Trigemino-Cardiac Reflex: A Phenomenon Neglected in Maxillofacial Surgery?

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Abstract

Background Trigemino-cardiac reflex is a physiologic response of the body to pressure effects in the region of distribution of the trigeminal nerve. Oral and maxillofacial surgical procedures can induce the development of this reflex, which leads to significant changes in the heart rate and sinus rhythms. This study intends to evaluate the effects of this reflex in patients with facial fractures and its subsequent management.

Patients and Methods A total of thirty-seven patients with facial fractures who reported to the Department of Oral and Maxillofacial Surgery at Basaveswar Teaching and General Hospital, Gulbarga during a period from July 2015–March 2016 were considered for the study.

Results A male preponderance is observed with the most susceptible age group being 21–30 years. Twenty-three patients sustained mid-facial fractures alone, nine patients had isolated mandible fractures and five patients had fractures of both the mid-face and mandible. A relative bradycardia was observed in the patients with mid-facial

trauma, both at the time of presentation and also during the surgical reduction of midfacial fractures which improved after completion of procedure in most of the patients. However, in two patients, the bradycardia progressed to a cardiac asystole during midface manipulation which required immediate halt of the procedure and intravenous administration of atropine.

Conclusion Trigemino-cardiac reflex though physiologic, which usually tends to subside without complications is not to be neglected in the surgeries of the maxillofacial skeleton. A propensity for unforeseen complications due to this reflex has to be avoided by meticulous monitoring of the ECG.

Keywords Trigemino-cardiac reflex · Trigeminal nerve · Midface fractures · Bradycardia

Introduction

Trigemino-cardiac reflex (TCR), earlier known as the oculo-cardiac reflex (OCR) is a cascade of physiological reactions secondary to the pressure effects in the distribution of the largest cranial nerve, the trigeminal nerve [1].

This aforesaid reflex precipitates effects; severe bradycardia and asystole, which may be unobtrusive yet are potential complications whilst the surgical manipulation of the mid-face either for facial fractures, soft tissue reconstruction, or orthognathic surgery involving the maxilla. It is crucial for the operating maxillofacial surgeon to be cognizant of the development of these effects.

This study intends to evaluate the severity of bradycardia and asystole during the surgical manipulation of mid-facial fractures under general anesthesia.

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Fig. 1 Distribution of case gender wise

Fig. 2 Distribution of case age wise

Patients and Methods

To achieve the study aims, patients reporting, with maxillofacial fractures, to the department of oral and maxillofacial surgery, Basaveshwar Teaching and General Hospital, Gulbarga, during the period, July 2015–March

2016 were enrolled. They were subjected to Pre-operative blood investigations, ECG and chest X-ray and those who showed no abnormalities in the investigations were selected for the study.

Patients with a history of cardiovascular disease and an age of above 60 years were excluded from the study. All the cases were assessed and treated by the same group of maxillofacial surgeons and anesthetists. The other concomitant injuries to the body were treated by pertinent consulting specialists in these patients.

Statistical Analysis

The descriptive analysis of data obtained was done using SPSS-16.0.

Results

This study involved 37 patients who sustained maxillofacial fractures. There was a male preponderance with male to female ratio of 5:1 (Fig. 1).

The most susceptible age group observed in the study is 21–30 years (Fig. 2).

Of the thirty-seven patients, twenty-three patients had isolated mid-facial fractures, nine patients had isolated mandible fractures and five patients had fractures of both the mid-face and mandible (Fig. 3). A significant bradycardia was observed in the patients with mid-facial fractures which spontaneously improved after cessation of stimuli in twenty-one of the twenty-three patients, while in two patients, bradycardia progressed to cardiac asystole, which required intravenous administration of atropine for management (Table 1).

