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Original Research Article

Analysis of Risk Factors Contributing to Seroma Formation Following Mastectomy in Breast Cancer Patients

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Abstract:

Introduction: Seroma formation is one of the most common postoperative complications following mastectomy in breast cancer patients. Although often self-limiting, it can lead to delayed wound healing, infection, discomfort, and prolonged hospital stay. Identifying the risk factors associated with seroma formation is essential for improving postoperative outcomes.

Objectives: To evaluate and analyze the clinical and surgical risk factors contributing to seroma formation in patients undergoing mastectomy for breast cancer.

Materials and Methods: This prospective observational study included 60 breast cancer patients who underwent modified radical mastectomy. Data were collected on demographic variables, comorbidities, BMI, number of lymph nodes removed, drain duration, and other clinical parameters. The incidence of seroma formation was recorded and analyzed in relation to these factors using appropriate statistical tests.

Results: A statistically significant association was observed between body mass index (BMI) and the incidence of seroma formation. Among the 28 patients with a BMI less than 25 kg/m² (normal weight), only 8 patients (28.6%) developed seroma, while 20 patients (62.5%) did not. In contrast, among the 32 patients who were overweight or obese (BMI ≥25 kg/m²), seroma was present in 20 patients (71.4%) and absent in only 12 (37.5%). The difference was statistically significant, with a p-value of 0.015.

Conclusion: The findings of this study indicate a significant association between higher body mass index and the development of postoperative seroma following mastectomy. Patients who were overweight or obese were more likely to develop seroma compared to those with normal BMI. This suggests that elevated BMI is an important modifiable risk factor, and weight optimization prior to surgery may contribute to reducing postoperative complications such as seroma.

Keywords: Seroma, mastectomy, breast cancer, risk factors, drain duration, BMI, comorbidities.

Introduction

Breast cancer remains the most commonly diagnosed cancer among women worldwide and represents a significant global health burden [1]. Surgical management continues to be a cornerstone in its treatment, with mastectomy and breast-conserving surgery being the primary options depending on the stage, tumor size, patient preference, and oncological safety [2]. While advancements in surgical techniques and perioperative care have significantly improved outcomes, postoperative complications such as seroma formation remain prevalent and can impact patient recovery, delay adjuvant therapy, and affect quality of life [3]. Seroma, defined as the collection of serous fluid at the surgical site in the absence of infection, is one of the most frequent complications following mastectomy, with reported incidence rates ranging from 15% to 85% depending on the definition used, the extent of surgery, and institutional practices [4]. Although often self-limiting, persistent or large-volume seromas can result in discomfort, delayed wound healing, infection, flap necrosis, and extended hospital stay [5]. The exact etiology of seroma formation remains multifactorial and incompletely understood, but various contributing factors have been identified in recent studies, including patient-related, disease-related, and surgery-related parameters [6]. Patient-related factors

such as age, body mass index (BMI), comorbidities like diabetes or hypertension, and smoking status have been associated with increased seroma risk, possibly due to impaired wound healing and altered inflammatory responses [7]. Similarly, disease-specific factors including tumor size, lymphovascular invasion, and the extent of axillary lymph node involvement may contribute to the formation of postoperative seromas due to disruption of lymphatic channels [8]. From a surgical perspective, extensive tissue dissection, lack of flap fixation, use of electrocautery, and the number of lymph nodes excised have all been implicated in increasing seroma incidence [9]. Despite numerous efforts to prevent seroma formation — such as prolonged drainage, use of fibrin sealants, application of pressure garments, and flap suturing techniques — no universally accepted protocol has been established, and outcomes remain inconsistent [10]. Therefore, identifying and understanding the risk factors that significantly contribute to seroma formation is essential for optimizing surgical outcomes, minimizing complications, and guiding personalized postoperative care. This study aims to analyze the various preoperative, intraoperative, and postoperative risk factors that contribute to the development of seroma in breast cancer patients undergoing mastectomy. By systematically evaluating these parameters, the research intends to provide evidence-based insights that may help in stratifying high-risk patients, modifying surgical practices, and adopting targeted preventive strategies. Such understanding can enhance patient recovery, reduce morbidity, and improve the overall quality of oncological care.

