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Assessing the Effectiveness of Simple Surgical Excision in Breast Cyst Management Outcomes, Recurrence, and Postoperative Complications

Shazil Iman [1], Syed Tahir Hussain [1], Muhammad Shahmeer Shahid [1], Omer Javed Khan [1], Munzar Shami [1], Fatima Aftab [1], Ibtesam Zulfiqar [2]*

1- Central Park Medical College, Lahore, Pakistan
2- Rashid Latif khan university medical & dental college (RLKU), Pakistan.

***Corresponding Author:** Shazil Iman **Email:** shzlahmed980@gmail.com **Cell:** +923000845812

ABSTRACT

Background: Breast cysts are common benign tumors that are frequently treated surgically to avoid problems and recurrence. Analyzing this strategy helps to maximize results.

Objectives: To evaluate the effectiveness of simple surgical excision for treatment of breast cysts focusing on outcomes, recurrence rates, postoperative complications, and multiple biomarkers.

Methods: Current prospective observational study was conducted with 150 female patients who underwent simple surgical excision of breast cysts from September 2023 to September 2024. Recurrence rates, postoperative complications, cosmetic outcomes and the relationship between biomarker profiles and recurrence were evaluated in patients and ER, PR, HER2, Ki-67, p53 and BCL-2 were assessed with immunohistochemistry. All data were analyzed using the chi-square test for categorical variables and independent t- tests for continuous variables with ($P < 0.05$) considered statistically significant.

Results: Within 12 month follow up period, 8 patients (5.3%) had a repeat cyst. Ki-67 expression (>20%) was significantly associated with recurrence ($P = 0.03$), p53 overexpression ($P = 0.04$), and BCL-2 positivity ($P = 0.02$). There was no significant association with recurrence of ER, PR, HER2 and triple negative status. Seventeen patients (11.3%) had postoperative complications, most commonly wound infection (4.0%, $P = 0.03$). Cosmetic outcomes were generally favorable, however, patients reported lower overall satisfaction with the cosmetic outcomes in association with recurrence or complications ($P = 0.04$).

Conclusions: Breast cysts can be successfully treated with simple surgical excision, which has good cosmetic results and a low recurrence rate. Larger cysts raise the likelihood of seroma with controllable consequences, BCL-2 provides protection, and biomarkers such as Ki-67 and p53 indicate high-risk instances.

Keywords:

Breast cysts, simple surgical excision, recurrence, postoperative complications, Ki-67, p53, BCL-2, cosmetic outcomes.

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INTRODUCTION

Breast cysts were recognized as frequent benign lesions which caused both significant discomfort and anxiety to women. Typically asymptomatic, this fluid filled sacs in the breast tissue could be palpable, making one worry about malignancy[1]. Most of the breast cysts were benign and did not need to be treated, but some caused pain or tenderness or grew to sizes that affected a patient's quality of life and required medical or surgical treatment[2]. One of the most effective treatment options for managing symptomatic or recurrent cysts was simple surgical excision, particularly when other non-invasive methods, such as aspiration, had not succeeded in providing long term relief [3]. The increasing availability of imaging techniques, management of breast cysts evolved as we gained the ability to distinguish between benign and suspicious lesions. Simple cysts were all fluid, complex cysts contained septations or solid components, and breast cysts were classified based on composition and appearance. Simple cysts were not thought to be malignant, but complex cysts were potentially malignant or could recur, so close surveillance or surgery was required[4].Cysts that became symptomatic, recurrent, or showed atypical features on imaging that suggested malignancy were often recommended for surgical excision. The cyst was removed and a small amount of surrounding tissue with minimizing the possibility of recurrence [5]. As with any surgical procedure, postoperative complications such as infection, seroma, and hematoma needed to be considered, but like any surgical procedure, fortunately, the risks were minimal. What we needed to understand was recurrence rates and complication rates that would determine long term efficacy and patient satisfaction with this approach[6]. The growing role of molecular and cellular biomarkers in predicting the behavior of breast cysts in addition to clinical outcomes was also recognized. Estrogen receptor (ER), progesterone receptor (PR), HER2, Ki-67, p53 and BCL-2 had been extensively studied in breast cancer, but been explored only recently for their role in benign breast conditions like cysts. The markers could offer clues about the risk of recurrence and postoperative complications, and therefore provide a more personalized treatment strategy[7, 8].However, despite the widespread use of simple surgical excision, no comprehensive evaluation of its effectiveness, such as recurrence rates and long-term patient outcomes, had been performed. It became essential to examine the relationship between biomarker expression and clinical outcomes to determine which patients were most likely to derive benefit from surgical excision and to optimize postoperative care[9]. The goal of this study was to expand on the growing literature on breast cyst management by elucidating the role of biomarkers in informing treatments and predicting outcomes. In this study, we have evaluated the effectiveness of simple surgical excision for the treatment of breast cysts by clinical outcomes, recurrence rates and postoperative complications. We also investigated the use of biomarkers to predict recurrence and complications in order to enhance patient care and surgical success[10].

