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PRECLINICAL STUDY

Risk of needle tract seeding of breast cancer: cytological results derived from core wash material

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Abstract Needle track seeding has been recognized as a possible, albeit rare, complication of breast core needle biopsy. The purpose of this study was to assess the risk of needle tract seeding of breast cancer from cytological results derived from core needle wash material. The study included biopsies of 207 breast cancers performed using ultrasonographically guided 18-gauge core needles. Each core needle without exposed sample notch was washed in saline solution immediately after removing the needles. Cytology derived from core wash material was performed by saline solution lavage of the fragments using a cytocentrifuge. The cytological diagnoses were divided into five categories: benign, atypical/indeterminate, suspicious/probably malignant, malignant and unsatisfactory. Atypical/indeterminate, suspicious/probably malignant and malignant categories were considered to represent positive cases of needle track seeding of breast cancer, whereas benign and unsatisfactory categories were counted as negative cases. Cytological diagnoses of the 207 lesions were as follows: 26 lesions (12%) were benign, 18 lesions (9%) were atypical/indeterminate, 37 lesions (18%) were suspicious/probably malignant, 79 lesions (38%) were malignant, and 47 lesions (23%) were unsatisfactory. The incidence of positive cases of cytology derived from core wash material was 65% (134/207). The 25% frequency of positive cases of invasive lobular carcinoma was significantly lower than the frequencies of DCIS (74%) and invasive ductal carcinoma (69%) ($P = 0.001$ and $P < 0.01$). The frequency of positive cases in the multiple passes group was 75%, which was slightly, although not significantly, higher than the 66% frequency in the single pass group ($P = 0.3$). In conclusion, the incidence of positive cases of cytology derived from ultrasonographically guided breast core needles' wash material was 65%. The clinical significance is debatable; however, there may be a theoretical risk of local recurrence if the tract is not excised or radiotherapy not given.

Keywords Breast · Core needle biopsy · Core wash · Cytology · Needle tract seeding

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Introduction

Percutaneous imaging-guided core needle biopsy (CNB) is being used increasingly as an alternative to surgical biopsy for the diagnosis of breast lesions that are suspicious or highly suggestive of malignancy [1]. The patient care advantages of imaging-guided CNB are that it is less invasive, does not deform the breast, can be performed quickly, and is low cost [1]. CNB can also decrease the number of surgical procedures performed in women with breast cancer [1]. A disadvantage of imaging-guided CNB is that needle tract seeding may occur and affect the local recurrence and overall survival rates of patients after breast-conserving surgery [1]. Although some recent studies showed that preoperative CNB might have no detrimental impact on local recurrence or overall survival after breast-conserving surgery and postoperative radiotherapy [2–5], the impact of needle tract seeding on the local recurrence and overall survival rates of patients after breast-conserving surgery without postoperative radiotherapy has not been fully investigated. In addition, epithelial displacement resulting from needle tract seeding may cause interpretive problems for the pathologist [1]. Needle tract seeding rates from 2% to 38% have been reported using CNB of the breast [6–9], but the histological examination of needle tract seeding employed in those previous studies might have failed to detect a single tumor cell or a small group of malignant cells. Moreover, the needle tract seeding rates may increase with intensive histological examination such as multiple sectioning. Therefore, the frequency and risk of needle tract seeding with CNB has not been determined. This study was undertaken to determine the risk of needle tract seeding of breast cancer from cytological results derived from core needle wash material.

Materials and methods

Patients

This retrospective study included 207 consecutive breast biopsies performed in 148 lesions in patients with a median age of 54 years (range 29–87 years) with pathologically diagnosed breast cancer who presented to our hospital between November 2003 and September 2004. Informed consent and coagulation history were obtained prior to the biopsy. The study was approved by our institutional review board.

Biopsy procedures

All CNBs were performed by one radiologist (T.U.) freehand with the patient in a supine or supine-oblique position. Imaging guidance for the 18-gauge automated gun (Bard Magnum Biopsy System; C.R. Bard, Covington, USA) was provided with an ultrasonography unit (Nemio SSA-550A, Toshiba, Japan) with a high-resolution linear array transducer (7.5 MHz). It is our practice to perform one core biopsy on each lesion when the post-fire needle position can be precisely evaluated by obtaining an image in the orthogonal plane before the needle is removed from the patient. This post-fire needle position verification was routinely performed in our study. When a biopsy of the mass periphery was performed, we continued the biopsy until the proper post-fire needle position in the target was achieved. However, non-mass lesions with indistinct margins, such as intraductal lesions, may be histologically heterogeneous. Therefore, we sometimes performed two to three core needle biopsies per lesion. We also performed two to three core needle biopsies of small lesions because the smaller the lesion, the higher the potential for sampling error when using post-fire needle position verification. The technique used to perform ultrasonographically guided CNB in this study has been previously described [10].

