A review and update of vertebral fractures due to metastatic tumors of various sites to the spine: Percutaneous vertebroplasty

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Abstract: *Background:* Vertebral fractures (VFs) are the most usual convolution of metastatic tumors and the vertebral column is the third most ordinary site for painful bone metastases and remains a chief factor of morbidity in cancer patients. *Methods:* In this paper, we investigated the previous literature on the status of clinical and prospects for the use of percutaneous vertebroplasty (PVP) with polymethylmethacrylate as a remedial alternative for the therapy of refractory pain resulting from malignant vertebral compression and pathologic fractures associated with metastatic tumors of various sites in numerous studies. The scientific document for this remedy, containing safety, immediate and long-term efficacy, and outcome measures, and also the risks of complications, was analyzed in detail. *Results:* PVP is a safe, feasible, reliable, effective, and useful procedure, a minimally invasive treatment, and a significant tool for reduction of pain and the relief of pain symptoms. *Conclusions:* This method can be employed as a further or narcotic remedy in elected patients. The techniques of PVP present a novel alternative therapy for diverse metastases with potentially large application.

Keywords: vertebroplasty, tumor, treatment, fracture, spine

Introduction

Based on published articles in scientific literature, the vertebral column is the third most ordinary site for painful bone metastases and remains a chief factor of morbidity in cancer patients, with a prevalence of 30%–70% of metastatic tumors [1–4]. These metastases occur in 65%–75% of patients with various tumors of the breast and prostate, 30%–65% of patients with pulmonary cancer, 47% of patients with advanced thyroid cancer, and 30% of patients with renal cell carcinoma of kidney as well as studies have showed that 9%–29% of patients with metastases will have a pathological fracture and 90% of fractures need surgery. Furthermore, in non-small cell lung cancer patients, approximately 70% of patients with bone metastases have bone pain [5–8]. Based on those descriptions, Jensen in his study has found the high outbreak of skeletal metastasis due to breast cancer of Denmark's population and it occurred in 47.6% of patients with breast neoplasms. Cancer lesions still more generally happen in the thoracic or lumbar regions [9].

The remedy procedures of the vertebral column metastasis are obscure, complex, and challenging, and need to be systemic and local treatments with a multidisciplinary or integrated care approach; moreover, these treatment strategies include surgery methods, radiotherapy, and sedative therapy [10–15].

To dominate the issues, a minimally invasive method, only a little research shows the long-term consequence of PVP in the treatment of metastatic damages of different tumors in the spine, and it has been expanded as an interventional technique to treat spinal osteolytic destruction, multiple myeloma, and painful vertebral compression fractures of vertebral bodies due to malignancy of different tumors, such as breast, prostate, etc. or osteoporosis. Although it has confined

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anticancer effect, PVP is considered as an impressive method for achieving fast pain control and preventing most spinal cord compression and vertebral collapse in patients with vertebral metastasis and also, PVP with polymethylmethacrylate (PMMA) *(Fig. 1)* is the administration of a vertebral body with bone cement [14, 16–30].

The aim of this article review is an update on new methods to determine the influence and the long-term consequence of PVP in the treatment of painful vertebral fractures (VFs) in metastatic patients of multifarious cancer of various sites on spine.

Methods

We performed search results using PubMed, Scopus, Google Scholar, Medline, EMBASE, and certain specialty databases, and we examined the recent literature on the clinical status and prospects for the use of PVP with PMMA as a therapeutic alternative for the remedy of refractory pain resulting from malignant vertebral compression and pathologic fractures associated with metastatic tumors of various sites in numerous studies.

Results and Discussion

Evaluation of the safety and efficacy of the therapy and complications

In a study on assessment of PVP method by Lim et al. [14], the 185 vertebral bodies of 102 patients during 6 years, which were composed of 81% patients with metastatic spine tumors and 19% with multiple myeloma, reported that VP could be a safe or secure and efficient method as a sedative treatment of the spinal tumor patients and pathological VFs due to these cancers. In parallel, in agreement with this finding, several series of the studies have found this as an effective and safety procedure in providing pain palliation [31–41]. In the literature of most studies, it has been revealed that there is a decrease in pain after VP, with the progress in pain ranging from 20% to 79% in 1 month [18, 19, 42, 43].

