Original Article

Evaluation of ultrasound-guided suprazygomatic maxillary nerve block in functional endoscopic sinus surgery for postoperative pain relief: A randomised controlled trial

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ABSTRACT

Background and Aims: Postoperative pain can impede functional recovery and delay hospital discharge after functional endoscopic sinus surgery (FESS). The study aimed to assess the efficacy of ultrasound (USG)-guided suprazygomatic maxillary nerve block (SZMNB) for postoperative pain in FESS. **Methods:** Forty-eight adult patients between 18 and 65 years of age with American Society of Anesthesiologists physical status I and II and scheduled to undergo FESS were enroled in this randomised controlled study. Patients were randomly allocated to either receive USG-guided SZMNB with general anaesthesia (n = 24) or general anaesthesia alone (n = 24). The numerical rating scale (NRS) pain score in the immediate postoperative period was recorded as the primary outcome. A total of 24 h postoperative rescue analgesic consumption, surgeon satisfaction score, postoperative haemodynamics, and postoperative complications were noted as secondary outcomes. **Results:** The median (interquartile range) of the NRS pain score in the immediate postoperative period was 0 (0-0.25)[95% confidence interval (CI): 0, 0.08] in the block group compared to 2 (1.75-3) [95% CI: 1.60, 2.40] in the control group, $P < 0.001$]. Pain scores were significantly reduced at all time intervals till 24 h after surgery ($P < 0.001$). None of the patients required rescue analgesia in the block group. In contrast, eight patients required diclofenac 75 mg intravenous as rescue analgesia within 1 h of surgery and ten patients within 1–6 h of surgery in the control group. Other secondary outcomes were comparable between groups ($P > 0.05$). **Conclusion:** The USG-guided SZMNB provides excellent postoperative analgesia for patients undergoing FESS without significant side effects.

Keywords: Functional endoscopic sinus surgery, nerve blocks, numerical rating scale, postoperative pain, regional nerve block, suprazygomatic maxillary nerve block, ultrasound

INTRODUCTION

Functional endoscopic sinus surgery (FESS) is currently the standard surgical method for treating sinonasal pathologies. Although associated with mild to moderate pain, it can impede functional recovery after surgery.[1] Non-steroidal anti-inflammatory drugs (NSAIDs) have been frequently used to reduce the severity of patient's pain in the first 24 h after FESS. Still, their use is associated with gastrointestinal and neurological adverse effects, which augment the patient's discomfort, resulting in delayed recovery, delayed hospital discharge, and re-admission after surgery.[2]

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Regional nerve blocks are a growing area of interest in clinical practice to provide adequate postoperative pain, better control of complications, rapid recovery, and timely discharge after surgeries.[3,4] The leading cause of postoperative pain and discomfort after FESS is the resection of the facial bones around the nasal cavity. The maxillary nerve is the principal nerve supplying the nasal septum, the lateral nasal wall, and the maxillary sinus. The blockade of sensory nerve fibres of the maxillary nerve in pterygopalatine fossa (PPF) can relieve postoperative pain in FESS.

Ultrasonography (USG) has significantly improved the safety and accuracy of regional blocks because of real-time visualisation of the anatomical field of interest and surrounding structures. In a retrospective cohort, Smith *et al*.[5] evaluated the safety of a suprazygomatic approach to maxillary nerve block (SZMNB) in a heterogeneous cohort of patients, of which 62% were for FESS surgery. Even though this block has been used in many patients undergoing FESS, it has not been evaluated in these surgeries.

We hypothesised that supplementing general anaesthesia (GA) with the USG-guided SZMNB technique would improve postoperative pain relief after FESS compared to GA alone. The study aimed to assess the analgesic efficacy of the USG guided SZMNB technique on postoperative pain in FESS. The primary objective was to compare the postoperative pain scores using a numerical rating scale (NRS) in patients after FESS with or without USG-guided SZMNB in the immediate postoperative period.

METHODS

The randomised controlled trial was conducted in the tertiary care centre from July 2022 to June 2023 after ethics approval by the Institute's Ethics Board (vide approval number IEC-INT/2022/MD-189, dated 16 March 2022). The study was prospectively registered in the Clinical Trials Registry-India (vide registration number CTRI/2022/06/043434, accessible at www.ctri.nic.in/) and complied with the Declaration of Helsinki's principles, 2013 and the Good Clinical Practice. Written informed consent was obtained from all participants regarding participation in the study and using data for educational and research purposes.

