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ORIGINAL ARTICLE

Impact of Specimen Weight and Body Mass Index on Surgical Site Infection following Mastectomy in a South Indian Tertiary Care Center

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Abstract

Background: A major post-operative complication that is associated with significant morbidity and increased health care costs is surgical site infection (SSI). Though Mastectomy is classified as a clean surgical procedure, done under strict asepsis, SSI still continues to occur and may delay recovery and start of adjuvant therapy. This study aims to determine the incidence of SSI following mastectomy and to identify associated risk factors. **Materials and Methods:** This prospective observational study was done in a tertiary care teaching hospital in Tamilnadu and included 149 females, who were above 18 years and underwent simple, modified radical, or radical mastectomy. The study was done over a period of two years. Immunocompromised patients or patients under prior chemotherapy were excluded. 30 day post operative follow up was done for all patients and SSI was diagnosed based on criteria devised by Centers for Disease Control and Prevention (CDC). **Results:** SSI was noted in 46 patients, with an incidence of 30.9%. Culture was positive in 22 cases (47.8%), while 24 cases (52.2%) were culture-negative. *Staphylococcus aureus* was the most common organism isolated. Higher BMI and greater specimen weight showed significant association with SSI. Other factors such as age, diabetes mellitus, serum albumin, type of mastectomy, and hospital stay did not show significant correlation. **Conclusion:** Higher BMI and increased specimen weight are significant predictors of SSI following mastectomy. Identification of high-risk patients may help in improving perioperative care and reducing postoperative infections.

Keywords: Surgical site infection, Mastectomy, Body mass index, Specimen weight, Breast cancer, Postoperative complications

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Graphical Abstract

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Background

A major post-operative complication that is associated with significant morbidity and increased health care costs is surgical site infection (SSI). Though Mastectomy is classified as a clean surgical procedure, done under strict asepsis, SSI still continues to occur and may delay recovery and start of adjuvant therapy. This study aims to determine the incidence of SSI following mastectomy and to identify associated risk factors.

Methods

This prospective observational study was done in a tertiary care teaching hospital in Tamilnadu and included 149 females, who were above 18 years and underwent simple, modified radical, or radical mastectomy. The study was done over a period of two years. Immunocompromised patients or patients under prior chemotherapy were excluded. 30 day post operative follow up was done for all patients and SSI was diagnosed based on criteria devised by Centers for Disease Control and Prevention (CDC).

Incidence and Microbiological Profile of SSI (n = 149)

Parameter	n	%
SSI cases	46	30.9%
Culture-positive SSI	22	47.8%
Culture-negative SSI	24	52.2%

Microbiological Profile of SSI (n = 22)

Parameter	n	%
Staphylococcus aureus	8	36.4%*
Pseudomonas	3	13.6%*
Polymicrobial infections	11	50.0%*

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Conclusions Higher BMI and increased specimen weight are significant predictors of SSI following mastectomy. Identification of high-risk patients may help in improving perioperative care and reducing postoperative infections

Introduction

A major post operative complication that is associated with significant morbidity, prolongation of hospital stay and increased health care costs is surgical site infection [1]. Though there is significant advance in aseptic techniques, perioperative care, and the routine use of prophylactic antibiotics, SSIs still occurs across all types of surgeries, including breast surgery [2,3].

Mastectomy is usually categorized as a clean surgical procedure. Postoperative wound complications like surgical site infections, formation of seromas and flap necrosis are still seen frequently [4]. The reported incidence of SSI following breast surgery differs widely, ranging from 3% to 15%, and depends on patient characteristics, surgical technique, and Institutional practices [5,6]. These infections can affect overall treatment outcomes by delaying wound healing and delay of start of adjuvant therapy.

Risk factors that are associated in the formation of SSIs need to be identified early to implement preventive strategies and to have better surgical outcomes. Patient-related factors like obesity and diabetes mellitus are important contributors to postoperative infections [7,8]. In addition, operative factors like the extent of dissection and mastectomy specimen weight have been known to influence wound healing and infection risk [9]. However, the relative contribution of these factors remains variable across different clinical settings.

