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Non-infective post-mastectomy complications: A comparison of outcomes of sharp and electrocautery dissection for modified radical mastectomy

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ABSTRACT

Objectives: Post-mastectomy seroma and haematoma increase morbidity and overall healthcare costs among patients undergoing mastectomy. Electrocautery and scissors are tools frequently used to raise the flap during mastectomy, each having advantages and disadvantages as to forming seroma and haematoma. The present study compared the incidence and volume of post-mastectomy seroma and haematoma following sharp and electrocautery dissection in mobilising flaps.

Material and Methods: A two-centre prospective, randomised comparative study involving patients with histologically diagnosed breast cancer who underwent mastectomy. Participants were randomly divided into two groups. Group A had electrocautery dissection and haemostasis, while group B had scissors dissection and haemostasis achieved by ligation and pressure packing. Seroma and haematoma formation, including Volume, surgery duration of drainage, and estimated blood loss, were recorded and analysed using SPSS for Windows version 25 (IBM Corp. Armonk, NY).

Results: The incidence of seroma was 60.9% for group A and 34.8% for Group B, while the mean duration of seroma drainage in Group A was 8.1 ± 0.7 and 6.6 ± 0.7 for Group B ($p < 0.001$). The mean total volume of seroma drained in group A was 587.9 ± 84.6, while that for Group B was 470.0 ± 75.2 ($p = 0.004$). The incidence of haematoma formation was 8.7% for group A and 4.3% for Group B ($p = 0.550$).

Conclusion: Sharp dissection significantly reduces the volume and duration of seroma drainage.

Keywords: Mastectomy, Sharp and electrocautery dissection, Seroma and Haematoma.

INTRODUCTION

Mastectomy is the procedure to remove all or some of the breast tissues with or without axillary dissection to treat or prevent breast cancer. It is the most common loco-regional therapy for operable breast cancer. Modified radical mastectomy (MRM) is the removal of the entire breast tumour, necessary skin, previous biopsy scar and levels I and II axillary nodes while sparing the two pectoralis muscles or the pectoralis major. It is the surgical treatment of choice for node-positive breast cancer. With increasing awareness from health education, effective prevention strategies and access to treatment, there has been an overall increase in surgical treatment for breast cancer.[1,2]

Modified radical mastectomy may be attended by non-infective complications such as seroma and hematoma. These complications may result in prolonged drainage of the wound bed, flap necrosis, wound infection and wound dehiscence, which may be confusing and treated as an infective complication of mastectomy.[3] Non-infective wound complications following mastectomy are not routinely tracked, and data are generally limited to single-centre studies with publications reporting only one summary measure for complications after a variety of different breast reconstruction procedures.[4]

Other non-infective complications include limitation in the range of shoulder movement, chronic pain, psychological trauma, and lymphedema of the arm. Surgical site infection (SSI) may also occur. SSI is defined as post-operative infective complications that occur within thirty days of the procedure or one year if a prosthesis is applied.[5] Complications increase surgical workload, cost of care, prolonged hospitalisation, morbidity and mortality, and reduce the patient's quality of life. Good surgical practice aims to eliminate or reduce these complications by adopting safe and evidence-based techniques.

Seroma is serous or sometimes blood-stained serous fluid collection beneath the mastectomy skin flaps occurring in the post-operative period in quantities enough to cause discomfort to the patient.[6] Its incidence varies between 3% and 90%.[7] It is the most common early postoperative complication of mastectomy with or without axillary dissection.[8] Implications of post-mastectomy seroma include delayed drain removal, flap necrosis, wound infection and delayed institution of adjuvant therapy. Others are chronic pain and limitation in the range of motion of the ipsilateral arm.

