Magnetic resonance imaging of dense breast: potential for lesion characterization

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Learning objectives

MRM relies on the presence of well-established morphological features that help distinguish malignant from benign lesions. In addition, angiogenesis induced by cancer is demonstrated by dynamic contrast-enhanced MRI.

Compared with conventional mammography and breast ultrasonography for clinically overt and occult breast disease, MRM offers higher sensitivity for the detection of multifocal cancer, which is important in selecting patients appropriate for breast-conserving surgery.

These include preoperative staging before a planned breast-conserving surgery in patients with dense parenchyma to exclude multicentricity, additional evaluation of dense breast tissue and scarring after breast-conserving therapy, evaluation of breast implants, and detection of the primary carcinoma in patients with axillary lymph node metastases.

Unilateral multifocal cancer has a frequency of a least 30% and is seldom detected by clinical examination. Filiations of these multiple cancers rather difficulty defined (multiple simultaneous cancers or cancers with plural different evolution). It seems, however, that the presence of multifocal lesions implies a high probability of malignancy and poor prognosis.

The aim of this study was to assess the diagnostic performance of conventional mammography, breast ultrasonography, and dynamic contrast-enhanced MRM with regard to the detection of breast malignancy and recognition of a multifocal cancer, in particular in a dense breast.
Background

One hundred equivocal mammographic abnormalities from 93 consecutive patients included in the study. Patients had been selected and referred because of the presence of breast lesions detected by palpation and/or mammography and/or sonography. The highest detection rate for multifocal invasive disease was seen with MRM, which identified 72.5% of confirmed multifocal invasive cancers, whereas mammography identified 20.5% (p=0.003).

Breast density was estimated visually with quantitative measures, that is, the percentage of the area of the breast encompassed by fibroglandular tissue dense enough to obscure a cancer was estimated.

MRM was performed in women with suspicious or equivocal results in conventional mammography and ultrasonography because of either dense parenchyma or heterogeneous echogenicity with dorsal shadowing with a purpose to exclude multifocal disease or contralateral breast cancer.

Definition of multifocal carcinoma required a distance <3 cm and for multicentric carcinoma a distance >3 cm between various lesions.

Interpretation of the various diagnostic procedures was compared with the histological examination with regard to sensitivity, specificity, accuracy, positive (PPV) and negative predictive value (NPV).

All lesions were analyzed regarding their qualitative characteristics. Lesions were divided into two groups: small (# 10 mm) and large (> 10 mm). Clinically, the mean estimated size of the lesion was 8.5 cm (range 4-13 cm), by mammography 8.5 cm (range 4-13 cm) and by MRM 7 cm (range 3.5-12 cm).

Additionally, the following lesions' characteristics were investigated separately on the first and last contrast-enhanced series: lesions' shape, characterized as regular (oval, round, or polygonal), or as irregular (linear, branching, or stellate); margin type (ill-defined or well-defined), and homogeneity of contrast medium enhancement (homogeneous or inhomogeneous; Table 1).

Uni-or multifocality is presented in Table 2. The highest detection rate for multifocal invasive disease was seen with MRM, which identified 21 (72.5%) out of 29 histologically confirmed multifocal invasive cancers, whereas mammography identified 6 out of 29 (20.7% ; p=0.003).

Lymph node metastases were present in 11 (37%) of 30 patients with malignant invasive carcinoma.
The most successful protocol in MRM that permits differentiation of malignant from benign lesions combines two techniques: surface coils for adequate spatial resolution, and dynamic contrast enhancement studies. MRM was performed in women with suspicious or equivocal results in conventional mammography and ultrasonography because of either dense parenchyma or heterogeneous echogenicity with dorsal shadowing with a purpose to exclude multifocal disease or contralateral breast cancer. All lesions were analyzed regarding their qualitative characteristics.

The sensitivity of MRM was significantly higher compared to mammography and sonography (p<0.005 and p<0.05, respectively; Table 3). The specificity of sonography was significantly higher than those of mammography and MRM (p<0.05 and p<0.005, respectively; Table 3). The positive predictive value (PPV) of MRM was much higher than mammography and sonography (p<0.005; Table 3). The negative predictive values for sonography and MRM were significantly higher than that of mammography (p<0.05 and p<0.005, respectively; Table 3). With regard to accuracy, no significant differences between the 3 imaging methods were found (Table 3). Combination of all 3 diagnostic methods (MRM, mammography and sonography) yielded the best result for cancer detection (PPV=95.3%, p<0.005).

In case of detection multifocal or multicentric disease it was applied mastectomy + axillary clearance + chemotherapy and/or radiotherapy pre- and post surgery, at an one-focal tumours (T1-2) - tumorectomie ± axillary clearance (depending on involving in malignant pathological process of regional lymph nodes) + chemotherapy and/or radiotherapy post surgery.

The present TNM staging system takes into consideration tumor size, nodal involvement, and metastases. MRM is able to improve the determination of tumor size and degree extension over presently used techniques. It is now more critical to know the size and disease extent within the breast, whether it invades adjacent tissues, and if multicentric disease is present.

Tumor size and extent primarily influences the choice of local treatment. Palpation was incorrect in 25% and mammography was incorrect in 10%.

MRM is more accurate for measuring breast cancer size. Since MRM can acquire data in a volumetric method, it should be able to obtain even more accurate tumor volume measurements based on 3-dimensional depiction of the frequently irregular tumors.
**Table 1:** RM findings in 93 pathologically characterized breast lesions

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Table 3: Comparison of mammography, sonography and MRM for preoperative prediction of invasive cancer (n=30) or benign disease (n=63)

<table>
<thead>
<tr>
<th>Diagnostic method</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>^1PPV (%)</th>
<th>^2NPV (%)</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammography</td>
<td>83.7</td>
<td>68.5</td>
<td>67.8</td>
<td>84.1</td>
<td>77.1</td>
</tr>
<tr>
<td>Sonography</td>
<td>89.1</td>
<td>69.1</td>
<td>65.7</td>
<td>90.9</td>
<td>73.4</td>
</tr>
<tr>
<td>MRM</td>
<td>94.6</td>
<td>78.5</td>
<td>78.6</td>
<td>94.6</td>
<td>79.5</td>
</tr>
</tbody>
</table>

^1positive predictive value; ^2negative predictive value

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Conclusion

If MRM detects multicentric breast cancer, which is a major correlate of local disease recurrence, then both the patient and her physician could reach a more correct treatment choice which would be mastectomy, thereby avoiding the morbidity associated with radiation therapy. If the patient chooses to accept the increased risk associated with the presence of multicentric disease, she can then be more closely monitored through MRM during follow-up after radiation therapy.

The multiplanar capability of MRM enables it to provide more definite information than mammography and ultrasonography. MRM is presently able to better stage breast cancer locally and to measure more accurately breast cancer size, and determine multicentricity.
References

Images for this section:

Fig. 1

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