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Research Article

The effect of endoscopic sphenopalatine ganglion block on hemodynamics in FESS operation.

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Abstract

Functional endoscopic sinus surgery (FESS) is considered one of the most common surgical procedures. General anesthesia (GA) is usually required during FESS. Regional analgesic techniques can be used during GA that inhibit the intra- and post-operative detrimental stimuli. Purpose of the study: To evaluate the efficacy of injection of local anesthetics in the sphenopalatine ganglion endoscopically trans-nasally on hemodynamics during endoscopic sinus surgery (FESS) under general anesthesia. Basic procedures: This prospective randomized, double-blind controlled study was conducted on 60 adult patients of both sex who were undergoing general anesthesia for elective bilateral FESS. The patients were allocated into three groups (20 patients in each group). Group I received sphenopalatine ganglion block by 2ML saline injection alone (C group) as a control group, Group II received sphenopalatine ganglion block by local anesthetic injection 2 ML bupivacaine 0.5% (B group) & Group III received sphenopalatine ganglion block by (1.5 ML bupivacaine 0.5% + 0.5 ML MgSo2 10%) as (group M). Observed variables included hemodynamic parameters (HR & MAP). Main findings: The results have shown that the regional anesthesia in Group B&M could achieve a stable hemodynamic profile with no need for using risky hypotensive drugs and B blockers. **conclusion**: The use of SPGB before sinus surgery has been shown to be a safe, easy, less invasive, and practical approach for controlled hemodynamics.

Keywords: Bilateral SPGB, FESS, Bupivacaine 0.5%, hemodynamics.

Introduction

Functional endoscopic sinus surgery (FESS) has been around since the 1970s, but its popularity has skyrocketed. The infected air cells are removed, and the paranasal sinuses are ventilated to promote better health and less frequent infections. (1)

Its great vascularity is one of the main obstacles to endoscopic approaches to the paranasal sinuses. A small amount of bleeding can frequently significantly limit visibility, resulting in a poor surgical field.(2)

Also, procedures involving the nasal sinuses are harrowing, and most patients must breathe through their mouth post-operatively. (3)

Thus, obtaining adequate hemostasis is of utmost importance during endoscopic sinus surgeries. That is why the anaesthetic plan must be tailored to ensure the best possible surgical field visualization and the adequate analgesia; while preserving the patient's hemodynamic stability and reducing complications during surgery, emergence from anaesthesia, and upon recovery. (4)

Several conditions affecting the head, facial region, and eyes have been clinically and therapeutically linked to the sphenopalatine ganglion (SPG), the largest group of neurons in the head and neck other than the brain. [4]

This ganglion (SPGB) has been blocked using transoral or transnasal techniques to treat headaches and facial pain. Based on prior studies, we predicted that intraoperative SPGB could reduce post-operative morbidities (pain, nausea, and vomiting) and speed up recovery from sedation in adult patients. [5]

We aim to evaluate the efficacy of sphenopalatine ganglion block on surgical conditions and hemodynamics in patients undergoing FESS.

Patient and methods

After obtaining Institutional Ethical Committee approval number 48:2021, The study was conducted in Minya university hospital from (November 2021 to April 2022).
This prospective randomized, double-blind controlled study was conducted on 60 adult patients.

Written informed consent was obtained from all consecutive adult patients undergoing general anaesthesia for elective bilateral functional endoscopic sinus surgery (FESS).
According to the sample size, the patients were allocated into three groups (20 patients in each group). Randomization was done according to the computer random number table.

Only the researcher doing the study knows the subject the participant received until the trial is over. The patient, the surgeon, and the anaesthetist who collected the data were blind to the patient group.

Primary outcome:
Hemodynamic changes: heart rate (HR)and mean arterial blood pressure (MAP) throughout the surgery.

Secondary outcome:
1. the Total number of patients required nitroglycerine infusion as a hypotensive agent.
2. the Total number of patients who required IV fentanyl top-up doses.
3. the Total number of patients required intraoperative propranolol injection.