Another study with a period of over a 1-year follow-up by Blasco et al. [44] suggested that VP is associated with a remarkable improvement in pain and quality of life in patients with painful osteoporotic VFs and it could be achieved to a quicker pain alleviation at the 2-month follow-up, but it was associated with a higher prevalence

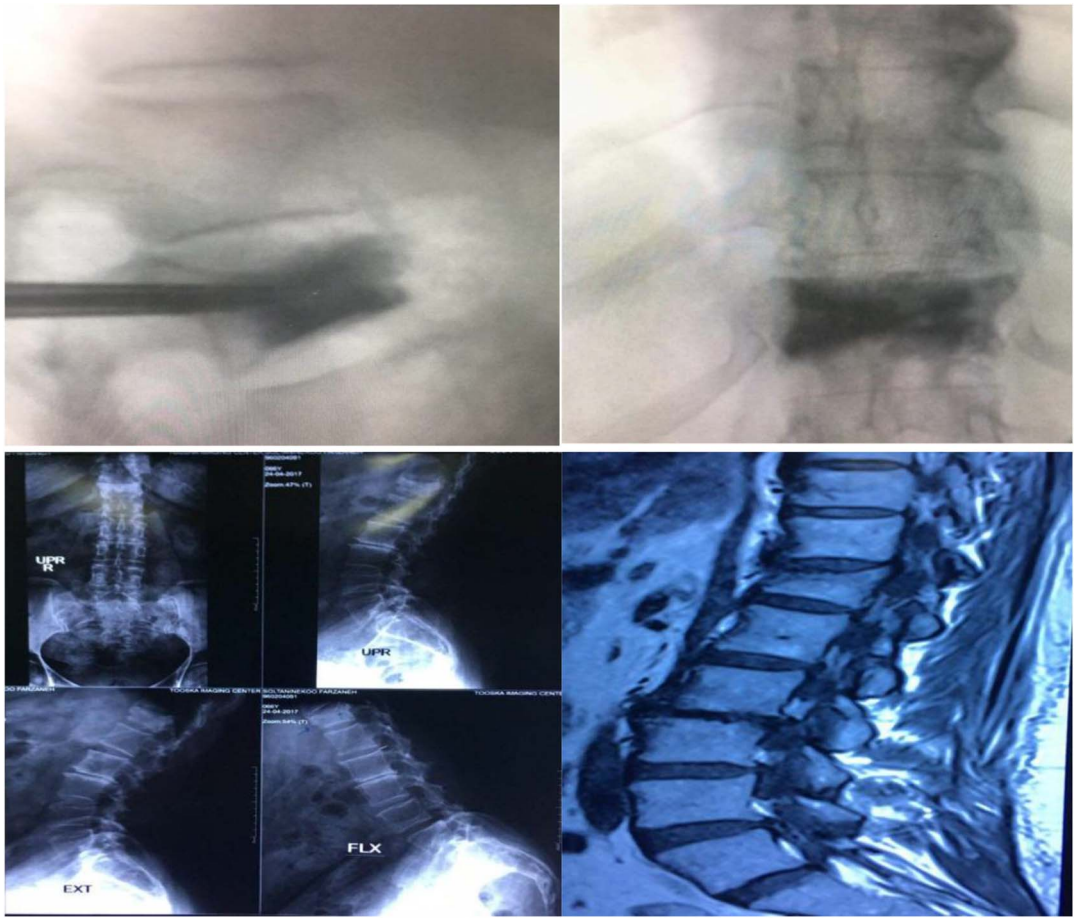

Fig. 1. Percutaneous vertebroplasty (PVP) with polymethylmethacrylate (PMMA) and hydroxyapatite

in vertebral defects. In contrast with these findings, some studies raised concern about the possible effect of VP on increasing the risk of new VFs after the procedure, particularly in the vertebrae located adjacent to the cemented vertebral body [45–48]. In addition, Hao and Hu [49] performed VP on 72 patients for vertebral hemangiomas, there was one major complication of vertebroplasty that involved bone cement leakage into the spinal canal and intervertebral foramen, compressing the left nerve root and causing leg numbness. The indications and limitations of the different forms of remedy have been addressed in multifarious researches. Moreover, the reported complication rate in PVP ranged from 0% to 10% depends on the initial indications of PVP: 2%–5% in patients with vertebral angiomas; 1%–3% with osteoporotic lesions; and 10% with spinal malignant tumors [50–53]. Minor complications commonly associated with local trauma. The approximately usual complication being pain away the infusion location, which generally subsides after 48–72 h; this may be composed with hemorrhage from the puncture place, which is further usual if several vertebral levels are being targeted or if many vascular lesions are being acted such as metastases from thyroid or renal cell carcinoma. Other complications associated with local trauma contain rib fractures and fracture of the posterior vertebral elements, which occur in <1% of cases and remaining cases are infection and allergic reaction to the cement, which can cause cardiovascular instability [50]. Permeation into the epidural space and neural foramina with resultant cord compression and radicular pain is the most feared complication associated with PVP augmentation of cement extravasation.

