ELSEVIER
Canadian Association of Radiologists Journal 63 (2012) S7–S10
CANADIAN ASSOCIATION OF RADIOLOGISTS JOURNAL
www.carjonline.org

Vascular and Interventional Radiology / Radiologie vasculaire et radiologie d'intervention

Cone-Beam Computed Tomography as an Adjunct to Performance of Percutaneous Cementoplasty of the Acetabulum

Peter L. Munk, MD, CM, FRCPC, FSIR[a,*], Manraj K. Heran, MD, FRCPC[a], David M. Liu, MD, FRCPC[a], Hugue A. Ouellette, MD, FRCPC[a], Paul W. Clarkson, MB, ChB, FRCSC[b]

[a]*Department of Radiology, Vancouver General Hospital and the University of British Columbia, Vancouver, British Columbia, Canada*
[b]*Department of Orthopedics, University of British Columbia and the British Columbia Cancer Agency, Vancouver, British Columbia, Canada*

Abstract

Acetabuloplasty is a valuable palliative adjunct for the treatment of patients with painful metastatic disease to the pelvis in selected cases. We report the case of a 45-year-old woman with morbid obesity and with breast carcinoma who was technically difficult to treat under fluoroscopic guidance due to very poor visualization secondary to her body habitus. It was possible to perform radiofrequency ablation and acetabuloplasty with the use of cone-beam computed tomography for guidance.

Résumé

L'acétabuloplastie est un traitement palliatif utilisé chez certains patients souffrant de maladies métastatiques douloureuses du bassin. Nous examinons le cas d'une femme de 45 ans souffrant d'obésité morbide et d'un carcinome mammaire techniquement difficile à traiter par guidage radioscopique en raison de la mauvaise visualisation attribuable à l'habitus. Une ablation par radiofréquence et une acétabuloplastie ont pu être réalisées en utilisant la tomodensitométrie à faisceaux coniques comme technique de guidage.

Key Words: Metastases; Acetabuloplasty; Cementoplasty; Radiofrequency ablation; Cone-beam computed tomography

Cementoplasty of the acetabulum (acetabuloplasty) has been a procedure performed almost as long as vertebroplasty has been [1]. The acetabulum was the first site outside the spinal column in which percutaneous injection of acrylic cement was used, principally for the treatment of painful metastatic disease. The complex 3-dimensional anatomy in this area makes visualization of the osseous landmarks challenging. Recently, several publications have appeared that described the usefulness of cone-beam computed tomography (CT) in facilitating the performance of vertebroplasty [2–4]. We postulated that this technique might be helpful in navigating needle placement and assessing cement distribution. Here, we describe our experience with using cone-beam CT in facilitating acetabuloplasty in a patient with bilateral acetabular metastases.

Case Report

A 45-year-old patient with a history of metastatic breast carcinoma presented with gradually increasing pain in both hips on weight bearing. Bilateral proximal femoral metastases were present and subsequently transfixed with gamma nails. Bilateral acetabular metastases were also present (Figure 1), which progressed to the point where, in the previous 4 weeks, the patient had been unable to bear weight at all and was restricted to a wheelchair. Transfers had become extremely painful. The patient was markedly obese, weighing 114 kg and measured 150 cm (body mass index, 51 kg/m^2).

Disclosures: Peter L. Munk is a recipient of research funds from Galil Therapeutics Inc and a speaker for Boston Scientific and Johnson & Johnson/DuPuy. The other authors have no conflicts of interest to disclose.

* Address for correspondence: Peter L. Munk, MD, CM, FRCPC, FSIR, Department of Radiology, University of British Columbia, Vancouver General Hospital, 899 West 12th Ave, Vancouver, British Columbia V5Z 1M9, Canada.

E-mail address: Peter.munk@vch.ca (P. L. Munk).

0846-5371/$ - see front matter © 2012 Canadian Association of Radiologists. All rights reserved.
doi:10.1016/j.carj.2011.12.003

Figure 1. Coronal reconstruction from computed tomography on bone windows, demonstrating the presence of bilateral destructive lesions in the acetabula as well as additional iliac lesions.

Our goal was to improve her quality of life by diminishing pain and improving mobility. We hoped to be able to achieve this goal by performing radiofrequency ablation for sterilization of as much of the tumour as possible and then by injecting methylmethacrylate cement (combined radiofrequency ablation and cementoplasty). This procedure has been described in a number of previously published reports as an effective and durable technique for palliation of bone metastases [5−7]. Fluoroscopic evaluation of the hips demonstrated very poor resolution of osseous structures in spite of tight coning done to minimize scatter radiation. On lateral and steep oblique fluoroscopy, the femoral heads and acetabulum could barely be discerned.

