Aspiration Biopsy of Mammary Lesions With Abundant Extracellular Mucinous Material

Review of 43 Cases With Surgical Follow-up

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Key Words: Aspiration biopsy; Breast; Mucin; Colloid adenocarcinoma; Mucocele-like lesion; Myxoid fibroadenoma

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Abstract

We reviewed 43 fine-needle aspiration biopsy (FNAB) smears with abundant extracellular mucinous material to determine whether accurate classification of mucinous lesions is achievable on FNAB: 26 had carcinoma (pure colloid carcinoma [CCA], 23; mixed CCA/invasive ductal carcinoma [IDC], 3); 17 had benign lesions on follow-up (benign MLL, 6; fibrocystic change [FCC], 6; myxoid fibroadenoma [MFA], 5). All carcinomas were identified correctly as malignant on FNAB. The initial cytologic diagnoses in benign cases were benign in 8, atypical in 8, and “suspicious” for carcinoma in 1. CCAs were moderate to markedly cellular with mild to moderate atypia and lacked oval bare nuclei. Marked nuclear atypia was confined predominantly to cases with mixed CCA/IDC. A distinct feature of CCA was thin-walled capillaries. FCCs and benign MLLs had overlapping cytologic features and showed variable cellularity and no or mild atypia. MFAs were markedly cellular with dyscohesion and variable atypia; stromal fragments and oval bare nuclei were present in every case. Mucinous lesions can be divided into 2 categories by FNAB: those that are adenocarcinomas and those that are not. CCAs have distinctive features that allow a definitive diagnosis on FNAB. Unnecessary surgery can be avoided in MFA by careful evaluation of smear characteristics. Cytologic features of FCC and MLL overlap. Owing to the documented association of MLL with carcinoma, we recommend that lesions that cannot be classified definitively as adenocarcinoma or MFA be considered for conservative excision, even in the absence of atypia.

Besides colloid (mucinous) carcinoma (CCA), a variety of mammary lesions might yield abundant extracellular mucinous material on fine-needle aspiration biopsy (FNAB). The cytologic features of CCA are well established.\textsuperscript{1-10} The diagnosis of malignancy on aspiration biopsy is straightforward when all the characteristic criteria are present. However, aspirates with abundant extracellular mucinous material originating from other mammary lesions, especially those with increased cellularity, may pose a diagnostic challenge on FNAB.\textsuperscript{1-10} Benign lesions, such as myxoid fibroadenoma and fibrocystic change (FCC), can mimic CCA with relatively cellular, mucin-rich smears and occasional atypical cells.\textsuperscript{7,8,11} Conversely, mucocele-like lesions (MLLs) can have a deceptively benign appearance on FNAB, and yet ductal carcinoma in situ (DCIS) or invasive ductal carcinoma may be revealed by excision, further complicating the diagnostic problem.\textsuperscript{6,7,12-14}

Comparative studies describing the cytologic features in MLLs, CCA, and other benign mucinous lesions that might mimic CCA are relatively few and consist of a small number of cases.\textsuperscript{1,4,6,7,9,10} We reviewed the FNAB smears and subsequent resected specimens from 43 mammary lesions containing abundant extracellular mucinous material on aspiration biopsy to determine whether accurate classification of lesions yielding copious mucinous material can be achieved on FNAB.

Materials and Methods

The computerized records of the Cytopathology Division at New York University Hospitals (Tisch and Bellevue Hospitals, New York, NY) for January 1992 to December 2001
were searched for mammary aspiration biopsy specimens that showed abundant extracellular mucinous material with or without associated epithelial cell atypia.

We identified 69 cases. The patients all were women who had palpable or nonpalpable radiologic abnormalities. Follow-up information was not available for 26 women whose FNABs were done by radiology groups at outside institutions. Aspirated material was processed and evaluated at our laboratory, and the treatment of all 26 women was managed by physician practice groups that are not affiliated with our institution. Thus, they were excluded from the study.

