

Original Article

Patterns of brain injuries associated with maxillofacial fractures and its fate in emergency Egyptian polytrauma patients

Adel Hamed Elbaih*, Doaa A. El-sayed, Ahmed E. Abou-Zeid, Ghada K. Elhadary

Department of Emergency Medicine, Faculty of Medicine, Suez Canal University, Ismailia, Egypt

ARTICLE INFO

Article history:

Received 29 September 2017

Received in revised form

21 January 2018

Accepted 7 March 2018

Available online 8 September 2018

Keywords:

Maxillofacial fractures

Brain injuries

Outcome

ABSTRACT

Purpose: Maxillofacial injuries are commonly encountered in the practice of emergency medicine. More than 50% of patients with these injuries have multisystem trauma that requires coordinated management between emergency physicians and surgical specialists in oral and maxillofacial surgery, otolaryngology, plastic surgery, ophthalmology, and trauma surgery. The aim of this study is to identify the patterns of brain injuries associated with maxillofacial trauma and its outcome.

Methods: This descriptive study (cross-sectional) was carried out among 90 polytrauma patients with maxillofacial fractures attending the Emergency Department at Suez Canal university Hospital and fulfilling our inclusion and exclusion criteria.

Results: This study demonstrates the relation between type of maxillofacial fracture and type of traumatic brain injuries in which the majority of patients with epidural hemorrhage presented with mid face fractures (60%), while the minority of them presented with upper and lower face fractures (20% for each of them). The majority of patients with subdural hemorrhage were associated with mid face fractures (75%), the majority of patients with brain contusions associated with mid face fractures (100%), and all of the patients presented by pneumocephalus were associated with mid face fractures (100%).

Conclusion: The results of this study confirm the value of quick diagnosis and early intervention, which is fundamental to prevent morbidity as well as mortality especially with regards to prevention of traumatic brain injury as even a short duration of hypoxia and edema will lead to significant permanent neurological deficits.

© 2018 Daping Hospital and the Research Institute of Surgery of the Third Military Medical University.

Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Trauma is an injury to human tissues and organs that results from the transfer of energy through the environment. Injuries are caused by some forms of energy that are beyond the body's resilience and tolerance. Trauma is a serious global health problem. It is the fifth leading cause of significant disability and is still the most frequent cause of death in the first four decades of life, accounting for approximately one in 10 deaths worldwide.¹

Years of life lost due to injury deaths in Egypt accounted for 8% and the fifth death leading cause in 2004. Injury in Egypt is expected to be several times higher due to the under-reporting and the defective research work.²

Polytrauma or multiple trauma is a medical term describing the condition of a person who has been subjected to multiple traumatic injuries and it is defined by an Injury Severity Score (ISS) equal to or greater than 16.³

Trauma to the maxillofacial region needs special attention as important sensory systems are present in the face (e.g. visual, auditory, somatic sensory & olfactory). Also, vital structures in the head and neck region are intimately associated (airway, blood vessels, nerves and gastrointestinal tracts). Lastly, such trauma causes a bad psychological impact on the patient.⁴

In the developing countries, road traffic accident (RTA) is the most common cause of jaw fracture, whereas in the developed countries, assault is the most common cause and RTA comes in the second place.⁵

Traumatic brain injury (TBI) is defined as damage to the brain resulting from external mechanical forces, such as rapid acceleration and deceleration impact or blast waves, in which the brain function is temporarily or permanently impaired and structural damage may or may not be detectable with current technology.⁵

* Corresponding author.

E-mail address: elbaihzi@yahoo.com (A.H. Elbaih).

Peer review under responsibility of Daping Hospital and the Research Institute of Surgery of the Third Military Medical University.

Brain injury can occur at the site of impact, but can also be at the opposite side of the skull due to a countercoup effect. If the impact causes the head to move, the injury may be worsened because the brain may ricochet inside the skull causing additional impacts.

