

ORIGINAL ARTICLE

Effectiveness of Ultrasound-Guided Needle Aspiration Versus Incision & Drainage in Breast Abscess Management: A Single-Centre Quasi-Experimental Study



Hidayat Ullah¹, Zulfiqar Ali², Hafiz Danyal Khan³, Ayesha Naseem³, Abdullah², Muhammad Imran Marwat³

Affiliation:

¹Cavan and Monaghan Hospital, RCSI Hospitals, Cavan, Ireland

²Ayub Teaching Hospital, Abbottabad, Pakistan

³Khyber Medical College Peshawar, Pakistan.

Correspondence:

Dr. Muhammad Imran Marwat, Associate Professor, Department of Community Medicine, Khyber Medical College, Peshawar Pakistan

E-mail: imranmarwat_30@kmc.edu.pk

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ABSTRACT

Background: Breast abscess is a frequent complication of lactational mastitis particularly in low-resource settings where the priority is continuing effective breastfeeding, optimizing the management course, while maintaining satisfactory cosmetic outcomes.

Objective: To compare the effectiveness of ultrasound-guided needle aspiration (USG-NA) with incision and drainage (I&D) for breast abscess with respect to short-term recurrence and overall clinical outcomes.

Method: This single-centre quasi-experimental study was conducted at Ayub Teaching Hospital from August 2022 to June 2023. Ethical approval was obtained and all participants provided written informed consent. Sixty women aged 20–60 years with a first episode of breast abscess (>1 cm) were enrolled and allocated equally to ultrasound-guided needle aspiration (USG-NA; n=30) or conventional incision and drainage (I&D; n=30) in a 1:1 ratio based on clinical indication and patient consent. Empirical antibiotics were administered to both groups and modified based on culture results. The primary outcome measure was abscess recurrence at two weeks, confirmed either clinically or through ultrasonography. Secondary analyses stratified outcomes by age, residence, abscess size, and lactation status.

Results: The mean age was 25.45±3.83 years. Overall recurrence was 21.7% (13/60). Recurrence was observed in 3 (10.0%) after aspiration versus 10 (33.3%) after incision and drainage; (p = 0.028). Subgroup analysis showed significantly lower recurrence with aspiration among patients ≤30 years (p=0.035), urban residents (p=0.021), and abscesses ≤2 cm (p=0.009). No major procedure-related adverse events were reported. Breastfeeding continuation was maintained in most patients post procedure.

Conclusion: USG-NA reduced short-term recurrence versus I&D, particularly in younger patients, urban residents, and smaller abscesses. It is safe, minimally invasive, preserves tissue, and supports continued breastfeeding. Trials with longer follow-up are recommended.

Keywords: Breast disease, Abscess, Drainage, Fine needle aspiration, Ultrasonography, Recurrence.

INTRODUCTION: Breast abscess is a common surgical condition that predominantly affects women during the reproductive and lactational periods [1]. It is the localized accumulation of purulent material within the breast parenchyma that frequently result from as a complication of mastitis. The incidence varies across regions, but lactating women are most frequently affected, with reported rates of mastitis ranging between 1% and 33%, of which 4.6% to 11% may progress to abscess formation [2]. Incidence of breast abscess in women of Pakistan is reported to be approximately 10.2% [3]. Predisposing factors include nipple trauma due to suckling, milk stasis from incomplete emptying of the breast, poor breastfeeding technique, and colonization by pathogenic bacteria such as *Staphylococcus aureus* [4]. In resource-limited settings where access to early medical care and breastfeeding support services is often limited, handling these risk factor is of extreme importance. Early

diagnosis and prompt treatment play a vital role in reducing morbidity, reduce recurrence, and allow continuation of breastfeeding [4].

In the management of breast abscess I&D has been used for decades as a gold standard [5]. It allows effective drainage of pus and ensures complete breakdown of loculated collections. However, the down side is that the procedure is invasive, painful, and requires anaesthesia (local or general). Disadvantages include prolonged wound healing, the need for frequent dressing changes, an increased risk of secondary infection, and unsatisfactory cosmetic outcomes due to scarring. Importantly, I&D often requires hospitalization and temporary cessation of breastfeeding, which have adverse psychological and nutritional effect on both mother and child.

