

Clinical investigations of percutaneous vertebroplasty combined with intensity-modulated radiotherapy for patients with spinal metastases

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Research

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Abstract

Background: This study aimed to explore the use of percutaneous vertebroplasty (PVP) plus radiotherapy in patients with bone metastases. However, percutaneous vertebroplasty (PVP) combined with intensity modulated radiotherapy (IMRT) has been rarely reported in the treatment of spinal metastases.

Methods: The effectiveness and feasibility of this procedure were initially observed in this paper. We retrospectively analyzed the clinical characteristics of 7 patients with spinal metastasis. They were all treated with PVP, followed by IMRT (6 MV-X linear at a dose of 40-60 Gy) for 4-6 weeks. All patients achieved technical success with PVP, and all successfully completed the IMRT program without serious complications or discomfort.

Results: After the initial exploration of PVP combined with IMRT in our tumor center, the patients' pain was alleviated, and no pain aggravation or fracture was found. The short-term effect was significant.

Conclusions: PVP combined with IMRT seems to be an effective way to improve the quality of life of patients with spinal metastasis of tumor, and the curative effect is definite, which can be further popularized in clinical practice.

Background

Spinal metastasis is a common complication of cancer. It can cause severe spinal pain, pathological vertebral fractures, spinal cord compression, paraplegia and so on. They all lead a poor prognosis [1]. Nowadays Percutaneous vertebroplasty (PVP) and radiotherapy are the most used in ensuring relief from discomfort at the end of life expectancy [2]. Radiotherapy (RT) can provide successful palliation of painful bone metastasis in 50–80% of patients [3]. IMRT makes it possible to deliver optimal radiation doses safely [4]. PVP is a recently developed treatment for spinal metastases. It appeared to be an alternative method to treat painful spine metastases [5]. But few studies report on the clinical observation of PVP combined with IMRT in the treatment of metastatic lesions of the spine. In this article, feasibility and clinical effects were discussed in the patients with spinal metastases who were treated with percutaneous vertebroplasty combined with intensity-modulated radiotherapy.

Methods

Patients

It is a retrospective study. We collected 7 patients from West China Hospital (2010-2012), and record the medical characters of these patients. They were all diagnosed as malignant tumor with spinal metastases. The primary tumor sites are laryngeal, nasopharyngeal, liver, and lung. Two of the patients are unknown primary focal. The mean age of the study participants was 55.8 years(range: 32–68 years). PVP combined with IMRT are used in these spinal metastases sites. The most commonly involved spine

levels are between C2 and L3. Clinical and pathological characteristics of the cases are showed in Table 1.

Treatment procedure

All patients underwent, computed tomograph , magnetic resonance imaging, or bone scanning for evaluation of metastasis lesions. The indication for PVP was an unstable or painful metastatic tumor. Specific methods for PVP: cervical puncture in the supine position, thoracolumbar prone position. Regular disinfection shop towels, local infiltration anesthesia. The anterior lateral approach is commonly used in cervical spine surgery, and the thoracic and lumbar spine can be operated by pedicle of vertebral arch or the posterior lateral approach under X-ray. 5-10 cm bone cement were used in one vertebral body. Once the bone cement is found to be leaking into the spinal canal, intervertebral foramen, or venous plexus, the injection should be stopped immediately. The IMRT was performed in the vertebral metastasis area after patients undergoing PVP for approximately 30 days using an 6 MV-X linear at a dose of 40-60 Gy. The gross tumor volume (GTV) of a tumor was defined as the volume of gross visible tumor plus margins of approximately 2 mm with a total dose of 40-60 Gy .The clinical tumor volume (CTV) was defined as the GTV plus a margin(35-50 Gy). The planning target volume was defined as the CTV plus 2 mm margins 30-50 Gy. Distribution of intensity-modulated radiation therapy plan was showed in Figure 1.

Results

All the patients complete the treatment procedures. 13 vertebral bodies were punctured, and the success rate of PVP puncture is 100%. There are no severe complications were observed, such as bone marrow mud leakage, Spinal cord injury, local pain and so on. 7 patients all received IMRT (40-60 Gy/20-30f). The process is successful, and the patients can endure the exposure during the position and limb braking requirements. Cancer pain were relieved in all the patients in 6-72 h after PVP. The total effective rate is 100%. No pain or fracture were found after PVP combined with IMRT. Three patients are still alive until now.

