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Comparison of Outcome with Ultrasonic Dissector Versus Electrocautery in Modified Radical Mastectomy

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ABSTRACT

Breast cancer is the most diagnosed cancer globally. Breast-conservative surgeries are done in several ways to treat non-metastatic breast cancer. **Objectives:** To compare the duration of surgery, duration of drains, and incidence of seroma formation between bipolar electrocautery and ultrasonic dissector in patients undergoing modified radical mastectomy (MRM) for breast cancer. **Methods**: This randomized controlled trial was conducted at the Department of Surgery in Bahawal Victoria Hospital, Bahawalpur, from June to December 2024. A total of 138 women aged 35 to 65 years with operable breast cancer planned for MRM were enrolled and randomized into two groups: bipolar electrocautery and ultrasonic dissector. The primary outcome was the incidence of seroma formation, and the secondary outcomes were duration of surgery and drain placement. Data were analyzed using SPSS version 23.0 with an independent sample t-test and chi-square test / Fisher's exact test applied where appropriate. A p-value<0.05 was considered statistically significant. **Results:** Patients had a mean age of 50.5±7.8 years; 52.2% of the patients were obese. Both groups were comparable at baseline. The mean operative time and drain duration were significantly lower in the ultrasonic dissector group (41.5 ± 4.4 min and 4.0 ± 0.8 days) compared to the electrocautery group (52.9 ± 4.2 min and 7.1 ± 1.2 days) (p<0.001). Seroma formation occurred in 10.1% cases and was significantly less frequent in the ultrasonic group (14.3% vs. 85.7%, p=0.009). **Conclusions:** Ultrasonic dissector significantly reduced operative time, drain duration, and seroma formation compared to electrocautery in patients undergoing MRM.

INTRODUCTION

Worldwide, breast cancer is the most prevalent cancer among women [1]. Breast cancer is becoming more common, particularly in developing parts of the world [2]. Halsted radical mastectomy, modified radical mastectomy (MRM), and breast conservative surgery are the three major forms of surgery that are still used to treat non-metastatic breast cancer [3]. One of the key parts of breast cancer surgery is axillary dissection, which can be done in several ways with a scalpel, scissors, electrocautery, or an ultrasonic dissector [4]. Numerous theories have been presented to explain the genesis of seroma development, a frequent consequence that occurs after MRM [5]. Ultimately, the volume of serous discharge predicts the length of hospitalization, postoperative drainage, and medical expenses [6]. Research has indicated that the use of monopolar electrocautery for dissection increases the risk of seroma production because it damages the lymphatics with heat [7]. Nonetheless, it has the benefit of less operating time and intraoperative blood loss [7]. The blades of an ultrasonic dissector vibrate at a frequency of 55,500 Hz. Tissues are sliced and coagulated as a result, and vascular and lymphatic capillaries are then sealed. There is less tissue injury as a result [8]. Though it costs more than monopolar electrocautery. In a study by Deori et al. seventy patients were randomly assigned to one of two groups (group B: electrocautery, group A: MRM using

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ultrasonic dissector). Group A had a shorter operating time (30.86 ± 5.79 vs. 40.63 ± 6.07 minutes), a mean mop count (5.51 ± 1.84) vs. 7.20 ± 1.32), a lower total drain output for the first three days (161.00 ± 40.38 vs. 219.00 ± 60.46 ml), and a shorter drain duration (4.17 ± 0.45 vs. 4.89 ± 0.87 days) than group B [9]. The two groups did not differ statistically. Seventy patients with breast cancer were recruited by Sharma AK et al and divided into two groups of thirty-five each. In MRM, dissection was carried out using either monopolar electrocautery (group B) or an ultrasonic dissector (group A). In group A, the mean length of hospital stays, mean total drain output for the first three days, mean total length of surgery, and mean mop count were 5.00 ± 0.54 days, 161.00 ± 40.38 ml, 77.20 ± 14.79 minutes, and 5.51 ± 1.84 respectively, while in group B, they were 5.83 ± 0.89 days, 219.00 ± 60.46 ml, 90.20 ± 14.47 minutes, and 7.20± 1.32. 8.5% of group B cases had seroma development, compared to none of the group A cases [10]. The findings from local setting will assist the surgeons in choosing the best MRM strategy to reduce the length of time spent in the hospital, the development of seromas, and other morbidities.