Specimen preparation and analysis

Each core needle without the sample notch exposed was washed in saline solution immediately after removing the needles. We note that the tissue contained within the needle notch was not directly in the saline solution because the needle notch was covered with the cannula in the saline solution. Cytology derived from core wash material was performed by saline solution lavage of the fragments using a cytocentrifuge. A combination of alcohol-fixed material stained by the Papanicoulau method and air-dried material stained by the Giemsa method was used for the preparation of slides because these stains highlight different features of the cytoplasm, background material, and nuclei. The cytological diagnoses were divided into five categories: benign, atypical/indeterminate, suspicious/probably malignant, malignant and unsatisfactory, according to the classification of breast fine-needle aspiration biopsy [11]. Atypical/indeterminate, suspicious/probably malignant and malignant categories were considered to represent positive cases of the risk of needle track seeding of breast cancer, whereas benign and unsatisfactory categories were counted as negative cases.

Statistical evaluation

Differences between rates of positive cases were tested by using the Mann–Whitney test with $P < 0.05$ considered significant, performed using a statistical software package (SPSS Inc., Chicago, IL).

Results

The histological diagnoses of these 207 breast cancer lesions were invasive ductal carcinoma (IDC) for 148 (72%), ductal carcinoma in situ (DCIS) for 31 (15%), invasive lobular carcinoma (ILC) for 15 (7%), and others, including two mucinous, for 13 (6%) lesions.

The cytological diagnoses of the 207 lesions were as follows: 26 lesions (12%) were benign, 18 lesions (9%) were atypical/indeterminate, 37 lesions (18%) were suspicious/probably malignant, 79 lesions (38%) were malignant, and 47 lesions (23%) were unsatisfactory. The incidence of positive cases of the risk of needle tract seeding of breast cancer derived from core wash material was 65% (134/207). The incidence of the risk of needle tract displacement including benign and malignant epithelium was 77% (160/207) (Table 1).

Table 1 Correlation of pathologic types, number of pierces and core wash cytology

Core wash cytologic diagnosis	Overall	Pathologic types			Number of pierces	
		IDC	DCIS	ILC	Single	Multiple
Benign	26 (12)	19 (13)	2 (6)	2 (13)	14 (13)	6 (14)
Atypical/indeterminate	18 (9)	11 (17)	5 (16)	0 (0)	11 (11)	3 (7)
Suspicious/probably malignant	37 (18)	28 (19)	7 (23)	1 (7)	19 (18)	8 (18)
Malignant	79 (38)	63 (43)	11 (36)	2 (13)	39 (38)	22 (50)
Unsatisfactory	47 (23)	27 (18)	6 (19)	10 (67)	21 (20)	5 (11)
Total	207 (100)	148 (100)	31 (100)	15 (100)	104 (100)	44 (100)

Note. Numbers in parentheses are percentages

IDC, invasive ductal carcinoma; DCIS, ductal carcinoma in situ; ILC, invasive lobular carcinoma

The 25% frequency of positive cases of ILC was significantly lower than the frequencies of DCIS (74%) and IDC (69%) ($P = 0.001$ and $P < 0.01$). This study included two cases of mucinous carcinoma, one of which had malignant core wash cytology and the other of which had unsatisfactory core wash cytology.

One hundred four of 148 (70%) breast cancer lesions underwent a single CNB on each lesion. Thirty-two of 148 (22%) breast cancer lesions underwent two core needle biopsies per lesion. Nine of 148 (6%) breast cancer lesions underwent three core needle biopsies per lesion. Three of 148 (2%) breast cancer lesions underwent four core needle biopsies per lesion.

The frequency of positive cases in the multiple passes group was 75% (33/44), which was slightly, but not significantly, higher than the 66% (69/104) frequency in the single pass group ($P = 0.3$) (Table 1).

Discussion

Ultrasonographically guided CNB has been regarded as an effective, safe, and high-yield method for tissue diagnosis of breast lesions [1]. However, although the chance is small, this procedure may be followed by implantation of a malignant neoplasm along the biopsy needle tract [1, 6–9, 13–16]. Some investigators have reported the frequency to be 2% to 38% (Table 2) [6–9]. Liberman et al. reported no needle tract seeding after stereotaxic 11-gauge directional vacuum-assisted breast biopsy [12]. The present study showed that the incidence of positive cases of the risk of needle tract seeding of breast cancer derived from core wash material was 65% (134/207) and the incidence of the risk of needle tract displacement including benign and malignant epithelium was 77% (160/207). The frequency rates were higher than the frequency rates of previous studies based on clinical and histological examinations [6–9, 12]. The histological examinations of needle tract seeding in those previous studies might have failed to detect a single tumor cell or a small group of malignant cells because the needle tract seeding rates will increase with intensive histological examination such as multiple sectioning. Therefore, the frequency and risk of needle tract seeding with CNB has not been determined. This study was undertaken to determine the risk of needle tract seeding of breast cancer from cytological results derived from core needle wash material to compensate for the imperfection of routine histological examination. The

