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Comparison between combined regional nasal block and general anesthesia versus general anesthesia with dexmedetomidine during endoscopic sinus surgery

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ABSTRACT

Background: Research findings are inconsistent regarding the efficiency of regional nasal blocks over hypotensive techniques. The current study aimed to compare regional nasal block to dexmedetomidine (DEX) for surgical field optimization.

Methods: A total of 70 patients (ASA I or II) aged 18 to 65 years were divided into two groups (35 patients each). The DEX group received 1 µg/kg of DEX in 10 minutes after induction of anesthesia, followed by 0.7 µg/kg/hour during maintenance of anesthesia. The other group [Sphenopalatine ganglion block (SPGB) group] was subjected to regional nasal block by SPGB immediately after induction of general anesthesia. This was done via a transoral approach using 2 ml of a mixture of lidocaine (2%) and bupivacaine (0.5%) for each side.

Results: Surgical conditions were satisfactory in all patients of both groups, but significantly better with bilateral SPGB. In addition, the block group had also improved extubation characteristics and postoperative analgesia. Patients who received bilateral SPGB complained significantly of dental numbness.

Conclusions: Both DEX and regional nasal block provided excellent functional endoscopic sinus surgery (FESS) with a high score of surgeons' satisfaction. The SPGB can provide better surgical field optimization with less blood loss, less intraoperative analgesic consumption, and early extubation with minor complications, and better immediate postoperative pain profile. So, SPGB can be used efficiently and safely in combination with general anesthesia in patients undergoing FESS.

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1. Background

Functional endoscopic sinus surgery (FESS) is a treatment of choice in a category of conditions, particularly nasal polyps and rhino-sinusitis [1]. One of the most major limiting factors for endoscopic approaches to paranasal sinuses is its high vascularity. Often, a slight hemorrhage is sufficient to dramatically reduce visibility, creating a poor surgical field [2]. Also, procedures involving the nasal sinuses are very painful, and in most of them, patients are obligated to breathe through their mouth post-operatively [3]. Thus, obtaining adequate hemostasis, and providing sufficient analgesia are of utmost importance during endoscopic sinus surgeries. That is why the anesthetic plan must be tailored to ensure the best possble surgical field visualization and the most adequate analgesia; while preserving the patient's hemodynamic stability and reducing complications during surgery, emergence from anesthesia and upon recovery [4].

Dexmedetomidine (DEX) has gained wide acceptance for induced hypotension. It is an α2-adrenoceptor agonist with sedative, sympatholytic and analgesic used effectively in optimizing surgical field in patients undergoing endoscopic sinus surgery through its hemodynamic stability effect [5]. The sphenopalatine ganglion block (SPGB) is considered one of the regional anesthetic techniques that was used effectively in patients undergoing endoscopic sinus surgery under general anesthesia to optimize surgical field by controlling bleeding and for analgesia postoperatively [6].

Results are inconsistent regarding the efficacy of regional nasal blocks over hypotensive techniques, so our study aim was to compare the efficiency of regional nasal block versus DEX for surgical field optimization.

2. Methods

This prospective randomized comparative study was conducted in Ain Shams University Hospitals, Cairo, Egypt from September 2021 to September 2022.

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After obtaining approval from the Research Ethical Committee of the Faculty of Medicine, Ain Shams University, Egypt (FMASU MD 60/2021), all of the selected patients were informed in detail regarding the purpose, procedure of the study and the possible side effects, and a written informed consent was obtained from each patient. This trial was registered at the ClinicalTrials.gov (ID: NCT05361642).

Randomization was performed using a computer-generated randomization sequence and allocation concealment to be maintained all through the time of procedure, by using opaque, numbered, and sealed envelopes.

We included patients with physical status ASA I, II whose age ranged between 18 and 65 years. We excluded patients with physical status ASA III or IV as well as those with known allergic reactions to local anesthetics, history for cerebrovascular or coronary insufficiency, infection at the block site, and/or coagulopathy.

Seventy patients enrolled in the study were randomly allocated in two groups:

(DEX) group ($n = 35$): Patients in this group received general anesthesia with the use of DEX.

(SPGB) group ($n = 35$): Patients received general anesthesia, immediately followed by SPGB.

3. Study interventions

Preoperative assessment was done which included full history taking, fasting hours, clinical examination, routine laboratory investigations including complete blood count (CBC), kidney function tests (KFT), liver function tests (LFT), prothrombin time (PT), activated partial thromboplastin time (aPTT), ECG, etc.

