The Egyptian Journal of Hospital Medicine (January 2024) Vol. 94, Page 1223-1228

Infrazygomatic Versus Intranasal Injection Approaches for Sphenopalatine Ganglion Blockade Effect on The Surgical Field in Functional Endoscopic Sinus Surgeries

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ABSTRACT

Background: Functional endoscopic sinus surgery (FESS) is a minimally invasive, efficient surgical procedure frequently utilized for treating nasal polyposis as well as chronic rhinosinusitis. A clear field is mandatory for surgeons to facilitate the operation; nevertheless, it is linked to complications such as postoperative pain.

Objectives: We aimed to determine the impact of infrazygomatic approach sphenopalatine ganglion blockade (SPGB) on hemodynamics, postoperative pain, and the surgical field, in FEES operations.

Patients and Methods: This a prospective controlled trial, in 35 patients conducted at Ain Shams University Hospitals, Cairo, Egypt, only submucosal lidocaine was injected after general anesthesia was induced, and one nasal side was randomly selected (left or right) utilizing the closed envelopes method (intranasal injection group). On the other side, the infrazygomatic sphenopalatine ganglion block technique was done (the infrazygomatic block group) then surgical field quality, hemodynamic changes, and postoperative complications (infection or epistaxis) were compared statistically.

Results: The surgical field quality was improved more in the infrazygomatic block side, and mean heart rate (HR) and arterial blood pressure demonstrated a statistically substantial decline in the infrazygomatic block intraoperatively but no significant change postoperatively. Additionally, the pain was relieved in the first postoperative 6 hours but statistically no difference was found between the two groups at 12 and 24 hours postoperatively, and also statistics showed no difference between the two sides as regards infection or epistaxis.

Conclusion: Infrazygomatic approach of SPGB improves surgical field quality, postoperative pain, and hemodynamic stability in FEES operation.

Keywords: Sphenopalatine block, Intranasal surgery, Infrazygomatic approach, Surgical field, Bloodless Surgery, Epistaxis.

INTRODUCTION

FESS is a minimally invasive, efficient surgical procedure frequently utilized for treating nasal polyposis as well as chronic rhino sinusitis where the cells of sinus ostia and sinus air are opened under direct visualization. The procedure aims to restore normal function and sinus ventilation **[1]**.

Intraoperative bleeding impairs the surgical vision and increases the risk of iatrogenic complications. Multiple factors can impact the severity of bleeding encountered throughout surgeries, including surgical factors and the patient. Factors entail severe chronic sinusitis forms with nasal polyposis correlated, with the vascular tumor on the surgical site, active infection, bleeding disorders, using anticoagulant therapy, increased vascularity, and a revision surgery that might impact surgical site bleeding **[2]**.

Opioid analgesics and systemic nonopioids are frequently utilized for pain treatment following FESS, despite the inevitability of adverse effects, including respiratory depression, nausea, and urinary retention **[3]**. SPG is the primary sensory innervation of the nasal mucosa **[4]**.

SPGB is a regional anesthetic technique used effectively prior to removing nasal packing under general anesthesia or postoperative analgesia to control bleeding **[5]**. It has numerous approaches, such as the infrazygomatic approach, in which local anesthetic is injected inferior to the zygomatic arch under fluoroscopic guidance **[4]**. Another form is the submucosal injection of local anesthetic combined with a vasoconstrictor, such as epinephrine, to block the nerve supply to the nasal mucosa **[6]**.

SPGB has been utilized in the treatment of cluster headaches, chronic cluster headaches, acute migraine headache, status migrainosus, facial neuralgias, and various surgeries, including FESS **[7]**.

We aimed to determine the impact of infrazygomatic approach SPGB on hemodynamics, postoperative pain, and the surgical field, in FEES operations.

PATIENTS AND METHODS

This a prospective controlled trial, on 35 patients conducted at Ain Shams University Hospitals, Cairo, Egypt. Only submucosal lidocaine was injected after general anesthesia was induced, and one nasal side was randomly selected (left or right) utilizing the closed envelopes method (intranasal injection group). On the other side, the infrazygomatic sphenopalatine ganglion

Received: 26/10/2023
Accepted: 26/12/2023

block technique was done (the infrazygomatic block group) then surgical field quality, hemodynamic changes, and postoperative complications (infection or epistaxis) were compared statistically.

