The Cytopathology of Soft Tissue Mxyomomas

Ganglia, Juxta-articular Myxoid Lesions, and Intramuscular Myxoma

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A b s t r a c t

We studied the practicality of issuing a cytologic diagnosis of myxoma/juxta-articular myxoid lesion/ganglion (MJG) by reviewing all fine-needle aspiration (FNA) biopsy specimens of soft tissue masses in our files with diagnoses of myxoma, myxoid cyst, myxoid lesion, ganglion, or ganglion cyst. The control group was soft tissue aspirates with abundant myxoid stroma.

Of 39 cases with a cytologic diagnosis of soft tissue MJG, 15 had subsequent tissue biopsy or complete resection of the mass; 24 had clinicoradiologic follow-up. All cases except 1 (fat necrosis) were diagnosed correctly as benign myxoid lesions. We grouped MJG aspirates into 3 subtypes based on clinicoradiologic features: soft tissue ganglion/ganglion cyst (12 cases), juxta-articular myxoid lesion (16 cases), and intramuscular myxoma (11 cases). MJG aspirates showed few, subtle cytopathologic differences among subtypes. They characteristically had a viscous, gelatinous quality when expressed from the needle onto the glass slide. The typical smear contained a film of paucicellular, often finely granular, myxoid stroma that contained few cells, usually macrophages or bland spindle cells. Control group aspirates always contained cellular components that allowed distinction from MJGs. The cytopathologic diagnosis of MJG lesions is accurate; FNA biopsy can be used to subtype MJGs into 3 categories when clinicoradiologic features are known.

A generic diagnosis of myxoma without further embellishment was the only term formerly given to a mass composed almost entirely of primitive mesenchymal cells and myxomatous stroma regardless of anatomic location.1 A recent review, however, subcategorized 5 different so-called mainstream myxomas of soft tissue, 6 different mainstream myxomas of non–soft tissue sites, and more than 20 soft tissue tumors that contained abundant myxoid stroma such that the adjective myxoid is part of the diagnostic nomenclature.2 Fine-needle aspiration (FNA) biopsy of somatic soft tissue masses that contain a copious amount of myxomatous material on the smear can be divided broadly into 2 categories: lesions in which the myxoid material is present along with a particular cellular element, eg, myxoid soft tissue tumors of a specific type and lesions in which almost no other cellular element is present with the exception of macrophages or fibroblasts.3 We report our experience with the latter group, which we generically term myxoma/benign juxta-articular myxoid lesion/ganglion (MIG).

Materials and Methods

Case Selection

A review of our FNA cytopathology files of soft tissue aspirates was restricted to analysis of all percutaneous aspirates of somatic soft tissue in which an FNA cytopathologic diagnosis of myxoma, intramuscular myxoma, benign myxoid cyst or lesion, or ganglion or ganglion cyst was issued. Cutaneous myxoid lesions were excluded specifically, as were myxoid lesions of the viscera, paranasal sinuses, and bone. In
addition, we selected a control group of 24 soft tissue tumor aspirates known to have such an abundant amount of myxoid stroma that it is an integral feature of the neoplasm (eg, myxoid liposarcoma, myxofibrosarcoma) and compared the cytopathologic features of these with the features of the former group.

The majority of cases were from patients referred to our tertiary orthopedic oncology clinic. The amount and gross characteristics of the aspirated material were noted whenever a pathologist performed the FNA biopsy. This information generally was unknown when the FNA biopsy was performed by a clinician. The sizes stated are the greatest dimension of the mass as measured by the aspirator at the time of percutaneous FNA biopsy.

Technique

Percutaneous FNA biopsy was performed using standard technique with 22- and 21-gauge needles. Conventional smears were performed in all but 1 case that consisted of a liquid-based slide only. A pathologist performed most but not all aspiration biopsies. Slides were stained using Papanicolaou and Romanowsky stains. All slides were air dried; Papanicolaou-stained slides underwent rehydration. When available, formalin-fixed, paraffin-embedded tissue sections from a cell block or subsequent surgical excision were stained with H&E.

