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Analysis of the effectiveness of sphenopalatine ganglion block on fentanyl needs in endoscopic endonasal surgery as measured by *qNOX* score

Agil Rumboko Sumitro[1], Agustina Salinding[1*], Dedi Susila[1], Budi Sutikno[1], Prananda Surya Airlangga[1], Prihatma Kriswidyatomo[1], Dhania Anindita Santosa[1]

[1]Specialist Doctor of Anesthesiology and Intensive Therapy Education Program, Faculty of Medicine Universitas Airlangga Surabaya;

*Corresponding author:
Agustina Salinding;
Specialist Doctor of Anesthesiology and Intensive Therapy Education Program, Faculty of Medicine Universitas Airlangga Surabaya;
agustina.salinding@fk.unair.ac.id

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ABSTRACT

Introduction: Endoscopic endonasal is one of the technological advances used as a supporting examination for diagnosis and therapy. This procedure is often used to evaluate medical problems of the nose and sinuses, such as functional endoscopic sinus surgery or FESS (functional endoscopic sinus surgery), turbinoplasty, and septoplasty. Surgery can be difficult to manage because there is often bleeding due to the large supply of blood vessels in the sinus area. This study aimed to investigate differences in *qNOX* scores and fentanyl requirement in patients undergoing endoscopic endonasal surgery with sphenopalatine ganglion block.

Methods: The total sample was 18 patients, with each treatment 9 patients. Patients were divided into two groups: group 1 patients who received sphenopalatine ganglion block with 0.75% ropivacaine and group 2 patients who did not receive a block. The selection of patients in groups 1 or 2 was done randomly (simple random) using lottery numbers and with a single blind.

Result: Statistical analysis showed significant differences in *intraoperatively in qNOX scores at the 5th, 10th, 15th and 20th minute* and the mean *qNOX* score in the first 1 hour between the control group and the sphenopalatine ganglion block group. Significant differences were also found in fentanyl requirement between the control group and intraoperative sphenopalatine ganglion block, where fentanyl requirement was lower in the treatment group.

Conclusion: The sphenopalatine ganglion block is a useful adjunct in patients undergoing endoscopic surgery and may reduce the need for fentanyl. In addition, it can provide a more stable qNOX score.

Keywords: Endoscopic endonasal, Fentanyl, Sphenopalatine ganglion block, *qNOX*.
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INTRODUCTION

Endoscopic endonasal is one of the technological advances in the field of ENT-KL, which is used as a supporting examination for diagnosis and therapy. This procedure is often used to evaluate medical problems of the nose and sinuses, such as functional endoscopic sinus surgery or FESS (functional endoscopic sinus surgery), endoscopic turbinoplasty, and septoplasty.[1] However, endoscopic endonasal surgery is often a problem. Surgery can be difficult to manage because there is often bleeding due to the large supply of blood vessels in the sinus area. Bleeding from this circulation can be well prevented by lowering the mean pressure (MAP) and using local vasoconstrictors. The anti-Trendelenburg position of 15 degrees also allows decongestion of the upper veins. Bleeding can decrease the visibility of the surgical field and is directly associated with the same risks of vascular, orbital, and intracranial complications as a surgical failure. Therefore, minimizing bleeding for surgeons and anesthesiologists is important in this surgery.[2]

General anesthesia is used more often in this operation. However, the combination with peripheral nerve blocks is expected to reduce bleeding and pain to improve surgical outcomes.[3] Sensory innervation from the sphenopalatine ganglion supplies the nasal turbinates, nasopharynx and palate. With sphenopalatine ganglion block, it is expected to provide perioperative analgesia, provide better hemodynamic control, reduce the dose of perioperative opioid use, and reduce bleeding. So this surgery hopes the patient can get up and mobilize quickly, return to comfortable airway protective reflexes, and the patient is pain-free.

Previous research has reported that regional anesthesia with general anesthesia provides better intraoperative hemodynamics and less bleeding.[4] Another study with 0.75% ropivacaine infiltration showed hemodynamic stability, better operating field, less bleeding, and lower consumption of fentanyl.[5]

Fentanyl, a synthetic opioid derivative of phenylpiperidine, acts on the miu opioid receptor. Fentanyl and its derivatives can

lower the pulse rate and blood pressure slightly. This drug does not release histamine, and the effect of myocardial depression is minimal. Fentanyl is a drug of great importance in anesthetic practice because of its rapid onset of analgesia, rapid elimination after small bolus doses, minimal myocardial depressant effect, and reduced need for inhaled anesthetics. Fentanyl is also used for the management of severe pain.[6]

Currently, no studies examine the *qNOX* score and the need for fentanyl in patients undergoing endoscopic endonasal surgery with sphenopalatine ganglion block with ropivacaine in Indonesia. Given the increasing use of endoscopic endonasal surgery and the importance of its postoperative complications, it is important to conduct this study. This study aimed to investigate differences in *qNOX* scores and fentanyl requirement in patients undergoing endoscopic endonasal surgery with sphenopalatine ganglion block.

