Acta Scientific Otolaryngology (ISSN: 2582-5550)

Volume 5 Issue 5 May 2023

Research Article

Concussion and Maxillofacial Traumatic Injuries - A Retrospective Analysis

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Received: March 17, 2023

Published: April 24, 2023

Abstract

Aim: To assess and associate the prevalence of concussion with traumatic cranio-maxillo-facial injuries.

Settings: Maxillofacial trauma is proven to be associated with varying degrees of traumatic head injuries of which concussion is the most common and deceiving. It is imperative to rule out the prevalence of concussion post-trauma since it often bears a risk of progressive brain injury if left neglected.

Methods: A retrospective analysis of 3350 patients reporting to the emergency department of a tertiary care centre in Tamil Nadu during March 2017- March 2020 was done. A detailed review of the patients sustaining traumatic cranio-maxillo-facial injuries was done in relation to the demography, trauma, injury sustained, primary and secondary survey, neurological records related to diagnosis of concussion were studied, recorded, and subjected to statistical analysis.

Results: 888 of them sustained cranio-maxillo-facial injuries. 21.9% of them sustained concussion. Of the 194 patients with concussion, 134 had no facial fractures and 60 of them sustained facial fractures. Significant correlation between the concussion and traumatic cranio-maxillofacial injuries was observed. Interestingly, correlation between concussion and soft tissue injuries was highly significant with p = 0.001. However there was no significant correlation evident between the type of maxillofacial fracture and the concussion.

Conclusion: Scrupulous examination with detailed history should be done by the surgeon to rule out concussion in every patient sustaining cranio-maxillo-facial traumatic injury to prevent unlikely complications in the future. Also, adequate follow up should be ensured.

Keywords: Concussion; Mild Head Injury; Maxillofacial Trauma; Facial Fractures

Introduction

Often traumatic injuries of the face occur with concomitant injuries of other regions that significantly increase the morbidity, and demands immediate intervention and management [1]. Most commonly associated are the traumatic brain injuries of varying severity which depends on the mechanism of injury and the force of impact. While moderate and severe brain injuries present with obvious symptoms, one that is often overlooked is mild head injury

especially concussion. A concussion is a physical injury to the head causing altered mental status with expected recovery within two to three weeks [2]. This study aims to assess the prevalence and association of concussion with cranio-maxillo-facial traumatic injuries and highlight the importance of the in depth evaluation and follow up of the neurological status of a cranio-maxillofacial trauma patient.

Materials and Methods

This study was carried out after obtaining approval from the Institutional Review Board and in accordance with the Declaration of Helsinki. A cross-sectional, retrospective Uni-center analysis was done on a total of 3350 trauma cases reported to the emergency department of our institution from March 2017 to March 2020. Out of the total 3350 cases, clinical records of 888 patients sustaining cranio-maxillo-facial injuries were analyzed. Data pertaining to the age, gender, mechanism of injury, type of maxillofacial injury sustained, frequency and type of facial fracture, the coexistence of traumatic brain injury, and prevalence of concussion among them was recorded. Type of maxillofacial injury was recorded as soft tissue and hard tissue injury. Hard tissue injuries or facial fractures were divided into isolated mandibular, isolated maxillary that included Lefort type I, type II, type III, isolated zygomaticomaxillary, combined fractures of the mandible and middle third of the face and finally pan facial fractures which involved more than three bony components. Traumatic brain injuries in general and Concussion in particular were identified based on the diagnosis and treatment records of the Department of Neurosurgery of our hospital. All the cases with complete medical records were included in the study. A deficit of information or intervention due to reasons other than traumatic brain injuries were excluded from the study. All the details were recorded and subjected to statistical analysis.

Statistical analysis

The collected data was analysed with IBM.SPSS statistics software 23.0 Version. To describe the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables. Chi-square test was applied and Pearson's correlation was used to find significance between the variables. In all the above statistical tools the probability value .05 is considered as significant level.

Results

The mean age was 31.4 years. 75.8% were males and 24.2% (n = 215) were females. Of the 888 patients, 61.4% (n = 545) sustained soft tissue injuries of the face while 38.6% (n = 343) sustained fractures to the cranio-facial skeleton. Figure 1 presents the type of maxillofacial fractures sustained. Isolated mandibular fractures (n = 148) were predominant followed by isolated zygomatico maxillary complex fractures (n = 77), combined fractures of the mandible and middle third of the face (n = 67), maxillary fractures (n = 37) and finally the pan facial fractures (n = 17). 42.4% of the patients sustained Traumatic head injuries post-trauma. About 21.9% (n = 194) of the total population with maxillofacial injuries sustained concussion. Of the 194 patients with concussion, 134 had no facial fractures and 60 of them sustained facial fractures. Figure 2 represents the distribution of concussion in various fractures of the facial bones. The incidence of concussion in various age groups of the study population is depicted in figure.