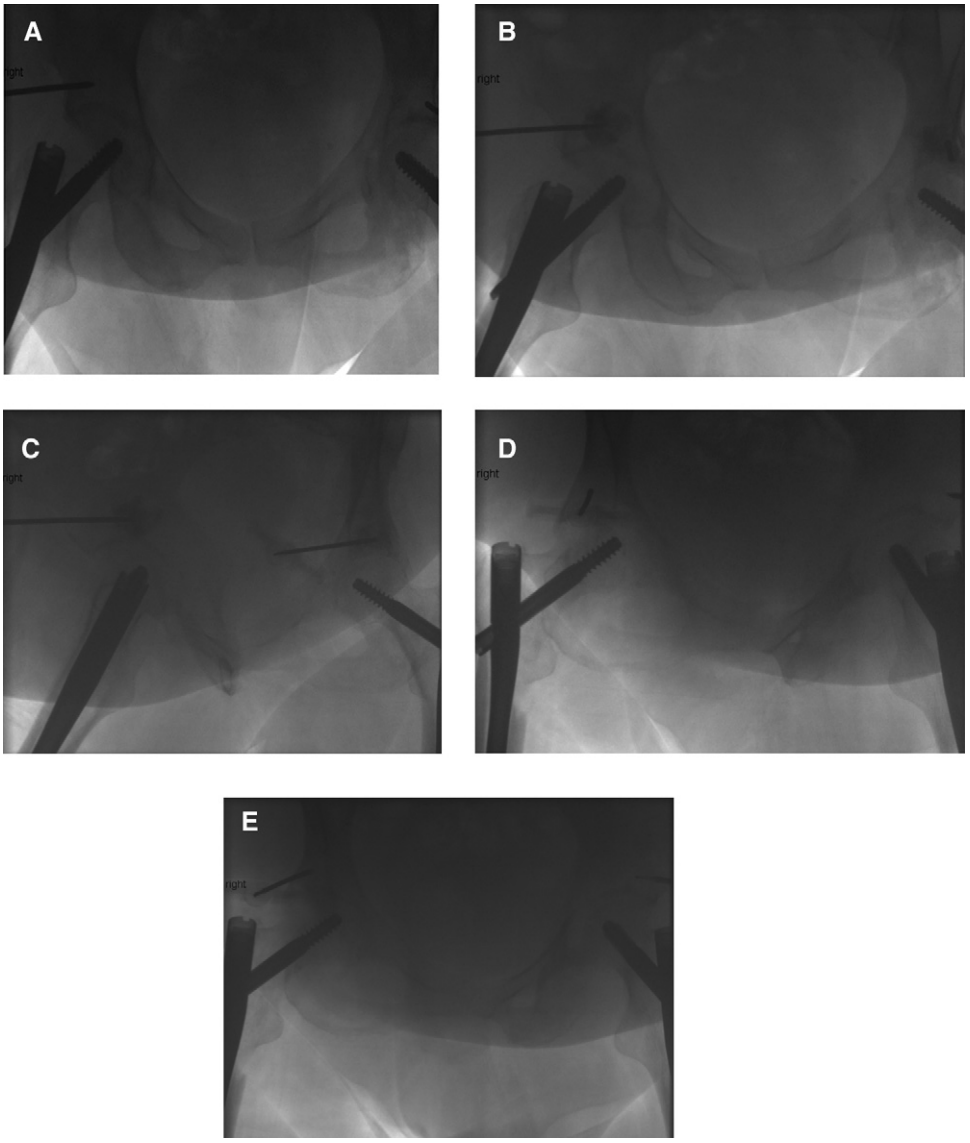

Figure 2. A series of planar images from a cone-beam computed tomography acquisition. (A) Vertebroplasty needles are present in the supra-acetabular regions bilaterally. (B−E) A series of images in different obliquities are provided, acquired periodically during injection of radiopaque cement. The image was degraded by the patient's body habitus.

The challenge that faced us in performing this procedure was that poor visualization made accurate placement of the needle and probes difficult. The procedure also would have required prohibitive fluoroscopy radiation doses not only to the patient but also to the operators due to extensive scatter radiation. It, therefore, was elected to guide the procedure by using cone-beam CT. Initially a 20-cm-long spinal needle was introduced through the skin after infiltration with 0.5% bupivacaine, and the tip of the needle was brought up against the cortex. The procedure was done with the patient under conscious sedation (fentanyl citrate, midazolam; Sandoz Canada, Boucherville, QC) and monitored by an anesthesiologist. The needle position was confirmed by using cone-beam CT (Artis zee; Siemens Canada, Burlington, ON). While leaving the needle in position, an incision was made immediately cranial to the site, and an 11-gauge, 15-cm-long vertebroplasty needle (Osteosite; Cook Inc, Bloomington, IN) was then advanced to the cortical surface and embedded in the cortex. Cone-beam CT was once again performed and confirmed needle placement (Figure 2). The needle was subsequently advanced in to the supra-acetabular region until the needle was well embedded within the bone; the position was once again confirmed by using cone-beam imaging. A pilot channel was then drilled and extended 3 cm beyond the tip of the vertebroplasty needle, and a 20-cm-long straight radiofrequency probe (Covidien, Boulder, CO) with a 2-cm active tip was then deposited within the pilot channel. Before radiofrequency ablation was performed, confirmation of the probe tip was obtained.