Fig. 3 Distribution of a/c pattern of fracture

Table 1 Distribution of cases based on age, sex, fracture site, pre-op heart rate, intra-op heart rate, post-op heart rate and presence or absence of bradycardia

Sl. no.	Name	Age	Sex	Fracture site	Pre op heart rate	Intra op heart rate	Post op heart rate	Bradycardia (present or absent)
1	Manoj	32	Male	RT. ZMC	60	40	72	Present
2	Kalyan	22	Male	LT. ZMC and symphysis	55	38 during midface reduction and 66 during mandible reduction	66	Present during midface reduction
3	Basavaraj	36	Male	RT ZMC and zygomatic arch	53	36	68	Present
4	Ahmed	18	Male	LT ZMC and zygomatic arch	60	42	74	Present
5	Eramma	47	Female	Mandibular symphysis	82	78	80	Absent
6	Subash	24	Male	Lefort I	50	48	82	Present
7	Anil	41	Male	Mandibular parasymphysis	74	82	78	Absent
8	Maharana	38	Male	Lefort II	62	52	84	Present
9	Abdul	23	Male	Lefort II and mandibular angle	64	45—during midface reduction and 70—during mandible reduction	86	Present during midface reduction
10	Majushree	16	Female	LT ZMC and zygomatic arch	63	44	80	Present
11	Basavaraj	28	Male	RT ZMC and zygomatic arch	58	38	82	Present lead to asystole; managed with i.v atropine intraoperatively
12	Irfan	18	Male	Mandibular symphysis	75	92	74	Absent
13	Ali	34	Male	Bilateral lefort I, LT zmc and para-symphysis	58	41 during midface reduction and 76 during mandible reduction	78	Present during midface reduction
14	Gayatri	29	Female	Lefort I	62	39	78	Present
15	Akbar	33	Male	Rt mandibular angle	74	90	80	Absent
16	Bhimappa	27	Male	LT zygomatic arch	68	28	74	Present; managed with i.v atropine intraoperatively
17	Ramling	54	Male	Bilateral lefort II, RT angle and symphysis	60	34 during midface reduction and 64 during mandible reduction	68	Present during midface reduction
18	Sharanu	26	Male	RT zygoma	70	41	66	Present
19	Afroz	28	Male	Comminuted body of mandible	68	74	75	Absent
20	Raju	29	Male	Lefort I	65	44	72	Present
21	Yallaling	27	Male	RT mandibular parasymphysis	83	76	80	Absent
22	Bhimanna	32	Male	RT ZMC	54	36	68	Present
23	Shivkumar	21	Male	LT zygomatic arch	60	41	72	Present
24	Sharan	27	Male	Lefort II	62	40	68	Present
25	Saibanna	28	Male	LT ZMC	64	44	74	Present
26	Basavaraj	31	Male	RT mandibular parasymphysis	78	82	76	Absent
27	Lingraj	33	Male	RT ZMC and zygomatic arch	63	46	68	Present
28	Suresh	40	Male	LT ZMC and zygomatic arch	70	42	76	Present

Table 1 continued

Sl. no.	Name	Age	Sex	Fracture site	Pre op heart rate	Intra op heart rate	Post op heart rate	Bradycardia (present or absent)
29	Kamlabai	32	Female	RT ZMC and zygomatic arch	58	36	74	Present
30	Veeresh	41	Male	Mandibular symphysis	82	76	78	Absent
31	Bandamma	30	Female	Bilateral lefort I, LT zmc	53	42	68	Present
32	Afroz	18	Male	LT. ZMC	56	36	64	Present
33	Asif	20	Male	RT. ZMC and symphysis	58	39 during midface reduction and 69 during mandible reduction	65	Present during midface reduction
34	Nazia	28	Female	LT ZMC and zygomatic arch	73	46	68	Present
35	Hanumant	24	Male	RT ZMC and zygomatic arch	70	42	74	Present
36	Lalappa	31	Male	RT mandibular angle	74	70	76	Absent
37	Quiser	35	Male	RT zygomatic arch	62	34	78	Present

Discussion

The TCR was originally described as an oculo cardiac reflex in 1908 by both Bernard Ascher and Guiseppe Dagnini [2]. The term Trigemino-cardiac Reflex (TCR) has been suggested by Shelly and Church [3]. It is speculated that the sensory nerve endings of the trigeminal nerve send impulses via the Gasserian ganglion to the sensory nucleus of the trigeminal nerve, forming the afferent pathway of the reflex arc. These neurons then continue in the reticular formation to connect with the efferent pathway in the motor nucleus of the vagus nerve from which the efferent fibers that are cardioinhibitory arise and terminate in the myocardium (Fig. 4). Thus the TCR can be called a ‘Trigeminal–Vagal arc’ that results in a decrease in heart rate [4]. Stimulation of the this reflex can precipitate sudden-onset sinus bradycardia, bradycardia terminating in asystole, asystole with no preceding bradycardia, and hypotension [5].

