

The Efficacy of Traditional Surgery Versus Minimally Invasive Surgery in Non-Lactation Mastitis Patients: A Retrospective Data Analysis

Ann. Ital. Chir., 2025 96, 8: 1064–1070
<https://doi.org/10.62713/aic.4092>

Shenbao Hu^{1,†}, Yajie Wang^{2,†}, Wei Liu³, Yifei Fan¹, Xiaofeng Luo³, Hong Huo⁴, Yue Wu¹

¹Department of Thyroid and Breast Surgery, Jingmen Central Hospital (Jingmen Central Hospital Affiliated to Jingchu University of Technology), 448000 Jingmen, Hubei, China

²Department of General Surgery, People's Hospital of Dongxihu District, 430040 Wuhan, Hubei, China

³Department of General Surgery, Jingmen Central Hospital (Jingmen Central Hospital Affiliated to Jingchu University of Technology), 448000 Jingmen, Hubei, China

⁴Department of Oncology, Jingmen Central Hospital (Jingmen Central Hospital Affiliated to Jingchu University of Technology), 448000 Jingmen, Hubei, China

AIM: This study comparatively analyzes the clinical efficacy and safety of traditional open surgery and minimally invasive approach for non-lactation mastitis using a retrospective cohort analysis. By assessing the impact of these surgical approaches on postoperative inflammatory indicators, recurrence rates, and recovery outcomes, the study intends to offer a scientific basis for optimizing clinical management strategies.

METHODS: This study included 109 patients diagnosed with non-lactation mastitis who were treated at Jingmen Central Hospital between January 2018 and December 2023. The study cohort included 61 patients who received traditional surgery and 48 who underwent minimally invasive surgery. Diagnosis was confirmed via preoperative pathological examination, and all patients were followed for 12 months post-surgery. Collected data included patient demographics, surgical parameters (e.g., operation duration, length of hospital stay, and complication rates), inflammatory marker levels (Neutrophil Count [NC] and C-reactive Protein [CRP]), and recurrence rates. Inflammatory markers were evaluated on postoperative days 7 and 30. Multivariate logistic regression analysis was employed to identify independent predictors of postoperative recurrence.

RESULTS: The minimally invasive surgery group demonstrated apparent clinical advantages over the traditional surgery group. The levels of NC and CRP were significantly lower in the minimally invasive surgery group on both postoperative day 7 ($p < 0.001$) and day 30 ($p < 0.001$). Furthermore, the minimally invasive group had a significantly lower recurrence rate (8.3%) compared to 32.8% in the traditional surgery group ($p < 0.01$). Additionally, patients in the minimally invasive group experienced shorter hospital stays (4.3 ± 1.2 days vs. 7.8 ± 2.4 days, $p < 0.01$) and a lower incidence of complications (4.17% vs. 16.39%, $p < 0.05$). Multivariate logistic regression analysis identified minimally invasive surgery as an independent protective factor against recurrence (Exponentiated Beta (Exp(β)) = 0.24, 95% Confidence Interval (CI): 0.069–0.832, $p = 0.024$).

CONCLUSIONS: Minimally invasive surgery offers significant advantages over traditional open surgery in managing non-lactation mastitis. It effectively reduces postoperative inflammatory marker levels and recurrence rates, shortens hospital stays, and lowers the incidence of complications, underscoring its role as a promising therapeutic modality for this condition.

Keywords: non-lactational mastitis; minimally invasive surgery; conventional open surgery; inflammatory markers; postoperative recurrence rate

Introduction

Non-lactational mastitis is a rare, chronic inflammatory breast condition characterized by recurrent lumps, pain, and

abscess formation, significantly impacting patients' health and quality of life [1,2]. Although its exact etiology is unclear, current evidence suggests that immune dysfunction, infections, and abnormal tissue responses contribute to its pathogenesis [3]. Despite its low global incidence, the prevalence of non-lactational mastitis, particularly granulomatous lobular mastitis (GM), has been rising, especially among Asian women [2]. Its treatment typically involves pharmacological therapy and surgery, with surgery being the primary option for refractory cases, with traditional open surgery providing thorough lesion excision despite the associated significant trauma, prolonged recovery, and higher complication risks [4,5]. In contrast, min-

Submitted: 1 April 2025 Revised: 13 June 2025 Accepted: 20 June 2025 Published: 10 August 2025

Correspondence to: Yue Wu, Department of Thyroid and Breast Surgery, Jingmen Central Hospital (Jingmen Central Hospital Affiliated to Jingchu University of Technology), 448000 Jingmen, Hubei, China (e-mail: 18772717205@163.com).

