Role of Magnetic Resonance Mammography in the Evaluation of Indeterminate Breast Lesions

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ABSTRACT

Background: Malignancy of the breast is one of the most common cancers among females worldwide. Magnetic resonance mammography (MRM) is a valuable complement to conventional methods for the early diagnosis of disease, thereby providing patients with a better prognosis. The number of unnecessary biopsies and repeated excisions in cases of indeterminate breast lesions detected on conventional imaging is high.

Aims: The purpose of this study was to evaluate the role of MRM in the evaluation of indeterminate breast lesions (Breast Imaging Reporting and Data System (BIRADS) 3/4) found in conventional mammography and ultrasonography (USG), taking the histopathological examination (HPE) as the gold standard.

Materials and methods: A total of 38 patients with conventional radiological imaging diagnosis of indeterminate breast lesions (BIRADS 3/4) were included in this study and evaluated using contrast-enhanced MRM according to the MR-BIRADS lexicon (5th edition). Morphological characteristics of lesions were evaluated to determine the probability of malignancy. Histopathology was kept as the gold standard for comparing all the statistical parameters.

Results: There were a total of 40 lesions, 35 masses, and five nonmass enhancement (NME) available for evaluation out of the 38 patients. The sensitivity of margins to detect malignancy approached 100%; however, it had a slightly lower specificity of 66.67%. Magnetic resonance imaging (MRI) showed good diagnostic performance with sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of 85, 90, 89.47, 85.71, and 87.50%, respectively.

Conclusion: The MRM has been shown to be useful as a problem-solving tool in breast cancer screening, clarifying indeterminate findings and avoiding unnecessary short follow-ups and percutaneous biopsies.

INTRODUCTION

Malignancy of the breast is one of the most common cancers among females worldwide. As per the Globocan data 2020, in India, breast malignancies accounted for 13.5% (178,361) of all cancer cases and 10.6% (90,408) of all deaths with a cumulative risk of 2.81. The global burden is projected to cross 2 million by the year 2030.2

Early detection and adequate characterization of the lesion are important for planning future management.3 Therefore, an investigation that is both sensitive and specific is required in such cases.

Radiological investigations such as conventional mammography, ultrasonography (USG), and magnetic resonance imaging (MRI) are used to diagnose and characterize various breast lesions. The latest updated version of the Breast Imaging Reporting and Data System (BIRADS) is 5th edition (2013).4

Conventional mammography and B-mode USG are the established gold standards for breast imaging; however, significant false positives and negatives still occur. False positive results evoke invasive diagnostic procedures, which are otherwise avoidable in these patients.5

The MRM has the capability of providing three-dimensional spatial information and better visual differentiation of breast lesions from normal breast tissue based on differences in vascularity and permeability of the lesions.6 Irregular shape, noncircumscribed margins, diffusion restriction, and heterogeneous/rim enhancement with washout kinetic curve are suggestive of malignant neoplastic etiology.

Evidence in the literature shows that using cutoff apparent diffusion coefficient (ADC) ranges of 1.3–1.5 × 10−3 mm²/second for benign lesions and 0.85–1.1 × 10−3 mm²/second for malignant lesions allows differentiation of benign from malignant lesions with high sensitivity and specificity.7,9

As stated in the BIRADS lexicon, lesions scoring BIRADS 4A/B/C (suspicion for malignancy 2–9, 10–49, and 50–94%, respectively) are advised histopathological confirmation to know the malignant potential of the lesion.5 However, the rate of negative biopsy is high.

Keeping in view the lack of sufficient data available for the North Indian population, this study was conducted with the main objective of evaluating the role of MRM in adequately characterizing breast masses that are found suspicious on clinical examination, routine mammography, and ultrasonography (i.e., BIRADS 3/4 lesions) taking histopathology as a gold standard to reduce the need of unnecessary biopsies and short-term follow-ups.

MATERIALS AND METHODS

Patients clinically found to have indeterminate breast lesions were referred from the department of surgery to the department of radiodiagnosis for further evaluation. The relevant patient history was taken by the principal investigator, and a physical examination of the patient was carried out by the surgeon. These patients underwent conventional mammography and USG. The lesion was characterized by the BIRADS lexicon. Patients with indeterminate/suspicious (BIRADS 3/4) breast lesions detected on conventional mammography and USG, who met the criteria of inclusion and did not have any exclusion criteria, were enrolled for this study post taking written informed consent.