Hence, this present study was done to determine the incidence of surgical site infection following mastectomy and to evaluate the association of patient-related and operative factors, particularly body mass index and specimen weight, with the occurrence of SSI.

Materials and Methods

This was a prospective observational study conducted in the Department of General Surgery of a tertiary care teaching hospital in South India. It was done over a period of two years. 149 females aged above 18 years who underwent mastectomy were included in the study. All types of mastectomy including simple mastectomy, modified radical mastectomy, and radical mastectomy were included. Patients who had received neoadjuvant chemotherapy, immunosuppressed patients and those undergoing immediate breast reconstruction were excluded from the study.

Approval was obtained from the Institutional Ethics Committee before the start of the study. All patients had the nature, purpose, and procedures of the study explained to them in their native language, and written informed consent was obtained from each patient before enrolment. All patient details were handled strictly confidential throughout the study. All procedures were carried out ethically.

Baseline clinical details like age, weight, height, body mass index (BMI), blood glucose and preoperative serum albumin levels were noted before the start of the study. Strict aseptic precautions were followed throughout surgery for all patients and prophylactic antibiotics were administered at induction. The choice of antibiotic was based on the institutional antibiogram. After mastectomy, two closed-suction drains were placed and the excised specimen was weighed and recorded in grams, intraoperatively, using a calibrated digital scale.

Postoperatively, all patients were followed up for a period of 30 days to assess for the occurrence of surgical site infection. SSI was defined according to the criteria established by the Centers for Disease Control and Prevention (CDC). Features like presence of purulent discharge, erythema, warmth, and tenderness at the surgical site were assessed for. In suspected infection, wound swabs or fluid samples were collected under strict aseptic precautions and sent for microbiological analysis. Processing was done using routine microbiological techniques by inoculation and incubation on appropriate culture media, followed by identification of organisms. Identification was done based on the morphological and biochemical characteristics of the colonies.

The data collected was compiled and analysed using IBM SPSS Statistics for Windows, Version 27.0 (Armonk, NY: IBM Corp). Categorical variables were analysed using descriptive statistics with frequencies and percentages. Mean and standard deviation was calculated for continuous variables. The association between categorical variables and SSI was evaluated using the Chi-square test, and continuous variables were assessed using the independent samples t-test. A p-value of less than 0.05 was considered statistically significant.

Results

149 females were included in the present study. The mean age of the patients was 52.2 years. The overall incidence of surgical site infection (SSI) in this study was 30.9%, which indicates a high incidence of postoperative infections following mastectomy. Among patients with SSI, 22 (47.8%) were culture-positive, while more than half (52.2%: n=24) were culture-negative, which suggests a possible role of prior antibiotic use or low bacterial load. Among the

culture-positive cases, the complex microbial etiology of SSIs are explained by the presence of polymicrobial infections (50.0%). This was followed by *Staphylococcus aureus* (36.4%) and *Pseudomonas spp.* (13.6%), indicating that both Gram-positive and Gram-negative organisms contribute significantly to postoperative infections (Tables 1 and 2).

Table 1. Incidence and Microbiological Profile of SSI (n = 149)

Parameter	**n**	**%**
SSI cases	46	30.9
Culture-positive SSI	22	14.77
Culture-negative SSI	24	16.11

Table 2. Microbiological Profile of SSI (n = 22)

Parameter	**n**	**%**
Staphylococcus aureus	8	36.4
Pseudomonas	3	13.6
Polymicrobial infections	11	50.0

Among the categorical risk factors, body mass index (BMI) showed a statistically significant association with SSI (p = 0.038). The incidence of SSI was highest among obese patients, with 10 out of 16 patients (62.5%) developing SSI, compared to 31 out of 114 (27.2%) in the normal BMI group, indicating obesity as a strong predictor of postoperative infection. In contrast, diabetes mellitus was not significantly associated with SSI (p = 0.828), with comparable rates observed among diabetics (21/70; 30.0%) and non-diabetics (25/79; 31.6%). Similarly, the type of mastectomy did not show a significant association (p = 0.467), although SSI was slightly more frequent in modified radical mastectomy (38/115; 33.0%) compared to simple (2/12; 16.7%) and radical procedures (6/22; 27.3%) (Table 3).