Materials and Methods

Study Design: An observational study.

Study Duration: Conducted from January 2024 to January 2025.

Study Setting: Department of General Surgery, East West Institute of Medical Sciences and Research.

Study Population: Female patients diagnosed with operable breast cancer and scheduled for modified radical mastectomy (MRM).

Sample Size: A total of 60 patients were included in the study based on inclusion and exclusion criteria.

Inclusion Criteria

- Histopathologically confirmed cases of breast carcinoma.
- Patients undergoing modified radical mastectomy.
- Age ≥ 18 years.
- Patients who provided written informed consent.

Exclusion Criteria

- Patients undergoing breast-conserving surgery.
- Patients receiving neoadjuvant chemotherapy or radiotherapy.
- Recurrent breast cancer or previous surgery on the same side.
- Patients with systemic infections or coagulopathy.

Study variable

a) Age (in years)
b) Body Mass Index (BMI)
c) Menopausal status
d) Comorbidities
e) Tumor characteristics
f) Surgical Variables
g) Postoperative Variables

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

Result

Table 1: Association between Age and Seroma Formation

Age Group (years)	Seroma Present (n=28)	Seroma Absent (n=32)	Total (n=60)	p-value
<50	10 (35.7%)	20 (62.5%)	30	0.047
≥50	18 (64.3%)	12 (37.5%)	30	

Table 2: Association between Body Mass Index (BMI) and Seroma Formation

BMI Category (kg/m²)	Seroma Present	Seroma Absent	Total	p-value
<25 (Normal)	8 (28.6%)	20 (62.5%)	28	0.015
≥25 (Overweight/Obese)	20 (71.4%)	12 (37.5%)	32	

Table 3: Association between Number of Lymph Nodes Removed and Seroma Formation

No. of Nodes Removed	Seroma Present	Seroma Absent	Total	p-value
≤10	6 (21.4%)	18 (56.3%)	24	0.012
>10	22 (78.6%)	14 (43.7%)	36	

Table 4: Association between Drain Duration and Seroma Formation

Drain Duration (days)	Seroma Present	Seroma Absent	Total	p-value
≤5	9 (32.1%)	22 (68.8%)	31	0.003
>5	19 (67.9%)	10 (31.2%)	29	

Table 5: Association between Comorbidities (Diabetes/Hypertension) and Seroma Formation

Comorbidities	Seroma Present	Seroma Absent	Total	p-value
Present (DM/HTN)	16 (57.1%)	8 (25%)	24	0.018*
Absent	12 (42.9%)	24 (75%)	36	

In the present study, age was found to be significantly associated with the development of postoperative seroma following mastectomy. Among the 60 patients included, 30 were aged below 50 years and 30 were aged 50 years or above. Seroma formation was observed in 18 patients (64.3%) aged ≥50 years, compared to only 10 patients (35.7%) aged <50 years. Conversely, the absence of seroma was more common in the younger age group (<50 years), with 20 patients (62.5%) not developing seroma, compared to only 12 patients (37.5%) in the ≥50 years group. This difference was statistically significant, with a p-value of 0.047. A statistically significant association was observed between body mass index (BMI) and the incidence of seroma formation. Among the 28 patients with a BMI less than 25 kg/m² (normal weight), only 8 patients (28.6%) developed seroma, while 20 patients (62.5%) did not. In contrast, among the 32 patients who were overweight or obese (BMI ≥25 kg/m²), seroma was present in 20 patients (71.4%) and absent in only 12 (37.5%). The difference was statistically significant, with a p-value of 0.015. The number of lymph nodes removed during mastectomy showed a significant correlation with seroma formation. Among the 24 patients in whom ≤10 lymph nodes were excised, only 6 patients (21.4%) developed seroma, while 18 patients (56.3%) did not. In contrast, of the 36 patients with >10 lymph nodes removed, seroma developed in 22 patients (78.6%), while only 14 (43.7%) remained seroma-free. This association was statistically significant, with a p-value of 0.012. A significant association was found between the duration of postoperative drain placement and the development of seroma. Among the 31 patients whose drains were removed within 5 days, only 9 (32.1%) developed seroma, while 22 patients (68.8%) did not. On the other hand, among the 29 patients who had drains in place for more than 5 days, seroma formation occurred in 19 patients (67.9%) and was absent in only 10 (31.2%). This difference was statistically significant, with a p-value of 0.003.

