ORIGINAL ARTICLE

Positive Predictive Value of Sonographic BI-RADS Final Assessment Categories for Breast Lesions

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ABSTRACT

Introduction: We want to evaluate the sensitivity, specificity, positive (PPV) and negative predictive values (NPV) of BI-RADS ultrasound, as well as PPV and NPV of BI-RADS ultrasound lexicon. **Methods:** A total of 517 ultrasound-guided breast biopsy cases were performed within three years. A total of 324 cases remained after 193 cases were excluded from this study. The sensitivity, specificity, accuracy, PPV and NPV of overall BI-RADS and PPV for each BI-RADS categories were calculated from the data when compared with histopathological examination (HPE) finding. One observer evaluated four criteria of BI-RADS ultrasound lexicon; margin, echogenicity, posterior artefact and internal echo from static sonographic images to determine the PPV and NPV of sonographic BI-RADS lexicon based on HPE correlation. **Results:** There were 236 (72.8%) benign and 88 (27.1%) malignant lesions. The overall BI-RADS has a sensitivity of 93.18%, specificity of 66.95%, accuracy of 74.07% with PPV and NPV of 51.25% and 96.34% respectively. The PPV of each BI-RADS categories were; BI-RADS 2 (9.09%), BI-RADS 3 (3.27%), BI-RADS 4 (39.02%) and BI-RADS 5 (91.89%). The highest predictive value for malignancy was irregular margin (52.3%) and for benign was well-defined margin (89.7%). Criteria for margin and posterior artefact had a significant association with HPE ($p<0.0001$) in differentiating between malignant and benign breast lesions in breast ultrasound. **Conclusion:** Overlapping benign and malignant sonographic breast lesion descriptors tend to influence radiologist's decision to overcall final BI-RADS categories. The margin and posterior artefact are the important criteria in BI-RADS lexicon in differentiating benign and malignant breast lesion.

Keywords: BI-RADS ultrasound, ultrasound breast, positive predictive value, BI-RADS ultrasound lexicon

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INTRODUCTION

Breast Imaging Reporting and Data System (BI-RADS) classification is an assessment tool for the radiologist to assess the malignancy risk of detected breast lesion. Each BI-RADS category from 1-6 has its own positive predictive value of malignancy based on the American College of Radiology (ACR) references, at the same time providing the recommendation of management for each category. The assignment of final BI-RADS classification is based on overall assessment from mammogram, ultrasound or MRI findings of breast lesion and patient's clinical history (1).

Nowadays, ultrasound becomes an important tool in the complimentary examination of mammogram in the screening and detection of breast cancer. It has the ability to differentiate benign from solid malignant masses, based on certain ultrasound characterization, thus can avoid the unnecessary biopsy of the benign breast lesion (2). The ACR has established two editions of BI-RADS lexicon for breast ultrasound to standardize the characterization of ultrasound lesions in 2003 and 2013. The latest second edition of ultrasound lexicon includes descriptors of shape, orientation, margin, posterior features and echo pattern (2). Based on these descriptors, each lesion was assigned to a final assessment category and recommendation of management.

In our institution, the usage of BI-RADS classification and ultrasound lexicon in breast reporting was started in 2009. Since then, it has been the standard of reporting that helps in the management. We conducted this study to evaluate the sensitivity, specificity, accuracy, positive (PPV) and negative predictive values (NPV) of BI-RADS ultrasound, as well the PPV and NPV of ultrasound BI-RADS lexicon by radiologists. We took the histopathological examination (HPE) as the gold standard to compare with the BI-RADS reporting system.

MATERIALS AND METHODS

Ethical Consideration

Ethical approval was obtained from the institution Research and Ethics Committee (Ethical approval code: FF-2017-018). This is a retrospective descriptive study and therefore, informed consent was waived.

Subjects and Procedures

This study was conducted in the Radiology Department in a tertiary university hospital in Kuala Lumpur. We retrospectively evaluated 517 cases that underwent ultrasound-guided biopsy based on the data list retrieved from the integrated radiology information system from January 2014 until December 2016.