In recent decades, minimally invasive surgery came into picture and where diagnostic imaging has better treatment outcomes. For breast abscess the better option is USG-NA, often repeated over several sittings, has been adopted by surgeons, as a less invasive option [6]. When carried out under ultrasound guidance, aspiration provides several clear benefits. It allows the surgeon to see the abscess cavity in real time, ensuring better drainage of pus. Also the procedure is less painful, promotes faster recovery, and helps preserve the natural appearance of the breast. [7]. Moreover, the patient reported greater satisfaction regarding the shorter hospital stay, fast recovery, and allowing mothers to continue breastfeeding safely during treatment [5].

Despite these advantages, the role of aspiration is still the topic of debate among surgeons. Literature reported treatment recurrence as the primary problem in this approach. One study reported a recurrence rate of 23.3% among patients treated with I&D, compared with 70.0% in those managed with USG-NA, a statistically significant difference ($p = 0.001$) [8]. Contradictory statements still exist in another study that no recurrence was noted in the USG-NA, whereas a recurrence rate of 3.3% was noted in patients treated with I&D [9]. Therefore, the absence of standardized treatment guidelines continues to fuel debate over the most effective management approach for breast abscesses.

Given these factors, a comparative assessment of I&D versus USG-NA is warranted for the optimal management of breast abscesses. A properly designed study can provide evidence to guide clinicians in selecting the most effective and least morbid. The present study was therefore undertaken to generate institution-specific evidence by comparing effectiveness of USG-NA and conventional I&D for the management of breast abscess, focusing on recurrence, treatment outcomes, and practical applicability in routine clinical practice.

METHOD: A Non-Randomized Trail was conducted in the Department of Surgery at Ayub Teaching Hospital Abbottabad from 29 August, 2022 to 1 June, 2023. Written informed consent was obtained from all participants prior to enrollment, retaining the right to withdraw at any time without providing a reason. The study was approved by the Institutional Research and Ethical Review Board (IREB) of Ayub Teaching Hospital (Ref: RC-2022/EA-01/122) on 29 August 2022.

Women aged 20–60 years presenting with a first episode of breast abscess, whether lactating or non-lactating, confirmed clinically or by ultrasonography. Eligible participants had an isolated breast abscesses measuring >1 cm in diameter on ultrasonography and were appropriate for either USG-NA or conventional I&D and did not exhibit extensive skin involvement. Exclusion criteria comprised recurrent abscess in the same breast, multifocal or multiloculated abscesses with extensive septations, or impending skin necrosis requiring urgent surgical intervention, those with suspected or confirmed breast malignancy, active pulmonary tuberculosis or tuberculous mastitis, and tuberculous cervical lymphadenitis. Patients with comorbid conditions likely to affect healing or infection control, such as uncontrolled diabetes mellitus, immunocompromised state, chronic renal failure (serum creatinine >1.5 mg/dL), or coagulopathy (INR >1.5), were excluded. Women subjected to prior invasive treatment for the current abscess, those with systemic sepsis requiring hospitalization, or those unwilling to provide informed consent were also excluded. Patients underwent either conventional I&D, performed through a radial incision over the point of maximal fluctuance with evacuation of pus, disruption of loculations, irrigation of the cavity with normal saline, and placement of sterile gauze packing for continued drainage; or USG-NA using a wide-bore needle under aseptic conditions. All procedures were performed by the same surgical team. Eligible participants had an isolated breast abscesses measuring >1 cm in diameter on ultrasonography and were appropriate for either USG-NA or conventional I&D and did not exhibit extensive skin involvement.

Using OpenEpi, the sample size was determined to compare two independent proportions. The recurrence rate is 33.3% for I&D and 66.7% for needle aspiration [7], with a two-sided $\alpha = 0.05$ and 80% power, the minimum required sample was 21 per group. To compensate for possible loss to follow-up and to enhance statistical precision, 30 patients were enrolled in each group, giving a total sample of 60.