Types of brain injuries includes⁶: traumatic subdural hematoma, a bleeding below the dura mater which may develop slowly; traumatic epidural hematoma, bleeding between the dura mater and the skull; traumatic subarachnoid hemorrhage; brain contusion, a bruise of the brain; concussion, a loss of function due to trauma; diffuse axonal injury that may lead to coma or death; Shaken baby syndrome, a form of child abuse.

Our research question is: what are the patterns of brain injuries associated with maxillofacial fractures in polytrauma patients presenting to the Emergency Department at Suez Canal University Hospital?

As we do not have clear data in Egypt about the patterns of TBI among patients with maxillofacial fractures and its outcome in Egypt, so the aim of this study was to identify the patterns of brain injuries associated with maxillofacial trauma and its outcome.

Methods

Research design

This study was conducted as a single centre, a cross-sectional, observational study of all polytrauma patients with maxillofacial fractures presenting to the emergency department.

Study population

All polytrauma patients with maxillofacial fractures attending the Emergency Department (ED) at Suez Canal university Hospital and fulfilling our inclusion criteria were included in the study.

Inclusion criteria

All age groups; both genders; polytrauma patients with maxillofacial fractures; positive radiological findings that prove maxillofacial fractures.

Exclusion criteria

Patients transferred from other hospitals after performing any medical or surgical procedure; patients with overlap multiple traumatic brain injuries or multiple maxillofacial injuries.

Study objectives

Primary objective: To identify the patterns of brain injuries that associates with maxillofacial trauma in polytrauma patients presenting to the Emergency Department at Suez Canal University Hospital.

Secondary objective: To improve the assessment of patients presenting by maxillofacial fractures to the Emergency Department at Suez Canal University Hospital. To identify the incidence of traumatic brain injuries associated with maxillofacial fractures. To identify the most common cause of maxillofacial injuries in Suez Canal University Hospital. To know the importance of neurological assessment in maxillofacial fracture patients.

Data collection

Data was collected in pre-organized data sheet by the researcher from patients fulfilling inclusion and exclusion criteria. Patients were clinically assessed and managed by the ABCDE protocol. All

polytrauma patients that have evidence of maxillofacial fracture presented to the Emergency Department at Suez Canal University Hospital were included.

Full history (from patients or relatives) was got including: patient's file number; patient personal data: age, sex, occupation and residence; date of admission and date of discharge to calculate the patient's length of stay in the emergency department; timing of injury and timing of admission; mechanism and type of injury; history of any chronic diseases (e.g. allergy, endocrinal disease, cardiovascular disease, coagulopathy); history of drug abuse or previous disability.

Clinical evaluation

Clinical evaluation of the patients was carried out on arrival to the emergency department.

Initial assessment: ABCDE (airway and cervical spine control, breathing, circulation, dysfunction of the central nervous system, GCS and exposure) and O₂ saturation. Then careful abdominal examination was done to identify the type of abdominal trauma. Assess the condition of the patients either stable or unstable which in order to determine the needed investigations and plane of management.

Neurological examination: motor, sensory examination, reflexes, condition of the pupils and GCS assessment.

Investigations: primary survey (focused assessment with sonography for trauma – chest X-ray – pelvic X-ray & cervical spine), brain CT (no abnormalities detected – subdural hemorrhage – epidural hemorrhage – subarachnoid hemorrhage – contusion), and 3D skull CT.

Record of treatment

To identify if craniotomy was done and time of the operation was registered or the patient had a conservative management.

Fate of the patient

It was recorded whether: The patient was admitted in inpatient. The patient was admitted in ICU. The patient remained under observation in emergency room. Craniotomy was performed. The patient died.

Data management and statistical analysis

Data was collected throughout history. Clinical examination and laboratory investigation were coded, entered and analyzed using Microsoft Excel software. Gathered data was imported into SPSS (Statistical Package for Social Sciences) software program version 13.0 for analysis. According to the type of data, the following tests were used to test differences for significance; Chi square, *t*-test, and one way ANOVA with least significance difference. Chi square test and non-parametric tests were used to compare categorical variables. *P* value was set at <0.05 for significant results.

