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Effect of gender and cause of injury on incidence of cranial nerves injuries in maxillofacial trauma; clinical study

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Abstract

Objectives To document the incidence and pattern of cranial nerves injuries that occur in association with maxillofacial trauma for early diagnosis and management.

Methods This study was done from April 2012 to April 2013 in Al-Salaam Teaching Hospital in Mosul/Iraq. We studied 367 patients presented with maxillofacial trauma. The demographic, medical information, and cause of injury are recorded for each patient. Clinical examination of the cranial nerves was done at time of admission. Plain X-ray film, CT scan, electromyography, Hess chart, and other investigations were done when clinically indicated.

Results 367 patients presented with maxillofacial trauma included in this study. 57 (15.5%) patients presented with cranial nerves injuries. 47(82.45%) patients are males and 10 (17.54%) are females. The mean age of the patients is 25 years. 45 (78.94%) patients had single nerve injury. 12 (21.05%) patients presented with multiple cranial nerves injuries. The facial nerve carries the highest rate of incidence.

Conclusions Cranial nerves injuries are most commonly detected in young age group male patients. High velocity missile significantly increase the chance of cranial nerves injuries. Early diagnosis of these injuries essential for better results with less morbidities and residual deformities.

Keywords Cranial nerves, maxillofacial injury, facial nerve injury.

Introduction

The wars and the internal conflicts that happen in the middle-east during this century leave many social, psychological, and general health problems. There are many victims, homeless people, and many widows and orphans without financial support. Many peoples who are injured during these conflicts remain bed-ridden with significant morbidities like limbs amputation, blindness, and spinal cord injuries. Maxillofacial trauma is considered one of the main causes of facial deformities like vital organs damage, soft and hard tissues damage, loss of reflexes and facial muscles functions. The skull consists of strong bones that provide protection for the brain from external insults. Basically, the skull can be divided into three bony components, the cranial vault, cranial base, and facial skeleton bones. The cranial base provides a seat for the brain and contain many foramens that provide a points for exit and entrance of many vessels and nerves.[1] There are 12 pairs of cranial nerves that pass through these foramens to the head and neck region. The cranial nerves have many functions including general and special sensation, secretion, muscles movements, and control of reflexes. These nerves liable for injury because of their superficial position over the soft tissues and bony parts of the facial skeleton. Maxillofacial injuries may occur after missiles, road traffic accident (RTA), assault, fall from height (FFH), and sports injuries. Those injured patients need special care because of risk of damage to many body functions including olfaction, hearing, swallowing, and phonation.[2] The nature of injury to the craniofacial region is dependent on degree of the force and the resistance of the facial bones and supporting soft tissue to the force that are applied to the craniofacial region.[1]

Injury to the cranial nerves can occur due to direct or in direct impact to the cranial base, penetrating craniofacial injuries, and as a complication of surgery.[3] Single or multiple cranial nerves may be affected by facial trauma and both adults and children may be complaining from post-traumatic neurological deficit.[4] Most of cranial nerve injuries do not need active management at the time of arrival to the causality unit. Morbidities that may occur following cranial nerves trauma may require a complex reconstructive surgery in a well-recognized center.[3] The aim of this study is to document the incidence of cranial nerves injuries that are associated with facial trauma for early management with better results and minimum facial deformities and morbidities.

Methods

The study consists of 367 maxillofacial injured patients referred to Al-Salaam Teaching Hospital in Mosul from April,2012 to April,2013. 57 patients were found to have cranial nerves injuries in association with maxillofacial trauma which is included in this study. Inclusion criteria include patients with maxillofacial trauma associated with neurological deficit including one or more of cranial nerves distributed in the facial region. Exclusion criteria including children, mentally retarded patients, non-traumatic cranial nerves palsies, patients with previous surgery, facial trauma without nerves damage and old trauma. The mean age of the patients is 25 years. There are 47 males and 10 females. The patients are grouped according to the cause of injury (missile injuries, RTA, assault, sport injuries, FFH, and others). Clinical examination of the cranial nerves was done meticulously at the time of admission. Radiological assessment, electromyography (EMG), Hess chart, and other investigation are done when clinically indicated. For every patient in the study, a standard case sheet was completed. This concentrated on demographic information, medical history, causes of trauma, clinical examination, and investigations.

Equipment of examination

1. Piece of cotton
2. Odor source (perfume).
3. Tuning fork (512HZ, 1024HZ).
4. Ophthalmoscope.
5. Tongue spatula.
6. Hummer.
7. Pricking pin.
8. Auroscope.
9. Light source.

