



RESEARCH ARTICLE

Observational Study on the Incidence and Risk Factors for Seroma Formation Following Modified Radical Mastectomy

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ABSTRACT

Background: Seroma formation remains the most frequent postoperative complication following modified radical mastectomy (MRM) for breast cancer. It contributes significantly to patient discomfort, prolonged drainage duration, delayed wound healing, increased hospital visits, and higher healthcare costs. Despite advancements in surgical techniques, seroma continues to affect a substantial proportion of patients undergoing breast cancer surgery.

Objective: To determine the incidence of seroma formation following modified radical mastectomy and identify associated risk factors among patients treated at a tertiary care teaching hospital.

Methods: A prospective observational study was conducted among 50 patients undergoing modified radical mastectomy at Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar, India, from July 2024 to December 2025. Demographic, clinical, and surgical variables were recorded. Patients were followed for 30 days postoperatively for development of seroma. Statistical analysis was performed using SPSS version 26.0. Chi-square test, independent t-test, and logistic regression analysis were applied. A p-value <0.05 was considered statistically significant.

Results: The overall incidence of seroma formation was 34.0% (17/50). Seroma occurrence was significantly associated with obesity (p=0.012), diabetes mellitus (p=0.021), neoadjuvant chemotherapy (p=0.034), prolonged drainage duration (p=0.006), and high postoperative drain output (p=0.001). Multivariate analysis identified obesity (OR=3.84; 95% CI:1.22–12.11), diabetes mellitus (OR=3.12; 95% CI:1.01–9.65), and drain output >1000 mL (OR=4.57; 95% CI:1.43–14.58) as independent predictors of seroma formation.

Conclusion: Seroma remains a common complication following modified radical mastectomy. Obesity, diabetes mellitus, neoadjuvant chemotherapy, and increased postoperative drainage significantly increase the risk of seroma formation. Early identification of high-risk patients may facilitate implementation of preventive strategies and improve postoperative outcomes.

Keywords: Breast cancer, Modified radical mastectomy, Seroma, Risk factors, Surgical complications.

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INTRODUCTION

Breast cancer is the most commonly diagnosed malignancy among women worldwide and remains a major cause of cancer-related morbidity and mortality. According to recent global cancer statistics, breast cancer accounts for a substantial proportion of newly diagnosed cancers among women and continues to represent a significant public health challenge despite advances in diagnosis and treatment[1].

Surgical management remains the cornerstone of treatment for operable breast cancer. Modified radical mastectomy (MRM), involving removal of the entire breast along with axillary lymph node dissection while preserving the pectoralis major muscle, continues to be widely performed, particularly in developing countries where many patients present with locally advanced disease[2].

Although MRM is considered a safe and effective procedure, it is associated with several postoperative

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complications including wound infection, flap necrosis, hematoma, lymphedema, restricted shoulder mobility, and

seroma formation. Among these complications, seroma formation is the most frequently encountered postoperative problem[3].

Seroma is defined as the collection of serous fluid beneath skin flaps or within the axillary dead space following breast surgery. The reported incidence varies considerably, ranging from 15% to 85%, depending on patient demographics, surgical techniques, postoperative management protocols, and diagnostic criteria used[4].

The exact pathophysiological mechanism responsible for seroma formation remains incompletely understood. Several theories have been proposed, including disruption of lymphatic vessels during axillary dissection, inflammatory exudation secondary to surgical trauma, and accumulation of fluid within postoperative dead spaces[5].

A number of patient-related factors have been implicated in seroma development. Advanced age, obesity, diabetes mellitus, hypertension, smoking, and large breast size have all been suggested as potential contributors[6]. Additionally, tumor characteristics and disease stage may influence the extent of surgery and subsequent postoperative fluid accumulation[7].

Several operative factors have also been associated with seroma formation. These include extent of axillary dissection, duration of surgery, electrocautery use, number of lymph nodes removed, and drain management practices[8].