[†]These authors contributed equally.

minimally invasive procedures, such as Mammotome-assisted rotational resection, offer the advantage of reduced trauma and faster recovery [4,6]. However, comparative analysis of the clinical outcomes, recurrence rates, and postoperative recovery profiles between traditional and minimally invasive surgical procedures is limited.

Although surgical intervention is the primary treatment option for non-lactational mastitis, there is no consensus on the optimal surgical approach [7]. Traditional open surgery offers reliable therapeutic outcomes; however, this approach is restricted by higher complication rates and prolonged recovery periods. Minimally invasive approaches are preferred due to their reduced trauma; however, their effectiveness, especially in cases involving extensive lesions or coexisting abscesses, requires further validation [8]. Moreover, postoperative recurrence, a key indicator of treatment success, remains inadequately addressed due to small sample sizes and a lack of long-term follow-up in most existing studies [7,9,10]. Additionally, the prognostic role of inflammatory markers, such as Neutrophil Count (NC) and C-reactive Protein (CRP), in predicting recurrence has not been comprehensively investigated. While inflammatory responses are believed to contribute to disease relapse, few studies have directly compared the impact of different surgical methods on postoperative inflammatory profiles and recurrence rates [7]. Thus, further research is needed to elucidate the comparative efficacy and inflammatory response between traditional versus minimally invasive surgical techniques.

Although advancements have been made in the treatment of non-lactational mastitis, therapeutic options remain limited. Mammotome-assisted minimally invasive resection has been reported to minimize operation time, shorten hospitalization, and improve patient satisfaction [11,12]. However, its long-term efficacy, particularly recurrence rates in complex or refractory cases, remains poorly assessed. Conversely, traditional open surgery, while more invasive, remains the preferred choice for complete lesion removal in severe cases despite being associated with more surgical trauma and longer recovery periods [7,13].

Although several studies suggest that minimally invasive techniques may reduce postoperative inflammation, others have observed no significant differences in inflammatory marker changes after surgery [6,7]. Overall, limitations such as small sample size, lack of methodological rigor, and single-center study designs restrict the generalizability of current findings. Therefore, a comprehensive evaluation of surgical efficacy and its impact on inflammatory marker dynamics is crucial for guiding treatment decisions.

To address these gaps, the present study retrospectively assessed clinical data from Jingmen Central Hospital to compare the clinical efficacy and recurrence rates of traditional open surgery and Mammotome-assisted minimally invasive resection in non-lactational mastitis patients. Additionally, this study evaluated postoperative inflammatory

marker profiles, recovery outcomes, hospital stay duration, and complication rates to provide insight for optimizing treatment strategies and guiding individualized management plans.

Materials and Methods

Study Design and Research Participants

This retrospective cohort study analyzed clinical data from patients with non-lactational mastitis who were treated at Jingmen Central Hospital between January 2018 and December 2023. Patients were divided into two groups based on the surgical approach: the traditional surgery group (n = 61) and the minimally invasive surgery group (n = 48). Key clinical outcomes assessed included recurrence rate, postoperative changes in NC and CRP levels, length of hospital stay, and postoperative complications. The study protocol was reviewed and approved by the Ethics Committee of Jingmen Central Hospital (Approval Number: 2024-03-017), and all research procedures adhered to the ethical principles outlined in the Declaration of Helsinki.

