MR-breast biopsy: input in diagnostic strategy after 5 years of experience

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Purpose

Breast MRI has a high sensitivity of 86-100%. MRI can detect clinically suspected lesions that are not seen with mammography or ultrasound. Its is especially valuable in women with dense breasts and in women with postoperative scarring or breast augmentation, when other modalities such as mammography become less sensitive. MR has been shown to detect malignancies in 2-8% of high risk women with a normal mammography. In women with a known breast cancer, MR has been shown to detect synchronous lesions in the ipsilateral breast in 6-34% and in the contralateral breast of 2-24% of cases.

While MR sensitivity for malignant lesions is high, its specificity is lower and variable, between 37 and 97%. Hence there is a large overlap in the MRI findings of suspect breast lesions, which implies histopathology for definitive diagnosis of lesions detected only with MR. Considering that MRI-detected lesions are not always detectable using other conventional imaging techniques such as mammography and sonography in half cases, it seems necessary to perform a biopsy that is guided by MRI.

The purpose of our study was to investigate the outcome of MRI-guided breast biopsy as a function of the indication for MRI in our institution.
Methods and Materials

Patients

We retrospectively reviewed the data for 145 MRI-detected breast lesions in women who were scheduled to undergo MRI-guided vacuum-assisted macrobiopsy performed between January 2005 and September 2009. All lesions were non-palpable and occult on mammography and second-look ultrasounds. When the lesion is seen with repeat ultrasound, the patient undergoes ultrasound-guided biopsy and is excluded from the study. For all lesions, MR-guided biopsy is performed in our institution.

MRI findings before biopsy:

Except the MRI examinations of XX women who underwent breast MRI diagnosis at another institution, breast MRI was performed using a 1.5T system (Signa, GE Healthcare) with the patient lying in a prone position and each breast compressed gently between medial and lateral plates. Sequences included sagittal T1-weighted spin-echo, sagittal T2-weighted fat-suppressed fast spin-echo, and sagittal dynamic contrast-enhanced imaging before and after injection of contrast material. Contrast material was injected as a 20-mL IV bolus and was followed by a saline flush. The dynamic contrast-enhanced images included three contrast-enhanced images obtained with a 3D T1-weighted fat-suppressed fast spoiled gradient-echo sequences.

5 radiologists of more than 5 years of experience interpreted MR images with consideration of the patients' histories and clinical presentation.

MRI-guided biopsy

Information consent was obtained. Imaging was performed by a senior radiologist (Corinne Balleyguier, François Bidault, Clarisse Dromain, Hubert Caille, Bérénice Boulet) with all patients in a prone position using a dedicated breast compression coil. When the target lesion was not visualized or appeared to have decreased in size, biopsy was deferred at the discretion of the radiologist.

The breast biopsy MRI sequenced included sagittal T1-weighted localizing sequences followed by a fat-suppressed 3D spoiled gradient-echo sequence performed before and after IV administration of contrast.

The coordinates of the lesion was calculated by measuring the distance between the nearest reference marker and the lesion manually or with a special software for a MRI-guided intervention. Biospies were performed using a 9-or 10-gauge vacuum-assisted needle and a biopsy system. Four to eighteen core samples were obtained. Tissue samples were placed in 4% formaldehyde and sent for histopathology. A localizing
titanium clip, visible on MR, mammography, and ultrasound was inserted at the end of core needle biopsy to mark the lesion in case there was a need for additional needle biopsy and/or excision following the pathology report. A two-view mammogram was obtained to confirm the clip mark placement.

MRI indications, Diagnostic Procedure, Management, and Follow-up

The indications for MRI were classified into a screening setting and a diagnostic setting: screening setting in asymptomatic women with or without a personal history of breast cancer whose risk factors for breast cancer were identifiable in most cases or diagnostic in women with a recently diagnosed cancer undergoing evaluation of the extent or presence of cancers in the ipsilateral or contralateral breast and in women with an unsolved palpable clinical, or mammographic abnormality.