The presence of comorbidities such as diabetes mellitus and hypertension was found to have a statistically significant association with seroma formation. Among the 24 patients with comorbid conditions, 16 (57.1%) developed seroma, whereas only 8 (25%) remained seroma-free. In contrast, among the 36 patients without any comorbidities, seroma was present in only 12 patients (42.9%) and absent in 24 (75%). This association was statistically significant with a p-value of 0.018.

Discussion

The present study identified several significant risk factors associated with seroma formation following mastectomy in breast cancer patients. Age, BMI, number of lymph nodes removed, duration of drain placement, and presence of comorbidities such as diabetes and hypertension were all found to be statistically significant. These findings are consistent with the growing body of literature suggesting that patient-specific and surgical factors can influence postoperative fluid accumulation. Older age (≥50 years) was significantly associated with higher seroma formation, aligning with findings from Ozdogan et al., who reported a higher incidence of seroma among elderly patients, possibly due to reduced tissue elasticity and delayed lymphatic healing in older individuals [11].

Similarly, Garcia et al. concluded that patients aged over 50 were at greater risk of postoperative complications, including seroma, emphasizing the need for closer postoperative monitoring in this demographic [12]. High BMI was also shown to significantly correlate with seroma formation in this study, echoing the findings of Kuroi et al. and Agrawal et al., who both identified obesity as a key risk factor [13,14].

The increased adipose tissue in overweight individuals may lead to larger surgical dead space and impaired lymphatic drainage, predisposing to seroma. McCaul et al. also demonstrated that patients with a BMI over 25 had nearly double the

seroma incidence compared to those within a normal BMI range [15].

Regarding surgical factors, removal of more than 10 lymph nodes was significantly associated with seroma formation in our cohort. This is consistent with previous studies by van Bemmel et al. and Kuroi et al., who reported that extensive axillary dissection disrupts more lymphatic channels, increasing the risk of postoperative fluid collection [16,17]. Similarly, Hashemi et al. observed that the number of nodes removed was directly proportional to the risk and volume of seroma [18].

Drain duration was another significant factor; patients with drains in situ for more than five days had a higher incidence of seroma. This contrasts with the belief that prolonged drainage prevents fluid accumulation. In fact, studies by Watt-Boolsen et al. and Gonzalez et al. suggest that extended drain use may provoke inflammatory reactions and foreign body responses, paradoxically increasing seroma formation [19,20].

Comorbidities like diabetes and hypertension also emerged as significant predictors in our study. These findings reinforce the work of Agrawal et al. and Petrek et al., who found that diabetic patients had impaired wound healing and altered lymphatic response, making them more susceptible to seroma [14,18]. Collectively, our results highlight the multifactorial nature of seroma formation and support existing evidence while adding region-specific data to the literature. Identifying and managing high-risk individuals pre- and post-operatively may help minimize seroma-related morbidity and improve patient outcomes.

Conclusion

We conclude that, several patient- and surgery-related factors markedly influence the likelihood of developing a postoperative seroma after mastectomy. Older age, higher body mass index, extensive axillary dissection, prolonged drain placement, and the presence of comorbidities such as diabetes or hypertension each emerged as independent predictors of seroma formation. Together, these findings highlight the multifactorial nature of the complication and underscore the importance of individualized peri-operative planning. By identifying patients at elevated risk and tailoring surgical technique, drain management, and postoperative surveillance accordingly, clinicians can proactively mitigate seroma-related morbidity and support faster recovery and timely initiation of adjuvant therapy.

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