

Surgical drainage of lactational breast abscess with ultrasound-guided Encor vacuum-assisted breast biopsy system

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Abstract

Lactational breast abscess is a serious complication of mastitis and commonly diagnosed in breast-feeding women. The traditional drainage of breast abscess was often performed with incisive technique which may result in prolonged healing time, regular dressings, dressing pain, interfering with breastfeeding and unsatisfactory cosmetic outcome. As minimal invasive alternatives to incisive drainage, needle aspiration or percutaneous catheter placement cannot completely replace incisive drainage for the inability to treat large, multiloculated or chronic abscess. Vacuum-assisted breast biopsy system (VABB) has been successfully applied in the treatment of benign breast diseases with satisfactory cosmetic outcomes. Among VABB devices, EnCor system has some distinctive features that make it an appropriate candidate for the treatment of lactational breast abscesses. In this study, for the first time, we investigated the feasibility, efficacy, and cosmetic results of surgical drainage of lactational breast abscess with US-guided Encor VABB system. Our data suggests this procedure could serve as a promising alternative for women with lactational breast abscess who require incisive intervention with high cure rate, relatively short healing time, low recurrence rate, few complications, satisfactory cosmetics outcome and without interfering with breastfeeding.

KEYWORDS

drainage, Encor vacuum-assisted breast biopsy system, lactational breast abscess, minimal invasive, ultrasound-guided

1 | INTRODUCTION

Lactational breast abscess is a serious complication of mastitis and commonly diagnosed in breast-feeding women. Clinical symptoms of breast abscess may involve redness, swelling and pain of the affected breast, fever and malaise, as well as interruption of breastfeeding.¹ Drainage of pus is generally considered as the mostly effective

procedure in the management of breast abscess.² Traditionally, the drainage of breast abscess was often performed with incisive technique. However, incisive drainage is now considered as the last resort for the management of breast abscess because of shortcomings such as prolonged healing time, regular dressings and dressing pain, interfering with breastfeeding and unsatisfactory cosmetic outcome (Figure 1).³⁻⁶

Chen Chen and Li-bo Luo are Co-first Author.

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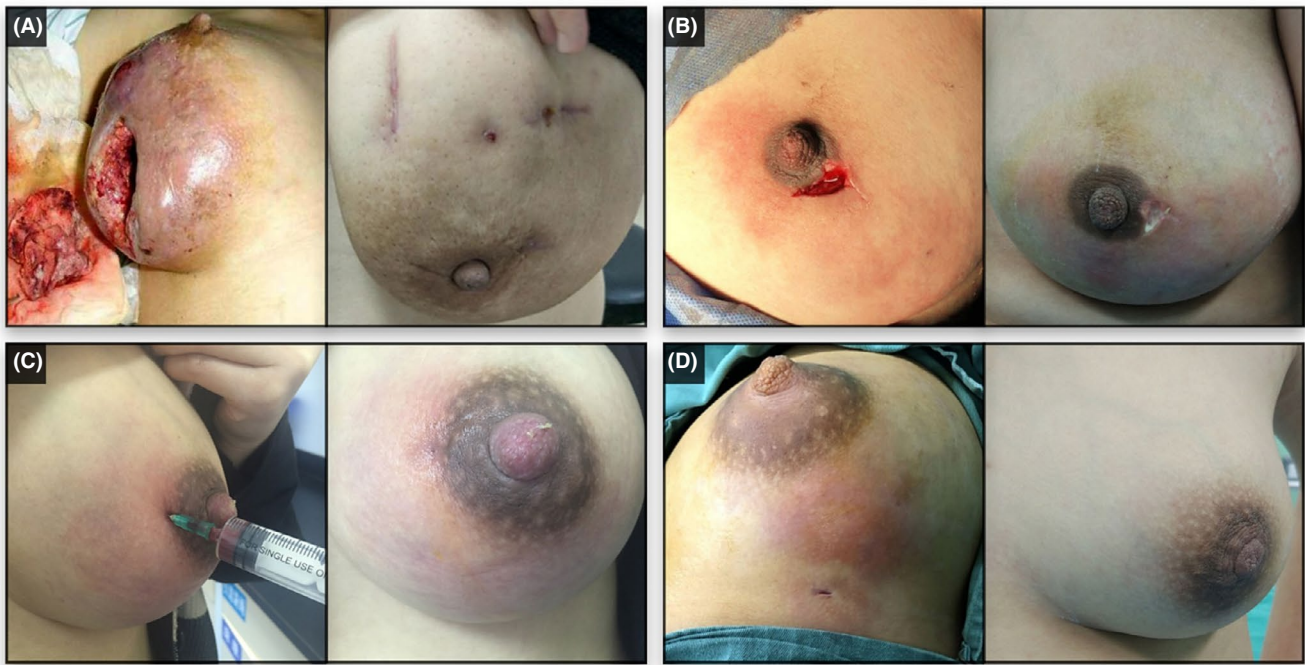