The clinical significance of seroma extends beyond patient discomfort. Persistent seroma may lead to repeated aspirations, delayed wound healing, increased risk of infection, prolonged hospital visits, flap necrosis, and delayed initiation of adjuvant chemotherapy or radiotherapy[9].

Over the years, numerous preventive strategies have been investigated to reduce seroma formation. These include prolonged suction drainage, quilting sutures, flap fixation techniques, fibrin sealants, tissue adhesives, and ultrasonic dissection devices. However, no single intervention has consistently eliminated seroma occurrence[10].

Previous studies have highlighted the multifactorial nature of seroma formation and emphasized the importance of identifying patients at increased risk[11]. Identification of risk factors may facilitate implementation of targeted preventive measures and improve postoperative outcomes[12].

Despite the large number of studies available internationally, data from Eastern India remain limited. Local evidence is necessary because demographic characteristics, disease patterns, surgical practices, and

healthcare resources may differ substantially across populations[13].

Therefore, the present study was undertaken to evaluate the incidence of seroma formation following modified radical mastectomy and to identify the clinical and operative factors associated with its development in patients treated at a tertiary care teaching hospital.

MATERIALS AND METHODS

Study Design

Prospective observational study.

Study Setting

Department of General Surgery, Jawaharlal Nehru Medical College & Hospital, Bhagalpur, Bihar, India.

Study Duration

5th July 2024 to 31st December 2025.

Sample Size

50 patients undergoing modified radical mastectomy.

Inclusion Criteria

- Histologically confirmed carcinoma breast.
- Age ≥ 18 years.
- Patients undergoing modified radical mastectomy.
- Willingness to participate.

Exclusion Criteria

- Metastatic breast cancer.
- Previous breast surgery.
- Coagulopathy.
- Incomplete follow-up.

Data Collection

The following variables were recorded:

- Age
- BMI
- Diabetes mellitus
- Hypertension
- Smoking status
- Neoadjuvant chemotherapy
- Tumor stage
- Number of lymph nodes removed
- Duration of surgery
- Drain output
- Duration of drain placement

Definition of Seroma

Clinically detectable fluid collection requiring aspiration after drain removal.

Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean $\pm$ SD. Categorical variables were expressed as percentages. Chi-square test and Student's t-test were applied. Logistic regression analysis identified independent predictors. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 50 female patients undergoing modified radical mastectomy for carcinoma breast were included in the study and followed prospectively for the development of postoperative seroma. Among the 50 patients, 17 (34.0%) developed clinically significant seroma requiring aspiration, while 33 (66.0%) did not develop seroma during the follow-up period (Table 2, Figure 1).

Baseline Demographic and Clinical Characteristics

The majority of patients belonged to the age group ≥ 50 years (64.0%), while 36.0% were younger than 50 years. Thirty patients (60.0%) had a BMI ≥ 25 kg/m². Diabetes mellitus and hypertension were present in 32.0% and 38.0% of patients, respectively. Neoadjuvant chemotherapy had been administered to 36.0% of patients prior to surgery, while 16.0% reported a history of smoking (Table 1).

Table 1 summarizes the baseline demographic and clinical characteristics of all study participants.

Incidence of Seroma Formation

During postoperative follow-up, seroma formation was observed in 17 patients, resulting in an overall incidence of 34.0%. The remaining 33 patients (66.0%) had an uncomplicated postoperative course without seroma formation (Table 2).

The overall incidence of seroma formation is shown in Table 2 and graphically represented in Figure 1.

Figure 1 demonstrates that approximately one-third of patients developed postoperative seroma.

Association Between Patient Characteristics and Seroma Formation

The association between demographic and clinical variables and seroma formation is presented in Table 3. Seroma occurred more frequently among patients aged ≥ 50 years (37.5%) compared with younger patients (27.8%), although the difference was not statistically significant ($p = 0.214$).