All palpable and non-palpable breast lesions with final BI-RADS stated in the report, ultrasound (USG) images and HPE reports were included in this study. The assignment of the final BI-RADS categories in this study was derived from the complimentary examination with the mammogram and ultrasound assessment only. BI-RADS sonography was applied to the breast lesion, which was only detected by complimentary ultrasound in the patient with dense breast parenchyma finding in the mammogram. This could obscure the breast lesion finding.

A total of 193 cases were excluded due to no final BI-RADS assignment, USG images or HPE report and inconclusive biopsy result. Thus, a total of 324 of palpable and non- palpable breast lesions from 315 patients were finally included in our study.

Sonography was performed using a linear transducer probe with frequency of 5-8 Megahertz of USG machine (Siemen Acuson S2000). The patient was imaged in the supine-oblique position for lesions in the lateral aspect of breast and supine for other locations. Images were acquired in both radial and anti-radial projections with and without calliper measurements. Doppler, colour Doppler and power Doppler images were not part of the routine imaging protocol.

The sonographic assessment of breast lesions was done by medical officers under the supervision of radiologists. There were five radiologists with breast subspecialty or special interest in breast imaging involved in this study. They will choose the most suitable BI-RADS category at the end of evaluation based on the sonographic images. The lesions were classified as BI-RADS 2 (benign lesion), BI-RADS 3 (most probably benign), BI-RADS 4 (suspicious of malignancy) and BI-RADS 5 (highly suspicious of malignancy).

Based on BI-RADS ultrasound lexicon, BI-RADS 1 was normal finding as no focal lesion detected in the ultrasound. BI-RADS 2 referred to benign lesions such as breast cyst, intra-mammary node or fatty component of the nodule. BI-RADS 3 was the breast lesion with benign descriptors such as a well-defined lesion, ovoid or rounded in shape, parallel in orientation in relation to skin axis, circumscribed margin, absent of posterior acoustic shadowing or presence of posterior acoustic enhancement and absence of alteration adjacent tissue. BI-RADS 5 lesion had at least three signs of malignancy descriptors; irregular contour, non- parallel orientation to skin axis, non-circumscribed margin, presence of hyperechogenic halo, posterior acoustic shadowing or alteration in the adjacent tissue. BI-RADS 4 lesion was indeterminate, neither did meet all benign ultrasound criteria nor had at least three signs of malignancy. Subsequently, after determining the suitable BI-RADS category for the breast lesion, the radiologist performed a biopsy of the breast lesions and specimens were sent to the pathology lab for HPE.

Data Collection and Statistical Analysis

Final BI-RADS of 2, 3, 4 and 5 were included in our study. BI-RADS 2 and 3 were grouped as benign categories and BI-RADS 4 and 5 were grouped as malignant categories. The sensitivity, specificity, accuracy, NPV and PPV of overall BI-RADS ultrasound, as well as PPV for each BI-RADS categories, were compared to HPE findings as the gold standard.

The static sonographic images of breast lesions and the final ultrasound reports were retrieved from PACS and RIS system by a radiology resident of 4 years of residency training. Four BI-RADS lexicon were assessed; margin, echogenicity, posterior artefact and internal echo. Subsequently, this data was compared with the HPE report to determine the PPV for malignant ultrasound lexicon and NPV for benign ultrasound lexicon.

Statistical analysis was performed with a commercially available software program (Statistical Package for Social Science - SPSS version 22.0). The descriptive statistics were shown as percentage (%). The diagnostic performance of ultrasound BI-RADS category was compared with final pathology result as the gold standard. Pearson's Chi-square testing was also used to assess statistical significance descriptors of benign and malignant mass as well as NPV and PPV of BI-RADS lexicon. P-value of <0.05 was considered to be significant.

RESULTS

Demographic data

The mean age of the patients was 52.3 old. The youngest patient was 19 years old and the oldest patient was 95 years old. For racial distribution, the majority of patients were Malay 60% (n = 189), Chinese 29.52% (n = 93), Indian 7.62% (n = 24) and only 9 patients (2.86%) for other races.

