

# Topical tranexamic acid versus hot saline for field quality during endoscopic sinus surgery

Ahmed Shehata<sup>a</sup>, Mohammed Sabra Ibrahim<sup>b</sup>, Mohammed Hamed Abd-El-Fattah<sup>b</sup>

<sup>a</sup>Department of Otorhinolaryngology,

<sup>b</sup>Anesthesia and ICU Department, Faculty of Medicine, Benha University, Benha, Egypt

Correspondence to Ahmed Shehata, MD, Department of Otorhinolaryngology, Faculty of Medicine, Benha University, Benha 13515, Egypt

Tel: 0133243801;

e-mail: ahmedshehata\_ent@yahoo.com

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## Objectives

This study conducted to evaluate and compare between topical tranexamic acid (TA) and hot saline as an alternative to local vasoconstrictors on bleeding and surgery site quality during endoscopic sinus surgery (FESS).

## Patients and methods

This study was performed on 75 patients with class I and II American society of anesthesiologists (A.S.A.), scheduled for elective FESS under general anesthesia. Patients divided into three groups, each (25 patients), group A: topical tranexamic acid (1000mg diluted in 20ml normal saline) was used during surgery for packing and irrigation, group B: hot saline up to 50°C was used and group C :(control group) normal saline was used.

## Results

The use of local (TA) was associated with significant decrease in estimated blood loss 214.2 ml more than local hot saline which was 216.75 and both is much better than the normal saline which was 272.66. Also (TA) and hot saline showed decrease in the duration of surgery, improve the surgical field quality and blinded surgeon satisfaction as compared with the control group.

## Conclusion

The use of local TA and local hot saline up to 50°C achieved reduction in blood loss, duration of surgery and improved surgical field quality during FESS.

## Keywords:

Tranexamic acid, hot saline, bleeding, surgical field quality, endoscopic sinus surgery

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## Introduction

Functional endoscopic sinus surgery (FESS) is frequently used in the treatment of recalcitrant chronic rhinosinusitis (CRS) [1]. Bleeding is a common inevitable complication that results from impaired visibility of ruptured blood vessels because of excessive bleeding during surgery [2], which takes a major concern for both anesthesiologists and otolaryngologists [3].

Bleeding during FESS can interfere with surgeon visibility, and then the surgeon will have to use suction frequently and this will increase the risk of further manipulation of field, more bleeding, and longer surgery duration. It also increases the risk of possible injuries of the vasculature of the eye and intracranial complications [4,5].

The most important source of bleeding during endoscopic sinus surgeries is the capillaries, and therefore mean arterial pressure (MAP) can influence the severity of bleeding [6,7].

In an effort to reduce bleeding during FESS and thus improve visualization, many surgeons use techniques such as hypotensive anesthesia, elevation of the head of the bed during surgery, and administration of local vasoconstrictors [8].

For nasal bleeding, tranexamic acid has been suggested to improve hemostasis and improve the surgical field [9]. Tranexamic acid can be administered topically or intravenously. In the clotting cascade, it serves to stabilize the fibrin clot and reduce overall bleeding [10]. The mechanism of action topical antifibrinolytics (tranexamic acid) is competitive binding with the lysine site on plasminogen. This prevents fibrinolysis and stabilizes the blood clot, potentially decreasing further bleeding. Conversely, a low dose (100 mg) of tranexamic acid provided hemostasis and improved quality of the surgical field at 2, 4, and 6 min after application ( $P < 0.05$ ). No adverse effects were found after topical application [11].

Hot water irrigation is an effective method of treating severe, life-threatening epistaxis [12,13]. In addition, it has recently been demonstrated that hot water irrigation, using temperature of up to 50°C, produces vasodilatation and edema of the nasal mucosa without the risk of necrosis. This mucosal edema leads to local compression of the bleeding vessels while at the same time triggering and probably accelerating the clotting cascade [14]. Vasodilatation also leads to decreasing the flow and the intraluminal blood pressure. Another benefit of warm water irrigation is that it allows the cleaning of the endoscopic lens [15].

The aim of this study was to evaluate and compare between topical tranexamic acid and hot saline on bleeding and quality of the surgery site during endoscopic sinus surgery.

### Patients and methods

Following approval of the ethics committee, informed written consent was obtained from the patients. A total of 75 patients with bilateral CRS with or without polypi, both male and female, between the age of 20 and 50 years, body weight ranging from 60 to 100 kg and classified according to the American Society of Anesthesiologists (ASA I and II), were randomly selected from the ENT Department lists from the period of December 2011 to October 2013.