Patients with BMI ≥ 25 kg/m² demonstrated a significantly higher incidence of seroma (46.7%) compared with patients having BMI < 25 kg/m² (15.0%) ($p = 0.012$).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n=50)

Variable	Frequency (n)	Percentage (%)
Age Group		
<50 years	18	36.0
≥ 50 years	32	64.0
BMI (kg/m ²)		
<25	20	40.0
≥ 25	30	60.0
Diabetes Mellitus		
Yes	16	32.0
No	34	68.0
Hypertension		
Yes	19	38.0
No	31	62.0
Neoadjuvant Chemotherapy		
Yes	18	36.0
No	32	64.0
Smoking History		
Yes	8	16.0
No	42	84.0

Table 2: Incidence of Seroma Formation Following Modified Radical Mastectomy

Outcome	Frequency (n)	Percentage (%)
Seroma Present	17	34.0
Seroma Absent	33	66.0
Total	50	100.0

Similarly, diabetes mellitus was significantly associated with seroma formation, with 56.3% of diabetic patients developing seroma compared with 23.5% of non-diabetic patients ($p = 0.021$).

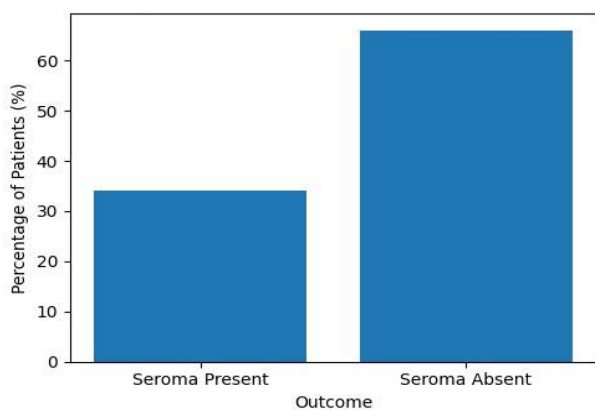
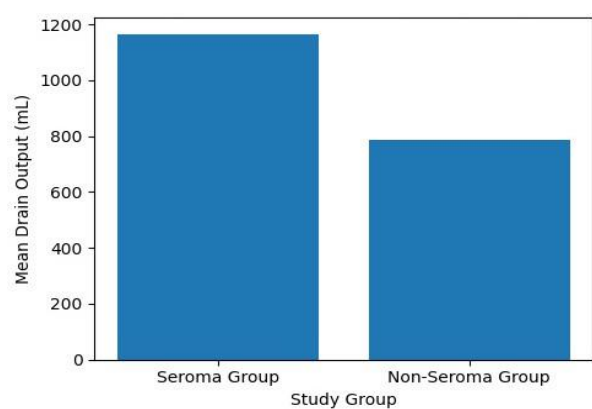
Neoadjuvant chemotherapy was also significantly associated with postoperative seroma (55.6% vs. 21.9%; $p = 0.034$). No significant association was observed for hypertension ($p = 0.498$) or smoking status ($p = 0.318$).

Table 3 demonstrates that obesity, diabetes mellitus, and neoadjuvant chemotherapy were significantly associated with seroma formation.

Table 3: Association of Demographic and Clinical Factors with Seroma Formation

Variable	Seroma (n=17)	No Seroma (n=33)	p-value
Age ≥ 50 years	12 (70.6%)	20 (60.6%)	0.214
BMI ≥ 25 kg/m ²	14 (82.4%)	16 (48.5%)	0.012*
Diabetes Mellitus	9 (52.9%)	7 (21.2%)	0.021*
Hypertension	8 (47.1%)	11 (33.3%)	0.498
Smoking	4 (23.5%)	4 (12.1%)	0.318
Neoadjuvant Chemotherapy	10 (58.8%)	8 (24.2%)	0.034*

*Statistically significant (p<0.05)

**Figure 1:** Distribution of Patients According to Seroma Formation**Figure 2:** Comparison of mean drain output between study groups drain output (mL)

Operative and Postoperative Factors Associated with Seroma Formation

Comparison of operative variables between patients with and without seroma is shown in Table 4.