Figure 1: Pattern of maxillofacial fractures sustained.

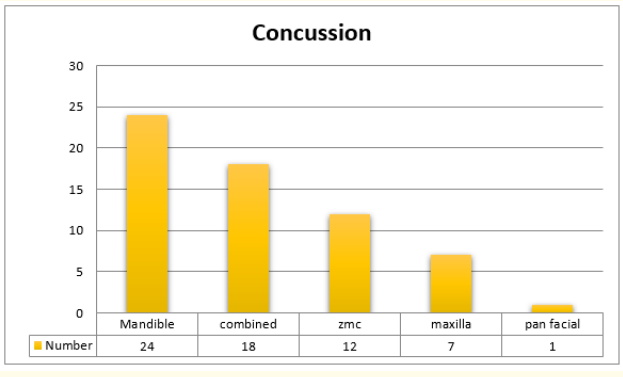

Figure 2: Incidence of concussion in different types of maxillofacial injuries.

Age range	Frequency	Percent
Less than 20	134	15.1
20-40	529	59.6
40-60	194	21.8
More than 60	31	3.5
Total	888	100.0

Table 1a: Distribution of age in the study population.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.036[a]	6	.002
Likelihood Ratio	23.966	6	.001
Linear-by-Linear Association	1.309	1	.253
N of Valid Cases	888		

Table 1b: Correlation between age and prevalence of concussion.

Hard tissue		Type of injury		Total
		Soft tissue		
Concussion	Absent	283	411	694
	Present	60	134	194
Total		343	545	888

Table 2A: Frequency of concussion in hard and soft tissue maxillofacial injury.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.594[a]	2	.014
Likelihood Ratio	9.081	2	.011
Linear-by-Linear Association	8.324	1	.004
N of Valid Cases	888		

Table 2B: Correlation between concussion and types of injury.

Discussion

Extensive research work has been done in the past to study the epidemiology and pattern of maxillofacial traumatic injuries. But when compared to self, data pertaining to the associated injuries to the head is scanty and those existing contradict one another. Several authors believed that face protects the brain like an airbag to the chest in a car injury and act like a cushion preventing massive amount of forces transmitted to the brain [3-5]. But several others found that proximity, complexity and fragility of the facial bones make the cranium more vulnerable to traumatic forces and when applied they produce significant damage to the brain. A strong association of the traumatic head injuries with maxillofacial trauma has been established by them [6-9]. But a maxillofacial surgeon, one among the first few to encounter the trauma patient in the emergency department fails to pay attention to these concomitant head injuries due to the extensiveness of facial injuries that narrows the focus of the surgeon. Sometimes a mild injury of the head like the concussion that is undiagnosed in the emergency could flare up later, showing up symptoms in delay, and put the patient in a fatal risk. This calls up for a scrupulous examination of the patient and rules out such latent injuries before proceeding with the management protocol.

This study was aimed to unveil the often unidentified and underestimated type of mild brain injury, the concussion, significant percentage of which coexists with maxillofacial injuries following trauma. Einsberg., *et al*. described concussion as accelerating or decelerating injury to the brain and stated it to be a transient stage with no organic damage [10]. But Oppenheimer., *et al*. disproved the fact and reported micro damages to the brain do occur however mild the severity of the injury could be [11].

In our study, majority of the patients were among the age group of 20 to 39 years with a mean age of 31.4 years and males were predominantly involved. This could be due to expanding globalisation, escalating traffic accidents and comparatively higher involvement of men in traumatising activities like interpersonal violence, sports etc. There was a significant positive correlation observed between the incidence of concussion and age ($p < 0.005$). This could be attributed to the same amount of forces that cause milder injuries in young adults, causes greater damage in older adults. Giacomin., *et al*. suggested that response to trauma varies