METHODS

Sample

The population of this study was patients who underwent endoscopic endonasal surgery at Dr. Soetomo General Hospital with a total sample of 18 patients, with each treatment 9 patients. This study is an experimental study with preoperative sphenopalatine ganglion block treatment with ropivacaine and without block to assess the effect of reducing the need for fentanyl on endoscopic endonasal surgery. The research design used was a single-blind randomized controlled trial. This study received ethical approval from the Ethics Committee of the Dr. Soetomo General Hospital Surabaya No. 0491/KEPK/IX/2022 in September 2021.

The inclusion criteria in this study included patients with PS ASA 1-2 who would undergo endoscopic endonasal procedures (FESS, turbinoplasty, and septoplasty) under general anesthesia. Patients aged 16 to 65 years and willing to follow and sign the consent Action. In contrast, the exclusion criteria in this study were patients with a history of hypersensitivity to the drug under study, patients with pre-anesthesia arrhythmias, and patients with chronic rhinosinusitis with polyps.

Research Implementation

General anesthesia was administered by induction of 0.05 mg/kg of midazolam + fentanyl 1 mcg/kg + propofol 1.5 mg/kg + atracurium 0.5 mg/kg. Anesthesia maintenance with sevoflurane 2.5% + O2. Patients were divided into two groups: group 1 patients who received sphenopalatine ganglion block with 0.75% ropivacaine and group 2 patients who did not receive a block. The selection of patients in groups 1 or 2 was done randomly (simple random) using lottery numbers and with a single blind.

In group 1, patients received sphenopalatine ganglion block using an applicator with a cotton tip soaked in 0.75% ropivacaine and gently inserted into the posterior wall with the guidance of a nasal endoscope, then maintained in the nasal cavity for 20 minutes. In group 2, patients who did not get the block.

Nociceptive response (pain) was assessed from the *qNOX* monitor. If it showed a number above 60 it was considered a nociceptive response (pain) to surgery so that resque fentanyl 0.5 mcg/kg could be given.

Statistic Test

Research results are recorded, collected and processed. The Shapiro-Wilk test carried out the normality test of the data. Parametric data with normal distribution were analyzed by independent t test.

RESULTS

In this study, most of the patients in the control group were male, while the treatment group was mostly female. The mean age in the control group was lower than in the treatment group. The average *body mass index* (BMI) in the control group was greater than in the treatment group. However, the two groups had no significant differences in gender, age, and BMI. The basic characteristics in the form of demographic data for the control and treatment groups are presented in Table 1 and Table 2.

In addition, there were no significant differences in *systolic blood pressure* (SBP), *diastolic blood pressure* (DBP), *mean arterial pressure* (MAP), *heart rate* (HR), *respiratory rate* (RR), *saturation oxygen* (SpO_2) in the two groups Table 3.

In this study, there were significant differences in *qNOX* scores at 5, 10, 15 and 20 minutes (p = 0.000; p = 0.000; p = 0.000; p = 0.007). At the 5th, 10th, 15th and 20th

Table 1. Demographic characteristics (gender).

Variable	Control (n=9)	Treatment (n=9)	P Value
Age			
male n (%)	5 (55.56%)	4 (44.44%)	1.000*
Female n(%)	4 (44.44%)	5 (55.56%)	

**Chi-square test;* significant if p<0.05

Table 2. Demographic characteristics (age and BMI).

Variable	Control (n=9)		Treatment (n=9)		P Value
	Mean	SD	Mean	SD	
Age, years	32.22	13.43	36.33	10.54	0.480*
IMT, kg/m^2	24.31	1.95	24.21	3.93	0.950*

**Independent T2 test*, significant if p<0.05

Table 3. Preoperative clinical characteristics of the sample.

Variable	Control (n=9)		Treatment (n=9)		P Value
	Median	Range	Median	Range	
SBP, mmHg	125.00	12.00	119.00	21.00	0.340*
DBP, mmHg	76.00	8.00	76.00	10.00	0.666*
MAP, mmHg	108.00	9.30	104.60	16.00	0.340*
HR, times/minute	82.00	16.00	78.00	15.00	0.222*
RR, times/minute	16	2.00	18	2.00	0.113*
SpO_2, %	98	00	98.00	1.00	0.730*

**Mann-Whitney test*, significant if p<0.05

minutes, the *qNOX* score in the treatment group were significantly lower than the control group.

