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Comparison between core needle biopsy and excisional biopsy for breast neoplasm

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Abstract

This study aimed to explore clinical significance of core needle biopsy (CNB) in pathological diagnosis of breast neoplasm.

Seventy one breast neoplasm samples were obtained from Tongzhou Maternal and Child Health Hospital of Beijing between the years of 2006 and 2014. Forty five specimens were obtained via CNB and cases offering 26 of them received neoadjuvant chemotherapy. Pathology, histology, and immunohistochemistry results were compared between CNB specimens and excisional biopsy.

Upward and downward tendencies could be observed in CNB specimens and excisional biopsy, respectively, in all items. Tumor proportion of CNB tissues was (33 + 2)/45 = 77.78%, when ductal carcinoma in situ detected by both CNB and excisional biopsy was 31/45 = 68.89%, with a consistency of (31 + 3)/45 = 75.56%. Tumor thrombus detected by both CNB and excisional biopsy was 2/45 = 4.44%. Among cases receiving neoadjuvant chemotherapy, CNB and excisional biopsy, in mitotic figure, cytological scoring and histological grading, showed a total change rate of >50% (50%–75%), while changes in duct and cellular heteromorphism were not distinct. Cases showing changes were up to 73.08%, with 8/26 = 30.77% for rise and 11/26 = 42.31% for descent.

CNB could be used for preoperative diagnosis of breast neoplasm, and help to determine proper treatment regimen, thus elevating the rate of breast conserving. However, this method still has several limitations, particularly in immunohistochemical tests of human epidermal receptor protein-2. Neoadjuvant chemotherapy may influence the accuracy of CNB diagnosis.

Abbreviations: CNB = core needle biopsy, DCIS = ductal carcinoma in situ, HER-2 = human epidermal receptor protein-2, IHC = immunohistochemistry, Ki-67 = cell proliferation antigen Ki-67.

Keywords: breast tissues, core needle biopsy, excisional biopsy

1. Introduction

Breast cancer presents one of the most common tumors among women. According to domestic statistics, >1.6 million individuals are diagnosed with breast cancer every year, and its morbidity shows an upward tendency year by year.[1,2] Several techniques have been applied for breast cancer diagnosis, mainly including molybdenum palladium X-ray, breast ultrasound, and breast magnetic resonance imaging (MRI).[3–7] However, major defect of these techniques lies in their insufficiency in reaching pathological diagnosis, failing to determine the nature of the tumor.[8]

Core needle biopsy (CNB) is minimally invasive and intrusive, which could help doctors obtain sufficient breast tissues for pathological diagnosis without invasive surgery.[9] Tissues obtained through CNB could provide doctors with a series of information to establish feasible treatment regimens.[10–12] CNB also has been used in the diagnosis of different cancers.[13,14] Nonetheless, whatever examination approaches are excellent, they inevitably have some restrictions; and so does CNB. A variety of studies have compared pathological results between CNB specimens and excisional biopsy, but relevant analysis results varied across laboratories.[15,16] Clinical values of CNB specimens in the diagnosis of breast lesions require further verification.

The present study was designed to investigate clinical value of CNB specimens in pathological diagnosis of breast neoplasm. In this study, pathology, histology, and immunohistochemistry

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(IHC) diagnosis results were compared between CNB specimens and excisional biopsy. In addition, the values of CNB specimens in clinical diagnosis of breast lesions were investigated among cases receiving neoadjuvant chemotherapy.

2. Materials and methods

2.1. Sample collection

A total of 71 clinical breast neoplasm samples were collected from Tongzhou Maternal and Child Health Hospital of Beijing between the years of 2006 and 2014. The samples came from women aged between 29 and 73 years with an average age of 55.5 years. Of the breast neoplasm samples, 37 were from left breast while 34 from right. In addition, 45 specimens were collected via CNB, and cases offering 26 of them had received neoadjuvant chemotherapy, 9 from left breast and 17 from the right. This study was approved by the ethics committee of Tongzhou Maternal and Child Health Hospital of Beijing. All patients signed written informed consents.