Wang et al. [54] have conducted a study on a large group of patients with metastatic lung cancer to spinal, the majority of treated lesions with VP method were located in the thoracic with 134 lesions or lumbar with 119 lesion areas and their results showed a pain intensity reduction of at least 50%, as well as Botton et al. [55] conducted a similar research on 42 patients and they also defined treatment efficacy as good (57%, 24/42). Furthermore, Qian et al. [56] reported that the first administration of PVP will allow continuous pain relief and spine stabilization and prevent further compression fracture due to metastasis. Another study by Zuozhang et al. [57] revealed that pain was relieved after PVP. A number of researches have shown the influence of VP in adjusting pathological spinal fractures [14, 58–60]. On the other hand, Cho et al. [61] suggested that VP could be served for short-term rein of localized pain; however, the number of patients was very little to acknowledge the inference. It is hard to assess the superiority of the therapy modalities; hence, a usual guideline for the recognition and remedy of metastatic pathological fractures of the spine is needed. Multiple studies found that VP provides prompt strengthening of the anterior column, which may limit painful VF [62–65]. Seo et al. [66] at a report on a 51-year-old woman with breast cancer for compression fracture in the C7 vertebra suggested PVP procedure as an anterolateral approach for treating metastatic osteolytic vertebral lesions in the cervical spine for alleviating intractable axial neck pain.

Cortet et al. [67] conducted VP in 37 patients, 29 with osteolytic metastases, and 8 with several myelomas and indicated in 97% of their 37 patients with cancers above a reduction of pain within 48 h of VP and complete absence of pain was in 13.5%, significantly decreased in 55%, and moderately decreased in 30%. Useful impacts were found in 3 months with 89% and next 6 months with 75%. Their complication rate was 2%–3%. In addition, Fourney et al. [18] reported a complete pain palliation of 65 patients undergoing VP on the treatment of cancer lesions. Cotten et al. [20] utilized PVP for metastases and reported that pain relief can occur despite insufficient lesion filling. Barr et al. [51] documented that the PVP involved noteworthy pain relief on osteoporotic fractures with great percentage of patients. In addition, Farrokhi et al. [60] proposed that VP seems to be significantly effective in pain sedation in metastatic spinal tumors. Cheung et al. [58] reported that PVP in metastatic fractures are notable. Weill et al. [68] with study on 37 patients who underwent 52 VP procedures for spinal metastases have demonstrated that VP as a minimally invasive procedure can provide immediate and long-term pain relief of metastases, contribute to spinal stabilization, and reduced many patients' back pain, and altogether, they achieved a final result that showed 73% of 33 patients have pain relief and according to this finding, VP was a safe procedure with no serious complications. Sun et al. [69] found that PMMA was leakage in 64% treated vertebrae as well as another study by Anselmetti et al. [70] indicated that employment of high PMMA during routine PVP is safe and practical and can remarkably reduce venous cement leakage without any substantial modifications in the VP technique. Saliou et al. [71] reported that PVP can relieve pain related to movement of weighted vertebrae and all complications associated with it by VP method are inactive, such as acute phase of infection, hemorrhagic diathesis, and severe cardiac disease. In a recent literature, PVP indicated complete or partial pain relief in 73%–100% on spinal metastases-treated patients [18, 20, 21, 68, 72–75].

A report on osteoblastic and mixed spinal metastases by Calmels et al. [21] concluded rate of 92% at 6 months VP as an analgesic efficacy and a complication rate of 12% in a series of 52 patients, and also Gu et al. [76] reported 88.6% pain relief or pain progress during follow-up with spinal metastatic tumor and/or malignant vertebral compression fractures. A study on 31 patients with metastatic spinal tumors and malignant vertebral compression fractures by Gu et al. [77] proposed that VP is safe, effective, and minimally invasive palliative therapies for reducing

pain and improving function in patients and in summary, they expressed that pain is reduced in six cases and unimproved in two cases, yielding a pain relief rate of 94%, and in study else on malignant vertebral compression fractures by Su et al. [78] reported that PVP is a safe and effective procedure, capable of providing significantly greater pain relief and vertebral stability in patients, and they achieved notable pain relief in 94% of their patients after treatment with PVP, which is at the higher end of the range of 73%–100% reported with other treatment modalities [1, 68, 73, 79].

This study had no any limitations.

Conclusions

In summary, our results suggest that PVP is a safe, feasible, reliable, effective, and useful procedure, a minimally invasive treatment, and a significant tool for reduction of pain and the relief of pain symptoms. This method can be used as an additional or palliative therapy in selected patients. The techniques of PVP present a novel alternative remedy for various metastases with potentially wide application.

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