



CONTINUING EDUCATION PROGRAM: FOCUS...

Cementoplasty of bone metastases

F. Deschamps*, T. de Baere

Department of Interventional Radiology, Institut Gustave-Roussy, 39, rue Camille-Desmoulins, 94805 Villejuif, France

KEYWORDS

Bone;
Metastasis;
Vertebroplasty;
Pain

Abstract Cementoplasty is a palliative treatment for bone metastases. It can be performed alone or in addition to other treatments, such as radiotherapy, radiofrequency ablation or cryotherapy. It is usually performed to reduce pain where the metastases involve the spine and pelvis. It can also be used to stabilise bones in the event of lytic metastases with a risk of fracture. Unlike ablation techniques, it should not be considered a cancer treatment. © 2012 Éditions françaises de radiologie. Published by Elsevier Masson SAS. All rights reserved.

Bone metastases occur in about 20% of cancer patients [1], and can produce pain and/or a pathological fracture. The therapeutic arsenal available to oncologists, just like radiotherapy and opioids, nowadays includes cementoplasty, an interventional radiology technique which is most often performed alone, but can be associated with percutaneous thermal ablation techniques, such as radiofrequency ablation or cryotherapy. Vertebral metastases (necessitating vertebroplasty) and acetabular metastases (requiring acetabuloplasty) are the most common indications, but cementoplasty can be performed, depending on the case, in any location where there is bone metastasis. It is now well-established that it has an analgesic effect, which justifies using this technique either as a first course of action or if radiotherapy has failed or is contraindicated, and/or if opioid treatments are poorly tolerated. Even if it seems very likely that it can consolidate bone, this has not been demonstrated and its action is often still inadequate in structures subject to high mechanical stresses such as long bones. A final point is that it is not an antitumour treatment and cannot therefore be offered as a cure for bone metastasis.

* Corresponding author.
E-mail address: frederic.deschamps@igr.fr (F. Deschamps).

Analgesic effect

The analgesic benefit of cementoplasty in bone metastases is well-documented in the medical literature as producing a reduction in pain in 80 to 97% of cases [2–8]. This benefit is obtained irrespective of the bone site treated, whether vertebrae, long bones or flat bones (Figs. 1–3). Alvarez et al. [3] have shown that cementoplasty of a painful metastatic vertebra produced a significant reduction in pain in 81% of the patients treated (the mean of the VAS/10 progressing from 9.1 to 3.2) and the possibility of walking again in 77% of patients initially bedridden because of it. Cementoplasty is also very effective for metastatic pain of the long and flat bones, producing a significant improvement in the pain in 91% of patients (the mean VAS/10 progressing from 8.7 to 1.9) [7]. This analgesic effect is obtained rapidly, generally between the

first and third day following the procedure, permitting early postoperative mobilisation of patients and a short hospital stay (24–48 hours). The physiological mechanisms of this analgesic effect can as yet only be hypothesised: the effect of the cement stabilising microfractures and/or the effect of destruction of nociceptive fibres on contact with the cement, through the exothermic reaction generated during its polymerisation. According to Urrutia et al. [9], the mechanical effect takes precedence over the thermal effect since no histological lesions of intraosseous nerve fibres were seen on contact with cement injected into the vertebrae of rabbits. This seems to be confirmed by Anselmetti et al. [10] who have found identical analgesic efficacy in three groups of patients treated with cements with very different peak polymerisation temperatures (group A = 87 °C, group B = 60 °C and group C = 45 °C).