Forty-eight adult patients between 18 and 65 years of age with American Society of Anesthesiologists (ASA) physical status I and II scheduled to undergo FESS were enroled. Patients with known allergies to local anaesthetics, bleeding disorders, infection at the puncture site, neuropathy, chronic renal disease, and those who refused consent were excluded from the study.

All the patients were evaluated a day before, for assessing their fitness for the proposed surgical procedure under GA. Patients were explained about the NRS for pain on a scale of 0–10, where 0 stands for no pain and 10 stands for worst imaginable pain. All patients were fasted overnight, and oral alprazolam 0.25 mg and oral ranitidine 150 mg were given as premedication.

Patients were randomised to either the USG-guided SZMNB group (Group B) or the control group, without USG-guided SZMNB (Group C) using computer-generated random numbers (www.randomization.com). Group B received general anaesthesia with USG-guided SZMN block, while Group C received GA alone. Allocation to the study group was done using consecutively labelled opaque sealed envelopes by investigators not involved in the patient care. The patients and assessors were blinded to group allocation. The block was given after the induction of anaesthesia, and the anaesthesiologist measuring the pain scores and other outcome parameters in the postoperative period was blinded to the group allocation.

In the operation theatre (OT), all patients were monitored for 5 lead electrocardiography (ECG), non-invasive blood pressure (NIBP), oxygen saturation (SpO_2), and oropharyngeal temperature. A standard GA technique was used during surgery in both groups. Intraoperative analgesia was provided with intravenous (IV) fentanyl 2 μg/kg, followed by induction of anaesthesia with IV propofol 2–3 mg/kg till loss of verbal response. IV atracurium 0.5 mg/kg was administered to facilitate tracheal intubation.

USG-guided SZMNB was performed after induction of anaesthesia before the commencement of the surgical procedure using a 22-gauge spinal needle. The patient was laid in supine position with the head turned so that the side to be blocked faced upward. A curvilinear USG probe was positioned inferior to the zygomatic arch and angled approximately 45° cephalad to image the PPF between the maxilla anteriorly and the ramus of the mandible and pterygoid process of the sphenoid bone posteriorly. The puncture was estimated at the

angle formed by the superior edge of the zygomatic arch below and the posterior orbital rim forward. After disinfection, the needle was inserted and directed at approximately 45° caudad, 100° anterior, and advanced at approximately 50 mm. The lateral pterygoid plate was identified. The needle tip was visualised near the anterior end of the lateral pterygoid plate. After a negative aspiration test for blood, 5 ml of 0.2% ropivacaine was slowly injected on the side to be operated. The correct position of the needle tip was confirmed by the spreading of the local anaesthetic in the PPF.

Anaesthesia was maintained with 60% nitrous oxide in oxygen and isoflurane mixture to achieve a minimum alveolar concentration (MAC) of 1–1.2. Patients' lungs were ventilated with positive pressure ventilation to maintain end-tidal carbon dioxide ($EtCO_2$) between 32 and 36 mmHg. Intraoperatively, if the mean arterial pressure (MAP) increased by 20% or more of baseline for two consecutive readings, IV fentanyl 0.5 μg/kg boluses were given. Hypotension (MAP <20% of baseline) was treated with normal saline boluses and IV mephentermine 3–6 mg bolus, if required. Bradycardia (HR <40 bpm) was treated with IV atropine 0.6 mg.

Before completion of the surgery, IV paracetamol 1 g infusion and IV ondansetron 4 mg were given to all participants. At the end of the surgery, IV neostigmine 50 μg/kg and glycopyrrolate 10 μg/kg were used to reverse residual neuromuscular blockade, and the trachea was extubated when the patient became awake, followed the verbal command, and breathed adequately. The patients were shifted to the recovery room for further management. The total duration of the surgery was noted.

In the recovery room, IV diclofenac 75 mg was administered as rescue analgesia to patients with NRS scores more than 3 or on the patient's demand. If no improvement was seen during pain assessment 30 minutes later, IV tramadol 50 mg was given up to the first 6 h of surgery. Total doses of rescue analgesics were noted. Paracetamol 500 mg orally was charted three times a day. Diclofenac 75 mg orally was prescribed as a rescue analgesic from postoperative 6 to 24 h.

