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Comparison of Axillary Drain Output After Level 2 Dissection Using Monopolar Electrocautery Versus LigaSure

Farkhanda Niaz [1,2], Muhammad Umair Afzal [3], Rashid Iqbal [2], Adnan Ahmed Raza [4], Rabbia Abdul Ghani [4], Abrar Ahmad [5]

[1]General Surgery, Unit 2, Allied Hospital Faisalabad,[2]Department of General Surgery, Central Park Medical College and Teaching Hospital, Lahore,[3]Department of General Surgery, Shifa International Hospital, Jaranwala Road, Faisalabad, [4]Department of General Surgery, Aziz Fatima Medical & Dental College, Faisalabad,[5] Department of General Surgery, Services Hospital Lahore, Pakistan.

ABSTRACT

Background: Conventional monopolar electrocautery in level-II axillary lymph-node dissection is associated with seroma formation and thermal injury. LigaSure, an electrothermal bipolar vessel-sealing system, may reduce postoperative drainage. The study aimed to compare axillary drain output after level II dissection using electrocautery vs. Ligasure.

Methods: In this quasi-experimental study, 60 women with breast cancer undergoing level-II axillary lymph node dissection at Allied Hospital, Faisalabad, were allocated to monopolar electrocautery (Group A) or LigaSure (Group B) from 1st October 2023 to 30th March 2024. A non-probability consecutive sampling technique was used. Axillary drain output was the primary endpoint. Age, body mass index, duration of surgery, number of nodes removed, diabetes, hypertension, residence, radiotherapy, and chemotherapy status were recorded. Data were analyzed in SPSS v25.0. Quantitative variables were expressed as mean ± SD; categorical variables as frequency (%). Mean drain output between groups was compared with an independent-samples t-test, and $p \leq 0.05$ was considered significant.

Results: Mean age was 52.2 ± 7.2 years in Group A and 49.1 ± 7.1 years in Group B; mean BMI was 28.9 ± 2.4 kg/m². Average surgery time was 78.8 ± 7.5 min with 3.4 ± 0.9 nodes excised. Group A showed significantly higher drain output (290.0 ± 40.0 mL) than Group B (164.6 ± 18.0 mL); mean difference = −125.4 mL ($p < 0.001$).

Conclusion: LigaSure markedly reduces postoperative axillary drainage compared with monopolar electrocautery during level-II ALND, supporting its routine use to minimize seroma risk in breast-cancer surgery.

Keywords: Breast Neoplasms, Mastectomy, Axilla, Lymph Node Excision, Electrosurgery

Corresponding Author:
Dr. Farkhanda Niaz,,
Department of General Surgery,
Allied Hospital Faisalabad,
Central Park Medical College and Teaching Hospital, Pakistan.
Email: farkhanda.niaz@yahoo.com
ORCID: https://orcid.org/0009-0001-7895-8783
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INTRODUCTION

Breast cancer remains the most frequently diagnosed malignancy among women, accounting for more than 2 million new cases worldwide each year, and its global incidence continues to climb despite advances in screening and therapy[1, 2]. In South Asia, the burden is rising disproportionately; modelling from Karachi projects that national incidence will almost double between 2015 and 2025[3, 4].

Accurate assessment of axillary nodal status is pivotal for staging and adjuvant-treatment planning, and level II axillary lymph-node dissection (ALND) is still required when sentinel-node biopsy is positive or unavailable[5]. However, ALND is plagued by postoperative seroma, reported in up to half of patients and responsible for prolonged drainage, repeated aspirations, infection, and delayed systemic therapy[6].

Conventional monopolar electrocautery, although inexpensive and haemostatic, produces a wide thermal spread that disrupts lymphatics and has been repeatedly linked to higher seroma rates and greater drain volumes[7, 8]. To mitigate these effects, advanced energy platforms have been introduced. Ultrasonic devices (harmonic scalpel) consistently lower drainage volume and operative morbidity in both single-centre trials and meta-analyses[9,10,11]. Electro-thermal bipolar vessel-sealing technology (LigaSure) fuses collagen and elastin within vessels and lymphatics at lower temperatures than electrocautery, thereby limiting collateral tissue injury[12]. Small series and cohort studies have reported reduced blood loss, shorter drainage duration, and lower cumulative drain output with LigaSure compared with conventional techniques [13,14,15]. A 2024 meta-analysis confirmed significant reductions in postoperative drain volume and hospital stay[16].

