Minimally Invasive Biopsy Methods – Diagnostics or Therapy? Personal Opinion and Review of the Literature

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Keywords

Minimally invasive biopsy · Vacuum-assisted biopsy · Core needle biopsy

Summary

This article provides an overview of different minimally invasive biopsy (MIB) methods for preoperative assessment of suspicious and indeterminate breast lesions. Accuracy depends on the choice of method and on lesion characteristics. An additional aspect deals with the question whether or not MIB is a suitable therapeutic approach in selected lesions.

Introduction

Minimally invasive biopsy (MIB) has replaced open excisional biopsy in patients with imaging-detected suspicious or indeterminate breast lesions. Compared to surgical excision, MIB has the same or even better precision, decreases the psychological burden affecting the patients, and reduces costs [1–3]. MIB decreases the number of surgical procedures required in patients with impalpable breast cancer compared to diagnostic open surgery [1, 2, 4].

MIB in the Multidisciplinary Setting

The accuracy of MIB depends on the lesion, the choice of biopsy device, and the radiological-pathological correlation. Therefore, interdisciplinary teamwork is mandatory in this field. Helpful in the communication between the radiologist and the pathologist are the Breast Imaging Reporting and Data System (BI-RADS) classification and the B-categorization. BI-RADS was established by the American College of Radiology to standardize radiological terms and reports [5]. It provides diagnostic categories that have implications for guidance regarding follow-up or biopsy of imaging-detected breast lesions. Further assessment with MIB is indicated for

Schlüsselwörter

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Zusammenfassung

Die vorliegende Arbeit gibt einen Überblick über die verschiedenen Methoden der minimal-invasiven Biopsie (MIB) zur Klärung von unklaren und verdächtigen bildgebenden Befunden der Mamma. Voraussetzung für eine hohe Treffsicherheit ist die Wahl der geeigneten Methode in Abhängigkeit vom bildgebenden Befund. Ein weiterer Aspekt beschäftigt sich mit der Frage, ob einzelne minimal-invasive Verfahren auch für einen therapeutischen Ansatz in Frage kommen.

all imaging findings categorized as BI-RADS 4 (suspicious of malignancy) and BI-RADS 5 (highly suspicious of malignancy). To provide quality assurance in the pathological assessment in MIB of non-palpable lesions, European guidelines recommend a pathology classification scheme that includes 5 reporting categories, the so-called B-categorization (table 1) [6, 7]. Both classifications have given an important tool to radiologists and pathologists to work towards optimal patient management.

Accuracy of the Different MIB Methods

Both an appropriate imaging modality and an appropriate biopsy device have to be selected by the radiologist. Current techniques that are available include fine-needle aspiration (FNA), core-needle biopsy (CNB), and vacuum-assisted biopsy (VAB).

Fine-Needle Aspiration

The reported sensitivity and specificity of FNA varies considerably. The frequency of insufficient samples ranges from 8.5–46% [8, 9]. Main disadvantages of FNA include unreliability of hormone receptor status assessment and the lack of distinction between invasive and non-invasive tumors in many cases.

Table 1. Reporting categories of needle biopsies (B-classification), according to the EC Working Group on Breast Screening Pathology [6]

Category	Terminology
B1	normal tissue or uninterpretable
B2	benign (usual ductal hyperplasia, sclerosing adenosis, fibroadenoma, involutionary calcification, periductal mastitis, hamartoma)
B3	benign but of uncertain biological potential (papillomas, radial scar, lobular intraepithelial neoplasia, atypical epithelial proliferation of ductal type (AEDT), phylloides tumor)
B4	suspicious (changes suggestive of in situ or invasive malignancy)
B5	malignant <ul style="list-style-type: none"> a) in situ b) invasive c) uncertain whether in situ or invasive d) other malignancies

In benign results, FNA is not able to reliably confirm the benign nature of calcifications. Because of these problems, there is no role for this method in the assessment of breast lesions [8, 10].