Data was presented in the form of graphs, numeric presentations & tubular presentations.

Ethical consideration

- 1) Approval of authority.
- 2) Agreement of participant without obligation.
- 3) Confidentiality of data.
- 4) Explanation of our study to the participants.

An informed written consent was taken from each patient or from his relatives before taking any data or doing any intervention.

The consent will contain: All samples used in research only; Arabic title of the research; aim of the research and brief scientific background; explanation of the aim in a simple manner to be understood by the common people; all direct and indirect benefits; no harmful maneuver being used; right of the patient to refuse involving in the research and he received his usual treatment; all data being confidential; right of the participant to withdraw from the study at any time without giving any reason; all participants being announced by results of the study; right of patient to have a copy from the informed consent; signature or fingerprints of the patient or his relatives; the researcher phone number and all possible communicating methods being identified to the participant.

Budget

Laboratory investigations and interventions' budget were covered as a part of the health service provided in the Emergency Department in Suez Canal University Hospital. Any extra investigations were afforded by the candidate.

Results

This descriptive study (cross-sectional) was conducted to evaluate the patterns of brain injuries that are associated with maxillofacial fractures in 90 polytrauma patients who presented to ED of Suez Canal University Hospital. And the data was collected from January 2017 to September 2017.

Our study showed that the age of the studied patients ranged from 2 to 70 years with majority of them between 21 and 30 years (40%) and the mean age of (30.7 ± 13.09) years. The majority of patients were males (63.3%), while female were (36.70%) of them (Table 1). The majority of the studied patients had motor car accident (53.30%), while falling from height was the second mechanism of trauma (30%), assault was the third mechanism (16.7%), but no patient presented due to sport trauma.

The present study revealed that the majority of the studied patients suffering from persistent vomiting (60%). The patients presented with convulsions were 33.3%, while those who did not develop fits were 66.7%. Also the majority of patients who presented with loss of consciousness were less than 30 min (40%) and minority of them lost their conscious level more than 24 h (23.3%) and majority of the patients who developed post-traumatic amnesia were less than one day (40%), and minority of them had post-traumatic amnesia for more than 7 days (Table 2).

Our study showed that the majority of patients with TBI associated with maxillofacial fractures presented vitally stable (80%), while the minority presented vitally unstable (20%). Most of the studied patients did not need airway stabilization (76.7%), while minority of them needed airway stabilization (23.3%). The majority of patients presented with spontaneous breathing (83.3%), while

Table 1
Demographic distribution among the studied patients.

Age (year)	Number	Percentage (%)
<10	6	6.7
11–20	12	13.3
21–30	36	40
31–40	24	26.6
41–50	6	6.7
>50	6	6.7
Mean ± SD	30.7 ± 13.09	
Range	67.5 (2.5–70)	
Gender	Male	Female
	63.3%	36.7%

Table 2
Symptoms of brain injury associated with maxillofacial fractures.

Symptoms		Number	Percentage (%)
Vomiting	Absent	36	40
	Present	54	60
Convulsions	Absent	60	66.7
	Present	30	33.3
Loss of consciousness	<30min	36	40
	30–24 h	33	36.7
	>24 h	21	23.3
Post traumatic amnesia	<1 day	36	40
	1–7 days	33	36.7
	>7 days	21	23.3

some of them presented with abnormal breathing (16.7%). The majority of patients presented with GCS between 9 and 12 (43.3%), while the minority of them presented with GCS below 8 (23.4%). Patients presented by normal pupils equaled the number of patients presented by abnormal pupils (50%, Table 3).

The present study revealed that majority of patients presented by mid face fractures (50%), while 20% of them presented by lower face fractures and 30% of them presented by upper face fractures.