Cranial nerves examination

1. **Olfactory nerve:** Assessment of anosmia by using flavoring agent like perfume and the patient was examined with closed eyes.
2. **Optic nerve:**
   2.1. Pupillary reflex by light source.
   2.2. Visual field assessment.
   2.3. Fundoscopy for assessment of optic disc and retina.
3. **Oculomotor nerve:**
   3.1. Ptosis of upper eyelid detected by clinical observation.
   3.2. Extraocular muscles function assessed by asking the patient to follow the finger of the physician by their eyes with fixed head and asking the patient about diplopia.
   3.3. Hess chart used for gaze examination in six directions
   3.4. Light source for pupillary reflex.
4. **Trochlear nerve:** Detection of superior oblique muscle function by asking the patient to look in down and inward gaze. Damage of this nerve may cause diplopia in downward gaze and problems in coming down stairs and reading.
5. **Trigeminal nerve:**
   5.1. Mouth opening and closure and teeth clenching for assessment of muscles of mastication.
   5.2. Pin pricking test for detection of sensation in the forehead, cheek, and chin region.
   5.3. Corneal reflex with a piece of cotton and observing the blinking reflex.
   5.4. Jaw jerk test by using special hummer for this purpose.
6. **Abducent nerve:** Assessment of lateral rectus muscle by asking the patient to look in lateral gaze. Injury of this nerve may be associated with convergence squint and diplopia.
7. **Facial nerve:**
   7.1. Assessment of facial symmetry.
   7.2. Assessment of eyes closure, teeth show, eye brows movement and smiling and detection of any facial weakness.
   7.3. Corneal reflex: assessment of blinking reflex by touching the cornea by a piece of cotton. There will be facial asymmetry, loss of corneal reflex and bells sign, in case of facial nerve injury.
8. **Vestibulocochlear nerve:**
   8.1. Weber test.
   Special fork (512Hz or 1024Hz tuning fork) applied in the top of patient head and we detected the direction of the sound (normally in the midline).
   8.2. Rinne test.
   Special tuning fork (512Hz or 1024Hz) placed in the mastoid process or near the ear and comparison done between both position (in normal condition air conduction higher than bone conduction).
   8.3. Vestibule-ocular of reflex. This test is done by moving the patient head from side-to-side and up-and-down with fixed vision to a certain straight point in front of the patient and looking for the eyes movement.
   8.4. Caloric test for assessment of nystagmus.
   In this cranial nerve injury, the patient complains of vertigo, tinnitus, and impaired hearing
9. **Glossopharyngeal and vagus nerves:**
   9.1. Assessment of any hoarseness or nasal speech.
   9.2. Gag reflex by touching the throat with tongue spatula.
   9.3. Swallowing reflex.
   Injury of those two nerves may cause dysphagia, dysphonia, and loss of gag reflex.
10. **Spinal accessory nerve:**
   10.1. Trapezius muscle examined by asking the patient to left the shoulder against resistance.
   10.2. Sternomastoid muscle examined by turning the patient head to the opposite side against resistance. Injury of this nerve cause paralysis of both of these skeletal muscles.
11. **Hypoglossal nerve:**
   11.1. Patient speech.
   11.2. Tongue position and movement.
   In case of hypoglossal nerve injury, the tongue is deviated to the affected side on protrusive movement with slurred speech.[3]

Investigations

1. Plain film (posterioanterior mandible view, panoramic view, occipitomental view).
2. CT-scan.
3. Electromyography
4. Hess chart.
5. Audiometry.

Results

Cranial nerves injuries were seen in 57 of 367 patients with facial trauma (15.5%).There was preponderance of male patients (47 males and 10 females) (Table 1, Fig 1).

Male to female ratio was 4,7:1. The age of most injured patients was between 20 and 35 years old (mean: 27.5 years). About 45 patients (78.94) had single cranial nerve injury. Facial nerve injury shows the highest incidence; 22 patients (48.88%). Trigeminal nerve injuries seen in 16 patients; (35.55%). Optic and hypoglossal nerves injuries were seen in

Table 1. **Sex distribution.**

Sex	No. of patients	%
Males	47	82.45
Females	10	17.54
Total	57	100

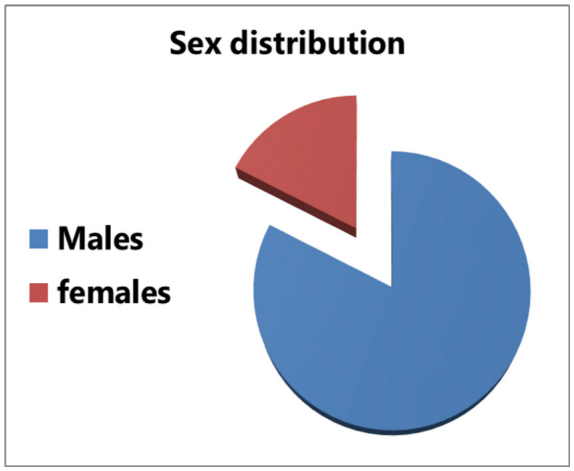

Fig 1.