General anesthesia was conducted with all patients under monitoring by electrocardiography (ECG), end-tidal CO_2 pressure capnography, pulse oximetry, and automated noninvasive blood pressure. 10 minutes before induction patients received intravenous loading dose 40 mg/kg magnesium sulphate diluted in 100 ml saline solution over 10 minutes.

Once adequate preoxygenation was achieved, anesthetic induction was done using rocuronium bromide (0.6 mg/kg), fentanyl (2 μg/kg), and propofol (2 μg/kg), following endotracheal intubation. The respiratory rate (RR) was set to 35–40 mmHg as the end-tidal CO_2 pressure ($EtCO_2$). Maintaining anesthesia was accomplished using 3% sevoflurane in 60% oxygen.

Subsequently, using the closed envelope method, one nasal side (intranasal injection group) was selected at random (right or left). In order to block the sphenopalatine ganglia's terminal nerve branches, 2 ml of lidocaine with 1/20000 epinephrine was injected posterior to the meatus of the middle conch. In the same place, 2 ml of saline was given on the opposite nasal side by a surgeon's assistant who was blind to the injection's ingredients (to prevent the surgeon from expecting intranasal group by viewing the injection site on one side only).

In the absence of surgeons, infrazygomatic SPGB was achieved (Infrazygomatic block group) as follows:

1. A lateral fluoroscopic image of the face was acquired using the C-arm by superimposing the mandibular rami (Fig. 1).
2. With 1% lidocaine, a skin wheal was created anterior to the mandible as well as inferior to the zygomatic arch.
3. Under lateral fluoroscopic guidance, a 22- or 25-gauge, a 3½-inch spinal needle with a slightly bent tip was inserted coaxially to advance the needle toward the sphenopalatine fossa. Superiorly and medially, the needle was moved toward the sphenopalatine fossa (Fig. 2).
4. An anteroposterior (AP) view was achieved intermittently to evaluate the needle's depth and prevent a rupture of the nasal wall. As demonstrated in the AP view, the needlepoint should end directly lateral to the ipsilateral nasal wall (Fig. 3).
5. Upon final needle placement, 0.2 ml of contrast material was administered using live fluoroscopic imaging to verify dye spread inside the sphenopalatine fossa and exclude intravascular spread (Fig. 4).
6. Slowly, 2 ml of lidocaine 1% was administered into the sphenopalatine fossa as a local anesthetic. Subsequently, the site of injection was covered bilaterally by gauze and adhesive tape to prevent the surgeon knowing where to inject.

Total sphenoethmoidectomy and bilateral middle meatal antrostomy were conducted in all patients. Not all patients' frontal sinuses were opened.

Surgeons assessed surgical field quality regarding bleeding utilizing five categories [2]. 1 = uncontrolled bleeding. 2 = severe bleeding, surgical conditions distorted immediately following suctioning. 3 = moderate bleeding, visibility of the surgical field is moderate, frequent suctioning needed. 4 = slight bleeding, visibility of the surgical field is good, and occasional suctioning is needed. 5 = no bleeding, nearly bloodless surgical field.

