ORIGINAL ARTICLE

ANNALS OF PUNJAB MEDICAL COLLEGE

OPEN ACCESS

Comparison of Postoperative Outcomes of Modified Radical Mastectomy (MRM) with and without Tumescent Technique

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Submitted for Publication: 12-06-2026
Revision Received: 20-06-2026
Accepted for Publication: 22-06-2026

ABSTRACT

Background: Modified radical mastectomy (MRM) is one of the common surgical approaches to breast cancer. The tumescent technique could help to reduce postoperative morbidity and enhance operative efficiency. **Objective:** To compare postoperative results of MRM with and without using the tumescent technique. **Study Design:** Randomized, controlled trial. **Settings:** Department of Surgery, Allied Hospital, Faisalabad, Pakistan. **Duration:** One year from 01-04-2023 to 31-03-2024. **Methods:** This was a randomized, comparative study of 230 female patients undergoing MRM, divided into 2 groups of 115 patients. The tumescent technique was used in Group A, and conventional MRM in Group B. Demographic variables, tumor characteristics, operative duration, and postoperative complications were recorded. Data was analyzed using SPSS v. 25.0. For categorical variables, the chi-square test was used, while the independent t-test was used for continuous variables ($p < 0.05$). **Results:** In several categories, the results were much better with the tumescent method. The operative time was significantly shorter in the tumescent group, with 28.7% of cases taking less than 90 minutes, compared with 50.4% of the conventional group taking more than 120 minutes ($p < 0.001$). There were fewer cases of seroma in the tumescent group (7.0%) than in the conventional group (16.5%) ($p = 0.024$). Finally, there was a trend toward decreased wound infection in the tumescent group (6.1% vs 10.4%), but this difference was not statistically significant ($p = 0.231$). The incidence of hematoma and flap necrosis did not differ between the tumescent and conventional groups, and only 3.5% of the conventional group experienced these complications ($p = 0.044$). Stratified analysis showed greater benefit in obese patients (5.6% vs 24.2%, $p = 0.028$) and ASA-III patients (2.9% vs 18.6%, $p = 0.030$). **Conclusion:** The tumescent technique results in a significant reduction of operative time, seroma formation, hematoma, and flap necrosis, especially in high-risk patients in MRM.

Keywords: *Modified radical mastectomy, Tumescent technique, Seroma, Breast cancer surgery, Hematoma, Flap necrosis.*

How to Cite: Iqbal MS, Arsalan M, Choudry ZA, Haider M, Ali S, Rohili SA, Shaukat M. Comparison of Postoperative Outcomes of Modified Radical Mastectomy (MRM) with and without Tumescent Technique. APMC 2026;20(2):67-71. DOI: 10.29054/APMC/2026.1933

INTRODUCTION

Breast cancer is the most common malignancy in women worldwide, with over 2.3 million new cases diagnosed annually and accounting for approximately 685,000 deaths in 2020.[1] Modified radical mastectomy (MRM) combined with axillary lymph node dissection (ALND) remains a cornerstone of surgical treatment, particularly in resource-limited settings and locally advanced disease.[2] Although oncological surgery advances have improved, the recovery from breast surgery with significant postoperative morbidity like seroma, infection, hematoma, and flap necrosis remains a challenge, especially in resource-limited areas and in locally advanced breast cancer.[3]

Conventional MRM typically employs electrocautery for dissection, which, while effective for hemostasis, may cause thermal tissue injury to skin flaps and potentially compromise wound healing.[4] Tumescent local anesthesia (TLA), first systematized by Klein in 1987 and subsequently refined for breast surgery, involves the subcutaneous infiltration of a dilute solution of lidocaine and epinephrine in crystalloid, creating hydrostatic planes that facilitate sharp dissection.[5,6] The underlying mechanisms of tumescent dissection have been well described: mechanical tamponade provided by high-volume infiltration and the epinephrine-induced vasoconstriction lead to significantly less bleeding during surgery, while the

anesthetic effect extends the duration of postoperative pain relief for 18–24 hours.[7]

Previous studies have shown promising results with the tumescent method. Abdelkader *et al*. demonstrated that the tumescent technique reduced seroma rates (6.67% vs. 16.67%) and eliminated hematoma and flap necrosis compared to conventional electrocautery in MRM.[8] In contrast, a large randomized trial by Lautrup *et al*. (n=357) found no statistically significant differences in seroma volume, infection, or flap necrosis between techniques, highlighting the need for further rigorous comparative data.[9] The present study was designed to contribute higher-quality evidence by comparing postoperative outcomes of MRM with and without the tumescent technique in a well-matched cohort.