Results

We identified 39 aspirates that fulfilled case selection criteria. No patient had a history of a myxoid lesion of any kind, and this was the first FNA biopsy for all patients. After review of clinical, radiologic, and histopathologic (when available) data, aspirates were reclassified into 3 categories: soft tissue ganglion (STG) or ganglion cyst (12 cases), juxta-articular myxoid lesion (JML) producing a somatic soft tissue mass (16 cases), and intramuscular myxoma (InM; 11 cases). All were palpable masses, and the FNA biopsy was performed without radiologic imaging guidance. When gelatinous fluid was obtained during the FNA procedure, no deliberate attempt to completely aspirate all liquid from the lesion was made because the intent of the FNA was to use it as a diagnostic, not therapeutic, procedure. Nevertheless, in 5 cases, the mass resolved with aspiration biopsy.

Ganglion: Clinical Features

Patients with STG ranged in age from 24 to 69 years (mean, 46.0 years) with an equal ratio of men to women. Table 1. Six masses occurred in the hand or wrist, 4 in the foot or ankle, and 1 each near the knee and anterior portion of the tibia. With the exception of 1 case, all masses were smaller than 2.3 cm in greatest dimension (size was not recorded in 2 cases). The cytologic diagnosis in this group was ganglion or ganglion cyst in all but 1 case in which a diagnosis of benign soft tissue myxoma was made. In 2 cases, the STG was removed surgically. Examination of 1 specimen confirmed the FNA biopsy diagnosis; the case diagnosed as soft tissue myxoma turned out to be a periosteal ganglion. In 3 cases, the mass resolved after the FNA biopsy; the remainder of patients were followed up for 1 to 3 years with no change in the mass and subsequently were lost to follow-up.

JML: Clinical Features

We identified 16 cases with myxoid lesions arising in and around a joint (but not intramuscularly) that produced a discrete soft tissue mass. Some were partially cystic. These lesions were grouped under a generic heading, benign JML. The patients ranged in age from 32 to 85 years (mean, 59.6 years) with an equal male/female ratio. Table 2. Seven masses occurred in the soft tissues surrounding the knee, 6 surrounded the shoulder, and 3 were in the region of the hip.

<table>
<thead>
<tr>
<th>Case No./Sex/Age (y)</th>
<th>Size (cm)</th>
<th>Site</th>
<th>FNA Diagnosis</th>
<th>GA</th>
<th>Clinical Follow-up</th>
<th>Tissue Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M/69</td>
<td>U</td>
<td>Dorsum, L wrist</td>
<td>Ganglion</td>
<td>Clear, viscous</td>
<td>Resolved, 3 y</td>
<td>—</td>
</tr>
<tr>
<td>2/F/36</td>
<td>2</td>
<td>Dorsum, L wrist</td>
<td>Ganglion</td>
<td>Unknown</td>
<td>2 y</td>
<td>—</td>
</tr>
<tr>
<td>3/M/42</td>
<td>1.5</td>
<td>L thenar eminence</td>
<td>Ganglion</td>
<td>Clear, viscous</td>
<td>1 y</td>
<td>—</td>
</tr>
<tr>
<td>4/F/32</td>
<td>1.5</td>
<td>Dorsum, L ankle</td>
<td>Ganglion</td>
<td>Clear, viscous</td>
<td>1 y</td>
<td>—</td>
</tr>
<tr>
<td>5/F/27</td>
<td>2</td>
<td>Dorsum, R foot</td>
<td>Ganglion</td>
<td>Unknown</td>
<td>1 y</td>
<td>—</td>
</tr>
<tr>
<td>6/M/81</td>
<td>1</td>
<td>Dorsum, L ankle</td>
<td>Ganglion</td>
<td>Unknown</td>
<td>EB</td>
<td>Ganglion</td>
</tr>
<tr>
<td>7/F/62</td>
<td>2</td>
<td>Dorsum, L ankle</td>
<td>Ganglion</td>
<td>Clear, watery</td>
<td>1 y</td>
<td>—</td>
</tr>
<tr>
<td>8/M/39</td>
<td>2.3</td>
<td>R knee</td>
<td>Ganglion</td>
<td>Unknown</td>
<td>1 y</td>
<td>—</td>
</tr>
<tr>
<td>9/F/54</td>
<td>1</td>
<td>L hand</td>
<td>Ganglion</td>
<td>Unknown</td>
<td>3 y</td>
<td>—</td>
</tr>
<tr>
<td>10/F/24</td>
<td>U</td>
<td>Dorsum, R wrist</td>
<td>Ganglion</td>
<td>Clear, viscous</td>
<td>Resolved, 5 y</td>
<td>—</td>
</tr>
<tr>
<td>11/M/60</td>
<td>1.5</td>
<td>Interphalangeal joint, R index finger</td>
<td>Ganglion</td>
<td>Clear, viscous</td>
<td>Resolved, 2 y</td>
<td>—</td>
</tr>
<tr>
<td>12/M/56</td>
<td>4</td>
<td>R tibia</td>
<td>STM</td>
<td>Clear, viscous</td>
<td>EB</td>
<td>Periosteal ganglion</td>
</tr>
</tbody>
</table>

