Accuracy of Percutaneous Core Needle Biopsy in Diagnosing Papillary Breast Lesions and Potential Impact of Sonographic Features on Their Management

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ABSTRACT: *Objective.* To assess retrospectively the accuracy of core needle biopsy in diagnosing papillary breast lesions and evaluate the prediction of malignant papillary lesions based on sonographic features.

Methods. Review of 130 papillary lesions diagnosed on core needle biopsy (2002–2008) in 110 patients. The biopsy results were compared with final surgical pathology or evolution on imaging follow-up. Lesion size, patient age, type of biopsy needle and guidance, and length of imaging follow-up were documented. Sonographic features were retrospectively reviewed according to the BI-RADS lexicon. Morphology, not part of BI-RADS, was assessed as intraductal, intracystic, or solid.

Results. Of the 130 papillary lesions, 6 were sampled with an 11-G vacuum-assisted needle under stereotactic guidance and the remaining 124 were sampled under US guidance with a 14-G (n = 115), 18-G (n = 8), or 10-G (n = 1) needle. Initial core needle biopsy diagnosis was benign (n = 103), showed atypia (n = 20), or malignancy (n = 7). Thirty-seven (36%) benign lesions were surgically excised and 66 (64%) were followed up. On final outcome, 10 benign lesions were upgraded to malignancy (9.7%) and 3 to atypia (3.6%). There was no significant difference in the benign, malignant, and upgraded groups with respect to size, age, or BI-RADS sonographic characteristics. None of the oval-shaped lesions nor the intraductal ones were upgraded.

Conclusions. Although some sonographic features could favor a benign diagnosis, when a core biopsy yields the diagnosis of a papillary lesion, surgical excision is recommended to definitely exclude malignancy. *J Clin Ultrasound* **00**:000–000, 2012; Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/jcu.21993

Keywords: papillary lesion; papilloma; breast cancer; breast US; core needle biopsy

Papillary breast lesions include a broad spectrum of lesions that range from benign papilloma to papilloma with atypical ductal hyperplasia to papillary carcinoma in situ and invasive papillary carcinoma.[1] They are found in up to 5% of breast biopsy specimens and represent <10% of benign breast neoplasms and 0.5% to 2% of malignant breast neoplasms.[2–4]

These lesions develop as tufts of epithelium with a fibrovascular core that arborize into branching papillae and protrude into the lumen of central or peripheral ducts. They may be single or multiple lesions and are broad-based or pedunculated.

On sonography (US), a benign papilloma commonly presents as an oval or round, hypoechoic or complex cystic mass with margins that can be circumscribed or indistinct.[5,6] However, these findings may also be present in malignant papillary lesions.[5,7] The central core of a papilloma contains a vascular pedicle with branching vessels arborizing within the mass.[8] Yang et al found that dilated ducts were often seen with associated visible intraluminal echoes.[9]

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Currently, surgical excision is considered the standard practice of management with regard to malignant and atypical papillary lesions.[10] Although several recent studies recommend excision of all papillary lesions including benign ones as there is a high association between breast cancer and papilloma, no consensus exists, however, regarding the management of benign papillary lesions diagnosed on core needle biopsy (CNB).[6,11] Indeed, others suggest that only close serial radiographic follow-up of biopsy-proven benign lesions is sufficient as they are high-risk lesions.[12–14]

The primary objective of our study was to assess the accuracy of CNB in the diagnosis of papillary breast lesions and therefore the potential impact on their management at our institution. Our secondary objective was to review the sonographic features of these papillary breast lesions retrospectively, including BI-RADS category, to identify imaging characteristics that can help differentiate benign from malignant papillary lesions.

MATERIALS AND METHODS

Approval by the institutional review board was not required for this retrospective analysis. Permission was obtained from the hospital to review the patient's medical records including images and data.

The pathology database at our institution was searched to identify cases of breast papillary lesions diagnosed between January 2002 and May 2008. Among 5,977 breast biopsies performed during this time, a total of 141 papillary lesions were identified. Of the 141 lesions, we excluded seven lesions that were diagnosed using fine needle aspiration techniques and four lesions that were either lost to follow-up imaging or were not surgically excised at our institution. One hundred and thirty lesions diagnosed from 110 women were therefore included in the study, 124 of which were diagnosed on ultrasound-guided CNB and 6 on stereotactic-guided biopsy.