In the histopathological diagnosis of 324 breast lesions,

236 (72.8%) lesions were proven to be benign and 88 (27.2%) lesions were proven to be malignant. The most prevalent benign HPE finding was fibroadenoma with 46 cases (19.49%) and the most prevalent malignant HPE finding was invasive carcinoma of no special type with 56 cases (63.64%). There were two cases (2.27%) of metastatic breast lesions, which the primary tumour was from neuroendocrine carcinoma and renal cell carcinoma respectively (Table I).

Table I: Distribution of benign and malignant histopathological findings.

Benign histopathological findings		Malignant histopathological findings	
Pathological diagnosis	**Number (%)**	**Pathological diagnosis**	**Number (%)**
Fibroadenoma	46 (19.49)	Invasive carcinoma of no special type	56 (63.64)
Fibroadenosis / Fibrocystic	22 (9.32)	Invasive ductal carcinoma	12 (13.64)
Papilloma / Papillary Lesion	21 (8.90)	High grade ductal carcinoma in situ (DCIS)	10 (11.36)
Inflammatory / Abscess	15 (6.36)	Invasive lobular carcinoma	4 (4.55)
Fibrotic tissue	9 (3.81)	Mucinous carcinoma	2 (2.27)
Usual ductal hyperplasia	8 (3.39)	Metastatic lesion	2 (2.27)
Sclerosing adenosis	5 (2.12)	Malignant phylloides tumour	1 (1.14)
Duct ectasia	4 (1.69)	Papillary carcinoma	1 (1.14)
Tissue / Fat necrosis	3 (1.27)		
Benign phylloides tumour	2 (0.85)		
Non-specific Benign breast tissue	94 (39.83)		
*Others	7 (2.97)		
Total	236 (72.80)	Total	88 (27.2)

*Other: Flat epithelial atypia, lactating adenoma, atypical lymphoid, diabetic mastopathy, hemangioma, schwannoma, intramammary node

Sensitivity, Specificity, Accuracy, PPV and NPV of BI-RADS Ultrasound

The distribution of BI-RADS ultrasound classification showed 11 cases (3.4%) of BI-RADS 2, 153 cases (47.22%) of BI-RADS 3, 123 cases (37.96%) of BI-RADS 4 and 37 cases (11.42%) of BI-RADS 5. In this study, we found the BI-RADS ultrasound in this centre had sensitivity of 93.18%, specificity of 66.95% and accuracy of 74.07%. The NPV and PPV of BI-RADS ultrasound were 96.34% and 51.25% respectively. The PPV for BI-RADS categories were; BI-RADS 2 was 9.09%, BI-RADS 3 was 3.27%, BI-RADS 4 was 39.02% and BI-RADS 5 was 91.89% (Table II).

Table II: Sensitivity, Specificity, Accuracy, PPV and NPV of BIRADS ultrasound

Sensitivity	93.18 %
Specificity	66.95 %
Accuracy	74.07 %
NPV	96.34 %
PPV (overall)	51.25 %
PPV BIRADS 2	9.09 %
PPV BIRADS 3	3.27 %
PPV BIRADS 4	39.02 %
PPV BIRADS 5	91.89 %

BI-RADS Ultrasound Lexicon

There were four criteria of ultrasound lexicon assessed in this study, which were margin, echogenicity, posterior artefact and internal echo. 194 lesions had a well-defined margin (59.9%) and 130 had irregular margin (40.1%). 297 lesions (91.7%) were hypoechoic, 17 lesions were isoechoic (5.2%), and ten lesions were hyperechoic (3.1%) in echogenicity. Regarding posterior artefact, 127 lesions (39.2%) had posterior shadow artefact, 115 lesions (35.5%) had posterior enhancement artefact and 82 lesions (25.3%) had edge shadowing. Heterogeneous internal echo constituted the majority (75.3%, n = 244) while homogenous accounted for 24.7% (n = 80). Table III tabulates the frequency and percentages of BI-RADS ultrasound lexicon and the association between HPE and USG lexicon.

