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Efficacy of pterygopalatine fossa injection with local anesthetic agent and adrenaline in reduction of intra-operative bleeding during endoscopic sinus surgery

Ahmed A. Kamel*, Khaled Harhash and Muhammad Abd Al-lateef

Abstract

Background: This study aimed to assess the effect of pterygopalatine fossa injection via greater palatine canal with xylocaine and adrenaline on intra-operative surgical field bleeding and overall blood loss during FESS.

Methods: We are doing this randomized blinded study on 60 patients who underwent FESS. Infiltration with 2 ml of xylocaine 2% with 1:100,000 adrenaline was slowly injected on one side and the surgeon was asked to assess the surgical field using a Boezaart scale.

Results: Operative time is significantly less in injected cases than the other cases with a *P* value < 0.001. blood loss in injected side was significantly less than Non-injected side with a *P* value < 0.001.

Conclusion: There was a significant decrease in blood loss, duration of surgery, and improvement in visual field using Boezaart score in injection group (cases) who underwent pterygopalatine fossa injection of xylocaine/adrenaline compared to the other non-injected group.

Keywords: Endoscopic sinus surgery, Pterygopalatine fossa, injection, Intraoperative bleeding, Local anesthesia

Background

Endoscopic sinus surgery (ESS) is the best treatment modality for chronic rhinosinusitis resistant to medical treatment. Intraoperative bleeding during ESS is a troublesome issue during this procedure, as it affects visualization of the intranasal anatomy. This could lead to serious complications such as skull base injury with cerebrospinal fluid leak or intracranial injury. Injury of the orbit, extra-ocular muscles and the optic nerve. In addition, poor visualization can lead to more tissue damage to healthy mucosa and development of post-operative synechiae, which is one of the common causes for revision surgery [1].

Achieving safe operative field with minimal complications either intraoperative or postoperative depends mainly on making the surgical field dry with better visualization during ESS to decrease operative time and reduce post-operative consequences. Many methods were used to decrease intra-operative bleeding during ESS, such as pre-operative preparation of nasal mucosa with vasoconstrictor nasal drops and steroids, and the patient's head is elevated by 30° to reduce venous pressure [2]. Bipolar cautery and microdebrider, premedication with beta blockers, a controlled hypotensive anesthesia technique, and total intravenous anesthesia [3] were used.

In spite of following these measures, some patients still suffer from a significant amount of intraoperative bleeding. Many surgeons routinely inject local anesthetic agents with adrenaline into the mucosa of the nose at the beginning of this procedure to reduce bleeding. We

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assumed that injection of this agent into the pterygopalatine fossa via greater palatine canal to reduce intra-operative pain that has an impact on vital signs such as heart rate, and induce vasoconstriction of the sphenopalatine artery and would help in dramatic reduction of intra-operative bleeding and improve surgical field during ESS [4]. This study aimed to assess the effect of pterygopalatine fossa injection via greater palatine canal with xylocaine and adrenaline on intra-operative surgical field bleeding and overall blood loss during FESS.

Methods

A prospective randomized double-blinded controlled study was performed in the otolaryngology department and operative room at the Faculty of Medicine, Cairo University, and we recruited participants from the otolaryngology outpatient clinic at the Faculty of Medicine, Cairo University.

Inclusion and exclusion criteria

We included 60 patients older than 18 years with bilateral symmetrical chronic sinusitis that includes CRS with NP (CRSwNP) and CRS without NP (CRSsNP) or allergic fungal sinusitis (AFS) and excluded all patients with asymmetrical disease. Patients with previous FESS, untreated or poorly controlled hypertension, history of bleeding diathesis and/or usage of aspirin, anticoagulant in the 4 weeks before surgery and patients with any long-standing medical disease such as bronchial asthma, diabetes mellitus, and renal impairment.