Core Needle Biopsy

CNB allows a tissue cylinder to be excised. Histopathological diagnoses including prognostic criteria such as tumor grading and hormone receptor status can be provided. When 14-gauge needles are employed, a sensitivity of 85–97% and a specificity of 100% have been reported [8, 11–14]. The accuracy is higher in non-calcified lesions. In assessing solely microcalcifications, CNB has limitations that need to be recognized. CNB may miss microcalcifications because the lesion is not reliably sampled. The failure of CNB to spare the patient a surgical procedure is higher for calcifications than for masses [15, 16]. A further limitation is incomplete characterization of disease extent within the samples that may lead to underestimation of disease. Underestimation occurs most commonly in lesions presenting as microcalcifications or architectural distortions. A diagnosis of atypical ductal hyperplasia (ADH) in CNB results in an upgrade to ductal carcinoma in situ (DCIS) or invasive carcinoma during open surgery in up to 56% [15, 17–19]. DCIS, when diagnosed with CNB, is upgraded to invasive carcinoma during surgery in up to 50% [17, 19, 20]. Thus, regarding the higher accuracy of CNB in non-calcified lesions, the method is the standard diagnostic procedure in assessing masses and is commonly used under ultrasound guidance. In microcalcifications suggestive of DCIS, stereotactic VAB has recognized advantages and should be the preferred method. CNB is associated with low morbidity and complication rates and low equipment costs. Precise BI-RADS categorization before biopsy and the use of the appropriate technical equipment (linear transducer with at least 7 MHz) are preconditions for reaching reliable results [12, 14].

Vacuum-Assisted Biopsy

VAB was introduced to circumvent limitations of CNB [21]. VAB removes a greater tissue volume and minimizes sampling error [19, 21]. When targeting microcalcifications with MIB, removal of calcification-containing tissue is mandatory to allow a reliable histopathological diagnosis [22, 23]. For subsequent operative planning, the histological differen-

tiation between invasive carcinoma, DCIS, and ADH is of major significance. Despite the relatively large biopsy specimen, VAB cannot completely avoid the problem of tumor upgrade in the surgical specimen. Nevertheless, several studies documented the higher precision of VAB compared to CNB. VAB reduced the probability of a subsequent upgrade in the surgical specimen by at least half compared to CNB [15, 19]. Stereotactic VAB has been established as the procedure of choice in assessing indeterminate and suspicious microcalcifications graded as BI-RADS 4. These lesions are associated with a malignancy rate of 20–35% [24, 25].

Several studies have documented efficiency and safety of VAB [15, 19, 26, 27]. A standardized procedure and close cooperation between radiologist and pathologist assure the utility of the method [28]. Close communication between the radiologist and the pathologist must deal with the size and morphology of the calcifications documented on the specimen radiograph. If no calcifications are visible in the biopsy specimens and the histological diagnosis is classified as benign, a sampling error may nonetheless have occurred, diminishing the reliability of the diagnosis [16]. VAB may also be used under ultrasound and magnetic resonance (MR) guidance. In ultrasound-guided biopsies, the accuracy of CNB is similar to the accuracy of VAB. Therefore, CNB is chosen most commonly. However, VAB might have advantages in selected difficult cases, such as complex cysts or small unspecific lesions without criteria of malignancy [29]. Precise ultrasound classification according to the BI-RADS categories before biopsy and the use of the appropriate technical equipment are necessary to reach reliable results [29]. VAB, when performed under MR guidance, is a reliable method in the assessment of suspicious lesions visible only on magnetic resonance imaging (MRI) [30, 31].

Biopsy as a Therapeutic Option?

Benign Lesions

A benign diagnosis following CNB or VAB is reliable if the diagnostic procedure is done in a standardized fashion and radiological-pathological correlation is provided in an interdisciplinary setting. Therefore, patients with a benign his-

topathological diagnosis can be spared the surgical removal of the lesion, especially in asymptomatic lesions. Nevertheless, on occasion, patients may warrant complete excision of the lesion. Since VAB gives the opportunity to remove relatively large tissue amounts, it can be used to excise small lesions as an alternative to open surgery for women with a known benign mass, who desire excision but prefer to avoid surgery or who are not suitable for surgery. VAB is well tolerated [32]. Thurley et al. [33] performed ultrasound-guided VAB in 134 patients with benign lesions. In 96% of the patients, the lesion was removed completely as assessed by ultrasound during the procedure. The procedure might be a save option in small fibroadenomas or complex cystic lesions without suggestion of malignant disease [29].

