Pictorial Essay

Radiologic Appearance of Intramuscular Hemangioma with Emphasis on MR Imaging

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Intramuscular hemangiomas are a subset of benign vascular lesions of skeletal muscle. Although terminology often is confusing, usually these lesions are classified according to the size of the vessels within the tumor. All hemangiomas contain variable amounts of nonvascular tissue such as fat, smooth muscle, fibrous tissue, myxoid stroma, hemosiderin, thrombus, and even bone [1]. These nonvascular components are most prominent in cavernous or large-vessel hemangiomas; this is especially true of adipose tissue [1]. The MR appearance of intramuscular hemangioma reflects this gross morphology, and in many cases MR may provide a presumptive diagnosis.

The imaging studies of 11 patients with intramuscular hemangiomas were reviewed, and the findings on radiography, angiography, CT, and MR are illustrated. Lesions that mimic intramuscular hemangiomas are also shown and distinguishing features are discussed.

Materials and Methods

The MR imaging studies of 11 patients with intramuscular hemangioma were reviewed retrospectively in a nonblinded fashion. The group included seven males and four females 3–36 years old (mean, 20). Hemangiomas occurred in the calf (three), thigh (two), arm (two), and foot (one). Two patients had extensive involvement of the upper extremity, and one had diffuse involvement of the chest wall and back. This group was selected from 135 patients in whom soft-tissue masses of diverse causes were evaluated with MR at Walter Reed Army Medical Center, Washington, DC.

The diagnosis of intramuscular hemangioma was established in accordance with commonly accepted histologic criteria after biopsy in eight cases. In the remaining three cases, the diagnosis was established by characteristic radiographs showing phleboliths in two. In the final case, the diagnosis was established by characteristic MR findings in conjunction with the clinical history of a soft, easily compressed, vascular mass with a bluish tinge that did not change in size or character over time. Two patients had previous surgery and recurrent or residual disease.

All patients had MR imaging, including gradient-recalled acquisition in the steady state (GRASS) sequences in four patients. In addition, nine patients had CT (seven with contrast-enhancement), eight had plain radiography, five had technetium-99m methylene diphosphonate bone scintigraphy with both flow and blood-pool images, four had angiography, and one had venography.

All MR scans were obtained on a GE 1.5-T Signa (General Electric, Milwaukee, WI) or a 1.5-T Teslacon (Technicare, Solon, OH) scanner, except one, which was obtained on a 0.5-T Picker (Picker International, Highland Heights, OH) scanner. Typical scanning sequences included spin-echo (SE) T1-weighted, 300–750/20–34 (TR/TE), and T2-weighted, 1800–2500/80–100, pulse sequences in each plane. At least two orthogonal planes were imaged in every case. The field of view ranged from 12 to 40 cm, the number of signal averages from two to four, and the slice thickness from 5 to 10 mm with a 20–100%