Inclusion criteria:
1. Age 20 – 50 years
2. Both genders.
3. ASA I – II
4. BMI<30

Exclusion criteria:
1. Drug allergy.
2. Blood Disease.
3. Infection at the site of injection.
4. Patient refusal.

Study groups:
Group I (C group): Will receive sphenopalatine ganglion block by 2ML saline injection alone.
Group II (B group): Will receive sphenopalatine ganglion block by local anesthetic injection of 2 ML bupivacaine 0.5% alone.
Group III (M group): will receive sphenopalatine ganglion block by (1.5 ML bupivacaine 0.5%+0.5 ML $MgSO_2$ 10%).

Technique:
There were no antibiotics or any pre-operative drugs used. After the patient was brought into the operating room and standard monitoring equipment was set up, baseline hemodynamics were collected (ECG, pulse oximeter, temp, non-invasive blood pressure).

All patients were given general anaesthesia. After pre-oxygenation, anaesthesia was induced with IV fentanyl 1.5µg/kg, propofol 2mg/kg, atracurium 0.5mg/kg for intubation, and then the oropharyngeal pack was applied, and the monitoring of blood pressure and HR was adjusted at 5 min interval through the study.

Maintenance of anaesthesia was achieved with a mixture of oxygen: air (1:1),

isoflurane at two minimum alveolar anaesthetic concentrations (MAC), and intermittent boluses of atracurium will be given 0.1mg/kg if required. MAP and HR will be maintained at 60-70mmHg and 60-70 beats/min. If MAP >70 mmHg, tachycardia (HR>70 beat/min) occurred, IV 25ug fentanyl and Propranolol was given, and If MAP >70 mmHg, we will use nitroglycerine infusion 0.5 to 10μg/kg/min according to patient response. Fundamental values of MAP and HR were recorded.

The nasal cavities will be soaked by 1ml lidocaine 2% and 1:100,000 adrenaline as a decongestant passed along the middle turbinate and kept in place for 5 minutes.

Patients were positioned in a reverse Trendelenburg at an angle of 15 degrees to facilitate the obstruction. Using an endoscope, a 25 mm segment of an 18-gauge intravenous needle was inserted between the middle and lower turbinate at an angle of 45 degrees to inject medicine into the pterygopalatine fossa. After aspiration, 1.5 mL of bupivacaine 0.5% + 0.5 mL of magnesium sulphate 10% (M group) or 2 mL of bupivacaine 0.5% (B group) or 2ml saline (C group) were injected (respectively) into the nasal cavity mucosa, posterior to and above the middle turbinate tail in the pterygopalatine fossa.

In the same way, the other side will be blocked to achieve a bilateral sphenopalatine ganglion block.

Table (1): Comparison between the two studied groups regarding patient characteristics:

	Group I (n = 20)		**Group II (n = 20)**		**Group III (n = 20)**		**Test of sig.**	**p**
Sex	**No.**	**%**	**No.**	**%**	**No.**	**%**		
Male	13	65.0	14	70.0	10	50.0	χ^2= 1.833	0.400
Female	7	35.0	6	30.0	10	50.0		
Age(years)								
Mean ± SD	35 ± 7.47		33.9 ± 6.97		36.65 ± 4.78		F = 0.904	0.411
Range (Min – Max)	25 (20 - 45)		25 (23 - 48)		18 (31 - 49)			
BMI (kg/m^2)								
Mean ± SD.	27.12 ± 1.10		28.05 ± 1.03		27.88 ± 1.42		F=1.039	0.361
Min. – Max.	26.0 – 29.0		٢٨.0 – 30.0		٢٧.0 – 30.0			
ASA								
1	13	65.0	17	85.0	15	75.0	2.133	0.344
2	7	35.0	3	15.0	5	25.0		
Anesthesia duration\min								
Mean ± SD.	100.50 ± 4.87		109.35 ± 7.73		115.78 ± 7.72		2.780	0.061
Min. – Max.	90 – 110		100.0 – 119.0		99.0 – 130.0			
Surgery duration\min	**Group I (n = 20)**		**Group II (n = 20)**		**Group III (n = 20)**		**F**	**p**
Mean ± SD.	92.25 ± 4.24		95.96± 4.36		100.12 ± 3.49		0.541	0.053
Min. – Max.	89.0 – 100.0		83 – 103.0		93.0– 106.0			

