Soft Tissue Imaging: Neoplasms and Their Mimickers

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Learning Objectives

- Understand strengths and limitations of MRI in characterizing soft tissue tumors
- Plan optimal imaging protocols for soft tissue tumors
- Identify characteristic MRI features of several soft tissue tumors that radiologists should not miss

Characterization of soft tissue masses as benign or malignant often will be incorrect if one relies solely on traditional imaging features such as sharpness of the margin, presence of local invasion, large size, and internal homogeneity of the lesion. However, if a mass demonstrates certain characteristic imaging features, a specific diagnosis frequently can be made (e.g., cyst, ganglion, lipoma, fat necrosis, giant cell tumor of tendon sheath, hemangioma, desmoid/fibromatosis, benign nerve sheath tumor, subacute hematoma, elastofibroma, Morton neuroma, de Quervain tenosynovitis). Lacking such characteristic features, the possibility of malignancy cannot be dismissed.

A specific diagnosis can often be suggested based on one or more of the following features:

- Chemical composition of the lesion (e.g., water, hemosiderin, methemoglobin)
- Tissue composition of the lesion (e.g., fat, collagen, myxoid matrix)
- Morphology of the lesion (e.g., serpiginous, target sign, infiltrative “tails”)
- Location of the lesion (e.g., deep to scapular tip, in an intermetatarsal space, along fascia, associated with a peripheral nerve, in a large joint space, around abductor pollicis longus and extensor pollicis brevis tendons)
- Clinical circumstances of the patient (e.g., post-amputation, immunosuppressed state, prolonged immobilization).

Examples of benign lesions that may be misinterpreted as sarcoma include muscle strain, myositis ossificans, rhabdomyolysis, ischemic fasciitis, parosteal lipoma, fat necrosis, and Morel-Lavallée lesion (a long-standing chronic hematoma along a subcutaneous fascial plane).

Malignant lesions that are prone to being misinterpreted as benign — clearly a much more serious error — include those sarcomas that are predominantly cystic, hemorrhagic, or myxoid. Extensive cystic change or hemorrhage within a sarcoma may overshadow the solid tumor elements present. Solid elements must be carefully sought and viewed as suspicious for tumor until proven otherwise; gadolinium-enhanced imaging is essential in this circumstance.

Myxoid liposarcoma also may look deceptively cyst-like on standard T1-weighted and T2-weighted MR images. The presence of subtle fatty streaks within the lesion may be a clue to the correct diagnosis of a myxoid liposarcoma. Even more importantly, enhancement within the lesion — ranging from fine and lacy to intense and coalescent — is typically evident after contrast material administration, and is an invaluable finding to prevent misdiagnosis of myxoid liposarcoma as a ganglion or other cyst.

Another specific type of myxoid sarcoma, myxofibrosarcoma, is increasingly recognized as one of the most common sarcomas of the extremities in the elderly. This tumor has an unusual, infiltrative growth pattern along fascial and vascular planes, resulting in wispy streaks or “tails” of edema-like signal that frequently extend for considerable distances from the primary tumor. These tails represent tumor, and need to be brought to the attention of the treating surgeon. Due to this atypical growth pattern, even low-grade myxofibrosarcoma tends to recur relentlessly, with subsequent recurrences being of higher grade. Myxofibrosarcoma metastasizes to sites atypical for most other soft tissue sarcomas, including pleura, peritoneum, adrenal glands, and bone.

Although no one particular MRI protocol is optimal, certain basic requirements pertain. High-resolution, small-field-of-view axial T1-weighted spin-echo and fat-suppressed T2-weighted fast (turbo) spin-echo images should be obtained through the entire tumor. Fat suppression is essential on the T2-weighted images to allow evaluation of the bone marrow for tumor involvement. The appropriate plane for longitudinal small-field-of-view T1-weighted and fat-suppressed T2-weighted images is selected by drawing a line through the center of the soft tissue mass and the center of the nearby bone on a representative axial image. Pre- and post-gadolinium fat-suppressed T1-weighted spin-echo images also are frequently helpful, both for distinguishing cysts from solid masses and for demonstrating necrotic portions of tumor to be avoided at biopsy. STIR images are not recommended for characterization of soft tissue masses, as many lesions show similar-appearing, very high signal on STIR images.

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