Original Article

The use of mandibular nerve block in unilateral mandibular fracture to evaluate the mouth opening for assessment of airway

ABSTRACT

Background: Facial area is one of the most frequently injured area of the body, accounting for 23–97% of all facial fractures. Treatments under general anesthesia as those for maxillofacial fractures or infections is a highly complicated and a major challenging task in trismus associated patients. The main culprit in trismus is the increase muscle tone of masticatory muscles which are supplied via the mandibular nerve, blocking which could help increase the mouth opening thus, changing the whole of airway management.

Material and Method: A prospective study was done on 50 patients of ASA grade I-II with unilateral mandibular fracture with trismus posted for maxillofacial surgery. Mandibular nerve block was given via extraoral approach with 5 ml of 0.5% bupivacaine using peripheral nerve stimulator to determine the difference in Pre block and Post block mouth opening and the VAS score at 2, 5, 10, 15, 20, 25, and 30 minutes.

Results: The Interincisor distance measured Pre block was 1.20 ± 0.32 mm and was significantly increased after 5 mins onwards from the block ($P < 0.005$). The VAS score determined Pre block was 5.14 ± 1.37 which significantly decreased just 2 minutes after the application of block ($P < 0.005$).

Conclusion: Mandibular nerve block decreases the pain and will aid in the decision making by an anesthetist regarding airway management as it helps in increasing the inter incisor distance significantly. Moreover, given the feasibility and effectiveness of the block it could be included in standard of care protocol for mandibular fracture patients.

Key words: Airway management, general anesthesia, mandibular nerve, trismus

Introduction

The precipitous style of today's life with easy accessibility to fast pace automobiles and a more and more society growing aggressive and intolerant has led to injuries to face a social illness. Facial injuries not only lead to disfigurement but also increases disability adjusted life years i.e., morbidity as well mortality.

Facial fractures cause an inflammation of the masticatory muscles and various sequelae follow like trismus, dental malocclusion, tenderness and swelling.[1,2]

Access this article online	
Website: www.saudija.org	Quick Response Code
DOI: 10.4103/sja.sja_773_21	

How to cite this article: Prasad MK, Jain P, Alam A, Varshnay RK, Rani K, Chaudhary AK. The use of mandibular nerve block in unilateral mandibular fracture to evaluate the mouth opening for assessment of airway. Saudi J Anesth 2022;16:194-9.

Mukesh Kumar Prasad, Payal Jain, Alauddin Alam, Rohit Kumar Varshnay, Kanchan Rani[1], Amit Kumar Chaudhary[2]

Departments of Anaesthesia and [1]Obstetrics and Gynaecology, Teerthanker Mahaveer Medical College, Moradabad, Uttar Pradesh, [2]Department of Critical Care Medicine, Manipal Hospital, Bengaluru, Karnatka, India

Address for correspondence: Dr. Payal Jain, Department of Anaesthesia, Teerthanker Mahaveer Medical College and Research Centre, Bagadpur, Moradabad – 244001, Uttar Pradesh, India.
E-mail: payalravi1408@gmail.com

Submitted: 30-Oct-2021, **Accepted:** 29-Nov-2021, **Published:** 17-Mar-2022

Trismus (*trigmos/trismos*) in Greek language means "a scream; a grinding, rasping or gnashing".[3] The anticipated normal mouth opening ranges from 3.5-4 cm in adults and 3 cm in children. Difficult direct laryngoscopy and orotracheal intubation could be anticipated if inter incisor gap is <3 cm.

The restricted mouth opening might lead to difficulty in speech articulation, non-convincing oral hygiene, societal prohibitions and various nutritional deficiencies. Treatments under general anesthesia for maxillofacial fractures is a highly complicated and a herculean challenging task in trismus associated patients.[4]

In a study done by P.J. Dhanrajani *et al*.[3] out of 779 patients of maxillofacial injury, one-third of the patients developed trismus within a week of the event. The main culprit in trismus is the increase muscle tone of masticatory muscles which are supplied via the mandibular nerve.[5] It can often be counteracted via anesthetic induction, until and unless it is a genuine mechanical obstruction. The major issue is that it is not possible to predict the cause of trismus during the preoperative airway assessment.

