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US-guided Vacuum-assisted Breast Biopsy with Air Localization for Patients with Microcalcifications

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유방촬영술상 이상병변의 공기정위술 후 초음파유도하 진공흡인 유방생검술

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Purpose: Stereotactic vacuum-assisted breast biopsy (SVAB) has recently been introduced as an alternative to the traditional surgical excisional biopsy with needle localization (NLBB). Although SVAB has excellent sensitivity and specificity with very low false negative results, patients might complain about the uncomfortable table and the painful breast compression that is done during SVAB. Furthermore, the cost of SVAB is too expensive to be widely adopted in Korea. So we developed a new technique of vacuum-assisted breast biopsy with air localization (VAB-AL) for the patients suffering with microcalcifications.

Methods: From April 2005 to Oct 2005, 10 microcalcification patients, whose lesions were difficult to be seen on breast ultrasonography, underwent vacuum-assisted breast biopsies with air localization (VAB-AL). First, classical NL was done to localize the mammographic abnormalities. Instead of insertion of the wire, 1 cc amounts of air were injected through a needle. The injected air could be easily visualized as a hyperechogenic density on breast sonography. Vacuum-assisted breast biopsy for the air-induced hyperechogenic densities was then done under sonographic guidance. The specimen radiography was performed to confirm that the lesion was removed.

Results: The mean age of the patients was 46 (range: 37～55). The upper-outer quadrant of the breast was the most common site of the lesions (6/10, 60%); the upper-inner quadrant (2/10, 20%), and then the lower-inner quadrant (1/10, 10%) followed. The specimen radiology for all 10 patients showed that the mammographic abnormalities were successfully removed. The most common pathologic type was fibrocystic disease (6/10, 70%); intraductal carcinoma (3/10, 30%), and then atypical ductal hyperplasia (1/10, 10%) followed. There were no major complications.

Conclusion: Vacuum-assisted breast biopsy with air localization is a new technique that can minimize the complaints of patients with microcalcifications about the uncomfortable table, the painful breast compression and the economic burden of SVAB. This new procedure was successfully performed in our 10 patients, and we believe this procedure shows a lot of promise as one of alternatives to classical NLBB and SVAB. **(J Korean Surg Soc 2006;71:12-17)**

Key Words: Microcalcification, Vacuum-assisted breast biopsy, Mammotome, Air localization

중심 단어: 미세석회화, 진공흡인 유방생검술, 맘모톰, 공기정위술

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INTRODUCTION

Routine breast cancer screening with mammography for women aged 50 years and older is recommended in most industrialized countries. This has resulted in not only reducing breast cancer mortality up to 30～40%,(1) but it has also increased the number of surgical biopsies.(2) Approximately 75% (range: 60～90%) of the breast abnormalities detected on mammography and that are referred for biopsy ultimately prove to be histologically benign,(3-6) and this means

that up to 90% of the women who are exposed to the discomfort, morbidity and cosmetic effects of surgical biopsy have benign lesions.

Although microcalcification is the commonest radiological feature of ductal carcinoma in situ (DCIS),(*7*) breast calcifications are a common occurrence in all aging women. Breast calcifications account for the highest percentage of the benign, screening provoked surgical biopsies.(*8*)

The fact that most breast biopsies are benign heightens the importance of achieving a diagnosis by the least invasive, most accurate method available.

Needle localized breast biopsy (NLBB) has for years been the common diagnostic procedure for evaluating a suspected mammographic lesion,(*9*) but it is invasive and it leaves surgical scars directly on the breast. Stereotactic vacuum-assisted breast biopsy (SVAB) has recently been introduced as a less invasive alternative to NLBB and it has proven to have high sensitivity and specificity with a very low rate of false negative results.(*10*) However, the patients who undergo SVAB have complaints about the uncomfortable table and the painful breast compression that are necessary during the procedure. Furthermore, this procedure requires expensive equipment. There are a few hospitals that have this equipment in Korea in contrast that the use of vacuum-assisted breast biopsy is popular nowadays.

We have developed the new biopsy technique for the patients with microcalcifications; ultrasonography guided vacuum-assisted breast biopsy with air localization (VAB-AL), and this technique is simpler and more cosmetically acceptable than NLBB and it is free of the disadvantages of SVAB.

