MR imaging-guided vacuum-assisted breast biopsy: diagnostic accuracy in a cohort of Patients with high prevalence of disease.

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Purpose

Magnetic resonance imaging (MRI) of the breast has taken on an important role as an adjunct to conventional imaging modalities in the early detection of breast cancer.

It is recommended that breast MRI is performed in specialized breast units and limited to specific indications: staging before treatment planning; screening on high risk women; evaluation of response to neo-adjuvant chemotherapy; patient with breast implant; occult primary breast cancer; breast cancer recurrence; nipple discharge; characterization of equivocal finding at conventional imaging; inflammatory breast cancer; male breast. [1]

Breast MRI is highly sensitive for the detection of benign and malignant abnormalities that are occult to physical examination, ultrasound and mammography, but the specificity is moderate. [2,3,4]

The number of lesions identified at MRI alone has led to a need to develop MRI-guided interventional procedures enabling correct characterization of lesions to avoid unnecessary surgical biopsies that was in the past the only option for the histological characterization of these lesions.

Recent technological innovations have made it possible to perform minimally invasive diagnostic procedures such as vacuum-assisted biopsy (VAB), even under MRI guidance, to obtain histologic proof of MRI detected lesions.

The aim of this study was to evaluate diagnostic accuracy of MRI-guided Vacuum-Assisted Breast Biopsy (VABB) in women with high prevalence of breast disease with lesion non detectable otherwise.
Methods and Materials

From January 2008 to June 2011, 198 high risk patients underwent breast MRI at the breast center of our hospital.

25 focal lesion (21 patients; mean age: 52 years; age range: 32-79 years), not visible neither in mammography nor in ultrasonography even after a second look, were identified and categorized as BI-RADS (Breast Imaging Reporting And Data System) 3, 4 or 5, according to MRI signs. (Table 1)

Hence those lesions underwent MRI guided VABB. [5]

All patients were studied by mammography, ultrasound, and MRI with paramagnetic contrast material [gadolinium diethylene triaminopentaoctacetic acid (DTPA)] that were conducted during the second week of the menstrual cycle or at least 4 weeks following discontinuation of hormone replacement therapy.

When one or more lesions were detected with MRI, mammograms and sonograms were reviewed, and targeted ultrasonographic second-look was performed to identify the MRI findings. If the lesions were visible on ultrasonographic second-look, the patients were excluded from the study, and the lesions were sampled under ultrasonography guidance (as the procedure is less expensive and generally simpler and faster).

All MRI studies were carried out on a commercial standard 1.5-T MRI scanner with a phased array 8-channel breast coil, in prone position.

The MRI localization system stabilizes the breast so that tissue shift due to needle insertion or application of local anaesthetic is minimized.

Such system is equipped with one fiducial marker, which is used as a reference for calculating the lesion coordinates. (Image 1)

Biopsies were performed with a 11-gauge MRI compatible vacuum assisted biopsy device; from 24 to 50 cores were then retrieved in all patients. [6,7]

CAD (computer aided detection), stream diagnostic and interventional guidance tool, was used to target coordinates for biopsy. CAD reported needle position (insertion location, depth and needle angle) in real time and displayed images and needle position in the patient's orientation.

After the acquisition of sagittal T1-weighted sequences without contrast administration to check the correct positioning of the external fiducial marker, dynamic axial T1 - weighted sequences were acquired (TR 150 ms; TE 2.0 ms; flip angle 10°; FOV30 cmand matrix 300×300 or FOV32 cmand matrix 329x329; phase FOV 1; SNR 70%; NEX 1; slice
thickness 3 mm) before and after the intravenous administration of 0.2 mmol Gd-DTPA/kg at a rate of 2 ml/s, followed by 20 ml of saline solution. (Images 2 and 3)

The pre-contrastographic images were then subtracted from the corresponding post-contrastographic images on a pixel-by-pixel bias with the use of the standard software subtraction function available on our console.

All the biopsy procedures were completed successfully, taking sufficient material to allow an adequate histologic evaluation by the pathologist (24-50 core specimens).

