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A Comparative Study of Diagnostic Accuracy of DCMRI Vs Mammography in Detecting Female Breast Cancer.

Manoj Ranjan[1], Meenakshi[2], Satin Dutta[3], Pradip Pokharia[4], Rajesh Ranjan[5], Indira Prasad[6]

[1]Assistant Professor, Department of Radio diagnosis, Heritage Institute of Medical sciences, Varanasi UP.
[2]Associate Professor, Department of Obstetrics and Gyneacology, Lady Harding Medical College, New Delhi-110001.
[3]MD Radio diagnosis, Radiologist, Primus Imaging and Diagnostic Centre.
[4]Senior Consultant & Head Department of Radiodiagnosis & Imaging, Synergy Institute Of Medical Sciences, Dehradun.
[5]Associate Professor, Department of Community Medicine, ESIC Medical College and Hospital, Faridabad, Haryana- 121001.
[6]Assistant Professor, Department of Obs & Gynae, Saraswathi Institute of Medical Sciences, Hapur.

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ABSTRACT

Background: Breast cancer is the most common female cancer worldwide representing nearly a quarter (25%) of all cancers with an estimated 1.67 million new cancer cases diagnosed in 2012. This study was designed with the primary aim to compare the difference between MRI and Mammography in patients presenting with breast related complaints. **Methods:** This prospective study was conducted between Oct 2006 and Feb 2008 in the department of Radio diagnosis & Imaging at Army Hospital (Research & Referral), Delhi Cantt. Fifty patients screened with suspicious malignant breast lesions were taken up for the study. **Results:** Mammography Imaging revealed that most of the malignant masses were found to have architectural distortion & calcification with fewer cases of skin involvement, PI& Nipple retraction respectively. Benign masses were diagnosed with comparatively fewer cases of calcification and presence of other morphological features was rare. Various Imaging techniques have been compared with the Histopathology gold standard technique, When compared with USG Our study showed the sensitivity, specificity, PPV,NPV& Accuracy 67%,75%,80%,72%. **Conclusion:** Mammography compared to DCMRI has shown to produce false negative results, especially showing less sensitivity for diagnosis of breast cancer in younger women having dense breast.

Keywords: Breast Cancer, Carcinoma, Mammography.

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INTRODUCTION

Breast cancer is the most common female cancer worldwide representing nearly a quarter (25%) of all cancers with an estimated 1.67 million new cancer cases diagnosed in 2012.[1] In India, although age adjusted incidence rate of breast cancer is lower (25.8 per 100 000) than United Kingdom (95 per 100 000) but mortality is at par (12.7 vs 17.1 per 100 000) with United Kingdom.[2] The estimated number of deaths in India in the year 2012 was 70,000.[3] Breast cancer in India has been attributed to few risk factors, such as - early age at menarche, late age at menopause, nulliparity, late age at first full term pregnancy (age>35), obesity, positive family history, benign breast diseases of certain types, high fat diet, heavy alcohol drinking, ionising radiation, long term use of hormone replacement therapy & OCP and gene mutations; BRCA 1 and BRCA 2.

Name & Address of Corresponding Author
Dr. Meenakshi,
Associate Professor,
Department of Obstetrics and Gyneacology,
Lady Harding Medical College,
New Delhi-110001

Despite the gloomy prognosis, increased morbidity and reduced survival time, it can be controlled if detection and diagnosis are made in the earliest stages i.e., in the pre-invasive and clinically non-palpable stage. Screening and diagnostic efforts for breast cancer are critical because the disease has a high rate of successful outcomes with early identification and treatment.[4] Early contrast enhanced breast MR imaging studies showed marked increased signal intensity in cancers compared to surrounding fibro glandular tissue, with sensitivities of almost 100 % for invasive disease.[5] Initial reports regarding use of dynamic contrast enhanced MR imaging to measure increased uptake of contrast in suspicious breast lesion revealed specificity of 30-85 % and sensitivity of 90-99 %.[6] Breast magnetic resonance imaging (MRI) is a useful tool for detection and characterization of breast disease, assessment of the local extent of the disease, evaluation of treatment response, and guidance for biopsy and localization.[7] Reported sensitivity of this modality in detection of invasive breast cancer has approached 100% in several series and that is one of the reasons why breast MRI is important in preoperative staging.[8] Mammography is the most commonly used method and is the only

