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Role of sphenopalatine ganglion block for postoperative analgesia after functional endoscopic sinus surgery

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Abstract The aim of this study was to evaluate the analgesic efficacy of sphenopalatine ganglion block performed under general anesthesia in patients undergoing functional endoscopic sinus surgery (FESS) with operative blood loss and postoperative complications (headache, visual disturbances, nausea, vomiting, sore throat, swallow difficulty). Forty-five consenting patients were randomized to receive bilateral sphenopalatine ganglion block with saline (Group S, $n = 15$), bupivacaine 0.5% (Group B, $n = 15$), or levobupivacaine 0.5% (Group L, $n = 15$) immediately following induction of general anesthesia. Esmolol was given during the intraoperative period for a 20% increase in arterial mean pressure or heart rate. Postoperative pain scores were checked on arrival at the postanesthesia care unit, 2, 6, and 24 h after surgery and diclofenac was administered intramuscularly for pain score $\geq$4. A statistically significant reduction was present in postoperative Visual Analog Scale scores between Group S and the block Groups B and L ($p < 0.05$). In Group L and B, fewer patients required additional analgesics in the postoperative 24 h ($p < 0.0001$). The comparison of postoperative complications was not statistically significant among the groups ($p > 0.05$). Sphenopalatine ganglion block with bupivacaine or levobupivacaine improved postoperative analgesia associated with better surgeon and patient satisfaction after FESS.

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Introduction

Functional endoscopic sinus surgery (FESS) is a minimally invasive, comfortable and safe technique to restore the drainage and aeration of the paranasal sinuses with preservation of the normal anatomical structures and function [1]. However, it is associated with complications such as bleeding and postoperative pain [2]. It is stated frequently that the combination of a peripheral nerve block with general anesthesia (GA) may be effective to limit these drawbacks [3].

Racemic bupivacaine is the most frequently used long acting local anesthetic. However, side-effects related to high doses limited its usefulness. Levobupivacaine is the S(−) enantiomer of bupivacaine and clinical studies have demonstrated that both agents are equally effective [4].

We designed this study to find out the efficacy of addition of sphenopalatine ganglion (SPG) block performed by bupivacaine or levobupivacaine to a standardized general anesthetic as regard to operative conditions, postoperative pain, analgesic need and incidence of postoperative complications following FESS.

Materials and methods

With institutional ethics committee approval and patients' written consent, 45 American Society of Anesthesiologists (ASA) physical status I–II patients, aged 18–65 years, undergoing FESS participated in this study. Patients having a history of severe renal, hepatic, respiratory, cardiac

disease or a neurological condition, drug or alcohol abuse, chronic pain requiring major analgesics, sedatives, or corticosteroids and known hypersensitivity to other drugs used in the study were excluded.

Preoperatively patients were instructed for the use of Visual Analog Scale (VAS) for pain (0 = no pain, 10 = most severe pain). No premedication was given. After standard monitorization, baseline (t1) heart rate (HR), non-invasive blood pressure, peripheral oxygen saturation (SpO_2), and respiratory rate (RR) values were recorded. General anesthesia was intravenously induced with 5–7 mg kg^{-1} thiopental and 2 μg kg^{-1} fentanyl, and the trachea was intubated with an endotracheal tube under muscle relaxation with 0.6 mg kg^{-1} rocuronium. Anesthesia was maintained with sevoflurane (1–2%) in 60% nitrous oxide with oxygen. The double-blind design was achieved using a sealed envelope for each patient from a list of random numbers, so that 45 patients matching the working criteria were assigned to one of the three groups; to receive 2 ml of bupivacaine 0.5% (Group B, $n = 15$), levobupivacaine 0.5% (Group L, $n = 15$) or saline (Group S, $n = 15$) injected into the nasal mucosa between the middle and inferior turbinates. The study solutions were prepared by a nurse not involved in the injection of the local anesthetics or follow-up of the study. The injections were performed by the ENT surgeon blinded to the solutions used. The hemodynamic control was maintained by adjusting sevoflurane concentrations. Esmolol was used if blood pressure and heart rate were not effectively controlled by sevoflurane. Hypotension (a 20% decrease in relation to the baseline value), bradycardia (HR < 45 beats/min) and hypoxemia ($SpO_2 < 90\%$) were recorded. At the end of surgery, all patients were extubated and transferred to the postanesthesia care unit (PACU). The hemodynamic differences among groups, amount of operative bleeding, and the frequency of esmolol use, postoperative complications such as nausea and vomiting (PONV), headache, visual disturbances, sore throat and swallowing difficulty during the first 24 h were recorded. Postoperative pain scores (using a 10 cm VAS) were evaluated on arrival at the PACU (t2), 2 (t3), 6 (t4), and 24 (t5) hours after surgery. Postoperative analgesia was standardized. If VAS was ≥4, patients received 75 mg of diclofenac intramuscularly followed by incremental oral diclofenac (50 mg) if VAS remained unchanged after 30 min.

