International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Incidentally Detected Breast Lesions on Computed Tomography: Comparison with Mammography and Ultrasound

Pongsakorn Ouwongprayoon MD[a], Jenjeera Prueksadee MD[b]*

[a,b]*Department of Radiology, Faculty of Medicine, Chulalongkorn University, King Chulalongkorn Memorial Hospital, Bangkok, 10330*

[a]*Email: tonnywa@yahoo.com*

[b]*Email: jenjeera@hotmail.com*

Abstract

The Objectives of this study is to determine the reliability of incidentally detected breast lesion on CT scan compared with mammography and ultrasound. The study group is consisted of 39 patients (49 breast lesions), who incidentally found breast lesions from chest or abdomen CT scan. The study was retrospectively reviewed CT features (size, shape, margin, density and enhancement pattern) and mammography with ultrasound features and categorized into American College of Radiology Breast Imaging Reporting And Data System (ACR BI-RADS). The comparison of ACR BI-RADS from CT scan and mammography with ultrasound was made by Kappa test to evaluate the agreement. Results: There was substantial agreement (k = 0.741, 95% CI 0.594-0.887) between CT and mammography with supplementary ultrasound findings. Mass lesions were found 46 in 49 lesions, macrocalcifications without mass 2 lesions and non-mass lesion 1 lesion (total 49 lesions).

---

* Corresponding author.

Most common shape of breast lesion from CT scan was oval shape seen 36 in 46 lesions (78.3%). Most common margin was circumscribed seen 38 in 46 lesions (82.6%). Iso-density lesions were seen 18 in 26 lesions (69.3%), 3 hyperdense lesions (11.5%) and 4 hypodense dense lesions (15.4%) and one fat-containing lesion (3.8%). Hounsfield unit (HU) study is between -50 to 61 HU (mean 27.1). Homogeneous enhancement were seen 27 in 44 lesions (61.4%) , non-enhancement pattern of 12 lesions (27.2%). Four non-enhance lesions were recognized as cysts due to low attenuation (< 20 HU) There were 11 lesions containing internal calcification, most of which were macrocalcification seen 9 in 11 lesions (81.8%). Overlying skin and nipple involvement were observed 2 in 49 lesions (4.1%). Lymphadenopathy and chest wall invasion were found in one case (2.0%).

CT was rather good for evalulation of shape and margin of breast masses, while density value, enhancement pattern and calcification show non-specific results.). Moreover, contrast enhanced CT scan has rather good reliability for diagnosis of benign lesion (BI-RADS 2) and malignant lesion (BI-RADS 5). However, for interpretation of suspicious lesion (BI-RADS 4) , it should be interpreted cautiously and compared with mammography and ultrasound due to over diagnosis in CT in this group.

Keywords: Incidentally; benign; malignant; mammography; ultrasound; computed tomography.

1. Introduction

Breast cancer is the most frequently diagnosed cancer and the leading cause of cancer death in females worldwide. Breast cancer is about 23% (1.38 million cases) of the total new cancer cases and 14% (458,400 cases) of the total cancer deaths in female [1,2]. Because of the disease's burden, early detection and prompt management is very crucial. Early breast cancer recommendation by National Cancer Institute (NCI) 2013 suggests mammography in patient more than 40 years old and then every year [3]. CT scan is not routinely used for imaging breast lesion. CT scan is a modality to evaluate extension of large breast lesion [4] . Normally, CT scan is used for diseases of the lung, mediastinum, pleura and chest wall. However, breast tissues are usually appearing together with all these studies and sometimes breast lesion may incidentally found. Because it is not routinely used of CT scan for detection of beast lesion then the reliability of CT scan for breast lesion is still questionable. The purpose of this study is to determine the reliability of incidentally detected breast lesion on CT scan compared with mammography

2. Materials and method

2.1 Sampling and participants

The study retrospectively selected the patients whome came to do CT scan at King Chulalongkorn Memorial Hospital between March 2010 to March 2016. Data collection was performed by using PACS (Picture Archiving and Communication System) and HIS (Hospital information system). All of the enrolled participants were the patients who had been referred for CT scan of the chest or abdomen. Thirty-nine patients with 49 lesions were enrolled into the study.