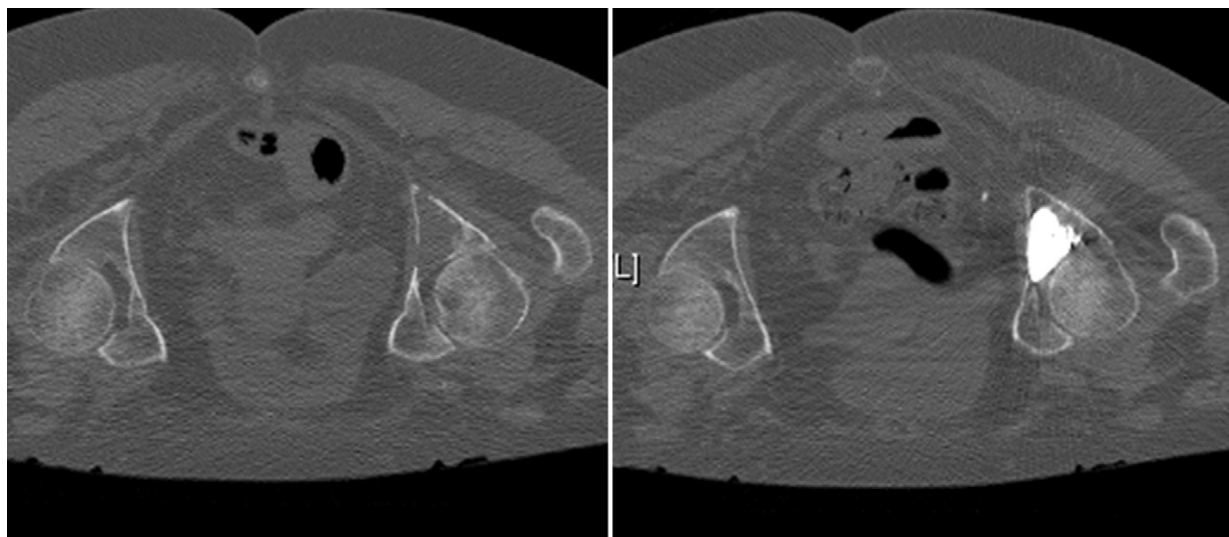


Figure 1. Consolidating cementoplasty of osteolytic metastasis of the acetabulum (acetabuloplasty).

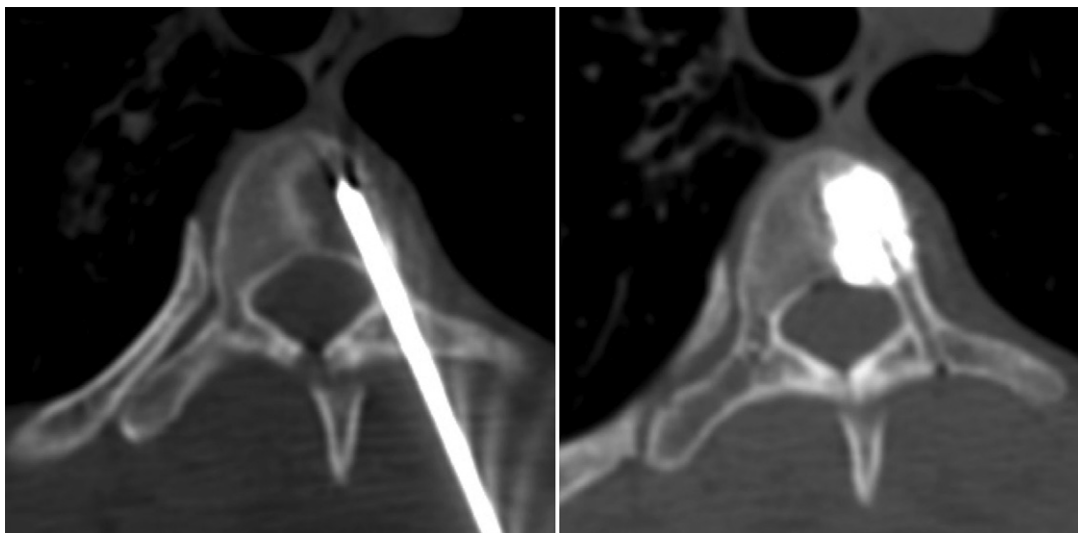


Figure 2. Consolidating cementoplasty of an osteolytic metastasis of the third thoracic vertebra (vertebroplasty).



Figure 3. Analgesic cementoplasty of a costal metastasis of a prostatic adenocarcinoma.

Consolidation effect

The bone stabilisation obtained with cementoplasty has been evaluated experimentally above all through mechanical compression manoeuvres on osteoporotic cadaver vertebrae. Using this simple investigational method, it was possible to confirm partial but significant improvement, due to vertebroplasty, in the solidity of an osteoporotic vertebra, fractured experimentally [11,12], but it was impossible to correlate the consolidation obtained either with the volume of cement injected or with the percentage of the vertebra filled [13]. Filling the vertebra with cement from one vertebral endplate to the other appears to provide better consolidation [14]. Concerning the stability obtained from cementoplasty of bone metastases, there are no data available because the model is extremely complex, including variability in the involvement of cortical bone and in the mechanical resistance of the metastatic tissues, the quality of diffusion of the cement within the metastasis, the quantity of cement that can be injected without problem, and performing thermal ablation before the cementoplasty. Studies are needed to measure this effect.