Discussion

Spinal metastases are becoming increasingly common because of the rising incidence of cancer and the improved survival of cancer patients [6, 7]. At least 40% of patients with advanced cancer will have spinal involvement during the course of their disease [8]. The treatment of painful vertebral metastases is a major target [6, 7]. The maintenance of spinal stability, reduction of pain, and prevention of neurological deterioration can affect a patient's quality of life. The treatment methods of spinal metastatic tumors include: double phosphate drugs, analgesic drugs, chemotherapy(including hormone therapy), radiation therapy, percutaneous vertebral angioplasty, percutaneous radiofrequency ablation, decompression surgery therapy, radionuclide therapy, etc. Nowadays radiation therapy and PVP are commonly used for spinal metastases. Under the treatment of PVP, 80% patients can achieve significant pain relief within 1 hours, and the analgesic effect is more than 75% [9]. Radiotherapy (RT) can provide successful palliation

of painful bone metastasis in 50–80% of patients [3]. While IMRT are particularly well suited for the treatment of spinal bone metastases when they are localized or require re-irradiation, and may provide superior tumor control [4].

There are article compared the efficacy of external radiotherapy (E RT) and PVP for spinal metastasis, and showed that ERT combined with PVP achieved pain remission in 84.8% of the patients, which was higher than ERT (72.5%) or PVP (76.3%) alone [2]. Yi Li, et al has evaluate the safety and efficacy of PVP combined with IMRT for vertebrae metastatic lesions of patients with non-small-cell lung cancer (NSCLC),They used the visual analog scale (VAS) to assess the degree of pain, the mean VAS score and the activities of daily living, evaluation showed that the patients had a significantly high life quality after the combined approach ($P < 0.05$) [10]. JEE-SOO JANG et al indicated that the mean VAS pain score was reduced from 8.2 to 3 under the treatment of PVP combined with RT [11]. In our series, all the patients got pain relief and no pain or fracture were found after PVP combined with IMRT. PVP combined with IMRT seems to be an effective and feasible means to improve the quality of life of patients with tumor vertebral metastasis.

Conclusion

Percutaneous vertebroplasty combined with intensity-modulated radiotherapy can provide pain relief and stability for cancer patients with spinal metastases.

Abbreviations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of West China Hospital, Sichuan University, China. Patients who participated in this research, signed the informed consent and had complete clinical data. Signed written informed consents were obtained from the patients and/or guardians.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

XX designed the study and drafted the manuscript. XC and HZ were responsible for the collection and analysis of the experimental data. ZL and FW revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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References

- 1 Bartels RH, van der Linden YM, van der Graaf WT. Spinal extradural metastasis: review of current treatment options. *CA Cancer J Clin*. 2008; 58: 24-59.
- 2 Huang M, Zhu H, Liu TG, Gui DD, Huang Y. Comparison of external radiotherapy and percutaneous vertebroplasty for spinal metastasis. *Asia-Pac J Clin Oncol*. 2016; 12: e201-e208.
- 3 Chow E, Harris K, Fan G, Tsao M, Sze WM. Palliative radiotherapy trials for bone metastases: a systematic review. *J Clin Oncol*. 2007; 25: 1423-1436.
- 4 Ejima Y, Matsuo Y, Sasaki R. The current status and future of radiotherapy for spinal bone metastases. *J Orthop Sci*. 2015; 20: 585-592.
- 5 Xie P, Zhao Y, Li G. Efficacy of percutaneous vertebroplasty in patients with painful vertebral metastases: A retrospective study in 47 cases. *Clin Neurol Neurosurg*. 2015; 138: 157-161.
- 6 Lo SS, Sahgal A, Wang JZ, et al. Stereotactic body radiation therapy for spinal metastases. *Discov Med*. 2010; 9: 289-296.
- 7 Sheehan JP, Jagannathan J. Review of spinal radiosurgery: a minimally invasive approach for the treatment of spinal and paraspinal metastases. *Neurosurg Focus*. 2008; 25: e18.
- 8 Jang JS, Lee SH. Efficacy of percutaneous vertebroplasty combined with radiotherapy in osteolytic metastatic spinal tumors. *J Neurosurg Spine*. 2005; 2: 243-248.
- 9 Li Y, Qing Y, Zhang Z, et al. Clinical efficacy of percutaneous vertebroplasty combined with intensity-modulated radiotherapy for spinal metastases in patients with NSCLC. *Onco Targets Ther*. 2015; 8: 2139-2145.
- 10 Böhm P, Huber J. The surgical treatment of bony metastases of the spine and limbs. *J Bone Joint Surg Br*. 2002; 84: 521–529.

11 Barr JD, Barr MS, Lerriey TJ, McCann RM. Percutaneous vertebroplasty for pain relief and spinal stabilization. Spine. 2000; 25: 923-928.

