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Safety of Ultrasound-Guided Trigeminal Nerve Block in Maxillofacial Surgery under General Anesthesia

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ABSTRACT

Background: Peripheral nerve blocks are being utilized more often, either as a part of multimodal analgesia or even as a substitute for drugs that treat systemic pain. Primary headache problems and secondary headaches have both been successfully treated with peripheral nerve blocks.

Objectives: This study aimed to assess safety of ultrasound-guided trigeminal nerve block (USGTNB) in individuals who are receiving general anesthesia and are undergoing unilateral maxillofacial surgery.

Methods: This cross-sectional study enrolled 25 adult patients aged more than 18 years, who had American Society of Anesthesiologists physical status I or II and were scheduled for elective unilateral maxillofacial surgery under general anesthesia. Patients received USGTNB using 5 ml of bupivacaine 0.25%. The intraoperative hemodynamic parameters were assessed.

Results: More than half of patients were males (64%) with a mean age of 37.28 ± 11.54 years old. Patients had mean duration of surgery of 2.96 ± 0.69 hours, most of them had ASA grade I**.** Patients had significantly lower HR compared to their baseline values. Patients had significantly lower MAP relative to their initial levels. The total fentanyl consumption was 0.36 ± 0.55 µ/kg. Regarding complications, 12% of patients had headache, 8% had paraesthesia and 4% had nausea\vomiting.

Conclusion: ultrasound-guided nerve block is a safe and reliable method for controlling pain in adult patients undergoing maxillofacial surgery with fewer side effects.

Keywords: Maxillofacial surgery, Trigeminal nerve block, Ultrasonography, Safety.

INTRODUCTION

Simple tooth extractions to complex reconstructive and free flap surgeries are all included in the broad category of maxillofacial surgery. The intricate anatomy and constrained operating room make these procedures difficult. Additionally, during maxillofacial surgery, discomfort and bleeding are frequent occurrences [(1)].

The cost of hospitalization and length of stay both rise due to postoperative discomfort. It also interferes with sleep and degrades life quality. The discomfort felt after surgery can be alleviated in a number of ways such as: with oral, intravenous, and regional anesthetics, opioid and non-opioid medicines, and other methods [(2)].

In particular in craniofacial procedures requiring mouth closure by intermaxillary fixation, patients who have taken opioids may experience postoperative nausea and vomiting as well as respiratory depression that makes it challenging to extubate them. Major bleeding is another issue in maxillofacial surgery. Head-up posture, local anesthetic injections including adrenaline, and avoiding hypertension are often effective ways to control blood loss [(3, 4)].

A multimodal approach has recently been proposed to minimize the harmful effects of opioids. In head and neck surgery, blocks that are guided by fluoroscopy are thought to be the standard of care for pain management. Operations that are guided by computed tomography as an alternative are advantageous yet expensive and radiation-risky. Recently, the utilization of ultrasonography for the purpose of perioperative pain control has seen a significant rise in recent years. Real-time needle placement and excellent soft tissue and vascular imaging are both provided by ultrasound [(5)].

Trigeminal neuralgia can now be treated using ultrasound-guided trigeminal nerve blocks (USGTNB). Injection within the pterygopalatine fossa, which houses the sphenopalatine ganglion, might indirectly block the trigeminal nerve. The superficial and deep petrosal nerves, respectively, influence the parasympathetic and sympathetic activity of this ganglion. The sensory duties of the sphenopalatine ganglion are carried through the orbit, nose, buccal mucosa, and palate [(6)].

Nerve blockades are advantageous for maxillofacial surgeries because they have fewer negative effects. Additionally, USGTNB protects blood vessels, especially the maxillary artery, from harm. The potential use of USGTNB for postoperative analgesia in craniofacial surgery has recently come up in a few papers [(7, 8)]. In this study, patients having unilateral maxillofacial surgery under general anesthesia had their perioperative use of USGTNB for pain management evaluated for safety.

METHODS

This study was carried out in Suez Canal University Hospital, and it was a cross-sectional investigation. Participants in the study ranged in age from 21 to 60 years old and were of both sexes. They had an American Society of Anesthesiologists (ASA) physical status of I or II and were scheduled to undergo

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elective unilateral maxillofacial surgery under general anesthesia. Patients who were necessitating postoperative ventilation from the start, since it was difficult to assess respiratory depression and postoperative pain. Patients who had a history of allergy to the used medications, and those with coagulopathy, polytrauma, fracture base of the skull, or infection at the puncture site were excluded from the study.