SD: **Standard deviation**

χ^2: **Chi-square test** **F**: **F for One way ANOVA test**

p: p-value for comparing the studied groups

Table (2): Comparison between the three studied groups regarding Heart rate (Beat/min.) intraoperative

Heart rate (Beat/min.)	Group I (n = 20)	Group II (n = 20)	Group III (n = 20)	F	p
Baseline					
Mean ± SD.	75.80 ± 5.22	74.85 ± 6.21	72.65 ± 6.47	1.444	0.232
Min. – Max.	63.0 - 70.0	63.0 - 68.0	60.0 - 68.0		
After induction					
Mean ± SD.	64.17 ± 4.83	65.88 ± 5.12	66.60 ± 6.24	1.562	0.352
Min. – Max.	60.0 – 69.0	61.0 - 69.0	60.0 - 70.0		
Before block					
Mean ± SD.	65.59 ± 3.41	65.45 ± 4.12	66.12 ± 6.24	1.562	0.238
Min. – Max.	60.0 - 70.0	61.0 - 69.0	60.0 - 70.0		
After block					
Mean ± SD.	63.43 ± 3.70	64.65 ± 5.30	64.52 ± 4.91	1.562	0.128
Min. – Max.	60.0 - 68.0	60.0 - 69.0	60.0 - 69.0		
After 15 minutes					
Mean ± SD.	65.43 ± 3.94	65.30 ± 4.66	66.24 ± 5.06	0.937	0.374
Min. – Max.	61.0 - 69.0	61.0 - 70.0	61.0 - 70.0		
After 30 minutes					
Mean ± SD.	65.70 ± 5.01	66.14 ± 4.83	65.95 ± 4.84	0.357	0.654
Min. – Max.	60.0 - 70.0	61.0 - 70.0	61.0 – 69.0		
After 45 minutes					
Mean ± SD.	65.21 ± 6.04	64.75 ± 5.91	64.11 ± 4.78	1.744	0.172
Min. – Max.	60.0 - 68.0	60.0 - 69.0	60.0 - 68.0		
After 60 minutes					
Mean ± SD.	65.43 ± 4.32	65.21 ± 3.91	64.76 ± 3.72	0.384	0.656
Min. – Max.	61.0 - 69.0	61.0 - 69.0	61.0 - 68.0		
After 75 minutes					
Mean ± SD.	65.52 ± 3.87	65.80 ± 3.18	65.42± 3.64	0.121	0.912
Min. – Max.	61.0 - 68.0	61.0 - 69.0	61.0 - 69.0		
After 90 minutes					
Mean ± SD.	65.65± 3.81	66.02± 3.15	65.55 ± 2.44	0.683	0.509
Min. – Max.	61.0 - 69.0	61.0 - 70.0	61.0 - 69.0		
After 120 minutes					
Mean ± SD.	66.14 ± 5.23	66.45 ± 4.78	66.10 ± 3.45	0.261	0.771
Min. – Max.	61.0 - 70.0	61.0 - 69.0	61.0 - 70.0		

F: **F for One way ANOVA test**, pairwise comparison bet. every two groups were done using **Post Hoc Test (Tukey)**

p: p-value for comparing the studied groups

Table (3): Comparison between the three studied groups regarding Mean Arterial Blood Pressure (mmHg) intraoperative

