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# Directional, Vacuum-Assisted Stereotactic Biopsy of Nonpalpable Breast Lesions with Surgical Correlation

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**Background :** The vacuum suction probe is an alternative to the 14-gauge needle and automatic gun for performing stereotactic core needle biopsies. This study assesses the accuracy of the directional, vacuum-assisted stereotactic biopsy (DVAB) of nonpalpable breast lesions. **Materials and Methods :** Four hundred and thirty DVABs were performed on 412 patients between January 1998 and December 2000. Using 11-gauge or 14-gauge needles, six to 22 core samples (mean=13) per lesion were obtained. One hundred and fifty-five lesions were subsequently excised, and 223 patients with benign diagnoses had mammographic follow-ups. The results of the DVABs and surgeries were reviewed and correlated. **Results :** The results of the DVABs and surgeries were concordant in 98 of 113 cases and discordant in 15 cases, including 15 cases for which DVAB results indicated ductal carcinoma *in situ* (DCIS) but surgery yielded invasive carcinoma. The overall sensitivity, specificity, and positive and negative predictive values of the DVABs were 99.3%, 100%, 100%, and 99.7%, respectively. The positive predictive value for the presence of invasion was 100% and the negative predictive value was 81%. Histologic comparison was performed in 19 of 31 atypical ductal hyperplasias (ADHs) diagnosed with DVAB. Of the 19 ADHs, histologic findings showed DCIS in one, ADH in 9, atypical lobular hyperplasia in one, and no residual lesions in 8. Cases with less than 3 lobules were involved with ADH, or cases with more than 50% of microcalcification retrieved were all adequately diagnosed. Only 17 of 240 benign lesions diagnosed with DVAB were subsequently excised. These were confirmed to be ADH in three of the cases, and other benign diagnoses were confirmed in 14 of the cases. The others were confirmed to be benign lesions upon mammographic follow-up. Lesions less than 1.0 cm in maximal diameter can be removed completely by DVAB. **Conclusion :** DVAB reduced the number of underestimated infiltrating tumors, but still, significant cases were found to be invasive. ADH diagnosed with DVAB does not require subsequent surgery for a rule-out diagnosis of carcinoma, if the sampling is adequate and less than 3 lobules are involved with ADH. Lesions less than 1.0 cm in maximal diameter can be removed completely by DVAB. Benign lesions diagnosed with DVAB did not require subsequent surgery, so DVAB can reduce the probability of unnecessary surgery for benign lesions and/or small lesions.

**Key Words :** Breast Diseases-Stereotactic Techniques-Surgery

Mammographies can demonstrate non-palpable breast lesions earlier than they can be diagnosed by physical examinations can diagnose them.[1] Most of non-palpable breast lesions are benign, but 15-35% of them prove to be malignant.[1,2] When breast cancer is diagnosed before it becomes palpable, breast cancer mortality can be reduced, even for younger women.[3] However, some benign lesions have mammographic features that mimic malignant lesions, and some malignant lesions have mammographic features that mimic benign lesions. For reaching a conclusive diagnosis, mammography alone is not enough, so tissue must be removed and examined histologically.[1] Thus, the standard of care for the diagnosis of nonpalpable breast lesion has traditionally been surgical biopsy after needle localization.[1,4] The diagnosis and treatment of non-palpable breast carcinoma in recent years have commonly required two separate surgical procedures. First, needle localization and surgical breast biopsy is performed. This diagnostic biopsy is the necessary surgical procedure under three conditions: the patient desires to undergo breast-conserving therapy, the diagnosis is of pure intraductal carcinoma with no disease at the margins, and there is no evi-

dence of residual tumor at mammography. If all of these criteria are not met, the patient usually needs to undergo additional breast surgery. If the tumor has extended to the margins of the diagnostic biopsy specimen or if the patient chooses to undergo mastectomy, she would have to return to undergo additional surgery. Furthermore, if the carcinoma is invasive, axillary lymph node dissection would be required for diagnostic and therapeutic reasons.[5,6] However, surgery is invasive and expensive, and it causes scarring and deformity of the breast.[1,7,8] These features are particularly disadvantageous in light of the fact that approximately 80% of palpable breast masses that undergo biopsies are benign. Thus, biopsy is the best way for reducing the disadvantages of surgery if we can get a sufficient tissue for definitive diagnosis with percutaneous biopsy procedure can be acquired. Directional, vacuum-assisted stereotactic biopsy (DVAB) is being used increasingly for the diagnosis of indeterminate or suspicious lesions identified at mammography and it has recently been advocated as an alternative to excisional, diagnostic surgical biopsy and automated large core biopsy in nonpalpable breast lesions detected with mammography.[9,10] Core biopsy can be performed faster, with less scarring and at a lower cost than diagnostic surgical biopsy.[1,7,8]