Intervention

Anesthetic management of all the patients was standardized using balanced anesthesia technique with anesthesia induction using sevoflurane (inhalational anesthesia) keeping mean arterial pressure from 65 to 70 mmHg with the patient in a supine position, and the patient's head is elevated by 30°. After general anesthesia, we identify the greater palatine foramen using the technique described by Mercuri [5]. It is located by placing a finger in the mouth and palpating the hard and soft palate's junction. The finger is drawn anterior to the hard palate's posterior rim for 3–5 mm until the foramen is felt. We usually find the foramen in the transverse line drawn from the posterior margin of the second upper molar to the other side. We insert a 26-gauge needle in the greater palatine canal at a depth of 20–25 mm. After aspiration to exclude intravascular penetration, 2 ml of xylocaine 2% with 1:100,000 adrenaline was slowly injected (Fig. 1), and we confirm that the infiltration is successful by the mucosal blanching around the greater palatine foramen in the oral cavity [7]. The injection was performed by an assistant surgeon and the injected side was recorded. The surgeon performed the surgery was blinded to the injected side. The patients were randomized according to the injected side (right or left) using computer-generated random numbers. The numbers were concealed in opaque envelops that were opened by the assistant surgeon immediately before injection.

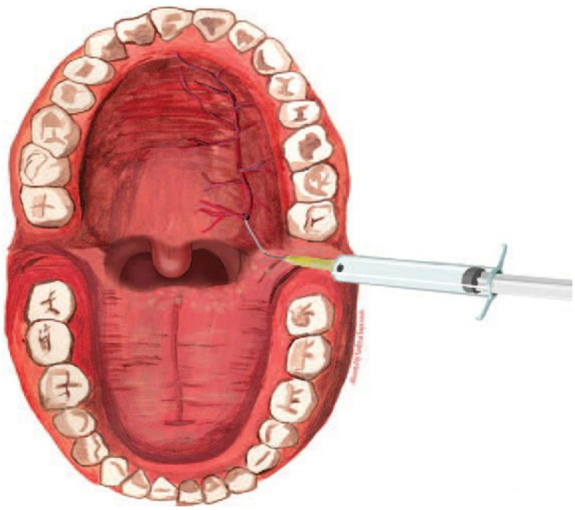

Fig. 1 Pterygopalatine fossa injection trans-oral [6]

The other side was not injected and served as the control. The surgeon was asked to grade the surgical field every 15 min using a standard Boezaart scale [8]. We recorded heart rate and blood pressure every 15 min to study the correlation between blood pressure and bleeding. After proper positioning of patient, an assistant was asked to startup a stopwatch then complete ESS was done on one side then the other side to assess all needed parameters on another side separately. We did not use topical adrenaline nasal packs before or during the surgery to exclude its local effect on the results. The intravenous hemostatics in the form of tranexamic acid was administered at the end of the surgery.

The assistant stops the stopwatch just as the anesthesia team begins the process of recovery.

During surgery

We measure the MAP (mean arterial pressure) in two cutoff points (15 and 90 min). The volume of bleeding on both sides was measured in CC by calculating the volume of fluid in the suction bottle excluding the amount of normal saline used for endoscopic scrub. The duration of surgery on both sides was recorded in all the patients. The quality of the surgical field in both sides based on Boezaart [1] grading system:

(0): No bleeding: cadaveric conditions;

(1) Slight bleeding: no suctioning required;
(2) Slight bleeding: we require occasional suctioning;
(3) Slight bleeding: we require frequent suctioning; bleeding threatens surgical field after a few seconds of suction;
(4) Moderate bleeding: we require frequent suctioning and bleeding threatens surgical field after suction is removed directly;
(5) Severe bleeding: we require constant suctioning; bleeding appears faster than can be removed by suction; we cannot complete the surgery usually)

- Merocele nasal packs 10 cm length were inserted bilaterally, and we discharged the patients on the same day of the operation.
- Post-operative antibiotics, analgesics, nasal wash, local steroids, systemic steroids are prescribed for the patients.

Statistical analysis

We entered and coded the data using the statistical package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). Collected data were summarized using mean, standard deviation, median, minimum, and maximum for quantitative data while frequency (count) and relative frequency (percentage) for categorical data. For comparison of paired measurements within each patient, the non-parametric Wilcoxon signed-rank test was used [9]. For comparing categorical data, a chi-square test was performed. Instead, an exact test was used when the expected frequency is less than 5 [10]. *P* values less than 0.05 were considered as statistically significant.