Eligible participants were non-randomly allocated in a 1:1 ratio to one of two treatment arms: Group A (USG-NA) and Group B (I&D). Patients in Group A underwent ultrasound-guided needle aspiration (USG-NA). Repeat aspiration was performed when residual collection persisted on ultrasonography, with a maximum of three sessions conducted at 48–72 hour intervals until clinical and radiological resolution, whereas those in Group B were treated with I&D. Both groups received empirical antibiotic therapy consisting of ciprofloxacin 500 mg twice daily and Danzen DS twice daily for 10 days, in accordance with local antimicrobial prevalence, resistance patterns, and institutional guidelines. Culture and sensitivity was performed for all the patients and further antimicrobial therapy was adjusted according to the results. Patients were assessed clinically and by ultrasonography and followed for recurrence and procedure-related outcomes. All participants were followed for two weeks after treatment, and recurrence was classified as present or absent on the basis of clinical or ultrasonographic evidence. Data regarding age, marital status, lactation status, duration and size of abscess, body mass index (BMI), presence of diabetes mellitus, and treatment outcome; satisfactory, with complete resolution of pain and abscess, no recurrence and normal breast morphology or unsatisfactory, with persistent pain and abscess, recurrence and significant complications, were systematically recorded.

Data analysis is done via SPSS version 23.0. Continuous data are summarized as mean $\pm$ SD or median (IQR), and categorical data as frequencies and percentages. The Chi-square test was applied to compare recurrence between the two groups. Confounders like age, marital status, lactation status, duration of abscess, abscess size, and obesity, were handled through stratification. Chi-Square test were used to find associations with treatment outcomes. A p-value ≤ 0.05 was considered statistically significant.

RESULTS: Sixty patients who met the predefined inclusion criteria, were non-randomly allocated in equal proportions to either of the two treatment groups. Group A (USG-NA, $n = 30$) or Group B (I&D, $n=30$) as mentioned in Table 1. All participants completed the scheduled two-week follow-up were considered eligible for inclusion in the final data analysis.

The mean age of the cohort was 25.45 ± 3.83 years (range 21–37); group means were 25.50 ± 3.54 years (Group A) and 25.40 ± 4.17 years (Group B) ($p = 0.921$). The majority of patients were ≤ 30 years (90%). Thirty-six patients (60.0%) resided in rural areas and 24 (40.0%) in urban areas. No cases of diabetes have been reported in either group. Eighteen patients (30.0%) were unmarried and 42 (70.0%) were married. Mean BMI was 24.97 ± 1.88 kg/m²; while 9 patients (15.0%) had a BMI >25 . Thirty-six patients (60.0%) were lactating. The mean duration of abscess was 3.31 ± 0.62 months, with 96.7% having duration ≤ 4 months. The mean abscess diameter was 1.21 ± 0.21 cm, and 91.7% had abscess size ≤ 2 cm. No patient in either group had diabetes, and there were no reports of major procedure-related adverse events.

Overall recurrence was observed in 13 (21.7%) patients as shown in Figure 1. Recurrence occurred in 10.0% patients in the USG-NA (Group A) compared with 33.3% in the I&D group (Group B) as shown in figure 1. This difference was statistically significant ($p = 0.028$), indicating a lower short-term recurrence rate following USG-NA. The difference remained evident in several clinically relevant subgroups (younger age, urban residence, and smaller abscess size) as demonstrated in table 1. When data were stratified by abscess size, patients with abscesses size measuring ≤ 2 cm showed difference in the recurrence indicating that abscess size may influence the effectiveness of the treatment modality. Other variables such as marital status, obesity, lactation status, and disease duration did not reach to a level of significance. USG-NA came out to be an effective, minimally invasive and cosmetically good option for managing breast abscesses.

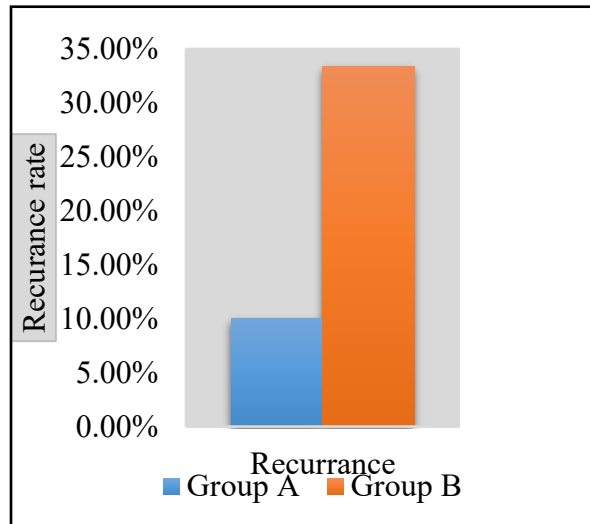


Figure 1: Recurrence rates after treatment of breast abscess with USG-NA (Group A) versus I&D (Group B).