The initial breast imaging interpretation and imaging-guided CNBs were performed by one of five attending radiologists with fellowship training (n = 2) or clinical experience (n = 3) in breast imaging.

Whole breast US imaging, using both gray-scale and color and power Doppler US, was performed using one of two high-resolution scanners with high-frequency linear-array 10–14-MHz transducers: 15L8W broadband transducer on Acuson, Sequoia (Siemens Medical Solutions, Mountain View, CA), or PLT1204AX matrix transducer on Aplio 80 (Toshiba Medical Systems, Tokyo, Japan). The lesions were first imaged with gray-scale US and then color Doppler US was performed. The lesion and a margin of surrounding tissue were included in the color box. Care was taken to apply minimal pressure with the probe on the lesion to limit vessel compression. The US-guided core biopsy needles used were 14-G and 18-G needles with a spring-loaded core biopsy device (Bard Magnum; Bard Urological, Covington, GA). Our standard protocol includes taking routinely four core samples per lesion biopsied. The US-guided vacuum-assisted biopsies (VABs) were performed using a 10-G handheld VAB system (Vacora; Bard Urological).

Mammography was performed in two standard imaging planes (mediolateral and craniocaudal) using dedicated film-screen mammographic equipment (M-IV mammographic unit; Hologic, Bedford, MA). Additional mammographic projections were performed as needed. The stereotactic-guided core biopsies were performed on a digital stereotactic table (LoRad DSM; Hologic) using an 11-G Mammotone directional VAB device (Ethicon Endo-Surgery, Cincinnati, OH) or a 9-G ATEC directional VAB device (Hologic).

All static and color Doppler images were stored on the Hospital's Picture Archiving and Communication System (IntelePACS, version 3.7.1; Intelerad Medical Systems, Montreal, QC).

The recorded pathology results from the percutaneous breast biopsies and surgical pathology specimens were considered for the study and no review of the pathology slides was performed. All pathology specimens were read by dedicated breast pathologists.

The papillary lesions were categorized based on the core biopsy result into two groups: benign or malignant. The benign category included the diagnoses of benign papillary lesion, intraductal papilloma, sclerotic intraductal papilloma, intraductal papilloma with florid epithelial hyperplasia without atypia, intraductal papillomatosis, and papillary hyperplasia. The malignant category included the diagnoses of papilloma with atypia, malignant papillary lesion, and ductal carcinoma in situ.

For each papillary lesion, the patient's medical records were reviewed to identify whether surgery was performed, which determined the final outcome of the lesion. For surgically excised lesions, the final surgical pathology (gold standard in our study) was classified into benign or malignant categories and compared with the initial core biopsy result. Concordance or discordance between the two results was documented.

An upgraded lesion was defined as a lesion that was benign on percutaneous biopsy but showed atypia or malignancy on pathologic examination of the surgical specimen. It was assumed that the lesions were fully removed at the time of surgery and follow-up imaging was therefore not documented for these lesions.

For nonexcised lesions, any follow-up imaging performed after the core biopsy was documented, including type of imaging (mammography for lesions diagnosed on stereotactic biopsy versus sonography for lesions diagnosed on ultrasound-guided biopsy), time (in months) elapsed since biopsy, and any changes in size (stable, increased, or decreased in size) or imaging features of the papillary lesion. If there was no change in size or imaging characteristics, then this was considered a marker of stability and of concordance with the initial core biopsy result. However, if a significant change was identified on follow-up, then note was made of whether delayed surgical excision was subsequently performed and of the final surgical pathology result.

The other clinical variables assessed were patient age at the time of biopsy ($\geq$50 versus $<$50 years old).