Inclusion Criteria

- Patients with clinically suspicious/indeterminate palpable lump in the breast, which is BIRADS 3 on conventional mammography and USG.
- Patients with clinically suspicious/indeterminate palpable lump in the breast, which is BIRADS 4 on conventional mammography and USG.
- Patients with suspicious (BIRADS 3) breast masses were seen incidentally on screening mammography and USG.

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- Patients with suspicious (BIRADS 4) breast masses were seen incidentally on screening mammography and USG.
- Patients who presented with other complaints like nipple discharge, mastalgia, or redness showed suspicious (BIRADS 3/4) lesions on conventional mammography and USG.

Exclusion Criteria

The following categories of patients were excluded from the study:

- Operative history of the breast in the past.
- History of radiotherapy (RT) or chemotherapy to the breast in the past.
- Breast lesions that were definitely benign, whether clinically or on conventional imaging, like simple cysts on mammography and sonomammography.
- Biopsy-proven cases of malignancy.
- Deranged renal function tests.
- Patients with claustrophobia.
- Any known contraindication to MRI, namely cochlear implants and pacemakers, metallic implants, dental fillings, and clips in the body noncompatible with MRI.
- Patients who did not give consent to participate in the study.

All these patients were asked to get their renal function tests, and those who had normal renal function tests underwent contrast-enhanced MRM during the mid-menstrual cycle, that is, week 2 (7–14 days) in premenopausal women and at any time in the postmenopausal women.

For acquiring these MRI sequences, the patient was placed in the prone position with the breasts hanging in a double breast coil at the isocentre of the magnet.

The following MRM sequences were acquired on the Phillips ACHIEVA 1.5 Tesla MRI scanner.

- Short tau inversion recovery (STIR) axial.
- T2 weighted image (T2W)-turbo-spin-echo (TSE) axial.
- T1W-TSE axial.
- T1W-TSE coronal.
- T2W-TSE coronal.
- Diffusion-weighted imaging (DWI)/ADC axial.
- T2W-TSE RT sagittal.
- T2W-TSE LT sagittal.
- Dynamic-enhanced T1 high-resolution isotropic volume excitation (dyn-eTHRIVE).
- T1W-TSE-PTGAD coronal.

Dynamic contrast-enhanced images were obtained after administration of 0.1 mmol/kg body weight of gadobenate dimeglumine contrast injected intravenously with the help of an automatic injector at the rate of 2 mL/second. This sequence was repeated sequentially before and five times after a bolus of contrast over a period of 5 minutes so that the rate and duration of enhancement could be assessed.

Image Analysis

On basic MRI sequences, the breast lesions were analyzed and characterized with emphasis on the number, size, and morphology of the lesion. On DWI, diffusion restriction, if any, with ADC mapping was recorded. On dynamic contrast-enhanced T1 weighted sequences, region of interest (ROI) was drawn in the most rapidly enhancing part(s) of the lesion, and time–signal intensity curve(s) (TIC) were obtained. Background parenchymal enhancement was categorized as symmetrical or asymmetrical and was also classified as minimal, mild, moderate, or marked.

- The shape of the lesion was classified as oval, round, or irregular.
- The margins of the lesions were classified as circumscribed or noncircumscribed. Circumscribed margins were taken as smooth, and noncircumscribed were further categorized as irregular or spiculated margins.

Internal enhancement characteristics of the lesions included homogeneous, heterogeneous rim enhancement or dark internal septations.

- Type I/persistent (sustained enhancement).
- Type II/plateau (stable enhancement).
- Type III/washout (rapid initial enhancement and decreasing late enhancement).

Nonmass enhancement (NME) is defined as those that are neither a focus nor a mass. Depending on the way the enhancement is distributed, NME is categorized as a focal area, linear, segmental, regional, multiple regions, or diffuse. The internal enhancement of NME can be further categorized as homogenous, heterogeneous, clumped, or clustered.

