Original Article

Efficacy of ultrasound-guided suprazygomatic maxillary nerve block on emergence agitation and postoperative analgesia after septorhinoplasty: A prospective randomized trial

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Abstract

Background and Aims: Emergence agitation (EA) is frequently encountered following nasal surgeries, and postoperative pain is a significant contributing element. We aimed to assess the role of suprazygomatic maxillary nerve (MN) block (SMB) guided by ultrasound (US) in lowering EA incidence and enhancing analgesia quality in septorhinoplasty cases.

Material and Methods: Sixty cases aged 18–60 years, of both genders, categorized by the American Society of Anesthesiologists (ASA) I–II and listed for septorhinoplasty, were randomized to receive general anesthesia (GA) with either no block (the control group) or combined with bilateral US-guided SMB (the SMB group). The incidence of EA, postoperative pain scores, total rescue 24-hour analgesic consumption, and incidence of adverse events were all noted.

Results: EA incidence was significantly reduced in the SMB group than in the control group (five patients (16.7%) vs 14 patients (46.6%), respectively; $P = 0.026$). Pain scores at 30 minutes and 1, 2, 4, and 6 hours postoperative were significantly decreased in the SMB group ($P = 0.024$, 0.000, 0.000, 0.009, and 0.038, respectively), with significantly less morphine consumption at 24 hours postoperative in the SMB group compared with the control group ($P = 0.000$). No serious adverse events were noted.

Conclusions: Preemptive application of US-guided SMB was effective in lowering EA incidence. Furthermore, it enhanced the analgesic quality and reduced the requirement for rescue analgesics in patients undergoing septorhinoplasty.

Keywords: Adult, analgesia, delirium, emergence, interventional, pain, postoperative, ultrasonography

Introduction

Emergence agitation (EA) is "aggressive psychomotor symptoms appearing during emergence from general anesthesia (GA)," which can cause harm to the patient and the medical personnel.[1] It is frequently encountered following nasal surgeries, with postoperative pain believed to be one of the main elements contributing to this phenomenon.[2] Hence, adequate pain control can be considered a keystone in preventing EA in these types of surgical procedures.[3]

Application of a multimodal approach for analgesia with systemic agents and regional nerve block techniques has been advocated for managing pain in septorhinoplasty when

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Access this article online

Quick Response Code:

Website: https://journals.lww.com/joacp

DOI: 10.4103/joacp.joacp_256_23

How to cite this article: Afandy ME, Abd Elghafar MS, Shoukr TG, El Mourad MB. Efficacy of ultrasound-guided suprazygomatic maxillary nerve block on emergence agitation and postoperative analgesia after septorhinoplasty: A prospective randomized trial. J Anaesthesiol Clin Pharmacol 2024;40:679-85.

Submitted: 11-Jun-2023 **Revised:** 24-Aug-2023
Accepted: 18-Sep-2023 **Published:** 19-Jul-2024

feasible.[4] The preemptive analgesia produced by peripheral nerve blocks employed with GA has the advantage of providing a stable hemodynamic profile and good quality of recovery besides a reduction in both intra- and postoperative analgesic requirements.[5]

The maxillary nerve (MN) is an entirely sensory nerve that carries sensation from the posterior part of the nasal cavity, ala of the nose, soft and hard palate, upper dental arch, cheek, upper lip, maxillary sinus, and lower eyelid. Thus, blocking this nerve can provide analgesia for different procedures, including septoplasty and endoscopic sinus surgery.[6,7]

MN can be blocked by different routes, among which the suprazygomatic approach is considered the safest as it avoids inadvertent injury of the orbital structures. Moreover, its application comprises no difficulty due to the more superficial and easily identified bony landmarks.[8,9] Block safety is enhanced using ultrasound (US) guidance, which allows accurate visualization of the main anatomic structures along with proper verification of local anesthetic (LA) spread.[10]

In this trial, we tested the hypothesis that bilateral application of suprazygomatic MN block (SMB) guided by US could decrease EA incidence as a primary outcome and reduce postoperative pain scores and total analgesic requirements as secondary outcomes in adult patients undergoing septorhinoplasty.

