Sonography of Intramuscular Myxomas

The Bright Rim and Bright Cap Signs

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Objective. The objective of this study was to retrospectively review sonographic images of pathologically proven soft tissue myxomas to determine whether a sonographic correlate to the bright rim and bright cap signs described in the magnetic resonance imaging literature is present. ***Methods.*** The study group consisted of 6 patients with pathologically proven soft tissue myxomas (1 man and 5 women; age range, 41–72 years; mean, 56.5 years). The available sonographic images for each subject were retrospectively reviewed by 2 authors (L.F. and K.F.), with agreement reached by consensus. Among other findings, images were also reviewed for a peripheral rim of increased echogenicity (termed the "bright rim sign") and for the presence of a triangular hyperechoic area adjacent to at least one of the poles of the mass (termed the "bright cap sign"). ***Results.*** The bright rim and bright cap signs were seen in 5 (83%) of the 6 myxomas . The single case without the bright cap sign was not the same case as the one lacking the bright rim sign. ***Conclusions.*** The sonographic bright rim and bright cap signs were associated with 5 (83%) of the 6 intramuscular myxomas. These findings correlate with their magnetic resonance imaging equivalents, which are well documented in the literature, due to muscle atrophy and adjacent fatty infiltration. Recognition of these features may assist in a more accurate sonographic diagnosis before biopsy. ***Key words:*** bright rim sign; magnetic resonance imaging; myxoma; sonography.

Abbreviations
MRI, magnetic resonance imaging

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Myxomas are benign connective tissue tumors that arise most commonly in the intramuscular compartment (82%), especially the thigh.[1,2] The usual appearance is that of a slow-growing, sometimes painful (51%) soft tissue mass, typically seen in older patients (fifth to seventh decades), with a female preponderance (59%).[1] Myxoid material may be present in both benign and malignant tumors, and a means to differentiate these two would be useful.

At magnetic resonance imaging (MRI), it has been shown that identification of the perilesional fat rind on T1-weighted sequences and edema in adjacent musculature on T2-weighted sequences increases the possibility of myxoma, rather than a myxoid liposarcoma, by 20.4- and 13.4-fold, respectively.[2] Sonographically, soft tissue myxomas are oval and fairly well defined, with a hypoechoic but heterogeneous echo texture and possible cyst formation[3]; the sonographic features have been considered nonspecific.

In our clinical experience, we have noted a hyperechoic rim around intramuscular myxomas at sonography that appear analogous to the perilesional findings described on MRI. The purpose of this study was to retrospectively characterize soft tissue myxomas at sonography and to assess whether a sonographic correlate to the perilesional MRI findings was present.

Materials and Methods

Institutional Review Board approval was obtained before initiation of this study, with informed consent waived. Patients with pathologically proven soft tissue myxomas and sonographic evaluation were identified through the clinical experiences of the authors over a 3-year period. Patient records were reviewed retrospectively by 1 author (K.F.) for information regarding location of myxoma, age, sex, and pathologic results, as well as other imaging such as MRI.

Sonographic images were acquired prospectively as part of the clinical care of each patient by the authors (8–12 years of experience with musculoskeletal sonography) with a LOGIQ 9 machine (GE Healthcare, Milwaukee, WI) and 9- to 12-MHz multifrequency linear probes. Liberal transmission gel was used in place of a standoff pad. Although image acquisition was not standardized because of the retrospective nature of this study, in general, a visualized soft tissue mass is imaged in transverse and longitudinal dimensions. The available sonographic images for each subject were reviewed retrospectively by 2 authors (L.F. and K.F.), with agreement reached by consensus. The echogenicity of a visible mass was recorded as anechoic, hypoechoic, isoechoic, or hyperechoic relative to the surrounding soft tissues. Any heterogeneities of the mass or focal echogenic areas with shadowing were noted, as well as posterior acoustic enhancement. The shape of each mass was also recorded as oval, round, or other. The presence of flow on color or power Doppler imaging was noted. Images were also reviewed for a peripheral rim of increased echogenicity, and findings were considered positive if a minimum of one fourth of the circumference displayed this feature on a single image (termed the "bright rim sign"). In addition, images were evaluated for the presence of a triangular hyperechoic area adjacent to at least 1 of the poles of the mass (termed the "bright cap sign"). Prospective sonography reports were also reviewed; images were assessed; and mass dimensions were recorded. Sonographic findings were directly correlated with MRI results when available.