EB, excisional biopsy; FNA, fine-needle aspiration; GA, gross appearance of fluid; L, left; R, right; STM, soft tissue myxoma; U, unknown.
Masses ranged from 1.8 to 25 cm in dimension (mean, 7.3 cm) by palpation but often were much larger when imaging data were reviewed. One patient (case 14) had a mass deep in the fascia that on pushing just above the popliteal fossa produced a ballottable fluid wave that extended along the posterior thigh and into the buttock.

The amount of viscous fluid retrieved with FNA biopsy, recorded in only 6 cases, ranged from 1 to 32 mL but was much more in some cases. In case 14, for example, 2 L of fluid was released from the mass during surgery. The patient with 32 mL of fluid obtained during FNA (case 16) had a history of colloidal silver injections into his hip as part of his self-treatment regimen (he was a doctor of homeopathy).

All but 3 patients (81%) had a known associated nonneoplastic orthopedic condition. Ten had osteoarthritis, degenerative joint disease, or meniscal tears; 2, rheumatoid arthritis; and 1, motor vehicle–induced hip fracture. In 1 case, there was no known joint disease, and for 2 patients, no other history was provided. Nine cases were diagnosed cytologically as soft tissue myxoma, 6 as myxoid lesion or cyst, and 1 as an inflamed myxoid cyst. Tissue diagnosis in 4 of 5 resected cases was synovial (parameniscal or bursal) cyst. One case was a histologically proven juxta-articular myxoma.

Because most patients returned to their primary orthopedist for further management of nonneoplastic orthopedic conditions, it is not known exactly what percentage of JML cases arose from bursae, directly communicated with the joint space, or had meniscal tears. In general, if intra-articular pathology was demonstrated by magnetic resonance imaging, patients were referred to their general orthopedist, and if no intra-articular pathology was found, patients were referred to their primary care physician and received follow-up as needed.

**InM: Clinical Features**

The third category included 11 cases of histologically proven InM (7 cases), myxoid tumors that clinically and radiologically were most consistent with InM but not surgically removed (3 cases), and 1 case misdiagnosed as InM [Table 3]. The latter was confirmed histologically as cystic fat necrosis with myxoid change. Patients ranged in age from 38 to 78 years (mean, 55.5 years) with a male/female ratio of 1:2.7. Masses ranged from 1.5 to 15 cm. Only 1 patient had a trunk mass, none had multiple masses, and none had masses in proximity to a joint. Most (82%) had a nonnontender extremity mass; the thigh was the most common site. With the exception of 1 patient with fibrous dysplasia and InM (Mazabraud syndrome) and 1 with osteoarthritis, no patients had associated orthopedic lesions. After the FNA procedure, it was learned that the patient with cystic fat necrosis was treated for infertility with testosterone injections into the muscle at the site of the thigh mass.

