HIGHLIGHTS

1. There are a variety of MR techniques available to assess bone tumors, including anatomic (T1-weighted, fluid-sensitive, static post-contrast T1-weighted), functional (dynamic contrast-enhanced imaging, diffusion weighted imaging) and metabolic (MR spectroscopy) sequences.

2. For defining intramedullary tumor extent, anatomic imaging with a noncontrast spin echo T1-weighted sequence is most important.

3. For characterizing a marrow signal abnormality for marrow-replacement, chemical shift imaging with in-phase and opposed-phase gradient echo sequences are very useful.

4. For characterizing a tumor for malignancy, functional and metabolic sequences may provide additional value.

4. For assessing treatment response, anatomic sequences are often inadequate.

5. For detecting recurrence following surgical treatment, dynamic contrast-enhanced imaging and quantitative diffusion weighted imaging may be helpful.

Target Audience: Radiologists and other physicians who diagnose or treat musculoskeletal tumors and researchers with an interest in musculoskeletal tumor imaging.

Outcome/Objectives: Attendees of this lecture will review the most important sequences for fulfilling the roles that MR imaging plays in the assessment of musculoskeletal tumors. This lecture also provides insights into the use of MR imaging sequences beyond anatomic imaging, that can be used for tumor evaluation.

Purpose: To review the various MR imaging sequences available for the evaluation of musculoskeletal tumors, and the function they serve in the different roles that MR imaging plays in assessing tumors, from detection, characterization, determining extent of disease and assessment following treatment.

Methods: There are anatomic sequences (T1-weighted, fluid-sensitive, static post-contrast T1-weighted), functional sequences (dynamic contrast-enhanced imaging, diffusion weighted imaging) and metabolic sequences (MR spectroscopy) available for clinical use (1); the utility of these has been investigated for various roles that MR imaging plays in evaluating musculoskeletal tumors.
Results:

A) Detection of tumor: Detection is usually accomplished clinically by radiography after the patient presents with pain. However, in the axial skeleton, lesions may be radiographically occult and therefore, first detected by MR imaging. Whole body imaging with STIR as well as diffusion weighted imaging has emerged as a tool for diagnosing widespread metastatic bone disease (2).

B) Determination of extent of disease: A spin echo T1 weighted sequence is most important (3). Occasionally, in regions marked by abundant red marrow (as in the pelvis or in pediatric patients), chemical shift imaging with in-phase and opposed-phased gradient echo sequences are helpful (4). Intravenous contrast is not necessary for identifying tumor extent.

C) Characterization: Although there are a few histologies with characteristic features, MR imaging by itself lacks specificity for characterizing musculoskeletal tumors. A few MR features may add specificity:

- Intravenous contrast distinguishes cysts and tumors.
- Chemical shift imaging with in-phase and opposed-phase imaging helps differentiate marrow replacement from non-marrow-replacing lesions.
- Quantitative DWI provides ADC values that may help distinguish normal marrow from abnormal marrow, cysts from tumors and benign from malignant disease (5).
- Proton MR spectroscopy is useful for its high negative predictive value (ruling out malignancy) (6).

D) Assessment of treatment response: Functional sequences with DCE-MR and DWI are helpful for identifying remaining viable tumor. (7)

E) Detection of recurrence following surgery: Intravenous contrast is always used, as recurrent tumor enhances following contrast administration.

Discussion: No single MR imaging pulse sequence can be used to fulfill all the various roles that MR imaging plays in the assessment of musculoskeletal tumors. Typically, a combination of features is used on multiple sequences to answer the clinical questions of whether a tumor is present, what its extent is, how to characterize it, determine whether there is response to treatment and whether the tumor has recurred.

Conclusion: There are various MR imaging techniques available clinically, which can be of value to assessing musculoskeletal tumors in different settings.

References


