ORIGINAL ARTICLE

Percutaneous cementoplasty of osteolytic metastases induces immediate and long-lasting pain relief in oncological patients

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Objective To evaluate the clinical efficacy of percutaneous cementoplasty with respect to pain relief in patients with refractory painful bone metastases.

Design Case series.

Setting Regional hospital, Hong Kong.

Patients All oncological patients with painful bone metastases despite conventional treatment seen between October 2006 and May 2010 were recruited.

Interventions Cementoplasty with or without radiofrequency ablation.

Main outcome measures Pain score before and after the procedure.

Results In all, 12 patients with 13 lesions received cementoplasty. Two patients were excluded from the analysis because of inadequate documentation of pain score due to rapid disease progression. For the remaining 10 patients with 11 metastases, the primary sites were the lung (n=3), renal cell carcinoma (n=2), rectum (n=2), pancreas (n=1), multiple myeloma (n=1), and soft tissue sarcoma (n=1). The locations of the metastatic lesions were scapula (n=1), thoracic vertebrae (n=1), lumbar vertebrae (n=3), and pelvic bones (n=6). Eight lesions were treated by cementoplasty alone, whereas the other three associated with large soft tissue components had radiofrequency ablation followed by cementoplasty in a single setting. Immediate or near-immediate pain relief after treatment was achieved in 10 out of 11 lesions; the median pain score was 5 before treatment and decreased to 2 a week after treatment (P=0.039). In all lesions for which the pain was successfully controlled in the first week, the palliation effect persisted at subsequent follow-ups. The median follow-up period for these patients was 16 weeks, and the longest pain-relieving effect was at least 9 months.

Conclusion In our experience, cementoplasty with or without radiofrequency ablation achieves satisfactory and long-lasting pain control in oncological patients with bone metastases. This is the first local study to describe the effect of cementoplasty for pain relief. Patients with painful bone metastases that are refractory to conventional treatments can benefit from cementoplasty, which should therefore be considered when conservative treatments fail.

Key words
Bone neoplasms; Cementoplasty; Pain management

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New knowledge added by this study

- This is the first local study to examine the effect of cementoplasty for pain relief.

Implications for clinical practice or policy

- Cementoplasty with or without radiofrequency ablation for pain relief should be considered whenever conservative treatments fail.

Introduction

Bone metastases are detected in 30 to 70% of oncological patients,[1] and are more likely to be found if the disease is advanced. For patients with terminal disease and multiple sites of metastases, preserving quality of life is one of the main concerns. However, their

針對溶骨性轉移的經皮骨水泥成形術於癌症患者引發的即時和持久鎮痛

目的 評估針對頑固性溶骨性轉移的經皮骨水泥成形術在鎮痛方面的臨床果效。

設計 病例系列。

安排 香港一所醫院。

患者 2006年10月至2010年5月期間，所有經常規治療但仍患有骨轉移疼痛的癌症患者。

干預 加入或不加入射頻消融的骨水泥成形術。

主要結果測量 術前和術後的痛苦比分。

結果 共12名患者（涉及13個腫瘤）接受骨水泥成形術，當中2名患者由於病情急轉直下，痛苦比分的資料不足，因而被摒出研究分析範圍。在餘下的10名患者（涉及11個癌細胞轉移），其腫瘤原位分別處於肺部（n=3）、腎臟細胞癌（n=2）、直腸（n=2）、胰腺（n=1）、多發性骨髓瘤（n=1）以及軟組織肉瘤（n=1）；而轉移位置分別為肩胛骨（n=1）、胸部椎骨（n=1）、腰椎（n=3）和盆骨（n=6）。當中8個腫瘤單以骨水泥成形術治療，其餘3個則由於涉及較大的軟組織成份，遂以骨水泥成形術後加射頻消融術作共同治療。在這11個腫瘤中，其中10個有術後的即時或迅速鎮痛功效，其痛苦比分中位數於術前為5，而在術後1週的得分則減至2（P=0.039）。在術後1週內能成功鎮痛的腫瘤中，其緩和作用仍可於及後的隨訪期持續。這些患者的隨訪期中位數為16個星期，而最長的緩痛期至少達9個月。

結論 根據我們的經驗，無論是否加入射頻消融術，骨水泥成形術皆可令有骨轉移疼痛的癌症患者達到令人滿意和持久的緩痛效果。這是本地首個檢視骨水泥成形術緩痛效用的研究。對於常規治療效果不理想的骨轉移疼痛患者，骨水泥成形術可令他們受益。因此，當保守治療效果不理想時，可考慮此療法。

quality of life can be greatly impaired by debilitating pain,[1,2] especially if the symptom arises from weight-bearing regions. Traditionally, such pain could be alleviated by various kinds of systemic and local treatments.[3] However, many treatment modalities achieve suboptimal palliation, and use of some of these treatments is often limited by their side-effects. Around 20% of the patients suffering from cancer pain had inadequate pain control by analgesic ladder.[3]

In recent years, the development of percutaneous interventional radiological procedures, including cementoplasty, radiofrequency ablation (RFA), alcohol injection, cryotherapy and others[4-7] provide alternatives to patients when the pain related to bone metastases cannot be adequately controlled by conventional methods. Our study aimed to assess the effectiveness of pain control in patients with refractory painful bone metastases by means of percutaneous cementoplasty and if indicated, RFA.