Associated features like nipple retraction or inversion, skin thickening and invasion, axillary lymphadenopathy, pectoralis muscle involvement, chest wall invasion, or any other associated architectural distortion were also recorded.

Keeping in view all the above parameters, the lesions were categorized as benign or malignant and were assigned the BIRADS category. Final BIRADS was assigned to the breast as per the highest category BIRADS lesion present in one or both breasts.

- BIRADS 1—negative.
- BIRADS 2—benign.
- BIRADS 3—probably benign.
- BIRADS 4—suspicious.
- BIRADS 5—highly suggestive of malignancy.
- BIRADS 6—known biopsy-proven malignancy.

The final diagnosis of the lesions was determined by subsequent histopathological examination (HPE) (fine needle aspiration cytology/biopsy/mastectomy specimen).

In the end, the MRI findings were correlated with the HPE and the results were statistically analyzed.

Statistical Analysis

Imaging parameters concerning MRM findings for different cases were described by using frequency distribution for qualitative data and by using mean along with standard deviation (SD) for qualitative parameters. Diagnostic values of MRI were evaluated, taking histopathology as the gold standard. These values were expressed in terms of sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy. The Chi-squared test was used for testing the significance between MRM findings and histopathology findings, and the $\kappa$ coefficient of agreement was calculated. Data analysis was carried out by using International Business Machines Corporation Statistical Package for the Social Sciences (25.0 version) software.
**Results**

A total of 38 patients referred from the department of surgery with clinical or conventional radiological imaging diagnoses of indeterminate breast lesions (BIRADS 3/4) were included in this study. A total of 40 lesions, 35 masses, and five NMEs were evaluated using contrast-enhanced MRM according to the MR BIRADS lexicon (5th edition).

**Morphology**

**Lesion Size**

Lesions were measured in three dimensions and the maximum dimension was considered for comparison analysis. The mean size of benign lesions was 24.20 mm (±25.899) mean (± SD) and of malignant lesions was 35.05 mm (±33.622) mean (SD). There was no statistically significant difference between the mean size of benign and malignant lesions (p-value of 0.307).

**Margins**

The margins of the lesions were described as circumscribed or noncircumscribed margins. Maximum lesions were noncircumscribed (n = 25, 71.42%) and the rest (n = 10, 28.57%) were circumscribed.

This study showed a strong positive correlation (Pearson’s product-moment correlation coefficient, r = 0.730) between malignancy and noncircumscribed (irregular and spiculated) margins. On the contrary, benign lesions were more likely to have smooth edges. These conclusions were highly statistically significant (p-value of <0.001).

**Diffusion Restriction**

In our study, 29 lesions showed diffusion restriction, out of which 18 came out malignant (n = 18, 62.06%) and 11 were benign (n = 11, 37.93%) on pathological results (Table 1).

Receiver operating characteristic (ROC) analysis curves were plotted to find out the maximum cutoff values of DWI between benign and malignant HPE groups (Fig. 1).

The area under the ROC curve was 0.821. At the cutoff value of 0.94, the sensitivity and specificity for predicting the presence of malignant lesions on HPE were 83.33 and 72.73%, respectively. A patient having an ADC value lower than the aforementioned cutoff value had a high probability of having a malignant lesion on HPE.

**Enhancement Characteristics**

**Internal Enhancement Pattern**

The enhancement pattern of the lesion was described as one of the following categories—homogeneous, heterogeneous, or rim enhancement. The results of our study showed that heterogeneous enhancement was the most prevalent pattern (n = 24, 60%), followed by homogeneous internal enhancement (n = 12, 30%), and rim enhancement (n = 4, 10%).

The distribution of the enhancement pattern of the lesion according to HPE is given in Table 2.

**Kinetic Curves**

**Early Enhancement Curve**

A fast curve was seen in 10 lesions (n = 10, 25%), out of which 30% (n = 3 out of 10) of these cases were benign. A medium curve was seen in 15 lesions (n = 15, 37.5%), out of which 30% (n = 9 out of the 15 lesions) were cancerous. Around 11 out of 15 lesions (73.33%) with a slow curve (n = 15, 37.5%) came out to be benign. Early enhancement curves were not statistically significant (p-value of 0.065) in predicting the nature of the lesion.