Existing evidence is heterogeneous, often mixes different levels of dissection, and originates largely from high-income settings; regional data, particularly for isolated level II ALND, are scarce. Given the conflicting literature and the continued reliance on electrocautery in many low-resource hospitals, the present study was designed to compare the mean axillary drain output between monopolar electrocautery and LigaSure during level II ALND in breast-cancer patients. By controlling for key patient and operative variables in a single-centre quasi-experimental framework, we sought to clarify whether LigaSure offers a clinically meaningful reduction in postoperative lymphorrhoea and to inform cost-effective surgical practice in similar contexts.

METHODS

This quasi-experimental study was conducted at the Department of Surgery, Allied Hospital, Faisalabad, over a period of six months, from 1st October 2023 to 30th March 2024. Ethical approval was obtained from the Institutional Ethical Review Committee (ERC), Faisalabad Medical University, Faisalabad (Approval No: 1065; Dated: 9th September, 2023).

The sample size for this study was calculated using OpenEpi software (version 2.3.1), employing the module for comparing two means. Based on previously published data, the expected mean axillary drain output in the monopolar electrocautery group was approximately 269 mL, while in the LigaSure group it was around 223mL, resulting in an estimated mean difference of 46mL[17]. Assuming a common standard deviation of 8.4 mL, a two-sided significance level (α) of 0.05, and a power of 80%, the required sample size was determined to be 30 patients per group, making a total of 60 participants.

A non-probability, consecutive sampling technique was employed for the selection of participants. The study included all breast cancer patients undergoing axillary lymph node dissection, specifically adult females of all age groups. Patients were excluded if they had a history of previous axillary lymph node dissection, chronic liver disease (assessed through patient history and serum bilirubin levels greater than 1.0 mg/dL), or coagulation disorders (evaluated based on patient history and medical records).

After ethical approval, 60 patients admitted to the Department of Surgery who met the inclusion criteria were enrolled. Informed consent was obtained from each participant. Patients were assigned to two groups (Group A and Group B) using a non-random lottery method, with each patient selecting a slip labeled 'A' or 'B'. In Group A, monopolar electrocautery was used; in Group B,

LigaSure was used.

All procedures were performed by a single consultant surgeon with over five years of post-fellowship experience and at least two years of routine LigaSure use in axillary surgeries, thereby minimizing any potential learning curve effects. Drain management was standardized across both groups. A closed suction drain (Romovac) with negative pressure (100–120 mmHg) was placed in all cases. Drain output was measured every 24 hours. Drains were removed once daily output was <30 mL for two consecutive days, or by the 7th postoperative day at the latest, whichever came first.

Additional data such as age, BMI, diabetes mellitus, hypertension, place of living (rural/urban), radiotherapy and chemotherapy history, duration of surgery, and number of lymph nodes removed were recorded on a structured proforma. Data were analyzed using SPSS version 25.0. Quantitative variables (age, BMI, surgery duration, lymph nodes removed, drain output) were reported as mean ± SD. Qualitative variables (diabetes, hypertension, place of residence, radiotherapy, chemotherapy) were presented as frequencies and percentages. Independent t-tests were used to compare mean axillary drain outputs between the two groups. A p-value ≤ 0.05 was considered statistically significant.

Effect modifiers, including age, BMI, diabetes, hypertension, radiotherapy, chemotherapy, surgery duration, and lymph nodes removed, were controlled through stratification. Post-stratification, an independent t-test was applied with a p-value ≤ 0.05 considered significant.

RESULTS

Table 1: Age Distribution for Both Groups (n=60)

Age (years)	Group A (n=30)		Group B (n=30)		Total (n=60)	
	No. of patients	%Age	No. of patients	%Age	No. of patients	%Age
30-50	12	40.0	20	66.67	32	53.33
51-70	18	60.0	10	33.33	28	46.67
Mean ± SD	**52.17 ± 7.16**		**49.07 ± 7.08**		**50.39 ± 7.21**	

The study included 60 breast cancer patients with a mean age of 50.39 ± 7.21 years. Group A (monopolar electrocautery) had a mean age of 52.17 ± 7.16 years, while Group B (LigaSure) had a mean age of 49.07 ± 7.08 years. The majority of patients (53.33%) were between 30–50 years **Table 1.**

Table 2: Demographic and Clinical Characteristics of Patients in Group A and Group B