The remaining 43 women had undergone FNAB at our institution. In this group, all underwent surgical excision 2 weeks to 3 months after the initial cytologic diagnosis. FNABs of the palpable breast nodules were performed by cytopathologists using 25- or 27-gauge needles. FNABs of the nonpalpable lesions were performed by cytopathologists by a stereotaxic approach using 22-gauge spinal needles in the presence of a radiologist who targeted the lesion or by radiologists using ultrasound guidance and 23- or 25-gauge needles in the presence of a cytopathologist who provided an immediate diagnosis. In each case, 2 to 8 smears were prepared. The material obtained at aspiration was expressed onto glass slides, air dried, and stained with a rapid Romanowsky–type stain (Quik-Dip stain, Mercedes Medical, Sarasota, FL), the Ultrafast Papanicolaou stain (Richard-Allan, Kalamazoo, MI), or both.

The smears were reviewed and evaluated for the following features: cellularity, nuclear atypia (increased nuclear/cytoplasmic ratios, irregularities of nuclear contour, clumped chromatin, prominent nucleoli), presence of single (dissociated) ductal epithelial cells and oval bare nuclei, and the quantity of extracellular mucinous material and its association with the epithelial component. Background components such as the presence of stromal fragments, macrophages, and apocrine cells also were noted. The cellularity of smears and cellular atypia were graded on a scale from 0 (none) to 3+ (marked). A 4-tiered grading system was used instead of a 3-tiered approach to emphasize the total absence of certain evaluated features such as atypia and cellularity in some cases. The slides from corresponding resections were reviewed to confirm the diagnosis and to document the source of the mucinous material.

### Results

Forty-three cases (43 women; age range, 28-92 years; mean age, 58.5 years) were identified. In 20 women, there were palpable nodules. In 23 women, there were nonpalpable lesions, of which 18 were masses, 4 were microcalcifications, and 1 was an asymmetric density. Of the 23 nonpalpable cases, 14 were sampled by stereotaxic guidance and the remainder by ultrasound guidance. The initial cytologic diagnoses in the 43 cases were as follows: benign, 8 (19%); atypical, 8 (19%); “suspicious” for carcinoma, 1 (2%); and positive for carcinoma, 26 (60%). The initial cytologic diagnoses with corresponding histologic diagnoses are noted in Table II.

### Cytoplastic Findings in CCA

All 26 malignant cases were identified correctly as adenocarcinoma on FNAB Image II. After excision, 3 of these were revealed to be mixed invasive ductal and colloid carcinomas, and 23 cases were pure CCAs. A specific diagnosis of “colloid adenocarcinoma” was made in only 9 (35%) of 26 cases by the original cytopathologist; others were designated as “adenocarcinoma with mucinous features.”

The majority (24/26) of malignant smears were moderately (2+) to markedly (3+) cellular. There were only 2 cases of CCA with scant cellularity. In 1 of these cases, the presence of single epithelial cells with large nuclei and prominent nucleoli justified a definitive diagnosis of adenocarcinoma. The second case was more problematic owing to the bland nature of the sparse epithelial component. The

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**Table II**

Summary of Cytologic-Histologic Correlation of Diagnoses

<table>
<thead>
<tr>
<th>Cytologic Diagnosis</th>
<th>Fibrocystic Change/ Duct Ectasia</th>
<th>Mucocele-Like Lesion</th>
<th>Myxoid Fibroadenoma</th>
<th>Colloid Carcinoma</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benign</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>—</td>
<td>8 (19)</td>
</tr>
<tr>
<td>Atypical</td>
<td>3†</td>
<td>1</td>
<td>4</td>
<td>—</td>
<td>8 (19)</td>
</tr>
<tr>
<td>“Suspicious”</td>
<td>0</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Positive</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>26†</td>
<td>26 (60)</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>26†</td>
<td>43 (100)</td>
</tr>
</tbody>
</table>

* Given as number (percentage).
† One case that was called atypical on fine-needle aspiration biopsy showed mostly FCC with dilated ducts and inspissated mucin, atypical ductal hyperplasia, and a few ducts with low-grade ductal carcinoma in situ.
‡ Three were mixed ductal (not otherwise specified type) and colloid carcinomas.
neoplastic cells were mostly cohesive with only a few single intact epithelial cells floating in mucin. A careful search revealed scattered single cells with eccentric, round, slightly enlarged nuclei and small but distinct nucleoli.

