Purpose

Mammography is nowadays the only imaging modality proved to reduce breast cancer mortality, with a high sensitivity (about 85-90%) and a good specificity, especially in presence of adipose tissue [1,2]. Mammography may sometimes reveal findings that are difficult to characterize: they may be only visible in one view and they can be both due to superimposition of normal breast tissue or to the presence of a lesion.

Ultrasound can help identify a suspicious finding that may undergo biopsy, especially in women with dense breasts in which the sensitivity of mammography is lower [3]. Even though, when negative, ultrasound is often considered not sufficient to rule out malignancy.

Breast Magnetic Resonance Imaging (MRI) has a very high sensitivity for the detection of invasive breast cancer (almost 100%) [4] and also a relatively high specificity [5]. The importance of breast MRI in clinical settings like cancer staging or screening of high risk women has already been underlined in many studies. The recommendations of EUSOMA working group specify that MRI may be useful when it is not possible to correctly localize the suspicious finding, but it must not be considered as an alternative to biopsy, when the area is well localized and a histological characterization can be performed [6]. MRI can identify areas of enhancement and can be helpful both in the localization of the lesion and in the exclusion of its presence [7,8].

The aim of our study was to evaluate if the use of magnetic resonance imaging can be helpful in the diagnostic work up of equivocal mammographic findings, by helping identify the correct position of a lesion, if present, or excluding the presence of lesions suspected by mammography.

Methods and Materials

Patients

Between June 2007 and December 2008, 940 patients underwent breast Magnetic Resonance Imaging (MRI) in our Institution. We retrospectively reviewed the 38 patients for whom the indication for the exam was an equivocal mammographic finding. Mammography and ultrasound were both performed before breast MRI. Patients with suspicious findings at MRI underwent a sonographic second-look that was performed by the same radiologist experienced in breast imaging who evaluated MR images.

We included all the cases in which patients had a follow up of at least 24 months or there was a definitive pathologic result available.
Patients’ age was between 38 and 78 years (mean: 57 years). Two patients had family history of breast cancer and four had a previous personal history of breast cancer or B3 lesion. In only one case the patient had a palpable lesion (Table 1).

**Mammography and Ultrasound**

Mammography examinations were obtained using dedicated full-field equipment (Digital Device, Giotto, IMS Bologna, Italy) in 2 projections (cranio-caudal and mediolateral oblique), and eventually with supplemental mammographic views, spot compression or magnification to better characterize the suspicious finding. Images were defined as inconclusive or equivocal when density asymmetries or architectural distortions visible in only one projection were found. According to the ACR lexicon, an asymmetry is an area of opacity that shows concave outward margins, may appear interspersed with fat, lacks the conspicuity of a mass and is recognizable only in one view. Architectural distortion is an area where the normal architecture of the breast is distorted, with no definite mass visible; it can include spiculations radiating from a point and focal retraction or distortion at the edge of the parenchyma [8,9].

Breast ultrasound was performed after mammography by a radiologist experienced in breast imaging and a sonographic second-look was required each time a MR image was found. All examinations were performed with a broadband 5-17-MHz linear-array transducer (iU22, Philips Healthcare, The Netherlands).

When the lesion found was considered eligible for a histologic characterization, three methods were used: core needle biopsy, vacuum assisted biopsy or surgical excision. Core Needle Biopsy was performed under ultrasound guidance with a semi-automatic biopsy gun (Precisa, Hospital Service) and a 14-gauge needle with sample window of 17 mm and total running of 23 mm. A medium of 5 cores was obtained per lesion (4-6).

Stereotactically-guided Vacuum Assisted Biopsy was performed on a dedicated digital table (Mammobed, Giotto, IMS Bologna, Italy) with an 11-gauge directional vacuum-assisted probe (Mammotome; Ethicon Endo-Surgery, Cincinnati, OH, USA). In each biopsy, 12 cores were obtained.

All the patients that didn’t undergo biopsy or that had a benign finding were controlled at follow up with examinations at 6 and 12 months, and then annually. When the histologic results were border-line or malignant lesions the patient was sent to surgery.

All images were available for review when MRI was performed.

