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Application of ultrasound-guided vacuum-assisted percutaneous excision technique in non-palpable breast lesions

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Summary

Objective: To determine the efficacy of ultrasound-guided vacuum-assisted percutaneous excision technique in treating non-palpable breast lesions. *Materials and Methods:* Between January 2012 and November 2014, a total of 452 non-palpable breast lesions diagnosed by ultrasonography in 400 patients were treated by ultrasound-guided vacuum-assisted percutaneous excision. All patients received pressure dressings, which were removed after 48 hours, then rechecked after three months. *Results:* Ultrasonography clearly displayed all 452 breast lesions during the mammotome biopsy. The operative process was successfully guided. All patients were free from infections or pneumothoraces, as well as skin lesions; four patients developed postoperative local hematomas and five patients had local bruising. The incidence of local hematomas was 6.0% (27/452). One mass residue was detected during the ultrasonographic follow up after three months. *Conclusion:* Ultrasound-guided vacuum-assisted percutaneous excision for non-palpable breast lesions has advantages, including simple operation, accurate positioning, safety, minimal invasion, fewer complications, rapid recovery, and good cosmetic appearance. It can substitute the traditional surgical approach and is thus recommended as an alternative minimally invasive technique.

Key words: Breast neoplasm; Mammary ultrasonography; Mammotome rotary cutting system; Operation.

Introduction

Breast cancer screening programmes have led to an increased rate of detection of breast lesions. Many benign lesions are treated surgically, either because the lesions fail to regress, progressively enlarge, or because the women who have lesions are uncomfortable with their diagnosis. Traditional open surgery for breast lesions, which can be associated with unfavourable cosmetic results and more extensive parenchymal dissection during surgery, have plagued physicians and patients, especially with respect to non-palpable breast lesions. Non-palpable breast lesions are breast lesions that cannot be palpated due to some factors, such as lesions too small in diameter, deep position, and high-density mammary glands. Thereby, necessitating safe and minimally invasive therapeutic options have been carried out. The excision of breast lesions using an ultrasound-guided vacuum-assisted device is a widely used technique for the diagnosis and treatment of breast diseases. An ultrasound-guided vacuum-assisted device facilitates a minimally invasive surgical approach. The present authors have been using an ultrasound-guided vacuum-assisted device to inspect breast lesions since 2008. In the current study they determined the efficacy the technique in 452 non-palpable breast lesions from January 2012 to November 2014.

Materials and Methods

Between January 2012 and November 2014, a total of 400 patients with 452 non-palpable breast lesions underwent ultrasound-guided vacuum-assisted percutaneous excision at the present hospital. Table 1 summarizes the characteristics of the 400 patients. All of the patients were females. The mean size of the lesions was 1.4 ± 0.9 (range, 0.5~2.8) cm. The mean age was 37 ± 13.9 (range, 15~62) years. None of the lesions were palpable during physical examination, but imaged clearly on ultrasound examination. The BI-RADS categories for the lesions were grades 3 to 4A. All of the patients requested surgery.

The SCM23k mammotome minimally invasive breast biopsy system was used. All rotary cutters were the 8G model. B ultrasound was performed with a SSD-α5 color ultrasound machine using a high-frequency probe at 7.5 mHz. Patients were in the supine position with both breasts fully exposed. The breast area was subjected to routine disinfection and was covered with surgical drapes. The ultrasound probe was wrapped in a sterile rubber sleeve and placed in sterile saline. The ultrasound probe was then coated with iodophor as a medium to detect and accurately locate the breast lesions in advance. An incision was made at the area close to the lump. Local anesthetic was administered using a long needle into the bottom of the mass and puncture the path. The skin incision was 0.3 cm in width and an 8G rotary knife was inserted. The long axis of the probe was aligned with the needle. The needle aperture was adjusted based on the location of the lesion and the needle was advanced to the bottom of the breast lesion. The aperture directly targeted the lesions, and by rotating the probe 90°, the lesion was sliced transversely (the so-called cross-location method). The aperture was opened and the vacuum was started. The lesion was held by the vacuum at the aperture