Patients presented with epidural hemorrhage accounted for 50%, while the minority of them presented by diffuse axonal injury and brain edema (10% for each of them, Fig. 1). Patients presented with moderate brain injury accounted for 40%, while the minority of them presented with severe traumatic brain injury (23.3%).

Craniotomy was done in 40% of these patients, while the minority of them died in the ER after presentation (6.7%, Fig. 2).

Patients that had upper maxillofacial fracture after road traffic accidents were 39.52%, while patients who had it after assault were 33.3%, while patients who had it after falling from height were 33.3% and no patient presented with maxillofacial fracture due to sport trauma. The patients who had mid face fractures due to road traffic accidents were 50%, while those presented with it due to assault were 40%, while those who presented due to falling from height were 55.6%. The patients who developed lower maxillofacial fractures due to road traffic accidents were 10.48%, while those developed it due to assault were 26.7%, and those developed it due to falling from height were 11.1%, which was a statistically significant relation.

The study revealed that patients presented with GCS of more than 13 were classified as follows: 30% of them presented by upper maxillofacial fractures, 30% of them presented by mid face fractures and 40% of them presented by lower face fractures, while for patients who came with GCS ranging from 9 to 12, most of them presented by mid face fractures (69.2%), while patients with upper and lower face fractures were 15.4%. The majority of patients presented with GCS less than 8 had upper face fractures (57.1%), while

Table 3
Examination of maxillofacial trauma patients with TBI.

		No. of patients	Percentage (%)
Vital signs	Stable	72	80
	Unstable	18	20
Airway	Patent	69	76.7
	Not patent	21	23.3
Breathing	Spontaneous	75	83.3
	Not spontaneous	15	16.7
Circulation	Normal	72	80
	Abnormal	18	20
GCS	>13	30	33.3
	9–12	39	43.3
	<8	21	23.4
Pupils	Normal	45	50
	Abnormal	45	50

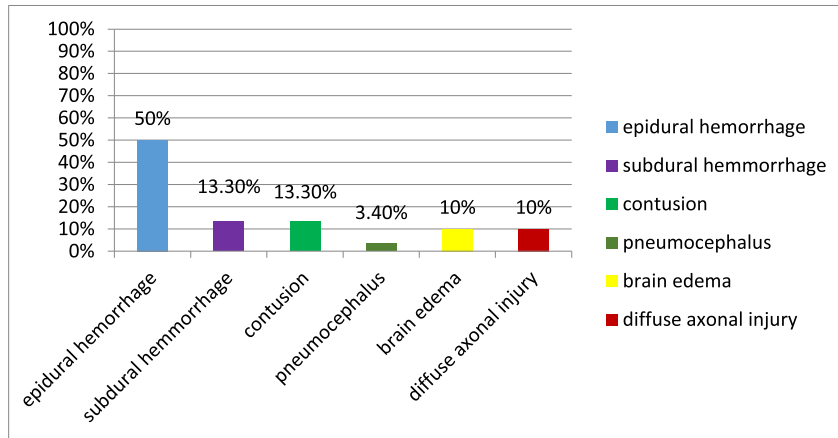


Fig. 1. Type of traumatic brain injury.

the minority of them had lower ace fractures (14.3%). There was a statistically significant relation between them.

The majority of patients with epidural haemorrhage presented with mid face fractures (60%), while the minority of them presented with upper and lower face fractures (20% for each of them). The majority of patients presented with subdural haemorrhage were associated with mid face fractures, while 25% of them presented with upper face fractures, and no patients presented with lower face fractures. The majority of patients with brain contusions associated with mid face fractures, while only 25% of them were associated with lower face fractures and none of them presented by upper face fractures. All of patients presented by pneumocephalus were associated with mid face fractures (100%). The majority of patients with brain edema were associated with upper face fractures (66.7%), while 33.3% of them were associated with lower face fractures and none of them presented by mid face fractures. All of the patients with diffused axonal injury were associated with upper face fractures.

