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EFFECT ON THE SURGICAL FIELD QUALITY DURING FUNCTIONAL ENDOSCOPIC SINUS SURGERY BY USE OF INTRAVENOUS AND TOPICAL TRANEXAMIC ACID

Original Research

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ABSTRACT

Background: The patients had trauma or hemorrhage condition, tranexamic acid (TXA) has been shown to decrease mortality. Intraoperative bleed is one of the major challenge a surgeon encounters during FESS. The purpose of this research is to study the effect of local or intravenous tranexamic acid on surgical field quality and about need for transfusions.

Objective: The objective of this study was to evaluate and compare the effects of topical and intravenous tranexamic acid (TXA) administration on surgical field quality, intraoperative blood loss, and the need for transfusions during functional endoscopic sinus surgery (FESS) in patients with chronic rhinosinusitis.

Methods: Seventy people with chronic sinusitis participated in the prospective observational research, which was carried out at department of ENT and Combined Military Hospital Rawalpindi. Thirty-five patients in the one group administrated with intravenous TXA and thirty-five received topical TXA before surgery. Boezaart grading system was used to assess the quantity of blood loss and quality of the operative field at fifteen, thirty and forty-five minutes during surgery.

Results: In all, there were 31 male patients and 39 female patients. The patients' ages ranged from 50.97±10.97 years and 52.47±10.48 years enrolled in intravenous and topical TXA administration groups. After 45 minutes after the start of surgery, most patients in the intravenous group (17.1%) were in grade II, whereas only 2.9% of those in the topical TXA group were at that point. Furthermore, there was considerably less bleeding in the topical group compared to the intravenous group across all time points studied ($P = 0.00$). The postoperative timings are statistically significant between intravenous and topical TXA groups ($p<0.05$).

Conclusion: The use of topical TXA prior to FESS in patients with rhinosinusitis significantly decreases blood loss and enhances visibility in the sinus cavity. These findings suggest that within 30 minutes of administration, topical TXA may help create a good surgical field.

Keywords: Surgical Field Quality, Functional Endoscopic Sinus, Intravenous, Topical Tranexamic Acid.

INTRODUCTION

One of the most common long-term conditions affecting the nasal and paranasal sinuses is called chronic rhinosinusitis. The treatment options of chronic sinusitis may include functional endoscopic sinus surgery (FESS) (1). About 31 million individuals are affected by it each year, making it the second most common chronic sinusitis condition in the western countries (2). The frequency of this disease in Pakistan is 26.7% in patients diagnosed with nasal polyps showed a 7% incidence rate (3). Paranasal sinus processes may involve or cause injury to the orbit because of their close proximity to the eye socket. FESS has the potential to cause shifts in the (intraocular pressure) IOP structure. The orbit, extraocular muscles, optic nerve, and lacrimal drainage system are all at risk of damage during FESS (4). The likelihood of complications during surgery depends on a number of factors, including the individual's anatomy, the patient's surgical history, the patient's current state, the scope of the procedure, and the surgeon's skill (5). There is no loss of vision is imminent without any improvement after 48 hours of medication therapy, then FESS emergency surgery may be necessary to treat their rhinosinusitis and nasal polyps (6). Furthermore, for patients presenting with severe complications of sinusitis, FESS is a safe, convenient, and minimally invasive method. The advantages of functional endoscopic sinus surgery (FESS) include its ability to drain the sinuses without disturbing the normal physiology of the nasal cavity, as well as its efficiency and adaptability in treating sinusitis (7). Radiologists doing functional endoscopic sinus surgery (FESS) is familiar with ocular abnormalities and their radiographic manifestations, as well as the clinical manifestations and mechanisms of injury (8). Image-guided surgery is rapidly gaining acceptance as a useful tool for endoscopic sinus surgery (9). Bleeding, infection, crusting, synechia development, ostial stenosis, numbness of the teeth or lips, and sickness recurrence are all examples of less serious complications. Hyposmia/anosmia, exposing orbital fat, damaging extraocular muscles, blindness, vascular damage, CSF leak, brain injury, and death are all potential outcomes (10).