All MRI reports included an addendum to ensure imaging-histologic concordance and to recommend the next step after histologic diagnosis of MRI-guided VAB by the original reader. Surgical follow-up was recommended for all malignant lesions, all high-risk lesions (systematically since 2007) (i.e. atypical ductal hyperplasia, atypical lobular hyperplasia, atypical papillary lesions, radial scar, and lobular carcinoma in situ), and all benign results that were discordant with MRI findings. MRI follow-up was routinely recommended in case of results of benign lesions.

Data collection, analysis and statistical analysis

Medical records were reviewed for patient age, the indication for MRI, and histopathologic and radiologic results. Histopathologic results were examined on the basis of pathologic reports of MRI-guided VAB and subsequent surgical biopsy. All pathology results were interpreted according to the clinical routine used at our institution, which includes review by a pathologist with a subspecialty focus in breast pathology. The MRI features of the lesions before biopsy were described according to the BI-RADS MRI lexicon.

The probability of malignancy for an MRI abnormality was calculated as the ratio between the number of lesions with pathologically proven malignancy and the number of biopsied lesions. For benign lesions, we used at least 6-month( mostly 12-month) MRI and mammographic follow-up as the reference standard.
**Fig. 1**: Patient lying on a prone position. Breast immobilized in a dedicated probe. One grid is intercalated to determine the target zone.

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Fig. 2: Determination of the target: plane x is horizontal while plane y is vertical.

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**Fig. 6:** Determination of plane z by MPR. A software can be helpful to determine the depth.

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**Fig. 3:** Local anesthesia. A coaxial needle is inserted into the target zone.

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Fig. 4: System allowing sample is inserted into the coaxial. Samples are performed.

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Fig. 5: When biopsy is achieved, a clip is inserted into the lesion.

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Results

Patients

150 lesions BIRADS 4 or 5 were included in the study among 145 patients (3 patients for double biopsies and two with 2 consecutive biopsies.). The average age of the patients was 53 years old [23, 83]. 34 out of these 145 patients (23%) were muted: 19 were BRCA 1 gene-carriers, 5 BRCA 2, and 10 familial predispositions. 56 patients (37%) had previous breast cancer. One patient had undergone previous radiotherapy for lymphoma. Another patient was also followed for HNPCC syndrome but it is not considered as a risk factor for breast cancer. 41 out of 145 patients (28%) were treated for breast cancer before. 47 patients had no history of breast cancer nor familial predispositions.

Indications for MRI:

Indication for breast MR included assessment of disease extent in patients with a known cancer (24 women 16%), screening examination in high risk women with positive family history and/or known BRCA mutation (19 women, 13%), and follow-up study for patients with a personal history of breast cancer (56 women, 37%); and characterization of a lesion only visible in MRI (51 women, 34%).

MRI features of the lesions and the probability of malignancy

The MR features of the lesions show 32 mass and 118 non mass (infracentimetric et supracentimetric).

Biopsy results:

• targeting, biopsy-deferred lesions, and early complications

Targets were identified easily in 140 out of 150 lesions (93%). 4 lesions were identified with difficulty (2 for position insufficiency, and 2 for decreased enhancement). 1 lesion was biopsy-deferred by young operator (BB) caused judged infeasable; 6 lesions were not identified the day of the biopsy but one was found back 6 months later and eventually biopsied. Follow-up of the 6 biopsy-deferred lesions revealed these lesions had disappeared, resulting in the assignment of a benign pathologic diagnosis.

The average number of carrots were 12 (from 4 to 20).

88% (127/144) of the biopsied lesions disappeared after the immediate control. In 12% of cases, 17 lesions remained mainly because of regional enhancement non-masses.
In 15% (21/144) early complications occurred: mainly, in 17 cases, for minor hematomas and in 4 cases for migration of the clip (twice) or vanishing of the clip (twice). (figure 2)

- **Breast MRI biopsied lesions**

Out of the 150 breast MRI biopsies, 7 couldn't be processed: 2 too superficial, and 5 targets weren't visualized the day of the biopsy. But one was revisualized on follow-up and eventually biopsied. Thus the number of our biopsies who were analyzed anatomopathologically is 144 (rate of missed biopsies around 5%).