The mean duration of surgery was significantly longer in the seroma group (134.8 ± 22.1 minutes) compared with the non-seroma group (119.5 ± 18.4 minutes) ($p=0.017$).

The mean cumulative drain output was significantly higher among patients who developed seroma (1165 ± 235 mL) than among those who did not (785 ± 192 mL) ($p=0.001$).

Similarly, drain duration was significantly prolonged in the seroma group (9.8 ± 2.3 days) compared with the non-seroma group (7.1 ± 1.8 days) ($p=0.006$).

The differences in mean drain output between the two groups are illustrated in Figure 2.

Figure 2 demonstrates substantially higher postoperative drain output among patients who developed seroma.

Tumor Characteristics and Seroma Formation

The incidence of seroma increased with advancing tumor stage. Patients with Stage III disease showed the highest

Table 4: Comparison of Operative Variables Between Study Groups

Variable	Seroma Group (n=17)	Non-Seroma Group (n=33)	p-value
Duration of Surgery (minutes)	134.8 ± 22.1	119.5 ± 18.4	0.017*
Drain Output (mL)	1165 ± 235	785 ± 192	0.001*
Drain Duration (days)	9.8 ± 2.3	7.1 ± 1.8	0.006*

*Statistically significant (p<0.05)

Table 5: Association between tumor stage and seroma formation

Tumor stage	Total patients	Seroma n (%)	No Seroma n (%)
Stage I	7	1 (14.3)	6 (85.7)
Stage II	24	7 (29.2)	17 (70.8)
Stage III	19	9 (47.4)	10 (52.6)

$$\chi^2 = 4.89, p = 0.087$$

Table 6: Multivariate logistic regression analysis of independent predictors of seroma formation

Variable	Odds Ratio (OR)	95% CI	p-value
BMI ≥ 25 kg/m ²	3.84	1.22–12.11	0.018*
Diabetes mellitus	3.12	1.01–9.65	0.041*
Neoadjuvant chemotherapy	2.74	0.92–8.15	0.067
Drain output >1000 mL	4.57	1.43–14.58	0.009*

*Statistically significant (p<0.05)

frequency of seroma formation (50.0%), whereas Stage I patients exhibited the lowest incidence (14.3%) (Table 5). However, the association did not reach statistical significance (p=0.087).

Table 5 indicates a trend toward increasing seroma frequency with advanced disease stage.

Multivariate Logistic Regression Analysis

Variables demonstrating significance on univariate analysis were entered into a multivariate logistic regression model. The results are presented in Table 6.

BMI ≥ 25 kg/m² remained an independent predictor of seroma formation (OR=3.84, 95% CI: 1.22–12.11; p=0.018). Diabetes mellitus was associated with a threefold increase in seroma risk (OR=3.12, 95% CI: 1.01–9.65; p=0.041).

The strongest predictor identified was cumulative drain output >1000 mL, which increased the odds of seroma formation by approximately 4.6 times (OR=4.57, 95% CI: 1.43–14.58; p=0.009).

Table 6 demonstrates that obesity, diabetes mellitus, and increased postoperative drain output were independent predictors of seroma formation.

Summary of Major Findings

The major findings of the present study are summarized in Figure 3.

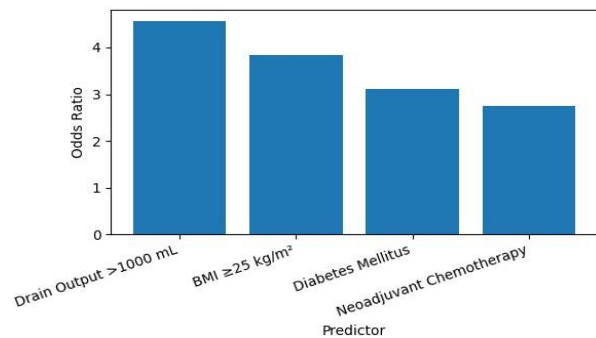
**Figure 3:** Significant predictors of seroma formation

Figure 3 highlights the relative contribution of major risk factors identified through multivariate analysis.

