Original Article

Effects of bilateral transmucosal sphenopalatine ganglion block on intraoperative anesthetic requirements and recovery profile in children undergoing palatoplasty under general anesthesia

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Abstract

Background and Aims: Sphenopalatine ganglion block (SPGB) given as injection provides excellent perioperative analgesia during palatoplasty. Our objectives were to assess the effect of transmucosal SPGB on anesthetic requirements, intraoperative hemodynamics, recovery time, and emergence delirium in children undergoing palatoplasty.

Material and Methods: This prospective, randomized study was conducted in 30 children with cleft palate undergoing palatoplasty, divided into two equal groups. After induction and intubation, patients in Group B received bilateral SPGB using cotton-tipped applicators soaked in 2% lignocaine, which were passed through both the nares, and the distal tip was positioned just superior to middle turbinate and anterior to pterygopalatine fossa and sphenopalatine ganglion. In Group C, saline-soaked cotton applicators were used. All patients received general anesthesia as per a standardized protocol. Intraoperative heart rate, mean arterial pressure, the requirement of anesthetics, extubation time, and emergence delirium were compared.

Results: Compared with Group C, patients in Group B had significantly lower sevoflurane consumption (17.2 ± 2.6 vs. 27.5 ± 5.0mL, $P < 0.001$) and fentanyl consumption (2.2 ± 0.5 vs. 3.2 ± 0.6 μg/kg, $P < 0.001$).The extubation time was significantly shorter in Group B (3.9 ± 0.7 vs. 9.5 ± 1.6 minutes, $P < 0.001$). PAED (Pediatric Anesthesia Emergence Delirium Scale) scores at 5and 10 minutes were significantly higher in Group C ($P < 0.001$). Intraoperative heart rate was significantly higher in Group C. Group C had significantly higher mean arterial pressure at 15, 60, and 75 minutes.

Conclusion: Preoperative, SPGB administered by mucosal application of local anesthetic significantly reduced sevoflurane and fentanyl requirements, with stable hemodynamics, quicker recovery, and less emergence delirium in children undergoing palatoplasty.

Keywords: Extubation, fentanyl, palatoplasty, sevoflurane, sphenopalatine ganglion block

Introduction

Although a calm child with optimal postoperative analgesia is considered ideal following palatoplasty, often the conditions are demanding at extubation in such patients. Excessive intraoperative opioid use can cause oversedation and airway obstruction in the immediate postoperative period in these children who are usually considered as having difficult airways. Underuse of opioids could result in incessant crying with risks of suture dehiscence and bleeding postoperatively. Supplemental sphenopalatine ganglion block (SPGB) as an injection given through the palatal cleft has been

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shown to provide excellent perioperative analgesia with improved recovery in children undergoing palatoplasty.[1] We investigated whether SPGB given through the nose, by mucosal application of local anesthetic using cotton-tipped applicators, could provide the same results. We hypothesized that preemptive analgesia provided by SPGB by this method would reduce the requirement of anesthetic agents as reflected by reduced use of opioids and inhalational agents that might provide better extubation conditions.

The primary objective of our study was to assess the effect of preoperative bilateral sphenopalatine ganglion block administered by mucosal application of local anesthetic on intraoperative sevoflurane requirement in children undergoing palatoplasty as compared with those who did not receive the block. The secondary objectives were to determine intraoperative fentanyl consumption and the effect on intraoperative hemodynamics in terms of heart rate, blood pressure, and random blood sugar values in both groups. The effect of the block on recovery time and emergence delirium was also compared.

Material and Methods

The study was designed as a prospective, randomized study. Children with cleft palate undergoing palatoplasty between the age group of 3 months to 2 years and belonging to the American Society of Anesthesiologists physical status (ASA PS) 1–2 were recruited into the trial after obtaining the Institutional Ethical Committee clearance and consent from parents. The study was registered at the Clinical Trial Registry India (CTRI/2020/01/022957). Patients having upper respiratory tract infection, allergy to local anesthetics, major cardiac or pulmonary disorders, bleeding disorders, anticipated difficult airway requiring fiber-optic or videoscope-assisted intubation, fasting blood sugar <65 mg/dL, and those posted for revision palatoplasty were excluded.