3 patients for each nerve (6.66%). Abducent nerve injury was seen in only 1 patient; (2.22%) (Table 2; Fig. 2).

Multiple cranial nerves injuries were seen in 12 patient (21.05%). 10 patients have both facial and trigeminal nerves injuries. One patient presented with both facial and oculomotor nerves injury. The other patient was presented with superior orbital fissure syndrome accompanied by facial nerve injury Table 3.

Table 2. **Incidence in relation to single cranial nerve injury.**

Cranial nerve involvement	No. of patients	% of injury
Facial nerve	22	48.88
Trigeminal nerve	16	35.55
Optic nerve	03	6.66
Glossopharyngeal nerve	03	6.66
Abducent nerve	01	2.22
Total	45	100%

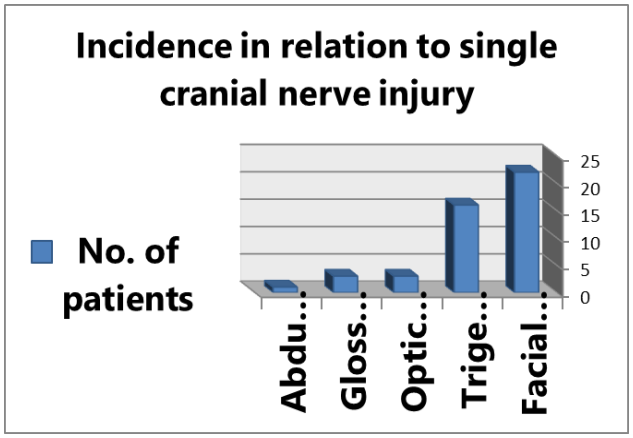

Fig 2.

Table 3. **Incidence in relation to multiple cranial nerves injuries.**

Cranial nerve involvement	No. of patients	%
Oculomotor, trochlear, Abducent and facial nerves	01	8.33
Oculomotor and facial nerves	01	8.33
Trigeminal and facial nerves	10	83.33
Total	12	100%

Missiles injuries show the highest incidence; 27/57(47.37%) followed by RTA 16/57(28.07%). The remaining etiological factors in a descending order are assault 3/57(5.26), sport injuries 2/57(3.50%), and others 1/57(1.7) (Table 4; Fig 3).

Discussion

Cranial nerves injuries may occur after maxillofacial trauma. These injuries may be misdiagnosed at the time of arrival to the emergency room, especially if there is more serious and life-threatening associated injuries. The incidence of cranial nerves injuries in craniofacial trauma varies between 5 and 23%.[3] In our study, the incidence of cranial nerves injuries

Table 4. **Incidence in relation to cause of injury.**

Cause of injury	No. of patients	%
Missiles	27	47.36
RTA	16	28.07
FFH	8	14.03
Assault	3	5.26
Sports	2	3.50
Others	1	1.75
Total	57	100%

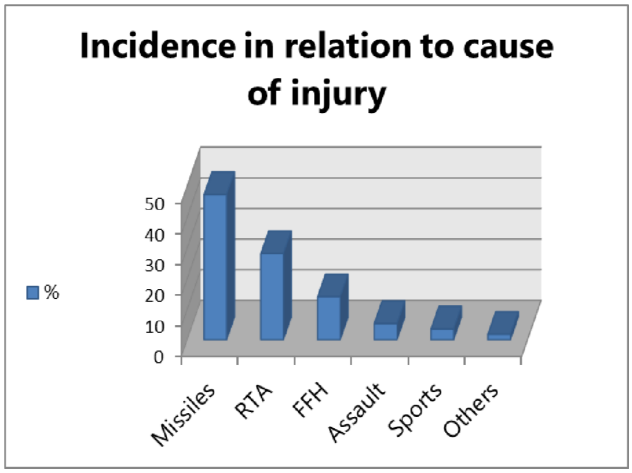

Fig 3.