Results

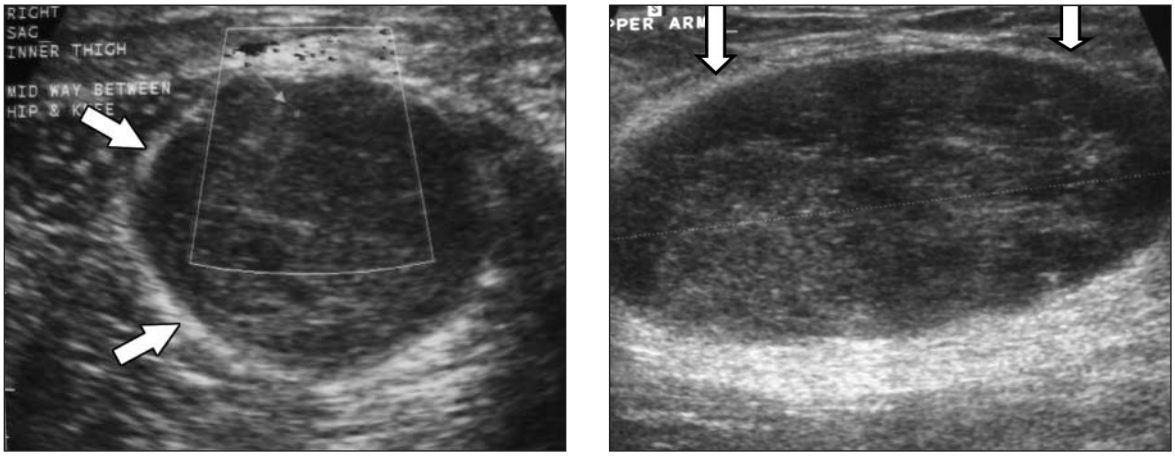
The study group consisted of 6 patients, 1 male and 5 female, with ages ranging from 41 to 72 years (mean, 56.5 years). All had percutaneous sonographically guided biopsy (14 gauge) with pathologic proof of soft tissue myxoma. Three patients had MRI evaluation. All myxomas were located intramuscularly. Two patients had myxomas in the upper limb musculature (upper arm and forearm), and 4 had myxomas in the lower limb musculature (thigh and buttocks). Three of the 4 lower limb musculature myxomas were in the thigh muscles.

A retrospective review of the sonographic images showed that all myxomas were hypoechoic to the surrounding soft tissue and showed a heterogeneous echo texture (Figure 1). Five (83%) of 6 showed posterior acoustic enhancement. No masses had hyperechoic foci with shadowing. The sizes of the myxomas (largest dimension) ranged from 2.6 to 5.5 cm (average, 4.3 cm). With regard to myxoma shape, 5 (83%) of 6 were oval, and 1 (17%) of 6 were round; 3 (50%) of 6 showed intrinsic flow on color or power Doppler imaging.

With regard to the bright rim sign at sonography, 5 (83%) of 6 myxomas had positive findings (Figure 1). This corresponded to high signal on T1-weighted images in each case for which MRI data were available (3). With regard to the bright cap sign at sonography, 5 (83%) of 6 myxomas had positive findings (Figure 2). This triangular echogenic area at a pole of the myxoma tapered within the adjacent musculature and correlated with increased signal on T1-weighted images on MRI in all 3 cases. Adjacent muscle atrophy was also noted. The single case without the bright cap sign was not the same as the case lacking the bright rim sign.