Material and Methods

This double-blind randomized controlled trial involved 60 patients aged 18–60 years, of both genders, classified by the American Society of Anesthesiologists (ASA) as ASA I–II and assigned to undergo elective primary septorhinoplasty surgery under GA after an informed written consent was obtained. The patients' data were used for research and educational purposes only.

The study was conducted from July 2020 to November 2022 after approval by the Institutional Ethical Committee (The Ethical Committee of the Faculty of Medicine, Tanta University: 1/6/2020, NO 33836/6/20). The trial was registered in the Pan African Clinical Trial Registry (PACTR202008687031377).Patients having a body mass index (BMI) of >35 kg/m^2, neurologic disorders, significant cardiopulmonary, hepatic, or renal impairment, needle entry site infection, coagulopathy, and allergy to LA, and those who declined to participate were excluded. Subjects who used analgesics chronically or could not express their numeric rating scale (NRS) scores were also omitted.

Patients were allocated randomly into two parallel arms in a ratio of 1:1 to receive GA with either no block (the control group) or combined with bilateral US-guided SMB (the SMB group).

A computer software program generated the randomization sequence, which was then concealed in opaque envelopes. A blinded nurse who was not involved in the research or data collection read the number and made group assignments. An anesthesiologist performed the blocks with no further involvement in the study. Furthermore, the patient, surgeon, and anesthesiologist evaluating the outcome measures were all blinded to the allocated groups.

A preanesthetic visit was conducted for a history check, physical examination, and evaluation of laboratory tests. The patients received a thorough explanation of the SMB technique and any potential consequences. Additionally, they learned how to express pain using the NRS.

Upon arrival in the operating room, a 22-gauge peripheral intravenous (IV) line was secured. Patients were premedicated with 2 mg of IV midazolam, and 8 mg of IV dexamethasone was given as antiemetic prophylaxis. Standard monitoring was applied, including pulse oximetry, electrocardiogram (ECG), and automated noninvasive blood pressure. A standardized technique for the induction of GA was performed in both groups using 1 μg/kg fentanyl, 2 mg/kg propofol, and 0.5 mg/kg atracurium for intubation. Maintaining anesthesia was performed with isoflurane in a mixture of 50:50 air/O_2 titrated to maintain an entropy value between 40 and 60 and 0.1 mg/kg atracurium as needed. Ventilatory parameters were adjusted to maintain $EtCO_2$ at 35 to 40 mmHg.

After induction of anesthesia and before surgical incision, patients in the SMB group received bilateral SMB with the aid of US guidance. The block was performed under strict aseptic conditions while the patient rested supine, tilting the head to the opposite side. A linear US transducer (5–13 MHz, US Philips Machine CX50, USA) was positioned in the infrazygomatic region, over the maxilla along the lower border of the zygomatic arch to identify the pterygopalatine fossa, bounded by the sphenoid's greater wing posteriorly and the maxilla anteriorly. A 25-G needle, 50 mm in length (B. Braun Medical Inc., Bethlehem, PA), was introduced perpendicularly at the angle between the zygomatic arch's top edge and the posterior orbital rim, followed by advancing toward the sphenoid's greater wing in the out-of-plane technique. To access the pterygopalatine fossa, the needle was redirected at a depth of 35–45 mm. After a negative blood aspiration, 5 mL of 0.25% bupivacaine was injected under real-time US visualization of the LA injection in the pterygopalatine fossa [Figure 1].