The mammographic features of the papillary lesions were not assessed. Only sonographic features of the lesions biopsied under sonographic guidance were retrospectively reviewed in consensus by two breast radiologists, with 14 and 8 years of experience, respectively, according to the American College of Radiology BI-RADS sonographic lexicon classification developed in 2003: shape (oval, round or irregular), margin (circumscribed, microlobulated, indistinct, angular, or spiculated), orientation (parallel or nonparallel to the skin), posterior acoustic features (enhancement, no posterior acoustic features, shadowing, or combined features), lesion boundary (abrupt interface or echogenic halo) and echo pattern (hyperechoic, isoechoic, hypoechoic, complex, or anechoic).[15] Doppler features were also reviewed (no color, one color signal, two or more color signals, or not applicable, ie, Doppler was not performed). In addition, we also evaluated lesion morphology (intraductal, intracystic, or solid), which is not part of the BI-RADS lexicon. The readers were requested to select a single term representing the most appropriate descriptor from each category of the lexicon. Both radiologists determined, by consensus, the largest diameter of each lesion using electronic calipers on the PACS monitor.

The readers were also required to assign a final BI-RADS category for each lesion, including the following subcategories of BI-RADS: 4a (2–9% suspicion of malignancy), 4b (10–49% suspicion of malignancy), and 4c (50–94% suspicion of malignancy). To eliminate bias in the description and categorization of the sonographic images, the readers were blinded to the clinical information, mammographic images, and pathology results. All data were entered in a spreadsheet program (Excel; Microsoft; Redmond, WA).

TABLE 1
Results of Core Needle Biopsy versus Final Outcome (Based on Follow-Up and Surgery)

	Benign on Core Needle Biopsy (n)	Malignant on Core Needle Biopsy (n)	Total
Benign on final outcome (n)	90	2	92
Malignant on final outcome (n)	13	25	38
Total	103	27	

The benign category includes benign papillary lesion, intraductal papilloma, sclerotic intraductal papilloma, intraductal papilloma with florid epithelial hyperplasia without atypia, intraductal papillomatosis, and papillary hyperplasia.The malignant category included papilloma with atypia, malignant papillary lesion, and ductal carcinoma in situ.

Descriptive statistics were calculated for all variables, including means, Standard Deviations, and proportions, as appropriate. Factors influencing whether initially diagnosed benign tumors are in fact malignant or remain benign were investigated through logistic regression models. Throughout all analyses, 95% confidence intervals were calculated for all parameters.

RESULTS

One hundred and twenty-four lesions, 95% (124/130), underwent US-guided CNB and 5% (6/130) underwent stereotactic-guided biopsy. Of the 124 lesions that were biopsied under US guidance, 93% (115/124) were done using 14-G needles, 6% (8/124) with 18-G needles, and 1% (1/124) with 10-G vacuum-assisted devices. Of the six lesions biopsied under stereotactic guidance, 83% (5/6) were done using 11-G needles and 7% (1/6) were done with a 9-G needle. Given the various sample sizes, no conclusion could be drawn regarding needle caliber and guidance technique and biopsy outcomes.

Pathologic examinations from CNB biopsies showed 79% (103/130) of lesions were categorized as benign and 21% (27/130) were categorized as malignant (20 lesions with atypia and 7 cancerous lesions).

Among 103 benign lesions on CNB (Table 1), 36% (37/103) were surgically excised (Figures 1, 2, 3), and 64% (66/103) were followed up with

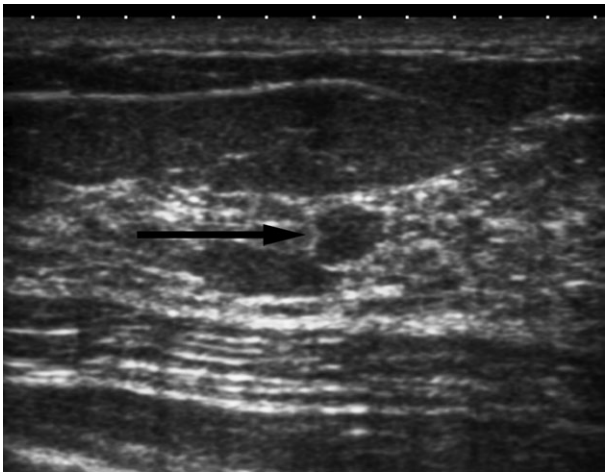

FIGURE 1. Asymptomatic 52-year-old woman. Sonogram shows a 7-mm solid-type mass (arrow) with a round shape and microlobulated margins, categorized as BI-RADS 4b. Core needle biopsy showed intraductal papilloma. Surgical excision revealed a papilloma containing ductal carcinoma in situ.