Discussion

Intramuscular myxoma represents a benign soft tissue neoplasm that typically appears as a slow-growing mass. Because high mucin and low cellular contents of myxomas exhibit intrinsic features similar to those of cysts on cross-sectional imag-

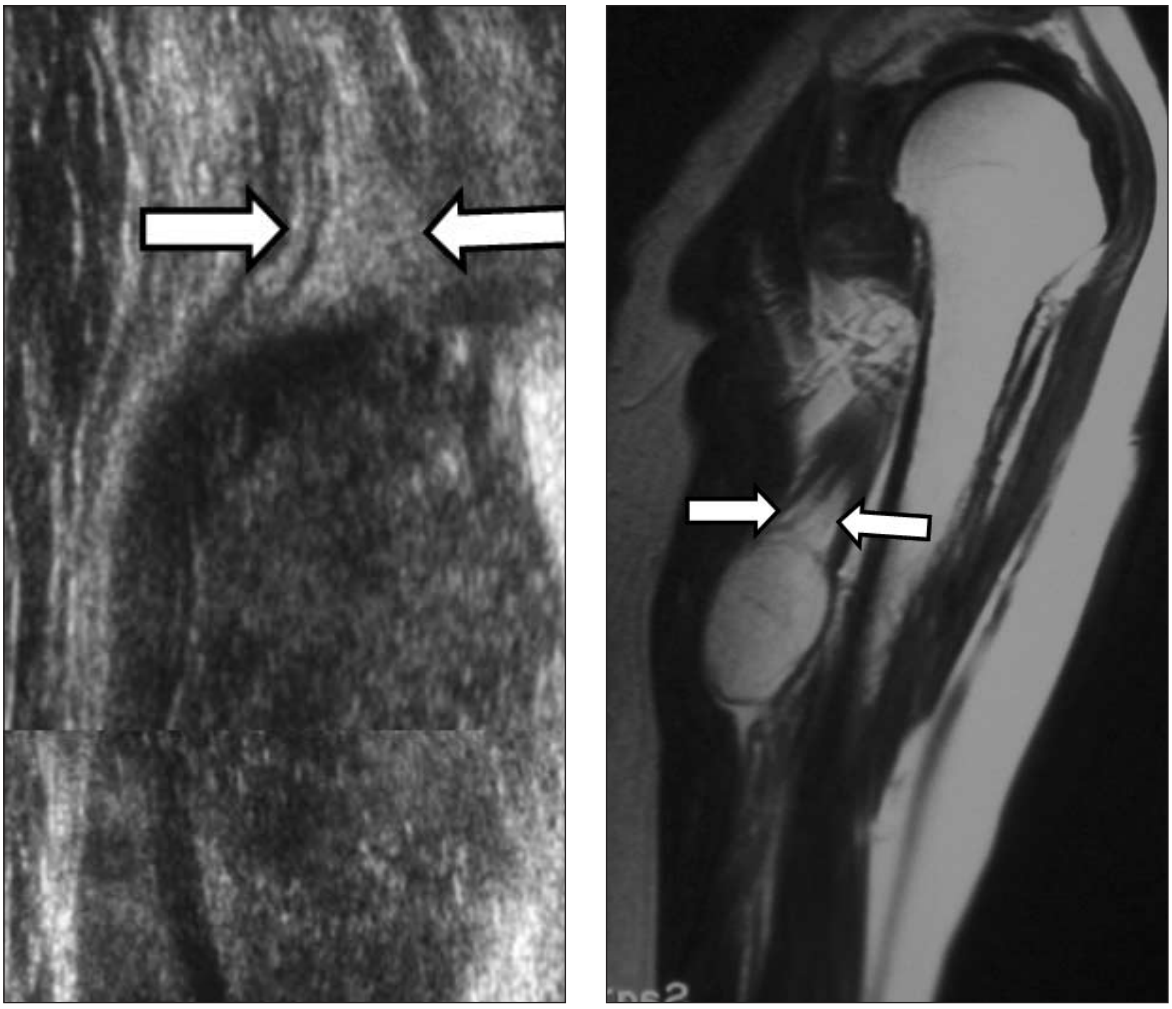


A B

Figure 1. Intramuscular myxoma in a 56-year-old man (**A**) and a 69-year-old woman (**B**). Short-axis (**A**) and long-axis (**B**) sonograms show a heterogeneous hypoechoic echo texture of the myxoma and a peripheral hyperechoic rim or bright rim sign (arrows). Note posterior acoustic enhancement.

Figure 2. Intramuscular myxoma in a 72-year-old woman. Long-axis sonogram (**A**) and T1-weighted MRI (**B**) show an echogenic triangle at the pole of the myxoma, representing a bright cap sign (arrows).

A B



ing,[1,2] benign cystic lesions (such as simple cysts, ganglia, and bursas) may confound the differential diagnosis. Initial investigations with plain radiography are often not helpful; however, if a soft tissue mass is identified and there is evidence of fibrous dysplasia in the visualized bony structures, Mazabraud syndrome may be indicated because of the association between fibrous dysplasia and myxomas.[3–9]

At our institutions, sonography is often the imaging modality used after plain radiography for evaluation of a soft tissue mass to detect areas of internal echoes in myxomas to distinguish them from simple cysts. This differentiation is important because 5 (83%) of 6 intramuscular myxomas in our series showed posterior acoustic enhancement, a finding seen with cysts; however, posterior acoustic enhancement has been described with other solid masses, such as peripheral nerve sheath tumors.[10] Location is an additional feature useful in differentiating intramuscular myxomas from other cystic lesions such as ganglia and bursas, which are usually near the joints, between muscles adjacent to tendons and ligaments, or under pressure points. In contrast, most myxomas are intramuscular.[1,2] Intramuscular myxomas may contain cysts and can be partially compressible. They often show little or no vascularity. Intramuscular low-grade myxoid liposarcoma is a sonographic differential diagnosis but is generally more vascular and contains varying amounts of echogenic fat. In general, sarcomas exhibit more vascularity than myxomas.