Methods

Subject selection

Between October 2006 and May 2010, 13 consecutive patients who had persistent and debilitating painful bone metastases, despite conventional therapies and undergoing cementoplasty and/or RFA under fluoroscopic and computed tomography (CT) guidance, were recruited. One patient was recruited in 2006, while others were recruited in 2009 to 2010. All the patients were under the care of a dedicated palliative care team in the Oncology Department. Pain was considered refractory when oral or parenteral analgesia was maximised, with radiotherapy given to the painful lesion still failed to adequately control the pain.

Pain score assessment and statistical analysis

Assessment of pain related to the site of metastases was performed just before the interventional procedures, and monitored serially afterwards until the last follow-up in the oncology clinic or when the patient died. The pain scores were retrospectively reviewed. Each score entailed a visual analogue scale, an instrument measuring a characteristic or an attitude that ranges across a continuum of values but cannot be objectively measured. Patients were asked to quantify the severity of pain from 0 to 10, with a score of 0 being completely pain-free and that of 10 meaning extremely painful. Pain scores were assessed immediately before and after the procedure, then weekly up to 4 weeks, and every month thereafter until the last follow-up or when the patient died.

FIG 1. An axial computed tomographic image of the pelvis showing an osteolytic bone lesion with soft tissue component at the left acetabulum

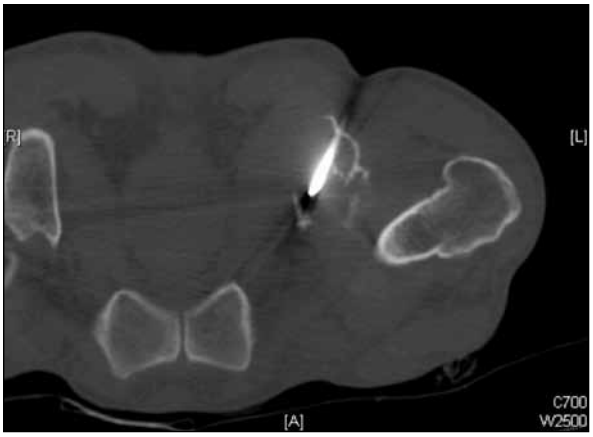

FIG 2. An axial computed tomographic (CT) image of the pelvis obtained during the procedure showing insertion of bone biopsy needle under CT guidance

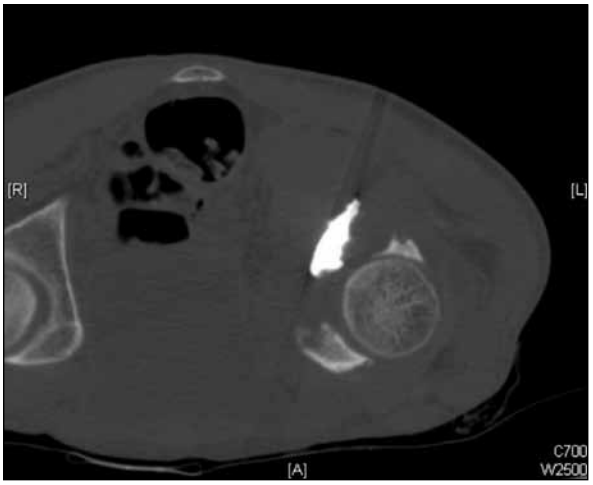

FIG 3. Post-treatment computed tomographic pelvis showing satisfactory cement injection into the metastatic lesion

As the sample size was small and the pain score was an ordinal variable, the two-tailed sign test was employed for statistical analysis. Statistical significance was set at the 5% level.

Interventional techniques

During cementoplasty with or without RFA, the location of the lytic bone lesion was first located by fluoroscopy or CT as shown in Figure 1. For lesions with significant soft tissue component, RFA was given before cementoplasty. For RFA, an ablation needle was first inserted into the bone lesion under image guidance; ablation was then performed according to the manufacturer's protocol. After ablation of the lesion, the ablation needle was removed and replaced by a bone biopsy needle, which was then inserted along the same tract (Fig 2). Bone cement was injected into the bone lesion under real-time fluoroscopic control until the whole lesion was filled with cement. For patients who did not receive RFA, the bone biopsy needle was introduced into the lesion directly under fluoroscopic or CT guidance, and cement injection was performed as described before. Post-treatment CT was performed to confirm the location, the amount of cement injection (Fig 3), and to look for extralesional cement leakage.

