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Original Research Article

Seroma Formation in Ventral Wall Hernia After Mesh Repair: Impact of Tranexamic Acid in Its Prevention

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Abstract: *Seroma formation is a common postoperative complication following mesh repair for ventral wall hernias, contributing to patient morbidity and prolonged hospital stays. Tranexamic acid (TXA), known for its antifibrinolytic action, is believed to limit postoperative fluid collection by reducing intraoperative bleeding. Its use may contribute to improved recovery. This study aimed to assess the effectiveness of TXA in reducing seroma incidence and improving surgical outcomes in a Pakistani population.* ***Objective:*** *To evaluate the impact of tranexamic acid on postoperative seroma formation and other surgical outcomes in patients undergoing ventral hernia mesh repair.* ***Methods:*** *This randomized controlled trial was conducted at the Department of Surgery, Shaikh Zayed Hospital, Lahore, from December 2024 to May 2025. A total of 120 patients undergoing elective open mesh repair for primary or incisional ventral hernia were randomized into two groups: Group A received intravenous TXA (1 g in 100 ml NS) at the time of skin incision followed by oral TXA 1g BID till third post operative day whilst Group B received a placebo (100 ml NS). Standard onlay mesh repair and postoperative protocols were followed. The primary outcome was the incidence of seroma; secondary outcomes included drain output, pain scores, haemoglobin drop, and length of hospital stay. Data were analysed using SPSS 20.0, with $p<0.05$ considered statistically significant.* ***Results:*** *The incidence of seroma was significantly lower in the TXA group compared to the control group (6.7% vs.21.7%, respectively, P=0.023). TX group also showed reduced considerably drain output (95.3±19.4ml vs.144.2±24.6ml, $p<0.001$), lower pain scores (3.6±0.9 vs. 4.6±1.1, $p<0.001$), smaller haemoglobin drop (0.8±0.3g/dL vs.1.4±0.4g/dL $p<0.001$), and shorter hospital stay (1.7±0.4 days vs.2.3±0.5 days, $p<0.001$). Higher BMI, diabetes, and larger defect size were significantly associated with increased risk of seroma. Multivariate analysis confirmed TXA as a protective factor (OR 0.25, p=0.022).* ***Conclusion:*** *Tranexamic acid significantly reduces the risk of postoperative seroma and improves key recovery parameters in patients undergoing ventral hernia repair. Its routine use may enhance surgical outcomes, especially in resource-constrained healthcare settings, such as those in Pakistan.*

Keywords: Seroma, Tranexamic Acid, Ventral Hernia, Mesh Repair, Randomized Controlled Trial

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Introduction

A hernia is described as the complete or partial emergence of a viscus through the anterior abdominal wall that confines it (I). Ventral wall hernias are relatively common, with a frequency of 1.7% in people of all ages and 4% in those over 45 years old. Inguinal hernias account for approximately 50% of abdominal wall hernias; the lifetime risk is 27% for men and 3% for women. It is estimated that more than 20 million hernias are treated annually worldwide (2). Surgical management is the mainstay of treatment, utilizing mesh repair, due to its numerous advantages, and is the most popular modality worldwide (3). The most frequent postoperative consequence of abdominal wall hernia surgery is seroma development (4). Numerous unavoidable circumstances, such as increased cautery usage, aggressive dissection below the Scarpa's fascia, and the use of sclerosants, lead to seroma production (2). If a seroma becomes infected and is not drained, it might result in consequences, including wound infection and dehiscence(5)

In countries such as Pakistan, where hernia repair is a frequent surgical intervention, addressing complications like seroma is essential for improving patient outcomes and healthcare resource management. Data demonstrates that factors such as surgical technique, mesh type, and postoperative care can significantly influence the incidence of seromas (6-8).

