Learning objectives

1. To describe step by step stereotactic- vacuum assisted breast biopsy (VABB) technique using pictures and illustrations schemes with didactic purpose.
2. To review the current indications, limitations and the most common complications for this procedure.
Background

We do percutaneous biopsies because imaging is not 100% specific. Histopathology remains as the gold standard, and allows us to establish or exclude malignancy, and assist in the surgical planning. When the result is benign and concordant, we may even be able to obviate surgery.

Image-guided percutaneous core-needle biopsy is a frequently used method to diagnose palpable and non-palpable breast lesions. Although sensitivity rates for 14-gauge automated needle biopsy are high (97%) some cancers are missed. Another shortcoming is that disease severity is sometimes underestimated. Not only is it psychologically distressing for patients when breast cancer is underestimated, but also implies a delay in establishing a definitive diagnosis, and appropriate treatment. In an attempt to overcome some of these negative aspects of core-needle biopsy, VABB was developed. VABB allows the radiologist to obtain sufficient amount of specimen with a single insertion to provide for a more accurate diagnosis and can aid in completely removing the lesion with stereotactic guidance.

VABB is a safe and minimally invasive procedure in which a sample of breast tissue is removed for pathology examination. The advantage of using VABB is to reduce sampling error, decrease the probability of a histological underestimation, decrease imaging-histological discordance, decrease the re-biopsy rate, and to diminish the likelihood of subsequent growth on follow-up. It is important for radiologists to know the procedure and to properly apply the technique.

Indications:

Suspicious mammographic abnormality detected on screening mammography without a sonographic correlate is the main reason for stereotactic guided VABB. Most common findings are calcifications that are not benign or cannot be categorized as BIRADS 2. Sometimes we also preform VABB in a mass with or without associated calcifications, architectural distortion or focal asymmetries that are occult on ultrasound.

Limitations:

1. **Histological underestimates**: Despite the higher reported accuracy rates, mammographic lesions that contain atypical ductal hyperplasia (ADH) during stereotatic VABB still have ADH underestimates rates sufficient to mandate open surgical excision for a diagnosis. ADH is a lesion with some but not
all of the features of ductal carcinoma in situ (DCIS) but measures < 2mm. Therefore, there is a probability that a small sample of DCIS lesion may be interpreted by the pathologist as ADH. Other benign conditions, including papillomatosis, radial scars and lobular neoplasia can also require an open excision.

2. Epithelial displacement: Benign or malignant epithelium may be displaced into tissue away from the target lesion during a variety of breast needling procedures (fine needle aspiration (FNA), core biopsy, directional VABB, local anesthetic injection, etc). Epithelial displacement can cause interpretative problems for the pathologist, as displaced DCIS can mimic infiltrating ductal carcinoma. Some studies suggest that epithelial displacement may be less frequent with VABB than after automated core biopsy. But the reality is that there are few studies that addressed the biological significance of epithelial displacement. Although no evidence exists to date that displaced carcinomatous epithelium remains viable and grows in the breast, there may be a theoretical risk for local recurrence if that needling tract is not excised or radiotherapy administered. Further studies with long term follow-up in women treated with breast conserving therapy after VABB are needed.

3. Incomplete excision: The rate of successful initial complete removal of a lesion varies widely from 22-100%, although most studies report rates of 75-100%. Follow-up rates without recurrence are 62-98%.

4. Costs: One of the mayor disadvantages are the costs associated with the disposable material of vacuum suction system, which are 3 to 4 times higher than that for the 14-gauge automated-needle biopsy.

Complications:

Most complications are mild to moderate in severity. Common complications may include subcutaneous bleeding, post-procedure hematoma, a skin defect or pneumothorax. The most frequent complication is the post-procedure hematoma. Some other complications reported in the medical literature are: Bleeding that lasted for more than 10 minutes even with proper compression, vasovagal response, infection, and skin tears.
Findings and procedure details

Pre-procedure Patient

When stereotactic biopsy is planned, the patient and the lesion must be evaluated to determine whether the stereotactic biopsy is clinically feasible as well as technically possible. The patient’s medical history and medication list including bleeding risk assessment, should be asked, like the use of anticoagulation, antiplatelet medications and/or herbal medications. Sometimes is necessary to complement with a laboratory analysis (PT, PTT, INR). Ask also about any allergy history with special attention to any previous adverse reactions to local anaesthetics, epinephrine, latex, disinfectant solutions or adhesives. Any physical limitations should be noted (i.e. being on a wheelchair, range of motion), also any history of susceptibility to vasovagal reaction. This is important since stereotactic biopsy requires that the patient’s breast remain in compression for at least 20-30 minutes, during which time the patient must be immobile. It is a relative contraindication when a patient is unable to tolerate positioning, since the motion precludes an accurate targeting and/or biopsy.