Results

Our study included 60 patients who underwent functional endoscopic sinus surgery (FESS). We had more of a middle-aged population. The youngest in our study was 18 years, and the oldest in our study was 45 years. The mean age in our study population was 30 years.

Among the 60 patients included in our study, 38(63.3%) were females and 22(36.7%) were males.

As shown in Fig. 2 below, among the 60 patients included in our study, 24(40%) patients had chronic sinusitis, 21(35%) patients had sinonasal polyposis, and 15(25%) patients had fungal sinusitis.

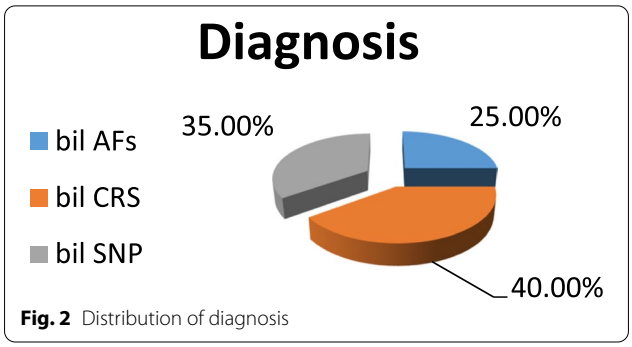

Fig. 2 Distribution of diagnosis

Effect of injection pterygopaltine fossa

There is a positive effect on the injected side compared to non-injected side, showing there is a decrease about 16% in blood loss and the operation, being 19% more time-efficient, as shown below in Table 1. This is important as it exposes the patient to fewer anesthetic drugs. The decrease in blood loss, along with a low Boezaart score, leads to a better visual field quality for the surgeon, less risk for complications, a more efficient and complete surgery (Figs. 3, 4, 5 and 6.

Operative time was less in injected side with mean time of 33.98 min ± 16.17 SD versus mean time 41.97 min ± 11.40 SD with a *P* value < 0.001.

Also, blood loss in injected side was significantly less than non-injected side with mean of 145.5 ml ± 69.97 SD versus a mean blood loss of 173.00 ± 59.10 SD with a *P* value < 0.001.

As regards surgical field stage of bleeding during ESS according to Boezaart, injected side was significantly less than non-injected side with mean values at 15 min, 30 min, 45 min, 60 min equals 1.92 ± 0.56 SD, 1.64 ± 0.71 SD, 1.54 ± 0.52 SD, 1.00 ± 0.00SD respectively in injected side versus, 2.15 ± 0.52 SD, 1.98 ± 0.55 SD, 1.86 ± 0.47 SD, 1.13 ± 0.35 SD respectively in non-injected side, with *P* value < 0.001 at 15 min, 30 min, 45 min, and > 0.05 at 60 min.

It is noticed that efficacy of injection on surgical field grade reach its peak after 30 min, and then start to gradually decrease after 60 min, yet, no further re-injection was needed because most of operations was finished by that time, as shown in Fig 7.

Discussion

It is markedly rare to encounter serious bleeding during ESS. However, even minimal bleeding may have a negative impact on the surgical view that may lead to an increase in surgery duration, associated with a high incidence of complications, and possibly results in incomplete surgery.

There are many methods that have been administrated to improve the surgical field and reduce bleeding, including reverse Trendelenburg positioning, topical vasoconstrictors, and a laryngeal mask airway to decrease hemodynamic response endotracheal

Table 1 Comparison between injected and non-injected side as regards the amount of bleeding and duration of surgery

	Injected					Non-injected					*P* value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Duration of surgery in minutes	33.98	16.17	30	15.00	75.00	41.97	11.40	40.00	25.00	75.00	< 0.001
Amount of bleeding in ml	145.50	69.97	125.00	50.00	300.00	173.00	59.10	180.00	90.00	350.00	< 0.001