Table 3. Association of Categorical Risk Factors with SSI

Risk Factor	**SSI Present (n=46)**	**SSI Absent (n=103)**	**Total (n=149)**	**P-Value**
Body Mass Index (BMI)				
Underweight (<18.5)	2 (28.6%)	5 (71.4%)	7	0.038
Normal (18.5–24.9)	31 (27.2%)	83 (72.8%)	114	
Overweight (25–29.9)	3 (25.0%)	9 (75.0%)	12	
Obese (≥30)	10 (62.5%)	6 (37.5%)	16	
Diabetes Mellitus				
No	25 (31.6%)	54 (68.4%)	79	0.828
Yes	21 (30.0%)	49 (70.0%)	70	
Type of Mastectomy				
Simple	2 (16.7%)	10 (83.3%)	12	0.467

Modified Radical Mastectomy	38 (33.0%)	77 (67.0%)	115	
Radical	6 (27.3%)	16 (72.7%)	22	
**Statistically Significant (p < 0.05) (Statistical Test: Chi-Square Test)*				

Among the continuous variables, specimen weight demonstrated a statistically significant association with SSI ($p = 0.016$), with a higher mean weight observed in the SSI group (1347.7 ± 337.4 g) compared to the non-SSI group (1217.2 ± 282.8 g). Although patients with SSI had slightly lower mean serum albumin levels (3.4 ± 0.6 g/dL) compared to those without SSI (3.6 ± 0.5 g/dL), this difference was not statistically significant ($p = 0.065$). Similarly, age (51.8 ± 12.3 vs 52.6 ± 11.9 years; $p = 0.482$) and duration of hospital stay (8.0 ± 5.2 vs 8.0 ± 4.8 days; $p = 0.989$) were comparable between the two groups, indicating no significant association with SSI (Table 4).

Table 4. Comparison of Continuous Variables

Variable	**SSI Present (Mean ± SD)**	**SSI Absent (Mean ± SD)**	**P-Value**
Specimen Weight (grams)	**1347.7 ± 337.4**	**1217.2 ± 282.8**	**0.016***
Age (years)	51.8 ± 12.3	52.6 ± 11.9	0.482
Serum Albumin (g/dL)	3.4 ± 0.6	3.6 ± 0.5	0.065
Hospital Stay (days)	8 ±5.2	8 ± 4.8	0.989
**Statistically Significant (p < 0.05) (Statistical Test: Independent Samples T-Test)*			

Discussion

Surgical site infection (SSI) remains a significant postoperative complication following breast surgery and contributes to increased morbidity, prolonged recovery, and higher healthcare costs [10-13]. Although mastectomy is considered a clean surgical procedure, the incidence of SSI reported in the literature ranges from 3% to 15% [5,6]. In the present study, the incidence of SSI was found to be 30.9%, which is considerably higher than previously reported rates. Recent studies have shown that surgical site infections remain a significant concern in breast surgery, particularly in low- and middle-income settings, where the incidence can be substantially higher due to patient-related and healthcare system factors [14]. This variation may be attributed to differences in patient characteristics, tumour burden, perioperative factors, and Institutional practices. Along with that, addition of clinically diagnosed infections, including culture-negative patients, may have contributed to the higher incidence that was observed. Tertiary care settings in

India, similar to developing countries reported similar high rates, which can be attributed due to delay in presentation, larger tumour burden, and resource-related factors, which can influence postoperative outcomes [15,16].

In our study, obesity was identified as a significant risk factor for SSI as it was observed more in obese individuals than in people in a normal BMI range, similar to earlier studies which showed an increased risk of postoperative infections in overweight individuals [8]. The higher incidence could be due to reduced vascularity of adipose tissue and impaired oxygen delivery along with technical challenges during surgery which can all negatively impact wound healing. Seroma formation is another risk factor than can be attributed to increased subcutaneous tissue thickness escalating pre existing infection. Xue et al. in their meta analysis, done for many surgical procedures observed that obesity significantly increases the risk of SSIs, re emphasizing BMI as an important modifiable risk factor for SSIs [17].