NRS for static pain in the immediate postoperative period was recorded as the primary outcome. Total 24 postoperative rescue analgesic consumption, the time required to perform the block, surgeon satisfaction score, postoperative haemodynamics, and postoperative complications, including nasal bleeding, headache, nausea, vomiting, cheek oedema or swelling, were noted as secondary outcomes.

Pain using NRS was noted upon the transfer to the postoperative care unit (PACU) when the patient could communicate at 30 min, 1 h, 2 h, 4 h, 6 h, 8 h, 12 h, and 24 h. The cumulative dose of rescue analgesia was noted. Postoperative haemodynamic parameters were noted every 15 min. The time taken from the start of USG imaging to visualise the landmarks until the time of drug deposition was considered as the time to perform the block and was recorded. Confirmation of anaesthetic spread was noted. Visualisation of the maxillary artery was noted. The surgeon satisfaction score was based on a Likert 5-point scale from 1 to 5 (very bad, bad, average, good, and excellent). Any complications related to block and postoperative complications, including nasal bleeding, headache, nausea, vomiting, cheek oedema, or swelling, were recorded.

Sample size calculation was based on the previous study by Bhattacharyya *et al*.,[6] where the block was performed via the intra-oral greater palatine approach after FESS, and the mean postoperative pain score was 4.0 with a standard deviation (SD) of 1.26 in the control group. Assuming a 25% reduction in the mean pain scores in the immediate postoperative period as a clinically significant reduction after SMZNB in FESS, we required 22 patients in each group at 95% confidence interval (CI) and 80% power. Therefore, considering the 10% dropout rate, we enroled 24 patients in each group.

Statistical analysis was conducted using Statistical Package for the Social Sciences statistics software version 21.0 (IBM Corp, Armonk, NY, USA). Continuous variables like age, body mass index (BMI), NRS scores, duration of surgery, and fentanyl consumption were presented as either mean (SD) or median and interquartile range (IQR). Categorical variables like gender and ASA physical status were expressed as frequencies or percentages. The *t*-test was used to compare normally distributed data, while the $\chi 2$ test was employed for inter-group differences in non-parametric data. Pain scores and total 24-hour analgesic consumption were compared using the Mann–Whitney U-test for pairwise comparisons. $P < 0.05$ was considered statistically significant.

RESULTS

The flow of patients in the study is depicted in the Consolidated Standards of Reporting Trials (CONSORT) flowchart [Figure 1]. The demographic variables were comparable in the two groups [Table 1]. There was a significant difference in the duration of anaesthesia between Group B with a mean of 139.6 (SD: 29.9) (95% CI: 127.6, 151.6) min and Group C with a mean of 116.7 (SD: 27.4) [95% CI: 105.7, 127.7] min ($P = 0.011$), though the mean duration of the surgery was comparable [96.5 (SD: 27.0) (95% CI: 85.7, 107.3) versus 88.8 (SD: 28.4) (95% CI: 77.4,100.2); $P = 0.305$] in Group B and C respectively.

The median NRS score in the immediate postoperative period was significantly less in Group B compared to Group C [0 (IQR: 0-0.25) (95% CI: 0, 0.08) versus 2 (IQR: 1.75-3) (95% CI: 1.60, 2.40), $P < 0.001$]. There was a significant reduction in the pain scores at all time intervals of 30 min, 1 h, 2 h, 4 h, 6 h, 8 h, 12 h, and 24 h in the postoperative period in the block group compared to the control group ($P < 0.001$) [Figure 2]. There was no difference in intraoperative fentanyl requirement between the groups, with mean difference of 5.2 (95% CI:-10.50, 20.90), $P = 0.700$. Patients in Group B did not require any rescue analgesia. Eight patients were given diclofenac IV as rescue analgesia within 1 h of surgery, and ten patients within 1–6 hours of surgery in Group C.

Bilateral blocks accounted for 16 cases, while unilateral blocks accounted for 8 cases. The mean time taken to perform each block was 485 (SD: 26.0) (95% CI: 476.8, 493.2) seconds. Drug spread was visually confirmed in 37 out of 40 of the blocks, while

Table 1: Demographic variables

	Group B (*n*=24)	Group C (*n*=24)
Age (years)	38.7 (13.2)	38.4 (14.2)
Gender: male/female	18/6	13/11
Height (cm)	169.5 (7.0)	166.9 (7.0)
Weight (kg)	67.4 (11.6)	64.0 (10.3)
BMI (Kg/m²)	23.3 (3.0)	22.9 (3.2)
ASA: I/II	22/2	17/7
Comorbidity		
None	21	17
Hypertension	2	5
Hypothyroidism	0	2
Asthma	1	0
Diagnosis		
Nasal polyposis	13	10
Chronic rhinosinusitis	10	6
AFRS	1	7
Papilloma	0	1
Surgery		
Bilateral FESS	17	14
Bilateral revision FESS	0	1
Right FESS	6	6
Left FESS	1	1
Right revision FESS	0	2