While monopolar electrocautery is widely used, it can damage lymphatics and increase seroma risk, whereas ultrasonic dissectors may reduce tissue injury and postoperative morbidity. However, comparative evidence from local settings on surgical outcomes using these two techniques remains limited. The study hypothesized that outcomes would be better for women undergoing modified radical mastectomy using ultrasonic dissector compared to electrocautery. Therefore, this study aims to evaluate and compare the surgical outcomes of axillary dissection in MRM performed with electrocautery versus an ultrasonic dissector to inform optimal surgical practice.

METHODS

This randomized controlled trial (Registry No. NCT07050329) was conducted at the Department of Surgery, Bahawal Victoria Hospital, after approval from the Institutional Ethics Review (ERC: 55/DME/QAMC Bahawalpur) from 4th June 2024 to 3rd December 2024. A total of 138 women, 35-65 years of age, diagnosed with breast cancer and planned to undergo modified radical mastectomy, were consecutively enrolled after written informed consent. Women with breast cancer recurrence, undergone radiotherapy or were planned for immediate reconstruction were excluded from the study. Patients' data on age (in years) was recorded from the interview. Body mass index (BMI) was calculated after measuring patients' height (in meters) and weight (in kilograms) through standard hospital protocol and formula: weight in kg/height in meters squared. BMI ≥30 kg/m2. Patients were randomly assigned to bipolar electrocautery (Monopolar, Electrosurgical pencil, Sabro) and ultrasonic dissector (Harmonic Scalpel Ethicon®) through a lottery method. Allocation concealment was ensured through sequentially numbered, sealed, opaque envelopes prepared by an independent researcher not involved in patient enrollment or data collection. In bipolar electrocautery, the current passes only between the bipolar forceps tips, minimizing lateral thermal spread and reducing the risk of skin flap necrosis or nerve injury. The surgeon grasps the bleeding vessel between the forceps tips, and controlled current is applied to achieve hemostasis. In the ultrasonic harmonic dissector, high-frequency mechanical vibrations (around 55.5 kHz) are used to simultaneously cut and coagulate tissue. The vibrating blade denatures protein within vessel walls, forming a coagulum that seals blood vessels up to 5 mm. These procedures were performed by a single surgery team with ≥5-years of experience in breast-related surgeries as per hospital protocol. Axillary dissection was performed as per the assigned groups. The primary outcome was the incidence of seroma formation, and the secondary outcomes were duration of surgery and drain placement. Surgery duration from skin incision to surgical wound closure was recorded by the in-charge nurse and documented immediately after the procedure. The surgical field was doused with saline postoperatively, and two 18F suction drains were placed, one in the axilla and the other in the skin flaps. Patients were discharged 24-hours postoperatively, all patients with drains in place, when vitally stable, ambulatory with adequate pain control, and after teaching them the drain output measurement technique. Once a weekly follow-up was done for four weeks. The drains were removed during the follow-up period when the patients reported with drainage volume < 30 ml over 24 hours for two successive days. At each visit, seroma formation was clinically assessed by inspection and palpation for localized swelling, fluctuation, or fluid collection at the surgical site, and confirmed on ultrasonography (Toshiba (Japan), Xario 100 / 200) by the presence of an anechoic or hypoechoic fluid collection without internal echoes or septations beneath the wound. Detected seromas were treated by opening stitches and draining fluid till the time the wound became dried then it was closed by delayed primary closure. A minimum sample size of 138 participants was calculated through the WHO sample size calculator, assuming 8.5% seroma formation in the electrocautery group and none in the ultrasonic dissector group at 80% power and 5% significance level [10]. Data were analyzed through SPSS version 23.0. Normality of the numerical data was assessed through the Shapiro-Wilk test. The continuous variables like age, surgery duration, and duration of drain placement are reported as mean and standard deviation, and categorical

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variables like age groups, gender, and seroma formation are reported as frequency and percentages. Duration of surgery (minutes) and drain placement (days) between the groups are compared through an independent sample t-test, and age groups, gender, and seroma formation are compared between the groups using a chi-square test (Fisher's exact test if cell count <5). For all the comparisons, p-value<0.05 was considered significant.

