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Radiology

IMAGE GUIDED CORE BIOPSY OF BREAST : IS IT A GOLD STANDARD TECHNIQUE ? IMPLICATIONS AND COMPLICATIONS

KEY WORDS: ultrasound, Vaccum assisted biopsy, breast core biopsy

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ABSTRACT

Ultrasound is an extremely valuable tool, with a variety of uses including screening, diagnostic imaging, image-guided biopsy techniques, image-guided percutaneous excision techniques, as well as image-guided open surgical excision procedures. Technology has advanced to include improved imaging and vacuum-assisted devices making percutaneous biopsies and excisions easier and more efficient. The number of patients who require breast biopsy has increased over the past years, mainly because of wider access of the population to breast cancer screening allowing earlier diagnosis. Thus expert radiologists and pathologists are required in order to reduce the wait for a definitive diagnosis and increase the patients' survival. Ultrasonography-guided core biopsy of breast has become the method of choice for all alterations visualized at the method, with sensitivity rates which are very close to those of surgical biopsy. Here we detail with various indications, advantages, limitations and complications of image guided core needle biopsy.

INTRODUCTION

An ultrasound-guided breast core biopsy utilizes sound waves to locate a lump or abnormality and remove a tissue sample for examination under a microscope. It has high sensitivity in the diagnosis of breast lesions. The present study is aimed at detailing the indications, advantages, limitations, follow-up and description of the technique. A multi disciplinary approach involving all the three clinical, radiological and pathological expertise is responsible for the highest rate of accuracy of the technique. Parker et al[1] first described it in 1990's and now US-guided core biopsy of the breast is currently one of the main diagnostic methods for breast lesions, and is frequently considered the procedure of choice.

Ultrasound (US) Image guided core needle biopsy of breasts

US-guided core biopsy is technically easier than stereotactic-guided biopsy as real-time imaging allows the radiologist to visualize the biopsy as it occurs. It is a minimally invasive technique for diagnosing both palpable and non-palpable lesions. An international interdisciplinary consensus conference held in 2001, 2005, and again in 2009 agreed that percutaneous biopsy of breast lesions should be the gold standard biopsy method with use of US guidance if the lesion is amenable and stereotactic biopsy for calcifications not visualized on US.[2] The Agency for Healthcare Research and Quality published an evidence report in 2014, that included 160 studies, and concluded that women were 15 times more likely to have their cancer treated with a single surgical procedure if they underwent image guided biopsy rather than open excisional biopsy.[3] In the image guided era core needle biopsy has almost replaced fine needle aspiration (FNA) as the pre-operative diagnostic method.

Indications

US-directed biopsy is performed for lesions that are palpable, but also for non-palpable, mammogram-detected lesions with a corresponding abnormality visualized on US. All lesions classified as BI-RADS 4 and 5, clearly visible on ultrasound, are amenable to ultrasound CNB[4]. This technique can also be used for some BI-RADS 3 lesions under certain circumstances: genetic or family risk, medical or social difficulties for follow-up, pregnancy, extreme anxiety and others, including the patient's decision. As well as diagnostic objectives, ultrasound guidance allows us to perform other interesting therapeutic procedures such as evacuation of liquid or semi-solid collections and placement of markers or coils for neoadjuvant chemotherapy. More recently, ultrasound guidance has been useful for tumour ablation using radiofrequency, cryoablation, laser therapy or focused ultrasound.[5]

Table 1 Advantages and Limitations of the technique [6]

ADVANTAGES
Evaluation of tumor grade and hormone receptors
Full control of the needle position in real time. Neither stereotactic guidance nor MR guidance offers this advantage.
Accessibility to all areas of the breast Multiple lesions (unilateral or bilateral) can be safely biopsied in one session, usually more quickly than with other imaging techniques.
Ultrasound involves non-ionising radiation.
Low incidence of complications and discomfort for the patient
Procedure swiftness (about 20 minutes)
Wide availability of the utilized equipment
Ultrasound equipment is cheaper and more readily available than stereotactic or MR units.
TECHNICAL LIMITATIONS
Difficulty in visualizing the finding
Cystic lesions
Nodules <5mm
Need for a new biopsy in selected cases
Breast implants
LIMITATIONS RELATED TO PATIENTS
Non co-operative patients
Hemorrhagic diathesis
Allergy to anesthetic agent

