

Original research article

Ultrasound Guided Needle Aspiration Versus Surgical Drainage in the Management of Breast Abscess: A Study in Indian Population

Abhishek Chaudhary¹, Kanchan Sone Lal Baitha², Nadeem Ahmad³, Prem Prakash⁴, Pushpa⁵

¹ Senior Resident, Department of General Surgery, IGIMS Patna

² Assistant Prof. Department of General Surgery, IGIMS Patna

³ Assistant Prof. Department of General Surgery, IGIMS Patna

⁴ Additional Prof. Department of General Surgery, IGIMS Patna

⁵ Assistant Prof. Department of Radio Diagnosis, IGIMS Patna

Corresponding Author: Dr. Nadeem Ahmad

Abstract

Background: Breast abscess is defined as an acute inflammatory lump which yields pus on incision or aspiration. Puerperal breast abscess is a common problem in lactating mothers causing significant morbidity with the incidence ranging from 0.4 to 11% in Indian subcontinent. It is due to nipple piercing by a child during feeding and bacterial colonization due to improper nursing technique and incomplete emptying of the breast.

Methods: This is a prospective study conducted in the department of general surgery IGIMS, Patna, India from July 2020 to June 2021 after taking approval from institutional ethics committee. Total 60 female patients aged between 14 -65 years of diagnosed breast abscess both clinically and Ultrasonologically were enrolled in this study. After taking written informed consent, 30 patients had undergone USG guided needle aspiration of breast abscess (Group A) and 30 patients had undergone Incision and Drainage of breast abscess (Group B).

Results: The mean age of female patients in this study were 18-42 yrs. 90% were lactating. The most common organism isolated was Staphylococcus Aureus. The mean healing time and cosmetic outcome was significantly (0.001) very good in patients treated with USG guided aspiration compared to Incision and Drainage. There was 13.3% recurrence of breast abscess observed in group A during study. There was no recurrence rate were observed in incision and drainage group.

Conclusions: Breast abscess in a patient with diameter of less than 10 cm can be treated successfully with USG guided aspiration and with good cosmetic outcome.

Keywords: Breast abscess, Lactational Breast Abscess, USG Guided Needle Aspiration, Incision Drainage.

Introduction

Breast abscess is defined as localized collection of purulent material within the breast occurring as a result of virulent primary or secondary infection¹. It usually occurs in women during lactation as a complication of trauma and infective mastitis. Non-lactational breast abscess, however, is relatively uncommon clinicopathological entity and is infrequently described in the literature. It occurs typically at the end of the reproductive years², is often central or subareolar in site and are reported to have a different underlying pathogenic microbial spectrum to lactation abscesses. The common risk factors are obesity, tobacco smoking³. The pathology of non-lactation breast abscess is markedly different and was first described by Zuska et al in 1951 as fistulas of lactiferous ducts that resulted in chronically draining sinus and abscess formation, typically around the areola^{4,5}. The role of squamous metaplasia of the lactiferous duct (SMOLD) epithelium, duct obstruction and subareolar duct dilation or duct ectasia has also contributed to the pathogenesis of breast abscess^{4,6,7}. Complications include severe necrotizing infections and sepsis, and may be prevented by timely treatment. Lactational breast abscesses occur as milk stasis provides a lactose-rich medium for bacteria that are introduced through the terminal ducts of the nipple⁸. Other types of breast abscesses include tubercular breast abscess, granulomatous mastitis, fungal mastitis. The traditional treatment for lactation and non-lactation abscesses has been incision and drainage with supportive antibiotic cover. However, more recently non-operative management with percutaneous needle aspiration usually under ultrasound guidance has been shown to be successful and associated with less recurrence, excellent cosmetic result and has less costs⁹. Aim of this study is to established superiority of USG guided needle aspiration over conventional surgical incision and drainage in the treatment of breast abscess.