The majority of patients who admitted in the in-patient ward had mid face fractures (41.7%), while the minority of them had upper face fractures (25%). Patients who admitted to ICU had upper or mid face fractures equally (50%). Craniotomy was done mostly in patients with mid face fractures (58.3%). Patients who died had upper and mid face fractures equally (50%), which did not show statistically significant relation.

The majority of patients presented with mild TBI had mid face fracture (42.4%), while the minority of them had lower face

fractures (27.2%). Most of patients with moderate TBI had upper maxillofacial fractures (66.6%). The majority of patients who had severe TBI had mid face fractures (52.4%), while the minority of them had lower face fractures (14.2%), which showed statistically significant relation.

Craniotomy was done for majority of the patients who presented with epidural haemorrhage (73.3%), while the majority of patients who had subdural haemorrhage admitted in ward (50%) Also most of the patients who had brain contusions admitted in ward (75%), while all of patients who had pneumocephalus and brain edema admitted in ward, and the majority of patients who had diffuse axonal injury admitted in ICU (66.7%, Table 4).

Discussion

Maxillofacial injuries are commonly encountered in the practice of emergency medicine. More than 50% of patients with these injuries have multisystem trauma that requires coordinated management between emergency physicians and surgical specialists in oral and maxillofacial surgery, otolaryngology, plastic surgery, ophthalmology, and trauma surgery.⁵

TBI is defined as damage to the brain resulting from external mechanical forces, such as rapid acceleration and deceleration impact or blast waves. The brain function is temporarily or permanently impaired and structural damage may or may not be detectable with current technology. TBI was present in 36.7% of maxillofacial cases.⁶

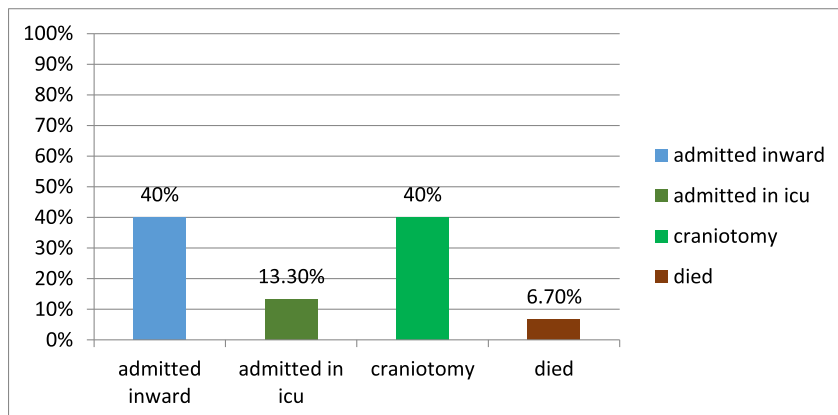


Fig. 2. Fate of the studied patients.

Table 4

Relation between types of TBI and outcome of patients.

Fate	EDH	SDH	Contusion	Pneumocephales	Brain edema	Diffuse axonal brain injury	<i>p</i>
Admitted inward	9 (20%)	6 (50%)	9 (75%)	3 (100%)	9 (100%)	0	<0.05
Admitted ICU	3 (6.7)	0	3 (25%)	0	0	6 (66.7%)	
Craniotomy	33 (73.3%)	3 (25%)	0	0	0	0	
Died	0	3 (25%)	0	0	0	3 (33.3%)	

This study showed that the age of the studied patients ranged from 2 to 70 years with the majority of them between 21 and 30 years and the mean age of 30.7 ± 13.09 .

These results agree with the results of a study conducted by Hasant et al., in which the age of the studied patients ranged from 5 to 64 years with the majority of them between 21 and 30 years (51.7%) and the mean age was 29.63 ± 12.0 .⁷

The possible explanation for this is that people in this age group take part in dangerous exercise and sports, drive motor vehicles carelessly and are more likely to be involved in violence.