**Cytopathologic Features**

The gross appearance in nearly all aspirates was that of a viscous, gelatinous material with the texture and stringy quality of egg whites. In most cases, it was clear but occasionally was light yellow [Image 1]. Only 2 samples were described as watery or serous. This tacky material spread onto the slide like a clear film with a glossy finish. With the Romanowsky stain, this myxomatous stroma on the slide was nearly always

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### Table 2

<table>
<thead>
<tr>
<th>Case No./Sex/Age (y)</th>
<th>Size (cm)</th>
<th>Site</th>
<th>FNA Diagnosis</th>
<th>GA/Amount of Material (mL)</th>
<th>Orthopedic Condition</th>
<th>Clinical Follow-up</th>
<th>Tissue Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>13/M/52</td>
<td>12</td>
<td>L knee</td>
<td>STM</td>
<td>C, V/4</td>
<td>RA, status postmeniscectomy</td>
<td>1 y</td>
<td>EB Dissecting synovial cyst</td>
</tr>
<tr>
<td>14/M/61</td>
<td>5.2</td>
<td>L popliteal fossa, posterior thigh</td>
<td>Myxoid cyst; acute inflammation</td>
<td>Serous/10</td>
<td>None</td>
<td>EB Synovial cyst</td>
<td></td>
</tr>
<tr>
<td>15/F/46</td>
<td>6.9</td>
<td>L knee</td>
<td>STM</td>
<td>C, V</td>
<td>RA</td>
<td>EB Synovial cyst</td>
<td></td>
</tr>
<tr>
<td>16/M/53</td>
<td>25</td>
<td>L hip</td>
<td>Myxoid cyst</td>
<td>Brown, V/32</td>
<td>Healed hip fracture; colloidal silver injections</td>
<td>1 y</td>
<td>EB</td>
</tr>
<tr>
<td>17/F/80</td>
<td>10</td>
<td>L knee</td>
<td>STM</td>
<td>C, V/12</td>
<td>DJD, knees</td>
<td>7 mo</td>
<td></td>
</tr>
<tr>
<td>18/M/53</td>
<td>7</td>
<td>L popliteal fossa</td>
<td>Myxoid cyst</td>
<td>U</td>
<td>DJD, knees</td>
<td>1.5 y</td>
<td>EB Synovial cyst</td>
</tr>
<tr>
<td>19/F/85</td>
<td>8</td>
<td>L shoulder</td>
<td>Myxoid cyst</td>
<td>C, V/5</td>
<td>Bursitis; meniscal tear</td>
<td>1.5 y</td>
<td>EB Synovial cyst</td>
</tr>
<tr>
<td>20/F/73</td>
<td>7</td>
<td>L shoulder</td>
<td>STM</td>
<td>U</td>
<td>DJD</td>
<td>EB</td>
<td>Synovial cyst</td>
</tr>
<tr>
<td>21/F/72</td>
<td>2</td>
<td>R axilla</td>
<td>STM</td>
<td>C, V</td>
<td>Meniscal tear</td>
<td>Surgical debridement</td>
<td></td>
</tr>
<tr>
<td>22/M/78</td>
<td>4.1</td>
<td>R shoulder</td>
<td>STM</td>
<td>Lt Y, V/1</td>
<td>DJD, meniscal tear</td>
<td>6 y</td>
<td>EB JAM</td>
</tr>
<tr>
<td>23/F/72</td>
<td>1.8</td>
<td>R shoulder</td>
<td>STM</td>
<td>C, V</td>
<td>DJD</td>
<td>Resolved, 1 y</td>
<td>EB</td>
</tr>
<tr>
<td>24/F/32</td>
<td>6.5</td>
<td>R groin and hip</td>
<td>STM</td>
<td>C, V</td>
<td>U</td>
<td>EB</td>
<td></td>
</tr>
<tr>
<td>25/M/40</td>
<td>4.5</td>
<td>R knee</td>
<td>Myxoid cyst</td>
<td>C, V</td>
<td>U</td>
<td>7 mo</td>
<td>EB</td>
</tr>
<tr>
<td>26/M/54</td>
<td>8.5</td>
<td>L knee</td>
<td>Myxoid cyst</td>
<td>Lt Y, V/7</td>
<td>Ankylosing spondylitis</td>
<td>4 mo</td>
<td>EB</td>
</tr>
<tr>
<td>27/M/77</td>
<td>5.3</td>
<td>L trapezius</td>
<td>STM</td>
<td>Lt Y, V/4</td>
<td>DJD, R hip</td>
<td>Resolved, 1 y</td>
<td>EB</td>
</tr>
<tr>
<td>28/F/46</td>
<td>3</td>
<td>L anterior iliac spine</td>
<td>Benign myxoid lesion</td>
<td>C, V/2</td>
<td>DJD</td>
<td>EB Synovial cyst</td>
<td></td>
</tr>
</tbody>
</table>

