J Anesth (2007) 21:277–281
DOI 10.1007/s00540-007-0498-x

Journal of
Anesthesia

Clinical outcome of percutaneous osteoplasty for pain caused by metastatic bone tumors in the pelvis and femur

Keisuke Yamada[1], Yoshihisa Matsumoto[1], Masaki Kita[1], Ken Yamamoto[1], Wataru Kohda[2], Takeshi Kobayashi[2], and Tsuyoshi Takanaka[2]

[1] Department of Anesthesiology and Intensive Care Medicine, Graduate School of Medical Science, Kanazawa University, 13-1 Takara-machi, Kanazawa 920-8641, Japan
[2] Department of Radiology, Graduate School of Medical Science, Kanazawa University, Kanazawa, Japan

Abstract
We examined the pain-relieving effects in five patients who underwent percutaneous osteoplasty (POP) for pain caused by metastatic bone tumors in the pelvis and femur. Pain intensity, improvement of walking, and complications associated with POP were evaluated. Pain was measured using a numerical rating scale (NRS), with scores ranging from 0 (no pain) to 10 (worst pain imaginable). The patients were four men and one woman (mean age, 65 years). POP was performed in the pelvis in three patients and in the femur in two patients. Three of the subjects had already received radiation therapy at the lesion. The scores on the NRS on moving in the five patients before POP were 5, 8, 5, 4, and 7. After POP, the NRS scores decreased to 0, 0, 2, 0, and 1, respectively, within 72 hs. Three of the patients showed improvements in walking. There were no complications associated with POP. However, pathological fracture occurred, while walking, 4 days after POP in one patient. Percutaneous osteoplasty is a safe and effective treatment for pain caused by metastatic bone tumors in the pelvis and femur. However, care and attention should be paid to the risk of pathological fracture after POP of the femur.

Key words Cancer pain · Metastatic bone tumor · Pain management · Percutaneous osteoplasty

Introduction

Metastatic bone tumors often cause severe pain (which is resistant to opioids), especially on moving. Radiation therapy (RT) is a standard palliative treatment for metastatic bone tumors. However, its pain-relieving effects generally take several weeks and so patients with metastatic bone tumors require treatments that are effective more rapidly. Once the pain recurs, RT cannot be performed again because of radiation overexposure. Recently, percutaneous vertebroplasty (PVP) has become widely recognized as a safe and effective treatment for pain caused by metastatic vertebral-body tumors [1,2]. This technique consists of inserting a percutaneous needle into the affected vertebral body and the injection of polymethylmethacrylate (PMMA). Similar to PVP, percutaneous osteoplasty (POP), which consists of the injection of PMMA into metastatic lesions in other bones, such as the pelvis and femur, has been reported to be effective [3–5]. Here, we report the pain-relieving effects and complications of POP in five patients.

Address correspondence to: K. Yamada
Received: March 31, 2006 / Accepted: January 4, 2007

Case reports

POP was approved by the local ethics committee, and written informed consent was obtained from all the patients. Table 1 shows the patients' demographic data. Vital organ functions had been preserved in all patients, and the prognoses were anticipated that they would survive for at least more than 1 month. Three of the five patients had already received RT to the affected bone, and had recurrent pain.

POP was conducted under local anesthesia with a needle for bone biopsy (Osteo-Site Bone Biopsy Needle Sets, 13-gauge; Cook, Bloomington, IN, USA; Bone Biopsy Needle, 12-gauge; Hakko, Chikuma, Japan; Ostycut Biopsy Needle, 14-gauge; Ostycut, Angiomed/Bad Karlsruhe, Germany). The needle was inserted into the affected bone with the aid of computed tomography (CT; Interventional Angio-CT, Toshiba, Tokyo, Japan), fluoroscopy, or normal X-ray fluoroscopy, and PMMA (Osteobond; Zimmer, Warsaw, IN, USA) was injected into the affected bone. During the injection, we checked for leakage of PMMA out of the affected bone by fluoroscopy. When leakage of PMMA was observed, the injection was stopped and the procedure ended.

