
MAMMOGRAPHIC AND ULTRASONOGRAPHIC FINDINGS CHARACTERISTICS OF INVASIVE DUCTAL CARCINOMA OF THE BREAST IN KING CHULALONGKORN MEMMORIAL HOSPITAL (KCMH*)

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ABSTRACT

Purpose: To review mammographic, ultrasonographic findings and histological grades of invasive ductal carcinoma (IDC) of breast in King Chulalongkorn Memorial Hospital.

Materials and methods: A total of 263 proven cases of IDC of breast and histological grading whose 252 mammographic studies and 233 ultrasound studies were retrospective reviewed for mammographic and ultrasonographic features.

Results: Two hundred and twenty two abnormal masses have been found in 217 mammography. Another 35 cases whose mammographic findings showed no mass lesions; 5 were normal, 19 were asymmetrical density and 11 were architectural distortion and adjunction ultrasound images could detect these lesions. The most common mammographic findings of IDC were abnormal mass with irregular shape (86.5%). The most frequent margin of mass from mammography was spiculate margin (39.6%) which most were histological grade 1 and 2 (77.27%) followed by indistinct (ill-defined) margin (33.7%). Malignant-type microcalcifications were observed in 111 cases (44%) and the most common type of microcalcifications were granular type(52.3%). Mammography was better than ultrasonography in depicting microcalcifications (111 Vs 58 lesions). Axillary lymphadenopathy was detected in 46% of cases. Ultrasonography was better than mammography in depicting soft tissue masses. Two hundred and forty four lesions have been found by ultrasonography. The most common ultrasonographic findings for IDC of breast cancer were irregular shape (80%) and thick echogenic rim (80%). Nearly most of lesions were hypoechoic lesions (hypoechoic lesions 83.2% and very low echoic lesions 7.38%). Most frequent posterior attenuation from ultrasonography was posterior enhancement (29.5%) followed by posterior shadowing (28.3%). In-group of posterior enhancement lesions were mostly in histological grade 3 and 2, while in posterior shadow group most lesions were in grade 1 and 2. Doppler study, available in 240 lesions, found that 79.9% have one or more feeding vessels to lesions.

Conclusion: Most common malignant mammographic features are spiculated margin (39.6%) and irregular shape (86.5%). Multiple suggestive malignancy signs such as malignant microcalcifications, axillary lymphadenopathy and skin thickening should be used to increase confidence of the diagnosis. Most common features on ultrasound are irregular mass, angular margin, thick echogenic rim and hypervascularity from Doppler study. Posterior shadowing of the mass tends to be found in grade 1 and 2 tumor, whereas posterior acoustic enhancement tends to be found in grade 3 tumor. Adjunctive ultrasonography was suggested to improved the confidence of diagnosis.

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INTRODUCTION

Breast cancer is the most prevalent cancer among women throughout the world and one of the mortality causes among women in the world today¹ without knowing the actual cause, probably due to multiple factors.² The risk of breast cancer increases with age and drops off at 80 years of age. However, the incidence of breast cancer is increasing in younger women and many cases of this disease are being reported in women in their twenties and thirties. The incidence of breast cancer among women across all ages are also continue to be rising.

In Thailand, breast cancer is the second most common cancer, leading by cervical cancer, and second cause of death in women today. The number of new breast cancer cases has been increased by approximately 17.2 per 100,000 women.³ Invasive ductal carcinoma breast cancer is the most common pathological type of breast cancer.²

Early and accurate diagnosis of breast cancer is a cornerstone of successful treatment. Mammography is the role acceptable method for breast cancer screening and diagnosis. Pre-operative mammographic features can predict patients likely to have residual microscopic disease or extensive intraductal carcinoma following conservation surgery for breast cancer. The sensitivity of the mammography to the index cancer range from 63% to 98% and has been reported to be as low as 30%-48% in dense breast.⁴ The use of ultrasound as an adjunct to mammography in the diagnosis of breast cancer is well established⁴⁻⁶ with increase in diagnostic accuracy of the breast cancer detection.⁷ An abnormal mass on mammography is reported in 50% of carcinomas of less than 10-mm diameter and 88% of those greater than 10 mm diameter⁸. A spiculated mass on mammography has been reported in up to 84% of breast malignancies.⁹ However in Gershon-Cohen J et al study¹⁰ in 1969 showed that up to 60% of malignant lesions showed no classical sign of breast cancer.