The *qNOX* score during operation in the control and treatment groups measured every 5 minutes until 120 minutes is presented in Figure 1.

Table 5 shows a significant difference in the mean *qNOX* score in the first 1 hour between the control and treatment groups. The mean *qNOX* score in the first 1 hour was significantly lower in the treatment group (p=0.001), but in the second 1 hour, the mean *qNOX* score in the control and treatment groups was not significantly different (p=0.563)

This study showed a significant difference in fentanyl rescue (p<0,05) shown in table 6. All samples (100%) in the control group received fentanyl rescue, while only 44.4% received fentanyl rescue in the treatment group.

The mean total dose of fentanyl in the treatment group was 82.77 µg, lower than the control group, which was 167.77 µg. Furthermore, a *t-test* was conducted on the need for fentanyl per body weight between the control and treatment groups. The *t-test* showed a significant difference in the fentanyl requirement per body weight in the two groups (p=0.001). The fentanyl requirement per body weight in the treatment group was lower than the control group (Table 7).

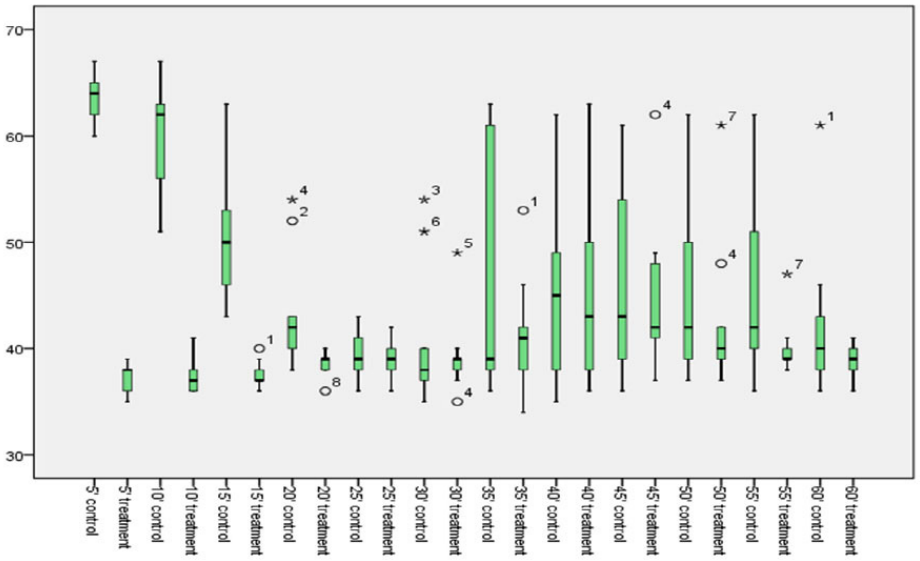

Figure 1. Boxplot diagram of *qNOX* scores in the control and treatment groups.

Table 4. ***qNOX* Score.**

qNOX score	Control (n=9)		Treatment (n=9)		P Value
	Median	Range	Median	Range	
Five minutes	64	60-67	38,0	35-39	0,001*
Ten minutes	62	51-67	37,0	36-41	0,001*
Fifteen minutes	50	43-63	37,0	36-40	0,001*
Twenty minutes	42	38-54	39,0	36-40	0,007*
Twenty-five minutes	39	36-43	39,0	36-42	1,000*
Thirty minutes	38	35-54	39,0	35-49	0,929*
Thirty-five minutes	39	36-63	41,0	34-53	0,478*
Forty minutes	45	35-62	43,0	36-63	0,825*
Forty-five minutes	43	36-61	42,0	37-62	0,658*
Fifty minutes	42	37-62	40,0	37-61	0,505*
Fifty-five minutes	42	36-62	39,0	38-47	0,068*
Sixty minutes	40	36-61	39,0	36-41	0,390*

*Uji *Mann-Whitney*, signifikan bila p<0,05

Table 5. **Average *qNOX* scores in the first and second 1 hour.**

Variable	Control (n=9)		Treatment (n=9)		P Value
	Median	Range	Median	Range	
1 hour first	47.833	41.83-50.50	38.33	37-38.9	0.001*
1 hour second	39.500	37.75-42.92	37.90	36.8-39.8	0.563*