Data expressed as mean (standard deviation) or numbers. AFRS=Allergic fungal rhinosinusitis, ASA=American Society of Anesthesiologists, BMI=Body mass index, FESS=Functional endoscopic sinus surgery, *n*=number of patients

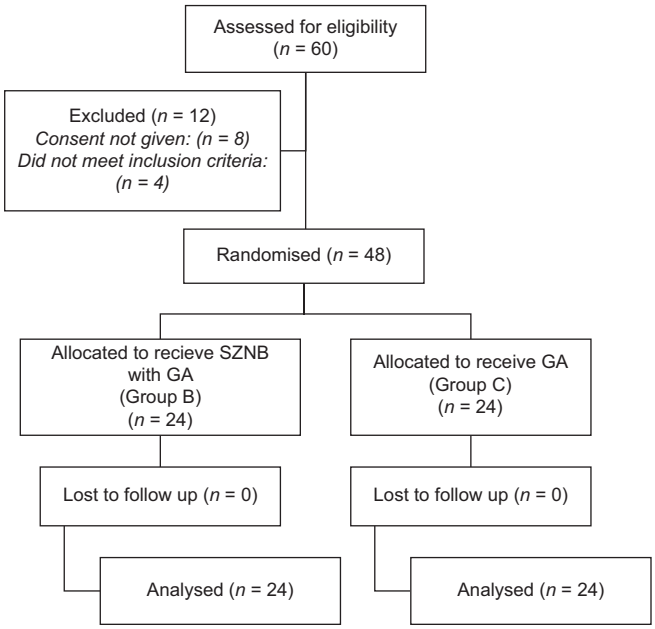

Figure 1: *Consolidated Standards of Reporting Trials* (CONSORT) flowchart. GA = general anaesthesia, SZNB = suprazygomatic approach to maxillary nerve block

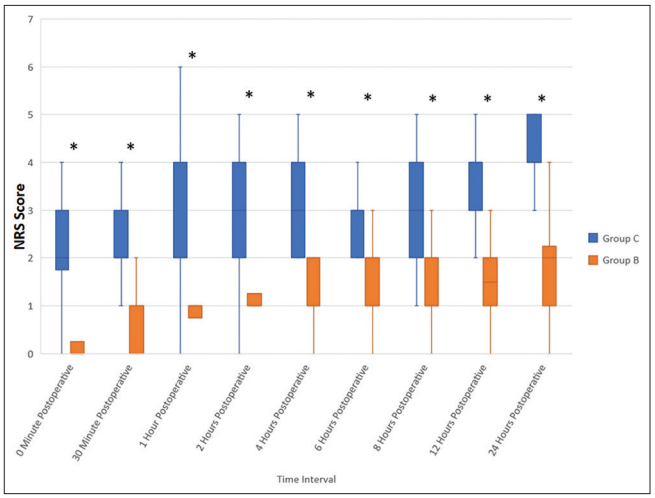

Figure 2: Comparison of postoperative numerical rating scale (NRS) pain score between the groups ($P < 0.001$ *at all time points of the study period)*

the maxillary artery was successfully visualised in USG imaging in 35 out of 40. The postoperative heart rate was significantly lower in Group B compared to Group C till 2 hours postoperatively ($P < 0.05$) [Figure 3]. At the same time, no significant difference was seen in the MAP between the two groups ($P = 0.52$) [Figure 4]. There was no statistical significance in the median surgeon satisfaction score [4 (IQR: 3-4) (95% CI: 3.69, 4.31) versus 3 (IQR: 3-4) (95% CI: 2.73,3.27), $P = 0.090$] in Groups B and C, respectively. One patient complained of mild numbness around the cheek bone, and blood was aspirated in one patient in Group B, while one patient complained of nausea and vomiting in Group C.

DISCUSSION

The results of our study demonstrated a significant reduction in postoperative pain with SZMNB not only in the immediate postoperative period but also at all time points over 24 h after FESS. The efficacy of the block may be attributed to the inhibition of nociceptive impulses transmitted through the sensory branches of the maxillary nerve and its effectivity in preventing both peripheral and central sensitisation, leading to the reduction of postoperative pain.