C, clear; DJD, degenerative joint disease; EB, excisional biopsy; FNA, fine-needle aspiration; GA, gross appearance of fluid; JAM, juxta-articular myxoma; L, left; Lt Y, light yellow; R, right; RA, rheumatoid arthritis; STM, soft tissue myxoma; U, unknown; V, viscous.
easily visible to the naked eye and varied from light lavender
to deep purple depending on the thickness of the smeared
material. Cytologic morphologic features were more or less
similar in all 3 categories, with only a few differences. No
aspirate slides from any of the 3 subtypes contained cytologic
atypia, multinucleated tumor giant cells, mitotic figures, or
acellular necrosis.

Most smears of STG contained abundant myxoid stroma.
Some aspirates retrieved only a small amount of myxoid
material, and the smears reflected this. Myxomatous stroma
typically smeared as a smooth film that was nearly transparent
microscopically and finely granular on high-power examina-
tion. Slides containing a large amount of material typically
showed the gelatinous stroma folded over itself in a pleated
manner Image 2. With Papanicolaou-stained smears, the
stroma varied from being barely visible when there was little
present to showing a “cracking” type of artifact on thickly pre-
pared slides. In a minority of all 39 cases, the myxoid stroma
was fragmented into discrete pieces, analogous to the inspis-
sated type of colloid seen in benign thyroid aspirates. No
slides of STG contained skeletal muscle or adipose tissue.

Slides were primarily hypocellular, but not always so, and
when cells were present, they were almost always mucinous
macrophages, ie, muciphages. Muciphages often were sepa-
rated widely from each other as single cells but also could be
threatened in clusters. Cells were isomorphic, round to oval
mononuclear structures. Some were finely vacuolated, but
most were not, and none had the cytologic appearance of
signet-ring cells or conventional lipoblasts. All displayed a
round, smooth nucleus with no visible nucleolus Image 3.

Immunohistochemical staining for CD68 (1:3,000 dilu-
tion; DAKO, Carpinteria, CA) was performed on the resected
tissue from 1 case of STG and 1 of JML. Positive cytoplasmic
staining for CD68 occurred in macrophages embedded within
the myxoid stroma.

Aspirates of JML were almost identical to those of STG
with only a few slight differences. One case contained a large
component of neutrophils dispersed throughout the myxoid
stroma, 1 case contained fragments of skeletal muscle, and 1
case contained mature adipose tissue. The single case of his-
tologically confirmed JAM contained a single cluster of spin-
dle cells identical to those seen in some cases of InM but oth-
erwise was identical to STG and JML smears.

Aspirates of InM were almost identical to those of STG
with only a few slight differences. One case contained a large
component of neutrophils dispersed throughout the myxoid
stroma, 1 case contained fragments of skeletal muscle, and 1
case contained mature adipose tissue. The single case of his-
tologically confirmed JAM contained a single cluster of spin-
dle cells identical to those seen in some cases of InM but oth-
erwise was identical to STG and JML smears.