Finally, since the cement is above all mechanically resistant to compression stresses, it is suitable for consolidation of vertebral and pelvic metastases. The torsion stresses to which the long bones are subject make consolidation indications more debatable in their regard [7,15–17].

Anticancer effect

Unlike thermal ablation techniques (radiofrequency ablation, microwaves, cryotherapy, etc.), cementoplasty is not an anticancer treatment and must not therefore be offered if the aim of treatment is curative in a patient with several

metastases. The cell lysis effect related to hyperthermia at the time of polymerisation is not constant and is limited to the interface with the cement [9,18,19]. Moreover, this hyperthermia is of very short duration *in vivo* (0 to 5 min) and extremely variable depending on the cements used [10].

Indications in practice

The prime indication for cementoplasty in oncology is therefore analgesic treatment of bone metastases in a palliative care patient. Only lytic or mixed metastases can be technically accessed using this technique, as a purely osteoblastic nature prevents correct diffusion of the cement, limiting the volume that can be injected and increasing the risk of leaks. Cortical lysis, particularly lysis of the posterior wall of a vertebra, is a relative contraindication, so that the benefit of the procedure must be weighed against the increased risk of leakage (Fig. 4). Cementoplasty can however be undertaken in these difficult cases if there is good control of injection of the cement and real time quality imaging during the procedure (Fig. 5). On the other hand, the existence of invasion of peripheral soft tissue is not an indication for cementoplasty but rather for thermal ablation techniques. The role of cementoplasty compared with analgesic radiotherapy is still to be defined. It does indeed have a number of advantages – its efficacy, the rapidity of its action, its action of consolidation, the possibility of treating areas already irradiated, – and more and more oncologists are employing percutaneous techniques, and cementoplasty in particular, as a first course of action for managing bone metastases. This enables them firstly to keep radiotherapy in reserve for contraindications to local treatment and secondly to preserve the bone marrow from irradiation; insufficient bone marrow could be a contraindication for performing future chemotherapy.

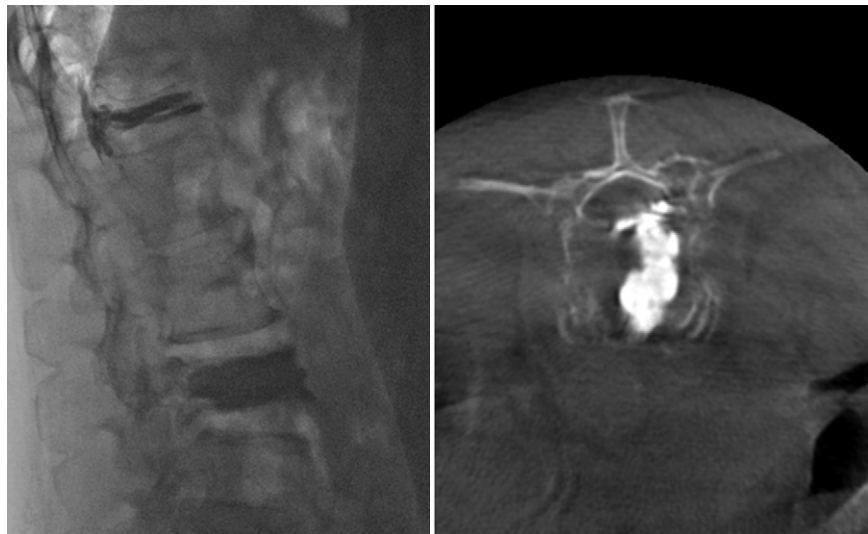


Figure 4. Epidural leakage of cement during cementoplasty of the 12th thoracic vertebra. No postoperative symptom.