The anesthetist's quandary while planning for intubation sways between two- that mouth opening will increase after induction if the cause is pain and spasm, and that there is no unanticipated difficult airway and if backup plan for awake fiberoptic intubation which has its own complication and hassles should be kept in mind.[6]

Mandibular nerve block have been previously used by Takemura H[7] in treating trismus of hypoxic ischemic encephalopathy as well as Meaudre *et al*.[8] in order to remove dentures in a tetanus patients.

Thus, this study was undertaken to determine whether application of mandibular nerve block in cases of unilateral mandibular fracture significantly change the mouth opening and pain score before and after the block.

Material and Method

This prospective study was performed in department of anesthesia in a tertiary care center in northern part of India between September 2019 and March 2020. The clinical trial was registered in Indian Clinical Trials Registry after ethical approval from institutional ethical committee. Enrollment of patients was done after obtaining written informed consent.

Total 50 patients of American Society of Anaesthesiologists (ASA) grade I–II, aged between 18–65 years, with unilateral mandibular fracture, restricted mouth opening were included. Exclusion Criteria included patient's refusal, hypersensitivity to local anesthetics, disoriented patients with associated head injury, requiring rapid sequence intubation, local site infection, uncooperative patients and absence of incisors.[9]

After complete pre anesthetic assessment patients were brought to pre-operative room. Entire procedure and use of 10 point (0-no pain to 10-most severe pain) visual analogue scale (VAS) was explained to the patients in preoperative period. After all baseline monitoring attached in block room, inter incisor distance was measured using Vernier's calipers. [Figure 1a] Mandibular nerve block was performed via lateral extraoral approach. The extraoral approach consisted of identifying mandible's coronoid process and zygomatic arch. The midpoint of the lower border of the arch was taken as point of entry. [Figure 1b] Under all aseptic precautions, local anesthesia was given with 1% lignocaine (2 ml). 1.5 mA current was set as initiating point. A 22 G (5 cm) insulated needle (Stimuplex A) from B Braun, Germany was inserted after palpating the zygomatic arch at midpoint of its lower border and was further advanced in perpendicular direction to face until the lateral pterygoid plate was contacted. The needle length at the skin was marked. The needle was slightly pulled back and readjusted in posteroinferior direction until a motor response from temporalis and masseter muscles in the form of jaw jerk was achieved. The current was reduced to 0.4 mA. After negative aspiration of blood slowly 10 ml of 0.5% Bupivacaine[9] was given and loss of twitches observed. Interincisor distance was measured using Vernier's calipers post block at 2,5,10,15,20,25 and 30 minutes [Figure 1c] The primary objective of our study was to measure inter-incisor distance with and pain score (VAS) pre and post block at different time intervals. The secondary objective of our study was to document Hemodynamic parameters and SpO2 noted at 2,5,10,20,25 and 30 minutes and documentation of any complication (paresthesia, hematoma, swelling, facial nerve palsy).

Minimum size of sample required was deduced using G*Power for windows; a free online software. Sample size was calculated considering confidence level of 95% (α = 0.05) and study power of (1–β) 0.80 was calculated to be 41 (forty one). The sample size increased to 50 considering any failure of block.

Data calculations was completed using SPSS (Statistical Package for the Social Science; SPSS Inc. ver. 21). Data recorded was expressed in form of mean and standard deviation. Frequency and percentage was used to describe categorical data when appropriate. Multiple numeric variables was calculated by ANOVA (One way analysis of variance) at

Figure 1: (a) Preblock inter incisor distance measured using Vernier's calipers. (b) The midpoint of the lower border of the arch was taken as point of entry. (c) Post block Interincisor distance measured using Vernier's calipers at 2, 5,10,15,20,25 and 30 minutes

different intervals of time and Post hoc test (Tukey's test) was used for variables between two different time intervals. $P < 0.05$ was taken as significant.

