Original Research Article

Role of Magnetic Resonance Imaging in Evaluation and Staging of Breast Cancer: A Prospective Study

Nirmalya Swain[1], Inuganti Gopal[2], Nirod Kumar Sahoo[3], Sumita Tripathy[4], Mukti Prasad Mishra[5]

[1]Post-Graduate, Department of General Surgery, M.K.C.G. Medical College, Berhampur, Odisha, India
[2]Associate Professor, Department of General Surgery, M.K.C.G. Medical College, Berhampur, Odisha, India
[3]Assistant Professor, Department of General Surgery, M.K.C.G. Medical College, Berhampur, Odisha, India
[4]Associate Professor, Department of Pathology, Dharanidhar Medical College, Keonjhar , Odisha
[5]Senior Resident, Department of General Surgery, M.K.C.G. Medical College, Berhampur, Odisha, India

Abstract

Background: Currently breast cancer is staged with ultrasound (USG) and computed tomography (CT). However, Magnetic resonance imaging (MRI) is giving superior results in the detection of axillary metastasis and in local staging of breast cancer. Optimal (local) staging of breast cancer could become crucial in selecting patients for neoadjuvant chemotherapy. In this study, we find out the diagnostic performance of MRI in staging of breast cancer and compare with histopathological study and thus find the accuracy of MRI in staging preoperatively.

Aim and Objective:

1. To determine the accuracy of MRI in diagnosis and staging of Breast Cancer and evaluation of axilla.

2. To assess the adequacy of MRI in detecting multi-focality of Breast Cancer.

Patients and Methods: It is a prospective study taking 60 number of breast cancer patients who were admitted to the MKCG Medical and Hospital during the period from August 2020 to July 2022. All the patients underwent MRI scan (1.5 Tesla:T1,T2 and diffusion weighted imaging) of the breast and axilla. Patients were staged accordingly. Early staged cancer patients were selected for surgery and locally advanced cancer patients were undergone neoadjuvant chemotherapy and again restaged after completion of chemotherapy and surgical cases selected. The results were recorded on various parameters like size, shape, calcification, margins of tumour and axillary lymph node involvement.

Results: The overall accuracy of TNM-staging using MRI when all cases were combined was 95% in our study with 96.3% sensitivity, 83.33% specificity, 98.11% positive predictive value and 71.43% negative predictive value.

Conclusion: Breast MRI plays an important role in breast cancer screening and diagnosis, based on the current indications, as per the ACR practice parameters. The best non-invasive tool for assessing accurate tumour size is breast MRI. Tumour size can be underestimated by mammography and ultrasound, but the size of the tumour at histology is not significantly different from that on MRI. In breast MRI, both breasts are imaged at the same time, which

helps to evaluate contralateral disease. It also assesses for multifocal or multicentric disease, which does alter surgical management. Breast MRI allows for the evaluation of levels 1, 2, and 3 axillary and internal mammary lymph nodes, which not only affects staging and treatment planning but is also the most important deterministic factor for the prognosis of breast cancer. Finally, it is imperative to look for and report extra-mammary findings in the lungs, bones, and visualized liver, especially if they are concerning for distant metastasis.

Introduction

Breast cancer is the most common cancer diagnosed in women, accounting for more than 1 in 10 new cancer diagnoses each year. It is the second most common cause of death from cancer among women in the world and the incidence is higher in more industrialized countries. Breast cancer accounts for 14% of cancers in Indian women. As per National Cancer Registry Program data of Indian Council of Medical Research (ICMR), the estimated number of incidence of Breast cancer for the year 2018 were 1,59,924 and 87,090 reported deaths.

As the most common cancer type in Indian women, women in their early thirties till fifties are at considerable risk to develop breast cancer, and the incidence risk increases till its peak by the time they reach 50-64 years of age. One in twenty-eight Indian women is likely to develop breast cancer during her lifetime. It is more (1 in 22) for urban women than the rural group (1 in 60). A report stated that cancer caused 5% of the total disability-adjusted life years (DALYs) in the Indian population in 2016.

Breast cancer always evolves silently. Most of the patients discover their disease during their routine screening. Others may present with an accidentally discovered breast lump, change of breast shape or size, or nipple discharge. However, mastalgia is not uncommon. Physical examination, imaging, especially mammography, and tissue biopsy must be done to diagnose breast cancer. The survival rate improves with early diagnosis. The tumor tends to spread lymphatically and hematologically, leading to distant metastasis and poor prognosis.

With early detection and significant advances in treatment, death rates from breast cancer have been decreasing over the past 25 years The incidence rate of breast cancer increases with age, from 1.5 cases per 100,000 in women 20 to 24 years of age to a peak of 421.3 cases per 100,000 in women 75 to 79 years of age; 95% of new cases occur in women aged 40 years or older. The median age of women at the time of breast cancer diagnosis is 61 years.

Breast cancer is a heterogeneous disease with many histological types and molecular subtypes that have different response to therapy and prognoses. [1,2] The main molecular subtypes of invasive breast carcinomas are related to the expression of hormone receptor and Her-2 status. Tumours with a high expression of hormone receptors are classified as luminal: luminal A subtype is associated with a low proliferation index and accounts for 50–60% of all breast cancers; luminal B subtype is associated with a high expression of proliferation-related genes and accounts for 20% of all breast cancers. Her-2 subtype accounts for 10% of all breast cancers and is characterized by the absence of hormone receptors and high expression of Her-2. Triple negative subtype accounts for 7–16% of all breast cancers and is characterized by the absence of expression of hormone receptors and Her-2, associated with a high expression of cytokeratin genes of high molecular weight and epithelial growth factor receptor. This subtype is

associated with less differentiated invasive carcinomas and accounts for 70% of breast cancers on BRCA1-mutated females. [3]

Most early breast cancer patients are asymptomatic and discovered during screening mammography. With increasing size, the patient may discover cancer as a lump that is felt accidentally, mostly during combing or showering. Breast pain is an unusual symptom that happens 5% of the time. The clinician determines the pre-operative stage of breast cancer by combining the physical examination and radiographic findings. Mammography is the mainstay of breast cancer screening and diagnosis. [4-6] Mammography is a two-dimensional image and relies on the identification of morphologic findings that are suspicious for breast cancer. These findings include masses, grouped calcifications, asymmetries, and areas of architectural distortion. A standard screening mammogram consists of mediolateral oblique (MLO) and craniocaudal (CC) views of each breast. The screening exam is intended solely to detect suspicious findings after which the woman would return for additional diagnostic views. Screening mammography has decreased the mortality for breast cancer by 30%. However, with a sensitivity of approximately 70%, mammography has its limitations.

Particularly in women with dense breasts, cancers might be occult on mammography. [8] Current recommendations for breast cancer screening in the United Diagnostic mammographic views may include spot compression, magnification, rolled, extended views, and true lateral views among others in order to characterize and localize abnormalities. The Breast Imaging Reporting and Data System (BIRADS) was developed by the American College of Radiology in order to standardize terminology describing mammographic findings. The BIRADS atlas also outlines acceptable performance metrics for screening mammography programs such as

a cancer detection rate of ≥2.5 cancers/1000 screens and a recall rate between 5 and 12%. [7]

Performance benchmarks are also available for diagnostic mammography, such as a positive predictive value of biopsy of between 20 and 45%. Randomized controlled trials have found States and Europe are somewhat variable. The Society of Breast Imaging, the American College of Radiology, and the National Comprehensive Cancer Network recommend annual screening mammography beginning at the age of 40 years for women at average risk for breast cancer. Women at increased risk for breast cancer (i.e., ≥ 20% lifetime risk) are recommended to undergo supplemental screening in addition to mammography with breast MRI. [9] Women who are BRCA1/2 gene mutation carriers or who are not tested but have an equivalent risk are offered annual mammography ± MRI. In addition, recent breast density legislation in the United States requires that women be informed if they have mammographically heterogeneously dense or extremely dense breasts and that supplemental breast cancer screening be considered. This has led to an increased use of mammography supplemented with whole-breast screening ultrasound in women with dense breast tissue. [10]

MRI has been increasingly used in the management of patients with breast cancer. Breast MRI was initially considered to be relatively poor for Breast cancer evaluation, with high false-negative rates due to its inability to identify microcalcifications. However, as MRI techniques shifted from an emphasis on high temporal resolution to high spatial resolution, morphologic features such as non-mass enhancement that commonly represent DCIS on MRI were recognized. Multiple studies have since shown the superiority of MRI over mammography for Breast Cancer detection (sensitivity 92% versus 56% respectively).