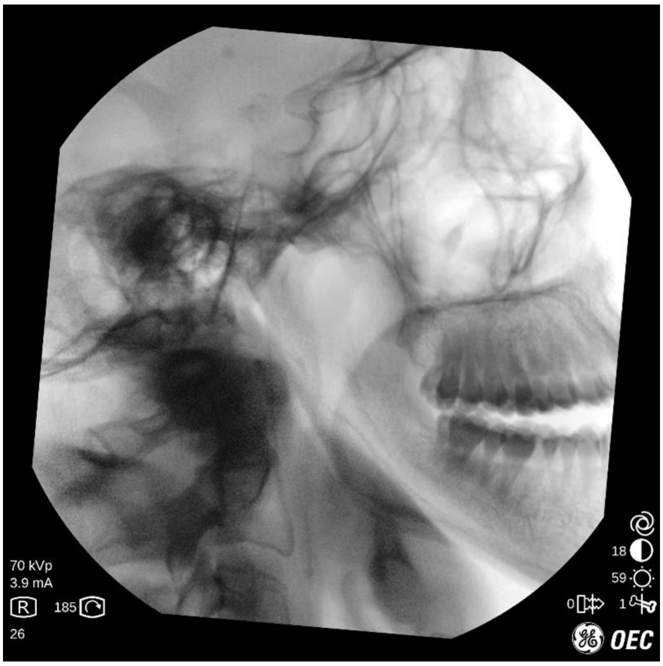

Fig. (1): Lateral view showing sphenopalatine ganglion (inverted vase).

Fig. (2): Final needle position at a lateral view.

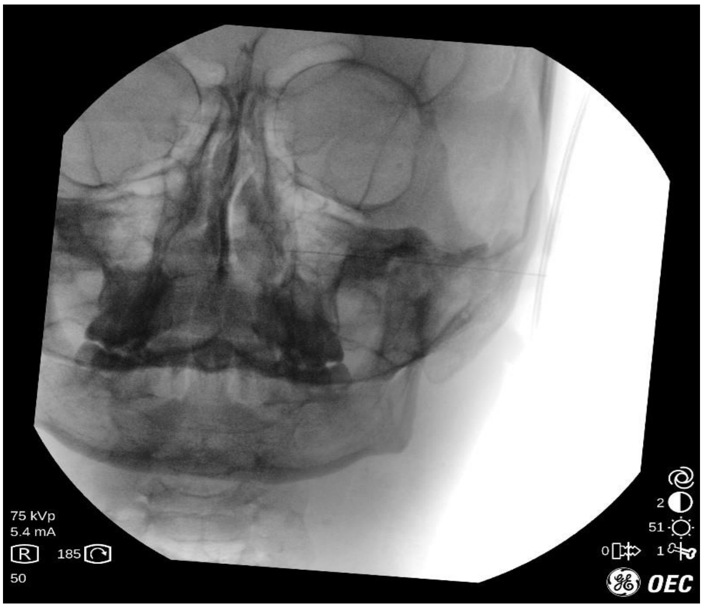

Fig. (3): A-P view showing the final needle position.

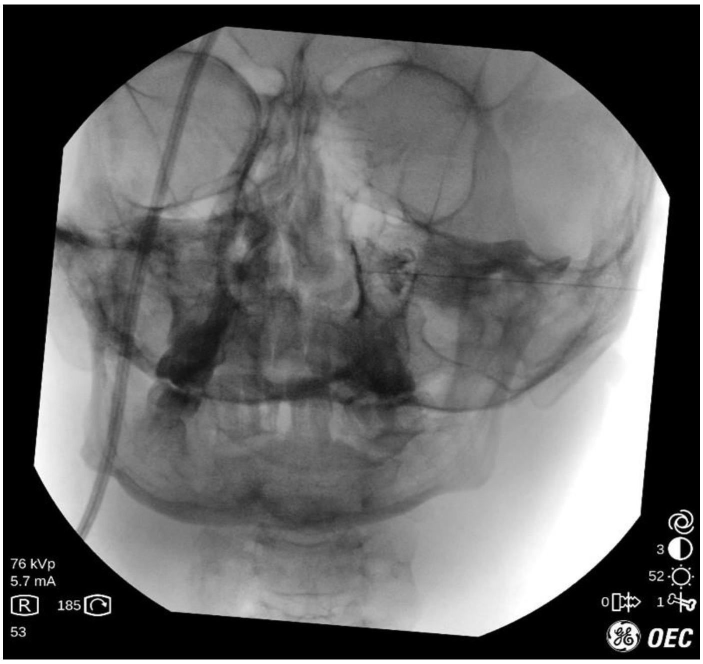

Fig. (4): A-P view showing the final needle position and contrast delineating the lateral nasal wall.

Primary Outcome Measure: surgical field quality.

