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Trigemino Cardiac Reflex and Its Importance in Maxillofacial Surgery- A Review

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Abstract: *Trigemino cardiac reflex (TCR) is a sudden physiological response due to the pressure effect or stretching of the largest cranial nerve, the trigeminal nerve.TCR is a triad of bradycardia ,bradypnea and gastric motility changes due to the efferent activation of the vagal nerve in response to the pressure distribution in V_5.TCR was originally called as oculo cardiac reflex (OCR) and the terminology was changed because the response is not only limited to the ophthalmic branch ,but for the entire nerve V_5.Activation of TCR is seen in post traumatic patients and during surgical manipulation in cranio facial surgeries.TCR is more common in children with orbital fractures and in extra ocular surgeries. It is well documented in cases of ophthalmic injuries and ocular surgeries. It is imperative to know about this sudden physiological response in maxillofacial surgery which is bound to happen with any oral surgical procedures ranging from extractions, elevation of palatal flaps to maxillary disimpactions.*

Knowledge of the TCR is essential as it may mimic a closed cranial injury or a cardiac dysarrythmia in a post traumatic patient to avoid unwarranted surgical intervention. A detailed ophthalmic examination in maxillofacial injuries is essential. Whenever surgery is planned in maxillofacial region and if TCR is anticipated a discussion with the anaesthesiologist is mandatory. This paper reviews about the clinical papers and abstracts on TCR relevant to maxillofacial surgery.

Keywords: *Achener Phenomenon, bradycardia, Oculocardiac reflex, Trigeminocardiac reflex, Trigemino-vagal reflex.*

I. Introduction

Trigemino cardiac reflex, previously called as oculo cardiac reflex is a cascade of physiological reactions secondary to the pressure effects in distribution of the largest cranial nerve - the trigeminal nerve. This unexpected phenomenon is usually seen in orbital injuries and during surgical manipulation of craniofacial structures in the distribution of trigeminal nerve. Maxillofacial surgeons should be aware of this phenomenon of TCR even though it is not common in day to day practise.

II. Discussion

Background

. Florian Kratschmer described the influences of reflexes produced by nasal mucosa on breathing and circulation[1]. Schaller described development of cardiac dysrhythmia upto asystole, arterial hypotension, apnoea and gastric hypermotility on manipulation of nasal mucosa on cats and rabbits[2]. Kumada et al in 1977 described the reflex bradycardia through neural stimulation in rabbits [3]. It is well documented that stimulation of nasal mucosa causes bradycardia, bradypnea and blood pressure changes and these reflexes were abolished by applying local anaesthetics to the distribution of V_5 nerve [4].

The TCR was first described as oculo cardiac reflex in 1908[5]. OCR was described as pressure induced neural reflex that causes cardiac depression through the stimulation of vagal nerve. Change of ten percent or more in the heart rate or dysrhythmia as compared to the control was taken as positive OCR [6]. This cascade of symptoms is not only limited to the ophthalmic branch of V_5, they are induced by pressure effects or stretching of entire division of V_5 and hence Shelly and Church coined the term trigemino cardiac reflex[7].

Mechanism

The afferent limb is the sensory fibres of the trigeminal nerve which sends signals to trigeminal sensory nucleus via Gasserian ganglion. The afferent arm is connected to the efferent pathway via short internuncial fibres in the reticular formation and connecting the motor nucleus of the vagus nerve. The efferent travel and end in muscuranic receptors of heart causing vagus mediated negative chronotropic and ionotropiic responses in the heart. The efferents also travel to the stomach which increases gastric motility.

TCR is actually endogenous physiological protective mechanisms found in brain against ischemia. It is one of the oxygen conserving reflexes. Within seconds of initiation of such reflex, there is activation of sympathetic nerves which leads to cerebro vascular vasodilatation. These responses are exaggerated and put the patient at risk .During initial period of vagal stimulation,the cardiac depression is peak leading to sinus arrest , asystole or ventricular fibrillation [8] .

