Original Article

Ultrasound-guided trigeminal nerve block and its comparison with conventional analgesics in patients undergoing faciomaxillary surgery: Randomised control trial

Address for correspondence:
Dr. Chandni Sinha,
Department of Anaesthesia,
AIIMS, Patna, Bihar, India.
E-mail: chandni.doc@gmail.com

Amarjeet Kumar, Chandni Sinha, Ajeet Kumar, Poonam Kumari, Sailesh Kumar Mukul[1]

Departments of Anaesthesiology and [1]Dentistry, AIIMS, Patna, Bihar, India

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ABSTRACT

Background and Aims: Ultrasound (USG)-guided injection in pterygopalatine fossa is an indirect approach to block the trigeminal nerve. Trigeminal nerve block for maxillofacial surgeries may provide preemptive analgesia, reduce opioid consumption and opioid-related adverse effects. **Methods:** In this randomised, prospective double-blind study, 60 American Society of Anesthesiologists I/II patients, within the age group of 18–60 years scheduled for faciomaxillary surgery (fracture/pathological lesion of maxilla or mandible and cleft lip), were recruited. The patients were allocated in either of the two groups: group I: general anaesthesia (FENT group) and group II: general anaesthesia + trigeminal nerve (TNB group). Perioperative opioid consumption and postoperative pain scores were recorded. Any adverse effects like respiratory depression and nausea were also looked for. **Results:** Patients in group II required less intraoperative fentanyl top ups (1.17 ± 0.53 vs 2.70 ± 0.53) ($P < 0.05$). Postoperative opioid consumption was also less in this group (0.93 ± 0.69 vs 3.53 ± 0.68) ($P < 0.05$). **Conclusion:** USG-guided TNB reduces perioperative opioid consumption in patients undergoing faciomaxillary surgery with better patient pain scores.

Key words: Analgesia, opioid, pterygopalatine fossa, trigeminal nerve block

INTRODUCTION

Nerve block to provide preemptive analgesia for maxillofacial surgeries improves postoperative analgesia and reduces opioid consumption and the adverse effects associated with it.[1] Few authors have mentioned the role of ultrasound (USG)-guided trigeminal nerve block (TNB) for facial pain. The injection in pterygopalatine fossa (PPF) is an indirect approach to block the trigeminal nerve. It is performed through the foramen rotundum that opens into the trigeminal ganglion which is situated at the floor of the middle cranial fossa.[2] We hypothesised that giving USG-guided TNB in patients undergoing faciomaxillary surgery could reduce the requirements of opioids perioperatively. Hence, the aim of this double-blind study was to evaluate the effect of USG-guided TNB perioperatively in terms of pain relief, opioid consumption and adverse effects in patients undergoing such elective surgeries.

METHODS

This randomised, prospective double-blind study was conducted over a period of 9 months between May 2017 and March 2018. Sixty American Society of Anesthesiologists (ASA) I/II patients, within the age group of 18–60 years scheduled for elective faciomaxillary surgery, were included. After approval from the Institutional Ethics Committee and Clinical Trial Registry – India (no. CTRI/2017/05/008613),

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written informed consent was obtained from all subjects. The patients were examined on the day before surgery and were familiarized with a standard Numerical Rating Scale (NRS) for pain (0 = no pain, 10 = worst pain imaginable). Premedication in the form of oral benzodiazepines (alprazolam 0.25 mg) was given at bed time on the day before surgery.

Exclusion criteria included patients with polytrauma, known allergy to the study drugs, coagulopathy, infection at puncture site, psychiatric disorder and patients necessitating postoperative ventilation.

The patients were allocated by computer-generated random numbers into two groups of 30 patients each. The random allocation sequence was concealed in opaque, sealed envelopes till a group was assigned: Group I: General anaesthesia (FENT group), Group II: General anaesthesia + TNB (TNB group);. The patients in group I did not receive any block, while patients in group II received 5 mL of 0.25% bupivacaine for TNB under USG after induction of anaesthesia [Figure 1].

On arrival to the induction area, all patients were monitored with electrocardiography, pulse oximeter and noninvasive blood pressure. Infusion of lactated Ringer's solution was started as maintenance (5 mL/kg/h). General anaesthesia was administered in a standardized manner (propofol 2 mg/kg, fentanyl 2 μg/kg, vecuronium 0.08 mg/kg) and endotracheal intubation was done. Anaesthesia was maintained with nitrous oxide in oxygen and isoflurane (Minimum alveolar concentration = 1). Senior anaesthesiologists experienced in TNB and not involved in the intra- or postoperative management of the patients performed TNB. The intra- and postoperative monitoring was done by an independent anaesthesiologist not involved in giving the block.

