

Original Research Article

EVALUATION OF TOPICAL TRANEXAMIC ACID IN REDUCING POSTOPERATIVE WOUND DRAINAGE FOLLOWING MODIFIED RADICAL MASTECTOMY

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ABSTRACT

Background: Seroma formation is one of the most common postoperative complications following modified radical mastectomy and contributes to prolonged drain duration, delayed wound healing, increased hospital stay, and patient discomfort. Tranexamic acid, an antifibrinolytic agent, has shown potential in minimizing postoperative bleeding and fluid collection when applied topically. The aim is to evaluate the effect of topical application of tranexamic acid on postoperative wound drainage and seroma formation following modified radical mastectomy.

Materials and Methods: This prospective comparative study was conducted over a period of 12 months in the Department of General Surgery at a tertiary care center. A total of 60 female patients undergoing modified radical mastectomy for carcinoma breast were included in the study. Patients were divided into two groups of 30 each. Group A received topical tranexamic acid application over the surgical field before wound closure, while Group B underwent conventional wound closure without tranexamic acid. Closed suction drains were placed in all patients. Postoperative parameters were recorded and analyzed. Statistical analysis was performed using appropriate tests, and a p-value of less than 0.05 was considered statistically significant.

Results: The mean age of patients in Group A was 52.6 ± 8.4 years, while in Group B it was 54.1 ± 7.9 years, with no significant difference between the groups. The mean postoperative drain output was significantly lower in Group A (412.5 ± 96.8 mL) compared to Group B (598.4 ± 118.2 mL) ($p < 0.01$). The mean duration of drain placement was shorter in the tranexamic acid group (5.3 ± 1.2 days) compared to the control group (7.1 ± 1.5 days) ($p < 0.01$). Seroma formation occurred in 4 (13.3%) patients in Group A and 11 (36.7%) patients in Group B, demonstrating a statistically significant reduction in the study group ($p = 0.03$). Wound-related complications were less frequent in the tranexamic acid group. The mean hospital stay was significantly reduced in Group A compared to Group B (6.2 ± 1.3 days vs. 8.0 ± 1.7 days; $p < 0.01$).

Conclusion: Topical application of tranexamic acid following modified radical mastectomy effectively reduces postoperative wound drainage, duration of drain placement, seroma formation, and hospital stay. It is a safe, simple, and cost-effective adjunct that may improve postoperative recovery and reduce morbidity associated with breast cancer surgery.

Keywords: Breast carcinoma; Modified radical mastectomy; Seroma formation; Topical tranexamic acid; Wound drainage

INTRODUCTION

Breast carcinoma is the most common malignancy affecting women worldwide and remains a major

public health concern due to its increasing incidence and associated morbidity.^[1] Surgical management continues to play a central role in the treatment of breast cancer despite advances in chemotherapy,

radiotherapy, hormonal therapy, and targeted therapy.^[2]

Modified radical mastectomy (MRM) is one of the most frequently performed surgical procedures for operable carcinoma breast, particularly in patients presenting with locally advanced disease or in settings where breast-conserving surgery is not feasible.^[3] The procedure involves removal of the entire breast tissue along with axillary lymph node dissection while preserving the pectoralis major muscle. Although MRM is considered an effective oncological procedure, it is commonly associated with postoperative complications that may adversely affect patient recovery and quality of life.^[4]

Among the various postoperative complications following modified radical mastectomy, seroma formation is the most common and troublesome complication.^[5] Seroma is defined as the accumulation of serous fluid beneath the skin flaps or in the axillary dead space following surgery.^[6,7] The reported incidence of seroma formation after MRM ranges widely from 15% to 85%, depending on surgical technique, extent of axillary dissection, use of electrocautery, and postoperative management protocols.^[8] Seroma formation contributes significantly to postoperative morbidity by causing patient discomfort, flap tension, delayed wound healing, repeated aspirations, risk of infection, prolonged drain placement, and increased duration of hospital stay. Persistent seroma may also delay initiation of adjuvant therapies.^[9]

The exact pathophysiology of seroma formation remains incompletely understood. It is believed to result from inflammatory exudation and lymphatic leakage due to extensive tissue dissection and disruption of lymphatic channels during surgery.^[10] Various methods have been proposed to reduce postoperative drainage and seroma formation, including the use of suction drains, quilting sutures, flap fixation techniques, fibrin sealants, pressure dressings, and tissue adhesives. However, none of these methods has completely eliminated the problem, and seroma formation continues to remain a significant postoperative challenge in breast surgery.^[11]