given the anatomic, physiologic and metabolic changes with age, which affects the ability to resist the stresses, higher incidence of complications due to systemic comorbidities reducing their rate of survival. They also highlighted the loss of proprioception and fine senses, loss of bone mineral density and muscle strength make them more vulnerable in sustaining injuries from trauma [12]. 22% of the males and 20.9% of females with maxillofacial injuries sustained a concussion and bears no statistical significance. When correlated with the type of maxillofacial injuries, a significant association of concussion with the former is evident with 17.5% incidence rate in hard tissue injuries and 24.5% incidence rate in soft tissue injuries. This result has an important clinical implication and has already been emphasised with similar results of Rajandram., *et al*. where 18.6% of the patients with maxillofacial soft tissue injuries had sustained concussion [13]. Most of the times, these patients go unnoticed of their brain injury and treated for the soft tissue injury and sent home. Concussion is underrated and they are lost eventually due to improper follow-ups. But this group of people pose a significant threat for complications like exacerbations of the symptoms as in post-concussion symptoms or second impact syndrome of which the latter is highly fatal. Commonly seen in sports injuries but evident also in trauma, second impact syndrome refers to lethal swelling of the brain that occurs when the patient sustains a second episode of traumatic injury to the brain within few days of the first [14]. This potentially causes an emergency catastrophe and might even end the life of the patient. Especially geriatric patients, unidentified discharged patients without symptoms and patients with delayed onset of symptoms are at risk of incurring the second impact syndrome. Very little data focussing on follow up of the patient with mild traumatic brain injury in maxillofacial injuries are present and we highlight the importance of follow up of such patients with an undiagnosed concussion to ensure the health of the patient.

In patients with maxillofacial fractures, other forms of brain injury predominated like the contusion, diffuse and focal injuries. Yet 17.5% of them were found to have incurred concussion. Of the total 343 hard tissue injuries, 43.1% had fractures of the mandible, 22.4% had zygomaticomaxillary complex fractures, 19.5% had combined fractures of the middle third and lower third of the face, 10.7% had isolated maxillary fractures and 4.9% with pan facial fractures. Epidemiological data of several authors concerning the type of maxillofacial fractures and its types portrayed similar results as ours. 12.3% of the patients with concussion incurred mandibular fractures, 9.27% with combined fractures of the mandible and middle third of the face, 6.1% with zygomaticomaxillary complex fractures, 3.6% with maxillary fractures and 0.5% with pan facial fractures. There was no statistical significance observed on correlating the incidence of concussion to the types of maxillofacial fractures. Mulligan., *et al*. observed intracranial haemorrhages and skull fractures to be predominant in patients with fractures of the facial skeleton. This could be attributed to the forces that are high enough to fracture the maxillofacial bones damages the cranium also and other forms of traumatic brain injury predominate in these cases.

Many times, the maxillofacial injuries and their severity tend to divert our attention from the associated injuries of the other organ systems. A lucid patient with no neurologic abnormalities with a Glasgow Coma Scale score of 15 post-trauma is generally considered not to have sustained and trauma to the brain. Kloss., *et al*. suggested that 2.8% of neurologically normal patients after a trauma exhibit some form of traumatic brain injury [15]. Trauma to the head of high magnitude and shorter duration produces acceleration injuries to the brain. Transient cerebral oedema occurs and the effect thereafter produces symptoms of concussion. Concussion was always considered a minor head injury and a clinical condition of altered mental state following a traumatic impact. It was addressed to be an altered conscious state or evidence of amnesia in the patient. But the loss of consciousness is not a prerequisite for diagnosing concussion and other symptoms explained by the patient should be carefully considered. Symptoms might be early or delayed onset. Early symptoms include headaches, dizziness, vomiting, nausea, drowsiness and blurred vision while the late ones include in addition to the above, poor memory, poor concentration, impaired vision, hearing etc [10]. If in doubt one should always opt for radiographic investigations. Although Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) doesn't show any abnormality, newer modalities like functional MRI or fusion tensor imaging accurately recognizes the damage incurred due to concussion [16]. Usually, symptoms resolve in a week or two a potentially fatal complication it entails is the second impact syndrome. Before the symptoms of the first impact subside, if the patient sustains a second concussion, it results in diffuse cerebral oedema and herniation and finally death

of the patient. Post-concussion syndrome is said to have set in if any of the three symptoms occur within less than three weeks from the first loss of consciousness. Concussion is designated simple if the symptoms resolve in ten days and less, if not complex. This depends on the extent and severity of injury and the brain's auto-regulatory mechanism that reverts to the normal functioning.

This study highlights the fact that maxillofacial injuries are significantly associated with injuries to the brain. Concussion though perceived to be mild traumatic injury causes significant morbidity and mortality if neglected. A high index of suspicion should be exhibited during the preliminary examination of the patient with maxillofacial injuries. A significant proportion of the study population who had no facial fractures presented with concussion which alarms the surgeon not to discharge such patients with a cursory glance but to have an in-depth detailing of all the signs and symptoms along with a thorough examination to rule out the presence of associated injuries of the brain.

Conclusion

Prompt diagnosis and early intervention is the key to prevent any grievous morbidity and mortality resulting from the co-existing traumatic brain injuries in maxillofacial trauma. Concussion by itself can be deceiving but most often overlooked due to complex injuries sustained by other organ systems. Onset of late symptoms should be anticipated and adequate follow up of such patients should be done.

Conflict of Interest

Nil.

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