Patients were informed about the use of visual analogue scale (VAS) during preoperative visit to assess the severity of pain with a score from 0 to 10 (0 = no pain, 10 = most severe pain).

On arrival to the operation room ward, IV cannula was inserted under complete aseptic condition, and the patients were given the intramuscular midazolam premedication (70–80 mcg/kg). They were monitored using SPO_2 pleth, ECG "lead II," NIPB, and $EtCO_2$.

In Both groups, GA was initiated with Fentanyl (1 µg/kg), and propofol (2 mg/kg). Muscle relaxation was obtained using Cis-atracurium Besylate (0.15 mg/kg) for intubation. Two puffs of 10% Lidocaine spray (one puff delivers 10 mg of lidocaine) for the laryngeal inlet and Lidocaine (1.5 mg/kg IV) was used to decrease the stress response of intubation. After intubation, an oropharyngeal pack was inserted, and anesthesia was maintained using Sevoflurane (1 MAC "2%") and lungs were ventilated with mixture of air 40% and oxygen 60%. Patients kept in head up position. Fluids given included deficit (fasting hours) 2 ml/kg/h to be administered as (50% in 1st hour, 25% in 2nd hour and 25% in 3rd hour) then maintenance 2 ml/kg/h then 3rd space according to surgical field (if minimal 2 ml/kg/h, moderate 4 ml/kg/h, severe 6 ml/kg/h).

At this point the patients were randomly divided into two groups:

DEX Group: Patients received 1 µg/kg DEX in 10 minutes after induction of anesthesia, followed by 0.7 µg/kg/hour during maintenance of anesthesia.

SPGB Group: immediately after induction of general anesthesia, regional nasal block by SPGB, which was done by via a transoral approach using 2 ml of a mixture of lidocaine (2%) and bupivacaine (0.5%) for each side. The ganglion was blocked at the greater palatine foramen. A curved dental needle passes through the greater palatine foramen (GPF) in the posterior portion of the hard palate. This should be just medial to the gum line opposite the third molar tooth to reach the superior aspect of the pterygopalatine fossa (Figure 1) [7].

The main objective of the anesthetic management in this study was to achieve an optimal surgical field. A value of Average Category Scale (ACS) of ≤ 3 was considered ideal (ACS was adapted by Boezaart et al. [8] where grade 0 is defined as no bleeding, grade 2 is defined as slight bleeding, no suctioning of blood required, grade 3 is defined as slight bleeding, frequent suctioning required. Bleeding threatens surgical field a few seconds after suction is removed, grade 4 is defined as moderate bleeding, frequent suctioning required. Bleeding threatens surgical field directly after suction is removed, grade 5 is defined as severe bleeding, constant suctioning required) [7,8].

After steady-state anesthesia in both groups was obtained, but still the ACS>3, an additional dose of fentanyl (1 µg/kg) was given once suspected intraoperative pain. Cis-atracurium byselate (0.15 mg/kg) was given at 30 minutes intervals to maintain muscle relaxation. Bradycardia (heart rate < 50 beats/min) was treated with atropine (0.01–0.02 mg/kg). When severe hypotension occurred (MAP < 65 mmHg), a fluid

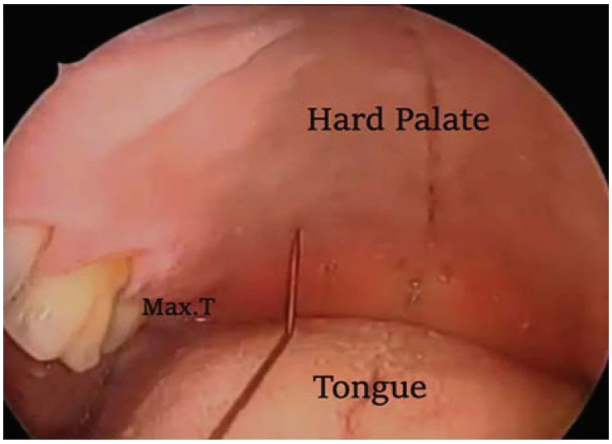

Figure 1. Transoral sphenopalatine ganglion block technique [7].

challenge (lactated Ringer's solution 3–4 ml/kg) and intravenous ephedrine (Initial dose: 0.05–0.1 mg/kg IV bolus, additional boluses were administered as needed, not to exceed a total dosage of 50 mg). At the end of surgery, the oropharyngeal pack was removed, dexmedetomidine infusion was stopped, sevoflurane was discontinued. Residual neuromuscular block was antagonized with neostigmine 0.05 mg/kg and atropine sulphate 0.02 mg/kg. Extubation was done only when the patients became fully awake (spontaneous eye opening, obeying verbal command and or tube localization), with satisfactory muscle power to support spontaneous regular ventilation with full tidal volume. In the postoperative settings, all patients were given a standard analgesic regimen with 1 gm paracetamol/8 h, patients with VAS score>3 at any point were given Ketorolac (30 mg) as a rescue analgesic by intravenous infusion with maximum dose 120 mg/day.