Post-mastectomy wound seroma collection can be attributed, in part, to the technique and instruments used for dissection during the procedure, be it conventional scalpel, scissors, electrocautery, ultrasound scissors, harmonic scalpel device and Argon LASER. Its incidence is also influenced by the method of drainage.[9] Post mastectomy seroma results in prolongation of hospital stay, patient discomfort and increased burden of care due to frequent aspirations.[10]

Haematoma is a localised blood collection outside the blood vessel due to trauma or disease. Its incidence varies in patients undergoing cosmetic surgery like breast augmentation.[11] It contributes to worsening morbidity associated with breast surgeries, ranging from extensive ecchymosis due to low-volume haematoma to debilitating pain from rapid expansion through the closed wound space. Haematoma can impede wound healing and, therefore, impact the cosmetic outcome. It is one of the risk factors for post-mastectomy surgical site infections.[12]

Haematoma following breast surgery occurs early in 0–2% of patients, while late haematoma, although rare, can occur after 6 months.[13] The mechanism of early haematoma includes failure of postoperative haemostasis.[11] Studies have shown that the incidence of post-mastectomy wound haematoma can be reduced preoperatively by stopping medications like aspirin and ketorolac, which increase the risk of bleeding, intra-operative use of electrocautery, fibrin sealants and use of deep dermal absorbable sutures to secure haemostasis and obliterate dead space.[14,15]

Several studies have compared complications following dissection with electrocautery, scalpel, harmonic device, or ultrasonic scissors. This study was conducted in two publicly owned and operated tertiary institutions in south-south Nigeria—the Universities of Uyo and Benin Teaching Hospitals, with the same demographics and study setting.

MATERIAL AND METHODS

This study was conducted in the surgical clinics of two tertiary health institutions in southern Nigeria with facilities and personnel to provide breast cancer care and a combined bed space of 1500. The study sample was drawn from consecutive adult female patients with histologically confirmed breast cancer scheduled for modified radical mastectomy.

This prospective, randomised comparative study was conducted over seven months (November 2020 to June 2021). Consecutive patients were assigned to two groups, monopolar electrocautery (Group A) or sharp using scissors dissection (Group B) by simple randomisation using balloting. Included were consecutive consenting female patients 18 to 80 years with histologically confirmed stage II breast cancer eligible for modified radical mastectomy as well as patients with stage III disease who, by assessment, can possibly have primary wound closure while excluded were patients with distant metastases who were inoperable or who had debilitating co-morbidities rendering them unfit for surgery and those requiring multiple procedures apart from a modified radical mastectomy.

All patients had complete clinical history, examination and relevant laboratory investigations. The minimum investigations were complete blood count (CBC), liver function test (LFT), fasting blood sugar, urine analysis, electrocardiography, serum electrolyte urea creatinine, chest X-ray and abdominopelvic ultrasound scan. A skeletal survey was done where there was a clinical suspicion of metastasis to bones. Antithrombotic prophylaxis with enoxaparin (40 mg) was given on the night before the surgery. Each patient received 10 mg of diazepam for sedation on the night of surgery. Written consent was obtained after clarifying all queries from the participants. Patients were admitted 48

hours before the procedure. A written consent to participate in this study was obtained from all the participants.

The procedure was carried out under general anaesthesia. The orientation of the incision was based on the tumour's location and previous biopsy scar. Monopolar diathermy was used for Group A (the cutting and coagulation modes set at a frequency of 35–40 Hz), while Group B underwent scissors dissection. The incision encompassed the tumour, biopsy site, overlying skin, nipple-areolar complex and 2 cm skin margin free of the macroscopic tumour was made using a scalpel.

Flaps were raised to the clavicle superiorly, the anterior margin of the latissimus dorsi muscle laterally, the edge of the sternum medially, and the 6th rib or 3 cm below the inframammary fold inferiorly. In group A, haemostasis was secured by digital pressure, gauze packing, and electrocoagulation, while in group B, suture ligation, digital pressure, and packing with gauze were used. The breast was dissected en bloc from the chest wall. Levels I and II axillary nodes were included in the mastectomy specimen. Negative pressure drains were inserted.