MATERIALS AND METHODS

1) Patients

From April 2005 to Oct 2005, 10 patients with microcalcifications underwent vacuum-assisted breast biopsies with air localization (VAB-AL). The patterns of microcalcifications were categorized as benign C3 (2 cases) if they showed regional distribution with relatively uniform size, density, and oval or round shape or as C4 (8 cases) if they showed segmental distribution or focal clustering with heterogenous size and density, according to the Breast Imaging Reporting and Data System (BI-RADS). Among the C4 cases, round or oval shape of microcalcifications were 4 cases (4a), mixed with round and linear or rod shape of microcalcifications were 2 cases (4b), mixed with round, linear or branching or comma shaped microcalcifications were 2 cases (4c). These mammographic abnormalities were categorized by a radiologist who had more than 10 years experience in reading mammograms (more than 4,000 cases per year). Thorough information concerning their disease and detailed information on the procedure of this new biopsy technique were given to the 10 patients, and a written consent was obtained from each of them prior to the procedures. Neither a palpable tumor nor a visible mass on mammograms or ultrasound was associated with the areas of microcalcifications.

2) Methods

First, mammography-guided needle localization with using a 20 G breast needle (BLN2007, Kopans™ style) without wire was done to localize the mammographic abnormalities. After confirming the accurate location of the needle with using mammography, 1 cc amounts of air were injected through a 3 cc needle syringe instead of inserting a wire (Fig. 1). Care was taken to prevent leakage of the injected air till it was identified as a hyperechoic density on sonography. Repeated mammography could be done to identify the correct location of the injected air at the site of the mammographic abnormalities.

The patient was then moved to the nearby ultrasonographic room to identify the hyperechogenic densities of injected air with the high-resolution near-field ultrasound units with 13-MHz transducers (HDI 5000, ATL, Bothell, WA, USA).

The hyperechogenic densities of injected air that were close to the location of the microcalcifications were resected with using a US-guided hand-held mammotome unit (Biopsys/Ethicon Endo-surgery inc., Johnson & Johnson Co., Cincinnati, OH, USA) (Fig. 2). Radiography of the specimen was performed to be sure that the intended lesion has been biopsied (Fig. 3).

3) Analysis

The patient characteristics and tumor characteristics were analyzed, and the complications of the procedure were recorded.

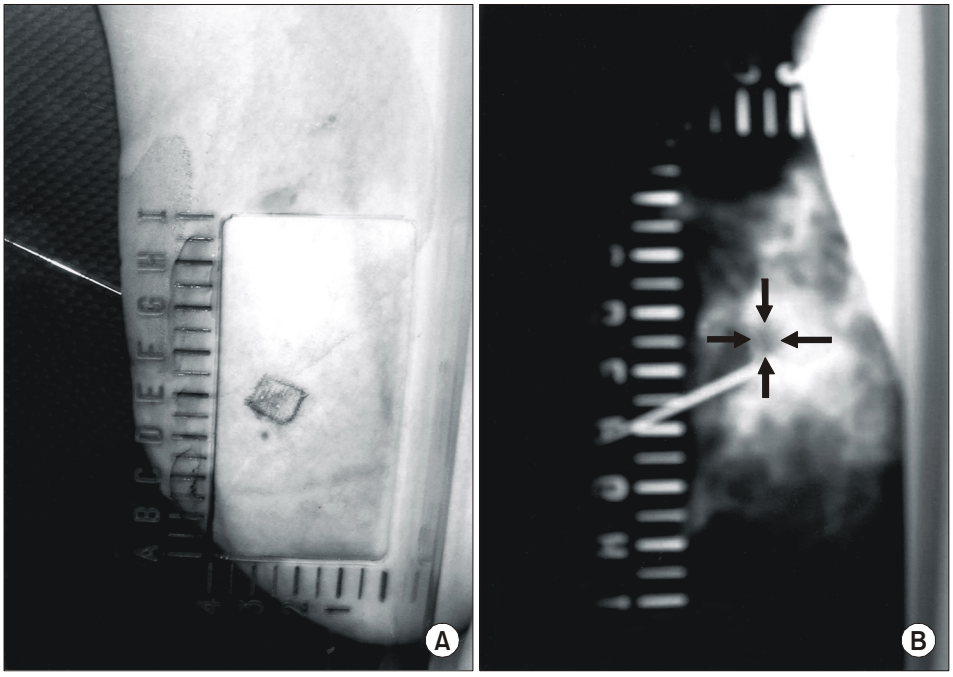

Fig. 1. Air localization. (A) After needle localization in the patients with microcalcifications, 1 cc amounts of air were injected via a needle instead of locating the wire, (B) Accurate localization of the air could be confirmed as oval radiolucent density (arrows) that overlapped on the mammographic abnormality lesions.