Patients with unilateral or previous FESS, cerebrospinal fluid rhinorrhea, benign or malignant tumors, pregnant or breast feeding, known allergy to antifibrinolytics, any bleeding diathesis, previous cardiac surgery, severe anemia, liver or kidney disorder, hypertension, uncontrolled diabetes, immunodeficiency disease, or on long-term medications such as steroids, nonsteroidal drugs, and chemotherapeutics were excluded from this study.

Patients were divided into three groups, each comprising 25 patients. In group A, tranexamic acid (1000 mg diluted in 20 ml normal saline) was used for packing and irrigation during surgery. In group B, hot saline was prepared by placing sterile normal saline (9%) into a basin, and then the basin was placed in a medical-grade warmer and the temperature up to 50°C. The external digital thermometer is also placed in the saline at all times to ensure that the temperature is about 50°C, and was used for packing and irrigation during and after surgery. In group C, normal saline was used for packing and irrigation during surgery.

All patients were premeditated with midazolam (0.02 mg/kg) and fentanyl (2 mg/kg). After monitoring, anesthesia induction with propofol (2 mg/kg), atracurium (0.5 mg/kg), and lidocaine was given (1.5 mg/kg) before intubation. At the beginning of the procedures, nasopharyngeal pack with gauze

was used to prevent blood from lowering down to the pharynx. Anesthesia maintained by isoflurane inhalation and muscle relaxant. MAP was maintained between 60 and 70 mmHg by using nitroglycerine infusion (5–10 µg/kg/min). After surgery, muscle relaxant was reversed with atropine (0.02 mg/kg) and neostigmine (0.05 mg/kg).

Hemodynamic parameters such as MAP and heart rate were recorded every 15 min. Prothrombin time, partial thromboplastin time, and complete blood count were carried out preoperatively and 6 h postoperatively. Any side effects of treatment such as nausea or vomiting were reported.

Blood loss intraoperatively was estimated by the attending anesthesiologist by counting the blood-soaked mops and gauze pieces, multiplying them by the estimated volume of blood they carried, and also measuring blood lost to suction bottles and estimating it after subtraction of irrigation fluid.

The surgical field was first suctioned clear of blood and then graded by the surgeon using the scale of Boezaart *et al.* [2] (Table 1). The surgeon adopted a wait and watch approach with the aid of endoscopy during and at the end of surgery to detect fresh bleeding. If the bleeding observed was due to an inflamed residual polyp, the polyp was removed and the patient was observed for any further bleeding. If the bleeding was from a particular spot, the spot was cauterized and again checked for further bleeding. All patients were packed with Merocell (Medical product Ltd. C0ronet House, Kearnstey Road Ripon, North Yorkshire, HG4, UK) for 24 h.

Statistical analysis of the collected data was performed by using SPSS version 17 (Chicago, Illinois, USA). Quantitative data were presented as mean and SD and were analyzed by using one-way analysis of variance test. Qualitative data was presented as numbers and percentages and were analyzed using  $\chi^2$ -test and Fisher's exact test. *P*-value less than 0.05 was considered significant, whereas *P*-value less than 0.01 was considered highly significant.

**Table 1 Grading scale for scoring of surgical field bleeding**

| Grades | Assessment   |
|--------|--|
| 0      | No bleeding (cadaveric conditions)   |
| 1      | Slight bleeding: no suctioning required  |
| 2      | Slight bleeding: occasional suctioning required  |
| 3      | Slight bleeding: frequent suctioning. Bleeding threatens surgical field a few seconds after suction is removed   |
| 4      | Moderate bleeding: frequent suctioning required and bleeding threatens surgical field directly after suction is removed  |
| 5      | Severe bleeding: constant suctioning required; bleeding appears faster than can be removed by suction; surgical field severely threatened and surgery usually not possible |

**Results**

This study was conducted on 75 patients with CRS with age ranging from 20 to 50 years, with mean ± SD of 35.88 ± 10.3 in group A, 36.52 ± 10.9 in group B, and 31.56 ± 12.1 in group C. There were no significant differences between the three groups.

Sex distribution showed male predominance as there were 45 males (60%) and 30 females (40%).

With regard to the bleeding scores in the three groups, according to the Boezaart grading scale, less bleeding was noticed in groups A and B, and more bleeding in group C. There were significant differences between groups A and B and group C, but no significant differences between groups A and B (Table 2).

According to the MAP, intraoperatively there were no significant differences between the three groups (Table 3).