Results

Consort flow diagram of fifty patients is shown in Figure 2. 5 patients not meeting the inclusion criteria were excluded from study and two denied participation. One patient was excluded as the block failed, due to performance glitches. Thus, finally forty two patients were taken in our study. Mean age of patients was 27.02 ± 4.84 years and out of them 38 (90.4%) were males. [Table 1]. The interincisor distance measured pre block was 1.20 ± 0.32 mm and was significantly increased after 5 minutes onwards from the block. [Table 2]. The VAS score determined pre block was 5.14 ± 1.37 which significantly decreased just 2 minutes after the application of block [Table 3]. Hemodynamics changes observed were not significant [Table 4] was. One patient got localized swelling and two patient got hematoma during the procedure but was treated conservatively [Table 5].

Table 1: Demographic characteristics

Variables	Mean±SD
Age (years)	27.02±4.84
BMI (kg/m^2)	23.90±2.15
Weight (kg)	62.14±9.58
Height (mt)	1.61±0.05
Gender	Male- 38 (90.4%) Female- 4 (9.5%)

Discussion

Incidence of Mandibular fractures is upsoaring because of the fast pace of today's youth. Demographically documented is that male gender is involved in around 80% of cases belonging to age group of 18-54 years[10] thus contemplating the need of safe and effective treatment. Mandibular fractures cause various complications ranging from infection, malocclusion, nonunion, delayed union, as well as neurological deficits.[11] Delay or ineffective treatment can lead to subsequent implications like osseous callus being malformed, facial depression, ankylosis of temporomandibular joint and mandibular hypoplasia.[12] In 17.5% to 52% of cases condylar process fracture is involved out of which 80% is unilateral in nature.[13] In a clinical retrospective case control study conducted by Hai-Hua–Zhou concluded that 23 out of 25 patients, 92%) with fracture of coronoid showed restricted mouth opening.[14] Limited mouth opening is because of contributory effects from factors such as masticatory muscle spasm, inflammation and mechanical obstruction.[15] Factually, it was seen that for patients who had restricted mouth opening, the probability of undergoing surgical treatment was high (OR = 2.118).[14] The odds ratio dropped to 0.703-fold for patients with normal mouth opening.

Failure to provide adequate oxygen to the patient even for a brief span of time can be life threatening. Challenging bag and mask ventilation, laryngoscopy and intubation account for 17% of respiratory related complications during general anesthesia. As a fact, around 30% of anesthesia related morbidities is because of inability to mask ventilate or intubate.[16]

Graham Cobb *et al*.[17] had observed difficult airway predictors like mandible fracture, Mallampati score, and interincisal opening during preanaesthetic evaluation. Dhanrajani PJ[3] studied 779 patients of facial trauma and found that spasm and inflammation of masticatory muscles make them stiff and swollen leading to varying degree of limited mouth opening.

Range of mouth opening is an important indicator of difficulty encountered during airway manipulation.[9] It becomes hard to determine if the patient is having restricted mouth opening only because of the pain or due to other factors such as swelling, spasm or mechanical obstruction. In those patients who have restricted mouth opening only due to pain, adequate analgesia can help in achieving sufficient mouth opening in order to assess the airway providing clue to any difficult airway prediction eventually helping in planning of airway management during induction of anesthesia.