All patients were subjected to:

- Preoperative management: Each patient underwent a comprehensive physical examination, including a close look at the area that will be punctured for the local anesthetic injection. Complete blood count, prothrombin time, partial tissue thromboplastin time, international normalized ratio, and random blood sugar were among the standard preoperative examinations carried out. Patients with lung illnesses had their chest x-rays taken, and those under 40 had their 12-lead electrocardiograms. Patients were given fasting instructions the day before surgery, which included a 6-hour fast for solid meals and a 4-hour fast for water and clear liquids.

Intraoperative management:

As soon as the patient entered the operating room, preliminary monitoring of the patient's heart rate (HR), non-invasive blood pressure, breathing rate, and temperature began. An intravenous line of at least 20-gauge was fastened. Fentanyl (2 g/kg), propofol (2 mg/kg), and rocuronium (1.2 mg/kg) were given intravenously (IV) to all subjects in both groups to cause general anesthesia. There was an endotracheal intubation. After that, datex-ohmeda® GE was used to mechanically ventilate the lungs. Cisatracurium (0.03 mg/kg) and low flow sevoflurane (1 liter oxygen/minute) were used to maintain anesthesia. Additional bolus doses of fentanyl (1 g/kg) were given if the mean arterial pressure (MAP) and/or the heart rate (HR) rose by 20% from the preoperative baseline.

The blocks were carried out in an aseptic environment while the patients were monitored by an oxygen face mask. On the same side of the surgery, the block was carried out. When the patient was in the supine position, the side of their face that required protection was the top side of their face. The high-frequency, linear array transducer that was used in the Sonosite M-Turbo ® US machine was placed longitudinally on the side of the face, somewhat below the zygomatic bone, above the mandibular notch, and in front of the mandibular condyle (Figure 1). The probe's angle was cephalad, pointing in the direction of the pterygopalatine fossa. It is possible that the local anesthetic will need to be administered somewhat deeply into the superior head of the lateral pterygoid muscle along the pterygomaxillary fissure in order to access the foramen rotundum.

In the pterygopalatine fossa, using ultrasound and color power Doppler ultrasound, it was possible to find the zygomatic bone, the lateral pterygoid muscle, the lateral pterygoid plate, the maxillary bone, and the maxillary artery.

After being implanted out of plane above the zygomatic bone using the suprazygomatic technique, a 22-G insulated echogenic needle was progressed using a lateral to medial and posterior to anterior orientation within the pterygopalatine fossa. The patient's mouth was maintained open with an oral airway to prevent the coronoid process from creating an auditory shadow. The probe was slightly elevated in one direction. A negative aspiration was followed by the administration of 5 mL of 0.25% bupivacaine. The intraoperative fentanyl top ups, hemodynamic parameters (oxygen saturation, HR, and MAP), and the NRS were recorded.

Ethical Approval: The study was approved by the Ethics Board of Suez Canal University and the patients were given all the information they need about the trial. An informed written consent was taken from each participant in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

IBM SPSS Statistics version 23 for Windows (SPSS Inc., Chicago, IL, USA) was used to conduct the statistical analysis. Means and standard deviations (SD) were used to describe the quantitative data. The qualitative data were shown as percentages and frequencies. The serial measurement test was used to do inferential statistics on continuous variables. For significance, a p-value ≤ 0.05 was used.

RESULTS

More than half of patients were males (64%) with mean age of 37.28 ± 11.54 years old. Patients had mean duration of surgery of 2.96 ± 0.69 hours, most of them had ASA grade I **(Table 1).**

Table (1): Demographic and surgical data

	(n = 25)
Sex, n (%)	
Male	16 (64.0%)
Female	9 (36.0%)
Age, Year, Mean ± SD	37.28 ± 11.54
Duration of Surgery, Hour, Mean ± SD	2.96 ± 0.69
Type of Surgery, n (%)	
Maxillary/Mandibular Fracture	24 (96%)
Mass Excision	1 (4%)
ASA physical status, n (%)	
I	20 (80.0%)
II	5 (20.0%)

SD: standard deviation; n: numbers; ASA: American Society of Anesthesiologists.

Patients had significantly lower HR contrasted with their initial levels (Table 2). Patients had significantly

lower MAP compared to their baseline values (Table 3). The total fentanyl consumption was 0.36 ± 0.55 µ/kg (Table 4).

