

Impact of Pterygopalatine Fossa Injection with Local Anesthetic and Adrenaline on Nasal Bleeding During Endoscopic Sinus Surgery

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Abstract

Background: The most effective management for chronic rhinosinusitis that is resistant to medical treatment is endoscopic sinus surgery (ESS).

Aim: To evaluate the effect of pterygopalatine fossa injection with local anesthetic and adrenaline on intraoperative surgical field hemorrhage, operative time, and total loss of blood throughout functional ESS.

Methods: A prospective comparative double-blind randomized controlled trial investigation has been performed in the otolaryngology department and the operative room at AL-Zahraa hospital, Al-Azhar University. Participants have been recruited from the otolaryngology outpatient clinic between November 2023 and November 2024.

Result: The statistically significant distinction (p -value equal 0.002) in the mean endoscopic grading of hemorrhage during surgery on the side of the PPF block and the side without the PPF block was $2.80 \pm 0.0.39$ and 3.53 ± 0.44 , correspondingly. The mean time of surgery on the side with the PPF block was 54.63 ± 17.77 minutes, while the mean operative time on the side without the PPF block was 63.38 ± 18.45 minutes. The distinction was statistically significant (p -value equal 0.034). The mean amount of blood loss on the side with the PPF block was 132.50 ± 31.68 ml, while the mean number of milliliters on the side without the PPF block was 162.50 ± 49.89 . The distinction was statistically significant (p -value equal 0.024).

Conclusion: The bleeding during the operation significantly decreased and the visualization of the surgical field throughout ESS was enhanced by infiltrating PPF with two percent xylocaine and 1:100,000 adrenaline. It additionally significantly decreases the total amount of blood loss and the duration of surgery.

Keywords: ESS; Intraoperative bleeding; Pterygopalatine fossa; Injection; Local anesthesia

1. Introduction

The most effective management for chronic rhinosinusitis that is resistant to medical treatment is endoscopic sinus surgery.¹

Intraoperative hemorrhage throughout endoscopic sinus surgery is a troublesome issue, as it reduces the capability of visualizing intranasal architecture. This could result in severe complications, including a skull base injury, additional damage to tissue and healthy mucosa, injury to the orbit, extraocular muscles, or the optic nerve, and an incomplete operation. Additionally, the operation may be prolonged.²

The control of hemorrhaging throughout

FESS is of 1ry importance for an efficient & safe procedure. Consequently, a variety of methods have been utilized to decrease intraoperative bleeding throughout FESS, including the utilization of induced hypotension with sodium nitroprusside, nasal decongestion with oxymetazoline and phenylephrine hydrochloride prior to surgery, rise of the head of the patient by thirty degrees (reverse Trendelenburg position) to decrease venous return, the utilize of bipolar cautery, premedication with beta blockers, and intravenous anesthesia for achieving controlled hypotension. Despite the utilization of all of these methods, many cases continue to have significant hemorrhage throughout FESS.³

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The 3rd part of the maxillary artery entering the pterygopalatine fossa would be targeted by vasoconstrictors that have infiltrated the area. This would result in vasospasm of the maxillary artery and a reduction in blood flow into the sphenopalatine artery, which will subsequently lead to a reduction in blood supply to the mucosa of the nasal cavity.⁴

The objective of this investigation was to evaluate the effect of a pterygopalatine fossa injection with adrenaline and local anesthetic on the surgical field hemorrhaging throughout operation, operative duration, and total loss of blood throughout functional endoscopic sinus surgery.

2. Patients and methods

Study design

A prospective comparative double-blind randomized controlled trial investigation has been conducted in the otolaryngology department & operative room at AL-Zahraa hospital, AL-Azhar University. Participants have been recruited from the otolaryngology outpatient clinic between November 2023 and November 2024. Ethics Committee Faculty of Medicine for Girls, AL-Azher University, Cairo, Egypt (IRP 2108) permitted this research protocol. Before enrolling in the research, each case has been required to provide written informed consent.

Patients

Inclusion and exclusion criteria

The investigation comprised forty (40) cases of both sexes, with bilateral symmetrical chronic sinusitis, such as CRS without NP (CRSsNP), allergic fungal sinusitis (AFS), or CRS with NP (CRSwNP). Cases with asymmetrical illness have been excluded. The ages of the cases varied from eighteen to sixty years old. Patients who have experienced earlier FESS, poorly or untreated controlled hypertension, a history of hemorrhage diathesis, and/or the use of aspirin or an anticoagulant within the four weeks prior to the operation, as well as cases with any chronic medical conditions, including diabetes mellitus, impairment of the kidneys, and bronchial asthma.

