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Original Article

Clinical analysis of stereotactic or ultrasound-guided vacuum-assisted breast biopsy in the diagnosis of breast micro calcifications

Jing Guo, Min Sun, Shuofeng Li

Department of Radiology, Cangzhou Central Hospital, Cangzhou, Hebei Province, China

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Abstract: Objective: Our aim was to evaluate the clinical value of stereotactic vacuum-assisted breast biopsy (SVAB) or ultrasound-guided vacuum-assisted breast biopsy (USVAB) in the diagnosis of breast micro calcifications. Methods: A total of seventy-five patients with breast micro calcifications diagnosed by mammography between January 2014 and January 2015 underwent SVAB or USVAB. The lesions were excised in patients diagnosed as breast cancer or ductal carcinoma in situ by biopsy. The histopathological and imaging features of the specimens were compared. Results: Forty-six lesions appearing as clustered calcifications were completely removed, six lesions were partially removed, and 17 lesions appearing as regional calcifications were partially removed. Pathological diagnosis showed 32 cases of ductal carcinoma in situ, 3 cases of infiltrating ductal carcinoma, 11 cases of infiltrating lobular carcinoma, and 29 cases of benign lesions. All of the patients were followed up for 6-24 months, with an average of 16 months. Three patients suffered bleeding at the puncture site and subcutaneous ecchymosis was observed in 2 patients. No recurrence was found in patients with breast cancer and the incision healed well. The appearance of the breast was satisfactory with no signs of malignancy. Conclusion: Vacuum-assisted breast biopsy (VAB) can be used to diagnose breast micro calcifications effectively and reliably. It is accurate, minimally invasive, and has less postoperative complications.

Keywords: Stereotactic vacuum-assisted breast biopsy, mammography, micro calcifications, ultrasonography

Introduction

With the progress of modern technology and the application of mammography, more clinically non-palpable breast micro calcifications have been found. It is generally believed that micro calcification is a clinical manifestation of breast cancer but further pathological diagnosis is still needed. The wire-guided localization biopsy under x-ray guidance causes severe trauma and obvious scars to patients and requires more operations. In contrast, stereotactic vacuum-assisted breast biopsy (SVAB), characterized by excellent cosmetic effect and accurate diagnosis, is the first choice for biopsy of micro calcifications [1]. SVAB presents higher requirements for equipment, breast size, and position of calcifications. For SVAB contraindicated patients or grass-roots hospitals, ultrasound-guided vacuum-assisted breast biopsy (USVAB) can be used [2-4]. In this study, SVAB or USVAB was conducted in patients with breast micro calcifications and the clinical value of SVAB and USVAB in the diagnosis of breast micro calcifications was discussed.

Materials and methods

Case selection

Our prospective study was approved by the Ethics Committee and informed consent of the patients was obtained. A total of 75 patients with breast calcifications who were treated in the Department of Breast Surgery in our hospital between January 2014 and January 2015 were enrolled, aged from 29-55 with an average age of 41.37±11.24. All patients underwent mammography in at least two postures before biopsy. Lesions were classified by the surgeons according to the Breast Imaging Reporting and Data System (BI-RADS) of