One of the main indications for breast MRI is pre-operative staging, since this method has a high sensitivity in the evaluation of tumour extension and detection of multifocal and multicentric tumours. MRI can identify additional tumour sites in 15–27% of patients in the same breast and 3–10% of patients in the contralateral breast. MRI is especially useful not only in patients with diagnosis of invasive lobular carcinoma, owing to the increased risk of additional sites of disease, but also in females with cancer diagnosis where it is difficult to accurately delineate the extent of disease on standard modalities.

The different types of tumour also have different presentations on imaging studies; [3,11] however, only few studies have evaluated the use of pre-operative MRI in patients with specific types of breast cancer. For example, the expression of negative hormone receptors is associated with more aggressive features of breast cancer on MRI, such as peripheral enhancement, washout dynamic curve, greater size and adenopathies. [12]

A number of studies have reported the capability of MRI in this clinical context, and have shown that MRI is able to identify additional cancer foci that would have otherwise remained undetected on the basis of clinical assessment and conventional imaging. Although data on MRI detection in this setting have varied between studies, experts have advocated MRI in breast cancer staging on the basis of its detection yield. To date, there is no consensus on whether the use of MRI to detect additional malignant foci within the affected breast improves patient outcomes, [13,14] and it is unclear whether data on the ability of MRI to identify Multifocal and Multicentric cancer originates from appropriately designed studies and how effective it is in local staging of the breast.

The purpose of this study was to assess the role of breast MRI for diagnosis and pre-operative staging in patients with breast cancer and identification of multifocal and/or multicentric disease.

Aim and Objective of the Study

1.To determine the accuracy of MRI in diagnosis and staging of Breast Cancer and evaluation of axilla.

2.To assess the adequacy of MRI in detecting multi-focality of Breast Cancer.

Material and Methods

It is a prospective study taking 60 number of breast cancer patients who were admitted to the MKCG Medical and Hospital during the period from August 2020 to July 2022.

Inclusion Criteria:

Patients of all age groups with Histo-pathologically proven / Diagnosed cases of Breast cancer and admitted for surgery.

Exclusion Criteria:

- Patients refusing to participate in the study.
- Previously operated or taken any treatment for breast cancer.
- Pregnancy.
- Patients unsuitable for Surgery.
- Patients with contraindication to MRI (Claustrophobia, Cardiac pacemakers, Metallic implants and Metallic Foreign Bodies).
- Patients with history of allergy / anaphylaxis to contrast agent.
- Male patients

Methods

All the patients were admitted in the Dept. of General Surgery, M.K.C.G. Medical College and Hospital, Berhampur with Histo-pathologically proven / diagnosed cases of Breast Cancer, who had undergone surgery, were enrolled in the study following the Inclusion and Exclusion criteria.

The patients, satisfying the inclusion criteria, after clinical evaluation, were subjected to MRI of Breast and Axilla and a report was obtained from the radiologist

regarding the status of staging of breast cancer. It was compared with the intra-operative findings regarding the size and extent of the cancer and also with the histopathology report of the resected specimen. The data were collected in a pretested Case Record Proforma designed for the study.

The patients at the time of discharge were advised to review with previous reports in the Dept. of General Surgery, M.K.C.G. Medical College and Hospital, Berhampur every 3 weeks for necessary Investigations and Interventions during follow-up.

The most common type of bias which was encountered during the study is Selection Bias, which was ruled out by including all the patients satisfying the Inclusion and Exclusion criteria into the study, instead of doing any Simple Random Sampling methods to obtain the required sample size. Information bias was ruled out by accurately measuring and cross-checking all the key study variables at least 3 times before classifying them in the study.

Qualitative variables were calculated using Chi Square Test. Descriptive statistical values like Sensitivity, Specificity, Positive Predictive value and Negative Predictive value were calculated using cross-tabulation of statistics. Mean and Standard Deviation were calculated for continuous variables. To compare the mean values between two groups, Unpaired t test was used. To compare the mean values among more than two groups, ANOVA testwas used. A p value of <0.05 was considered statistically significant.

Data collected as above were compiled and tabulated in Microsoft® Excel and statistically analysed using IBM® SPSS® 20.0, for Windows®, to bring out the results of the study.

Observations and Results:

Observations and results were analysed and compiled as following:

Table 1: Distribution based on age groups of patients studied

Age groups (Years)	No. of patients (N)	Percentage (%)
≤30	5	8.3
31-40	22	36.7
41-50	19	31.7
51-60	12	20
61-70	2	3.3
Total	**60**	**100**
Min–Max- 21-66 years old		**Mean ± SD- 43.25 ± 10.3**

Out of 60 patients studied, majority belonged to age groups 31 to 40 years old (22 cases, 36.7%); followed by 19 patients (31.7%) from age group 41 to 50 years old, 12 (20%) patients, 5 (8.3%) patients and two (3.3%) patients were seen in age groups 51 to 60 years old, less than 30 years old and 61 to 70 years old respectively.

Youngest patient enrolled was 21 years old while oldest one was 66 years old patient. Mean age was 43.25 ± 10.3 years.
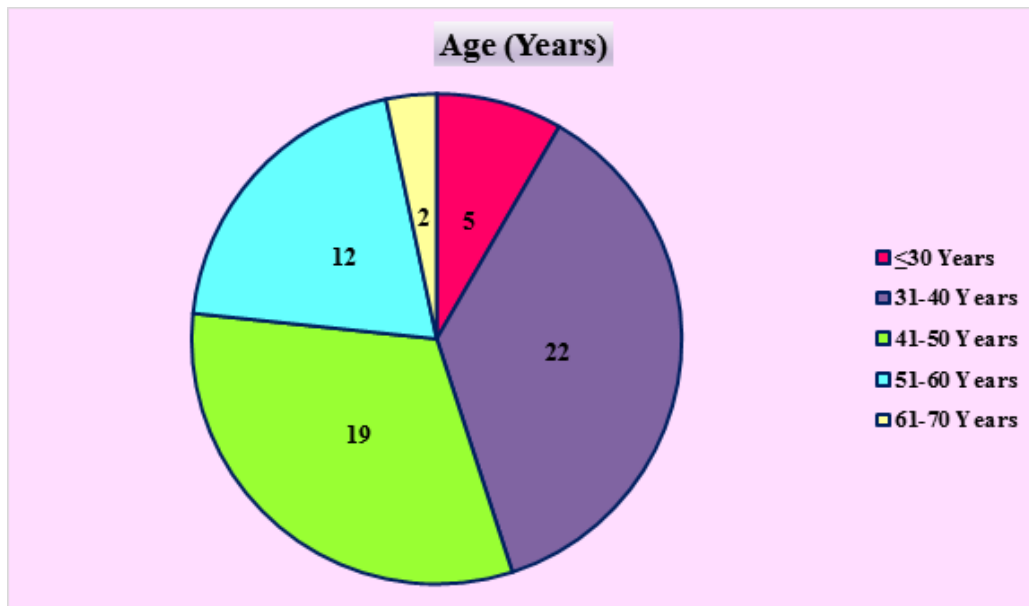
Figure 1: Distribution based on age groups of patients studied

Table 2: Distribution based on family history

Family history	No. of patients (N)	Percentage (%)
Positive	18	30
Negative	42	70
Total	**60**	**100**