Preoperative evaluation of all cases through clinical, endoscopic, laboratory, and radiological examinations. The Lund-Mackay CT grading system has been utilized to ascertain the illness's symmetry between the right and left sides of the preoperative computed tomography (CT) examinations.^{5,6} Asymmetric diseases were diagnosed in cases with a distinction of more than one point between the sides, and they have been excluded.

Operative technique

Anesthetic management was standardized using balanced anesthesia with sevoflurane induction, maintaining mean arterial pressure (65–75 mmHg) in a supine position. Following general anesthesia, the greater palatine foramen has been determined by palpating the junction of the soft and hard palates, which is located three to five millimeters anterior to the posterior rim of the hard palate. A 25-gauge needle bent 45 degrees (twenty-five millimeters from the tip) has been inserted into the greater palatine canal to a depth of twenty to twenty-five millimeters using a sterile three-milliliter syringe. Two milliliters of xylocaine 2% with 1:100,000 adrenaline have been slowly injected following aspiration to exclude intravascular penetration, as confirmed by mucosal blanching. The injection was administered by an assistant surgeon, and the side (right or left) was determined by randomly selecting computer-generated numbers that were concealed in opaque envelopes. The other side served as the control. The surgeon has been blinded to the injected side, and neither the cases nor the surgeon was aware of the laterality. Both sides underwent complete endoscopic sinus surgery separately, without the use of topical adrenaline nasal packs. Tranexamic acid has been administered intravenously at the conclusion of the surgical procedure to facilitate hemostasis.

During surgery

The surgeon has been selected to evaluate the surgical field every fifteen minutes utilizing a conventional Boezaart scale (Table 1).⁷ In order to investigate the association between blood pressure and hemorrhage, we monitored pulse rate and blood pressure every fifteen minutes. The suction bottle volume of fluid has been determined in CC, excluding the amount of normal saline that was utilized for endoscopic scrub, and the amount of blood absorbed by surgical gauze & not gathered in the suction has been estimated utilizing the Gauze visual analogue. The volume of hemorrhage on both sides has been determined.⁸

The period of operation on both sides has been documented for all cases.

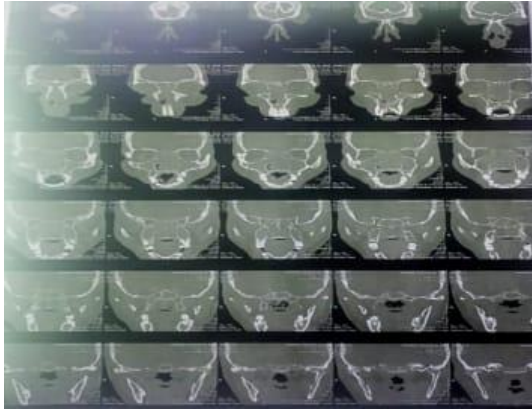


Figure 1. CT nose and paranasal sinus, coronal view showing CRSWNP with symmetrical disease, Lund-Mackay grade 12 on the left and 12 on the right

Table 1. Grading system of the endoscopic surgical field (Boezaart scale)

0	NO HEMORRHAGE: CADAVERIC CONDITIONS
1	SLIGHT HEMORRHAGE: NO SUCTIONING NEEDED
2	SLIGHT HEMORRHAGE: WE NEED IRREGULAR SUCTIONING
3	SLIGHT HEMORRHAGE: WE DEMAND REGULAR SUCTIONING, AS HEMORRHAGE POSES A THREAT TO THE SURGICAL FIELD FOLLOWING A FEW SECONDS OF SUCTIONING.
4	MODERATE HEMORRHAGE: WE DEMAND REGULAR SUCTIONING, AND HEMORRHAGE REPRESENTS A THREAT TO THE SURGICAL FIELD FOLLOWING THE SUCTION IS REMOVED DIRECTLY.
5	SEVERE HEMORRHAGE: WE NEED TO SUCTION CONSTANTLY; HEMORRHAGE APPEARS TO BE FASTER THAN WHAT MAY BE REMOVED BY SUCTION; AND, IN MOST CASES, THE OPERATION CAN'T BE COMPLETED.

