ORIGINAL ARTICLE

ACR Appropriateness Criteria Follow-Up of Malignant or Aggressive Musculoskeletal Tumors

Catherine C. Roberts, MD[a], Mark J. Kransdorf, MD[a], Francesca D. Beaman, MD[b], Ronald S. Adler, MD, PhD[c], Behrang Amini, MD, PhD[d], Marc Appel, MD[e], Stephanie A. Bernard, MD[f], Ian Blair Fries, MD[g], Isabelle M. Germano, MD[h], Bennett S. Greenspan, MD, MS[i], Langston T. Holly, MD[j], Charlotte D. Kubicky, MD, PhD[k], Simon Shek-Man Lo, MB, ChB[l], Timothy J. Mosher, MD[f], Andrew E. Sloan, MD[m], Michael J. Tuite, MD[n], Eric A. Walker, MD[f], Robert J. Ward, MD[o], Daniel E. Wessell, MD[p], Barbara N. Weissman, MD[q]

Abstract

Appropriate imaging modalities for the follow-up of malignant or aggressive musculoskeletal tumors include radiography, MRI, CT, ^{18}F-2-fluoro-2-deoxy-D-glucose PET/CT, ^{99m}Tc bone scan, and ultrasound. Clinical scenarios reviewed include evaluation for metastatic disease to the lung in low- and high-risk patients, for osseous metastatic disease in asymptomatic and symptomatic patients, for local recurrence of osseous tumors with and without significant hardware present, and for local recurrence of soft tissue tumors. The timing for follow-up of pulmonary metastasis surveillance is also reviewed.

The ACR Appropriateness Criteria are evidence-based guidelines for specific clinical conditions that are reviewed every three years by a multidisciplinary expert panel. The guideline development and review include an extensive analysis of current medical literature from peer-reviewed journals and the application of a well-established consensus methodology (modified Delphi) to rate the appropriateness of imaging and treatment procedures by the panel. In those instances in which evidence is lacking or not definitive, expert opinion may be used to recommend imaging or treatment.

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[a]Mayo Clinic, Phoenix, Arizona.
[b]University of Kentucky, Lexington, Kentucky.
[c]New York University Center for Musculoskeletal Care, New York, New York.
[d]University of Texas MD Anderson Cancer Center, Houston, Texas.
[e]Warwick Valley Orthopedic Surgery, Warwick, New York, American Academy of Orthopaedic Surgeons.
[f]Penn State University Milton S. Hershey Medical Center, Hershey, Pennsylvania.
[g]Bone, Spine and Hand Surgery, Chartered, Brick, New Jersey, American Academy of Orthopaedic Surgeons.
[h]Mount Sinai School of Medicine, New York, New York.
[i]Medical College of Georgia, Augusta, Georgia.
[j]University of California Los Angeles Medical Center, Los Angeles, California.
[k]Oregon Health & Science University, Portland, Oregon.
[l]University Hospitals Seidman Cancer Center, Case Western Reserve University, Cleveland, Ohio.
[m]University Hospital Case Medical Center, Cleveland, Ohio.
[n]University of Wisconsin Hospital, Madison, Wisconsin.
[o]Tufts Medical Center, Boston, Massachusetts.
[p]Mayo Clinic, Jacksonville, Florida.
[q]Brigham & Women's Hospital, Boston, Massachusetts.

Corresponding author: Catherine C. Roberts, MD, Attn: Radiology Dept, Mayo Clinic, Phoenix, 5777 E. Mayo Blvd, Phoenix, AZ 85054; e-mail: roberts.catherine@mayo.edu.

Reprint Request to: publications@acr.org.

The ACR seeks and encourages collaboration with other organizations on the development of the ACR Appropriateness Criteria through society representation on expert panels. Participation by representatives from collaborating societies on the expert panel does not necessarily imply individual or society endorsement of the final document.

Conflict of Interest: Dr Shek-Man Lo has received research support to his department from Elekta AB through the International Oligometastasis Research Consortium and is the site principal investigator, and has received travel expenses and an honorarium from Accuray to give two lectures at an Accuray users' meeting (one-time agreement). The other authors have no conflicts of interest related to the material discussed in this article.

