Percutaneous Vertebroplasty in the Treatment of Pain Caused by Metastatic Tumor

Togao, Osamu
Department of Clinical Radiology, Kyushu University

Mihara, Futoshi
Department of Clinical Radiology, Kyushu University

Yoshiura, Takashi
Department of Clinical Radiology, Kyushu University

Noguchi, Tomoyuki
Department of Clinical Radiology, Kyushu University

他

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Case Report

Percutaneous Vertebroplasty in the Treatment of Pain Caused by Metastatic Tumor

Osamu Togao, Futoshi Mihara, Takashi Yoshiura, Tomoyuki Noguchi, Yasuo Kuwabara, Kengo Yoshimitsu and Hiroshi Honda

Department of Clinical Radiology, Kyushu University, Maidashi 3-1-1, Higashi-ku Fukuoka 812-8582, Japan

Abstract

Percutaneous vertebroplasty is a radiologically guided therapeutic procedure that consists of percutaneous injection of polymethylmethacrylate (PMMA) into pathologic vertebral bodies. It is a minimally invasive procedure that is effective in the treatment of pain resulting from bone metastasis. This procedure has the advantage of providing rapid pain relief and spinal stabilization. A patient with severe, aggressive pain from metastatic lumbar spinal tumor of thyroid follicular carcinoma is presented herein. Despite treatment with analgesic agents, external beam radiation therapy, radioiodine therapy, and posterior fusion surgery, the pain reemerged and progressed. After percutaneous vertebroplasty, definite pain relief was achieved. Vertebroplasty would be useful as an additional or alternative pain relief method in patients with metastatic vertebral tumors.

Introduction

Metastatic bone tumors are the most significant cause of pain in patients with cancer. Today, since survival rates and the control of primary tumors have improved, pain due to metastasized spine tumors has been recognized as an important problem. Percutaneous vertebroplasty is a treatment in which bone cement is injected into fractured vertebral bodies. In 1984, Deramond in France for the first time ever treated a vertebral huge hemangioma in the cervical spine by vertebroplasty using polymethylmethacrylate (PMMA). Since then, it has been widely used in the treatment of painful compression fracture caused by vertebral tumors, osteoporosis, multiple myeloma, and other spinal tumors. The utility, safety, and lack of invasiveness of this method have been recognized in recent years. We report herein a case with thyroid cancer and refractory bone pain caused by lumbar vertebral metastasis in which percutaneous vertebroplasty was effective in achieving pain relief.

Case

A 54-year-old man with lumbago was admitted to our department. In 1989, he had a tumor in the right neck. It was diagnosed as follicular carcinoma of the thyroid gland. The right lobe of the thyroid gland was excised. In 1994, he had lumbago, and a metastasis was found in the L3 vertebral body. After resection of the remaining thyroid gland, he received the first radioiodine therapy. Since lumbago had gradually advanced, external irradiation therapy of 50 Gy was performed on the L3 vertebra. Moreover, in 1997, a posterior fusion was done from the thoracic vertebra...
to the fifth lumbar vertebra. From 1994 to 2002, iodine treatments were performed eight times (total dosage 32.2 GBq). After 1997, the lumbago improved and remained stable until October 2003, at which point it deteriorated and the patient began taking nonsteroidal anti-inflammatory drugs (NSAIDs). There was no metastatic lesion other than on the lumbar spine. The patient was admitted to our hospital for the purpose of percutaneous vertebroplasty in March 2004.

Complete blood cell count, blood coagulation, and biochemistry demonstrated no special findings. Hormonology revealed that thyroglobulin was 33640 (<30) ng / ml, TSH was 1.17 (0.2-4.7) μU / ml, free T3 was 2.5 (2.1-4.3) pg / ml, and free T4 was 1.0 (0.9-2.0) ng / ml.

**Percutaneous vertebroplasty**

The computed tomography (CT) before the vertebroplasty showed that the L3 vertebra had a compression fracture on the right side (Fig. 1a, b). Local anesthesia using 1% xylocaine was administered with the patient in a prone position. The puncture was performed under fluoroscopy with both anteroposterior and lateral projection. A hammer was used to carefully insert an 11-gauge metallic biopsy needle (Osteo-site bone biopsy needle, Murphy side bevel type: COOK Co.) into the centrum of a vertebra via a right pedicle (Fig. 2a). The liquid and

**Fig. 1** The plain radiograph in the anteroposterior image (a) shows osteolytic lesions on the right side of the L3 vertebral body. The patient had already undergone posterior fusion. A coronal (b) view of multiplanar reconstruction CT shows a compression fracture of the right side of the L3 verterbra due to metastatic carcinoma.
powdered PMMA (Bristolmaiyarzscib Co. sales, and Zimmer Co. manufacturing) was mixed with 15 g of barium sulfate to a dough-like consistency. After several minutes of mixing, bone cement was injected under real-time fluoroscopic observation to prevent leakage outside the vertebral body (Fig. 2b). The injection was terminated when optimal distribution of PMMA was obtained. The total volume of PMMA injected was approximately 3 ml. The CT obtained immediately after the vertebroplasty showed that bone cement was injected into the osteolytic lesion on the right side of the vertebral body (Fig. 3a, b). There were no complications originating from this procedure. The lumbago improved immediately after vertebroplasty, the visual analogue scale (VAS) decreased from 8 to 2, and the frequency of taking NSAIDs decreased from 4 times to once a day. In the six months follow up after the procedure, the pain had been stable. No local regrowth of the tumor or new vertebral fracture was clinically diagnosed. This procedure was approved by the ethics committee of Kyushu University Hospital.