The use of tranexamic acid (TXA) has garnered attention as a potential agent for seroma prevention in surgical settings. Tranexamic acid, known for its antifibrinolytic properties, may reduce bleeding and fluid accumulation postoperatively (9). Recent studies have shown that administering TXA can lead to a significant decrease in postoperative seroma formation (7,9,10). In the context of Pakistan, where healthcare systems are often strained by complications that arise from primary surgical procedures, employing an effective adjunctive treatment like TXA may enhance recovery and decrease the rate of seroma complications among patients undergoing ventral wall hernia repairs (7,1).

These insights are crucial for tailoring surgical practices to minimize post-operative complications. The integration of TXA in conjunction with optimized surgical techniques may provide a dual approach to reducing seroma incidence, identifying a significant area of need within Pakistani surgical practices (6,7).

Considering the prevalence of complications, such as seroma, in surgical practices for hernia repair, this study aims to investigate the impact of tranexamic acid in preventing their occurrence. By focusing specifically on the Pakistani context, the research aims to contribute to the local medical literature and enhance surgical outcomes across healthcare facilities.

Methodology

The present randomized controlled trial was conducted at the Department of Surgery, Shaikh Zayed Hospital, Lahore, from December 2024 to May 2025, to evaluate the effect of tranexamic acid (TXA) on preventing seroma formation in patients undergoing mesh repair for ventral wall hernia. The study included a total of 120 patients, aged between 16 and 70 years, who were diagnosed with primary ventral hernias (epigastric,

umbilical, paraumbilical) and incisional. Patients were enrolled after obtaining written informed consent and ethical clearance from the institutional review board.

The participants were randomly allocated into two equal groups using the lottery method. Group A(TXA group) received 1 gram of intravenous tranexamic acid diluted in 100 mL of normal saline at the time of skin incision, followed by 1 gram BID of oral tranexamic acid until the third postoperative day. Group B (Control group) received 100 ml of normal saline without TXA, serving as the placebo. Allocation concealment was ensured using computer-generated numbers, sealed opaque envelopes, and both the surgeon and the data collectors were blinded to the group assignment.

Standardized surgical techniques were employed for all patients, involving open hernia repair with 15 x 15 cm polypropylene mesh placement in the onlay mesh position. Closed suction drains were placed in all patients and removed when the output was less than 30 mL over 24hours. All patients received perioperative prophylactic antibiotics and analgesia by hospital protocol.

Intraoperative parameters such as size of defect and postoperative outcomes were evaluated for each participant, including seroma formation, drain output, visual analogue scale (VAS) score for pain at 24 hours, drop in hemoglobin level, and length of hospital stay. Drain output was used as a measure of seroma formation, and if needed, confirmed via ultrasound. Drain output was recorded on postoperative days 1 and 3, and the cumulative sum was calculated for analysis. Pain was assessed using a standard 10-point VAS, where 0 represented no pain and 10 represented the worst imaginable pain.

Data were collected on a structured proforma and analysed using SPSS version 20.0. Continuous variables were presented as mean ± standard deviation and compared using the independent samples t-test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant. Normality of continuous variables was assessed using the Shapiro-Wilk test before applying parametric tests. Multivariate logistic regression was also conducted, and post Hoc analysis was performed to identify independent predictors of seroma formation.

Results

This randomized controlled trial evaluated the efficacy of tranexamic acid (TXA) in reducing seroma formation after mesh repair in patients with ventral wall hernias. A total of 120 patients were included, randomized into two equal groups: Group A (TXA Group) and Group B (Control Group). The mean age was slightly higher in the TXA group (441±117 years) compared to the control group (410±132 years), but the difference was not statistically significant (p=0.157). The gender distribution showed a higher number of males in the TXA group (37 males, 23 females) compared to the control group (28 males, 32 females), with a p-value of 0.078. Both groups had similar BMI values (TXA: 5±9 kg/m^2 vs. Control: 27.4±31 kg/m^2, p = 0.842), as well as similar ASA classifications, smoking habits, and prevalence of comorbidities, including diabetes mellitus and hypertension. No statistically significant differences were observed in any of these variables (p>005), confirming successful randomization and homogeneity between the groups at baseline. (Table 1)