Hypothesis: The results of Modified Radical Mastectomy (MRM) performed with the tumescent method are different to those without.

Objective: To evaluate the postoperative results of Modified Radical Mastectomy (MRM) with and without the tumescent Technique.

Outcomes and Operational Definitions: Primary outcomes were seroma (serous discharge beneath mastectomy flap or in axilla requiring aspiration within 30 days of surgery), wound infection (purulent discharge, peri-incisional erythema, or fever >38°C within 7 days), hematoma (blood collection around the incision within 7 days), and flap necrosis (visible darkening or hemorrhagic blister at the edge of the flap by days 2–7). Total operative time was used as a secondary outcome and was classified as ≤90 min, 91-120 min or >120 min.

METHODS

This was a prospective, randomized, controlled trial conducted at the Department of Surgery, Allied Hospital, Faisalabad, Pakistan, for 1 year following ethical approval. All participants provided informed consent, and the study was conducted in accordance with the Declaration of Helsinki.

Based on the WHO calculator (95% confidence level, 80% power), and seroma rates reported by Abdelkader (6.67% tumescent vs. 16.67% conventional),8 the sample size was calculated to be 115 patients per group (n=230 in total). Simple random sampling technique was used.

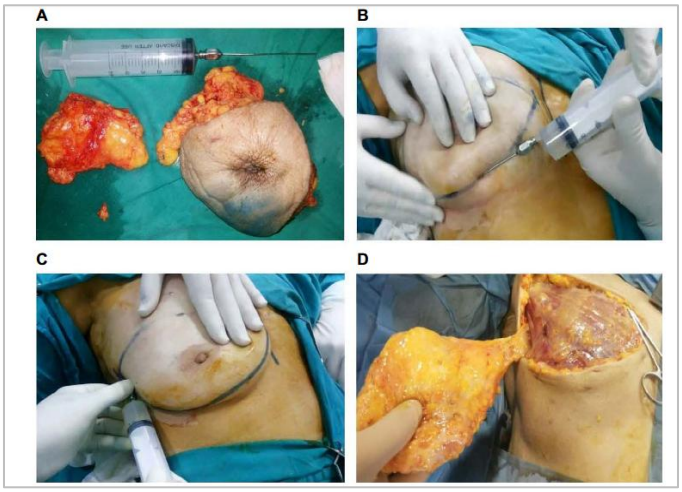
Patients aged 18–45 years and ASA Grade I–III patients undergoing MRM was included in the study.

Patients who have early breast cancer (T1), patients with a history of previous breast surgeries, patients on neo-adjuvant therapy and presence of comorbidities such as diabetes mellitus and other comorbid diseases was excluded from the study.

After approval from the Institutional Ethical Review Committee & Informed consent, the patients were randomly allocated (1:1) to Group A (tumescent technique) or Group B (conventional MRM). The tumescent solution consisted of 300-500 mL of normal saline (or lactated Ringer solution) containing between 1% lidocaine and 3-5 mL of epinephrine (1 mg/mL), which was injected into the subcutis before dissection. After tumescent infiltration, sharp scissor dissection was used for MRM in group A, and electrocautery was used in group B in standard MRM. A special pro-forma was created for all data to be recorded.

Data were analyzed using SPSS v25. The continuous variables are reported as mean ± standard deviation and compared using an independent samples t-test. Categorical variables are presented as frequencies and percentages and compared with the chi-square test. Stratified analysis was done by age, BMI, and ASA status as effect modifiers. A p-value < 0.05 was considered statistically significant, with two-tailed p-values being used.

Figure 1: Tumescent process



(A) Used cannula and syringe, (B) Infiltration of lower flap with tumescence, (C) Infiltration of the lateral flap and axilla, (D) Nearly bloodless field.