The mucinous material was abundant in all cases and originated from the extracellular mucin in which the tumor cells were floating on histologic sections. It appeared thin and wispy or thick and resembling colloid on aspiration biopsy smears.

Cellular atypia was mild to moderate (1+ to 2+) in 22 (96%) of 23 cases of pure CCA. Only 1 case of pure CCA had 3+ nuclear atypia.

In general, the cases of CCA lacked oval bare nuclei. The cytologic pattern was highly variable from predominantly dyscohesive single epithelial cells floating in a mucinous background to predominantly cohesive sheets and 3-dimensional aggregates of cells with only scattered dissociated single intact atypical cells.

A distinct feature of CCA was the presence of thin-walled capillaries, either free-floating or coursing through the thick mucin, noted in 22 (96%) of the 23 cases. The quantity of mucin was abundant in all CCAs, and in all cases, epithelial cells were embedded in mucin in clusters or singly.
The 3 mixed adenocarcinomas differed from pure CCA cases in that they were all markedly (3+) cellular, and all displayed 3+ nuclear atypia.

**Cytologic Findings in Benign Mucinous Lesions**

Among the cases that were benign at resection, 6 were benign MLLs, 6 were FCCs, and 5 were myxoid fibroadenomas. Women with benign lesions were young (mean age, 47.0 years) compared with those with CCA (mean age, 65.0 years).

**Mucocele-Like Lesions**

The original cytologic diagnoses were benign in 4 patients, atypical in 1 patient, and suspicious for CCA in 1 patient. All cases contained abundant extracellular mucinous material (3+). The cellularity was low (0 to 1+) in 4 and moderate (2+) in 2 cases. In the lesions originally designated as benign, mucin was mostly acellular or contained macrophages or apocrine cells and rare benign ductal cells. Two cases were overcalled as atypical and suspicious because a low-grade, paucicellular CCA could not be excluded. Review revealed that one of these contained scattered cohesive clusters of benign ductal cells that were not embedded in mucin and lacked dyscohesion and cellular atypia. Excision revealed a benign MLL surrounded by proliferative FCC, which was the source of the epithelial component on the FNAB smears. The other lesion was moderately (2+) cellular with cohesive sheets and small clusters of cells and rare linear arrays of single epithelial cells embedded in mucin. Some epithelial cells displayed nuclear enlargement. Myoepithelial cells overlying the cellular clusters and oval bare nuclei were present. Excision revealed this case as a benign MLL with papillary ductal hyperplasia. None of the other MLLs displayed usual ductal hyperplasia.
atypical ductal hyperplasia, or carcinoma on excision. Case 4, with 2+ cellularity, was adjacent to a fibroadenoma, likely accounting for the pronounced cellularity.