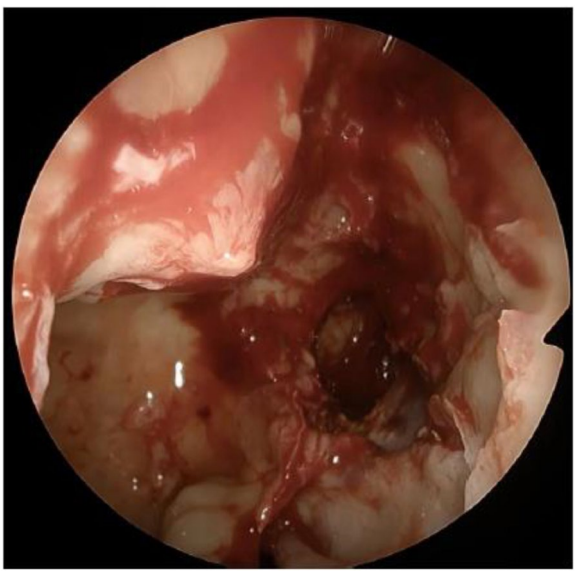

Fig. 3 Injected right side shows better surgical grade field with less intraoperative bleeding

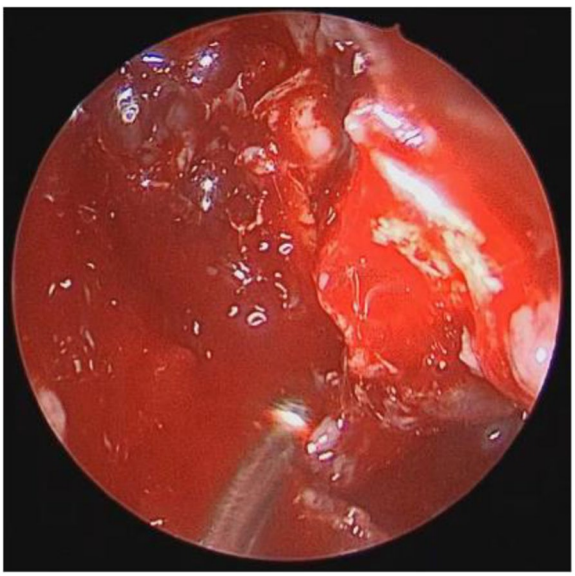

Fig. 4 Non-injected left side shows more intraoperative bleeding

intubation, and alteration of ventilation mode to minimize positive end-expiratory pressure (PEEP) and improve venous return [11].

Although the routine application of topical vasoconstrictors, local injection of adrenaline, induced hypotension are widely used; however, none of these provided an ideal solution for an ideal surgical field during endoscopic sinus surgeries.

In our study, results showed that operative time was less in the Injected side with a mean time of 33.98 min ± 16.17 SD versus mean time 41.97 min ± 11.40 SD. Also, blood loss in the injected side was significantly less than the non-injected side with a mean of 145.5 ml ± 69.97 SD versus a mean blood loss of 173.00 ± 59.10 SD the surgical field stage of bleeding during ESS according to Boezaart [1]. The injected side was significantly less than the non-injected side at 15 min, 30 min, and 45 min, yet, of questionable significance at 60 min.

A similar clinical trial was done in Australia in 2005 by Wormald et al. conducted the first prospective, blind, randomized controlled trials that evaluated the usefulness of the preoperative infiltration of epinephrine and lidocaine into the pterygopalatine fossa. They had 55 patients (24 women and 31 men) with a median age of 50 years (range 20–78 years) undergoing ESS due to CRS with ($n = 25$) or without nasal polyp ($n = 23$) and fungal sinusitis ($n = 7$). They used computer-generated randomization to determine which side the patient would receive their pterygopalatine fossa injection and which side of the nose would be operated on first. The results show significant improvement in the surgical field on the side of intervention [4].

Compared to our study, the study mentioned above showed a statistically significant benefit (p 0.01) in favour of the injected side yet; however, we include only new cases, no revision, and more cases with extensive allergic fungal sinusitis (15 cases versus 7 cases). Also, he did not assess the effect of injection on the duration of surgery.