Estimation of intraoperative blood loss was done by weighing the sponges and gauze pads used pre- and post-operatively using a weighing scale (Precision Electronic Balance Model XY1000-1B, M/S. Contech Instruments Ltd, Turbhe, Navi Mumbai-40075. India). The difference between the dry and wet weight expressed in ml was added to the blood volume in the suction containers. The 4 × 4 cm gauze was estimated to hold approximately 10 mls, and the 30 × 30 cm laparotomy pads had approximately 100 mls of blood. These values were added to the total blood loss.

Drains were removed when the effluent volume was 30–50 mls in 24 hours for two consecutive days, between the 7th and 10th day post-operatively. No patient went home with a drain in situ. Seroma monitoring commenced on day 3 and subsequently on days 5, 7, and 10. Further monitoring occurred at the outpatient clinic on days 14, 21, and 30. No patient required ultrasound scan confirmation for haematoma and residual seroma collection.

Residual seroma was aseptically aspirated, and the volume was recorded. Skin sutures were removed on the 10th day post-operatively, and the patient was discharged.

Data was analysed using SPSS for Windows version 25 (IBM Inc. Chicago, Illinois, U.S.A). Results are demonstrated in percentages and tables. The student's t-test was used to compare continuous variables, while chi-square or Fisher's exact test was used for categorical variables. A $p < 0.05$ was considered significant.

Approval was obtained from the Institutional Health Research Ethics Committee (IHREC) of the Universities of Uyo (UUTH/AD/S/96/VOL.XXI/275) and Benin (ADM/E22/A/VOL.VII/1483034) Teaching Hospitals.

RESULTS

Patient characteristics: A total of 46 participants were enrolled in the study; twenty-three (23) were in each group. Characteristics such as age, body mass index, hypertension and tumour site were found not to have any statistical significance on both groups that might have affected the outcomes differently as shown in Table 1 ($P > 0.05$).

Table 1: Clinical Characteristics of Participants.

Variable	Total (n = 46)	Electrocautery (n = 23)	Sharp (n = 23)	χ^2/fisher's exact/t-Test	P-Value
Age (Mean ± SD) in years	47.0 ± 12.2	49.1 ± 11.4	45.0 ± 12.8	1.164t	0.251
Range	25-73	27-66	25-73		
BMI (Kg/m²):	25.2 ± 3.1	24.8 ± 2.6	25.6 ± 3.5	–0.879 t	0.384
• **Normal weight**	22 (47.8)	12 (52.2)	10 (43.5)	1.914f	0.487
• **Overweight**	19 (41.3)	10 (43.5)	9 (39.1)		
• **Obesity**	5 (10.9)	1 (4.3)	4 (17.4)		
Hypertension:					
• **Present**	13 (28.3)	7 (30.4)	6 (26.1)	0.107f	0.743
• **Absent**	33 (71.7)	16 (69.6)	17 (73.9)		

[f]Fisher's exact, [t]t- test, $x^2 = chi^2$, BMI = Body mass index, SD = Standard deviation

These characteristics were independently evaluated to assess if they directly influence seroma and haematoma formation in both groups. As shown in Table 2, there was no statistically significant difference in seroma and haematoma formation ($P > 0.05$).

Table 2: TNM distribution (stage grouping).

Stage	Electrocautery	Sharp	(n = 46)	χ^2	P-value
II	2 (8.7)	5 (21.7)	7 (15.2)	1.517	0.218
III	21 (91.3)	18 (78.3)	39 (84.8)		

TNM: Tumour, Node, Metastasis.

For both groups, most patients were in stage 3. As shown in Table 3, there was no significant statistical difference in the tumour stage between both groups with P > 0.05.

The duration of surgery and estimated blood loss were documented as the major intra-operative variables, as seen in Table 4 below.

The total average volume drained and average duration of drainage in days was significantly higher in patients who underwent electrocautery than those who underwent sharp dissection, P-value < 0.05 [Table 5]. There was no significant statistical difference in the maximum volume drained. Minimum volume drained and average daily drainage between patients in the electrocautery and those in the sharp dissection group, P-value > 0.05.