Statistical analysis

The sample size estimation was based according to the data taken from both pilot study and our clinical experience at the beginning of the study. The change in postoperative pain at PACU was the primary outcome variable on which sample size estimation was based at the beginning of the study. After exploration of the results of a previous study by Friedman [5] and our clinical experience, we decided to include a total of 45 patients.

Data analysis was performed using SPSS 11.5 software (SPSS Inc., Chicago, IL, United States). Kolmogorov–Smirnov test was used to test the normality of distribution for continuous variables. Data were expressed as number of patients, mean ± standard deviation (SD) (minimum–maximum), median (25–75%), where applicable.

For parametrical data, one way analysis of variance (ANOVA) was used and Bonferroni correction was applied when there was a significant difference. The repeated hemodynamic parameters were analyzed by Repeated Measures of Variance Analysis with Bonferroni Adjustment for multiple comparisons. Kruskal–Wallis test was used for the comparisons of non-parametric data among the groups, the Bonferroni adjusted Mann–Whitney *U* test was applied for the statistically significant differences among groups. The differences in the groups regarding for the differences according to the baseline (t1) were analyzed by Wilcoxon Signed-Rank test.

Type of surgery, postoperative nausea and vomiting and need for analgesics were analyzed by Chi-square or Fischer's exact tests. Statistical significance was set at a p value < 0.05 for all analysis and $p < 0.033$ (0.1/3) for Bonferroni adjusted.

Results

All forty-five patients completed the study. The groups were similar with respect to age, weight, type and duration of surgery (Table 1). There were no significant differences between Group B and Group L in terms of HR during the postoperative follow-up ($p > 0.05$). However, HR values were significantly higher in Group S at t3, t4 and t5 measurement times in comparison to the other two groups ($p < 0.05$). There were significant reductions in Group B and Group L at t3, t4 and t5; and in Group S at t5 with respect to baseline values ($p < 0.05$) (Fig. 1). Mean arterial blood pressure (MAP) was comparable in the Group S and L. However, there was a significant difference between Group B and L at t3 and S at t4, t5 ($p < 0.05$) (Fig. 2). Blood loss was comparable in the three groups. All patients in Group S required supplemental esmolol to maintain the target MAP, while only two patients in Group L and none of the patients in Group B required it ($p < 0.001$) (Table 1).

At PACU admission, there was no statistically significant difference among the groups with respect to VAS. The pain intensity in both block groups was lower than in group

Table 1 The physical and surgical characteristics of the groups

	Group B ($n = 15$)	Group L ($n = 15$)	Group S ($n = 15$)	p
Age (years)	28.0 ± 6.7 (18–39)	28.4 ± 8.7 (19–52)	30.1 ± 9.7 (19–58)	NS
Weight (kg)	72.4 ± 14.6 (48–96)	70.1 ± 15.2 (49–100)	78.4 ± 11.2 (50–94)	NS
Height (cm)	162.1 ± 8.6	163.8 ± 8.1	161.1 ± 8.2	NS
Surgical procedures				NS
Functional endoscopic sinus surgery (n)	3	2	2	
Septoplasty (n)	11	11	13	
Functional endoscopic sinus surgery + septoplasty (n)	1	2	0	
Surgical duration (min)	100.3 ± 35.1 (45–160)	106.7 ± 35.6 (45–175)	88.3 ± 35.1 (30–135)	NS
Number of patients requiring esmolol (n)	0	2	15*	0.001
Blood loss (ml)	60.05 ± 4.61 (52–68)	64.05 ± 5.59 (55–75)	96.75 ± 8.39* (80–112)	0.001

Values are mean ± standard deviation or *n.* Bupivacaine (Group B); levobupivacaine (Group L); normal saline (Group S)