Historically, at ultrasound examination posterior acoustic shadowing was said to be associated with the majority of malignant breast mass: 70%-80% over all and almost 100% of speculated lesions.⁵ However, it is now widely recognized that not all-invasive breast mass demonstrate posterior shadowing; they may have no distal effect or even be associated with acoustic enhancement. Sometime, the tumors associated with distal acoustic enhancement tend to be designated high-grade at subsequence histological examination.

The purpose of this study was to demonstrate mammographic findings, ultrasound characteristic of invasive ductal carcinoma of breast in King Chulalongkorn Memorial Hospital's patients.

MATERIAL AND METHODS

Institutional ethics approval was obtained for this study.

Between January 1, 2004-December 31, 2005, 378 patients pathological proved to be invasive ductal carcinoma of the breast with Modified Bloom-Richardson histological grading system of histological grade, who admitted in KCMH.* Available prediagnostic mammography and/or ultrasonographic studies of 263 patients were reviewed.

Mammography was performed with dedicated equipment (Senography 2000D full field digital mammography, GE healthcare Waukesha UI, USA). Standard craniocaudal and mediolateral oblique views were routinely obtained and additional views such as magnification view were also obtained for better delineation of a mass or microcalcifications.

Mammographic findings were assessed for malignant features of breast cancer including soft tissue abnormalities both with mass or with no mass,

such as normal, asymmetric density or architectural distortion. In-group of the mass lesions, characteristics of the masses were reviewed such as shape and margin. Including presence or absence of microcalcification, type of microcalcifications and associate findings such as axillary lymphadenopathy, skin thickening and nipple retraction were also noted. All of the findings were reviewed via the same definition according to ACR BIRADS Lexicon.¹¹

All cases after mammography had been performed, were sent to breast ultrasonography using high frequency (10-12 MHz) linear transducers (Philip HDI 5000, Advanced technology laboratory Bothell Wash USA and GE logic,⁹ GE healthcare Waukesha WI, USA) and experienced radiologists. Ultrasonography characteristics assess size of mass, characteristics of mass (margin, attenuation, echotexture, halo, depth/width ratio, vascularity) peripheral duct extension and calcification.¹² All cases had Doppler studying performed. Vascularity of the mass was studied and divided into three groups according to the number of feeding vessels: avascular, hypovascular (one) and hypervascular (more than one). And then pattern of the feeding vessels of the tumor were characterized by inner, periphery and both inner-periphery locations.

All films were retrospective reviewed by a radiologist who has experienced in breast imaging.

RESULT

In the study period, there were 263 women with pathological proved invasive ductal carcinoma of the breast and multiple lesions in 6 patients. The histological grading according to Modified Bloom Richardson grading systems were revealed that, grade I: 29 (10.8%), grade II: 144 (53.5%), grade III: 79 (29.4%) and no recording of the histological grading in 17 patients. Associating pathological findings were the presence of axillary lymph node metastases in 80 patients (30.4%) and positive extensive intraductal component or ductal carcinoma insitu component in

36 patients (13.6%).

All 263 women underwent mammography and/or ultrasonography. The 222 women had both available prediagnostic mammography and ultrasound studies. There were 30 women having only mammography and 11 women having only ultrasound study.

Their ages ranged from 24 to 80 years (mean, 51.6 years). Site and side of the lesions were shown in Table 1. There are 2 patients who have lesions in both breasts. Size of the lesions ranged from subcentimeter to more than 5 cm and correlation with histological grading were shown in Table 2.

MAMMOGRAPHIC FINDINGS

Two hundred and fifty-two mammography were reviewed, 222 masses were found in 217 patients. In five patients, there were two masses in one mammography. In 35 (13.8%) patients, the mammography showed no mass on mammography. Of these 35 patients, 5 were normal, 19 were asymmetrical density and 11 were architectural distortion.

Of the 222 masses on mammography, 22(10%) were round, 10(3.5%) were oval and 192 (86.5%) were irregular shape. Margins of these masses were spiculate (Fig.1) in 86 lesions (38.7%), indistinct (poorly defined, ill-defined) margin (Fig.2): 73 lesions (32.9%) and the least frequent margins such as obscured, microlobulated and circumscribed (well-defined) margins. Correlation between histological grading and margin of the lesions was also reviewed on Table 3.

Microcalcifications (Fig.3) in the lesions were detected on 111 patients. Most common findings are granular type microcalcifications about in 58 lesions follow by mixed type microcalcification (39 lesions) and linear (14 lesions).