2.2 Assessment of CT features

All CT images of the lesions were reviewed by experienced radiologist with blinded to clinical data.

The radiologist reviewed CT scan including size, shape, margin, density and enhancement pattern as well as Hounsfield unit (HU) in pre-contrast (if available) and post-contrast phases.

Calcification and associated findings were also recorded. And the final result was concluded into ACR BI-RADS category [5] (Table 1).

All the features of CT findings were described in Table 2.

Table 1: ACR BI-RADS Atlas 2013

Assessment	Management	Likelihood of Cancer
Category 0: Incomplete — Need Additional Imaging Evaluation	Recall for additional imaging	N/A
Category 1: Negative	Routine screening	Essentially 0% likelihood of malignancy
Category 2: Benign	Routine screening	Essentially 0% likelihood of malignancy
Category 3: Probably Benign	Short-interval (6-month) follow-up or continued surveillance	> 0% but ≤ 2% likelihood of malignancy
Category 4: Suspicious Category 4A: Low suspicion for malignancy Category 4B: Moderate suspicion for malignancy Category 4C: High suspicion for malignancy	Tissue diagnosis	> 2% but < 95% likelihood of malignancy > 2% to ≤ 10% likelihood of malignancy > 10% to ≤ 50% likelihood of malignancy > 50% to < 95% likelihood of malignancy
Category 5: Highly Suggestive of Malignancy	Tissue diagnosis	≥ 95% likelihood of malignancy
Category 6: Known Biopsy-Proven Malignancy	Surgical excision when clinically appropriate	N/A

Table 2 : The CT features for evaluation of breast lesions

CT findings parameters (adapt from Mammography and MRI ACR BI-RADS lexicon)
Mass lesion
Shape (round, oval, irregular)
Margin (circumscribed, obscured, microlobulated, indistinct , speculated
Density (high, low, iso, fat containing)
Enhancement pattern (homogeneous, heterogeneous, rim enhanced, internal septation and non-enhanced)
Non-mass lesion
Distribution (focal, linear, segmental, regional, multiple lesion , diffuse)
Enhanced pattern (homogeneous, heterogeneous, clumped, clustered ring)
Calcification
Microcalcification (</= 0.5 mm) or macrocalcifications (>0.5 mm)
Distribution (diffuse, regional, grouped , linear, segmental)
Associated findings
Skin and nipple involvement
Lymphadenopathy
Chest wall invasion
Other findings

2.3 Assessment of mammography

The mammography with additional ultrasound images were reviewed by the same radiologist but in separate time from CT images. The standard craniocaudal (CC) and mediolateral-oblique (MLO) views were interpreted with providing information about location of the lesion to ensure that the lesion from CT scan and mammographic images are the same one. The features were recorded by the standard reference of ACR BI-RADS findings, including breast composition as well as size, shape, margin, density, calcification and associated findings. The final result was also concluded into ACR BI-RADS category. All the feature of mammographic findings were described in Table 3.

Table 3: The mammographic features for evaluation of breast lesions

Mammographic findings parameters
Breast composition
Entirely fatty breast
Scattered fibroglandular tissue
Heterogeneously dense fibroglandular tissue
Extremely dense fibroglandular tissue
Mass lesion
Shape (round, oval, irregular)
Margin (circumscribed, obscured, microlobulated, indistinct, speculated)
Density (high, low, iso, fat containing)
Calcification
Microcalcifications (</= 0.5 mm), macrocalcification (.0.5 mm)
Distribution (diffuse, regional, grouped , linear, segmental)
Associated findings
Skin and nipple involvement
Lymphadenopathy
Chest wall invasion
Other findings

2.4 Comparison of the findings between CT scan and mammography

The final result of lesions from CT scan and mammography with ultrasound were interpreted into ACR BI-RADS category.

Each lesion was compared one by one to evaluate the agreement between two imaging technics.

2.5 Statistical analysis

Statistical analysis was performed by using software SPSS version 17.0 (Statistical Package for the Social Sciences, IBM corporation, United States) and Medcalc 16.1 (MedCalc software bvba, United States).

The comparison of the two ACR BI-RADS category from CT scan and mammography was used weighted Kappa test for agreement between two tests.