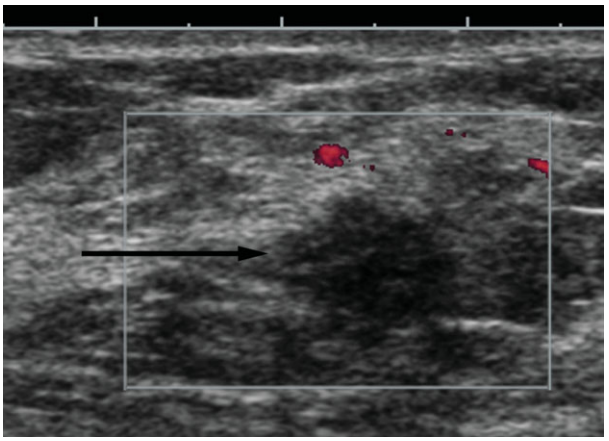

FIGURE 2. Asymptomatic 61-year-old woman. Sonogram shows a 9-mm solid-type mass (arrow) with an irregular shape and microlobulated margins, categorized as BI-RADS 4c. There was no abnormal vascularity on power Doppler imaging. Core needle biopsy showed intraductal papilloma. Surgical excision yielded invasive papillary carcinoma. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

imaging. With respect to the lesions categorized as malignant (atypia and cancerous) on CNB, 93% (25/27) were surgically excised, whereas 7% (2/27) were lost to follow-up. The mean follow-up time for lesions was 21 months (range, 2–72 months).

Among the 103 benign lesions on CNB, 13 (12.6%) were upgraded into 3 lesions with atypia (2.9%, 3/103) and 10 cancerous lesions (9.7%, 10/103: false-negative rate of 9.7%) (Figures 1, 2, Table 1). Twelve of the 13 upgraded lesions were found on final surgical pathology, whereas one lesion developed sonographic features suggestive of malignancy after 34 months of imaging follow-

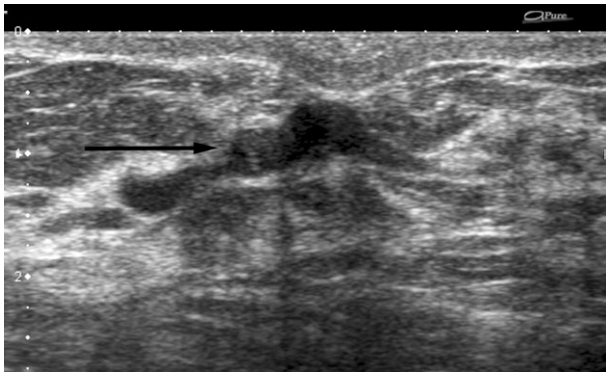

FIGURE 3. Asymptomatic 53-year-old woman. Sonogram shows a 9-mm intraductal mass (arrow) with an oval shape and microlobulated margins, categorized as BI-RADS 4a. There was no abnormal vascularity on power Doppler interrogation (not shown). Core needle biopsy and surgical excision showed intraductal papilloma.

up (invasive carcinoma). Ninety of the 103 benign lesions on CNB remained benign after surgical excision (n = 24) or imaging follow-up (n = 66).

Among the 20 lesions with atypia on CNB, 10 remained papillary lesions with atypia following surgery, whereas 7 were deemed cancerous, 2 benign, and 1 lost to follow-up. With respect to the two benign lesions following surgery (2/27, overestimation rate of 7%), one was initially diagnosed as a papillary proliferative lesion with focal atypia, and postsegmental mastectomy specimen only revealed benign fibrous breast tissue with focal areas of sclerosing adenosis and associated microcalcifications; the second lesion (atypical papillary lesion on CNB) was found to be benign breast tissue with areas of fibrosis on mastectomy specimen. With respect to the seven cancerous lesions, one was lost to follow-up and the other six were surgically excised.

With an underestimation rate of 12.6% and an overestimation rate of 7.4%, our study shows an accuracy of 88.5% of CNB in the diagnosis of breast papillary lesions.

The mean patient age was 57 years (range, 25–91). Sixty-two percent (80/130) of all lesions were found in the left breast, whereas 38% (50/130) of the lesions were identified in the right breast. With respect to the benign group, 64.1% (59/92) of patients were 50 years old or older in comparison to 78.9% (30/38) in the malignant group. This proportion increased to 92.3% (12/13) in the upgraded group (95% confidence interval; 0.02, 0.46).

