MR Imaging of Soft Tissue Masses in Children

Rebecca Stein-Wexler, MD

KEYWORDS

• MR imaging • Soft tissue mass • Soft tissue tumor
• Pediatric

In approaching a child who has a soft tissue mass, clinical history and physical examination (including lesion location) play a critical role in diagnosis, and patient age also can narrow the differential. The typical presenting complaint is a palpable mass; larger masses are more likely to present with pain. Reactive processes and benign neoplasms are the most common lesions, whereas malignant tumors are rare. Radiography and CT offer limited assistance, being most useful for characterization of calcification or ossification, as in myositis ossificans. Ultrasonography can be helpful in the evaluation of small, superficial masses and in determining the cystic nature of some lesions. In general, however, MR imaging provides the most information, determining lesion extent and, in some cases, specific diagnoses.

MR imaging sometimes provides definitive diagnosis of common benign lesions. The most common benign lesions are hemangioma/lymphangioma, lipoma, periarticular cyst, inflammatory masses, fat necrosis, neurofibroma, and giant cell tumor of the tendon sheath.[1] Coincidentally, this list correlates well with those lesions for which definitive diagnosis at MR imaging is possible: hemangioma, lymphangioma, and other vascular tumors; lipoma; periarticular cysts; hematoma; giant cell tumor of the tendon sheath; benign neural tumors; and fat necrosis.

Many benign and malignant soft tissue masses have common imaging characteristics.[2–5] Many lesions are iso- or hypointense to muscle on T1-weighted (T1-W) imaging and hyperintense on T2-weighted (T2-W) imaging. Although some investigators have found MR imaging capable of determining the benignity of specific lesions (discussed previously), accuracy often is uncertain, necessitating biopsy. When MR imaging appearance is nondiagnostic, benign origin may be more likely if a patient is less than 20 years old, the mass measures less than 10 cm, its position is subcutaneous or fascial, and it appears well circumscribed, homogeneous on T2-W imaging, and with no surrounding edema.[6] Enhancement characteristics may facilitate diagnosis of malignant lesions, which may show less rapid enhancement and more rapid washout.[7] MR imaging also defines the cystic nature of some lesions, provided T1 and T2 characteristics are evaluated carefully and contrast is administered in equivocal cases.[8] Only 1% to 6% of soft tissue masses are malignant.[1] Of the malignant tumors in the 0- to 5-year age group, fibrosarcoma is most common, followed by rhabdomyosarcoma. In the older age group, 6 to 15 years old, malignant fibrous histiocytoma is most common, followed by synovial sarcoma and rhabdomyosarcoma.[9]

Even when MR imaging fails to differentiate between benignity and malignancy or provide a tissue diagnosis of a malignant tumor, it does provide essential information, delineating the extent of the lesion, extension beyond facial planes, and involvement of adjacent structures, such as the neurovascular bundle, joints, and bone. It also is useful in assessing response to therapy, although differentiation of residual or recurrent tumor from postoperative edema, hemorrhage, or inflammation often is difficult.[10] If high T2-W signal is present without mass effect, differential considerations include seroma,

This article originally appeared in *Magnetic Resonance Imaging Clinics of North America*, Volume 17, Issue 3.
Department of Radiology, University of California, Davis, 4860 Y Street, Suite 3100, Sacramento, CA 95817, USA
E-mail address: rebecca.steinwexler@ucdmc.ucdavis.edu

Radiol Clin N Am 47 (2009) 977–995
doi:10.1016/j.rcl.2009.08.010
0033-8389/09/$ – see front matter

hematoma, postradiation change, packing material, fat necrosis, or hygromas.[1] Mass effect increases concern for tumor recurrence,[1] as does gadolineum enhancement.[10]