3. Results

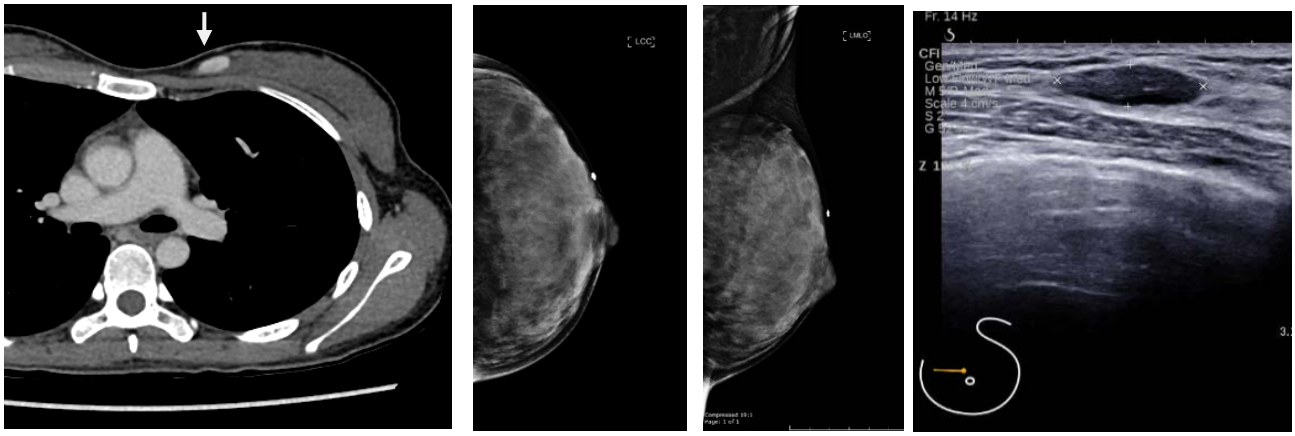
The total 49 breast lesions were included in the study. The demographic data are shown in Table 4.

Table 4 : Demographic data of the patients and lesions

Number of patients	39
Number of lesions	49
Age (year)	
Range	15-88
Median	52.00
Mean (Standard deviation)	52.08 (15.04)
Breast composition	Number (%)
Fatty breast	2 (4.1%)
Scattered fibroglandular tissue	5 (10.2%)
Heterogeneously fibroglandular tissue	27 (55.1%)
Extremely dense fibroglandular tissue	5 (10.2%)
Side of the lesion	Number (%)
Right	28 (57.1%)
Left	21 (42.9%)
Size of the lesion	(cm)
Range	0.2-9.0
Mean (Standard deviation)	1.57 (1.32)

There were 9 lesions which seen on the CT scan but could not be seen on the mammography (9/49 lesions, 18.4%), especially in extremely dense fibroglandular breast tissue (Figure1).

But when added the supplementary ultrasound images, all of these lesions can be seen.



a b c d

Figure1: (a) Axial contrast enhanced CT showed circumscribed enhancing mass on the left breast (arrow). (b) and (c) Mammography CC and MLO views with skin marker showed extremely dense fibroglandular breast, no mass visualized.(d) Additional ultrasound demonstrated a well-defined hypoechoic mass at left upper inner quadrant which corresponding to the mass on CT scan (BI-RADS 4 lesion).

The weighted Kappa test for agreement between BI-RADS category of CT scan and mammography with supplementary ultrasound findings, the weighted Kappa test for agreement was 0.741, 95% CI 0.594-0.887, considered as substantial agreement. The result was shown in Table 5.

Table 5: The results of comparison between ACR BI-RADS of CT scan and mammography with supplementary ultrasound findins.

Total 49 lesions		ACR BIRADS from mammogram with ultrasound			
		BIRADS 2	BIRADS 3	BIRADS 4	BIRADS 5
ACR BI-RADS from CT scan	BIRADS 2	12	3	0	0
	BIRADS 3	4	17	0	0
	BIRADS 4	1	3	2	0
	BIRADS 5	0	0	1	6

In total, 49 breast lesions were detected (46 mass lesions, 2 macrocalcifications and 1 non-mass lesion).