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SUMMARY OF LITERATURE REVIEW

Introduction/Background

This topic specifically excludes (1) metastatic disease from nonmusculoskeletal primary tumors, (2) head and neck tumors, (3) spine tumors, (4) chest wall tumors, (5) multiple myeloma, and (6) benign or nonaggressive bone or soft tissue tumors. Evaluation for chemotherapy or radiation therapy effectiveness, preoperatively after induction therapy, is also not included.

It should be noted that there are no controlled studies in the literature that directly address the issue of tumor follow-up, and the recommendations here are based on consensus of the ACR Appropriateness Criteria Expert Panel on Musculoskeletal Imaging, are subject to change if new data comes out, and should be used only as a guideline, with generous opportunity for modification in individual circumstances.

This topic addresses two issues regarding follow-up for tumor therapy: the timing of the follow-up examination and the type of imaging best used.

Ideally, the timing of follow-up for tumor recurrence or metastatic disease would be individualized for each tumor type and each patient. To design a follow-up protocol, one would generally wish to know the following: (1) the effectiveness of the imaging test to be used for detecting the presence of tumor, (2) the importance of early detection of relapse in relation to salvage effectiveness (utility/risk analysis), and (3) when the relapse is most likely to occur (hazard rate). Individual hazard rate is related to tumor type, grade, size, and central location; patient age and gender; tumor stage; type of treatment; and surgical margins. Overall, the goal of an imaging protocol is to concentrate testing when the relapse is most likely to occur. This presumes that testing frequency should gradually decrease over time. There are outstanding reviews of model development for such protocols in lymphoma and other tumors [1-3]. However, such models do not exist for individual extremity tumors.

Because models relating to the hazard rate and utility/risk analysis do not exist for individual extremity bone and soft tissue tumor types, we consider the sarcomas as a group and try to evaluate general local recurrence rate and timing as well as metastatic rate and timing. The most helpful general information can be found in previously published practice guidelines [4-6]. The information most commonly agreed to among these authors is that approximately 80% of high-risk patients with local or systemic recurrence will experience recurrence within two to three years of their primary treatment. This suggests that the most aggressive follow-up should occur in the first two years, with tapering of imaging after that time. The risk for relapse never drops to zero, so lifetime surveillance is warranted [4-7].

Overview

The incidence of metastatic disease from sarcomas varies considerably in large studies and is dependent on the length of follow-up. Metastatic disease only to the lung involves about a third of patients [8-10]. In one study of extremity soft tissue sarcomas, there was no significant difference in distant metastases or death due to disease in patients who either did or did not have local recurrence [11]. In at least some of these studies, it seems as though the incidence of local recurrence is less frequent than the occurrence of metastatic disease in high-grade sarcomas, although the adequacy of local therapy is one of the crucial factors determining durable local tumor control [12,13]. Therefore, local failure may not be the initiating factor in systemic metastases. This finding suggests that follow-up studies should include systemic surveillance as well as imaging for local recurrence. Although the prognosis for patients with metastatic disease is poor, surveillance is warranted because early detection and treatment of locally recurrent and metastatic disease can prolong survival [8,14-16].

The specific type of imaging for follow-up to check for local recurrence will depend on the site of the original tumor (osseous versus soft tissue) as well as the type of therapy used (including curettage with bone graft versus resection with allograft versus soft tissue resection, all taking into account the presence or absence of hardware). The following comments relate to each of these situations.

Discussion of Imaging Modalities by Variant

Variants 1, 2, 3, and 4: Metastatic Disease to Lung in Lower Risk and Higher Risk Patients. Of the systemic metastases, lung metastasis is by far the most frequent. It is generally accepted that CT is more accurate for diagnosing lung parenchymal metastatic disease than is chest radiography. However, that increased accuracy may not translate to a positive cost/benefit ratio. One study retrospectively assigned patients to a low- or high-risk theoretical protocol. The incremental cost-effectiveness ratio was $731,000 for routine chest CT imaging to detect each additional case of metastatic disease [17]. On the basis of this finding, those authors