Results

In this study, the age of the patients ranged from 28 to 72 years. All 12 patients had intolerable pain despite conventional treatments; 10 of them also received radiotherapy for pain control weeks or months before the interventional procedure. These 12 patients had 13 lesions treated by cementoplasty; three of these lesions were treated by RFA before cementoplasty at the same setting, while the rest were

TABLE 1. Summary of patient characteristics, type of primary malignancy, and site of painful metastases for the 11 procedures analysed in this study*

Lesion No.	Sex	Age (years)	Primary site	Site of metastatic lesion	Date	Procedure
1	M	69	RCC	Acetabulum	October 2006	RFA/cementoplasty
2†	M	49	Lung	Ischium	January 2009	RFA/cementoplasty
3	M	72	Rectum	Pubic ramus	May 2009	Cementoplasty
4	M	62	Multiple myeloma	Thoracic spine	September 2009	Cementoplasty
5	F	59	RCC	Lumbar spine	September 2009	RFA/cementoplasty
6	M	28	Sarcoma	Acetabulum	January 2010	Cementoplasty
7	M	72	Rectum	Acetabulum	February 2010	Cementoplasty
8†	M	49	Lung	Lumbar spine	February 2010	Cementoplasty
9	F	46	Pancreas	Lumbar spine	February 2010	Cementoplasty
10	F	64	Lung	Pelvis	April 2010	Cementoplasty
11	M	51	Lung	Scapula	May 2010	Cementoplasty

* RCC denotes renal cell carcinoma, and RFA radiofrequency ablation

† Lesion No. 2 and 8 are of the same patient

only treated by cementoplasty. Two patients were excluded from further study because of inadequate documentation of pain scores due to rapid disease progression. Among the remaining 10 patients with 11 metastases, the primary sites were lung (n=3), renal cell carcinoma (n=2), rectum (n=2), pancreas (n=1), multiple myeloma (n=1), and soft tissue sarcoma (n=1). The location of metastatic lesions were scapula (n=1), thoracic vertebrae (n=1), lumbar vertebrae (n=3), and pelvic bones (n=6) [Table 1]. In all, there were eight lesions treated by cementoplasty alone while three had both RFA and cementoplasty in a single setting. The latter three patients had large soft tissue components associated with the lytic lesions.

Immediate or near-immediate pain relief after treatment was observed for 10 lesions, with the median pain score of 5 before treatment and decreased to 2 a week later (P=0.039) [Table 2 and Fig 4]. In these 10 lesions for which the pain was successfully controlled in the first week, the palliation effect was noted to be lasting in subsequent follow-ups. The median follow-up period for these patients was 16 weeks, and the longest pain-relieving effect was at least 9 months. One patient who had a metastasis at L1 vertebra and received combined RFA and cementoplasty developed irreversible left lower limb paralysis after the treatment. Post-procedural magnetic resonance imaging and CT scans demonstrated no cement leakage into the epidural space, no evidence of cord compression, and the needle tract was shown to be totally transpedicular and had not entered the spinal canal.

TABLE 2. Pain scores of patients recorded before and after treatment until last follow-up or death*

Lesion No.	D0	D1	D2	Wk 1	Wk 2	Wk 3	M1	M2	M3	M4	M5	M6	M7	M8	M9
1	6	-	-	1	-	2	-	-	-	-	-	-	-	-	-
2	2	7	2	-	-	-	1	-	1	-	0	-	0	-	1
3	8	3	-	-	-	-	4	2	2	-	0	-	0	-	-
4	5	2	0	0	0	0	0	0	0	0	-	-	-	-	-
5	7	4	4	4	4	-	-	-	4	4	-	-	-	-	-
6	2	2	0	1	1	2	2	-	-	-	6		0		
7	-	3	4	0	0	0	0	0	0	0	-	-	-	-	-
8	2	3	4	4	3	0	-	-	-	-	-	-	-	-	-
9	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
10	5	5	3	3	-	-	3	3	-	-	-	-	-	-	-
11	5	-	4	4	3	-	-	-	-	-	-	-	-	-	-