Table 1. Patient data

Patient no.	Age (years)	Sex	Original cancer	Location of metastatic tumor	Radiation therapy before POP
1	70	M	Lung	Left ilium	Finished (40 Gy)
2	64	F	Breast	Left femoral head	None
3	63	M	Hepatic	Right femur	Finished (40 Gy)
4	75	M	Lung	Right acetabulum	Finished (40 Gy)
5	54	M	Lung	Right ilium	None

POP, percutaneous osteoplasty

Table 2. Clinical results before and after POP

Patient no.	NRS score before POP	NRS score after POP	Amount of injected PMMA (ml)	Improvement of walking	Complications
1	5	0	8	Improved	None
2	8	0	5	No change	None
3	5	2	6	Improved	Pathological fracture 4 days after POP
4	4	0	1	No change	None
5	7	1	2	Improved	None

NRS, numerical rating scale; POP, percutaneous osteoplasty; PMMA, polymethylmethacrylate

We evaluated pain intensity, changes in walking, and complications associated with POP. Pain was measured using a numerical rating scale (NRS) with scores ranging from 0 (no pain) to 10 (worst pain imaginable) [6]. We interviewed patients after POP regarding whether they felt there had been any improvement in their walking.

Table 2 shows the clinical results before and after POP. In all patients, the NRS score decreased within 72 h. In three patients, the NRS score decreased to zero after POP. Three of the five patients reported subjective improvements in walking. There were no major complications associated with POP. In patient 3, however, pathological fracture occurred in the treated area, while walking, 4 days after POP.

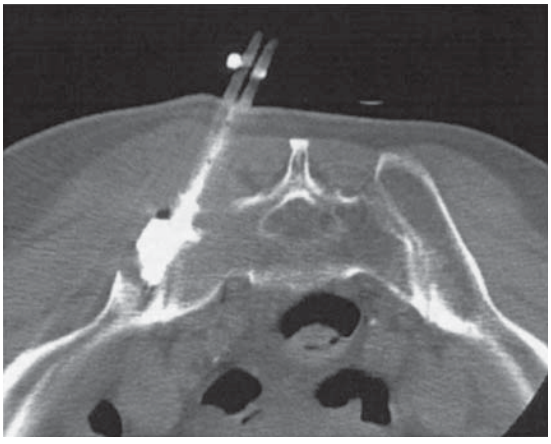

Fig. 1. Computed tomography (CT) during percutaneous osteoplasty (POP) in patient 1, showing the needle and bone cement injected into the ilium

Patient 1

A 70-year-old man with lung cancer and left ilium metastasis received POP to the left ilium (Fig. 1). He had already received RT to the affected bone. However, he had recurrent back pain, due to the metastasis in the left ilium. POP was performed with the patient in the prone position. Eight ml of PMMA was injected into the left ilium.

Patient 2

A 64-year-old woman with breast cancer and left femur metastasis received POP to the left femur head (Fig. 2), which had previously had a pathological fracture. When she changed her body position, she had severe leg pain. POP was performed with the patient in the prone position. Five ml of PMMA was injected into the left femur. Although leakage of PMMA was observed, there were no complications. After obtaining pain relief, she could change body position easily. However, she could not walk because the fractured femur head was not treated.

Patient 3

A 63-year-old man with hepatic cancer and right femur metastasis received POP to the femur (Fig. 3). He had

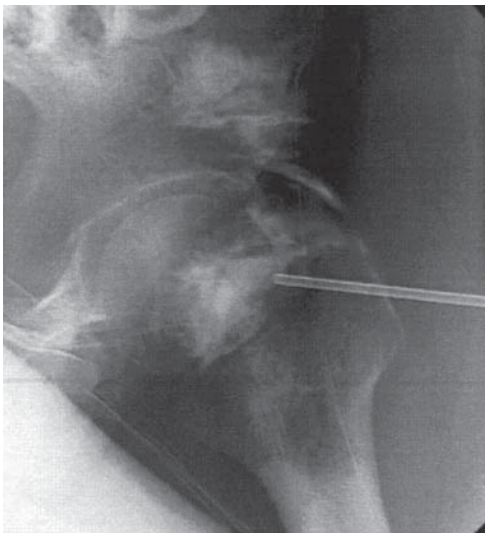

Fig. 2. X-ray during POP in patient 2, showing the needle and bone cement injected into the left femur head

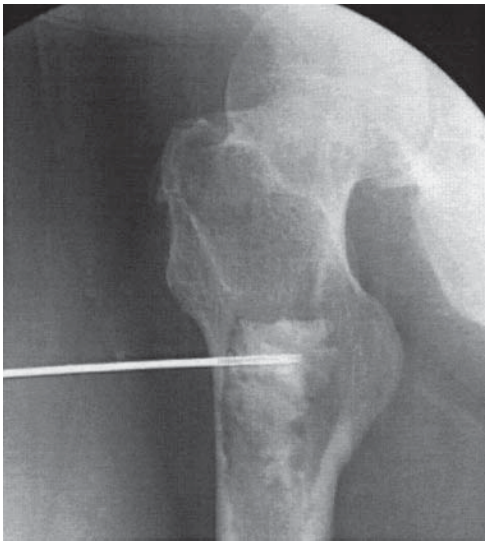

Fig. 3. X-ray during POP in patient 3, showing the needle and bone cement injected into the right femur

previously undergone RT to the femur. However, he experienced recurrent right-leg pain. POP was performed with the patient in the semilateral position, and 6 ml of PMMA was injected, after which he could walk easily. Four days after the POP, however, he fell and fractured his left femur in the treated area (Fig. 4).