Secondary outcomes: Hemodynamic changes, postoperative pain, and complications (epistaxis and infection). Intraoperatively hemodynamic changes were observed every 10 minutes and were compared between the two sides. Patients were monitored in the post-anesthesia care unit (PACU). Throughout the observation period, RR, HR, and arterial blood pressure were continuously recorded every 15 minutes for an hour. Patients who met PACU release requirements were transported to the surgical ward. Every 4 hours for 24 hours, vital signs were recorded, and patients were given 1 g of oral paracetamol every 6 hours. Tramadol IV was used as a rescue analgesic in 25 mg increments. Postoperative pain was assessed, and individuals were asked to compare the two nasal sides in the PACU at 6-, 12-, and 24-hours following surgery using a 10-cm visual analogue scale (VAS) (10 = most severe pain, 0 = no pain). Pain severity was categorized into 3 three groups: mild <4, moderate 4 to 6, and severe >6, as well as postoperative complications such as epistaxis, infection, and local anesthetic toxicity were recorded.

Sample Size Calculation:

Using the two-sided paired t-test, a sample size of 35 data pairs provides 80% power to reject the null hypothesis of zero effect size when the population effect size is 0.50 (medium effect size) and the alpha level is 0.50.

Ethical approval: The study was approved by the Ethics Committee of the Faculty of Medicine at Ain Shams University [Approval Number: R 99 / 2021 and ClinicalTrials.gov ID: NCT04996576]. A detailed description of the study's objectives was given to each participant before they completed an informed consent form. The Helsinki Declaration was adhered to at every stage of the investigation.

Statistical methods

Data collection, revision, entry, and coding were done utilizing the 20th version of IBM SPSS. For quantitative data with a parametric distribution, Mean±Standard deviation (SD), and range were used to convey the data and for nonparametric distribution, median, interquartile range (IQR), and range were used. For qualitative data, number and percentage were used. Using Fisher exact test, where the predicted cell count was less than five, two groups' qualitative data were compared. Using quantitative data and a parametric distribution, the independent t-test was used to compare two separate groups. When it was equal to or less than 0.05, the p-value was deemed significant.

RESULTS

The mean age of the participants was 39.43 ± 10.40 years, with a female predominance (62.9%) (Table 1).

Table (1): Demographic data of the studied patients.

Data		No. = 35
Sex	Female	22 (62.9%)
	Male	13 (37.1%)
Age (years)	Mean ± SD	39.43 ± 10.40
	Range	21 – 55
Weight (kilograms)	Mean ± SD	71.20 ± 9.68
	Range	55 – 85
Height (meters)	Mean ± SD	1.59 ± 0.11
	Range	1.39 – 1.76
Body Mass Index (Kg/m^2)	Mean ± SD	28.28 ± 3.84
	Range	19.96 – 39.41

Values are presented as numbers (%) or as mean ± SD and range, No.: Number

Surgical field quality: Infrazygomatic approach showed better surgical field quality than intranasal approach. Duration of operation: No statistically significant difference between the two sides was found (Table 2).

Table (2): Comparison between infrazygomatic and intranasal approaches regarding surgical field quality and duration of operation.

		Infrazygomatic	Intranasal	Test value	P-value	Sig.
		No.= 35	No.= 35			
Duration of operation (minutes)	Mean ± SD Range	29.83 ± 6.46 20 – 40	31.24 ± 5.25 22 – 40	-1.005	0.318	NS
Surgical field Quality	Median (IQR) Range	2 (2 – 2) 1 – 4	3 (2 – 3) 1 – 4	-4.073	<0.001	HS

Values are presented as mean ± SD, and range or as median, interquartile range (IQR), and range, Sig.: Significance, NS: Non-Significant, HS: Highly Significant.

Hemodynamics: Regarding mean heart rate and the mean arterial blood pressure, the infrzygomatic approach showed a significant statistical decrease throughout the intraoperative period, while there were no statistically substantial differences throughout the postoperative period between the two approaches (Tables 3, 4).

Table (3): Comparison between infrazygomatic and intranasal approaches regarding mean arterial pressure.