NS not significant

* $p < 0.05$: Group S in comparison to Group B and Group L

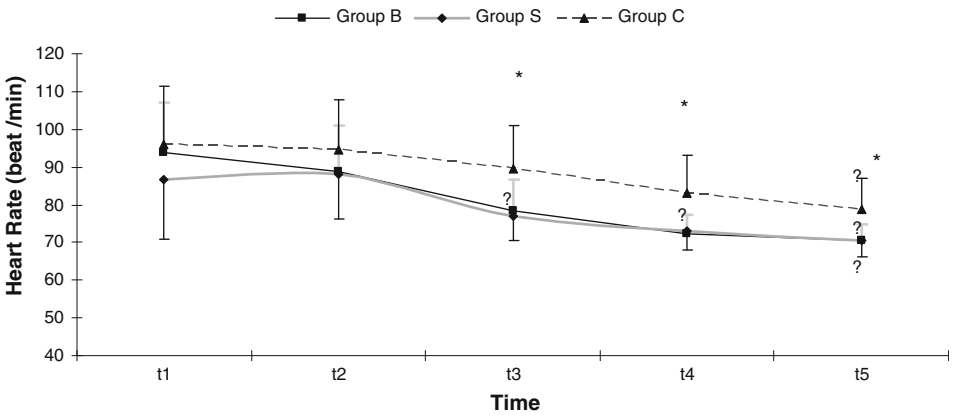

Fig. 1 Comparison of HR values of patients

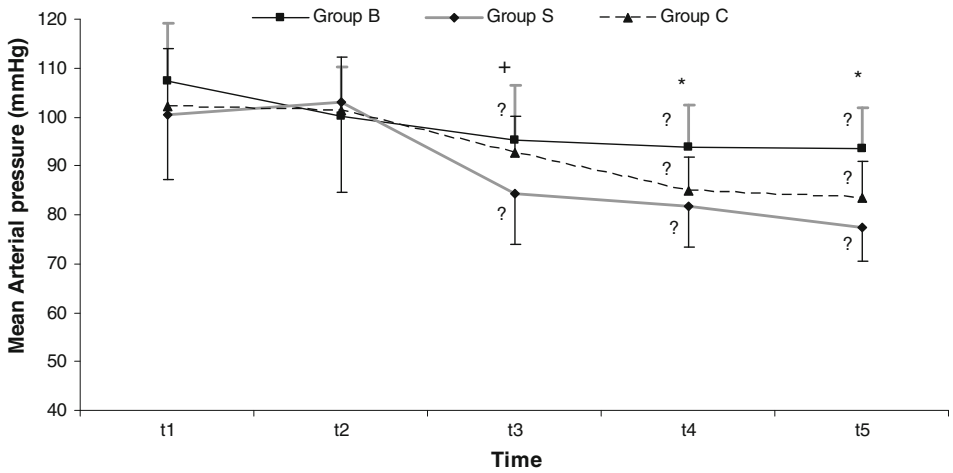

Fig. 2 Comparison of MAP values of patients

S over the four different time intervals ($p < 0.05$). In Group S, VAS was significantly higher in comparison to basal measurements at t2, t3 and t4 ($p < 0.0001$) (Table 2). None of the patients complained of sore throat. Besides, VAS at swallowing was significantly lower in Group B and L until 2 h ($p < 0.05$). In Group S, it was significantly higher in comparison to basal measurements at t2 and t3 ($p = 0.017$, $p = 0.018$, respectively). At the end of 24 h, the number of the patients requiring rescue analgesics was 3 (20%) in Group B and L, and 14 (93.3%) in Group S, respectively. In addition, 8 (53.3%) of the patients in Group S used incremental oral diclofenac tablets (Table 3). The

Table 2 Postoperative pain scores of patients

	Group B ($n = 15$)	Group L ($n = 15$)	Group S ($n = 15$)	p
t1	0.0 (0–0)	0.0 (0–0)	0.0 (0–0)	0.342
t2	0.0 (0–0)*	0.0 (0–0)*	4.0 (2–5)[?]	<0.0001
t3	0.0 (0–0)*	0.0 (0–0)*	3.0 (2–4)[?]	<0.0001
t4	0.0 (0–0)*	0.0 (0–0)*	2.0 (1–3)[?]	<0.0001
t5	0.0 (0–0)*	0.0 (0–0)*	0.0 (0–2)	0.001

Values are median (25–75%)

* $p < 0.05$: Group B and Group L in comparison to Group S

[?] $p < 0.05$: in comparison to t1 measurement time

Table 3 The distribution of patients requiring rescue analgesics and the total dose of analgesics consumed at the end of 24 h