[11] Intramuscular hemangiomas have contrasting appearances when compared with myxomas and frequently exhibit a characteristic combination of findings that include hypoechoic flow channels, hyperechoic fat, and echogenic foci, with posterior acoustic shadowing when phleboliths are present.[11]

Myxomas typically lack a capsule, and their pseudocapsule is often incomplete.[1] It is postulated that this may allow mucoid material from the lesion to infiltrate into the adjacent musculature and lead to muscle atrophy, with increased fat deposition and surrounding edema.[2] This pathologic finding would explain the sonographic bright rim sign of echogenicity around the myxoma, which is similar to the rind of fatty tissue around intramuscular myxoma described on MRI.[2] Five (83%) of 6 cases showed the bright rim sign in our retrospective study. Although we acknowledge that the percentage is higher than that quoted in MRI literature (Murphey et al[1] [71%] and Bancroft et al[2] [65%]), we think this is not an accurate comparison because of our smaller study sample; however, we do believe that the trends are similar and that larger studies are needed to compare the sensitivities of sonography and MRI.

Areas of more prominent adipose tissue have also been described at the poles of an intramuscular myxoma.[1] The cause of this focal fatty tissue is unknown but likely reflects the same process of fatty infiltration at the site of atrophy of muscle fibers. This was also seen in 5 of our cases and appeared on sonography as a hyperechoic triangular cap, termed the bright cap sign. The best visualization of the bright cap is seen in the longitudinal plane of the lesion at the poles, in the longitudinal dimension of the myxoma. In our series, the bright cap sign was over at least 1 of the poles of the myxoma, typically in the maximum longitudinal plane. Magnetic resonance imaging uses traditional planes for imaging and may not show the myxoma in its longitudinal plane. This may be one of the reasons that the percentage of our cases showing a bright cap sign was higher than that suggested in the MRI literature (Murphey et al[1] [64%]).