The position of the patient was supine, with the side of the face to be blocked on the upper side. High-frequency linear array transducer (7–12 MHz) (M-Turbo, Fujifilm Sonosite Inc, Bothell, W.A, U.S.A) was kept longitudinally on the side of the face just

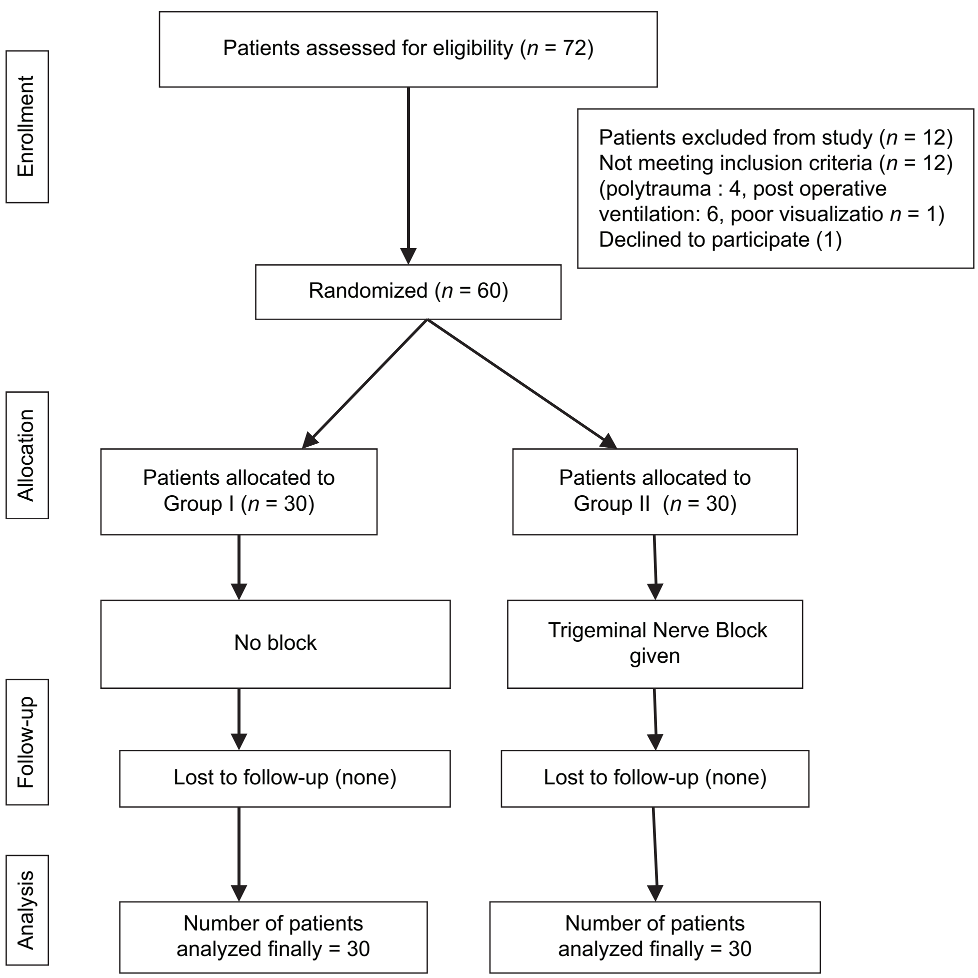

Figure 1: Consort flow chart

below the zygomatic bone, superior to mandibular notch and anterior to the mandibular condyle. The angle of the probe was tilted in a cephalad direction towards the PPF. This position allowed the local anaesthetic to be deposited deep into the superior head of the lateral pterygoid muscle along the pterygomaxillary fissure into the PPF to reach the foramen rotundum. The following structures were identified: the zygomatic bone, the lateral pterygoid muscle, the lateral pterygoid plate, the maxillary bone by USG and maxillary artery using colour power Doppler in the PPF.

The lateral pterygoid muscle quadrilateral in shape was seen originating from the condyle and extending anteroinferiorly. The pterygoid plate emerges as a straight hyperechoic structure that attaches to the anterior part of the lateral pterygoid muscle. The maxillary artery was seen pulsating between the lateral pterygoid and temporalis muscles. An insulated echogenic needle (22 G, 5 cm, Pajunk, Germany) was inserted out of plane and advanced in a lateral to medial and posterior to anterior direction in PPF. To avoid acoustic shadow of coronoid process, the patient's mouth was kept open using an oral airway. The probe was tilted in a slightly superior direction. Following negative aspiration, 5 mL of 0.25% bupivacaine was injected [Figure 2].

