pushed through cannula until resistance in vacuum area was felt, this signifies that there is no leakage in vertebrae and by measuring volume of saline got an idea of amount of cement to be used. After that by fine cannula all saline was sucked out and bone cement was pushed. After injecting the cement expansion of vertebrae seen in C-arm. Vertebroplsty canula rotated at same place until cement settled down and then canula is removed. This avoids the leakage of cement through the perforated pedicle if it could have happened in removing the canula.

Regardless of exact measurements, visual filling of the body on the AP projection from the inner margins of the endplates along the lateral 1/3 on each side is ideal, though this is not always technically feasible

Post-operative evaluation

- After completion of procedure patients were instructed to lie flat in supine position for an hour. Throughout the procedure and after that, constant watch was kept on neurological status.
- After 6 hours of procedure patients were allowed to stand and walk
- Before discharging patient asses for improvement in pain immediately after the procedure and at 24 hours then patients were observed for the presence of any neurological deficit and any other complication.
- Radiological assessment were done by X-ray on same day ,at one, three, six, twelve month after percutaneous vertebroplasty
- MRI scan were asked after three month whenever feasible

- Aggressive treatment for osteoporosis was given after the procedure.

Results

The 72 patients were treated with vertebroplasty for last 2.8 years with average follow up of 1.3 years. All patients were evaluated as per fixed protocol of our unit and procedure was conducted with local anesthesia with mild sedation so that the patient can respond to the verbal commands while the procedure was being done.

The results were and the deformity correction by physical examination as well as the improvement in vertebrae height by vertebroplasty.

The VAS score was used to assess pre and post procedure improvement. The 47% patients showed excellent results, 13% good and 40% fair by pain score.

Good improvement was seen in 43% patients, 40% showed fair improvement and 17% showed no improvement in stature by physical examination pre and post operatively. The vertebral height improved 1 to 7 mm pre and post operatively as measured by radiologically with an average of 4.1mm.

In the follow up all of 72 patient 6 lost and 66 were followed for the period of 2.8 years with an average of 1.3 years.

Discussion

Most of the patients of osteoporotic vertebral compression fracture managed conservatively with bed rest analgesic, muscle relaxant, bracing, calcium. Elderly patients with medical problem have difficulties with bed rest they can develop complication like DVT, embolic phenomenon, UTI and even bed sores.

In literature significant pain reduction was achieved in 70% to 95% of patients within 24 hours [11, 19, 20].

In our study because of modification in procedure we have found that pain relief or reduction after percutaneous vertebroplasty was achieved 73.3% pt after 24 hours while these same patient suffered on an average 8 weeks of pain before percutaneous vertebroplasty these results are comparable to the literature. After 6 months of percutaneous vertebroplasty 93.3% of patients have pain relief which is comparable to the result of Liliang (2005) [20].

Because of modification of procedure in injecting cement no patient was reported with cement leakage as compared to 16.7% in literature due to rent in vertebrae.

In this series of study, the mean pre-procedure VAS score was 8.9 ± 1.1 which decreased significantly ($P < 0.001$) to 4.7 ± 2.4 within 1 month of percutaneous vertebroplasty and to 2.3 ± 1.3 after 6 months ($P < 0.001$) which is highly significant. These results are comparable to the results of Perez-Higueras, et al. (2002) [21] and Yeom, et al. [22].

The age of fracture with degree of osteoporosis is the main determinant of achieving satisfactory pain reduction [23]. The mean increase in anterior vertebral height after percutaneous vertebroplasty was 4.1 mm (range 1 to 7 mm). This result is better than the result of Hiwatashi, et al. (2003) [24]; Jang, et al. (2003) [23]. We believe that the high cement viscosity used in these cases helped in restoring vertebral body morphology compared with using a more liquid cement mixture.

Even with a long follow-up period, we did not observe any modification of the vertebral bodies that had been treated. Therefore, we suggest that percutaneous vertebroplasty can prevent the progression of vertebral collapse at the level of the treated vertebrae. Our long-term follow-up showed a slight but significant increase in the incidence of fracture in the vicinity of a cemented vertebra in comparison with the incidence in the vicinity of an uncemented fractured vertebra. The percutaneous

vertebroplasty with PMMA might increase the risk of fracture of adjacent vertebrae by shifting the normal load transmission through the spine. This risk should be weighed against the benefit of percutaneous vertebroplasty in preventing further collapse at the level of the treated vertebrae.

Conclusion

Percutaneous vertebroplasty is a technically feasible treatment in patients with osteoporotic vertebral compression fractures which does not respond to the best possible conservative treatment.

Percutaneous vertebroplasty works as internal splint for the micro fractures of vertebral body by methylmethacrylate cement which helps to relieve severe pain.

The pain relief and improvement of deformity, mobility, function and stature after Percutaneous vertebroplasty is immediate.

Successful treatment depends largely on appropriate patients selection, preoperative assessments, proper planning, meticulously performed procedure.

In our opinion, the Percutaneous vertebroplasty is an extremely useful procedure in the management of complication of vertebral compression fracture including severe pain and vertebral deformity. Improvement in the vertebral deformity in turn corrects the stature of the patient. Percutaneous vertebroplasty helps in overall improvement of morbidity.

Modification in conventional technique of vertebroplasty significantly decreases the incidence of cement leakage during procedure.

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