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: (1) a pathologically confirmed diagnosis of non-lactational mastitis, including common subtypes such as granulomatous lobular mastitis and periductal mastitis; (2) patients underwent either traditional open surgery or minimally invasive surgery; (3) availability of complete preoperative and postoperative clinical records with a minimum follow-up duration of 12 months; (4) availability of preoperative and postoperative serum NC and CRP data; and (5) patients aged between 18 and 65 years.

The exclusion criteria included: (1) diagnosis of other breast diseases, such as breast cancer or lactational mastitis; (2) loss to follow-up or incomplete postoperative data, preventing the assessment of key inflammatory markers or recurrence; (3) patients underwent preoperative treatments potentially that may affect outcomes, including hormone therapy or immunosuppressive agents; (4) presence of serious comorbidities (e.g., cardiovascular or cerebrovascular diseases, metabolic disorders) that contraindicated surgery; and (5) postoperative recurrence cases managed at other institutions.

Intervention Measures

Patients in the traditional surgery group underwent open surgical excision of the lesion under general anesthesia. The lesion was removed through a local incision, with the goal of achieving complete resection of the pathological tissue. Routine postoperative care and monitoring were provided to minimize the risk of complications. Patients in the minimally invasive surgery group underwent lesion removal using the Mammotome minimally invasive excision system under local anesthesia. This technique enabled the precise removal of the lesion through a small incision,

resulting in reduced surgical trauma and a faster recovery. Additionally, these study groups received standardized postoperative follow-up care, including regular evaluation of NC and CRP levels to monitor treatment outcomes and recovery progression.

Data Collection

The following data were collected for subsequent analysis: demographic information (age, gender, and disease duration); surgical parameters (surgery duration and postoperative complications); and treatment efficacy indicators (postoperative recurrence rate and changes in NC and CRP levels before and after surgery).

Patients who discontinued follow-up or had not completed the 1-year follow-up period were excluded from the recurrence rate calculation. Changes in the inflammatory response were evaluated by monitoring NC and CRP levels preoperatively and on postoperative days 7 and 30 to capture the trend of postoperative inflammatory activity. Furthermore, postoperative complications were assessed during hospitalization and at scheduled follow-up visits. The complications monitored included incision site infection, delayed wound healing, and recurrence of breast abscess. Complications were identified through clinical assessment and physical examination.

Follow-up

All patients underwent postoperative follow-up for a minimum of one year, with scheduled visits at 1, 6, and 12 months after surgery. Inflammatory markers (NC and CRP) were measured only on postoperative days 7 and 30 to assess the early postoperative inflammatory response. Follow-up at other time points focused on evaluating disease recurrence, recovery status, postoperative complications, and the need for additional treatments or interventions.

For patients unable to attend in-person follow-up, information was obtained via telephone or email. Recurrence status was determined based on patient-reported symptoms in combination with available medical records.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed data were presented as mean $\pm$ standard deviation (SD). Between-group comparisons of continuous variables were conducted using independent sample *t*-tests. Within-group comparisons of NC and CRP levels at preoperative, postoperative day 7, and day 30 were performed using repeated measures analysis of variance (ANOVA), with Bonferroni correction applied for multiple comparisons. Categorical variables were expressed as frequencies and percentages. Intergroup comparisons were performed using the chi-square test, with

Yates' continuity correction applied when the expected cell count was less than 5. Fisher's exact test was used when the expected frequencies in any cell were less than 1. Furthermore, univariate logistic regression analysis was initially performed to identify potential predictors of postoperative recurrence. Statistically significant variables ($p < 0.05$) in the univariate analysis were subsequently included in a multivariate logistic regression model. Multivariate results were reported as Odds Ratios (ORs) with corresponding 95% Confidence Intervals (CIs). All statistical tests were two-tailed, and a p value of <0.05 was considered statistically significant.