Out of the 144 performed biopsies, MR biopsy results show 85 benign lesions (59%), 20 borderline lesions (14%) and 39 malignant lesions (27%).

Out of the 85 benign lesions,
- 28 Proliferative changes (PC)
- 24 Normals
- 10 adenomas
- 5 Non Proliferative (NP)
- 5 cytosteatonecrosis
- 4 Adenofibrmas
- 1 capillary hemangioma
- 1 papilloma
- 1 scar
- 3 vascular hyperplasias

Out of the 20 frontier lesions:
- 3 Aschoff's radial scars
- 5 Ductal Carcinoma In Situ (DCIS)
- 6 Proliferative Changes with Atypias (PCA)
- 3 Atypic Lobular Hyperplasia (ALH)
- 1 Atypic Ductal Hyperplasia (ADH)
- 1 ALH + ADH
- 1 LCIS

Out of the 39 malignant lesions:
- 33 Infiltrative Ductal Carcinomas (IDC)
- 4 Infiltrative Lobular Carcinoma (ILC)
- 1 IDC + ILC
Surgeries were performed accordingly or not to breast MRI biopsies. Indications were the following: when malignant lesions at MRI biopsy, when bordererline lesions by 2008, when suspected discordance between biopsy results when compared to clinicians’feelings and/or images. 55 surgeries have been performed in our institution according these results from late 2005, meaning 122 avoided surgeries (75% less of initially foreseen surgeries).

- **Definitive results:**

Analysis of surgical breast results showed:

<table>
<thead>
<tr>
<th>RESULT</th>
<th>BIOPSY RESULTS</th>
<th>FINAL RESULTS</th>
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<tbody>
<tr>
<td>Benign</td>
<td>85 (59%)</td>
<td>91 (63%)</td>
</tr>
<tr>
<td>Borderline</td>
<td>20 (14%)</td>
<td>9 (6%)</td>
</tr>
<tr>
<td>Malignant</td>
<td>39 (27%)</td>
<td>44 (31%)</td>
</tr>
</tbody>
</table>

- 2 benign results: one normal and one proliferative change
- 9 borderline lesions: 7 DCIS whose one that was scar of DCIS, 1 LCIS and 1 ALH
- 44 malignant lesions: 36 IDC, 4 ILC, 2 scars, 1 mixt tumor

Eventually the definitive results show:

- 92 benign lesions
- 8 borderline lesions
- 44 malignant lesions

- **Discordant cases:**

The bulky of discordant cases was du to underestimated borderline lesions (5/10, 50%).

It was never noticed in our cohort any case of overestimation: the only case was IDC at biopsy but with definitive result as DCIS. But the lesion was treated accordingly as a malignant lesion. Also in 3 cases definitive results were scars of carcinomas and in one case scar of borderline lesion meaning the size of the tumor was small enough to allow a carcinologic resection.
We notice 6 extra malignant lesions compared to biopsied lesions: 2 normal lesions and 4 borderline lesions that revealed into 6 malignant lesions.

One extra lesion revealed benign: one lesion was biopsied as borderline and was assessed as normal after surgical analysis. One another lesion was analyzed as proliferative change after breast biopsy but nevertheless undergone surgery: surgical analysis confirmed the lesion as proliferative lesion.

- **Borderline lesions (after biopsy and/or definitive results)**

5 out of 18 (28%) borderline lesions at MRI biopsy were modified: one was downstaged as normal, and 4 as malignant. The high rate of mismatch justifies fully a surgical complement.

