Up-right stereotactic vacuum-assisted biopsy (UP-VAB) of non palpable breast lesions: Results and correlations with radiological suspicion (BI-RADS classification)

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Purpose

The widespread use of mammography in early detection of breast carcinoma has led to increasing detection of small non palpable lesions. Until a few years ago, surgical biopsy was required to obtain histological diagnosis of such breast lesions. Nowadays, thanks to the introduction of a novel sampling vacuum-assisted technology which is directional and uses vacuum aspiration needles, histological diagnosis of small lesions can be achieved with the same accuracy of surgical biopsy, although causing less patient discomfort and with lower costs.

Most published studies confirming the efficacy of vacuum-assisted biopsy (VAB) have focused on the use of dedicated prone units [1, 2, 3].

The aim of our study was to assess accuracy and safety of up-right stereotactic vacuum-assisted biopsy (UP-VAB) of non palpable breast lesions and to correlate histological UP-VAB results with the BI-RADS classification (Breast Imaging Reporting and Data System) of the American College of Radiology [4].
Methods and Materials

Between January 2007 and March 2009, 113 patients (mean age 59.5 ± 10 years; range 40-82 years) with a total of 114 non palpable breast lesions underwent stereotactic UP-VAB. The inclusion criteria were women with suspicious non palpable breast lesions, only detected by mammography and including microcalcifications, masses with or without calcifications and architectural distortion. Lesion size was # 10mm in 89 cases (78%) and ranged between 10-20mm in the remaining 25 (22%) cases.

Lesions were classified according to the BI-RADS grading of the American College of Radiology [4] (Tab. 1).

Tab. 1

<table>
<thead>
<tr>
<th>BI-RADS 0</th>
<th>Not defined (need additional evaluations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI-RADS 1</td>
<td>Negative</td>
</tr>
<tr>
<td>BI-RADS 2</td>
<td>Benign</td>
</tr>
<tr>
<td>BI-RADS 3</td>
<td>Probably benign</td>
</tr>
<tr>
<td>BI-RADS 4</td>
<td>Suspicious abnormality</td>
</tr>
<tr>
<td>BI-RADS 5</td>
<td>Highly suggestive of malignancy</td>
</tr>
<tr>
<td>BI-RADS 6</td>
<td>Known biopsy (proven malignancy)</td>
</tr>
</tbody>
</table>

Fig.: Tab 1: BI-RADS classification according to the American College of Radiology

Prior to biopsy a coagulation history was obtained and any coagulation treatment was suspended, if possible, 48 h before and 24 h after the procedure; any intolerance to local anaesthetics was excluded.

All procedures were carried out with the patients sitting on a wheeled chair and using an up-right support system for vacuum-suction needles add-on unit, applied on a mammograph with a stereotactic unit (Fig. 1) on page .

After obtaining the patient's written informed consent, VAB was performed using the 11-Gauge Mammatome probe and directional sampling of the lesions by vacuum aspiration, according to well-known standardized procedure [5-6]. The steps can be resumed as follows:

- **The x-, y-, and z-axes were determined by the standard techniques of stereo pair images and selection of the target by the radiologist. Once the lesion's coordinates were determined by the treatment unit (Fig. 1) on page , it was clamped into a fixed position. Needle insertion was made perpendicular to the image receptor in the z-axis of compression.**

- **The patient's skin was disinfected at the site of the determined skin entry, and local anaesthetic was administered along the expected track of the needle. An incision was made with a scalpel blade (Fig. 2,a) on page 7. After needle insertion was complete (Fig. 2,b) on page 7, a pair of stereo views was obtained to document that the needle tip was adjacent to the lesion (Fig. 3) on page 8.**

- **The needle of mammatome was then automatically inserted at calculated depth into the breast tissue; next specimens of tissue were sucked into the needle thanks to negative pressure automatically generated by vacuum device, and then cut by internal part of the needle (Fig. 4 on page 9). The collecting specimens has been dispatched through a single introduction of the needle, with coaxial system, effecting 1 - 2 complete turns on 360°, with specimens number ranging between 6 and 12.**

- **At the end of the procedure two (cranio-caudal and medio-lateral) views images were obtained (Fig. 5) on page 10. In case of microcalcifications, at the end of the procedure a titanium micromarker was placed within the site of biopsy to verify the position site of microcalcifications (Fig. 6) on page 11. When microcalcifications were present, a radiography of the specimens was obtained to document microcalcifications retrieval (Fig. 7). on page 12**

Patients with benign lesions at UP-VAB were scheduled for 6-month mammography follow-up, whereas surgical excision was recommended for malignant lesions. A jointly
assessment (radiologist, pathologist and surgeon) was performed in patients with borderline lesion and in cases of discordance between radiological suspicion and histological findings.

