CLINICAL STUDY

Combination Radiofrequency Ablation and Percutaneous Osteoplasty for Palliative Treatment of Painful Extraspinal Bone Metastasis: A Single-Center Experience

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ABSTRACT

Purpose: To evaluate combined radiofrequency (RF) ablation and percutaneous osteoplasty (POP) in patients with painful extraspinal bone metastases.

Materials and Methods: In a retrospective study, 38 patients with 54 extraspinal bone metastases (ilium, n = 24; acetabulum, n = 21; femur, n = 7; ischium, n = 1; tibia, n = 1) were treated with RF ablation and POP. All patients had pain refractory to analgesic medication with intensity > 3 on a visual analog scale (VAS). Changes in quality of life were evaluated based on pain relief (VAS score), function on a Karnofsky performance scale, and analgesic dose before and immediately after the procedure and during follow-up. VAS score was the primary outcome, and the others were secondary outcomes.

Results: Technical success was achieved in 37 patients (97.4%). Mean VAS score declined significantly from 7.1 ± 1.5 before treatment to 2.2 ± 2.0 at 24 hours after treatment ($P < .05$), 1.6 ± 1.8 at 3 months after treatment ($P < .05$), and 1.3 ± 1.8 at 6 months after treatment ($P < .05$). Pain relief immediately after the procedure was reported by 35 patients (92.1%); pain regressed completely in 7 (18.4%) patients. After 6 months, narcotic analgesia had been suspended in 32 of 33 patients (97.0%). Pain was controlled by nonsteroidal antiinflammatory drugs in 8 patients (24.2%), and no analgesia was necessary in 24 patients (72.7%). Mean Karnofsky performance scale score after treatment was higher than before treatment ($P < .05$). The major complication rate was 2.6% (1 of 38 patients), with one case of vasovagal shock. The minor complication rate was 23.7% (9 of 38 patients).

Conclusions: RF ablation with POP is effective for pain relief and functional recovery in patients with painful extraspinal bone metastases and can significantly improve quality of life.

ABBREVIATIONS

PMMA = polymethyl methacrylate, POP = percutaneous osteoplasty, VAS = visual analog scale

Bone is a common site of spread for many cancers, including breast, prostate, and lung, and is usually affected in multiple myeloma as well. Bone metastasis may occur in 20%–80% of cases during the evolution of neoplasia (1,2). Among patients with bone metastasis, 50% develop intractable pain resulting in mobility limitations and significantly decreased quality of life (3). Pain control is a common strategy for these patients; the usual treatments for painful metastases are chemotherapy, analgesic drugs, radiotherapy, and surgery (4). More recently, minimally invasive techniques have been introduced for the treatment of painful bone lesions, including ethanol ablation, laser ablation, microwave ablation, cryoablation, and radiofrequency (RF) ablation (5–7). Rosenthal et al (8) and Galibert et al (9) were the first to report the use of RF ablation and percutaneous vertebroplasty for the treatment of osteoid osteoma. Percutaneous osteoplasty (POP) can provide

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immediate pain relief and restore mechanical stability in these patients. Combined RF ablation and POP seems to be promising for the palliative treatment of painful neoplastic lesions (10–14). The aim of our study was to assess the efficacy and safety of RF ablation and POP in the treatment of extraspinal bone metastases causing pain resistant to conventional treatment.

MATERIALS AND METHODS

The Institutional Ethics Committee of our hospital approved this study. Informed consent was obtained from all participants. From January 2008–June 2011, 38 patients (20 men and 18 women) with a mean age 52.6 years ± 12.2 (range, 23–75 y) with painful extraspinal bone metastases were treated with combined RF ablation and POP in a tertiary care center. All of the patients were referred to our institution because of pain that was resistant to conventional treatments, including opioids, chemotherapy, and radiotherapy. Patient and procedural data are presented in **Table 1**. Tumor types were lung (n = 19); breast (n = 7); thyroid (n = 5); liver (n = 2); and prostate, pancreas, leukemia, spindle cell tumor, and alveolar soft tissue sarcoma (each n = 1). The number of treated lesions ranged from one to three; 24 of the 38 patients had one lesion (63%), 12 patients had two lesions (32%), and 2 patients had three lesions (5%), for a total of 54 metastases.