For the mass lesions, several parameters were used for evaluation as followings

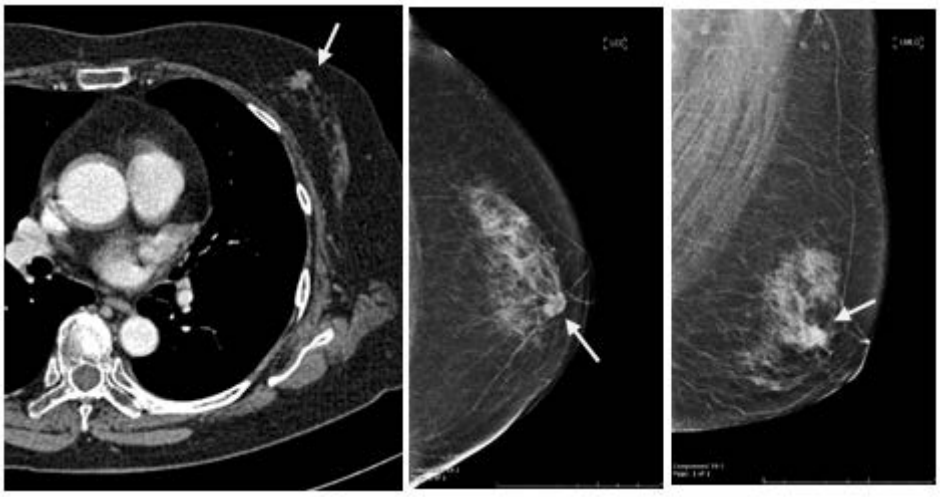
3.1 Shape

Forty six mass lesions can be characterized for shape (Table 6).

Table 6: Number of shape features found from CT scan in 46 mass lesions of the breast (n=46).

Description	No. of lesions (%)	ACR BIRADS from mammogram			
		BIRADS 2	BIRADS 3	BIRADS 4	BIRADS 5
Round	8 (17.4)	1	5	0	2
Oval	36 (78.3)	15	17	2	2
Irregular	2 (4.3)	0	0	1	1

The most common shape of breast lesion from CT scan in our study was oval shape, 36 lesions (78.3%). Round and oval shape were found in mammographic BI-RADS 2 to 5. There were only 2 lesions (4.3%) from CT scan that showed irregular shape and found in BI-RADS 4 and 5 (suspicious for malignancy) (Figure 2).



a b c

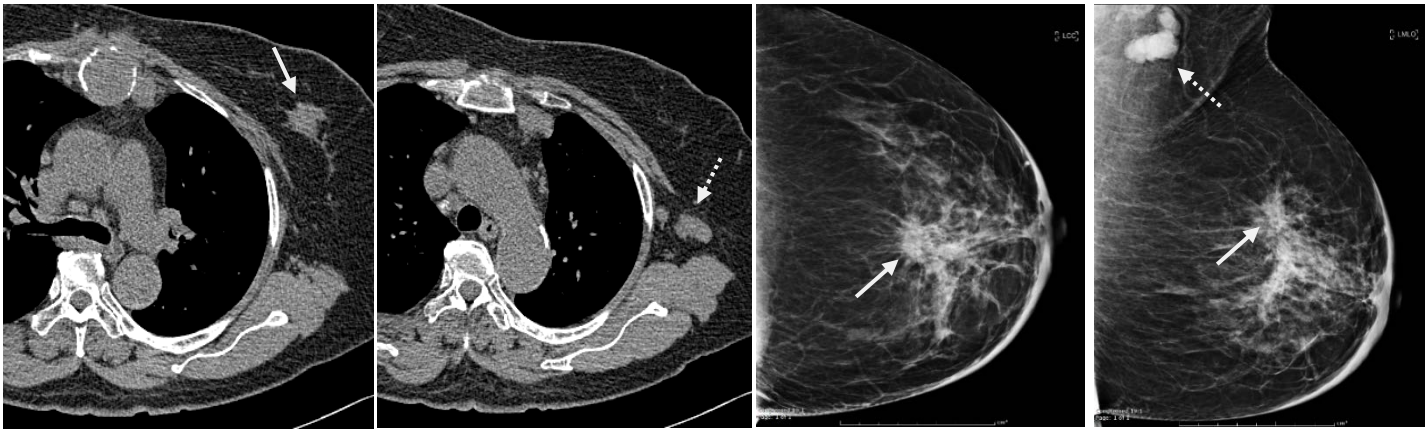
Figure 2: (a) Axial contrast enhanced CT showed left breast mass with irregular margin (arrow), (b) and (c) Mammography CC and MLO views showed irregular hyperdense mass with indistinct margin at subareolar region of left breast (arrow).

