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Effect of methylprednisolone for reducing seroma and drainage in modified radical mastectomy: A Prospective study

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Abstract
Aim: This study evaluates the effect of preoperative intravenous methylprednisolone in reducing postoperative drain output and seroma incidence.
Study design: A prospective study
Place and duration of study: The study was conducted in the Department of Surgery at SGRDIMSR tertiary care teaching hospital, Amritsar from July 2024 to December 2025.
Methodology: A prospective study was conducted with 60 female patients scheduled for elective MRM. Participants were equally allocated into Group A (intervention), receiving 120 mg of IV methylprednisolone one hour before incision, and Group B (control), receiving standard care. Primary outcomes included daily drain volume, duration of drainage, and the incidence of seroma as per CTCAE v3.0 criteria.
Results: Group A demonstrated a statistically significant reduction in drain output during the early postoperative phase. Specifically, on Day 1, Group A recorded lower volumes (83.0 ± 6.51 ml) compared to Group B (94.67 ± 24.74 mL; p=0.015). This significant trend continued through Day 3 (p=0.021) and Day 4 (p=0.015). Consequently, 93.33% of patients in the steroid group achieved drain removal by Day 5, whereas Group B showed a higher rate of delayed removal (13.33% on Day 6). The incidence of seroma was lower in Group A (10%) compared to Group B (13.33%), though this did not reach statistical significance.
Conclusion: A single preoperative dose of 120 mg methylprednisolone significantly reduces early postoperative fluid drainage and accelerates drain removal in MRM patients. This low-cost pharmacological intervention offers a viable strategy to minimize surgical morbidity and facilitate faster transitions to adjuvant therapies.

Keywords: Breast neoplasms, drainage, mastectomy, modified radical, methylprednisolone, postoperative complications, seroma

Introduction

Breast cancer is the most frequently diagnosed malignancy among women and remains one of the leading causes of cancer-related mortality worldwide. According to the latest GLOBOCAN 2022 estimates, approximately 2.3 million women were newly diagnosed with breast cancer, accounting for nearly one in four female cancers globally, while more than 670,000 deaths were attributed to the disease [1-3]. The burden of breast cancer continues to increase in low- and middle-income countries, particularly in India, where changing reproductive patterns, urbanization, obesity, and lifestyle modifications have contributed to a steady rise in disease incidence. Despite advances in screening, early diagnosis, targeted therapies, and multidisciplinary management, a substantial proportion of Indian patients continue to present with locally advanced disease, making surgical treatment the cornerstone of curative management [2-4].

Modified radical mastectomy (MRM) remains one of the most commonly performed surgical procedures for operable breast cancer, particularly in patients with locally advanced tumors or when breast-conserving surgery is not feasible. Although the procedure provides excellent oncological control, postoperative complications continue to pose significant challenges during recovery. Among these, seroma formation is the most frequent complication, with reported incidences ranging from 3% to 85% depending on patient characteristics, surgical techniques, and postoperative management protocols [5-7]. Seroma results from the accumulation of serous fluid within the postoperative dead space created by extensive tissue dissection and disruption of lymphatic channels. Clinically, it contributes to pain, restricted shoulder mobility, repeated aspirations, wound infection, flap necrosis, prolonged drain placement, delayed wound healing, and postponement of adjuvant chemotherapy or radiotherapy, thereby increasing both patient morbidity and healthcare costs [6-8].

The pathogenesis of seroma is multifactorial, involving inflammatory exudation, lymphatic leakage, increased capillary permeability, and inadequate tissue adherence following surgery. Numerous preventive measures have therefore been explored, including closed-suction drainage, flap fixation techniques, quilting sutures, fibrin sealants, tissue adhesives, compression dressings, and modifications of surgical dissection. However, no single intervention has consistently demonstrated superior efficacy, and seroma formation continues to represent an unresolved postoperative concern [7-9].

