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Musculoskeletal Sarcoma: Update on Imaging of the Post-treatment Patient

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Abstract

Post-treatment imaging of musculoskeletal sarcoma remains challenging, but newer imaging techniques are improving our ability to recognize both local and distant recurrence and accurately distinguish local recurrence from post-treatment change. We review recent advances in dynamic contrast-enhanced magnetic resonance imaging, diffusion-weighted magnetic resonance imaging with apparent diffusion coefficient mapping and positron emission tomography/computed tomography in the post-treatment follow-up of musculoskeletal sarcoma. We also describe our multidisciplinary sarcoma team approach to patient care and the essential role of the radiologist in the clinical follow-up scheme.

Résumé

La tenue d'examens d'imagerie suivant le traitement d'un sarcome musculo-squelettique soulève encore des difficultés. Toutefois, grâce aux techniques d'imagerie récentes, il est plus facile de reconnaître une récurrence locale et à distance, et de distinguer avec exactitude une récurrence locale des changements résultant du traitement. Nous analysons les percées récentes touchant l'imagerie par résonance magnétique dynamique avec injection de produit de contraste, l'imagerie par résonance magnétique de diffusion avec calcul du coefficient de diffusion apparent ainsi que la tomographie par émission de positrons couplée à la tomodensitométrie dans le cadre du suivi effectué après le traitement d'un sarcome musculo-squelettique. Nous décrivons également la démarche en matiére de soins aux patients adoptée par notre équipe multidisciplinaire de prise en charge des sarcomes et le rôle essentiel que joue le radiologiste dans le processus de suivi clinique.

Key Words: Sarcoma; Post-treatment imaging; Musculoskeletal; Soft tissue; Bone

The American Cancer Society estimates that soft tissue and bone sarcoma combined will account for 0.9% of new malignant cancer cases in the United States in 2014, with soft tissue sarcoma approximately 4 times more common than bone sarcoma (12,020 new cases vs 3,020 new cases, respectively) [1]. Over the last 12 years a huge amount of data on the molecular and gene biology of these tumours has been uncovered, yielding an exponential increase in our knowledge and understanding of sarcoma behavior and refinement of sarcoma classification, reflected in the newest 2013 World Health Organization classification of tumours of soft tissue and bone [2−4]. Unfortunately, overall patient survival has not yet benefited from this recent gain in knowledge. After a sharp improvement in survival during the 1970s and 1980s following the advent of multidrug chemotherapy, radiotherapy and improved surgical techniques, overall survival rates for sarcoma patients have plateaued over the last 30-40 years [5−8]. According to the most current SEER (Surveillance, Epidemiology, and End Results) Program cancer statistics review, the age-adjusted 5-year survival rate is 65.3% for soft tissue sarcoma and 66.6% for bone sarcoma [9]. This data emphasizes the seriousness of musculoskeletal sarcoma and underscores the importance of systemic and local surveillance in conjunction with coordinated post treatment care to ensure optimal outcome.

Because recurrences usually develop within the first 2 years following therapy [10], with only 5% developing after 5 years [11−13], follow-up imaging is most aggressive

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during this early post-treatment period. In this review we present a systematic approach to the imaging of patients following treatment for a musculoskeletal sarcoma, highlighting fundamental concepts, the importance of a systematic coordinated approach, and emphasizing the recent advances in imaging.

Multidisciplinary Sarcoma Teams

Many tertiary care medical centers in the United States have developed multidisciplinary teams of specialized allied health practitioners and physicians, including medical oncologists, radiation oncologists, orthopedic oncology surgeons, musculoskeletal pathologists, and musculoskeletal radiologists, in the hope of advancing long-term outcomes through coordinated collaboration. The primary therapeutic goal is extending disease-free and overall survival while still maintaining good functional outcome. Some of these teams, including our own, have joined forces across multiple institutions to broaden ideas for optimal management and further enhance individual patient care. Our 12-institution team meets weekly to review a list of patients recently diagnosed or being followed for sarcoma. The primary medical or surgical oncologist for each case presents the patient and then invites input from other medical specialists on areas ranging from diagnosis, imaging evaluation, medical and surgical management options and appropriate follow-up.