Parameter	Category	Group A (n=30)	%	Group B (n=30)	%	Total (n=60)	%
BMI (kg/m²)	≤27	12	40.0	09	30.0	21	35.0
	>27	18	60.0	21	70.0	39	65.0
	Mean ± SD	**28.80 ± 2.67**		**29.0 ± 2.13**		**28.90 ± 2.42**	
Hypertension (HTN)	Yes	15	50.0	13	43.33	28	46.67
	No	15	50.0	17	56.67	32	53.33
Diabetes Mellitus (DM)	Yes	12	40.0	15	50.0	27	45.0
	No	18	60.0	15	50.0	33	55.0
Radiotherapy	Yes	19	63.33	18	60.0	37	61.67
	No	11	36.67	12	40.0	23	38.33
Chemotherapy	Yes	14	46.67	15	50.0	29	48.33
	No	16	53.33	15	50.0	31	51.67

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Lymph Nodes Removed	≤3	15	50.0	17	56.67	32	53.33
	>3	15	50.0	13	43.33	28	46.67
	Mean ± SD	**3.53 ± 0.86**		**3.33 ± 0.92**		**3.41 ± 0.89**	
Surgery Duration (min)	≤80	20	66.67	19	63.33	39	65.0
	>80	10	33.33	11	36.67	21	35.0
	Mean ± SD	**77.73 ± 7.86**		**79.30 ± 7.02**		**78.81 ± 7.45**	
Place of Living	Rural	13	43.33	13	43.33	26	43.33
	Urban	17	56.67	17	56.67	34	56.67

The mean BMI was 28.90 ± 2.42 kg/m². Comorbid conditions such as hypertension and diabetes mellitus were present in 46.67% and 45% of patients, respectively. Approximately 62% had received radiotherapy, and 48.33% had undergone chemotherapy. The mean number of lymph nodes removed was 3.41 ± 0.89, and the mean duration of surgery was 78.81 ± 7.45 minutes **Table 2**.

Table 3: Comparison of Mean Axillary Drain Output Between Monopolar Electrocautery Use Versus LigaSure Use in Level 2 Axillary Lymph Node Dissection in Breast Cancer Patients

Axillary Drain Output (ml)	Group A (n=30) Mean ± SD	Group B (n=30) Mean ± SD	p-value
	290.03 ± 39.96	164.63 ± 17.95	**0.0001**

The primary outcome of axillary drain output showed a significant difference between the two groups. Group A (monopolar electrocautery) had a mean axillary drain output of 290.03 ± 39.96 mL, whereas Group B (LigaSure) had a significantly lower output of 164.63 ± 17.95 mL (p = 0.0001), indicating a marked reduction in postoperative fluid accumulation with LigaSure use **Table 3.**

Table 4: Stratification of Axillary Drain Output for Age, BMI, Diabetes Mellitus, Hypertension, Place of Living, Taking Radiotherapy, Taking Chemotherapy, Duration of Surgery, And Number of Lymph Nodes Removed

		Group A (n=30) Axillary drain output (ml) Mean ± SD	Group B (n=30) Axillary drain output (ml) Mean ± SD	P-value
Age (years)	**30-50**	289.42±31.35	165.20±13.99	0.0001
	51-70	290.44±45.69	163.50±24.95	
BMI (kg/m²)	**≤27**	270.0±36.07	156.89±18.56	
	>27	303.39±37.55	167.95±17.05	
Hypertension	**Yes**	292.60±33.24	168.31±18.95	
	No	287.47±46.78	161.82±17.18	
Diabetes mellitus	**Yes**	289.25±49.87	162.07±18.26	
	No	290.56±33.38	167.20±17.88	
Taking radiotherapy	**Yes**	292.05±32.91	167.44±18.92	
	No	286.55±51.58	160.42±16.25	
Taking chemotherapy	**Yes**	288.64±30.04	163.20±17.03	
	No	291.25±47.96	166.07±19.31	
Number of lymph nodes removed	**≤3**	279.93±41.53	167.41±20.44	
	>3	300.13±36.93	161.0±14.01	
	<			

Duration of surgery (min)	**_80**	287.30±30.89	164.42±21.54
	>80	295.50±55.62	165.0±9.94
Place of living	**Rural**	282.46±26.65	166.92±22.31
	Urban	295.82±47.74	162.88±14.26