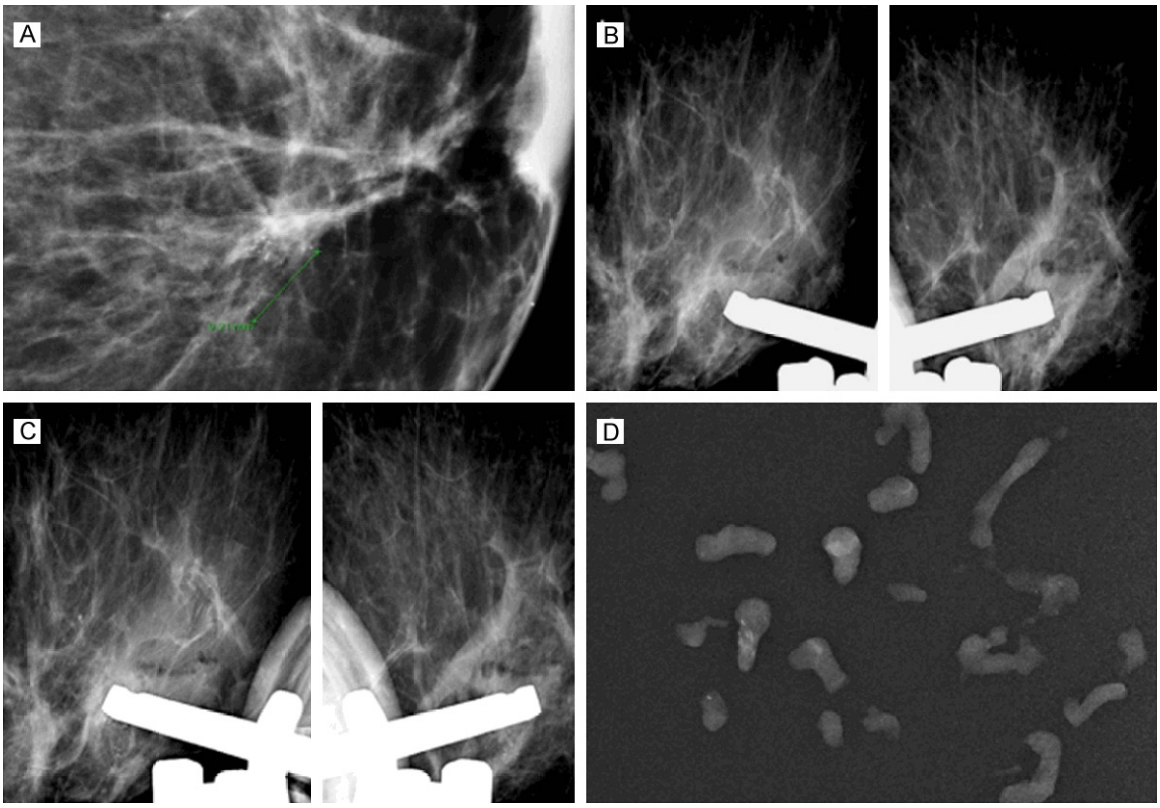

Figure 1. SVAB. A: 9 mm clustered breast calcification of a 62-year-old patient; B: Pre-biopsy image; C: Post-biopsy image; D: Specimen mammography showed that aimed microcalcifications were retrieved. SVAB, stereotactic vacuum-assisted breast biopsy.

American College of Radiology. There were 34 cases of left calcifications, 32 cases of right calcifications, and 9 cases of calcifications on both sides. Calcification distributions showed that they were clustered in 52 cases, regional in 17 cases, and diffuse in 6 cases. According to BI-RADS criteria, there were 6 cases of calcifications in grade 3, 54 cases in grade 4, and 15 cases in grade 5. The patients were divided into two groups based on the singular and plural number of their registration number. Patients with a singular number received SVAB examination while patients with a plural number received USVAB examination.

Inclusion criteria: all patients underwent SVAB or USVAB; the indications for use and no contraindications of SVAB or USVAB were met; patients agreed individually; patients could be followed up completely after operation.

Exclusion criteria: patients aged <30 or >60; patients combined with other malignancies; patients with mental dysfunction; patients were pregnant or breastfeeding women.

Indications for use of SVAB and USVAB were as follows: all patients with BIRADS grade 4 and 5 micro calcifications; patients with grade 3 micro calcifications are followed up routinely for 6 months; patients with a history of breast cancer, family history of breast cancer, and those whose number and scope of micro calcifications increase during follow up; patients with mental stress [5].

Methods

Instruments

Prone Stereotactic Mammography Unit (Chengdu Perlong Medical Equipment Co., Ltd.); Doppler Diagnostic Ultrasound System (GE, USA); Mammotome System (Mammotome, Johnson & Johnson, USA); Puncture Needle (8 G and 11 G, Johnson & Johnson, USA).

Procedures

SVAB: All patients routinely underwent bilateral mammography and the position of calcifications was clearly defined. Needles were placed

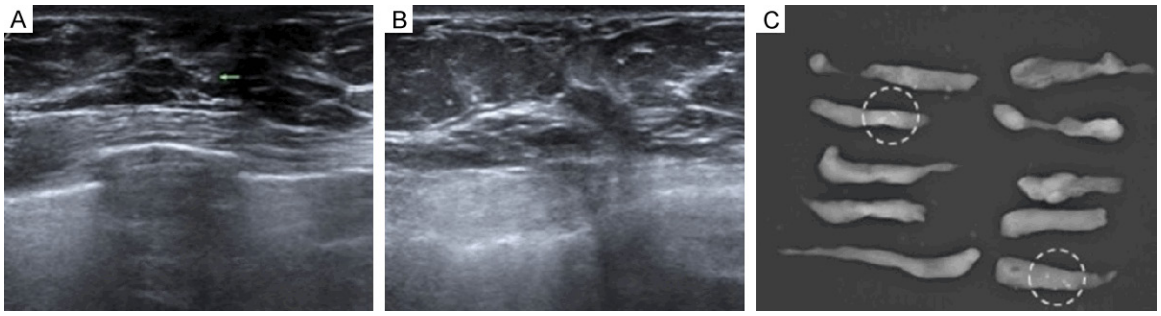

Figure 2. USVAB. A: Breast micro calcifications detected by ultrasound; B: The calcifications were completely removed; C: Specimen mammography showed that aimed micro calcifications were retrieved. USVAB, ultrasound-guided vacuum-assisted breast biopsy.