Aspirates of InM showed myxoid stroma similar to that
described for STG. Unlike STG, however, strips of skeletal
muscle were scattered within the stroma in 4 of 11 cases Image
4, and 3 cases contained aggregates of mature adipose tissue.
In addition, 5 (71%) of 7 cases of histologically confirmed InM
contained loose aggregates of bland, isomorphic spindle cells.
Cell clusters were considered numerous in 2 cases, ie, more than 5 per slide; these 2 cases also contained rare branching capillaries in some clusters, but none formed a vascular plexus. Spindle cells had long, extremely thin, tapering cytoplasmic extensions that intersected with one another, producing a delicate, hair-like reticulum. Smoothly contoured oval or fusiform nuclei lacked visible nucleoli. Spindle cell clusters were not identified in any cases of STG or JML.

All MJG cases, in particular those of InM, were compared with 24 aspirates of histologically confirmed myxoid soft tissue lesions as classified by the World Health Organization. This control group consisted of the following cases: myxoid liposarcoma (LPS), 7; nodular fasciitis (NF), 4; extraskeletal myxoid chondrosarcoma (EMC), 4; myxofibrosarcoma, 3; low-grade fibromyxoid sarcoma (LGFMS), 2; chordoma (manifesting as soft tissue masses), 2; and fibromyxolipoma and metastatic mucinous adenocarcinoma, 1 each.

The principal morphologic differences between MJG cases and control cases were as follows: the presence of discrete, tightly clustered, syncytial cell microfragments (all cases of myxoid LPS, EMC, myxofibrosarcoma, LGFMS, and chordoma), opaque stroma (all cases of EMC, LGFMS, and chordoma), and cell clusters (all cases of control cases).

**Image 2** Ganglion. A (Case 2), Acellular myxoid stroma folded in a pleated pattern (Romanowsky, ×20). B (Case 3), Thick myxomatous stroma producing a glaze-like crackle pattern (Papanicolaou, ×10).

**Image 3** A, Ganglion. Singly dispersed cells and a loose 8-cell cluster show polygonal cells with uniform size and shape and rounded nuclei. Cytoplasm is finely reticulated and the cell border is sharp in most (Romanowsky, ×60). B, Juxta-articular myxoid lesion. Isomorphic cells with abundant cytoplasm contain 1 or more cytoplasmic vacuoles (Papanicolaou, ×40).
and chordoma), and a marked difference in cellularity (3 of 4 cases of NF, 6 of 7 cases of myxoid LPS, and all cases of EMC, myxofibrosarcoma, LGFMS, chordoma, and mucinous adenocarcinoma). With the exception of myxoid LPS and LGFMS, cell nuclei from all other malignant neoplasms had a conspicuously larger diameter than the nuclei of InM; cell nuclei of NF also were consistently larger and always had distinctly visible nucleoli. A thick “film” of myxoid stroma analogous to that seen in MJG cases was present in 1 of 7 myxoid LPS cases, 4 of 4 EMC cases, 1 of 3 myxofibrosarcoma cases, and 1 of 2 LGFMS cases and was absent from all other cases.

The 2 cases of LGFMS were the only lesions that showed considerable morphologic similarity with 4 of 10 cases of InM (and none with STG or JML) by virtue of their cell clusters. But even these LGFMS aspirates showed greater cluster cellularity and a more opaque, collagenous stroma with embedded spindle cells.

**Discussion**

Myxoid change is a nonspecific but not uncommon phenomenon in the sphere of soft tissue tumors. It is so ubiquitous in some soft tissue neoplasms that the adjective myxoid has been incorporated into their officially sanctioned nosologic classification. In these specific benign or malignant tumors, the myxoid change always is combined with a cellular component that defines the neoplasm, eg, LGFMS, myxoid LPS, and myxofibrosarcoma. We studied the cytologic features of a different set of soft tissue myxoid “tumors and masses”—those that completely lack this definitional cellular ingredient and those in which the cellular element is considered a secondary feature.