The blinded surgeon's satisfaction about the significant reduction in bleeding during the operation showed that there was significant reduction in bleeding in groups A and B in comparison with group C; however, there were no significant differences between groups A and B (Table 4).

There were no significant differences between the three groups, either preoperative or postoperative in the coagulation profile (Table 5).

The duration of surgery showed significant increase in time in group C (control group) compared with groups A and B. However, no significant differences were observed between groups A and B (Table 6).

The blood loss during surgery showed no significant differences between groups A and B; however, the amount of bleeding showed a significant increase in group C (control group) in comparison with the other two groups (Table 7).

**Table 2 Bleeding score in the three groups**

| Bleeding scores | Group A [n (%)] | Group B [n (%)] | Group C [n (%)] | F-factor | P-value |
|-----------------|-----------------|-----------------|-----------------|----------|---------|
| 1               | 6 (24)          | 6 (24)          | 0 (0)           | 4.09     | 0.0003  |
| 2               | 15 (60)         | 14 (56)         | 12 (48)         |          |         |
| 3               | 4 (16)          | 5 (20)          | 10 (40)         |          |         |
| 4               | 0 (0)           | 0 (0)           | 3 (12)          |          |         |
| 5               | 0 (0)           | 0 (0)           | 0 (0)           |          |         |
| Mean ± SD       | 1.92 ± 0.64     | 1.96 ± 0.67     | 2.64 ± 0.7      |          |         |

**Table 3 Distribution of the mean arterial pressure**

| Variables | Group A (mean ± SD) | Group B (mean ± SD) | Group C (mean ± SD) | F-factor | P-value |
|-----------|---------------------|---------------------|---------------------|----------|---------|
| MAP       | 65.28 ± 6.08        | 56.16 ± 6.19        | 56.28 ± 6.17        | 0.0032   | 0.9972  |

MAP, mean arterial pressure.

**Table 4 Blinded surgeon's satisfaction about the significant reduction in bleeding during the operation**

| Blinded surgeon assessment | Yes [n (%)] | No [n (%)] | Mean ± SD   | F-factor | P-value   |
|----------------------------|-------------|------------|-------------|----------|-----------|
| Group A                    | 23 (92)     | 2 (8)      | 0.42 ± 0.22 | 20.042   | 0.0000009 |
| Group B                    | 22 (88)     | 3 (12)     | 0.88 ± 0.33 |          |           |
| Group C                    | 8 (32)      | 17 (68)    | 0.32 ± 0.47 |          |           |

**Table 5 The coagulation profile of the three groups**

| Variables                               | Group A        | Group B        | Group C        | F-factor | P-value |
|---|----------------|----------------|----------------|----------|---------|
| Platelet count (1.000/mm <sup>3</sup> ) | 259.36 ± 11.66 | 258.44 ± 11.87 | 258.16 ± 12.27 | 0.0693   | 0.934   |
| Preoperative PT (s)                     | 11.97 ± 0.33   | 11.95 ± 0.35   | 11.59 ± 0.43   | 0.0236   | 0.9781  |
| Preoperative PTT (s)                    | 30.9 ± 0.89    | 30.56 ± 1.09   | 30.57 ± 1.5068 | 0.5065   | 0.6024  |
| Postoperative PT (s)                    | 12.16 ± 0.25   | 11.47 ± 0.23   | 11.55 ± 0.46   | 0.5012   | 0.7024  |
| Postoperative PTT (s)                   | 30.2 ± 0.79    | 30.76 ± 1.08   | 30.56 ± 1.5167 | 0.5123   | 0.5922  |

PT, prothrombin time; PTT, partial thromboplastin time.

**Table 6 Duration of surgery in the three groups**

| Groups         | Group A      | Group B      | Group C     | F-factor | P-value |
|----------------|--------------|--------------|-------------|----------|---------|
| Duration (min) | 75.92 ± 7.64 | 79.22 ± 7.54 | 88.54 ± 8.3 | 9.32     | 0.0002  |

**Table 7 Blood loss during surgery in the three groups**

| Groups                    | Group A      | Group B       | Group C       | F-factor | P-value     |
|---------------------------|--------------|---------------|---------------|----------|-------------|
| Estimated blood loss (ml) | 214.2 ± 0.77 | 216.25 ± 1.45 | 272.66 ± 1.78 | 29685.81 | 0.000000032 |

Early postoperative nausea but not vomiting was reported in 12% of the patients in group A, 4% in group B, and 4% in group C. None of the studied patients showed signs or symptoms of thromboembolic events.