**Magnetic Resonance Imaging**

Breast MR was performed with a 1.5-T MR scanner (Magnetom, Avanto Siemens Medical System, Erlagen, Germany) with a dedicated, bilateral, 7-channels surface breast coil and
the patient in the prone position. In pre-menopausal patients, the exam was performed between the 7th and the 14th day of the menstrual cycle. Images were acquired in the coronal plane using a 3D FLASH (fast low-angle shot pulse) sequence. Gadobenate Dimeglumine (Gd-BOPTA - Multihance, Bracco, Milan, Italy) was administered IV as an automated bolus injection at a dose of 0.1 mL/kg body weight at a flow rate of 2 mL/s, followed by flushing of 20 mL of saline. Serial dynamic images were acquired before injection of contrast agent and five times after the start of injection. After the examination, images underwent post-processing: subtraction of the pre-contrast images from the post-contrast images, multi-planar reconstruction (MPR) and maximum intensity projections (MIP). Curves of the variations in time/signal intensity were constructed placing a region of interest (ROI) on detected lesions.

T2-weighted images were acquired on the axial plane using a STIR (fat-saturated fast spin-echo short-time inversion recovery) sequence.

Parameters of the sequence used are:

<table>
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<th>Parameter</th>
<th>Value</th>
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<tr>
<td>TE</td>
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<tr>
<td>TI</td>
<td>/</td>
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<td>Matrix</td>
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</table>

**Data Analysis**

Mammography and ultrasound images were reviewed: breast tissue composition and characteristics of the abnormality (morphology, size, location, sonographic characteristics) were defined.

A radiologist experienced in breast imaging reviewed the breast MR images. The study was considered negative if there was no suspicious enhancement and positive if an area of enhancement was identified and classified according to the ACR BI-RADS lexicon as 3, 4 or 5 [9]. All the areas were described according to their morphology, borders, kinetics and homogeneity of enhancement.

The data were entered into an Excel spreadsheet (Microsoft Corporation, Redmond, WA), that was used to calculate sensitivity, specificity, negative and positive predictive value.
Table 1: 31 patients had no history of breast cancer, personal or family, and no symptoms. The other 8 patients are summarized in the Table.

<table>
<thead>
<tr>
<th></th>
<th>No (%)</th>
<th>Presence of cancers</th>
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<tbody>
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<td>Family History of breast cancer</td>
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</tr>
<tr>
<td>Personal History of breast cancer</td>
<td>4 (10.5)</td>
<td>0</td>
</tr>
<tr>
<td>Palpable Lesions</td>
<td>1 (2.6)</td>
<td>1</td>
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Results

An equivocal mammographic finding was the indication to perform breast MRI in 38 cases on 940, with a prevalence of 4% (Confidence Interval CI95%: 2.9-5.5%). Breast density was classified according to the ACR BI-RADS [9]:
• 10 patients were category 1 (fibroglandular tissue <25%);
• 17 patients were category 2 (fibroglandular tissue < 50%);
• 6 patients were category 3 (fibroglandular tissue <75%);
• 5 patients were category 4 (dense breast).
Mammographic findings were 27 asymmetries and 11 architectural distortions (Fig. 1). In 15 patients ultrasound performed after mammography and before MRI was considered positive but the radiologist wasn’t confident enough with the finding to perform biopsy and decided to perform MRI first. After breast MRI and sonographic second-look, 14 US findings were identified.

Results of breast MRI according to ACR BI-RADS are summarized in Table 2. MRI showed no abnormal enhancement in the area identified by mammography and was classified as BI-RADS 1 or 2 in 26 patients:
• 19 had a density asymmetry (73%);
• 7 had an architectural distortion (24%) (Fig. 2).
Three patients underwent biopsy (2 ultrasound guided and 1 surgical excision) because the sonographic findings were considered suspicious, and histology showed benign lesions. The other patients had only follow up. During follow up, one patient repeated MRI after two years: a suspicious enhancement in the area of the initial mammographic asymmetry was found. The lesion was biopsied and the histologic examination showed a mucinous ductal carcinoma. This was the only False Negative result at breast MRI.

MR showed enhancement in the area identified by mammography in 12 patients:
• 8 had a density asymmetry (67%) (Fig. 3);
• 4 had an architectural distortion (33%) (Fig. 4).
According to ACR BI-RADS lexicon:
• 5 were classified as ACR BI-RADS 3;
• 4 were classified as ACR BI-RADS 4;
• 3 were classified as ACR BI-RADS 5.
Eleven patients underwent biopsy (5 ultrasound-guided, 4 stereotactically-guided and 2 surgical excisions). The histologic results were the following:
• 1 benign lesion;
• 2 border-line lesions (Radial Sclerosing Lesions);
• 8 malignant lesions (4 Invasive Ductal Carcinoma, 2 Invasive Lobular Carcinoma, one with a Ductal Carcinoma In Situ component, and 2 Ductal Carcinoma In Situ).
Results of MR imaging and biopsy are summarized in Figure 5-6.
Follow up and histologic results obtained are summarized in Figure 7-8.

