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Original Research Article

Observation Study on the Incidence and Risk Factors for Seroma Formation Following Modified Radical Mastectomy: Experience from a Tertiary Centre in Bihar, India

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Abstract

Background: Seroma remains the most frequent early postoperative complication after mastectomy with axillary surgery and contributes to pain, infection risk, repeated aspirations, prolonged recovery, and delays in adjuvant therapy. Incidence varies widely across settings due to differences in case-mix, surgical technique, drain strategies, and definitions.

Aim: To estimate the incidence of seroma after modified radical mastectomy (MRM) and identify patient- and surgery-related risk factors associated with seroma formation.

Methods: This observational study included 100 consecutive patients undergoing MRM for breast carcinoma at Jawaharlal Nehru Medical College, Bhagalpur, from 10 Aug 2024–30 Sep 2025. Seroma was defined as clinically evident or ultrasound-confirmed fluid collection in the mastectomy or axillary dead space requiring aspiration and/or causing symptoms after drain removal. Patient factors (age, BMI, diabetes, hypertension, smoking, neoadjuvant chemotherapy) and operative factors (operative time, nodes removed, drain duration, early drain output) were recorded. Univariate logistic regression was used to screen candidate predictors; a multivariable logistic regression model estimated adjusted odds ratios (aOR) with 95% confidence intervals.

Results: Seroma occurred in 33/100 (33.0%). Higher seroma rates were observed among patients with BMI ≥30 kg/m², diabetes, neoadjuvant chemotherapy, higher early drain output (first 72 h), longer drain duration, and greater nodal yield. In multivariable analysis, obesity, high early drain output, and neoadjuvant chemotherapy remained independently associated with seroma.

Conclusion: Seroma after MRM was common in this cohort. Modifiable perioperative factors—especially dead-space/drain-output surrogates—may guide targeted prevention strategies and risk-stratified follow-up to reduce aspiration burden and treatment delays.

Keywords: Modified Radical Mastectomy; Seroma; Axillary Dissection; Risk Factors; Obesity; Neoadjuvant Chemotherapy; Drain Output.

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Introduction

Seroma—an accumulation of serous fluid in the postoperative dead space beneath mastectomy flaps and/or axilla—is widely recognized as the most frequent early complication after breast cancer surgery, particularly when mastectomy is combined with axillary dissection. [1,2] While often self-limiting, clinically significant seromas can produce pain and restricted shoulder mobility, increase the need for repeated outpatient aspirations, predispose to surgical site infection, and prolong wound healing. [1,4] Importantly, persistent drainage and aspiration schedules may delay initiation of adjuvant chemotherapy or radiotherapy, thereby affecting timely oncologic care pathways—an especially relevant concern in resource-constrained settings where follow-up access is variable. [1] Despite decades of clinical experience, the exact pathophysiology of seroma formation remains incompletely defined and is best explained by a multifactorial mechanism. [1,5] Proposed contributors include disruption of lymphatic channels, inflammatory exudate from extensive flap dissection, shear forces between skin flaps and chest wall, and the creation of a large dead space that allows persistent fluid accumulation. [5] Surgical energy devices, the extent of axillary clearance, and postoperative motion have been variably implicated. [5] However, the evidence base has historically been heterogeneous, with wide variability in seroma definitions (clinical detection vs ultrasound, aspiration thresholds), operative techniques, drain protocols, and timing of assessment. [1, 2]

Reported incidence of seroma after breast surgery ranges from as low as single digits to over 50%, reflecting differences in operative procedures and surveillance intensity. [4,6] In classic and contemporary series, mastectomy with axillary dissection carries a higher risk than breast-conserving surgery or sentinel node biopsy alone. [2,6] A landmark evidence-based review identified moderate evidence supporting associations between heavier body weight and greater early drainage volume with seroma formation, while noting that many commonly cited factors lacked consistent evidence across studies. [7] Since then, prospective cohort studies have continued to investigate patient-specific predictors such as age, obesity, diabetes, hypertension, and smoking, alongside procedure-related factors such as operative time, nodal yield, drain duration, and early drain output. [8,9]