Table 2 Rates of needle track seeding in published studies

Study	No. of lesions	No. of cases	Frequency (%)	Needle type
Diaz et al. [6]	352	114	32	18 to 11-gauge automated or vacuum
Diaz et al. [6]	201	74	37	14-gauge automated
Diaz et al. [6]	34	13	38	18 to 14-gauge automated with coaxial technique
Diaz et al. [6]	117	27	23	14 to 11-gauge vacuum
Hoorntje et al. [7]	64	11	17	14-gauge automated
Youngson et al. [8]	43	12	28	14-gauge automated
Stolier et al. [9]	89	2	2	14 to 11-gauge automated or vacuum
Stolier et al. [9]	8	2	25	14-gauge automated
Stolier et al. [9]	23	0	0	14 to 11-gauge vacuum
Stolier et al. [9]	58	0	0	14-gauge automated with coaxial technique
Liberman et al. [12]	28	0	0	11-gauge vacuum

results of this study suggest that the frequency of needle tract seeding might be underestimated in routine histological examinations.

The number of needle passes may be an important factor for needle tract seeding [9]. In this regard, this study showed that the frequency of positive cases in the multiple passes group was 75%, which was slightly, although not significantly, higher than the 66% frequency in the single pass group. Our technique used ultrasonographically guided CNB that was basically a single pass (70% single pass cases versus 30% multiple passes cases in 207 cases) with post-fire needle position verification with an 18-gauge automated gun [10], and therefore needle tract seeding using our CNB technique might have been less frequent than that of the generally accepted multiple needle passes CNB technique.

The type of carcinoma is one of most important factors for the rate of needle tract seeding [6]. Our results showed that the 25% frequency of positive cases of ILC was significantly lower than the frequencies of DCIS (74%) and IDC (69%) ($P = 0.001$ and $P < 0.01$). This result is in accordance with the results of Diaz et al. [6] for ILC, but not for DCIS. In that series, ILC and carcinomas of mixed lobular and ductal differentiation had lower rates of needle tract seeding than IDC, and DCIS had a lower rate (19%) of needle tract seeding than IDC (35%). An important factor, contributing to the observed differences between studies for DCIS may be the time interval between breast biopsy and pathological examination. For the subset of cases of DCIS in the series of Diaz et al. [6], the median interval was reported to be 20 days, whereas the median interval was 0 day in this study. In addition, the histological examination of needle tract seeding in that study might have failed to detect a single tumor cell or a small group of malignant cells of DCIS in the needle tract.

Two cases of needle tract seeding of mucinous carcinoma after CNB of the breast have been reported [13, 15]. This study included two cases of mucinous carcinoma, and one had malignant core wash cytology, while the other had unsatisfactory core wash cytology. Further studies will be needed to determine if mucin promotes needle tract seeding by acting as a vehicle for the malignant cells during CNB.

This study has some limitations. First, the use of the simple technique of washed-biopsy cytology to determine the risk of needle tract seeding of breast cancer in the current study means that some details may be lost; however, this is not likely to reduce the usefulness of the results because cytological results derived from core needle wash material might compensate for the imperfection of routine histological examination and correspond to intensive histological examination such as multiple sectioning.

Second, it is certainly possible that tumor cells are lodged between the shaft of the inner and outer portions of the needle that wash out with the saline, falsely elevating the risk. However, this phenomenon can occur in vivo, namely the core needle in the breast may be washed in blood or body fluid. Therefore, our method is not wrong in our opinion. Moreover, the method of showing that tumor cells do adhere to the core needle is novel.

Third, we do not know whether the needle tract seeding can sustain viability and develop into local tumor growth at the site of deposition if the tract is not excised or radiotherapy not given, and the clinical significance of the results of this study may be debatable; however, this study showed that there was a theoretical risk of local recurrence if the needle tract is not excised and radiotherapy not given. Several cases of local recurrence caused by CNB have been reported [13, 14, 16], but some investigators have reported that the CNB technique had no impact on local recurrence after breast-conserving surgery with postoperative radiotherapy, and that postoperative radiation therapy may control microscopic seeding in the needle tact [2–5]. Although Diaz et al. reported that the inverse relationship between the amount of displacement observed and time to excision suggested that tumor cells do not survive displacement [6], the impact of needle tract seeding on the local recurrence and overall survival rates of patients after breast-conserving surgery without radiation has not been fully investigated. Further studies of the impact of needle tract seeding are needed. Moreover, knowing the risk of needle tract seeding after CNB for breast cancer and the histological findings is important for differentiating them from stromal invasion to prevent misdiagnosing displaced DCIS [17].