MR IMAGING TECHNIQUE

The goal of MR imaging is to evaluate the entire lesion with as small and tight a coil as possible and to image with as small a field of view possible, within the limitation of obtaining adequate signal to noise. T1 and fat-suppressed T2 sequences in at least two orthogonal planes provide essential information. Coronal T1 sequences reveal contour changes and signal alterations due to the presence of fat or hemorrhage, although the lesion itself usually is poorly defined, often iso- or slightly hypointense to muscle. At T2-W sequences, the lesion and adjacent edema are hyperintense; thus, there is excellent contrast with adjacent tissues, delineating lesion extent, along with peritumoral edema. This allows determination of encasement of the neurovascular bundle, extension to bone, and the presence of tumor within nearby joints. Gadolinium rarely helps narrow the differential diagnosis, but it can provide important information regarding the cystic or solid nature of the lesion, and it also can help locate viable tissue for biopsy. Gradient-recalled echo imaging may help assess the presence of high flow, which assists in differentiation of vascular lesions; it also helps define adjacent vasculature. Occasionally, magnetic resonance angiography or magnetic resonance venography provides similar assistance and may simplify preoperative planning.

BENIGN PROCESSES: SOFT TISSUE MASSES

Fibrous Lesions

Many kinds of fibrous tumors occur in children, and all except for fibrosarcoma are benign. In general, these tumors are more common in boys.[11] Infantile myofibromatosis and desmoid tumor are the most common,[12] with the former usually diagnosed during the first year of life and the latter during the second decade. Fibromatosis colli and fibrous hamartoma of infancy are also discussed, but a thorough discussion of the less common fibrous lesions is beyond the scope of this article.

Fibromatosis Colli

Fibromatosis colli presents as fusiform or eccentric expansion of the sternocleidomastoid muscle. Found in approximately 0.4% of infants,[13] it usually presents at age 2 or 3 weeks with a firm anterior neck mass, often on the right, rarely bilateral, and sometimes followed by development of torticollis.[14] The mass typically increases in size over the course of several weeks and in 90% of cases resolves spontaneously during the next 4 to 8 months.[13] Cause is uncertain. There often is a history of birth trauma,[15] but pathologic evaluation demonstrates myoblasts, fibroblasts, and myofibroblasts in various stages of differentiation,[16] arguing for a developmental origin. The younger the baby, the more immature the cells appear.[16]

Ultrasound usually is diagnostic, demonstrating well-defined, unilateral, fusiform expansion of the sternocleidomastoid muscle. At MR imaging, the mass is isointense to muscle on T1-W images and hyperintense on T2-W images, with subtle patchy and linear areas of decreased signal intensity.[14] An atypical imaging appearance—such as irregular margins, extension of the mass beyond the sternocleidomastoid muscle, lymphadenopathy, or encasement of vascular structures—suggests an alternative diagnosis, such as lymphoma, rhabdomyosarcoma, neuroblastoma, or an inflammatory process.[15]

Infantile Myofibromatosis

Infantile myofibromatosis manifests itself in infancy, usually in the neonatal period, with presentation after 2 years of age unusual.[17] It consists of nodules composed of spindle cells, having features of smooth muscle and fibroblasts at histologic evaluation. Although unifocal disease can occur, the typical appearance is that of multiple soft tissue nodules confined to the subcutaneous tissues or involving the skeleton, intestinal tract, heart, and lungs. Subcutaneous masses typically involve the head, neck, and trunk. Pulmonary involvement may result in interstitial fibrosis and pleural and pulmonary nodules.[18] If visceral involvement is present, the disease is lethal in 75%, but otherwise recovery is the rule, and spontaneous regression occurs in 30%.[19] Boys tend to have solitary lesions, whereas multicentric lesions are more common in girls.[17]

The lesions are round and may be well or ill defined. They usually are isointense to muscle on T1-W imaging and hyperintense on T2-W sequences, but signal intensity is variable (**Fig. 1**).[17] The center may appear mildly hyperintense on T1. Enhancement often is intense and may demonstrate a target appearance, with a nonenhancing center.[20]

Desmoid Tumor

Also known as infantile fibromatosis and aggressive fibromatosis, this nonmetastasizing and technically benign but locally infiltrative tumor consists