Ultrasound core needle biopsy (CNB) is becoming the first-line guidance technique for CNB in the evaluation of non-palpable solid breast lesions. It can be virtually be applied to any mass visualized on sonograms and it has many advantages over stereotactic CNB.[4,11] But, lesions suspected of calcification and masses not identified by sonograms are now primarily applied in the stereotactic CNB.[1,4,12] Some studies have addressed the impact of stereotactic CNB on the surgical treatment of impalpable breast lesions.[4,13] Although stereotactic 14-gauge automated core biopsy is accurate and cost-effective,[10,14,15] it has limitations; it is less successful in calcific lesions than in masses because of problems with calcification retrieval and histologic underestimation of lesions containing atypical ductal hyperplasia (ADH) and ductal carcinoma *in situ* (DCIS).[10,15,16] Thus, lesions smaller than 5 mm have been excluded from stereotactic 14-gauge automated core biopsies.[8,17] Also, lesions that are superficial or in thin breasts may not be amenable to the stereotactic 14-gauge automated core biopsy.[18,19] The stereotactic automated core biopsy can underestimate malignancy, resulting in the lesion's need for additional surgery.[9,10,19-22]

An 11-gauge DVAB has advantages in lesions in which the stereotactic 14-gauge automated core biopsy is less reliable or not feasible, including lesions that are small or superficial, are in thin breasts, or contain calcifications. The DVAB can extract larger and more contiguous specimens.[9,10,22-25] Moreover, a some data addresses the cost-effectiveness of the 11-gauge DVAB.[26] Therefore, the authors expect that the DVAB can minimize underestimation of the diagnosis and unnecessary subsequent surgery, and it allows the patient to proceed directly to definitive surgical treatment. According to the Darling *et al.*,[27] underestimation rates of DCIS and infiltrating duct carcinoma (IDC) were 39% and 19% with the 14- and 11-gauge DVABs, respectively. However, differences between the 14-gauge DVAB and the automated 14-gauge needle did not reach statistical significance.

This study was undertaken to compare nonpalpable breast lesions revealed by the DVAB (using 11-gauge or 14-gauge needle) with those revealed by subsequent surgery. We performed a retrospective study to assess the overall sensitivity, specificity, positive/negative predictive value, and positive/negative predictive value for the presence of invasion; to evaluate the requirement of subsequent surgery or not in ADH diagnosed with the DVAB for rule-out carcinoma; and to determine the sufficiency of DVAB-diagnosed benign lesions in order to confirm the diagnoses without unnecessary subsequent surgery.

## MATERIALS AND METHODS

From January 1998 to December 2000, stereotactic CNBs were consecutively performed on 430 breast lesions visualized on mammograms from 412 patients at the University of Texas, MD Anderson Cancer Center. The patient was set in the prone position in the stereotactic unit (LoRad with Digital Spot Mammography; LoRad, Danbury, CT, U.S.A.). Scout images were obtained, and the target coordinates were confirmed. The skin was cleaned in an aseptic manner. Thereafter, 1% xylocaine with epinephrine mixed with sterile sodium bicarbonate was administered as local anesthesia. A short skin incision was made with a scalpel. The lesion was targeted and the biopsy device was advanced to the appropriate depth. The pre-fire and post-fire images were obtained. Core samples were obtained, and the cores were radiographed. The areas containing calcifications were marked with India ink. CNB was performed by use of a single-insertion, directional, vacuum-assisted breast biopsy instrument (Mammotome; Biopsys Medical, Irvine, U.S.A.) by radiologists. A single needle insertion was used, and an 11-gauge (or 14-gauge) probe was rotated to obtain more tissue specimens. An average of 13 (6-22) cores per lesion was obtained. Specimen radiography was performed for all cases of calcification. The cores were placed in 10% neutral buffered formalin solution and sent to the

histology laboratory for routine processing.

The results of stereotactic core needle biopsy were correlated with the subsequent surgical histology to identify cases in which a lesion was underestimated by stereotactic core needle biopsy. Accurately diagnosed cases were defined as those in which the histologic diagnosis from the excisional biopsy was the same, or a lower, stage than the diagnosis of the stereotactic core needle biopsy, including cases in which no residual lesions were discovered during surgery.

The histologic diagnoses of DVAB specimens were categorized as to type of lesions: 1) malignant neoplasms [invasive carcinoma, DCIS with undetermined invasion, DCIS, and DCIS vs. LCIS (lobular carcinoma *in situ*)], 2) ADH/atypical hyperplasia (AH), 3) lobular neoplasia [LCIS or ALH (atypical lobular hyperplasia)], and 4) benign lesions (specific types or not otherwise specified). Subsequent confirmation of DVAB findings consisted of surgery (155 lesions) and clinical follow-up by mammography for at least 12 months (223 lesions). Histopathologic results of DVAB and follow-up were correlated.