Associated findings such as axillary lymphadenopathy (Fig.4) were founded in 116

mammograms, skin thickening and retraction in 47 mammograms and nipple retraction in 67 mammograms. The criteria suggestive of axillary metastases were enlargement of axillary lymphnodes (more than 2 cm), round or irregular shape, increase nodal density with absence of radiolucent fat within (fatty hilar).^{13,14} However in pathological database, nodal metastases were depicted only 80 patients. In these 80 patients, there were 55 patients who presenting with abnormal axillary lymph node appearances on mammography, another 25 patients showed normal appearances.

ULTRASONOGRAPHIC FINDINGS

Ultrasound images were available in 233 cases: of these 21 were grade 1 tumors, 123 were grade 2 tumors, 75 were grade 3 tumor and 14 had no histological grading record. There were 244 lesions in ultrasound images. The ultrasonographic findings of the mass were reviewed for size, depth/width ratio, shape, margin, echogenicity, attenuation and vascularity.

With regard to the depth/width ratio, 52 lesions (21.3%) of all tumor masses had an increased ratio representing taller than wide appearance.

Most common shape of the lesions were irregular shape, 195 lesions (80.1%). Angular margin (Fig.5) was the most common findings of the lesions, in 156 lesions (73.9%). Correlation between histological grading and margin were shown in Table 4.

In 203 lesions showed hypoechogenicity whereas 13 lesions were mixed solid-cystic echogenicity and other 18 lesions were very low

echogenicity with shadowing on posterior attenuation.

Attenuation patterns of all lesions and correlation to histological grading were shown in Table 5.

Thick echogenic rim (Fig.5) was depicted in 195 lesions (80.1%).

Doppler ultrasonography available in 240 lesions were revealed for the amount of feeding vessels, location of vessels and correlation to histological grades shown in Table 6 and 7.

According to criteria of suggestive malignant lymph nodes from ultrasonography and Color doppler study in previous studies:¹⁵⁻¹⁷ longitudinal/transverse ratio of abnormal lymph node less than 2, concentric or asymmetrical eccentric cortical thickening more than 2 mm, absence or abnormal echo of central fatty hilum and predominate peripheral flow were suggestive of malignant lymphnodes.¹⁵⁻¹⁷ In our study, ultrasonography detected only 17 patients with abnormal axillary lymph nodes (Fig.4), while all the malignant axillary lymph nodes of all patients on mammograms. The associated findings were observed in ultrasound images such as intraductal extension 52 patients, daughter nodules 17 patients, subnipple extension in 14 patients and skin thickening in 11 patients.

In the detection of microcalcifications from ultrasound study, we depicted 58 lesions having small hyperechoic spots with acoustic shadow suggestive of microcalcifications. All of them were demonstrated on mammography.