Tranexamic acid is a synthetic antifibrinolytic agent that acts by inhibiting the activation of plasminogen to plasmin, thereby reducing fibrinolysis and blood loss. It has been widely used in various surgical specialties including orthopedic, cardiac, trauma, and gynecological surgeries to minimize perioperative bleeding.^[12] More recently, topical application of tranexamic acid has gained attention because it delivers high local concentrations at the surgical site while minimizing systemic absorption and adverse effects. In breast surgery, topical tranexamic acid may reduce postoperative ooze, inflammatory exudation, and lymphatic leakage, thereby decreasing wound drainage and seroma formation.^[13,14]

Several recent studies have suggested that topical tranexamic acid may reduce drain output and

postoperative fluid collection after breast surgery. Furthermore, studies evaluating its effectiveness in Indian tertiary care settings are comparatively few. Establishing an effective, simple, and economical method to reduce postoperative morbidity can significantly improve patient outcomes and reduce healthcare burden.

Aims and Objectives

- To evaluate the effect of topical application of tranexamic acid on postoperative wound drainage and seroma formation following modified radical mastectomy.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of General Surgery at Sree Mookambika Institute of Medical Sciences over a period of 12 months from January 2025 to December 2025. Informed written consent was obtained from all patients prior to participation.

Female patients aged >18 years with histologically confirmed carcinoma breast undergoing elective modified radical mastectomy were included. Patients with operable breast cancer, irrespective of menopausal status, and those who had received neoadjuvant chemotherapy but were fit for surgery were also included.

Patients with bleeding or coagulation disorders, severe hepatic or renal dysfunction, hypersensitivity to tranexamic acid, recurrent or locally advanced unresectable disease, distant metastasis, active surgical site infection, or undergoing breast-conserving surgery were excluded. Patients on anticoagulant therapy, with a history of thromboembolic disorders, as well as pregnant and lactating women, were also excluded.

A total of 60 female patients diagnosed with carcinoma breast and planned for modified radical mastectomy were included in the study. Patients were allocated into two groups comprising 30 patients each. Group A received topical tranexamic acid application before wound closure, while Group B underwent conventional wound closure without tranexamic acid application. Allocation was performed based on institutional protocol and surgeon preference. All patients underwent detailed clinical evaluation including history taking, physical examination, staging workup, and routine preoperative investigations. Baseline demographic data, tumor characteristics, associated comorbidities such as diabetes mellitus and hypertension, and previous treatment history were recorded.

All surgeries were performed under general anaesthesia using a standardized modified radical mastectomy technique with axillary clearance. Hemostasis was meticulously secured intraoperatively in all cases. In Group A, after completion of the procedure and achievement of surgical hemostasis, topical tranexamic acid solution was applied uniformly over the surgical field and

axillary bed before wound closure. The solution was allowed to remain in contact with the tissues for a few minutes before placement of closed suction drains. In Group B, standard wound closure was performed without tranexamic acid application. Closed suction drains were placed in the axillary and chest wall regions in all patients before closure of the wound. Postoperative monitoring was carried out in all patients with assessment of daily drain output, drain duration, wound status, and occurrence of seroma formation. Drains were removed when the output was less than 30 mL over a 24-hour period. Seroma formation was diagnosed clinically by the presence of fluctuant swelling at the operative site after drain removal and was managed with aspiration when required. Other postoperative complications including flap necrosis, surgical site infection, hematoma formation, and wound dehiscence were also recorded. Duration of hospital stay and requirement for repeated aspirations were documented. All collected data were entered into a structured proforma and analyzed using appropriate statistical methods. Continuous variables were expressed as

mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Statistical analysis was performed using SPSS software. The independent t-test and chi-square test were used for comparison between groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Patients were divided equally into Group A (topical tranexamic acid application) and Group B (conventional closure without tranexamic acid), with 30 patients in each group. Most patients belonged to the age group of 41–60 years, and infiltrating ductal carcinoma was the predominant histological subtype observed in both groups. Both study groups were comparable with respect to age distribution, comorbidities, and tumor stage, with no statistically significant differences observed ($p > 0.05$). Majority of patients in both groups belonged to Stage II disease, indicating similar baseline clinical characteristics suitable for comparative evaluation. [Table 1]

