Cementoplasty of extraspinal painful osteolytic lesions

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Authors: L. Huwart, A. IANESSI, P. Y. Marcy, M.-E. AMORETTI, O. Andreani, N. Amoretti; Nice/FR
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Learning objectives

To illustrate the spectrum of percutaneous cementoplasty of painful malignant osteolytic lesions. To precise the indications, contraindications and technique of this intervention. To indicate the results of this technique on a series of 70 patients. To discuss its mechanism of action and its advantages.
Background

Metastatic cancer invades the bone in 60-84% of cases. Multiple myeloma is the hematological malignancy most frequently associated with lytic bone lesions.

The presence of bone metastases is the most common cause of cancer-related pain (Brescia FJ et al. J Pain Symptom Manage 1990;5:221-7).

The osteolytic bone disease frequently gives rise to complications that have an important impact on the patient’s quality of life, and causes difficulty in ambulation or immobility, and pathological fractures (Mercadante S Pain 1997;69:1-18).

When appropriate systemic treatment for the underlying cancer fails, patients are considered for localized treatment.

External-beam radiation therapy is the current standard of care for the alleviation of pain caused by skeletal metastases.

However, radiotherapy leaves approximately up to 40% of patients with inadequate pain control (Roos DE, Fisher RJ Clin Oncol 2003;15:342-4).

This failure of radiotherapy prompted the search for other strategies aimed at bone pain control, such as: cementoplasty; thermoablation (radiofrequency ablation (RFA), cryoablation and microwaves ablation; and magnetic resonance-guided focused ultrasound (Kurup AN, Callstrom MR JVIR 2010;21:S342-50).

Ablative procedures (RFA, cryoablation, microwaves, and MR-guided focused ultrasound) (1) have a delayed effect on pain and (2) they do not consolidate bone structure as early results.

Cementoplasty is probably the best option to treat painful malignant lesions with a risk of pathological fracture and/or decreased mobility (Anselmetti GC Semin Intervent Radiol 2010;27:199-208).
Imaging findings OR Procedure details

Indications: painful lytic and mixed malignant bone lesions, refractory to conventional pain therapy, including: metastases (Anselmetti GC et al. CVIR 2008;31:1165-73) and multiple myeloma (Masala S et al. Support Care Cancer 2011;19:957-62)

Contraindications: noncorrectable coagulation disorders; infection.

Procedures were performed under strict aseptic conditions by a senior interventional radiologist in a CT suite using combined CT (GE Lightview 8-row MDCT scanner; GE Healthcare, Milwaukee, Wis, USA) and lateral fluoroscopy (GE Stenescop C-arm) guidance (Gangi A et al. AJNR 1994;15:83-6). Fig. 1 on page 7

Planning of the approach

CT acquisition (with millimetric multiplanar reconstructions) centered around the bone lesion:

i. An imaginary line of the needle trajectory passing through the tumor was drawn on the CT images for guidance

ii. A skin entry point (with a radiopaque marker put on the skin) was determined, and the angle and distance from entry point to the center of the lesion can be easily calculated.

Cementoplasty procedure: 3 times under local anesthesia

1. Insertion of the Chiba needle: using a 22-gauge needle, a local anesthesia (lidocaïne 1% [Xylocaïne]) was administered in subcutaneous tissues. A 20-gauge 20-cm Chiba needle was then inserted to bone contact under fluoroscopy guidance. A CT control (via the SmartStep mode) confirmed the correct positioning of the tip of the needle. A local anesthesia of the periosteum was then administered at the bone entry point.

2. Insertion of the Trocar t’am: the Chiba needle was then used as a guide for a 13-gauge 10-cm Trocar t’am (Thiebaud, France). The Trocar was inserted under CT and fluoroscopy guidance into the center of the lesion. The correct positioning of the tip of the Trocar was checked by a CT acquisition. Fig. 2 on page 7

3. Cement filling: PMMA bone cement (prepared in a closed-system mixer with 4 g of tungsten powder to increase its radiopacity) was injected in its pasty phase by using 1-cc luer-lock syringes under combined CT and fluoroscopy guidance. Fig. 3 on page 8
A post-procedural CT scan centered around the treated lesion was performed to assess the extent of lesion filling, and to detect cement leakages. Fig. 4 on page 9

Fig. 5 on page 10  Fig. 6 on page 11

Results

In our series of 70 patients, the mean volume of bone cement injected in each lesion was 4.3 ± 1.9 mL (range, 3 - 10 mL).

Procedures were technically successful in all cases, without immediate and delayed complications.

Interventions were performed under local anesthesia, and were well tolerated by patients.

After the procedure, all the patients were asked to remain at rest for 1 hour, then they were allowed to gradually increase mobility.

Normally, hospital discharge can occur within the same procedural day.