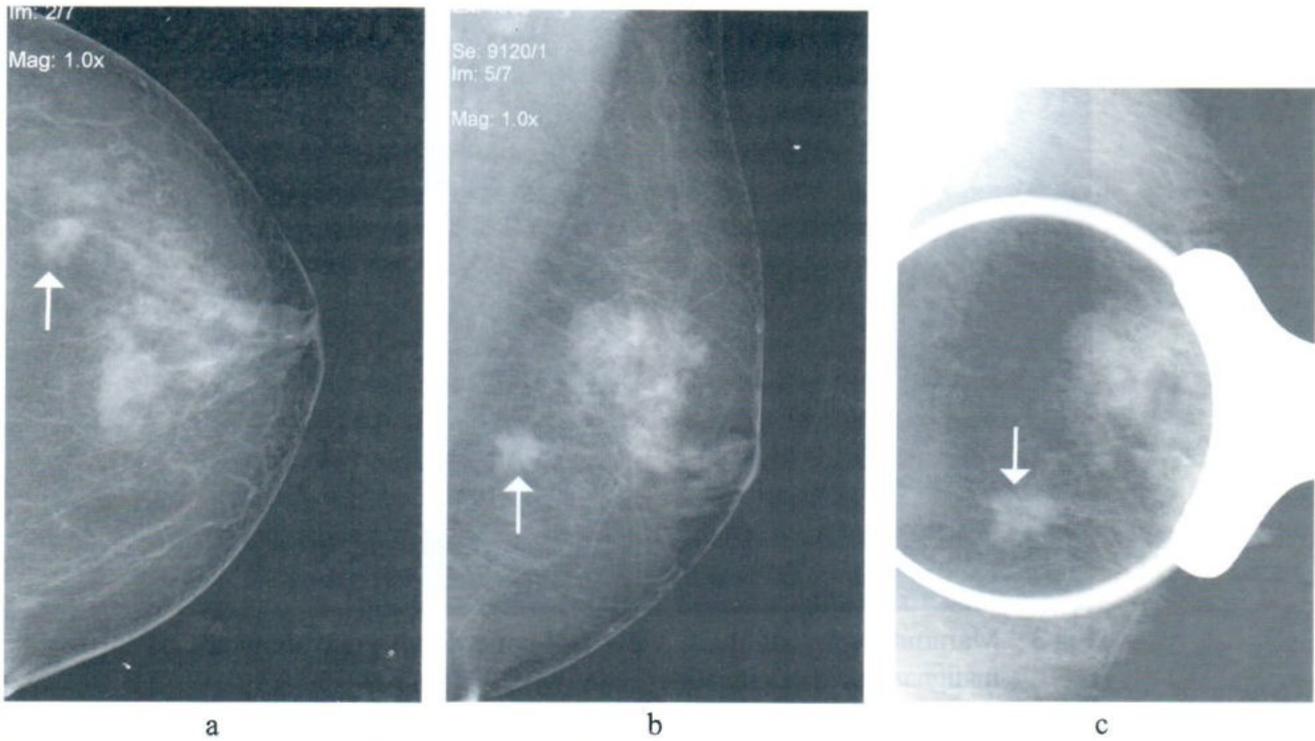


Fig.1 Mammography: left CC view (a), left MLO view (b), and cone compression (c) showed spiculated mass (white arrow) at left upper mid region.

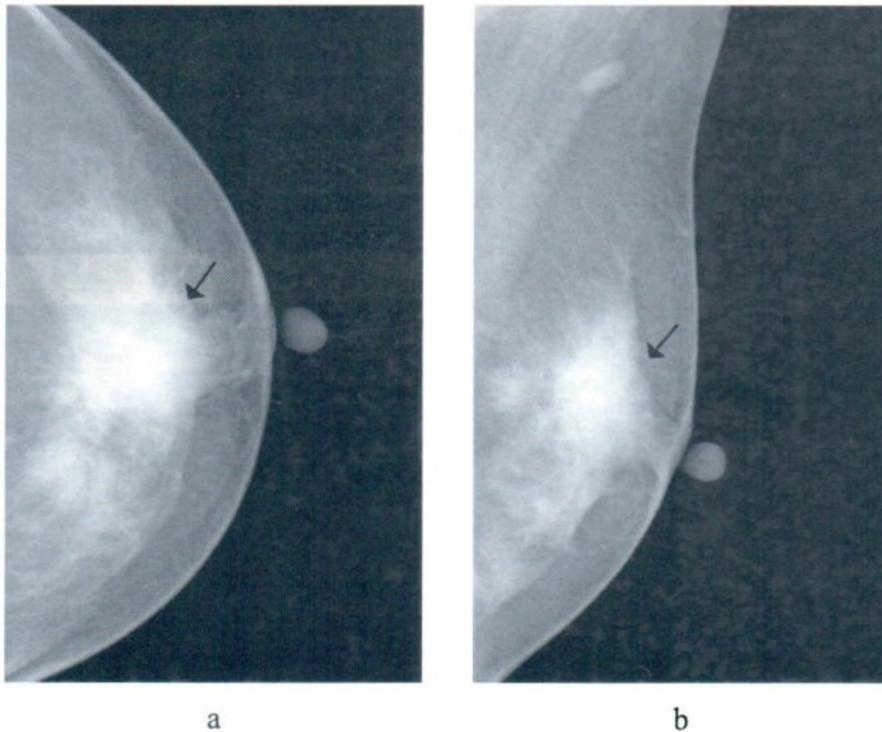


Fig.2 Mammography left CC view (a), and left MLO view (b), showed an ill-defined margin mass (arrow) at left upper inner quadrant.