Statistical analysis

The quantitative data were presented as mean± standard deviation, while non-parametric data were presented as median with inter-quartile range, using SPSS version 23.0 to analyze the recorded data of the investigation. Numbers and percentages have been utilized to represent qualitative variables. Kolmogorov-Smirnov and Shapiro-Wilk tests have been implemented to investigate normality. The tests administered were the independent-samples t-test, Spearman's rank correlation coefficient, paired sample t-test, and Pearson's correlation coefficient. The p-value was deemed to be statistically significant.

3. Results

This is a prospective randomized controlled trial including 40 cases (18–55 years, mean 36.10±10.14) of both sexes with bilateral chronic sinusitis. Patients underwent endoscopic sinus surgery and received unilateral pterygopalatine fossa (PPF) block with lidocaine and adrenaline. Of the forty cases, thirty-one (77.5 percent) were women and nine (22.5 percent) were males. Diagnoses included 32 (80%) with chronic sinusitis, 2 (5%) with chronic sinusitis and nasal polyposis, and six (15 percent) with allergic fungal sinusitis (AFS). No significant variance in Lund-Mackay CT

scores (p-value equal 0.386) was observed between sides with or without PPF block, revealing symmetrical illness (Table 2).

Table 2. Preoperative evaluation of illness symmetry by Lund-Mackay CT score (n =40)

LUND MACKAY	RIGHT SIDE	LEFT SIDE	T-TEST	P-VALUE
RANGE	8-12	7-12	1.583	0.386
MEAN±SD	10.43±1.48	10.58±1.58		

The left side was the side of injection in 26 patients (65%) and the right side was the side of injection in 4 patients (35%).

A repeated measure ANOVA test was conducted to assess the mean arterial blood pressure at various time points throughout operation. The results indicated that there was statistically insignificant distinction between the time intervals in terms of MAP (mmHg), with a p-value (P-value more than 0.05) (Figure 1). And also, there is statistically insignificant correlation between MAP with different time in SFQ, with p-value (P-value more than 0.05) as shown in figure 2 below. However, there was a statistically significant variance between heart rate measures in “beat/min.”, at different time-points during surgery with p-value (P<0.05).

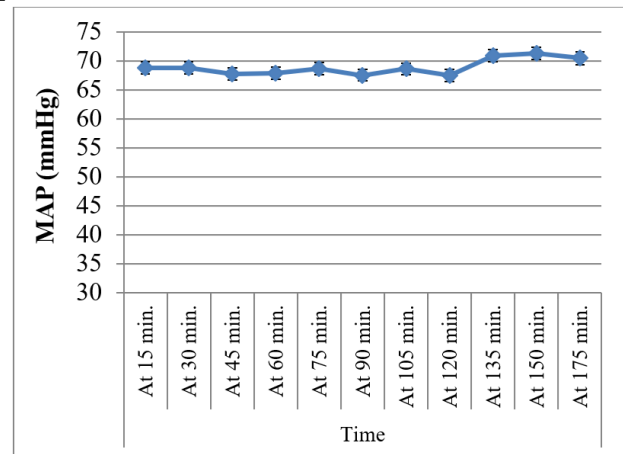


Figure 2. Showing Mean arterial blood pressure at various operative times.

Effect of pterygopalatine fossa injection

A positive effect is observed on the injected side in comparison to the non-injected side. As illustrated in Table 3, the mean period of operation was shorter in injected side, with a mean of 54.63±17.77 SD, compared to the mean of 63.38±18.45 SD, as indicated by a p-value of 0.034.

Table 3. Comparison among Injected side and non-injected side according to surgical field quality (SFQ) of hemorrhage with regard to Boezaart scale and operative time.

OPERATIVE TIME "MINUTES."	INJECTED SIDE (N=40)	NON INJECTED SIDE (N=40)	TEST VALUE	P-VALUE	SIG.
MEAN±SD	54.63±17.77	63.38±18.45	-2.16	0.034	S
RANGE	20-100	30-120			

Additionally, the mean loss of blood in

injected side was significantly less than that in non-injected side, with a mean of 132.50 ± 31.68 SD compared to 162.50 ± 49.89 SD in the non-injected side (p-value equal 0.024). This is illustrated in Table 4 below.

Table 4. Comparison among Injected side & non-injected side according to amount Blood loss in ml.