Mean Arterial Blood Pressure (mmHg)	Group I (n = 20)	Group II (n = 20)	Group III (n = 20)	F	P
Baseline					
Mean ± SD.	76.81 ± 5.91	75.52 ± 5.26	73.28 ± 5.12	2.182	0.124
Min. – Max.	69.0 – 89.0	66.0 – 80.0	60.0 – 87.0		
After induction					
Mean ± SD.	64.47 ± 4.31	65.40 ± 4.91	63.25 ± 4.35	1.152	0.294
Min. – Max.	62.0 – 69.0	61.0 – 70.0	62.0 – 69.0		
Before block					
Mean ± SD.	63.38 ± 4.12	64.33 ± 4.45	63.47 ± 4.48	1.174	0.410
Min. – Max.	63.0 – 66.0	62.0 – 69.0	61.0 – 69.0		
After block					
Mean ± SD.	64.42 ± 4.24	65.45 ± 4.91	62.41 ± 4.31	1.212	0.410
Min. – Max.	62.0 – 69.0	62.0 – 70.0	62.0 – 79.0		
After 15 minutes					
Mean ± SD.	65.75 ± 7.38	66.44 ± 6.89	63.25 ± 3.89	1.403	0.251
Min. – Max.	62.0 – 71.0	62.0 – 71.0	62.0 – 70.0		
After 30 minutes					
Mean ± SD.	60.14 ± 5.23	60.12 ± 4.81	58.87 ± 5.14	1.153	0.345
Min. – Max.	62.0 – 70.0	60.0 – 69.0	60.0 – 69.0		
After 45 minutes					
Mean ± SD.	62.31 ± 7.75	63.45 ± 7.74	62.45 ± 5.59	0.072	0.839
Min. – Max.	63.0 – 69.0	61.0 – 71.0	61.0 – 70.0		
After 60 minutes					
Mean ± SD.	67.68 ± 11.46	67.52 ± 11.54	61.61 ± 7.87	2.193	0.147
Min. – Max.	61.0 – 71.0	62.0 – 71.0	60.0 – 70.0		
After 75 minutes					
Mean ± SD.	69.85 ± 11.25	70.24 ± 9.15	66.34 ± 3.87	1.204	0.311
Min. – Max.	60.0 – 71.0	63.0 – 71.0	61.0 – 70.0		
After 90 minutes					
Mean ± SD.	65.13 ± 4.47	66.78 ± 3.77	63.01 ± 3.85	2.214	0.121
Min. – Max.	60.0 – 69.0	63.0 – 69.0	60.0 – 69.0		
After 120 minutes					
Mean ± SD.	65.45 ± 4.28	66.17 ± 5.62	64.28 ± 5.14	0.853	0.412
Min. – Max.	62.0 – 70.0	62.0 – 69.0	62.0 – 68.0		

F: **F for way ANOVA test**
p: p-value for comparing the studied groups

Table (4): Comparison between the three studied groups regarding the need for intraoperative Propranolol

Need for intraoperative Propranolol top-up dose	Group I (n = 20)		Group II (n = 20)		Group III (n = 20)		χ^2	p
	No.	%	No.	%	No.	%		
Yes	20	100%	2	10%	3	15%	X2 = 37.965	<0.001
No	0	0%	18	90%	17	85%		

χ^2: **Chi-square test**
p: p-value for comparing the studied groups

Table (5): Comparison between the three studied groups regarding the need for intraoperative fentanyl top-up dose

Need for intraoperative fentanyl top-up dose	Group I (n = 20)		Group II (n = 20)		Group III (n = 20)		χ^2	p
	No.	%	No.	%	No.	%		
Yes	20	100%	3	15%	2	10%	X2 = 37.965	<0.001
No	0	0%	17	85%	18	90%		

χ^2: **Chi-square test**
p: p-value for comparing the studied groups

Table (6): Comparison between the three studied groups regarding the need for intraoperative Nitroglycerin top-up doses

Need for intraoperative Nitroglycerin top-up dose(mic\kg\min)	Group I (n = 20)		Group II (n = 20)		Group III (n = 20)		χ^2	p
	No.	%	No.	%	No.	%		
Yes	20	100%	3	15%	2	10%	X2 = 37.965	<0.001
No	0	0%	17	85%	18	90%		