Histological UP-VAB results were correlated with mammography follow-up or with histopathologic results. Also radiological suspicious according to BI-RADS classification was correlated with histological UP-VAB results.
Fig. 0: The x-, y-, and z-axes were determined by the standard techniques of stereo pair images and selection of the target by the radiologist on the treatment unit.

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After skin disinfection a local anaesthetic was administered along the expected track of the needle. An incision was made with a scalpel blade parallel to the compression paddle.
Fig. 0: After needle insertion was complete, a pair of stereo views was obtained to document that the needle tip was adjacent to the lesion.

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Fig. 4: Specimens of tissue were sucked into the needle thanks to negative pressure automatically generated by vacuum device (a), and then cut by internal part of the needle (b).

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Fig. 0: Fig. 5: After needle insertion was complete, a pair of stereo views was obtained.

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Fig. 0: Fig. 6: Images obtained at the end of the procedure to verify the position site of the titanium micromarker.

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Fig. 0: Fig. 7: Radiography of the specimens documents microcalcifications retrieval.

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Results

At mammography, the 114 breast lesions included in our study showed the following patterns:

- 90 (79%) clusters of microcalcifications;
- 18 (15.8%) masses with or without microcalcifications;
- 6 (5.2%) architectural distortions.

At UP-VAB, 66 (57.9%) lesions resulted to be benign, 46 (40.4%) were malignant whereas the remaining 2 (1.75%) lesions were considered borderline.

Table 2 on page  shows histological type distribution according to the mammographic pattern whereas Table 3 on page  shows the benign lesions distribution.

Tab. 2

<table>
<thead>
<tr>
<th>Micropathological findings</th>
<th>Mammographic pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>microcalcifications</td>
</tr>
<tr>
<td></td>
<td>mass</td>
</tr>
<tr>
<td></td>
<td>distortion</td>
</tr>
<tr>
<td></td>
<td>totals</td>
</tr>
<tr>
<td>benign</td>
<td></td>
</tr>
<tr>
<td>54 (60%)</td>
<td>11 (61.1%)</td>
</tr>
<tr>
<td>1 (16.7%)</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td></td>
</tr>
<tr>
<td>malignant</td>
<td></td>
</tr>
<tr>
<td>34 (37.8%)</td>
<td>7 (38.9%)</td>
</tr>
<tr>
<td>5 (83.3%)</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td></td>
</tr>
<tr>
<td>borderline</td>
<td></td>
</tr>
<tr>
<td>2 (2.2%)</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
The 66 benign lesions did not show any change at the short-term mammography follow-up performed 6 months after the biopsy. The 46 malignant lesions underwent surgery. Among the 2 borderline lesions, according to the decision of the joint multidisciplinary assessment, one ductal hyperplasia without severe atypia (classified as BI-RADS 3) was followed with mammography and resulted unchanged 6 months after the biopsy; one ductal hyperplasia with severe atypia (classified as BI-RADS 4) was surgically resected. At post-operative pathology, 7/47 (14.9%) malignant lesions were underestimated by UP-VAB although the underestimation did not affect the therapeutic decision. In particular at post-operative pathology, 1 atypical ductal hyperplasia (ADH) resulted ductal carcinoma in situ (DCIS); 1 ductal carcinoma in situ (DCIS) resulted micro-infiltrating ductal
carcinoma (T1mic); 5 ductal carcinoma in situ (DCIS) resulted infiltrating carcinoma (Tab.4) on page.

**Tab. 4**

![Pathological findings table](image)

**Fig.**: Tab. 4: In 7 lesions there was discordance between microhistological findings of UP-VAB and the pathological results of surgical procedures [1 atypical ductal hyperplasia (ADH) vs ductal carcinoma in situ (DCIS); 1 ductal carcinoma in situ (DCIS) vs micro-infiltrating ductal carcinoma (T1mic); 5 ductal carcinoma in situ (DCIS) vs infiltrating carcinoma].

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Distribution of malignant lesions according to histological type is shown in Table 5 on page.