Tranexamic acid (TXA), a synthetic antifibrinolytic medication, competes with lysine for binding sites on plasmin and plasminogen. Once the binding site is occupied by fibrin, plasminogen is no longer able to bind to the surface fibrin and the fibrinolysis process is halted (11). In reaction to the substantial tissue damage induced by any surgical therapy, the body releases tissue plasminogen activator, an enzyme that converts plasminogen to plasmin and begins fibrinolysis (12). c including nausea, vomiting, diarrhea, allergic dermatitis, dizziness, hypotension, seizures, visual impairment, achromatopsia (impaired color vision), and thromboembolic events (13). However, there is a lack of information on the effectiveness of TXA as a hemostatic agent in nasal surgeries. The efficacy of TXA in preventing blood loss during FESS has only been investigated in a few of trials. There is also unclear about whether or not TXA concentration is used for halting bleeding. That’s why there is a need to be conducted to identify more reliable methods of stopping bleeding during endoscopic sinus surgery. While major blood loss is common with endoscopic treatments increasing the likelihood of complications including blindness, diplopia, internal carotid artery damage, a more drawn-out surgical operation, or a failed result (13, 14).

The goal of this research was to see whether chronic sinusitis patients undergoing FESS would benefit from the use of intravenous and topical TXA to decrease blood loss and improve visibility during the procedure.

METHODS

The study was conducted between August 2024 and December 2024 with the approval of the institutional review board (IRB) hospital ethics committee (reference number). All participants provided written informed consent. This prospective observational study included patients scheduled for functional endoscopic sinus surgery (FESS) at the Department of [Name of the Department]. The sample size was calculated using the WHO sample size calculator, assuming a 5% margin of error, 95% confidence interval, and a prevalence rate of 27% based on prior research. The minimum calculated sample size was 70 participants (3).

The inclusion criteria encompassed patients aged 18 to 60 years, with a hemoglobin level of at least 10 mg/dl and normal clotting parameters, including bleeding time, clotting time, international normalized ratio, prothrombin time, and partial thromboplastin time. Patients were excluded if they had hemophilia, thrombosis, acute or chronic renal failure, cirrhosis, chronic diseases such as hypertension, diabetes, or heart failure, heparin use within 48 hours of surgery, aspirin use within 14 days of surgery, sensitivity to tranexamic acid (TXA), pregnancy, color blindness, cardiac stents, or nasal tumors. All patients underwent standardized anesthesia protocols. Isoflurane at 1% in an oxygen-air mixture (1:1 ratio) was used for maintenance, and atracurium 0.1 mg/kg was administered

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every 20 minutes to sustain neuromuscular blockade. Normocapnia was maintained through controlled ventilation, and a fentanyl bolus of 0.5 mcg/kg was used to regulate mean arterial pressure (MAP) between 60 and 70 mmHg, with a maximum cumulative dose of 5 mcg/kg. A saline-soaked throat pack was inserted to prevent blood from entering the gastrointestinal system. Epinephrine-soaked nasal packs (1:1000) were applied, and an additional 2 mL of epinephrine (1:100,000) was injected into the middle turbinate and the lateral nasal wall region. Patients were observed in a consistent position for 24 hours postoperatively.

To minimize intraoperative bleeding and inflammation, oral prednisone at 1 mg/kg was prescribed for five days prior to surgery. On the day of surgery, pre-medications included intravenous midazolam (0.05 mg/kg), ranitidine (50 mg), and dexamethasone (10 mg). Patients were randomized into two groups using a computer-generated list. Group A received 15 mg/kg of TXA intravenously over 30 minutes, while Group B received a topical application of TXA, prepared as 2 g in 400 mL normal saline for irrigation. Additional irrigation in Group B, if required, was performed with normal saline. A pharmacist prepared and labeled the medications and irrigation solutions with patient-specific identifiers. All surgeries were performed by the same surgeon.

Intraoperative blood loss, MAP, and heart rate (HR) were measured at baseline (pre-induction), immediately after induction, and every 15 minutes until the surgery concluded. Recovery time was recorded as the interval between the discontinuation of isoflurane and the patient's response to verbal commands. Surgical site quality was evaluated by the surgeon using the Boezaart scale (1 to 5). Laboratory investigations, including prothrombin time (PT), partial thromboplastin time (PTT), and complete blood count (CBC), were performed preoperatively and six hours postoperatively. Postoperative complications such as epistaxis, nausea, vomiting, impaired vision, discomfort, and venous thromboembolism (VTE) were assessed in the post-anesthesia care unit (PACU) and every six hours for the first 24 hours. All patients underwent preoperative paranasal sinus (PNS) CT scans and endoscopic grading for polyposis. Patients with polyposis were treated with oral corticosteroids for ten days preoperatively to reduce inflammation and minimize surgical bleeding.