As there was no previous study published that assessed the effect of transmucosal SPGB on anesthetic requirements in children undergoing palatoplasty, we conducted a pilot study in 20 patients with two equal groups. The mean sevoflurane consumption was found to be lower in SPGB group compared with those who did not receive it (17.1 ± 2.7 vs. 25.3 ± 2.7mL), with a mean difference of −8.2. From these data, the sample size was calculated as three per group, with 95% confidence interval and 90% power using the formula

$$n = (Z_{\alpha/2}+Z_{\beta})^2*2*\sigma^2 d^2$$

Where $Z_{\alpha/2}$ is the critical value of the normal distribution at $\alpha/2$, Z_{β} is the critical value of the normal distribution at β, σ^2 is the population variance, and d is the likely difference. However, 30 children were recruited with 15 in each group during the study period January 2020 to April 2021.

Following a detailed preanesthetic evaluation, those patients fulfilling inclusion criteria were randomly allocated to either of the two groups, Group B or C, based on acomputer-generated random sequence of numbers. Sequentially numbered opaque sealed envelopes were used for concealing allocation. All patients were kept fasting 6 hours for formula feeds and solids, 4 hours for breast milk, and 2 hours for clear fluids.

In the operation theater, standard preinduction monitors were attached, and all children were induced with sevoflurane 8% in 4L oxygen initially; following induction, intravenous (IV) access was secured, and the concentration of sevoflurane was reduced to 2%. All patients received IV glycopyrrolate 0.01mg/kg, fentanyl 2mcg/kg, propofol 1mg/kg, and atracurium 0.5mg/kg followed by oral endotracheal intubation with an appropriate-sized Ring, Adair, and Elwyn tube, which was fixed in the midline. Anesthesia was maintained with sevoflurane 1.5% to 2% in air and oxygen mixture (1:1, 1L/minute flow rate) with positive pressure ventilation keeping end-tidal carbon dioxide levels between 30 and 35mmHg by adjusting the tidal volume and respiratory rate.

After intubation, the patients belonging to Group B received bilateral SPGB using cotton-tipped applicators soaked in 2% lignocaine, which were passed through both the nares with the patient in the supine position till resistance was encountered. At this point, the distal end of the applicator tip would be positioned just superior to the middle turbinate and anterior to the pterygopalatine fossa and sphenopalatine ganglion[Figure 1]. The applicators were kept in this position for 5 minutes. The pictorial representation is depicted in Figure 2. The applicator tip was kept immersed in

Figure 1: Child receiving sphenopalatine ganglion block

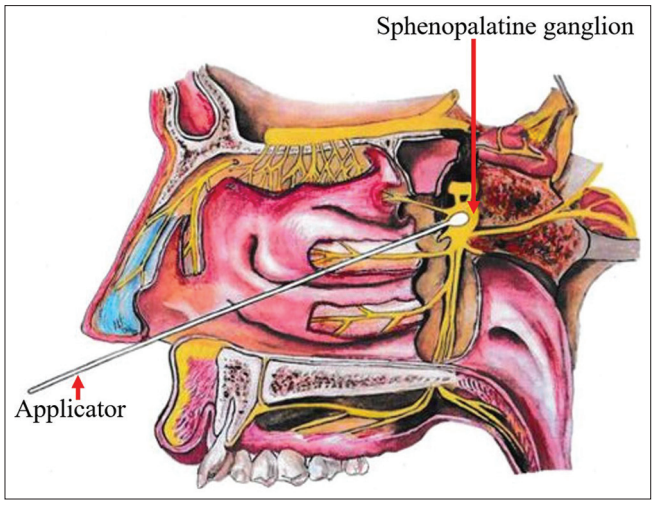

Figure 2: Pictorial representation of sphenopalatine ganglion block being given

2% lignocaine solution prior to use, and each absorbed 0.15 to 0.2 mL solution. In Group C, saline-soaked cotton applicators were used. All the blocks were performed by the same anesthesiologist, and the correct placement of applicators was assessed and confirmed with a fiber-optic bronchoscope passed through the palatal defect.