FIGURE 1 Surgical drainage of breast abscess with different incisions. A, Radial incision: The radial incision was often used in the incision drainage of breast abscess, which is always associated with prolonged healing time, regular dressings, dressing pain as well as unsatisfactory cosmetic outcome. B, Periareolar incision: The periareolar incision was used in some breast abscess located in the central area with better cosmetic outcome compared with radial incision. However, as is interfering with breastfeeding and emptying breast, some patients may experience relapse of disease because of milk stasis. C, Needle Aspiration: Sometime the pus is too viscous to aspirate by needle that repeat aspirations are often required. For large (>3 cm) or multiloculated abscesses, the effect of needle aspiration is also limited. D, Inframammary fold incision: Breast abscesses can be efficiently drained with inframammary incision using ultrasound-guided Encor vacuum-assisted breast biopsy system. Such incision is far away from nipple without interfering with breastfeeding, minimizing the risk of disease recurrence. Moreover, this minimal invasive incision is hardly visible or even totally invisible as hidden from the natural breast ptosis

Recently, it has been reported that ultrasound-guided (US-guided) percutaneous catheter placement or needle aspiration could be considered as alternative approaches to incision drainage.⁷⁻¹⁰ Although, it is demonstrated that these minimal invasive procedures can be effective and safe in the treatment of breast abscess of small diameter (<3 cm) or monolocular, these methods still have several potential disadvantages mainly including: lower cure rate and higher recurrent risk compared with incision drainage, repeat aspirations, difficulty in treating multiloculated or long-standing abscesses. Therefore, incision drainage is often inevitable and recommended for the following situations³: (a) treatment failure of needle aspiration or catheter drainage; (b) large abscess with a minimum diameter of 5 or more centimeters; (c) multiloculated abscesses; (d) long-standing abscesses.

As a minimally invasive procedure of breast, vacuum-assisted breast biopsy system (VABB) provides more accurate diagnosis and has been successfully applied in the excision of benign breast lesions.¹¹⁻¹⁴ Patients show much interest in this procedure for its satisfactory cosmetic outcomes. Compared with percutaneous catheter placement or needle aspiration, VABB system has the following advantages for the treatment of breast abscesses: (a) the viscous pus can be easily aspirated with vacuum suction, which is difficult for needle aspiration; (b) the septa among abscesses can be easily broken

with the ultra-sharp cutting tip and the rotating cutter, which is difficult for percutaneous catheter placement, and thus guaranteeing thorough drainage just as incision drainage; (c) a tissue sample of the lesion area can be obtained concurrently with drainage, which makes the pathologic diagnosis possible and enabling differential diagnosis of inflammatory breast cancer¹⁵ or concurrent breast cancer.¹⁰

In this study, we investigated the feasibility, efficacy, and cosmetic results of surgical drainage of lactational breast abscess with US-guided Encor VABB system. To our knowledge, our data demonstrate, for the first time, that Encor system can be applied in the treatment of breast abscesses with high cure rate, relatively short healing time, low recurrence rate, few complications, satisfactory cosmetics outcome, and without interfering with breastfeeding.

2 | PATIENTS AND METHODS

2.1 | Patients

From January 2017 to May 2018, a total of 36 female patients in the first people's hospital of Zunyi were included. The diagnosis of breast abscess was made based on the status of breastfeeding, symptoms (breast or nipple pain, malaise), clinical signs (redness, swelling and tenderness in the affected breast; fever), blood test, breast ultrasound,

and US-guided aspirated material. All cases were confirmed with aspiration of pus. Lactational patients with the following conditions were considered to meet the eligibility criteria for surgical drainage of breast abscess with US-guided Encor system: (a) single breast abscess identified on US with a minimum diameter of five or more centimeters; (b) multiple breast abscesses identified on US with a minimum diameter of three or more centimeters; (c) treatment failure with needle aspiration (a maximum of three times without complete resolution). This study was approved by the Ethical Committee of the first people's hospital of Zunyi. Informed consent was obtained in all cases.

2.2 | Surgical procedures

All the surgeries were performed by two skilled surgeons with experience of breast ultrasound by using the 7-gauge Encor VABB system. A Chison Q6 ultrasound system (KeeboMed Corporation) with high-resolution linear array transducers (7.5 MHz) was used to provide real-time ultrasound guidance. Patients were maintained in a supine position with the target area sterilized and draped. Local anaesthesia is performed with the mixture of 0.5% lidocaine, 1:200 000 epinephrine and normal saline solution in a total volume of 80-100 mL. The ultrasonic transducers and tubing of Encor device were protected with sterile covers.