The present study showed that the majority of patients were males (63.3%), while females were 36.70% of them. These results were similar to the results of a study by Latifi, in which 72% of the studied patients were males and 28% were females.⁸

Regarding the mechanism of injury, this study showed that the majority of the studied patient had motor car accident (53.30%), while falling from height was in the second mechanism of trauma (30%) and assault was the third mechanism (16.7%).

These results were similar to the results of a study done by Hasant et al., in which road traffic accidents caused 60% of the patients with maxillofacial trauma, followed by falling from heights (13.3%) and then violence (8.3%).⁷

This study showed that the majority of patients presented by mid face fractures (50%), while the minority of them presented by lower face fractures (20%). These results correspond to the results of a study conducted by Rajandram et al., in which 60.9% of the patients had mid face fractures, while minority of them had upper and lower face fractures (13.4% and 25.6% respectively).⁹

Concerning the type of traumatic brain injury, this study revealed that most of the studied patients presented with epidural hemorrhage (50%), 13.3% had subdural hemorrhage, while a minority of them presented by diffused axonal injury and brain edema (10% for each of them). Unlike the results of our study, the results of a study conducted by Hasant et al. showed that victims who had subdural hemorrhage accounted for 18.3%, followed by epidural hemorrhage (15%), and subarachnoid hemorrhage (11.7%). This may be due to the difference in the mode and severity of injuries.⁷

This study revealed that the majority of patients presented with moderate brain injury (40%), while the minority of them presented with severe traumatic brain injury (23.3%). These results were close to the results by Hasant et al., in which 55% of the patients had moderate head injury followed by severe head injury (20%).⁷

This study showed that for most of the patients admitted, craniotomy was done (40%), while the minority of them died in ER after presentation (6.7%). Unlike the results done by Zandi et al., in which 26% of the studied patients admitted inpatient while the remaining (74%) entered ICU for different duration and this difference may be the severity of the injuries and large sample size (302 patients in comparison to 90 patients only in our study).¹⁰

This study showed that the mean age in patients with upper face fractures was (28.3 ± 15.5) years, while the mean age in patients with mid face fractures was (29 ± 9.15) years and the mean age in patients with lower face fractures was (38.6 ± 15.08) years, which was not statistically significant relation ($p = 0.1$). Also, it showed that 26.3% of male patients had upper maxillofacial fracture and 36.4% of female patients had upper maxillofacial fracture; 52.6% of

male patients had mid face fractures and 45.5% of female patients had mid face fractures; and 21.1% of male patients had lower face fractures and 18.2% of female patients had lower face fractures, which was not statistically significant relation between gender and types of fractures ($p = 0.4$). These results were similar to the results of a study conducted by Latifi, in which 3.7% of male patients had upper face fractures and 3.4% of female patients had upper face fractures; 71.1% of male patients had mid face fractures and 76.9% of female patients had mid face fractures and 7.7% of male patients had lower face fractures and 5.6% of female patients had lower face fractures with p -value being 0.208 and it was concluded that there is no significant relationship between gender and types of fractures in this study.⁸

Concerning the type of maxillofacial trauma and mechanism of injury, this study showed that 39.52% of the patients with upper maxillofacial fracture and 50% of the patients with mid face fractures were due to road traffic accidents, while 20% of patients with lower maxillofacial fractures was due to assault, which was a statistically significant relation.

These results agree with the results of a study done by Mabrouk et al., in which concerning the site of fracture in relation to cause of injury, 50% of mandibular fractures were likely to occur with violence. On the contrary, 4% of upper face fractures and 52% of mid face fractures were more likely in motor car accident (MCA).¹¹

Regarding the relation between the type of maxillofacial fractures and GCS, the current study showed that for patients presented with GCS more than 13, 40% of them presented by lower face fractures, while patients who came with GCS ranging from 9 to 12, most of them presented by mid face fractures (69.2%) and the majority of patients presented with GCS 8 or less had upper face fractures (57.1%), which was a statistically significant relation ($p = 0.04$). These results were similar to the results of a study by Hasnat et al., in which 54.5% of the patients with GCS 9–12 had mid face fractures, 58.3% of the patients with GCS 8 or less had upper maxillofacial fractures and 80% of patients with GCS 13 or more had lower face fractures with a statistically significant relation ($p = 0.002$).⁷

