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Percutaneous femoroplasty for the treatment of proximal femoral metastases

H. Feng [a,c], J. Feng [a,c], Z. Li [a], Q. Feng [a], Q. Zhang [b], D. Qin [b], W. Chen [b], Z. Li [b], Y. Zhang [b,*]

[a] *Department of Orthopedics, The Fourth Affiliated Hospital of Hebei Medical University, 12 Health Road, Shijiazhuang, Hebei 050011, PR China*

[b] *Department of Orthopedic Surgery, The Third Affiliated Hospital of Hebei Medical University, 139 Ziqiang Road, Shijiazhuang, Hebei 050051, PR China*

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Abstract

Purpose: To investigate the clinical value of percutaneous perfusion of bone cement as a treatment for proximal femoral metastases.

Methods: Twenty-one patients with 23 lesion sites of proximal femoral metastases were treated using percutaneous femoroplasty (PFP) and followed up for 6–12 months. Patient responses to the Verbal Rating Scale pain classification scheme were used to assess the degree of pain relief after 2 days and again after 6 months. The Barthel Index of Activities of Daily Living (BIADL) was used to assess the patients' quality of life after 6 months.

Results: PFP effectively reduced the levels of pain in all 21 patients. Two patients experienced cement leakage into the hip during the operation, whereupon the cement injection was stopped immediately. One patient experienced irritating pain during the operation caused by the bone cement injection, and the pain was alleviated immediately upon stopping the injection. None of the patients experienced pulmonary embolism or complications of proximal femur pathological fractures during the study period. The pain relief efficiencies of PFP at 2 days and 6 months postoperation were 90% and 84%, respectively. The patient scores on the Barthel Index of Activities of Daily Living 6 months postoperation were significantly improved compared to preoperative scores ($P < 0.05$).

Conclusions: PFP is an effective and minimally invasive treatment for proximal femoral metastases that can significantly improve the patient's quality of life. However, the proposed indications should be strictly followed.

Keywords: Percutaneous femoroplasty; Femur; Metastasis; Quality of life; Pain relief

Introduction

Approximately 80% of malignant tumors eventually progress to bone metastases,[1,2] and the spine, proximal femur, and pelvis represent the most common sites for such metastases. Proximal femoral metastases can cause severe pain and even pathological fractures, which can negatively affect a patient's quality of life (QoL).[3] Percutaneous vertebroplasty (PVP) has become widely used in the clinic as an effective treatment option for patients with vertebral tumors.[3] This treatment is associated with only mild trauma and more favorable analgesic effects.[4] PVP treatment can be used in cervical, thoracic, and lumbar vertebra, and relief from pain is experienced in approximately 82% of cases.[3] In a previous study on the effectiveness of PVP for treating vertebral fractures caused by malignant metastases, 82% of patients experienced pain alleviation after PVP, and 52% of patients regained mobility.[3]

The proximal femur is richly vascularized and represents the second most common site of bone metastasis following the centrum.[5] Standard treatments for proximal femoral metastasis include radiotherapy, excision with internal fixation, and tumor resection with hip replacement prosthesis. However, radiotherapy has not been associated with an immediate curative effect, nor can it effectively repair the osteolytic damage caused by bone metastasis. Use of the other treatment options is limited because they are

* Corresponding author.

E-mail address: yzling_liu0311@126.com (Y. Zhang).

[c] H. Feng and J. Feng contributed equally to this study and should be considered as co-first authors.

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relatively high-risk procedures, and many patients cannot afford the cost of surgical removal with either internal fixation or prosthesis. For these reasons, PVP represents an attractive treatment option for proximal femoral metastases.

Although we have used PVP to treat vertebral metastases, we have also developed percutaneous cementoplasty indications. From January 2010 to January 2012, we performed percutaneous femoroplasty (PFP) on 23 lesion sites of 21 patients and observed a good curative effect. Therefore, in this study, we analyzed the clinical value of PFP as treatment for proximal femoral metastases.