Intraoperatively, vitals were noted: heart rate (HR), mean arterial pressure (MAP) and oxygen saturation (SPO2). Hourly top-up of fentanyl (0.5 μg/kg) was given in both the groups. Despite this, if there was any increase in HR/MAP by more than 20%, it was treated with 1 μg/kg fentanyl.Additional doses of fentanyl required in both the groups were noted.

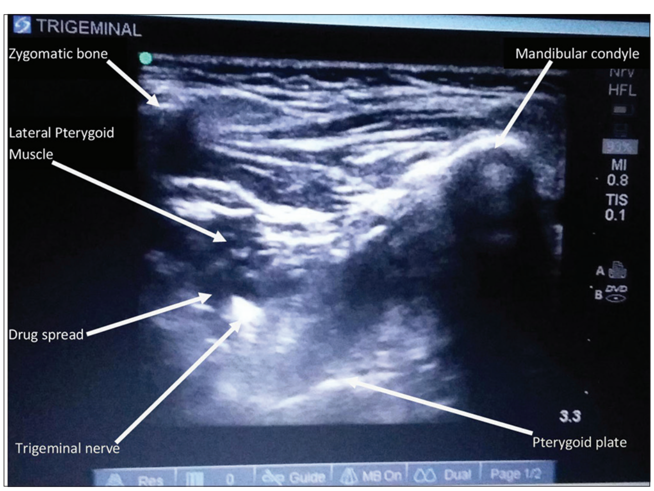

Figure 2: Sonoanatomy showing the drug spread

On shifting to postanaesthesia care unit, the patients were started on patient-controlled analgesia (PCA) with fentanyl. The regime used was demand dose of 50 μg (NRS >3) with a lockout interval of 10 min and no basal infusion rate. In addition to this, all the patients received 1 gram I.V. paracetamol 6 hourly for 48 h.

Various parameters like perioperative fentanyl top ups, vital parameters (HR, MAP, SP02), post operative pain scores (NRS 0- no pain, 10- maximal pain) hourly for 24 h and patient satisfaction score (1 = not satisfied, 10 = highly satisfied) was assessed 24 h after surgery.

Complications such as bradycardia, sedation, respiratory depression, nausea, vomiting, persistent paresthesia, toxicity of bupivacaine like seizure, arrhythmia and haematoma were also noted.

The primary objective was the additional fentanyl consumption during the intraoperative period. The secondary objectives included postoperative opioid consumption and the pain scores.

Sample size calculation was done on the basis of difference in fentanyl dose during the intraoperative period between TNB and FENT groups with a power of 90% and significance level of $\alpha = 0.05$. There was a 50% (1.3 μg/kg) difference in fentanyl dose between the two groups in a pilot study done earlier based on which the sample size was calculated to be 60.

Statistical analysis was performed using SPSS 16 software. Continuous variables were analyzed with unpaired *t*-test and categorical variables were analyzed using Chi-square test. *P* value results were considered statistically significant if $P < 0.05$.

RESULTS

A total of 60 patients were included in the study [Table 1]. There was no statistical difference in between the two groups with respect to age, weight and duration of surgery [Table 2].

The requirement of fentanyl top-ups (1 μg/kg) intraoperatively was more in group I (2.70 ± 0.53) when compared with group II (1.17 ± 0.53). This was statistically significant [Table 3]. HR during this period was more in group I (FENT), but the difference between both the groups was insignificant. The mean MAP was similar in both the groups at all the time except at the time of extubation [Figure 3]. Patients in TNB group

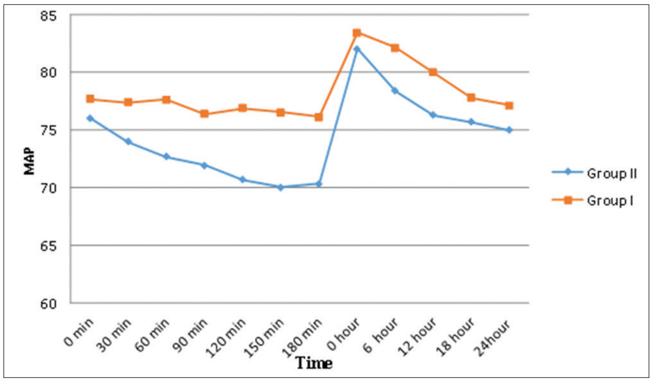

Figure 3: Trend of Mean arterial Pressure over time. Group I: FENT group. Group II: TNB group

had lower MAP during extubation. (70.30 ± 7.54 vs 76.13 ± 9.38).