In summary, the incidence of positive cases of cytology derived from ultrasonographically guided breast core needle wash material was 65%. The 25% frequency of positive cases of ILC was significantly lower than the frequencies of DCIS (74%) and IDC (69%). The frequency of positive cases in the multiple passes group was 75%, which was slightly, although not significantly, higher than the 66% frequency in the single pass group. The clinical significance is debatable; however, there may be a theoretical risk of local recurrence if the tract is not excised or radiotherapy not given.

References

1. Liberman L (2000) Percutaneous imaging-guided core breast biopsy: state of the art at the millennium. AJR Am J Roentgenol 174:1191–1199
2. Fitzal F, Sporn EP, Draxler W, Mittlbock M, Taucher S, Rudas M, Riedl O, Helbich TH, Jakesz R, Gnant M (2006) Preoperative core needle biopsy does not increase local recurrence rate in breast cancer patients. Breast Cancer Res Treat 97:9–15

3. Chen AM, Haffty BG, Lee CH (2002) Local recurrence of breast cancer after breast conservation therapy in patients examined by means of stereotactic core-needle biopsy. Radiology 225:707–712
4. King TA, Hayes DH, Cederbom GJ, Champaign JL, Smetherman DH, Farr GH, Bolton JS, Fuhrman GM (2001) Biopsy technique has no impact on local recurrence after breast-conserving therapy. Breast J 7:19–24
5. Knight R, Horiuchi K, Parker SH, Ratzer ER, Frenoglio ME (2002) Risk of needle-track seeding after diagnostic image-guided core needle biopsy in breast cancer. JSLS 6:207–209
6. Diaz LK, Wiley EL, Venta LA (1999) Are malignant cells displaced by large-gauge needle core biopsy of the breast? AJR Am J Roentgenol 173:1303–1313
7. Hoorntje LE, Schipper MEI, Kaya A, Verkooijen HM, Klinkenbijl JG, Rinkes IHMB (2004) Tumor cell displacement after 14G breast biopsy. Eur J Surg Oncol 30:520–521
8. Youngson BJ, Liberman L, Rosen PP (1995) Displacement of carcinomatous epithelium in surgical breast specimens following stereotaxic core biopsy. Am J Clin Pathol 103:598–602
9. Stolier A, Skinner J, Levine EA (2000) A prospective study of seeding of the skin after core biopsy of the breast. Am J Surg 180:104–107
10. Uematsu T, Kasami M, Uchida Y, Yuen S, Sanuki J, Kimura K, Tanaka K (2007) Ultrasonographically guided 18-gauge automated core needle breast biopsy with post-fire needle position verification (PNPV). Breast Cancer 14:219–228
11. Developed and approved at the National Cancer Institute-sponsored conference, USA (1997) The uniform approach to breast fine-needle aspiration biopsy. Cytopathology 16:295–311
12. Liberman L, Vuolo M, Dershaw DD, Morris EA, Abramson AF, LaTrenta LR, Polini NM, Rosen PP (1999) Epithelial displacement after stereotactic 11-gauge directional vacuum-assisted breast biopsy. AJR Am J Roentgenol 172:677–681
13. Thurfjell MG, Jansson T, Nordgren H, Bergh J, Lindgren A, Thurfjell E (2000) Local breast cancer recurrence caused by mammographically guided punctures. Acta Radiol 41:435–440
14. Chao C, Torosian MH, Boraas MC, Sigurdson ER, Hoffman JP, Eisenberg BL, Fowble B (2001) Local recurrence of breast cancer in the stereotactic core needle biopsy site: case reports and review of the literature. Breast J 7:124–127
15. Harter LP, Curtis JS, Ponto G, Craig PH (1992) Malignant seeding of the needle track during stereotaxic core needle breast biopsy. Radiology 185:713–714
16. Uriburu JL, Vuoto HD, Cogorno L, Isetta JA, Candas G, Imach GC, Bernabo OL (2006) Local recurrence of breast cancer after skin-sparing mastectomy following core needle biopsy: case reports and review of the literature. Breast J 12:194–198
17. Youngson BJ, Cranor M, Rosen PP (1994) Epithelial displacement in surgical breast specimens following needling procedures. Am J Surg Pathol 18:896–903