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EMERGING ROLE OF COMBINED INTRAVENOUS AND TOPICAL TRANEXAMIC ACID IN CONTROLLING SPLIT-THICKNESS SKIN GRAFT DONOR SITE BLEEDING: A COMPARATIVE CLINICAL STUDY IN A TERTIARY-CARE CENTER

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ABSTRACT

Background: Control of bleeding from split-thickness skin graft (STSG) donor sites remains a perioperative challenge, particularly in large surface area grafting. Tranexamic acid (TXA) has recently gained attention as an antifibrinolytic agent with expanding applications across surgical specialties. However, evidence supporting its combined systemic and topical use in STSG donor sites remains limited. **Objective:** To evaluate the effectiveness and safety of a modified hemostatic protocol using combined intravenous and topical tranexamic acid compared with conventional adrenaline-based infiltration for reducing donor site bleeding in split-thickness skin grafting. **Methods:** A prospective comparative clinical study was conducted in the Department of Reconstructive Surgery at a tertiary-care university hospital between November 2022 and November 2023. Eighty-five patients requiring STSG were allocated into two groups. Group A received local infiltration with lidocaine–adrenaline solution (1:100,000). Group B received intravenous tranexamic acid (10 mg/kg) administered 30 minutes preoperatively, followed by topical application of TXA-impregnated gauze to the donor site after graft harvesting. Intraoperative bleeding severity, postoperative dressing change requirements, hemoglobin variation, need for transfusion, graft take, and donor site epithelialization were assessed. **Results:** Patients in the TXA group demonstrated significantly reduced donor site bleeding compared with the adrenaline group ($p < 0.01$). The requirement for dressing change within the first 24 hours postoperatively was also significantly lower in the TXA group. No statistically significant differences were observed between groups regarding postoperative hemoglobin levels, blood transfusion requirements, graft success rates, or donor site epithelialization. No thromboembolic or serious adverse events related to TXA were recorded. **Conclusion:** The combined intravenous and topical administration of tranexamic acid represents an emerging and effective hemostatic strategy for controlling bleeding from STSG donor sites. This modified protocol is safe, cost-effective, and suitable for implementation in tertiary-care surgical settings.

KEYWORDS: Tranexamic acid; split-thickness skin graft; donor site bleeding; perioperative hemostasis; reconstructive surgery.

INTRODUCTION

Split-thickness skin grafting remains a fundamental reconstructive technique for the management of soft tissue defects resulting from trauma, burns, infection, and oncologic resection. Despite its widespread use, morbidity related to the donor site continues to pose a significant clinical challenge, with bleeding being one of the most frequent and troublesome complications.

Donor site hemorrhage can lead to increased postoperative pain, frequent dressing changes, delayed healing, anemia, and, in some cases, the need for blood transfusion. Effective perioperative

hemostasis is therefore essential, particularly in patients requiring large-area graft harvesting or those treated in high-volume tertiary-care centers.

Adrenaline-containing local anesthetic solutions have traditionally been used to reduce bleeding at donor sites through vasoconstriction. However, their effect is short-lived and may be insufficient in extensive grafting procedures. In recent years, tranexamic acid (TXA), a synthetic antifibrinolytic agent that inhibits plasminogen activation, has gained increasing attention due to its proven efficacy in reducing surgical blood loss across multiple specialties.

While systemic TXA administration is well established in cardiac, orthopedic, trauma, and obstetric surgery, its application in plastic and reconstructive surgery—particularly at split-thickness skin graft donor sites—represents an emerging clinical area. Moreover, evidence regarding the combined use of intravenous and topical TXA in this setting remains limited.

This study was designed to evaluate a modified hemostatic protocol utilizing combined intravenous and topical tranexamic acid and to compare its effectiveness and safety with conventional adrenaline-based infiltration in controlling donor site bleeding following split-thickness skin graft harvesting.

OBJECTIVES

Primary Objective

- To assess the efficacy of combined intravenous and topical tranexamic acid in reducing bleeding from split-thickness skin graft donor sites.

Secondary Objectives

- To compare the need for donor site dressing changes within the first 24 hours postoperatively.
- To evaluate graft take and early graft success.
- To assess donor site epithelialization.
- To monitor perioperative safety and adverse effects associated with tranexamic acid use.

MATERIALS AND METHODS

Study design

Prospective comparative clinical study.

Study period and place

The study was conducted at the Surgical Department of a tertiary-care referral center from September 2024 to September 2025.

Study sample

Eighty-five patients requiring split-thickness skin grafting for reconstruction of soft tissue defects were included.

Inclusion criteria

- Patients with skin defects suitable for coverage with split-thickness skin grafts.
- Adult patients of either sex.