**Fibrocystic Change**

The major difference in the findings between MLL and FCC was the cellularity of smears. In contrast with MLL, the cellularity in the aspirates from FCC cases varied from 0 to 3+, depending on the extent of epithelial ductal proliferation. The source of mucin in each case seemed to be from dilated ducts and cysts. Smears from 3 cases were diagnosed as benign and 3 as atypical. Two cases were as cellular as CCAs; in 1 case, the lack of significant atypia, the absence of crowding and overlapping of epithelial cells in the clusters, the lack of single atypical cells floating in mucin, and the absence of vascular structures led to a benign diagnosis. In the second case, despite the absence of cytologic atypia, the presence of a substantial number of dissociated intact epithelial cells led to a diagnosis of atypia. A careful search revealed a variable amount of oval bare nuclei in the majority of FCC cases, supporting a benign diagnosis. A second lesion originally was classified as atypical on the basis of moderate cellularity with papillary cohesive clusters of uniform ductal epithelial cells without atypia. No single cells were noted. At excision, there was a focus of low-grade solid and cribriform DCIS; however, the main lesion was proliferative FCC. In this case, mucin came from dilated ducts within areas of proliferative FCC. The DCIS had no associated mucin and was thought to be an incidental finding. The third atypical diagnosis was based on the presence of increased cellularity, numerous small clusters of ductal cells, and scattered single ductal cells without atypia. A radial scar was noted at excision.

All smears from FCCs contained a variable number of myoepithelial cells associated with clusters and sheets of ductal cells and oval bare nuclei in the background.

**Myxoid Fibroadenoma**

Aspirates from myxoid fibroadenomas were highly cellular (3+) with numerous single intact epithelial cells, mucinous pools, and occasional single cells with abundant cytoplasm and eccentric nuclei. These features led to the classification of 4 cases as atypical (Table 1). Retrospective review revealed that fibrovascular stromal fragments and numerous oval bare nuclei characteristic of fibroadenoma were present in every case. The fibrovascular structures in myxoid fibroadenomas always were seen within the stromal fragments, differing from CCAs wherein the vessels were thinner and often were free-floating or embedded in wispy strands of mucin.

**Sensitivity and Specificity of FNAB for Detection of Carcinoma in Lesions With Abundant Extracellular Mucinous Material**

In our series, the detection rate of carcinoma by FNAB in lesions with abundant extracellular mucinous material was 100% (sensitivity). We had no false-negative cases. The specificity of a cytologic diagnosis of malignancy in such lesions was 94% if one considers the suspicious category as false-positive and 65% if the atypical and suspicious categories are
regarded as false-positive. The specificity of a specific diagnosis of “colloid adenocarcinoma” was 77%. Of 9 cases that originally were designated as colloid adenocarcinoma on FNAB, 2 were mixed carcinomas with an invasive ductal component, not otherwise specified (NOS) type.

**Discussion**

Mucinous material on FNAB smears from mammary lesions is observed in a variety of lesions ranging from benign to malignant. It is well recognized that distinguishing benign mucinous lesions from colloid adenocarcinoma can be difficult on aspiration biopsy specimens.1,3,4,6,8,11,13 The goal of the present study was 2-fold: to explore the range of lesions that yield abundant extracellular mucinous material on aspiration biopsy and to determine whether benign mucinous lesions can be distinguished reliably from CCA based on cytology.

Our study indicated that CCA can be diagnosed as malignant by FNAB alone with a high level of accuracy. However, although one can suggest or favor the “colloid” subtype based on characteristic cytologic features, a specific histologic classification as CCA is not advocated, as 12% (3/26) of adenocarcinomas with abundant extracellular mucinous material were mixed mucinous and ductal (NOS) types on excision in our series. High nuclear grade is a good cytologic indicator that the tumor contains a substantial percentage of nonmucinous ductal carcinoma (NOS type).

The cytologic features of CCA noted in our cases are similar to those described by others.1-5,15 The smears usually are hypercellular and display relatively uniform epithelial cells in cohesive sheets and in 3-dimensional clusters with a variable number of single, intact epithelial cells floating in a