RESULTS

The mean age of the participants was 50.5 ± 7.8 years, 71 (51.4%) were 50-years or below, and 72 (52.2%) were obese. Patients undergoing electrocautery and ultrasonic dissection were comparable in age and obesity (Table 1).

Table 1: Characteristics of Women Undergoing Modified Radical Mastectomy (n=138)

Characteristics	Overall (n=138)	Electrocautery (n=69)	Ultrasonic Dissector (n=69)	p-value*
Age				
Years	50.5 ± 7.8	50.1 ± 7.6	50.9 ± 8.1	0.574
≤50-Years	71 (51.4%)	37 (52.1%)	34 (47.9%)	0.609
>50-Years	67 (48.6%)	32 (47.8%)	35 (52.2%)	
Obesity				
Yes	72 (52.2%)	37 (51.4%)	35 (48.6%)	0.733
No	66 (47.8%)	32 (48.5%)	34 (51.5%)	

*Independent sample t-test for numerical comparison, chi-square test for categorical comparison

The mean duration of surgery was 47.2 ± 7.1 minutes, and drains were placed for an average duration of 5.5 ± 1.8 days. Seroma formation was observed in 14 (10.1%) cases. The mean surgery (41.5 ± 4.4 vs. 52.9 ± 4.2 minutes) and drain duration (4.0 ± 0.8 vs. 7.1 ± 1.2 days) were significantly lower in the ultrasonic dissector group compared to the electrocautery group. Similarly, seroma formation was significantly lower in the ultrasonic dissector group compared to the electrocautery group (14.3% vs. 85.7%, p-value=0.009) (Table 2).

Table 2: Outcomes of Women Undergoing Modified Radical Mastectomy (n=138)

Characteristics	Overall (n=138)	Electrocautery (n=69)	Ultrasonic Dissector (n=69)	p-value*
Surgery Duration (min)	47.2 ± 7.1	52.9 ± 4.2	41.5 ± 4.4	0.001
Drains Duration (days)	5.5 ± 1.8	7.1 ± 1.2	4.0 ± 0.8	<0.001
Seroma Formation				
Yes	14 (10.1%)	12 (85.7%)	2 (14.3%)	0.009
No	124 (89.9%)	57 (46%)	67 (54%)	

*Independent sample t-test for numerical comparison, Fisher's exact test for categorical comparison

After stratification on age and obesity, the mean surgery and drains duration and seroma formation remained significantly lower in the ultrasonic dissector group compared to the electrocautery group (Table 3).

Table 3: Effect of Women's Age and Obesity on Outcomes of Modified Radical Mastectomy (n=138)

Characteristics		Electrocautery (n=69), Mean ± SD, n (%)	Ultrasonic Dissector (n=69), Mean ± SD, n (%)	p-value*
Age				
Surgery Duration (min)	≤50-Years	52.9 ± 4.7	42.0 ± 47	<0.001
	>50-Years	52.6 ± 3.7	41.1 ± 4.0	<0.001
Drain Duration (day)	≤50-Years	7.1 ± 1.1	4.2 ± 0.7	<0.001
	>50-Years	7.0 ± 1.3	3.8 ± 0.7	<0.001
Seroma Formation (yes)	≤50-Years	5 (13.5%)	1 (2.9%)	0.201
	>50-Years	7 (21.9%)	1 (2.9%)	0.023
Obesity				
Surgery Duration (min)	Obese	54.3 ± 4.2	43.3 ± 3.8	<0.001
	Non-obese	51.0 ± 3.6	39.8 ± 4.3	<0.001
Drain Duration (day)	Obese	7.8 ± 0.9	4.5 ± 0.6	<0.001
	Non-obese	6.3 ± 0.8	3.5 ± 0.5	<0.001
Seroma Formation (yes)	Obese	12 (32.4%)	2 (5.7%)	0.006
	Non-obese	–	–	–

*Independent sample t-test for numerical comparison, Fisher's exact test for categorical comparison.