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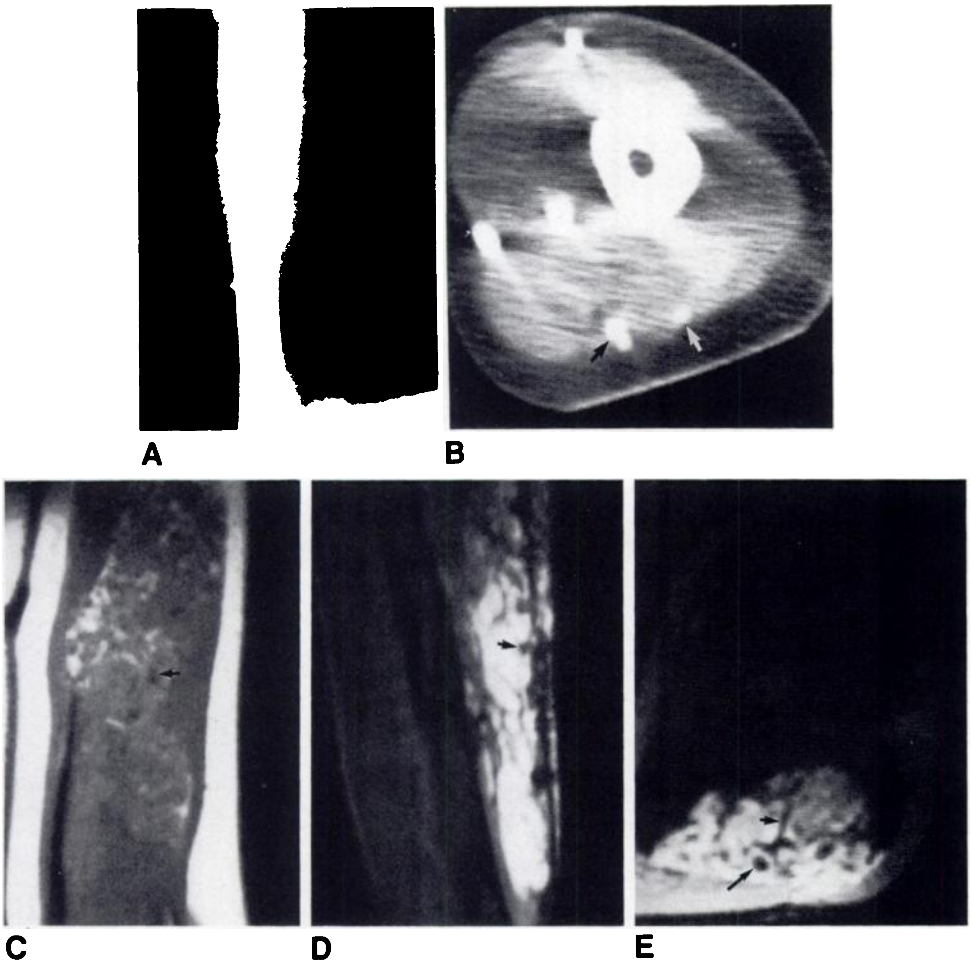


Fig. 1.—Intramuscular hemangioma of triceps in a 23-year-old woman.

***A*, Radiograph of arm shows multiple phleboliths in soft tissues, suggesting intramuscular hemangioma.**

***B*, Axial contrast-enhanced CT scan confirms presence of phleboliths (*arrows*) within poorly defined soft-tissue mass. Contrast-enhanced veins could be distinguished from phleboliths on serial axial images.**

***C*, Coronal T1-weighted MR image, 500/20, shows fat distributed in lacelike pattern throughout hemangioma. Subtle signal voids represent phleboliths (*arrow*).**

***D*, Sagittal gradient-echo MR image, 100/25/10° flip angle, shows high signal intensity compatible with marked vascularity of hemangioma. Within mass are signal voids (*arrow*) due to phleboliths, also seen on radiograph (*A*).**

***E*, Axial T2-weighted MR image, 2000/100, shows hemangioma is hyperintense relative to subcutaneous fat. Linear regions isointense relative to skeletal muscle (*short arrow*) and signal voids representing phleboliths (*long arrow*) are seen within hemangioma.**

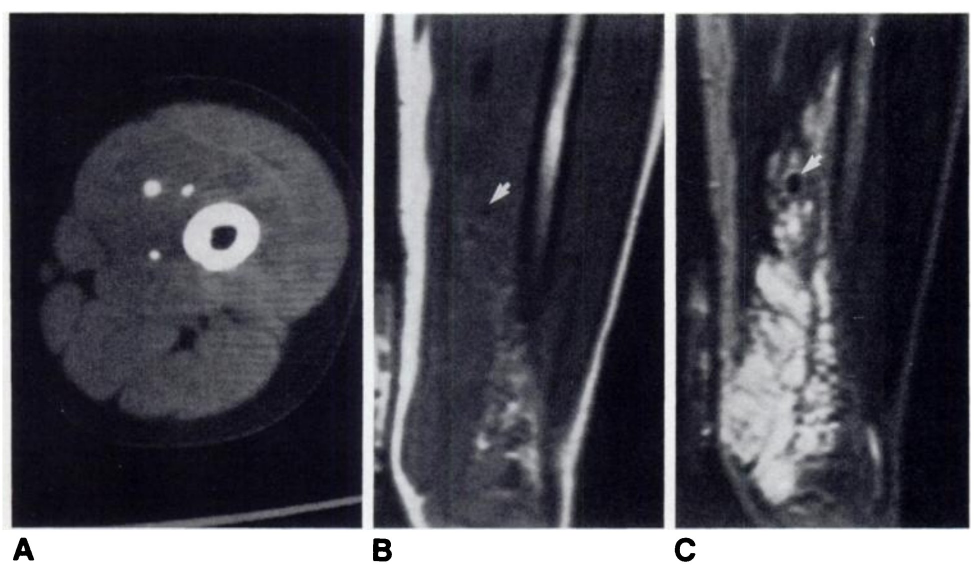


Fig. 2.—Intramuscular hemangioma of thigh in a 6-year-old girl.