![Image 4](Image 4) Myxoid fibroadenoma mimicking colloid carcinoma. **A**, This smear demonstrates the bimodal pattern of a typical fibroadenoma: staghorn epithelial clusters and stromal fragments. In addition, this myxoid fibroadenoma contains abundant strandy or fibrillar mucoid material in comparison with the true mucin of colloid adenocarcinoma, which is thin and wispy or thick and colloid-like (rapid Romanowsky, ×4). **B**, Note the mucoid stromal fragment containing a fibrovascular core and spindled cells. Although similar vasculature is present in colloid adenocarcinoma, the vessels are not embedded in stromal fragments that contain spindled cells (rapid Romanowsky, ×40). **C**, Histologic section of the preceding myxoid fibroadenoma shows abundant mucoid matrix that is the source of the mucoid background in aspirate smears of myxoid fibroadenoma (H&E, ×10).
mucinous background. Atypia usually is mild to moderate. In our study, marked nuclear atypia was confined predominantly to cases with mixed colloid and ductal (NOS type) adenocarcinomas. An additional feature described in CCA is the presence of thin endothelial-lined vessels within a background of mucin.3–6,10 This feature was particularly prominent in our study. Thin blood vessels coursing through mucin were seen in the majority (22/23 [96%]) of our cases.

We identified FCC, myxoid fibroadenoma, and MLL as the benign mammary proliferations that can yield abundant extracellular mucin on aspiration biopsy. The distinctive cytologic features of each of these are summarized in Table 2 and compared with those of CCA. Among these, myxoid fibroadenoma represents the most difficult diagnostic challenge based on increased cellularity and dissociation of intact epithelial cells if extracellular mucinous material is abundant and no fibromyxoid or spindle cell stromal component is sampled.7,8,11 Aspiration smears from myxoid fibroadenomas typically are hypercellular with numerous clusters of ductal epithelial cells without substantial cytologic atypia and contain a bimodal pattern with a fibromyxoid stromal component and oval bare nuclei in a background of mucinous material.3,5,15 A lack of the characteristic cytologic features of fibroadenoma and the presence of abundant mucinous pools can be a source of cytologic misdiagnosis.7,11,15 The background mucinous material is derived from the prominent mucous change in the stroma of the myxoid fibroadenoma. Although it resembles true mucin on FNAB, it is tinctorially different from the neutral and acid mucin seen as wispy material in colloid adenocarcinoma.11 The true mucin in colloid adenocarcinoma stains with mucicarmine, periodic acid–Schiff (PAS), and alcian blue, whereas the mucoid material in myxoid fibroadenoma does not react with mucicarmine but is positive for PAS and alcian blue stains.8,11 Owing to the hypercellularity of the smears, the dyscohesion of the ductal epithelial cells, and scantiness of the stromal component, 4 of our 5 cases of myxoid fibroadenomas were diagnosed as atypical, necessitating excision for further characterization. Knowledge of the age of the patient is useful because women with fibroadenoma and benign fibroepithelial lesions typically are younger than those with CCA, as noted in our study (mean ages, 47 years and 65 years, respectively).

Extracellular mucin in smears of FCC originates from dilated ducts and microcysts that contain mucicarmine–, PAS–, and alcian blue–positive mucin, similar to CCA.8 In our cases of FCC, the degree of cellularity corresponded to the amount of ductal hyperplasia seen in histologic sections, and on occasion, it was as high as CCA. The most helpful cytologic findings to distinguish these cases from CCA are the presence of myoepithelial cells, the absence of crowding and overlapping of epithelial cells in the clusters, the lack or rarity of single atypical intact epithelial cells floating in mucin, and the absence of vascular structures characteristic of CCA.

MLL of the breast is an uncommon tumor initially described by Rosen16 as a benign process characterized by multiple cysts lined by flat or cuboidal epithelium with breaks and spillage of mucoid material into the stroma. In his original communication involving 6 patients, Rosen16

| Table 2 |

Comprehensive Cytologic Features in Mammary Lesions With Abundant Extracellular Mucinous Material on Fine-Needle Aspiration Biopsy*