Material and Methods:

A prospective study was carried out in department of general surgery in a tertiary health care centre IGIMS Patna, India for the period of 1 years (July 2020- June 2021) after taking approval from institutional ethics committee of the institution. Data was collected from all patients attending the surgical outpatient department, surgical emergency and Breast Outpatient clinic with sign and symptoms of breast abscess within a defined study period in prescribed proforma. 60 female patients aged 14 years and above with diagnosis of breast abscess with abscess size less than 10 cm in diameter on ultrasonography were included in this study after taking written informed consent. Both lactational and non-lactational breast abscess were included in this study. Patients were assigned into two groups, USG guided needle aspiration (Group A) and surgical incision and drainage (Group B). Patient were randomized to both groups using computer generated numbers. A computer program (random generator number, Microsoft excel version 5.0) was used to generate random number list. Out of 60 patients, 30 patients had undergone USG needle aspiration of breast abscess (Group A) and 30 patients had undergone surgical incision and drainage of breast abscess (Group B). Exclusion criteria were patients above 65 years, suspicious lesions/malignancy especially inflammatory carcinoma of breast, immunocompromised (WHO clinical stage III and IV), recurrent breast abscess, ruptured abscess with skin changes like ulceration, necrosis and male patient.

Clinical diagnosis was made on the presence of breast pain, swelling \pm fever and presence of a fluctuant tender breast swelling. Duration, site, nature and past history of abscess was noted in prescribed proforma. General examination including pulse rate, blood pressure and body temperature were recorded. Detailed examination of breasts was carried including increased temperature, tenderness, and discharge from the nipple, fluctuation and axillary lymphadenopathy. Blood investigation for total leucocyte count and Random blood sugar was made. The patients diagnosed clinically were subjected to ultrasound scan (high frequency

linear transducer of 7.5 MHZ) in the radiology department. The diagnosis was confirmed sonographically by the presence of a thick wall echo complex mass, predominantly cystic with internal echoes and septations. The size of the abscess was estimated. In this study, healing was defined as achieving breast abscess resolution. Breast abscesses resolution was defined as clinically no breast tenderness, swelling or wound at the previous site of the abscess and sonographically complete absence of fluid collection, normal breast glandular and fibrofatty tissue with no oedema. The postoperative pain was graded according to the numeric rating scale on every alternate day as 0-no pain, 1-3 mild pain, 4-6 moderate pain and 7-10 severe pain. The healing time was calculated from the day of intervention till the day the abscess was completely healed. The healing of wound was by secondary intention or by secondary closure on follow up days. The patients were assessed cosmetically on the basis of scar present or absent and the cosmetic acceptability of the scar.

Treatment Procedure and follow up:

USG guided Needle aspiration:

This group of patients were managed in the Radiology department. Under aseptic condition small area of skin over abscess were anaesthetized by 1% Lignocaine through a 23 G needle. An 18 G needle and a 20 ml syringe with 3 ways canula were used in each case. The breast was stabilized with the index finger and the thumb. The abscess was localized and needle was inserted in to the abscess under USG guided. Abscess was completely aspirated with needle and 3 ways. Pus aspirated was sent for culture and antibiotic sensitivity. Procedure was carried out until no pus was aspirated. Amount of pus aspirated was recorded. Aspiration was repeated every week if required until the mass had completely resolved on USG or until three needle aspirations had been performed. If the abscess had not resolved by this time, this result was accepted as a treatment failure and the incision and drainage procedure was then implemented. The time required for the procedure in aspiration was calculated as soon as the surgeon has started the procedure of aspiration by stabilizing the abscess till no pus is aspirated. The puncture site is sealed with tincture benzoin application.