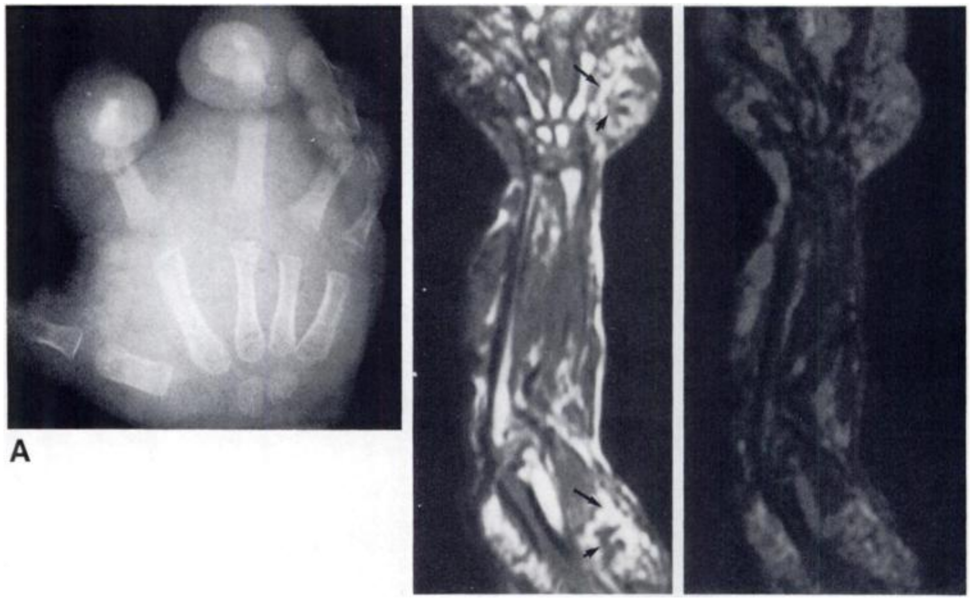
***A*, Axial unenhanced CT scan clearly shows phleboliths within soft-tissue mass, although margins of hemangioma are not well defined.**

***B* and *C*, Corresponding coronal T1-weighted, 600/20, (*B*) and T2-weighted, 2000/80, (C) MR images show lesion is isointense with regard to skeletal muscle on T1-weighted image, with lacelike areas of increased signal corresponding to fat interposed between vascular elements. Because of lesion's hyperintensity, its extent is clearly visualized on T2-weighted image.**

gap depending on the body part imaged. GRASS images (25–100/13–25) were obtained with a 10–30° flip angle.

Results

On T1-weighted SE images, the hemangiomas were typically isointense relative to skeletal muscle and had poorly delineated or imperceptible margins. Within the hemangiomas were areas of increased signal approximating that of subcutaneous fat. These were noted in nine cases and varied from fine, delicate, lacelike, or linear strands (Figs. 1C and 2B) to coarse, linear bands (Fig. 3B). Fatty signal predominated in two cases (Fig. 4). On T2-weighted SE images, the heman-

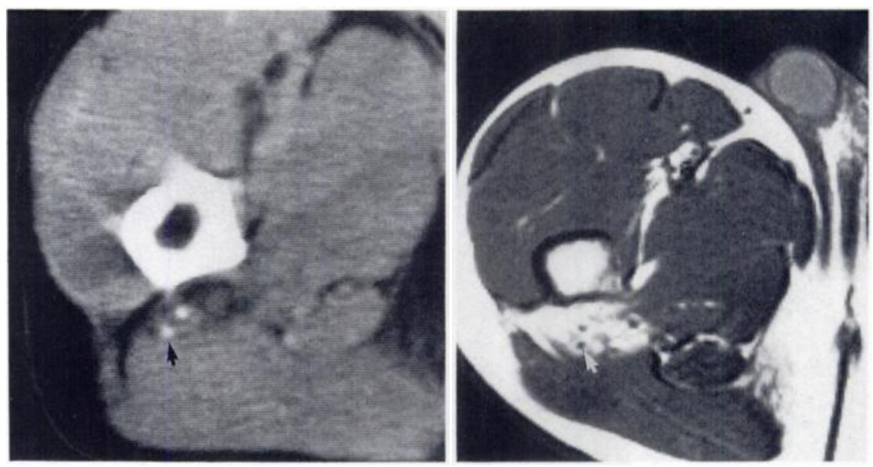


A B C

Fig. 3.—Hemangiomatosis of upper extremity in a 3-year-old boy.