<table>
<thead>
<tr>
<th>Fibrocystic Change</th>
<th>Mucocele-Like Lesion</th>
<th>Myxoid Fibroadenoma</th>
<th>Colloid Carcinoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellularity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pattern</td>
<td>0 to 3+</td>
<td>Mostly 0 or 1+; rarely 2+</td>
<td>3+ to 3+</td>
</tr>
<tr>
<td></td>
<td>Cohesive epithelial cell clusters associated with myoepithelial cells</td>
<td>Presence and amount of an epithelial component directly proportional to the degree of hyperplasia within the MLL; pattern similar to that for FCC</td>
<td>Staghorn epithelial clusters, stromal fragments, and numerous oval bare nuclei</td>
</tr>
<tr>
<td>Atypia</td>
<td>No</td>
<td>No</td>
<td>Mild atypia and dissociation are usual</td>
</tr>
<tr>
<td>Background</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oval bare nuclei and macrophages present; no stromal fragments</td>
<td>Similar to that for FCC</td>
<td>Numerious oval bare nuclei; stromal fragments</td>
</tr>
<tr>
<td>Nature of mucinous material</td>
<td>Wispy or colloid-like; positive for mucicarmine, PAS, alcian blue</td>
<td>Wispy or colloid-like; positive for mucicarmine, PAS, alcian blue</td>
<td>Strandy; negative for mucicarmine; positive for PAS, alcian blue</td>
</tr>
<tr>
<td>Association of mucinous material with other smear components</td>
<td>Similar to MLL</td>
<td>Mostly acellular mucin; mucin may contain rare macrophages, apocrine cells, and benign ductal epithelial cells</td>
<td>Epithelial cells, stromal fragments, and oval bare nuclei float in mucin</td>
</tr>
</tbody>
</table>

NOS, not otherwise specified; PAS, periodic acid–Schiff.

* The scale for cellularity was as follows: 0, acellular; 1+, hypocellular; 2+, moderate; 3+, marked. The scale for atypia was as follows: 0, none; 1+, mild; 2+, moderate; 3+, marked.
commented that the FNAB findings in MLL may be indistinguishable from CCA. In fact, the preoperative aspiration biopsy specimens for 2 women were interpreted as suspicious for CCA based on the presence of abundant extracellular mucin. Rosen and Oberman stated that the ratio of extracellular mucin to epithelial component in CCA varies from 40% to 99%, in some cases requiring evaluation of numerous histologic sections to detect small neoplastic foci. Thus, aspirates rich in extracellular mucin and low in cellular content may be disconcerting, and benign MLL must be distinguished from paucicellular CCA in such cases. However, in our experience, low cellularity in aspirates of CCA is a rare occurrence, and in such cases, the presence of single intact epithelial cells with atypia leads to the correct diagnosis.

The entity of MLL was revisited in a subsequent report by Hamele-Bena et al, in which MLL was classified into benign and malignant categories. Benign MLL comprises MLL associated with proliferative changes ranging from mild ductal hyperplasia to atypical ductal hyperplasia. Malignant MLL comprises those with DCIS (micropapillary and cribriform) and with foci of invasive carcinoma (mucinous type). Our findings, as well as findings reported by others, suggest that MLL encompasses a spectrum of features of malignant MLLs fall between benign MLL and CCA in that they are more cellular, dyscohesive, and atypical than benign MLLs. Most authors agree that CCA can be diagnosed definitively on aspiration biopsy in the majority of cases by experienced cytopathologists, and the diagnosis of benign MLL can be suggested with a high level of accuracy on FNAB. However, the surgical removal of all mucin-rich lesions diagnosed by FNAB is advocated owing to the possibility that the aspiration biopsy material may not be representative of the whole lesion; foci of DCIS or invasive carcinoma in malignant MLL may not be sampled by FNAB. Wong and Wann and Yeoh et al reported 2 MLLs associated with DCIS that were virtually acellular on FNAB (Table 3).