To ensure uniformity in pre-surgical preparation, all patients, regardless of group assignment, received a nasal pack saturated with 1:1000 epinephrine prior to initiating surgery to reduce intraoperative bleeding. This step was standardized across groups and did not conflict with the randomization of TXA administration. Additionally, the degree of sinus involvement was evaluated preoperatively using the Lund-Mackay scoring system, which assesses sinus opacification on CT scans. For patients with polyposis, grading was performed using the Meltzer clinical scoring system to classify the severity of nasal polyps, ensuring a consistent and standardized approach to preoperative evaluation and treatment. Data analysis was performed using SPSS version 20. Continuous variables were analyzed using the t-test, while categorical variables were evaluated using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

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RESULTS

Of the 100 patients who participated; 30 were excluded out of which n=23 did not give consent and n=7 had severe health issues. The remaining 70 patients were finally recruited for the study, with 35 patients assigned to the intravenous TXA and 35 patients assigned to the topical TXA group.

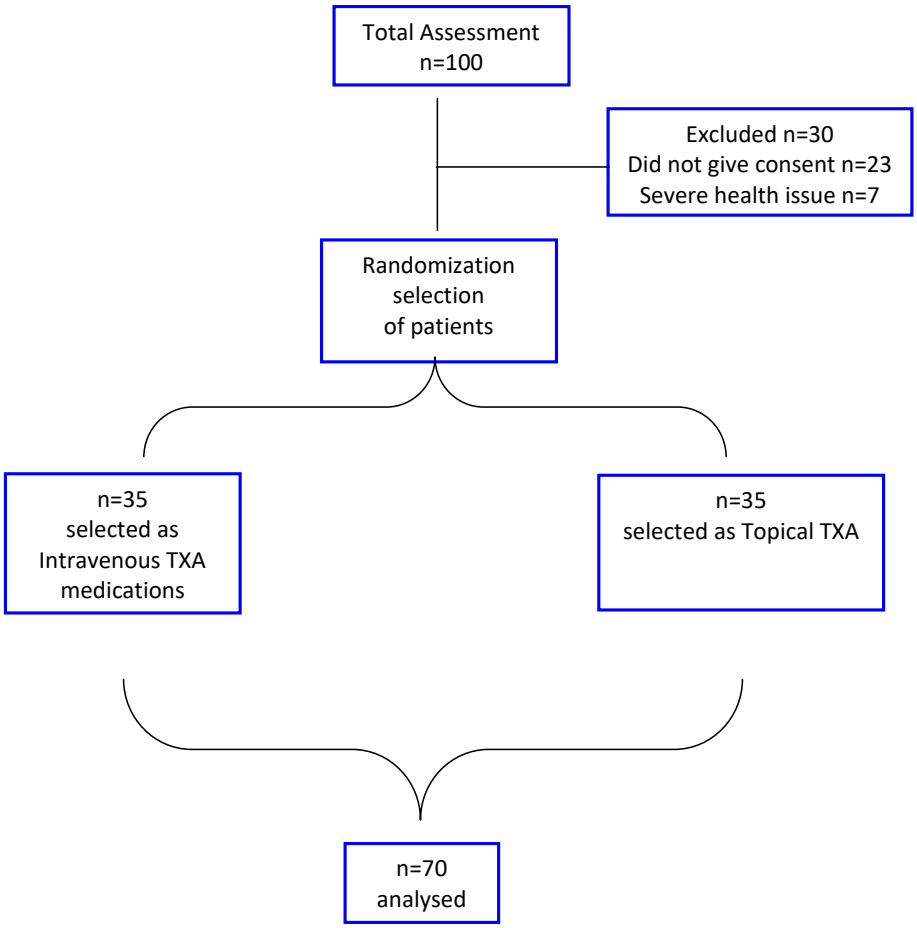

Figure 1 Flow chart of the study protocol and selection process.

In all, there were 31 male patients and 39 female patients. The patients' ages ranged from 50.97±10.97 years and 52.47±10.48 years enrolled in intravenous and topical TXA administration groups. There was no statistically significant difference between the demographic age and sex represented in tables I and II respectively.