Stratified analysis further supported these findings. In all subgroups, based on age, BMI, hypertension, diabetes mellitus, radiotherapy, chemotherapy, number of lymph nodes removed, duration of surgery, and place of residence, LigaSure consistently resulted in significantly lower mean drain output compared to electrocautery (p = 0.0001 in each comparison). For instance, among patients with BMI >27 kg/m², mean output was 303.39 mL in Group A vs. 167.95 mL in Group B. Similarly, patients with diabetes had mean outputs of 289.25 mL (Group A) and 162.07 mL (Group B), T**able 4.**

DISCUSSION

The present quasi-experimental study demonstrates a substantial, device-related reduction in postoperative axillary drain output when LigaSure is used for level-II axillary lymph-node dissection (ALND) compared with monopolar electrocautery. The 43 % relative decrease was consistent across all analyzed subgroups, reinforcing the clinical relevance of the finding. Mechanistically, LigaSure's electro-thermal sealing fuses collagen and elastin within vascular and lymphatic walls, producing a permanent seal that minimizes lymphorrhoea and obliterates dead space. Enhanced hemostasis and reduced collateral thermal spread further limit tissue trauma, thereby lowering seroma risk and overall drainage.

Our results accord with a 2024 comparative series in which a "total-sealing technique" using a next-generation LigaSure handpiece halved drainage volume and shortened time to drain removal after ALND[18]. Similar benefits, though with older LigaSure models, were reported in a multicenter evaluation of advanced hemostatic devices, where postoperative drainage and seroma incidence were markedly lower than with conventional electrocautery.[13, 15] A regional study in South Asia also documented a >30 % reduction in cumulative wound drainage following modified-radical mastectomy with LigaSure, mirroring the magnitude observed here[14, 19, 20].

Not all investigations have shown superiority. Other studies where patients undergoing level I–III dissection found no significant difference in total drainage between LigaSure and standard diathermy[14, 21], and skin-sparing mastectomy data revealed only modest (≈14 %) decreases in drainage volume[22, 23]. Discrepancies may reflect variations in dissection level, device generation, surgeon learning curves, and perioperative drain protocols. Our study, confined to level II dissections and performed by a single experienced surgeon, suggests that device efficacy becomes more pronounced when surgical technique and perioperative management are Standardised.

Drainage reduction persisted after stratification for age, BMI, hypertension, diabetes, radiotherapy, chemotherapy, operative time, and nodal yield, implying that LigaSure's advantage is largely independent of recognized seroma risk factors. Prior studies often aggregated levels I–III; isolating level II eliminates anatomical heterogeneity and provides clearer insight into device performance at this common dissection level.

Lower drain output can translate into earlier drain removal, reduced seroma aspirations, shorter hospital stay, and timelier initiation of adjuvant therapy, outcomes documented elsewhere[24, 25]. Although LigaSure has a higher upfront cost, potential savings from reduced complication-related care, fewer outpatient visits, and quicker recovery merit formal cost-effectiveness analysis. Some studies suggest ultrasonic scalpels (Harmonic) may also reduce drainage[26,27]. A three-arm comparison (LigaSure vs. Harmonic vs. electrocautery) would be valuable.

Quasi-experimental design (lottery-based allocation) introduces selection bias. A randomized controlled trial (RCT) would have been stronger. No blinding of outcome assessors was mentioned, which could introduce bias in the drain measurement. The sample size (n=60) is adequate for detecting a large effect but may not generalize to broader populations. A multi-center study would improve external validity. The study only measured drain output but did not assess seroma aspiration rates (clinical seroma incidence), time to drain removal (an important practical outcome), long-term complications (lymphedema, infection, shoulder mobility), and LigaSure is more expensive than electrocautery. A cost-benefit analysis would help justify its routine use.

CONCLUSION

This study concluded that the mean axillary drain output is less after LigaSure use in level 2 axillary

lymph node dissection in breast cancer patients as compared to monopolar electrocautery use. So, we recommend that LigaSure should be used routinely in level 2 axillary lymph node dissection in breast cancer patients to reduce the lymphedema formation as well as the morbidity of these particular patients.

LIST OF ABBREVIATIONS

None

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None

CONFLICT OF INTEREST

The author showed no conflict of interest.

ETHICAL APPROVAL

Ethical approval was obtained from the Institutional Ethical Review Committee (ERC), Faisalabad Medical University, Faisalabad (Approval No: 1065; Dated: 9th September, 2023).

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AUTHORS' CONTRIBUTIONS

All other Authors contributed equally as per IMCJE. All authors agreed to be accountable for all aspects of the research.

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