	MAP variation		Infrazygomatic	Intranasal	Test value	P-value	Sig.
			No. = 35	No. = 35			
Intraoperative	Intraoperative	Mean ± SD Range	70.40 ± 6.93 60 – 80	78.34 ± 6.66 65 – 90	-4.890	<0.001	HS
	1st time	Mean ± SD Range	76.77 ± 6.33 66 – 87	83.20 ± 6.38 74 – 95	-4.232	<0.001	HS
	2nd time	Mean ± SD Range	74.66 ± 6.66 64 – 92	81.43 ± 7.28 67 – 94	-4.061	<0.001	HS
	3rd time	Mean ± SD Range	69.14 ± 6.84 61 – 81	79.40 ± 7.28 63 – 91	-6.071	<0.001	HS
Postoperative	PACU	Mean ± SD Range	74.94 ± 7.47 60 – 85	77.37 ± 10.40 67 – 95	-1.122	0.266	NS
	6 hours	Mean ± SD Range	80.03 ± 7.31 65 – 90	82.37 ± 10.40 72 – 100	-1.091	0.279	NS
	12 hours	Mean ± SD Range	77.74 ± 7.08 64 – 89	80.91 ± 10.42 70 – 99	-1.489	0.141	NS
	24 hours	Mean ± SD Range	81.57 ± 8.36 67 – 99	82.49 ± 10.41 72 – 100	-0.405	0.687	NS

Values are presented as mean ± SD and range, Sig.: Significance, NS: Non-Significant, HS: Highly Significant

Table (4): Comparison between infrazygomatic and intranasal approaches regarding heart rate.

Heart rate		Infrazygomatic	Intranasal	Test value	P-value	Sig.
		No. = 35	No. = 35			
Intraoperative						
Intraoperative	Mean ± SD Range	62.34 ± 6.10 55 – 78	69.71 ± 5.07 60 – 78	-5.498	<0.001	HS
1st time	Mean ± SD Range	67.49 ± 6.28 60 – 89	74.29 ± 5.36 65 – 83	-4.872	<0.001	HS
2nd time	Mean ± SD Range	70.57 ± 4.97 64 – 83	78.71 ± 5.07 69 – 87	-6.785	<0.001	HS
3rd time	Mean ± SD Range	63.69 ± 4.64 57 – 74	67.11 ± 5.11 58 – 77	-2.936	0.005	HS
Postoperative						
PACU	Mean ± SD Range	67.00 ± 8.40 55 – 80	69.97 ± 5.05 64 – 80	-1.793	0.077	NS
6 hours	Mean ± SD Range	73.74 ± 8.54 61 – 87	77.03 ± 5.31 70 – 87	-1.933	0.057	NS
12 hours	Mean ± SD Range	67.34 ± 8.51 55 – 81	70.51 ± 5.36 64 – 81	-1.865	0.066	NS
24 hours	Mean ± SD Range	74.51 ± 8.46 62 – 88	77.71 ± 5.28 71 – 88	-1.898	0.062	NS

Values are presented as mean ± SD and range, Sig.: Significance, NS: Non-Significant, HS: Highly Significant

There was a statistically significant decline in pain assessed by the VAS score in the infrzygomatic approach compared to the intranasal approach in PACU and after the first 6 hours postoperatively. In contrast, there was no statistically significant difference at 12 and 24 hours postoperatively. Also, statistics showed no difference between the two sides as regards infection or epistaxis (Table 5, 6).

Table (5): Comparison between infrazygomatic and intranasal approaches regarding VAS Score:

VAS score		Infrazygomatic	Intranasal	Test value	P-value	
		No.= 35	No.= 35			
PACU	Median (IQR) Range	2 (1 – 2) 0 – 4	3 (3 – 4) 1 – 4	-5.277	<0.001	HS
6 hours	Median (IQR) Range	2 (2 – 3) 2 – 5	5 (4 – 5) 2 – 6	-6.311	<0.001	HS
12 hours	Median (IQR) Range	4 (4 – 5) 4 – 6	4 (4 – 5) 4 – 6	-0.921	0.357	NS
24 hours	Median (IQR) Range	6 (5 – 6) 4 – 6	6 (5 – 7) 4 – 7	-1.483	0.138	NS

Values are presented as median, interquartile range (IQR), and range, Sig.: Significance, NS: Non-Significant, HS: Highly Significant.