Table 2 shows the Boezaart grading of the operative field 15, 30, and 45 minutes after surgery began for both groups. The higher prevalence of 15 minutes after surgery was found in grade III. Patients in both groups was more likely to be in grade III (48.6%) 30 minutes into the operation. Moreover, 11.4% of patients in the topical group reached grade IV as compared to 14.3% in the intravenous group.

After 45 minutes of surgery, most patients in the intravenous group (17.1%) were in grade II, whereas only 2.9% of those in the topical TXA group were at that point. The post operative timings are statistically significant between intravenous and topical TXA groups ($p<0.05$). Table 2 shows the percentage of patients in the intervention group who had previous functional endoscopic sinus surgery and grading of polyposis. In every case of both groups the amount of bleeding was recoded. And it was noticed that 32.03 ml in topical TXA were recorded as compared to 35.16 ml in intravenous group (P= 0.000).

From the total of 70 patients, 3 (8.6%) developed grade III polyposis, including 2 (5.7%) in topical TXA group. Patients with and without polyposis were studied independently to assess the quality of the surgical field and the quantity of bleeding in both groups. The quality of the surgical field was significantly higher in the topical TXA compared to the intravenous TXA group across all time points, regardless of whether or not the patient had polyposis. In individuals with polyposis, however, neither group differed significantly from the other. Postoperative nausea, vomiting, and color vision loss due to TXA were assessed 24 and 72 hours after surgery. However, nobody had any negative consequences.

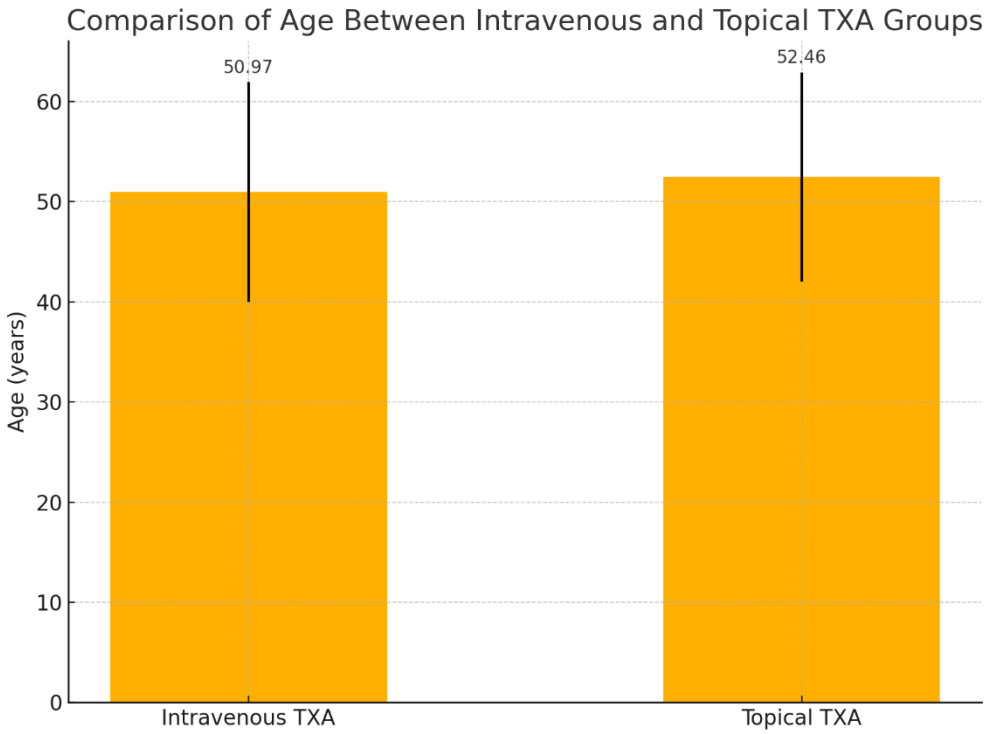

Figure 2 Comparison of Age Between Intravenous and Topical TXA Groups

Table 1 Comparison between intravenous and topical TXA drug administration.