Margin

Out of 194 well-defined margin lesions, 174 (89.7%) were benign and 20 (10.3%) were malignant. Sixty-

Table III: The distribution of BI-RADS ultrasound lexicon and Chi-square test between HPE and USG lexicon. PPV for malignant ultrasound descriptors and NPV for benign ultrasound descriptors are in the parenthesis.

Criteria of ultrasound lexicon		Frequency (%)	Benign, Frequency (NPV)	Malignant, Frequency (PPV)	p-value
Margin	Well defined	194 (59.9)	174 (89.7%)	20 (10.3%)	0.000
	Irregular	130 (40.1)	62 (47.7%)	68 (52.3%)	
Echogenicity	Hypoechoic	297 (91.7)	214 (72.1%)	83 (27.9%)	0.568
	Isoechoic	10 (3.1)	8 (80.0%)	2 (20.0%)	
	Hyperechoic	17 (5.2)	14 (82.4%)	3 (17.6%)	
Posterior artefact	Enhancement	115 (35.5)	93 (80.9%)	22 (19.1%)	0.000
	Shadow	127 (39.2)	74 (58.3%)	53 (41.7%)	
	Edge	82 (25.3)	69 (84.1%)	13 (15.9%)	
Internal echo	Homogenous	80 (24.7)	62 (77.5%)	18 (22.5%)	0.280
	Heterogeneous	244 (75.3)	174 (71.3%)	70 (28.7%)	
Total			324 (100.0%)	88 (27.2%)	

eight lesions (52.3%) from 130 irregular lesions were malignant lesion as compared to the rest, 62 (47.7%) were benign irregular lesion. The highest PPV for malignant ultrasound descriptor was irregular margin (52.3%) while the highest predictive value of benign ultrasound descriptors was well-defined margin (89.7%). The chi-square test indicates that there is a significant difference between HPE and margin of the lesion (χ^2 (1) = 69.4, p<0.001).

Echogenicity

There were 297 hypoechoic lesions, with 88 (27.9%) lesions were malignant, contributing to the highest predictive value of malignancy of 27.9% and the rest of the hypoechoic lesions, 214 (72.1%) were benign. As for isoechoic, only 2 out of 10 lesions were malignant and for hyperechoic, 14 out of 17 lesions were benign, which contribute to the highest predictive value of benign of 82.4%. There is no statistical significance between HPE and echogenicity with p>0.05.

Posterior Artefact

As for posterior enhancement, there were 93 (80.9%) benign lesions and 22 (19.1%) malignant lesions. Posterior shadowing had 74 (58.3%) benign lesions and 53 (41.7%) malignant lesions. Edge shadowing had 69 (84.1%) benign lesions and 13 (15.9%) malignant lesions. The highest PPV for malignant ultrasound descriptor was posterior shadowing with 41.7% while the highest NPV for benign ultrasound descriptor was posterior enhancement with 80.9%. The chi-square test indicates that there is a significant difference between HPE and posterior artefact (χ^2 (2) = 22.678, p<0.001).

Internal Echo

Out of 80 homogenous internal echo, 62 lesions (77.5%) was benign and 18 lesions (22.5%) was malignant. 174 lesions (71.3%) of heterogeneous internal echo was benign and 70 lesions (28.7%) were malignant. The highest PPV for malignant ultrasound descriptors was heterogeneous internal echo and highest NPV for benign ultrasound descriptor was homogenous internal echo. There is no statistical significance between HPE and internal echo with p>0.05.

DISCUSSION

BI-RADS lexicon for sonographic assessment was established by American College Radiologist (ACR) in 2003 to standardize the characterization of ultrasound breast lesions. Ultrasound becomes an important screening tool, apart from the mammogram and MRI breast in detecting breast cancer as previous studies proved that its ability to differentiate benign and malignant breast lesions (2,3).