A 5 mm inframammary incision was made with a #11 triangular blade to served as the access for the probe. The probe was then positioned beneath the lesion under real-time ultrasound guidance using freehand technique. The pus were drained by vacuum aspiration, and some were sent for bacteriological culture. The septa among abscesses, if exist, were broken with the ultra-sharp cutting tip and the rotating cutter to ensure thorough drainage. A sample of the lesion tissue was excised using the rotating blade with vacuum aspiration, and were sent for pathologic evaluation. When all abscesses were no longer visible under ultrasound, the procedure was considered done. A longitudinally and transversely sonographic rescanning was performed to confirm the complete drainage. 100-250 mL normal saline solution was irrigate in the previous abscess cavity using 50 mL syringe under real-time ultrasound guidance, and then was aspirated to remove cellular debris and surface pathogens. Next, a catheter connected with a plastic suction bottle was placed for continuing drainage through the same inframammary incision. The catheter was fixed securely to the skin with silk suture. The catheter could be removed when the volume of drainage became less than 20 mL/d and with the confirmation of no residual abscesses. The previous abscess cavity was irrigated once a day with normal saline to remove surface microorganisms or tissue debris and to prevent occlusion of catheter. Continuation of breastfeeding was always encouraged for all patients.

2.3 | Pharmacologic administration and supportive measures

Empiric oral antibiotics were prescribed for all patients, and sensitive antibiotics are administrated according to the results of bacterial

cultures. Ibuprofen was prescribed for patients with intolerable breast pain or sustained fever ($\geq 38.5^{\circ}\text{C}$ for 24 hours). All patients were educated with breastfeeding and skills and the prevention of mastitis. Breastfeeding from the affected breast were encouraged 24 hours after drainage to prevent milk stasis and relapse of the infection. The importance of adequate rest, sufficient fluids, and proper nutrition were also emphasized.

2.4 | Evaluation & follow-up

The blood test and breast ultrasonography were repeated 3 days for postoperative evaluation until complete resolution. Pain of the affected breast was evaluated at the surgery day and the 1-3 days after surgery. The pain score was recorded using Numeric Rating Scale (NRS),¹⁶ which 0 stands for no pain and 10 for worst possible pain. The cosmetics satisfaction was evaluated at 8 weeks after the surgery for all cases through telephone or outpatient visits. Score for cosmetics satisfaction was rated as follows: 0 for no satisfaction, 1 for mild satisfaction, 2 for moderate satisfaction, and 3 for pronounced satisfaction. Continuation of breastfeeding was investigated at 3 days, 4 weeks, and 8 weeks after surgery via telephone or outpatient visits.

3 | RESULTS

3.1 | Before surgery

Clinical characteristics of included patients are shown in Table 1. The average age of included patients was 24.7 ± 4.9 years (range 18-41 years). Seventy-five percent (27/36) women were at the 2nd-8th postpartum weeks at the time of diagnosis. 80.5% (29/36) patients were primiparae while 19.5% (7/36) were multiparae. 86.1% (31/36) patients have the history of milk stasis of the affected breast within 3 days before symptoms onset. 22.2% (8/36) patients have inverted nipples, while 11.1% (4/36) have damaged nipples. The mean duration of symptoms is 9.4 ± 6.2 days. 91.7% (33/36) patients presented with symptoms of redness and swelling of the affected breast. 19.5% (7/36) patients ran a sustained fever ($\geq 38.5^{\circ}\text{C}$ for 24 hours) at the time of consultation, thus ibuprofen was administered for fever resolution. For patients with a body temperature between 36.0°C and 38.4°C , timely breast emptying, sufficient rest, adequate fluids, and proper nutrition were emphasized without pharmacologic administration. All of the abscesses were unilateral and most were located in the right breast (61.1%). 52.8% (19/36) patients were identified to have multiloculated abscesses. The average diameters of these abscesses are 74.8 ± 29.1 mm, with the largest one measuring 130 mm.

3.2 | Surgery

Surgical drainage of lactational breast abscesses with US-guided Encor VABB system was successfully performed in all 36 patients (Figure 2). All of the surgeries were performed under local anesthesia. The average operating time was 39.3 ± 10.4 minutes (range

