Correlation between MR BI-RADS and histological pattern in breast lesions: genoa experience

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Purpose

Magnetic Resonance Imaging (MRI) provides the highest sensitivity among imaging techniques currently available in breast imaging. When MRI identifies lesions not previously detected or suspected on traditional imaging, further studies are needed to point out malignancy of the lesions and to achieve their characterization. However, despite high sensitivity, specificity reported by MRI is relatively low, with values ranging from 40% to 80%: precisely because of this limitation, in cases where it is highlighted a new suspicious findings, it becomes necessary a cytologic or histologic characterization by needle-biopsy. MRI-guided biopsy should be considered as the natural continuation of the diagnostic iter in presence of these findings, but the high costs and the complexity and duration of the procedure, together with the absence of a widespread availability of suitable instrumentation on the territory, often make it difficult. Therefore, to this procedure is often preferred, when possible, sampling with ultrasound guide, representing this a cheaper and less uncomfortable modality. Ultrasound can also provide informations useful for assessment and characterization of the lesion and it is important to consider the correlation with the results of the two methods. The so-called "second-look" ultrasound, executed on the basis of the informations offered by the MR images, allows, in most cases, to identify the lesions detected by MRI, which were not previously implicated to mammography or ultrasound, thereby allowing immediate characterization by histological biopsy. It follows that it is of great interest to investigate how to obtain the characterization of a suspicious findings on MRI, and how this corresponds to the classification of the finding assessed on MRI. The aim of our study was to analyze the correlation between the MRI BI-RADS classification and histologic patterns of breast lesions accidentally encountered during MR examinations.
Methods and Materials

We retrospectively analyzed 1413 breast MRI exams, carried out between January 2007 and December 2011. All patients older than 40 years had previous mammograms and breast ultrasound, while those under the age of 40 years only underwent breast ultrasound.

The indications to breast MRI were:

- presence of suspicious findings on mammography or ultrasound;
- extension evaluation of previously diagnosed tumors in dense glandular pattern or in suspect of bilateral disease;
- evaluation of response to neoadjuvant therapy;
- family history of breast cancer (BRCA+);
- suspect of tumor recurrence;
- cytologic cellular atypia;
- evaluation of breast implants.

In case of premenopausal women, all MRI were performed between the 7th and the 14th day of the menstrual cycle. In case of patients on HRT, this was discontinued, when possible, at least 2 months before the test.

The study was performed in all cases using a 1.5T MRI system equipped with a dedicated coil. The studies were performed with the standard sequences for the evaluation of the breast: STIR and T2-weighted sequences on axial plane and thereafter, for 6 times, T1-weighted 3D FLASH (TR: 3.99 ms, TE: 1.36 ms; FA: 12 °; single acquisition signal; rectangular FOV <36cm; matrix: 400x400, slice thickness: 1.6 mm) sequences before and after intravenous administration of a bolus of Gd-DTPA (0, 2 mmol/kg of body weight) at a speed of 3ml/sec, followed by 20ml of saline at the same speed. Both breasts were included in the volume studied, using a thickness of partition not greater than 3 mm, with no gap between the partitions. The time of acquisition of each dynamic phase variated between 84 and 90 seconds. The post-contrastographic sequences were acquired from 12 seconds after the start of the administration of contrast material and repeated up to 8 minutes after the injection of contrast material (Fig. 1A). Then elaborations of digital subtraction were performed, we calculated the MIP (Maximum Intensity Projection) and, after placing a ROI in the area of suspicion, we measured the increase in signal intensity over time; the semi-quantitative analysis considered the numerical values resulting from the analysis in sequence of a ROI of small size, centered in the area of greatest impregnation of contrast, which formed a curve of intensity of the signal in function of time (Fig. 1B). These curves have been classified depending on the morphology: the curves of type I, with enhancement of continuous type and corresponding to a straight line (Ia) or to a curve (Ib) have been associated more frequently to benign lesions; curves of type II, characterized by a rapid and early increase in signal intensity followed by a plateau, were considered borderline; curves of type III, comprising curves with rapid and early

\[\text{Figure 1A} \quad \text{Figure 1B}\]
increase in signal intensity followed by a rapid wash-out of contrast, were considered as indicative of malignancy.

The evaluation of the MR images was conducted according to the morphology of the injury and the characteristics of impregnation of contrast agent according to the classification BI-RADS (Breast Imaging Reporting And Data System). The "second look" ultrasound was performed within two weeks after the MR exam by the same operator. We used an ultrasound system equipped with high-frequency linear probe (5-12 MHz) and the examination was performed focusing on the location of the suspicious findings revealed by MR (Fig. 1C). The average time required for this examination was 8 minutes.