Eighteen patients (30%) gave positive family history of breast cancer. Forty two patients (70%) did not have any positive family history.
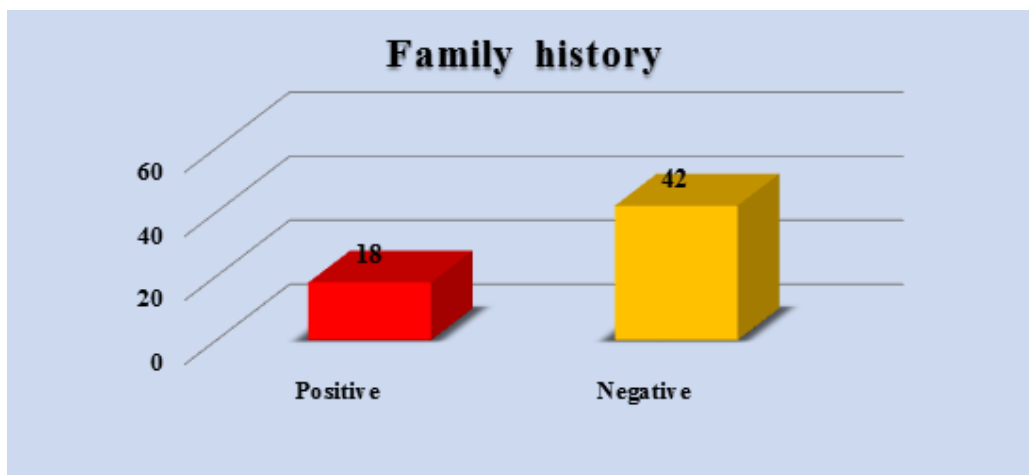
Figure 2: Distribution based on family history

Table 3: Frequency distribution of chief complaints

Chief complaints	No. of patients (N)	Percentage (%)
Lump	37	61.7
Pain	36	60
Nipple discharge	24	40

Presence of lump, associated pain and nipple discharge was seen in 37 (61.7%), 36 (60%) and 24 (40%) patients respectively.
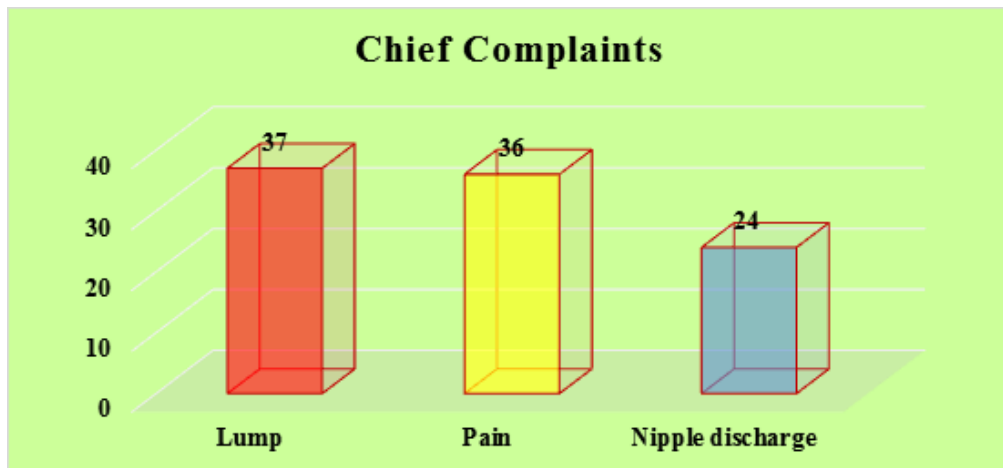
Figure 3: Distribution of chief complaints

Mammographic assessment of patients

Table 4: Frequency distribution of density of lesion

Density	No. of patients (N)	Percentage (%)
Predominantly fatty	11	18.3
Fibro-fatty	11	18.3
Heterogeneously dense	21	35
Extremely dense	17	28.4
Total	**60**	**100**

Mammographic assessment was done for all patients. Mostly heterogeneously dense lesions were seen in 21 (35%) patients, followed by extremely dense lesions in 17 (28.4%) patients. Predominantly fatty and fibro-fatty breast lesions were seen in 11 (18.3%) patients each.
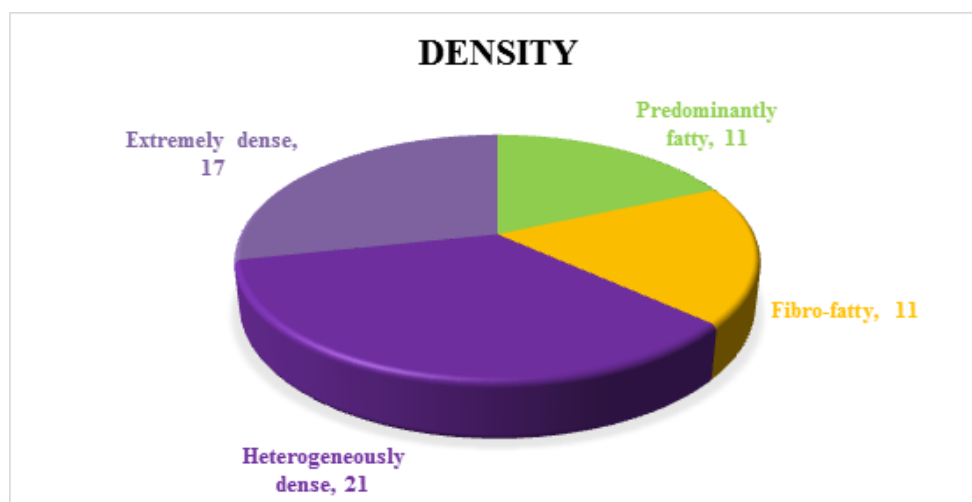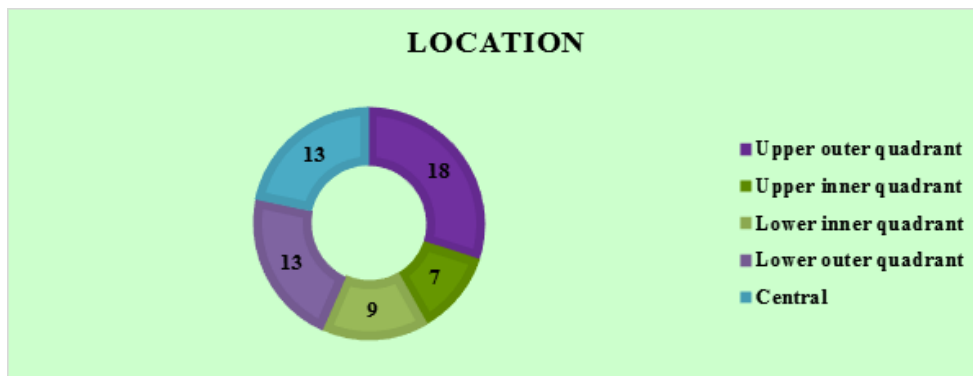

Figure 4: Frequency distribution of density based on mammogram

Table 5: Frequency distribution of location of lesion

Location	No. of patients (N)	Percentage (%)
Upper outer quadrant	18	30
Upper inner quadrant	7	11.6
Lower inner quadrant	9	15
Lower outer quadrant	13	21.7
Central	13	21.7
Total	**60**	**100**

Predominant site of lesions was found to be upper outer quadrant (18 cases, 30%). Lower outer quadrant and central region of breasts had lesions in 13 (21.7%) patients each. Lower inner quadrant exhibited lesions in 9 (15%) patients. In seven patients (11.6%) lesions were associated with upper inner quadrant.
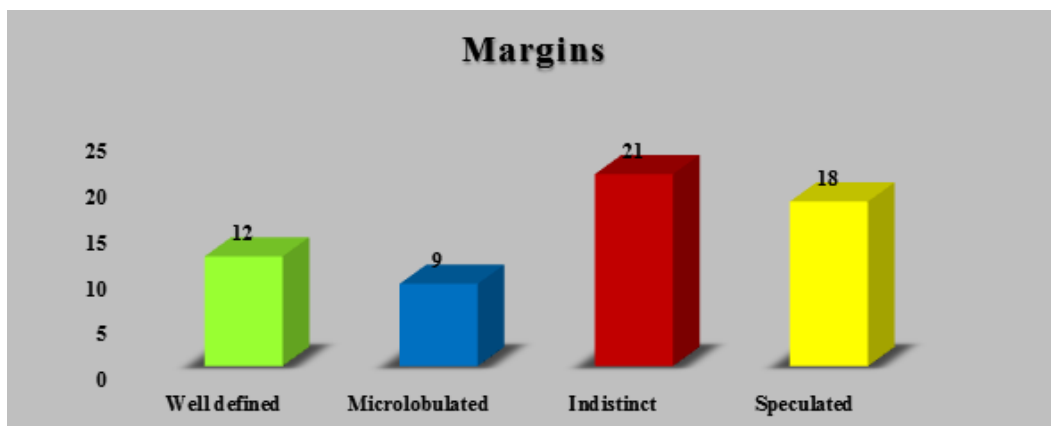