Mandibular nerve supplies motor innervations to muscles involved in mastication and sensory supply to temporomandibular joint.[18] Mandibular nerve blocks have been successfully used in treatment of trismus and muscle

Table 2: Mouth Opening of studied patients at different time intervals

	Mouth Opening							
	Pre Block	Time Post Administration of Mandibular nerve block (Minutes)						*P*
	PB	2 MIN	5 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN	
Mean±SD	1.20±0.32	1.30±0.27	1.40±0.26	1.67±0.22	1.97±0.25	2.23±0.28	2.33±0.26	2.35±0.26	
P: Total intergroup significance									0.003
P1 Significance between PB and 2 MIN									0.729
P2: Significance between PB and 5 MIN									0.026
P3: Significance between PB and 10 MIN									0.058
P4: Significance between PB and 15 MIN									0.001
P5: Significance between PB and 20 MIN									0.001
P6: Significance between PB and 25 MIN									0.001
P7: Significance between PB and 30 MIN									0.001
F: one way ANOVA									133.421

P<0.05 (significant), *P*>0.05 (Non-significant)

Table 3: Visual Analogue Score (VAS) at different time intervals

	Visual Analogue Score (VAS)								
	Pre Block	Time Post Administration of Mandibular nerve block (Minutes)							*P*
	PB	2 MIN	5 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN	
Mean±SD	5.14±1.37	4.17±1.17	3.00±1.10	1.14±0.95	0.83±0.73	1.02±0.56	1.02±0.68	1.12±0.80	
P: Total intergroup significance									0.001
P1 Significance between PB and 2 MIN									0.001
P2: Significance between PB and 5 MIN									0.001
P3: Significance between PB and 10 MIN									0.001
P4: Significance between PB and 15 MIN									0.001
P5: Significance between PB and 20 MIN									0.001
P6: Significance between PB and 25 MIN									0.001
P7: Significance between PB and 30 MIN									0.001
F: one way ANOVA									131.629

P<0.05 (significant). *P*>0.05 (Non-significant)

Table 4: Hemodynamic Variables of the studied patients

	Hemodynamic Variables		Heart Rate (HR)	Systolic Blood Pressure (SBP)	Diastolic Blood Pressure (DBP)	Mean Arterial Pressure (MAP)
Mean±SD	Pre Block	PB	81.19±5.10	124.38±8.80	83±7.63	96.79±7.60
	Post Block	2 MIN	80.21±6.28	120.47±8.63	79.33±7.64	93.04±7.64
		5 MIN	79.76±6.98	120.07±9.20	79.11±8.16	92.95±7.97
		10 MIN	81.14±5.35	120.38±9.44	79.52±6.44	93.09±6.69
		15 MIN	82.07±5.28	120.73±8.99	79.54±6.94	93.27±7.01
		20 MIN	83.61±5.49	121.11±8.49	79.85±6.65	93.61±6.68
		25 MIN	81.11±5.22	121.71±9.47	79.61±6.48	93.64±6.78
		30 MIN	79.76±6.34	120.23±8.06	79.94±7.02	93.11±5.84
F (one way ANOVA)				1.076	1.348	1.379
P (Total intergroup significance)			*P*>0.05	*P*>0.05	*P*>0.05	*P*>0.05

P<0.05 (significant), *P*>0.05 (Non-significant)

Table 5: Complications observed

Symptoms	Number of patients	Percentage
Swelling	1	2.3%
Facial nerve palsy	Nil	0
Hematoma	2	4.6%
Allergic reaction	Nil	0

spasm. It can be helpful in differentiating the cause of restricted mouth opening. If the cause is pain, adequate analgesia can be achieved with mandibular nerve block. Range of mouth opening can then be assessed which guide's in choosing the mode of airway intervention needed eventually helping in optimal use of resources available.