DISCUSSION

In MRM, flap and axillary dissection were traditionally performed with a cold knife. Using a cold knife reduces tissue damage and increases the collagen and tensile strength of the flaps. Bleeding, however, is a significant cold knife complication that hurts the intraoperative surgical field and lengthens the surgical procedure [11]. Decades ago, monopolar electrocautery was developed to treat surgical hemostasis. Although it has significantly decreased operating time and intraoperative hemorrhage, heat dissipation has exacerbated tissue injury in the surrounding area [12]. Research comparing the profile of inflammatory markers found in the drain fluid of MRM patients showed that, in comparison to cold knife and ultrasonic dissector, electrocautery-assisted MRM has the greatest levels of inflammatory mediators [9]. The ultrasonic dissector is based on a new technique that uses vibration instead of heat to coagulate proteins. In our study, the mean surgery time, drain duration, and seroma formation were significantly lower in the ultrasonic dissector group compared to the electrocautery group. In a study by Deori *et al.* the electrocautery group's mean operating time for axillary dissection was substantially longer than that of the ultrasonic dissector group [9]. Earlier investigation by Archana *et al.* also demonstrated this [13]. The benefit of the smokeless field when using an ultrasonic dissector helps to explain this. Seroma formation after MRM has been attributed to a variety of reasons [14]. The dissection technique is one of the many elements that have been extensively researched. In the current study, the ultrasonic dissector group's daily axillary drain output was substantially lower than that of the electrocautery group.

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This was consistent with earlier research [13, 15]. The harmonic-scalpel group experienced a significantly shorter operative time (mean 111 vs. 169.5 minutes, p<0.0001), a significantly lower incidence of seroma formation, less intraoperative blood loss, and a shorter hospital stay in a prospective study of 40 women undergoing MRM. These results closely match ours, confirming that ultrasonic dissection speeds up surgery and lowers the likelihood of seroma [16]. In a 60-patient randomized prospective study, the ultrasonic-shears group removed the drain earlier than the electrocautery group and experienced significantly fewer postoperative sequelae, such as seroma, wound infection, and flap necrosis. The efficacy advantage we reported is supported by reduced seroma and early drain removal, even if the difference in operative time and drain output was not statistically significant [17]. Seroma rates were much lower in the harmonic scalpel group (7.8% vs. 26.6%, p=0.005), with fewer hematomas, marginal necrosis, lymphedema, and wound infections, according to another cohort of 56 MRM patients. Operative time was comparable, but drainage duration and associated morbidity were obviously decreased, which is consistent with our findings of fewer seroma formations and quicker drain removal [18]. When compared to electrocautery, the use of harmonic scalpels during axillary node dissection in 98 patients with breast cancer resulted in a considerably shorter operating time, less blood loss, and an earlier drain removal. Reduced drainage discharge and quicker drain removal imply lower postoperative seroma risk, which is entirely consistent with our MRM-specific findings, even though seroma formation per se was not the main endpoint [19]. It has been hypothesized that electrocautery results in thrombosis of subdermal veins and inadequate closure of lymphatic vessels, which increases fluid coming out in the drain. However, because it causes less tissue damage, the ultrasonic dissector has a better sealing effect on lymphatic capillaries and also causes less immunological reaction, which lowers the drain output [20]. The study's design and patient randomization were among its strong points. Strong causal inference between the surgical technique and postoperative outcomes was made possible by the randomized controlled trial (RCT) design, which also reduced bias. One skilled surgical team carried out all of the procedures, guaranteeing uniformity in operating technique and lowering inter-operator variability. Additionally, baseline characteristics were similar across groups.

There were certain limitations of this study. For instance, the study did not evaluate long-term complications like lymphedema, recurrence, or delayed wound healing; instead, it presented early postoperative outcomes. Because research was only done at one institution, there is little chance that the findings will apply to other contexts, especially ones with different surgical specialties or patient demographics. Multi-center trials with bigger, more varied populations should be carried out in the future to confirm results in various clinical settings. Long-term follow-up studies are required to assess cancer recurrence, lymphedema, and wound healing.

CONCLUSIONS

Ultrasonic dissector significantly outperformed bipolar electrocautery in reducing operative time, drain duration, and seroma formation in patients undergoing MRM. It presents a more effective and clinically advantageous tool for optimizing surgical outcomes in breast cancer management.

Authors' Contribution

Conceptualization: MN
Methodology: MN, TI, SR, GD
Formal analysis: SR
Writing and drafting: MN
Review and editing: MN, TI, SR, GD

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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