Bilateral Sphenopalatine Ganglion block in Functional Endoscopic Sinus Surgery under General Anaesthesia

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Abstract

The purpose of this study was to examine the effects of bilateral sphenopalatine ganglion block on the surgical conditions, haemodynamics, intraoperative blood loss, consumption of anaesthetics, recovery characteristics and postoperative pain relief during functional endoscopic sinus surgery under general anaesthesia.

STUDY DESIGN: A double-blinded randomised controlled trial was performed to evaluate the efficacy of bilateral sphenopalatine ganglion block in 60 patients undergoing functional endoscopic sinus surgery (FESS). They were categorized into 2 equal groups (30 patients each). In group I (block group), bilateral sphenopalatine ganglion block was performed after induction of general anaesthesia while group II (non-block group) received no similar injection. Anaesthesia was maintained with N_2O-O_2, fentanyl and sevoflurane. Urapidil was administered to induce hypotension as needed. Observed variables included haemodynamic parameters, visibility of the surgical field and intraoperative blood loss. Also, the requirements of sevoflurane, fentanyl and urapidil to provide optimal surgical field were assessed. Moreover, recovery characteristics, postoperative analgesia and any complication related to the technique used were recorded.

RESULTS: Patients in group I (block group) had more stable haemodynamics with no fluctuations, better visibility of the surgical field and decreased blood loss as compared with non-block group. Also, less fentanyl, sevoflurane and urapidil doses were consumed in the block group. In addition, there were significant differences between both groups as regards the recovery criteria, the time to first rescue pain medication and analgesic requirements. Minimal postoperative complications occurred.

It could be concluded that bilateral sphenopalatine ganglion block is a useful adjunct in patients undergoing endoscopic sinus surgery. It provided more stable haemodynamics, good operative conditions and lower blood loss. Also, it decreased consumption of sevoflurane, fentanyl and urapidil. Moreover, it improved recovery characteristics and postoperative pain relief with minimal recorded complications.

Introduction

Functional endoscopic surgery of sinuses (FESS) is the standard surgical method for treatment of sinus pathology.[1] Complicated anatomic structure with its unique variations and vicinity of delicate cranial base, brain, eyes, blood vessels and nerves require from the surgeon to know anatomy in detail and to precisely identify structures in a clear bloodless surgical field.[2] General anaesthesia is usually required during FESS, particularly complicated and prolonged cases.[2-4] Nasal bleeding which may worsen the surgical field and bilateral haemostatic posterior nasal packing at the end of surgery represent challenges to the anaesthetist. [2-4] Moreover, rapid complete awakening after the end of surgery and return of protective airway reflexes in comfortable, pain-free patients are fundamental.

The use of hypotensive anaesthesia in FESS has been advocated by some authors.[5-8] Nevertheless, excessive bleeding in the surgical field can still occur, which can make surgery hazardous and jeopardize the success of the operation.[6] It seems also reasonable to prevent perioperative increases in sympathetic tone by providing adequate anaesthetic depth and analgesia.[6] Several previous studies proved that good surgical conditions during FESS could be achieved by opioid-based total intravenous (TIVA) or inhalational anaesthesia without further need for vasoactive drugs.[9-11] However, the use of

excess narcotics has its significant postoperative disadvantages including decreased alertness, inadequate spontaneous breathing and more nausea and vomiting. Regional analgesic techniques during general anaesthesia is known to inhibit intraoperative and postoperative noxious stimuli,[12] and can therefore, be used as a better alternative to high doses of narcotics avoiding their inconvenient drawbacks. The sphenopalatine ganglion block was used effectively as a sole anaesthetic technique before removal of nasal packing [13], and in patients undergoing endoscopic sinus surgery under general anaesthesia to control bleeding[14] or for postoperative analgesia.[15] However, there are few available researches to clarify the benefits of bilateral sphenopalatine ganglion block under general anaesthesia in FESS. Therefore, this randomised double blinded study was designed to test the hypothesis that this block under general anaesthesia could provide good surgical conditions, decrease blood loss, reduce anaesthetic requirements, improve recovery characteristic and postoperative analgesia in patients undergoing FESS.