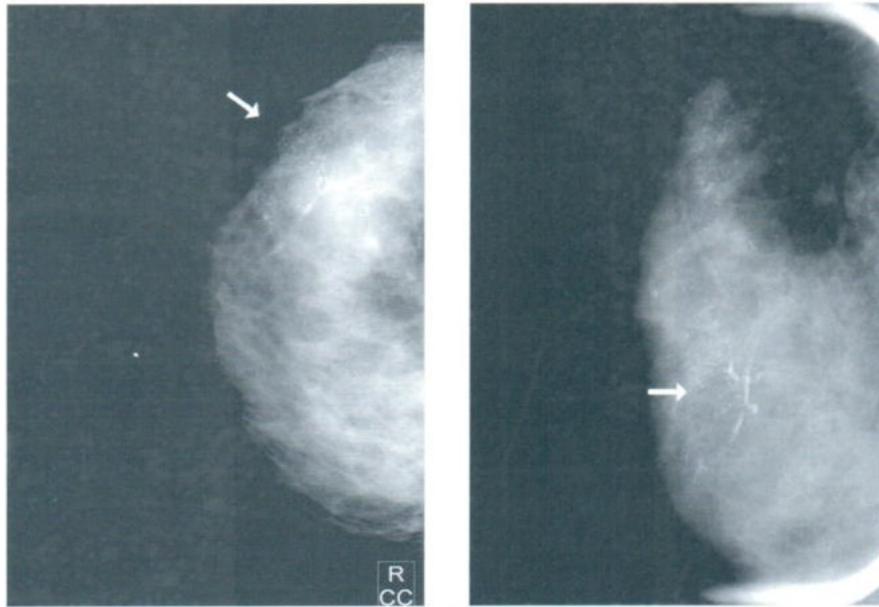


Fig.3 Mammography right CC view and cone down view showed malignant microcalcification (mixed type) white arrow;

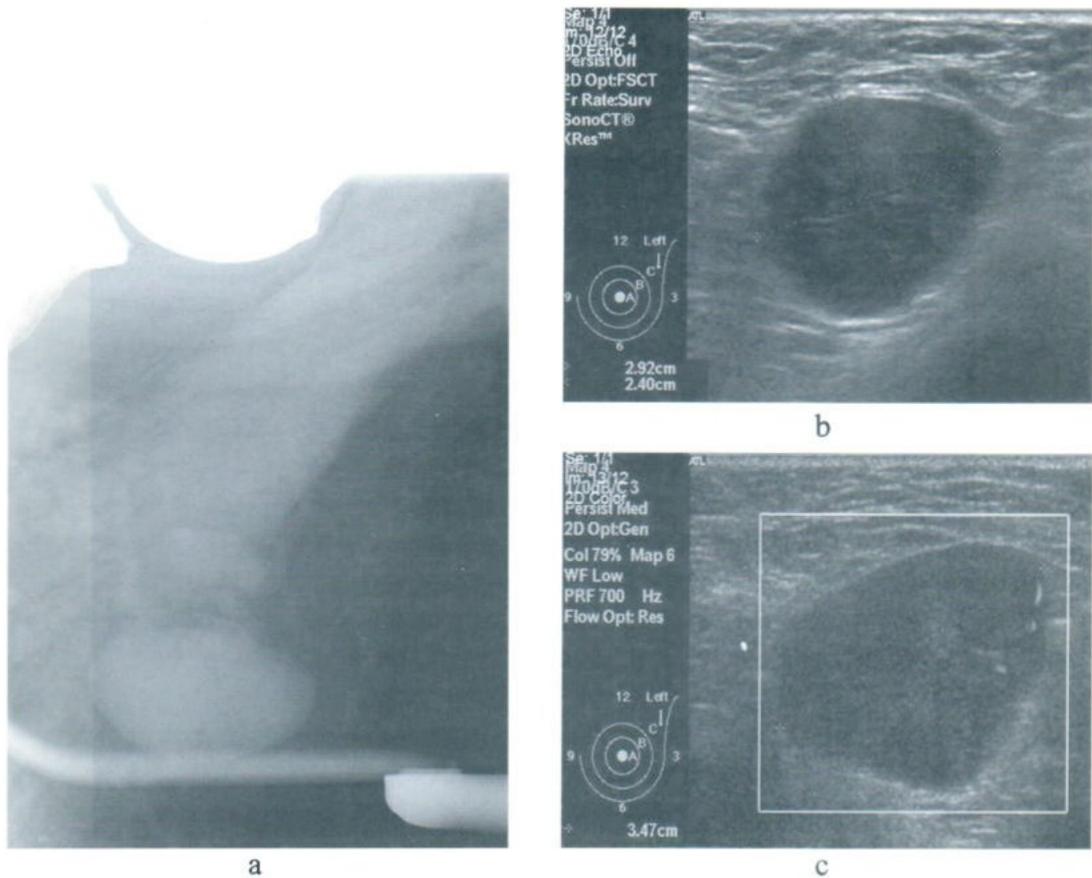


Fig.4 Enlarged dense axillary lymphadenopathy in mammography (a), and a round-shaped node form ultrasonography (b), and hypervascularity from Doppler study (c)