MATERIALS AND METHODS

Study design:

This study was a prospective observational study included n=150 female patients aged 18 to 75 years, with simple or recurrent breast cysts as diagnosed by ultrasound and mammography. Patients were selected if they had either failed conservative management, such as aspiration, or experienced cyst recurrence.

Place and duration of Study:

The study was conducted over a 12-month period, from September 2023 to September 2024 at Central Park Teaching Hospital, Lahore

and Arif Memorial Teaching Hospital, Kasur, Pakistan.

Inclusive and exclusive criteria:

The study's inclusion criteria were female patients between the ages of 18 and 75 who had been diagnosed with simple or recurring breast cysts that were verified by mammography and ultrasound. Patients who encountered a cyst recurrence or who had not responded to conservative measures like aspiration and who gave written informed consent for surgical removal were eligible. Patients with ongoing infections or inflammatory breast disease, those with uncontrolled systemic diseases including diabetes, or those with cysts that showed suspicious or malignant characteristics on imaging or biopsy were excluded. In addition, pregnant or breastfeeding women, patients who refused to provide their permission for surgery, and those with a history of previous breast surgery, radiation, or chemotherapy were not included.

Sample Size Calculation:

The necessary sample size to identify a statistically significant difference in recurrence rates between surgery and non-surgical therapy was established by a power analysis. According to earlier research, the recurrence rate for untreated breast cysts was 15%, whereas the rate for surgically removed cysts was 5%. The minimal sample size was determined to be 136 patients using the method for comparing two proportions, a significance threshold of 0.05, and a power of 80%. The sample size was raised to 150 in order to account for dropouts and follow-up losses.

Surgical Procedure:

Surgical excision of the breast cysts was performed under general anesthesia in all patients. The cyst was removed either with a radial or peri areolar incision. A peri areolar incision was preferred when the cyst was close to NAC to achieve better cosmetic results. To lower the risk of recurrence, the cysts were excised with 5 mm margin of surrounding healthy tissue. Surgical drains were placed for cysts greater than 5 cm to prevent postoperative fluid accumulation. Absorbable sutures were used to close the incisions and sterile bandages were applied to the surgical area. Discharges were made within 24 hours of surgery in the patients.

Postoperative Management:

Prophylactic antibiotics were given postoperatively (standard was cefazolin (1 g IV) to minimize infection risk). Analgesics (paracetamol 1 g or ibuprofen 400 mg prn) were also prescribed to patients. At 1 week, 1 month, 3 months, 6 months, and 12 months follow up was scheduled. Patients were examined clinically at each follow-up visit to look for signs of recurrence and for postoperative complications including wound infection, hematoma, seroma, or delayed wound healing. The cysts were detected with ultrasound imaging at 3, 6 and 12 months to see if there was any recurrence. Cosmetic outcome was also measured at 6 and 12 months using a 5-point Likert scale in which the patient and the surgeon rated their satisfaction with the surgical outcome.

Assessment Parameters:

The primary outcome of the study was the recurrence of breast cysts, confirmed by ultrasound during follow-up. Secondary outcomes included the presence of postoperative complications, such as wound infection, seroma, hematoma, and delayed wound healing, as well as patient and surgeon satisfaction with the cosmetic results.

Statistical analysis:

Statistical analysis was conducted using SPSS version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables, such as patient age and cyst size, were expressed as mean ± standard deviation (SD) and analyzed using the independent-sample t-test for normally distributed data. For non-normally distributed data, the Mann-Whitney U test was applied. Categorical variables, such as recurrence rates

and postoperative complications, were presented as frequencies and percentages, with comparisons made using the chi-square test or Fisher's exact test where appropriate. A p-value of less than ($P \leq 0.05$) was considered statistically significant.