A, Radiograph of hand and wrist shows extensive soft-tissue involvement and hypertrophy, with overgrowth of bones.

B and *C*, Coronal T1-weighted, 600/20, (*B*) and T2-weighted, 2000/80, (*C*) MR images of arm show foci of both hyperintense (*long arrows*) and hypointense (*short arrows*) signals, corresponding to interlaced fibrous and fatty elements, respectively.

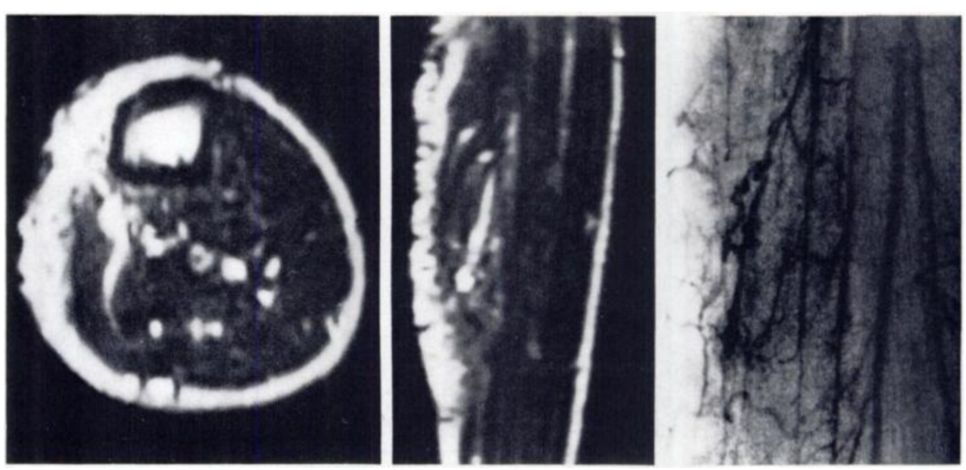


A B

Fig. 4.—Intramuscular hemangioma of thigh in a 24-year-old man.

A, Axial contrast-enhanced CT scan shows mostly fatty mass posterior to femoral neck. Phleboliths (*arrow*) were not apparent on radiograph (*not shown*).

B, Axial T1-weighted MR image, 700/32, confirms fatty nature of hemangioma. Within mass are signal voids (*arrow*) due to phleboliths, corresponding to those noted on CT.



A B C

Fig. 5.—Intramuscular hemangioma of left lower leg in a 20-year-old man.

A and *B*, Axial (*A*) and coronal (*B*) T2-weighted MR images, 2000/80, show hemangioma in gastrocnemius muscle, with extension into adjacent subcutaneous fat. More typical pattern seen in Figs. 1–3 is absent. Overgrowth of tibia and soft tissues is readily apparent.

C, Corresponding arteriogram shows nonspecific neovascularity, with "puddling" of contrast material and subtle tumor blush.