		Mean	Std. Deviation	P Value
Hematocrit (%)	Intravenous.TXA	44.57	2.49	0.75
	Topical.TXA	45.37	2.56	
Bleeding Time (min)	Intravenous.TXA	1.37	0.19	0.047*
	Topical.TXA	1.76	0.12	
Systolic (mmHg)	Intravenous.TXA	113.31	15.96	0.012*
	Topical.TXA	125.83	22.37	
Diastolic (mmHg)	Intravenous.TXA	51.00	9.11	0.34
	Topical.TXA	51.26	10.07	
Total Score (CT scan)	Intravenous.TXA	16.17	2.36	0.06
	Topical.TXA	16.11	3.22	
Hemoglobin (mg/dl)	Intravenous.TXA	13.24	2.06	0.53
	Topical.TXA	12.84	2.27	
	Intravenous.TXA	81.71	5.75	0.035*

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		Mean	Std. Deviation	P Value
Mean artrial pressure (mmHg)	Topical.TXA	70.40	8.73	
Heart rate (per minute)	Intravenous.TXA	88.06	8.71	0.88
	Topical.TXA	83.49	9.23	
Prothrombin (seconds)	Intravenous.TXA	11.72	1.71	0.20
	Topical.TXA	12.53	2.21	
Partial thromboplastin time (s)	Intravenous.TXA	31.41	1.45	0.87
	Topical.TXA	31.86	1.46	
Platelet count (103/mm3)	Intravenous.TXA	102.23	19.21	0.28
	Topical.TXA	93.71	12.94	
Duration of surgery (miutes)	Intravenous.TXA	116.83	13.27	0.79
	Topical.TXA	117.91	12.18	
Amout of bleeding (ml)	Intravenous.TXA	35.16	5.55	0.00*
	Topical.TXA	32.03	1.74	

Table 1 presents a comparison of outcomes between intravenous and topical TXA administration during functional endoscopic sinus surgery. Significant differences were observed in bleeding time, systolic blood pressure, mean arterial pressure, and amount of bleeding, with topical TXA showing lower bleeding and systolic pressure ($p < 0.05$). Other parameters, including hematocrit, hemoglobin, heart rate, and surgery duration, did not show statistically significant differences between the two groups.

Table 2 Comparison the quality of surgical filed between intravenous and topical TXA drug administration.

		Intravenous TXA		Tropical TXA		
		Frequency	Percent	Frequency	Percent	P-Value
Sex	Male	17	48.6	14	40.0	0.47
	Female	18	51.4	21	60.0	
Previous functional endoscopic sinus surgery	Yes	7	20	11	31.4	0.274
	No	28	80	24	68.6	
Polyposis	None	12	34.3	8	22.9	0.594
	GradeI	18	51.4	21	60.0	
	GradeII	2	5.7	4	11.4	
	GradeIII	3	8.6	2	5.7	
0-15minutes	Grade I	0	0	4	11.4	0.038*
	Grade II	14	40	13	37.1	
	GradeIII	16	45.7	17	48.6	

		Intravenous TXA		Tropical TXA		
		Frequency	**Percent**	**Frequency**	**Percent**	**P-Value**
	GradeIV	5	14.3	1	2.9	
16-30minutes	GradeI	0	0	2	5.7	0.030*
	GradeII	8	8	14	40.0	
	GradeIII	17	48.6	17	48.6	
	GradeIV	10	10	2	5.7	
31-45minutes	GradeI	0	0	2	5.7	0.044*
	GradeII	1	2.9	6	17.1	
	GradeIII	30	85.7	22	62.9	
	GradeIV	4	11.4	5	14.3	

Table 2 compares the quality of the surgical field between intravenous and topical TXA administration. Significant improvements were observed with topical TXA at various time intervals (0–15, 16–30, and 31–45 minutes), with higher frequencies of Grade I and Grade II surgical fields ($p < 0.05$). Other parameters, such as sex, prior surgeries, and polyposis grading, showed no significant differences between the groups.

DISCUSSION

FESS may assist patients with recurrent sinusitis who have not responded to traditional medical treatment (15). Nasal endoscopic is restricted sometime due to complex anatomical features in the nose that contains blood vessels, therefore good sight is essential during FESS (16). Hence, there is a chance of excessive bleeding during endoscopy sinus surgery. Sacrafoni et al describes the use of antifibrinolytic medicines administered by intravenous infusion during and after surgery showed successfully minimize intraoperative and postoperative blood loss. The risk of thromboembolism may be raised by the systemic infusion of fibrinolysis inhibitors, which can enhance the propensity to thrombosis (17). Surgery operations targeted to the use of topical TXA to prevent or lessen the likelihood of thromboembolism. It has been utilized as an effective antifibrinolytic drug for quite some time, also confirmed by Franchini et al (18). There have been several attempts to employ TXA to lessen blood loss and enhance visibility in FESS. Most often, TXA is injected into a vein. However, several researchers employ it topically in a wide range of surgical operations (19, 20).