TABLE 1 Clinical characteristics of the 36 included patients

Characteristics	N = 36	mean ± SD [range] (unit/notes)
Before surgery		
Age	24.7 ± 4.9 [18-41] (y)	
Postpartum (wk)	6.9 ± 4.0 [2-17] (wk)	
Parity	Primiparae: 29 (80.5%)	Multiparae 7 (19.5%)
History of milk stasis ^a	Yes: 31 (86.1%)	No: 5 (13.9%)
Duration of symptoms	9.4 ± 6.2 [3-30] (d)	
Location of breast abscess	Left: 14 (38.9%)	Right: 22 (61.1%)
Inverted nipples	Yes: 8 (22.2%)	No: 28 (77.8%)
Damaged nipples	Yes: 4 (11.1%)	No: 32 (88.9%)
Abscess cavity	Single: 17 (47.2%)	Multiple: 19 (52.8%)
Max. diameter of abscesses	74.8 ± 29.1 (S ^b : 50-100; M ^c : 35-130 mm)	
Breast redness & swelling	Yes: 33 (91.7%)	No: 3 (8.3%)
Fever (≥38.5°C for 24 h)	Yes: 7 (19.5%)	No: 29 (80.5%)
Surgery		
Operation time	39.3 ± 10.4 [23-56] (minutes)	
Sustained or massive hemorrhage	Yes: 0 (0%)	No: 36 (100%)
Volume of drained pus	81.7 ± 40.6 [35-220] (mL)	
After surgery		
Pain score (0-10)	2.2 ± 0.7 (day1), 1.6 ± 0.6 (day2), 1.2 ± 0.5 (day3)	
Fever (≥38.5°C)	Yes: 1 (2.8%)	No: 35 (97.2%)
Resolution of breast skin	1.8 ± 0.9 [1-4] (d)	
Duration of antibiotics	4.3 ± 1.3 [3-7] (d)	
Duration of drainage	4.4 ± 1.3 [3-8] (d)	
Occluded catheter	Yes: 2 (5.6%)	No: 34 (94.4%)
Pus culture	S. aureus: 27 (75%) MRSA: 4 (11.1%)	Others: 2 (5.6%) Sterile: 3 (8.3%)
Complications ^d	Yes: 0 (0%)	No: 36 (100%)
Relapse (within 8 w)	Yes: 0 (0%)	No: 36 (100%)
Cosmetic satisfaction (8 w)	3.0 ± 0.2 [2-3] (0-3)	
Breastfeeding (start within 3 d)	Yes: 25 (69.4%)	No: 11 (30.6%)
Breastfeeding (within 4 w)	Yes: 22 (61.1%)	No: 14 (38.9%)
Breastfeeding (within 8 w)	Yes: 18 (50.0%)	No: 18 (50.0%)

^aHistory of Milk Stasis of the affected breast within 3 d before symptoms onset.

^bS: single breast abscess.

^cM: multiple breast abscesses.

^dPostoperative hemorrhaging, hematoma, or wound infection.

23-56 minutes). The mean volume of drained pus was 81.7 ± 40.6 mL (range 35-220 mL). None of included patients experienced sustained or massive hemorrhage during operation. These were no case of postoperative hemorrhaging, hematoma and wound infection in our study.

3.3 | After surgery

The mean pain score was 4.6 ± 0.9 at surgery day, and 2.2 ± 0.7, 1.6 ± 0.6, and 1.2 ± 0.5 at day 1, day 2, and day 3 after surgery, respectively. The average time of fever resolution and breast skin

resolution were 1.8 ± 0.9 days for 33 patients with preoperative symptoms. The body temperatures of all the seven patients with preoperative fever were lower than 38°C within postoperative 3 days. The mean duration of antibiotics use was 4.3 ± 1.3 days (range 3-7 days). The results of bacterial cultures were mostly *Staphylococcus aureus* (27/36, 75%) with MRSA being less common (4/36, 11.1%), while sterile were found in 8.3% cases. The average duration of drainage was 4.4 ± 1.3 days, while the duration in two patients was more than 1 week for sustained massive milk drainage (>50 mL/d for 3 days). Two cases experienced occluded catheter and all were solved with irrigation and suction.



FIGURE 2 Surgical drainage of breast abscess using ultrasound-guided Encor vacuum-assisted breast biopsy system. A, Preoperative photograph of a patient with breast abscess. B, C, A 5 mm inframammary incision was made to serve as the access for the probe. D, E, The ultrasound images of the patient with multiloculated abscesses. F-H, The probe was positioned beneath the lesion under ultrasound guidance, and the pus was drained with vacuum aspiration. I, The aspirated pus. J, A catheter connected with a plastic suction bottle was placed for continuing drainage through the same inframammary incision. K, Postoperative photograph of this patient

3.4 | Follow-up

All patients were followed up via telephone or outpatient visits at 1 week, 4 weeks, and 8 weeks after surgery for evaluation of relapse, wound healing, continuation of breastfeeding as well as cosmetic satisfaction (Figure 3). Disease recurrence in our study was defined as redness and swelling, or breast abscess identified on US in the same quadrant of the affected breast. None of the patients in our study had disease recurrence within postoperative 2 months. All incisions were healed within 1 week after decannulation, and no case of wound infection occurred. The mean score for cosmetics satisfaction was 3.0 ± 0.2 , with 97.5% (35/36) of the patients rated for pronounced satisfaction (3 score) and none rated for dissatisfaction (0 score). One patient

aged 22 years who has small breasts and without breast ptosis rated 2 score for relatively evident scar. Breastfeeding on the both breasts was continued in 69.4%, 61.1%, and 50% patients at postoperative 3 days, 4 weeks, and 8 weeks, respectively. Two patients discontinued breastfeeding for sustained milk drainage (>50 mL/d for 3 days) that caused delayed decannulation, significant discomfort and anxiety. Bromocriptine was administered orally to (2.5 mg twice daily for 14 days) stop milk production with satisfactory effect. None of included patients discontinued breastfeeding for difficulty in emptying milk of the affected breast after surgery. Other reasons for patients to discontinue breastfeeding involved introduction of other feeds, infant's self-weaning, inverted nipples, personal choice (fatigue, inconvenience, or work), and so on.