Table 1. Pathologic diagnosis on 430 stereotactic core needle biopsies and 155 subsequent surgical confirmation

| Category | Stereotactic CNB No. of lesions (%) | Subsequent surgery No. of lesions (%) |
|---|---|---|
| Malignant | 143 (33.3) | 113 (72.9) |
| Invasive carcinoma | 44 (10.2) | 35 (22.6) |
| DCIS with undetermined invasion | 2 (0.5) | 1 (0.7) |
| DCIS | 96 (22.3) | 76 (49.0) |
| DCIS vs. LCIS | 1 (0.2) | 1 (0.7) |
| ADH/AH | 31 (7.2) | 19 (12.3) |
| ADH | 28 (6.5) | 19 (12.3) |
| AH | 3 (0.7) | 0 |
| Lobular neoplasia | 16 (3.7) | 6 (3.9) |
| LCIS | 8 (1.9) | 5 (3.2) |
| ALH | 7 (1.6) | 0 |
| ALH vs. LCIS | 1 (0.2) | 1 (0.7) |
| Benign | 240 (55.8) | 17 (11.0) |
| FA | 63 (14.7) | 0 |
| Papilloma | 9 (2.1) | 1 (0.7) |
| Other specific lesions | 103 (24.0)[a] | 9 (5.8)[b] |
| NOS | 65 (15.1) | 7 (4.5) |
| Total | 430 (100) | 155 (100) |

[a]Other proliferative lesions (45 FCCs, 5 moderate to florid DH, 12 SA, and 1 CAPSS) and non-proliferative lesions (23 mild DH, 5 FN, 8 cysts, 3 inflammation, and 1 apocrine metaplasia). [b]Other proliferative lesions (2 SA and 6 FCC) and non-proliferative lesion (1 mild DH).
ADH: atypical ductal hyperplasia, AH: atypical hyperplasia (cannot exclude ADH), ALH: atypical lobular hyperplasia, CAPSS: columnar alteration with prominent apical snouts and secretion, DCIS: ductal carcinoma *in situ*, DH: ductal hyperplasia, FA: fibroadenoma, FCC: fibrocystic changes, FN: fat necrosis, IDC: invasive ductal carcinoma, ILC: invasive lobular carcinoma, LCIS: lobular carcinoma *in situ*, NOS: not otherwise specified (benign, fibrocystic changes, inflammation, and/or fibrotic breast parenchyma, etc.), SA: sclerosing adenosis.

## RESULTS

Four hundred and thirty stereotactic DVABs were performed in 412 females. The average age was 56.1 years, with a range from 22 years to 83 years. Females in the 50-59 year age group were biopsied most commonly; they account for 35% of the total. The diagnoses of 430 stereotactic DVABs are summarized in Table 1. Confirmation was available for 155/430 (36 %) DVABs (Table 1).

### Malignant neoplasia

Subsequent confirmative diagnoses of malignant neoplasms on stereotactic CNBs are shown in Table 2. Of 113 cases, 35 cases were diagnosed as invasive carcinoma, 1 DCIS with undetermined

Table 2. Subsequent findings of 113 cases diagnosed as malignant neoplasms on stereotactic core needle biopsy

| Stereotactic CNB diagnosis | Subsequent surgical specimens (%) |
|---|---|
| Invasive: 35 | |
| IDC: 25 | IDC: 18 (72.0) |
| | ILC: 2[a] (8.0) |
| | Tubular carcinoma: 1 (4.0) |
| | DCIS: 3 (12.0) |
| | NRT: 1 (4.0) |
| Mucinous Carcinoma: 1 | Mucinous carcinoma: 1 (100) |
| ILC: 2 | ILC: 2 (100) |
| IDC vs. ILC: 3 | IDC: 1 (33.3) |
| | ILC: 1 (33.3) |
| | Mixed IDC & ILC: 1 (33.3) |
| Mixed IDC & ILC:1 | ILC: 1 (100) |
| Tubular Carcinoma: 2 | Tubular carcinoma: 1 (50) |
| | NRT: 1 (50) |
| ACC: 1 | ACC: 1 (100) |
| DCIS with undetermined invasion: 1 | IDC: 1 (100) |
| DCIS: 76 | Invasive carcinoma: 15 (19.7) |
| | IDC: 13 (17.1) |
| | ILC & DCIS: 2 (2.6) |
| | DCIS: 53 (69.7) |
| | ADH: 4 (5.3) |
| | No residual tumor: 4 (5.3) |
| | DH: 1 (1.3) |
| | FCC: 1 (1.3) |
| | NRT: 2 (2.6) |
| DCIS vs. LCIS: 1 | LCIS: 1 (100) |

[a]Previous stereotactic core needle biopsy was diagnosed as IDC and LCIS in one case.
CNB: core needle biopsy, ACC: adenoid cystic carcinoma, DCIS: ductal carcinoma *in situ*, IDC: invasive ductal carcinoma, ILC: invasive lobular carcinoma, LCIS: lobular carcinoma *in situ*, NRT: no residual tumor.

invasion, 76 DCIS, and 1 DCIS vs LCIS on CNB.