Overall, breast MRI was able to identify 10 of the 11 malignant or border line lesions diagnosed at histology, with a sensitivity of 90.9% (IC$_{95\%}$: 76-97.3%), a negative predictive value of 96.2% (IC$_{95\%}$: 82.9-99.6%), a specificity of 92.6% (IC$_{95\%}$: 78.1-98.2) and a positive predictive value of 83.3% (IC$_{95\%}$: 67.1-99.6%).

There were 6 incidental findings in 6 patients (15.8%):
• 2 patients showed a suspicious image at sonographic second-look and underwent Core Needle Biopsy, resulting in a border-line lesion (Papilloma; Fig. 9) and a benign lesion.
• 4 patients had MR and ultrasound images suggestive for benignity and were stable at two-years radiologic follow up.

Images for this section:

Fig. 1: Among the women who underwent breast MRI in our Institution between June 2007 and December 2008, in only 38 cases the exam was done because of a mammographic equivocal finding.
**Table 2:** MR findings according to the ACR BI-RADS. Studies classified as 1 or 2 were considered non suspicious, in finding classified as 3, 4 or 5 a sonographic second-look was undertaken to eventually localize a suspicious finding to biopsy.
**Fig. 2:** A marked architectural distortion in the superior quadrants found in a Patient who underwent mammography in the screening program. There were no suspicious images at US or MRI. The patient underwent surgical biopsy and the result was a benign lesion.

**Fig. 3:** A) An area of asymmetric density was identified during mammographic screening in the retroareolar region of the right breast. B) MRI showed several small areas of enhancement (II, 104%) at the same level. A lesion was found at sonographic second-look and underwent biopsy. The histologic diagnosis was Invasive Ductal Carcinoma.
Fig. 4: A) Patient with an area of architectural distortion in the outer quadrants of the right breast identified with mammography. B) MRI showed a suspicious area of enhancement (II; 154%) in the right outer quadrants. At sonographic second-look a suspicious image was identified, that histology proved to be a Radial Sclerosing lesion.
Fig. 5: Flow-chart of the management of the mammographic asymmetric densities encountered, considering the presence of an image in a comparable area with MR or with US. CNB = Core Needle Biopsy with sonographic guidance; VAB = Vacuum Assisted Biopsy stereotactically-guided. *1 biopsy was performed 2 years after first MRI when the repetition of the exam showed enhancement in the area of the asymmetry. This was the only false negative finding at MRI. **wire localization stereotactically-guided.

Fig. 6: Flow-chart of the management of the mammographic architectural distortions encountered, considering the presence of an image in a corresponding area with MR or with US. CNB = Core Needle Biopsy with sonographic guidance; VAB = Vacuum Assisted Biopsy stereotactically-guided. *wire localization under sonographic guidance. **wire localization stereotactically-guided.
Fig. 7: Follow up of the mammographic findings. As = Asymmetry; A:D. = Architectural Distortion

Fig. 8: Follow up of the breast MRI findings.
Fig. 9: A) Patient with an area of asymmetric density in the inner quadrants of the right breast found during screening mammography, with no suspicious findings at US. B) MRI showed no enhancement in the area identified by mammography but recognized an additional finding: a small area of enhancement, with a corresponding image at US second-look, was identified in the inner superior quadrant of the left breast. Histology identified a Papilloma.
Conclusion

An equivocal mammographic finding is not a frequent indication to perform breast MRI: in our Institution it was the indication in 4% of the cases. Similar results were found also by Moy et al [7], who found this indication in 3.9% of breast MRI performed in a 5-year period. Magnetic Resonance Imaging has a high sensitivity and specificity also when used to define the importance of a mammographic equivocal finding. It should not be used as an alternative to biopsy when the lesions can be correctly identified either by ultrasound or by a complete mammographic work up with at least 2 projections and eventually spot compression, but it can be a useful tool when the suspicious area can't be correctly identified [10].

Breast MRI showed three main strengths:
1. it has a high negative predictive value (96.2%): it appeared useful especially to rule out the presence of a malignant lesion;
2. it can help in the localization of the equivocal finding, that can be afterwards better identified and may undergo a histological characterization;
3. it gives a better definition of the extension of a malignant lesion, when present.

References


Personal Information