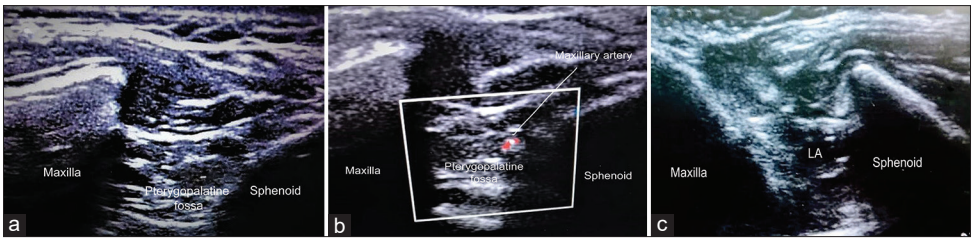

Figure 1: Ultrasound-guided suprazygomatic maxillary nerve block. (a) Sono-anatomical view of the suprazygomatic maxillary nerve block. (b) Doppler flow (red) identification of the maxillary artery. (c) Spread of local anesthetic in the pterygopalatine fossa. LA: local anesthetic

The same technique of injecting a similar LA solution volume was applied to the contralateral side. The pressure was applied to the injection site for one minute to avoid hematomas. In addition, the surgeons infiltrated 10 mL of a mixture of 2% lidocaine and 1:200000 adrenaline to reduce bleeding during surgery.

Hemodynamic parameters were observed continuously, including heart rate (HR) and mean arterial blood pressure (MAP). An elevation of MAP or HR ≥20% of baseline values was considered a sign of inadequate analgesia. In this case, 50 μg of fentanyl was administered, and the cumulative amount of intraoperative fentanyl given as rescue analgesia was documented. 0.5 mg of IV atropine was used to treat bradycardia (HR less than 50 beats/min). 6 mg increments of IV ephedrine were used to treat hypotension (MAP less than 60 mmHg).

At the end of the operation, awake extubation was performed following the reversal of neuromuscular blockade (using 0.04 mg/kg neostigmine and 0.02 mg/kg atropine). Then, the cases were referred to the postanesthesia care unit (PACU), where they received analgesia regularly in the form of IV 1 g/6 h paracetamol to be discharged to the ward when reaching a modified Aldrete's score of ≥9.

Our primary outcome variable was the incidence of EA (the period between stopping isoflurane (time zero) and two minutes following extubation).[11] Agitation level with emergence was assessed using the Sedation–Agitation Scale established by Riker *et al.*,[12] ranging from one to seven (1: minimal or no reaction to painful stimuli; 2: arousal to physical stimuli but noncommunicative; 3: difficult to arouse but awakens to verbal stimuli or gentle shaking; 4: exhibits a state of calmness and obeys orders; 5: displays physical agitation or anxiety but calm in response to verbal instructions; 6: necessitates restraint along with constant verbal reminders of limits; and 7: attempting to remove tracheal tube or catheters or striking staff), and scores of ≥5 indicated EA; we documented the highest score. At first, verbal commands were used to treat agitation, and then, IV 0.05 mg/kg midazolam was used in case of failure of verbal commands to calm down the patient. Assessment of pain was conducted by the NRS (0: no pain to 10: the worst pain) at the following intervals: on arrival to the PACU and then at 1, 2, 4, 6, 8, 12, and 24 hours postoperative. Patients received a bolus dose of 3 mg IV morphine if NRS was ≥4, and the onset of the first analgesic requirement and the total rescue morphine consumption for 24 hours postoperatively were recorded. Furthermore, the adverse events during the first 24 hours after surgery, including postoperative nausea and vomiting (PONV) and block-related complications (hematoma and LA toxicity (local anesthetic systemic toxicity (LAST)), were also recorded.

Statistical analysis

Our primary outcome variable was EA incidence, which was 62.5% according to the results of a previous study.[13] We assumed that SMB would reduce EA by 50% at 0.05 α error and 90% power; hence, a minimum of 25 subjects would be allocated in each group. We enrolled 30 cases per group to overcome possible dropouts.

The Minitab® 16 software (Minitab, Inc., LLC, State College, Pennsylvania) was used for statistical analysis. Data distribution was checked with the Kolmogorov–Smirnov test. Numerical data were compared using Student's independent *t*-test for normally distributed data and the Mann–Whitney U-test otherwise. Categorical data were described as numbers and percentages and analyzed utilizing Fisher's exact or Chi-square tests. At <0.05, the P value was considered significant.