## Discussion

The quality of the field was considered the most important factor during FESS. Many methods have been used to reduce bleeding during sinus surgery to allow for the best surgical view and to reduce the risk of complications in surgery [2,16]. Controlled hypotension is used as an aid to reduce bleeding in patients undergoing middle ear or nasal surgery [2,17].

Tranexamic acid is an antifibrinolytic agent that reduces bleeding following certain surgical procedures [18]. The side effects of systemic tranexamic acid are mainly gastrointestinal in nature such as nausea, vomiting, and diarrhea. Giddiness and hypotension have also been reported. Worldwide postmarketing reports have shown thromboembolic events as deep vein thrombosis, acute renal cortical necrosis, and central retinal artery and vein obstruction. The main advantage of topical application of tranexamic acid is to lower the risk of side effects by reduced systemic absorption [19,20].

Topical hot saline irrigation has been described as a simple and noninvasive technique to control bleeding sites and produce hemostasis.

This study used strict inclusion and exclusion criteria to ensure a homogeneous population so that a standardized anesthetic protocol could be applied. In this study, we did not use vasoconstrictors or microdebrider. The effectiveness of application and irrigation of topical hemostatic agent during FESS is assessed in this study.

The results of the study verify the efficacy of local tranexamic acid and local hot saline in rendering a bloodless surgical field during FESS. The results were independent of demographic or hemodynamic variables to prevent the introduction of confounding factors. All operations were performed by the same team with the same technique.

With regard to the quality of the surgery site, based on the Boezaart grading scale, there were significant differences between groups A and C and groups B

and C, with a *P*-value of 0.0003; however, there were no significant differences between groups A and B. Moreover, the tranexamic acid group was better than the hot saline group.

With respect to the level of blinded surgeon satisfaction about the quality of field during the surgery, the mean number of positive answers in group A was  $0.92 \pm 0.27$ , that in group B was  $0.88 \pm 0.33$ , and that in group C was  $0.32 \pm 47.04$ , with *P*-value less than 0.05. There were significant differences and this is in accordance with a study by Abbasi *et al.* [17] who appreciated the use of topical tranexamic acid in nasal sinus surgery, and Ozmen and Ozmen [16] as they demonstrated that the 50°C saline irrigation was more effectual for hemostasis in comparison with room temperature (25°) saline irrigation [14].

With regard to the coagulation profile of the three groups (platelet count, prothrombin time preoperative and postoperative, partial thromboplastin time preoperative and postoperative), the study showed no significant differences between the three groups and this is in agreement with most of the earlier studies, such as Brown *et al.*, [18] Jabalameli *et al.*, [19] and Wellington *et al.* [21].

The time of surgery was  $75.92 \pm 7.64$  min in the group A, whereas in group B it was  $74.22 \pm 7.54$  min and 98.54 min in group C (*P* = 0.0002), and this showed significant differences between both groups A and B and group C, and this in accordance with Jebel *et al.* [22] who concluded that using tranexamic acid can decrease bleeding and duration of surgery, and Ozmen and Ozmen [16] who stated that 50° hot saline irrigation provides a lesser hemostasis time and reduce operative time.

The mean amount of collected blood during surgery was  $214.2 \pm 0.77$  ml for group A,  $216.75 \pm 1.45$  ml for group B, and  $272.66 \pm 1.78$  ml for group C, showing significant differences between groups A and B and group C (control group). There were no significant differences between groups A and B, although the amount of blood collected from group A was less. This is in agreement with the results of most of the previous studies such as that of Mottaghik *et al.* [23].

## Conclusion

Bleeding during FESS remains a challenge for both surgeons and anesthesiologists.

Tranexamic acid, an antifibrinolytic that is known to reduce operative bleeding, leads to local compression of the bleeding vessels, accelerating the clotting cascade. Local tranexamic acid improves intraoperative visualization and results in a clinically meaningful reduction in blood loss, duration of surgery, and achieves hemostasis during FESS for treatment of CRS.

Hot saline 50°C irrigation is considered a simple noninvasive, efficient, and cost-effective method to control bleeding. Moreover, it enhances hemostasis and reduces operative time during FESS.

The use of topical tranexamic acid provided less much superior results over the use of hot saline in terms of hemostasis, surgical field quality, amount of bleeding, duration of surgery, and surgeon satisfaction during FESS.

Further studies are recommended to detect the optimum time needed to achieve the hemostatic effect after the application of tranexamic acid and hot saline and larger amount of patient population to further clarify the safety of these agents.

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## Acknowledgements

### Conflicts of interest

None declared.

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