2.2. Sample disposal and slide preparation

Samples were disposed according to methods recommended in ASCO/CAP guidance (2007).[17] CNB was performed through 14-core routine puncture on 3 to 7 tissues. Obtained samples were immediately sent to pathology department after collection. While excisional biopsy specimens, following general examination by pathologists, were cut into 5 mm slices and put into sufficient 4% neutral formalin. Then, the samples were embedded into paraffin, and cut into 4 μm slices. All CNB specimens and excisional biopsy ones were detected via hematoxylin-eosin staining and IHC analyses. Research flowchart was shown in Fig. 1.

2.3. HE staining

Sections obtained for CNB specimens were detected adopting Hematoxylin and Eosin Staining Kit (Beyotime) following with the product specification.

2.4. IHC analysis

Sections were treated with sodium citrate buffer for antigen retrieval. 3% H_2O_2 was used to eliminate endogenous peroxidase activity. Then these sections were used for IHC which detected relative expressions of estrogen receptor, progesterone receptor, human epidermal receptor protein-2 (HER-2), and cell proliferation antigen Ki-67 (Ki-67) in breast neoplasm samples. The sections were cultured with anti-ER (abcam, ab32063), anti-PR (abcam, ab16661), anti-HER-2 (abcam, ab134182), and anti-Ki-67 (abcam, ab16667) antibodies at 4 °C overnight. After washed with phosphate buffered solution buffer for 10 minutes, the sections were cultured with second antibodies at room temperature for 1 hour. Finally, the sections were incubated with streptavidin-peroxidase complex for 20 minutes.

Staining intensity was defined as follows: weak, moderate, and strong. Staining area was defined to be 1, <10%; 2, 10% to 50%;

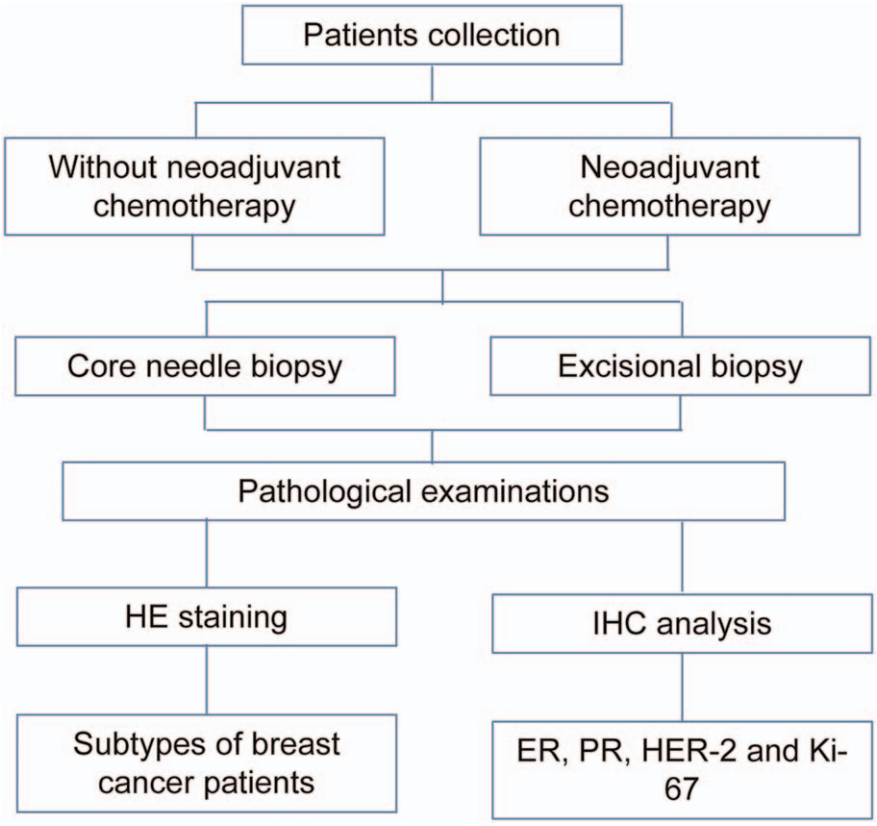

Figure 1. Flowchart for research process.