Table (6): Comparison between infrazygomatic and intranasal approaches regarding postoperative epistaxis and infection.

Postoperative epistaxis	Infrazygomatic		Intranasal		P-value	Sig.
	No.	%	No.	%		
No	34	97.1%	33	94.3%	1	NS
Yes	1	2.9%	2	5.7%		
Postoperative infection	Infrazygomatic		Intranasal		P-value	Sig.
	No.	%	No.	%		
No	35	100.0%	34	97.1%	1	NS
Yes	0	0.0%	1	2.9%		

Values are presented as numbers (%), NS: Non-Significant.

DISCUSSION

Functional FESS is a common procedure; nevertheless, the proximity of the surgical area to major blood vessels necessitates the use of effective hemostasis to reduce problems related to blood loss. Additionally, it is linked to moderate to severe postoperative pain [6].

Many anesthesiologists use controlled hypertensive anesthesia to increase surgical field visibility without compromising perfusion to vital organs. However, associated neurological and gastrointestinal adverse effects can augment patient's discomfort pain postoperatively [7].

SPG is located in the pterygopalatine fossa and is responsible for sensory innervation of the nasal and paranasal tissues [8], which explains the reduction of HR and blood pressure during FEES under the direct blockade of the SPG by infrazygomatic approach. Cluster headache's pathophysiology is defined by activating parasympathetic nerve structures within the SPG and a persistent unilateral orbital location. The associated autonomic phenomena of miosis, flushing cheek, ptosis, lacrimation, injected conjunctivae, rhinorrhea, and a blocked nostril are frequently present [9] that SPGB decreases parasympathetic vasodilator effect causing a decrease in bleeding and the increase of surgical field quality.

There are many approaches to the SPGB, including the infrazygomatic and intranasal approaches. **Barre** reported the intranasal technique using a dropper to infuse local anesthetic into the nose. However, the nasopharynx absorbed most of the anesthetic without reaching the SPG [10].

The infrazygomatic approach does not rely on secondary spread via the greater palatine canal's nerves; instead, it uses a direct lateral approach and C-arm fluoroscopic guidance to insert a cannula into the superior portion of the pterygopalatine fossa without the need for local anesthetic to diffuse across mucous and bony membranes [11].

In our study, we demonstrated that the infrazygomatic approach of SPGB combined with general anesthesia improves the surgical field in functional endoscopic sinus surgeries more effectively than the traditional intranasal approach.

Consistent with our findings, **Bhattacharyya *et al.*** [12] illustrated that SPGB improved surgical field quality when an intraoral greater palatine canal approach combined with general anesthesia was used to block the SPG in FESS. In addition, **Mohamed and her colleagues**[13] reported the same block efficacy in enhancing the quality of the nasal surgical field during transsphenoidal endoscopic hypophysectomy in 15 anesthetized patients who received topical SPG block.

Wormald and his colleagues[5] showed that pterygopalatine fossa injection by lidocaine transorally improved the surgical field during FESS.

The results of **Kesimci *et al.*** [14] align with our study that SPGB stabilizes the HR during FESS. Nonetheless, our study showed a decrease in mean arterial blood pressure intraoperatively.

Furthermore, our study confirmed the analgesic effect of this approach only in the first 6 hours post operatively using the VAS score. This finding is consistent with **Al-Qudah**[3], who injected local anesthetic posterior and over the middle meatus to block SPG terminal branches to control pain after FESS.

In addition, it is relatively consistent with **Cho *et al.*** [15] who performed SPG block in FEES by a transoral approach through the greater palatine foramen. **Hassan and Abu-Zaid**[16] who blocked SPG under endoscopic guidance, showed improvement in postoperative pain after FEES, without increasing the incidence of postoperative bleeding or infection.

CONCLUSION

Infrazygomatic approach of SPGB improves surgical field quality, hemodynamics stability, and postoperative pain in FEES operation.

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