After confirmation of probe placement within the bone, 10 minutes of radiofrequency ablation at 50 W was performed. The probe was withdrawn, and the vertebroplasty needle was advanced a further 2 cm; 1-mL aliquots of cement (Osteo-Firm; Cook Inc) were injected with the distribution of cement being verified by cone-beam CT after each aliquot, until a total of 3 mL had been injected. The needles were subsequently removed. A similar procedure was followed for both left and right acetabula (Figures 2 and 3). A total of 7 cone-beam CT runs were performed.

Before radiofrequency ablation and cementoplasty, the patient was unable to bear weight and transferred with great difficulty. On a continuous visual analog scale, she rated her pain as 8.5 of 10. Within 3 days after treatment the patient was able to ambulate with assistance, was able to transfer easily, and rated her pain as 2.0 of 10. At 3 months' follow-up, the visual analog scale score remained unchanged.

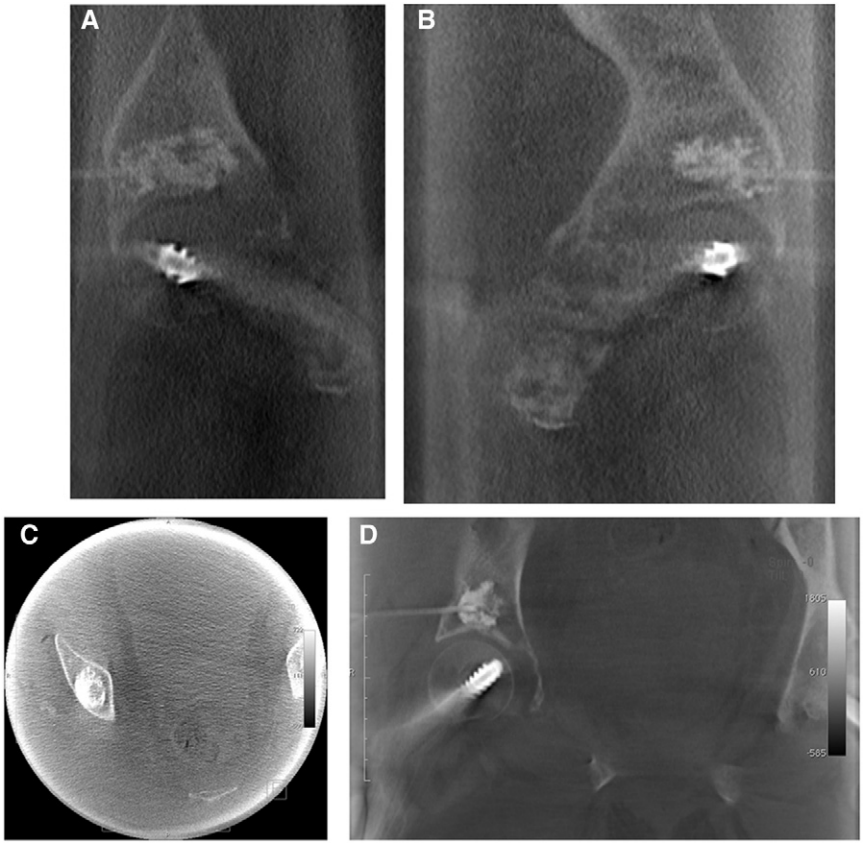

Figure 3. Reconstructions obtained from cone-beam computed tomography data acquisitions. (A) Coronal reconstruction from left hip, showing the needle in position (which was introduced via an anterolateral approach), with cement in the supra-acetabular area. (B) Parasagittal reconstruction of the left hip, showing the lateral position of the needle and cement distribution. (C) Axial reconstruction, showing the cement distribution in the right acetabulum. (D) Paracoronal reconstruction, showing cement in the right acetabulum before needle removal. Some additional cement was subsequently injected.