Malignant Lesions

The goal of surgical management in malignant lesions is the complete removal of invasive carcinoma and/or DCIS with clear margins. CNB and VAB are not suitable in this setting and are not recommended as a therapeutic option in malignant disease. Even after complete removal of small microcalcification areas by VAB and the diagnosis of DCIS, surgical excision of the area is mandatory to assure clear margins. Importantly, Penco et al. [34] demonstrated residual cancer at surgery in 87% of 1,016 VAB procedures with malignant preoperative histopathology. After complete removal of microcalcifications by VAB, the rate of residual malignancy at surgery was still as high as 70%.

In an attempt to avoid open surgery, different percutaneous excisional devices were developed with the goal to allow complete removal of small malignant lesions. The Advanced Breast Biopsy Instrumentation (ABBI™; United States Surgical Corp., Norwalk, CT, USA) and SiteSelect™ (SiteSelect Medical Technologies Ltd., Edinburg, TX, USA) devices were manufactured to allow the excision of a whole tissue cylinder. More recently, devices with the utilization of radio-frequency energy have become available [35]. Due to a very high rate of positive margins and the higher complication rate compared to VAB, these tools are however currently not used as standard procedures [10, 36, 37].

Lesions with Uncertain Biological Potential (B3)

With the widespread use of MIB in non-palpable lesions frequently detected in mammography screening, B3 lesions are more often diagnosed than in the prescreening era. Lesions included in this group are atypical epithelial proliferations, lobular neoplasia, phylloides tumor, papillary lesions, and radial scars. Management of B3 lesions remains a challenge for the multidisciplinary team. While the majority of women with a B3 diagnosis will have benign findings after surgical excision, some will have a malignancy associated with the B3 lesion which was insufficiently sampled by MIB. The likelihood of malignancy following a B3 biopsy result varies widely according to the lesion type. The standard approach is

the surgical removal of the lesion and subsequent histological assessment. In an attempt to avoid unnecessary surgery in non-malignant lesions, some groups try to increase the diagnostic yield by performing additional VAB after MIB diagnosis of B3. The success of such an approach depends on the lesion type.

In ADH, most authors recommend surgical excision, because upgrade at surgery reaches 45% [38, 39]. No significant difference was found using VAB with larger needle size [39]. Recently, Kohr et al. [40] found an upgrade at surgery in 20% of patients with ADH. Underestimation in MIB was higher when ADH involved at least 3 foci. The authors defined a subgroup where the microcalcification area was completely removed by VAB. This subgroup was characterized by ADH involving less than 3 foci. Upgrade to DCIS or invasive carcinoma was still 12%. Thus, the authors recommend surgical excision in all ADH lesions.

VAB as a minimally invasive alternative to open surgery was studied in other B3 lesions found via CNB or VAB. Papillary lesions without atypia have a low likelihood of malignancy at surgery. Some authors suggest VAB as an alternative treatment to open surgery in small single papillomas without atypia found upon MIB. However, careful case selection and the goal of complete lesion removal are important [41–43].

Radial scars on MIB warrant surgical excision because of frequently associated malignancies. Some authors recommend VAB as an alternative to open excision in the management of radial scars without atypia in MIB. In some studies, the rate of malignancy detected in open surgery after radial scar diagnosis via VAB was very low [44, 45]. Recently, Rajan et al. [46] showed confirmation of radial scars without atypia in 11/14 patients undergoing VAB after an initial diagnosis of non-atypical radial scar. The question whether or not VAB can be recommended as a treatment option in small radial scars without atypia is still under discussion [47].

Conclusion

CNB and VAB provide high accuracy in assessing suspicious and indeterminate lesions. In benign lesions, MIB can prevent surgery. In malignant lesions, exact preoperative assessment of the extent and characteristics of the lesion assures optimal and individualized treatment. VAB and CNB are standard procedures to assure this goal. Success depends on the right choice of MIB method, a standardized performance, and radiological-pathological correlation on a regular basis. There is limited relevance for MIB as a therapeutic approach in selected benign lesions and selected small non-atypical B3 lesions.

Disclosure Statement

The author declares no conflict of interest.

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