4. Outcome measures

(1) Base line heart rate and mean arterial blood pressure were recorded then every 15 min till the end of surgery.
(2) Average category scale (ACS) assessment was done by the surgeon at 15 min interval till the end of surgery.
(3) Intraoperative narcotic consumption as indicated by total dose of fentanyl in mcg.
(4) Extubation time (time from the discontinuation of anesthesia to tracheal extubation) in min.
(5) Postoperative pain assessment was done using VAS score immediately on arrival to post anesthetic care unit (PACU) then at 6, 12, and 24 h.
(6) Postoperative ketorolac consumption in the first 24 h was recorded.
(7) Postoperative complications including bleeding, postoperative nausea and vomiting or dental numbness were recorded.

5. Sample size

Using the outcomes in Amin et al. [9] the effect sizes were large. Group sample sizes of 35 and 35 were achieved at least 80% power to reject the null hypothesis of zero effect size when the population effect size is 0.70 and the significance level (alpha) is 0.050 using a two-sided two sample equal-variance t-test.

6. Statistical package and analysis

Data were analyzed using Statistical package for Social Science (SPSS) version 22.0., Quantitative data were expressed as mean ± standard deviation (SD) or Median (Interquartile range [IQR]) when indicated. Qualitative data were expressed as frequency and percentage. Independent-samples t-test of significance was used when comparing between two means. Chi-square (X^2) test of significance was used in order to compare proportions between two qualitative parameters. Mann Whitney U test: for two-group comparisons in non-parametric data. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the *p*value was considered significant if less than 0.05.

7. Results

Seventy patients were included in the study (35 patients in each group) (Figure 2). Groups were compared in demographic data (in terms of age, sex, body mass index, and ASA) and there was no statistically significant difference between groups (Table 1).

Data expressed as mean ± SD, proportion, t: student t test, X^2: Chi square test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group, BMI: body mass index

Comparing hemodynamics between the two groups all over the surgery as regarding mean arterial blood pressure (MABP) and heart rate (HR) at regular intervals (base line, start of surgery, 15 min, 30 min, 45 min, 60 min, 75 min and 90 min) showed no statistical difference between them throughout the surgery (Tables 2 and 3).

Data expressed as mean ± SD, t: student t test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group, MABP: mean arterial blood pressure

Data expressed as mean ± SD, t: student t test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group

For ACS at regular intervals, it was lower in SPGB group with statistically significant difference at 15 and 30 min, being highly significant afterwards. The difference was insignificant only at the start of surgery (Table 4).

Data expressed as median and interquartile range (IQR), Z: Mann-Whitney test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group, ACS: Average Category Scale

There was a significantly lower intraoperative fentanyl consumption in the favor of SPGB group (Table 5).

Data expressed as proportion, X^2: Chi square test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group

There was a significantly faster extubation time in the favor of SPGB group (Table 6).

Data expressed as mean ± SD, t: student t test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group

On comparing groups for postoperative pain using VAS score immediately on arrival to PACU, there was statistically significant difference in the favor of SPGB group then at 6,12 and 24 hours) there was no