Table 1. Detailed Demographic Characteristics of Study Participants(n=120)

Variable	TXA Group($n = 60$)	Control Group ($n = 60$)	p-value
Age (years), Mean±SD	44.1 ± 11.7	41.0 ± 13.2	0.157
Gender	37 M/23 F	28 M/32 F	0.078
BMI(kg/m²), $Mean \pm SD$	27.5 ± 2.9	27.4 ± 3.1	0.842
ASA Class I/II	34/26	31/29	0.581
Smoking Status (Yes / No)	14/46	17/43	0.521
Diabetes Mellitus (Yes/ No)	11/49	13/47	0.663
Hypertension (Yes/No)	16/44	18/42	0.698

Patients in the TXA group showed significantly better postoperative outcomes, including a reduced incidence of seroma, lower drain output, lower pain scores, smaller haemoglobin drop, and shorter hospital stays. The use of TXA was statistically beneficial (p< 0.05) across all outcomes.

Table 2. Comparison of Postoperative Outcomes Between Groups

Outcome Variable	TXA Group($n = 60$)	Control Group ($n = 60$)	$p - value$
Seroma Formation,n(%)	4(6.7%)	13(21.7%)	0.023*
Drain Output(mL),	95.3±19.4	144.2±24.6	<0.001*
VAS Pain Score at 24h, Mean ± SD	3.6±0.9	4.6±1.1	<0.001*
Hemoglobin Drop (g/dL)	0.8±0.3	1.4±0.4	<0.001*
Hospital Stay (days), $Mean \pm SD$	1.7±0.4	2.3±0.5	<0.001*
*Statistically significant			

Patients with seroma (n=17) had a significantly higher BMI than those without seroma (n=103; p=0.008), and diabetes was more prevalent in the seroma group (41.2% vs 16.5%; p=0.019). Hypertension and smoking were numerically higher among patients with seroma but not statistically significant (p=0.083 and p=0.341, respectively). Defect size showed a clear association: small defects (<3 cm) were less frequent among seroma cases, while medium (3–6 cm) and large (>6 cm) defects were more common, with each comparison reaching significance (p=0.045, p=0.039, and p=0.040). (Table3)

Multivariate regression confirmed that use of TXA significantly reduced the odds of seroma formation, whereas higher BMI and diabetes increased the risk. These findings reinforce the protective role of TXA in hernia repair surgeries.

(Table 4)

Table 3. Stratification of Seroma Formation by Risk Factors

Variable	Seroma Present($n = 17$)	No Seroma($n = 103$)	p-value
BMI(kg/m²), $Mean \pm SD$	29.2 .8	27.1 ± 22.9	0.008*
Diabetes, n (%)	7(41.2%)	17(16.5%)	0.019*
Hypertension, n (%)	8(47.1%)	26(25.2%)	0.083
Smoking, n (%)	6(35.3%)	25(24.3%)	0.341
Size of defect			
<3cm	3(17.6%)	40(38.8%)	0.045*
3-6cm	8(47.1%)	42(40.8%)	0.039*
>6cm	6(35.3%)	21(20.4%)	0.040*

Table 4. Multivariate Logistic Regression for Predictors of Seroma

Variable	Odds Ratio (OR)	95% CI	p-value
TXA Use	0.25	0.08-0.82	0.022*
BMI > 28	2.76	1.10-6.94	0.031*
Diabetes	3.21	1.11-9.31	0.032*

Multivariate regression confirmed that use of TXA significantly reduced the odds of seroma formation, whereas higher BMI and diabetes increased the risk. These findings reinforce the protective role of TXA in hernia repair surgeries.

The use of tranexamic acid significantly reduced seroma formation and improved several critical postoperative parameters, including pain, haemoglobin drop, drain output, and hospital stay. Additionally, patient factors like elevated BMI, the presence of diabetes, and larger mesh size were associated with increased risk of seroma. This study supports the incorporation of TXA in surgical protocols for ventral hernia repair to enhance patient outcomes, especially in resource-limited Pakistani healthcare systems.