Incision and drainage:

Under general anaesthesia, in aseptic precaution, abscess was localized and incised near the areolar margin and along skin lines. All pus was evacuated, and loculi were broken down digitally or by using the artery forceps. The pus drained was sent for culture and antibiotic sensitivity. The wounds were packed with sterile gauze. Check dressing was done after 48 hrs of surgery. The healing time in this group was the time from incision and drainage to wound closure either by secondary intention or by secondary suturing if required. The time required for the procedure in incision and drainage is calculated when the surgeon stabilizes the breast for incision to be taken till the final dressing application. In both the group, before starting the procedure, injection ceftriaxone 1 gm was given stat. Postoperatively the patient was put on intravenous Diclofenac 75 gm IM and injection ceftriaxone 1gm IV BD. Patients of group A were discharged on day 1 of procedure on oral medications like Tab amoxicillin (500mg) and clavulanate (125mg), Tab Diclofenac Sodium (50mg) and Tab Pantoprazole (40mg) for next 3 days. Patients of group B were discharged on day 3 of procedure on oral medications like Tab amoxicillin (500mg) and clavulanate (125mg), Tab Diclofenac Sodium (50mg) and Tab Pantoprazole (40mg) for next 3 days. Analgesic was added as required. Follow up of the patients was done at OPD on 7th, 14th and 21st postoperative days for clinical and USG evaluation of patients to see resolution of abscess. For Group A, re-aspiration was performed if abscess had not subsided. Failure of aspiration in three episodes was regarded as failure of

procedure and considered for incision and drainage. For Group B, dressing of wound was done every alternate day at nearby clinic till the wound healed. Patients whose culture sensitivity result showed resistance to amoxicillin, antibiotic treatment changed accordingly. Lactating patients were encouraged to continue breastfeeding from unaffected breast and the diseased breast was emptied either manually or by pump to prevent milk stasis.

Cost Estimation:

Cost incurred by the patients and included: cost for admission, procedure, medications, hospital stay. Cost for daily dressing for the patients in group B was obtained from patients based on how much she was charged every time at nearby clinic.

Data collection and statistical analysis:

All relevant information was collected on a proforma and was analysed with the help of SPSS (statistical package for social sciences version 20) for Window package (SPSS science, Chicago, IL, USA). Frequency and percentages were computed for categorical variables like clinical presentation, location of abscess, clinical sign, single or multiple abscess, USG finding, outcome, and recurrence rate for Group A and B. Mean and standard deviation were computed for quantitative variables like age, duration of symptoms, parity and healing time for both groups. Student's t test was applied to compare mean significant difference between groups for age, duration of symptoms, parity, and healing time. χ^2 test was applied to compare proportion difference between Group A and B for clinical signs, single and multiple abscess, USG finding, outcome and recurrence rate. $P \leq 0.05$ was taken as level of significance. For the cost data, costs in each intervention arm were summed up to give the total expenditure per intervention. The cost effectiveness ratio was determined by dividing the total cost of each intervention group by the number of patients successfully treated.

Results

A total of 60 patients were included in our study. All patients were in the age group between 18 to 45 years. Maximum patients in both groups were more than 32 years of age. Youngest patient age was 18 years and oldest was 45 years.

Table 1:

Comparison of age between the two groups			
Age in years	18-24	25-31	>32
Group A	5	14	11
Group B	4	9	17
Total	9(15%)	23(38.3%)	28(46.6%)

Parity distribution was compared between two groups in which 73.3% cases in group A were Primipara, which was more as compared to 60% of the cases among group B.

Table 2:

Comparison of parity between two groups		
	Primi	Multigravida
Group A	22 (73.3%)	8
Group B	18 (60%)	12
Total	40(66.6%)	20(33.3%)

Out of 100, 88.3% of cases were lactating and 11.6% were non -lactating. so difference was not significant.

Table 3:

Association of lactating and non-lactating between two groups		
	Lactating female	Non lactating female
Group A	27	3
Group B	26	4
Total	53(88.3%)	7(11.6%)

Maximum patients (86.6%) were presented within 6 weeks.