The Role of the Radiologist

Whether or not one is a member of a multidisciplinary sarcoma team, the radiologist must have an integral role in the evaluation of patients with suspected musculoskeletal tumours. No one is better suited to determine and assess the appropriate imaging studies required for diagnosis and staging. While the essential value of radiographs in the workup of bone lesions is well established, their importance in the assessment of soft tissue masses is too often underestimated. Although magnetic resonance imaging (MRI) is the favored modality to fully characterize soft tissue masses, radiographs should always be the first imaging study obtained in a patient with a suspected soft tissue mass [14]. Among many other reasons, radiographs are the best method for identifying a skeletal deformity which may masquerade as a mass or detecting mineralization associated with a mass, sometimes suggesting a specific diagnosis (Figures 1 and 2). Similarly, radiographs, even when negative, are incredibly helpful for correlation with MRI in the evaluation of any lesion. In our experience interpretation of a soft tissue or bone lesion on MRI without comparison radiographs is fraught with danger.

Excisional biopsy or unplanned marginal excision as the initial surgery is an unfortunate reality for many patients ultimately diagnosed with sarcoma, with a significant negative impact on local control and survival. In assessing the effect of unplanned excision in patients with soft tissue sarcoma, Qureshi et al. [15] noted that unplanned excision

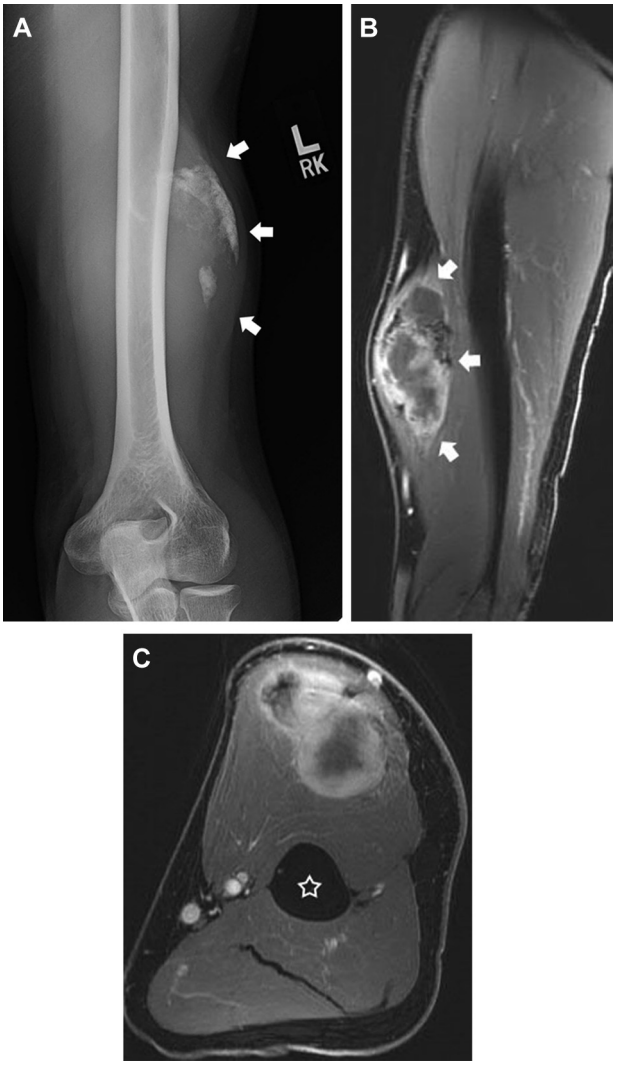

Figure 1. Diagnostic value of radiographs in a 58-year-old man with a synovial sarcoma of the left upper arm. Anteroposterior radiograph (A) of the left upper arm obtained at presentation demonstrates a protuberant soft tissue mass (arrows). There is coarse and sheet-like mineralization associated with the soft tissue mass and minimal scalloping of the underlying humeral cortex. Differential considerations proposed were chronic calcifying hematoma and soft tissue sarcoma. Sagittal (B) and axial (C) postgadolinium T1-weighted fat saturated magnetic resonance (MR) images obtained 1 week later demonstrated a heterogeneously enhancing mass (arrows) with eccentric areas of nonenhancement and wispy perilesional reticular enhancement. The underlying bone (star) was not involved (C). Given the MR imaging features of a large, deep, soft tissue mass with necrosis, a diagnosis of a sarcoma is highly likely. Based on the additional radiographic findings of calcification and osseous remodeling, a diagnosis of synovial sarcoma was proposed as the primary differential consideration and orthopedic oncology referral was recommended in the report.

may occur as the initial surgical procedure in as many as 40% of patients, who then have a twofold increased incidence of local recurrence. As previously emphasized over many different publications, when imaging is not sufficient to suggest a specific diagnosis, a conservative approach is warranted [16]. A clear statement in the radiologist report of the need for orthopedic oncology referral prior to biopsy can help avert such a misadventure.