Results

Comparison of Baseline Characteristics Between the Two Groups

A total of 109 patients were included in this study, comprising 61 in the traditional surgery group and 48 in the minimally invasive surgery group. The baseline characteristics were comparable between the two groups, with no statistically significant differences observed in age ($p = 0.649$), disease duration ($p = 0.540$), body mass index (BMI) ($p = 0.613$), or prevalence of hypertension and diabetes ($p = 1.000$) (Table 1). The mean age of patients in the traditional surgery group was 28.43 ± 3.23 years, compared to 28.15 ± 3.14 years in the minimally invasive group. The mean disease duration was 1.54 ± 0.37 years in the traditional surgery group and 1.58 ± 0.31 years in the minimally invasive group. Furthermore, mean BMI was 22.5 ± 2.1 kg/m² and 22.7 ± 2.0 kg/m², respectively. In terms of comorbidities, the prevalence of hypertension was 3.28% in the traditional group and 2.08% in the minimally invasive group, while the prevalence of diabetes was observed in 1.64% and 2.08% of cases, respectively.

Comparison of Operation Duration, Postoperative Hospital Stays and Complication Rates

The minimally invasive surgery group demonstrated significant advantages over the traditional surgery group in terms of operation duration, length of postoperative hospital stays, and complication rates (Table 2). Specifically, the mean operation time was significantly shorter in the minimally invasive surgery group ($p < 0.001$), indicating greater procedural efficiency. The mean length of hospital stay was also substantially reduced in the minimally invasive surgery group, at 4.3 ± 1.2 days compared to 7.8 ± 2.4 days in the traditional surgery group ($p < 0.001$). This finding indicates that patients undergoing minimally invasive surgery experience a faster postoperative recovery. Furthermore, the postoperative complication rate was significantly lower in the minimally invasive surgery group ($p = 0.043$), highlighting its advantage in reducing the risk of postoperative complications.

Table 1. Comparison of baseline characteristics between groups.

Baseline characteristic	Traditional surgery group (n = 61)	Minimally invasive surgery group (n = 48)	t/χ^2	p-value
Age (years)	28.43 ± 3.23	28.15 ± 3.14	0.457	0.649
Disease duration (years)	1.54 ± 0.37	1.58 ± 0.31	-0.615	0.540
BMI (kg/m ²)	22.50 ± 2.10	22.7 ± 2.00	-0.507	0.613
Hypertension, n (%)	2 (3.28%)	1 (2.08%)	0.000	1.000
Diabetes (%)	1 (1.64%)	1 (2.08%)	0.000	1.000

Data were expressed as mean ± standard deviation (SD) or n (%). Abbreviations: BMI, body mass index.

Table 2. Comparison of surgical duration, postoperative hospital stays, and complication rates.

Variables	Traditional surgery group (n = 61)	Minimally invasive surgery group (n = 48)	t/χ^2	p-value
Surgical duration (minutes)	120.50 ± 18.40	85.20 ± 15.60	10.621	<0.001
Postoperative hospital stays (days)	7.80 ± 2.40	4.30 ± 1.20	9.922	<0.001
Complication rates (%)	10 (16.39%)	2 (4.17%)	4.099	0.043

Data were expressed as mean ± SD or n (%).

Table 3. Changes in NC and CRP before and after surgery.

Timeline	Traditional surgery group (n = 61)	Minimally invasive surgery group (n = 48)	t	p-value
Preoperative NC (10 ⁹ /L)	9.50 ± 2.20	9.20 ± 2.10	0.725	0.470
Postoperative Day 7 NC (10 ⁹ /L)	7.80 ± 1.9*	6.00 ± 1.50*	5.527	<0.001
NC ratio Day 7 after surgery	0.82 ± 0.13	0.65 ± 0.11	7.283	<0.001
Postoperative Day 30 NC (10 ⁹ /L)	6.30 ± 1.70*#	4.50 ± 1.30*#	6.263	<0.001
NC ratio Day 30 after surgery	0.66 ± 0.10	0.49 ± 0.09	9.345	<0.001
F (time effect, within group)	126.598	4.910		
p (time effect, within group)	<0.001	0.009		
Preoperative CRP (mg/L)	28.00 ± 5.00	27.50 ± 4.80	0.531	0.597
Postoperative Day 7 CRP (mg/L)	20.50 ± 4.20*	12.80 ± 3.50*	10.436	<0.001
CRP ratio Day 7 after surgery	0.73 ± 0.12	0.47 ± 0.09	12.520	<0.001
Postoperative Day 30 CRP (mg/L)	10.50 ± 2.80*#	6.80 ± 2.00*#	8.038	<0.001
CRP ratio Day 30 after surgery	0.38 ± 0.08	0.25 ± 0.06	10.365	<0.001
F (time effect, within group)	719.901	17.453		
p (time effect, within group)	<0.001	<0.001		