Discussion

The randomized controlled trial assessing the efficacy of tranexamic acid (TXA) in the context of ventral wall hernia repair provides evidence for its role in minimizing postoperative complications, particularly seroma formation. Although individual day-wise outputs were recorded, cumulative values were used for analysis as they better reflect the overall postoperative drain burden and simplify interpretation. Findings indicate a reduction in seroma incidence among the TXA group (6.7%) compared to the control group (21.7%), with a statistically significant p-value of 0.023, supporting a protective effect of TXA in this surgical setting. This aligns with prior studies that emphasize the utility of TXA in various surgical procedures where fluid accumulation is a concern (8,11). TXA's mechanism of action, which inhibits fibrinolysis, is believed to reduce bleeding and associated seroma formation (11).

Additionally, patients receiving TXA exhibited improved postoperative outcomes, reflected in reduced drain outputs, lower pain scores, more minor haemoglobin drops, and shorter hospital stays (all with $p < 0.001$). Similar results had been observed by Kang et al, who reported a reduction in pain score and swelling of the surgical site when TXA was used (12).

Another study, conducted by Li et al., showed similar results, with a slight decrease in HB in a group of patients administered TXA compared to the other group, in which no TXA was used (13).

A meta-analysis conducted by Karthik et al. demonstrates a reduction in hospital stay for patients who received TXA compared to those who underwent surgery without TXA (14).

This is crucial, as effective management of postoperative recovery can significantly enhance patient satisfaction and reduce healthcare costs. Our data are consistent with prior local research, further validating the utility of TXA in ventral hernia repair.

By mitigating complications such as seroma, the use of TXA may contribute to both clinical efficiency and patient-centred care (7,10). Similar results regarding pain reduction and hospitalization duration have been documented across surgical (15,16).

Risk stratification revealed that higher body mass index (BMI) and diabetes mellitus were significantly associated with seroma formation($p<0.05$). A higher BMI showed mean differences indicative of an increased risk (29.2±2.8 vs. 271±29, p=0.008), while diabetes also correlated significantly with seroma occurrence (41.2% vs. 16.5%), reinforcing the need for targeted perioperative care. Previous research has corroborated these findings, establishing that obesity and metabolic conditions contribute to elevated seroma risk across various surgical modalities(17,18).

Our multivariate regression analysis confirmed that the use of TXA significantly reduced the odds of seroma formation (OR 0.25,p=0.022). This statistic reflects both the efficacy of TXA and the decision-making capacity of surgical teams to favor this intervention in high-risk populations. This reduction in odds is supported by findings from studies identifying the positive impact of TXA on seroma prevention in contexts requiring meticulous postoperative management, such as mastectomy surgeries (1).

Comparative literature from the last five years has strengthened the rationale for integrating TXA into surgical protocols. For instance, Verma et al. demonstrated the effectiveness of TXA in reducing drain output and seroma formation among breast cancer patients after axillary lymph node dissection, underscoring its broad applicability (16). Similarly, Hashemi et al. conducted a systematic review and meta-analysis, confirming the efficacy of topical TXA applications in surgery and emphasizing its role in minimizing complications, such as seroma (18).

Overall, our research advocates for the incorporation of TXA into surgical protocols for ventral hernia repairs, particularly in resource-limited settings where patient outcomes are of paramount importance. Its implications for practice extend beyond immediate surgical recovery, offering benefits that may enhance the overall efficiency of healthcare delivery.

Conclusion

The use of tranexamic acid in ventral wall hernia repair significantly reduced seroma formation and improved postoperative outcomes such as pain, blood loss, and hospital stay. Given its safety and efficacy, TXA should be considered as a standard adjunct in hernia repair protocols to enhance patient recovery and reduce complications.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-24)

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

ALA (Trainee Registrar)
Review of literature, manuscript drafting, data entry, data analysis
MIA (Professor of Surgery and Head of Department, Supervisor)
Conception of study, development of study design, review of manuscript

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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