We analyzed the cytopathologic features of 39 FNA biopsy cases of noncutaneous, nonosseous, and nonvisceral soft tissue myxoid lesions and were able to subclassify them (with incorporation of clinical and radiologic data) into STG, JML, and InM. Not surprisingly, the cytopathologic features among these subtypes were remarkably similar. The gelatinous fluid that produces the mass in the first place dominated aspirate slides. Smears typically were paucicellular (with the exception of some aspirates of InM), containing few cells other than the inflammatory or phagocytic type.
The clinical diagnosis of an STG (ganglion cyst) generally was straightforward and nearly always correct in cases in which it was recorded in our series. Thus, FNA often was performed in our series merely to confirm the clinical impression. For example, in case 7, recently diagnosed by FNA as a sarcoma of the thigh, the surgeon was quite confident that the ipsilateral lesion on the patient’s ankle was merely a ganglion. Nevertheless, the surgeon wanted cytologic confirmation of his clinical impression before operating; a diagnosis of sarcoma on the ankle would have meant an above-knee amputation, whereas a diagnosis of ganglion meant wide excision of the thigh tumor. If patients with STG were not particularly symptomatic, no further treatment was administered.

Almost all of the aspirates of STG echoed what has been described for this lesion: clear or light yellow viscous fluid that appears as a finely granular precipitate in high-power examination (Romanowsky stains only) and often produces a folding or overlapping of the myxoid material on the glass slide.\(^6\)\(^6\) In thickly prepared slides, this gelatinous material produced a glaze-like crackle pattern that was seen in Papanicolaou-stained but not Romanowsky-stained smears. Cells were isolated single forms or appeared in loose clusters. Regardless of the degree of cellularity, cells had similar morphologic features that were typical of muciphages or histiocytes and mirrored what has been described previously: round to oval with single nuclei, indistinct nucleoli, dense or vacuolated cytoplasms, and a well-defined cell border. Although occasional clusters contained as many as 15 cells in our series, we found none with 30 or more cells or any with so-called cannonball features as described in a series of 21 patients.\(^6\)

Many cases (16) were categorized as JML because of proximity of the lesion to a large joint. Almost all had an associated nonneoplastic orthopedic condition. About half had osteoarthritis (degenerative joint disease), but others had rheumatoid arthritis or meniscal tears before the FNA, indicating that most masses were secondary to leakage of synovial fluid from an injured joint or had a direct communication with the joint.

JMLs have been the subject of only a few studies. Punia et al\(^7\) described the cytologic findings in 19 cases diagnosed as bursal cyst. These occurred in the popliteal fossa, elbow, knee, shoulder, and calf. The cytomorphic features of these cases is identical to what we found, with the exception of 2 cases having what Punia et al\(^7\) illustrate as cells in a pseudopapillary configuration. They do not mention whether any of their patients had associated orthopedic conditions.

In only 5 of our 16 cases of JML was a follow-up tissue specimen available. The reason is that these lesions usually are treated conservatively with nonsteroidal anti-inflammatory drugs, compression sleeves, and physical therapy. Arthroscopic evaluation might be indicated if an intra-articular lesion causes mechanical symptoms, but patients with such symptoms are referred to a general orthopedic surgeon for care. Thus, the FNA finding of a benign myxoid lesion from a mass in proximity to a large joint mass is a reassuring diagnosis for orthoped oncologists and patients. Patients can be treated appropriately by a general orthopedist, and surgical intervention can be performed on an elective basis if symptoms warrant or conservative measures as aspiration have failed.