3.2 Margin

Table 7: Number of margin features found from CT scan in 46 mass lesions of the breast (n=46)

Description	No. of lesions (%)	ACR BIRADS from mammogram			
		BIRADS 2	BIRADS 3	BIRADS 4	BIRADS 5
Circumscribed	38 (82.6)	13	22	2	1
Obscured	2 (4.3)	2	0	0	0
Microlobulated	1 (2.2)	0	0	0	1
Indistinct	2 (4.3)	1	0	1	0
Spiculated	3 (6.6)	0	0	0	3

Most breast lesions in our study show circumscribed margin, 38 lesions (82.6%) and found in BI-RADS 2 to 5. There are two lesions with indistinct margin with different BIRADS category, classified as BI-RADS 2 and 4. The BI-RADS 2 lesion contained few internal macrocalcification and interpreted as benign, likely fibroadenoma. All of spiculated margin lesion are BI-RADS 5 (3/3 lesions, 100%) (Figure 3).



a b c d

Figure 3 : (a) Axial non-enhanced CT showed left breast mass with spiculated margin (arrow).

(b) Axial non-enhanced CT showed enlarged left axillary nodes (dot arrow).

(c) and (d) Mammography CC and MLO views demonstrated spiculated isodense mass at upper central zone of left breast (arrow) with enlarged left axillary nodes (dot arrow), corresponding to the mass and lymph node seen on CT.

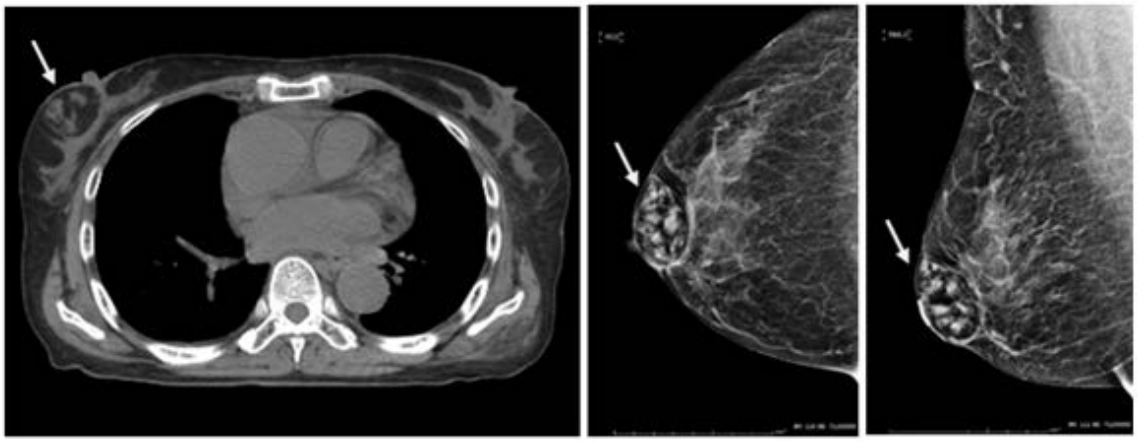
3.3 Density

Only 26 lesions can be evaluated the lesion density on pre-contrast study (the other lesions were performed only post contrast study) (Table 8).

Table 8: Number of lesions with non-enhanced density from CT scan (n=26)

Description (compared with fibroglandular tissue)	No. of lesions (%)	ACR BIRADS from mammogram			
		BIRADS 2	BIRADS 3	BIRADS 4	BIRADS 5
High (Hyperdense)	3 (11.5)	0	3	0	0
Low (Hypodense)	4 (15.4)	4	0	0	0
Iso	18 (69.3)	4	8	3	3
Fat-containing	1 (3.8)	1	0	0	0

Iso-density lesions were most common group in our study seen 18 lesions (69.3%) and found in BI-RADS 2 to 5. There are 3 hyperdense lesions found in BI-RADS 3 (11.5%) and 4 hypodense dense lesion in BI-RADS 2 (15.4%). One fat-containing lesion, recognized as hamartoma from CT scan was classified into BI-RADS 2 (3.8%) as in Figure 4. The range density of the lesions measured in our study was between -50 to 61 HU and mean of density was 27.1 HU.



a b c

Figure 4: (a) Axial non-enhanced CT demonstrated right fat-containing breast mass with well-encapsulation (arrow), likely breast hamartoma and classified as BI-RADS 2.