Technique

There is a wide spectrum of core-needle devices that can be used under ultrasound guidance **(Fig 1a & b).** The thickness of the needles can be selected, varying from 18- to 8-gauge; however, 14-gauge conventional Tru-cut devices have been the most commonly used. Nowadays there is a trend towards using 10- to 11-gauge vacuum-assisted devices. The professional must be experienced in manipulating the CB device and also be aware on how many millimeters the needle will advance when the device is triggered, in order to avoid transfixion of the chest wall.

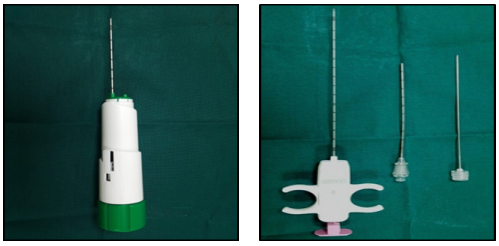

Fig 1a & b Various biopsy devices used under ultrasound guidance Pre Biopsy Preperation

Routine prophylactic antibiotics are not indicated, but the sterile technique should be used, minimizing post-biopsy infections. The room must be appropriate for the performance of the procedure, with adjustable lighting and circulation area at both sides of the table, in order to facilitate the assistant's movements and access to all regions of the breast and axilla. The transducer must be of high-frequency linear type, and must be cleaned with antiseptics.

Check list:

1) The patient must be duly explained the reason for the biopsy, the technique that will be utilized, the risks and benefits, and on the existence of alternative techniques.
2) A term of free and informed consent should then be signed by the patient.
3) Previous images should be reviewed, and then an US scan should be performed to document the lesion and establish the technique to be utilized, confirm whether the indication for biopsy is appropriate and evaluate limitations which may negatively impact the procedure. The lesion documentation will be useful for follow-up and comparison purposes. 4) Proper measurements and localization of the lesion must be performed (the clock position system is recommended and the distance between the lesion and the nipple should be measured and recorded).
5) All the viral markers and INR should be done beforehand.
6) Biopsies should be avoided in the perimenstrual period, where the breasts are more sensitive
7) Anticoagulant drugs for 7 days as well as NSAIDS for 2-5 days should be avoided prior to the biopsy.
8) Interruption of oral anticoagulant drugs should only be made after multidisciplinary analysis, considering the risk for thrombotic events *versus* the risk for development of important hematoma.[31]

Procedure of core Needle biopsy

The patient is asked to lie in dorsal decubitus position, and the upper limb ipsilateral to the lesion is placed behind her head. The anterior oblique position may be beneficial in patients with large breasts or extreme lateral lesion location. Lesions located in the outer quadrant are usually better approached with the professional positioned at the side of the ipsilateral breast, while in lesions located in the inner quadrant the professional should be positioned at the side of the contralateral breast.

A sterile surgical drape should be placed on a portable table and the instruments for biopsy should be positioned over that drape. The radiologist puts on the sterile gloves and performs a triggering test, informing the patient that the clicking sound will be heard each time a sample is obtained. In cases of very dense breasts, the radiologist should pay special attention to the clicking sound, as when it sounds differently than expected, this may mean that the sample is inappropriate.