Figure 5: Frequency distribution of location of lesion

Table 6: Distribution based on margins

Margins	No. of patients (N)	Percentage (%)
Well defined	12	20
Microlobulated	9	15
Indistinct	21	35
Spiculated	18	30
Total	**60**	**100**

Indistinct margins were seen in most cases (21 patients, 35%) followed by spiculated margins in 18 (30%) patients. Well defined margins were seen in 12 patients (20%). In 9 patients (15%) microlobulated margins were observed.
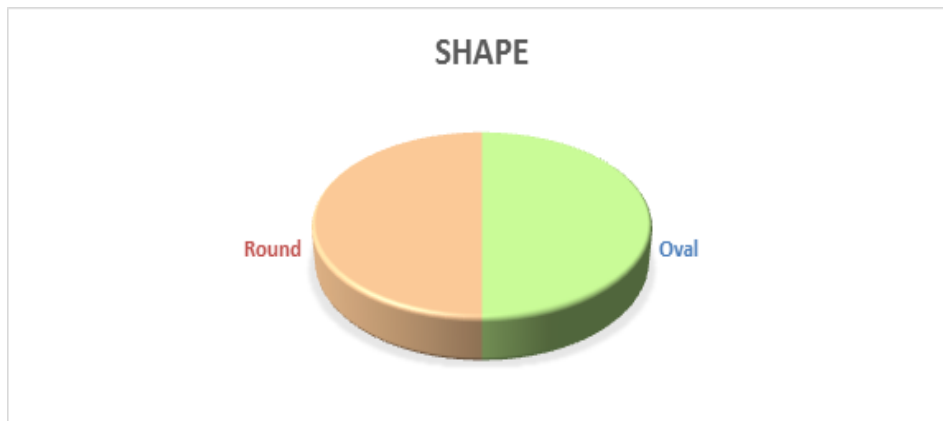

Figure 6: Distribution based on margins

Table 7: Frequency distribution of shape of lesion

Shape	No. of patients (N)	Percentage (%)
Oval	30	50
Round	30	50
Total	**60**	**100**

Oval and round shaped lesions were seen in equal distribution (30 cases each, 50%).
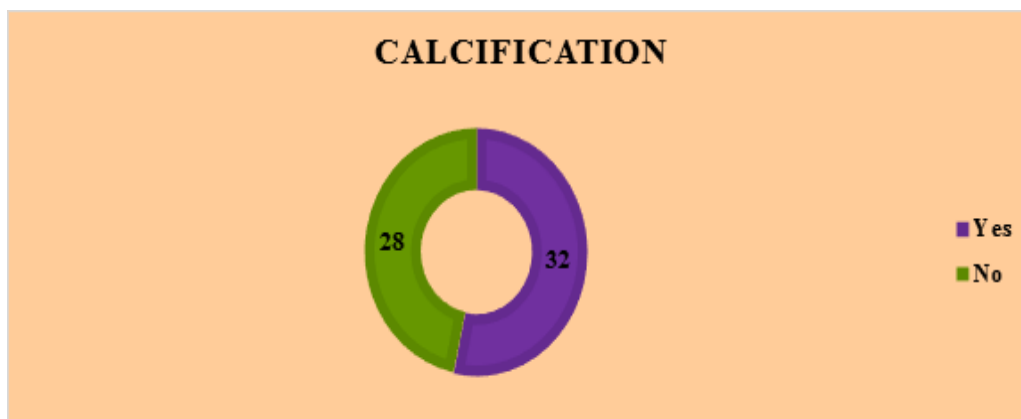
Figure 7: Frequency distribution of shape of lesions

Table 8: Frequency distribution based on calcification of lesions

Calcification	No. of patients (N)	Percentage (%)
Yes	32	53.3
No	28	46.7
Total	**60**	**100**

In majority patients calcification was seen. Calcified lesions were noted in 32 (53.3%) patients.

Figure 8: Frequency distribution of calcification of lesion

Table 9: Frequency distribution based on overlying skin

Overlying skin	No. of patients (N)	Percentage (%)
Normal	32	53.3
Skin retraction	12	20
Skin thickening	16	26.7
Total	**60**	**100**

In more than half of our study population, overlying skin was normal (32 cases, 53.3%). In 12 patients (20%) skin retraction was noted and 16 patients (26.7%) had thickened overlying skin.
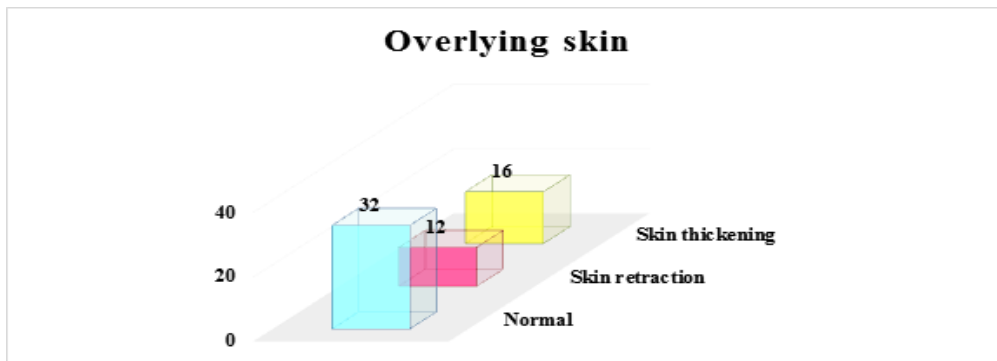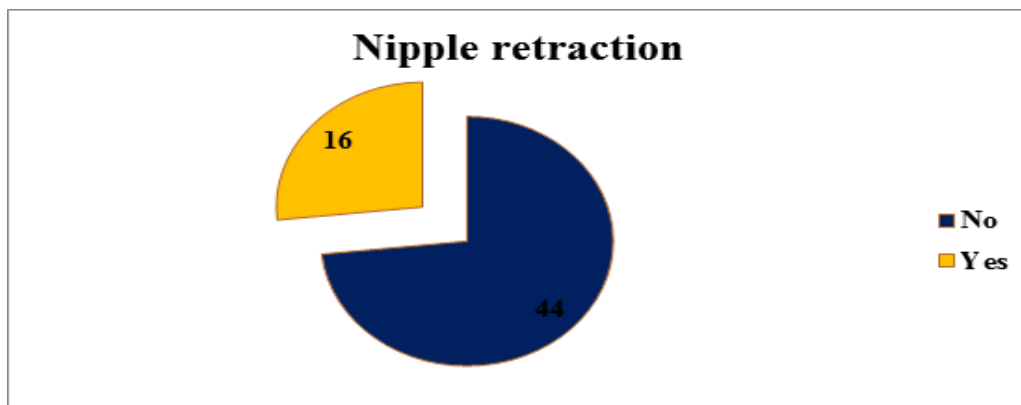
Figure 9: Frequency distribution based on overlying skin

Table 10: Frequency distribution based on nipple retraction

Nipple retraction	No. of patients (N)	Percentage (%)
Yes	16	26.7
No	44	73.3
Total	**60**	**100**

Nipple retraction was present in 16 patients (26.7%). In 44 patients (73.3%) normal nipple without retraction was seen.