χ^2: **Chi-square test**
p: p-value for comparing the studied groups

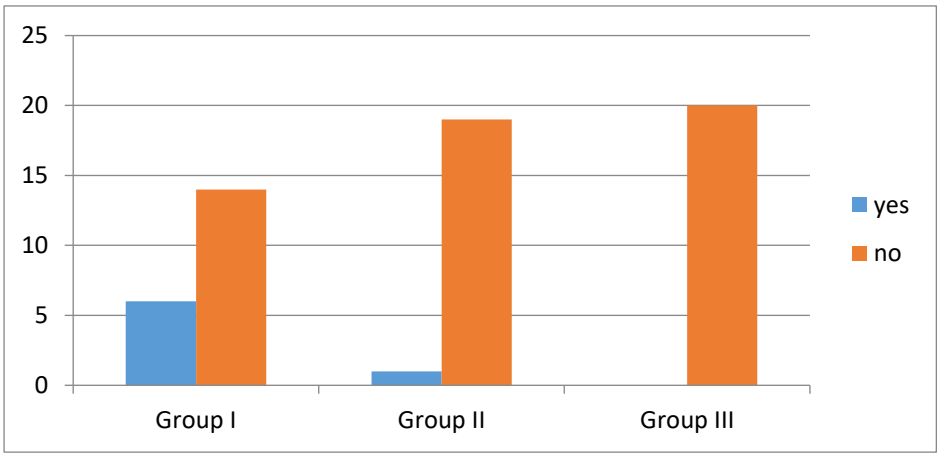

Figure (1): Comparison between the three studied groups regarding the need for intraoperative Propranolol top-up dose

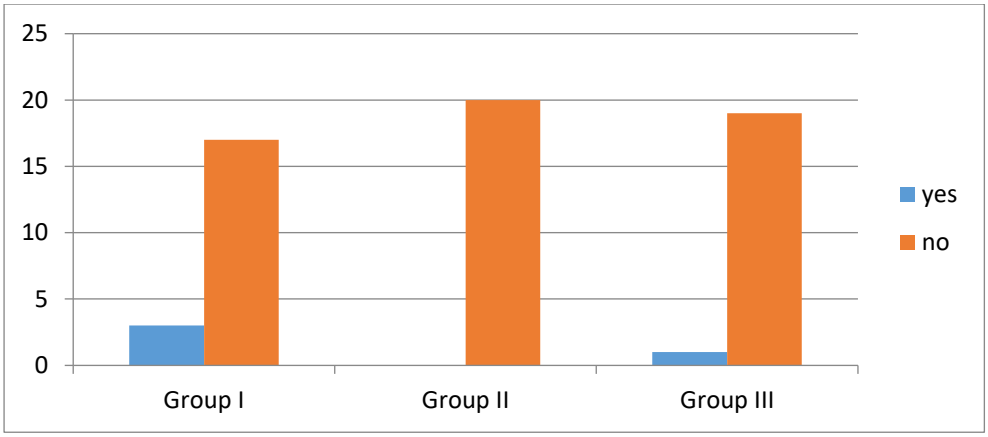

Figure (2): Comparison between the three studied groups regarding the need for intraoperative fentanyl top-up dose