Table 1

Comparisons on histological grading between CNB and excisional biopsy (cases/total number = %).

	Duct	Cellular heteromorphism	Mitotic figure	Histological scoring	Histological grading
Upward	2/44 = 4.55	8/44 = 18.18	20/44 = 45.45	23/44 = 52.27	13/44 = 29.55
Downward	3/44 = 6.82	5/44 = 11.36	4/44 = 9.09	7/44 = 15.91	3/44 = 6.82
General alteration	(2 + 3)/44 = 11.36	(8 + 5)/44 = 29.55	(20 + 4)/44 = 54.55	(23 + 7)/44 = 68.18	(13 + 3)/44 = 36.36
equivalent	39/44 = 88.64	31/44 = 70.45	20/44 = 45.45	14/44 = 31.82	28/44 = 63.64

CNB = core needle biopsy.

and 3, >50%. Total staining score was the sum of staining intensity and area: 0 to 2 = negative expression and 3 to 6 = positive expression.

2.5. Statistics analysis

All data analyses were performed with SPSS 18.0 software (IBM Corporation, Armonk, NY, USA). Continuous variables were presented as mean ± standard deviation (SD), while categorical ones as case number and percentage. The comparison of continuous data was performed via student *t* test, and chi-square test was adopted for categorical variables. All analyses were two-tailed, and *P* values <.05 were considered to be significant threshold.

3. Results

3.1. Comparisons on histological grading between CNB specimens and excisional biopsy ones

As shown in Table 1, upward and downward tendencies could be observed in CNB and excisional biopsy specimens, respectively, in all items (duct, cellular heteromorphism, mitotic figure, histological scoring, and histological grading),[18–20] with equivalency taking a dominant position in duct, cellular heteromorphism, and histological grading (Fig. 2). However, in mitotic figure and histological scoring, equivalent situation only accounted for 45.45% and 31.82%, respectively, while the proportions of significant alterations were up to 54.55% and 68.18%, respectively.