Table 1: Comparison of Recurrence Rates Between USG-NA and I&D Across Patient Subgroup.

Factors studied	Category	Group A Recurrence		Group B Recurrence	
		Yes (n, %)	No (n, %)	Yes (n, %)	No (n, %)
Age (In years)	≤30 (A=28, B=26)	3 (10.7%)	25 (89.3%)	9 (34.6%)	17 (65.4%)
	>30 (A=2, B=4)	0 (0.0%)	2 (100.0%)	1 (25.0%)	3 (75.0%)
Residential status	Rural (A=19, B=17)	3 (15.8%)	16 (84.2%)	5 (29.4%)	12 (70.6%)
	Urban (A=11, B=13)	0 (0.0%)	11 (100.0%)	5 (38.5%)	8 (61.5%)
Marital status	Unmarried (A=10, B=8)	1 (10.0%)	9 (90.0%)	3 (37.5%)	5 (62.5%)
	Married (A=20, B=22)	2 (10.0%)	18 (90.0%)	7 (31.8%)	15 (68.2%)
Obesity	Yes (A=5, B=4)	0 (0.0%)	5 (100.0%)	2 (50.0%)	2 (50.0%)
	No (A=25, B=26)	3 (12.0%)	22 (88.0%)	8 (30.8%)	18 (69.2%)
Lactation status	Lactating (A=19, B=17)	2 (10.5%)	17 (89.5%)	5 (29.4%)	12 (70.6%)
	Non-lactating (A=11, B=13)	1 (9.1%)	10 (90.9%)	5 (38.5%)	8 (61.5%)
Disease duration	Up to 4 months (A=29, B=29)	3 (10.3%)	26 (89.7%)	9 (31.0%)	20 (69.0%)
	>4 months (A=1, B=1)	0 (0.0%)	1 (100.0%)	1 (100.0%)	0 (0.0%)

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Size of abscess	Up to 2 cm (A=28, B=27)	1 (3.6%)	27 (96.4%)	8 (29.6%)	19 (70.4%)
	>2 cm (A=2, B=3)	2 (100.0%)	0 (0.0%)	2 (66.7%)	1 (33.3%)

A = USG-NA; B = I&D.

DISCUSSION: Breast abscess is a frequently painful, morbid condition that affects particularly women during the post-partum period and arises commonly due to inadequately treated mastitis. The contemporary management of breast abscesses entails a multifaceted approach, including systemic anti-microbial regimens, USG-NA, and the traditionally invasive approach of I&D.

To reconcile and address the present discordance in the existing literature, this study was undertaken to compare the effectiveness and clinical results of USG-NA versus the invasive approach of I&D employed in the therapeutic stratagem of breast abscesses at the Ayub Teaching Hospital, Abbottabad. This study enrolled a group of 60 patients clinically diagnosed with breast abscess. The mean age reported was 25.50 years in the USG-NA group and 25.40 years in the I&D group, which aligns with the data reported by studies provided by Francisco, and Prashanth et al [10]. Majority of the patients were from younger age group, ≤ 30 years. Sixty percent of the study population belonged to rural areas and had no history of diabetes in either group. The potential factors attributed to this include delayed healthcare access to the rural residents, poor hygiene, socioeconomic barriers, and lack of postnatal follow-up [11].

Seventy percent of women were married, and the mean BMI (body mass index) was 24.97 ± 1.88 kg/m². 15.0 % of women were found to be obese, a critical risk factor for the progression of breast abscesses and inflammation via various mechanisms [12].

Sixty percent of the women were lactating, which is significant as nursing women are highly vulnerable to breast abscesses, and it is often considered a sequel of untreated lactational mastitis [13].

