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Review

Expanding role of percutaneous ablative and consolidative treatments for musculoskeletal tumours

A.N. Kurup*, M.R. Callstrom

Department of Radiology, Mayo Clinic College of Medicine, Rochester, MN 55905, USA

ARTICLE INFORMATION

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Interventional approaches to musculoskeletal tumours have significantly changed over the last several years, and new treatments continue to be developed. All ablative modalities are currently applied to the treatment of bone tumours, including radiofrequency, cryo-, microwave, and laser ablation devices. Indications for ablation of bone and soft-tissue tumours have expanded beyond palliation of painful bone metastases and eradication of osteoid osteomas to the local control of oligometastatic disease from a number of primary tumours and ablation of desmoid tumours. In addition, tools for consolidation of bone tumours at risk of pathological fracture have also expanded. With these developments, ablation has become the primary treatment for osteoid osteomas and, at some institutions, desmoid tumours. It may be the primary or secondary treatment for palliation of painful bone tumours, frequently used in patients with pain refractory to or recurrent after radiation therapy. It is used as a treatment for limited metastatic disease or for metastases that grow disproportionately in patients with multifocal metastases, either in combination with systemic therapy or to reserve systemic therapy and its toxicity for more widespread disease progression. Moreover, percutaneous methods to consolidate bone at risk of fracture have become more commonplace, aided by techniques using materials beyond typical bone cement.

Introduction

Bone is the most common metastatic site and the one that produces the greatest morbidity for cancer patients.[1] As the population ages in most developed countries and the all-site cancer mortality rate has declined over the past decade, the number of individuals living longer with cancer has increased.[2] With increased longevity and rising use of advanced cross-sectional surveillance imaging, metastases to bone will likely be detected with greater frequency.[3,4] These trends lead to a greater need for targeted therapy for bone metastases, as cancer survivors focus on quality of life and limiting morbidity associated with their disease.

In this review, we will discuss the current status of percutaneous therapy for malignant and aggressive musculoskeletal (MSK) tumours as well as newly developing practices in this field. We focus on a few emerging themes. These include technical aspects of bone tumour treatment, namely improved ability to mitigate the risks associated with ablation of MSK tumours and increased use of consolidation for bone tumours within and outside the

* Guarantor and correspondent: A. N. Kurup, Department of Radiology, Mayo Clinic College of Medicine, Rochester, MN 55905, USA. Tel.: +1 507 284 3908; fax: +1 507 284 8996.
E-mail address: kurup.anil@mayo.edu (A.N. Kurup).

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spine. In addition, we discuss the most important and emerging indications for bone tumour ablation, including palliative therapy for painful skeletal metastases, treatment of oligometastases for local tumour control, and ablation of desmoid tumours.

Technical developments

Mitigation of risk associated with bone tumour ablation

Ablation of MSK tumours has increased, in part, due to better understanding of the risks associated with the technique. Specifically, collateral damage to the neurovascular structures associated with, and often in close proximity to, MSK tumours has been the main limitation to the application of the technique.[5–7] These risks may be reduced with careful use of pre-procedural imaging and intra-procedural monitoring techniques. A dedicated neuroanatomical guide related to tumour ablation has been published to assist interventional radiologists review the relevant risks.[8] This assessment can influence the procedural approach and inform pre-procedural clinical decision-making, including the decision whether to treat a particular MSK tumour and the discussion of risks and benefits with patients and referring clinicians. Likewise, reviews focused on ablation in the spine avoiding complications in bone, and soft-tissue tumour ablation generally, have recently appeared in the literature.[9–11]

Ablation also may pose additional risk to periarticular structures as well as contribute to collapse or fracture of diseased bone.[12,13] The risks of ablating in weight-bearing bone near a major joint has specifically been described with particular focus on osteochondral injury or frank collapse of the femoral head as a result of aggressive ablation of an acetabular tumour near the hip joint.[14,15]

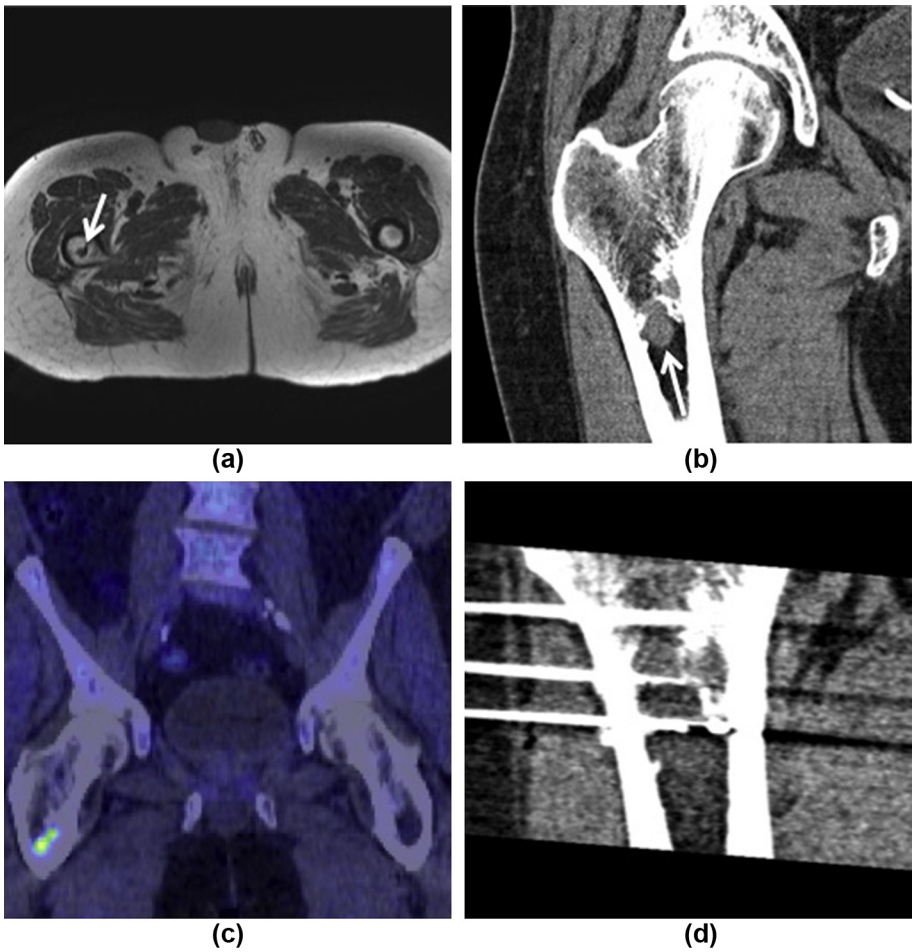

Figure 1 Multimodality imaging used to direct focal therapy of a bone metastasis. (a) A small T1-hypointense focus (arrow) was identified in the proximal right femur of a 56-year-old man with previously treated metastatic prostate carcinoma and a rising prostate-specific antigen (PSA) level. (b) A coronal reformatted image from a staging CT confirmed the soft-tissue metastasis within the centre of the medullary cavity (arrow). (c) Fused ^{11}C-choline PET/CT image showed that the metastasis was actually bilobed with a subtle component located superomedial to the central component detected on the other imaging tests. (d) Cryoablation was performed with multiple probes to cover the entire tumour and prevent local recurrence with the patient's PSA level returning to undetectable levels. This case illustrates how multiple imaging modalities may be required to identify the extent of viable tumour, particularly in the setting of previously treated metastases. Adjacent vulnerable neural structures to be avoided may be best depicted on MRI, whereas CT is typically used for guidance and monitoring during tumour ablation for practical reasons.

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