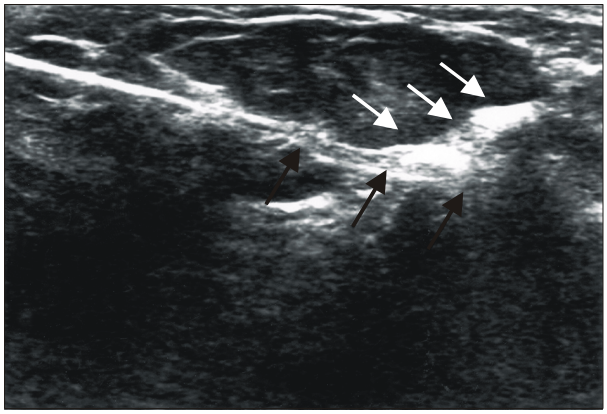

Fig. 2. Removal of the lesion using an 8-gauze Mammotome device. Hyperechogenic densities of injected air (white arrows) were resected by the vacuum-assisted breast biopsy device. The needle tract that was formed by the needle-localization procedure was visualized (black arrows).

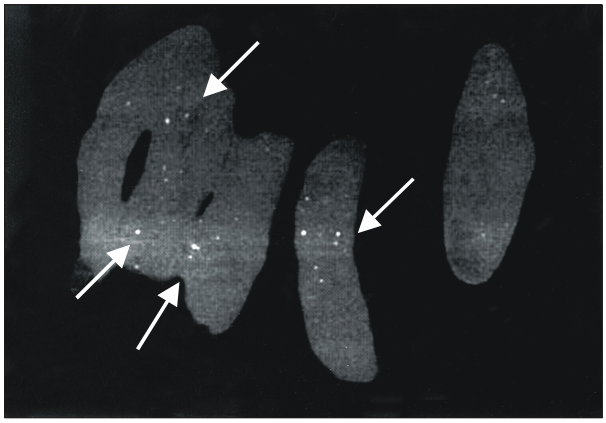

Fig. 3. Specimen radiology. Specimen radiology revealed the microcalcifications (arrow) included within the specimen that was resected with the Mammotome device.

RESULTS

1) Patients characteristics

The mean age of the patients was 46 years (range: 37～55).

The upper-outer quadrant of the breast was the most common site of the lesions (6/10 cases, 60%), and the upper-inner quadrant (3/10, 30%) and lower-inner quadrant (1/10 case, 10%) were the next most common sites.

2) Characteristics of the procedures

Radiology of the specimens of all 10 patients succ-

essfully revealed the microcalcifications.

The most common pathologic type was fibrocystic disease (6/10 cases, 60%), and then intraductal carcinoma (3/10 cases, 30%), and then atypical duct hyperplasia (1/10, 10%) followed. Two of three patients with intraductal carcinoma underwent further total mastectomy, and the other one, breast conserving surgery. One patients with atypical duct hyperplasia received additional wide excision.

One patient (1/10 case, 10%) experienced dizziness during the needle localization, and this was improved with placing the patient in the supine position. Two patients (2/10 cases, 20%) had transient ecchymoses on the overlying skin after the procedure, and this spontaneously resolved with only observation. No major complication was experienced.

DISCUSSION

Microcalcifications that can not be visualized on breast sonography remain a diagnostic problem. For clustered microcalcifications, precise differentiation between the benign and malignant lesions is difficult, (*11-13*) and ultrasound and MRI are often not helpful in resolving this problem.(*14*) Microcalcifications are the current indication for approximately 50% of breast biopsies for nonpalpable abnormalities.(*15*) Especially, lesions of BI-RADS category 4 and 5 and some of the BI-RADS 3 lesions are the classical indications for biopsy.(*16,17*) In our study, we had 2 procedures with C3 and 8 procedures with C4 that were within classical indications for biopsy.