	Group B ($n = 15$)	Group L ($n = 15$)	Group S ($n = 15$)	p
t1	0 (0)	0 (0)	1 (6.7)	0.326
t2	0 (0)	0 (0)	1 (6.7)	0.326
t3	3 (20)*	2 (13.3)*	13 (86.7)	<0.0001
t4	0 (0)*	1 (6.7)*	7 (46.7)	0.001
t5	0 (0)	0 (0)	0 (0)	–
At the end of 24 h	3 (20)*	3 (20)*	14 (93.3)	<0.0001
Total dose of analgesic consumed (mg)	75.00 ± 0.00* (75–75)	100.00 ± 43.30 (75–150)	176.79 ± 55.87 (75–225)	0.016

Values are mean ± standard deviation or n (%)

* $p < 0.05$: in comparison to Group S

three groups were similar with respect to the incidence of headache, visual disturbances and nausea and vomiting in the first 24 h, although the incidences were lower in block groups compared to Group S.

Discussion

In this study, we determined the association between the beneficial effects of bilateral sphenopalatine ganglion blocks combined with general anesthesia in improvement of postoperative analgesia quality following FESS. However, we failed to demonstrate a reduction in the postoperative complications when compared to GA alone.

Although, FESS is a commonly performed procedure, close proximity of the surgical area to major blood vessels, makes good hemostasis necessary to decrease complications associated with blood loss [4]. It is usually associated with moderate pain intensity which reaches its maximum level in the first few postoperative hours [5]. Non-steroidal anti-inflammatory drugs have been demonstrated to reduce the severity of a patient's pain in the first 24 h after FESS [6].

However, associated gastrointestinal and neurological adverse effects may augment patient's discomfort after the surgery.

Recently, the combination of general anesthesia with a regional nerve block is an area of growing interest in clinical practice to provide adequate postoperative analgesia, better control of complications and rapid recovery, and timely discharge [7, 8].

The effects of ganglion block with different local anesthetics during or after sinonasal surgery have been broadly investigated. In two of these studies, SPG block was demonstrated to exert a beneficial effect [5, 9]. In the only study in which bupivacaine was used for SPG block and compared with a short-acting local anesthetic, lidocaine; by Friedman, it was demonstrated that patients had less severe pain than expected after endoscopic sinus surgery. In that study, the addition of epinephrine to local anesthetics did not significantly affect postoperative pain scores and use of analgesics between the two groups [5]. In our study, we compared identical volumes and concentrations of levobupivacaine and bupivacaine to induce the block. From an evaluation of the overall results obtained in our study, we could not find any beneficial effect of one local anesthetic to another during the postoperative follow-up of VAS pain scores in the 24 h. Moreover, the patients did not differ with respect to complications such as sore throat and difficulty in swallowing. In another study, bupivacaine was administered for infraorbital nerve block in combination to general anesthesia for the endoscopic

endonasal maxillary sinus surgery [10]. Similarly, this combination was effective not only in reducing postoperative pain, but also volatile anesthetic consumption during the surgery.

For providing optimal operating conditions, FESS procedures are preferred to be performed by general anesthesia with local anesthetic solution infiltration [11, 12]. The sphenopalatine ganglion has connections to the internal carotid plexus [1]. Thus, the transnasal local anesthetic infiltration may cause systemic absorption of the local anesthetics, and thereby analgesic effects [12]. Besides, the combined effect of local anesthetics and general anesthesia in inducing hypotension may minimize the risk of surgical complications and stabilize hemodynamics [2]. In our study, the decrease in HR in the block groups is obviously reported; however, MAP remained high in bupivacaine group after the operation. We could not correlate this effect with the benefits of nerve block or the local anesthetics used. Most of the data in this aspect are related to intraoperative follow-up. Thus, it is hard to comment on this point with regard to effects of local anesthetics on hemodynamics. On the other hand, patients in the bupivacaine group did not experience high VAS scores. Therefore, there is no clear explanation of this data.

Following these operations, the most dangerous problems awaiting anesthetists are the ones occurring at emergence and early in the postoperative period. Recently, Westreich et al. [13] reported 8% of all case reports of postoperative negative pressure pulmonary edema after FESS. In our study; we found no statistically significant differences with regard to the respiratory parameters, or side-effects among the groups.

In conclusion, our findings do not encourage a beneficial effect of either of the two local anesthetics over another in sphenopalatine ganglion block; however, this procedure, in combination with general anesthesia is preferred in alleviating postoperative pain during FESS in comparison to saline.

Conflict of interest The authors declare that they have no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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