Discussion

Acetabuloplasty is a well-established procedure, principally used in palliation of pain from metastatic disease [1,8−10]. Pain in this situation is particularly problematic when patients attempt to stand as an axial load is placed on the acetabulum and pain worsens dramatically. Pain typically precludes ambulation, in most cases, considerably decreasing the patient's mobility and quality of life. An added burden is that nursing care for these patients becomes far more challenging.

Although external-beam radiation therapy can be helpful in diminishing pain in some instances, it does not provide structural support and may not improve patient mobility. In addition, radiotherapy often requires up to several weeks to have any effect [11]. Surgery is often challenging and requires complex surgical reconstruction and may result in considerable perioperative morbidity as well as hospital stays of many days. The cost can be considerable because of the protracted treatment course. Acetabuloplasty, however, can often be performed as an overnight procedure and is relatively fast and inexpensive [10]. Some investigators have suggested that combined radiofrequency ablation with cementoplasty may produce better results than cementoplasty alone and may also diminish the risk of embolization of live tumour in patients who are expected to have more prolonged survival (months to years) [5−7].

Performance of acetabuloplasty in a safe and efficient fashion requires excellent visualization of needle placement and the ability to monitor the injection of cement to determine that the cement is adequately and safely distributed within the target lesion. Usually, monitoring can be safely done by using fluoroscopy. In this particular patient, due to body habitus, adequate visualization was extremely difficult, and it was a concern that accurate needle placement would not be possible under conventional fluoroscopic technique. Furthermore, visualization of cement would have been extremely difficult, and nontarget extravasation of cement into vessels or adjacent neurovascular trunks was a serious concern. An additional concern is the marked scatter of radiation to the operator is this setting, which was minimized by use of this technique because the operator was not standing adjacent to the patient while imaging was performed.

In this patient, use of cone-beam CT was undertaken to guide the procedure, based on the documented utility in facilitating vertebroplasty, as shown in a few previous reports. Confirmation of accurate needle positioning as well as detailed distribution of cement after injection was well demonstrated by these investigators. Even during injection of cement, cone-beam CT can be performed quickly enough that additional injection by using the same batch of methylmethacrylate can be done before the degree of polymerization renders the material too viscous. This technique illustrates the potential usefulness of cone-beam CT as an important adjunct to the performance of cementoplasty and/or radiofrequency ablation in the skeleton in problematic situations in which fluoroscopic monitoring may not be sufficient.

References

[1] Cotton A, Demondion X, Boutry N, et al. Therapeutic percutaneous injection in the treatment of malignant acetabular osteolyses. Radiographics 1999;19:647−53.
[2] Kinght JR, Heran M, Munk PL, et al. C-arm cone-beam CT: applications for spinal cement augmentation demonstrated by three cases. J Vasc Interv Radiol 2008;19:1118−22.
[3] Hiwatashi A, Yoshiura T, Nogucki T, et al. Usefulness of cone-beam CT before and after percutaneous vertebroplasty. AJR Am J Roentgenol 2008;191:1401−5.
[4] Tam AL, Mohamed A, Pfister M, et al. C-arm cone beam computed tomography needle path overlay for fluroscopic guided vertebroplasty. Spine (Phil Pa 1976) 2010;35:1095−9.
[5] Munk PL, Rashid F, Heran MK, et al. Combined cementoplasty and radiofrequency ablation in the treatment of painful neoplastic lesions of bone. J Vasc Interv Radiol 2009;20:903−11.
[6] Hoffman RT, Jakobs T, Trumm C, et al. Radiofrequency ablation in combination with osteoplasty in the treatment of painful metastatic bone diseases. J Vasc Interv Radiol 2008;19:419−25.
[7] Toyota N, Naito A, Kakizawa H, et al. Radiofrequency ablation therapy combined with cementoplasty for painful bone metastases: initial experience. Cadiovasc Interv Radiol 2005;28:578−83.
[8] Basile A, Giuliano G, Scuderi V. Cementoplasty in the management of painful extraspinal bone metastases: our experience. Radiol Med 2008; 113:1018−28.
[9] Sapkota BH, Hirsch AE, Yoo AJ, et al. Treatment of metastatic carcinoma to the hip with CT-guided percutaneous acetabuloplasty: report of four cases. J Vasc Interv Radiol 2009;20:548−52.
[10] Maccauro G, Liuzza F, Scaramuzzo L, et al. Percutaneous acetabuloplasty for metastatic acetabular lesions. BMC Musculoskeletal Disord 2008;9:66.
[11] Janjan N, Lutz ST, Bedwinek JM, et al. American College of Radiology Therapeutic guidelines for the treatment of bone metastasis: a report from the American College of Radiology Appropriateness Criteria Expert Panel on Radiation Oncology. J Palliat Med 2009;12: 417−26.