Seroma formation was 60.9% in the electrocautery group as against 34.8% in the sharp dissection group. However, a statistical significance test did not show any difference, P = 0.077. There was also no statistical difference in both groups for the number of patients with seroma aspiration, P > 0.05 [Table 6].

The mean duration of surgery and mean estimated blood loss were significantly lower in patients who underwent

Table 3: Independent sample test for seroma and haematoma formation.

Variable	Number	Overall Seroma formation	Overall Haematoma formation	fisher's exact/t-Test	P-value
Age (Mean ± SD) in years					
BMI (Kg/m²):	6	48.0 ± 8.9	54.0 ± 12.8	–0.667 t	0.542
• **Normal**	2 (33.3)	0 (0.0)	2 (66.7)	4.000 f	0.135
• **Overweight**	2 (33.3)	1 (33.3)	1 (33.3)		
• **Obesity**	2 (33.3)	2 (66.7)	0 (0.0)		
Hypertension:					
• **Present**	4 (66.7)	2 (66.7)	2 (66.7)	0.000 f	1.000
• **Absent**	2 (33.3)	1 (33.3)	1 (33.3)		

[f]Fisher's exact, [t]t-test, SD = Standard deviation, BMI = Body mass index

Table 4: Intra-operative variables.

	Electrocautery Mean ± SD Range	Sharp Mean SD Range	t-Test	P-value
Duration of Surgery (mean ± SD in minutes)	113.7 ± 17.6 90-162	123.7 ± 15.3 100-170	–2.059	0.045*
Estimated Blood loss (mean ± SD in ml)	487.4 ± 111.7 320-750	587.8 ± 194.7 350-1100	–2.146	0.037*

SD: Standard deviation, *P-value < 0.05

Table 5: Seroma assessment (Primary outcome).

	Electrocautery Mean ± SD Range	Sharp Mean ± SD Range	t-Test	P-value
Total Volume drained (ml)	587.9 ± 84.6 470-750	470.0 ± 75.2 370–580	3.265	0.004*
Maximum Volume drained (ml)	121.1 ± 19.4 100–180	117.5 ± 9.3 105–130	0.486	0.633
Minimum Volume drained (ml)	19.3 ± 7.8 10–30	22.5 ± 11.3 10–40	–0.788	0.440
Average duration of drainage (in days)	8.1 ± 0.7 7–9	6.6 ± 0.7 6–8	4.946	<0.001*
Average daily drainage (ml/day)	72.1 ± 7.6 58.9–83.3	70.7 ± 5.7 61.7–80	0.156	0.657

SD = Standard deviation, *P-value = 0.05

Table 6: Comparison of seroma formation and aspiration.

	Electrocautery (n = 23)	Sharp (n = 23)	Total (n = 46)	χ^2/fisher's exact	P-value
Total number of patients that formed seroma	14(60.9)	8(34.8)	22(47.8)	3.136 x2	0.077
Number of aspirations	2(8.7)	1(4.3)	3(6.5)	0.357 f	0.550

[f]Fisher's exact, x^2 = chi^2

Table 7: Haematoma assessment (primary outcome).

	Electrocautery (n = 23)	Sharp (n = 23)	Total (n = 46)	fisher's exact/t-Test	P-value
Total number that formed haematoma	2(8.7)	1(4.3)	3(6.5)	0.357 f	0.550
The total Volume of haematoma formed	70.0 ± 14.1	100		-1.732t	0.333
Incidence of haematoma	2(8.7)	1(4.3)	3(6.5)	0.357 f	0.550

[f]Fisher's exact, [t]t-test

electrocautery than those who underwent sharp treatment, P-value < 0.05

There was no significant statistical difference in the total number of patients who formed haematomas, the total Volume of haematomas formed, or the incidence of a haematoma between the electrocautery and sharp dissection groups, P-value > 0.05 [Table 7].