The anesthetist administering the block was unaware of the type of solution used to soak the cotton applicators. They were prepared by another anesthetist who was not involved in the study and were kept in the theater before the child was brought in. The anesthetist who gave the block conducted the anesthesia, and the outcome measurements were entered by a postgraduate student present in the theater. The parents of the study subjects and the outcome assessors were blinded to the techniques followed in both groups.

The heart rate (HR) and blood pressure were documented immediately after induction and then at every 15 minutes until the end of surgery. An increase in HR or mean arterial pressure (MAP) by >20% of the baseline value was initially managed by increasing sevoflurane to 2% to 2.5%.If not effective, fentanyl 0.5mcg/kg bolus was supplemented not exceeding 1 mcg/kg in1 hour. The number of times an increase in HR or MAP >20% from baseline occurred requiring an intervention such as increasing sevoflurane concentration or supplemental fentanyl bolus was documented in both groups.

Ringer's lactate (RL) with 1% dextrose was administered as maintenance fluid according to body weight using the Holliday–Segar formula, and the total volume of IV fluid used was noted. Random blood sugar (RBS) levels were checked at hourly intervals at 1, 2, and 3 hours or at the end of surgery if the duration of surgery lasted <3 hours, using a standard glucose meter (FreeStyleOptium H System, © 2023 Abbott Laboratories, Abbott Park, Illinois, USA) with the test strip, on capillary blood from the big toe.

Hypoglycemia was defined as RBS <65 mg/dL, which was corrected with the administration of 10% dextrose 2.5 mL/kg body weight. RBS >150mg/dL was considered as hyperglycemia, and in such circumstances the glucose containing maintenance solution was replaced with plain RL. Incidence of hyper- and hypoglycemia, if any, was documented, and these children were excluded from the study.

Thirty minutes prior to the end of surgery, paracetamol 15 mg/kg body weight was given intravenously to all infants for postoperative analgesia. At the end of surgery, anesthetic agents were tapered and discontinued, and the residual neuromuscular blockade was reversed with neostigmine and glycopyrrolate. Patients were extubated when awake with the return of protective airway reflexes and shifted to postoperative intensive care unit. Avance S5 workstation (Datex-Ohmeda, Inc., Madison, USA) and Tec 7 vaporizer were used for administering general anesthesia in all cases. The total intraoperative fentanyl requirement was noted at the end of surgery.

Sevoflurane consumption was noted from the anesthesia workstation for the period starting after intubation till the end of surgery. It was noted by selecting the main menu and then choosing the fresh gas usage option, the inhalation agent (sevoflurane) used in milliliters was noted. The first value was noted after intubation and the second value was noted at the end of surgery. The difference between the values was taken as the sevoflurane consumption in each case.

Extubation time was calculated from the time inhalational agents were discontinued to extubation. Postoperatively, patients were assessed using the Pediatric Anesthesia Emergence Delirium (PAED) scale score[2] to rule out emergence delirium at 5 and 10 minutes after extubation (minimum score = zero, maximum score = 20).

Categorical variables were presented as number and percentage, and normally distributed continuous variables as mean with standard deviation. When continuous variables were skewed, median and interquartile range were used. Pearson Chi-square test was used to compare gender between the groups. An independent samples *t* test was used to compare the normally distributed continuous variables. Mann–Whitney *U* test was used to compare PAED score and number of total and fentanyl bolus interventions. Statistical analyses were conducted using SPSS Version 20.0 for Windows (IBM Corporation Armonk, NY, USA).

Results

Data from 30 children were analyzed [Figure 3]. Patients in both groups had comparable age (12.4 ± 2.5 vs. 13.5 ± 3.6 months, $P = 0.326$), weight (10.0 ± 1.8 vs. 10.3 ± 1.5 kg, $P = 0.524$) and distribution of gender ($P = 0.464$). Compared with Group C, patients in Group B had significantly lower sevoflurane consumption (17.2 ± 2.6 vs. 27.5 ± 5.0mL, $P < 0.001$) and fentanyl consumption (2.2 ± 0.5 vs. 3.2 ± 0.6 μg/kg, $P < 0.001$). Extubation time was significantly shorter in Group B (3.9 ± 0.7 vs. 9.5 ± 1.6 minutes). The duration of surgery and total volume of IV fluid used were comparable in both groups [Table 1]. The number of times fentanyl bolus was given and the total number of times interventions needed were significantly higher in Group C. PAED scores at 5and 10 minutes were significantly higher in Group C ($P < 0.001$) [Table 2].