In the group of invasive carcinomas, invasive carcinoma was confirmed in 30 cases on surgical specimens. DCIS only and no residual tumor (NRT) were found in 3 cases and 2 cases, respectively, but obvious invasive lesions were found in all of these cases on histologic review of stereotactic CNBs. In one case with diagnosis of DCIS with undetermined invasion, infiltrating duct carcinoma was found upon subsequent surgical excision.

In 76 cases with diagnosis of DCIS, invasive carcinoma was found in 15 (19.7%) cases. So, overall histologic underestimation occurred in 15 (13.3%) out of 113 malignant neoplasias in this study. However, of the 15 cases, 7 cases had invasive components of less than 5 mm, including 2 cases with less than 1 mm (Table 3). Fifteen underestimated cases consisted of 8 mixed (5 mixed comedo and cribriform type, and 3 mixed comedo and

Table 3. Radiologic and subsequent histologic findings of underestimated ductal carcinoma *in situ* on stereotactic core needle biopsy in 15 cases

| Case No. | Preoperative mammogram | | MC core No./ total core No. | Invasive tumor size (cm) |
|---|---|---|---|---|
| | MC pattern | Lesion size (cm) | | |
| 1 | P | 0.5 | 9/15 | 0.1 |
| 2 | S | 3.0 | 3/6 | 0.35 |
| 3 | P | 0.5 | 5/10 | 0.5 |
| 4 | P | 0.8 | 5/9 | 1.5 |
| 5 | P | 2.5 | 6/9 | 1.1 |
| 6 | P | 1.0 | 3/6 | 0.55 |
| 7 | I | 3.5 | 8/8 | 0.15 |
| 8 | P | 1.0 | 10/12 | 0.6 |
| 9 | I | 1.0 | 4/9 | 1.5 |
| 10 | P | 1.0 | 6/11 | 0.9 |
| 11 | P | 8.5 | 12/12 | 0.8 |
| 12 | P | 7×5 | 4/5 | 0.4 |
| 13 | P | 4×3.5 | 11/18 | 0.1 |
| 14 | P | 3.0 | 6/8 | 0.25 |
| 15 | A | 6.0 | 4/1 | 2.5 |
| Mean | | 2.9 | 6.4/9.9 | 0.75 |

11-gauge probe was used to obtain tissue specimens. #8 and 15 were invasive lobular carcinoma with ductal carcinoma *in situ*.
MC: microcalcification, P: pleomorphic, S: scattered, I: irregular, A: amorphous.

Table 4. Extent of microcalcification as determined by mammogram in the completely excised cases of ADH (9) and malignant (6) lesions by stereotactic core needle biopsy

| Case No. | CNB diagnosis | MC pattern | Maximal dimension (cm)[a] | MC core No./ total core No. | % MC removal |
|---|---|---|---|---|---|
| 1 | ADH | I | 0.5 | 4/8 | 100 |
| 2[b] | ADH | A | 1.0 | 7/11 | 100 |
| 3 | ADH | G | 0.5 | 3/8 | |
| 4 | ADH | PT | 0.5 | 4/11 | 100 |
| 5 | ADH | P | 0.5 | 10/15 | |
| 6[b] | ADH | A | 8.5 | 6/22 | |
| 7 | ADH | A | 0.5 | NA | |
| 8 | ADH | H | 0.9 | 4/7 | |
| 9 | ADH | I | 1.0 | 6/11 | |
| 10 | DCIS | C | 0.5 | 3/9 | |
| 11 | DCIS | C | 0.5 | 5/15 | 100 |
| 12 | DCIS | IND | 0.6 | 4/11 | 100 |
| 13 | DCIS | A | 0.5 | 8/10 | 100 |
| 14 | Tubular ca | A | 0.8 | 6/11 | |
| 15 | IDC | PT | 0.5 | 5/10 | |
| Mean | | | 1.2 | 4.7/11.4 | |

[a]This is mammographically measured size. [b]11-gauge probe was used except these cases.
A: amorphous, ADH: atypical ductal hyperplasia, C: Casting (branching), MC: microcalcification, CNB: core needle biopsy, DCIS: ductal carcinoma in situ, G: granular, H: heterogenous, I: irregular, IDC: invasive ductal carcinoma, IND: indeterminate, NA: not available, PT: punctate.