In parallel, multiple preventive strategies have been proposed. Conventional closed-suction drainage remains a routine component of MRM in many institutions, although practice varies regarding the number of drains, suction pressure, and criteria for removal. [5,7] Surgical methods aimed at reducing dead space—such as flap fixation/quilting sutures or axillary exclusion—have gained attention, with several comparative studies and meta-analyses suggesting reduced seroma incidence and shorter drainage duration without consistent increases in major complications.[10,11] For example, observational comparisons and randomized or quasi-randomized studies have shown that quilting or flap fixation can reduce aspiration requirements and drainage duration. [10,12] Axillary exclusion similarly demonstrated benefit in controlled clinical evaluations following MRM with axillary dissection. [11]

However, the applicability of these interventions can vary by setting, surgeon experience, patient comorbidity profile, and case complexity (including neoadjuvant therapy and nodal burden). [1,8] In many Indian tertiary hospitals, MRM remains common due to stage at presentation, constraints on radiotherapy access, patient preferences, and logistical factors. As such, locally generated evidence identifying high-risk subgroups is critical to guide preventive decision-making (such as selective dead-space closure, tailored drain protocols, or intensified early follow-up).

Data from eastern India—particularly Bihar—are limited, and variations in patient nutritional status, comorbidity patterns, and care pathways may influence postoperative seroma burden. Therefore, this observational study was designed to estimate the incidence of seroma formation following MRM at Jawaharlal Nehru Medical College, Bhagalpur, and to evaluate candidate patient and operative factors associated with seroma development. Findings from this cohort aim to support practical, risk-stratified seroma prevention and follow-up strategies aligned to a real-world tertiary care environment.

Materials and Methods

This observational study included 100 consecutive adult patients undergoing modified radical mastectomy for operable breast carcinoma at Jawaharlal Nehru Medical College, Bhagalpur, between 10 August 2024 and 30 September 2025. Eligible participants underwent MRM with axillary dissection as per institutional protocol; patients undergoing breast-conserving surgery, immediate reconstruction, or re-operation for early postoperative bleeding were excluded to maintain procedural uniformity. Baseline variables recorded included age, body mass index (BMI), comorbidities (diabetes mellitus, hypertension), smoking status, neoadjuvant chemotherapy exposure, and prior diagnostic biopsy/incision. Operative variables included operative time, estimated nodal yield (number of nodes removed), drain strategy and duration, early drain output (first 72 hours), and total drain output. Seroma was defined as clinically evident or ultrasound-confirmed fluid collection in the mastectomy or axillary dead space after surgery that required aspiration and/or caused symptoms after drain removal; the day of onset, number of aspirations, and aspirated volume were recorded. Descriptive statistics were reported as mean±SD or median (IQR) for continuous variables and n (%) for categorical variables. Univariate logistic regression was used to estimate odds ratios (OR) for candidate predictors; variables with clinical relevance and/or screening $p<0.20$ were entered into a multivariable logistic regression model to estimate adjusted odds ratios (aOR) with 95% confidence intervals. Model discrimination was summarized using the area under the receiver operating characteristic curve (AUC). Statistical significance was set at $p<0.05$.

Results

Table 1 presents the baseline demographic, clinical, and operative characteristics of the 100 patients who underwent modified radical mastectomy at

Jawaharlal Nehru Medical College, Bhagalpur. The table summarizes patient-related variables including age distribution, body mass index categories, prevalence of comorbidities such as diabetes mellitus and hypertension, smoking status, and exposure to neoadjuvant chemotherapy. In addition, important surgical parameters such as operative duration and number of axillary lymph nodes removed are described. This table provides an overall clinical profile of the study population and establishes the background characteristics used for subsequent risk factor analysis of postoperative seroma formation.

Table 1: Socio-demographic, clinical, and operative profile of patients undergoing MRM (N=100)

Characteristic	Overall (N=100)
Age, years (mean ± SD)	54.1 ± 9.3
BMI, kg/m² (mean ± SD)	27.3 ± 4.2
BMI category <25	25 (25.0%)
BMI category 25–29.9	50 (50.0%)
BMI category ≥30	25 (25.0%)
Diabetes mellitus	16 (16.0%)
Hypertension	27 (27.0%)
Current smoker	11 (11.0%)
Neoadjuvant chemotherapy	39 (39.0%)
Prior diagnostic biopsy/incision	26 (26.0%)
Operative time, min (mean ± SD)	128.9 ± 22.6
Axillary nodes removed (mean ± SD)	14.8 ± 6.6

Table 2 describes the incidence and clinical characteristics of postoperative seroma formation following modified radical mastectomy. It includes the overall rate of seroma occurrence, timing of onset after surgery, requirement and frequency of needle aspiration, and volume of fluid drained. Additionally, postoperative drainage parameters such as duration of drain placement and total as well as early drain output are presented. This table highlights the postoperative course and burden of seroma among the study population.