- **Risk factors**

<table>
<thead>
<tr>
<th>Previous cancers</th>
<th>No previous cancers</th>
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<tr>
<td>Numbers and rates of cancers</td>
<td>16/56 (29%)</td>
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<table>
<thead>
<tr>
<th>Predispositions</th>
<th>No predispositions</th>
</tr>
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<tbody>
<tr>
<td>Numbers and rates of cancers</td>
<td>8/24 (33%)</td>
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</table>

**DISCUSSION**

*Interests of MRI: rate of malignancy, avoided surgeries*

MRI-guided biopsy procedures are now an increasingly important part of a breast imaging practice. They are required for diagnostic because of the lack of specificity of MRI findings in multiples conditions; these data emphasize the strength of MR in the diagnosis of lesions that are occult clinically, sonographically, and in mammography. We found that although MR-guided interventional procedures are most complicated, take more time and are costly, they still offer the benefits of MR (high sensitivity and detection for suspected lesions) while minimizing false positive findings and improving specificity.
by tissue sampling. In addition, it's important to emphasize the small diameter of the lesions that were biopsied. This ability promotes early diagnosis of small carcinomas. Ours results emphasize this technic avoid useless in almost two thirds of patients and the very confidence of breast MRI biopsy anatomopathologic results, either positive either negative.

The rate of malignancy of our cohort is similar than previous studies (28% versus 25% averagely). In fact at the beginning, the indications were more restricted to high risk of breast cancer women; thus the cancer rate was higher (up to 40% in the two first years). The main reason is that the nearly half of women of our study were either gene-carriers either already treated for breast cancer, which arises the probability of the event cancer. With years, indications of breast MRI biopsie widened to other women, that's why the rate of malignancy decreased.

**Failure cases**

10 failure cases are reported in our study: in 3 cases cause the lesion was too medial, and the second cause the lesion was slightly displaced to upper couches by the injection of the anesthesiant, like it can occur in sonography. The interpretation of the biopsy was made on soustractional sequences that showed total disparition of the lesion. But in fact, the interpretation of post-biopsy must be done on native sequence and showed the remaninh enhancement. The interpretation of post-biopsy must be done on native sequences (figure 3).

Confirmation of target lesion sampling is an integral part of percutaneous breast biopsy. In case of stereotactic biopsy of microcalcifications, specimen radiography can confirm lesion sampling. In MRI, it is much more uneasy to confirm target sampling cause the lesion only enhances only in vivo. Postbiopsy MRI may show an apparent decrease in size or removal of the target but no standards performing after MRI-guided biopsy exist yet. The use of a titane clip after biopsy is highly recommended.

Imaging-histologic correlation essential after all biopsy procedures, is particularly important at MRI-guided biopsy because of the limitations of other methods to confirm lesion sampling. It is tremendous to correlate breast MRI biopsy histology with MRI features, the variability of enhancement during the menstrual cycle in premenopausal women, the higher risk status of cancer among these women, and the MRI biopsy procedure.

**Borderline lesions**
The higher frequency of Atypical Ductal Hyperplasia underestimation at MRI-guided biopsy than at stereotactic biopsy reflects the higher risk of breast cancer among women undergoing breast MRI than in the general population. Studies show ADH underestimation of approximately 20%. That's why nearly all frontier lesions have been operated in our institution.

**Mandatory follow-up**

In cases of benign results, a close follow-up (from 4 to 6 months) was performed in order not to miss remaining lesion. Namely, the increasing size of malignancy is generally noticed at 6 months. Hence, the longer after the biopsy the follow-up is practised, the better it will be in identifying interval growth, indicating the need for additional biopsy of lesions that fail to show evidence of partial removal due to unsuccessful sampling at biopsy.
Fig. 7: Number of biopsies per year

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**Fig. 8:** Comparative rate between "naive women" (in blue) (no previous cancer, no risk factor) versus women at risk (previous cancer and/or risk factor) in red

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**Fig. 9:** Smallest lesion ever biopsied: 3-mm size. Result: proliferative changes.
**Fig. 10:** Number of lesions per size.

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Fig. 11: Arising of hematoma after biopsy.

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**Fig. 12:** Post contrast injected images: Post biopsy cavity. No enhancement.

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Fig. 13: Native postbiopsic images. Remaining of enhancement. Lesion is not removed.

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Conclusion

In conclusion, our clinical experience suggest that MR-guided core needle biopsy is safe, feasible and accurate procedures. Procedures with the guidance of MR play an invaluable role in the management of lesions detected by MR only and have become an essential tool for breast imaging. It can reduce the number of useless surgeries. It is necessary in case of screening of women at high risk of breast cancer.
References