Table 5. Correlation of results of stereotactic core biopsy with subsequent surgery and/or clinical follow-up

| Stereotactic core biopsy | Surgical & clinical follow-up | | Total |
|---|---|---|---|
| | Benign | Malignant | |
| Benign | 284[a] | 1[b] | 285 |
| Malignant | 0 | 145[c] | 145 |
| Total | 284 | 146 | 430 |

[a]Includes 30 cases of ADH/AH, 14 cases of lobular neoplasia, and 240 cases of other benign lesions. [b]Includes 1 case of ADH on CNB turned out DCIS on surgery. [c]Includes 1 case of LCIS and 1 case of ALH/LCIS on CNBs turned out mixed IDC and ILC on surgery. These two patients had known invasive ductal carcinomas, and the CNBs were done on adjacent the other lesions, respectively.
ADH: atypical ductal hyperplasia, AH: atypical hyperplasia, CNB: core needle biopsy, DCIS: ductal carcinoma *in situ*, LCIS: lobular carcinoma *in situ*, ALH: atypical lobular hyperplasia, IDC: invasive ductal carcinoma, ILC: invasive lobular carcinoma.
Sensitivity=99.3% (145/146). Specificity=100% (284/284). Positive predictive value=100% (145/145). Negative predictive value=99.7% (284/285).

Table 6. Correlation of results of stereotactic core biopsy and subsequent surgery among the malignant neoplasms

| Stereotactic core biopsy | Surgical pathology results | | Total |
|---|---|---|---|
| | No invasion | Invasion | |
| No invasion | 62 | 15 | 77 |
| Invasion | 5[a] | 31[b] | 36 |
| Total | 67 | 46 | 113 |

[a]Includes 4 cases of IDC, and a case of tubular carcinoma identified at stereotactic core biopsy but not seen invasion (3 DCIS and 2 NRT) at surgery (true positive). [b]Includes 1 case of DCIS with undetermined invasion on stereotactic CNB. Positive predictive value for the presence of invasion=100% (36/36). Negative predictive value for the presence of invasion=81% (62/77).
IDC: invasive ductal carcinoma, DCIS: ductal carcinoma *in situ*, NRT: no residual tumor, CNB: core needle biopsy.

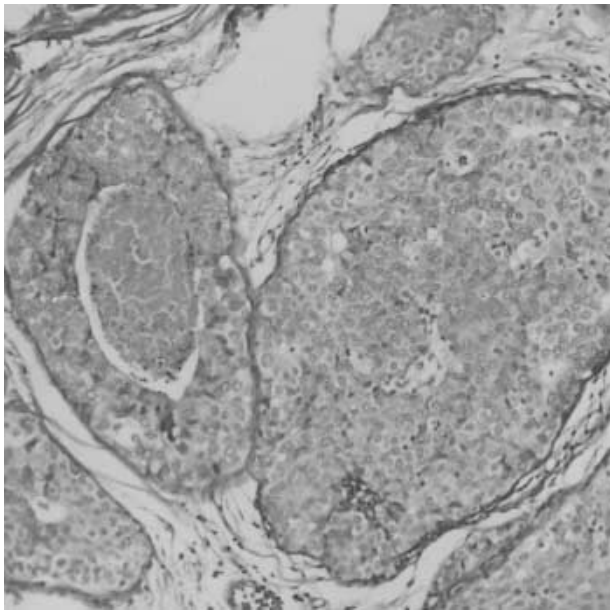

Fig. 1. Histologic findings of underestimated core needle biopsied ductal carcinoma *in situ*, comedo type.

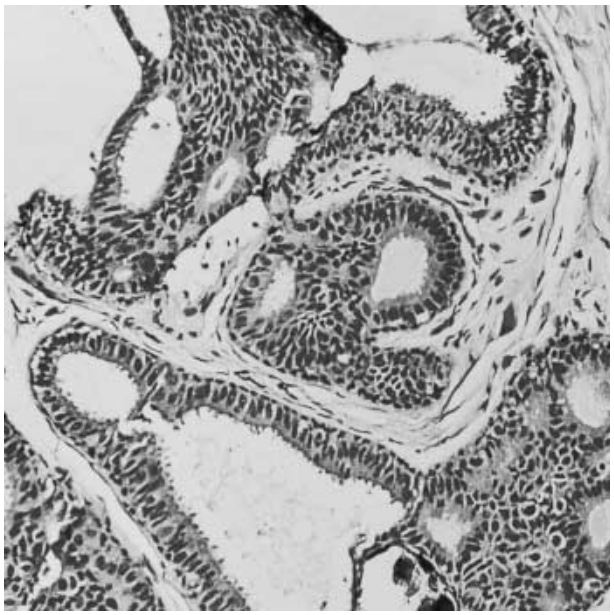

Fig. 2. Histologic findings of underestimated core needle biopsied atypical ductal hyperplasia, micropapillary pattern with microcalcification.

micropapillary type), 4 comedo, 2 solid, and 1 micropapillary types (Fig. 1). Their nuclear grade showed 11 high and 4 intermediate grades. No low nuclear grade DCIS was found in this group. NRT on subsequent surgical specimens was found in 4 cases of DCIS and 2 cases of invasive carcinoma (1 IDC and 1 tubular carcinoma). Therefore, lesions less than 1.0cm in maximal