This study demonstrates the relation between type of maxillofacial fracture and type of traumatic brain injuries in which the majority of patients with epidural haemorrhage presented with mid face fractures (60%), while the minority of them presented with upper and lower face fractures (20% for each of them). The majority of patients presented with subdural haemorrhage was associated with mid face fractures (75%), the majority of patients with brain contusions associated with mid face fractures (75%) and all of the patients presented by pneumocephales was associated with mid face fractures (100%). The results of previous studies evaluating the relationship between facial and head injuries are conflicting. Hohlrieder et al. reported that Le Fort-II and III, orbit, nose, zygoma and maxillary fractures were associated with a 2-to 4 fold risk of intracranial hemorrhage, while mandibular fracture did not significantly increase the chance of intracranial hemorrhage.¹² Haug et al. reported that although the mandible was the most frequent fractured bone in patients with concomitant facial and head injuries, mid face fractures were more frequently associated with closed head injuries than mandible fracture.¹³ And Kloss et al.

reported the zygoma and orbit to be the most common fractured bones in a group of conscious patients with intracranial hemorrhage and concomitant facial fractures.¹⁴ These difference in the facial bone or head injury being studied and the variation in classification or methodology of prior studies may explain these conflicting results.

This study showed that the majority of patients who admitted in the in-patient ward had mid face fractures (41.7%), while the minority of them had upper face fractures (25%). Patients who admitted to ICU had upper or mid face fractures equally (50%). Craniotomy was done mostly in patients with mid face fractures (58.3%). Patients who died had upper and mid face fractures equally 50%, which was not a statistically significant relation between type of fractures and outcome ($p = 0.2$).

This study showed that most of patients with moderate TBI had upper maxillofacial fractures (66.6%) and the majority of patients who had severe TBI had mid face fractures (52.4%) which was statistically significant relation. Unlike the results of the present study, the results of a study by Hasnat et al. showed that 54.5% of the patients with moderate TBI had mid face fractures, 58.3% of the patients were severe TBI had upper maxillofacial fractures ($p = 0.002$).⁸

Maxillofacial fractures had 1.5 times greater chance of presenting with TBI compared with the non-facial fracture group. This is of clinical importance as it indicates that in severely injured patients with facial fractures, early neurosurgical intervention is needed and emergency computed tomography should be performed without delay to prevent the morbidity associated with TBI. Quick diagnosis and early intervention are fundamental to prevent morbidity as well as mortality especially with regards to prevention of TBI as even a short duration of hypoxia and edema will lead to significant permanent neurological deficits.

Limitations of the study

There are some limitations of this study that should be discussed. Firstly the size of the sample population is small which could affect the results of this study. Besides that, the study only involved one Trauma Centre and the study was done only in 8 months duration, which reduces the generalization of our results. However, it must emphasize that our results are consistent with the results from larger multicenter and are statistically significant.

Recommendations

Patients with maxillofacial fractures remain a significant management challenge. A thoughtful approach to the management has the potential to optimize outcome for these conditions.

The final decision should also take into account future functionality, available recovery programs, and the patient's demeanor and, as a final criterion, the surgeon's enthusiasm and skill.

It is important for the patient and her family to understand that operative intervention will guarantee the best results and return of normal functions and physiology of the patients.

Evidence based protocols for management of TBI and maxillofacial fractures should be developed for every aspect of care, from pre-hospital health education to post hospital discharge of patients.

Neurosurgeons, plastic surgeons and emergency physicians should participate at all levels of planning for TBI & maxillofacial fractures care and management.

To increase the awareness of potential risk factors of maxillofacial fractures and how to avoid preventable causes, presenting symptoms and possible lines of management. In Egypt, MCA, alcoholism, increased violence and psychiatric diseases are factors to be considered, evaluated and try to find possible solutions for them.