RESULTS

A- Baseline Characteristics: There were no differences between the groups in any baseline parameters. Mean age was 32.69 ± 8.00 years in Group A and 31.36 ± 8.29 years in Group B (p=0.217). The distributions of BMI, ASA classification, tumor pathology, quadrant location, and cancer staging were comparable between groups (p=0.472, p=0.445, p=0.404, p=0.988, and p=0.831, respectively), suggesting good randomization. The most common histopathological subtype (both in Group A and B, about 40%) was infiltrative ductal carcinoma. In both groups, the upper medial quadrant was the most commonly involved quadrant (~37–38%). In both groups, about 40% of the patients had Stage II disease.

Figure 2: Age distribution between groups

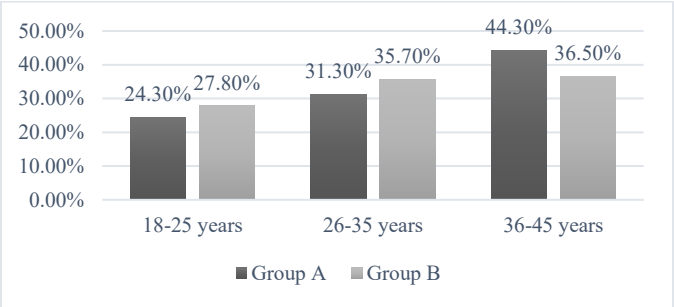


Figure 3: BMI distribution between groups

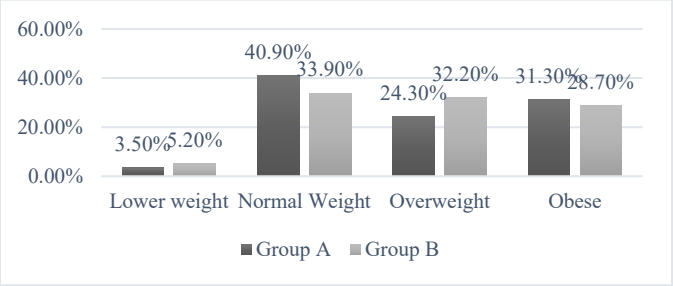


Figure 4: ASA physical status classification

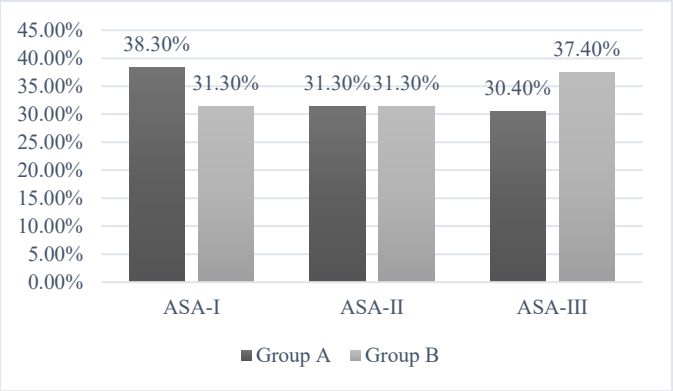


Figure 5: Histopathological types of breast cancer

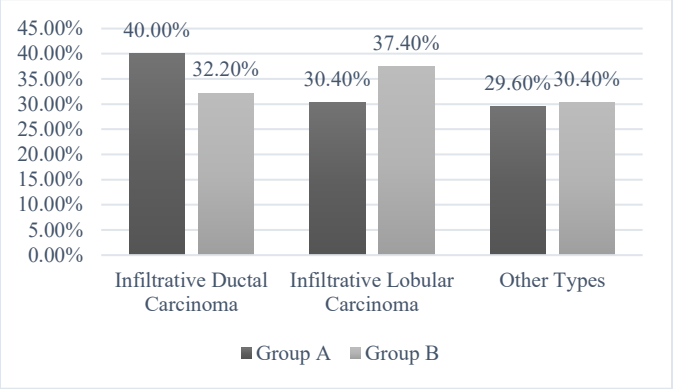


Figure 6: Tumor quadrant distribution

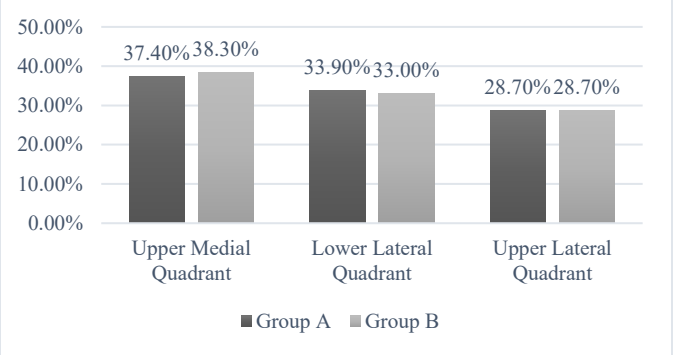


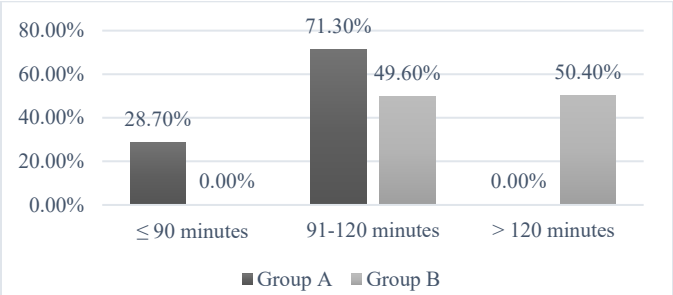
Table 1: Cancer stage distribution

Cancer Stage	Group A, n (%)	Group B, n (%)
Stage I	41 (35.7%)	39 (33.9%)
Stage II	47 (40.9%)	45 (39.1%)
Stage III	27 (23.5%)	31 (27.0%)
p-value	0.831	Not Significant

B- Operative Duration Analysis