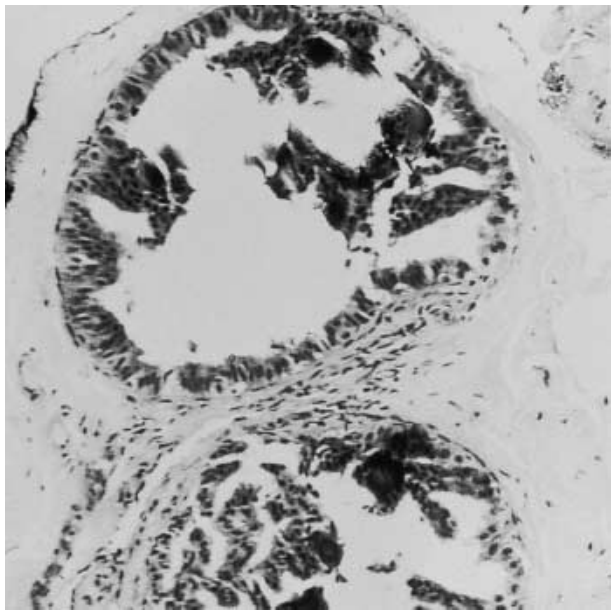

Fig. 3. The same case as the figure 2 shows atypical ductal hyperplasia with background of diffuse columnar alteration with prominent apical snouts and secretions (CAPSS) with microcalcification in core needle biopsy.

diameter can be removed completely by DVAB. The mammographic data of these cases are listed in Table 4. The correlation of results of stereotactic core biopsy and subsequent surgery or clinical and mammographic follow-up is shown in Table 5 and 6. The positive predictive value of stereotactic biopsy for the presence of invasion was 100% (36 of 36 cases) and the negative predictive value was 81% (62 of 77 cases) (Table 6).

## Atypical ductal hyperplasia/Atypical hyperplasia (ADH/AH)

Thirty-one ADH/AHs were diagnosed on stereotactic CNB. Nineteen stereotactic biopsies were subsequently excised and confirmed 1 (5%) ALH, 9 (47%) ADH, 1 (5%) DCIS, and 8 (42%) no atypia (Table 7). Therefore, malignant neoplasms accounted for about 5% of CNBs with an ADH diagnosis.

Histologic underestimation occurred in one (5%) of the 19 ADHs in this study (Fig. 2). The rate of overall microcalcification retrieval was 15% to 100% (mean; 77±29.3%). No underestimated case occurred in cases of more than 50% of the retrieval rate of microcalcification. The underestimated case was detected as a big microcaicified lesion (7×7×4 cm) by mammogram. The obtained number of core biopsies was 20, and the 10 of them showed microcalcification. Stereotactic CNBs were shown to be ADH involving 3 lobular units with background of diffuse

Table 7. Surgical finding of 19 core needle biopsy cases diagnosed as atypical ductal hyperplasia and 6 core needle biopsy diagnosed as lobular neoplasia

| CNB diagnosis | Surgical findings (%) | | | |
|---|---|---|---|---|
| ADH (n=19) | No atypia | ALH[a] | ADH | Carcinoma |
| | 8 (42) | 1 (5) | 9 (47) | 1 (5)[b] |
| Lobular neoplasia (n=6) | LCIS | DCIS | ILC | Mixed IDC & ILC |
| LCIS (n=5) | 3 (50) | 1 (16.7) | 1 (16.7) | 0 |
| ALH vs. LCIS (n=1) | 0 | 0 | 0 | 1 (16.7)[c] |

[a]Includes single focus of ALH; on review of the core needle biopsy, atypical hyperplasia with Pagetoid extension was identified. [b]Includes 1DCIS. [c]This patient had known invasive ductal carcinoma, and the core needle biopsy was done on adjacent the other lesion.
ADH: atypical ductal hyperplasia, ALH: atypical lobular hyperplasia, IDC: invasive ductal carcinoma, ILC: invasive lobular carcinoma, LCIS: lobular carcinoma *in situ*, CNB: core needle biopsy, DCIS: ductal carcinoma *in situ*.

columnar alteration with prominent apical snouts and secretions (CAPSS) (Fig. 3). The retrieval rate of microcalcification for this case was 15%. Even though 20 CNBs were obtained, the obtained samples were not representative of limited sampling for adequate diagnosis. Cases with less than 3 lobules were involved with ADH, or cases of more than 50% of microcalcification retrieved were all adequately diagnosed.

Nine cases of ADH were completely excised by stereotactic CNB and confirmed by subsequent surgical excision. Therefore, lesions less than 1.0 cm in maximal diameter can be removed completely by DVAB. The mammographic data of these cases are listed in Table 4.