Postoperatively, pain scores were lower in patients in group II (TNB)($P < 0.05$). These patients also had higher satisfaction scores compared with group I ($P < 0.05$)[Table 4]. The differences in fentanyl requirements between two groups were highly significant ($P < 0.00$).

Postoperative nausea was noted in two patients in group I (FENT). No patients in group II had similar complaints. This was not statistically significant.

Table 1: Type of surgeries and the nerve involved.

S. no	Diagnosis	Surgery	Nerve involved
1.	Maxillary/mandibular fracture	Plating	Maxillary/mandibular nerve
2.	Odontogenic cysts	Enucleation	Maxillary/mandibular nerve
3.	Impacted tooth	Removal	Maxillary/mandibular nerve
4.	Cleft lip	Repair	Maxillary nerve
5.	Maxillary sinus fistula/infection	Repair/drainage	Maxillary nerve

Table 2: Patient characteristics

Variables	Group I (FENT)		Group II (TNB)		P
	Mean	SD (±)	Mean	SD (±)	
Age* (year)	36.23	12.87	31.56	12.20	0.155
Weight* (kg)	57.70	10.65	57.20	11.14	0.860
Duration of surgery* (h)	3.52	0.82	3.48	0.70	0.840

SD – Standard deviation. *Student's *t*-test

Table 3: Fentanyl consumption perioperatively

Variables	Group I (FENT)		Group II (TNB)		P
	Mean (μg/kg)	SD(±)	Mean (μg/kg)	SD (±)	
Additional dose of fentanyl[a] (intraoperative period)	2.70	0.65	1.17	0.53	<0.0001*
Additional dose of fentanyl[a] (postoperative period)	3.53	0.68	0.93	0.69	<0.0001*

SD – Standard deviation. [a]Unpaired *t*-test *Highly significant

Table 4: Postoperative pain and satisfaction scores

Time	Group I (FENT)		Group II (TNB)		P-value
	Mean NRS (0-10)	SD(±)	Mean NRS (0-10)	SD (±)	
0 h	4.13	0.73	2.23	0.89	<0.0001*
6 h	3.60	0.56	2.43	0.67	<0.0001*
12 h	3.43	0.56	2.43	0.81	<0.0001*
18 h	3.33	0.47	2.26	0.63	<0.0001*
24 h	3.23	0.43	2.10	0.30	<0.0001*
Patient satisfaction score (1-10)	7.10	0.60	8.00	0.78	<0.0001*

SD – Standard deviation. Unpaired *t*-test **P*-value highly significant

DISCUSSION

The management of postoperative pain after faciomaxillary surgery remains poorly studied. Pain relief is generally provided with an intravenous opioid delivered with a PCA system.[3] The use of regional analgesic techniques may provide superior analgesia compared with systemic opioids and may even improve rehabilitation.[4,5] Several case reports suggest a role for continuous maxillary nerve block (MNB) for pain control in patients suffering from trigeminal neuralgia,[6] fracture of the mandible[7] or terminal orofacial cancer.[8] Till date, no published study has evaluated the value of USG-guided TNB for control of perioperative pain in faciomaxillary surgery.

TNB is usually given for providing pain relief in patients suffering from trigeminal neuralgia or in patients with atypical facial pain who have failed previous medical interventions. Fluoroscopy-aided intervention is the most common method used for this purpose. Lately, USG-aided blocks have been described wherein the drug is deposited anterior and medial to lateral pterygoid plate. Initially, USG was used to demonstrate a highly accurate deposition of local anaesthetic in the superficial branches of TGN and this was validated in cadavers.[9] Later in 2013, USG-guided block was described to target Gasserian ganglion through PPF.[10] The Gasserian ganglion lies in the middle cranial fossa within the Meckel cave. Three branches, namely, ophthalmic, maxillary and mandibular, arise from the ganglion and exit from the skull through three distinct foramina: the superior orbital fissure, foramen rotundum and foramen ovale. The injection of local anaesthetic anteromedial to lateral pterygoid plate into the upper part of PPF places it in close vicinity to foramen rotundum from where the drug migrates into the middle cranial fossa. This has been confirmed by fluoroscopy.[10] Visualisation of the vascular structure in real time has been found to minimise the potential inadvertent needle puncture.[1]

In another study, Nader *et al*.[11] evaluated the efficacy of USG-guided TNB in 50 patients with facial pain. About 80% of the patients had complete sensory analgesia in one side of the face within 10 min of injection. Also, they did not report any neurological sequelae to this block when followed for 6–12 months. We also had better analgesia in our patients with Numerical Rating Scale (NRS) scores being statistically lower till 24 h after surgery.