There was a significant difference in operative time. Of the surgeries, 28.7% in Group A were finished in less than 90 minutes, and none lasted more than 120 minutes. With no procedure completed in 90 minutes or less, 50.4% of procedures in Group B lasted longer than 120 minutes ($p < 0.001$).

Figure 7: Comparison of operative duration between groups



C- Postoperative Complications

There were fewer postoperative complications in the tumescent group. The incidence of seroma was 7.0% as compared to the conventional group (16.5%) ($p = 0.024$). Wound infection was 6.1% versus 10.4% ($p = 0.231$). The tumescent group did not have any flaps with hematomas or necrosis, whereas 3.5% of the conventional group did ($p = 0.044$).

Figure 8: Overall comparison of postoperative complications

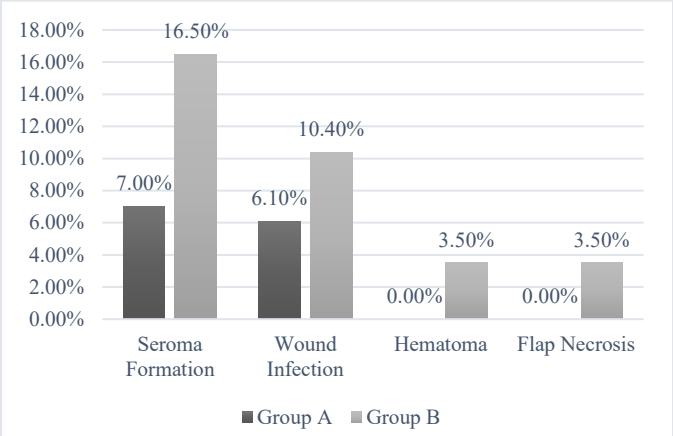


Table 2: Postoperative Complications

Seroma	8 (7.0%)	19 (16.5%)	0.024*
Wound Infection	7 (6.1%)	12 (10.4%)	0.231
Hematoma	0 (0.0%)	4 (3.5%)	0.044*
Flap Necrosis	0 (0.0%)	4 (3.5%)	0.044*

Stratified Analysis for Effect Modifiers

Stratified analysis revealed that the tumescent technique was particularly useful in obese patients, with a seroma rate of 5.6% versus 24.2% in the conventional group (p = 0.028). In ASA-III patients, seroma occurred in 2.9% versus 18.6% (p = 0.030)

Table 3: Seroma formation stratified by age groups

Age Group	Group A Seroma %	Group B Seroma %	p-value
18-25 years	7.1%	25.0%	0.064
26-35 years	5.6%	14.6%	0.193
36-45 years	7.8%	11.9%	0.510