Patients and Methods

After approval of the local ethics committee and an informed consent from each patient, sixty adult patients ASA I-II of both sexes participated in this study at the Suez Canal University hospital. The patients had different nasal sinus pathology including chronic sinusitis and polypal removal. Patients were scheduled to undergo FESS and randomly categorized into two equal groups. Group I (block group): Received preemptive transoral bilateral sphenopalatine ganglion block after induction of general anaesthesia. Group II (non-block group): Received no block as a control group. Patients with clinically significant cardiovascular, pulmonary, hepatic, neurologic or metabolic diseases and those with hypersensitivity to ropivacaine were excluded. Thorough preoperative examination aided by laboratory data needed for exclusion criteria was performed for all patients. All patients received 5 mg of diazepam orally as premedication an hour before the induction of general anaesthesia. On arrival to the operating room, standard monitoring equipment was applied for ECG (lead II); noninvasive arterial blood pressure and SpO_2 measurement. The inspired O_2, end-tidal CO_2, sevoflurane and N_2O concentrations were measured continuously with a calibrated infrared gas analyzer (Capnomac, Datex, Ultima, Finland). General anaesthesia was induced intravenously with 2-3 $mg \cdot kg^{-1}$ propofol and 2 $\mu g \cdot kg^{-1}$ fentanyl, and the trachea was intubated with a cuffed endotracheal tube under muscle relaxation with 0.1$mg \cdot kg^{-1}$ vecuronium. No anticholinergic or vagolytic agents were used. Anaesthesia was maintained with sevoflurane in 50% N_2O in O_2 with fresh gas flow of 3 $l \cdot min^{-1}$. Positive pressure ventilation was employed to attain $ETCO_2$ of 35 mmHg. All patients were placed in a 15° reverse Trendelenburg position to maintain venous drainage. After induction of anaesthesia, only patients in group I (block group) received bilateral sphenopalatine ganglion block, while patients in group II did not receive the block (control group).

Sphenopalatine ganglion block technique:

The intraoral greater palatine canal approach to block the sphenopalatine ganglion was used.[14] The greater palatine foramen has a constant location posteromedial to the third maxillary molar and anteromedial to the maxillary tuberosity and pterygoid hamulus. The instruments required were a 5 mL syringe and a 25-gauge needle. The needle was bent about 60 degree, approximately 25-30 mm from the tip. After using finger palpation to determine the location of greater palatine foramen, the needle was pushed through the mucosa until bone was encountered. With slight exploratory movements to localize the foramen, the needle slipped up the canal with ease. A negative pressure with aspiration ensured the correct position. Air bubbles or a bloody aspirate indicated entry into the nasopharynx or a vessel, in which case

the needle was withdrawn and repositioned. Thereafter, 3 mL of ropivacaine 0.75% was injected in each side of greater palatine canal. In both groups, no local anaesthetic or vasoconstrictor was injected into the nasal mucosa.

The haemodynamic objective of the anaesthetic management in this study was the maintenance of enough hypotension for producing an optimal surgical field. A value of Average Category Scale (ACS) of ≤ 3 was considered ideal (table I). After steady-state anaesthesia was obtained, the arterial blood pressure was incrementally reduced by increasing the sevoflurane concentration in a stepwise fashion until a mean blood pressure of 55-65 mmHg was achieved or the end-tidal concentration of sevoflurane reached 3%. If blood pressure control was not achieved with a 3% sevoflurane concentration, incremental boluses of 1 $\mu g.kg^{-1}$ fentanyl were administered up to a total dose of 3 $\mu g.kg^{-1}$. When both drugs failed to achieve good surgical field, a bolus 0.2-0.4 $mg.kg^{-1}$ of urapidil, a selective α1-adrenoreceptor antagonist [16, 17], was given to induce the required hypotension. If the target MAP (55-65 mmHg) was achieved but still the ACS was > 3, the patient was excluded from the study. An additional dose of vecuronium (0.02 mg. kg^{-1}) was given at 30 minutes intervals to maintain muscle relaxation. Bradycardia (heart rate < 50 beats.min) was treated with atropine (0.4 mg). When severe hypotension occurred (MAP < 55 mmHg), a fluid challenge (lactated Ringer's solution 3-4 $ml.kg^{-1}$) and intravenous ephedrine (5mg increments) were administered. Fluid therapy included maintenance fluid plus the deficit replaced over the procedure and 3 ml of crystalloids for every ml of estimated blood loss. When controlled hypotension was no more necessary, sevoflurane concentration was decreased to 1%. At the end of surgery, sevoflurane and N_2O were discontinued. Residual neuromuscular block was antagonized with neostigmine 2.5 mg and atropine sulphate 1 mg. The trachea was extubated when adequate spontaneous ventilation and patient response to verbal commands were established. After surgery, the patients were admitted to the postoperative care unit (PACU). When it was confirmed that there was no significant post-anaesthetic complications, they were discharged to their ward. The same surgeon performed all the operations to ensure consistency in the estimation of the surgical field. To eliminate the observer bias, the observing anaesthetist did not attend the induction of anaesthesia and performance of the block. Also, the operating surgeon was blinded to the pharmacological treatments and the used techniques

Table I: Average Category Scale (ACS).