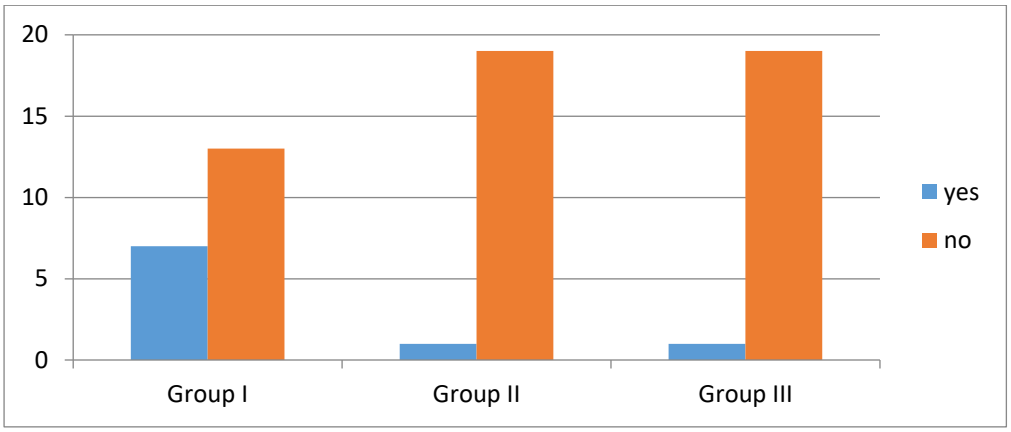

Figure (3): Comparison between the three studied groups regarding to need for intraoperative Nitroglycerin top up dose.

Statistical analytics:
Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. The Shapiro test was used to verify the normality of the distribution.

Parametric data were presented as mean ± standard deviation and minimum and maximum of the range, while they were done for categorical data by numbers and percentages.

Analysis was done for parametric and quantitative data between 3 groups using a one-way ANOVA test followed by (post hoc tuky correction) between every two groups.

Analysis was done for qualitative data using: (Fishers' exact test) or (Chi-square test**)**.

Results of the work
There was no statistically significant difference when comparing the three studied groups regarding Sex, Age, BMI, ASA, Anesthesia duration, and Surgery duration, as shown in (Table 1).

Hemodynamic changes:
1-HR:
There was no statistically significant difference when comparing the three studied groups regarding heart rate, as shown in (Table 2).

The heart rate (Beat/min.) was maintained between 60-70 beats/min by using Beta blockers and fentanyl, so there were insignificant differences between the study groups throughout different periods.

2-**MAP:**
There was no statistically significant difference when comparing the three studied groups regarding Mean Arterial Blood Pressure, as shown in (Table 3).
Nitroglycerine was used to keep the participants' average arterial pressure steady between 60 and 70 mmHg; therefore, no significant changes in blood pressure were seen across the groups throughout time.

Intraoperative Propranolol:
When comparing the three groups investigated, there was a statistically significant difference in the frequency with which additional doses of Propranolol were required during the surgery., as shown in (Table 5, figure 2).
Propranolol 0.2 mg IV was given to control the HR in 20 (100%) patients in group **I,** 2(10%) patients in group **II,** and 3 (15%) patients in group **III,** with highly significant difference between the control group (Group **I**) and the other two groups.

Intraoperative fentanyl top up dose:
When comparing the three groups, there was a massive disparity in how often additional fentanyl was administered during surgery., as shown in (Table 6, figure 3).
Top-up doses of fentanyl 25 mic were given to all patients (100%) in group **I**, 3(15 %) patients in group **II,** and 2 (10%) patients in group **III** to control the HR with highly significant difference between group **I** and the other two groups.

Intraoperative Nitroglycerin top-up dose:
There was a highly statistically significant difference when comparing the three studied groups regarding the need for intraoperative Nitroglycerin top-up doses, as shown in (Table 6, figure 3).
Nitroglycerine infusion in a dose of (0.5-10) mic\kg\min was given to control the MAP around 60-70 mmHg in the three groups as required.
All the patients (100%) in group **I** received top-up doses of nitroglycerine, while only 3(15%) and 2 (10%) patients in group **II** and group **III,** respectively, received top-up doses of nitroglycerine.
A highly significant difference was when comparing the control group to the other two groups.

Discussion

Functional endoscopic sinus surgery (FESS) is currently a prevalent surgical technique in the Rhinology speciality. It has a high success rate for symptomatic enhancement in patients with medically refractory chronic rhinosinusitis and chronic polypoid rhinosinusitis. [(6)]

Regarding hemodynamic changes in our study, there was no statistically significant difference when comparing the three studied groups throughout the surgical procedure regarding the mean arterial blood pressure and the mean heart rate.
The MAP was maintained between 60-70 mmHg by nitroglycerine infusion, and the HR was held between 60-70 beat \min by using a B-blocker and fentanyl injection.