Results

Seventy-one cases were initially assessed for eligibility; six declined to participate, and five cases were subsequently excluded (three cases were using chronic analgesics, and two had a BMI greater than 35 kg/m^2) [Figure 2].

The groups were well equivalent in age, gender, BMI, and duration of surgery [Table 1].

Compared to the control group, the SMB group had a significantly lower incidence of emerging delirium (46.6% vs 16.7%; $P = 0.026$) [Table 2].

There was a significant decrease in the intraoperative use of fentanyl, isoflurane, and the need for morphine for 24 hours after surgery ($P = 0.000$, 0.001, and 0.000, respectively) in the SMB group compared with the control group [Table 3].

At 30 minutes and 1, 2, 4, and 6 hours, patients in the control group demonstrated significantly higher pain scores ($P = 0.024$, 0.000, 0.000, 0.009, and 0.038, respectively), although pain scores at 8, 12, and 24 hours were comparable (0.716, 0.402, and 0.891, respectively) [Figure 3].

Four patients in the SMB group and twelve in the control group had PONV, whereas two in the SMB group showed hematoma development. There were no signs of LAST in the included patients.

Discussion

In the current study, using US-guided SMB in conjunction with GA significantly decreased the incidence of emergence delirium and the intraoperative use of fentanyl and isoflurane.

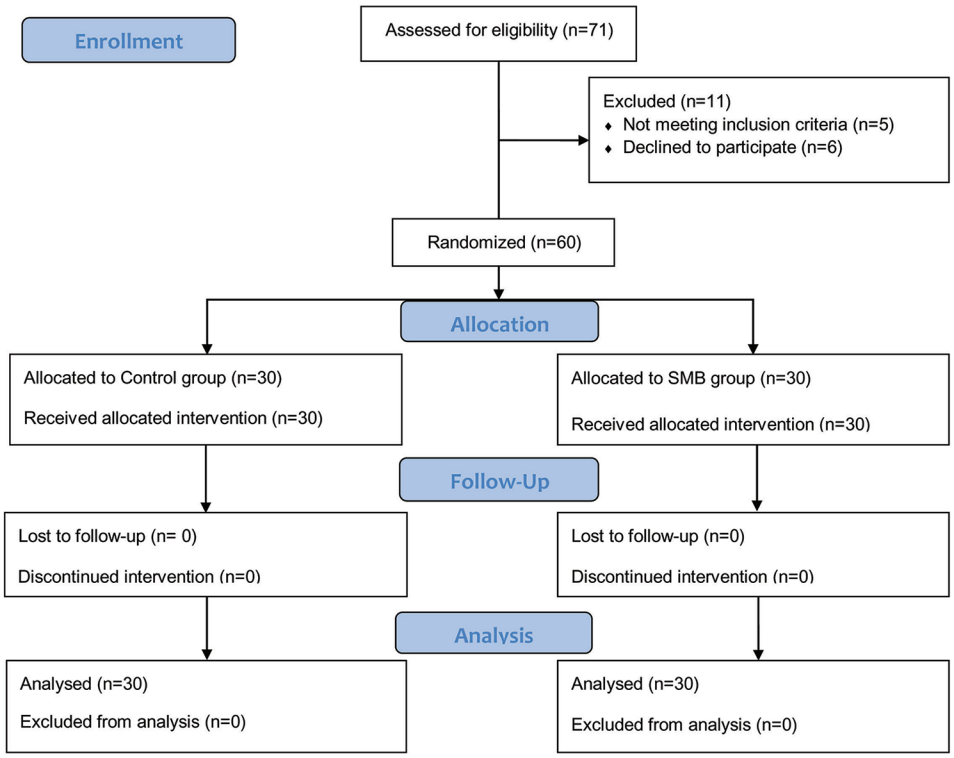

Figure 2: Consort flow chart of participants throughout the study

Table 1: Demographic characteristics

Variable	Control Group (*n*=30)	SMB Group (*n*=30)	*P*	95% CI
Age (years)	26.87±6.26	29.60±7.15	0.121	(-6.21; 0.74)
Gender M/F	17 (56.66%)/13 (43.33%)	20 (66.66%)/10 (33.33%)	0.595	
BMI (kg/m^2)	28.33±3.09	27.77±2.64	0.457	(-0.931; 2.042)
Duration of procedure (min)	114.8±15.3	122.4±16.6	0.068	(-15.92; 0.59)