Table 1: Comparison of anesthetic requirements, volume of intravenous fluids, extubation time, and duration of surgery

Variables	Group B		Group C		*P*
	n	Mean±SD	*n*	Mean±SD	
Sevoflurane consumption (mL)*	15	17.2±2.6	15	27.5±5.0	<0.001
Fentanyl consumption (μg/kg)*	15	2.2±0.5	15	3.2±0.6	<0.001
Total IVF volume used (mL)*	15	178.0±63.8	15	185.3±37.6	0.704
Extubation time (minutes)*	15	3.9±0.7	15	9.5±1.6	<0.001
Duration of surgery (hours)*	15	163.0±35.3	15	172.0±21.1	0.406

**Independent samples t test, SD=standard deviation, IVF=intravenous fluid*

Table 2: Comparison of number of times sevoflurane concentration increased, fentanyl bolus given, PAED scores and random blood sugar

Variable	Group B		Group C		*P*
	n	Median (IQR)	*n*	Median (IQR)	
Number of times fentanylbolus given*	15	0 (0-1)	15	3 (2-4)	<0.001
Total number of times interventions needed*	15	0 (0-1)	15	4 (4-6)	<0.001
PAED score at 5 minutes*	15	7 (7-7)	15	15 (15-15)	<0.001
PAED score at 10 minutes*	15	6 (6-6)	15	14 (14-14)	<0.001
Comparison of random blood sugar#					
Time	***n***	**Mean±SD**	***n***	**Mean±SD**	***P***
Baseline	15	93.0±5.6	15	94.9±9.0	0.487
First hour	15	101.9±15.5	15	126.5±21.3	0.001
Second hour	15	107.9±17.9	15	137.1±33.0	0.005
Third hour/end of surgery	15	110.3±14.3	15	147.7±15.5	<0.001

** Mann–Whitney Utest,#Independent samplest test. PAED=Pediatric Anesthesia Emergence Delirium Scale, IQR=interquartile range, SD=standard deviation*

Mean baseline HRs were similar in both groups. But at all other time points, heart rate was significantly higher in Group C compared with Group B [Figure 4]. Baseline MAP was comparable in both groups. Group C had significantly higher MAP at 15, 60, and 75 minutes. At other time points, MAP was comparable [Figure 5].Baseline RBS was comparable in both groups. At first, second, and third hours, RBS was significantly higher in Group C [Table 2].

Discussion

In the study, it was shown that Group B had significantly reduced sevoflurane and fentanyl requirements, more stable intraoperative hemodynamics and glycemic levels with quicker recovery and reduced emergence delirium compared with Group C. In children undergoing facial cleft surgeries, administration of supplemental infraorbital nerve block and SPGB have been shown to reduce anesthetic requirements leading to faster awakening and extubation during cleft lip and cleft palate surgeries, respectively.[1,3-6]

Parameswaran *et al.*[1] had shown that SPGB given preemptively provided excellent intraoperative and postoperative analgesia and optimal intraoperative hemodynamics with a significant reduction in blood loss, resulting in a better surgical field. This study was conducted in pediatric patients with complete cleft palate undergoing primary palatoplasty, and the local anesthetic, 1mL of 0.75% ropivacaine, was injected transorally through the palatal defect to the posterior aspect of the middle turbinate.

In our study, cotton-tipped applicators soaked with 2% lignocaine were used transnasally for giving SPGB. The advantages of using this technique are that it is simple, atraumatic, needs less skill, and can be used in patients with incomplete palatal clefts where approach through palatal cleft could be difficult. Although we have looked for blood staining on the cotton applicator on removal as an evidence of trauma, we did not notice it in any patient.