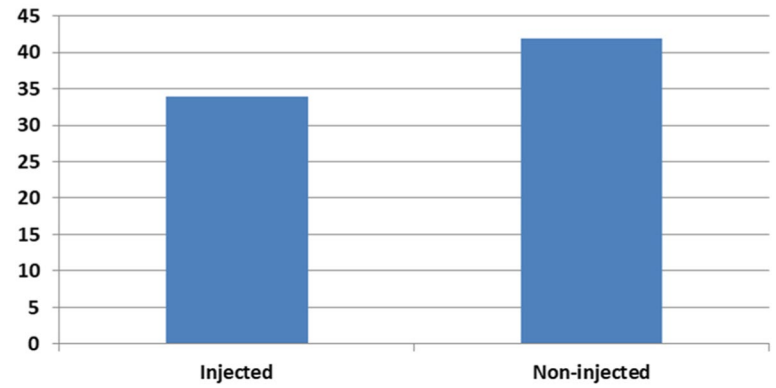

Fig. 5 Comparison between injection and non-injection side as regards duration of surgery

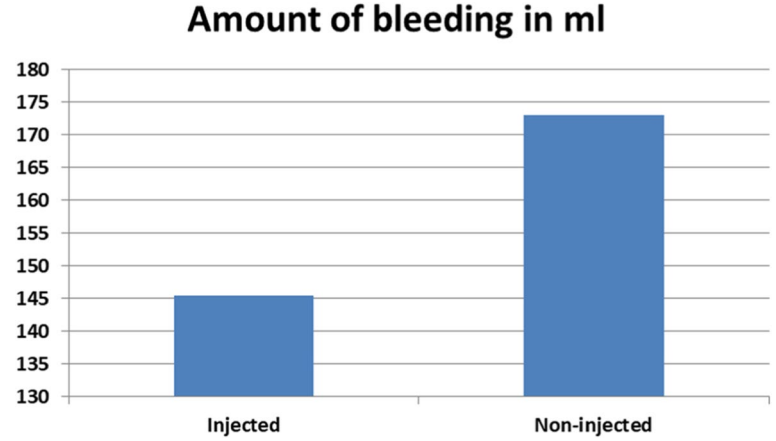

Fig. 6 Comparison between injection and non-injection side as regards amount of bleeding

Shanker et al. enrolled 55 patients (27 women and 28 men) with an age range from 20 to 40 undergoing ESS due to CRS. Their study showed a considerable decrease in the intra-operative bleeding on the blocked side [12].

In comparison to our study, we were doing a complete side at one time with a complete assessment of all needed parameters then the other side in order to avoid a possible source of error done by Shanker et al., where the surgeon finishes 15 min on one side then moves onto the opposite side for the next 15 min. During this time, the first side is left undisturbed. This site may show an abnormally low grade of bleeding due to hemostatic mechanisms. We included an assessment of the effect of injection on surgery duration and the amount of bleeding.

In the study by Shenoy et al., 68 patients (30 women and 38 men) with a mean age of 33 years (range 23–33 years) undergoing ESS due to CRS with ($n = 38$) or without nasal polyp ($n = 27$) and fungal sinusitis ($n = 3$) were included for assessing the effectiveness of pterygopalatine fossa infiltration. They found a statistically significant improvement in the surgical field on the infiltrated side, with almost 25–30% improvement in the surgical field [13].

Compared to our study, the degree of improvement in the surgical field was more than our study, most probably due to more cases of allergic fungal sinusitis in our study (15 versus 3), which are associated with more inflammation extensiveness of the disease. Also, all cases in our study were de novo, while this study included six revision cases.

Mathew et al. performed a randomized controlled trial to assess whether the infiltration of pterygopalatine fossa with xylocaine with adrenaline is effective in controlling operative bleeding during ESS or not. They had 32 patients (14 women and 18 men) with a mean