In this study, all the twenty-three cases with midfacial fractures exhibited bradycardia during surgical manipulation of the fracture site. This can be attributed to the stimulation of the sensory nerve endings of maxillary nerve, in turn leading to the development of the Trigemino-cardiac reflex, through the above mentioned pathway. A more severe fall in the heart rate was observed, during the elevation of zygomatic arch which is similar to the findings of Loewinger et al. [6] and Shearer and Wensione [7] who also observed a fall in heart rate during the reduction of the zygomatic arch. In this series, bradycardia followed by asystole was observed during the elevation of zygomatic arch in a Zygomatico Maxillary Complex fracture.

- (a) Gasserian Ganglion
 (b) Sensory Nucleus of Trigeminal Nerve
 (c) Reticular Formation
 (d) Motor Nucleus of Vagus
 Oph → Ophthalmic division of Trigeminal Nerve
 Max → Maxillary division of Trigeminal Nerve
 Mand → Mandibular division of Trigeminal Nerve

Fig. 4 a Gasserian ganglion, b Sensory nucleus of trigeminal nerve, c Reticular formation, d Motor nucleus of vagus. Oph, ophthalmic division of trigeminal nerve; Max, maxillary division of trigeminal nerve; Mand, mandibular division of trigeminal nerve

Coincidentally, a Cardiac asystole was observed by Baiton and Lizi during surgery for zygomatic arch fracture [8]. It is observed through this study that the patients with mid-facial fractures had relatively lower heart rates at the time of presentation. This finding concurs with the observations of Kosaka et al. [9] who observed OCR induced by fracture

zygoma. The incidence of development of bradycardia during maxillofacial surgical procedures was reported to be 1.6 % by Precious and Skulsky [10]. This study did not observe development of bradycardia during mandibular fracture reduction.

In this series, unforeseen complications due to the TCR were not reported, as the heart rate improved spontaneously after cessation of stimuli in nine of the eleven patients while in two patients who developed severe bradycardia and subsequent asystole, the procedure was halted and intra-operative infusion of intravenous atropine (0.6 mg) was given. Once the heart rate was regained to baseline, the procedure was completed uneventfully. Post-operatively, the heart rate restored to the normal range in all of these patients. Ragano et al. [11] managed the intraoperative dysrhythmia with both atropine and glycopyrrolate that allowed the down fracture of maxilla to continue without further occurrence of dysrhythmia.

Exercising prudence during the maxillofacial surgical procedures will avoid unanticipated consequences due to this reflex, as, at least 60 deaths due to the oculo-cardiac reflex have been reported in literature [12].

Devakumari et al. also surmised that most cases of TCR are associated with only a 10–50 % heart rate reduction that usually returns back to baseline upon cessation of stimuli, failing which atropine and glycopyrrolate should be administered intravenously [1].

Arasho et al. have outlined the management of TCR as following:

1. Identification of risk factors and their modification.
2. Prophylactic treatment using vagolytic drugs and/or peripheral nerve blocks in procedures involving manipulation of V5.
3. Cardiovascular monitoring during anaesthesia [13].

A wide range of maxillofacial surgeries and oral surgical procedures are performed under local anesthesia, during which TCR may be precipitated and its significance should not be underrated. The first step in treatment is to recognize the bradycardia. The reflex has varied features ranging from sudden onset of sinus bradycardia, bradycardia terminating in asystole, asystole with no preceding bradycardia, arterial hypotension, apnea, and gastric hypermobility [1].

Conclusion

During the manipulation of the midface trauma, the awareness of the possible development of ECG changes due to the TCR is essential to both the anesthetist as well as

the operating surgeon. Though an effect of the surgery which usually subsides upon cessation of stimuli, TCR has the potential to become fatal. This study is to persuade the perception of this significant effect in maxillofacial surgery and be equipped to manage the same in severe cases to prevent undesirable consequences.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Informed Consent “Informed consent was obtained from all individual participants included in the study.”

Ethical Approval “All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.”

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