InM is classified as a tumor of uncertain differentiation.\(^4\) The cases in our series fit the typical demographic qualities of this tumor with a decided female predominance; manifestation as a painless, palpable, firm mass; extremity location; and mean age in the sixth decade of life. A few series of InM have been published with cytopathologic findings nearly identical to ours. Caraway et al\(^8\) described 10 histologically proven cases of InM. The gross description of their material was identical to that in our cases. However, a slightly lower percentage of their cases (60% vs 71% in our series) contained aspirates with spindle cells. They also found rare cells in 2 cases with intranuclear inclusions—a finding that was absent in our material. These spindle cell aggregates were morphologically similar to what we encountered with long intersecting processes that formed fibrillar tangles. \(\text{Akerman et al}^{10}\) also described identical-appearing loose spindle cell clusters and found them in all 10 (100%) of their cases along with degenerating skeletal muscle fibers (70% of cases) mimicking multinucleated giant cells. These authors also described the sparse presence of coarsely vacuolated cells, a feature not encountered by us or by Caraway et al\(^8\).

Although we were able to correctly make a preoperative FNA diagnosis in all cases of InM in this series, this is not necessarily the experience of others. Silver et al\(^10\) retrospectively examined a series of 17 cases of histologically proven InM. In 8 cases, a preoperative FNA biopsy of the mass was done, yet only 3 (38%) were diagnosed correctly as myxoma. Two were deemed inadequate or inconclusive, and 3 were diagnosed as suggestive of malignancy.

One of our surgically resected cases (case 29) showed histopathologic features of the recently emphasized cellular myxoma.\(^11\) These variants have been subclassified based on A zones of hypercellularity and hypervascularity in an otherwise conventional InM. In most cases, foci of hypercellularity (with cells cytologically identical to those seen in paucicellular foci) occupy more than 50% of the tissue.\(^11\) Yet, this increased cellularity and vascularity did not transfer to the aspirate in case 29; the slides showed cytomorphic features similar to other cases of InM.

To our knowledge, 1 other cytologic report of a so-called cellular variant of InM exists. Unlike our case in which a percutaneous FNA biopsy with conventional smears was done, in this report, a single liquid-based slide was made from fluid aspirated from a cystic component of the myxoma during an incisional biopsy.\(^12\) The authors describe atypical cells and...
atypical multinucleated cells on the smear and in a cell block. Thus, based on 2 cases, generalizations cannot be made about whether cellular myxoma could be a source of diagnostic confusion in FNA biopsy.

When compared with a control set of aspirates from specific myxoid soft tissue tumors, the distinctive features of MJG lesions were recognized easily in nearly all cases. The MJG group of aspirates not only was deficient in cellularity compared with specific myxoid lesions but also lacked other features. These included an absence of discrete cell microfragments (whereby cells are clustered closely together in a syncytial arrangement instead of the loose spindle cell tangles of InM) and an opaque chondromyxoid type of stroma. LGFMS seems to have the greatest potential to be confused with InM, even though we were able to recognize the 2 cases in our files as sarcoma before resection and not as myxoma (unpublished observations). Our 2 cases of LGFMS contained greater cellularity within the cell cluster and a more collagenous stroma than seen with cases of InM. Lindberg et al reported 3 cases illustrating the FNA cytopathologic features of LGFMS and stated that a definitive diagnosis of LGFMS cannot be made from FNA biopsy, yet they did not contrast specifically the cytologic differences between this tumor and InM. The illustrations from their figures 1 and 3 taken in isolation without examination of the entire set of slides from an FNA biopsy are identical to foci seen in cell clusters from some of our cases of InM (Image 5).

The FNA cytopathologic diagnosis of MJG lesions can be highly accurate, not only for distinguishing a benign from a malignant entity but also for distinguishing STG, JML, and InM when clinical and radiologic data were considered with the cytopathologic features. In our practice, FNA biopsy that confirms any of these 3 lesions permits us to defer surgery unless clinical symptoms warrant surgical intervention. However, this approach to non-neoplastic soft tissue myxomas is highly dependent on a very close working relationship between the cytopathologist and orthopedic surgeon or surgical oncologist.

References