Discussion

The spine is the most common region for metastatic bone tumors to occur\(^9\). It is considered that pain from these tumors is caused by the destruction of the vertebral body, spinal instability, or compression of the adjacent neurological elements\(^6\). The treatment of compression fractures caused by vertebral metastasis is controversial and must be integrated into the overall manage-

![Fig. 2](image-url) The lateral fluoroscopic image (a) shows the needle tip in the anterior third of the vertebral body. The lateral fluoroscopic image (b) just after PMMA injection shows vertebral body-filling.
Fig. 3 CT after percutaneous vertebroplasty in coronal (a) and axial (b) views shows that the right side of the vertebral body is filled with PMMA. No leakage into the extravertebral space is found. The height of the site of the compression fracture increases after vertebroplasty.

It is widely known that the pain relief achieved in response to radiation therapy is significant. The pain can be completely or nearly completely eliminated by radiation in 83% of patients with painful bone metastasis. However, radiation therapy cannot correct the destruction and instability of the vertebra caused by metastatic tumors. In addition, the pain relief achieved in response to radiation therapy is often not immediate. Surgical therapy such as spinal fusion is an alternative therapy that achieves pain relief by stabilizing an unstable spine. However, due to its invasiveness, surgery is not always recommended for patients with malignancy or for those with a poor general condition.

Percutaneous vertebroplasty is a treatment to inject bone cement into a weakened and fractured vertebral body through a metallic needle under X-rays or CT fluoroscopy. This technique is far less invasive and faster than surgical therapy. Even if the pain relief is not sufficient, a decrease in the amount of the analgesic used is often observed. Pain relief is often achieved within 48 hours after treatment. It has been reported that complete or eminent pain relief is observed in approximately 70-80% of patients with the metastasis. It has also been reported that 69% of nonambulatory patients become ambulatory after percutaneous vertebroplasty. As a mech-
anism of the pain relief of vertebroplasty, not only stabilization of the destroyed osseous tissue but also an antitumor effect of PMMA was suggested. PMMA has the cellular toxicity against tumors based on the chemical effect of methylmethacrylate monomer as well as on the thermal effect from the heat of polymerization of the cement. Peak temperatures in the center of the vertebral bodies after PMMA injection ranged from 49°C to 112°C. The heating effect of polymerized bone cement to the tumor necrosis was confirmed by the histopathological evaluation. In this case, because pain improvement could be achieved even though the patient had already undergone posterior fusion surgery, the antitumor effects of PMMA might have been effective.

Differentiated thyroid carcinoma is a tumor with relatively good prognosis even if there is a distant metastasis. In patients with such a chronic course, pain control is important to maintaining quality of life. The effects of radioiodine therapy on tumors that have grown beyond a certain size can be expected to be reduced. In this case, the patient had undergone radioactive iodine treatments, external irradiation, and a surgical procedure as treatments for metastatic vertebral tumor. Percutaneous vertebroplasty was effective in achieving pain relief after such treatments. It is considered that vertebroplasty can function as an additional or alternative therapy for pain caused by metastatic vertebral tumors.

In a safe and successful vertebroplasty, the selection of adequate patients, the decision regarding the appropriate puncture site, and the timing of the beginning and ending of cement injection is important. It has been reported that the amount of injected cement does not correlate with the effects of pain relief, especially in patients with metastatic tumors. Even if the amount injected is small, a sufficient pain-relief effect is often observed. Complications of the procedure are primarily related to leakage of PMMA into adjacent structures. Cement leaks into the epidural veins, epidural space, intervertebral disc, and neural foramina can occur. The most serious complication is epidural overflow with spinal cord compression. Leaks into the paravertebral veins can cause pulmonary cement embolism. Radiculopathy is the major risk of neural foramina leak. Cement leaks into the disc usually do not have clinical importance, although these leaks may increase the risk of adjacent vertebral collapse. Gangi et al. have reported that, in their series of 868 vertebroplasties, epidural leaks were observed in 15 patients, which caused neuralgia in only 3 patients without spinal cord compression. In 2 patients, asymptomatic pulmonary embolisms were detected. Symptomatic pulmonary embolus is considered to be significantly rare. Leakage outside the vertebral body can be prevented by performing an appropriate puncture and observing the movement of PMMA in real time under fluoroscopy.

We have reported herein a case in which percutaneous vertebroplasty was effective in treating the refractory pain caused by a metastatic lumbar vertebral tumor from thyroid cancer. The patient had previously undergone radioiodine treatments, external radiation therapy, and surgery to achieve posterior spinal fusion. Percutaneous vertebroplasty is a method of achieving pain relief that involves not only stabilization of the destructed vertebral body but also the antitumor effects of PMMA. It is consid-
erved that vertebroplasty can serve as an additional or alternative treatment for painful metastatic spinal tumors.

References


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転移性脊椎腫瘍に対する経皮的椎体形成術

九州大学大学院医学研究院臨床放射線科学分野

毎尾 理，三原 太，吉浦 敬，野口 智幸，桑原 康雄，吉満 研 吾，本田 浩

経皮的椎体形成術はX線またはCT透視下に病的椎体にpolymethylmetacrylate（PMMA）を注入する治療法である。転移性脊椎腫瘍について、本治療法により迅速かつ侵襲少なく十分な除痛効果と脊椎の安定化が得られる。甲状腺滤胞癌の腰椎転移による難治性疼痛に対して本治療が有効であった1例を報告する。腰椎転移に対して放射性ヨード内服治療、放射線外照射、脊椎固定術および鎮痛剤内服など様々な治療を行うも疼痛が再出現、増悪したが本治療を行い十分な疼痛緩和が得られた。経皮的椎体形成術は転移性椎体腫瘍による難治性疼痛に対する追加治療または代替治療として有用であると考えられた。