Patients and methods

The case series of this study included a total of 23 lesion sites in 21 patients with proximal femoral metastases (2 patients presented with bilateral lesions). The patient population consisted of 8 males and 13 females (age range, 35–65 years). The primary malignancies of patients included the following types of cancer: 8 cases of lung cancer, 7 cases of breast cancer, 4 cases of esophageal cancer, 1 case of liver cancer, and 1 case of cervical cancer. Pathological examination during each operation confirmed these primary malignancies. Prior to the operations, the patients were thoroughly examined via contrast-enhanced X-ray computed tomography, which can reveal a more precise location than X-ray imaging alone and can help to determine the sites of metastases, and magnetic resonance imaging.

Hip pain was evaluated using the Verbal Rating Scale (VRS),[6–9] in which level 0 = no pain, level I = mild pain (a level of tolerable pain that does not affect daily life or sleep), level II = moderate pain (pain that affects sleep and for which patients request analgesic treatment), and level III = severe pain (unbearable pain that seriously affects sleep and for which patients urgently request analgesic treatment). Level III pain can be associated with dysfunction of the autonomic nervous system and/or impaired passive range of motion.

This study was approved by the Ethical Committee of The Third Affiliated Hospital of Hebei Medical University, and all of the patients provided their signed informed consent.

Surgical technique

The PFP treatment was applied to 23 lesion sites in 21 patients. Using fluoroscopy, the pelvis and involved hip of each patient was imaged in the anteroposterior position. The patient was then placed in the lateral decubitus position with the affected side up and the hip slightly flexed. Polymethylmethacrylate (PMMA; Mendec Spine High Barium Content Acrylic Resin, Tecres S.P.A, Italy) bone cement was prepared by mixing to a semi-liquid consistency and loaded into 1-mL syringes. The administration of PMMA was performed under fluoroscopic imaging in the anteroposterior and lateral view. To achieve a satisfactory filling of the affected bone, the needle was withdrawn during the cement injection, directing the bevel of the needle toward the site that required more filling. The quantity of PMMA injected varied depending on the extent of the metastatic lesion and patient size. Filling was stopped once sufficient distribution of cement within the metastatic area was achieved. During the operation, the amount of injected bone cement ranged between 5 and 10 mL. Each patient was placed in the lateral decubitus position with the affected limb abducted.

After the administration of local anesthesia, the angle and entry site of the needle were fixed using fluoroscopy. In most cases, a needle entry site was selected at 2–3 cm below the greater trochanter. Fluoroscopy was used to adjust the entry angle until the needle reached into the metastatic lesion site of the proximal femur (Fig. 1C). First, a lesional biopsy was taken and sent to the Department of Pathology of our hospital for pathological examination. Next, the needle was changed for injection of bone cement that had been mixed to a semi-liquid consistency and loaded into pressurized syringes (Fig. 1D). Under fluoroscopic monitoring, the bone cement was injected into the lesion site. Once the bone cement began to leak into the hip parenchyma, either the operation was stopped or the needle position was adjusted prior to resumption of the injection (Fig. 1E & F). Each patient's vital signs were subsequently monitored carefully, particularly pulse oximetry, as well as the amount of injected cement. Upon completion of the operation, the patients were maintained in the surgical position for 15 min pending solidification of the bone cement.

Evaluation of pain relief and QoL

The VRS was used to evaluate pain during follow-up at 2 days and again at 6 months after the operation. Patient responses of level 0 and I pain were considered as indicative of an effective treatment outcome, whereas responses of level II and III pain were considered as indicative of ineffective treatment outcome.

We used the Barthel Index of Activities of Daily Living (BIADL) to evaluate the patients' QoLat 6 months after each operation.

Statistical analysis

Statistical analyses were completed using SPSS 18.0 software (SPSS, Inc., Chicago, IL, USA). The patient-reported pain levels prior to and following each operation were compared using *t*-tests, and *P*-values less than 0.05 indicate statistically significant differences.

Results

All of the cases of proximal femoral metastases were treated effectively with PFP in this case series. Only two patients experienced bone cement leakage into the hip. One patient presented with irritating pain in the lower limbs during the injection; immediately stopping the injection