Pterygopalatine blocks targeting the maxillary nerve and sphenopalatine ganglion (SPG) have been extensively used as a multimodal analgesic regime for postoperative pain relief in FESS and other faciomaxillary surgery using transnasal, intraoral, and external techniques.[7-9] However, the literature on using SZMNB in FESS under USG guidance is replete.

Previous studies using intraoral or intranasal routes for giving SPG block in PPF have reported rescue analgesics in almost 20–25% of patients.[9,10] The use of an USG-guided technique for injecting the drug in the PPF in our study ensured a much more reliable block of the maxillary nerve, providing excellent analgesia for the FESS surgery postoperatively. The spread of anaesthetic was observed in 94% of cases, indicating the effectiveness of the block.

Our study used a guided suprazygomatic approach to block the maxillary nerve. This approach makes use of the surrounding bony anatomical landmarks of PPF to provide a direct pathway for the needle to navigate through the pterygomaxillary fissure to the fossa, thereby minimising the risk of inadvertently introducing the needle into unintended locations, ensuring a higher level of safety.[5] In contrast, infra-zygomatic approach directs the needle towards the infra-orbital fissure, risking the needle entry into the orbit, and is associated with a higher rate of complications like haematoma formation and swelling over the cheek.[11,12] In our study, no serious side effects were seen in the patients who were given SZMN block. The results are in alignment with Smith *et al*.,[5] who failed to observe any adverse events in 429 patients receiving SZMNB.

The results of our study should be interpreted in the light of some limitations. First, the study had a relatively small sample size. Secondly, the patients were observed for 24 hours only. Pack removal after surgery is one of the most painful events in the postoperative period, and this time point was not taken into account. Thirdly, we did not consider the objective measurements of the severity of the disease. Additionally, the study did not consider the extent of FESS surgery, such as simple polypectomy, antral washout, or various sinus surgeries. This factor could

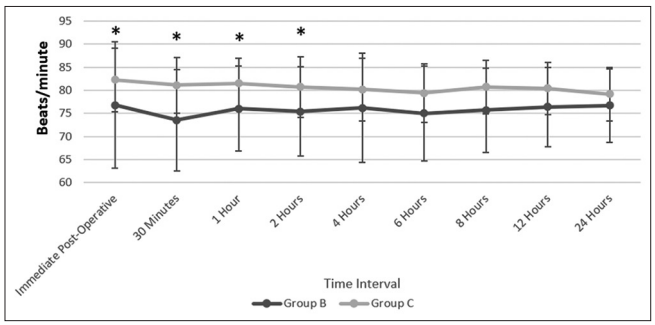

Figure 3: Comparison of postoperative heart rate between the groups. *(*P < 0.05 at immediate, 30 mins, 60 mins, 120 minutes postoperatively)*

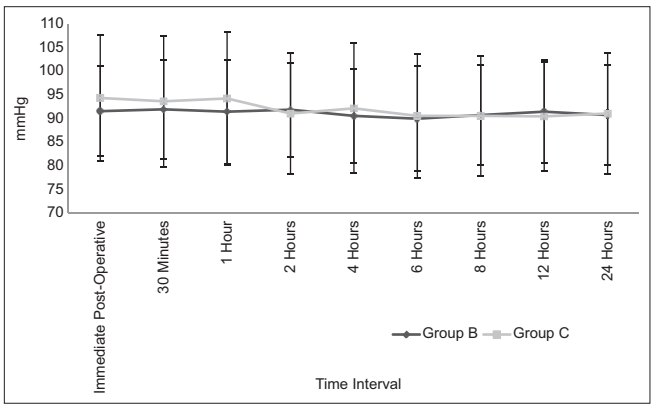

Figure 4: Comparison of postoperative mean blood pressure between the groups. ($P > 0.05$ *at all time points of the study period)*

potentially impact the primary outcome of pain intensity. Lastly, different surgeons performed the surgeries, introducing the possibility of bias. Further studies are needed to strengthen the validity and generalisability of the study findings.

CONCLUSION

The study demonstrates that the ultrasonography-guided suprazygomatic approach to maxillary nerve block provides excellent postoperative analgesia for patients undergoing functional endoscopic sinus surgery without significant side effects.

Study data availability

We declare that de-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared after approval as per the authors' Institution policy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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