Getting stared and checklist:

Medications:

- Local anaesthesia: (a) Superficial: Lidocaine 1% buffered with sodium bicarbonate (8.4%) at 9:1 rate. (b) Deep: Lidocaine 1% with epinephrine (1:100,000) buffered with sodium bicarbonate (8.4%) at a 9:1 rate. If allergic to lidocaine, it is possible to use chloroprocaine with epinephrine (1:200,000).
- Premedication of at-risk patients (prior syncope, significant anxiety, needle phobia): Short-acting benzodiazepine (lorazepam, IV atropine, reverse Trendelenburg position).

Equipment list

- Stereotactic system: Analog (slow, film-based) vs Digital with integrated computer targeting (Fig. 1). Before getting started one should remember to check the stereotactic equipment calibration.
- Stereotactic needle holder (Fig. 1)
- Mammographic chair or dedicated biopsy table (lateral decubitus approach).
- VABB biopsy system (Fig. 1) and needle (Fig.2)
- Biopsy cart:
  - Skin preparation solutions
  - Local anaesthetic medications
  - Scalpel blade
Lesion Evaluation

Before the biopsy, the patient’s mammograms should be reviewed to determine the approach that allows the lesion’s best visualization, shortest distance from the skin to the lesion, and avoidance of intervening vessels (Fig. 3). The best approach is also determined by the patient’s breast size, compressed breast thickness, and lesion’s depth and location. A scout or a CC view of the targeted lesion should first be obtained with the patient’s breast in compression (Fig. 4). The lesion’s x (horizontal), y (vertical), z (depth from the skin surface) axes are determined through measurement of the parallax shift of the targeted area from defined angles of view at +15º and -15º from midline and along the x-axis (Fig. 5). Most stereotactic units have a dedicated software, although manual calculation is possible. The compressed breast thickness must be 5mm or greater than the z (depth) calculated by the system to ensure that the needle would not exit the breast and strike the image receptor or breast support. We recommend targeting just inferior or superior to the lesion, especially if the lesion is small, so that the lesion is visible adjacent to the needle aperture, on the prefire images to permit confirmation of accurate targeting (Fig. 9).

Technical Challenges:

Stereotactic biopsy is challenging in patients with a small or thin breast, superficial lesion close to the skin, deep lesion adjacent to the chest wall, or lesion located in the very superior portion of the breast (inner or outer quadrants). In thin breast one can either build up the breast or consider a short-throw probe. In all cases, it is important to remember that the lesion does not need to be at the center of the needle aperture for successful sampling. With VABB needles as long as the lesion is at the edge of the needle aperture, successful tissue retrieval can generally be achieved.

Stereotactic Biopsy Technique and Needle Selection

Once the lesion coordinates have been calculated and confirmed to be adequate for biopsy, the skin is marked and cleansed (Fig. 6). The skin and breast parenchyma are anesthetized, and a skin incision is made (Fig. 7). The VABB needle is then introduced through the skin incision into the breast parenchyma, to prefire position just proximal to the target (Fig. 8). Prefire stereotactic images are obtained to confirm the expected needle trajectory (Fig. 9). After the prefire images confirm accurate targeting we initiate tissue sampling in 360º fashion. VABB are performed with an Automated Tissue Excision
and Collection (ATEC®) device using 7-gauge or 10-gauge needles. VABB needles are powered with suction and have a rotating cutter. They obtain multiples samples without the need to remove the needle from the lesion, and are obtained at consecutive clock positions to achieve contiguous sampling (Fig. 10-11). The vacuum draws the breast tissue into an aperture in the probe, where tissue is cut; the tissue is then transported to the specimen port for collection (Fig. 12). For small cluster of calcifications, a small number of samples may be sufficient for accurate diagnosis. However, an area of architectural distortion generally requires a larger number of core samples to avoid missing any underlying malignancy and to ensure accurate diagnosis.

Once the sampling retrieval is complete post-biopsy images are taken to confirm removal of the lesion (Fig. 13), and a percutaneous clip is placed to mark the biopsy site (Fig. 14-15). This clip facilitates future mammographic monitoring of the area and serves to guide future surgical excision. Because clip migration has been reported in up to 20% of cases, a two-view mammography with craniocaudal and oblique views should be performed after the breast is decompressed to assess the final position of the deployed clip (Fig. 20). If clip migration occurs, it should be documented in the radiological report, and it should be specified how far away is it from the lesion. Sometimes is necessary to place a second percutaneous clip.

**Specimen Management**

The core biopsy specimens retrieved from the VABB needle device are laid out in a petri or a small dish and imaged (Fig. 16-17). The specimen radiography serves to document the tissue retrieval and the presence of the targeted lesion within the specimen cores, especially the calcifications (Fig. 17). The specimens are immersed in formalin, labelled appropriately, and sent to the pathology department.