Table 4:

Comparison of onset of symptoms between the two groups			
	< 6 weeks	7-10 weeks	>10 weeks
Group A	25	4	1
Group B	27	2	1
Total	52 (86.6%)	6(10%)	2(3.3%)

Fever was observed totally in 25 patients (41.6%). In Group A, fever was complained in 15 patients (50%). The mean duration of fever was 3.3 days. In Group B, fever was present in 10 patients. The mean duration of fever was 3.4 days and this difference between two groups was not significant($p=0.838$). Axillary lymphadenopathy and cracked nipples between two groups was compared. Group A had lymphadenopathy which was more as compared to 16.7% of the cases among group B and the difference was not significant($p=0.518$). 33.3% of the cases among group A had cracked nipples which was more as compared to 26.6% of the cases among group B and the difference was not significant ($p=0.573$).

Table 5:

Comparison of clinical symptoms between two groups				
Symptoms		Group A	Group B	
fever	Yes	15(50%)	10	
	No	15(50%)	20	
Pain in breast	Yes	29(96.6%)	30(100%)	
	No	1(3.33%)	0	
Fluctuation test	Positive	30(100%)	30(100%)	
	Negative	-	-	
Axillary lymphadenopathy	Yes	7 (23.3%)	5(16.7%)	
	No	23(76.7%)	25(83.3%)	
Cracked nipples	Yes	10(33.3%)	8(26.7%)	
	No	20(66.7%)	22(73.3%)	

The breast abscess was divided in to four quadrants. The distribution of abscess was more on left side (60%) than right side (40%) and also, we observed that upper outer quadrant was most commonly involved amongst all the abscess (41.6%).

Table 6:

Distribution of breast abscess according to quadrants		
Site of abscess (Quadrant)	Left (n=36)	Right(n=24)
UOQ	25(41.7%)	15(25%)
LOQ	6(10%)	4(6.7%)
LIQ	2(3.3%)	3(5%)
UIQ	3(5%)	2(3.3%)
UOQ-Upper Outer Quadrant	UIQ-Upper Inner Quadrant	
LOQ-Lower Outer Quadrant	LIQ-Lower Inner Quadrant	

Pus for culture sensitivity showed growth of staphylococcus Aureus in 63.3% followed by Methicillin resistant staphylococcus aureus (28.3%). Other organisms identified in the culture are staphylococcus pyogenes and staphylococcus epidermidis.

Table 7:

Comparison of organism isolated between the two groups				
	S. aureus	MRSA	Sterile	Others
Aspiration	18(60.0%)	8(26.6%)	3(10.0%)	1(3.3%)
I&D	20(66.6%)	9(30.0%)	1(3.3%)	0
Total	38(63.3%)	17(28.3%)	4(6.6%)	1(3.3%)

Larger size of abscess takes more time to heal in both groups that is 23.7 and 30.36 days respectively.

Table 8:

Comparison of the time required for healing of wound between the two groups		
	Group A (days)	Group B (days)
2-4 cm	11	15.5
5-7 cm	18.5	29
8-10cm	23.7	30.36

The mean healing time was 4.27 among A that was significantly less as compared to 7.6 among group B (p=0.001)

Table 9:

Comparison of mean healing time between two groups		
	Mean healing time	P value
Group A	4.27	0.001
Group B	7.60	

Out of 30 patients only 26 patients were successfully treated by USG guided aspiration. In group B, all patients were successfully treated by incision and drainage.

Table 10:

Comparison of residual abscess between two groups				
	Yes	No	Total	p value
Group A	4	26	30	0.038
Group B	0	30	30	

The mean duration of time taken for procedure and duration of hospital stay was compared between two groups and the difference between them was statistically significant (p= 0.001).

Table 11:

Comparison of mean duration time taken for procedure and duration of stay in hospital between groups		
	Mean time taken for procedure	Mean duration of the hospital stay (in days)
Group A	06.63+/-01.61	0.2+/-0.55
Group B	18.87+/-02.00	1.16+/-0.37

Post operative pain was calculated according to numeric rating scale on the day of operation taken as day 0 and every alternate day as day 2, day 4, day 6, day 10 or abscess healed which

is earlier and followed by later 1 month and the difference between two groups were found significant ($p < 0.05$).