**Mann-Whitney test*, significant if p<0.05

DISCUSSION

This study showed significant differences in the intraoperative *qNOX* score in the sphenopalatine ganglion block group, with 0.75% ropivacaine significantly lower than the control group. This study shows that the probability of the treatment group responding to a noxious stimulus is lower than the control group, which means that the analgesic effect in the treatment group is more adequate. The *qNOX* index is a nociceptive index that can predict the presence of intraoperative nociceptive stimulation through EEG frequency.[7] In a study by Jensen (2014), an increase in *qNOX* indicates a response to noxious stimuli. In addition, there was a significant difference in *qNOX* before and after stimulation during the initial surgery. A *qNOX* number above 60 is considered a nociceptive response (pain) to surgery.[8] Endoscopic endonasal surgery, including sinus surgery, is usually associated with moderate to severe pain intensity during and after surgery. The amount of painful stimulation due to endoscopic endonasal surgery can fluctuate to very painful during the procedure.[9]

Fentanyl in this study acts as a modality of anesthesia induction and adjuvant analgesia or rescue fentanyl. Rescue fentanyl 0.5 mcg/kg was administered if the patient had a nociceptive pain response as assessed by a *qNOX* score >60. Fentanyl is an opioid with rapid onset of analgesia, rapid elimination after small bolus doses, minimal myocardial depressant effect, and reduced need for inhaled anesthetics. However, fentanyl has side effects on the central nervous system, such as sedation, nausea, vomiting, dizziness,

respiratory depression (even apnea at high doses), bradycardia due to central vagal stimulation, and decreased consciousness at high doses.[10] Therefore, the number of doses plays an important role in reducing these side effects.

This study showed a significant difference in the mean total fentanyl to body weight between the control group and the sphenopalatine ganglion block group. It was found in the sphenopalatine ganglion block group that the average total fentanyl was smaller than the control group, thus placing the control group at high risk for the effects of opioids. These results are consistent with the fact that using a sphenopalatine ganglion block reduced the need for fentanyl analgesia compared to the group that did not receive a sinus block.[11] The previous research showed significant results for postoperative analgesia using a sphenopalatine ganglion block.[12] The other study demonstrated that sphenopalatine ganglion block decreased analgesia when combined with general anesthesia during trans-sphenoidal endoscopic surgery in cases of pituitary adenoma.[9]

The benefits of reducing fentanyl needs in endoscopic endonasal surgery can be caused by several mechanisms, one of which is the analgesic efficacy of the sphenopalatine ganglion block. A study has proven that sphenopalatine ganglion block, part of a peripheral nerve block, can suppress mechanical hyperalgesia caused by the inflammatory process.[13] Peripheral nerve block suppresses catecholamine responses to surgical stimuli and is associated with blocking afferent nociceptive impulses from the surgical site to the hypothalamus. As a result, the pituitary adrenocortical axis can be inhibited.[14] This method has also been used for a long time in the field to treat pain in the head area, such as cluster headaches, trigeminal neuralgia, migraine, facial pain syndrome, and cancer pain.[15] Therefore, the use of sphenopalatine ganglion block combined with general anesthesia in complex surgery, such as sinonasal surgery, is expected to have many advantages in surgical outcomes, both intraoperatively and postoperatively.[16]

Sphenopalatine ganglion block is a convenient, efficient, and safe method.[17] This technique includes a noninvasive technique into the nasal cavity.[18] However, this technique has limitations and complications. Several other complications, such as postoperative epistaxis, hematoma of the cheek, and hypoesthesia of the palate, have also been documented although only transiently.[19]

CONCLUSION

There was a significant difference in the need for fentanyl with intraoperative sphenopalatine ganglion block. And there is also a significant difference in intraoperative qNOX scores on sphenopalatine ganglion block, especially in the first 1 hour of surgery. Thus, it can be concluded that sphenopalatine ganglion block is a useful adjunct in patients undergoing endoscopic endonasal surgery and may reduce the need for fentanyl. In addition, it can provide a more stable qNOX score.

Table 6. Fentanyl rescue.

Variable	Control (n=9)	Treatment (n=9)	P Value
Fentanyl rescue			
Yes, n (%)	9 (100%)	4 (44.4%)	< 0.005*
No, n (%)	0 (0.0%)	5 (55.6%)	

**Chi-square test*; significant if p<0.05

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CONFLICT OF INTEREST

The authors declare there is no conflict of interest in this study.

AUTHOR CONTRIBUTION

All authors contributed equally in conducting the study as well as writing and revising the manuscript.

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Table 7. Table of results of the independent samples test for the total average dose of fentanyl on body weight.

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Fentanyl/ BB	Equal variances assumed	7.044	16	0.001	1.27112	0.18045	0.88858	1.65367
	Equal variances not assumed	7.044	12.633	0.001	1.27112	0.18045	0.88013	1.66212

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