### Lobular neoplasia

Surgical findings of 5 CNBs diagnosed as LCIS revealed 1 ADH, 1 ALH and 3 LCIS; and 1 CNB diagnosed as ALH vs LCIS revealed mixed IDC and ILC (Table 7).

### Benign lesions

Of the 240 cases with a diagnosis of benign lesions (fibroadenoma (FA), papilloma, other specific lesions and NOS (showed on stereotactic CNB, only 17 cases (2 sclerosing adenosis (SA), 6 fibrocystic changes (FCCs), 1 papilloma (Pap), 1 ductal hyperplasia (DH), and 7 NOS) underwent confirmative surgery. None of 63 FA underwent surgery. Mammographic follow-up for 12 months or longer of the benign lesions (63 FAs, 8 Pap, 39 FCCs, 10 SA, 5 other proliferative lesions, 40 non-proliferative lesions, and 58 NOSs) was done. On subsequent excision, 2 SA were found to be an ADH and a SA, 1 Pap was found to be a Pap, 1 DH was found to be an ADH, 6 FCCs confirmed as 2 FCCs, 1 FN, an ADH and ALH, a CAPSS and ALH, and a fibrosis, and 7 NOS were found to be 3 DH, 2FCC, a NOS, and a fibrosis (Table 8)

Table 8. Subsequent surgical follow-up of 17 cases and clinical mammographic follow-up of 223 cases results with benign diagnosis on stereotactic core needle biopsy

| Stereotactic CNB diagnosis | Subsequent surgical diagnosis | Mammography follow-up[a] |
|---|---|---|
| FA: 63 | | FA: 63 |
| Pap: 9 | Pap: 1 | Benign: 8 |
| Others | | |
| Benign, NOS: 65 | DH: 3, Fibrosis: 1, FCC: 2, NOS: 1 | Benign: 58 |
| FCC: 45 | FCC: 2, FN: 1, Fibrosis: 1 | Benign: 39 |
| | ADH & ALH: 1 | |
| | CAPSS & ALH: 1 | |
| Non-proliferative lesion: 40 | | Benign: 40 |
| SA: 12 | ADH: 1 | Benign: 10 |
| | SA: 1 | |
| DH: 5 | ADH: 1 | Benign: 4 |
| CAPSS: 1 | | Benign: 1 |

[a]Mammography follow-up for 12 months or longer.
ADH: atypical ductal hyperplasia, ALH: atypical lobular hyperplasia, CAPSS: columnar alteration with prominent apical snouts and secretion, DH: ductal hyperplasia, FA: fibroadenoma, FCC: fibrocystic changes, not otherwise specified (benign, inflammation, and/or fibrotic breast parenchyma, etc), Pap: papilloma, SA: sclerosing adenosis, CNB: core needle biopsy.

The overall sensitivity, specificity, positive predictive value and negative predictive value of CNB were 99.3% (145 of 146 cases), 100% (284 of 284 cases), 100% (145 of 145 cases), and 99.7% (284 of 285 cases). There was no false-positive diagnosis (Table 5).

## DISCUSSION

With the availability of the percutaneous imaging-guided biopsy technique, the radiologist must determine whether the information obtained from a core biopsy is adequate for the surgeon to plan appropriate therapy in patients with nonpalpable mammary lesions. Stereotactic breast biopsy has evolved as a less-invasive alternative to open biopsy in the evaluation of nonpalpable mammographic abnormalities.[4,11] It is widely used in place of surgical biopsy for the diagnosis of mammographically detected lesions of the breast. It has been suggested that stereotactic core biopsy of mammary lesions may obviate diagnostic surgical biopsy in many cases, which allows the patient to proceed directly to definitive surgical treatment.[15,28] Although stereo-

tactic core needle biopsy has been shown to be highly accurate in diagnosing benign and malignant mammary diseases, it can underestimate malignancy.[20,22,24,25] Many breast cancers contain a mixture of intraductal and infiltrating components, and also can have ADH. Given that the total volume sampled stereotactically is smaller than that sampled by surgical biopsy, it is not surprising that the stereotactic core biopsy technique may result in small areas of DCIS or invasion being missed, particularly in larger lesions that consist predominantly of ADH or DCIS, respectively. Moreover, because of the difficulty in distinguishing ADH from DCIS, particularly low-grade DCIS, more tissue is often required to make a firm diagnosis.[21] Open surgical excision of these lesions has been recommended because of this observation. Underestimation due to stereotactic core needle biopsy often results in the need for additional surgery. Therefore, minimizing underestimation would be desirable. A newer percutaneous breast biopsy technique using the vacuum-assisted biopsy device is an alternative to the automatic gun technique for performing stereotactic core needle biopsy.[9,10,19,20,22-24,26] This method, using either 14- or 11-gauge probes can extract larger specimens, more specimens per unit time, and more contiguous tissue than the automated large-core device with no increase in complications. Assuming equal accuracy of needle placement, we would expect a biopsy technique that removes more tissue from the lesion site to be more accurate. Burbank[9] described no underestimation of DCIS in 32 lesions that were biopsied with a 14-gauge DVAB. But, Won *et al*.[22] reported a 15% underestimation of DCIS in 20 cases that were biopsied with a 11-gauge DVAB, and Brem *et al*.[24] reported ADH which was underdiagnosed in 25% of the lesions in tissue obtained from 11-gauge DVAB.