Van Lancker *et al*.[12] evaluated the effect of the perioperative use of the MNB with lignocaine in mandibular base osteotomy surgery in terms of analgesia and perioperative adverse effects. The intraoperative opioid consumption was less with no increase in adverse effects in either group. The effect of MNB was limited to the intraoperative period in the study. In our study, the analgesic effect could be seen till 24 h as we used a long-acting local anaesthetic.

Plantevin *et al*.[1] performed MNB before general anaesthesia for oropharyngeal cancer surgery. They found improved postoperative analgesia, severe pain in fewer patients and reduced postoperative morphine consumption at 24 h with no increase in adverse effects. This is similar to the results of our study.

In our study, we performed TNB, hence not limiting our cases to only one particular segment of nerve distribution. In all the cases receiving the block, the perioperative opioid consumption was less, NRS scores were lower and patient satisfaction was more. Haemodynamically there was no statistical difference in either group.

Opioid analgesics are associated with an increased incidence of emesis and sedation. Postoperative sedation and nausea was noted in two patients in group 2 (FENT), but this was not statistically significant.

The limitation of the study was that we did not confirm the spread of the drug fluroscopically. Also, we did not include patients who would require postoperative ventilation. Hence, many of our patients who can actually benefit from the block got excluded.

CONCLUSION

USG-guided TNB reduces intra- and postoperative opioid consumption in patients undergoing faciomaxillary surgery with better patient satisfaction scores

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. PlantevinF, Pascal J, Morel J, Roussier M, Charier D, Prades JM, *et al*. Effect of mandibular nerve block on postoperative analgesia in patients undergoing oropharyngeal carcinoma surgery under general anaesthesia. Br J Anaes 2007;5:708-12.
2. Nader A, Kendall MC, De Oliveria GS, Chen JQ, Vanderby B, Rosenow JM, *et al*. Ultrasound-guided trigeminal nerve block via the pterygopalatine fossa: An effective treatment for trigeminal neuralgia and atypical facial pain. Pain Physician 2013;16:E537-45.
3. Roussier M, Mahul P, Pascal J, Baylot D, Prades JM, Auboyer C, *et al*.Patient-controlled cervical epidural fentanyl compared with patient-controlled i.v.fentanyl for pain after pharyngolaryngeal surgery. Br J Anaesth 2006;96:492-6.
4. NguyenA, Girard F, Boudreault D, Fugère F, Ruel M, Moumdjian R, *et al*. Scalp nerve blocks decrease the severity of pain after craniotomy. Anesth Analg 2001;93:1272-6.
5. Wang H, Boctor B, Verner J. The effect of single-injection femoral nerve block on rehabilitation and length of hospital stay after total knee replacement. Reg Anesth Pain Med 2002;27:139-44.
6. Umino M, Kohase H, Ideguchi S, Sakurai N. Long-term pain control in trigeminal neuralgia with local anesthetics using an indwelling catheter in the mandibular nerve. Clin J Pain 2002;18:196-9.
7. Singh B, Bhardwaj V. Continuous mandibular nerve block for pain relief. A report of two cases. Can J Anaesth 2002;49:951-3.
8. Kohase H, Umino M, Shibaji T, Suzuki N. Application of a mandibular nerve block using an indwelling catheter for intractable cancer pain. Acta Anaesthesiol Scand 2004;48:382-3.
9. Spinner D, Kirschner JS. Accuracy of ultrasound-guided superficial trigeminal nerve blocks using methylene blue in cadavers. Pain Med 2012;13:1469-73.
10. Nader A, Schittek H, Kendall MC. Lateral pterygoid muscle and maxillary artery are key anatomical landmarks for ultrasound-guided trigeminal nerve block. Anaesthesiology 2013;118:957.
11. Nader A, Kendall M. Dexamethasone versus triamcinolone side effects for ultrasound-guided trigeminal nerve block for the treatment of refractory typical or atypical facial pain. J Pain 2016;17:S72.
12. Van Lancker P, Abeloos JV, De Clercq CA, Mommaerts MY. The effect of mandibular nerve block on opioid consumption, nausea and vomiting in bilateral mandibular osteotomies. Acta Anaesthesiol Belg 2003;54:223-6.