Maxillofacial Literature Review

I) TCR reported in fracture orbit and zygoma and its management

AUTHOR	YEAR	TCR observed
Baiton and Lizi[9]	1987	Cardiac asystole during surgery for zygomatic arch fracture
Loewinger et al[10]	1987	Bradycardia - elevation of zygomatic arch
Shearer and Wensione[11]	1987	Bradycardia - elevation of zygomatic arch
Kosaka et al [12]	2000	OCR induced by fracture zygoma. Initial diagnosis was total A-V block. Patient underwent cardiac pacing. After fracture repair, the dysrhytmia disappeared and pacemaker removed on first post operative day
Lynch and Parker[13]	2000	Bilateral penetrating ocular injuries
Yilmaz[14] et al	2006	TCR developed after 48 hours in an orbital trauma patient with intra orbital metallic foreign body
Schaller[15] et al	2006	Delayed TCR induced by intra orbital foreign body
Lubbers[16] et al	2010	TCR observed during repositioning of zygoma and optic nerve manipulation

II) TCR reported in minor oral surgeries

Cha et al[17]	2002	Asystole during bilateral peripheral rhizotomies to treat trigeminal neuralgia
Webb and Unkel[18]	2007	TCR observed during flap elevation for removal of mesiodens
Arakeri and Arali[19]	2010	TCR observed during extraction of tooth
Krishnan et al[20]	2011	Recommendation on use of suitable nerve blocks to prevent TCR in maxillofacial surgery

III) TCR reported in maxillary and mandibular osteotomies

Reaume and McNicol [21]	1988	TCR observed during Lefort I osteotomy in a patient of mandibulofacial dysostosis
Ragno et al[22]	1987	Several episodes of ventricular asystole during downfracture of maxilla (Lefort I osteotomy)
Precious and Skulsky[23]	1990	Bradycardia or asystole during advancement of maxilla
Lang et al[24]	1991	Combination of bradycardia and asystole during maxilarry and mandibular osteotomies

Bohuli et al[25]	2010	TCR observed in maxillary osteotomies
Bohuli et al [26]	2011	TCR in mandibular osteotomies
Robideaux [27]	1978	OCR during mid face disimpaction
Bainton et al [28]	1990	Sinus arrest during bitemporal approach for treatment of panfacial fracture
Precious and Skulsky[23]	1990	TCR during manipulation of temporalis muscle grafting in a case of total bony ankylosis
Roberts et al [29]	1999	TCRobservedduring temporomandibular joint arthroscopy in a 29 year old woman
Puri et al [30]	2011	TCR in juvenile nasopharyngeal angiofibroma embolisation
Potti et al[31]	2011	TCR in percutaneous injection of ethylene vinyl alcohol copolymer in a juvenile nasopharyngeal angiofibroma
Yorgancilar et al[32]	2012	TCR observed in 8.3% of study patients following lateral osteotomies and nasal pyramid fracture procedures in rhinoplasty
Wartak et al [33]	2012	TCR observed in a facial injury in a 56 old male
Schames et al[34]	2012	Sleep bruxism as a cause for inducing TCR

Predisposing Factors

Hypercarbia, hypoxemia, insufficient anaesthesia and nature of stimulus are the pre disposing factors. It is more in children because of high resting vagal tone[2] . It is observed that OCR normally fatigues with repetitive stimuli [24]. Lubbers et al [16] classified various facial surgery into low (TMJ surgeries , Le Fort I osteotomy, elevation of zygoma) , medium (skull base surgeries) , high risk surgeries (ophthalmic surgeries, orbital exenteration and fracture in children with cardiac disease) for the precipitation of TCR. Campbell R et al [35] tabulated the risk factor that precipitated TCR (table 1). So it is imperative for any craniofacial surgeon to know about TCR.

Predisposing and risk factors for trigeminocardiac response- Table 1

	PREDISPOSING AND RISK FACTORS
1	Children
2	Males
3	High sympathetic activity
4	Hypoxemia
5	Hypercarbia
6	Light anaesthesia
7	Neuromuscular blockers
8	Opiods
9	β Adrenergic blockers
10	Strength and duration of stimulus

Prevention and Management

Incidence of TCR is bound to occur with any type of oral surgical procedures and hence its importance should not be under estimated. Arasho et al [36] had summarised 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 V_5
3. Cardiovascular monitoring during anaesthesia

Most importantly, preoperative infiltration of the possible afferent pathway to achieve local anaesthesia should block the response and is highly recommended in craniomaxillofacial surgeries involving manipulation of the trigeminal nerve branches. Prophylactic administration of glycopyrolate is debatable. The type of stimulus, strength and the duration of stimulus are to be considered. The depth of anaesthesia is an important factor. In deeper anaesthesia planes, the activation of TCR is minimal. Controlled ventillation is absolutely essential in

monitoring of arterial oxygen saturation and end tidal CO2 to prevent hypercarbia and hypoxemia. Interaction between the anaesthetist and surgeon before the surgery and during the surgical procedure especially when a traction or elevation is done in craniofacial region is important

Pharmacological agents such as potent narcotics like sufentanil and alfentanil, beta-blockers, and calcium channel blockers may predispose to OCR. The clinical importance of the TCR lies in the fact that its clinical features range from sudden onset of sinus bradycardia, bradycardia terminating asystole, asystole with no preceding bradycardia, arterial hypotension, apnea, and gastric hypermobility. Recognition of bradycardia is the first step in treatment.