Grade	Assessment
0	No bleeding.
1	Slight bleeding, no suctioning of blood required.
2	Slight bleeding, occasional suctioning required. Surgical field not threatened
3	Slight bleeding, frequent suctioning required. Bleeding threatens surgical field a few seconds after suction is removed.
4	Moderate bleeding, frequent suctioning required. Bleeding threatens surgical field directly after suction is removed.
5	Severe bleeding, constant suctioning required. Bleeding appears faster than can be removed by suction. Surgical field severely threatened and surgery usually not possible.

Validated in previous studies; adapted from Fromme et al [18] and Boezaart et al [5].

Measurements

At the commencement of surgery and at regular 15-minute intervals the anaesthetist prompted the surgeon for a surgical field assessment. Surgical field was assessed using the scale given in Table I, originally described by Fromme et al[18] but adapted by Boezaart et al[5]. The average of surgical field scores obtained throughout the operation was calculated for each patient and the means of average scores were compared between both groups. In addition, the following parameters were recorded: 1) The HR and MAP were measured at the commencement of surgery and at each assessment of the surgical field. The average mean values during the surgical procedures were calculated in each group. 2) Blood loss was measured in milliliters as that collected in the suction apparatus and by weight of the nasal swabs; 3) End-tidal sevoflurane concentration was used as an indicator of inhaled anaesthetic dose. Mean end-tidal sevoflurane concentration was calculated for each patient as the average of all concentrations recorded; 4) The total dose of fentanyl given, including the "rescue" fentanyl doses and the additional hypotensive agent (urapidil) requirements; 5) Duration of anaesthesia and surgery were obtained. 6) Early recovery times were measured from the discontinuation of anaesthesia to: eye opening, obey verbal commands, tracheal extubation, orientation and an Aldrete [19] recovery score ≥ 9; and 7) Pain intensity was evaluated with a 10-cm VAS (where 0 is defined as no pain at all and 10 as the worst possible pain) at 2, 6, 12 and 24 hours postoperatively. The time to first rescue pain medication and analgesic requirements were assessed. The patients received 30 mg of ketorolac intravenously and 50 mg of pethidine intramuscularly as required for postoperative supplemental analgesia, on request. The incidence of postoperative complications including bleeding, nausea, vomiting, dental numbness, headache and sense of retro-ocular pressure was recorded.

All results are expressed as means ± SD unless otherwise specified. Data were analyzed using Student's unpaired t-test and Chi-square test whenever appropriate. A p value < 0.05 was considered statistically significant.

Results

The demographic data of the patients, duration of anaesthesia and surgery were comparable in both groups with no significant intergroup difference (table II). Three patients were excluded from the study due to the inability to probe the greater palatine foramen. The average mean HR (beats / min) was significantly less in group I (66.1 ± 11.5) compared to group II (75.3 ± 14.7) during the assessment periods ($p < 0.001$). There was no significant difference between both groups in the average mean of MAP during the overall measurement periods (63.1 ± 10.5 and 59.3 ± 11.3 mmHg in group I and II respectively $p > 0.05$) (table III).

There was a significant difference between both groups as regards the mean score of the average category scale of all periods of assessment ($p < 0.001$). The mean blood loss was significantly less in the block group ($p < 0.001$). The mean consumption of fentanyl and sevoflurane in the block group was significantly lower when compared to the control group ($p < 0.001$). Fewer patients required urapidil in the block group in comparison with the non-block group ($p < 0.05$) (table III).

Early recovery variables (eye opening, response to command, extubation and orientation times) were significantly faster in block group ($p < 0.001$). The percentage of patients with modified Aldrete score ≥ 9 at the recovery room was significantly higher and earlier in the block group in comparison with non-block group (table IV).

Fewer patients required additional analgesics throughout the postoperative period in the block group compared to the non block group during the first 24 hours postoperatively (group I versus II, 6 of 30 versus 24 of 30 patients respectively).