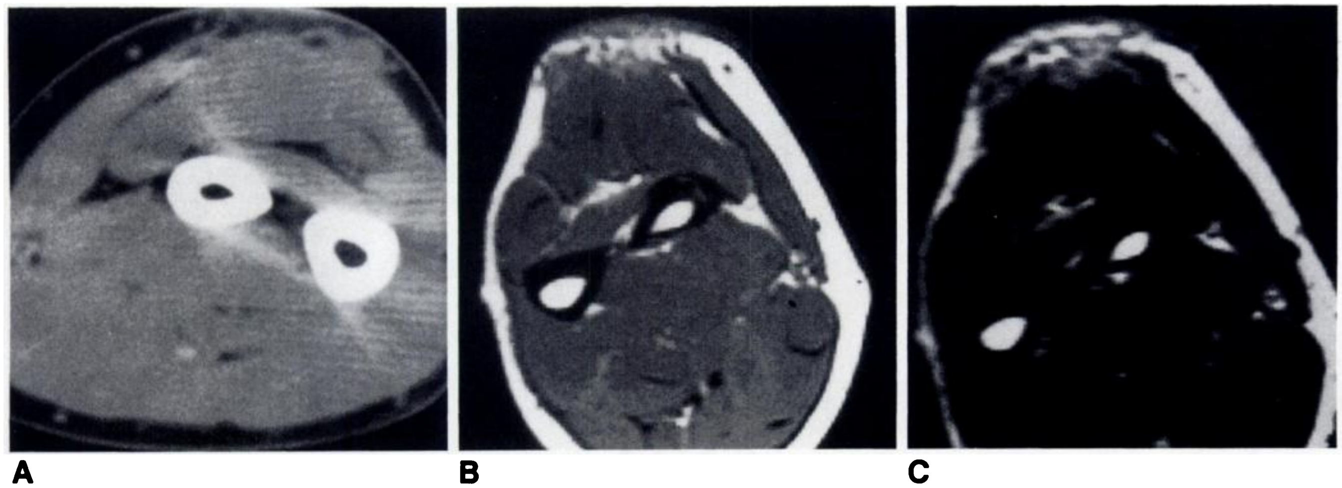


Fig. 6.—High-grade malignant fibrous histiocytoma of forearm in a 45-year-old man.
A, Axial contrast-enhanced CT scan shows poorly defined soft-tissue mass infiltrating subcutaneous fat.
B and *C*, Corresponding axial T1-weighted, 700/34, (*B*) and T2-weighted, 2000/80, (*C*) MR images show malignant fibrous histiocytoma lacks lacelike fatty pattern typically seen in hemangiomas on T1-weighted images and also lacks typical hyperintense signal seen on T2-weighted images. Lesion infiltrates subcutaneous fat and mimics many findings seen in hemangioma in Fig. 5.

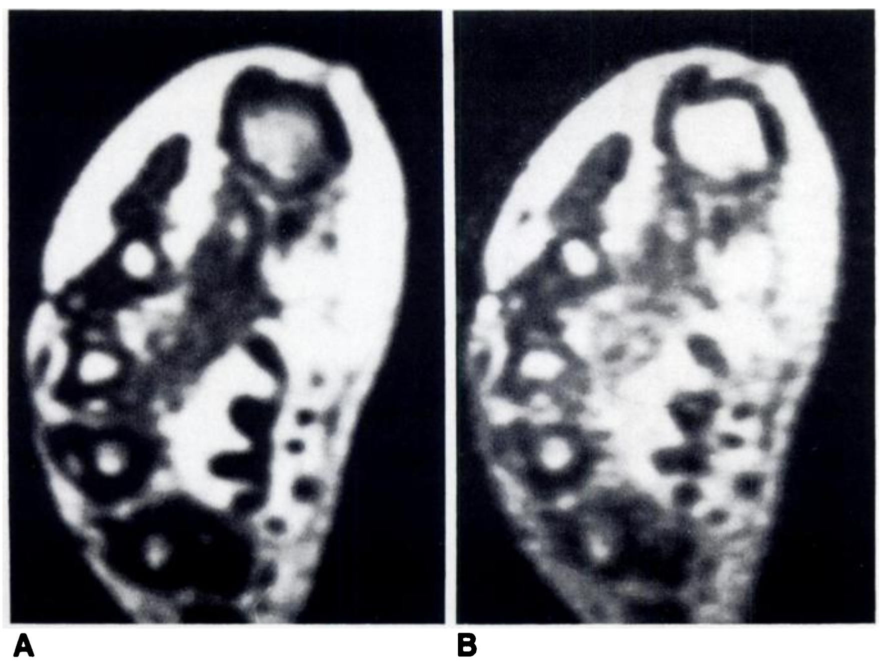


Fig. 7.—Lipomatosis of right hand in a 5-month-old boy.
A and *B*, Axial T1-weighted, 500/30, (*A*) and T2-weighted, 2500/80, (*B*) MR images show diffuse fatty overgrowth throughout right hand and wrist. Bony overgrowth was better visualized on plain radiographs (*not shown*). Lesion is mostly fatty and mimics those hemangiomas in which fat predominates. Typical features such as hyperintensity on T2-weighted images and lacelike fibrofatty septa are absent.

giomas were typically hyperintense as compared with subcutaneous fat, and the margins were relatively well defined. Within the hemangiomas were areas that were isointense relative to fat and muscle (Figs. 1E and 2C). These were typically linear in configuration. Phleboliths were identified easily in one case (Figs. 2B and 2C) and retrospectively in two additional cases (Figs. 1C–1E and 4B). Phleboliths could not be identified with MR in a fourth case in which they were readily apparent on both plain radiographs and CT scans. Extension of the tumor into the subcutaneous fat was apparent in three cases (Figs. 3 and 5).