The results of our study provide additional information on the cytologic spectrum of benign and malignant mucinous lesions of the breast. Mucinous lesions can be divided into 2 categories by aspiration biopsy: those that are adenocarcinomas and those that are not. In malignant cases, surgical treatment can be performed based on a cytologic diagnosis alone. The majority of adenocarcinomas with abundant extracellular mucinous material, low nuclear grade, and other characteristic cytologic features such as thin vasculature will be CCA on excision. Caution must be taken in diagnosing any malignant mucinous lesion with a high nuclear grade specifically as CCA as these lesions most likely will harbor ductal adenocarcinoma, NOS component.

The majority of other mammary mucinous lesions encountered on aspiration biopsy will be due to FCC and myxoid fibroadenoma, with MLL as a small minority. Unnecessary surgical intervention may be avoided in myxoid fibroadenomas and FCC by careful evaluation of cytologic criteria; oval bare nuclei, in particular, are almost never seen in CCA. It may not be possible to avoid surgery in all cases of FCC, owing to overlapping features with MLL. The association of MLL with small foci of DCIS and invasive adenocarcinoma warrants further management of paucicellular mucin-rich aspirates. We recommend that acellular or sparsely cellular lesions that lack cytologic atypia, whether representative of FCC or MLL, be

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**Table 3**

<table>
<thead>
<tr>
<th>Reference</th>
<th>No. of Cases</th>
<th>Histologic Findings</th>
<th>Cytologic Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhargava et al</td>
<td>2</td>
<td>Benign MLL</td>
<td>Scant cellularity, cohesive sheets, no single cells, no atypia</td>
</tr>
<tr>
<td>Fanning et al</td>
<td>3</td>
<td>Benign MLL</td>
<td>Scant cellularity, cohesive sheets, no single cells, no atypia</td>
</tr>
<tr>
<td>de la Vega et al</td>
<td>1</td>
<td>Benign MLL</td>
<td>Moderate cellularity* and dispersion, no atypia</td>
</tr>
<tr>
<td>Yeoh et al</td>
<td>12</td>
<td>Benign MLL, 8 malignant MLL (with DCIS), 4</td>
<td>Benign: acellular or scant cellularity, cohesive sheets, oval bare nuclei, no atypia; malignant: mild to moderate cellularity, 1 was acellular, mild dyscohesions, rare single cells, mild atypia</td>
</tr>
<tr>
<td>Wong and Wann</td>
<td>7</td>
<td>Benign MLL, 5 malignant MLL (with DCIS), 2</td>
<td>Benign: scant cellularity, cohesive sheets, no or rare single cells, no atypia; malignant: 1 was as above; 1 showed moderate cellularity, single cells, mild atypia</td>
</tr>
<tr>
<td>Sohn et al</td>
<td>2</td>
<td>Benign MLL, 1 malignant MLL (with DCIS), 1</td>
<td>Benign: scant cellularity, cohesive clusters, rare single cells, no atypia; malignant: moderate cellularity, single cells, mild atypia</td>
</tr>
</tbody>
</table>

DCIS, ductal carcinoma in situ; MLL, mucocele-like lesion.

* Cellularity due to fibrocystic change in surrounding tissue.
considered for conservative surgical excision based on the lack of reliable cytologic and radiologic criteria to distinguish MLLs that may contain foci of DCIS or an invasive adenocarcinoma. Radiologic follow-up of such lesions without excision is not optimal. Although malignant MLLs are slightly larger (2.8 vs 1.8 cm) and have a higher rate of calcification (71% vs 46%) in comparison with benign MLLs, radiologic features overlap, and, furthermore, 18% of malignant MLLs are not detectable by mammography.\textsuperscript{13} While mucinous lesions with cytologic atypia must also be removed, the majority will represent proliferative-type FCC, myxoid fibroadenoma, or, less commonly, MLL with ductal hyperplasia with or without atypia at excision. Most mucinous lesions can be classified accurately by FNAB, findings similar to those noted by core needle biopsy.\textsuperscript{21}

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\textbf{References}