Perioperative corticosteroid therapy has recently attracted attention as a potential pharmacological strategy to reduce postoperative fluid accumulation. Methylprednisolone exerts potent anti-inflammatory effects by inhibiting phospholipase A_2 activity, suppressing prostaglandin and leukotriene synthesis, reducing pro-inflammatory cytokine release, and stabilizing capillary membranes, thereby limiting vascular permeability and inflammatory exudation. Emerging clinical studies and recent systematic reviews have suggested that perioperative corticosteroids may reduce postoperative drainage volume and facilitate earlier drain removal without increasing wound-related complications or surgical site infections [10-12]. Nevertheless, available evidence remains limited, particularly from prospective studies conducted in the Indian population, where differences in patient characteristics, disease stage, and surgical practices may influence postoperative outcomes.

Considering the growing burden of breast cancer and the need for simple, cost-effective interventions that enhance postoperative recovery, the present prospective comparative study was undertaken to evaluate the effect of a single preoperative intravenous dose of 120 mg methylprednisolone on postoperative drain output and seroma formation in patients undergoing modified radical mastectomy. The findings of this study may provide additional evidence regarding the role of perioperative corticosteroid therapy in reducing surgical morbidity and improving postoperative recovery following breast cancer surgery.

Materials and methods

Study Design and Setting

This prospective comparative study was conducted at the Department of General Surgery, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, Punjab, India. The study protocol was approved by the Institutional Research and Ethics Committee (Approval No. SGRD/IEC/2024-305). Written informed consent was obtained from all participants after explaining the study objectives and procedures in their native language. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Study Duration and Population

The study was carried out over an 18-month period from July 2024 to December 2025. Female patients with biopsy-confirmed breast carcinoma attending the General Surgery Outpatient Department (OPD) and planned for elective Modified Radical Mastectomy (MRM) were screened for eligibility. Eligible patients who fulfilled the selection criteria and provided written informed consent were recruited using a convenience sampling technique.

Eligibility Criteria

Female patients aged 18 years or older with a confirmed diagnosis of breast cancer scheduled for upfront elective Modified Radical Mastectomy were included in the study. Patients receiving chronic corticosteroid therapy, those with uncontrolled diabetes mellitus, advanced hepatic dysfunction, known hypersensitivity to corticosteroids, active systemic infection, immunosuppressive disorders, or those who had received neoadjuvant chemotherapy were excluded from the study.

Study Groups

Sixty eligible patients were enrolled and divided into two groups comprising 30 patients each according to the perioperative treatment protocol adopted by the treating surgical unit.

Group A (Intervention Group): Patients received a single intravenous dose of 120 mg methylprednisolone one hour before skin incision.

Group B (Control Group): Patients underwent the standard surgical protocol without preoperative corticosteroid administration.

Clinical Methodology

The diagnosis of breast carcinoma was established based on clinical evaluation, radiological imaging (ultrasonography and/or mammography), and histopathological confirmation obtained by core needle biopsy. All patients underwent standard Modified Radical Mastectomy with axillary lymph node dissection under general anaesthesia. Perioperative anaesthetic management was standardized using propofol and fentanyl for induction, followed by routine intraoperative monitoring including electrocardiography, pulse oximetry, and non-invasive blood pressure monitoring.

At the completion of surgery, two closed-suction drains were placed routinely, one within the axillary cavity and the other beneath the mastectomy skin flap over the pectoral muscle before wound closure. Drains were monitored daily and removed when the combined drainage volume was less than 30 mL during the preceding 24 hours.

Outcome Measures

The primary outcome measure was postoperative drain output recorded daily until drain removal. Secondary outcome measures included duration of drain placement, timing of drain removal, and incidence of postoperative seroma formation. Seroma severity was graded according to the Common Terminology Criteria for Adverse Events (CTCAE) Version 3.0 as Grade 1 (asymptomatic), Grade 2 (symptomatic requiring aspiration or medical intervention), and Grade 3 (symptomatic requiring image-guided intervention).

Quality Control

To minimize procedural variability, all operations were performed by the same surgical team following a standardized operative technique, while uniform perioperative care and postoperative management protocols were maintained throughout the study period. Data were collected prospectively using a predesigned case record form by trained investigators.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables

were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Comparisons between the two groups were performed using the independent Student's *t*-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, as appropriate. A two-tailed *p*-value of less than 0.05 was considered statistically significant.