In our study, the overall sensitivity of BI-RADS ultrasound was 93.18%, slightly lower than four previous studies (2,4–6). In Park et al., the sensitivity was reported to be 96-100% (5). Lee et al. reported sensitivity of 97 – 98%, Constantini et al. with sensitivity of 98.1% and Zengin et al. with 100% sensitivity (2,4,6). However, our sensitivity was higher than two other studies such as Nascimento et al. with sensitivity of 70.5 – 82.3% and Okeji et al. with 74.07% (7,8).

The level of BI-RADS's sensitivity depends on the false negative (FN) rate. In our study with the overall sensitivity of 93.18%, the FN rate was 6 cases (6.82%) out of 88 cases with malignant HPE findings. In these 6 cases, one of them was assigned as BI-RADS 2 (Fig. 1) with the rest of the cases were BI-RADS 3. These cases were shown in Fig. 2 and Fig. 3 as examples of false-

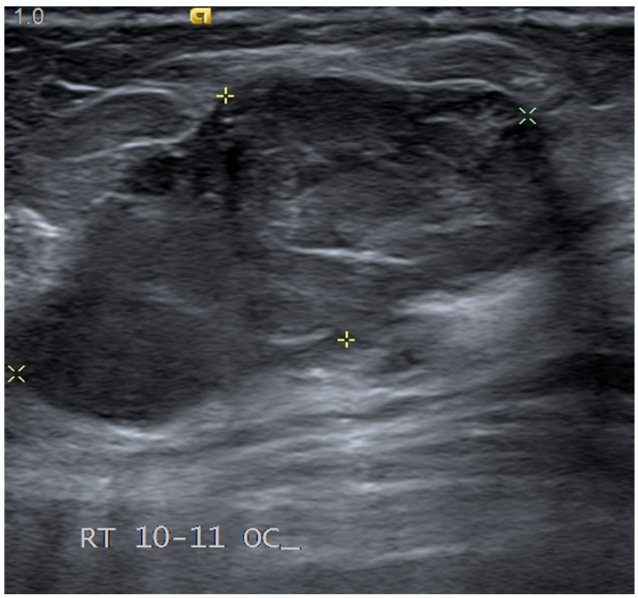

Figure 1: Ultrasound image of a heterogeneous breast lesion at right 10-11 o'clock (BIRADS 2). Biopsy was performed in view of the palpable lesion. HPE finding was invasive carcinoma with mucinous differentiation.

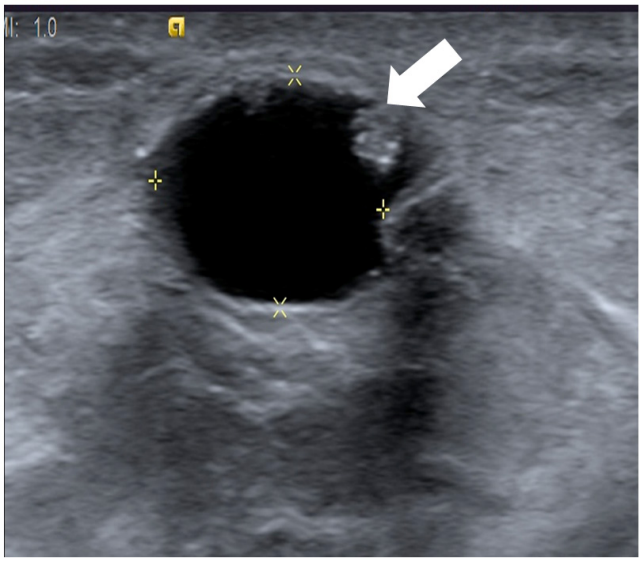

Figure 2: Ultrasound image in the axial view of right 9 o'clock BIRADS 3 lesion with well-defined cystic lesion. The presence of intramural nodule (*arrow*) at non-dependent site which was stable in term of size and appearance at three months later assessment. Biopsy revealed HPE finding of low-grade ductal carcinoma in situ (DCIS).