Figure 10: Frequency distribution based on nipple retraction

Table 11: Frequency distribution of grades of BI-RADS (Mammography and USG)

BI-RADS grades	Mammography (N=60)		USG (N=60)	
	N	%	N	%
0	4	6.7	0	0
1	6	10	0	0
2	4	6.7	6	10
3	5	8.3	5	8.3
4	16	26.7	18	30
5	23	38.3	25	41.7
6	2	3.3	6	10

Breast imaging reporting and database scoring system was used to find out the stages of breast lesions. In mammographic findings, 4 patients each (6.7%) had grade 0 and 2 and 6 patients (10%) of grade 1 suggestive of no cancerous tissue. Five patients (8.3%) had BI-RADS score 3; suggesting probability of benign tumor. Sixteen patients (26.7%) had suspicious tumor activity detected (grade 4). Twenty three (38.3%) patients had grade 5 highly suggestive of malignancy; while two

patients (3.3%) had been detected to have malignant tumor with grade 6 staging.

In USG findings, no patient with grade 0 and 1 was detected. Grade 2, 3, 4, 5 and 6

were seen in 6 (10%), 5 (8.3%), 18 (30%), 25 (41.7%) and 6 (10%) patients respectively.
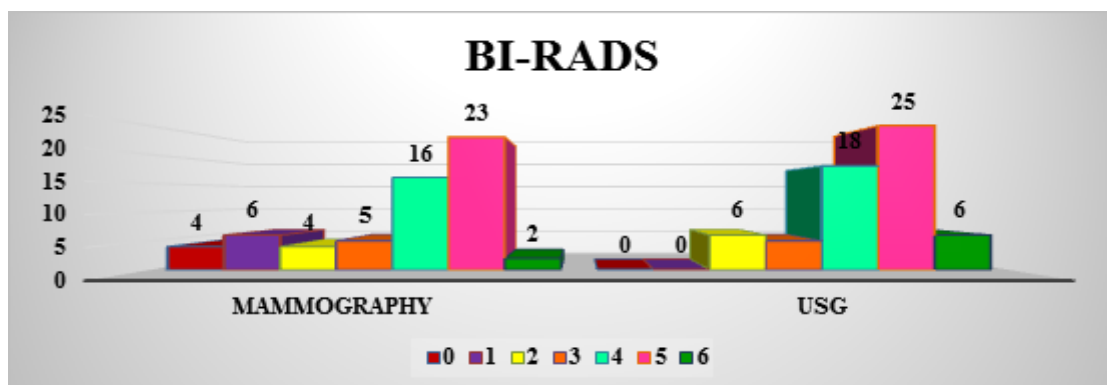
Figure 11: Frequency distribution of grades of BI-RADS (Mammography and USG)

Table 12: Distribution of FNAC and IHC report

FNAC	No. of patients (N=60)	Percentage (%)
Tumor grading		
I	19	31.7
II	28	46.7
III	13	21.7
ER status		
Positive	29	48.3
Negative	31	51.7
PR status		
Positive	19	31.7
Negative	41	68.3
HER 2 Neu status		
Positive	27	45
Negative	33	55

Fine needle aspiration cytological assessment was also done in all patients. Using FNAC, tumor grading was done. Nineteen (31.7%), 28 (46.7%) and 13 (21.7%) patients were established to have tumors of grade I, II and III respectively.

Figure 12: Frequency distribution of tumor grades based on FNAC

On immune-histo-chemistry, Estrogen receptor positivity was seen in 29 patients (48.3%).

Nineteen patients (31.7%) were progesterone receptor positive.
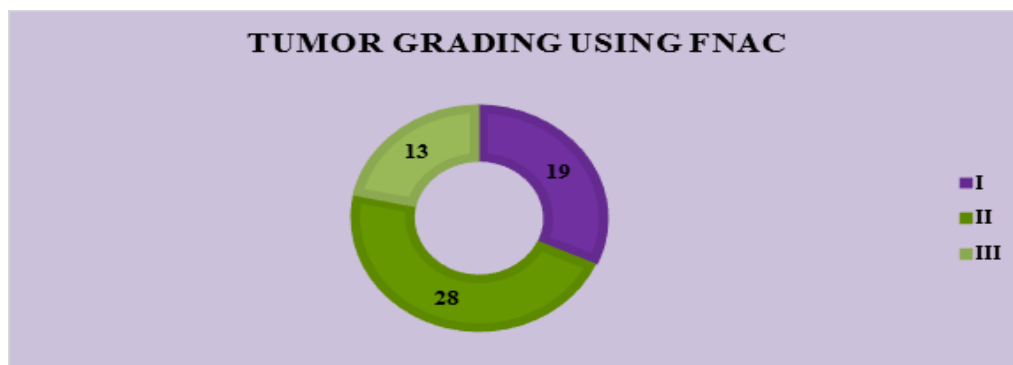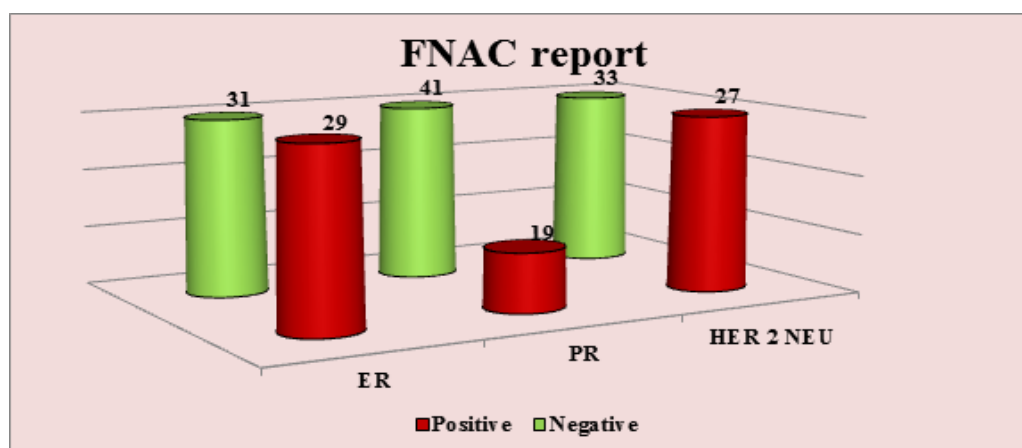In 27 patients (45%) HER 2 Neu was positive.

Figure 13: Distribution of FNAC report

Table 13: Distribution of breast MRI sequences

MRI	No. of patients (N=60)	Percentage (%)
T1 sequence		
Hypointense	18	30
Hyperintense	25	41.7
Isointense	17	28.3
T2 sequence		
Hyperintense	48	80
Very hyperintense	12	20
Background enhancement		
Homogeneous	9	15
Heterogeneous	8	13.3
Rim	10	16.7
Dark internal septation	16	26.7
Enhancing internal septation	17	28.3

T1- weighted sequences were analysed for detecting presence of fatty components within breast lesions, which in turn detects nature of lesion. Hypointense, hyperintense and isointense lesions were seen in 18 (30%), 25 (41.7%) and 17 (28.3%) patients. T2-weighted sequences were studied to know in depth about perifocal edema, which helped determining malignant nature of lesion. Hyperintense and very hyperintense lesions were seen in 48 (80%) and 12 (20%) patients respectively. Homogeneous, heterogeneous, rim background enhancement, dark internal septation and enhancing internal septation was seen in 9 (15%), 8 (13.3%), 10 (16.7%), 16 (26.7%) and 17 (28.3%) patients.

Table 14: Distribution of lesion characteristics based on MRI breast

MRI	No. of patients (N=60)	Percentage (%)
Size of lesion		
≤20 mm	34	56.7
20-40 mm	22	36.7
>40 mm	4	6.7
Mean±SD- 21±11.9		**Min-Max- 3 mm- 55 mm**
Focal lesions		

Present	29	48.3
Absent	31	51.7
Shape		
Oval	31	51.7
Round	29	48.3
Margins		
Circumscribed	9	15
Non-circumscribed	13	21.7
Spiculated	38	63.3
Microcalcification		
Present	27	45
Absent	33	55

Characteristics of lesions were studied using magnetic resonance imaging. Mean size was found to be 21 mm with a standard deviation 11.9 mm with a range of 3 mm to 55 mm. In 29 patients (48.3%) focal lesions were noted. Thirty one patients (51.7%) had oval shaped lesion while, 29 patients (48.3%) patients had round or spherical shaped lesions.