Transnasal SPGB was initially introduced as a treatment modality for cluster headaches, migraine, and other trigeminal autonomic cephalalgias.[7-9] Later, it was found to be effective in the management of postdural puncture headaches also.[10-12] Perioperative use of SPGB is limited. Other than palatoplasty, it is also used during functional endoscopic sinus surgery (FESS). Concomitant use of bilateral SPGB with conventional general anesthesia in patients undergoing FESS provided stable hemodynamics with reduced intraoperative blood loss and minimized consumption of inhalational agent, early recovery, and prolonged postoperative analgesia.[13,14]

The significantly lower HR and MAP in Group B in our study could be secondary to the supplemental analgesia

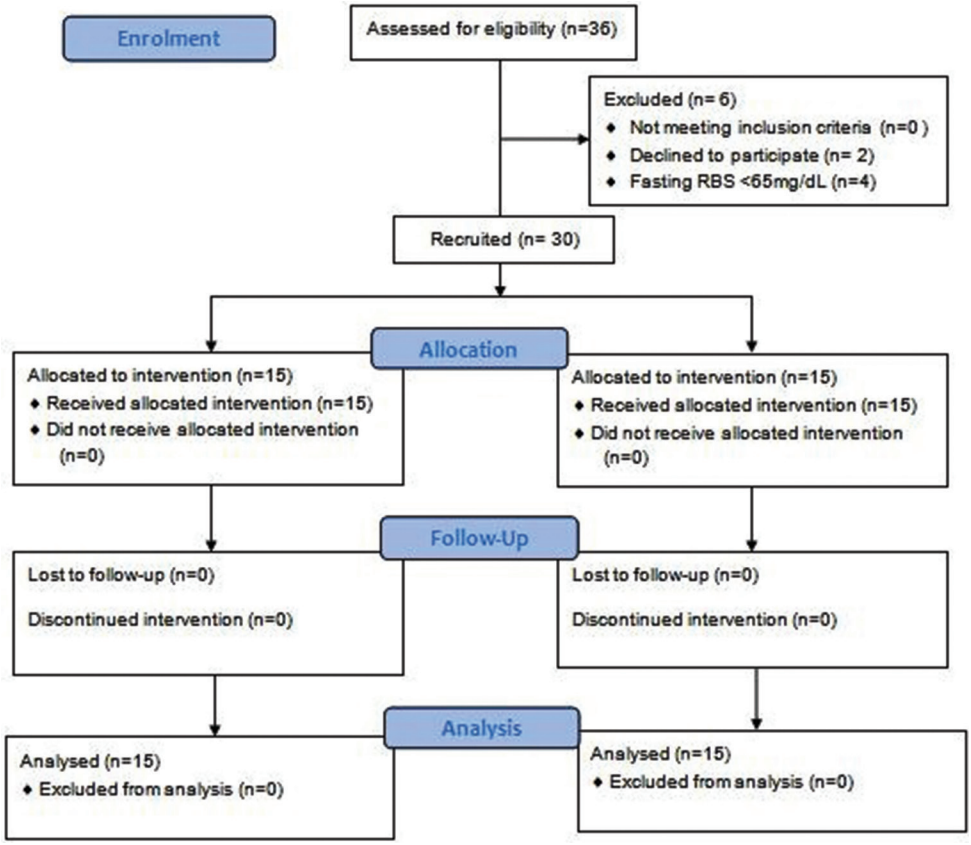

Figure 3: CONSORT (Consolidated Standards of Reporting Trials) flow chart

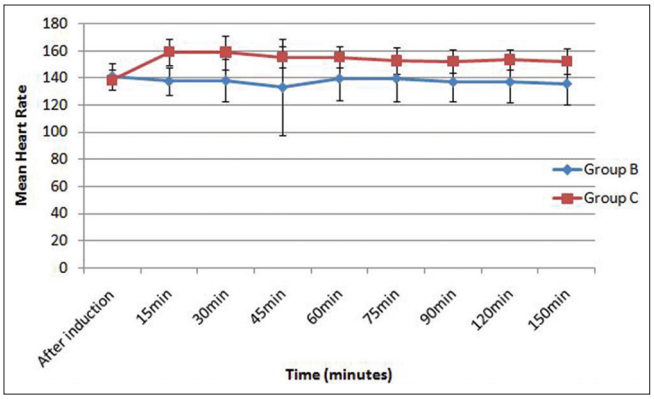

Figure 4: Changes in heart rate

provided by SPGB. Because of the same reason, intraoperative requirements of fentanyl and sevoflurane were also reduced resulting in quicker extubation. Significantly lesser PAED scores observed in Group B could also be attributed to SPGB. The blunted hyperglycemic responses observed in Group B could be due to attenuated stress responses to anesthesia and surgery following supplemental SPGB with reduced intraoperative catecholamine surge.

The strongpoint of our study is that no previous study had assessed the effectiveness of transmucosal SPGB on anesthetic requirements or recovery profile in children undergoing palatoplasty. The limitation of our study was that we did not have any criteria to confirm that the block has been effectively achieved.However, as there were no outliers in our study, it could be assumed that effective blocks were achieved in all patients in Group B.

Although it was observed that most children in Group B had no to mild pain in the immediate postoperative period and Group C had moderate to severe pain, assessment of postoperative pain was not part of the study, which was a major drawback.This was partly because it was assumed that as long-acting local anesthetics such as bupivacaine or ropivacaine were not used, the action of SPGB with lignocaine might be over by the end of surgery, which lasted for 2.5 to 3 hours. Moreover, all patients in our study received paracetamol towards the end of surgery as one group of patients had not received SPGB with local anesthetic. We should have assessed the severity of postoperative pain and the duration of analgesia provided by the block as reflected by time to receive first analgesic in the postoperative period.