The trauma caused by a baby's teeth or the cracked nipple serves as a gateway for the entry of *Staphylococcus aureus*, and milk provides an optimal growth medium for the proliferation of such bacteria, leading to infection with abscess formation [14]. These results align with data reported by Toomey et al, who documented that approximately 4-11% of women with breast abscess were lactating mothers [15].

Our primary finding was a statistically significantly ($p=0.028$) lower recurrence rate of breast abscesses after USG-NA [10%] as compared to I&D (33.3%) over a follow-up period of two weeks. These findings are in close alignment with recent evidence provided by Totadri et al [16], who reported no recurrent cases in USG-NA in comparison with the I&D group which found a recurrence of 28%. This superiority warrants the discussion for possible underlying causes, which include the preservation of tissue integrity due to the fine needle placement in the localized area, causing less trauma, faster healing, less pain, and complete evacuation of pus with the help of ultrasound guidance [16, 15]. Conversely, the higher recurrence (33.3%) with the I&D approach can be attributed to the large open wound that prolongs the healing, more significant tissue disruption, damage to breast parenchyma, lactiferous ducts, and difficulty in breastfeeding, causing milk stasis, contributing to recurrence again [17]. Our results, however, contradict with findings of Javed et al, who observed 70% recurrence rate following USG-NA compared to I&D. This point of discrepancy can be explained by the fact that they performed blind aspiration without ultrasound guidance, which likely led to inadequate localization of the abscess and consequently higher recurrence rates [8].

Based on subgroup analysis, stratified according to age group ≤ 30 years, reported a significantly lower recurrence ($p=0.035$) between the two treatment groups, possibly as with age, the risk of ductal ectasia, fat necrosis, diabetes, immunodeficiency, and risk of smoking increases, leading to recurrence of the breast abscess [18]. Similarly, a lower incidence of recurrence was reported among the urban residents with USG-NA in comparison with I&D ($p=0.021$), which stems from quality access to health facilities with ease and awareness among the residents.

Lastly, stratification based on abscess size revealed that USG-NA is more efficacious for abscesses ≤ 2 cm, as the recurrence was 3.6% in comparison group A and 29.6% in comparison group B. These findings align with existing literature [19]. For larger complex abscesses that involve multiple compartments, the standard treatment is I&D, which allows complete evacuation of pus from the abscess cavity [19, 20]. Further subgroup

analysis based on marital status, lactation status, obesity, and disease duration revealed non-significant differences statistically between the treatment groups, as all p-values surpassed 0.05, indicating the absence of any meaningful association between the treatment and outcomes.

The key strength of this non-randomized controlled design is its systematic data collection and its prospective design, which minimizes the different biases. Further, the method of allocation of patients into different groups and pre-defined inclusion and exclusion criteria enhances the robustness of our study. With strength, there are crucial limitations as well. It was a single-centered study with a short follow-up duration (14 days) for the primary outcome of recurrence, which in the future should be extended to 6 months. These limitations serve as room for future researchers to conduct multicenter randomized controlled trials with adequate follow-up.

CONCLUSION: USG-NA significantly lowers the risk of recurrence of breast abscesses as compared to I&D, particularly in younger patients with ages of less than 30 years, urban residents, and those with relatively smaller size of breast abscesses. Additional patient factors did not significantly influence the outcomes of the study. Hence, we can conclude that USG-NA can potentially serve as a safer, less invasive, and effective management option for breast abscesses.

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The Authors:

- Dr. Hidayat Ullah, SHO surgery, Department of Surgery, Cavan and Monaghan Hospital, RCSI Hospitals, Cavan, Ireland
- Dr. Zulfiqar Ali, PGR surgery Ayub Teaching Hospital, Abbottabad, Pakistan.
- Hafiz Danyal Khan, Final Year MBBS Student, Khyber Medical College, Peshawar, Pakistan
- Ayesha Naseem, 4th Year MBBS Student, Khyber Medical College, Peshawar, Pakistan
- Dr. Abdullah, PGR surgery, Ayub Teaching Hospital, Abbottabad, Pakistan
- Dr. Muhammad Imran Marwat, Associate Professor, Department of Community Medicine, Khyber Medical College, Peshawar, Pakistan