As with MRI, we believe that identification of these findings of a bright rim and bright cap on sonography will substantially increase the sensitivity and specificity of diagnosing myxomas when compared with other malignant myxoid lesions such as myxoid liposarcoma.[2] Further research is needed, however, to assess the presence or absence of these findings in other slow-growing intramuscular lesions. In addition, it would be important to compare and contrast the bright rim sign of a myxoma with the split fat sign of a peripheral nerve sheath tumor, although peripheral nerve continuity with the latter condition would assist in this differentiation.[12]

We acknowledge several limitations of our study, which include the small number of cases and lack of MRI correlation in all cases. In addition, selection bias exists in that the cases were identified through the clinical experience of the authors and not through a more extensive database or medical record search. Selection bias also exists in that it is possible that larger myxomas may more likely be symptomatic and will be evident during evaluation; it is not known whether the described sonographic signs of myxomas are present with smaller myxomas. In addi-

tion, although the exact pathologic cause of the bright rim and bright cap signs in our patients was not determined, these findings have been proved with other studies that used MRI, which correlates with the imaging findings in our patients. Other limitations include intrinsic observer bias and the retrospective nature of the study.

In summary, we describe the sonographic bright rim and bright cap signs associated with 5 (83%) of 6 intramuscular myxomas. These findings correlate with their MRI equivalents, which are well documented in the literature, due to muscle atrophy and adjacent fatty infiltration.

References

1. Murphey MD, McRae GA, Fanburg-Smith JC, Temple HT, Levine AM, Aboulafia AJ. Imaging of soft-tissue myxoma with emphasis on CT and MR and comparison of radiologic and pathologic findings. Radiology 2002; 225:215–224.
2. Bancroft LW, Kransdorf MJ, Menke DM, O'Connor MI, Foster WC. Intramuscular myxoma: characteristic MR imaging features. AJR Am J Roentgenol 2002; 178:1255–1259.
3. Fornage BD, Rohmsdahl MM. Intramuscular myxoma: sonographic appearance and sonographically guided needle biopsy. J Ultrasound Med 1994; 13:91–94.
4. Ly JQ, Bau JL, Beal DP. Forearm intramuscular myxoma. AJR Am J Roentgenol 2003; 181:960.
5. Iwasko N. Imaging findings in Mazabraud's syndrome: seven new cases. Skeletal Radiol 2002; 31:81–87.
6. Miettinen M, Hockerstedt K, Reitamo J, Totterman S. Intramuscular myxoma: a clinicopathological study of twenty-three cases. Am J Clin Pathol 1985; 84:265–272.
7. Wakely PE Jr. Myxomatous soft tissue tumours: correlation of cytopathology and histopathology. Ann Diagn Pathol 1999; 3:227–242.
8. Henschen F. Fall von ostitis Fibrosa mit multiplen Tumoren in der umgebenden Muskulatur. Verh Dtsch Ges Pathol 1926; 21:93–97.
9. Mazabraud A, Semat P, Roze R. Apropos of the association of fibromyxomas of the soft tissues with fibrous dysplasia of the bones [in French]. Presse Med 1967; 75:2223–2228.
10. Reynolds DL Jr, Jacobson JA, Inampudi P, Jamadar DA, Ebrahim FS, Hayes CW. Sonographic characteristics of peripheral nerve sheath tumors. AJR Am J Roentgenol 2004; 182:741–744.
11. Hwang S, Adler RS. Sonographic evaluation of the musculoskeletal soft tissue masses. Ultrasound Q 2005; 21: 259–270.
12. Murphey MD, Smith WS, Smith SE, Kransdorf MJ, Temple HT. Imaging of musculoskeletal neurogenic tumors: radiologic-pathologic correlation Radiographics 1999; 19:1253–1280.