DISCUSSION

Post-operative seroma and haematoma are known complications in patients undergoing mastectomy. Studies have examined multiple patient characteristics as possible risks for their occurrence, and the conclusions have not shown a consistent pattern. This is the first study in the two participating institutions on aspects of post-mastectomy complications. Our findings did not show the age of patients, their body mass index (BMI), and the presence of hypertension to be risk factors for the development of post-operative seroma or haematoma; neither did these factors determine the volume and duration of drainage of seroma in either arm of the study in which most of the participants had stage III disease. Post-operative seroma occurred with both electrocautery and scissors dissectionv. Still, its incidence, total volume, and duration of drainage were significantly higher in patients who underwent electrocautery flap dissection than in scissors dissection [Table 5]. The surgery duration and intra-operative blood loss volume were significantly more with scissors dissection [Table 6]. However, the incidence and volume of post-extubation seroma and haematoma between the two groups requiring needle aspiration during follow-up clinic visits were insignificant.

Some studies associate post-mastectomy seroma with increasing patient age and BMI. Our patients were young and middle-aged at diagnosis and surgery (mean age of 47 ± 12.2 years). Their ages were not independently found to be a risk factor for either post-operative seroma or haematoma formation in either arm of our study. Garzali made a similar conclusion in a survey of the incidence of post-mastectomy seroma in North-Western Nigeria.[16] Some other studies regarding age as a risk factor for postoperative seroma were inconclusive.[17,18] BMI was equally not found in our study to be independently significant for seroma and haematoma formation in either group; only 5 (10.9%) participants were obese, others being normal or overweight. Jabir[19] and Wings[20] made a similar observation, but Alawad[21] and Jacek[22] reported a positive association between body weight and seroma formation. At the same time, Santosh observed the incidence of seroma to be higher in individuals with BMI > 25,[23] and they further premised that seroma can be predicted even on the first postoperative day if the drain volume exceeded 150 ml. Other studies show that a longer operative time, as seen in modified radical mastectomy, increases the risk of seroma formation.[24]

Hypertension is another factor considered a risk for post-operative seroma and haematoma formation. Hypertension was present in 13 (28.3%) of our patients. However, we did not find it to be a risk factor for post-operative seroma or haematoma formation in our study. Xiao-Fen[6] and Jabir[19] made similar conclusions, but Wings[20] and Santosh[23] observed an increased incidence of seroma among hypertensives undergoing mastectomy. Independent assessment of participants who developed both seroma and haematoma did not show an association with BMI or hypertension.

Factors like diabetes mellitus, the skill of the operating surgeon and exposure of the patient to chemotherapeutic agents were studied by other researchers as possible risks for seroma and haematoma formation. Some studies consistently report a positive association between the presence of diabetes mellitus and seroma formation.[25] Still, there was inconclusive

evidence regarding a surgeon's skill or experience with postoperative complications or outcomes.[26–28] A study by Lorentzen et al showed that neoadjuvant chemotherapy use was not associated with an increased risk of non-infective wound complications after controlling for underlying co-morbidities and other risk factors.[29]

Post-operative seroma was a critical complication in this study. We observed a significant increase in the total Volume of seroma formed, the maximum Volume drained, the average daily Volume drained, and the duration of drainage in the electrocautery group compared to scissors; we could still aspirate seroma in a few of these patients even in the third week, similar to findings by Hasnat[30] and Porter.[31]