On CT, the hemangiomas typically were poorly defined, with tissue attenuation approximating that of skeletal muscle, and contained areas of decreased attenuation, some approaching fat (Figs. 1B and 4A). Phleboliths were identified in four lesions (Figs. 1B, 2A, and 4A); in three of these, they were easily identified on plain radiographs. Two lesions were mostly fatty, thereby allowing confident delineation of their margins (Fig. 4A).

Plain radiographs were available in nine cases. Phleboliths were seen in four (Fig. 1A), and two showed bone overgrowth (Figs. 3 and 5). The patient with extensive chest wall involvement had marked rotatory scoliosis. Three of the five scintigrams showed increased blood-pool activity; two of these also showed increased flow. There was no evidence of increased bone activity.

Three of four hemangiomas assessed angiographically showed small areas of neovascularity and tumor blush (Fig. 5). All showed some small abnormal draining veins. No dominant abnormal feeding vessels could be identified. No arterial abnormality was detected in the final tumor, which was mostly fatty. The single venogram showed an extensive network of dilated draining veins.

Discussion

The MR appearance of intramuscular hemangiomas reflects the morphology: benign vascular masses containing nonvascular elements such as fat, fibrous and myxoid tissue, smooth muscle, thrombus, and bone [1]. Tumors composed mostly of small vessels (diameter < 20 RBCs) are small-vessel or capillary hemangiomas, whereas those with mostly larger vessels are large-vessel, cavernous, or venous hemangiomas. Mixed-type hemangiomas are composed of large and small vessels in about equal proportions [1]. Cavernous hemangiomas are larger than capillary hemangiomas and usually contain more nonvascular tissue. This is especially true of adipose tissue, so much so that portions of the cavernous hemangioma may be indistinguishable from a lipoma [1]. These nonvascular tissues may be encountered to a lesser extent in mixed-type hemangiomas, and small quantities may be noted in capillary hemangiomas [1]. It is the combination of larger vessels (containing stagnant blood) and nonvascular elements (predominantly fat and fibrous tissue) that produces a characteristic MR appearance (Figs. 1–5).

The marked hyperintensity of these hemangiomas on T2-weighted SE images is related to the increased free water present within the stagnant blood found in the larger vessels of these lesions. Low-signal linear structures throughout the lesion represent the fibrofatty septa between vessels [2]. Lacelike and linear fat signal within the tumor represents fat between the vascular elements—a feature not emphasized previously as characteristic of hemangioma.

Previous reports [3, 4] have shown the superiority of MR over CT or angiography in delineating the extent of these lesions. Dynamic CT may show contrast enhancement of curvilinear structures with attenuation values similar to those of vessels. CT was more sensitive in detecting phleboliths but did not delineate the extent of the hemangiomas well, except for the two that were mostly fatty (Fig. 4).

The appearance of hemangiomas might be mimicked by rare vascular tumors, such as hemangioendotheliomas or angiosarcomas, but the MR findings in these rare tumors have not been described yet. Tumors that infiltrate the subcutaneous fat (Fig. 6) or are primarily fatty (Fig. 7) may resemble hemangiomas but do not exhibit all of the features encountered in typical hemangiomas, such as lacelike fibrofatty septa, hyperintense T2 signal, and phleboliths. Hemorrhagic lesions might display a similar signal intensity at some point in their evolution, but an accompanying septated pattern would be unusual.

In no instance did angiography establish the diagnosis, but it assisted in planning the surgical approach. Bone scintigraphy could be used confidently to exclude bone involvement, but provided no information not readily derived from MR.

In summary, intramuscular hemangiomas are benign vascular lesions that may contain considerable amounts of nonvascular tissue. This underlying morphology is reflected on MR, which allows a presumptive diagnosis in most cases.

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