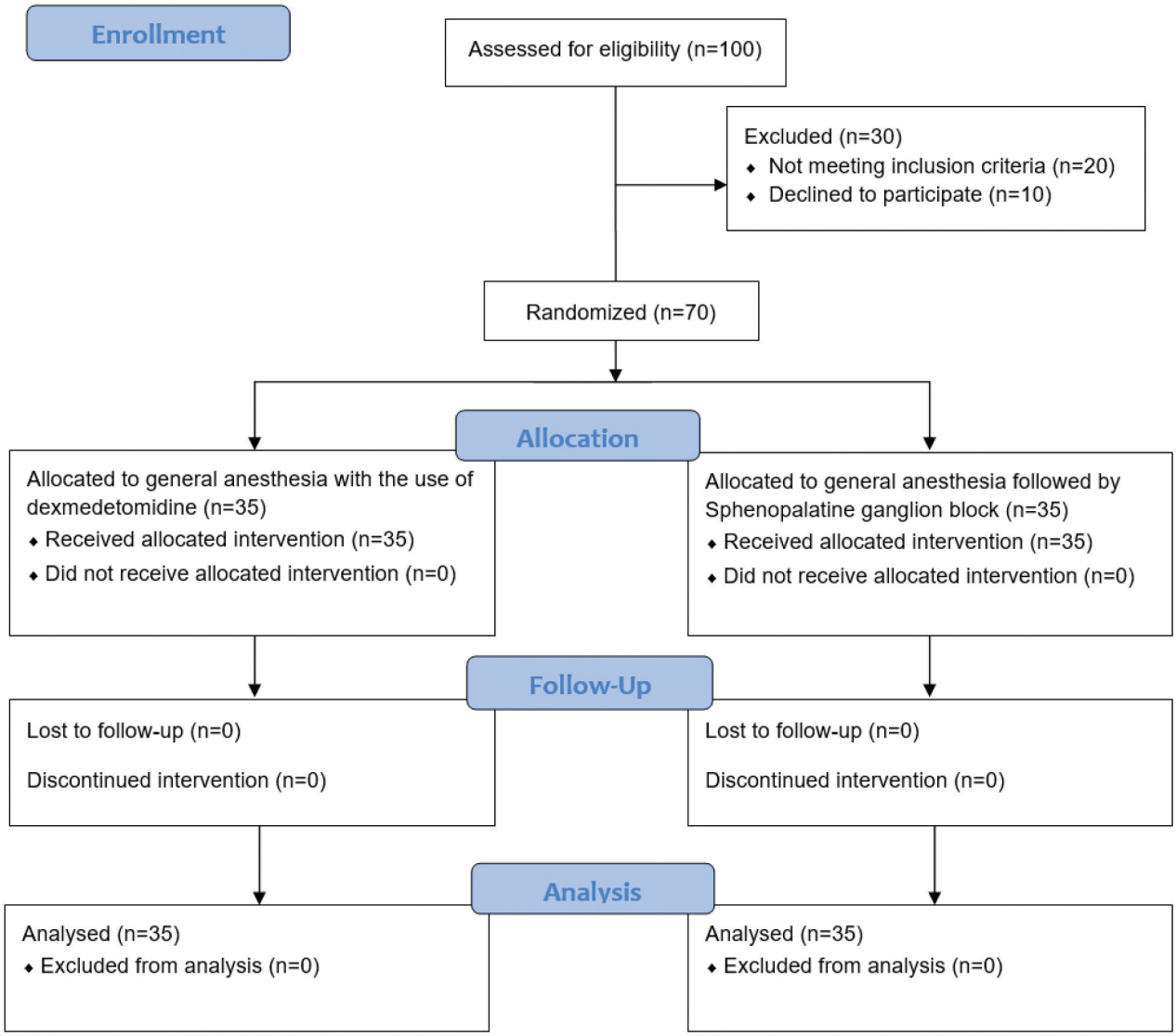

Figure 2. The CONSORT flow diagram of the trial.

Table 1. Comparison between groups as regard demographic data.

Demographic data		DEX group (n = 35)	SPGB group (n = 35)	T/X^2	p-value
Age (years)		38.9±11.7	40±12.4	0.39^t	0.7
ASA	I	16 (45.7%)	20 (57.1%)	0.9 X^2	0.34
	II	19 (54.3%)	15 (42.9%)		
Sex	Male	16 (45.7%)	18 (51.4%)	0.23X^2	0.63
	Female	19 (53.3%)	17 (48.6%)		
BMI (Kg/m^2)		21.5±1.6	21.4±1.7	0.2^t	0.83

Table 2. Comparison between groups as regard mean arterial blood pressure.

MABP (mmHg)	DEX group (n = 35)	SPGB group (n = 35)	t-test	p-value
Baseline	83±4.7	82.8±4	0.25	0.8
Start	72.6±2.8	73.2±1.7	1.1	0.29
15 min	71.3±3	72.2±1.8	1.5	0.15
30 min	70.9±2.4	71.7±1.99	1.5	0.14
45 min	70.77±2.3	71.4±2.37	1.2	0.25
60 min	70.6±2.9	70.4±2.2	0.33	0.7
75 min	69.7±2.2	69.6±2.5	0.2	0.84
90 min	70.4±2.6	70.5±2.4	0.14	0.89

Table 3. Comparison between groups as regard heart rate.