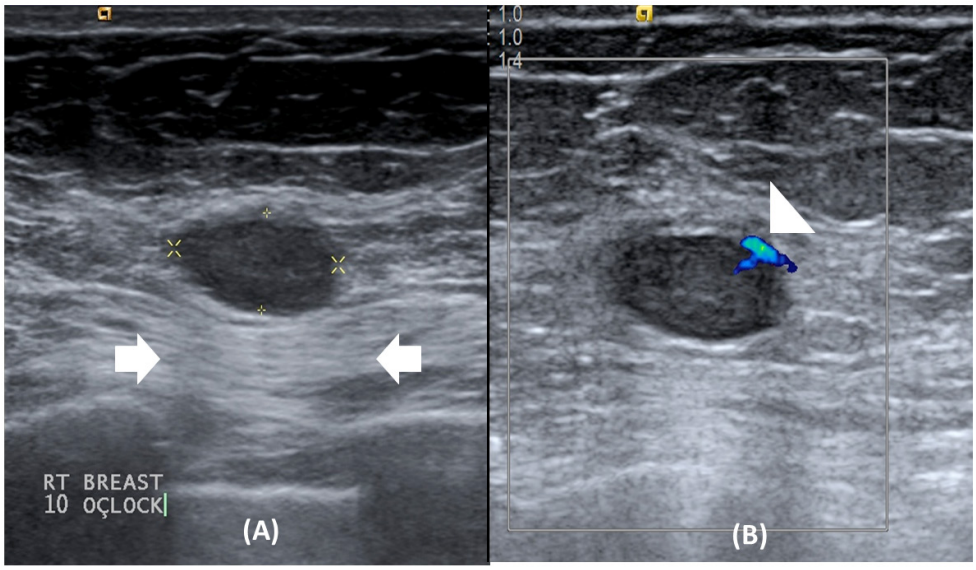

Figure 3:(A) Axial view and (B) Colour Doppler - example of false-negative case. A 61 years old lady with an underlying history of right renal cell carcinoma, presented with right breast 10 o'clock lesion (BIRADS 3) which showed well defined, homogenous, hypoechoic lesion with edge shadowing (*arrow*), but with internal vascularity (*arrowhead*) HPE finding was metastatic lesion from renal cell carcinoma.

negative cases. In the current study, BI-RADS 2 and 3 lesions were included in the benign BI-RADS category. This study was different from Lee et al. (6), Constantini et al. (2) and Zengin et al. (4) studies, which only included BI-RADS 3 in the benign BI-RADS category. Apart from that, there was a high biopsy rate of benign breast lesions in our centre which was 164 out of 324 cases (50.61%). In our centre, the radiologist tends to choose shorter follow up for benign lesions for quick management due to a few factors such as patient's logistic with patient's and clinician's preference. These two factors are likely to be contributing factors to the number of FN rate in our study.

Our study's overall specificity was 66.95%, which was higher than several studies in the literature (2,4–7) and lower than Hille et al. (9) and Okeji et al. (8) with the specificity of 85% and 83.33% respectively. In our study, the false positive (FP) rate for overall BI-RADS assessment was 78 (33.05%) cases out of a total of 236 cases with benign HPE findings. The high false-positive rate could be due to overlap ultrasound descriptors for benign and malignant lesion, especially BI-RADS 3 and 4. This could indirectly affect the tendency of the radiologist to assign breast lesions to a higher level of BI-RADS for biopsy purpose in view of high-risk factor breast cancer of patient's clinical background.

The overall accuracy and NPV of our study were similar to previous studies. The overall accuracy in this current study was 74.07%, which was similar to four other studies which had an accuracy of 60.9 – 87% (2,7–9). Our study shows a high level of NPV, which was 96.34%. NPV is the probability of benign breast lesions under BI-RADS that is truly negative of breast cancer. Our NPV percentage was in between 4 studies done by Constantini et al. (2) with NPV 92.3%, Park et al. (5) with NPV of 95-100%, Lee et al. (6) with NPV of 94-96% and Elvarici et al. (4) with NPV of 100%.