Subramanyam et al and King et al studied on the use of TXA, either orally or intravenously, has been shown to have similar effects on blood loss and surgical visibility. The effects of topical TXA on bleeding and the improvement of the surgical area in FESS have only been investigated in two trials (21, 22). Topical epsilon-aminocaproic acid (EACA) and tranexamic acid (TXA) were compared for their ability to decrease bleeding at surgical sites in a randomized controlled trial conducted by Ausen et al (23). Similarly, the Houstan et al conducted the study on total of 30 people were randomly assigned to receive either 2.5 g of EACA, 100 mg of TXA, or 1 g of TXA, with saline injected into the untreated side. They found that TXA used topically might effectively control bleeding and enhance the operating environment. This trial's findings corroborated those we obtained in our own study (24). In the quality of surgical field to determine whether or not intravenous and topical TXA may promote hemostasis and performed a clinical experiment on patients. In this study the quantity of bleeding experienced by the tropical TXA group was lower than that of the intravenous group, the research found (25). Similarly, it was in other study conducted by Husian et al observed that FESS intraoperative hemorrhage may be reduced by topical administration of TXA (19).

No analyses of TXA's effectiveness were performed at varying postoperative intervals. In contrast, we found that TXA significantly reduced blood loss and improved the surgical field after 15, 30 and 45 minutes of surgery when we compared the results to those obtained from intravenous TXA. Further, we compared patients with and without polyposis to determine TXA's impact on blood loss and surgical field quality. We demonstrated that, in patients without polyposis, topical TXA may offer an adequate surgical area and efficient hemostasis. Topical TXA's is more impact on bleeding and surgical field quality was modest in polypectomy patients. This may be

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because the hemorrhagic nature of polyps counteracts the hemostatic action of TXA, or it may be because the research lacked the necessary sample size of polyp patients to reliably detect any differences between subgroups (1, 2). Because of this, the risk of bleeding among polyp patients was greater in the intravenous group compared to topical group (19) . It's possible that our study's statistical power would increase if there was no significant difference in the incidence of polyps between the two groups. Our research shows that in patients with rhinosinusitis undergoing FESS, topical TXA may effectively decrease blood loss and enhance the surgical field.

A recent study by Rizzo et al. (2020) evaluated the efficacy of intravenous versus topical administration of tranexamic acid (TXA) in reducing blood loss during primary uncemented total hip arthroplasty. In this randomized controlled trial, 75 patients were divided into three groups: topical TXA, combined intravenous and topical TXA, and a control group. The combined group showed significantly higher postoperative hemoglobin and hematocrit levels on postoperative days 1 and 3, along with a lower rate of blood transfusions (0% vs. 20%, $p = 0.014$) compared to the control group. Interestingly, while both the topical and combined groups demonstrated a reduction in blood loss compared to controls, the combined group was more effective in minimizing perioperative bleeding. This study highlights the potential for combined TXA administration to optimize hemostasis while reducing the need for blood transfusions in surgical settings. These findings support the growing evidence of TXA's versatility and safety in managing surgical bleeding (26).

The study's primary flaw was its very small sample size. The findings of any subgroup analysis comparing patients with and without polyposis might be skewed by chance. It is recommended that separate randomized controlled studies be conducted on patients with and without polyposis to determine the impact of TXA on bleeding and the quality of the surgical field. A sufficiently driven future research focusing on patients with polyps should focus this question.

CONCLUSION

It has been shown that in patients with rhinosinusitis, topical TXA may effectively decrease bleeding and enhance the surgical field during FESS. This research suggests that topical TXA may be an effective way to create a clean surgical field within the first 30 minutes following application. However, further studies are needed to determine the effectiveness of TXA in various patient subgroups, including those with and without polyposis.

Author Contribution

Author	Contribution
Inamul Haq*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Umar Asim	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Mian Amer Majeed	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Usman Afzal Malik	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhibullah Younus	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Tahir Liaqat	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Junaid Akram	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Hamza Asad	Writing - Review & Editing, Assistance with Data Curation

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