Data presented as mean±SD or patient's number (%). SMB; suprazygomatic maxillary nerve block. BMI; body mass index. CI: confidence interval. P<0.05 is significant

Table 2: Incidence of emergence delirium and Riker Sedation–Agitation Scale

Variable	Control group (*n*=30)	SMB group (*n*=30)	*P*	95% CI
Incidence of emergence delirium	14 (46.6%)	5 (16.7%)	0.026*	
Riker Sedation–Agitation Scale	4 (4-6)	4 (3-4)	0.004*	(-0.000;2.000)

*Data are presented as patient's number (%) or median (interquartile range). *Denotes statistically significant difference between groups (P<0.05)*

Table 3: Anesthetic and analgesic consumption in the study groups

Variable	Control group (*n*=30)	SMB group (*n*=30)	*P*	95% CI
Intraoperative fentanyl (μg)	100 [100-150]	75 [50-100]	0.000*	(-0.00;50.00)
Intraoperative isoflurane consumption (ml)	24.90±4.99	20.83±3.70	0.001*	(1.79; 6.34)
Postoperative morphine (mg)	9 [6-9.75)	6 [3-6]	0.000*	(3.000;3.001)
Onset of first analgesic requirement (min)	30 [25-120]	265 [52.5-375]	0.000*	(-270.0;-85.0)

*Data presented as median (interquartile range) or mean±SD. SMB: suprazygomatic maxillary nerve block. CI: confidence interval. *Denotes statistically significant difference between groups (P<0.05)*

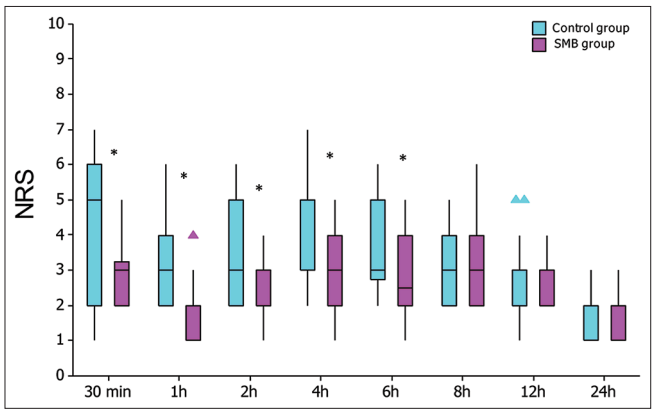

Figure 3: Postoperative Numerical rating scale (NRS). *Denotes statistically significant difference between groups ($P < 0.05$)

Additionally, the SMB group showed significantly lower pain scores 0–6 h after surgery, along with reduced 24 hours postoperative morphine requirements when compared to the control group.

EA commonly appears in the immediate recovery phase from GA and can lead to severe adverse sequelae, including injury, self-extubation, bleeding, hypoxia, and aspiration pneumonia, with a subsequent lengthy hospital stay.[11,14] The reported EA incidence in adults after GA was around 20%[3], whereas following nasal surgery, additional challenges are posed due to the experienced sense of suffocation brought on by the surgical packs obstructing the nasal airway, causing a further rise in the prevalence of EA to reach up to 55.4%,[2] which nearly approximates the incidence found in the control group in our study (46.6%).

Various pharmacological interventions have been demonstrated to be beneficial for preventing EA in adults, including dexmedetomidine, ketamine, and propofol[11,15,16]; however, they were linked to side effects such as hemodynamic abnormalities and persistent sedation.

