

Percutaneous Posterior Stabilization with Vertebroplasty in Painful Thoracolumbar Spinal Metastatic Disease: A Retrospective Study

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ABSTRACT

Objective: To do a retrospective evaluation of clinical outcome of the patients with spinal metastases treated with minimally invasive posterior spinal stabilization and vertebroplasty.

Methods and results: We retrospectively analyzed 22 patients with biopsy proven metastatic thoracolumbar spinal lesion treated with percutaneous posterior stabilization with pedicle screws and vertebroplasty operated in Ramachandra Medical University from June 2006 to May 2012. Neurologically intact patients with Tokuhashi's score of 9 or and Spine instability neoplastic score of more than 6 were included. Average age group was 61.8 years with 14 males and eight females. Clinical outcome was assessed using pre- and postoperative visual analog score (VAS), intraoperative blood loss, duration of surgery, time taken to mobilize the patients after surgery and length of hospital stay.

The average VAS decreased from 9.2 preoperatively to 4.1 postoperatively ($p < 0.001$) and 2.2 (< 0.04) at 3 months postoperative period. The mean Karnofsky's performance index increased from 45% preoperatively to 70% postoperatively. Average blood loss was 80 ml and the average duration of surgery was 85 minutes. Fifteen patients were mobilized on the second postoperative day with most patients discharged on 4th day. No patients had evidence of implant loosening and failure. Three patients had radiological evidence of cement extravasation. No patient had neurological deficit postoperatively and none had radiological evidence of deformity or adjacent level fracture in follow-up X-rays.

Conclusion: Percutaneous pedicle screw stabilization with vertebroplasty provided good pain relief and short-term clinical improvement in patients with thoracolumbar spinal metastasis with minimal postoperative morbidity.

Keywords: Metastasis, Pedicle screws, Percutaneous, Stabilization, Vertebroplasty.

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INTRODUCTION

Spine is the most common location of skeletal metastasis with thoracic region (70%) being the most affected followed by lumbar and cervical region.^{1,2} About 30% of cancer patients develop spinal metastasis during their illness with pain being the most common presenting complaint.^{3,4} Treatment in these patients is primarily palliative and operative treatment is advocated in patients not responding to nonoperative management.⁵ However, traditional surgical methods have their limitations of prolonged postoperative recovery period and increased morbidity in these patients with limited life expectancy.⁶ Thus, minimally invasive techniques were introduced in managing these patients.⁷ Percutaneous Vertebroplasty was used in treating vertebral hemangiomas⁸ was later extended to osteoporotic⁹ and metastatic¹⁰ compression fractures.

Many studies have evaluated the efficacy of vertebroplasty in managing painful thoracolumbar spinal metastasis.¹¹ We asked whether addition of posterior instrumentation to vertebroplasty of the involved vertebra improved clinical outcome in these patients. To our knowledge, no studies had been published previously in this regard.

MATERIALS

With the approval of the Institutional Review Board, we performed a retrospective analysis of all the patients who underwent percutaneous vertebroplasty with minimally invasive pedicle screw stabilization for metastatic thoracolumbar spinal disease operated in Sri Ramachandra Medical University between June 2006 and May 2012. In all the patients included, CT guided biopsy of involved vertebra showed evidence of metastasis. The diagnosis of primary tumor was also established. All patients had painful single or contiguous two level thoracic or lumbar vertebral metastatic fractures not responding to conservative therapy, such as bed rest, pain medication and bracing (Fig. 1). All the patients included were neurologically intact (Frenkel's grades D and E) with revised Tokuhashi score¹² (which includes Karnofsky's performance scale and Frenkel's grades) of more than 8. The spine instability neoplastic score (SINS)¹³ was greater than 6 in all patients

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included. Patients with primary malignancy of bone, such as multiple myeloma were excluded. Contraindications included more than two level involvement and noncontiguous involvement, failure to localize symptomatic level, involvement above T6 vertebra, neurological involvement (Frenkel A, B and C), significant neural compression with disruption of posterior vertebral cortex on MRI, pain that was significantly radicular in nature, local skin infection and patients with severe medical comorbidities.

Patient details are given in Table 1. Total of 22 patients underwent the procedure of which 14 were males and rest females. Nine patients had Bronchogenic carcinoma, all of them were males. Five patients had GI malignancy out of which four were males and one was a female. Six female patients had breast cancer. Two patients had the diagnosis

of thyroid cancer; one was a male and the other female. The average age of the patient group was 61.8 years. Duration of low back pain ranged from 1 week to 20 months with median duration being 14 weeks, although exact chronology of pain was not identified in some patients. Preoperative visual analog score (VAS) back pain score and Karnofsky's performance scale were recorded in each patient.