**Post-procedure Patient Treatment and Follow-Up**

Immediately after the biopsy needle is withdrawn from the breast, focal compression of the biopsy site is performed to achieve hemostasis. We place an ice pack at the biopsy site and keep the breast under the compression paddle for 5 to 10 mins (Fig. 18). When hemostasis is achieved, the skin incision is closed with Steri-strips and compression bandage to cover it (Fig. 19). After the procedure mammography is performed (Fig. 20), a compression bandage may also be applied across the breast for a few hours or overnight to ensure continued hemostasis. We instruct patient to keep applying ice on the biopsy site at home, and to sleep with their bra on that night. Patients are examined the next day to detect complications and they are followed-up by the breast unit one week later to give biopsy results and treatment considerations when applicable. We make an emphasis in this part, since is imperative to compare the results of imaging and pathologic analysis to determine radiologic-pathologic concordance and to determine whether surgical excision or additional intervention is necessary.
Findings and Reporting

When writing the radiological report it is important to note the indication and patient history, and for the lesion location, for example, the clockface orientation and distance from the nipple can be used. A description of the approach, the biopsy device and number of gauge used, and the volume and type of local anaesthesia applied. It should also include the total number of samples obtained and if calcifications were obtained in the specimen radiography. Further on, clip location relative to biopsy site should be specified as well as note if migration occurred. And for last mentions about any complication occurred, like sampling error, bleeding, infection, or skin injury.
Fig. 1: In our hospital we perform VABB with the EnCor Enspire ® Breast Biopsy System (B), and with digital stereotactic system (A).

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Fig. 2: 10-gauge needle for VABB system.

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Fig. 3: Craniocaudal mammography (A) and magnification view (B) in a 56-year-old woman shows too numerous microcalcifications in the upper outer right breast.

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**Fig. 4:** A scout view of the targeted lesion is first obtained with the patient’s breast in compression.

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**Fig. 5:** The lesion’s x (horizontal), y (vertical), z (depth from the skin surface) axes are determined through measurement of the parallax shift of the targeted area from defined
angles of view at +15º and -15º from midline and along the x-axis (cross in both views mark the lesion).

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**Fig. 6:** Once the lesion coordinates have been calculated and confirmed to be adequate for biopsy, the skin is marked and cleansed.

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Fig. 7: The skin and breast parenchyma are anesthetized using lidocaine with epinephrine, and a skin incision is made. (A) Yellow arrows show sterile caps for stereotactice device.

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Fig. 8: The VABB needle is then introduced through the skin incision into the breast parenchyma, to prefire position just proximal to the target.

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Fig. 9: Pre-fire paired -15° and +15° stereotactic images demonstrate the relationship of a 10-gauge needle to targeted Ca++ (yellow circle). The inserted needle tip is confirmed to be correctly positioned.

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Fig. 10: Automated Tissue Excision and Collection (ATEC ®) device using 10-gauge place in patients breast (A), with VABB system screen (B) showing the options of the number or samples are going to be taken, size of those samples and type of breast
normal or dense (arrows), and pedal that allows the system suction to start and stop when necessary (C).

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**Fig. 11:** After the prefire images confirm accurate targeting we initiate tissue sampling in 360° fashion. VABB are performed with an Automated Tissue Excision and Collection (ATEC ®) device using 7-gauge or 10-gauge needles. VABB needles are powered with suction and have a rotating cutter. They obtain multiples samples without the need to remove the needle from the lesion, and are obtained at consecutive clock positions to achieve contiguous sampling.

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Fig. 12: The vacuum draws the breast tissue into an aperture in the probe, where tissue is cut; the tissue is then transported to the specimen port for collection (yellow arrow).

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**Fig. 13:** Once the sampling retrieval is complete post-biopsy images are taken to confirm removal of the lesion (yellow circle).

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**Fig. 14:** Percutaneous clip is placed to mark the biopsy site. The same VABB system is used for this purpose, we choose marker option on the screen (A), place the clip using the VABB needle (B) and push it into the parenchyma for deployment (C).

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**Fig. 15:** Post-procedure mammogram taken in stereotactic mode confirms deployment of post-biopsy clip (yellow arrows) on the left, and illustration on the right.

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**Fig. 16:** The core biopsy specimens retrieved from the VABB needle device are laid out in a petri or a small dish and imaged (A-B). Needle can now be retrieved (C).
**Fig. 17:** Clinical photograph on the left and radiography on the right of the specimen. The specimen radiography serves to document the tissue retrieval and the presence of the targeted lesion within the specimen cores, especially the microcalcifications (yellow arrow).

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Fig. 18: We place an ice pack at the biopsy site and keep the breast under the compression paddle for 5 to 10 mins

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Fig. 19: When hemostasis is achieved, the skin incision is closed with steri-strips (A), and compression bandage to cover it (B).

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Fig. 20: After the procedure craniocaudal view (A) and mediolateral oblique (B) is performed. In it, it is important to identify the clip that marks the biopsy site (yellow circle) and determine if any migration occurred.

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Conclusion

VABB allows for a sufficient specimen to be obtained with a single insertion. It can provide an accurate diagnosis and completely remove some lesions. By learning how to perform VABB the radiologist has an additional tool for making accurate breast biopsy.
References


