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Original Article

Factor Associated with Prolong Drain Insertion Time in Breast Cancer Patients Undergone Surgery at Lamphun Hospital

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ABSTRACT

Background: Breast cancer remains the most common malignancy in female patients, with surgical intervention being the primary treatment approach. One of the most common postoperative complications is the formation of seroma underneath the surgical incision. The standard management for seroma following modified radical mastectomy (MRM) or mastectomy typically involves the placement of subcutaneous closed-suction drainage. However, the optimal timing for drainage placement and the appropriate duration of drainage remains uncertain. We observed that some patients had their closed-suction drains removed earlier, leading to a shorter hospital stay compared to others. Therefore, this study aims to identify risk factors associated with prolonged indwelling of closed-suction drains after breast cancer surgery at Lamphun Hospital.

Method: This retrospective cohort study entailed a total of 301 female patients, aged 20 years or older, who had a medical record of receiving breast cancer surgery in Lamphun Hospital from January 2019 to December 2023. Patients were divided into two groups: the "standard drainage" group, where drainage catheters were removed within 6 days, and the "prolonged drainage" group, where catheters remained in place for more than 6 days. Binary logistic regression analysis was performed to elicit risk factors associated with prolonged drainage.

Results: Among 301 female breast cancer patients who underwent surgery at Lamphun Hospital, the mean age was 59.4 ± 10.4 years, and their average BMI was 24.1 ± 4.4 kg/m^2. The most common comorbidities were hypertension, dyslipidemia, and diabetes mellitus, in the order of prevalence. Most patients had stage IIA breast cancer, and 98.6% of all patients underwent modified radical mastectomy (MRM). Of the 301 patients, 179 (59.5%) were in the prolonged drainage group. Statistically significant risk factors for prolonged drainage included: BMI (adjusted odds ratio [aOR] 2.42, 95% confidence interval [CI] = 1.20–4.90, p = 0.014), the number of axillary lymph nodes removed (aOR 1.30, 95% CI = 1.02–1.68, p = 0.033), and the 48-hour postoperative drain output (aOR 1.12, 95% CI = 1.07–1.18, p < 0.001).

Conclusions: Prolonged drainage was significantly associated with higher BMI, a greater number of axillary lymph nodes removed, and greater 48-hour postoperative drain output. These findings may help guide postoperative care for patients at higher risk of requiring prolonged drainage.

Keywords: Breast cancer, close suction drainage, duration of postoperative surgical drain, seroma

Introduction

According to data from the National Cancer Institute (NCI) registry in 2021, breast cancer was the most common malignancy among Thai women, accounting for 37.9% of cases, followed by cervical cancer at 13.8%. The incidence of breast cancer in Thailand is approximately 34.2 cases per 100,000 women per year, while in Lamphun province, the incidence is slightly higher at 36 cases per 100,000 women per year[1]. Over the past decade, chemotherapy and radiotherapy have become integral components of breast cancer management, however, surgical intervention remains the gold standard treatment[2,3]. Surgical options include modified radical mastectomy (MRM), simple mastectomy with sentinel lymph

node biopsy, and breast-conserving surgery (BCS). According to the medical archives of Lamphun Hospital from 2017 to 2022, the most frequently performed procedure was MRM, followed by simple mastectomy with sentinel lymph node biopsy (SLNB), and BCS.

Frequently encountered postoperative complications following breast surgery include seroma and hematoma[4]. A study by Engsirorat T. reported that the incidence of seroma among breast cancer patients who underwent MRM was approximately 22.7%, with total drainage volume exceeding 200 ml within 48 hours identified as a significant risk factor for seroma formation[5]. Additionally, research by Zielinski J et al. identified age over 60 years and a BMI $\geq$ 30 kg/m² as risk factors for seroma[6]. In contrast, Sirisut B.'s study, which examined factors such as age, BMI, number of axillary lymph nodes removed, number of malignant nodes, disease stage, neoadjuvant chemotherapy, and type of surgery, found no significant associations with seroma formation[7].