Heart rate (beat/min)	DEX group (n = 35)	SPGB group (n = 35)	t-test	p-value
Baseline	81.9±5.8	81.8±5.1	0.04	0.97
Start	74.8±3.99	75.69±5.7	0.75	0.45
15 min	75.4±3.8	76.5±5.2	0.97	0.34
30 min	76.2±3.2	76.1±5.9	0.15	0.88
45 min	79.1±4	77.4±6.2	1.4	0.17
60 min	78.7±5	77.1±5.9	1.2	0.24
75 min	79±4.99	77.8±5	1.03	0.3
90 min	79.9±4.76	80.3±2.9	0.46	0.65

Table 4. Comparison between groups as regard Average Category Scale.

	DEX group (n = 35)			SPGB group (n = 35)				
ACS	Range	Median	IQR	Range	Median	IQR	z	P -value
Start	0–2	1	1–2	0–3	1	1–2	0.8	0.42
15 min	0–3	2	1–2	0–3	1	1–2	2.4	0.017
30 min	1–3	2	1–2	0–3	1	1–2	2.3	0.019
45 min	1–3	2	1–2	0–2	1	1–2	3.8	<0.001
60 min	1–3	2	2–2	0–3	1	1–2	5.2	<0.001
75 min	1–3	2	2–3	0–3	1	1–2	4.4	<0.001
90 min	1–3	2	2–3	0–2	1	1–1.75	5.2	<0.001

Table 5. Intraoperative fentanyl consumption.

	DEX group (n = 35)	SPGB group (n = 35)	X^2	p-value
Intraoperative fentanyl (100 mic)	14 (40%)	4 (11.4%)	7.3	0.007

Table 6. Comparison between groups as regard extubation time.

	DEX group (n = 35)	SPGB group (n = 35)	t-test	p-value
Extubation time (min)	14.17 ± 2.46	7.54 ± 1.77	12.95	<0.001

Table 7. Comparison between groups as regard visual analog scale.

	DEX group (n = 35)			SPGB group (n = 35)				
VA	Range	Median	IQR	Range	Median	IQR	z	P - value
On arrival	1–2	2	1–2	0–1	1	0–1	5.3	<0.001
6 hours	1–2	1	1–2	1–2	1	1–2	0.25	0.8
12 hours	1–3	2	1.25–2	1–3	2	2–2	0.51	0.61
24 hours	2–4	2	2–4	1–5	2	2–3	1.76	0.078

Table 8. Comparison between groups as regard rescue analgesia.

	DEX group (n = 35)	SPGB group (n = 35)	X^2	p-value
Ketorolac 30 mg	17 (48.6%)	12 (34.3%)	1.47	0.23

statistical difference between them throughout the 24 hours (Table 7).

Data expressed as median and interquartile range (IQR), Z: Mann-Whitney test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group, VAS: visual analog scale

Also, postoperative need for NASID (ketorolac 30 mg) as rescue analgesia were comparable and there was no statistical difference between them (Table 8).

Data expressed as proportion, X^2: Chi square test, DEX: dexmedetomidine group, SPGB: sphenopalatine ganglion block group

There was no statistical difference between the two groups as regarding complications except for dental numbness which was significantly less in DEX group (Table 9).

Data expressed as proportion, X^2: Chi square test, DEX: dexmedetomidine group, SPGB: sphenopalatine

Table 9. Comparison between groups as regard postoperative complication.

	DEX group (n = 35)	SPGB group (n = 35)	X^2	p-value
Bleeding	2 (5.7%)	1 (2.9%)	0.35	0.56
PONV	4 (11.4%)	8 (22.9%)	1.6	0.2
Dental numbness	0 (0%)	27 (77.1%)	43.95	<0.001

ganglion block group, PONV: postoperative nausea and vomiting

8. Discussion

In this study, surgical conditions were satisfactory in all patients of both groups, but significantly better with bilateral SPGB indicated by ACS score. Although the difference between both groups in MAP did not reach significance, the heart rate response to surgical stimulation was blunted non-significantly yet more efficiently with a significantly reduced blood loss in the block group. A slow heart rate allows greater filling of the venous capacitance vessels, thus, decreasing venous oozing in the surgical field. In addition, the intraoperative consumption of fentanyl was significantly lower in SPGB group. The block group also improved the recovery characteristics and improved immediate postoperative analgesia profile indicated by significantly lower VAS scores with less postoperative consumption of rescue analgesic. No significant difference was found between groups except for dental numbness which was significantly lower in DEX group.