* D denotes day, Wk week, and M month

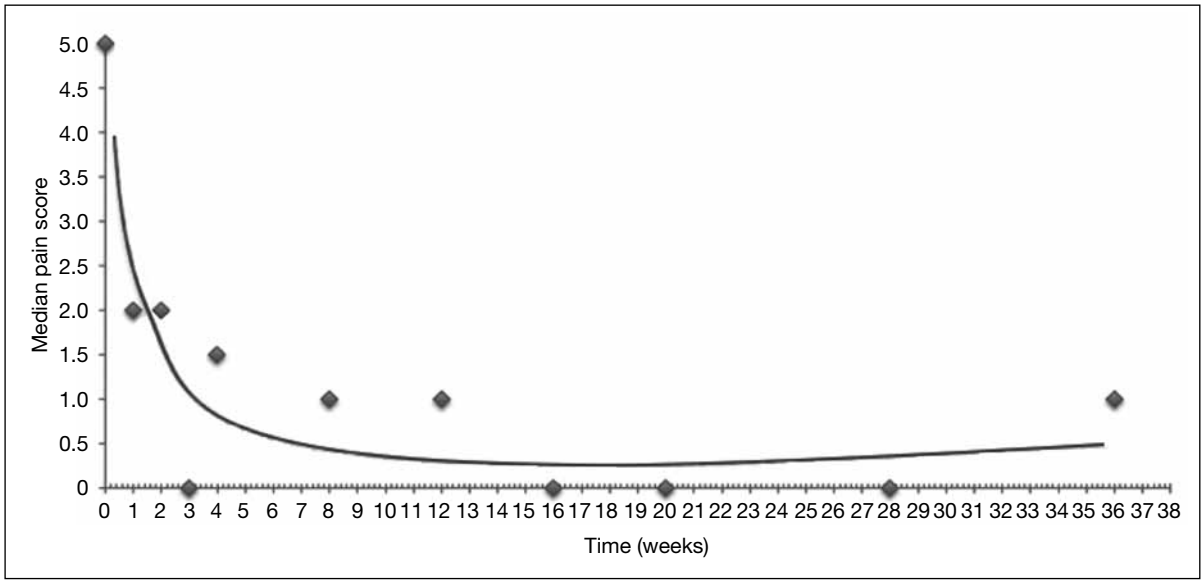

FIG 4. Median pain score of patients before and after treatment

Discussion

The primary aim of this study was to evaluate the pain-relieving effect of cementoplasty with or without RFA in bone metastases over time. Oncological patients with bone metastases could suffer from debilitating pain, especially in weight-bearing regions. Thus, pain control is one of the major steps in improving the quality of life in these terminal patients.

Analgesics, in form of the enteral or parenteral agents, and radiation therapy are traditional means of controlling pain related to bone metastases. In recent years, the development of percutaneous interventional radiological procedures, including cementoplasty, RFA, alcohol injection, cryotherapy and others[4-7] provide alternative strategies for patients with bone metastases causing pain that cannot be adequately controlled by conventional methods.

Different studies have demonstrated improvement in pain and walking ability after percutaneous radiological interventions that have also been shown to be safe.[7-14] However, their potential complications include local wound infection or inflammation, leakage of cement outside the bone into adjacent soft tissue or joint spaces, all of which could be prevented by delayed instillation of cement and close monitoring by fluoroscopy during the injection. In our study, one patient developed left lower limb paralysis after the procedure, which was attributed to thermal injury of the nerve roots during RFA. The complication was uncommon, even in patients with vertebral tumours associated with a posterior wall defect.[15]

Among all of the percutaneous interventional radiological procedures, cementoplasty and RFA have demonstrated more promising results in pain control, both of which can be used separately or together in the same setting (depending on the nature of the lesions).[13,14] However, there is no large-scale study to evaluate whether combined treatment by cementoplasty and RFA is superior to cementoplasty alone. Whilst RFA can help debulking of the tumour mass,[11,12] cementoplasty may help consolidate the damaged bone sufficiently to decrease the chance of pathological fracture.[7-10] Thus, in theory, the combined use of RFA and cementoplasty could provide better palliative effects than either treatment alone.

In our study, most of the sites with painful metastases that received treatment were at weight-bearing regions; the sites involved included the thoracic and lumbar spine, the pelvis, and the scapula. Regarding the 11 evaluated lesions, 10 enjoyed pain-relief effect within the first week and the median pain score decreased from 5 to 2 within this period (P=0.039). The pain scores were documented until the last follow-up or death of the patients. Looking at the changes of pain score over time, we demonstrated that in most of the patients, pain relief after cementoplasty with or without RFA was evident in the first 2 to 3 weeks after treatment. In addition, the effect could last until the patient died, disease progression, or was lost to follow-up.

The limitations of this study included its retrospective nature, and the small number of patients studied. Nevertheless, the pain scores were recorded prospectively during the course of treatment and follow-up, thus avoiding recall bias. We also limited selection bias by including consecutive patients treated during the study period. The pain-relieving effect was nevertheless shown to be promising, and therefore a large-scale randomised study appears warranted.

Conclusion

In our experience, cementoplasty with or without RFA shows satisfactory, long-lasting pain control effects in oncological patients with bone metastases. The use of cementoplasty in painful bone metastases that are refractory to conventional treatments can be beneficial. However, the addition of RFA in treating vertebral metastases should be considered with caution, as it might give rise to neurological damage.

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