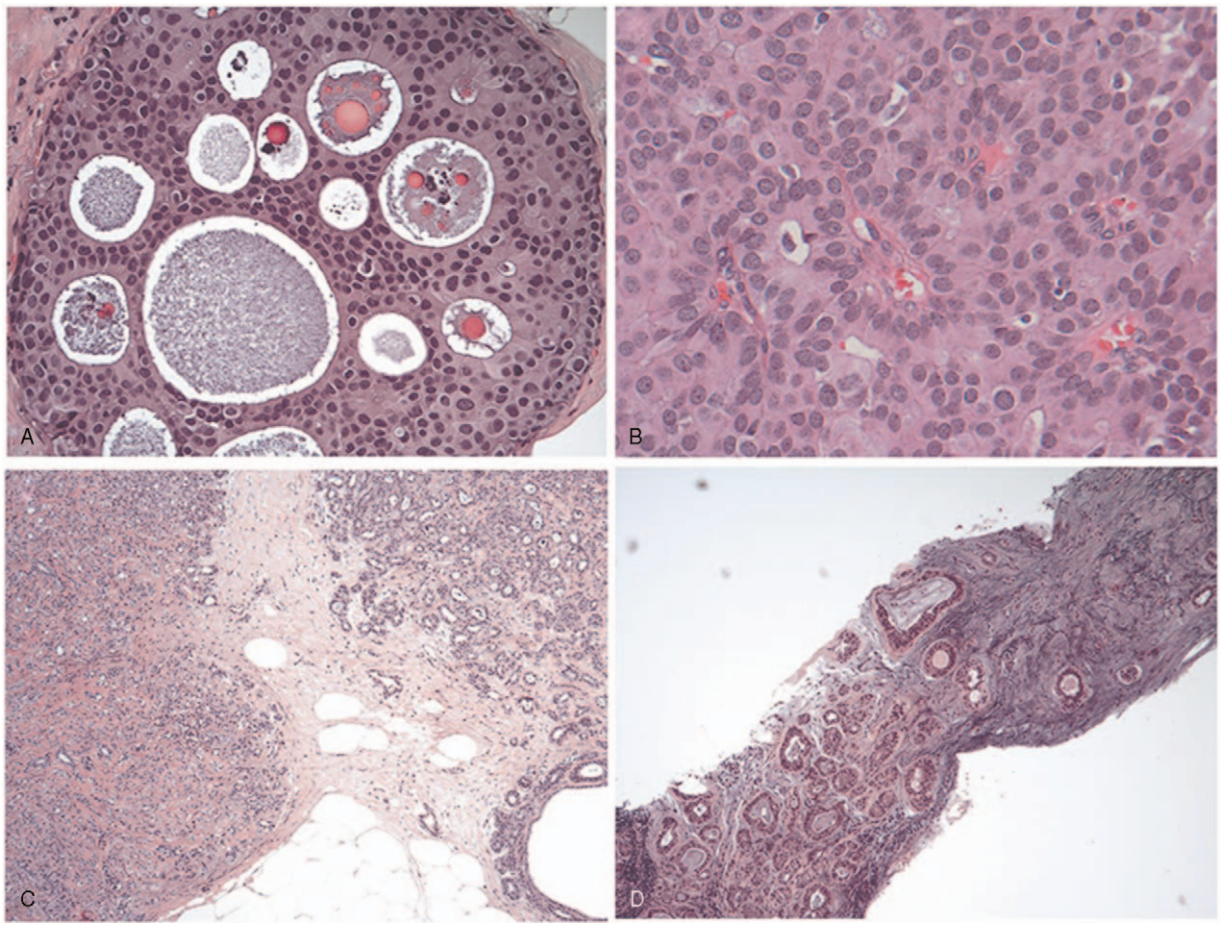

Figure 2. HE staining results for breast cancer patients with different subtypes. A, Ductal carcinoma in situ; B, papillary carcinoma; C, atypical lobular hyperplasia; D, fibroadenoma. HE = hematoxylin-eosin.

Table 2

Comparisons on pathology between CNB and excisional biopsy (cases/total number = %).

	Tumor proportion		DCIS	Tumor thrombus	Nerve invasion
Upward	33/45 = 73.33	All	31/45 = 68.89	2/45 = 4.44	2/45 = 4.44
Downward	2/45 = 4.44	None	3/45 = 6.67	33/45 = 73.33	35/45 = 77.78
General alteration	(33 + 2)/45 = 77.78	Consistent	(31 + 3)45/75.56	(2 + 33)/45 = 77.78	(2 + 35)/45 = 82.22
Equivalent	10/45 = 22.22	Existing only in CNB	3/45 = 6.67	1/45 = 2.22	3/45 = 6.67
		Existing only in general group	8/45 = 17.78	9/45 = 20	5/45 = 11.11
		Existing in CNB	34/45 = 75.56	3/45 = 6.67	5/45 = 11.11
		Existing in general group	39/45 = 86.67	11/45 = 24.44	7/45 = 15.56

CNB = core needle biopsy, DCIS = ductal carcinoma in situ.

Taking mitotic figure and histological scoring as examples, the former elevated 20/44 = 45.45% and descended 4/44 = 9.09%; while the upward and downward values for the latter were 23/44 = 52.27% and 7/44 = 15.91%, respectively.

3.2. Comparing pathology between CNB and excisional biopsy

According to data in Table 2, change in tumor proportion was (33 + 2)/45 = 77.78%, showing an upward value of 33/45 = 73.33% and a downward value of 2/45 = 4.44%.

3.2.1. Ductal carcinoma in situ (DCIS). The proportion of DCIS detected by both CNB and excisional biopsy was 31/45 = 68.89%, and those not detected by either of the techniques accounted for 3/45 = 6.67%, with a consistency of (31 + 3)45 = 75.56%. The proportion of DCIS detected only by CNB was 3/45 = 6.67%, and that only by excisional biopsy was up to 8/45 = 17.78%, extremely higher in excisional biopsy than in CNB. Besides, cases detected by CNB accounted for 34/45 = 75.56% while the value for excisional biopsy was 39/45 = 86.67%.