After informed consent, vertebroplasty was performed in operating room under C-Arm guidance under general anesthesia. In prone position, a 13 gauge needle (Osteo-Site bone biopsy needle; Cook Inc., Bloomington, IN) was introduced to the posterior aspect of the pedicle along its superolateral cortex and directed anteriorly, medially and caudally to reach the anterior third of vertebral body near the midline in sagittal plane. 40 mg polymethyl methacrylate (PMMA) cement was mixed with 10 ml of liquid monomer (Simplex P; Stryker-Howmedica-Osteonics, Rutherford, NJ) and was injected into vertebral body with the help of multiple 1 ml syringes till the anterior two-thirds of the body was filled; leakage of cement was confirmed with fluoroscopy. Average amount of 5 ml was used. Pedicles were cannulated using Jamsheedi needle, guidewire inserted in the pedicle tract and cannulated pedicle screws were inserted (Depuy Synthes, Warsaw, IN) percutaneously, followed by rod insertion. All the patients underwent short-segment instrumentation.

Duration of surgery, amount of blood loss and intraoperative complications were noted for each case. Length of hospital stay and time taken to mobilize after surgery was also noted. Visual analog score back pain scores and neurological outcome using Frenkel's grading were determined in immediate postoperative period. Postoperative radiographs were assessed for implant positioning and cement leakage. Patients were mobilized postoperatively with brace support. Follow-up was done at 1 month, 3 and 6 months and at 1 year. Visual analog score pain score and Karnofsky's performance index were recorded during each follow-up. Patients were also started on Chemo/Radiotherapy at 2 weeks postoperative period depending upon the cancer. Follow-up radiographs were assessed for change in implant position, implant failure, and increase in kyphotic angle and vertebral body collapse.

Statistical analysis was performed using statistical package for the social sciences (SPSS) software (version). Student's paired t-test was used to assess the significance of difference between means.

RESULTS

Average duration of follow-up was 4.5 months (1-16 months). All patients were available to follow-up at 1 month, 18 (81%) patients at 3 months, and 12 (54%) patients at 6 months



Fig. 1: Lytic metastatic lesion

Table 1: Demographics

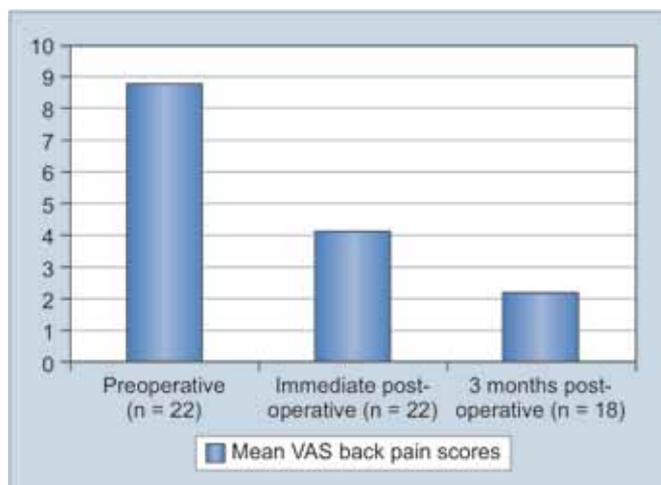
Characteristics	No. of cases
Total no. of cases	22
Sex	
Males	14
Females	8
Tumor type	
Bronchogenic	9
Breast	6
GI malignancy	5
Thyroid	2
Levels involved	
Single level	14
Two levels	8
Total no. of levels	30
Levels treated	
T9	1
T10	2
T11	4
T12	9
L1	7
L2	4
L3	3



and 10 (45%) patients at 1 year follow-up. One patient died during the follow-up period at 2 months after index procedure. The operated levels were from T9 to L3 with T12 and L1 being the most common levels operated. Fourteen (63%) patients had single level surgery and rest had two level surgery. Fourteen patients had Tokuhashi's score of 9 to 11 (predicted survival of 6–12 months) and rest of eight patients had score of 12 to 15 (predicted survival of greater than 1 year). Ten patients had potentially unstable spine and 12 had unstable spine according to SINS scoring system.

The mean preoperative VAS score was 8.8 (7–10) and Karnofsky's performance index was 45% (30–80%) with five patients wheelchair bound due to severe pain and 5 patients using assistive devices to walk. The mean postoperative pain score was 4.1 (2–8) ($p < 0.001$). Eighteen (81%) patients had improved or complete pain relief in immediate postoperative period. No patient had worsening of pain with pain scores remaining the same in four patients in immediate postoperative period. The VAS score at 3 months follow-up further reduced to 2.2 which was significant compared to immediate postoperative period ($p < 0.04$) (Graph 1). The mean Karnofsky's performance index improved to 70% at final follow-up with 50% of patients carrying out normal household activities with minor symptoms.

At final follow-up three patients remained wheelchair bound and five patients were walking with assistive devices. Two patients who were wheelchair bound preoperatively walked with assistive devices, whereas two patients who walked with assistive devices, walked unsupported at final follow-up. No patient's ambulatory capacity decreased after surgery. Fifteen (68%) patients were mobilized on the second postoperative day and 18 (81%) patients were discharged on the 4th postoperative day. No patient had worsening of neurological status. No surgeries were done after the index procedure.