Table 4: Seroma formation stratified by BMI categories

BMI Category	Group A Seroma %	Group B Seroma %	p-value
Normal Weight	12.8%	17.9%	0.504
Overweight	0.0%	10.8%	0.072
Obese	5.6%	24.2%	**0.028***

** Statistically significant (p < 0.05)*

Table 5: Seroma formation stratified by ASA status

ASA Status	Group A Seroma %	Group B Seroma %	p-value
ASA-I	9.1%	16.7%	0.308
ASA-II	8.3%	13.9%	0.453
ASA-III	2.9%	18.6%	**0.030***

** Statistically significant (p < 0.05)*

DISCUSSION

The present randomized controlled trial provides evidence of clinically relevant benefits of the tumescent technique over conventional MRM across a range of outcomes. The groups were well balanced at baseline, and there was no confounding due to differences in age, BMI, ASA status, tumor pathology, or disease staging. Most patients (32 years) were young, consistent with breast cancer in South Asian populations, which typically occurs 10 years younger than in Western populations; the mean age of 32 years is indicative of the younger age group of breast cancer patients in the region, and the predominantly Stage II distribution of the two groups reflects the ongoing challenge of delayed presentation due to low cancer awareness and poor screening systems.[10,11,14] The effect of tumescent infiltration on hydro-dissection, visualization, and reduced bleeding allows for accurate, sharp dissection without electrocautery, resulting in a highly significant decrease in operative time (p<0.001).[15] This has wider implications, including reduced exposure to anesthetic gases, decreased risk for surgical site infection, and increased anesthetic efficiency and operative throughput in resource-limited environments.[7] The tumescent technique was associated with a significant decrease in seroma formation compared to the standard technique (7.0% vs. 16.5%; p=0.024). In contrast, the trial by Lautrup *et al*. included patients undergoing simple mastectomy and used aspirated volume rather than clinical seroma as the endpoint, with no difference in seroma volume observed.[9] In their trial, Kumar *et al*. reported a 18.6% versus 8.2% seroma rate.[16] These results also match a systematic review by Thompson *et al*., who showed that techniques aimed at dead space and hemostasis decrease seroma incidence.[17] Wound infection rates were generally lower in Group A (6.1% vs. 10.4%); however, no statistical significance was found (p=0.231), possibly because of the sample size of the study and the low wound infection rate. Sustained epinephrine-mediated vasoconstriction indirectly decreases the risk of infection by reducing hematoma formation, which serves as a bacterial culture medium. This is a particularly significant result, with no flap necrosis in the tumescent group and 3.5% in the control group, compared to Peterson *et al*., who found a significant difference in flap necrosis between the tumescent dissection group (1.8%) and the control group (7.2%) (p=0.003). This benefit is due to an anatomically defined dissection that maintains flap vascularity.[18] Stratified analyses offer key insight into treatment decisions for each patient. This substantial benefit in the obese patient group (seroma: 5.6% vs. 24.2%; p=0.028) and ASA-III patients (2.9% vs. 18.6%; p=0.030) suggests that the tumescent technique is especially useful for high-risk groups of patients, where postoperative complications may have more clinical and logistical impact, such as timely initiation of adjuvant therapy.

CONCLUSION

MRM was performed using the tumescent technique, which minimized operative time, seroma, hematoma, and flap necrosis and did not increase the risk of major complications. It showed a greater beneficial effect in obese patients and those with ASA-III grade, indicating its potential usefulness in certain high-risk patients.

LIMITATIONS

Some limitations included a single-center design, which may have limited generalizability, and no evaluation of the learning curve for the tumescent technique.

DECLARATIONS

Ethical Approval: The study was conducted after receiving clearance from the Ethical Review Committee (ERC), Faisalabad Medical University. Written informed consent was obtained from all participants.

SUGGESTIONS / RECOMMENDATIONS

Larger multi-centre trials with longer follow-up are warranted to validate these results and assess quality of life.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflict of interest.

FUNDING

No funding was received for this study.

ACKNOWLEDGEMENTS

To all colleagues and seniors who provided continuous support for completion of the project.

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