Data were expressed as mean ± SD or n (%). "Ratio" values refer to the postoperative-to-preoperative NC/CRP ratio (Day 7 after surgery and Day 30 after surgery). Independent sample *t*-tests were used for intergroup comparisons at each time point, and Bonferroni correction was applied to control for multiple comparisons. F values represent the time effect within each group obtained from repeated-measures analysis of variance (ANOVA). Abbreviations: NC, Neutrophil Count; CRP, C-reactive Protein. **p* < 0.05 vs. Preoperative levels; #*p* < 0.05 vs. Postoperative Day 7 levels.

Changes in Inflammatory Factor Levels

Before surgery, both the traditional and minimally invasive surgery groups exhibited elevated NC and CRP levels, with no significant differences between the two groups (Table 3). By post-surgery day 7, both groups showed a substantial decline in NC and CRP levels, with more pronounced reductions observed in the minimally invasive surgery group (*p* < 0.001). On postoperative day 30, this trend persisted, with the minimally invasive surgery group exhibiting further reductions in NC and CRP levels, achieving significantly lower levels compared to the traditional surgery group (*p* < 0.001). These results suggest that minimally invasive surgery may be more effective in reducing postoperative inflammatory responses than conventional open surgery.

Impact of Surgical Methods on the Risk of Postoperative Recurrence

To identify independent predictors of postoperative recurrence, univariate logistic regression analyses were performed for variables, including surgery type, age, disease duration, and preoperative inflammatory markers (Table 4). Among these, surgery type (*p* = 0.004) and preoperative CRP levels (*p* = 0.033) were significantly associated with recurrence. These two variables were subsequently included in the multivariate logistic regression analysis (Table 5).

The results revealed a significant difference in postoperative recurrence rates between the two groups: 8.3% (n = 4/48) in the minimally invasive surgery group and 32.8% (n = 20/61) in the traditional surgery group (*p* = 0.002).

Table 4. Univariate logistic regression analysis for factors affecting postoperative recurrence.

Variables	β value	SE	Wald value	Exp(β)	95% CI	<i>p</i> -value
Surgery type	-1.680	0.589	8.132	0.186	0.059–0.591	0.004
Age	0.047	0.073	0.406	1.048	0.907–1.210	0.524
Disease duration	0.020	0.010	3.812	1.020	1.000–1.040	0.051
Preoperative NC level	0.179	0.104	2.956	1.196	0.975–1.466	0.086
Preoperative CRP level	0.102	0.048	4.547	1.107	1.008–1.216	0.033

Abbreviations: Exp(β), Exponentiated Beta; NC, Neutrophil Count; CRP, C-reactive Protein; CI, Confidence Interval.

Table 5. Multivariate logistic regression analysis for factors affecting postoperative recurrence.

Variables	β value	SE	Wald value	Exp(β)	95% CI	<i>p</i> -value
Surgery type	-1.419	0.633	5.025	0.242	0.069–0.832	0.024
Preoperative CRP level	0.135	0.140	0.926	1.144	0.870–1.505	0.334

Abbreviations: Exp(β), Exponentiated Beta; CI, Confidence Interval; NC, Neutrophil Count; CRP, C-reactive Protein.

In the multivariate model, surgery type remained an independent predictor of recurrence ($p = 0.024$, Exponentiated Beta (Exp(β)) = 0.242, 95% CI: 0.069–0.832), indicating that minimally invasive surgery significantly reduced the risk of recurrence. Overall, surgery type was identified as the sole independent predictor of postoperative recurrence, highlighting its prognostic significance in clinical decision-making.