In majority patients spiculated margins were seen (38 cases, 63.3%). Circumscribed and non-circumscribed margins were observed in 9 (15%) and 13 (21.7%) patients respectively. Microcalcification was seen in 27 (45%) patients.

Table 15: Distribution of breast characteristics based on MRI breast

MRI	No. of patients (N=60)	Percentage (%)
Nipple morphology		
Normal	42	70
Indrawing	9	15
Retracted	9	15
Internal mammary Nodes		
Enlarged	12	20
Normal	48	80
Supraclavicular Nodes		
Enlarged	9	15
Normal	51	85
Metastasis		
Present	6	10
Absent	54	90
Architectural distortion		
Present	33	55
Absent	27	45
Ulceration		
Present	49	81.7
Absent	11	18.3

From morphological aspect, in 42 patients (70%) no abnormality in nipple was observed. In drawning and retraction was noticed in 9 patients (15%) each.

Internal mammary and supraclavicular lymph nodes were enlarged in 12 (20%) and 9 (15%) patients respectively.

In six patients (10%) metastasis was observed. Metastasis to liver and lungs in 2 patients each, to ribs and hilar nodes in one patients each was seen.

Architectural distortion and ulceration was seen in 33 (55%) and 49 (81.75) patients respectively.

Table 16: Distribution based on MRI axilla

MRI	No. of patients (N=60)	Percentage (%)
T1 sequence		
Hyperintense	18	30
Hypointense	25	41.7
Isointense	17	28.3
T2 sequence		
Hyperintense	48	80
Very hyperintense	12	20
Diffusion restriction		
Present	17	28.3
Absent	43	71.7
Axillary lymph nodes		
Enlarged	19	31.7
Normal	41	68.3

Hyperintense, hypointense and isointense lesions were detected using T1-weighted sequencing in 18 (30%), 25 (41.7%) and 17 (28.3%) patients. T2-weighted sequencing detected hyperintense and very hyperintense lesions in 48 (80%) and 12 (20%) patients respectively. Diffusion restriction was present in 17 (28.3%) patients. Enlarged axillary lymph nodes were seen in 19 (31.7%) patients. Location of enlarged axillary lymph nodes was anterior wall, axillary inlet and apex of axilla (3 cases each), medial wall and posterior wall (2 cases each) and lateral wall in 6 patients.

Table 17: Frequency distribution of final diagnosis based on histo-pathological report

Diagnosis	No. of patients (N)	Percentage (%)
Invasive ductal carcinoma	37	61.7
Invasive lobular carcinoma	10	16.7
Ductal carcinoma in situ	8	13.3
Lobular carcinoma in situ	5	8.3
Total	**60**	**100**

Final diagnosis was made considering histo-pathological report. Invasive ductal and lobular carcinomas were diagnosed in 37 (61.7%) and 10 (16.7%) patients respectively. In situ ductal and lobular carcinomas were seen in 8 (13.3%) and 5 (8.3%)patients respectively.
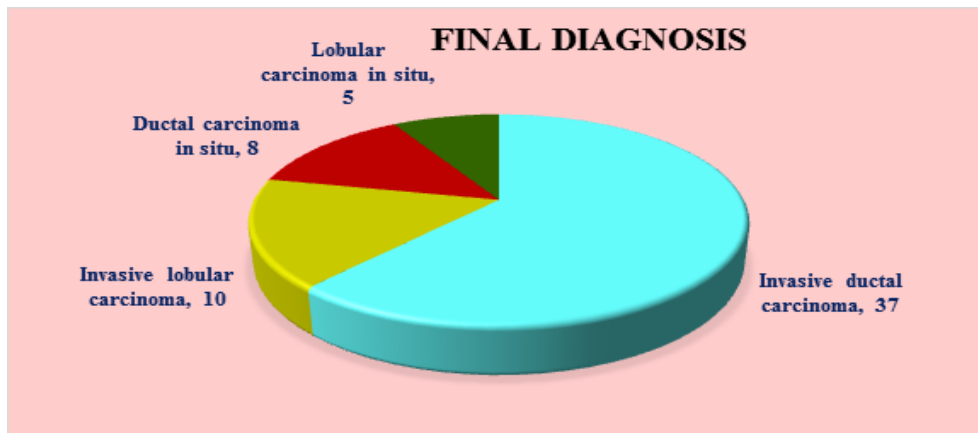
Figure 14: Frequency distribution of final diagnosis based on histo-pathological report

Table 18: Frequency distribution of neo adjuvant therapy used

Treatment	No. of patients (N)	Percentage (%)
Chemotherapy	38	63.3
Hormonal therapy	22	36.7
Total	**60**	**100**

Based on FNAC report, hormonal therapy was given to 22 (36.7%) patients. Chemotherapy was delivered to 38 (63.3%) patients.
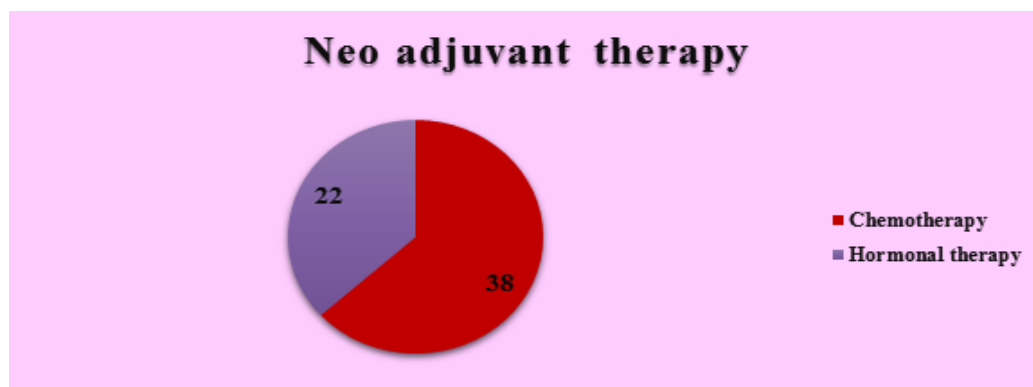

Figure 15: Frequency distribution of neo adjuvant therapy used

Table 19: Distribution of correlation between findings of Mammography, USG and MRI as compared to histo-pathological findings

Diagnostic modality		Diagnosis +ve	Diagnosis –ve
Mammography	Positive	40	4
	Negative	13	3
USG	Positive	43	2
	Negative	8	7
MRI	Positive	52	1
	Negative	2	5

In our study, mammography, USG and MRI was done in all patients. Out of 60 cases, 40, 43 and 52 carcinomas were correctly diagnosed using mammography, USG and MRI respectively. False negative diagnosis were noted in mammography (13 cases), USG (8 cases) and MRI (2 cases). Also, false positive diagnosis were observed in mammography (4 cases), USG (2 cases) and MRI (1 case).

Table 20: Diagnostic efficacy of various modalities used to diagnose Ca. breast with respect to histo-pathology as gold standard

	Sensitivity %	Specificity %	PPV %	NPV %	Accuracy %
Mammography	75.47	42.86	90.91	18.75	71.67
USG	84.31	77.78	95.56	46.67	83.33
MRI	96.3	83.33	98.11	71.43	95

Findings of histo-pathological analysis were considered as final and gold standard for comparison of other diagnostic methods viz. mammography, USG and MRI. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of mammography was determined to be 75.47%, 42.86%, 90.91%, 18.75% and 71.67% respectively. In USG and MRI sensitivity was 84.31% and 96.3%, specificity was 77.78% and 83.33%, PPV was 95.56% and 98.11%, NPV was 46.67%and 71.43% and accuracy was 83.33% and 95% respectively.

Higher sensitivity and specificity along with greater accuracy was noted in MRI as compared to mammography and USG.