currently known means of proven effectiveness especially in patients with non palpable carcinoma.[11,12] Other complementary methods for detecting breast cancer are ultrasonography, colourdoppler ultrasound study, scintimammography using technitium-99m methoxyisobutylisonitrite, thermography and Magnetic Resonance Imaging (MRI) In a screening study by Kolb who compared the performance of mammography,[13] physical examination (PE) and breast ultrasound in 27,825 patients, Sensitivity, specificity, negative and positive predictive values, and accuracy of mammography were 77.6%, 98.8%, 99.8% 35.8%, and 98.6%, respectively Breast Ultrasound is real time imaging modality and has invaluable role in characterizing a mass as cystic or solid. It is the preferred modality employed during pregnancy and lactation and in painful conditions, for evaluation of post surgical and irradiated breasts & lumps that are hard to see on a mammogram. In the screening study by Kobl, Sensitivity, specificity, negative and positive predictive values, and accuracy of US was, 75.3%, 96.8%, 99.7%, 20.5%, and 96.6% respectively.[4] This study was designed with the primary aim to compare the difference between MRI and Mammography in patients presenting with breast related complaints.

MATERIALS & METHODS

This prospective study was conducted between Oct 2006 and Feb 2008 in the department of Radio diagnosis & Imaging at Army Hospital (Research & Referral), Delhi Cantt. Fifty patients screened with suspicious malignant breast lesions were taken up for the study .The clinical breast examination (CBE), ultrasound, two-view mammography, and dynamic contrast enhanced breast MRI were performed within a time frame of 1 week.

Mammography was carried out on 'MAMMO-DIAGNOST U-C' Philips mammography machine. Mammograms were obtained and interpreted in accordance with current Radiological Practice Guidelines. Ultrasonography of the breast and axillary region was performed on Philips 5000 ultrasound system using multifrequency linear transducer (4-11 Hz) Diagnoses were scored on a five-point scale identical to the mammographic BI-RADS categories. The Standard dynamic axial contrast-enhanced subtracted breast MRI of both entire breasts was performed using 3 Tesla whole body MR System Trio 'Siemens', Germany. MRI diagnoses were scored on a five-point scale identical to the mammographic BI-RADS categories.

Parameters studied were (a) On mammography the site of the lesion, margin of the lesion, surrounding halo, clustered micro calcification, surrounding parenchymal distortion and thickening of the skin. (b) On USG the size, shape, margins, echo texture, homogeneity of internal echoes, lateral shadowing, posterior effect, calcification, infiltration across tissue space and surrounding fat were studied. (c) On DCMRI the lesion morphologic features (shape, margins, and internal architecture) and lesion enhancement kinetics (enhancement rate in the early postcontrast phase and signal intensity time course pattern in the intermediate and late postcontrast phase).

RESULTS

The Study included 50 patients of which 13 (26%) were in the age group of 31-40 years (Mean age 46.1). The youngest patient was of 31 years and the oldest was of 68 years. [Figure 1] The complaints produced by these patients were mobile breast lump (76%), Nipple discharge (10%), Tethered skin / Nipple retraction (08%) and breast pain (06%). [Table 1] The pathologic findings of these patients revealed 18 malignant lesions,16 benign, 9 inflammatory, 4 Normal and others 3. [Table 2] Patients ageing from 51 to 60 were majorly diagnosed with lesions while the least were in between 41 to 50. Mammography Imaging revealed that most of the malignant masses were found to have architectural distortion & calcification with fewer cases of skin involvement, PI& Nipple retraction respectively. Benign masses were diagnosed with comparatively fewer cases of calcification and presence of other morphological features was rare. [Table 3] Various Imaging techniques have been compared with the Histopathology gold standard technique, When compared with USG Our study showed the sensitivity, specificity, PPV,NPV& Accuracy 67%,75%,80%,72% Malur et al study showed 89.1, 79.1, 65.7, 90.9, 83.4 Tan KP et all showed 82%,84%,60%,94%,84% and Manoranjanet al study it is 89%,100%,100%% respectively [Table 4] When compared with Mammography Our study showed the sensitivity, specificity, PPV,NPV& Accuracy 67%,75%,80%,72% Malur et al study showed 89.1, 79.1, 65.7, 90.9, 83.4 Tan KP et all showed 82%,84%,60%,94%,84% and Manoranjanet al study it is 89%,100%,100%% respectively [Table 5] When compared with DCMI When compared with DCMRI Our study showed the sensitivity, specificity, PPV, NPV& Accuracy 78%,81%,64%,81%,80%. Malur et al study showed 83.7%,68.5%,67.8%,84.1%,77.1% Tan KP et al study showed 49%,89%,53%,88%,81% and Raikhlin et al showed 30.8%, 96.8%, 21.1%, 98.1% respectively.