The distribution of the early enhancement curve of lesions according to HPE is given in Table 3.

**Late Enhancement Curve**

The late enhancement curve is subclassified as persistent, plateau, and washout kinetics. The most common late enhancement kinetic curve was plateau (n = 18, 45%), followed by persistent curve (n = 11, 27.5%), and washout kinetic curve (n = 11, 27.5%).

Kinetic curves for each lesion were defined after choosing the appropriate site for the ROI. A type one/persistent curve was observed in 11 cases, all of which were benign (n = 11), 100%. 18 lesions with a type two/plateau curve had 12 malignant lesions (n = 12 out of 18, 66.67%). Eight of the 11 lesions showed the type three/washout kinetic curve (n = 11), out of which 72.72% of them were cancerous.

**Table 1:** Frequency distribution of mean ADC values of diffusion restriction in benign and malignant lesions.

<table>
<thead>
<tr>
<th>Pathological diagnosis</th>
<th>Frequency</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benign</td>
<td>11</td>
<td>1.27</td>
<td>0.44</td>
<td>1.32</td>
</tr>
<tr>
<td>Malignant</td>
<td>18</td>
<td>0.79</td>
<td>0.20</td>
<td>0.80</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>0.97</td>
<td>0.39</td>
<td>0.85</td>
</tr>
</tbody>
</table>

**Table 2:** Distribution of enhancement pattern of the lesion according to HPE.

<table>
<thead>
<tr>
<th>Enhancement</th>
<th>Benign</th>
<th>Malignant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homogeneous</td>
<td>5</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Heterogeneous</td>
<td>13</td>
<td>11</td>
<td>24</td>
</tr>
<tr>
<td>Rim</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>

**Table 3:** Distribution of early enhancement curve of lesions according to HPE.

<table>
<thead>
<tr>
<th>Enhancement</th>
<th>Benign</th>
<th>Malignant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Medium</td>
<td>6</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Slow</td>
<td>11</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
<td>40</td>
</tr>
</tbody>
</table>
The sensitivity, specificity, positive predictive value, and negative predictive value of MRM in differentiating benign from malignant lesions based on kinetic curves of the lesion came out to be 100, 55, 68.97, and 100%, respectively. These findings were highly statistically significant, with a p-value of <0.001.

Based on the persistent kinetic curves of the lesion, the sensitivity, specificity, positive predictive value, and negative predictive value of MRM in distinguishing benign from malignant lesions were found to be 55, 100, 100, and 68.97%, respectively. With a p-value of 0.001, these results were highly statistically significant.

In terms of sensitivity, specificity, positive predictive value, and negative predictive value for the identification of malignant lesions, the plateau kinetic curve of a lesion performs better than all other shapes, measuring 60, 77.78, 75, and 63.64%, respectively. Because of this, the plateau kinetics of a lesion is a valuable diagnostic of malignancy with a

Figs 2A to F: Case 1: Irregular lesion appearing. (A) Hypointense on T1WI; (B and C) Hypointense on T2WI and STIR images; (D and E) Showing diffusion restriction with; (F) Heterogeneous enhancement on postcontrast images

Figs 3A to D: Dynamic evaluation shows fast (early phase) and washout (late phase) types of kinetic curves
Role of MRM in Evaluation of Indeterminate Breast Lesions

Discussed

Breast cancer and its exponential rise in incidence remains one of the major causes of malignancy-related deaths among women. Epidemiological studies have predicted that the worldwide burden of malignancies related to the breast is expected to cross almost 2 million by the year 2030. According to recent trends, Indian women experience the disease more frequently and at a younger age than Western women. Imaging is crucial for a precise breast diagnosis and the early identification of high level of specificity and accuracy (68.42%) p-value of 0.05.

For the purpose of diagnosing malignant lesions, the washout kinetics of a lesion is important and has shown diagnostic performance in terms of sensitivity, specificity, positive predictive value, and negative predictive value, measuring 40, 85, 72.73, and 58.62%, respectively.