FIGURE 3 Breast skin resolution and cosmetic outcome of the patients treated with ultrasound-guided Encor vacuum-assisted breast biopsy system. A, B, Surgery day. C, 2 d after surgery. D, 14 d after surgery. E, F, 28 d after surgery

4 | DISCUSSION

4.1 | Breast abscess

The incidence of breast abscess, which are mostly estimated from retrospective studies and varies widely, ranges from 0.4% to 11% of all lactating mothers.^{1,2,17} Milk stasis is the primary cause of mastitis that can sharply increase the risk of developing breast abscesses.^{2,5} The main purpose of treating abscesses is to remove the infected fluid as speedily as possible, reducing the pain and relieve the fever or discomfort, thereby allowing patients to continue breastfeeding without interruption. In addition, optimal management of lactational breast abscess should also include effective milk removal, antibiotics, analgesia, and other supportive measures such as sufficient rest, adequate fluids, and proper nutrition.^{1,17} Traditional incisive drainage may be the most effective way to treat breast abscess with the highest cure rate and lowest recurrent rate.^{4,6,18} However, such procedure often results in unsatisfactory cosmetic outcome with evident scar, great pain associated with regular wound dressing, interfering with breast feeding and prolonged healing time. Hence, the aim of our study was to explore an alternative procedure to incisive drainage with high cure rate, low recurrent risk, and minimally invasive character.

4.2 | Needle aspiration

With the popularization of minimal invasive procedures, percutaneous drainage of breast abscesses using needle aspiration with or without US guidance has been studied as an alternative to incisive drainage. It has been proved that needle aspiration was effective for abscess smaller than 3 cm with shorter healing time and excellent cosmetic outcomes.^{18,19} However, the limitations of needle aspiration for breast abscesses cannot be ignored. For abscesses treated with needle aspiration, the cure rate could be low as 59%,⁷ while the risk of recurrence could be high as 50%¹⁹ especially for the treatment of multiloculated abscesses¹⁹, and repeat aspirations were often required.⁹ Therefore, surgical drainage cannot be completely replaced by needle aspiration.

4.3 | Catheter placement

US-guided percutaneous catheter placement is considered as a minimal invasive alternative to larger abscesses. The previous reports of percutaneous catheter placement⁸⁻¹⁰ were mostly done with pigtail catheter or the Cook catheter. As breaking down the loculi or septa among abscesses, which ensuring complete drainage, may be the most important procedure in the surgical drainage of breast

abscesses,²⁰ catheter drainage may fail that purpose in some cases of multiloculated abscesses. Moreover, the details of treating multiloculated breast abscesses were little²¹ or even never mentioned in previous studies of catheter drainage. It is also reported that catheter drainage is not a definitive procedure for chronic breast abscesses.¹⁰ In addition, the catheter of drainage can be occluded by viscous pus or debris of necrotic tissue. Therefore, incisive drainage is often recommended when the abscesses are multiple or chronic^{1,3,22} and we have reason to believe that catheter drainage is not the optimal management of breast abscesses.

4.4 | Vacuum-assisted breast biopsy

Vacuum-assisted breast biopsy system was developed in 1995 by Fred Burbank and Mark Retchard in an effort to overcome the shortcomings of core biopsies.¹² It is now widely used for diagnostic and therapeutic purpose,²³ including biopsy of suspected malignancy,²⁴ evaluating the efficacy of neo-adjuvant therapy,²⁵ excision of benign breast tumors or complicated cysts,²⁶⁻²⁸ and so on. The satisfactory cosmetic outcomes of VABB in the treatment of benign breast diseases led us extend the indications of this procedure to include lactating breast abscesses.

4.5 | Encor

Several VABB systems are currently available on the market, including EnCor, Mammotome, Finesse, Vacora, and ATEC. Among these devices, EnCor system has some distinctive features that make it an appropriate candidate for the treatment of lactational breast abscesses. It can get all the samples out continuously with probe of variable size and proper vacuum level, thus enabling a significant less duration than Mammotome and Vacora devices.^{13,29} Moreover, the vacuum canister in EnCor system provides an extra storage (~1000 mL) for drainage liquid or pus other than the tissue collection chamber, which is of uniqueness among these VABB devices. Therefore, the EnCor system was chosen to perform the surgical drainage with VABB in our study.