Results and discussion

A total of 60 female patients with biopsy-confirmed breast carcinoma undergoing modified radical mastectomy (MRM) were enrolled and divided equally into two groups. Group A received a single intravenous dose of 120 mg methylprednisolone one hour before surgery, whereas Group B underwent standard perioperative management without corticosteroid administration. Baseline demographic and clinical characteristics were generally comparable between the groups (Table 1). Most patients belonged to the 51–70-year age group, reflecting the common age distribution of breast cancer in the Indian population. The majority of patients in both groups had no significant comorbid illnesses, and right-sided MRM was performed more frequently than left-sided surgery.

Comparable baseline characteristics are essential for minimizing confounding and improving the validity of present study. Previous studies by Khan *et al* [13]. and Fatima *et al* [10]. similarly reported no clinically meaningful differences in demographic variables between steroid-treated and control groups, suggesting that postoperative outcomes were primarily attributable to the intervention rather than patient-related factors.

The principal outcome of this study was postoperative drain output. Patients receiving preoperative methylprednisolone demonstrated significantly lower drainage volumes during the early postoperative period. On postoperative day 1, the mean drain output was 83.0 ± 6.51 mL in Group A compared with 94.67 ± 24.74 mL in Group B ($p = 0.015$). Similar statistically significant reductions were observed on postoperative day 3 (31.0 ± 12.96 vs. 41.0 ± 19.00 mL; $p = 0.021$) and day 4 (17.0 ± 9.15 vs. 24.67 ± 14.08 mL; $p = 0.015$). However, differences during postoperative days 2, 5, 6, and 7 were not statistically significant, indicating that the beneficial effect of methylprednisolone was greatest during the initial inflammatory phase after surgery (Table 2).

These findings are biologically plausible because corticosteroids suppress phospholipase A2 activity, inhibit prostaglandin and leukotriene synthesis, reduce capillary permeability, and decrease inflammatory cytokine production, thereby limiting postoperative exudative fluid formation. Similar reductions in postoperative drainage have been demonstrated by Khan *et al* [13]., reported significantly lower drain volumes following preoperative intravenous steroids, and by Fatima *et al* [10]., observed reduced postoperative fluid accumulation after intravenous hydrocortisone administration. Likewise, Qvamme *et al* [14]. demonstrated that methylprednisolone significantly decreased postoperative drainage by attenuating the inflammatory response within the surgical dead space.

The duration of drain placement also showed a favorable trend in the methylprednisolone group. Drain removal by postoperative day 5 was achieved in 93.33% of patients receiving methylprednisolone compared with 86.67% in the control group. Delayed drain removal beyond day 5 occurred more frequently in the control group (13.33%) than in the steroid group (3.33%), suggesting faster postoperative recovery among patients receiving corticosteroids.

Early drain removal has important clinical implications because prolonged drainage increases patient discomfort, delays rehabilitation, and may increase the risk of ascending infection. Although the present study did not demonstrate a statistically significant reduction in overall drain duration, the earlier trend toward drain removal agrees with the observations of Seth *et al* [15]., also reported accelerated postoperative recovery following perioperative steroid administration. Conversely, Subramanian *et al* [9]. observed only modest reductions in drain duration despite lower drainage volumes, suggesting that institutional drain removal protocols may substantially influence this outcome.

Seroma formation remained relatively uncommon in both treatment groups. Seroma developed in 3 patients (10%) in Group A and 4 patients (13.33%) in Group B, with no statistically significant difference between groups. Although numerically lower in the methylprednisolone group, the reduction was insufficient to demonstrate statistical significance.

This finding is consistent with previous reported study by Qvamme *et al* [14]. in which methylprednisolone significantly reduced postoperative drainage, it did not consistently reduce clinically significant seroma formation. Similarly, Okholm and Axelsson [16] concluded that corticosteroid administration alone was insufficient to prevent seroma because multiple factors, including lymphatic disruption, extent of axillary dissection, dead-space obliteration, and patient-specific healing responses, contribute to its development. Therefore, although corticosteroids effectively reduce inflammatory exudation, they cannot completely eliminate lymphatic leakage following axillary clearance.

The present findings also support the current understanding of seroma pathophysiology. Seroma formation represents a multifactorial process involving disruption of lymphatic channels, inflammatory exudation, tissue trauma, and inadequate adherence between tissue planes. As described by Kuroi *et al* [6]., inflammatory mediators released after surgery increase vascular permeability, promoting accumulation of protein-rich fluid within the surgical cavity. Corticosteroids primarily target the inflammatory component of this process but have relatively little influence on mechanical lymphatic leakage, which may explain why drain output decreased without a corresponding statistically significant reduction in seroma incidence.