Magnetic Resonance (MR) BIRADS

Most of the lesions in our study were upgraded to BIRADS 5 (n = 19). The majority of the BIRADS 5 lesions (n = 19) were found to be malignant (n = 17 out of 19, 89.47%). Lesions categorized as BIRADS 3 (n = 8); all came out to be benign (n = 8, 100%). Around 13 lesions were categorized as BIRADS 4. A total of 10 lesions (n = 10 out of 13, 76.92%) turned out benign and 3 lesions (n = 3 out of 13, 23.07%) came out to be malignant on pathological diagnosis.

The MR BIRADS lexicon is highly significant in predicting the nature of the breast lesions and thereby characterizing the lesion further (p-value <0.001). The sensitivity and specificity, positive predictive value (PPV), and negative predictive value (NPV) of MRM were 85, 90, 89.47, and 85.71%, respectively. Accuracy came out to be 87.50%.

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Discussion

Breast cancer and its exponential rise in incidence remains one of the major causes of malignancy-related deaths among women. Epidemiological studies have predicted that the worldwide burden of malignancies related to the breast is expected to cross almost 2 million by the year 2030. According to recent trends, Indian women experience the disease more frequently and at a younger age than Western women. Imaging is crucial for a precise breast diagnosis and the early identification of

Figs 4A and B: Photomicrograph shows (hematoxylin and eosin) (×200) and (×400) infiltrating ductal carcinoma. Sections show sheets and cords of tumor cells with intervening desmoplastic stroma and moderate lymphocytic infiltrates. Pathological diagnosis—infiltrating ductal carcinoma

Figs 5A to F: Case 2: Large circumscribed lobulated lesion involving almost entire left breast. (A) Hypointense signal on axial T1WI; (B and C) Hyperintense signal on axial T2WI and STIR images with; (D and E) Diffusion restriction; (F) Heterogeneous enhancement on postcontrast images
Role of MRM in Evaluation of Indeterminate Breast Lesions

However, the statistical significance of age and malignancy in our study is not consistent as found in literature in various studies.\textsuperscript{16,17} No statistically significant difference was seen between the mean size of the benign and malignant lesions (\(p\)-value = 0.307). In literature, various studies have found statistically significant differences between the size of benign and malignant lesions.\textsuperscript{18,19} Our results are not consistent with the literature, which may be because of a smaller number of patients in our study. Our cutoff value of 17.5 mm for size was higher in comparison to the studies conducted.

The MRM can considerably increase the diagnosis of cancer that is otherwise clinically, mammographically, and sonographically occult, according to clinical trials from the United States and Europe in 2010.\textsuperscript{14,15} In a total of our 38 patients, there were 35 focal breast lesions and five NME cases. The age of our 38 female patients ranged between the age group of 18–72 years. The mean age (SD) of the study subjects was 43.9 (+14.180) years. Malignant lesions, like infiltrating carcinoma, had a higher mean age-group (+SD) of 44.95 (+ 13.296) years but were statistically insignificant (\(p\)-value of 0.831). However, the statistical significance of age and malignancy in our study is not consistent as found in literature in various studies.\textsuperscript{16,17}

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by Gutierrez et al. and Kawai et al., who reported the cutoff to be 10 and 12 mm (with a sensitivity of 81.6% and specificity of 50.0%), respectively.18,19

Lesions’ margins were classified as having circumscribed or noncircumscribed margins. The majority of lesions (n = 25, 71.42%) were noncircumscribed, whereas the remainder (n = 10, 28.57%) were circumscribed. Lesions with circumscribed margins were divided into smooth and noncircumscribed margin categories and were further divided into irregular or spiculated margin categories.

The overall sensitivity of margins on MRM to diagnose malignancy approached 100%; however, had a specificity of 66.67%. The positive predictive value, negative

Figs 8A to F: Case 3: Round, noncircumscribed lesion in upper outer quadrant of right breast showing (A) hypointense signal on axial T1WI; (B and C) hyperintense on axial T2/STIR images with; (D and E) diffusion restriction; (F) chest wall invasion