4.6 | Inframammary fold incision

The inframammary fold incision is widely used in breast surgery for cosmetic reasons.³⁰⁻³² Incision at this area is often hardly visible or even totally invisible as hidden from the natural breast ptosis. Moreover, the inframammary incision is also far away from the nipple, minimizing the risk of interfering with breastfeeding. In addition, with the assistance of the extra long VABB probe, abscesses from any area of the affected breast can be easily drained through the inframammary access, while traditional incision that near the abscess cavity may cause serious cosmetic problems. The length of traditional incision for abscess drainage is often no less than 2 cm in order to put a finger in. In our procedure, the access is much less invasive that just measuring just 5 mm long, thus enabling shorter healing time and decreasing the distress of regular dressings.

4.7 | Complications

The most common complications after the VABB surgery including postoperative pain, hemorrhaging and hematomas, the incidence of which is mostly associated with the volume of excised tissue.³³ However, there are no data regarding the incidence of VABB associated complications in the treatment of breast abscesses. In our study, no patient underwent the condition of hemorrhaging and hematomas, and the postoperative pain is mild and tolerable for the majority of patients. This could be partly explained with the little volume of excised breast tissue. In addition, 5-10 minutes manual compression to the breast was reported adequate for hemostasis, and the majority of hematomas seem not to necessitate further intervention.^{33,34} Thus, surgical drainage of breast abscess with US-guided VABB system could be considered as a safe procedure with little postoperative complications, but further data are still required to draw conclusion.

4.8 | Milk-fistula

In our study, two patients suffered from sustained massive milk drainage, and they both chose to discontinue breast feeding by using bromocriptine with satisfactory outcomes. Based on the distribution of milk ducts, central lesions seem to be at higher risk for developing milk fistula compared to peripheral lesions.³⁵ Unfortunately, for VABB drainage or incisive drainage, the incidence and data related to the recovery time of milk fistula are extremely rare.^{35,36} This can be partly explained by the fact that only a few patients would choose to continue lactation as milk leakage sharply decreases their life quality. Eric M. Schackmuth reported³⁷ that a fistula can dry up spontaneously while lactation continues, but this result is not certain and closure can take several weeks. The only reliable means of stopping a milk leak is to suppress lactation.

4.9 | Irrigation

Wound irrigation can remove surface microorganisms and tissue debris which may impede the healing process, and was considered as the most effective method of wound cleansing.³⁸ Although, it is recently reported that irrigation of cutaneous abscesses does not improve treatment success,^{39,40} the irrigation procedure was still performed routinely in our study. In clinical practice, it is not an uncommon phenomenon that the drainage tubing was obstructed by tissue debris or viscous pus.⁴¹ Rational approaches to the solution of this problem usually involve flushing and irrigation. Moreover, recent reviews have suggested that wound irrigation may accelerate wound healing.⁴² Another reason we endorse wound irrigation is that the color and type of the irrigation fluid can provide signs for state of healing: purulent drainage may indicate continuation of drainage, while clear and watery drainage suggests removal of catheter.

4.10 | Antibiotics

The optimal duration of antibiotic use is not well studied, but the usual courses are 10 to 14 days.^{1,43} However, some evidence-based

data suggested that "short may be better".⁴⁴ Brad⁴⁴ reported that the duration of antibiotic therapy should be customized according to patient's response, and longer courses does not ensure better cure rate. An intervention review conducted by the Cochrane Collaboration⁴⁵ showed that breast emptying suggested more rapid symptom relief compared with antibiotics. Therefore, we discontinued antibiotics 48 hours after symptoms resolution.

4.11 | Nonpuerperal breast abscess

Breast abscess could also be consequences of nonlactational diseases. The causes of nonpuerperal breast abscess are mostly involved with periductal mastitis and granulomatous lobular mastitis.⁴⁶⁻⁴⁸ Technically, it is absolutely feasible to perform such a surgery on patients with nonlactational breast abscess. However, simple drainage of such abscesses may often result in relapse.^{8,49} Drainage of abscess, extended resection,⁵⁰ administration of antibiotics⁴⁹ as well as steroid⁵¹ are often required for the treatment of nonpuerperal breast abscess. Considering the optimal management of nonpuerperal mastitis is still under controversy, patients with nonpuerperal breast abscess were not enrolled in our study.

5 | LIMITATION

It is undeniable that this study has a few limitations. First, it is a consecutive cases study rather than randomized comparative trial (RCT), which may lead to a potential selection bias. Second, the number of patients in our study is too small that a definite conclusion cannot be drawn. Therefore, we suggest that our results should be confirmed in larger series and in the form of RCT to ensure reproducibility.