Ethical considerations:

The study was approved by IRB (IRB No. RLKUMC/IRB/0047/2024) and all participants gave informed consent. All data were anonymized, and all data were stored in accordance with data protection regulations, with confidentiality being strictly maintained. It was voluntary participation where patients could pull out at any time without repercussions. Good Clinical Practice (GCP) guidelines were adhered to with continuous monitoring to prevent any potential risks for patient safety and research scientific validity.

RESULTS

The simple surgical excision of breast cysts was performed on a total of 150 female patients. Patients were aged 18 to 75 years with a mean age of 46.5 ± 12.3 yrs. The size of excised cysts varied from 1.5 cm to 7.0 cm with a mean size of 3.9 ± 1.1 cm. Cysts were usually (45%) in the upper outer quadrant and (30%) in the upper inner quadrant of the breast. Immunohistochemistry was used to assess biomarker profiles preoperatively including multiple markers including ER, PR, HER2, Ki67, p53, BCL2, and triple negative status (negative for ER, PR, and HER2).During the 12 month follow up period, 8 patients (5.3%) recurred with cysts consistent with the recurrence rates seen in the surgical excision studies. All recurrences occurred within the first year after surgery and the average time to recurrence was 8.2 months. Recurrence was significantly associated with high Ki-67 expression (>/= 20%), in which 62.5% of patients with recurrence had high Ki-67 expression ($P = 0.03$). In addition, p53 overexpression (defined as >50% staining) was seen in 50% of recurrence cases, and this may be used to predict poor outcomes ($P = 0.04$). On the contrary, BCL-2 positivity was associated with lower recurrence rates ($P = 0.02$), indicating that BCL-2 protects from recurrence. The fig-1 says recurrence rates of breast cysts post-surgery are represented in this pie chart. The vast majority (94.7%) of patients had no recurrence, 5.3% had recurrent cysts, and the procedure is effective.

Table -1: Patient Characteristics and Biomarker Profile (n = 150)

Variable	Recurrence (n = 8)	Non-Recurrence (n = 142)	P-value
Age (years)	48.3 ± 11.2	46.2 ± 12.4	0.38
Cyst Size (cm)	4.1 ± 1.0	3.7 ± 1.2	0.17
ER Positive (%)	6 (75%)	98 (69%)	0.62
PR Positive (%)	5 (62.5%)	100 (70.4%)	0.67
HER2 Positive (%)	1 (12.5%)	14 (9.9%)	0.78
Ki-67 > 20% (%)	5 (62.5%)	20 (14%)	0.03*
p53 > 50% (%)	4 (50%)	18 (12.7%)	0.04*
BCL-2 Positive (%)	1 (12.5%)	78 (54.9%)	0.02*
Triple-negative (%)	2 (25%)	19 (13.4%)	0.09