The mean sizes for upgraded (n = 13) and malignant lesions (n = 38) were 1.1 cm and 1.0 cm versus 0.8 cm for benign lesions (n = 86), with the mean lesion size of 0.9 cm (range, 0.2–2.8 cm). No significant difference was noted between

TABLE 2
Sonographic Features of Papillary Lesion Diagnosed as Papillary Lesions on US-Guided Core Needle Biopsy (N = 124)

Descriptor	Lesions (%)
Mass shape	
Oval	37 (29.8)
Round	45 (36.3)
Irregular	42 (33.9)
Mass orientation	
Parallel to the skin	43 (35)
Not parallel to the skin	81 (65)
Mass margin	
Circumscribed	17 (13.7)
Indistinct	4 (3.2)
Angular	12 (9.7)
Microlobulated	88 (71)
Spiculated	3 (2.4)
Lesion boundary	
Abrupt interface	115 (92.7)
Echogenic halo	9 (7.3)
Echo pattern	
Anechoic	0 (0)
Hyperechoic	2 (1.6)
Isoechoic	50 (40.3)
+Hypoechoic	57 (46)
Complex	15 (12.1)
Posterior acoustic shadowing	
None	36 (29)
Enhancement	76 (61.3)
Shadowing	1 (0.8)
Combined pattern	11 (8.9)
BI-RADs	
4A	35 (28.2)
4B	64 (51.6)
4C	25 (20.2)
Morphology	
Intraductal	16 (12.9)
Intracystic	17 (13.7)
Solid	91 (73.4)
Total	124

TABLE 3
Sonographic Features of Papillary Lesions as per Final Outcome Compared with Upgraded Lesions

	No. (%) of Lesions with Final Outcome		
Descriptor	Malignant (N = 38)	Benign (N = 86)	Upgraded (N = 13)
Mass shape			
Oval	7 (18.4)	30 (34.9)	0 (0)
Round	13 (34.2)	32 (37.2)	5 (38.5)
Irregular	18 (47.4)	24 (27.9)	8 (61.5)
Mass orientation			
Parallel to the skin	11 (28)	32 (37.2)	4 (30.1)
Not parallel to the skin	27 (72)	54 (62.8)	9 (69.2)
Mass margin			
Circumscribed	2 (5.3)	15 (17.4)	2 (15.4)
Indistinct	1 (2.6)	3 (3.5)	0 (0)
Angular	6 (15.8)	6 (7)	1 (7.7)
Microlobulated	28 (73.7)	60 (69.8)	9 (69.2)
Spiculated	1 (2.6)	2 (2.3)	1 (7.7)
Lesion boundary			
Abrupt interface	36 (94.7)	79 (91.9)	12 (92.3)
Echogenic halo	2 (5.3)	7 (8.1)	1 (7.7)
Echo pattern			
Anechoic	0 (0)	0 (0)	0 (0)
Hyperechoic	1 (2.6)	1 (1.2)	1 (7.7)
Isoechoic	15 (39.5)	35 (40.7)	5 (38.5)
Hypoechoic	18 (47.4)	39 (45.4)	6 (46.2)
Complex	4 (10.5)	11 (12.8)	0 (0)
Posterior acoustic shadowing			
None	12 (31.6)	24 (27.9)	5 (38.5)
Enhancement	25 (65.8)	51 (59.3)	7 (53.8)
Shadowing	0 (0)	1 (1.2)	1 (7.7)
Combined pattern	1 (2.6)	10 (11.6)	0 (0)
BI-RADs			
4A	4 (10.5)	31 (36)	1 (7.7)
4B	22 (57.9)	42 (48.8)	8 (61.5)
4C	12 (31.6)	13 (15.1)	4 (30.8)
Morphology			
Intraductal	1 (2.6)	15 (17.4)	0 (0)
Intracystic	7 (18.4)	10 (11.6)	3 (23.1)
Solid	30 (79)	61 (70.9)	10 (76.9)
Total	38	86	13

The benign category includes benign papillary lesion, intraductal papilloma, sclerotic intraductal papilloma, intraductal papilloma with florid epithelial hyperplasia without atypia, intraductal papillomatosis, and papillary hyperplasia.The malignant category includes papilloma with atypia, malignant papillary lesion, and ductal carcinoma in situ.The upgraded category includes benign papillary lesions on percutaneous biopsy showing atypia or malignancy on postoperative pathology.

the different subgroups, particularly between the upgraded group and the benign group (95% confidence interval; −1.5, 5.0) (Figures 1–3).