6 | CONCLUSION

In conclusion, our data demonstrate that surgical drainage of breast abscess with US-guided Encor VABB system is a feasible and safe procedure with excellent cosmetic outcomes. It could serve as a promising alternative for women with lactational breast abscess who require surgical intervention.

CONFLICT OF INTEREST

None.

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REFERENCES

- Mastitis: causes and management. World Health. Organization. 2000.
- Kataria K, Srivastava A, Dhar A. Management of lactational mastitis and breast abscesses: review of current knowledge and practice. *Indian J Surg*. 2013;75(6):430-435.
- Lam E, Chan T, Wiseman SM. Breast abscess: evidence based management recommendations[J]. *Expert Rev Anti Infect Ther*. 2014;12(7):753-762.
- Fahrni M, Schwarz EI, Stadlmann S, Singer G, Hauser N, Kubik-Huch RA. Breast abscesses: diagnosis, treatment and outcome. *Breast Care*. 2012;7(1):32-38.
- Trop I, Dugas A, David J, et al. Breast abscesses: evidence-based algorithms for diagnosis, management, and follow-up. *Radiographics*. 2011;31(6):1683-1699.
- Bharat A, Gao F, Aft RL, Gillanders WE, Eberlein TJ, Margenthaler JA. Predictors of primary breast abscesses and recurrence. *World J Surg*. 2009;33(12):2582-2586.
- Eryilmaz R, Sahin M, Hakan Tekelioglu M, Daldal E. Management of lactational breast abscesses. *Breast*. 2005;14(5):375-379.
- Christensen AF, Al-Suliman N, Nielsen KR, et al. Ultrasound-guided drainage of breast abscesses: results in 151 patients. *Br J Radiol*. 2005;78(927):186-188.
- Ullitzsch D, Nyman MK, Carlson RA. Breast abscess in lactating women: US-guided treatment. *Radiology*. 2004;232(3):904-909.
- Berna-Serna JD, Madrigal M, Berna-Serna JD. Percutaneous management of breast abscesses. An experience of 39 cases. *Ultrasound Med Biol*. 2004;30(1):1-6.
- Ding B, Chen D, Li X, et al. Meta analysis of efficacy and safety between Mammotome vacuum-assisted breast biopsy and open excision for benign breast tumor. *Gland Surg*. 2013;2(2):69-79.
- Park H, Hong J. Vacuum-assisted breast biopsy for breast cancer. *Gland surgery*. 2014;3(2):120.
- Mariscotti G, Durando M, Robella M, et al. Mammotome? and EnCor?: comparison of two systems for stereotactic vacuum-assisted core biopsy in the characterisation of suspicious mammographic microcalcifications alone. *Radiol Med*. 2015;120(4):369-376.
- Wang ZL, Liu G, Huang Y, Wan WB, Li JL. Percutaneous excisional biopsy of clinically benign breast lesions with vacuum-assisted system: comparison of three devices. *Eur J Radiol*. 2012;81(4):725-730.
- Robertson FM, Bondy M, Yang W, et al. Inflammatory breast cancer: the disease, the biology, the treatment. *CA Cancer J Clin*. 2010;60(6):351-375.
- Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: visual analog scale for pain (VAS Pain), numeric rating scale for pain (NRS Pain), McGill pain questionnaire (MPQ), short-form mcgill pain questionnaire (SF-MPQ), chronic pain grade scale (CPGS), short form-36 bodily pain scale (SF). *Arthritis Care Res*. 2011;63(S11):S240-S252.
- Amir LH. ABM Clinical Protocol #4: Mastitis, Revised March 2014. *Breastfeeding Medicine*. 2014;9(5):239-243.
- Eryilmaz R, Sahin M, Hakan Tekelioglu M, Daldal E. Management of lactational breast abscesses. *The Breast*. 2005;14(5):375-379.
- Elagili F, Abdullah N, Fong L, Pei T. Aspiration of breast abscess under ultrasound guidance: outcome obtained and factors affecting success. *Asian J Surg*. 2007;30(1):40-44.
- Kingsnorth A, Majid AA. Principles of Surgical Practice. Greenwich Medical Media, 2001.
- Karstrup S, Solvig J, Nolsoe CP, et al. Acute puerperal breast abscesses: US-guided drainage. *Radiology*. 1993;188(3):807-809.
- Irusen H, Rohwer AC, Steyn DW, et al. Treatments for breast abscesses in breastfeeding women. *Cochrane Database Syst Rev*. 2015;8:D10490.
- Park HL, Kim LS. The current role of vacuum assisted breast biopsy system in breast disease. *J Breast Cancer*. 2011;14(1):1-7.
- Park HL, Hong J. Vacuum-assisted breast biopsy for breast cancer. *Gland Surg*. 2014;3(2):120-127.