Discussion

This retrospective study compared the clinical efficacy of traditional open surgery and minimally invasive rotational resection in patients with non-lactational mastitis. The results demonstrated that minimally invasive surgery offered significant advantages in both therapeutic outcomes and postoperative recovery. Patients in the minimally invasive group exhibited significantly reduced levels of inflammatory markers (NC and CRP) on postoperative days 7 and 30, suggesting a lower systemic inflammatory response and a more favorable recovery trajectory. Furthermore, the recurrence rate in the minimally invasive group was substantially lower. Multivariate logistic regression analysis confirmed a minimally invasive surgical approach as an independent protective factor against recurrence. These findings indicate that minimally invasive surgery not only ensures effective lesion removal but also reduces surgical trauma and improves short-term outcomes, supporting its potential as a preferred treatment option for appropriately selected patients with non-lactational mastitis.

The observed advantages of minimally invasive surgery, including reduced postoperative inflammatory factor levels, lower recurrence rates, and shorter hospitalization time, align with findings reported in both national and international studies, providing new insights into these key clinical outcomes [6,11]. Specifically, this study showed that patients in the minimally invasive surgery group had significantly lower NC and CRP levels on postoperative days

7 and 30. These findings align with the results of Huang *et al.* [14], who reported that minimally invasive approaches effectively suppress postoperative inflammatory responses, likely due to reduced tissue damage and lower immune system stimulation. NC and CRP are well-established markers of inflammatory responses [15,16], and their reduction is associated not only with lower postoperative complication risks but may also be associated with enhanced wound healing and tissue recovery. This study further supports the notion that the reduced trauma associated with minimally invasive surgery provides significant advantages in controlling inflammation, thereby offering new directions for postoperative rehabilitation management.

Regarding postoperative recurrence, the minimally invasive surgery group demonstrated a significantly lower recurrence rate than the traditional surgery group, confirming the efficacy of minimally invasive approaches in managing non-lactational mastitis. This finding aligns with the research by Chen *et al.* [17], who proposed favorable outcomes and low recurrence rates using ultrasound-guided precise debridement and vacuum sealing drainage in patients with non-lactational mastitis. However, some studies have indicated that traditional open surgery may be preferable for complex cases involving abscess formation or extensive lesions, as it allows for more thorough debridement and tissue resection [4,5,18]. Thus, the selection of surgical methods should be tailored to the complexity of the lesion and the patient's clinical needs. The application of minimally invasive surgery in more complex cases requires further investigation. Notably, the relatively small number of recurrence events in our dataset may limit the statistical power of the regression analysis, potentially affecting the stability of coefficient estimates and standard errors. Therefore, these results should be interpreted with caution and validated in larger, prospective studies.

Furthermore, the findings of this study regarding hospitalization time and postoperative recovery align with previ-

ous reports on non-lactational mastitis, which have demonstrated that minimally invasive surgical techniques are associated with significantly shorter hospital stays and lower complication rates [6,17]. In our study, patients who underwent minimally invasive surgery had a shorter postoperative hospital stay and a significantly reduced incidence of complications compared to those who received traditional open surgery. These advantages not only underscore the role of minimally invasive approaches in promoting faster recovery but also highlight their potential to improve healthcare efficiency and reduce the overall consumption of medical resources.

Despite some promising outcomes, this study has several limitations. First, the relatively small sample size and retrospective design may affect the representativeness and generalizability of the findings. Although propensity score matching (PSM) was not applied, the two groups were statistically comparable in key baseline characteristics, which helps minimize potential confounding bias. However, the lack of PSM remains a methodological limitation, and future studies should consider using matching approaches to improve group comparability. Second, due to incomplete data, several important factors that may impact recurrences—such as intraoperative blood loss, hormone levels, and perioperative antibiotic use—were not included in the analysis. Additionally, the lack of long-term follow-up data restricted the evaluation of recurrence mechanisms and the long-term efficacy of different surgical approaches. Moreover, due to the limited number of recurrence events and heterogeneous follow-up intervals, survival analysis and dynamic modeling of postoperative inflammatory marker trends were not performed, though their potential prognostic value warrants further investigation in well-designed prospective studies.