In the present study, among the 76 cases with a diagnosis of DCIS, invasive carcinoma was found in 15 (19.7%) cases. So, overall histologic underestimation occurred in 15 (13.3%) out of 113 malignant neoplasia cases in this study. However, of the 15 cases, 7 cases had an invasive component of less than 5 mm including 2 cases of less than 1 mm. Thus, microinvasion might not be detected in stereotactic CNB. The majority of the underestimated cases were comedo type or mixed type bearing comedo area, and high nuclear grade DCIS. Therefore, thorough sampling and examination are required if the stereotactic CNB shows comedo areas or a high nuclear grade. One case (5%) of ADH was also underdiagnosed in this study. It was detected as a big microcaicified lesion by mammogram and showed ADH involving 3 lobular units with a background of diffuse CAPSS in stereotactic CNB. Even though 20 CNBs were obtained, the retrieval rate of microcalcification of this case was 15%, and so the obtained samples were not representative by limited sampling for adequate diagnosis. A recent study suggested that ADH of less than 3 mm in maximal dimension and confined to a single lobular unit predicts a final specimen free of higher-risk lesions.[29] In the present study, however, cases in which less than 3 lobules were involved with ADH or cases in which more than 50% of microcalcification retrieved were all adequately diagnosed. Therefore, the authors think that ADH diagnosed with DVAB doesn't require subsequent surgery to rule-out a diagnosis of carcinoma, if the sampling is adequate and less than 3 lobules are involved with ADH. However, a larger series of studies should be done to reach the conclusion of this aspect.

So, the overall underestimation rate of DVAB is still variable depending on the institute, but obviously underestimation of malignancy with DVAB has been shown to be less than that with a 14-gauge needle and an automated gun, however, underestimation still occurs. According to the Lee *et al*.,[30] none of the cases showed microcalcifications in areas of invasive tumor alone. They found that microcalcifications usually occur in areas of DCIS and/or adjacent benign tissue. Therefore, because DVAB specifically targets microcalcifications, underestimation of the cases initially diagnosed as ADH or DCIS without invasion will continue to occur regardless of the number of core specimens obtained. An underestimation may have affected the radiologists' and the pathologists' experience in performing and interpreting stereotactic biopsies. But no underestimation occurred when all calcifications were removed. Retrieval of all (most likely more than 50%), rather than some, of the calcifications-"adequate sampling"-was associated with a lower frequency of ADH and DCIS underestimation. Although it is infrequent, underestimation may still occur in 11-gauge DVAB, particularly when sampling larger lesions.[22,24,25] Obtaining tissue from more than one site within a larger lesion may be beneficial in such cases. Our results indicate that it is possible to completely remove small areas of ADH or DCIS presenting as microcalcifications on mammography using a DVAB. Complete removal is facilitated by small size on mammography and by taking more specimens. When no residual DCIS, ADH, or benign lesion was identified histologically after a DVAB in an adequately localized specimen, the lesion was considered to have been completely excised at the time of DVAB. Our data suggests that at least 5.3% (6 of 113 cases) of malignancy, 42% (8 of 19 cases) of ADH, and 23.5% (4 of 17 cases) of benign lesion may be pathologically completely removed by DVAB. The cases removed completely by DVAB ranged from 0.5 to 8.5 cm in maximal dimension. The majority (87%) of cases measured less than 1.0cm. Thus lesions less than

1.0 cm can be removed completely by DVAB. Currently, percutaneous biopsy is only approved for diagnosis, not for treatment. In the future, after more additional data accumulated, DVAB may be useful for percutaneous excision of mammary lesions such as benign, ADH, and DCIS, particularly if it is small.

As long as the technical aspects of the stereotactic biopsy procedure continue to improve, pathologists need to pay attention to critical pathologic findings and the correlation with mammographic findings to allow elimination of sampling errors. However, Lee *et al*.[30] reported that the factors usually thought to be predictive of occult invasion such as size, nuclear grade, and subtype of DCIS do not correlate with the presence of invasive tumors. Therefore, physicians as well as patients undergoing these procedures have to understand the limitations of the procedure in order to choose the appropriate biopsy technique, optimize treatment strategies, and avoid potentially unnecessary axillary lymph node dissections or sentinel node biopsies.

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