Table 1: Demographic and Clinical Characteristics of Study Population

Variable	Category	Group A n (%)	Group B n (%)	p-value
Age Group (years)	≤ 40	6 (20.0%)	5 (16.7%)	0.91
	41–50	11 (36.7%)	12 (40.0%)	
	51–60	9 (30.0%)	8 (26.7%)	
	> 60	4 (13.3%)	5 (16.7%)	
Diabetes Mellitus	Present	10 (33.3%)	11 (36.7%)	0.79
	Absent	20 (66.7%)	19 (63.3%)	
Hypertension	Present	9 (30.0%)	8 (26.7%)	0.77
	Absent	21 (70.0%)	22 (73.3%)	
Tumor Stage	Stage I	5 (16.7%)	4 (13.3%)	0.88
	Stage II	17 (56.7%)	18 (60.0%)	
	Stage III	8 (26.7%)	8 (26.7%)	

Patients in the tranexamic acid group demonstrated significantly lower postoperative drain output, shorter drain duration, and reduced hospital stay compared to the conventional closure group ($p <$

0.01). These findings indicate improved postoperative recovery and reduced morbidity with topical tranexamic acid application. [Table 2]

Table 2: Postoperative Recovery Parameters

Parameter	Group A (Mean $\pm$ SD)	Group B (Mean $\pm$ SD)	p-value
Total drain output (mL)	412.5 $\pm$ 96.8	598.4 $\pm$ 118.2	$< 0.01^*$
Drain duration (days)	5.3 $\pm$ 1.2	7.1 $\pm$ 1.5	$< 0.01^*$
Hospital stay (days)	6.2 $\pm$ 1.3	8.0 $\pm$ 1.7	$< 0.01^*$

The incidence of seroma formation and requirement for seroma aspiration were significantly lower in the tranexamic acid group ($p < 0.05$). Although surgical

site infection and flap necrosis were less common in Group A, the difference was not statistically significant. [Table 3]

Table 3: Postoperative Complications

Complication	Category	Group A n (%)	Group B n (%)	p-value
Seroma formation	Present	4 (13.3%)	11 (36.7%)	0.03*
	Absent	26 (86.7%)	19 (63.3%)	
Seroma aspiration required	Present	3 (10.0%)	9 (30.0%)	0.04*
	Absent	27 (90.0%)	21 (70.0%)	
Surgical site infection	Present	2 (6.7%)	5 (16.7%)	0.22
	Absent	28 (93.3%)	25 (83.3%)	
Flap necrosis	Present	1 (3.3%)	4 (13.3%)	0.16
	Absent	29 (96.7%)	26 (86.7%)	

Seroma formation showed significant association with diabetes mellitus, prolonged drain duration, increased drain output, and conventional wound closure technique ($p < 0.05$). Patients treated with topical tranexamic acid had significantly lower rates

of postoperative seroma formation, suggesting its beneficial role in reducing postoperative fluid accumulation after modified radical mastectomy. [Table 4]

Table 4: Correlation of Clinical Variables with Seroma Formation

Variable	Category	Seroma Present n (%)	Seroma Absent n (%)	p-value
Age Group	≤50 years	5 (14.7%)	29 (85.3%)	0.18
	>50 years	10 (38.5%)	16 (61.5%)	
Diabetes Mellitus	Present	9 (42.9%)	12 (57.1%)	0.02
	Absent	6 (15.4%)	33 (84.6%)	
Drain Duration	≤6 days	4 (12.5%)	28 (87.5%)	0.01
	>6 days	11 (39.3%)	17 (60.7%)	
Total Drain Output	≤500 mL	3 (10.7%)	25 (89.3%)	<0.01
	>500 mL	12 (37.5%)	20 (62.5%)	
Type of Closure	Tranexamic acid	4 (13.3%)	26 (86.7%)	0.03
	Conventional	11 (36.7%)	19 (63.3%)	

DISCUSSION

The present study evaluated the effect of topical tranexamic acid application on postoperative wound drainage and seroma formation following modified radical mastectomy in 60 patients. Thirty patients received topical tranexamic acid before wound closure, while 30 patients underwent conventional closure without tranexamic acid. The study demonstrated that topical tranexamic acid significantly reduced postoperative drain output, drain duration, seroma formation, and hospital stay, thereby improving postoperative recovery and reducing morbidity.

The majority of patients belonged to the age group of 41–60 years, accounting for 20 (66.7%) patients in both groups. Baseline demographic characteristics and comorbid conditions such as diabetes mellitus and hypertension were comparable between the two groups. Most patients presented with Stage II carcinoma breast, observed in 17 (56.7%) patients in Group A and 18 (60.0%) patients in Group B. Similar age distribution was reported by Thomas GR et al,^[14] who observed that most patients undergoing modified radical mastectomy belonged to the 50–60 years age group.