These effects were mostly because of the pre-emptive blocking of the nociceptive impulses transmitted through the sensory afferents of the maxillary nerve while passed into the ganglion [10]. Moreover, injection of the sphenopalatine ganglion with local anesthetic could control the mucosal blood flow of the nasal sinuses and turbinates. This could be due to the blocking of the vasodilator parasympathetic effect of the sphenopalatine ganglion on the nasal mucous membrane of leading to mucosal vasoconstriction and a better surgical field [9].

While lowering of MAP during general anesthesia can minimize intraoperative bleeding, many research demonstrated that MAP and blood loss are not necessarily correlated. Moreover, there is good evidence that decreasing MAP below 70 mmHg during FESS may increase intraoperative bleeding because of vasodilation and tachycardia. In addition to reduction of blood loss, the primary aim during FESS is to improve intraoperative endoscopic visibility [11].

It is important to maintain a level of analgesia to be satisfactory following endoscopic sinus surgery. If the patient becomes agitated or distressed, there is a risk of bleeding secondary to the rise in venous and arterial pressures. At the same time, the patient shouldn't be over sedated with a risk of dangerous upper airway obstruction [12].

Hwang et al. [13] performed SPGB before removal of nasal packing, where it was an effective method of analgesia with minimal side effects. The study done by Ahmed and Abu-Zaid [14] to evaluate the role of endoscopic SPGB in sinus surgery showed that recovery time was significantly lower in the block group when compared with control group and this matched with the results of our study.

In agreement with the present study, Amorocho and Fat [15] has reported that the SPGB is a useful adjunct in patients undergoing FESS; as it provided good operative conditions with lower ACS numbers, and lower blood loss. This is all along with better recovery characteristics, less consumption of anesthesia and better postoperative analgesia.

Bhattacharyya et al. [6] reported that patients of the block group showed significantly lower ACS compared with the control group. Ghanem and Elmalt [16] also found that the bleeding did not compromise the field and the surgeon was very satisfied. They have assessed the surgical field using ACS and have reported that the numbers in all cases were ≤2, which means that there was no significant bleeding enough to adjust the extent of surgical dissection for all the study population.

In the study done by Dyomina et al. [17]. They have found that the group that received bilateral SPGB have encountered less blood loss, less anesthetic consumption, less use of hypotensive agents, less recovery and anesthesia times, and better postoperative analgesia than control group.

Also, Scott et al. [18] have concluded, in their studies, that FESS under local anesthesia offers many advantages over general anesthesia alone as the blood loss was very minimal. The field conditions were very appropriate and major and minor orbital and intracranial complications were not seen during the study.

Against the results of this study, the study done by Demaria et al. [19] reported that despite better recovery times and faster discharge, there were no significant differences between block group and control group as regard pain intensity and satisfaction with pain. But these results differences may be attributed to different local anesthetic used and in adding 1:100,000 epinephrine as an additive to the local anesthetic as Demaria et al. [19] used palatal approach for the block technique and lidocaine 1% injection as local anesthetic used while this study used a transoral approach using 2 ml of a mixture of lidocaine (2%)

and bupivacaine (0.5%) for each side as local anesthetic which is more potent and longer acting.

When Guven et al. [20] explored the effect of DEX on the outcome of patients undergoing FESS. The result showed that the patients that received DEX had less bleeding, postoperative pain, and nausea, as well as a better hemodynamics when compared with the group that received normal saline. While according to the results of a study carried out by Praveen et al. [21], there was a statistically significant reduction in HR in the DEX group, compared to that in the nitroglycerin group, and the patients in the DEX group required less intraoperative opioid, but not less than block group.

Limitations: The first limitation is that only a small number of patients were enrolled, the second was GA was used as baseline in all groups which likely biased the anesthetic effects of SPGB, also the block need skill and experience.

Conclusion: Both DEX and regional nasal block provide excellent FESS surgery with a high score of surgeons' satisfaction. Sphenopalatine ganglion block can provide better surgical field optimization with less blood loss, less intraoperative analgesic consumption, and early recovery with minor complications and better immediate postoperative pain profile. So, SPGB can be used efficiently and safely along with general anesthesia in FESS.

Disclosure statement

The authors declare that they have no conflicts of interest.

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