The results of our study showed that hemodynamics were not significantly changed among Pre block and within 30 mins of Post Block. There was significant difference in the mouth opening at 5 min, 10 min, 15 min, 20 mins and 30 mins Post

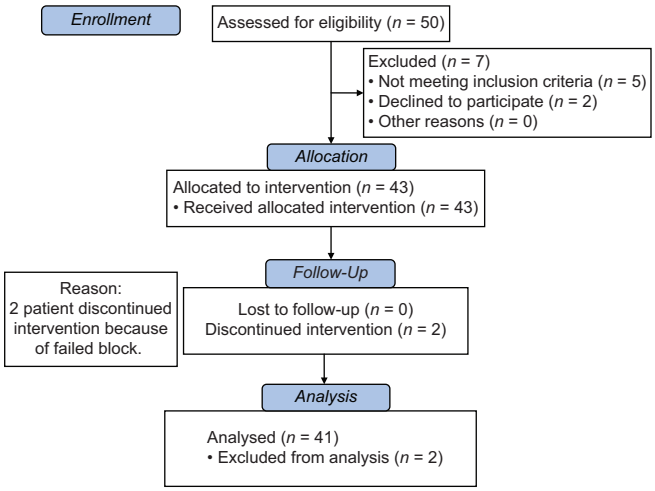

Figure 2: Consort flow diagram

Block (Preblock- Mean 1.2 cm ± 0.32 to 2.35 cm ± 0.26 at 30 mins), which could drastically change our plan of airway management. In a study conducted by Shah N. *et al*.[16] drafted that the inter incisal mouth opening required for direct nasotracheal intubation was 1.54 cm, fiberoptic guided laryngoscope is 0.9 cm and blind nasal intubation is 0.5 cm in patients having submucosal fibrosis. Heard A.M.B.[9] concluded that there was significant (p = 0.027) improvement observed in inter-incisor opening after mandibular block (median (range) distance during pre-block and post-block were 16.5 (14–30) and 34 (32–35) mm respectively There was no further change after induction 37 (30–40) mm; $P = 0.276$ as compared with post-block. Various studies have showed that minimum mouth opening required for the conventional laryngoscopy is 3 cm and for supraglottic device insertion is 2 cm. The VAS score was also documented in our study which showed significant decrease in pain from Preblock (5.14 ± 1.37) in all the time frames studied. A case series conducted by Parate L.H. *et al*. on 3 patients using three different approaches to mandibular nerve block in decreasing pain for oral carcinoma patient showed the high effectiveness of this block for improving the quality of life of these patients (VAS decreased from 9 to 2).[19]

A study by Plantevin F[20] done on 42 patients posted for oropharyngeal carcinoma surgery documented significant decrease in both number of patients experiencing pain on 1st postoperative day (3 vs 10. respectively, $P < 0.05$) as well as consumption of morphine in patients given mandibular nerve block group. No significant complications like paresthesia, hematoma, facial nerve palsy were seen in our study.

Being a non-emergent surgery patients posted for mandibular fixation have to suffer pain for which also this is a quick, easy and accessible approach with rare complications associated.

Thus, In comparison to other techniques of relief of trismus like botulinum injection and physiotherapy this a highly feasible approach to follow preoperatively to help relieve pain and aid in anesthetist decision making on how to tackle the airway.

Strength of study

It was that we used Peripheral nerve stimulator which will increase our accuracy as well decrease the complication rate plus is better than Ultrasound guided approach because of the deep seated nature of the nerve and bony structures surrounding it. It was an observational study so no patient was devoid of the pain relief and equal chance was given to all for change in plan of airway management.

Limitation of our study

It was that small sample size was taken and this could be regarded as our first stepping stone in this direction. The study could not be blinded as the patient knew (case and control were the same), block provider and observer were the same thus affecting the precision of the study. Bilateral mandibular nerve block has been used for analgesia[21,22] but it is fraught with increased risk of suffocation or respiratory distress due to lack of tongue control and collection of fluid in the oral cavity.[23] For the issue of safety concerns of bilateral mandibular nerve blocks, we decided to proceed with our study using unilateral mandibular blocks in unilateral mandibular fractures.

Conclusion

On the basis of our observations we documented that mandibular nerve block decreases the pain and will aid in the decision making by an anesthetist regarding airway management as it helps in increasing the inter incisor distance significantly. Moreover, given the feasibility and effectiveness of the block it could be included in standard of care protocol for mandibular fracture patients.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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