Figs 9A to D: Dynamic evaluation shows washout/type three kinetic curve
Role of MRM in Evaluation of Indeterminate Breast Lesions

predictive value, and accuracy came out to be 75, 100, and 83.33%, respectively, when considering the margins on MRM. In a study done by Balasubramanian et al., they reported a sensitivity, specificity, positive predictive value, and negative predictive value of MRM in differentiating benign from malignant lesions based on margins of the lesion were 95.45, 84.62, 91.3, 91.67%, respectively.20 Hence, the sensitivity and NPV were in concordance with the study conducted by Balasubramanian et al.20

In our study, smooth margins had a higher specificity for predicting the benign nature of the disease (100%) but lower sensitivity (66.67%). Irregular margins have a higher specificity for predicting malignancy (73.33%) but a lower sensitivity (65%). Spiculated margins showed the highest specificity (93.33%) for predicting malignancy. However, the sensitivity of this finding was low (35%). With the best of literature search and knowledge, no such studies evaluating the individual diagnostic performances of the various types of margins, namely—smooth, irregular, and spiculated, were found.

The overall sensitivity of the shape of the lesion on MRM to diagnose malignancy came out to be 60%; however, it had a specificity of 85%. The findings were similar to a study done by et al.16

The mean ADC values in benign and malignant lesions were 1.27 ± 0.44 × 10^{-3} mm²/second and 0.79 ± 0.20 × 10^{-3} mm²/second, respectively. Our findings are in concordance with studies done by Park et al. and Palle and Reddy.9,21 Park et al. reported a mean ADC value of invasive ductal carcinoma as 0.89 ± 0.18 × 10^{-3} mm²/second.21

In our study, the cutoff value of ADC for predicting the presence of malignancy was found to be 0.94 × 10^{-3} mm²/second with a sensitivity and specificity of 83.33 and 72.73%, respectively. Our ADC value cutoff is lower but with comparable sensitivity and higher specificity than the cutoff proposed by Kawai et al.19

The internal enhancement pattern of lesions, however, had no statistical significance in predicting the nature of lesions in our study. Gul et al. reported that heterogeneous rim and central enhancement patterns in a breast lesion favored malignancy, while homogeneous internal enhancement was mostly a feature of benign breast masses (p-value < 0.001).16 Our results are not consistent with the literature, which may be because of a smaller number of patients in our study.

Overall, the enhancement kinetic curves showed a statistically significant relationship with the final pathological diagnosis. Findings in our study correspond but with higher sensitivity and NPV compared to the research done by Balasubramanian et al. However, specificity in our research was lower.20

All the lesions were scored according to the MR BIRADS lexicon. MR BIRADS lexicon has shown high significance in predicting the nature of the breast lesions in our study (p-value < 0.001). The overall sensitivity and specificity, PPV, and NPV of MRM were 90, 75, 78.26, and 88.24%, respectively, for MRM diagnosing the breast lesions in the present study. The accuracy of MRM came out to be 82.50% when correlated with HPE. We have found a better NPV and similar sensitivity and specificity than reported by Fatima et al. in which they have reported sensitivity, specificity, diagnostic accuracy, PPV, and NPV as 93.9, 73.5, 89.3, 92.3, and 78.1%, respectively, of MRM in diagnosing malignant breast lesions taking histopathology as the gold standard.22

Our study has also found a better sensitivity and diagnostic accuracy of MRM than in one of the most recent studies conducted by Sedguli et al., in which they reported CE-MRM sensitivity to be 71.7%, specificity—96.6% and diagnostic accuracy 83.7%.23

A few MRM cases with associated histopathological findings have been demonstrated below:

- Case 1–(Figs 2 to 4)
- Case 2–(Figs 5 to 7)
- Case 3–(Figs 8 to 10)

Figs 10A to C: Photomicrographs showing MGG (×100) and (×200) infiltrating ductal carcinoma. Cytological smears are cellular and show loose clusters of tumor cells. Pathological diagnosis—infiltrating ductal carcinoma
CONCLUSION
This study provides the necessary evidence of the usefulness of an integrated approach for adding MRM and contrast-enhanced MRM to supplement the existing conventional regime using mammography and USG in an effort to reduce the number of unnecessary biopsies and repeated excisions for the benefit of the patients by helping in better preoperative staging and management planning. The various parameters in MRM provide the clinicians with ample information so as to decide on further management.

REFERENCES