Table

Table 1. Patient characteristics, PVP and IMRT

Case NO.	Age	Sex	Primary Cancer	PVP Levels	Follow-up [mos]	Comment
1	66	M	Laryngeal cancer	C2-3	40	dead
2	45	M	Nasopharyngeal cancer	C5	73	alive
3	68	F	Metastais of unknown origin	L1	59	alive
4	65	F	Liver Cancer	L1-3	3	dead
5	32	M	Metastais of unknown origin	C2-3	20	dead
6	50	M	Lung Cancer	L1-2	46	alive
7	65	F	Lung Cancer	T L	24	dead

Figures

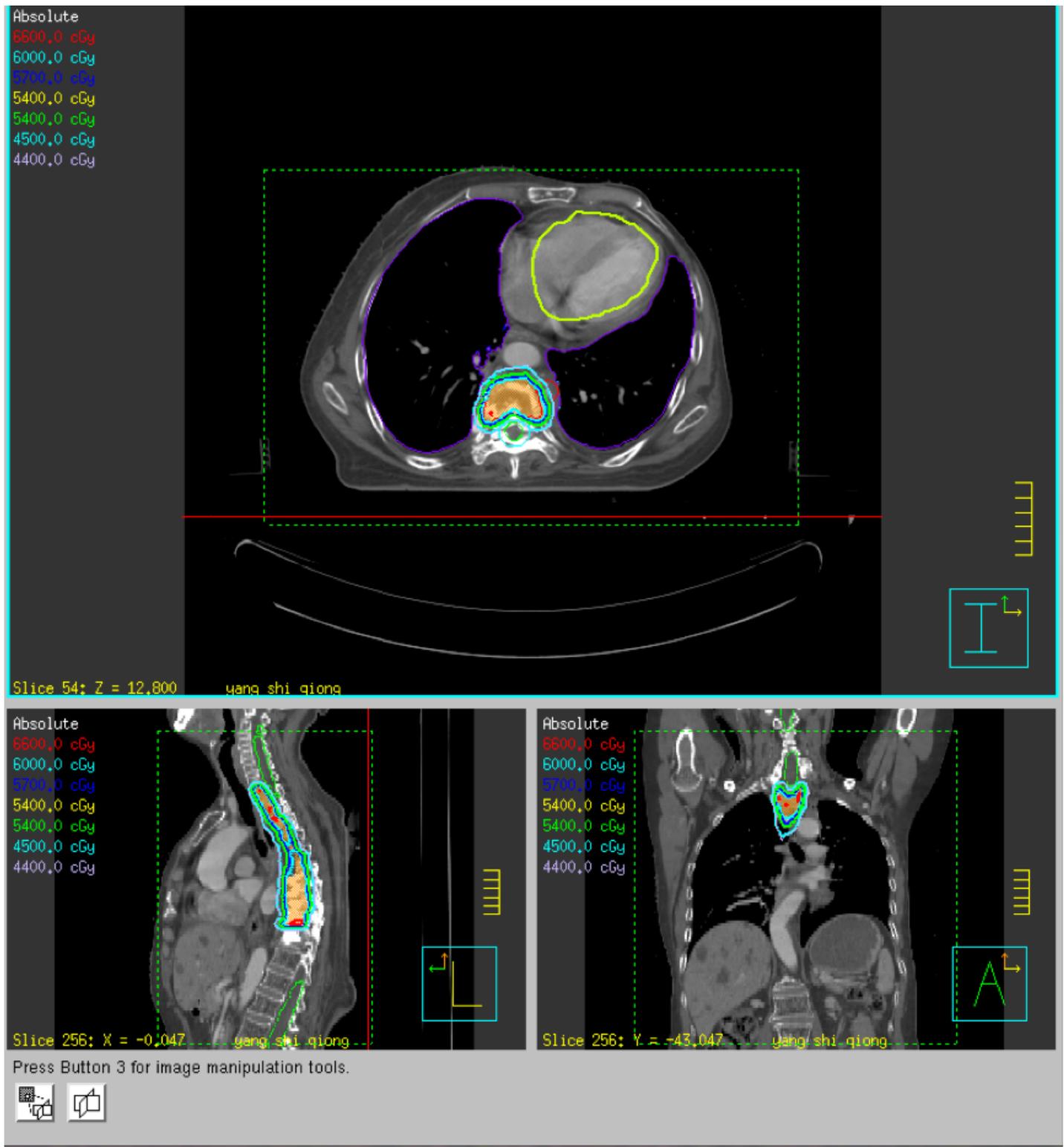


Figure 1

Distribution of IMRT plan