Graph 1: Mean VAS back pain scores

The average blood loss was 80 ml (50–110 ml) and average duration of surgery was 85 minutes (70–99 minutes). No patient died in the 1 month after surgery. There was no vertebral body collapse at any time during follow-up. The average improvement in local kyphotic angle was $7.2 \pm 3.2^\circ$ at final follow-up. No patient had radiological evidence of implant loosening or failure (Fig. 2). No patient had worsening of existing deformity or evidence of adjacent level fracture at final follow-up.

Three patients had evidence of cement extravasation (Fig. 3); one had leakage anteriorly and two had leakage into the adjacent disk space through the fractured end plates. No patient had leakage in epidural space or neural foramina, although we did not confirm with a computed tomography (CT) scan. One of these patients had persistent back pain at final follow-up. None of these patients had worsening neurological symptoms.

DISCUSSION

The main aims of the surgery in spinal metastasis are pain control, functional preservation and restoration of stability and the surgical management is primarily palliative



Fig. 2: At 3 months postoperative period



Fig. 3: Cement extravasation

rather than curative due to the short-life expectancy in these patients.¹⁴ Even though, operative treatment in symptomatic spinal metastasis improves quality of life, conventional surgery has several disadvantages, such as massive blood loss, excessive soft tissue damage, neurovascular and visceral injury.¹⁵ Various minimally invasive surgical techniques including Vertebroplasty, endoscopy assisted surgery, and mini-open surgery have been introduced and shown to have acceptable clinical outcomes in metastatic spine disease.¹⁶

Even though, percutaneous cement augmentation has been used successfully in managing patients with metastatic spinal disease successfully, the rate of complication of this procedure is higher in these patients compared to osteoporotic compression fractures.¹⁰ There is a risk of symptomatic leakage of cement into spinal canal and neural foramina due to the bone destruction from osteolytic metastasis.¹⁷ Weill et al¹⁸ and Cotten et al¹⁰ were the earliest to report the use of percutaneous vertebroplasty in the management of spinal metastasis and Myeloma. The largest North American series reporting augmentation of cement for metastatic spinal disease and Myeloma is that by Fourney et al.¹¹ A total of 97 procedures (65 vertebroplasty and 32 kyphoplasty) were performed in 56 patients. Patients noted marked or complete relief from pain after 49 procedures (84%) and no change after five (9%). Asymptomatic leakage of cement occurred during vertebroplasty at six of 65 levels (9.2%) while no extravasation was seen during kyphoplasty. Important findings included considerable, lasting relief from pain with a corresponding decrease in the narcotic requirements in the patients treated.

But vertebroplasty alone seldom addresses instability due to metastatic fractures. Cho et al¹⁹ and Acosta et al²⁰ concluded that, kyphoplasty/vertebroplasty supplementation may improve the long-term integrity of short segment pedicle screw constructs and allow improved rates of fusion and better clinical outcomes in patients with traumatic thoracolumbar burst fractures. Park et al,²¹ in their retrospective single centre study used percutaneous pedicle screw stabilization to treat unstable metastatic spinal disease. They concluded that, minimally invasive treatment using percutaneous pedicle screw fixation with adjuvant treatment is a good alternative treatment option for potential instability of the thoracolumbar and lumbar spinal metastasis.

Combining the above principles, we used short-segment percutaneous pedicle screw fixation along with cement augmentation of the involved vertebra in managing spinal metastasis. In our study, patient outcomes were similar to those in the literature.^{10,11,18,21} Complete pain relief or improvement occurred 81% of patients

after the index procedure. Mean VAS scores significantly reduced at 3 months follow-up compared to immediate postoperative period. However, results at 6 months and 1 year did not reach statistical significance because of the small numbers of patients at these follow-up periods. The mean surgery time and mean estimated blood loss in our study is comparable to the other study using percutaneous management of metastasis.²¹

Subjective ambulatory capacity with pain free mobility improved in most patients, although there was no statistical improvement in functional ambulatory capacity according to Frenkel's grades. Three (13%) of our patients had cement leakage which is comparable to other studies in literature.^{10,11,18} Although, vertebroplasty does not improve kyphosis, addition of posterior instrumentation allowed us to obtain and maintain kyphosis correction. There are several drawbacks to our study, such as smaller patient size and absence of control group. Moreover, CT scans were not done to localize the leakage of cement and to confirm screw positioning.

CONCLUSION

Results from our study indicate that percutaneous posterior stabilization with pedicle screws and vertebroplasty provides good pain relief and short-term clinical improvement in patients with thoracolumbar spinal metastasis with spinal instability. Patients had decreased intraoperative and postoperative morbidity, shorter hospital stay and early return to activity in our series. Randomized control trials with larger sample size and longer follow-up are needed to formulate precise indications, and further analyze risks and benefits of this procedure.

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