[Table 6] Data shows USG has sensitivity of 67.4 %, specificity of 75.8%, NPP 80.8 and PPV 60.5 when compared against histopath, the gold standard. While in the detection of Cancer various imaging modalities has been tested for the accuracy Among other modalities DCEMRI was found to have maximum number of true positive & true negative cases, followed by USS and Mammography.

Combination of different modalities resulted in the absence of false positive & false negative cases [Table 7] While comparing with the other imaging modalities, The DCMRI technique showed better performance in terms of sensitivity, specificity, Positive predictive value, negative predictive value and Accuracy with 94%, 97%, 94%, 97%, and 96% [Table 8] Comparing the modalities with gold standard Histopath on the parameters of Sensitivity, specificity, NPP and PPV ; Mamography showed 78.9 %, 79.9%, 80.9 and 64.1 while USG showed 67.4 %, 75.8%, 80.8 and 60.5 and DCEMRI showed 94.4 %, 96.9%, 96.9% and 94.4%.

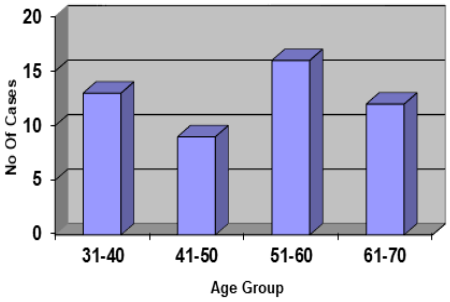

Figure 1: Age Distribution.

Table 1: Symptoms.

Symptoms	Number	Percentage
Lump in breast	38	76
Nipple discharge	05	10
Tethered skin / nipple retraction	04	08
Pain	03	06

Table 2: Pathologies.

Pathologies	Number	Percentage
Normal	04	08
Inflammatory	09	18
Benign	16	32
Malignant	18	36
Others	03	06

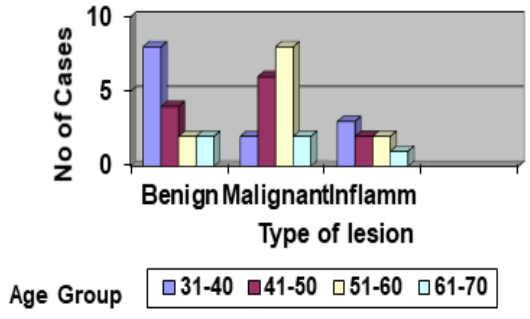

Figure 2: Age Distribution.

Table 3: USG From USG to Histo.

Mammographic Features	Total Number of Cases	Benign Lesions	Malignant Lesions
Architectural Distortion			
Suspicious Calcification	22	10	12
Skin Involvement	06	00	06
Pectoralis Involvement	04	00	04
Nipple Retraction	04	01	03

Table 4: Mamography From USG to Mamography

Studies	Numbe	Sensitivity	Specificity	Positive	Negative	Accuracy
Our Study	50	67	75	60	80	72
Malur et al	invasive	89.1	79.1*	65.7	90.9	83.4
Tan KP et all13	326	82%	84%	60%	94%	84%
		97.30 %	92.3% ,	97.29 %		
Manoranjanet	68	89.47 %,	100%.	100%.		