BLOOD LOSS (ML)	INJECTED SIDE (N=40)	NON INJECTED SIDE (N=40)	TEST VALUE	P-VALUE	SIG.
MEAN±SD	132.50±31.68	162.50±49.89	-2.782	0.024	S
RANGE	30-260	50-440			

Regarding surgical field grade of hemorrhage with regard to Boezaart scale ;There was a statistically significant highest mean value of a mean of surgical field quality in the non-injected side of 3.53 ± 0.44 in comparison with the injected side of 2.80 ± 0.39 with a p-value of 0.002 ,the total of all the grades over time has been taken & compared with the control side and Results showed that, the mean surgical grade the injected side was 16.80 ± 2.35 compared to the non-injected side with a mean of 20.09 ± 2.62 The variance in mean surgical grade between two sides was significant different, with a p-value of 0.002 favoring the injected side as shown in table 5 below.

Table 5. Comparison between Injected side (case side) and non-injected side (control side) as regards Operative time in "minutes".

SURGICAL FIELD GRADE OF BLEEDING REGARDING BOEZAART	INJECTED SIDE (N=40)	NON INJECTED SIDE (N=40)	TEST VALUE	P-VALUE
TOTAL OF SFQ OVER TIME	16.80±2.35	20.09±2.62		0.002
MEAN±SD	2.80±0.39	3.53±0.44	-2.397	
RANGE	2-4	3-4		

Regarding surgical field quality allover time interval ; the mean values of injected side at fifteen minute, thirty minute, forty-five minute, sixty minute, seventy-five minute, ninety minute equals 2.15 ± 0.44 SD , 2.42 ± 0.33 S, 2.58 ± 0.31 SD , 3.16 ± 0.51 SD, 3.23 ± 0.51 SD , 3.26 ± 0.25 SD respectively versus 3.14 ± 0.52 SD , 3.29 ± 0.50 SD , 3.34 ± 0.48 SD , 3.39 ± 0.41 SD , 3.42 ± 0.39 SD , 3.51 ± 0.32 respectively in non-injected side .There was a statistically significant lowest mean value of surgical field quality at 15minutes, at 30 minutes and at 45 minutes in injected site compared to non-injected side, with p-value ($p > 0.05$);while there is a statistically insignificant variance among injected side and non-injected at 60 min,75min and 90 min , with p-value ($p > 0.05$) (Figure 3).

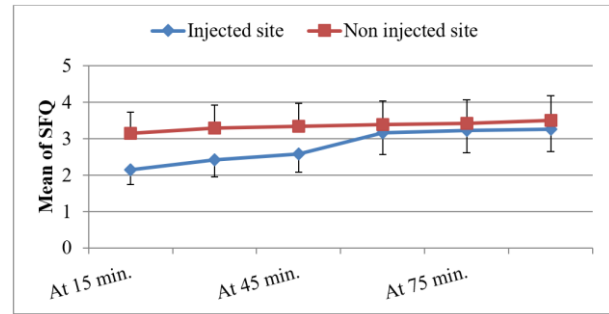


Figure. 3. Comparison among injected & non-injected side according to surgical field grade of hemorrhage with regard to Boezaart at various time intervals.

4. Discussion

One of the most frequently conducted surgical procedures by otolaryngologists for the CRS with NP that isn't responding to maximal medical treatment is functional endoscopic sinus surgery.⁹

The injected side has been randomly selected in the present research, and one side has been completed prior to operating on the contralateral side, irrespective of the side of the PPF block. This approach was comparable to the investigation performed by Valdes et al. and Kamel et al.,¹. In contrast, Khadgi et al.⁹ and Bhardwaj et al.³ conducted an investigation in which the PPF block side was operated 1st to evaluate the effect of the block. This prevented the possibility of the effect fading off over time if the non-PPF block side had been operated at first. The side of operation changed every thirty minutes in the research conducted by Mathew et al.¹⁰, Shenoy et al.⁴, and Wormald et al.¹¹. Shankar et al.¹² conducted an investigation in which the surgeon was blinded to the side of the PPF block & the PPF block was alternated every fifteen minutes.