There was a significant difference between both groups in the time to first rescue pain medication (group I versus II, 6.3 ± 3.1 hours versus 14.7 ± 8.3 hours respectively, $p < 0.001$) (table V). The pain intensity in the block group was lower than that in the non-block group at 6, 12 and 24 hours postoperatively (table V).

As regard the postoperative complications; while the incidence of nausea, vomiting were significantly higher in the control group, dental numbness and transient sense of retro-ocular pressure were much more common in the block group (table VI).

Table II: Patient demographic data and characteristics.

	Group I (block group) n = 30	Group II (non-block group) n = 30	p value
Age (years)	45.4 ± 16.4	42.8 ± 16.1	0.537
Weight (kg)	59.7 ± 8.9	63.2 ± 8.6	0.126
Height (cm)	161.4 ± 9.0	165.6 ± 9.9	0.090
Gender (F/M)	16/14	18/12	0.602
Anaesthesia time (min)	128 ± 42	140 ± 39	0.265
Duration of surgery (min.)	91 ± 36	96 ± 33	0.577

Data are represented as means ± SD unless otherwise indicated.
M = Male, F = Female.

Table III: Intraoperative data

	Group I (Block group) (n = 30)	Group II (non-block group) (n = 30)	p value
Average mean of heart rate (beats / min)	66.1 ± 11.5	75.3 ± 14.7	< 0.001**
Average mean of MAP (mmHg)	63.1 ± 10.5	59.3 ± 11.3	0.356
Blood loss (ml)	108 (65-210)	176 (107-275)	< 0.001**
Average Category Scale (ACS) points	1.9 ± 0.6	2.8 ± 0.4	< 0.001**
Fentanyl, $\mu g.kg^{-1}$	2.5 (2.3-3.0)	3.4 (2.9-3.8)	< 0.001**
Sevoflurane, end-tidal concentration%	2.01 ± 0.27	2.60 ± 0.39	< 0.001**
Urapidil (number of patients)	6	15	0.015*
Fluid intake ($ml \cdot kg^{-1} \cdot h^{-1}$)	5.6 ± 2.8	5.1 ± 1.5	0.392

Data are represented as means ± SD, median (range) and number of patients.
MAP = Mean arterial pressure.
*A significant difference between both groups ($p < 0.05$).
**A high significant difference between both groups ($p < 0.01$).

Table IV: Early recovery parameters

	Group I (Block group) (n = 30)	Group II (non-block group) (n = 30)	p value
Eye opening (min)	9.3 ± 2.1	12.5 ± 3.4	< 0.001**
Obey commands (min)	11.6 ± 2.9	14.2 ± 4.1	< 0.001**
Extubation (min)	12.8 ± 3.1	15.8 ± 3.3	< 0.001**
Orientation (min)	15.3 ± 2.1	18.8 ± 3.2	< 0.001**
Aldrete recovery score ≥ 9 (min)	18.2 ± 2.3	20.8 ± 3.7	< 0.001**
Discharge time from the recovery room (min)	40.1 ± 12.2	49.3 ± 17.6	0.022*

Data are represented as means ± SD.
*A significant difference between both groups ($p < 0.05$).
**A high significant difference between both groups ($p < 0.01$).

Table V: Postoperative VAS and analgesia during the first 24 hours in both groups.

	Group I (Block group) (n = 30)	Group II (non-block group) (n = 30)	p value
2-hours	1.98 ± 1.8	2.1 ± 1.9	0.802
6-hours	2.1 ± 1.9	3.8 ± 2.8	0.007**
12-hours	2.4 ± 2.1	4.1 ± 3.1	0.015*
24-hours	2.7 ± 2.3	4.4 ± 3.3	0.024*
Postoperative rescue analgesics	6	24	0.001*
The time to first rescue analgesia (hours)	6.3 ± 3.1	14.7 ± 8.3	< 0.001**

Data are represented as means ± SD or number of patients.
*A significant difference between both groups ($p < 0.05$).
**A high significant difference between both groups ($p < 0.01$).

Table VI: Postoperative complications in both groups.

	Group I (Block group) (n = 30)	Group II (non-block group) (n = 30)	p value
Hypotension	1	0	0.313
Hypertension	0	1	0.313
Dizziness	6	12	0.273
Nausea and vomiting	6	15	0.015*
Bleeding	1	2	0.553
Headache	5	3	0.447
Dental numbness	24	1	< 0.001**
Sense of retro-ocular pressure	4	1	0.161

Data are represented as number of patients.
*A significant difference between both groups ($p < 0.05$).
**A high significant difference between both groups ($p < 0.01$).