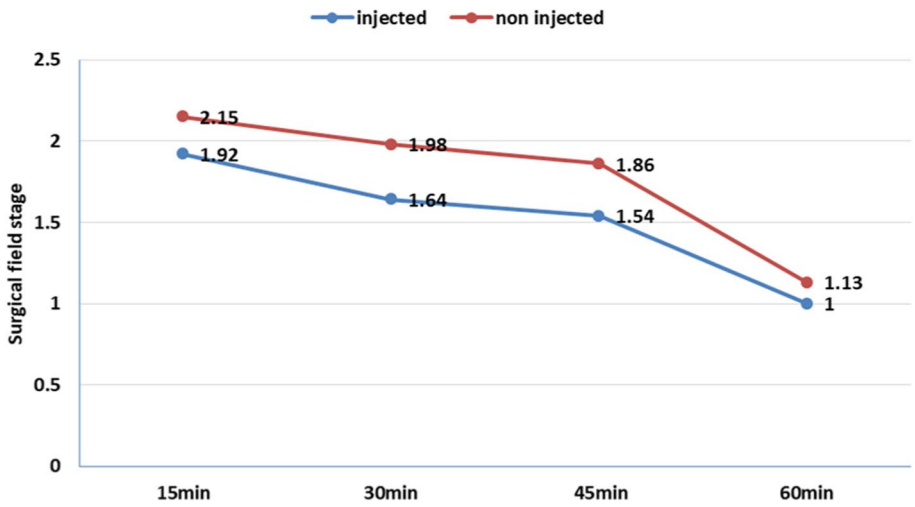

Fig. 7 Comparison between injected and non-injected side as regards surgical field stage of bleeding according to Boezaart at different time intervals

age of 39 years undergoing ESS due to CRS with polypi ($n = 17$) or without nasal polypi ($n = 13$) and fungal sinusitis ($n = 2$). They show significant improvement in the surgical field on the infiltrated side [14].

In comparison to our study, we included assessing the effect of injection on surgery duration and the amount of bleeding, which shows a significant effect in favor of injection with a P value < 0.001.

By contrast, in Valdes et al.'s study, they included 45 patients (15 women and 30 men) with a mean age of 48 years (range 29–74 years) undergoing ESS due to CRS with or without nasal polyp (patient number per disease was not defined). Computer-generated randomization was used to determine the side on which the patient would receive the pterygopalatine fossa injection. They found that there is no statistically significant difference to be mentioned in the surgical field grade between the injected and non-injected sides. They suggested that pterygopalatine fossa injection before functional endoscopic sinus surgery did not decrease intraoperative surgical field bleeding despite a safe procedure [15].

To conclude, many studies have been conducted by many researchers and have proven to decrease blood loss and improve the quality of visual field; some of them have already been adopted by most surgeons and anaesthetists such as using hypotensive anaesthesia, reverse Trendelenburg position, the use of preoperative steroids, the use of oxymetazoline, or adrenaline pledgets. Although these methods have been of great help for surgeons to perform a complete and safe FESS procedure, still new method are proposed by researchers to make an ideal surgical field.

No postoperative complications were documented after injection, and there was no postoperative pain noticed on the side of infiltration or any ulceration locally at the infiltration site. This technique is relatively safe, simple, and also reduces bleeding significantly. Hence, it can be routinely incorporated in all ESS.

Conclusion

The result of this study shows that infiltration of PPF with 2% xylocaine with 1:100,000 adrenaline significantly reduces the bleeding, thus improving visualization of the surgical field during FESS. It also shows significant improvement of operative duration and total amount of bleeding. Since the technique is simple with minimal complications, it can be routinely incorporated in all ESS.

However, a major drawback is that although surgeries were performed at the same facility, same operative setting, anaesthesia team, but surgeries were carried out by multiple surgeons. So, we recommend that in further studies that surgeries should be carried out by the same surgeon.

Acknowledgements
Not applicable.

Authors' contributions
AK had done most of surgeries included in this study, supervised the statistical analysis and wrote most of the paper (corresponding author). KH had put the research plan and done some surgeries. MA prepared the patients for surgery, supervised the follow up, statistical analysis and collection of data.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study is approved by the ethical committee of Kasr Elainy College of Medicine, Cairo University, with no available reference number. All patients gave their written informed consent to undergo surgery and participate in this study and if the patient is under 16 years old, a written informed consent was obtained from the legal guardian of the patient.

Consent for publication
All the participants in this study gave their written informed consent or from their legal guardian if under 16 years old for the publication of this study.

Competing interests
The authors declare that they have no competing interests.

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