A randomized controlled trial (RCT) conducted by Gupta et al. compared the incidence of seroma in breast cancer patients whose drains were removed at 5 days versus 8 days postoperatively. The study, which included 112 patients, found that the early removal group had a higher incidence and volume of seroma compared to the group with delayed drain removal. They also found that prolonging the drainage could also reduce the volume of subsequent seroma as well as the frequency of seroma aspiration[8]. Despite these findings, the optimal duration of drain indwelling time has yet to be thoroughly studied.

At Lamphun Hospital, a standardized protocol dictates that drains are removed only when the output is less than 30 ml per day in each bottle for two consecutive days. Patients undergoing modified radical mastectomy (MRM) have two drainage catheters inserted, one at the chest wall and one at the axilla, with each catheter connected to a separate collection bottle, and the fluid output measured separately for each bottle, while patients undergoing simple mastectomy with sentinel lymph node biopsy have a single drainage catheter inserted at the chest wall. Additionally, patients are required to have their drains removed before discharge. As a result, the duration of drain indwelling directly impacts the length of the hospital stay. Therefore, the author aims to identify risk factors associated with prolonged indwelling of closed-suction drains after breast cancer surgery at Lamphun Hospital.

Method

This research study is a retrospective cohort study conducted on breast cancer patients who underwent treatment with Modified Radical Mastectomy (MRM) or simple mastectomy with sentinel lymph node biopsy at Lamphun Hospital from January 2019 to December 2023. This study

received ethical approval from the Lamphun Hospital Ethics Committee (approval number: Ethic LPN 008/2567), ensuring compliance with ethical standards for research involving human participants. All patients had postoperative closed-suction drain placed under surgical wound after surgery and the drain removed according to the Lamphun hospital's protocol. The exclusion criteria include breast cancer patients who underwent breast conserving surgery (BCS) without a drain inserted under the wound, patients who underwent breast reconstruction, patients who had a second breast surgery during the same admission, and patients who developed wound infections. The primary outcome of this study is the duration of postoperative drainage, categorized as standard drainage insertion or prolonged drainage insertion. The secondary outcomes included identifying significant risk factors associated with prolonged drainage, such as age, BMI, comorbidities, stage of disease, the number of axillary lymph nodes removed, 48-hour postoperative drain output and operative details. Definitions in this research study:

1. In our study, the stage of disease using TNM classification was classified according to the AJCC (American Joint Committee on Cancer) system

2. The number of axillary lymph nodes is defined as the total number of axillary lymph nodes removed during breast surgery at the same time as breast surgery.

3. 48-hour post-operative drain output defined as total volume of drain output, measured in milliliters, recorded over the first 48 hours after surgery from the bottles connected to the closed-suction drain. Each of the two drain catheters is connected to a separate bottle, with fluid output recorded separately for each.

4. First drain is a drainage catheter that is removed first

5. Last drain is a drainage catheter that is removed last

Data Analysis

This research study uses descriptive statistics to describe the characteristics of the study sample. A categorical data such as comorbidities are reported as frequencies and percentages (n (%)). Numerical data such as age, lymph fluid volume, and surgery duration are presented as mean and standard deviation (mean ± SD) for data that follow a normal distribution. For data with a skewed distribution, the median and interquartile range (IQR) are used. Frequency distribution is visualized using a histogram for categorical data or continuous data, and a quantile-quantile (Q-Q) plot for examining the normality of numerical data.

Inferential statistics were used to analyze the nature and strength of the relationships between variables. This included univariable

analysis to examine the relationship between each independent variable (e.g., age, BMI) and the outcome variable (e.g., prolonged drainage), using the independent sample t-test for normally distributed data and the rank-sum test for non-normally distributed data.