Emergency Medicine Service providers should be trained and educated in the management of TBI and maxillofacial fracture patients and how to deal in critical cases.

The Ministry of Health should increase the awareness of general population about TBI and maxillofacial fractures and its possible complications.

New studies about TBI associated with maxillofacial trauma and its outcome with a larger sample size and in different centers should be carried out.

Data in many developing countries about TBI and its outcome should be available to know its definite prevalence, and follow up its mortality rate in order to improve its management.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.cjtee.2017.12.005>.

References

1. Elbaih AH. Resuscitation of polytrauma patients: an overview. *Narayana Med J*. 2016;5:126–140.
2. Mahran DG, Farouk OA, Qayed M, et al. Hospitalized injuries and deaths in a trauma unit in Upper Egypt. *Int J Crit Illn Inj Sci*. 2013;3:235–240. <https://doi.org/10.4103/2229-5151.124108>.
3. Keel M, Trentz O. Pathophysiology of polytrauma. *Injury*. 2005;36:691–709. <https://doi.org/10.1016/j.injury.2004.12.037>.
4. Gausche-Hill Marianne, Hockberger Robert, Walls Ron. *Rosen's Emergency Medicine Concepts and Clinical Practice*. 5th ed. St. Louis: Mosby-Year Book; 2017:315–329.
5. Tintinalli JE, Kelen GD, Stapczynski JS. *Emergency Medicine: A Comprehensive Study Guide*. 6th ed. New York, NY: McGraw-Hill; 2004:1583–1589.
6. Maas AI, Stocchetti N, Bullock R. Moderate and severe traumatic brain injury in adults. *Lancet Neurol*. 2008;7:728–734. [https://doi.org/10.1016/S1474-4422\(08\)70164-9](https://doi.org/10.1016/S1474-4422(08)70164-9).
7. Hasant A, Kamrujjaman M, Akhtar M, et al. Pattern of maxillofacial trauma among patients with head injuries. *Update Dent Coll J*. 2017;7:14–20.
8. Latifi H. Prevalence of different kinds of maxillofacial fractures and their associated factors are surveyed in patients. *Glob J Health Sci*. 2014;6:66–73. <https://doi.org/10.5539/gjhs.v6n7p66>.
9. Rajandram RK, Syed Omar SN, Rashdi MF, et al. Maxillofacial injuries and traumatic brain injury – a pilot study. *Dent Traumatol*. 2014;30:128–132. <https://doi.org/10.1111/edt.12052>. Epub 2013 Jun 19.
10. Zandi M, Seyed Hoseini SR. The relationship between head injury and facial trauma: a case–control study. *Oral Maxillofac Surg*. 2013;17:201–207. <https://doi.org/10.1007/s10006-012-0368-z>. Epub 2012 Oct 26.
11. Mabrouk M, Helal H, Mohamed AR, et al. Incidence, etiology, and patterns of maxillofacial fractures in Ain-Shams University, Cairo, Egypt: a 4-year retrospective study. *Cranio-Maxillofac Trauma Reconstr*. 2014;7:224–232.
12. Hohlrieder M, Hinterhoelzl J, Ulmer H, et al. Maxillofacial fractures masking traumatic intracranial hemorrhages. *Int J Oral Maxillofac Surg*. 2004;33:389–395. <https://doi.org/10.1016/j.ijom.2003.10.011>.
13. Hung YC, Montazem A, Costello MA. The correlation between mandible fractures and loss of consciousness. *J Oral Maxillofac Surg*. 2004;62:938–942.
14. Kloss F, Laimer K, Hohlrieder M, et al. Traumatic intracranial haemorrhage in conscious patients with facial fractures—a review of 1959 cases. *J Cranio-Maxillo-Fac Surg*. 2008;36:372–377. <https://doi.org/10.1016/j.jcms.2007.12.002>.