Table (2): Heart rate during the intraoperative period

	(n = 25)	**p_0**
Heart rate, Beat/min, Mean ± SD		
Baseline	90.76 ± 15.13	
Skin incision	81.56 ± 11.36	***0.009****
1 h	79.24 ± 9.48	***0.003****
2 h	76.48 ± 5.91	***<0.001****
3 h	77.38 ± 9.86	***<0.001****

SD: standard deviation; n: number; significant at $p \leq 0.05$

Table (3): Mean arterial pressure during the intraoperative period

	TNB group (n = 25)	**p_0**
Mean arterial pressure, mmHg, Mean ± SD		
Baseline	101.1 ± 9.94	
Skin incision	85.44 ± 10.72	***<0.001****
1 h	74.12 ± 5.83	***<0.001****
2 h	81.28 ± 6.56	***<0.001****
3 h	81.76 ± 7.11	***<0.001****

Table (4): Total fentanyl consumption during the intraoperative period

	(n = 25)
Total intraoperative fentanyl consumption, µ/kg	0.36 ± 0.55

Regarding complications, 12% of patients had headache, 8% had paraesthesia and 4% had nausea\vomiting **(Table 5).**

Table (5): Postoperative complications

Variable	**(n = 25)**
Nausea/vomiting, n (%)	1 (4%)
Headache, n (%)	3 (12%)
Paraesthesia, n (%)	2 (8%)
Respiratory depression, n (%)	0 (0.0%)

Figure (1): Sonosite M-Turbo® ultrasonography machine.

DISCUSSION

The purpose of this research was to determine if USGTNB was safe for use for managing pain in adult patients having elective maxillofacial surgery. Our primary conclusions were that the USGTNB significantly reduced intraoperative fentanyl consumption as well as postoperative analgesic consumptions, and it improved patient hemodynamic management. USGTNB hasn't been associated with any serious side effects. Similar outcomes were reported by **Kumar *et al.*** [9], who examined the effectiveness of TNB in adult patients scheduled for elective faciomaxillary surgery.

At 1, 2, and 3 hours into the procedure, the block was connected to considerably reduced MAP and HR in terms of hemodynamics. Similarly, **Wang *et al.*** [8] and **Abdelghafar *et al.*** [4] found that patients with trigeminal nerve block had hemodynamic values that were considerably lower than those in the control group. Sphenopalatine ganglion block was shown in several trials (24–26) to be effective in achieving hemodynamic stability throughout a variety of surgical procedures, including sino-nasal surgery and trans-sphenoidal endoscopic hypophysectomy. The sphenopalatine ganglion and the nerves that exit it may be responsible for the deep anesthesia that causes the hemodynamic consequences of trigeminal nerve block. The local anesthetic can travel into the foramen rotundum to block the Gasserian ganglia, eliminate any unpleasant stimulation that would cause blood pressure to rise during the procedure.

Unlike our findings, **Kumar *et al.*** [10] discovered no variations in HR between the block and control groups at all time periods. The MAP during extubation was dramatically reduced by trigeminal nerve block. The differences between our results and those of **Kumar *et al.*** [10] may be due to the hourly delivery of fentanyl top-ups (0.5 g/kg) to all the patients under study. In our study, additional fentanyl doses were not routinely given to all subjects; rather, they were only given when there was a 20% rise in either the HR or the MAP.

Patients receiving USGTNB showed considerably less headache as surgical consequence. It could be accounted for by the fact that headache pathways' switching center is the sphenopalatine ganglion. One specific way to stop primary headaches is to block this ganglion [11]. Additionally, TNB significantly decreased postoperative nausea and vomiting without causing statistically significant differences between the groups. Similar findings are made by **Abdelghafar *et al.*** [4] and **Kumar *et al.*** [10] who noted decreased rates of postoperative problems in patients who received trigeminal nerve block, although without seeing any appreciable differences from the control group. In contrast to USGTNB patients, patients having orthognathic operations under general anesthesia experienced much more vomiting, according to **Wang *et al.*** [8] research. This was attributed by **Wang *et al.*** [8]

to the patients' significant opioid use while under merely general anesthesia.

Regional anesthesia practitioners can avoid puncture issues, identify key anatomical landmarks, and see how the local anesthetic is dispersed by using ultrasonographic guidance [(12)].

CONCLUSION

Ultrasound-guided nerve block is a safe and reliable method for controlling pain in adult patients undergoing maxillofacial surgery with fewer side effects.

DECLARATIONS

- **Consent for publication:** I attest that all authors agreed to submit the work.
- **Availability of data and material:** Available
- **Competing interests:** None
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- **Conflicts of interest:** no conflicts of interest.

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