For multivariable analysis includes a set of risk factors proposed from the previous literature[5,6,7,10]. Multivariable binary logistic regression is used to examine the relationship between multiple independent variables and a binary outcome (whether the patient had prolonged drainage or not). This provides an adjusted odds ratio (aOR) and 95% confidence interval (CI), where statistical significance is determined with a p-value less than 0.05. All statistical calculations are performed using Stata version 18.0 (StataCorp. 2023)

Results

Among 301 female breast cancer patients who underwent surgery at Lamphun Hospital from January 2019 to December 2023, the mean age was 59.4 ± 10.4 years, with an average BMI was 24.1 ± 4.4 kg/m^2. Hypertension, dyslipidemia, and diabetes mellitus were the most prevalent comorbidities. The majority of patients were diagnosed with stage IIA of the disease. Modified radical mastectomy (MRM) was performed on 297 patients (98.6%), while 4 patients (1.3%) underwent a simple mastectomy with sentinel lymph node biopsy. Of the 301 patients, 59 (19.6%) patients developed post-operative seroma formation after drain removal. The average hospital stay across the two groups was 6 days, as seen in Table 1. In the absence of an established guideline for optimal drain placement duration, we selected median drainage duration observed in our study population. Approximately half of the patients had their drains removed within six days. This threshold divides the population into two groups, standard drainage insertion and prolonged drainage insertion (Figure 1).

The catheter indwelling time was measured

Table 1 Patients and clinical characteristic

Characteristic	N (%) (N = 301)
Age (year)	59.4 ± 10.4*
BMI (kg/m^2)	24.1 ± 4.4*
Underlying disease	
Hypertension	42 (34.4)
Dyslipidemia	27 (22.1)
Diabetes mellitus	21 (17.2)
Stage	
Stage IIA	94 (31.2)
Operative procedure	
Simple mastectomy with sentinel lymph node biopsy	4 (1.3)
Modified radical mastectomy (MRM)	297 (98.7)
Length of hospital stay (day)	6.3 ± 2.2*
Seroma	59 (19.6)

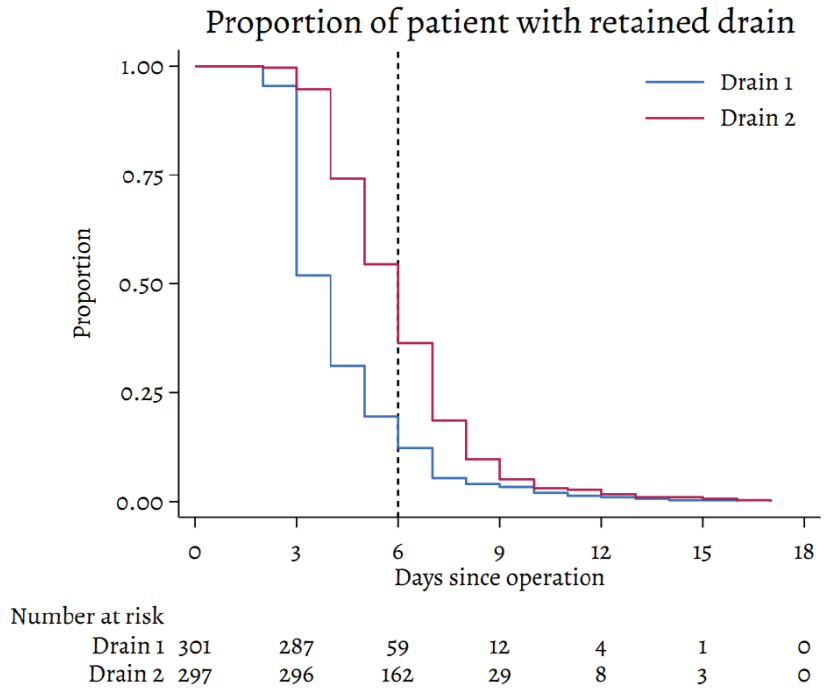

Figure 1 Median drainage duration of breast cancer patients who underwent surgery at Lamphun Hospital.