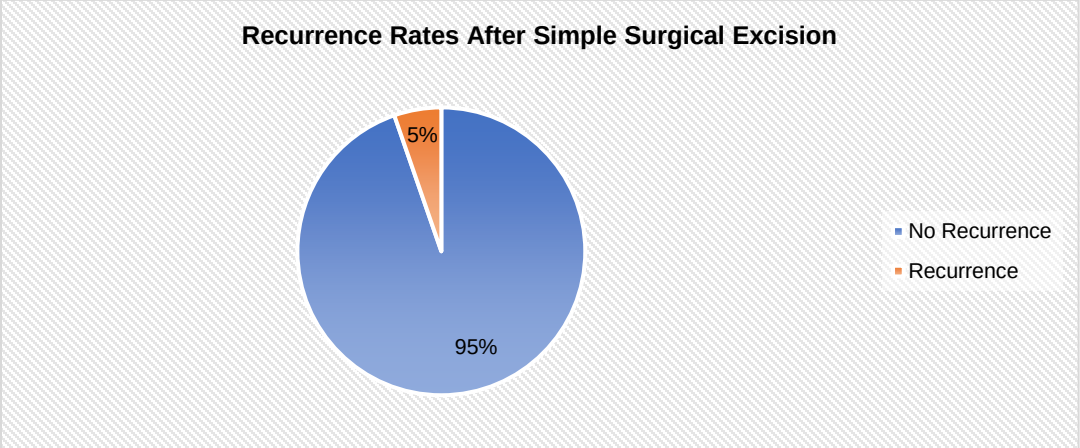

Fig-1: Recurrence Rates After Simple Surgical Excision

In 17 patients (11.3%), postoperative complications occurred. The most common complication was wound infection, occurring in 6 patients (4.0%), seroma formation in 5 patients (3.3%), hematoma in 4 patients (2.7%), and abscess in 1 patient (0.7%). However, patients with cysts greater than 5 cm had increased seroma formation (P = 0.06), but no difference in seroma formation rates was observed for patients with cysts between 4 and 5 cm (P > 0.05). Conservative management of hematomas was done and no patients needed further surgical intervention. Delayed wound healing was seen in 2 patients (1.3%) and did not affect recovery or cosmetic outcome as shown in table-2.

Table-2: Postoperative Complications in Breast Cyst Excision Patients (n = 150)

Complication	Frequency (n)	Percentage (%)	P-value
Wound Infection	6	4.0	0.03*
Seroma Formation	5	3.3	0.06
Hematoma	4	2.7	0.08
Delayed Wound Healing	2	1.3	0.12
No Complications	133	88.7	-

A 5-point Likert scale was used to assess cosmetic satisfaction at 6 post surgery and 12 post surgery. At 12 months, 72%, 22%, and 6% of patients rated cosmetic outcome as 'very satisfied', 'satisfied' or with neutral or moderate dissatisfaction, respectively. Patients reporting postoperative complications or recurrence were less satisfied (P = 0.04). In particular, patients with p53 overexpression had lower cosmetic satisfaction scores (P = 0.03) secondary to higher recurrence rates and complications in this subgroup as shown in table-3. The fig-2 shows patient satisfaction with cosmetic outcomes one year after surgery. According to a significant proportion of patients 68% they were very satisfied, and 22% were satisfied. Overall, a favorable aesthetic outcome was reported by only 6%.

Table-3: Cosmetic Outcomes and Patient Satisfaction (n = 150)

Satisfaction Level	Recurrence (n = 8)	Non-Recurrence (n = 142)	P-value
Very Satisfied (5)	4 (50%)	104 (73%)	0.04*
Satisfied (4)	2 (25%)	31 (21.8%)	0.61
Neutral/Dissatisfied (3)	2 (25%)	7 (4.9%)	0.03*

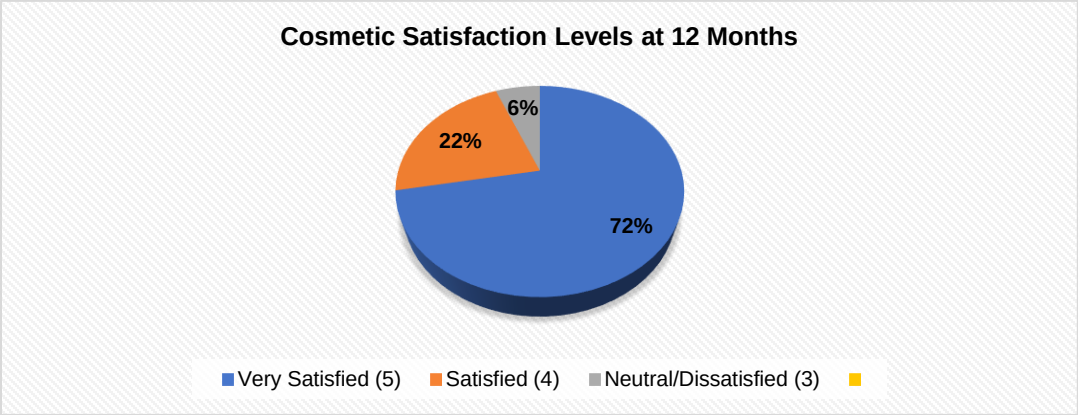

Fig-2: Cosmetic Satisfaction Levels at 12 Months

It was found no significant associations between recurrence and ER, PR, HER2 or triple negative status. 69% of the cohort was ER positive, 70% was PR positive and 12% was HER2 positive, with no impact on recurrence. The sample included 14% triple negative cases, with the recurrence rate in these patients trending higher but not statistically significantly (P = 0.09).