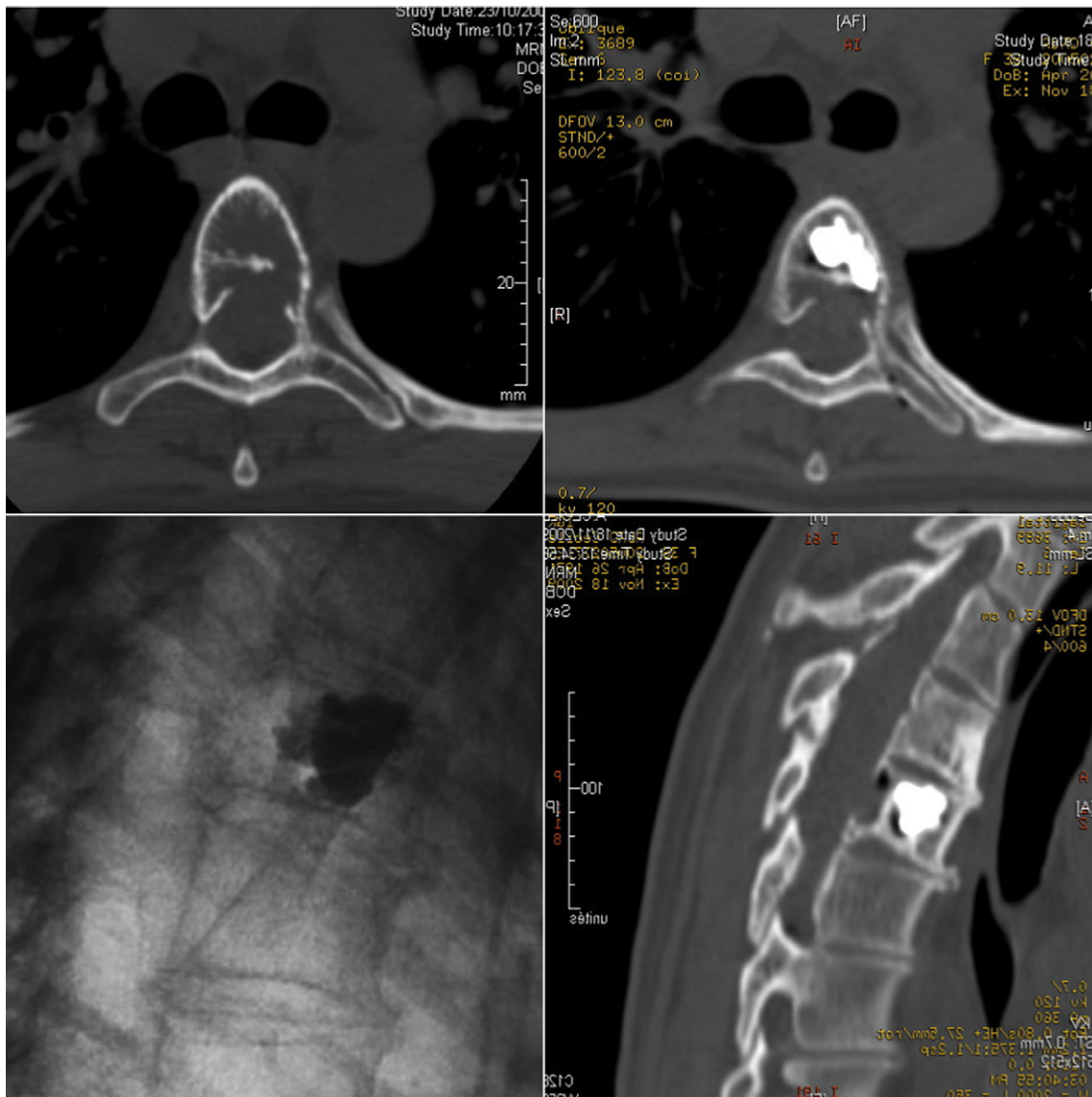


Figure 5. Consolidating cementoplasty of an osteolytic metastasis of the fifth thoracic vertebra with lysis of the posterior wall.

Conclusion

Due to his or her knowledge of cementoplasty indications and mastery of this technique, the interventional radiologist is called upon to play a key role in the multidisciplinary management of bone metastases, and consequently in improving the quality of life of cancer patients.