Patients included in the study were known to have a primary malignancy with metastatic osseous disease. For inclusion in the study, focal pain was required to be clinically localized to a single region with imaging confirming the presence of bone tumor involvement. Other inclusion criteria were life expectancy < 3 months, age > 18 years, and provision of informed consent. Exclusion criteria were noncorrectable coagulation disorder (platelets < 90,000/mL; international normalized ratio > 1.50), systemic infection, distance between lesion and vessels < 10 mm, and the presence of more than six painful bone lesions requiring treatment.

Table 1. Baseline Characteristics and Clinical Outcomes in Patients with Extraspinal Metastatic Tumors

Characteristic	RF Ablation and POP (n = 38)
Age (y), mean ± SD (range)	52.6 ± 12.2 (23–75)
Male/female	20/18
Lung cancer/other cancer	19/19
Ilium/acetabulum/other location	24/21/9
Technical success	37 (97.4%)
RF ablation time (min), mean ± SD (range)	8.6 ± 1.4 (5–10)
Cement filling volume (mL), mean ± SD (range)	6.6 ± 4.6 (21–45)
Clinical follow-up (mo), mean ± SD (range)	13.3 ± 7.8 (3–33)
Overall pain relief	35 (92%)

POP = percutaneous osteoplasty, RF = radiofrequency.

Technique

All procedures were performed under biplane fluoroscopic guidance (AXIOM Zee Biplane; Siemens Healthcare, Munich, Germany). Acetabular, iliac, and ischium procedures were performed with the patient in the prone position; femoral and tibial procedures were performed with the patient in the supine position. Acetabular and ischial lesions were treated via an anteroposterior approach, and ilial lesions were approached posteroinferiorly along the long axis of the ilium. An appropriate approach was chosen for all bones, giving priority to the shortest and safest route and avoiding neurovascular structures.

Two dispersive grounding pads were placed on the patients' calves bilaterally, and markers were placed on the surface around the target lesions. In all procedures, a 10 cm 11-gauge (41/54) or 13-gauge (13/54) bone needle (Cook, Inc, Bloomington, Indiana) was inserted close to the lesion under imaging guidance after administration of local anesthetic (2% lidocaine) along the course of the bone needle. A RF ablation electrode with a 3-cm or 5-cm active tip (UniBlate 17-gauge or StarBurst XL 14-gauge; AngioDynamics, Latham, New York) was inserted coaxially into the needle, and the midportion of the active length of the electrode was positioned at the estimated center of the metastasis to be treated. An AngioDynamics RF generator was used. In 14 of the 38 procedures, heat was applied at several different points. The temperature at the tip of the needle ranged from 70°C–90°C in all procedures. The mean duration of heating was 8.6 minutes (range, 5–10 min).

Immediately after the RF ablation procedure, POP was performed on all patients. Mixed bone cement (polymethyl methacrylate [PMMA]) (Simplex P; Howmedica Osteonics, Kalamazoo, Michigan) was injected into the lesion through the bone needle under fluoroscopic guidance. The amount of bone cement was determined by measuring the tumor size and the appropriate place to inject by computed tomography (**Fig 1a–d**). The mean volume of PMMA injected per lesion was 6.6 mL ± 4.6 (range, 3–28 mL).

All patients were asked to rest for 1 hour after the procedure, after which they were allowed to mobilize gradually. Patients underwent computed tomography scanning immediately after the procedure and were asked to rank their pain from 0–10 (where 10 indicated the strongest pain ever experienced and 0 indicated absence of pain) using a visual analog scale (VAS) at 24 hours after the procedure (15).

Data Collection

This study was a retrospective, single-arm, paired comparison observational study with patients serving as their own controls. Technical success and complications were

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