At the end of the procedure a titanium clip was released in the site of biopsy. (Image 4)

The histological diagnosis provided by VABB allowed us to divide the lesions as follows: 9 B5 grade (malignant), 1 B4 grade (suspicious), 1 B3 grade (lesion of uncertain malignant potential), 12 B2 grade (benign lesion) and 2 B1 grade (unsatisfactory/normal tissue). [8]

According to histopathologic results, 10 B4 and B5 grade lesions (40 %) underwent surgical treatment because we considered them as malignant lesions (5 invasive ductal carcinomas, 2 invasive lobular carcinomas, 3 ductal carcinomas in situ).

12 B2 (48 %) grade lesions were sent to a 24 months follow up (2 cases of sclerosing adenosis, 3 of fibroadenoma, 5 ductal hyperplasia with apocrin metaplasia or flat epithelial atypia and 2 of fibrocystic disease).

The only B3 lesion (atypical ductal hyperplasia; 4%) was anyway sent to surgery due to its clinical and radiological features.

We found 2 B1 (8%) grade lesions: the one consisted of fat tissue and some inflammatory cells and was identified as liponecrosis; the other one consisted of tissue in adipose involution and some lymphoid elements that were insufficient for a correct histological diagnosis but since the patient had an history of lymphoma and other localizations, she was sent to the haematologist. After chemotherapy this mammary localization responded to the treatment, confirming our diagnosis. (Table 2)
Table 1: BI-RADS distribution of lesions according to MRI signs.

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Fig. 1: MR-guided breast biopsy system consists of a patient support with "universal grid" that is used in place of the lateral or medial compressor. A fiducial marker which is used as a reference for calculating the lesion coordinates is attached to the outside of the grid.

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**Fig. 2:** MR sequences acquired before VABB procedure: a. Sagittal T1-weighted sequence to check the correct location of the external fiducial marker. b. Axial T1-weighted sequence in order to detect the suspected lesion

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**Fig. 3:** a. Placing of fiducial marker and aiding device for the correct positioning of the needle (according to the CAD coordinates). b. Insertion of the introducer. c. Axial T1-weighted sequence documenting the needle position within the target breast lesion.

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Fig. 4: a. Sampling for histologic examination. b. A titanium clip is released in the site of biopsy.

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Table 2: B-grade distribution of lesions after VABB.

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Results

As mentioned, all B4 and B5 grade lesions underwent surgical treatment, B2 grade lesions were sent to a 24 months follow up and the only B3 lesion was anyway sent to surgery.

Histology after surgical excision confirmed the malignancy of B4 and B5 grade lesions. The other lesions were confirmed as benign lesions in 24 months at least of imaging follow up, because they disappeared or remained stationary.

Only one lesion, first considered atypical hyperplasia on biopsy (B3), was upgraded to invasive ductal carcinoma after surgery. (Table 3)

Hence in our study vacuum assisted breast biopsy proved to be effective and accurate in identifying patients requiring surgery, avoiding unnecessary surgery to the remaining patients.

VABB therefore shows good values of sensitivity and specificity (respectively 91% and 100%), a PPV of 100% and NPV of 93%. [9] (Table 4)
Table 3: Results of the comparison between histopathological findings of VABB and surgery in patients with B4-B5 lesions and 12-24 months follow up in patients with B2 lesions.

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<tr>
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<th>Surgery / Follow up</th>
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<tr>
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<td>Malignant lesions</td>
<td>Benign lesions</td>
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<tr>
<td>VABB</td>
<td>B4-B5</td>
<td>10</td>
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<tr>
<td></td>
<td>B3</td>
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<td><strong>Prevalence</strong></td>
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<tr>
<td><strong>NPV</strong></td>
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**Table 4:** Diagnostic performance values of VABB-MR guided in our study.

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Conclusion

In conclusion, advances in technology and equipment allow us to regard MRI-guided Vacuum-Assisted Breast Biopsy (VABB) of lesions visible and suspicious on MRI only (findings not definitely characterizable with traditional techniques like mammography and ultrasonography) as an important innovation in breast diagnostics; in a selected group of women with high prevalence of disease, VABB has a high diagnostic accuracy in separating cases that require surgery from ones that are worthy of surveillance.

This procedure should therefore become increasingly adopted in the clinical practice of high-level breast centers.
References

7. Tozaki M et al. MR-guided vacuum-assisted breast biopsy using a non-titanium needle.