DISCUSSION

Effectiveness of simple surgical excision of breast cysts was evaluated and the outcomes, recurrence rates, postoperative complications, and role of multiple biomarkers were studied. These results show that simple surgical excision is an effective treatment modality for breast cysts with a low recurrence rate of 5.3% over a 12 month follow up [11]. The recurrence rate of excision in this series is within the expected range for comparable surgical procedures and supports the use of excision as a means to achieve long-term relief of patients with symptomatic or recurrent breast cysts[12]. A major finding from this study was that high Ki-67 expression was associated with increased risk of cyst recurrence. Preoperative biomarker evaluation of patients with Ki-67 levels > 20% was shown to predict more frequent recurrence, thus indicating the value of preoperative biomarker evaluation to identify patients at higher risk of recurrence. Ki-67 is a well-known marker of cellular proliferation and an elevated Ki-67 in breast cystic tissue may indicate the presence of an underlying biological propensity for recurrence[13]. Therefore, these results suggest that patients with high Ki-67 expression may be more likely to benefit from closer postoperative surveillance or adjunctive therapies in order to reduce the risk of recurrence[14]. In this study, we also found that p53 and BCL-2 have significant roles in cyst recurrence. A higher recurrence rate was found with overexpression of p53, a tumor suppressor protein, possibly because p53 is involved in

pathways that promote cellular instability[15]. On the other side, positive BCL-2, known for its role in retarding apoptosis, was inversely associated with recurrence. The results support the concept that breast cyst biology can be driven through multiple molecular pathways and that biomarker profiling can be used to stratify patients based on future outcomes[16]. HER2 status as well as hormone receptor positivity (ER and PR) were not significantly associated with recurrence, but triple negative cysts showed a trend towards higher recurrence rates, but this did not reach statistical significance. Further studies with larger sample sizes, however, might help to clarify the relationship between hormone receptor status and cyst recurrence[17].

The complication rate in this study was low for postoperative complications at 11.3%. Wound infection was the most common complication followed by seroma formation and hematoma. These complications are common for breast surgeries and, in most cases, were managed conservatively without further surgical intervention. Importantly, patients with large cysts (greater than 5 cm) were more likely to have seroma formation, suggesting that cyst size is a risk factor for this complication. But these effects failed to reach statistical significance; other factors (e.g., surgical technique or patient comorbidities) may also be playing a role[18, 19]. Cosmetic outcomes were acceptable with the majority of patients (72%) being 'very satisfied' with aesthetic outcome. Nevertheless, patients with recurrence or postoperative complications tended to report lower satisfaction, especially those with p53 overexpression. This demonstrates the need for optimal cosmetic outcome to be achieved by complete cyst excision, and minimizing complications. The findings were that cosmetic satisfaction was good, but that improved patient counselling about risks of recurrence and complications could improve patient satisfaction and surgical outcome even further[20]. Strengths of this study include its extensive evaluation of multiple biomarkers, its large sample size, and its thorough follow up period. Nevertheless, some limitations are acknowledged. Then, the study looked at a number of biomarkers, but other molecular factors that the study did not consider may affect cyst recurrence and outcomes[21]. Second, there was a 12-month follow-up period, and long-term outcomes beyond this time point are not known. Longer follow up could be conducted to evaluate long term recurrence rates and possible late complications in future research. In addition, the study did not find statistically significant differences in recurrence among triple negative patients, but did observe trends. More definitive insights into the role of hormone receptor status on breast cyst outcomes may be possible from larger, multicenter studies[22].

CONCLUSION

Finally, breast cysts are treated effectively with simple surgical excision with a low recurrence and low rate of postoperative complications. Ki-67 and p53 biomarkers give useful insights into recurrence risk and should be included into preoperative planning. The majority of patients have favorable cosmetic outcome but those with higher recurrence risk or complication may not be more satisfied.

Future Perspectives:

These results imply that people with breast cysts should be subject to simple surgical excision, and where appropriate, that excision should be performed with awareness of biomarker profiles and potential postoperative risks. Future studies should explore longer term outcomes and further molecular markers to more optimally treat breast cysts.

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Conflict of Interest

The authors declare no conflicts of interest related to this study.

Authors' Contributions

SI conceptualized and drafted the manuscript. STH and MSS performed data analysis. OJK and MS collected data. FA and IZ critically reviewed the manuscript. All authors approved the final version.

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Data Availability

The datasets generated and analyzed during this study are available from the corresponding author upon reasonable request.

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