from insertion to the day of last drain removal. We observed that roughly half of the participants had their last drain removed within 6 days, thus we divided the patients into two groups. The standard drainage group refers to those who had their drains removed before the sixth day and the delayed drainage group refers to those whose drains were removed on the sixth day or later. In the delayed drainage group of 179 patients (59.5%), the mean age was 60.3 ± 9.9 years, and the mean BMI was 25.0 ± 4.7 kg/m^2. Hypertension was the most common comorbidity, followed by diabetes mellitus and dyslipidemia. Univariate analysis identified several significant risk factors for prolonged drainage, including BMI (P < 0.001), number of axillary lymph nodes removed (P < 0.001), and 48-hour postoperative drain output (P < 0.001) (Table 2).

Multivariate logistic regression confirmed the significance of these three risk factors. For each 10 kg/m^2 increase in BMI, the adjusted odds ratio (aOR) is 2.42 (95% CI 1.20-4.90, P = 0.014). Each additional 5 axillary lymph nodes removed corresponded to an aOR of 1.30 (95% CI 1.02-1.68, P = 0.033). Similarly, each 10 ml increase in 48-hour postoperative drain output resulted in an aOR of 1.12 (95% CI 1.07-1.18, P < 0.001) (Table 3)

Table 2 Univariable analysis for risk factors for prolonged drainage insertion time

Characteristic	Standard drainage insertion N=122	Prolong drainage insertion N=179	*p*-value
Age (years)	58.1 ± 10.9*	60.3 ± 9.9*	0.063*
BMI (kg/m^2)	22.7 ± 3.7*	25.0 ± 4.7*	< 0.001*
Underlying disease			
Hypertension	42 (34.4%)	86 (48.0%)	0.024
Diabetes mellitus	21 (17.2%)	30 (16.8%)	1.00
Dyslipidemia	27 (22.1%)	47 (26.3%)	0.50
Chronic kidney disease	5 (4.1%)	0 (0.0%)	0.010
Ischemic heart disease	4 (3.3%)	2 (1.1%)	0.23
Staging			
Stage 0	2 (1.6%)	0 (0.0%)	0.24
Stage IA	19 (15.6%)	20 (11.2%)	
Stage IIA	30 (24.6%)	64 (35.8%)	
Stage IIB	24 (19.7%)	31 (17.3%)	
Stage IIIA	23 (18.9%)	31 (17.3%)	
Stage IIIB	12 (9.8%)	13 (7.3%)	
Stage IIIC	9 (7.4%)	18 (10.1%)	
Stage IV	3 (2.5%)	2 (1.1%)	
Neoadjuvant chemotherapy	29 (23.8%)	37 (20.7%)	0.57
Operative procedure		0.31	
Simple mastectomy with sentinel LN biopsy	3 (2.5%)	1 (0.6%)	
Modified radical mastectomy (MRM)	119 (97.5%)	178 (99.4%)	
Operative time (minute)	85.0 (60.0-115.0)**	95.0 (75.0-120.0)**	0.007**
Blood loss (mL)	30.0 (20.0-50.0)**	30.0 (20.0-50.0)**	0.21**
Number of lymph node removal	11.0 (8.0-16.0)**	14.0 (10.0-18.0)**	< 0.001**
48 hr. of chest wall drain volume (mL)	30.0 (15.0-60.0)**	60.0 (30.0-100.0)**	< 0.001**
48 hr. of axillary drain volume (mL)	60.0 (40.0-90.0)**	105.0 (70.0-170.0)**	< 0.001**
Duration of chest wall drainage insertion (day)	3.0 (3.0-4.0)**	4.0 (3.0-6.0)**	< 0.001**
Duration of axillary drainage insertion (day)	4.0 (4.0-5.0)**	7.0 (6.0-8.0)**	< 0.001**

*Mean ± SD with independent sample *t*-test

**Median (Quartile 1 – Quartile 3), tested with rank-sum test

Table 3 Multivariable analysis for risk factors for prolonged drainage insertion time