The preferred biopsy technique is the "freehand" technique where the radiologist manipulates the transducer with one hand and the CB device with the other. As a general rule, the shortest route from the skin to the lesion should be used. The recommended access area is the peripheral curvature of the breast, positioning the needle at 2 to 3 cm away from the edge of the transducer, in parallel to the chest wall and perpendicularly to the transducer, allowing a better US visualization of the needle and reducing the risk for pneumothorax. The access through the nipple-areolar complex should be avoided. In cases of very deep or centrally and superficially located lesions, the oblique needle access may be necessary, which may impair its visualization at US. In such cases, the transducer should be angled at approximately ninety degree. **(Figure 2)**

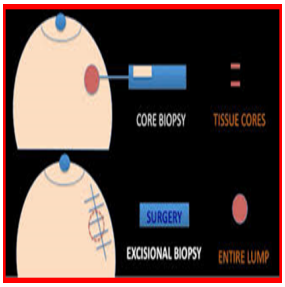

Figure 2 The approach to the lesion should be parallel to the chest wall to avoid pneumothorax

The anesthetic agent is introduced in the lesion from where the biopsy is to be performed. It can be used to move the lesion to a more convenient place, especially if it is injected deep to the lesion. The needle is positioned parallel to the nodule, the patient is warned that the sample is about to be collected, and the CB device is triggered. An important difficulty may be observed in patients with very dense breasts. In such cases, breast fibrosis may impair the progression of the needle and repeating the trajectory after each triggering represents an important limitation. Thus the technique with coaxial needle should be utilized, allowing for different areas to be biopsied by just changing the angle of the trocar.[4] **(Figure 3a&b)**

Once the device is triggered, the operator must sonographically confirm whether the needle is inside the nodule, by analyzing the needle in the two planes (cross sectional and longitudinal). Frequently during the biopsy, air enters through the needle and is visualized as a hyperechoic line in the triggering trajectory. Such artifact may be useful in the determination of lesion locations yet to be biopsied. The lesion sample must be retrieved from the core needle and placed in a vial containing 10% formalin.

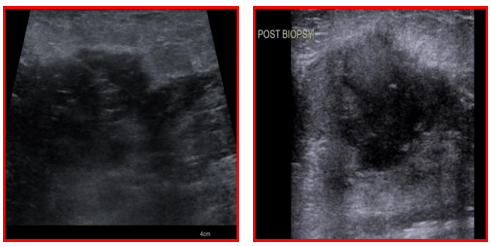

Figure 3a,b Real time visualization of pre and post biopsy lesion

Sample adequacy At least five cores should be taken which ideally should be intact, homogeneous, predominantly white,

and sinks as soon as it is put in the formaldehyde solution. The macroscopic evaluation of the specimens is also important, because it can give additional information about their quality: colour, consistency and grade of immersion of the cylinders in formaldehyde can be useful criteria for knowing their suitability for diagnosis. **Figure 4a&b** Intact, white or brown samples that quickly sink are considered more representative and are consequently preferred to fragmented, floating yellow ones, normally containing only adipose tissue[7]

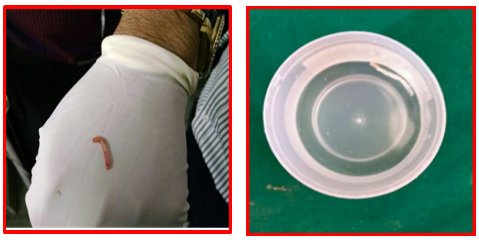

Figure 4a,b White specimen that sink is more representative than floating yellow specimen

According to Liberman et al[8] nodules < 5 mm may occasionally be completely removed during the biopsy procedure in 4% to 9% of cases, impairing the surgical marking. In such cases, the placement of a metal clip is suggested, to serve as a marker for later surgery. The false-negatives rates are associated with poor needle visualization, lesion mobility, deep lesions, central lesions in large breasts, dense breast with fibrosis, nodules ≤ 5 mm, and lesions obscured by blood accumulation.

Post Biopsy precautions

1) The patient is requested to avoid more intense physical exertion for at least two days.
2) Pain relieving and anti-inflammatory medications are prescribed as necessary, avoiding the utilization of acetylsalicylic acid for seven days after the procedure.