The other parameter interpreted in our study was PPV, which is the probability of malignant breast lesions under BI-RADS that is truly positive of breast cancer. In our study, the calculated for overall PPV was moderate with a value of 51.25%. Our PPVs were lower than Constantini et al. (2) and Okeji et al. (8) with PPV of 67.8% and 71.42% respectively. Our PPV was higher than four other studies, in which Badam et al. (10) with PPV of 23.64%, Zengin et al. (4) reported PPV of 24.7 – 27.2%, Park et al. (5) with PPV of 30 – 40% and Nascimento et al. (7) with PPV of 42.1 – 45.1%. When the prevalence of malignancy increases, the PPV is also increasing (4). The pathology results established a malignancy rate of 27.1% (total of 88 cases) in our study. Comparing to studies done by Constantini et al. (2) and Okeji et al. (8), the prevalence of malignancy in these studies were higher than our study which were 58.98% and 36% respectively.

For the final assignment of BI-RADS ultrasound, ACR has established PPV of malignancy for each BI-RADS classification. BI-RADS 2 has PPV of 0%, BI-RADS 3 with PPV of less than 2%, BI-RADS 4 with PPV between 2-95% and BI-RADS 5's PPV of more than 95%. According to BI-RADS recommendation, the biopsy is warranted for BI-RADS 4 and 5 lesion due to high level of predictive malignancy. In our centre, a biopsy of BI-RADS 2 and 3 lesions are mainly performed due to palpable in nature, patient's anxiety, logistic issue, physician's demand and presence of high-risk factors for breast cancer.

For BI-RADS 2, our study showed higher PPV than ACR established PPV, which was 9.09%. In our study, there were a total of 11 biopsied lesions and 1 of them turned out to be invasive carcinoma with mucinous differentiation. At the moment there were two studies done to determine PPV of BI-RADS 2 as the lesion is rarely biopsied due to 0% likelihood of malignancy. Kim et al. in 2007 (11) and Kim et al. in 2012 (12) proved that BI-RADS 2 PPV was 0% for both. The high level of our PPV could be due to the fact of the low

number of BI-RADS 2 cases for biopsy. The main reason for performing the biopsy for BI-RADS 2 lesions was due to the patient's preference and palpable in nature.

For BI-RADS 3, our study showed higher PPV, which was 3.27% than ACR's PPV which was less than 2%. There were several studies done to determine PPV BI-RADS 3 and the results were in between 0.02 – 1.6% (3,9–11,13–15). In Constantini et al. (2), the PPV BI-RADS 3 reported as 7.7% which was higher than our result. In their study, they stated that a high level of PPV BI-RADS 3 was due to the low number of BI-RADS 3 cases that underwent for biopsy. In our study, there were 5 cases with malignant HPE result from a total of 153 cases under BI-RADS 3.

In the present study, PPV for BI-RADS 4 was 39.02%, which was within the expected predictive malignancy range, between 2-95%. Our PPV was comparable with three other studies; Kim et al. (11) with 31.1%, Badan et al. (10) with 33.08% and Eda et al. (16) with 38.7%. In view of the wide range of PPV BI-RADS 4, there is subcategorization into three groups into 4a, 4b and 4c based on clinical judgement of the physician. Our centre does not practice routine BI-RADS 4 subcategorizations. Thus, we were unable to provide PPV for BI-RADS 4 subcategories.

ACR states that BI-RADS 5 has predictive malignancy value of more than 95% and in the present study, the PPV for BI-RADS 5 was 91.89% which was lower than ACR established PPV. Some studies were able to prove PPV BI-RADS 5 more than 95% similar to ACR PPV. The studies reported PPV BI-RADS 5 of 96.9% - 97.0% (6,9,11,17). The other studies' PPV for BI-RADS 5 ranged from 66.7 – 94.0% which were almost similar to our study's PPV (2–4,10,13,15,17). In our study, there were 3 cases of false positive (FP) out of total 37 cases of BI-RADS 5 which found to be benign findings of a breast abscess (Fig. 4), fibrotic tissue and fibroadenoma