Discussion:

The selection of appropriate treatment for patients with breast carcinoma is determined by accurate assessment of disease stage. Complete locoregional staging should enable the accurate assessment of tumour size, multifocality, the presence of an extensive intraductal component (EIC), and involvement of nipple, pectoralis muscle, and axillary node metastases. The fact that cancer cells may exist beyond the confines of the palpable tumor is well recognized. In radiologic-histologic evaluation of the breast in 264 mastectomy specimens from patients with clinically unifocal breast cancer measuring 4 cm or smaller, Holland et al showed cancer foci further than 2cm from the reference tumor in 41% of the cases. The additional foci were entirely intraductal in 27% and a combination of invasive and intraductal in the remaining 14% of cases. Clinical assessment of tumor extent and axillary node metastasis correlates poorly

with histology and is subject to significant interobserver variation. Thus pre-treatment staging is highly dependent on appropriate imaging findings.

Mammography tends to underestimate tumor size and multifocality, and about 5 to 15% of cancers are not visualized at all, with resultant delay in diagnosis. Sonography is more accurate in determining actual tumour size but is of limited value in the detection of multifocality and intraductal disease.

Early studies with MRI of the breast were aimed at evaluating its diagnostic accuracy for differentiation between benign and malignant breast lesions. However, use of MRI as a diagnostic technique in patients with symptomatic breast cancer (defined as those presenting with palpable masses, skin or nipple changes, or palpable axillary lymph nodes) may not be justified compared with the accuracy provided by combined clinical examination, mammographic with or without sonographic examination, and needle biopsy evaluation (triple examination) of breast lesions.

Present study was designed to determine the accuracy of MRI in staging of breast cancer diagnosed by triple examination and to identify clinical situations in which pre-operative MRI may provide useful additional information in treatment planning. Sixty cases of breast cancer, attending Department of General surgery at M.K.C.G. Medical College and Hospital, Berhampur were included in the study. Mean age was 43.25 ± 10.3 years with 68.4% cases belonging to age group 31-50 years. 30% of cases had positive familial history of breast carcinoma. The age

incidence was comparable with that in various other studies. Meshram II et al (2009) [15] found maximum number of cases (23.81%) in the age group of 45-49 years followed by 40-44 years (14.29%), with mean age 48.4±11.28 years. Sandhu DS et al (2010) [16] found 65.8% cases in 31-50 years of age with mean age 47.39±10.90 years. Bhadoria AS et al (2013) [17] found 62.5% patients between 30-50 years with mean age 45±10.29 years. Balasubramaniam SM et al (2013) [18] found 35.5% patients in 41-50 years with mean age 49.1±10.85 years.

In present study, 61.7% of breast cancer cases attended the hospital with clinical sign and symptom of lump/ mass in the breast whereas percentages of pain, discharge through breast was seen in 60% and 40% respectively. This late presentation of disease may be due to low level of awareness about breast cancer in rural community, fear of cancer or poverty. Acharya SC [19] from Nepal also reported that 98.2% cases were presented with lump in breast whereas nipple retraction was shown in 7 % cases. Lump in the breast was the commonest finding observed by Sandhu DS[59] from north India and Kokiwar P [20] from south India.

On mammographic examination, heterogeneously dense and extremely dense tissue was observed in majority of patients. Upper outer quadrant was involved in majority cases followed by central and lower quadrant involvement in 13 cases each. In 12 patients (20%) skin retraction was noted and 16 patients (26.7%) had thickened overlying skin. Margins of the lesion were indistinct (35%) and speculated in 30% of cases. In a study conducted by Muradas RR et al [21] 81.1% (n=184) of patients had a palpable mass on breast examination; 3.5% (n=8) had an ulcerated lesion; and 15% (n=34) showed no abnormality on physical examination. The association of nodular and ulcerated lesion was present in one patient only (0.4%). The authors found that 41.7% (n=81) of the lumps were located in the upper outer quadrant. Of these lumps, 49.5% (n=96) were in the left breast, 47.8% (n=93) in the right breast, and only 2.7% (n=5) of the women had bilateral deformation when inspected. 50.7% (n=98) of the palpable lumps measured more than three centimeters, as shown in the description of the physical examinations.

Shape of the lesion on mammography was either oval or round. Calcifications were seen in 53.3% of cases. In a study conducted by Wendie et al [22] showed that pleomorphic calcification seen within a mass was mostly proven on histopathology to be a typically invasive ductal carcinoma. 46.7% of the breast lesions without any calcification were positive for malignancy from which we could conclude that not all breast malignancies had calcifications.

In mammographic findings, 4 patients each (6.7%) had grade 0 and 2 while Five patients (8.3%) had BI-RADS score 3; suggesting probability of benign tumor. Sixteen patients (26.7%) had suspicious tumor activity detected (grade 4). Twenty three (38.3%) patients had grade 5 highly suggestive of malignancy; while two patients (3.3%) had been detected to have malignant tumor with grade 6 staging. In USG findings, Grade 2, 3, 4, 5 and 6 were seen in 6 (10%), 5 (8.3%), 18 (30%), 25 (41.7%) and 6 (10%) patients respectively.

In Muradas RR et al [21] study, Of 199 mammograms described in the records, classifications according to the Breast Imaging Reporting and Data System (BI-RADS®) and mentioned in written were: 40% BI-RADS 5; 33% BI-RADS 4; and 13% BI-RADS 0 (zero). Only one patient had a BI-RADS category 6 on mammography. Out of the mammograms described as BI-RADS 4 and 5, the image of a lump was present in 79.7% (n=158), while microcalcifications were reported in 18.2% (n=36) of the expert opinions, and the combination of lump and

microcalcifications was seen in 2.1% (n=5) of the results.

On cytology, Nineteen (31.7%), 28 (46.7%) and 13 (21.7%) patients were established to have tumors of grade I, II and III respectively. On IHC, Estrogen receptor positivity was seen in 29 patients (48.3%). Nineteen patients (31.7%) were progesterone receptor positive. In 27 patients (45%) HER 2 Neu was positive. 11 cases were triple negative in present study. In Rathod V et al [23] study from Bihar, the majority of tumors were grade II (55.6%), followed by grade III and grade I in 24.7% and 19.8% patients, respectively. Lymphovascular invasion was seen in 45.6% of patients and perineural invasion in 18.4%. Estrogen receptor (ER) expression was found in 41.8%, progesterone receptor (PR) was positive in 47.3%, and human epidermal growth factor receptor-2 (HER-2/Neu) overexpression was observed in 39.8%. Triple-negative receptor status was found in 26.2% of our study population.

MRI was done to evaluate characteristics of the lesion, staging and restaging. Mean size of the lesion on MRI was 21±11.9mm. Enhancement pattern in majority cases was hyperintense with background enhancement as dark internal septation rim. Focal lesions were observed in 29 cases. Non circumscribed and speculated margins were commonly observed with 45% of cases had microcalcifications.

Our results correlate well with the study conducted by Mumtaz et al. [24] The median size of tumor on MRI was 24 mm. The morphologic characteristics of primary enhancing masses included speculated edges or irregular borders in 15 cases with homogenous enhancement in 55 cases and peripheral or rim pattern in 12 cases. 18 cases had patchy areas of non-enhancement within the main enhancing mass. The area of non-enhancement correlated with spontaneous tumor necrosis, areas of tumor fibrosis or mucinous change within the tumor.

On MRI metastasis was detected in 6 cases of which metastasis to liver and lungs in 2 patients each, to ribs and hilar nodes in one patients each was seen. Internal mammary and supraclavicular lymph nodes were enlarged in 12 (20%) and 9 (15%) patients. On MRI Axilla, enlargement was observed in 19 cases. Location of enlarged axillary lymph nodes was anterior wall, axillary inlet and apex of axilla (3 cases each), medial wall and posterior wall (2 cases each) and lateral wall in 6 patients.