Pain relief Fig. 7 on page 12

Considering the poor general conditions of the treated patients with malignancy, pain relief represents a sensible and simple index about mobility and quality of life, which is why the clinical outcome was evaluated by means of Visual Analog Scale (VAS). Patients experienced a rapid decrease of their pain at 24 hours after osteoplasty (mean difference of 4.1 points, p < 0.001). The maximal response was obtained at 1 month (mean VAS # 0.5), and this effect was sustained throughout the follow-up (mean follow-up of 7.7 months).

Hypothesis about the mechanism of action of cementoplasty

Pain relief would probably due to mechanical consolidation, and not to thermal nerve injuries or MMA monomer-related cytotoxicity.

Thermal damage to intraosseous neural tissue and periosteal sensory nerves can be ruled out as the main mechanism in pain relief. Indeed, the same clinical results are achieved using either relatively high-temperature cements (> 60°C) or low temperatures (< 50°C) (Anselmetti GC et al. CVIR 2009:32;491-8).

A half-full lesion Fig. 8 on page 13
Even if the best radiological (not clinical!) result seems to be the full cement replenishment of the lesion, a good clinical outcome can be achieved with partial cement filling only.

No statistically significant difference on pain relief (p = 0.800) was shown in our series whatever the cement filling was > or < 50% of the lesion.

This was confirmed in other studies: Anselmetti GC Semin Intervent Radiol 2010:27:199-208; Cotten A et al. Radiology 1995;197:307-10.

The runoff Fig. 9 on page 14

Asymptomatic leakages of PMMA in the soft tissues were observed in 4/70 patients (6%), and required no treatment.

Our results are in line with other series by Anselmetti et al. (Anselmetti GC et al. CVIR 2008:31;1165-73; Anselmetti GC Semin Intervent Radiol 2010:27:199-208) who reported no major early complications (with 10% of asymptomatic leakages).

Our very low rate of cement leakage is probably due to the precision of the combination of CT and fluoroscopy guidance.


1. CT- and fluoroscopy-guided percutaneous cementoplasty is a safe, rapid and efficient procedure performed under local anesthesia only.
2. Cementoplasty could (1) determine immediate bone consolidation, (2) reduce the risk of a pathological fracture, (3) achieve pain regression, and (4) improve mobility.
3. More than one lesion can be treated during the same session depending upon operator experience and patient compliance.
4. It is possible to treat small painful lesions as well as large lesions (> 10 cm diameter).
5. Osteoplasty could be combined with osteosynthesis to treat impending pathological fractures, and thermoablative procedures to treat bulky lesions. Fig. 10 on page 15 Fig. 11 on page 16 Fig. 12 on page 17
All patients were treated by an interventional radiologist.

Procedures were performed under strict aseptic conditions in a CT suite using combined CT (GE Lightview 8-row MDCT scanner; GE Healthcare, Milwaukee, Wis, USA) and lateral fluoroscopy (GE Stenescop C-arm) guidance.

Fig. 1

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Second time: 13-gauge 10-cm Trocar t’am

- The Chiba needle was then used as a guide for a 13-gauge 10-cm Trocar t’am (Thiebaud, Thonon-les-Bains, France).
- The Trocar was inserted under CT and fluoroscopy guidance into the center of the lesion.
- The correct positioning of the tip of the Trocar was checked by a CT acquisition.

Fig. 2

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PMMA bone cement (prepared in a closed-system mixer with 4 g of tungsten powder to increase its radiopacity) was injected in its pasty phase by using 1-cc luer-lock syringes under combined CT and fluoroscopy guidance.

Fig. 3

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Fig. 4

A post-procedural CT scan centered around the treated lesion was performed:

- To assess the extent of lesion filling
- To detect cement leakages
Fig. 5

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Fig. 6

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Fig. 7

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Fig. 8

Partial cement filling of a bulky lytic lesion of the left iliac wing, with nonetheless an excellent pain alleviation.
Cement filling of an acetabular left lytic lesion, with an asymptomatic cement leakage into the posterior soft tissues

**Fig. 9**

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An acetabular pathological fracture in a patient with a myelomatous bone marrow infiltration

Fig. 10

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A 6.5-mm cannulated self-drilling/tapping screw (Asnis III; Stryker, United States) was placed over the Kirschner guidewire (white arrow). Screw fixation was performed using a hollow screwdriver (black arrow).
Fig. 12

-checked Cement filling around the screw under CT and fluoroscopy guidance

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Conclusion

CT- and fluoroscopy-guided percutaneous cementoplasty performed under local anesthesia is a safe, rapid and effective method to treat painful malignant osteolytic lesions.

Percutaneous combinations with thermoablation and osteosynthesis may enlarge its indications to bulky lesions and those at risk of impending pathological fractures, respectively.

The future of percutaneous cementoplasty could be enlarged to benign lytic lesions such as para-articulat cysts.
References

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6. Anselmetti GC et al. CVIR 2008;31:1165-73
9. Anselmetti GC et al. CVIR 2009:32;491-8