Complications

1) Risk of pneumothorax is observed in the cases of small breasts with axillary or medial lesions39.
2) Fistulas may occur during pregnancy or lactation, particularly in central and deep regions of the breast.
3) Minor complications such as pain, edema, psychological trauma, small hemorrhages and vasovagal reactions are frequently observed.
4) Hemorrhages are more frequent in hypertensive women and in breasts submitted to radiotherapy, whose vessels are more friable.[9]

Despite the innumerable advantages of utilizing US-guided biopsy, some lesions are not visible at the method, and in such cases the utilization of stereotactic biopsy is preferable. Patients with suspicious microcalcifications or with breast implants may benefit from vacuum-assisted biopsy, because of the higher number of calcifications in the specimens and lower risk for implant rupture[10,11,12].

Image guided Vaccum assisted core biopsy

Vacuum-assisted core biopsy is based on the same general principle as the CNB but represents a significant advance in technology. **(Figure 4 a, b, c)** Vacuum is used to pull tissue into a sampling chamber, where it is removed with high-speed internal rotating knives.[13] The specimen is then suctioned to a chamber outside the breast, where it can be retrieved. Multiple samples can be removed through this single-insertion technology, which has been approved for complete removal of benign imaged abnormalities under US or stereotactic guidance Standard core needle (12- & 14-gauge) biopsy limits the amount of tissue available to pathologists for establishing the histologic diagnosis and biochemical markers. For example, a standard core biopsy specimen may show ductal carcinoma *in situ*, but the final pathology of the lumpectomy specimen may demonstrate focal areas of infiltrating carcinoma.

Vacuum-assisted core biopsy offers the ability of obtaining larger (3–5 mm × 19 mm) contiguous samples from the same area by rotating the device rather than by withdrawal and reinsertion, as is necessary with the core biopsy needle. Theoretically, this minimizes seeding of the core tract and affords more accurate diagnosis (18,19). Patients diagnosed by vacuum-assisted or standard CNB have shown no difference in recurrence rates compared with patients diagnosed by excisional breast biopsy, suggesting that with radiation limited seeding of the needle tract does not affect outcome.[14,15,16]

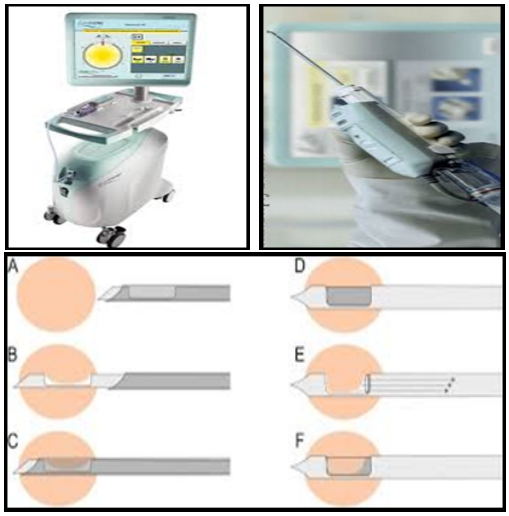

Figure 4a,b,c The complete machine for vaccum assisted core biopsy with the cutter. Diamond-shaped needle tips are better than conventional ones to traverse the fibrous tissue.

CONCLUSION

Lot of advances have been made in the diagnosis of breast lesions where image guided techniques of percutaneous core needle biopsy (CNB), stereotactic biopsy, and vacuum-assisted biopsy may provide promising solutions. As nearly 80 percent of mammographic abnormalities are benign, the need for open biopsy has dramatically decreased, in turn supporting the use of minimally invasive percutaneous techniques. The ability to obtain a diagnosis of cancer prior to surgery can allow for proper pre-operative planning, decrease the subsequent positive margin rate, and thus decrease the re-excision rate. The US-guided CB of breast is better tolerated than surgical biopsy, and can be performed quickly and at a much lower cost. There are two main objectives of percutaneous biopsy techniques: first, achieving the maximum degree of accuracy and second, offering as much information as possible about the tumour (type, grade, invasion, hormonal receptors, HER-2 NEU, etc.). To achieve these objectives, the percutaneous biopsy devices have evolved, from fine-needle aspiration cytology towards core-needle biopsy (CNB) and later vacuum-assisted biopsy (VAB.

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