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Table 1. — *Patient demographics and characteristics of the original breast lesions in all cases.*

	All patients	All cases	Percentage (n=452)
Total number	400	452	
Age (median, years)	37±13.9 (15~62)		
Lesion size on ultrasound (median, cm)		1.4±0.9 (0.5~2.8)	
BI-RADS classification on ultrasound			
Category 3		406	89.8%
Category 4A		46	10.2%

Table 2. — *Histopathology from the breast biopsy core specimens harvested at the time of the original ultrasound-guided diagnostic breast biopsy procedure.*

Histopathology	Cases	Percentage (n=452)	Further therapy
Intraductal papillomas	22	4.9%	
Ductal ectasia	6	1.3%	
Fibroadenomas	382	84.5%	
Ductal epithelial hyperplasia	25	5.5%	
Cyst formation	3	0.7%	
Atypical ductal hyperplasia	7	1.5%	Observation
Ductal carcinoma *in situ*	4	0.9%	Re-operation and postoperative adjuvant therapy
Infiltrating duct carcinoma	3	0.7%	Re-operation and post-operative adjuvant therapy

and samples were cut and collected repeatedly. The lesion strip was removed. The cutter did not need to be removed during sample acquisition. The entire process was monitored and guided in real-time by ultrasound. Attention was paid to avoid cutting blood vessels. Sample tissues were collected several times until a satisfactory tissue was obtained with an eye-detectable negative edge. The process ended, as no residues were detected by ultrasound. After surgery was completed, the vacuum was re-applied to clear from blood at the biopsy site. The wound was wrapped with an elastic bandage which was removed after 48 hours, and follow-up was conducted with ultrasound after three months.

Results

All patients successfully underwent the procedure. The pathologic results revealed 22 cases of intraductal papillomas, six cases of ductal ectasia, 389 cases of fibroadenomas, 25 cases of fibrocystic breast disease, three cases of inflammation, three cases of invasive ductal carcinomas, and four cases of ductal carcinomas, which are shown in Table 2. Postoperatively there were four cases of hematomas near the site of excision and 23 cases of partial skin bruising; the total local bleeding incidence rate was 6.0% (27/452). During the three-month follow-up, all hematomas and bruisings self-absorbed. A review of ultrasonographic examinations showed a residual lesion in one case. Because the lesion was pathologically benign, no additional surgery was performed and the patients were examined regularly. All patients diagnosed with pathologically malignant lesions underwent re-operation and received postoperative adjuvant therapy. Complications and the follow-up variables are shown in Table 3.

Table 3. — *Post-procedural complications for all cases and follow-up variables after three months.*

Type of post-procedural complication	Cases	Percentage (n=452)	Further therapy
Mild hematoma / Moderate hematoma	4/23	6.0%	Observation
Severe hematoma	0	0	
Skin ecchymosis	0	0	
Infectious complication	0	0	
Follow-up ultrasound per formed after three months	438	96.9%	
Was a residual ultrasound lesion visible for those undergoing follow-up ultrasound	1	0.2%	Observation

Discussion

A lengthy amount of time is required to detect breast cancer in patients with non-palpable breast masses using the traditional ultrasound-guided needle positioning method. The process can cause significant trauma and require incisions, which greatly impacts patients physiologically and psychologically. The mammotome system was developed in 1994 by Burbank and others based on the hollow needle biopsy technique. Ultrasound-guided mammotome minimally invasive surgery has been used for incisional biopsies of breast lesions and the removal of small benign lesions due to its minimal invasion and convenience [1, 2]. Compared to other imaging devices, such as mammography and magnetic resonance imaging, the mammotome has the advantage of being non-radioactive, rapid, and with low cost. It requires simple equipment and poses no location restrictions. It also employs a special transfer system to obtain sample tissues without removal of the outside needle. The aperture can be rotated multiple times until the tumor is removed completely, thus reducing unnecessary surgeries. Because the incision is only three mm wide, no internal stitching is required, which significantly reduces the impact on the appearance of the breast and is consistent with the developing trends in breast surgery. The mammotome is a great alternative to the traditional surgical approach [3, 4]. It can be applied to B ultrasound-identifiable benign breast tumor resection, biopsy of suspicious lesions, and pathologic examination to determine the biochemical characteristics of breast cancer. Due to the length (23 mm) and diameter (3.9 mm) of the 8G needle, and based on the present authors' experience, they propose that the length of the

tumor should be < three cm with a width < two cm for ease of complete resection.