In management of patients we followed the diagnostic algorithm shown in Fig. 2. All lesions found on MRI classified as BI-RADS MR3, MR4 or MR5 were evaluated at "second look" ultrasound. In case of suspicious findings at the "second look" ultrasound (BI-RADS E4 or E5) an histological examination was performed. The lesions classified as BI-RADS MR3 appearing as benign or probably benign finding (BI-RADS E2 or E3) at the "second look" ultrasound, were followed with six-month follow-up with MRI and ultrasound for two years. For suspicious lesions on MR (BI-RADS MR4 or MR5) with no evidence of findings at "second look" ultrasound, MR-guided biopsy was performed, whereas lesions classified as BI-RADS MR3 unmatched at ultrasound were managed with follow-up with MRI every six months to two years.
Images for this section:

**Fig. 1:** MR sequence post-contrastographic with processing of digital subtraction of the pre-contrastographic sequence, calculation of the MIP and positioning of an ROI in the area of suspicious enhancement (A): the semi-quantitative analysis produced a curve of signal intensity versus time (B). "Second Look" ultrasound evaluation conducted focusing on the location of the suspicious findings seen on MR examination (C).

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Fig. 2: Algorithm of diagnostic management.

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Results

We identified 148 non-palpable lesions which were occult to mammography and ultrasound in 125 patients, with mass-like characteristics of impregnation in 123 cases (83%) and not-mass-like in 25 cases (17%). The size of these findings was <10 mm in 96 cases (65%), between 10mm and 20mm in 33 cases (22%) and >20 mm in 19 cases (13%). They were classified as MRI BI-RADS MR5 in 22 cases (15%), BI-RADS MR4 in 65 cases (44%) and BI-RADS MR3 in 61 cases (41%).

102 out of 148 (69%) lesions were detected by "second look" ultrasound, including 20 out of 22 (92%) lesions classified as BI-RADS MR5, 51 out of 65 (79%) lesions classified as BI-RADS MR4 and 31 out of 61 (51%) lesions classified as BI-RADS MR3. In this group, 15 out of 31 lesions had a sonographic appearance of benignity (BI-RADS E2) and therefore in such cases the diagnostic procedure was completed, while 16 out of 31 lesions were classified as BI-RADS E3 and were then initiated to ultrasound follow-up for a duration of 24 months, in order to determine their stability over time. In the remaining 30 out of 61 BI-RADS MR3, who weren't detected at "second look" ultrasound, MR follow-up was performed every six months for a period of 24 months. The follow-up ultrasound confirmed the stability of all lesions, while in the group of lesions followed with MR, only one showed an alteration of the morphological characteristics that led to characterization by MR-guided biopsy. Of the remaining 87 lesions out of 148, classified as suspicious (BI-RADS MR4 and MR5), 71 were visible at the "second look" ultrasound, and of these 41 out of 71 showed a suspicious aspect: these lesions were studied with an ultrasound-guided biopsy, while the remaining 30 lesions out of 71, found as probably benign on ultrasound (BI-RADS E3), were also sent to the six-month follow-up for 24 months. Of these 30 specimens, none showed significant modifications. The 16 highly suspicious lesions on MR without correpondance on ultrasound required a MR-guided biopsy. The results are represented graphically in Fig. 3.

We performed biopsy on 41 lesions and MR-guided biopsy on 16 lesions: of these 57 lesions, 22 were classified as BI-RADS MR5 and 35 as BI-RADS MR4. The totality of the lesions classified as BI-RADS RM5 presented an histological correspondence, with alterations that ranged from hyperplasia to ductal carcinoma, with great prevalence for the latter (41%). In regard to lesions classified as BI-RADS MR4, 32 lesions out of 35 (91%) presented an histological correspondence, with prevalent phenotype of ductal carcinoma, while 3 out of 35 lesions were referred to alterations of benign type (adenosis, reactive lymph nodes, fibrous scar).
Fig. 3: Graphical representation of results.

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Conclusion

Magnetic resonance imaging of the breast is a technique approved by the U.S. Food and Drug Administration (FDA) in 1991 as an important tool in addition to mammography and ultrasound for the diagnosis of breast cancer. It proved to be very useful in various clinical situations, including the "problem solving" in breast imaging with questionable results, the pre-operative assessment of disease's extent in patients with breast cancer, the evaluation of residual disease after surgery and the evaluation of response to neoadjuvant therapy. MRI is useful in the evaluation of patients with axillary lymphnode metastases without evidence of primary tumor (CUP syndrome) and screening of high-risk patients (BRCA+). The "second-look" ultrasound represents a more simple and unexpensive modality that constitutes a fundamental stage after the detection of a lesion with MR, as in the case of a univocal correspondence of an artifact, it makes easy an appropriate rapid characterization, bypassing, when possible, the need for MR-guided procedures (which still have prohibitive costs and present lack of geographical spread).

The value of MRI in the diagnostic and therapeutic management of breast lesions is therefore very important; in particular, the BI-RADS MR classification showed a very high correlation with the pattern of histological lesions biopsied, in particular as regards the lesions classified as BI-RADS MR5, and is therefore a tool of considerable utility for the characterization and for the setting of the subsequent therapeutic management of these lesions.
References