Variables	Multivariable analysis		
	Adjusted odds ratio	95% CI	*P*-value
Age (years) *	1.21	(0.90-1.63)	0.215
BMI (kg/m2) **	2.42	(1.20-4.90)	0.014
Stage			
Stage IA	Reference		
Stage IIA	1.42	(0.60-3.39)	0.424
Stage IIB	0.95	(0.37-2.45)	0.919
Stage IIIA	0.88	(0.32-2.46)	0.809
Stage IIIB	0.61	(0.16-2.27)	0.456
Stage IIIC	0.79	(0.23-2.71)	0.703
Stage IV	0.68	(0.08-6.03)	0.729
Hypertension	1.74	(0.91-3.30)	0.092
Diabetes mellitus	0.73	(0.32-1.64)	0.442
Dyslipidemia	0.89	(0.43-1.83)	0.747
Neoadjuvant chemotherapy	1.47	(0.67-3.24)	0.339
Total lymph node removal***	1.31	(1.02-1.68)	0.033
Optime (minutes)****	1.05	(0.96-1.15)	0.263
Blood loss (mL) *****	1.02	(0.92-1.12)	0.714
Last drain volume (mL)******	1.13	(1.07-1.18)	< 0.001

*Age: aOR for each increase of 10 years,
**BMI: aOR for each increase of 10 kg/m^2
***Total lymph node removal: aOR for each increase of 5 lymph nodes
****Optime: aOR for each increase of 10 minutes
*****Blood loss: aOR for each increase of 10 ml.
******Last drain volume: aOR for each increase of 10 ml.

Discussion

This study identifies risk significant factors associated with prolonged drainage in breast cancer patients undergoing surgery at Lamphun Hospital. The findings demonstrate that higher BMI, a greater number of axillary lymph nodes removed, and increased 48-hour postoperative drain output were statistically significant predictors of prolonged drainage.

A higher BMI was strongly associated with prolonged drainage time, as shown by an adjusted odds ratio (aOR) of 2.42 (95% CI = 1.20–4.90, *p*

= 0.014) for every 10 kg/m² increase. This finding is consistent with previous studies, such as those by Zielinski et al. and Omer et al., which reported similar associations between obesity and prolonged drain indwelling time.[7,11] A plausible explanation for the link between high BMI and seroma development may be the greater breast tissue volume requiring extensive dissection, which increases the likelihood of blood and lymphatic vessel injury. Such an injury can facilitate seroma formation and raise postoperative drain output.

The number of axillary lymph nodes removed during surgery also emerged as a significant factor, with an aOR of 1.30 (95% CI = 1.02–1.68, p = 0.033) for every 5 additional lymph nodes removed. This result underscores the importance of lymphatic disruption in prolonged drainage. Extensive axillary lymph node dissection (ALND) increases the risk of postoperative complications, including seroma, due to greater disruption of lymphatic channels.[12,13] Sentinel lymph node biopsy (SLNB), which involves the removal of fewer lymph nodes, may reduce these risks.

A higher 48-hour postoperative drain output was the strongest predictor of prolonged drainage, with an aOR of 1.12 (95% CI = 1.07–1.18, $p < 0.001$) for every 10 mL increase in drain output. This finding highlights the importance of monitoring early postoperative drainage as a potential indicator for prolonged indwelling time. Similar observations were previously reported by Theunissen et al., who found a significant correlation between seroma formation on the first day and total seroma volume and total time of seroma treatment.[14]

In the era of axillary de-escalating, modified radical mastectomy (MRM) is still the main surgical procedure in Lamphun Hospital due to our institute's inability to perform frozen section SLNB, nonfrozen sentinel problem along with the lack of RT to limit positive SLNB along with patient unaccepted of second operation due to cost and Transport limitation. In addition, surgeons with different surgical techniques may be affected by seroma volume, since various techniques are used to dissect the skin flaps such as electrocautery, laser scalpel, argon diathermy, and ultrasonic scalpel. The use of electrocautery is associated with seroma formation compared with scalpel dissection alone. No specific method of skin flap dissection has proved to be beneficial in reducing seroma formation.[15-17]