Kettritz et al(*18*) have reported a 33% malignancy rate for their study of SVAB in 500 women with microcalcifications even though 84% (422 cases) of their 500 cases were classified as having BI-RADS 4 or 5 lesions. Our 10 cases showed a similar malignancy rate of 30% (3/10 cases).

The relatively low predictive rate of a malignancy for the patients with nonpalpable mammographic abnormalities has led to the increased use of less invasive biopsy techniques.

Needle localization and open surgical biopsy has been performed for decades, but they are associated with physical pain and mental stress, and there are significant operative and perioperative risks for the patients who are eventually found to have benign lesions. Furthermore, the postoperative scarring and particularly the scarring or complications that occur after multiple surgeries may lead to the impaired diagnostic assessment of future mammograms. The less invasive biopsy technique with conventional core needle biopsy or fine needle biopsy obtains a relatively small volume of tissue (or cells only), and the occasional "misses" may be difficult to avoid, particularly if small indeterminate lesions or microcalcifications are being biopsied.

Stereotactic vacuum-assisted breast biopsy (SVAB) allows contiguous tissue harvesting of a significantly larger volume of tissue.(*19*) In contrast to the popular use of vacuum-assisted breast biopsy (mammotome) for the patients with a sonographically visible breast mass, the relative low cost-effectiveness of SVAB under the system of Korean medical insurance is an obstacle to its popular use for the patients with abnormalities that are noted only upon mammography. Hand-held vacuum-assisted mammotome biopsy can not be performed for the patients with nonpalpable mammographic abnormalities because US-guidance would not be possible. Research on echo-contrast agents is in progress and a number of contrast agents, most consisting of gas bubbles, have been introduced for US imaging to improve or increase the diagnostic yield. (*20*) The ideal criteria for an echocontrast agent are that it should be a safe, effective echo-enhancer and it should be easily available with an economically acceptable cost. It is a well known fact that gas is demonstrated as hyperechogenic density on an ultrasonographic examination. So we hypothesized that it may be possible to identify the location of mammographic abnormalities with sonography if air is introduced as the echo-contrast agent into the exact site of lesions that are localized with mammograms. For all 10 patients in our study, the specimen radiology after the procedures successfully demonstrated the microcalcifications and this was confirmed by the permanent pathology.

In our early two cases, we experienced retraction of the injected air through the syringe because of high intraparenchymal pressure of dense breast. So after those cases, we fixed the syringe with plaster to prevent the air leaking. There had been no cases of air leakage along the needle tract that we thought 1 cc amount of air would be appropriate for this

procedure.

The failure rate for needle localization breast biopsy with using nonstereotactic needle insertion is low; it ranges from 0% to 6%.(*21,22*) There is the possibility for failure and complications during all parts of the procedure. In our study, it is absolutely critical to ensure the accuracy of needle placement, and to prevent air leakage during the procedure. We kept and fixed the needle and syringe so that we could easily identify the depth of inserted portion of needle and the 1 cc amounts of injected air until the probe of the mammotome device met the air-induced hyperechogenic density under sonography guidance. Specimen radiology was done in all cases to identify the microcalcifications. The pieces of specimen were seperatively bottled up according to the presence or absence of microcalcifications on the pieces of specimen radiology and they were sent to the pathologist to confirm the microcalcification in the specimen. With using these careful efforts, we successfully performed all the procedures (failure rate: 0%, 0/10).

J-wire localization could be used for this procedure instead of air localization. But, J-wire should be removed before the actual performance of mammotome biopsy procedure to avoid the collision of mammotome probe and J-wire.

We could insert marker via mammotome probe to identify the location of the lesion for the following operation.

CONCLUSION

Vacuum-assisted breast biopsy with air localization is a new technique that can minimize complaints from the patients with microcalcifications concerning the uncomfortable table, the painful breast compression and the economic burden of SVAB, and this new technique is less invasive than NLBB. The procedure was performed successfully in all 10 of our patients, and it has promise to be one of the alternatives to the classical NLBB and SVAB, but further evaluation to establish the usefulness of this technique is needed.

FUTURE TRIALS

Randomization of the patients with mammography-only abnormalities that are classified as more than C4 according to the Breast Imaging Reporting and Data System (BI-RADS) is now in progress. One arm includes the patients who scheduled to undergo NLBB and the patients in the other arm are scheduled to undergo SVAB-AL. Failure rates, accuracy, complications, cost effectiveness and pathologic underestimation between the groups will be analyzed.

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