into the areas with the highest density of diffuse or regional calcifications. Patients lied in a prone position and kept the breast natural. They adjusted the splints to fix the breast and performed mammography at 0°, +15°, and -15°, respectively at the best target, as shown in **Figure 1**. They connected the vacuum device and fixed the puncture needle. Local anesthesia was given to the conventional puncture point and a 3mm incision was cut. According to the target, the needle placed into the breast to reach the calcifications indicated by imaging. They levered the needle and determined the position of calcifications and the needle by imaging to remove calcified tissues. Once the rotary cutting was completed, imaging was performed to determine if the calcifications were completely or partially removed and then the needle out removed. The puncture site was compressed for hemostasis for 10 minutes and then pressured with an elastic bandage for 3 days. The excised tissues were subject to routine pathological examination.

USVAB: Patients lied in a prone position, the position of calcifications was clearly defined by ultrasound, and the best point of puncture was selected. Local anesthesia was given to the conventional puncture point and a 3-5 mm incision was cut. They placed the needle into the lesion under the guidance of ultrasound for rotary cutting at the best target and rotated the needle in a fan shape for repeated cutting. Once the rotary cutting was completed, imaging was performed to determine if the calcifications were completely or partially removed, as shown in **Figure 2**. The puncture site was compressed for hemostasis for 10 minutes and then pressured with an elastic bandage for 3 days. The excised tissues were subject to routine pathological examination.

Outcome measures

According to the pathological examination results of vacuum-assisted breast biopsy (VAB) and USVAB, the positive predictive values of both methods were compared. Healing of the incisions after the operation was observed.

Statistical method

Statistical analysis was conducted using SAS 11.0. Utilization rate of enumeration data (%) and other indicators between the two groups were compared using Chi-square test. Data are expressed as mean ± standard deviation. Comparison between the two groups was conducted using t-test of two independent samples. $P<0.05$ represents a statistically significant difference.

Results

General data of SVAB and USVAB biopsy specimens

SVAB and USVAB biopsy specimens presented no statistically significant differences in age, position of calcifications, calcification distribution, and BI-RADS classification (all $P>0.05$). See **Table 1**.

Biopsy results of calcifications

A total of 42 patients underwent SVAB. The length of operation was 42 minutes to 2 hours, with an average of 87±12 min. The length of rotary cutting was 13-46 minutes, with an average of 21±4 min. Calcifications were observed

Table 1. General data of SVAB and USVAB biopsy specimens

Method		SVAB (n=42)	USVAB (n=33)	t/χ^2	P
Age (years old)		41.03±10.31	41.56±12.72	9.59	0.312
Position of calcifications	Left side	16	18	10.05	0.292
	Right side	16	16		
	Both sides	5	4		
Calcification distribution	Clustered	35	17	7.04	0.114
	Regional	10	7		
	Diffuse	2	4		
BI-RADS classification	Grade 3	3	3	11.36	0.373
	Grade 4	29	25		
	Grade 5	6	9		

Note: SVAB, stereotactic vacuum-assisted breast biopsy; USVAB, ultrasound-guided vacuum-assisted breast biopsy; BI-RADS, Breast Imaging Reporting and Data System.

in the biopsy specimens and confirmed pathologically by imaging. Preoperative molybdenum targets and postoperative breast mammography were compared, indicating that clustered calcifications (range ≤1 cm) were completely removed in 29/35 cases and partially removed in 6/35 cases and regional calcifications were partially removed in 10 cases.

A total of 33 patients underwent USVAB. The length of operation was 14-37 minutes, with an average of 21±3 min. The length of rotary cutting was 8-16 minutes with an average of 11±2 min. Calcifications were observed in the biopsy specimens and confirmed pathologically by imaging. Postoperative breast mammography showed that clustered calcifications (range ≤1 cm) were completely removed in 17 cases and regional calcifications were partially removed in 7 cases.

Pathological results and treatment of biopsy

Postoperative pathological results showed that 32 cases were diagnosed as ductal carcinoma in situ, among which 4 cases suffered micro invasion, 3 cases underwent mastectomy and sentinel lymph node biopsy, and 1 case underwent modified radical mastectomy because of enlarged axillary lymph nodes. Three cases were diagnosed as infiltrating ductal carcinoma, among whom 2 cases underwent mastectomy and sentinel lymph node biopsy, and 1 case underwent modified radical mastectomy. Eleven cases were diagnosed as infiltrating lobular carcinoma and underwent mastectomy and sentinel lymph node biopsy. The remaining 29 cases were diagnosed as benign breast lesions including 3 cases of cystic hyperplasia of breast, 6 cases of ductal epithelial hyperplasia, 3 cases of fibro adenoma, and 1 case of intraductal papilloma.