Another important observation was that no steroid-related complications were encountered following administration of a single 120 mg intravenous dose of methylprednisolone. This finding supports previous reports demonstrating that a single perioperative corticosteroid dose is generally safe and is not associated with increased postoperative wound complications or infectious morbidity [9, 13]. Consequently, this inexpensive intervention may be considered a practical adjunct in enhanced recovery protocols for breast cancer surgery.

Overall, the present study demonstrates that preoperative intravenous methylprednisolone effectively reduces postoperative drainage following modified radical mastectomy, particularly during the early postoperative inflammatory period. Although seroma incidence was not significantly altered, the reduction in drain output and the

trend toward earlier drain removal may improve postoperative patient comfort, facilitate earlier discharge, and potentially reduce healthcare utilization. Larger multicenter study incorporating inflammatory biomarkers, standardized drain removal criteria, and longer follow-up are warranted to further define the role of corticosteroids in optimizing postoperative outcomes after breast cancer surgery.

Table 1: Demographic Profile and Baseline Clinical Characteristics

Age group	Group A		Group B	
	Frequency (n)	**Percentage (%)**	**Frequency (n)**	**Percentage (%)**
30-40	6	20.00	8	26.67
41-50	4	13.33	10	33.33
51-60	8	26.67	6	20.00
61-70	9	30.00	6	20.00
>70	3	10.00	0	0.00
Total	30	100.00	30	100.00
Surgical Procedure				
Left MRM	9	30.00	13	43.33
Right MRM	21	70.00	17	56.67
Total	30	100.00	30	100.00
Comorbidities				
DM Type 2+ Hypertension	0	0.00	4	13.33
Hypertension	5	16.67	3	10.00
Hypertension + Hypothyroidism	0	0.00	1	3.33
Hypothyroidism	2	6.67	1	3.33
Nil Comorbidities	23	76.67	21	70.00
Total	30	100.00	30	100.00

Table 2: Post-operative Drain Output, Removal Timing, and Complications

Drain output	**Group A Mean±SD**		**Group B Mean±SD**	**p-value**
Day 1	83.0±6.513		94.667±24.738	0.015
Day 2	54.667±11.666		62.000±20.240	0.091
Day 3	31.0±12.959		41.000±19.001	0.021
Day 4	17.0±9.153		24.667±14.077	0.015
Day 5	11.176±3.321		12.941±4.697	0.215
Day 6	10.0±0.50		12.500±5.000	0.541
Day 7	5.00±0.100		8.333±2.887	0.219
Removal of drain output in both groups				
Days	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)
4 [th]	12	40.00	13	43.33
5 [th]	16	53.33	13	43.33
6 [th]	1	3.33	4	13.33
7 [th]	1	3.33	0	0.00
Total	30	100.00	30	100.00
Seroma formation				
Absent	27	90.00	26	86.67
Present	3	10.00	4	13.33
Total	30	100.00	30	100.00

Conclusion

The present prospective comparative study demonstrates that preoperative administration of a single 120 mg intravenous dose of methylprednisolone is an effective adjunct in reducing early postoperative drain output following modified radical mastectomy. Patients receiving methylprednisolone exhibited significantly lower drainage volumes during the initial postoperative period and a trend toward earlier drain removal, reflecting attenuation of the postoperative inflammatory response. Although the intervention was associated with a lower incidence of seroma formation, the difference did not reach statistical significance, suggesting that seroma development is influenced by multiple patient- and surgery-related factors beyond inflammation alone. Importantly, no steroid-related adverse events or wound complications were observed, supporting the safety and feasibility of a single perioperative dose. Given its low cost, ease of administration, and favorable safety profile, preoperative intravenous methylprednisolone may represent a practical strategy for enhancing postoperative recovery after modified radical mastectomy. Nevertheless, larger multicenter prospective studies with adequate sample sizes, standardized surgical protocols, adjustment for potential confounding variables, and longer postoperative follow-up are warranted to confirm these findings and establish evidence-based recommendations for routine clinical practice.