Patient 4

A 75-year-old man with lung cancer and right acetabular metastasis received POP to the acetabulum. He had an old cerebral infarction. He suffered from pain in the left hip joint on changing his body position. He had received RT to the acetabulum, but the pain had not decreased. POP was performed with the patient in the prone position. Only 1 ml of PMMA was injected into the acetabulum to prevent leakage of PMMA into the hip joint. He gained pain relief, but could not walk by himself because of the after effects of the old cerebral infarction.

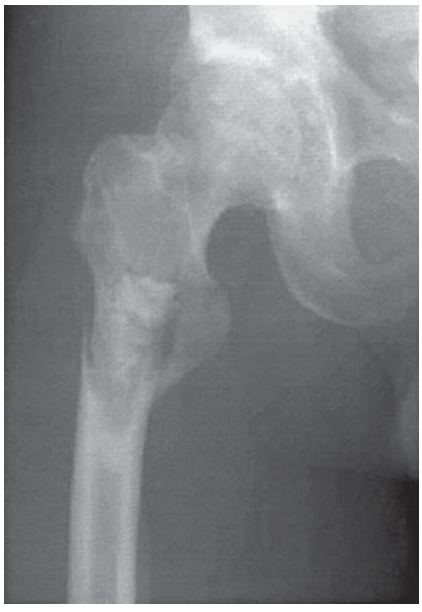

Fig. 4. X-ray 4 days after POP in patient 3, showing pathological fracture in the treated area

Patient 5

A 54-year-old man with lung cancer and right ilium metastasis received POP to the ilium. POP was performed with the patient in the semilateral position (Figs. 5, 6). Although leakage of PMMA was observed when 2 ml of PMMA was injected, there were no complications. He could walk easily after POP.

Discussion

Metastatic tumors in the pelvis or femur often cause pain on walking, which adversely affects the patient's daily activity. Metastatic vertebral-body tumors also cause severe pain on walking. PVP has been widely used for alleviating such pain by the injection of PMMA into the affected vertebral bodies. The POP technique is similar to that of PVP, and is used for injecting PMMA into other bones. Good clinical results of POP have been reported in the acetabulum [3] and ilium and ischium [4,5]. Our clinical results were also good.

Radiation therapy is the standard palliative treatment for metastatic bone tumors. However, RT cannot be

Fig. 5. Photograph during POP in patient 5. POP was conducted, with the patient under local anesthesia, with computed tomography fluoroscopy

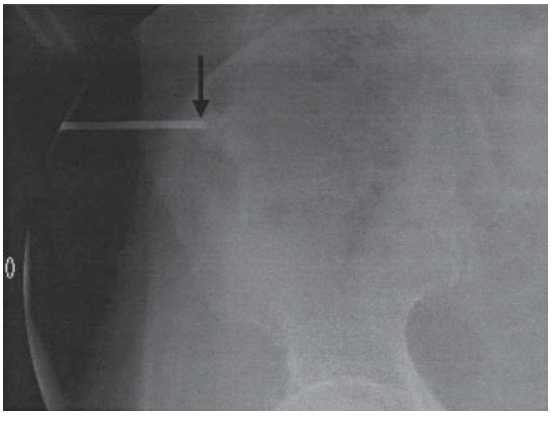

Fig. 6. X-ray during POP in patient 5, showing the needle (*arrow*) and bone cement injected into the right ilium

performed again in patients in whom RT has already been performed, due to the dangers of radiation overexposure. In the present series, POP alleviated the pain caused by metastatic pelvic and femoral tumors within 72 h in all five patients, including three who had already received RT. POP also improved walking in three patients.

In patients 2 and 5, we conducted POP prior to RT. Although the indications of POP for metastatic bone tumors have not yet been established, we consider that POP can precede RT because of its rapid pain relief effect. Additional RT can be performed after the obtaining of pain relief by POP, similarly to the additional RT after PVP [7,8].

The alleviation of pain by POP is considered to be due to the stabilization of the metastatic bones by the injection of PMMA. Microfractures caused by osteolytic metastatic changes are stabilized, and then stimulation to the periosteum is decreased on walking or moving. Although other chemical mechanisms responsible for pain relief have been considered, the details are still unclear. The optimal volume of bone cement to use for POP is also unclear. In PVP, we have reported that a small amount of bone cement can alleviate pain and that excess cement injection, causing cement leakage, can cause some complications [8]. For this reason, we stopped injecting bone cement in patients 4 and 5 in the present series when bone cement leakage was detected. In both patients, good pain relief was obtained.