**Tab. 5**
Distribution of malignant lesions by histological type

<table>
<thead>
<tr>
<th>Histological type</th>
<th>Lesions n.</th>
<th>Lesions %</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCIS</td>
<td>19</td>
<td>40.4%</td>
</tr>
<tr>
<td>LCIS</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>DLCIS</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>T1mic</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>DCI</td>
<td>12</td>
<td>25.5%</td>
</tr>
<tr>
<td>LCI</td>
<td>3</td>
<td>6.4%</td>
</tr>
<tr>
<td>DLCI</td>
<td>10</td>
<td>21.4%</td>
</tr>
</tbody>
</table>

Fig.: Tab. 5: Distribution of malignant lesions according to histological type: DCIS, ductal carcinoma in situ; LCIS, lobular carcinoma in situ; DLCIS, ductal-lobular carcinoma in situ; T1mic, in situ micro-infiltrating carcinoma; DCI, invasive ductal carcinoma; LCI, invasive lobular carcinoma; DLCI, invasive ductal-lobular carcinoma

References: Dept. of radiology, university - Chieti/IT

Since the exact significance of borderline lesions in still controversial [7], in terms of sensibility, specificity and diagnostic accuracy our data can be resumed as follows:

- when considering borderline lesions as benign, we obtained 67 TN (true negative), 1 FN (false negative), 46 TP (true positive), 0 FP (false positive), sensibility 97.8%, specificity 100% and diagnostic accuracy 99.1%;
- when considering borderline lesions as malignant, we obtained 66 TN (true negative), 0 FN (false negative), 47 TP (true positive), 1 FP (false positive), sensibility 100%, specificity 98.5% and diagnostic accuracy 99.1%;
- when considering borderline lesions according to the joint multidisciplinary assessment (1 potentially benign and 1 potentially malignant) we obtained 67 TN (true negative), 0 FN (false negative), 47 TP (true positive), 0 FP (false positive), sensibility 100%, specificity 100% and diagnostic accuracy 100%.
Among the 114 lesions, 104 (58 benign, 2 borderline, 44 malignant) had been classified by the radiologist according to BI-RADS classification as follows (Tab.6): 

- 13 (12.5%) highly suspicious lesions (BI-RADS 5);
- 66 (63.5%) suspicious lesions (BI-RADS 4);
- 25 (24%) probably benign lesions (BI-RADS 3) (Fig.1).

Tab. 6

![Correlation according to Breast Imaging Reporting and Data System (BI-RADS) and micropathology](image)

**Correlation according to Breast Imaging Reporting and Data System (BI-RADS) and micropathology**

<table>
<thead>
<tr>
<th>Micro-pathology</th>
<th>BI-RADS category</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>III n (%)</td>
<td>IV n (%)</td>
</tr>
<tr>
<td>malignant</td>
<td>25 (24%)</td>
<td>66 (63.5%)</td>
</tr>
</tbody>
</table>

Fig.: Tab. 6: Correlation between radiological judgment according to BI-RADS classification and micropathology.

**References:** Dept. of radiology, university - Chieti/IT

Correlation between radiological judgment and pathologic diagnosis showed that radiological suspicious was correct (BI-RADS 4 or 5) in 40/44 (91%) malignant (infiltrating or in situ) lesions (Fig. 2 on page 20,3) on page 21
The number of specimens excised in each patient ranged from a minimum of 7 to a maximum of 25 with a mean number of 13 per procedure.

Minor complications following UP-VAB occurred in 5/114 (4.4%) cases: three cases of hypotensive reaction and two cases of profuse bleeding during the procedure. None of the complications nevertheless affected the success of procedure [8, 9].
Fig. 0: A small cluster of microcalcifications involving an area of 5 mm classified as BI-RADS 3 by radiologist and resulted a fibrocystic mastopathy at histology (UP-VAB)

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**Fig. 0:** Histologic underestimation of UP-VAB. Microcalcifications involving an area of 6 mm classified as BI-RADS 4 by radiologist. UP-VAB result: ductal carcinoma in situ; surgical excision result: infiltrating ductal carcinoma

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**Fig. 0:** An architectural distortion classified as BI-RADS 4 by radiologist and resulted an infiltrating ductal carcinoma at histology (UP-VAB).

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Conclusion

In our experience, UP-VAB proved to be a feasible and accurate procedure for histological diagnosis of small non palpable breast lesions and showed similar results to that reported for dedicated prone unit-VAB. As a matter of fact, in our series of 114 non palpable breast lesions,

- surgery could be avoided in all patients with benign results at UP-VAB,
- a good correlation was found between histology obtained at UP-VAB and surgery of malignant lesions,
- a good correlation was observed between the radiologist BI-RADS classification of breast lesions and histological findings.

A potential limitation of UP-VAB could be the patients' mental pressure due to wound and blood sight. We believe that it is very important to make the patients relaxed during biopsy procedure. We managed to reduce patients' mental pressure by explaining the procedure in advance and by speaking with them during the biopsy. With these simple shrewdness we were able to complete the procedure and obtained definite diagnosis in all patients.
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