Discussion

In the present study, surgical conditions were satisfactory in all patients of both groups, but significantly better with bilateral sphenopalatine ganglion block. Although the difference between both groups in MAP did not reach significance, the heart rate response to surgical stimulation was blunted 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.[24] In addition, the consumption of sevoflurane and fentanyl, and the requirement of urapidil to induce and maintain hypotension were lower in the block group than in the non-block group. The block also improved the recovery characteristics and prolonged postoperative analgesia.

These effects were probably due to the preemptive blocking of the nociceptive impulses transmitted through the sensory afferent branches of the maxillary nerve while passing into the ganglion.[20] Moreover, injection of the sphenopalatine ganglion with local anaesthetic could reduce the mucosal blood flow of the nasal sinuses and turbinates.[21] This could be attributed to blocking of the vasodilatory parasympathetic effect of the sphenopalatine ganglion on the mucous membrane of the nose leading to mucosal vasoconstriction and a better surgical field.[22, 23]

Lowering of MAP during general anaesthesia can minimize intraoperative bleeding.[5-7] However, many researches demonstrated that MAP and blood loss are not necessarily correlated. [18, 24] There is good evidence that decreasing MAP below 70 mmHg during FESS may increase intraoperative bleeding due to local vasodilation and tachycardia.[5,6] In addition to reduction of blood loss, the primary aim during FESS is to improve intraoperative endoscopic visibility. Local measures such as topical and locally injected vasoconstrictors are used to improve the surgical field.[24] Also, β-blockers were proven to be effective in providing good operating conditions during FESS.[5,7] Nevertheless, these methods are not without side effects [24] and the sphenopalatine ganglion block appears to be an attractive alternative.

The results of the present study agree with the results of previous studies.[13, 14, 25] Hwang et al [13] performed sphenopalatine ganglion block before removal of nasal packing, where it was an effective method of analgesia with minimal side effects. Wormald et al[14] proved that unilateral trans-oral pterygopalatine fossa infiltration with lidocaine improved the surgical conditions on the injected side relative to the other side during FESS. Moreover, greater palatine canal injection of xylocaine or normal saline was a successful alternative to the posterior nasal packing and arterial ligation in epistaxis.[25]

Various previous studies are in accord with the present study in combining nerve blocks with general anaesthesia during induced hypotension in maxillofacial surgeries. They showed that this combination provided stabilized non-fluctuating haemodynamics, reduced blood loss and decreased the dose of the anaesthetic and hypotensive agents.[12, 26-29]

It is important to maintain a satisfactory level of analgesia 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 should not be oversedated with a risk of dangerous upper airway obstruction.[2-4] Improved recovery criteria and prolonged postoperative analgesia were evident in this study in the block group. These results are in agreement with previous researchers.[12-15] Friedman et al.[15] showed that sphenopalatine ganglion block was associated with prolonged postoperative analgesia in FESS. Higashizawa and Koga [12] demonstrated that general anaesthesia combined with infraorbital nerve block was effective in reducing the consumption of isoflurane and postoperative pain intensity in FESS. In children undergoing FESS, bilateral infraorbital nerve block was equipotent for postoperative pain relief as with morphine.[30]

Sevoflurane is an inhalational anaesthetic whose clinical profile suggests that it could be a suitable agent for controlled hypotension.[31] It has a more rapid onset of action than isoflurane making it easy to rapidly control blood pressure in response to changing levels of surgical stimulation.[31] Its effect on sympathetic tone, baroreflex sensitivity and heart rate is minimal, thereby limiting the potential for tachycardia.[31] Several previous studies had confirmed the sevoflurane efficacy combined with a potent narcotic in providing controlled hypotension in different surgeries. [10, 11, 31-33]

In this study, sphenopalatine ganglion block was an easy procedure, associated with few minor complications. The most frequent complains were mild dental numbness and transient sense of retro-ocular pressure.

In conclusion, sphenopalatine ganglion block is a simple and useful adjunct during FESS under general anaesthesia. It provided a satisfactory operative field, haemodynamic stability without fluctuations and less blood loss. It also decreased sevoflurane, fentanyl and urapidil consumption with smoother recovery and long-lasting postoperative pain relief.

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