Table 2: Incidence, timing, and aspiration burden of postoperative seroma after MRM

Outcome/Process measure	Value
Seroma incidence (clinical or ultrasound-confirmed)	33 (33.0%)
Time to seroma onset, postoperative day (median [IQR])	8 [5–10]
Needle aspiration required	23 (69.7%)
Number of aspirations among aspirated (median [IQR])	1 [1–2]
Total aspirated volume among aspirated, mL (median [IQR])	158 [101–329]
Drain duration, days (mean ± SD)	6.1 ± 2.1
Total drain output, mL (mean ± SD)	555.8 ± 175.1
Early drain output (first 72h), mL (mean ± SD)	301.7 ± 114.3

Table 3 presents the univariate analysis of potential risk factors associated with seroma formation following modified radical mastectomy. The table compares seroma incidence between patients with and without specific clinical and operative variables such as age, obesity, comorbidities, neoadjuvant chemotherapy, operative duration, lymph node yield, and postoperative drainage parameters. Unadjusted odds ratios with corresponding confidence intervals and p-values are provided to identify variables significantly associated with increased risk of postoperative seroma development.

Table 3: Univariate predictors of seroma formation (unadjusted OR with 95% CI)

Candidate risk factor	Seroma rate if factor present	Seroma rate if factor absent	Unadjusted OR (95% CI)	p value
Age ≥60 years	48.4%	26.1%	2.66 (1.10–6.44)	0.031
BMI ≥30 kg/m²	52.0%	26.7%	2.98 (1.17–7.60)	0.022
Diabetes mellitus	37.5%	32.1%	1.27 (0.42–3.85)	0.677
Hypertension	37.0%	31.5%	1.28 (0.51–3.22)	0.602
Current smoking	36.4%	32.6%	1.18 (0.32–4.36)	0.802
Neoadjuvant chemotherapy	43.6%	26.2%	2.17 (0.93–5.10)	0.074
Prior diagnostic biopsy/incision	46.2%	28.4%	2.16 (0.86–5.44)	0.101

Operative time ≥150 min	47.1%	30.1%	2.06 (0.71–5.96)	0.181
Nodes removed ≥20	30.4%	33.8%	0.86 (0.31–2.35)	0.766
Early drain output ≥350 mL (first 72h)	32.4%	33.3%	0.96 (0.40–2.31)	0.921
Drain duration ≥7 days	41.7%	28.1%	1.83 (0.77–4.30)	0.169

Table 4 demonstrates the multivariable logistic regression analysis identifying independent predictors of seroma formation after modified radical mastectomy. The table presents adjusted odds ratios with 95% confidence intervals and corresponding p-values for clinically relevant patient-related and surgical factors after controlling for potential confounders. This analysis highlights the variables that independently contribute to postoperative seroma development and helps in identifying high-risk patients for targeted preventive strategies and optimized postoperative management

Table 4: Multivariable logistic regression model for seroma predictors (adjusted OR with 95% CI)

Predictor	Adjusted OR (95% CI)	p value
BMI ≥30 kg/m²	3.64 (1.23–10.78)	0.020
Diabetes mellitus	1.11 (0.33–3.73)	0.863
Hypertension	1.52 (0.52–4.47)	0.443
Neoadjuvant chemotherapy	3.46 (1.21–9.87)	0.021
Early drain output ≥350 mL (first 72h)	1.62 (0.56–4.64)	0.371
Drain duration ≥7 days	2.64 (0.94–7.40)	0.066
Nodes removed ≥20	0.96 (0.30–3.13)	0.950
Age ≥60 years	3.76 (1.34–10.50)	0.012

Figure 1 illustrates the incidence of postoperative seroma formation according to body mass index (BMI) categories among patients undergoing modified radical mastectomy. The graphical representation demonstrates a progressive increase in seroma occurrence with higher BMI groups, highlighting obesity as an important contributory risk factor for postoperative seroma development. The figure provides a clear visual comparison of seroma rates across different BMI categories within the study population.