The final group of 92 benign lesions included 86 masses visualized and biopsied by US and six lesions visualized at mammogram and biopsied under stereotactic guidance. The final 38 malignant lesions were visualized and biopsied under US.

US findings are summarized in Table 2. The most common US features of the 124 papillary lesions were masses with microlobulated margins (71%), abrupt interface (92.7%), and hypoechoic or isoechoic echotexture (46%, 40.3%) (Figures 1–3). No dominant shape was noted because the lesions displayed almost equivalent percentages of irregular (33.9%), round (36.3%), and oval (29.8%) shapes.

Regarding the different subgroups (Tables 3 and 4), there was a substantial amount of overlap in the shape characteristics of benign and malignant lesions. However, a large proportion of upgraded lesions (61.5%) displayed an irregular shape and more importantly none displayed an oval shape (95% confidence interval; −0.49, −0.20). Microlobulated margins were the dominant margin characteristic for benign (70%), malignant (74%), and upgraded (69%) lesions.

Color Doppler was only available for 114 of the 124 lesions (79 benign and 35 malignant lesions). The majority of the lesions did not show any signal at color Doppler interrogation (63.7%) (Figure 2). Similarly, no color signal was noted in the majority of lesions in all subgroups (60% [21/38] in the malignant group, 65.8% [52/85] in the benign group, and 55% [6/13] in the upgraded group). No difference was noted between the different subgroups.

TABLE 4
Characteristics of Upgraded Cases

Case	Patient Age (years)	Lesion Size (mm)	Biopsy Finding	BI-RADS Category	Biopsy Needle Gauge	Surgical Pathology
1	50	8	Intraductal papilloma	4b	14	DCIS and intraductal papilloma
1	54	7	Sclerosing intraductal papilloma	4c	18	DCIS and intraductal papilloma
1	55	5	Intraductal papilloma	4a	14	DCIS and intraductal papilloma
4	52	15	Intraductal papilloma	4b	14	Atypical papilloma with focal sclerosis
5	51	6	Intraductal papilloma	4b	14	DCIS with surrounding atypia
5	51	9	Intraductal papilloma	4b	14	DCIS with surrounding atypia
7	63	6	Intraductal papilloma	4c	14	Intraductal papilloma with Atypical hyperplasia
8	65	6	Sclerosing papilloma	4b	14	Invasive cribiform carcinoma
9	65	8	Papillary lesion	4b	14	DCIS
10	65	10	Intraductal papilloma	4c	14	DCIS + papillomatosis+ ADH
11	66	9	Intraductal papilloma	4c	14	Invasive papillary carcinoma
12	56	25	Intraductal papilloma	4b	14	Atypical papilloma
13	37	18	Intraductal papilloma	4b	14	Invasive ductal carcinoma

Abbreviations: DCIS, ductal carcinoma in situ; ADH, atypical ductal hyperplasia.

BI-RADS categorization of the 124 lesions biopsied under US guidance (Tables 2 and 3) showed that the majority of the lesions were classified as BI-RADS 4b in the overall population (64/124, 52%) and in all subgroups including the upgraded group (49% of benign, 57.9% of malignant, and 61% of upgraded lesions). Regarding the upgraded group, no statistically significant difference was noted with the other subgroups except the relative low rate of BI-RADS 4a lesions within this group, compared with the benign group (7.7% versus 36%) (95% confidence interval; −0.50, −0.06).

Regarding the morphology (intraductal, intracystic, and solid), the majority of the lesions displayed a solid appearance (73.2% of overall lesions, 79% of the malignant, 71% of the benign, and 77% of the upgraded lesions). However, the percentage of lesions with an intraductal morphology was significantly lower in the upgraded group (0%) compared with the benign group (17.6%) (95% confidence interval; −0.30, −0.05) (Figure 3).