TAKE-HOME MESSAGES

- Cementoplasty is an analgesic treatment and one of consolidation.
- Cementoplasty alone is not a curative treatment.
- Cementoplasty may be combined with radiofrequency ablation or cryotherapy during the same procedure.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References

- [1] Wasserman J, De la Lande B, Pecking A, Brasseur A. Le patient métastatique et son environnement. Douleur et métastases osseuses. *Prog Urol* 2008;(Suppl. 7):399–409.
- [2] Cotten A, Dewatre F, Cortet B, Assaker R, Leblond D, Duquesnoy B, et al. Percutaneous vertebroplasty for osteolytic metastases and myeloma: effects of the percentage of lesion filling and the leakage of methyl methacrylate at clinical follow-up. *Radiology* 1996;200:525–30.
- [3] Alvarez L, Pérez-Higueras A, Quiñones D, Calvo E, Rossi RE. Vertebroplasty in the treatment of vertebral tumors: postprocedural outcome and quality of life. *Eur Spine J* 2003;12:356–60.
- [4] Shimony JS, Gilula LA, Zeller AJ, Brown DB, Aebli N. Percutaneous vertebroplasty for malignant compression fractures with epidural involvement. *Radiology* 2004;232:846–53.
- [5] Weill A, Chiras J, Simon JM, Rose M, Sola-Martinez T, Enkaoua E. Spinal metastases: indications for and results of percutaneous injection of acrylic surgical cement. *Radiology* 1996;199:241–7.
- [6] Yamada K, Matsumoto Y, Kita M, Yamamoto K, Kobayashi T, Takanaka T. Long-term pain relief effects in four patients undergoing percutaneous vertebroplasty for metastatic vertebral tumor. *J Anesth* 2004;18:292–5.
- [7] Anselmetti. Osteoplasty: percutaneous bone cement injection beyond the spine. *Semin Intervent Radiol* 2010;27(2):199–208.
- [8] Botton E, Edeline J, Rolland Y, Vauleon E, Le Roux Catherine, Mesbah H, et al. Cementoplasty for painful bone metastases: a series of 42 cases. *Med Oncol* 2012;29(2):1378–83.
- [9] Urrutia J, Bono CM, Mery P, Rojas C. Early histologic changes following PMMA injection (vertebroplasty) in rabbit lumbar vertebrae. *Spine* 2008;33(8):877–82.
- [10] Anselmetti GC, Manca A, Kanika K, Murphy K, Eminefendic H, Masala S, et al. Temperature measurement during polymerization of bone cement in percutaneous vertebroplasty: an in vivo study in humans. *Cardiovasc Intervent Radiol* 2009;32:491–8.
- [11] Farooq N, Park JC, Pollintine P, Annesley-Williams DJ, Dolan P. Can vertebroplasty restore normal load-bearing to fractured vertebrae? *Spine* 2005;30(15):1723–30.
- [12] Luo J, Skrypiec DM, Pollintine P, Adam MA, Annesley-Williams DJ, Dolan P. Mechanical efficacy of vertebroplasty: influence of cement type. *BMD, fracture severity and disc degeneration. Bone* 2007;40(4):1110–9.
- [13] Molloy S, Mathis JM, Belkoff SM. The effect of vertebral body percentage fill on mechanical behavior during percutaneous vertebroplasty. *Spine* 2001;26(14):1537–41.
- [14] Steens J, Verdonchot N, Aalsma AM, Hosman AJ. The influence of endplate-to-endplate cement augmentation on vertebral strength and stiffness in vertebroplasty. *Spine* 2007;32(15):E419–22.
- [15] Dayer R, Peter R. Percutaneous cementoplasty complicating the treatment of a pathologic subtrochanteric fracture: a case report. *Injury* 2008;39(7):801–4.
- [16] Chang SW, Murphy KP. Percutaneous CT-guided cementoplasty for stabilization of a femoral neck lesion. *J Vasc Interv Radiol* 2005;16(6):889–90.
- [17] Basile A, Giuliano G, Scuderi V, Motta S, Crisafi R, Coppolino F, et al. Cementoplasty in the management of painful extraspinal bone metastases: our experience. *Radiol Med* 2008;113(7):1018–28.
- [18] Togawa D, Baueur TW, Lieberman IH, Takikawa S. Histologic evaluation of human vertebral bodies after augmentation with PMMA. *Spine* 2003;28(14):1521–7.
- [19] Togawa D, Kovacic JJ, Bauer TW, Reinhardt MK, Brodke DS, Lieberman IH. Radiographic and histologic findings of vertebral augmentation using PMMA in the primate spine: percutaneous vertebroplasty versus kyphoplasty. *Spine* 2006;31(1):E'–10.