(b) and (c) Mammography CC and MLO views showed well-encapsulated breast mass with fat content at right subareolar region (arrow), corresponding to the mass on CT scan.

3.4 Enhancement

Forty four lesions have different patterns on contrast enhanced CT images (Table 9).

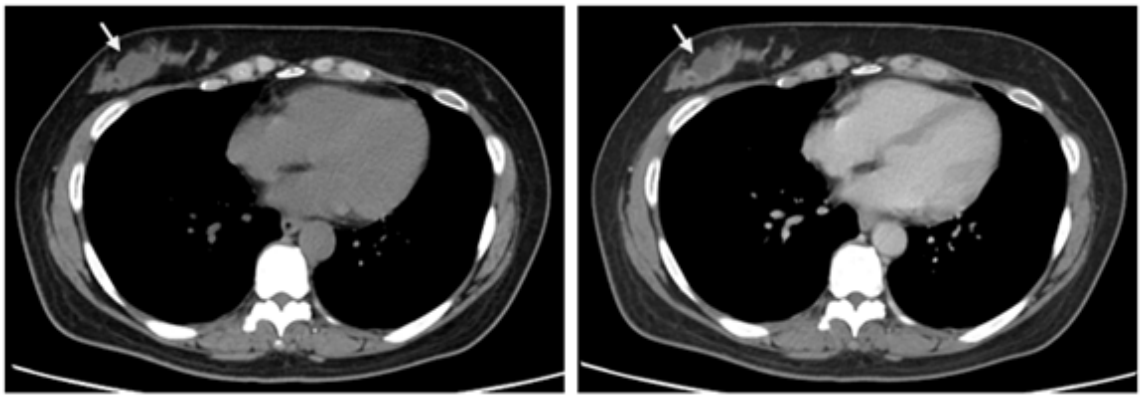
Table 9: Number of enhancement pattern of the breast mass from CT scan (n=44).

Description	No. of lesions (%)	ACR BIRADS from mammogram			
		BIRADS 2	BIRADS 3	BIRADS 4	BIRADS 5
Homogeneous	27 (61.4)	4	20	1	2
Heterogeneous	5 (11.4)	1	0	1	3
Non-enhancement	12 (27.2)	10	1	1	0

Homogeneous enhancement was the most common pattern in our study seen 27 lesions (61.4%) and found in BI-RADS categories 2-5. Non-enhancement pattern is found in total of 12 lesions (27.2%) and 10 lesions were BI-RADS 2 (10/12 , 83.3%).

Four of the non-enhance lesions were recognized as cysts due to low attenuation (< 20 HU) (Figure 5).

Heterogeneous enhancement pattern was also found in both benign (BI-RADS 2) and malignant (BI-RADS 5) lesions.



a b

Figure 5: (a) and (b) Axial non-enhanced and contrast enhanced CT demonstrated circumscribed hypodense lesion (arrow) without enhancement in right breast (15 HU) , likely cyst, BI-RADS 2.

3.5 Calcification

There were eleven lesions containing internal calcification. Nine lesions were macrocalcification (9/11 , 81.8%) and interpreted as benign lesion (BI-RADS 2). Two lesions with microcalcification were classified as BI-RADS 3. No lesion with suspicious microcalcification was observed in our study.

3.6 Non-mass lesion

There was one non-mass lesion in our study without enhancement (2.0%).