Some studies suggest that the incidence of seroma formation may not significantly differ between patients with and without drains. Taylor et al. demonstrated the lack of difference in symptomatic seroma incidence and requirement for seroma intervention between mastectomy patients managed with and without drains.[18] However other studies have reported that early drain removal, between POD 1-2, increased seroma incidence and concluded it is unsafe

and will require additional interventions.[19,20] Gupta et al. has studied a comparison of 5-day and 8-day drainage following mastectomy and axillary clearance reported that prolonged drainage reduces seroma incidence and aspiration requirements[8]. In our institute policy, we insert closed suction drainage in all cases undergoing modified radical mastectomy (MRM) and simple mastectomy with sentinel lymph node biopsy. The drain is removed when the output is less than 30 ml per day in each bottle for two consecutive days in hospital before discharge because the patient has difficulty coming to the hospital frequently for follow-up visits and faces financial challenges regarding hospital expenses.

Drain volume also varies with the type of surgery performed. It is believed that MRM would have a higher incidence of seroma compared to simple mastectomy and breast-conserving surgery. Sentinel lymph node biopsy could prove to be a viable alternative to axillary dissection, potentially leading to a lower incidence of seroma. Removing fewer lymph nodes in sentinel biopsy results in less tissue and lymphatic vessel damage, which may contribute to reduced seroma formation[21]. In this study, the population of patients undergoing simple mastectomy with sentinel lymph node biopsy (SLNB) was notably small compared to those undergoing modified radical mastectomy (MRM). Only 4 out of 301 patients underwent simple mastectomy with SLNB, representing just 1.3% of the study population. This small sample size limits the ability to draw statistically robust conclusions regarding the differences in outcomes between these two surgical techniques. Additionally, the small sample size reduces the statistical power to detect subtle differences or trends between groups, making it challenging to determine whether the shorter drain duration and lower drain output in SLNB patients are truly significant or merely an artifact of the limited data.

Less invasive procedures reduce postoperative complications and hospital stays. Promoting BCS at Lamphun Hospital could further these benefits, provided that patient selection and surgical techniques are carefully managed. Future studies with larger cohorts of SLNB patients are needed to validate these findings and provide a clearer comparison of outcomes between MRM and SLNB. Expanding the sample size would also allow for subgroup analyses to explore the impact of patient characteristics, such as BMI, comorbidities, and tumor stage, on postoperative drainage duration and fluid output for both surgical techniques. Until such data are available, the conclusions regarding SLNB in this study should be interpreted with caution.

These findings highlighted the risk factors which could lead to prolonged drainage in postoperative breast cancer patients and allow us to provide more cohesive care to patients at risk. Adopting advanced and minimally invasive

surgical techniques, particularly sentinel lymph node biopsy instead of full axillary lymph node dissection, could also lower the risks of seroma formation and postoperative drain output. In our results of this study, we will apply to improve postoperative care protocol and decrease hospital stay. Further research is needed to explore the clinical significance of these approaches.

Conclusion

Prolonged drainage in breast cancer patients was significantly associated with higher BMI, a greater number of axillary lymph nodes removed, and higher 48-hour postoperative drain output. These insights may aid in tailoring postoperative care to patients at an increased risk of prolonged drainage.

Limitation

As a single-center retrospective study, this research may have limitations regarding completeness of data due to certain parts of information missing from the medical records. These could negatively impact the accuracy of the analysis and limit the study's external applicability to other research centers. Retrospective data may not cover other important variables, such as patient behavior or variations in specific surgical techniques. There was no use of randomization, which could lead to selection bias. Finally, given the paucity of participants who undergone mastectomy and SLNB, this result should not be applied in the mastectomy with SLNB and necessitate a further study.

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