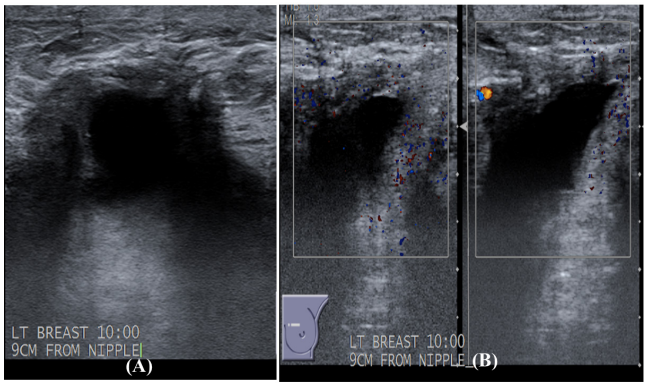

Figure 4: (A) Axial view and (B) Colour Doppler - example for false-positive case. Ultrasound images showed irregular, hypoechoiec lesion with posterior shadowing and thick wall at left breast 10 OC, adjacent to scar tissue (post wide local excision for previous left invasive ductal carcinoma). BI-RADS 5 was given and biopsy performed with HPE turn out to be breast abscess secondary to chronic granulomatous mastitis.

respectively. The overlapping benign and malignant sonographic features of breast lesion in patients with a high risk of breast cancer are the reasons for false-positive cases of BI-RADS 5 in our centre.

As for BI-RADS lexicon, we found that the margin and posterior artefact criteria were highly significant ($p < 0.0001$) in differentiating between malignant and benign masses. Our study was similar to Hong et al. study in 2004 (18), which conclude the margin and posterior artefact had the statistically significant difference for malignant and benign masses. Most of the studies stated that the margin, shape and orientation were the important criteria for benign and malignant mass differentiation (12,16).

There were several descriptors of BI-RADS lexicon that had high predictive value towards determining the malignancy of a lesion. We found that irregular margin had highest predictive value for malignancy with PPV of 52.3%, followed by posterior shadowing (PPV 41.7%), heterogenous internal echo (28.7%) and hypoechoiec (27.9%). Descriptors of BI-RADS lexicon that had high predictive value towards determining benign lesions were well defined (NPV 89.7%), edge shadowing (NPV 84.1%), hyperechoiec (NPV 82.4%) and homogenous internal echo (NPV 77.5%).

Our study was similar with Nascimento et al. study which stated that non circumscribed margin, hypoechoiec and posterior shadowing were among the highest PPV for malignant descriptors and circumscribed margin and posterior enhancement were among the highest NPV for benign findings (7). Most of the studies concluded that spiculated margin, irregular shape, non-parallel, echogenic halo, posterior shadowing and hypoechoiec were descriptors that associate with malignant features. In contrast, circumscribed margin, parallel, oval shape, abrupt interface, posterior enhancement and hyperechoiec were descriptors that associate with benign features (2,8,16,18).

There were two limitations to our study. First, the observer had the opportunity to re-evaluate static images of the lesion without performing real-time ultrasound and this could contribute to the suboptimal evaluation of BI-RADS lexicon. Secondly, the study did not take into account interobserver variability. Perhaps, this limitation and bias can be addressed in the future study

CONCLUSION

Our study proves that BI-RADS sonography has a high value of sensitivity and NPV with a moderate value of specificity, accuracy and PPV. This indicates that BI-RADS sonography assessment is good in screening for a malignant lesion in the complimentary breast assessment. However, this modality has the limitation due to overlapping sonographic descriptors for benign

and malignant breast lesion, in which influence radiologist judgement in choosing final BI-RADS categories of breast lesion. We found that the margin and posterior artefact are the relevant descriptors in differentiating benign and malignant breast lesion among BI-RADS lexicon's criteria. Hence, we believed that by precise understanding and routine practice of BI-RADS sonography in the reporting, will lead to a more accurate assignment of the final classification of breast lesions. Further training and periodic performance evaluations would be helpful to overcome this weakness.

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