Lignocaine was chosen as the study drug for giving SPGB as it already was being regularly used in our institute for managing postdural puncture headaches in parturients. The use of lignocaine, a short-acting local anesthetic, rather than

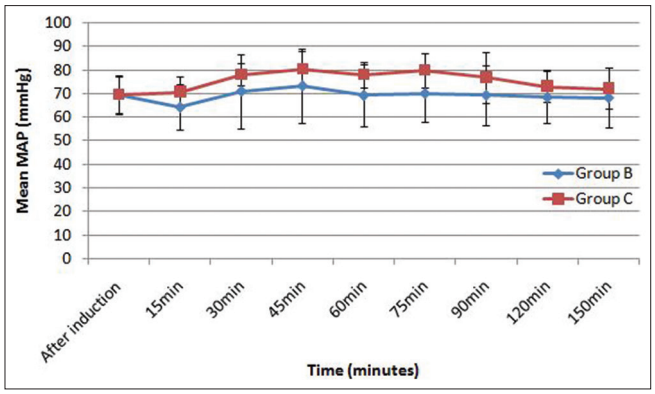

Figure 5: Changes in mean arterial pressure

bupivacaine or ropivacaine, was another shortcoming of the present study. Yet another drawback was that estimation of blood glucose alone as a measure of the stress response could be unreliable. PAED score assessed at 5 and 10 minutes could have been affected by the pain control rather than emergence delirium itself, and the score assessed at 20 to 30 minutes also would have been more informative regarding the recovery profile.

Future studies using longer acting local anesthetic agents such as bupivacaine or ropivacaine and the use of additives along with the assessment of postoperative pain may provide more information to the usefulness of this block during palate surgeries.

Based on our observations, we recommend this simple and effective technique of SPGB by transmucosal application of local anesthetic be made a regular practice during pediatric palatoplasty. In patients with an associated or previously corrected cleft lip, the correct placement of the applicator could be difficult due to the anatomical defects of the nose. In such cases, fiber-optic bronchoscopic assessment through the palatal defect or even direct visualization after placement of the mouth gag in those with complete cleft palate could be helpful in confirming accurate positioning of the applicator tip.

Conclusion

Preoperative bilateral SPGB administered by mucosal application of local anesthetic significantly reduces sevoflurane and fentanyl requirement in children undergoing palatoplasty as compared with those who did not receive the block. Preemptive SPGB provides more stable intraoperative hemodynamics and glycemic levels with quicker recovery and reduced emergence delirium.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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