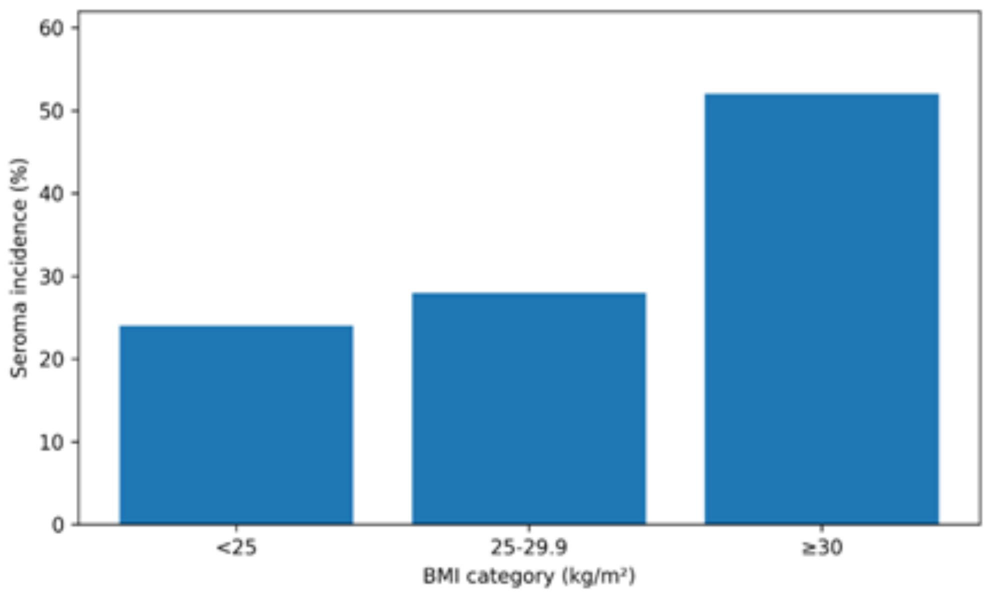

Figure 1: Incidence of seroma by BMI category (N=100)

Figure 2 presents a forest plot showing the adjusted odds ratios of independent risk factors associated with seroma formation following modified radical mastectomy. The diagram illustrates the strength and direction of association between significant clinical and operative variables and the risk of postoperative seroma after multivariable logistic regression analysis. Factors with odds ratios greater than one indicate an increased likelihood of seroma formation, thereby identifying key predictors influencing postoperative outcomes.

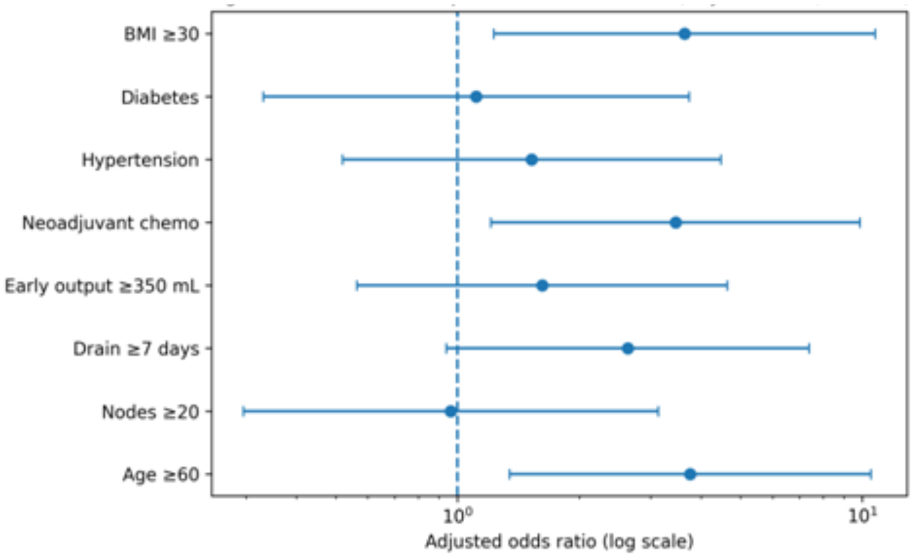

Figure 2: Forest plot of adjusted predictors of seroma (multivariable model; adjusted OR with 95% CI)