Exclusion criteria

- Polytrauma or intensive care unit patients.
- Diabetes mellitus or chronic systemic steroid use.
- History of thromboembolic disease.
- Known hypersensitivity to tranexamic acid.
- Hepatic, renal, or hematological disorders affecting coagulation.

METHODOLOGY

Preoperative assessment

A detailed medical history was obtained from all patients, including defect etiology, size, location, comorbidities, medication history, and coagulation status. Written informed consent was obtained from all participants following institutional ethical committee approval.

Operative procedure

All procedures were performed under general anesthesia with controlled systemic blood pressure. In Group A, donor sites were infiltrated with lidocaine 2% combined with adrenaline (1:100,000). In Group B, patients received intravenous tranexamic acid at a dose of 10 mg/kg 30 minutes preoperatively. Donor sites were infiltrated with lidocaine 2% only, followed by topical application of TXA-impregnated gauze for 10 minutes after graft harvesting.

Split-thickness skin grafts of uniform thickness were harvested using a dermatome. Standardized donor site dressings were applied in both groups.

STATISTICAL ANALYSIS

Data were entered and analyzed using SPSS version 22. Qualitative variables were analyzed using the chi-square test, while quantitative variables were analyzed using the Student's t-test. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of **85 patients** undergoing split-thickness skin grafting were included in the study. Patients were divided into **Group A (adrenaline group)** and **Group B (tranexamic acid group)**. Both groups were comparable with respect to demographic and clinical variables.

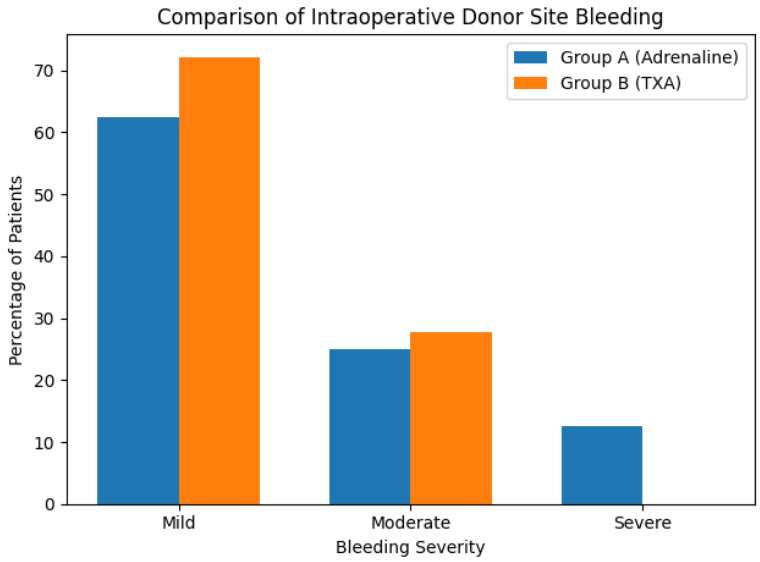
Baseline Characteristics

There was **no statistically significant difference** between the two groups regarding age, sex distribution, indication for grafting, graft size, or

donor site location, indicating adequate baseline comparability (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics.

Variable	Group A (Adrenaline)	Group B (TXA)	p-value
Number of patients (n)	40	45	—
Mean age (years)	42.6 ± 11.2	43.1 ± 10.8	>0.05
Male/Female	28 / 12	31 / 14	>0.05
Mean graft size (cm²)	118.4 ± 22.6	121.2 ± 24.1	>0.05
Donor site (thigh)	34 (85%)	38 (84.4%)	>0.05
Indication (burns/trauma/others)	Comparable	Comparable	>0.05

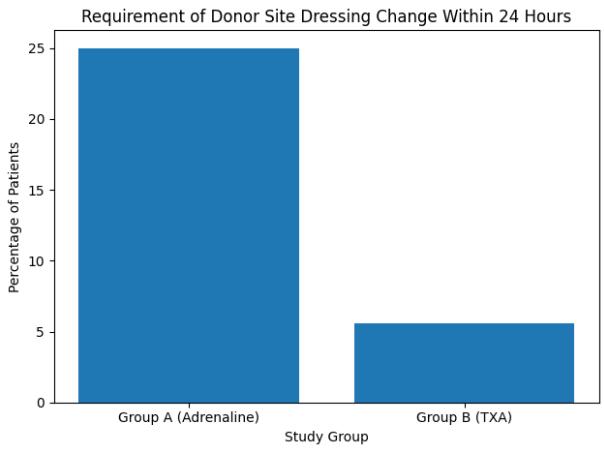


Intraoperative Donor Site Bleeding

Intraoperative bleeding severity differed significantly between the two groups. In **Group A**, mild bleeding was observed in 62.5% of patients, moderate bleeding in 25%, and severe bleeding in 12.5%. In contrast, **Group B** demonstrated superior hemostasis, with 72.2% experiencing mild bleeding, 27.8% moderate bleeding, and **no cases of severe bleeding**. This difference was **statistically significant ($p < 0.01$)** (Table 2).