Most cases are associated with only a 10% to 50% heart rate reduction and sinus rhythm usually returns to baseline upon stimuli cessation. Most cases of TCR will therefore resolve spontaneously without any other therapeutic measures. If resolution does not happen during a reasonable amount of time after cessation of the evolving surgical manoeuvre, atropine or glycopyrrolate should be administered intravenously. Atropine would be given before epinephrine only if bradycardia was thought to be attributable to vagal stimulation and not due to some other cause such as hypoxia.Cardiac massage should be reserved for the cases in which routine treatment measures fail to reestablish the expected cardiac activity.

III. Conclusion

Maxillofacial surgeons should be familiar with TCR to combat with this sudden physiological response which may be even fatal at times .The key points that should be kept in mind are:

1. Abrupt and sustained traction of craniofacial structures should be avoided
2. Administration of regional nerve block in the operating site especially if hypotensive anaesthesia is planned
3. Administration of glycopyrolate (vagolytic agent) + lignocaine prophylactically
4. Continuous cardiac monitoring, adequate oxygenation and watching for additional CO2 waves
5. If TCR found to be activated, removal of stimulus and administration of glycopyrolate is to be done
6. If refractory to vagolytic drugs, epinephrine is to be added.
7. Cardiac massage is reserved for cases where normal cardiac activity is not established with above treatment

References

[1]. Widdicombe J. Kratschmer and nasal reflexes. Respir Physiol 2001;127:89-91.
[2]. Schaller B. Trigeminocardiac reflex. A clinical phenomenon or a new physiological entity? J Neurol 2004;25:658-65.
[3]. Kumada M, Dampney RA, Reis DJ (1977) The trigeminal depressor response: a novel vasodepressor response originating from the trigeminal system. Brain Res 119:305–326
[4]. Blanc VF. Trigeminocardiac reflexes. Can J Anaesth 1991;38:696-9.
[5]. Ashner, B. : Concerning a hitherto not yet described reflex from the eye on circulation & respiration, Wien, Klin, Woschanschr, 1908, 21, 1529-30
[6]. Apt. L ; Isenberg, S. & Gaffney, W.L. : The oculocardiac reflex in strabismus surgery. Amer. J. Ophthalmol, 1973 , 76. 533-35
[7]. Shelly MP, Church JJ. Bradycardia and facial surgery [letter]. Anaesthesia 1988;43:422.
[8]. Roberts RS, Best JA, Shapiro RD. Trigeminocardiac reflex during temporomandibular joint arthroscopy: report of a case. J Oral Maxillofac Surg 1999;57:854-6.
[9]. Bainton R, Lizi E. Cardiac asystole complicating zygomatic arch fracture. Oral Surg Oral Med Oral Pathol 1987;64:24-5. 10
[10]. Loewinger J, Cohen M, Levi E. Bradycardia during elevation of a zygomatic arch fracture. J Oral Maxillofac Surg 1987;45: 710-1.
[11]. Shearer ES, Wensione R. Bradycardia during elevation of zygomatic fractures. Anaesthesia 1987;42:1207-8.
[12]. Kosaka M, Asamura S, Kamiishi H. Oculocardiac reflex induced by zygomatic fracture: a case report. J Craniomaxillofac Surg 2000;28:106-9.
[13]. Lynch MJ, Parker H (2000) Forensic aspects of ocular injury. Am J Forensic Med Pathol 21(2):124–126
[14]. Yilmaz T, Erol FS, Yakar H, Ko¨hle U, Akbulut M, Faik Ozveren M (2006) Delayed trigeminocardiac reflex induced by an intraorbital foreign body. Case report. Ophthalmologica. 220(1):65–68
[15]. Schaller BJ, Buchfelder M (2006) Delayed trigeminocardiac reflex induced by an intraorbital foreign body. Ophthalmologica 220(5):348
[16]. Lu¨bbers HT, Zweifel D, Gra¨tz KW, Kruse A (2010) Classification of potential risk factors for trigeminocardiac reflex in craniomaxillofacial surgery. J Oral Maxillofac Surg 68(6):1317–1321
[17]. Cha ST, Eby JB, Katzen JT, Shahinian HK. Trigeminocardiac reflex: a unique case of recurrent asystole during bilateral trigeminal sensory root rhizotomy. J Craniomaxillofac Surg 2002; 30:108-11.
[18]. Webb MD, Unkel JH (2007) Anesthetic management of the trigeminocardiac reflex during mesiodens removal—a case report. Anesth Prog. 54(1):7–8
[19]. Arakeri G, Arali V (2010) A new hypothesis of cause of syncope: trigeminocardiac reflex during extraction of teeth. Med Hypotheses 74(2):248–251
[20]. Krishnan B (2011) Re: classification of potential risk factors for trigeminocardiac reflex in craniomaxillofacial surgery. J Oral Maxillofac Surg 69(4):960
[21]. Reaume CE, MacNicol BM. Complications encountered during LeFort I osteotomy in a patient with mandibulofacial dysostosis. J Oral Maxillofac Surg 1988;46:1003-4.
[22]. Ragno JR Jr, Marcoot RM, Taylor SE. Asystole during Le Fort I osteotomy. J Oral Maxillofac Surg 1989;47:1082-3.
[23]. Precious DS, Skulsky FG. Cardiac dysrhythmias complicating maxillofacial surgery. Int J Oral Maxillofac Surg 1990;19:279-82.
[24]. Lang S, Lanigan DT, van der Wal M. Trigeminocardiac reflexes:maxillary and mandibular variants of the oculocardiac reflex.Can J Anaesth 1991;38:757-60.
[25]. Bohluli B, Bayat M, Sarkarat F, Moradi B, Tabrizi MH, Sadr-Eshkevari P (2010) Trigeminocardiac reflex during Le Fort Iosteotomy: a case-crossover study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 110(2):178–181