3.7 Associated findings

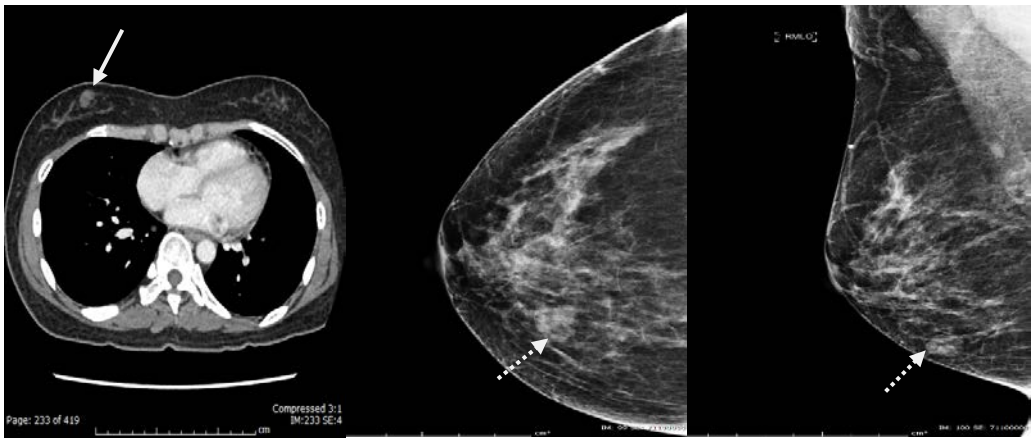
Overlying skin and nipple involvement were observed in 2 lesions (4.1%). Lymphadenopathy and chest wall invasion were found in one lesion (2.0%). All of the lesion with these associated findings were categorized as BI-RADS 5.

4. Discussion

The result in our study showed substantial agreement (k = 0.741, 95% CI 0.594-0.887) between CT scan and mammography with supplementary ultrasound findings. This could be implied that the incidental breast lesion from CT scan could be interpreted with the similar result as BI-RADS from mammographic images with addition ultrasound. From the data, there was no benign or probably benign lesion (BI-RADS 2 and 3) from CT scan that was interpreted as suspicious or malignant lesion on mammograms (BI-RADS 4 and 5). However, there was one lesion that CT features suggested suspicious lesion (BI-RADS 4) but the result from

mammography interpreted as BI-RADS 2. This lesion was suspected breast hamartoma from mammography, shown characteristic of well-encapsulated fat-containing lesion (Figure 6). In CT scan, capsule and fat in the lesion were difficult to be seen due to small size and inadequate spatial resolution.

There were 3 lesions from 6 lesions (3/6 lesions, 50%) of BI-RADS 4 from CT scan interpreted as BI-RADS 3 from mammography with ultrasound. Because management guideline between BI-RADS 3 and 4 is different (follow- up for BI-RADS 3 and tissue pathology for BI-RADS 4), over-investigation could be occurred. However, the result as malignant lesions (7 lesions of BI-RADS 5) from CT features and mammography were nearly complete consistent (6/7 lesions, 85.7%). There was one lesion that CT features interpreted as BI-RADS 5 but mammography was shown as B-IRADS 4 , however management of BI-RADS 4 and 5 were not different.



a b c

Figure 6: (a) Axial contrast enhanced CT showed right breast mass with enhancement (arrow), interpreted as BIRADS 4. No obvious internal fat or capsule was observed.

(b) and (c) Mammography CC and MLO views showed fat-containing (dot arrow) mass with well encapsulation at right lower inner quadrant, suspected breast hamartoma, interpreted as BIRADS 2.

From the CT appearances including irregular shape and spiculated margin were usually found in malignant lesions. These data was corresponding with malignant CT appearance such as irregular border, high-density mass and spiculates which associated with malignant lesion [6] and spiculated margins and irregular shape were highest PPV for malignancy [7]. However high-density feature was found not associated with high category BI-RADS in our study. Other features that associated with BI-RADS 5 were associated findings including skin and nipple involvement, lymphadenopathy and chest wall invasion [6,7].

Enhancement patterns of the incidental breast mass from CT scan showed heterogeneous enhancement had a higher PPV for malignancy than homogeneous enhancement (67% versus 11%) [7]. However, our study showed no specific pattern associated with malignant lesion, corresponding with the study from Lin and his colleagues that reported no significant difference of heterogeneous or homogeneous enhancement between the malignant and benign for incidental enhancing breast lesions [8].