The side that received the PPF block exhibited a lower endoscopic grading of hemorrhage in this investigation. The mean endoscopic grading on the PPF block side was 2.80 ± 0.39 SD, whereas on the non-PPF block side it was 3.53 ± 0.44 SD with a p value of 0.002. However, it has been found that the effectiveness of the injection on the surgical field grade began to gradually reduce after forty-five minutes. We presented significant outcomes throughout the first forty-five minutes. There was a statistically significant shorter operative time in the injected side, with a mean of 54.63 ± 17.77 , compared to the non-injected side, with a mean of 63.38 ± 18.45 , with a p-value of 0.034. Also, there was a statistically significantly higher mean value of the amount of blood loss in the non-injected side of 162.50 ± 49.89 in comparison with the injected side of 132.50 ± 31.68 , with a p-value of 0.024. This resonated with the outcomes of Khadgi et al.⁹, who reported that the mean of endoscopic

grading of bleeding on the side with PPF block 2.06 ± 0.50 SD was less than the mean on the side without PPF block 2.50 ± 0.47 SD, the difference being statistically significant during the first 45 minutes of the surgery ($p = 0.04$), and The results of Kamel et al.¹ demonstrated that the injected side was significantly lower compared to the non-injected side at fifteen minutes, thirty minutes, and forty-five minutes, but the difference was of questionable significance at sixty minutes. Additionally, our findings were close to those of Bhardwaj et al.³, Paudel et al.¹³, and Mathew et al.¹⁰.

In the investigation conducted by Shenoy et al.,⁴ The surgical field's grading was significantly superior on the infiltrated side in comparison with the non-infiltrated side (p -value equal 0.000); this significance was consistent throughout the time interval. The surgical field experienced a greater degree of enhancement compared to our research, which is likely the result of a variety of factors. For example, the concentration of saline adrenaline in this investigation was greater (1:80,000) compared to our research (1:100,000). This could have been a factor, as a lower concentration of adrenaline results in a comparatively weakened vasospasm, which in turn results in a greater rate of medication absorption into the systemic circulation & a quicker clearance from the pterygopalatine fossa, resulting in a shorter action. Additionally, there were more cases of AES in our investigation (6 versus 3), which are related to a greater degree of inflammation in the illness.

Additionally, they changed the operation side every thirty minutes, and the side that was left undisturbed may exhibit an abnormally reduced level of hemorrhage as a result of homeostatic mechanisms.

Shankar et al.¹² additionally stated that the surgical grades of hemorrhage on the unblocked side were significantly greater than those on the blocked side throughout the time interval from 30 minutes to 120 minutes, with a P value of less than 0.05. The variation from our research might additionally be due to the fact that they employed adrenaline (1:80000) for infiltration. Additionally, the operation has been conducted in an alternating fashion, with the surgeon operating on one side for fifteen minutes before transitioning to the other. Following the surgeon's completion of fifteen minutes on one side, they will move to the opposite side for the subsequent fifteen minutes. The 1st side remains undisturbed throughout this time. This side might demonstrate an abnormally low level of hemorrhage as a result of the activation of homeostatic mechanisms. Therefore, the side that was completed second will exhibit the most

hemorrhaging when the reading is taken at the end of thirty minutes. In contrast, the investigation conducted by Nasirmohtaram et al.¹⁴ demonstrated a statistically insignificant variance in blood loss between both groups. The mean volume of blood in the group under investigation was 35.8 ± 20.9 milliliters (range, 8–92.6 milliliters), while the control group had a mean of 38.4 ± 23.7 milliliters (range, 9–104 milliliters) (p -value equal 0.49). Additionally, the findings of the investigation conducted by Valdes et al.¹⁵ didn't demonstrate a statistically significant variance in the loss of blood. The mean loss of blood in the injected side was 165.07 ± 141.548 mL, while in the non-injected side it was 153.62 ± 117.882 mL, with a p -value of 0.630.

In the present investigation, no complications after surgery have been identified following the injection, with the exception of palatal discomfort at the side of the PPF block in five cases. No pain following surgery has been observed on the infiltration side, and no ulceration or ecchymosis has been observed locally at the infiltration side. Cardiovascular complications, intracranial or orbital complications, weren't observed. Valdes et al.¹⁵ stated postoperative palatal discomfort in eight of sixty-five cases. Shenoy et al.,⁴ stated transient tachycardia for many minutes, not needing therapy, in three of thirty-three cases.

In the investigation conducted by Khadgia et al.,⁹ the only reported complication was self-resolving ecchymosis over hard palate in a case.

4. Conclusion

The bleeding during the operation is significantly decreased by the infiltration of PPF with two percent xylocaine and 1:100,000 adrenaline, thereby enhancing visualization of the surgical field throughout FESS. It additionally significantly decreases the total amount of blood loss and the operative period. Since the method is simple, safe, and without or with minimal complications, our research suggests routine incorporation of this method in all FESS.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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