DISCUSSION

With an underestimation rate of 12.6% and an overestimation rate of 7.4%, our study shows an accuracy of 88.5% of CNB in the diagnosis of breast papillary lesions. Although our upgrade rate for benign papilloma to cancerous lesions (9.7%) falls within the 0–25% underestimation rates quoted previously,[16] it appears slightly higher than reported in the two more recent studies (5% and 3.1% including, respectively, 318 and 64 papillary lesions).[6,11] However, unlike these two studies, our upgrade rate of benign to atypical papillary lesions appears lower (2.9% versus 5.6% and 10.9%, respectively). These results reinforce the recommendation for surgical excision of all papillary lesions diagnosed on CNB, even in cases of benign results.

Our overestimation rate of 7.4% with two lesions showing atypia on CNB (14-G) subsequently being categorized as benign on final outcome (two partial mastectomies) shows an unusual type of discordance between CNB pathology and postsurgical pathology. The reasons are unclear but might include complete excision of some lesions on biopsy and mostly underline the challenges represented by the distinction for pathologist of benign from atypical papillary lesions, particularly on CNB specimen.[17]

Lesion sampling is expected to be influenced by whether VAB devices are used and by the selection of biopsy needle size. However, the very small number of biopsies performed with 18-G or 10-G and 11-G needles precludes any valid interpretation of our results in that regard. In addition, Mercado et al and Plantade et al have shown that use of VAB devices did not obviate the need for surgical excision.[18,19]

With respect to the patient's age, our results are in keeping with recent studies that showed a different upgrade to malignancy with regard to age and lesion size.[11] Our study confirms that age greater than 50 years is significantly related to the risk of lesion upgrade in case of benign results of CNB. Our results also indicate that papillary lesions in general are more common with increasing age. Although it is likely that the

mere increase in age confers a higher baseline risk of cancer/atypia for the lesions in the malignant group, this does not explain the increased frequency of the benign lesions too.

With respect to the lesion's size, similarly to previous studies, upgraded lesions and malignant papillary lesions had a larger mean lesion size (1.1 cm and 1.0 cm, respectively) compared with the benign lesions (0.9 cm). However, this was not statistically significant, possibly due to the small sample size.[6,11]

Recent studies report contradictory results about final BI-RADS categorization of upgraded papillary lesions. On one hand, the study of Youk et al shows a significant difference in the BI-RADS categorization of upgraded lesions, with upgrade rates of 27% and 25% in the BI-RADS category 4c and 5 (as opposed to 2.5% and 6% in BI-RADS 4a and 4b).[11] On the other hand, in Chang et al's series, eight of nine of the upgraded lesions were categorized as BI-RADS 4a, none of them being categorized as BI-RADS 4c or 5.[6] Our results partly support Youk et al's conclusions because we noted that a benign papillary lesion on CNB, classified BI-RADS 4a, has a low risk of upgrade if surgically excised.

In the past, attempts have been made to use clinical and radiologic features to identify a subset of papillary lesions associated with malignancy, but the varied results have not led to a consensus and to our knowledge the current literature suggests that neither mammographic nor sonographic features allow for accurate differentiation between the benign and malignant subtypes.[20] Our study focused on the sonographic features according to the BI-RADS classification. No difference was noted between the different subgroup categories with respect to the lesion boundary, shape, echo pattern, posterior acoustic enhancement, and color Doppler signal. Most papillary lesions showed abrupt interface, had iso- or hypoechoic echotexture, posterior acoustic enhancement, and showed no internal color Doppler signal.

Interestingly, microlobulated margin is the dominant margin characteristic for the benign (70%), malignant (74%), and upgraded (69%) papillary lesions, suggesting that it is a common feature of all papillary lesions. This feature differs significantly from the sonographic features reported by Chang et al,[6] who identified mostly indistinct margins for papillary lesions (26/55). With respect to Youk et al's study, the margins were reported as noncircumscribed (130/152) with no specification of the type. No clear explanation supports these differences, but microlobulated and indistinct contours are descriptors known to reach only fair (0.33 and 0.39, respectively) interobserver agreement.[21]