Based on the present authors extensive surgical experience and reports from others, they have the following suggestions: the incision is usually made at the outer rim of the glands or around the areolar edge. With the exception of lumps deep in the fascia of the pectoralis major, the incision should be made near the periphery to facilitate the insertion through the gaps in the fascia. The needle angle is important. For deep lesions, the needle angle should extend the distance between the incision and the lesion. For large masses, the selection of the incision location is also affected by the diameter of the tumor. Because the effective cut length of the aperture is approximately two cm, and most tumors have different diameters, for large masses the side with a diameter < two cm can be held at the aperture. The needle enters along the short axis and the long side can be removed by the cross-location method.

The present authors recommend a double-team operation with one person operating the B ultrasound and the other person operating the needle. This can stabilize the needle operator's hand and prevent the needle from sliding back and forth. The needle sliding can lead to tumor falling off from the needle aperture, causing unnecessary damage and leaving residual tumor, especially during a large tumor resection. The needle should be advanced below the tumor, and for a small tumor, fan resection is possible [5]. For larger tumors, because the inner diameter of the 8G needle is only 3.9 mm, fan resection is difficult to cover the tumor completely, resulting in residual tumor. The present authors also recommend cutting from the bottom upwards in battlement-shaped layers to complete the tumor resection and to avoid tumor residue. For tumors close to the pectoralis major fascia, the needle can be inserted close to the pectoralis major fascia. An attempt should be made to be close to the tumor side and start from the lowest level to perform the transverse resection.

Postoperative hematomas and subcutaneous ecchymoses are the most common problems of minimally invasive surgery, often due to the postoperative hemostasis time being too short, pressing in the wrong location, or damaging major blood vessels during surgery. Generally speaking, no treatment is necessary and treatment can often be self-absorbed. After resection of the large tumor, there are large residual cavities. Over-squeezing to empty the residual blood should be avoided because it can easily lead to local breast depression. For patients with small breasts, residual cavity blood can help maintain the shape of the breast.

Attention should be paid to observe the tissue sample strips. If there are no tumor tissues on the tissue sample strips, when combined with evidence from B- ultrasound, it is possible that the aperture misses the tumor due to operative errors. The technique should be promptly adjusted to avoid unnecessary damage and hematomas. When cutting the edge of the tumor, due to the interference of hematomas and restriction of B-ultrasound resolution, the resection should be expanded to the edge where no tumor tissue can be visualized. B-ultrasound can be used to confirm a complete excision to avoid leaving a small amount of residual tumor.

For hard tumors, the rotary cutter might slip or get stuck. Thus, for large calcified or diffuse calcified tumors, the present authors recommend open surgery for resection. For tumors deep in the medial border of the breast, special attention must be paid not to damage the blood vessels around intercostals 1-4 and surrounding muscles.

In summary, a large number of breast disease patients, especially young patients, are in urgent need for effective, aesthetically favorable, and minimally invasive breast surgery methods. Use of a mammotome to achieve a minimally invasive biopsy of breast tumor is performed with a high-resolution sonogram. It has the advantage of being accurate, thorough, convenient, minimally invasive, effective, cosmetically favorable, and safe with few complications, in agreement with the requirements of medical progress [6]. For non-palpable breast lesions and suspicious lesions, a mammotome offers benefits worthy of promotion and wide applications. Because of its advantages, early-stage breast-conserving surgeries using this technology have been reported [7]. The present authors believe that more therapeutic applications in treating breast diseases are yet to come.

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