In the post-operative period, there was a statistically significant difference in the MAP and the mean HR in the three studied groups depending on the intensity of post-operative pain being less in groups II & III than in group I due to the analgesic effect of the block.

Our study was supported by the study of Ismail et al., 2022[(7)], who studied 40 patients who underwent elective endoscopic sinus surgery divided into two groups: Group A, who received general anaesthesia with the use of an induced hypotensive technique aiming to reduce the mean arterial blood pressure and the heart rate by 20% of the basal reading. Propranolol increments (0.5 mg) and glyceryl trinitrate infusion (0.2-1µg/kg/min) were used, and Group B, who received general anaesthesia, immediately followed by a regional block for the nose (transoral SPGB). They reported that the

mean arterial blood pressure (MAP) and the mean heart rate measurements had shown no statistically significant difference.

However, the stable hemodynamic profile was easily achievable in the block group as there was no need for maintaining a continuous infusion of the hypotensive agent (glyceryl trinitrate) or frequent increments of the beta blocker (Propranolol).

Whereas in the study of Bhattacharyya et al., 2016[8], They discovered that the study groups' baseline blood pressure (mmHg) was the same but that the block group's intraoperative MAP was significantly lower than the control group's (81.07 mmHg), which was statistically significant. In the study population, there was no change in baseline heart rate (HR; beats per minute), but intraoperative HR was significantly lower in the block group (74.06 beats per minute) compared to the control group (78.26 beats per minute; P=0.0018).

While in the study of Sarhan et al., 2020[9], the differences in averages of the heart rate (71.4 ± 0.36,74.4 ± 0.0, and 74.8 ± 0.2 beat\min) and arterial blood pressure (71.0 ± 0.0 0.00 72.1±0.08 0.00 75.5 ± 0.0 mmHg) in the three SPGB studied groups respectively [group I (bupivacaine 0.5%), group II (ropivacaine 0.75%), and group III (xylocaine 2%)] were statistically significant.

Our results showed a highly statistically significant difference when comparing the non-block group (group C) and block groups (M&B) regarding the need for intra-operative Nitroglycerin, propranolol, and fentanyl top-up doses.

The work by Higashizawa & Koga, 2001[10], which combined general anaesthesia with nerve blocks during induced hypotension in maxillofacial operations, validated our findings. They demonstrated that this mixture reduced blood loss, stabilized non-fluctuating hemodynamics, and reduced the dose of anaesthetic and hypotensive drugs. Sevoflurane, fentanyl, and the need for urapidil to induce and sustain hypotension were all used less frequently in the block group than in the non-block group, according to Ismail and Anwar's study from 2005[11]. The block enhanced post-operative analgesia duration and recovery characteristics. The dose of fentanyl was (2.5 g.kg) in the block group and (3.4 g.kg) in the non-block group. Six patients got urapidil in the block group and 15 in the non-block group. The SP ganglion block is an appealing alternative approach that can achieve hypotensive anaesthesia.

Additionally, Ali et al., (2010)[12] demonstrated that the successful blocking of intense fluctuating painful stimulation occurring during various stages of surgery and the management of intra-operative hemodynamics were achieved when SPGB was used in conjunction with general anaesthesia. This effect was apparent because the block group consumed considerably less sevoflurane, nitro-glycerine, and Propranolol than the non-block group did to reach the target MAP.

In the same aspect, Ismail et al., 2020[7] found that the group that received bilateral sphenopalatine block encountered less blood loss, less anaesthetic consumption, less use of hypotensive agents, less recovery, fewer anaesthesia times, and better post-operative analgesia. The number of patients who needed top-up intraoperative doses was 20 in the non-block group. In contrast, only one patient required a top-up intraoperative amount in the block group, which is significantly different.