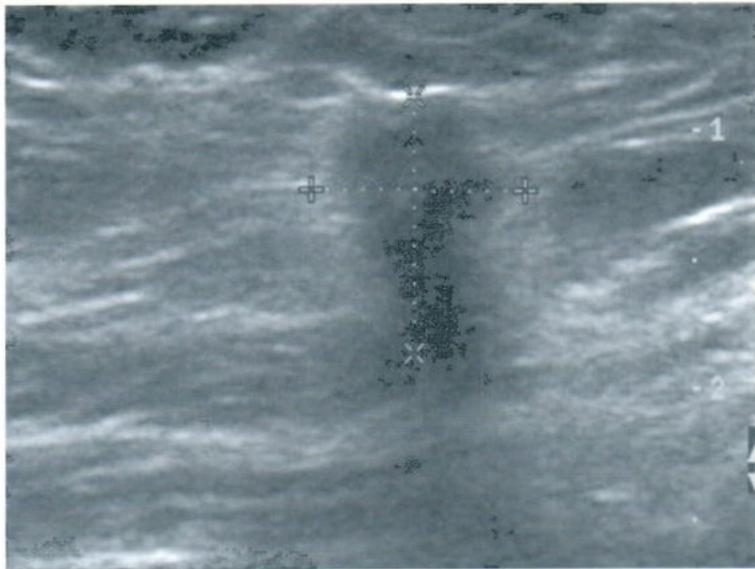


Fig.5 Ultrasonography of left breast mass showed Irregular shape, angular margin, taller than wide mass with thick echogenic rim and posterior shadowing.



Fig.6 Ultrasonography of breast mass showed well-defined oval shaped mass with posterior enhancement, pathological proved to be invasive ductal carcinoma.

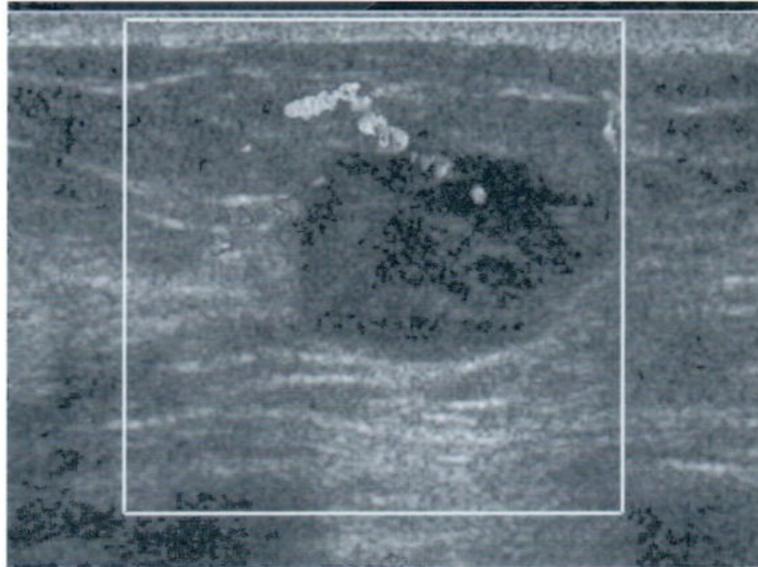


Fig.7 Color doppler study shows hypervascularity with intratumoral and peripheral location of breast mass.

Table 1 Sites of the lesions

Site	RT	LT	Total
UO (upper outer)	45	52	97 (36.6%)
MO (mid outer)	15	20	35 (13.2%)
LO (lower outer)	3	5	8 (3.0%)
ML (mid lower)	3	2	5 (1.9%)
LI (lower inner)	19	18	37 (13.9%)
MI (mid inner)	4	0	4 (1.5%)
UI (upper inner)	12	21	33 (12.5%)
MU (mid upper)	8	10	18 (6.7%)
Central	14	14	28 (10.6%)
Total	123 (46.4%)	142 (53.5%)	265

Table 2 Sizes of lesions * and histological grade

Size Histo grade	<1 cm	1-2 cm	2-5 cm	> 5 cm
No Histo grade	5	6	6	0
1	5	12	5	0
2	16	58	47	5
3	5	33	37	4
Total (244)	31 (12.7%)	109 (44.67%)	95 (38.9%)	9 (3.7%)

* Size of the lesions comes from ultrasonographic measurement in maximum diameter.