A significant association was also noted between SSI and specimen weight after mastectomy in this study. Women whose specimen weight was higher had a higher chance of developing an infection, which adds to the hypothesis that larger breast size and wider surgical dissection may lead to increased dead space and fluid accumulation, which predispose bacterial proliferation and cause an impairment in wound healing. Similar observations were noted in many other previous studies done to analyse risk factors for development of post operative infections [9]. In clinical practice, the importance of meticulous planning and surgical technique is re inforced and adequate drainage with close postoperative monitoring in patients with larger specimen weights is mandated. It has also been noted that a higher breast volume and specimen weight were associated with higher rates of seroma formation and wound complications thereby causing an increased susceptibility to post operative infection [18].

On the other hand, in the present study there was no significant association between SSI and diabetes mellitus. This finding is different from many other older studies that proved that diabetes is an independent risk factor for postoperative infections [7]. The lack of association in the present study may be because of excellent perioperative glycemic control or the relatively balanced proportion of diabetics and non-diabetics in the study group. This underlines the significance of good metabolic control in reducing risk of infections in diabetics. Few studies have shown that well-controlled diabetes may not increase SSI risk, stating the importance of optimisation of glycemia control perioperatively [19].

Likewise, other factors like age, serum albumin levels, type of mastectomy, and duration of hospital stay were not associated with SSI significantly in the present study. Hypoalbuminemia is frequently regarded as an indicator of inadequate nutritional status and compromised wound healing; however, the absence of statistical significance in this study may be attributed to the limited number of patients exhibiting mild to severe hypoalbuminemia. The type of mastectomy also did not influence rate of infection significantly, which recommends that patient-related factors and extent of tissue dissection may play a more important role than the actual surgical technique.

As for the microbiological profile of the organisms causing SSI, Staphylococcus aureus was the most common, followed by *Pseudomonas* species, with a remarkable proportion of cases showing polymicrobial infections. These findings are in line with older studies that observed that skin flora was a main source of infection in mastectomy [11,12]. Similar findings have been reported in a recent study, where Staphylococci account for the majority of surgical site infections in breast surgery, followed by Gram-negative organisms and polymicrobial infections [20]. Appropriate empirical antibiotic coverage is needed and is highlighted by the presence of polymicrobial infections. Also, the emergence of resistant organisms highlights the importance of continuous microbiological surveillance and judicious antibiotic use [13]. The synergistic interaction of aerobic and anaerobic organisms cause polymicrobial infections in surgical wounds, which can increase virulence and complicate the management post operatively [21].

The relatively high percentage of culture-negative SSI cases seen in the present study can be due to previous antibiotic administration, low bacterial load, or the presence of sterile inflammatory conditions like a seroma. This highlights that clinical diagnosis is mainstay and we should not be dependent on microbiological confirmation alone. Prior studies done have reported similar findings where previous antibiotic exposure and low bacterial load cause culture-negative infections despite clinical evidence of SSI [22].

Limitations

This study has certain limitations. Being conducted in a single tertiary care centre, the findings may reflect local patient characteristics and may not be generalizable to other settings. The sample size was moderate, and multivariate analysis was not performed, thereby limiting the ability to identify independent predictors of surgical site infection. In addition, the follow-up period was restricted to 30 days, which may have led to underestimation of late-onset infections. Furthermore, a significant proportion of cases were culture-negative, which may have influenced the observed microbiological profile.

Conclusion

There was a 30.9% incidence of surgical site infection following mastectomy in our present study. Higher body mass index and increased specimen weight were significantly associated with SSI, while other factors did not show any significant association. These results highlight the importance of targeted perioperative care in high-risk patients. Sharp surgical technique, efficient dead space management along with immediate identification and treatment of seromas may reduce the risk of post op infections. More larger multicentric studies with multivariate analyses are necessary to validate these findings and design reliable predictive factors for surgical site infection (SSI) following mastectomy.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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