Ethics Committee Approval: This prospective hospital-based study was conducted after approval from the Institutional Ethics Committee of SGRDIMSR (Approval No. SGRD/IEC/2024-305).

Informed Consent: Written informed consent obtained from all the participants

Competing interests disclaimer

The authors declare that they have no known competing financial interests, non-financial interests, personal relationships, or affiliations that could have appeared to influence the work reported in this manuscript.

Artificial intelligence (AI) disclosure

The AI tools were not used for data collection, data analysis, interpretation of results, generation of scientific conclusions, or decision-making. All scientific content, study design, data accuracy, interpretations, and final manuscript revisions were reviewed, verified, and approved by the authors, who take full responsibility for the integrity and accuracy of the work.

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, *et al*. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: A Cancer Journal for Clinicians,2024:74(3):229-263.
2. Lei S, Zheng R, Zhang S, Wang S, Chen R, Sun K, *et al*. Global patterns of breast cancer incidence and mortality: A population-based cancer registry data analysis from 2000 to 2020. Cancer Communications,2021:41(11):1183-1194.
3. Arnold M, Morgan E, Rumgay H, Mafra A, Singh D, Laversanne M, *et al*. Current and future burden of breast cancer: Global statistics for 2020 and 2040. Breast,2022:66:15-23.
4. Mathur P, Sathishkumar K, Chaturvedi M, Das P, Sudarshan KL, Santhappan S, *et al*. Cancer statistics, 2020: Report from National Cancer Registry Programme, India. JCO Global Oncology,2020:6:1063-1075.
5. Srivastava V, Basu S, Shukla VK. Seroma formation after breast cancer surgery: What we have learned in

the last two decades. Journal of Breast Cancer,2012:15(4):373-380.
6. Kuroi K, Shimozuma K, Taguchi T, Imai H, Yamashiro H, Ohsumi S, *et al*. Pathophysiology of seroma in breast cancer. Breast Cancer,2005:12(4):288-293.
7. Sampathraju S, Rodrigues G. Seroma formation after mastectomy: Pathogenesis and prevention. Indian Journal of Surgical Oncology,2010:1(4):328-333.
8. Escandón JM, Aristizábal A, Langstein HN, Christiano JG, Gooch JC, Prieto PA, *et al*. Single versus double drainage for immediate two-stage implant-based breast reconstruction: A propensity score-matched analysis. Aesthetic Plastic Surgery,2024:48(17):3304-3316.
9. Subramanian P, Arumugam M, Vaithianathan R. Role of methylprednisolone in the prevention of seroma formation after mastectomy: A randomized controlled trial. Indian Journal of Cancer,2023:60(2):206-210.
10. Fatima S, Shafique MS, Shabana B, Nawaz S, Khan JS, Hasan SW. The prevention of seroma formation following modified radical mastectomy by intravenous hydrocortisone injection. Cureus,2024:16(2):e55017.
11. Xiong X, Ou X, Wang L, Zheng X. Efficacy and safety of methylprednisolone in the prevention of seroma formation after mastectomy: Systematic review and meta-analysis. Medicine,2025:104(43):e45353.
12. Alnajjar JS, Bakheet HA, Addas MA, Alghamdi RA, AlSharit MA, Farghal NN, *et al*. Does the use of perioperative corticosteroids reduce the incidence of seroma formation after breast cancer surgery? A systematic review and meta-analysis. Annals of Saudi Medicine,2025:45(6):435-444.
13. Khan MA. Effect of preoperative intravenous steroids on seroma formation after modified radical mastectomy. Journal of Ayub Medical College Abbottabad,2017:29(2):207-210.
14. Qvamme G, Axelsson CK, Lanng C, Mortensen M, Wegeberg B, Okholm M, *et al*. Randomized clinical trial of prevention of seroma formation after mastectomy by local methylprednisolone injection. Journal of British Surgery,2015:102(10):1195-1203.
15. Seth US, Perveen S, Khan I, Ahmed T, Kamal MT, Khomusi MM. Effect of preoperative intravenous steroids on seroma formation after modified radical mastectomy. Journal of Pakistan Medical Association,2023:73(1):69-73.
16. Okholm M, Axelsson CK. No effect of steroids on seroma formation after mastectomy. Danish Medical Bulletin,2011:58(2):A4241.