Studies report a wide variation in the incidence of post-mastectomy wound seroma ranging between 3% and 90%,[5,32,33] those comparing electrocautery, harmonic scalpel and conventional scalpel use in mastectomy confirm a lower incidence of seroma with dissection using a conventional scalpel.[33,34] Chavan *et al*.[35] compared electrocautery and scalpel dissection in modified radical mastectomy and found less post-operative seroma in the scalpel group. Yilmaz[24] compared ultrasonic scissors to electrocautery and scalpel and concluded that ultrasonic dissectors reduced seroma formation owing to a less inflammatory response from tissue injury. They reported that the Vseroma volume was directly related to complications such as wound dehiscence and infection. Although appreciably lower in the sharp dissection arm, the differences in the complication rates in both groups were not statistically significant with $P > 0.05$. This we consider may be due to the population size in this study. Tomasz[36] observed that electrocautery was associated with a 20% incidence of seroma formation, while none was recorded using the harmonic scalpel. A prospective study in Iran showed that the type of surgery has a significant effect on seroma formation and that modified radical mastectomy was significantly associated with seroma formation compared to breast-conserving surgery.[37]

The pathophysiological mechanism of seroma formation in patients undergoing electrocautery dissection is thought to be due to thermal injury.[38] According to Faisal,[39] electrocautery causes more tissue inflammation and the biochemistry of seroma is inflammatory. The consequent local inflammatory reaction and resultant exudate formation reflect the increased intensity and prolongation of the first phase of wound repair.[39] Postoperative seroma causes discomfort and may delay healing. Seroma can be prevented by reducing potential dead space with flap fixation, and the obliteration of the axillary region with quilting sutures is believed to reduce the volume and incidence of seroma formation beneath the mastectomy flaps.[40] Lin observed that seroma formation and aspiration frequency were less in patients with prolonged low-pressure suction drainage of the operative field, unlike those with short-term drainage or no drainage catheters.[41] Eleanor[42] concluded that prevention is the key to seroma management, and the most frequently employed technique for prevention is closed suction drainage. Early drain removal in mastectomy is associated with improved quality of life and is safe.[17,20] A direct implication of prolonged duration of wound drainage in patients undergoing electrocautery dissection is increased risk of postoperative wound infection and nurses' workload.

The mean surgery duration and intra-operative blood loss volume were significantly lower in the electrocautery arm of the study. Porter[31] previously made the same observation. Reducing operative time and blood loss is an important benefit of electrocautery dissection, as these patients had a shorter exposure to anaesthesia. However, cautery was associated with a higher incidence of haematoma.

The incidence of haematoma formation in this study was low in both groups. In the electrocautery group, the incidence was 8.7% against 4.3% in the sharp dissection group; however, there was no statistical difference when compared using Fisher's exact test. Findings in this study were similar to that of Bangaly, who, in a 10-year retrospective study, reported an overall incidence of haematoma of 9.6%.[43] Post-operative haematoma contributes to worsening morbidity, including increased risk of postoperative infection, extensive ecchymosis from low-volume hematoma and debilitating pain from chronic expanding hematoma through the closed wound space, which can be treated with intralesional triamcinolone injection.[44]

Studies have shown that widespread use of electrocautery compared to scalpel dissection has reduced the incidence of this complication owing to better haemostasis. Seth *et al*.,[45] in a 10-year retrospective study, reviewed the demographic and operative factors and information on haematoma formation of patients who had a mastectomy with immediate reconstruction. They concluded that the risk of postoperative haematoma is not affected by any measurable preoperative, operative or oncologic factors.

Limitation of study: The small number of patients in this study and the non-representation of patients in all adult age groupings limit our findings' national and universal application; well-distributed national and regional studies involving multiple sites may produce a more representative observation.

CONCLUSION

The instrument used for flap dissection in mastectomy is a significant risk factor for the formation of seroma and haematoma. Sharp (scissors) and electrocautery dissection have advantages and disadvantages which should be exploited

to obtain an optimum outcome for patients undergoing mastectomy.

Ethical approval

The Institutional Review Board approved the research/study at Uyo and Benin Teaching Hospitals, number UUTH/AD/S/96/VOL. XXI/275 (Uyo), ADM/E22/A/VOL. VII/1483034 (Benin), dated 2019.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that no artificial intelligence (AI)-assisted technology was used to assist in the writing or editing of the manuscript, and no images were manipulated using AI.

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