was 15.55% of maxillofacial trauma referred to the emergency room in Al salaam Teaching Hospital in Mosul/ Iraq. This percentage coincides with a study done by Purav Patel. In this study, the percentage of cranial nerves damage is about 12.6% (100 of 794 patients).[5] The main causative factor for maxillofacial injuries in our country is the missile injuries with its massive effect on bone and soft tissues because of state of war in which the Iraq was involved in the last 10 years in comparison with study done by Kiran et al, in which the RTA is the main etiological factor.[6] The highest incidence of cranial nerves injuries was seen in the young age group patients. This may be explained by the fact that this age group of patients is the most active, productive, and working members of Iraqi community. Most injured patients are free workers at public places, stores workers and police men in comparison with low incidence between official employee because most of explosions occurs in markets and common places. Male to female ratio was 4,7:1. This could be ascribed to the fact that most males in Iraqi society are outdoor workers and carries the effort of daily life requirements. Anosmia is the commonest manifestation of olfactory nerve damage following trauma and fracture of cribriform plate of ethmoid bone. In a study done by Alej Andro et al, the incidence of olfactory nerve damage was 21% (13 of 49 patients).[7] In our study, no patient was recorded with post-traumatic olfactory nerve damage. This is because most of these injuries are fatal and most patients who are associated with olfactory nerve damage presenting with intracranial complications, so those patients usually referred to neurosurgical emergency. The incidence of traumatic optic neuropathy in head injuries ranges from 0.5 to 5%.[8] This percentage is approximately similar to the results that are obtained in our study which about 6.66%. Oculomotor nerve is one of most important nerves supply of the extraocular muscles of the eye. Injury of this nerve may cause ophthalmoplasia and affect the visual pathway resulting in visual disturbance. The incidence of oculomotor nerve damage in craniofacial trauma is approximately 1.2%.[9] This percentage coincides with our study in which the incidence about 2.9%. Trochlear nerve is a motor nerve that supply the superior oblique muscle of the eye. Injury of the trochlear nerve may be associated with significant morbidity represented by diplopia in downward gaze and problems with reading and descending stairs.[3] In our study, only one case of trochlear nerve was documented in combination with other cranial nerves injuries. In a study performed by Eniolami et al, the incidence of trochlear nerve was 18%.[10] This difference in the percentage may be due to involvement of large data of patients and long period of study. It takes about 15 years in comparison with 1 year in our study. Trigeminal nerve injuries may cause significant neurosensory deficits in the facial region, along with co-morbidities due to changes in chewing habits and changes in the sensation of oral cavity. In the present study, 33.5% of patients were diagnosed with neurosensory deficit due to trauma of the trigeminal nerve. Our finding is low when compared with a study done by Khaled et al. In this study, traumatic trigeminal nerve injury was found in 88.2% of displaced maxillofacial bones fractures and 54.4% of non-displaced fractures.[11] This may be due to many factors like percentage of population, numbers of patients, and duration of the study. Abducent nerve is a pure motor nerve that supply the lateral rectus muscle of eye. The incidence of post-traumatic abducent nerve palsy is 1–2.7%.[12] This result come in accordance with percentage in our study which about 2.2%. Facial nerve injury more likely occurs following craniofacial trauma. Penetrating high velocity missiles injuries can damage both the intra- and extratemporal parts of the facial nerve. The incidence of facial nerve injury in our study was about 50%. This result coincides with retrospective study performed by Singh et al. In this study, the incidence is about 60%, after motor vehicle accident.[13] Hypoglossal nerve is a motor nerve that supply the intrinsic and extrinsic muscles of the tongue. Hypoglossal nerve damage may occur after direct trauma, head malposition and traction in the operation theater.[14] The prognosis of hypoglossal nerve injury is usually poor, unless the nerve is immediately repaired.[15] In our study, hypoglossal nerve injury was noted in three patients (6.7%). The hypoglossal nerve is deeply seated and this relatively high percentage may be attributed to the fact that these injuries caused by penetrating high velocity missiles that cause significant bones and soft tissues damage.

Conclusions

Missile injuries are the most common etiological factors for the cranial nerves injuries in Mosul/Iraq. The facial nerve is the most common injured nerve. Cranial nerves injuries are more common in young age group patients. Early diagnosis and management of cranial nerves injuries enhance operative outcome, reduce post-traumatic residual deformities and morbidities, improve social, psychological status of the patients and help the victims in early returning to normal daily activities.

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