Future studies should adopt multicenter, large-scale prospective cohort designs that systematically incorporate a comprehensive set of clinical, inflammatory, and molecular variables. Such effort would be crucial for optimizing treatment strategies, identifying candidates best suited for minimally invasive surgery, and advancing precision medicine approaches in managing non-lactational mastitis.

Conclusions

This study demonstrates that minimally invasive surgery offers significant benefits in managing non-lactational mastitis. These advantages include a reduced postoperative inflammatory response, lower recurrence rates, shorter length of hospitalization, and a decreased risk of complications. The findings further substantiate the clinical significance of minimally invasive approaches and provide new insights into the development of optimized, individualized treatment strategies for these patients.

Availability of Data and Materials

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

Author Contributions

SBH, Conceptualization, Writing - Original Draft, Writing - Review and Editing; YJW, Methodology, Writing - Original Draft, Writing - Review and Editing; WL, Formal Analysis, Resources, Critical Revision of the Manuscript; YFF, Formal Analysis, Visualization, Critical Revision of the Manuscript; XFL, Data Curation, Critical Revision of the Manuscript; HH, Data Curation, Supervision, Critical Revision of the Manuscript; YW, Conceptualization, Writing - Review and Editing, Project Administration, Funding Acquisition. All authors have read and approved the final version to be published and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study protocol was reviewed and approved by the Ethics Committee of Jingmen Central Hospital (Approval Number: 2024-03-017), and all research procedures adhered to the ethical principles outlined in the Declaration of Helsinki. All patients signed the consent form before participation in the study.

Acknowledgment

Not applicable.

Funding

This study was supported by 2024 Hubei Province Jingmen City General Science and Technology Plan Project (2024YFYB080).

Conflict of Interest

The authors declare no conflict of interest.

References

- [1] Boakes E, Woods A, Johnson N, Kadoglou N. Breast Infection: A Review of Diagnosis and Management Practices. *European Journal of Breast Health*. 2018; 14: 136–143. <https://doi.org/10.5152/ejbh.2018.3871>.
- [2] Yuan QQ, Xiao SY, Farouk O, Du YT, Sheybani F, Tan QT, et al. Management of granulomatous lobular mastitis: an international multidisciplinary consensus (2021 edition). *Military Medical Research*. 2022; 9: 20. <https://doi.org/10.1186/s40779-022-00380-5>.
- [3] Wang X, He X, Liu J, Zhang H, Wan H, Jing L, et al. Immune pathogenesis of idiopathic granulomatous mastitis: from etiology toward therapeutic approaches. *Frontiers in Immunology*. 2024; 15: 1295759. <https://doi.org/10.3389/fimmu.2024.1295759>.
- [4] Zhang C, Lei S, Kong C, Tan Y, Dai X, He J, et al. Clinical study on surgical treatment of granulomatous lobular mastitis. *Gland Surgery*. 2019; 8: 712–722. <https://doi.org/10.21037/gs.2019.11.12>.
- [5] Zhou F, Liu L, Liu L, Yu L, Wang F, Xiang Y, et al. Comparison of Conservative versus Surgical Treatment Protocols in Treating