Although 47.4% of the malignant lesions had an irregular shape and 34.9% of the benign lesions had an oval shape, a substantial amount of both had a round shape (34.2% versus 37.2%), suggesting that there is much overlap with respect to shape. In comparison with two recent studies assessing the US BI-RADS descriptors of papillary lesions, both noted a predominantly oval shape for all papillary lesions (benign and malignant).[6,11] In our series, the oval shape was not the more frequent shape (35% of the benign lesions, 18.4% of the malignant lesions). In addition, none of the upgraded lesions showed an oval shape. Following this result, we consider that a papillary lesion displaying an oval shape and yielding a benign result at CNB has a low risk of being upgraded if surgically excised. According to our results, the round shape appears to be more frequent in cases of papillary lesions, whereas previous studies including large numbers of biopsied lesions noted a frequency of round masses in 9% only.[21]

With respect to the 13 upgraded lesions, no definite BI-RADS descriptor appears to be specific. Only a trend toward more irregular shape was noted in 61.5% lesions, suggesting that if a benign biopsy result is obtained and the lesion has an irregular shape, then this should raise the index of suspicion for possible malignancy. In addition, 0% of the false-negative lesions had an oval shape and hence this characteristic may help reassure us of the benign nature of a papillary lesion deemed benign on core biopsy.

We intended to evaluate the lesion morphology (intraductal, intracystic, and solid) because we expected intuitively that one of these features could be associated with malignant or atypical papillary lesions. However, these different criteria were not found to be a reliable feature when attempting to differentiate the benign from malignant subtypes. The majority of all lesions displayed a solid type, meaning that most of the lesions did appear as solid masses, without the classic pattern of papillary lesions (intracystic or intraductal). This type of presentation is probably expected to be encountered more with the increased use of breast US as a screening tool and as a second look following breast MRI. Of interest is the observation that none of the 13 upgraded lesions were intraductal, suggesting that the presence of this feature can help support the diagnosis in biopsy-proven benign lesions.

The study demonstrates that in our institution there is no standard of care/guidelines with

regards to the management and follow-up of documented benign papillary lesions. The current practice is dependent on the individual clinician's and radiologist's assessment of each case. This is demonstrated by the fact that only 36% of benign lesions were surgically excised; the others undergoing follow-up imaging within a time period ranging from 2 to 72 months from the date of the percutaneous biopsy (mean of 21 months). Although the study did not investigate the factors that contributed to the variability of management exhibited, we suspect that factors such as patient preference, personal or family history of breast cancer, clinician experience and preference, among others, may have contributed to management decisions. In addition, our experience shows that there is no definitive follow-up imaging time period that can guarantee the stability of a benign lesion. One of these initially benign lesions developed sonographic features consistent with malignancy on follow-up imaging after 34 months.

The study was limited by its retrospective nature. Although our study included 6 years of data, the small number of lesions (130) obtained from a single metropolitan-based breast center affected the statistical power of the study. Papillary lesions are relatively rare and are found in less than 5% of breast biopsies. Although our sample size is comparable to other studies in the literature, multicenter collaboration can be performed in the future to address this issue.

Only the sonographic features of the papillary lesions were retrospectively assessed. We did not investigate mammographic features that might help in differentiating benign from malignant lesions. In a review of the literature, Lam et al (2006), and Schneider (1989) suggested that most papillary lesions are not visible mammographically. We therefore did not analyze the mammographic findings as the yield would be low, particularly in view of the small number of cases in our study.

In addition, our study did not assess other clinical and radiologic variables, such as personal or family history of breast cancer, clinical presentation such as nipple discharge or palpable mass, and lesion distance from the nipple.

Based on the high upgrade rate (12.6% at surgery) of papillary lesions diagnosed as benign on CNB, the lack of definitive sonographic characteristics that can differentiate benign from malignant lesions, and the fact that no specific follow-up time period can ensure the stability of benign lesions, we recommend excision of all papillary lesions diagnosed on CNB.

If, however, a decision is made to not excise a benign papillary lesion (eg, due to patient preference or in cases with multiple papillomas), special attention should be paid to the presence of more benign features, such as an oval shape, an intraductal situation, and a BI-RADS 4a categorization, which could help support the benign diagnosis of a CNB. On the contrary, the presence or development of more suspicious sonographic features, such as spiculated margins and irregular shape, should raise the radiologist's and clinician's index of suspicion for malignancy.

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