3.2.2. Tumor thrombus. The proportion of tumor thrombus detected by both CNB and excisional biopsy was 2/45 = 4.44%, and those not detected by either of the techniques accounted for 33/45 = 73.33%, with a consistency of (2 + 33)/45 = 77.78%. The proportion of tumor thrombus detected only by CNB was 1/45 = 2.22%, and that only by excisional biopsy was up to 9/45 = 20%, extremely higher in excisional biopsy than in CNB as well. Besides, cases detected by CNB accounted for 3/45 = 6.67% while the value for excisional biopsy was 11/45 = 24.44%.

3.3. Comparisons on IHC results between CNB and excisional biopsy

According to statistics in Table 3, for all immunohistochemical items, CNB and excisional biopsy, in terms of both proportion and magnitude, showed a total change rate of >50% either in an upward or in a downward trend, ranging from 52.5% to 72.5% (Fig. 3).

3.4. Comparisons between CNB and excisional biopsy among cases receiving neoadjuvant chemotherapy

Twenty six cases had received neoadjuvant chemotherapy, and we estimated clinical value of tissues obtained by CNB among them. As shown in Table 4, CNB and excisional biopsy, in terms of mitotic figure, cytological scoring, and histological grading, showed a total change rate of >50% either in an upward or in a downward trend, ranging from 50% to 75%, while changes in duct and cellular heteromorphism were not distinct.

According to Table 5, the total of changes, regardless of their upward or downward tendencies, was up to 73.08%, and the proportion was 8/26 = 30.77% for rise and 11/26 = 42.31% for descent. Compared with those without chemotherapy, the number was significantly decreased in cases exhibiting upward trends while increased in those with downward trends, which made us wonder whether puncture sites happened to be located at chemotherapy sensitive-positions. However, chemotherapy wielded certain effects in the most of cases, and the proportion of leveling off was similar.

4. Discussion

Upward and downward tendencies could be observed in CNB and excisional biospsy in all items (duct, cellular heteromorphism, mitotic figure, histological scoring, and histological grading).[21,22] Tumor thrombus was more frequently detected by excisional biopsy than CNB. There was no extremely distinct difference between CNB and excisional biopsy. CNB is operated with the assistance of B ultrasound, but dose not obtain samples directly guided by eyes, so such sampling could be regarded to be accomplished blindly.[23,24] Consequently, without any knowledge about tissue features, purposeful puncture could not be realized; besides, tissue ribbons obtained by CNB are slimsy, and after dehydration, embedding and slicing, only several banded

Table 3

Comparisons on immunohistochemistry between CNB and excisional biopsy (cases/total number = %).

	ER proportion	ER magnitude	PR proportion	PR magnitude	HER-2 magnitude	Ki-67 proportion
Upward	22/40 = 55	16/40 = 40	22/40 = 55	14/40 = 35	10/41 = 24.39	14/41 = 34.15
Downward	5/40 = 12.50	5/40 = 12.50	7/40 = 17.50	8/40 = 20	14/41 = 34.15	15/41 = 36.59
General alteration	(22 + 5)/40 = 67.5	(16 + 5)/40 = 52.5	(22 + 7)/40 = 72.5	(14 + 8)/40 = 55	(10 + 14)/41 = 58.54	(14 + 15)/41 = 70.73
Equivalent	13/40 = 32.50	19/40 = 47.50	11/40 = 27.50	18/40 = 45	17/41 = 41.46	12/41 = 29.27

CNB = core needle biopsy, ER = estrogen receptor, HER-2 = human epidermal receptor protein-2, Ki-67 = cell proliferation antigen Ki-67, PR = progesterone receptor.