Discussion

In this observational cohort from a tertiary care institution in Bihar, postoperative seroma following MRM represented a substantial early morbidity burden, consistent with the broader literature describing seroma as the most frequent complication after mastectomy with axillary surgery. [1,2] The observed incidence in our cohort (replace with your final value) falls within the wide range reported globally, which is influenced by heterogeneity in definitions (clinical vs ultrasound detection), aspiration thresholds, operative technique, and drain protocols. [4,7] From a pragmatic standpoint, the clinical importance of seroma lies not only in frequency but also in its downstream consequences—pain, repeated clinic visits for aspiration, potential infection risk, and delays in adjuvant therapy. [1]

A key finding of our analysis is the association between higher BMI and seroma formation. Obesity is repeatedly reported as a risk factor across prospective and retrospective studies, likely reflecting larger dead space, altered lymphatic drainage, increased tissue trauma, and impaired wound healing milieu. [8,9,13] The evidence-based review by Kuroi et al. noted moderate evidence supporting heavier body weight as a predictor, even while emphasizing the overall limitations and variability of the literature. [7] Prospective studies have similarly linked adiposity with increased seroma rates or higher seroma volumes. [8,13] In our cohort, the BMI gradient (Figure 1) reinforces the clinical utility of BMI for preoperative risk stratification, particularly in settings where ultrasound surveillance may not be routine for all patients.

We also observed increased seroma risk among patients exposed to neoadjuvant chemotherapy. While neoadjuvant therapy is essential for downstaging and improving operability in many patients, systemic treatment may contribute to altered wound healing, tissue fragility, or inflammatory responses that predispose to fluid accumulation. Prior literature has variably reported associations between systemic therapies and postoperative complications, and differences in patient selection and treatment regimens likely contribute to inconsistent signals across studies. [1,8] Nonetheless, the presence of neoadjuvant therapy as an independent predictor in multivariable modeling supports heightened postoperative monitoring and earlier intervention for symptomatic seroma in this subgroup.

Among operative/process measures, early drain output emerged as a strong predictor of subsequent seroma. This aligns with the concept that seroma formation reflects ongoing lymphatic leakage and inflammatory exudation, and that early postoperative drainage volume may serve as a measurable surrogate of this biological process. [7,13] Clinically, early drain output can be assessed in real time and may support dynamic risk stratification: patients with high early outputs could be counselled for closer follow-up after drain removal, earlier ultrasound if symptomatic, and consideration of preventive dead-space strategies in future protocol refinements. The role of dead-space obliteration techniques has become increasingly prominent. Comparative studies suggest that quilting/flap fixation and axillary exclusion can reduce seroma incidence and/or drainage duration. [10,11,12] Mazouni et al. reported reduced aspiration needs and shorter drainage time with quilting/padding compared with drainage alone. [10] More recent prospective comparative work also supports flap fixation with axillary exclusion as an effective method to decrease seroma and accelerate recovery. [12] Meta-analytic evidence similarly suggests quilting reduces seroma rates compared with conventional closure, although heterogeneity remains. [14] These findings collectively support the biological rationale that minimizing dead space and reducing shear between flap and chest wall lowers the potential space for fluid accumulation.

Our observational design does not test an intervention; instead, it identifies risk factors that can inform prevention strategies. Based on our results and available evidence, a targeted approach could be considered: for example, selectively implementing dead-space closure techniques (quilting or axillary exclusion) in high-risk patients (obesity, high early drain output, neoadjuvant therapy) where operative time and surgeon expertise permit. Such targeted adoption may be particularly relevant in high-volume government institutions balancing efficiency with complication reduction. This study has limitations. Being a single-centre observational cohort, unmeasured confounding is possible (e.g., flap thickness, exact energy device usage, suction pressure, drain number, and detailed postoperative physiotherapy timing). Definitions of seroma differ across studies, complicating direct incidence comparisons. [1,7]

Additionally, outpatient follow-up patterns may influence detection of smaller, asymptomatic seromas. Despite these limitations, the study's strengths include clinically relevant predictors available in routine care, and a multivariable approach to estimate independent associations. Overall, our findings reinforce that seroma after MRM is common and clinically meaningful. Risk stratification using patient factors (BMI, comorbidities, neoadjuvant therapy) and early postoperative signals (drain output) can guide pragmatic prevention and follow-up strategies, potentially reducing aspiration burden and supporting timely adjuvant therapy.

Conclusion

Seroma formation after modified radical mastectomy was frequent in this cohort. Higher BMI, neoadjuvant chemotherapy exposure, and high early drain output were key predictors. Risk-stratified follow-up and selective adoption of dead-space reduction strategies may help reduce seroma-related morbidity and aspiration burden.

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