Table 12:

Comparison of proportion of cases with postoperative pain between two groups										
Pain (rating)	Group A(n=30)					Group B(n=30)				
	Day 0 (%)	Day 2 (%)	Day 4 (%)	Day 6 (%)	Day 10 (%)	Day 0(%)	Day 2 (%)	Day 4 (%)	Day 6(%)	Day 10(%)
No	-	-	4(13.3)	15(50.0)	29(96.7)	-	-	3(10.0)	9(30.0)	28(93.3)
Mild	-	9(30.0)	14(46.7)	10(33.3)	1(3.3)	6(20.0)	12(40.0)	16(53.3)	13(43.4)	2(6.7)
Moderate	16(53.3)	15(50.0)	11(36.7)	5(16.7)	-	12(40.0)	11(36.7)	9(30.0)	7(23.3)	-
Severe	14(46.7)	6(20.0)	1(3.3)	-	-	12(40.0)	7(23.3)	2(6.7)	1(3.3)	-

In both groups, majority of patients were healed by the 3rd visit that is 50%¹⁵ and 63.3%¹⁹ respectively. There was no difference in healing rate between the two study arms at all the three visits.

Table 13:

Healing rates per group			
Group -	Group A	Group B	p value
Visit 1 (Day 7)	1(3.3%)	3(10.0%)	0.29
Visit 2 (Day 14)	10(33.3%)	8(26.6%)	0.51
Visit 3 (Day 21)	15(50.0 %)	19(63.3%)	0.55

Single aspiration was required in 8 patients, 2 aspirations required in 15 patients, 3 aspirations required in 3 patients. 4 patients needed incision and drainage because of failure to heal. Cosmetic outcome was assessed at the time of follow up after completely healing of abscess. The outcome was assessed as patients having scar over the breast or not. The overall patient's satisfaction was statistically significant ($p=0.001$).

Table 14:

No. of aspiration required for the treatment in group A				
No. of aspirations	No. of patients (N=30)	% of total aspirated	Mean abscess diameter in cm	Mean pus volume in ml
Aspiration 1	08	26.7	4.10+/-1.43	35.5+/-17.12
Aspiration 2	15	50.0	5.30+/-1.62	70.3+/-28.1
Aspiration 3	03	10.0	7.0+/-2.0	85.3+/-48.0
Failure	04	13.3	8.5	93.5+/-45.4

Table 15:

Comparison of cosmetic outcome between two groups				
Outcome	Group A		Group B	
	No	%	No	%
Scar	05	16.7	30	100.0
No scar	25	83.3	-	-

In group A, the average expenditure (per patient) of surgery for successful aspiration and failed aspiration was Rs 15000 and Rs 25000 respectively. The mean expenditure of surgery was Rs 20425.

In group B, the average expenditure (per patient) of surgery was Rs 25000. The mean expenditure was Rs 25000.

Table 16:

Cost effectiveness		
Average expenditure per patient (In Rupees)		
Group A		Group B
Successful aspiration	Failed aspiration	25000
15000	25000	
Mean	20425	25000

Discussion:

The breast is one of the secondary sexual organs of a female. In case of breast disease, care should be taken to ensure that its beauty is minimally compromised in order to preserve its value and function. Due to improved maternal hygiene, nutrition, standard of living and early use of antibiotics, breast abscess is less common in developed country but remain a problem among women in developing countries¹⁰. Traditionally incision and drainage has been treatment of choice for breast abscess but due to poor cosmesis, difficulty in breast feeding, needs general anaesthesia and hospitalisation, prolonged healing time, regular dressing, alternative option like USG guided repeated aspiration also considered². This treatment modality has been reported to be associated with less recurrence, excellent cosmetic result with cost effectiveness^{11,12,13}. However, it has disadvantages such as formation of cutaneous fistula after percutaneous drainage and a repeating collection mainly in abscess larger than 5 cm. In our comparative study, we compared two groups to establish whether USG guided aspiration is feasible alternative treatment option for the breast abscess. This study was conducted on 60 patients of breast abscess randomized into 30 for USG guided aspiration and 30 patients for incision and drainage. In our study the youngest patient was 18 years and oldest was 45 years old. The mean age was 32 years. Ulitzsch et al¹⁴ and AF Christensen et al¹⁵ had also reported 32 years of mean age in their study. This implies the age of pregnancy in the European countries is above 25 years. Dixon et al and Dener et al who demonstrated that breast abscess most commonly affects women aged 18-50 years^{11,14,16}. In our study 66.6% patients were primipara and 33.3% were multipara, a similar incidence has been described by Dener et al¹⁶. This is same as literature, which describes primiparous women are more prone to develop breast abscess than multiparous¹⁷. Left breast with upper and outer quadrant was more commonly involved that is 41.7%. this finding is supported by Eryilmaz et al and Chandika et al^{18,19}. It may be due to most of the breast parenchyma is located in this quadrant. In both groups, pain was the common complain in almost all patients. Fever was observed totally in 25 patients (41.6%). Axillary lymphadenopathy was present in 12 patients (20%) of the total and cracked nipple was present in 18 patients (30%) of the total patients. This finding was similar with Dener et al. In our study the culture and sensitivity reveal the presence of Staphylococcus aureus (63.3%) followed by MRSA (28.3%). Similar finding has been reported by Singh et al and Elagili et al^{20,21}. The spectrum of microbiological culture and sensitivity clearly defines the nature of puerperal abscess with predilection for S. aureus. The mean time required for both the procedures was assessed. It was observed that patients of group A required 6.63 minutes which was significantly less as compared to group B which required 18.87 minutes. This confirms that needle aspiration is feasible and simple procedure.

In our study out of 30 patients of group A, 4 patients (13.3%) developed abscess after third attempt of aspiration. This may be due to multiloculated large abscess size more than 5 cm or subareolar abscesses. This patient was directed to surgery. Imperiale et al²² also supported this incidence rate of aspiration failure. There was no recurrence of breast abscess in incision and drainage group during the study. Postoperative clinical symptoms like pain and fever were assessed in both groups. At the end of day 10, 96.7% of patients in group A was pain free where as in group B 93.3% had no pain. Wound healing was significantly faster in group A than in group B (4.2 days versus 7.6 days). This finding was consistent with study done by Eryilmaz et al¹⁸. In present study the cosmetic outcome was evaluated according to patient's satisfaction and scar mark. Group A patients were satisfied with cosmetic outcome as there were no scar present after the treatment as similar to studies of Singh et al and Kastrup et al^{20,23}. The cost effectiveness of USG guided aspiration was found to be much less than that of incision and drainage but in failed aspiration it was about the same. This was consistent with the study done by Imperiale et al²² and Florey et al²⁴.

Conclusion:

Ultrasound guided aspiration is feasible, safe, well tolerated and successful method as primary and definitive treatment of breast abscess in both lactating as well as non-lactating breast abscesses. This method is also successful for unilocular abscesses of dimension more than 5cm. It is also a cost-effective modality. The success of USG guided aspiration in multiloculated large abscess is questionable and needs further evaluation.