Table 3 margin of the mammographic lesions and histological grades

		Margin					Total
		Circumscribed (Well-defined)	Indistinct (Poorly or ill-defined)	Obscured	Spiculate	microlobulate	
Histological grade	No grade	0 (0%)	10(4.5%)	1(0.45%)	3(1.35%)	0(0%)	14(6.3%)
	1	1(0.45%)	7(3.15%)	5(2.25%)	11(4.95%)	0(0%)	24(10.8%)
	2	2(0.90%)	33(14.06%)	18(8.10%)	57(25.67%)	6(2.70%)	116(52%)
	3	4(1.8%)	25(11.26%)	14(6.3%)	17(7.66%)	8(3.6%)	68(30.6%)
Total		7(3.15%)	75(33.7%)	38(17.11%)	88(39.6%)	14(6.3%)	222(100%)

Table 4 margin of the ultrasound lesions and histological grade

Histological grade	Margin					Total
	Well-circumscribed	Poorly defined	Microlobulate	Angulated	Spiculate	
No grade	1(0.4%)	2(0.82%)	4(1.64%)	7(2.87%)	0(0%)	14(5.3%)
1	1(0.4%)	0(0%)	4(1.64%)	16(6.56%)	0(0%)	21(7.79%)
2	4(1.64%)	10(4.1%)	22(9.22%)	77(31.56%)	5(2.04%)	131(53.3%)
3	1(0.4%)	6(2.45%)	16(6.56%)	45(18.44%)	3(1.23%)	78(31.9%)
Total	7(2.87%)	18(7.38%)	46(18.85%)	145(59.43%)	8(3.28%)	244(100%)

Table 5 posterior attenuation of the ultrasonographic lesions and histological grade

Histological grade	Attenuation				Total
	Shadowing	Posterior enhancement	Mixed distal effect	No distal effect	
No grade	1(0.4%)	3(1.23%)	2(0.82%)	8(3.28%)	14(5.3%)
1	10(4.1%)	3(1.23%)	3(1.23%)	5(2.05%)	21(7.79%)
2	46(18.85%)	31(12.7%)	24(9.83%)	30(12.29%)	131(53.3%)
3	13(5.32%)	35(14.34%)	13(5.33%)	17(6.97%)	78(31.9%)
Total	70(28.69%)	72(29.5%)	42(17.21%)	60(24.59%)	244(100%)

Table 6 Vascularity form color doppler study of masses and histological grade

Histological grade	Attenuation				Total
	Shadowing	Posterior enhancement	Mixed distal effect	No distal effect	
No grade	1(0.4%)	3(1.23%)	2(0.82%)	8(3.28%)	14(5.3%)
1	10(4.1%)	3(1.23%)	3(1.23%)	5(2.05%)	21(7.79%)
2	46(18.85%)	31(12.7%)	24(9.83%)	30(12.29%)	131(53.3%)
3	13(5.32%)	35(14.34%)	13(5.33%)	17(6.97%)	78(31.9%)
Total	70(28.69%)	72(29.5%)	42(17.21%)	60(24.59%)	244(100%)

Table 7 Location of feeding vessels and histological grade

Histological grade	Location of feeding vessels			Total
	inner	Periphery	Both	
No grade	0 (0%)	8(4.1%)	4(2.05%)	12(6.15%)
1	4(2.05%)	7(3.59%)	9(4.61%)	20(10.25%)
2	15(7.69%)	61(31.28%)	22(11.28%)	98(50.26%)
3	8(4.1%)	38(19.49%)	19(9.74%)	65(33.33%)
Total	27(13.85%)	114(58.46%)	54(27.69%)	195(100.0%)

DISCUSSION

The role of mammography and ultrasonography in imaging of breast cancer has been accepted more over the years. The classical appearance of the breast cancer on mammography such as spiculate mass was also accepted.⁸

In this study the classical spiculate appearance of the breast cancer was found in 88 lesions (39.6%) follow by poorly defined margin in 75 lesions (33.6%). However well defined margin lesions, mostly indicate benign lesions were depicted in 7 lesions (3.15%). All of these lesions had other secondary signs¹⁰ such as microcalcifications, axillary lymphadenopathy, skin thickening and adjunctive ultrasounds, which can help us to make diagnosis. The most common findings of the malignant breast cancer in our study were irregular shape, about 192 lesions from 222 mammographic lesions (86.5%).