- Idiopathic Granulomatous Mastitis: A Meta-Analysis. *Breast Care* (Basel, Switzerland). 2020; 15: 415–420. <https://doi.org/10.1159/000503602>.
- [6] Liao H, Guo J, Chen X, Hua Z, Lin J, Weng Y. Ultrasound classification-guided minimally invasive rotary cutting in granulomatous lobular mastitis. *BMC Women's Health*. 2020; 20: 252. <https://doi.org/10.1186/s12905-020-01118-y>.
- [7] Costa Morais Oliveira V, Cubas-Vega N, López Del-Tejo P, Baía-da-Silva DC, Araújo Tavares M, Picinin Safe I, et al. Non-lactational Infectious Mastitis in the Americas: A Systematic Review. *Frontiers in Medicine*. 2021; 8: 672513. <https://doi.org/10.3389/fmed.2021.672513>.
- [8] Shu J, Wang XJ, Li JW, Bie P, Chen J, Zheng SG. Robotic-assisted laparoscopic surgery for complex hepatolithiasis: a propensity score matching analysis. *Surgical Endoscopy*. 2019; 33: 2539–2547. <https://doi.org/10.1007/s00464-018-6547-8>.
- [9] Sun J, Shao S, Wan H, Wu X, Feng J, Gao Q, et al. Prediction models for postoperative recurrence of non-lactating mastitis based on machine learning. *BMC Medical Informatics and Decision Making*. 2024; 24: 106. <https://doi.org/10.1186/s12911-024-02499-y>.
- [10] Singh D, Srivastava A, Dhar A, Kataria K, Ranjan P, Hari S, et al. Prospective Cohort Study with a Decision Analysis Approach for the Management of Non-lactational Mastitis. *Indian Journal of Surgery*. 2025; 1–9. <https://doi.org/10.1007/s12262-025-04303-1>.
- [11] Fu ZL, Zhang L, Feng R, Wan FX. Clinical research on minimally invasive rotary resection in the treatment of lactational breast abscess. *Gland Surgery*. 2021; 10: 3294–3304. <https://doi.org/10.21037/gs-21-729>.
- [12] Wang O, Zhang W, Chen S, Cao F, Chen L, Chen H. A Multicenter, Randomized, Controlled Study of the Breast Biopsy and Circumferential Excision System for Breast Lesions. *Clinical Breast Cancer*. 2023; 23: 640–648. <https://doi.org/10.1016/j.clbc.2023.05.007>.
- [13] Hu T, Li S, Huang H, Huang H, Tan L, Chen Y, et al. Multicentre, randomised, open-label, non-inferiority trial comparing the effectiveness and safety of ductal lavage versus oral corticosteroids for idiopathic granulomatous mastitis: a study protocol. *BMJ Open*. 2020; 10: e036643. <https://doi.org/10.1136/bmjopen-2019-036643>.
- Excision System for Breast Lesions. *Clinical Breast Cancer*. 2023; 23: 640–648. <https://doi.org/10.1016/j.clbc.2023.05.007>.
- [14] Huang YM, Lo C, Cheng CF, Lu CH, Hsieh SC, Li KJ. Serum C-Reactive Protein and Interleukin-6 Levels as Biomarkers for Disease Severity and Clinical Outcomes in Patients with Idiopathic Granulomatous Mastitis. *Journal of Clinical Medicine*. 2021; 10: 2077. <https://doi.org/10.3390/jcm10102077>.
- [15] Khan S, Yang J, Cobo ER, Wang Y, Xu M, Wang T, et al. Streptococcus uberis induced expressions of pro-inflammatory IL-6, TNF- α , and IFN- γ in bovine mammary epithelial cells associated with inhibited autophagy and autophagy flux formation. *Microbial Pathogenesis*. 2023; 183: 106270. <https://doi.org/10.1016/j.micpath.2023.106270>.
- [16] Xu J, Jia Z, Chen A, Wang C. Curcumin ameliorates Staphylococcus aureus-induced mastitis injury through attenuating TLR2-mediated NF- κ B activation. *Microbial Pathogenesis*. 2020; 142: 104054. <https://doi.org/10.1016/j.micpath.2020.104054>.
- [17] Chen R, Chen J, Peng A, Yang L, Zhou R. Clinical therapeutic evaluation of vacuum sealing drainage and precise ultrasound-guided debridement in the treatment of non-lactational mastitis. *Experimental and Therapeutic Medicine*. 2021; 21: 480. <https://doi.org/10.3892/etm.2021.9911>.
- [18] Scott-Conner CE, Kaiser AM, Nguyen NT, Sarpel U, Sugg SL. Chassin's operative strategy in general surgery: An expositive atlas. Springer Nature: Cham, Switzerland. 2022.

© 2025 The Author(s).