Table 5: DCMRI From USG to DCMRI

Studies	Number	Sensitivity	Specificity	Positive	Negative	Accuracy
Our Stud	50	78 %	81	64	81	80
Malur et al	invasive	83.7	68.5	67.8	84.1	77.1
Tan KP et all13	326	49%	89%	53%	88%	81%
Raikhlin	13	30.8	96.8	21.1	98.1	

Table 6: Accuracy Of Cancer Detection By The Imaging Modalities Used

Studies	Number of Patients	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Accuracy
Our Study						
Raikhlin et al. AJR: 204, April 2015	13	92.3	85.9	15.2	99.8	
	488	92.3	85.9	15.2	99.8	

Table 7: Performance Chracteristics Of Each Imaging Modalities Used

Modality	True Positive	False Positive	True Negative	False Negative
Mammography	14	06	26	04
USS	12	08	24	06
DCEMRI	17	01	31	01
Combined	18	00	32	00

Table 8: Performance characteristics of various modalities after final results evaluation were estimated as under.

Character	Mammography	USS	DCMRI
Sensitivity	78 %	67 %	94 %
Specificity	81 %	75 %	97 %
Positive predictive value	64 %	60 %	94 %
Negative predictive value	81 %	80 %	97 %
Accuracy	80 %	72 %	96 %

DISCUSSION

Various modalities have been developed till now for the detection of breast cancer. Most demanding requirement of a modality is early and accurate diagnosis of lesions, so that clinically beneficial therapy should be given to the patients. Mammography still remains the primary imaging modality used in the detection of early breast cancer, the frequency of false-negative results is estimated to be 5%–15% (30). The inability to detect breast cancer at mammography is often due to obscuration of the tumor by superimposed fibroglandular tissue. This imperfect sensitivity of mammography has led to the use of adjunctive imaging methods, including MR imaging. Currently, breast MRI demonstrates a high sensitivity in the range of 93-100%.[1]

Performance of DCMRI in case invasive breast cancer diagnosis

The invasive cancers in these studies have predominantly been invasive ductal carcinoma.Mammography is the mainstay for diagnosing DCIS, whereas other breast imaging techniques—eg, sonography, MRI, scintimammography have been previously shown to be unreliable. American Cancer Society Guidelines, according to which MRI is proposed as an adjunct to mammography for screening women with a lifetime risk of 20% or more.[2]

Kriege screened 1,909 unaffected women aged 25 to 70 years with an estimated 15% or higher lifetime risk of breast cancer. Eighty percent of the invasive cancers were detected by MRI, compared with 33% by mammography. However, mammography outperformed MRI for detecting DCIS. The specificity of MRI was 90%, compared with 95% for mammography.

Senstivity of MRI Vs Mammography in diagnosis of BRAC associated breast carcinoma.

Reported sensitivity of MRI was 77%, compared with 40% for mammography, with specificities of 81% and 93%, respectively for women with BRCA1 mutations (24).The International Breast MRI Consortium screened 390 women with more than a 25% lifetime risk of breast cancer at 13 centers on a single occasion.[27] MRI specificity was 95%, compared with 98% for mammography.

Overall, studies have found high sensitivity for MRI, ranging from 71% to 100% versus 16% to 40% for mammography in these high-risk populations.In this prospective study comparing three different breast imaging modalities (mammography, high-frequency breast ultrasound,and Dynamic contrast enhanced MRI) in patients with suspicious malignant lesions in clinical examination,we found that MRI had the highest sensitivity, specificity,and positive predictive value for the detection of invasive as well as of intraductal cancer. If breast ultrasound is used in combination with mammography, it can help compensate for some but by far not for all of the shortcomings of mammography, and it causes a substantial number of false-positive diagnoses. If DCEMRI is available as diagnostic tool, mammography proved to be of limited and ultrasound of no additional value. Hence Breast DCEMRI should be considered an integral part of diagnostic tools for women having suspicious malignant lesions

CONCLUSION

Our study reveals high potential of DCMRI in screening of various breast lesions having sensitivity, specificity, PPV, NPV & Accuracy of 94%, 97%, 94%, 97%, 96% respectively. Data obtained from various literature shows that DCMRI is efficient in detecting breast cancer in women having life- time risk of 20% or more. But still its diagnostic potential for ductal carcinoma requires further exploration.

Mammography compared to DCMRI has shown to produce false negative results, especially showing less sensitivity for diagnosis of breast cancer in younger women having dense breast. Data on survival and reoccurance of this lethal disease is still inadequate .Further improvement & development in the modalities is required. None of the modalities alone is ideal therefore, for early and accurate detection of lesion combined assessment of various modalities like, USG, Mammography & DCMRI is required and can be life-saving.

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