Conclusion

General anaesthesia can be used safely in conjunction with bilateral sphenopalatine ganglion blocks during FESS because they can improve hemodynamic control, cause less blood loss, and have only minor side effects.

Funding: This work received no financial support.

Availability of data and materials: The datasets used are available from the corresponding author upon request.

Ethics approval: The study was approved by the institutional ethics committee of the hospital of Minya University (Approval no. 48:2021).

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

References

1. Schlinkert RT. Laparoscopic-assisted right hemicolectomy1-Park, S. S., Yoon, B. N., Cho, K. S. and Roh, H. J.: Pneumatization pattern of the frontal recess: relationship of the anterior-to-posterior length of frontal isthmus and/or frontal recess with the volume of agger nasi cell. Clinical and Experimental Otorhinolaryngology, (2010); 3(2): 76-83.
2. Kastl, K. G., Betz, C. S., Siedek, V. and Leunig, A.: Control of bleeding following functional endoscopic sinus surgery using carboxy-methylated cellulose packing. European Archives of Oto-RhinoLaryngology, (2009); 266(8): 1239-1243.
3. Miłoński, J., Zielińska-Bliźniewska, H., Golusiński, W., Urbaniak, J., Sobański, R. and Olszewski, J.: Effects of three different types of anaesthesia on perioperative bleeding control in functional endoscopic sinus surgery. European Archives of Oto-Rhino-Laryngology, (2013); 270(7): 20452050.
4. Kesimci, E., Öztürk, L., Bercin, S., Kırış, M., Eldem, A. and Kanbak, O.: Role of sphenopalatine ganglion block for post-operative analgesia after functional endoscopic sinus surgery. European Archives of Oto-Rhino-Laryngology, (2012), 269(1): 165-169.
5. Al-Qudah M. Endoscopic sphenopalatine ganglion blockade efficacy in pain control after endoscopic sinus surgery. Int Forum Allergy Rhinol. 2016;6:334-338.
6. Di Mauro R, Lucci F, Martino F, Silvi MB, Gidaro E. and Di Lorenzo S.: The role of intraoperative stroke volume variation on bleeding during functional endoscopic sinus surgery. Minerva Anestesiol., (2018),84[11]:1246- 1253.
7. Ismail Owais Amin, Abdalla Mohammad Abdalla, Ali Abdalla AlKumity and Amr aMohammad Al-Mowafy: Combined Regional Nasal Block And General Anesthesia Versus General Anesthesia With Induced Hypotension Technique During Endoscopic Sinus Surgery. Al-Azhar Med. J. (2020), 49(1), 1-14
8. Bhattacharyya S, Tewari MK, Ghosh S, Chakroborty J, Das W, Barman U.: Evaluation of the efficacy of bilateral sphenopalatine ganglion block in endoscopic sinus surgery under general anesthesia: a randomized prospective controlled trial. Res Opin Anesth Intensive Care; (2016), 3:173-8.
9. A Sarhan, N., A Fathalla, M., H Alahmer, M., E Mohamed, M., & M Khalifa, M.: Effects of bilateral sphenopalatine ganglion block in functional endoscopic sinus surgery under general anesthesia. Al-Azhar Medical Journal, (2020), 49(3), 1453-1464.
10. Higashizawa T, Koga Y. Effects of infraorbital nerve block under general anaesthesia on consumption of isoflurane and post-operative pain in endoscopic endonasal maxillary sinus surgery. J Anaesth (2001); 15:136–8.
11. Ali, A. R., Sakr, S. A., & Rahman, A. S. M.: Bilateral sphenopalatine ganglion block as adjuvant to general anaesthesia during endoscopic transnasal resection of pituitary adenoma. Egyptian Journal of Anaesthesia, (2010); 26(4), 273-280.
12. Ali, A. R., Sakr, S. A., & Rahman, A. S. M.: Bilateral sphenopalatine ganglion block as adjuvant to general anaesthesia during endoscopic transnasal resection of pituitary adenoma. Egyptian Journal of Anaesthesia, (2010); 26(4), 273-280.