We found that applying SMB has significantly reduced EA incidence to only 16.7% and reduced intraoperative consumption of opioids and inhalational anesthetics. Pain is a significant risk factor for EA occurrence along with young age, male sex, smoking, substance abuse, urinary catheter, inhalational anesthesia, and benzodiazepines intraoperatively.[14] Previous studies showed a positive correlation between EA and pain.[17,18]

Until now, only a small number of research studies have focused on investigating the efficacy of regional block techniques as a modality for pain relief in preventing EA after nasal procedures. The administration of combined infraorbital and infratrochlear nerve blocks has shown beneficial effects on reducing EA after septorhinoplasty.[13,19] Parthasarathy *et al.*[20] demonstrated that the regional blocks (of bilateral MN and nasociliary nerve) and GA effectively reduce EA in adults undergoing nasal surgery. Furthermore, Ibrahim *et al.*[17] demonstrated that blocking the external nasal nerve reduces EA and improves recovery quality in nasal surgeries.

The effects might be attributed to decreased anesthetic medication usage and improved discomfort caused by the profound analgesia and effective pain control. Regional anesthesia has the advantage of decreasing the intraoperative anesthetic requirements promoting rapid recovery and shortened hospital stay.[21] This agrees with our findings, where the isoflurane and fentanyl intraoperative consumption was decreased in patients receiving SMB in our research, which has been accompanied by a lower EA occurrence.

The surgical field in septorhinoplasty involves sensory innervation by the ophthalmic and maxillary divisions of the trigeminal nerve; the ophthalmic division innervates the posterior part of the septum and anterolateral nasal wall, while the maxillary division supplies the posterior nasal cavity and the mobile ala nasi.[9,22]

After septorhinoplasty, significant pain is encountered in the postoperative period and a pain score of >3 or >6 was reported in almost 45% and 30% of patients, respectively, peaking at the first 24 h postoperative.[23] One of ASA's clinical guideline recommendations is the multimodal analgesia interventions whenever appropriate.[24] Hence, we implemented administering IV paracetamol as regular analgesia to both groups and IV morphine was given as a rescue analgesic. Various facial block techniques were successfully implemented alone or in combination to provide analgesia following nasal surgeries.[17,20,21,23,25] They were

associated with reduced postoperative pain scores and the need for rescue analgesia medications.

In our study, bilateral SMB is an efficient alternative for early postoperative pain management after septorhinoplasty as the blocks cover a large nose area.[26] It delivers an efficient block to the entire sensory region of the mandibular nerve,[27] accompanied by a significant decrease in the cumulative 24-h rescue analgesic requirements.

In the current study, PONV was observed in four cases and 12 cases in the SMB and control groups, respectively. The PONV occurrence reduction in patients receiving the block was attributed mainly to the decrease in postoperative opioid consumption, which has a significant role in developing PONV.[21] Cheek hematoma was noticed in two patients in the SMB group, but no other side effects of the block were noted. Multiple research studies have documented the safety of the MN blockade by the suprazygomatic approach, and the use of real-time US guidance has contributed to preventing inadvertent puncture of neural or vascular structures.[27,28]

Our trial had some limitations. First, we could not assess the success of the blocks as they were performed while the patients were under GA; however, we relied on the intraoperative consumption of anesthetic medications and hemodynamic parameters as indicators for adequate analgesia. Second, we did not perform a sham block for ethical reasons although it might have been the most convenient method to ensure blinding in our study. Third, the SMB does not cover all the nose's sensory innervation as it spares the areas supplied by the trigeminal nerve's ophthalmic branch. Furthermore, combining the SMB with other techniques blocking branches from the ophthalmic nerve could have enhanced the quality of analgesia. Fourth, we discussed certain risk factors for EA; however, as other risk factors for EA were not studied, we could not exclude the possibility that these factors had an impact on EA.

Conclusion

The administering bilateral US-guided SMB in conjunction with GA lowered EA incidence in septorhinoplasty cases. Additionally, it resulted in a decrease in the administration of anesthetic medications, a decrease in pain scores during the early postoperative period, and a reduction in the consumption of postoperative analgesics with no serious adverse effects.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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