Radiofrequency ablation (RFA) has also been noted to provide pain relief for metastatic bone tumors [9]. There are some reports of combination treatments of cement injection (POP or PVP) and RFA for the pain caused by metastatic bone tumors [10,11]. The coagulation necrosis produced by RFA can improve cement distribution in the metastatic lesion. Another benefit of RFA is the local control of tumors. Further clinical studies are needed to determine the effectiveness of combinations of POP and RFA.

Complications of POP are considered to be the same as those of PVP [5,12]. Pulmonary embolism caused by leakage of PMMA into the venous system is the most serious complication. Also, PMMA leakage into soft tissue near nerves can cause nerve injury. PMMA leakage into the hip joint is also considered to cause joint injury. We experienced no such complications in the present series.

We experienced one case of pathological fracture in the treated area after POP of the femur. The fracture occurred 4 days after POP, when the patient walked after obtaining pain relief. As the injection of PMMA does not strengthen the affected bones, physicians should pay attention to the risk of pathological fracture, especially in patients receiving POP to the femur.

In summary, we described good pain-relieving effects and improvement of walking following percutaneous osteoplasty in five patients with metastatic bone tumors in the pelvis or femur. Percutaneous osteoplasty can also alleviate recurrent pain after the completion of palliative RT. Percutaneous osteoplasty similarly to PVP, is considered to be an effective treatment modality for pain caused by metastatic bone tumors in the pelvis and femur.

Acknowledgments. This study was supported in part by Grants-in-Aid from the Sasakawa Health Science Foundation and the Hokkoku Cancer Foundation.

References

1. Hentschel SJ, Burton AW, Fourney DR, Rhines LD, Mendel E (2005) Percutaneous vertebroplasty and kyphoplasty performed

at a cancer center: refuting proposed contraindications. J Neurosurg Spine 2:436–440
2. Alvarez L, Perez-Higueras A, Quinones D, Calvo E, Rossi RE (2003) Vertebroplasty in the treatment of vertebral tumors: postprocedural outcome and quality of life. Eur Spine J Epub 12:356–360
3. Hokotate H, Baba Y, Churei H, Nakajo M, Ohkubo K, Hamada K (2001) Pain palliation by percutaneous acetabular osteoplasty for metastatic hepatocellular carcinoma. Cardiovasc Intervent Radiol 24:346–348
4. Hierholzer J, Anselmetti G, Fuchs H, Depriester C, Koch K, Pappert D (2003) Percutaneous osteoplasty as a treatment for painful malignant bone lesions of the pelvis and femur. J Vasc Interv Radiol 14:773–777
5. Kelekis A, Lovblad KO, Mehdizade A, Somon T, Yilmaz H, Wetzel SG, Seium Y, Dietrich PY, Rufenacht DA, Martin JB (2005) Pelvic osteoplasty in osteolytic metastases: technical approach under fluoroscopic guidance and early clinical results. J Vasc Interv Radiol 16:81–88
6. Chapman CR, Syrjala KL (1990) Measurement of pain. In: Bonica JJ (ed) The management of pain. Lea and Febiger, Philadelphia, pp 580–594
7. Jang JS, Lee SH (2005) Efficacy of percutaneous vertebroplasty combined with radiotherapy in osteolytic metastatic spinal tumors. J Neurosurg Spine 2:243–248
8. Yamada K, Matsumoto Y, Kita M, Yamamoto K, Kobayashi T, Takanaka T (2004) Long-term pain relief effects of four patients undergoing percutaneous vertebroplasty for metastatic vertebral tumor. J Anesth 18:292–295
9. Posteraro AF, Dupuy DE, Mayo-Smith WW (2004) Radiofrequency ablation of bony metastatic disease. Clin Radiol 59:803–811
10. Schaefer O, Lohrmann C, Herling M, Uhrmeister P, Langer M (2002) Combined radiofrequency thermal ablation and percutaneous cementoplasty treatment of a pathologic fracture. J Vasc Interv Radiol 13:1047–1050
11. Halpin RJ, Bendok BR, Sato KT, Liu JC, Patel JD, Rosen ST (2005) Combination treatment of vertebral metastases using image-guided percutaneous radiofrequency ablation and vertebroplasty: a case report. Surg Neurol 63:469–474
12. Laredo JD, Hamze B (2005) Complications of percutaneous vertebroplasty and their prevention. Semin Ultrasound CT MR 26:65–80