On histopathological examination, Invasive ductal and lobular carcinomas were diagnosed in 37 (61.7%) and 10 (16.7%) patients respectively. In situ ductal and lobular carcinomas were seen in 8 (13.3%) and 5 (8.3%) patients respectively. Histopathological examination was considered as gold standard in diagnosis. In our study, mammography, USG and MRI was done in all patients. Out of 60 cases, 40, 43 and 52 carcinomas were correctly diagnosed using mammography, USG and MRI respectively. False negative diagnosis were noted in mammography (13 cases), USG (8 cases) and MRI (2 cases). Also, false positive diagnosis were observed in mammography (4 cases), USG (2 cases) and MRI (1 case).

We found that, of the three modalities, higher sensitivity and specificity along with greater accuracy was noted in MRI as compared to mammography and USG. Sensitivity, specificity and accuracy of mammography (75.4%, 42.8% and 71.6%), USG (84.3%, 77.7% and 46.6%), and MRI (96.3%, 83.3% and 95%) were compared.

Phurailatpam et al. [25] had described in women > 30 years of age the mammographic evaluation with FNAC was 92.3% sensitive, 91.8% specific, 85.7% was the positive predictive value and 95.7% was the negative predictive value. Whereas the result with ultrasonographic evaluation

with FNAC was 80.7% sensitive, 100% specific, 100% was the positive predictive value and 90.7% was the negative predictive value.

Zonderland et al. [26] described an overall sensitivity of 85% and specificity of 98.7%. The sensitivity of diagnostic examinations in the study was 92.9% and specificity 97.7%, whereas that of screening examinations was 69.2% and specificity 99.2% with combination of both USG and mammography88%.

Mumtaz et al [24] concluded that MRI was more accurate than mammography in determining invasive tumour size, in depicting multifocality and extensive intraductal component (sensitivity 81% versus 62%). Sensitivity and specificity of axillary LN metastasis were 90% and 82% respectively.

Summary:

Present study was conducted on 60casesof breast cancer attending Department of General Surgery at M.K.C.G. Medical College and Hospital, Berhampur. These patients were selected based on the inclusion and exclusion criteria.

The results are summarized below:

Demographic details:

- Mean age was 43.25 ± 10.3 years with minimum and maximum age of 21 to 66 years.
- Eighteen patients (30%) gave positive family history of breast cancer.
- Presence of lump, associated pain and nipple discharge was seen in 37 (61.7%), 36 (60%) and 24 (40%) patients respectively.

Mammographic assessment:

- Mostly heterogeneously dense lesions were seen in 21 (35%) patients, followed by extremely dense lesions in 17 (28.4%) patients. Predominantly fatty and fibro-fatty breast lesions were seen in 11 (18.3%) patients each.

- Predominant site of lesions was found to be upper outer quadrant (18 cases, 30%). Lower outer quadrant and central region of breasts had lesions in 13 (21.7%) patients each. Lower inner quadrant exhibited lesions in 9 (15%) patients. In seven patients (11.6%) lesions were associated with upper inner quadrant.
- Indistinct margins were seen in most cases (21 patients, 35%) followed by spiculated margins in 18 (30%) patients. Well defined margins were seen in 12 patients (20%). In 9 patients (15%) microlobulated margins were observed.
- On mammography, oval and round shaped lesions were seen in equal distribution (30 cases each, 50%).
- Calcified lesions were noted in 32 (53.3%) patients.
- In 12 patients (20%) skin retraction was noted and 16 patients (26.7%) had thickened overlying skin.
- Nipple retraction was present in 16 patients (26.7%).

BI-RADS findings of mammography and USG:

- In mammographic findings, grade 0, 1, 2, 3, 4, 5 and 6 were seen in 4 (6.7%), 6 (10%), 4 (6.7%), 5 (8.3%), 16 (26.7%), 23 (38.3%) and 2 (3.3%) patients respectively.
- In USG findings, no patient with grade 0 and 1 was detected. Grade 2, 3, 4, 5 and 6 were seen in 6 (10%), 5 (8.3%), 18 (30%), 25 (41.7%) and 6 (10%) patients respectively.

Fine needle aspiration cytology report:

- Based on FNAC report, 19 (31.7%), 28 (46.7%) and 13 (21.7%) patients were established to have tumors of grade I, II and III respectively.
- Estrogen receptor positivity was seen in 29 patients (48.3%).
- Nineteen patients (31.7%) were progesterone receptor positive.

- In 27 patients (45%) HER 2 Neu was positive.

Magnetic resonance imaging assessment of breast:

- Hyperintense, hypointense and isointense lesions were seen in 18 (30%), 25 (41.7%) and 17 (28.3%) patients.
- Hyperintense and very hyperintense lesions were seen in 48 (80%) and 12 (20%) patients respectively.
- Homogeneous, heterogeneous, rim background enhancement, dark internal sepattionand enhancing internal septation was seen in 9 (15%), 8 (13.3%), 10 (16.7%), 16 (26.7%) and 17 (28.3%) patients.
- Mean size was found to be 21 mm with a standard deviation 11.9 mm with a range of 3 mm to 55 mm.
- In 29 patients (48.3%) focal lesions were noted.
- Thirty one patients (51.7%) had oval shaped lesion while, 29 patients (48.3%) patients had round or spherical shaped lesions.
- In majority patients spiculated margins were seen (38 cases, 63.3%). Circumscribed and non-circumscribed margins were observed in 9 (15%) and 13 (21.7%) patients respectively.
- Microcalcification was seen in 27 (45%) patients.
- Indrawning and retraction was noticed in 9 patients (15%) each.
- Internal mammary and supraclavicular lymph nodes were enlarged in 12 (20%) and 9 (15%) patients respectively.
- In six patients (10%) metastasis was observed. Metastasis to liver and lungs in 2 patients each, to ribs and hilar nodes in one patients each was seen.
- Architectural distortion and ulceration was seen in 33 (55%) and 49 (81.75) patients respectively.

Magnetic resonance imaging assessment of axilla:

- Hyperintense, hypointense and isointense lesions were detected using T1-weighted sequencing in 18 (30%), 25 (41.7%) and 17 (28.3%) patients.
- T2-weighted sequencing detected hyperintense and very hyperintense lesions in 48 (80%) and 12 (20%) patients respectively.
- Diffusion restriction was present in 17 (28.3%) patients.
- Enlarged axillary lymph nodes were seen in 19 (31.7%) patients. Location of enlarged axillary lymph nodes was anterior wall, axillary inlet and apex of axilla (3 cases each), medial wall and posterior wall (2 cases each) and lateral wall in 6 patients.

Histo-pathological report and final diagnosis:

- Invasive ductal and lobular carcinomas were diagnosed in 37 (61.7%) and 10 (16.7%) patients respectively. In situ ductal and lobular carcinomas were seen in 8 (13.3%) and 5 (8.3%) patients respectively.
- Hormonal therapy was given to 22 (36.7%) patients. Chemotherapy was delivered to 38 (63.3%) patients.

Diagnostic efficacy of mammography, USG and MRI:

- Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of mammography was determined to be 75.47%, 42.86%, 90.91%, 18.75% and 71.67% respectively. In USG and MRI sensitivity was 84.31% and 96.3%, specificity was 77.78% and 83.33%, PPV was 95.56% and 98.11%, NPV was 46.67%and 71.43% and accuracy was 83.33% and 95% respectively.
- Higher sensitivity and specificity along with greater accuracy was noted in MRI as compared to mammography and USG.

Conclusion

Breast MRI plays an important role in

breast cancer screening and diagnosis, based on the current indications, as per the ACR practice parameters. The best non-invasive tool for assessing accurate tumor size is breast MRI. Tumor size can be underestimated by mammography and ultrasound, but the size of the tumor at histology is not significantly different from that on MRI. In breast MRI, both breasts are imaged at the same time, which helps to evaluate contralateral disease. It also assesses for multifocal or multicentric disease, which does alter surgical management. Breast MRI allows for the evaluation of levels 1, 2, and 3 axillary and internal mammary lymph nodes, which not only affects staging and treatment planning but is also the most important deterministic factor for the prognosis of breast cancer. Finally, it is imperative to look for and report extra-mammary findings in the lungs, bones, and visualized liver, especially if they are concerning for distant metastasis.

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