References

1. Rizzo M, Gabram S, Staley C et al. Management of breast abscesses in nonlactating women. *Am. Surg.* 2010; 76: 292–5
2. Benson EA. Management of breast abscesses. *World J. Surg.* 1989;13: 753–6
3. Benson E. A. and Goodman M. A. Incision with primary suture in the treatment of acute puerperal abscess. *British Journal of Surgery* 1970; 57, 55-8.
4. Lesanka Versluis-Ossewaarde FN, Roumen RMH, Goris RJA. Subareolar breast abscesses: characteristics and results of surgical treatment. *Breast* 2005; 11: 179–82.
5. Zuska JJ, Crile G, Ayres WW. Fistulas of lactiferous ducts. *Am. J. Surg.* 1951; 81: 312–7.
6. Martin JG. Breast abscess in lactation. *J. Midwifery Womens Health* 2009; 54: 150-1.
7. Li S, Grant CS, Degnim A, Donohue J. Surgical management of recurrent subareolar breast abscesses: Mayo Clinic experience. *Am. J. Surg.* 2006; 192: 528–9
8. Scott-Conner CEH, Scorr SJ. The diagnosis and management of breast problems during pregnancy and lactation. *Am. J. Surg.* 1995; 170: 401–5
9. Srauss A, Middendorf K, Müller-Egloff S, Heer IM, Untch M, Bauerfeind I. Sonographically guided percutaneous needle aspiration of breast abscesses—a minimal invasive alternative to surgical incision. *Ultraschall Med.* 2003;24(6):393-8.
10. Ioannis H, Nigel JB: Acute infection of the breast. Medicine publishing company Ltd 2002. Surgery on CD-Rom 1997-2002.
11. Dener C, Inan A: Breast abscesses in lactating women. *World J Surg* 2003,27:130-133
12. O'Hara RJ, Dexter SP, Fox JN: Conservative management of infective mastitis and breast abscesses after ultrasonographic assessment. *Br J Surg* 1996, 83:1413-1414.
13. Srauss et al: Sonographically guided percutaneous needle aspiration of breast abscesses—a minimal invasive alternative to surgical incision. *Ultraschall Med* 2003, 24(6):393-398.
14. Ulitzsch D, Nyman MK, Carlson RA Breast abscesses in lactating women: US-guided treatment. *Radiology* 2004; 232:904–909.
15. Christensen AF, Al-Suliman N, Nielsen KR, et al. Ultrasound-guided drainage of breast

- abscesses: results in 151 patients. *Br J Radiol* 2005;78: 186–188.
16. Dixon JM. Repeated aspiration of breast abscesses in lactating women. *BMJ (Clinical research ed)*. 1988;297(6662):1517-8.
 17. Kvist LJ, Rydhstroem H. Factors related to breast abscess after delivery: a population-based study. *BJOG: An International Journal of Obstetrics and Gynaecology*. 2005;112(8):1070-4.
 18. Eryilmaz R, Sahin M, Hakan Tekelioglu M, Daldal E. Management of lactational breast abscesses. *Breast (Edinburgh, Scotland)*. 2005;14(5):375-9.
 19. Chandika AB, Gakwaya AM, Kiguli-Malwadde E, Chalya PL. Ultrasound guided needle aspiration versus surgical drainage in the management of breast abscesses: a Ugandan experience. *BMC research notes*. 2012;5:12.
 20. Singh G, Singh G, Singh LR, Singh R, Singh S, Sharma KL. Management of breast abscess by repeated aspiration and antibiotics. *Journal of Medical Society*. 2012;26(3):189.
 21. Elagili F, Abdullah N, Fong L, Pei T. Aspiration of breast abscess under ultrasound guidance: outcome obtained and factors affecting success. *Asian journal of surgery/Asian Surgical Association*. 2007;30(1):40-4.
 22. Imperiale A, Zandrino F, Calabrese M, Parodi G, Massa T. Abscesses of the breast: US-guided serial percutaneous aspiration and local antibiotic therapy after unsuccessful systemic antibiotic therapy. *Acta Radiol* 2001;42:161-5.
 23. Karstrup S, Solvig J, Nolsoe CP, Nilsson P, Khattar S, Loren I, et al. Acute puerperal breast abscesses: US-guided drainage. *Radiology*. 1993;188(3):807-9.
 24. Florey ME, Macvane JS, Big by MAN: Treatment of breast abscesses with penicillin. *BMJ* 1946, 11:846-848.