[26]. Bohluli B, Schaller BJ, Khorshidi-Khiavi R, Dalband M, Sadr-Eshkevari P, Maurer P (2011) Trigeminocardiac reflex, bilateral sagittal split ramus osteotomy, Gow-Gates block: a randomized controlled clinical trial. J Oral Maxillofac Surg 69(9):2316–2320
[27]. Robideaux V. Oculocardiac reflex caused by midface disimpaction. Anesthesiology 1978;49:433.
[28]. Bainton R, Barnard N, Wiles JR, Brice J. Sinus arrest complicating a bitemporal approach to the treatment of pan-facial fractures. Br J Oral Maxillofac Surg 1990;28:109-10.
[29]. Roberts RS, Best JA, Shapiro RD (1999) Trigeminocardiac reflex during temporomandibular joint arthroscopy: report of a case. J Oral Maxillofac Surg 57(7):854–856
[30]. Puri AS, Thiex R, Zarzour H, Rahbar R, Orbach DB (2011). Trigeminocardiac reflex in a child during pre-Onyx DMSO injection for juvenile nasopharyngeal angiofibroma embolization. A case report. Interv Neuroradiol 17(1):13–16
[31]. Potti TA, Gemmete JJ, Pandey AS, Chaudhary N (2011) Trigeminocardiac reflex during the percutaneous injection of ethylene vinyl alcohol copolymer (Onyx) into a juvenile nasopharyngeal angiofibroma: a report of two cases. J Neurointerv Surg 3(3):263–265 Epub 2010 Dec 16
[32]. Yorgancilar E, Gun R, Yildirim M, Bakir S, Akkus Z, Topcu I (2012) Determination of trigeminocardiac reflex during rhinoplasty. Int J Oral Maxillofac Surg 41(3):389–393
[33]. Wartak SA, Mehendale RA, Lotfi A (2012) A unique case of asystole secondary to facial injury. Case Rep Med 2012:382605
[34]. Schames SE, Schames J, Schames M, Chagall-Gungur SS (2012). Sleep bruxism, an autonomic self-regulating response by triggering the trigeminal cardiac reflex. J Calif Dent Assoc 40(8): 670-1–674-6
[35]. Campbell R, Rodrigo D, Cheung L. Asystole and bradycardia during maxillofacial surgery. Anesth Prog 1994;41:13-6.
[36]. Arasho B, Sandu N, Spiriev T, Prabhakar H, Schaller B (2009) Management of the trigeminocardiac reflex: facts and own experience. Neurol India 57(4):375–380