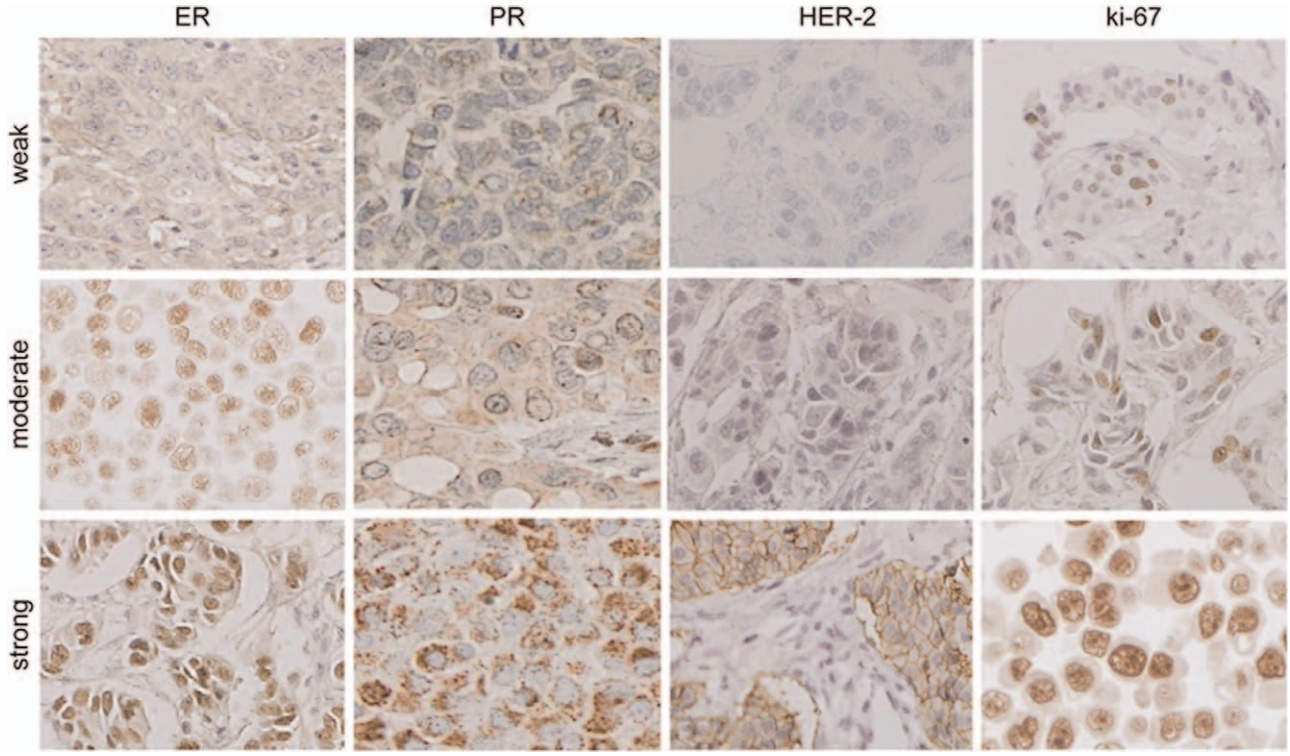

Figure 3. IHC analysis results for ER, PR, HER-2, and ki-67. ER = estrogen receptor, HER-2 = human epidermal receptor protein-2, Ki-67 = cell proliferation antigen Ki-67, PR = progesterone receptor.

Table 4

Comparisons on histology between CNB and excisional biopsy among cases receiving neoadjuvant chemotherapy (cases/total number %).

	Duct	Cellular heteromorphism	Mitotic figure	Histological scoring	Histological grading
Upward	2/24 = 8.33	6/24 = 25	7/24 = 29.17	10/24 = 41.67	8/24 = 33.33
Downward	0/24 = 0	3/24 = 12.5	5/24 = 20.83	8/24 = 33.33	5/24 = 20.83
General alteration	(2 + 0)/24 = 8.33	(6 + 3)/24 = 37.5	(7 + 5)/24 = 50	(10 + 8)/24 = 75	(8 + 5)/24 = 54.17
Equivalent	22/24 = 91.67	15/24 = 62.5	12/24 = 50	6/24 = 25	11/24 = 45.83

CNB = core needle biopsy.

tissues could be observed under a microscope. On the contrary, naked eyes can see the whole and sections of neoplasms in excisional biopsy, and targeted sampling could be performed according to their color and luster, texture, and shape and properties.[25–27] Therefore, the number of tissue blocks obtained in excisional biopsy could be determined based on visual inspection; and the size of each tissue block is significantly larger than that of tissue ribbons, so microscopic observational area is bigger as well, making pathological observation more sufficient and thus getting a relatively full view of lesions.