Most of breast calcifications in our study were macrocalcifications and all were benign lesions (BIRADS 2). These results is probably due to poorer spatial resolution of CT scan compared with mammographic images, so the detection rate of malignant microcalcification was extremely low in CT scan. Several studies reported calcification was diagnostically unuseful on CT study [7,8]. So interpretation of calcification from CT scan should be aware due to low detection rate of microcalcification.

Four non-mass breast lesions from incidental breast lesion in 23 patients and all of these lesions were malignant [9]. For non-mass lesion, there was only one lesion in our study and considered as malignant lesion (BI-RADS 5).

Additional advantages of CT scan were characterization of specific pattern of some lesion such as cyst (seen as non-enhancing lesion with fluid density) and delineation border of the enhancing lesion. The lesions with characteristic appearances on mammography were also observed in CT scan and be given the specific diagnosis without further investigation, such as breast hamartoma which seen as well-capsulated lesion with fat content. Our study also suggested that contrast enhanced CT scan showed a good rate of lesion detection, even in the extremely dense fibroglandular tissue because of enhancement of breast lesion can be seen easily in the contrast enhanced study.

5. Limitations

The limitations of our study have occurred. First, it was retrospective study, otherwise selection bias may encounter. Second, this study has small number of cases. Future study with a large number of breast masses with various BI-RADS categories and more character of breast lesions including calcifications may increase reliability of the study.

6. Conclusion

In conclusion, contrast enhanced CT scan has rather good reliability for diagnosis of benign lesions (BI-RADS 2) and malignant lesions (BI-RADS 5). However, in suspicious lesion (BI-RADS 4) from CT scan should be interpreted cautiously and compared with mammography and ultrasound, because over diagnosis in this group can be established. Otherwise, CT features that usually found in malignant lesions were irregular shape, spiculated margin, skin and nipple involvement and lymphadenopathy.

7. Recommendation

We recommended that BI-RADS category 4 from CT scan should not be interpreted without mammography and ultrasound. On the other hand, contrast enhanced CT scan can diagnose BI-RADS 2 and 5 of breast lesions because it was good reliability compared with mammography and ultrasound in these categories.

Conflict of Interests

The authors have no conflict of interests to declare.

Acknowledgements

Special thanks to staffs and technicians at Division of Diagnostic Radiology, Department of Radiology, King Chulalongkorn Memorial Hospital for the support.

References

[1] Jemal A, Bray F, Center N, Ferlay J, War E, Forman D. **"**Global Cancer Statistics**,"** Ca Cancer J Clin, Vol. 61, pp. 69-90, 2011.

[2] Curado M. "Breast cancer in the world: Incidence and mortality,**"** Salud Publica Mex, vol 53, pp.372-384, 2011.

[3**]** "Breast Cancer: Early Detection National Cancer Institute (NCI); 2013.". Available: http://www.cancer.org/acs/groups/cid/documents/webcontent/003165-pdf.pdf. [Oct 24, 2013]

[4] "Breast Cancer Tests: Screening, Diagnosis, and Monitoring : CT (CAT) Scans (Computerized Tomography)." . Available: http://www.breastcancer.org/symptoms/testing/types/cat_scans. [Aug 20, 2013]

[5**]** "American College of Radiology.ACR practice guideline for communication of diagnostic imaging finding." (http://www.acr.org/media/ACR/Documents/PGTS/guideline/Comm Diag Imaging.pdf). [Nov 11, 2013]

[6] Shojaku H, Seto H, Iwai H, Kitazawa S, Fukushima W, Saito K. "Detection of incidental breast tumors by noncontrast spiral computed tomography of the chest," Radiat Med**,** vol 26, pp. 362-367.

[7] Moyle P, Sonoda L, Britton P, Sinnatamby R. "Incidental breast lesions detected on CT: what is their significance?," Br J Radiol , vol 3, pp. 233-240, 2010.

[8] Porter G, Steel J, Paisley K, Watkins R, Holgate C. "Incidental breast masses detected by computed tomography: are any imaging features predictive of malignancy?," Clin Radiol, vol 64, pp. 529-533, 2009.

[9**]** Lin W, Hsu H, Li C, Yu J, Hsu G, Yu C, et al. "Incidentally Detected Enhancing Breast Lesions on Chest Computed Tomography," Korena J Radiol, vol 12, pp. 44-51, 2011.