Incidence of adverse reactions

All patients underwent the biopsy without failure. Three patients suffered intraoperative bleeding presenting no further increase after pressure dressing. Two patients suffered postoperative hematoma and ecchymosis but received no special treatment. No infection of puncture sites occurred. All patients were followed up for 6-24 months with an average of 16 months. Among the patients with benign lesions, the incisions healed well, the appearance of breast was satisfactory, and no signs of malignancy were seen. No recurrence was found in the patients with breast cancer.

Discussion

Clinical significance of breast micro calcifications

Deposition of breast cancer secretions and calcifications of cancer cells contribute to breast calcifications [6]. At present, calcifications with a diameter of <1 mm are defined as microcalcifications. Microcalcifications may suggest early breast cancer. Microcalcifications can be observed by early mammography in some breast cancer patients [7]. However, microcalcifications are not equivalent to breast cancer, which needs to be identified based on the shape and distribution. First, 80% of linear and branched calcifications and about 30% of small pleomorphic calcifications are malignant while about 20% of amorphous calcifications, about 7% of large and special-shaped calcifications, and about 11% of punctate calcifications are malignant. Second, 78% of segmental calcifications are malignant followed by regional and cluster calcifications and then cluster calcifications [8-11]. The study results also show that the shape of microcalcifications is closely relat-

ed to breast cancer. In this study, all diffuse calcifications were benign lesions while 73.1% of cluster calcifications and 47.1% of regional calcifications were malignant. Therefore, cancerization risk of microcalcifications should be assessed combined with BI-RADS classification and characteristics of calcifications.

Advantages and disadvantages of SVAB and USVAB

VAB, characterized by less trauma and error, is the first choice for biopsy of breast cancer calcifications. Compared with other techniques, VAB rotary cutting can remove more calcifications, increasing the chance of diagnosing breast cancer [12, 13]. Clinically, some scholars have reported that the sensitivity of SVAB in diagnosis of breast cancer was over 99.7% and its false negative rate was 1.7%-7.1% [14]. In addition, some scholars believe that the accuracy of USVAB in the diagnosis of breast cancer is 94.4%-95.9% [15]. Penco et al. followed up patients with breast micro calcifications who underwent USVAB and the results showed that no false negative cases appeared, indicating that USVAB can be used for biopsy of breast micro calcifications instead of VAB [16]. Our results showed that breast microcalcifications in all patients who underwent VAB and USVAB were detected and diagnosed clearly and among the patients with benign lesions, no signs of breast cancer were seen.

Histologic underestimation means that the lesion is diagnosed as infiltrating carcinoma pathologically but intraductal carcinoma detected by biopsy, or clearly diagnosed as breast cancer pathologically but atypical ductal epithelial hyperplasia suggested by biopsy [17]. It was reported that approximately 0-17.8% of patients who were diagnosed as ductal carcinoma in situ by SVAB pathologically were diagnosed as infiltrating carcinoma after operation while approximately 0-18.8% of patients who were diagnosed as carcinoma *in situ* by USVAB pathologically were diagnosed as infiltrating carcinoma after operation [18, 19]. Histologic underestimation can delay the treatment of breast cancer and affect the quality of life in patients. However, histologic underestimation is closely related to the removal of microcalcifications [20]. In this study, no patients who were diagnosed as carcinoma in situ by biopsy were diagnosed as infiltrating carcinoma after operation. Analysis results show that this may be related to more materials taken for biopsy and most of the calcifications having been removed completely.

There are limitations to this study. Scattered calcifications with special shape in breasts on x-ray mammography can affect the diagnosis of breast cancer when calcifications of breast nodules are detected. This study did not focus on the scattered calcifications outside nodules but it will be further studied in the future. In addition, more cases will be enrolled in further study since fewer cases were included in this study. Nevertheless, this study provides a clinical reference for further study.

To sum up, SVAB achieves high positive predictive value. It is accurate, minimally invasive, and with less postoperative complications. Therefore, it can be used as a preferred method to clinically detect breast calcifications

Disclosure of conflict of interest

None.

Address correspondence to: Jing Guo, Department of Radiology, Cangzhou Central Hospital, No.16 Xinhua West Road, Cangzhou 061001, Hebei Province, China. Tel: +86-13315777581; E-mail: guojing1407@126.com

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