Table 5

Comparisons on pathology between CNB and excisional biopsy among cases receiving neoadjuvant chemotherapy (cases/total number %).

	Tumor proportion		DCIS	Tumor thrombus	Nerve invasion
Upward	8/26 = 30.77	All	13/26 = 50	2/26 = 7.69	
Downward	11/26 = 42.31	None	4/26 = 15.38	17/26 = 65.38	
General alteration	(8 + 11)/26 = 73.08	Consistent	(13 + 4)/26 = 65.38	(2 + 17)/26 = 73.08	
Equivalent	7/26 = 26.92	Existing only in CNB	0/26 = 0	0/26 = 0	
		Existing only in general group	9/26 = 34.62	7/26 = 26.92	7/26 = 26.92
		Existing in CNB	13/26 = 50	2/26 = 7.69	
		Existing in general group	22/26 = 86.62	9/26 = 34.62	

CNB = core needle biopsy, DCIS = ductal carcinoma in situ.

Reportedly, CNB could not obtain sufficient samples, and fail to effectively reflect pathological changes in lesions.[28,29] In addition, for some lesions, it is hard to accomplish diagnosis only based on HE staining results due to small and little samples.[28]

In our study, excisional biopsy tissues showed dramatically higher proportions of carcinoma in situ and tumor thrombus than CNB specimens. It indicated again that CNB frequently fails to represent whole lesions, which easily led to under-diagnosis due to limited samples.[30] This conclusion was in accordance with that in a previous study.[31] The earlier research reported that it was more common for CNB to miss the components of invasive carcinoma, causing underestimation in diagnosis. This phenomenon suggested that CNB for breast had major deficiency in the diagnosis of carcinoma in situ and invasive carcinoma.[32] In a relevant study, 2 cases diagnosed as ductal intraepithelial neoplasia by CNB were conformed to be invasive ductal carcinoma in postoperative pathological diagnosis, demonstrating certain discrepancy between 2 approaches.[33] Huo et al[34] reported that 20% of ductal carcinomas in situ declared by results from CNB were conformed to be invasive carcinoma according to postoperative diagnosis, while such figure in China was supposed to be 30% in some literature, without difference. With regard to immunohistochemical results, different degrees of elevation, descent and leveling off could be found in terms of ER, PR, HER-2, and Ki-67. Since these results, especially those for HER-2, are directly related to the development of postoperative chemotherapy regimens, they would be better to be reached using tissue blocks, and fluorescence in situ hybridization test would be adopted if necessary, with the expectation of getting more accurate results.

Difference between CNB and excisional biopsy was not obvious, with observational value slightly higher for the latter technique than for CNB. Such situation might be explained by the small number of the cases and morbidity rate of nerve invasion, and further reasons still should be explored on the basis of larger sample size. Mitotic figure, cytological scoring, and histological grading indicated that changes in duct and cellular heteromorphism were not distinct. Puncture site happened to be associated with chemotherapy sensitive-position. However, chemotherapy wielded certain effects in the most of cases, and the proportion of leveling off was similar. In the analysis of leveling off, high consistency was found between CNB and excisional biopsy, according to observations on duct and cellular heteromorphism.

5. Conclusion

In conclusion, the appearance of CNB has solved many clinical problems, with the advantages of simple operation and tiny injury. Besides, this technique could be used for preoperative diagnosis, and after obtaining essential information on tumor type, grading and staging, help to determine proper treatment regimen, thus elevating the rate of breast conserving. That being said, CNB has its own defects, just like any other examination approaches as we discussed before. Therefore, when operating this technique, special attentions should be paid to some respects, such as the sufficiency of sampling and the fineness of slide preparation. In addition, when mitotic figure, histological scoring, and IHC (especially those items on HER-2) are involved, tissue blocks are recommended for examinations; besides, fluorescence in situ hybridization staining could also be employed, if necessary, for more precise results. Consequently, the combination of CNB with other examinations is necessary.

Author contributions

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Supervision: Yuehong Zhang.
Writing – original draft: Zhongqiu Zhang.
Writing – review & editing: Wen He.

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