Table 2: Comparison of Intraoperative Donor Site Bleeding Severity.

Bleeding severity	Group A (n=40)	Group B (n=45)	p-value
Mild	25 (62.5%)	33 (72.2%)	
Moderate	10 (25%)	12 (27.8%)	<0.01
Severe	5 (12.5%)	0 (0%)	



Postoperative Outcomes

The requirement for donor site dressing change within the first 24 hours postoperatively was significantly higher in **Group A (25%)** compared with **Group B (5.6%)**, demonstrating improved early hemostatic control in the TXA group (**$p < 0.01$**).

There was **no statistically significant difference** between the groups regarding postoperative hemoglobin drop or need for blood transfusion. One patient in each group required postoperative transfusion.

Graft take rates were comparable between groups, with success rates of **93.8% in Group A** and **94.4% in Group B**. Delayed donor site epithelialization was observed in three patients in Group A and two patients in Group B, with no significant difference. No thromboembolic or serious adverse events related to tranexamic acid were observed (Table 3).

Table 3: Comparison of Postoperative Outcomes.

Outcome	Group A (Adrenaline)	Group B (TXA)	p-value
Dressing change within 24 hrs	10 (25%)	3 (5.6%)	<0.01
Mean hemoglobin drop (g/dL)	1.3 ± 0.4	1.2 ± 0.3	>0.05
Blood transfusion required	1 (2.5%)	1 (2.2%)	>0.05
Graft take success	93.8%	94.4%	>0.05
Delayed epithelialization	3 (7.5%)	2 (4.4%)	>0.05
Thromboembolic events	0	0	—

The combined intravenous and topical administration of tranexamic acid resulted in **significantly reduced intraoperative donor site bleeding** and **lower early postoperative dressing requirements** compared with conventional adrenaline-based infiltration, without adversely affecting graft take, wound healing, or safety outcomes.

A total of 85 patients were included in the study. The male-to-female distribution was comparable between the two groups, with no statistically significant difference. The mean age was comparable between the two groups, with no statistically significant difference.

DISCUSSION

Effective control of perioperative bleeding remains a critical factor in optimizing surgical outcomes, particularly in reconstructive procedures requiring split-thickness skin grafting. Donor site hemorrhage can contribute to patient discomfort, increased dressing requirements, prolonged hospital stay, and the need for blood transfusion.

Tranexamic acid has emerged over the past decade as a versatile antifibrinolytic agent with expanding applications across multiple surgical specialties.

While its systemic use is well established in cardiac, orthopedic, and trauma surgery, its role in plastic and reconstructive surgery—particularly in skin graft donor sites—has only recently gained attention.

The findings of this study demonstrate that a combined intravenous and topical TXA protocol provides superior control of donor site bleeding compared with conventional adrenaline-based infiltration. The significant reduction in bleeding severity and early dressing change requirements highlights the clinical relevance of this emerging hemostatic strategy.

Importantly, the use of TXA did not adversely affect graft take or donor site epithelialization, addressing a common concern regarding antifibrinolytic agents and wound healing. Additionally, no thromboembolic complications were observed, supporting the safety of TXA when used in appropriately selected patients.

Recent studies published between 2022 and 2025 have reported similar benefits of TXA in reducing surgical blood loss and postoperative ecchymosis in reconstructive and aesthetic procedures. Our findings are consistent with this growing body of evidence and further extend its application to split-thickness skin graft donor site management.

The tertiary-care setting of this study underscores the feasibility and cost-effectiveness of implementing this protocol in high-volume surgical centers, particularly in resource-limited environments where minimizing blood loss and transfusion requirements is critical.

Limitations

One limitation of this study is its single-center design; however, the inclusion of 85 patients strengthens the statistical reliability of the findings. Larger multicenter studies are recommended to validate these findings and to establish standardized dosing and application protocols.

CONCLUSION

The combined intravenous and topical administration of tranexamic acid represents an effective and safe emerging strategy for controlling bleeding from split-

thickness skin graft donor sites. This modified hemostatic protocol significantly reduces early postoperative bleeding and dressing requirements without compromising graft success or wound healing. Its simplicity, safety profile, and cost-effectiveness support its integration into routine practice in tertiary-care reconstructive surgery settings.

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