25. Heil J, Kümmel S, Schaeffgen B, et al. Diagnosis of pathological complete response to neoadjuvant chemotherapy in breast cancer by minimal invasive biopsy techniques. *Br J Cancer*. 2015;113(11):1565-1570.
26. Park HL, Min SY, Kwon SH, et al. Nationwide survey of use of vacuum-assisted breast biopsy in South Korea. *Anticancer Res*. 2012;32(12):5459-5464.
27. Yao F, Li J, Wan Y, et al. Sonographically guided vacuum-assisted breast biopsy for complete excision of presumed benign breast lesions. *J Ultrasound Med*. 2012;31(12):1951-1957.
28. Baez E, Huber A, Vetter M, Hackelöer B-J. Minimal invasive complete excision of benign breast tumors using a three-dimensional ultrasound-guided mammotome vacuum device. *Ultrasound Obstet Gynecol*. 2003;21(3):267-272.
29. Jiang Y, Lan H, Ye Q, et al. Mammothome((R)) biopsy system for the resection of breast lesions: Clinical experience in two high-volume teaching hospitals. *Exp Ther Med*. 2013;6(3):759-764.
30. Gerbasi D. Inframammary fold approach in breast conserving surgery for cancer. *Updates Surg*. 2011;63(4):283-286.
31. Lassus C. Reduction mammoplasty with short inframammary scars. *Plast Reconstr Surg*. 1986;77(4):680-681.
32. Sun J, Mu D, Liu C, et al. Scar Assessment after breast augmentation surgery with axillary incision versus inframammary fold incision: long-term follow-up in chinese patients. *Aesthetic Plast Surg*. 2016;40(5):699-706.
33. Zagouri F, Gounaris A, Liakou P, et al. Vacuum-assisted breast biopsy: more cores, more hematomas? *Vivo*. 2011;25(4):703-705.
34. Fu SM, Wang XM, Yin CY, et al. Effectiveness of hemostasis with Foley catheter after vacuum-assisted breast biopsy. *J Thorac Dis*. 2015;7(7):1213-1220.
35. Larson KE, Valente SA. Milk fistula: diagnosis, prevention, and treatment. *Breast J*. 2016;22(1):111-112.
36. Lim GH, Ng RP. Milk fistula following puerperal breast abscess. *Clin Case Rep*. 2018;6(4):773-774.
37. Schackmuth EM, Harlow CL, Norton LW. Milk fistula: a complication after core breast biopsy. *AJR Am J Roentgenol*. 1993;161(5):961-962.
38. Morison M. *Chronic Wound Care: A Problem-based Learning Approach*. Edinburgh, UK, Amsterdam, the Netherlands: Elsevier, Health Sciences. 2004.
39. Chinnock B, Hendey GW. Irrigation of cutaneous abscesses does not improve treatment success. *Ann Emerg Med*. 2016;67(3):379-383.
40. St Peter SD, Adibe OO, Iqbal CW, et al. Irrigation versus suction alone during laparoscopic appendectomy for perforated appendicitis: a prospective randomized trial. *Ann Surg*. 2012;256(4):581-585.
41. Zacharski LR, Colt J, Mayor MB, et al. Mechanism of obstruction of closed-wound suction tubing. *Arch Surg*. 1979;114(5):614-615.
42. Chatterjee JS. A critical review of irrigation techniques in acute wounds. *Int Wound J*. 2005;2(3):258-265.
43. Spencer JP. Management of mastitis in breastfeeding women. *Am Fam Physician*. 2008;78(6):727-731.
44. Spellberg B. The new antibiotic mantra—"Shorter Is Better". *JAMA Int Med*. 2016;176(9):1254.
45. Jahanfar S, Ng CJ, Teng CL. Antibiotics for mastitis in breastfeeding women. *Cochrane Database Syst Rev*. 2013;2:D5458.
46. Gopalakrishnan Nair C, Hiran, Jacob P, Menon RR, Misha. Inflammatory diseases of the non-lactating female breasts. *Int J Surg*. 2015;13:8-11.
47. Dixon JM. Periductal mastitis/duct ectasia. *World J Surg*. 1989;13(6):715-720.
48. Kessler E, Wolloch Y. Granulomatous mastitis: a lesion clinically simulating carcinoma. *Am J Clin Pathol*. 1972;58(6):642-646.
49. Versluijs-Ossewaarde FN, Roumen RM, Goris RJ. Subareolar breast abscesses: characteristics and results of surgical treatment. *Breast J*. 2005;11(3):179-182.
50. Li J. Diagnosis and treatment of 75 patients with idiopathic lobular granulomatous mastitis. *J Invest Surg*. 2018;1-7. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Diagnosis+and+treatment+of+75+patients+with+idiopathic+lobular+granulomatous+mastitis
51. Mahmoulou R, Dadkhah N, Abbasi F, Nasiri J, Valizadeh R. Idiopathic granulomatous mastitis: dilemmas in diagnosis and treatment. *Electron Physician*. 2017;9(9):5375-5379.

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