The classic spiculate margin of the malignant lesions showed more than 77% is grade 1 and 2 lesions similar findings as the previous study on Lamb et al study in 2000¹⁸ that the classical malignant appearances tend to be low grade tumor.

Malignant microcalcifications were also

observed in 111 patients from mammography and only 58 patients from ultrasound study. In all 58 patients with detected microcalcifications on ultrasound study were also detected on mammograms. As we known that mammography is more sensitive to detected microcalcification.¹⁹

Malignant appearance of axillary lymph nodes were noted from 116 mammograms, while ultrasound detected only 17 patients with abnormal appearances and all 17 cases were detected axillary lymphadenopathy on their mammograms. There were only 80 patients having pathological approved nodal metastases. To explain this, there were some patients receiving neoadjuvant chemotherapy and causing decrease in number of pathological detection. However to review mammography in 80 cases of pathological proved nodal metastases referred back to the mammographic findings, only 55 cases could detect malignant features of axillary lymph nodes. In other 25 cases, there were no abnormal appearances of the axillary lymph nodes. Two cases of these 25 patients, the pathological reports revealed positive nodal metastases only in the apical lymph nodes and they could not detect on mammogram. Other 6 cases, the pathological reports revealed evidence of

lymphatic vessels invasion. The rest in this group, abnormal findings of axillary lymph nodes could not be detected by mammography possible from small size of nodal metastases or micrometastases.

Ultrasound has been accepted as a role to help for the diagnostic of breast cancer especially in young patient with dense breasts.^{12, 19-21} Stavros A T, et al in 1995¹² showed that spiculation, angular margins and hypoechogenicity are reliable malignant findings. There was similar finding in our study which angular margin (59.3%) and hypoechogenicity (83.2%) of the masses were the most common findings. Thick echogenic rim was the most common sign of malignant lesions in our study, about 195 lesions similar to the study on 2005.²² In our study, only 52 lesions (21.3%) showed taller than wide appearances, similar to Stavros study. This sign is low sensitivity but high positive predictive value. According to Rahbar's study on 1999,¹⁹ the width-AP dimension ratio more than 1.4 seem to be benignity criteria, however in our study about 90 lesions (36.8%) had width-AP ratio more than 1.4. This sign seem to be less specificity in our study.

Posterior shadowing is a sign of the malignant lesions.¹² And in later several previous studies^{18, 22} revealed posterior shadowing more likely to represent low or intermediate grade tumor and posterior acoustic enhancement of the mass more likely found to be high-grade tumor. Similar to our study, it was found that about 70 lesions (28.69%) had posterior shadowing most by in histological grade 1 and 2. Another 72 lesions (29.5%) having posterior acoustic enhancement, about 48.9% in this group were histological grade 3.

Hypothesis of angiogenesis can represent malignant process. In our study, about 195 lesions had one or more feeding vessels and only 45 lesions shown no detectable feeding vessels from color Doppler sonography.

We also recognized some limitations of our

study. These included the fact that the evaluation of the cases were retrospective, that there was unavoidable case-selection bias, and no case of benign study included. For example some cases have only mammography without ultrasound or some imaging findings could be found in both benign and malignant processes.

CONCLUSION

Most common malignant features of invasive ductal carcinoma of the breast are spiculate margin (39.6%) and irregular shape (86.5%). However some of invasive ductal carcinoma of the breast showed benign features. Additional suggestive malignancy features such as malignant microcalcification, axillary lymphadenopathy, skin thickening should be use to increase the confidence of the diagnostic. Adjunctive ultrasound images are recommended to increase the confidence in the diagnostic too. Most common malignant features of breast cancer on ultrasonography such as irregular mass, angular margin, thick echogenic rim and color Doppler for feeding vessels searching are detected. Posterior shadowing of the mass are mostly found in low and intermediate grade tumors, whereas posterior acoustic enhancement mostly found in intermediate and high-grade tumors. To evaluate axillary adenopathy, mammography and ultrasonography still has limitation for those metastatic nodes locating in high level, being small size or micrometastases.

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