Overall, the study demonstrated an incidence of seroma formation of 34.0%, with obesity, diabetes mellitus, neoadjuvant chemotherapy, prolonged drain duration, and high postoperative drain output emerging as important risk factors. Among these variables, obesity, diabetes mellitus, and drain output >1000 mL were identified as independent predictors of postoperative seroma formation following modified radical mastectomy.

DISCUSSION

The present study demonstrated an overall seroma incidence of 34.0% following modified radical mastectomy. This finding is consistent with the observations of Kuroi et al., who reported that seroma remains the most common complication following breast surgery and continues to represent a significant postoperative challenge despite advances in surgical techniques[14].

Increasing age was associated with a higher frequency of seroma formation in the present study, although the association was not statistically significant. Similar findings were reported by Hashemi et al., who observed that age alone may not independently predict postoperative seroma after adjustment for other clinical variables[15].

Obesity emerged as one of the strongest predictors of seroma formation in our study. Patients with elevated BMI experienced significantly higher rates of postoperative seroma. This observation is consistent with the findings of Agrawal et al. and Gonzalez et al., who demonstrated a significant association between obesity and seroma development after breast cancer surgery[16,17]. Increased adipose tissue may contribute to larger dead spaces, greater tissue trauma during surgery, and impaired adherence of skin flaps to the underlying chest wall.

Diabetes mellitus was also significantly associated with seroma formation. Similar findings have been reported by Kumar et al., who suggested that impaired wound healing, microvascular dysfunction, and chronic inflammatory changes associated with diabetes contribute to postoperative fluid accumulation[18].

Neoadjuvant chemotherapy demonstrated a significant association with seroma formation in the present study. Classe et al. similarly reported increased postoperative complications among patients receiving preoperative systemic therapy, likely due to treatment-related alterations in tissue healing and lymphatic regeneration[19].

The duration of surgery was significantly greater among patients who developed seroma. Prolonged operative time may indicate more extensive dissection and greater tissue manipulation, thereby increasing lymphatic disruption and inflammatory exudation. Similar observations have been reported by Almond et al[20].

Postoperative drain output was significantly higher among patients who developed seroma. Petrek et al. reported that excessive drainage reflects extensive lymphatic injury and serves as an important predictor of subsequent seroma formation[21]. Likewise, Vinton et al. demonstrated a positive correlation between drainage volume and postoperative fluid collection[22].

Drain duration was also significantly prolonged in the seroma group. Kuroi et al. suggested that prolonged drainage often reflects persistent lymphatic leakage rather than providing complete protection against seroma formation[23].

Multivariate analysis identified obesity, diabetes mellitus, and high drain output as independent predictors of seroma formation. These findings reinforce the multifactorial etiology of seroma and emphasize the importance of perioperative risk stratification.

Various preventive measures have been evaluated in the literature. Van Bommel et al., in a systematic review, concluded that flap fixation techniques significantly reduce seroma incidence by minimizing dead space formation.²⁴ Similarly, Srivastava et al. demonstrated that quilting sutures decrease drainage volume and reduce the requirement for postoperative aspirations[24-25].

The clinical implications of seroma formation extend beyond patient discomfort and include increased healthcare utilization, delayed wound healing, risk of infection, and postponement of adjuvant therapy. Early identification of high-risk patients and implementation of targeted preventive strategies may therefore improve postoperative outcomes.

The present study has limitations including its relatively small sample size and single-center design.

Nevertheless, the prospective methodology and comprehensive assessment of multiple risk factors provide valuable insight into predictors of seroma formation following modified radical mastectomy.

CONCLUSION

Seroma formation remains a common postoperative complication following modified radical mastectomy, occurring in approximately one-third of patients. Obesity, diabetes mellitus, neoadjuvant chemotherapy, prolonged drainage duration, and high postoperative drain output significantly increase the risk of seroma formation. Identification of high-risk patients and implementation of targeted preventive strategies may reduce postoperative morbidity and improve surgical outcomes.

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