Postoperative wound drainage was significantly lower in patients who received topical tranexamic acid. The mean total drain output in Group A was 412.5 ± 96.8 mL compared to 598.4 ± 118.2 mL in Group B. Reduced postoperative drainage may be attributed to the antifibrinolytic effect of tranexamic acid, which decreases capillary ooze and tissue exudation. Comparable findings were reported by Eldesouky MS et al,^[15] who demonstrated significantly lower wound drainage in the tranexamic acid group (798.06 ± 107.3 mL) compared to controls (1067.1 ± 188.6 mL). Similar reduction in drain output was also observed by Ahmed FM et al,^[16] who reported significantly lower drain volumes in patients receiving tranexamic acid compared to placebo.

The mean duration of drain placement was shorter in the tranexamic acid group (5.3 ± 1.2 days) compared to the control group (7.1 ± 1.5 days). Earlier drain

removal facilitated faster mobilization and improved patient comfort. Similar observations were made by Rose K et al,^[17] who reported significantly earlier drain removal in patients receiving tranexamic acid. Guggenheim L et al,^[18] also demonstrated significantly shorter drain duration and reduced hospital stay in patients receiving tranexamic acid following breast surgery.

Seroma formation remained one of the most important postoperative complications following modified radical mastectomy. In the present study, seroma developed in 4 (13.3%) patients in the tranexamic acid group compared to 11 (36.7%) patients in the control group. Repeated seroma aspiration was required in only 3 (10.0%) patients in Group A compared to 9 (30.0%) patients in Group B. These findings indicate that topical tranexamic acid effectively minimizes postoperative fluid accumulation and reduces the need for repeated interventions. Similar reduction in clinically detectable seroma was observed by Ahmed FM et al,^[16] who reported lower seroma rates in patients treated with tranexamic acid. MadhuBabu M et al,^[19] also observed lower postoperative seroma formation in the tranexamic acid group, although the difference was not statistically significant.

Postoperative wound complications were comparatively lower in the tranexamic acid group. Surgical site infection occurred in 2 (6.7%) patients in Group A and 5 (16.7%) patients in Group B, while flap necrosis was observed in 1 (3.3%) and 4 (13.3%) patients respectively. Although these differences were not statistically significant, the overall trend favored topical tranexamic acid application. Similar findings were reported by Ahmed FM et al,^[16] who demonstrated reduced wound infection and lower rates of wound-related complications in the tranexamic acid group. Rose K et al,^[17] also reported significantly fewer wound healing complications following tranexamic acid administration.

The mean duration of hospital stay was significantly reduced in Group A (6.2 ± 1.3 days) compared to Group B (8.0 ± 1.7 days), suggesting improved postoperative recovery and reduced healthcare

burden. Comparable reduction in hospital stay was reported by Guggenheim L et al,^[18] and MadhuBabu M et al,^[19] both of whom demonstrated improved postoperative recovery with tranexamic acid use. Comparable evidence was also provided by Calpin GG et al,^[20] who performed a systematic review involving 1446 patients undergoing 1830 breast surgery procedures. Tranexamic acid was administered in 797 (43.6%) cases and was associated with a significant reduction in haematoma and seroma formation compared to controls.

Correlation analysis in the present study revealed that seroma formation was significantly associated with diabetes mellitus, prolonged drain duration, increased drain output, and conventional wound closure technique. Seroma developed in 9 (42.9%) diabetic patients compared to 6 (15.4%) non-diabetic patients. Patients with drain duration exceeding 6 days and drain output greater than 500 mL also showed significantly higher rates of seroma formation. These findings highlight the role of topical tranexamic acid in reducing postoperative morbidity by minimizing wound drainage and seroma formation.

CONCLUSION

Topical application of tranexamic acid during modified radical mastectomy significantly reduced postoperative wound drainage, drain duration, seroma formation, and length of hospital stay. Patients receiving tranexamic acid demonstrated improved postoperative recovery with lower requirement for seroma aspiration and fewer wound-related complications. The study also identified diabetes mellitus, prolonged drain duration, and increased drain output as important factors associated with seroma formation. Topical tranexamic acid was found to be a safe, simple, and effective adjunct in breast surgery without significant adverse effects. Its routine use may help reduce postoperative morbidity and improve surgical outcomes following modified radical mastectomy.

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