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Main Article

Ear Nose Throat Manifestations in Head Injury Cases Necessitating Hospitalization

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ABSTRACT

Introduction

Major consequences of head injury arise either from traumatic brain injury or from temporal bone fracture. Critical intracranial injuries often demand early management, thus overlooking ear nose throat manifestations. This study was undertaken to highlight the otorhinolaryngeal manifestations necessitating hospital admission in cases of head injuries.

Materials and Methods

A prospective study was conducted in a tertiary care hospital of Indian Armed Forces to study the otorhinolaryngeal manifestations necessitating hospital admission in 30 patients of head injuries fulfilling the requisite criteria. After a thorough clinical examination, appropriate radio-imaging studies were done for head injury, temporal bone fracture and nasal fracture. Hearing was evaluated by pure tone audiogram. Data was analysed using validated statistical software.

Results

Majority were male in the age group of 30-40 years having sustained head injury in road traffic accidents. 90% patients showed otological manifestations including ear bleed, Battle sign, hemotympanum, perforation of tympanic membrane, hearing loss, tinnitus, vertigo, nystagmus, facial palsy, and CSF otorrhea. 50% cases of otic capsule violating fractures were complicated with facial palsy, sensorineural hearing loss, tinnitus and vertigo. Nasal findings were noted in 56.6% cases which included epistaxis, impaired olfaction, CSF rhinorrhea and maxillofacial fractures. Extradural haemorrhage, subarachnoid haemorrhage and subdural haemorrhage were seen in 23.3% cases. There were no cases with throat manifestations.

Conclusion

A large proportion of cases of head injury necessitate hospitalization for management by a multi-specialty team. Major consequences of such events arise either from brain injury or from temporal bone fracture. Though life-saving neurosurgical intervention is always a priority, timely appropriate attention to otorhinolaryngeal morbidities cannot be overemphasized.

Keywords

Head Injury; Temporal Bone Fracture; Hearing Loss; Facial Palsy; Otic Capsule; Maxillofacial; Anosmia

Head injury has been a cause of concern all over the globe, acquiring the state of a tragic problem irrespective of the nation being developed, developing or underdeveloped. The incidence is even increasing due to vehicular accidents, industrial mishaps, sporting misadventures etc. Traumatic brain injury (TBI) is referred to as 'the silent epidemic' by Dewan et al who stated that TBI contributes to worldwide death and disability more than any other traumatic insult and reported that 69 million (95% CI 64 -74 million) people in the world are estimated to suffer TBI from all causes each year, with the Southeast Asian and Western Pacific regions experiencing the greatest overall burden of disease.[1] According to an Indian study, approximately 75% of road traffic accidents (RTA) result in head injury.[2]

A large proportion of cases of head injury do necessitate hospitalization for management by a multi-specialty team. Major consequences of such events arise either from TBI or from temporal bone fracture (TBF) but may also include maxillofacial and cervical spine injuries. TBF may cause significant morbidity by injuring

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the in-house structures, namely the external auditory canal (EAC), middle ear structures, cochlea, vestibule, cochleovestibular nerve and the facial nerve. Yet, it is not the TBF but the critical intracranial injuries that often dictate their early management, including subarachnoid haemorrhage, subdural haemorrhage, brain contusion, and cerebral oedema.[3] Attention of the medical team to the life-saving priority often results in the ear nose throat (ENT) manifestations being over looked or go unnoticed. Patients later present with delayed manifestations such as external ear canal laceration, hemotympanum, tympanic membrane perforation, hearing loss, facial palsy, Cerebrospinal fluid (CSF) rhinorrhea, tinnitus, vertigo or features of nasal/maxillofacial fractures, etc. Functional impairment following hearing loss, vestibular deficit, facial palsy, CSF leak and disturbed olfaction cause significant distress to these patients.

Appropriate clinical and radiological examination can detect all the ENT symptoms and signs related to head injury which in turn guides the suitable intervention and recovery pattern. This study is hence being undertaken to draw special attention to ENT manifestations necessitating hospital admission in cases of head injuries and to emphasize the role of ENT surgeons in accidents and emergencies.

Materials and Methods

This prospective observational study was done in a tertiary care hospital of Indian Army over a period of 12 months. Clearance was obtained from the Institutional Ethics Committee to conduct the study. The cases of head injury were evaluated and primarily stabilized in the Accident & Emergency (A&E) department. Some of them were directly sent from there to ENT department, whereas majority were subsequently referred from the department of Neurosurgery or Maxillofacial surgery after their initial management. Cohort of 30 consecutive such cases of head injury who needed to be treated as in-patients, were included in this study without any age or gender bias.

Case history was recorded in details including the date of trauma, mechanism of trauma, first line of treatment, and onset and progress of ENT symptoms. Complete ENT examination was done including neurotologic and maxillofacial evaluation. Evaluation for hearing status was initially done by tuning fork tests and subsequently by pure tone audiometry (PTA) after the patients were clinically stable enough to cooperate in audiometry. Pure tone average was calculated as the arithmetic mean of the air conduction (AC) thresholds calculated at frequencies of 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz. Type of hearing loss (conductive, sensorineural, or mixed) and its quantification (mild, moderate, severe, and profound) was done as per World Health Organisation (WHO) guidelines. All the patients underwent plain computed tomogram of head in A&E department and those suspected to have TBF were further evaluated with high resolution computed tomogram (HRCT) of temporal bone to map the fracture line, to find the extent of trauma and to correlate the findings with clinical features. X-ray of nasal bone was done as indicated.

Data were entered into a Microsoft excel spreadsheet and analyzed statistically by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism version 5. Numerical variables have been summarized as the mean and standard deviation and the categorical variables as count and percentages. One-way analysis of variance (one-way ANOVA) has been employed to compare the means of three or more samples for numerical data (using the F distribution). Unpaired proportions have been compared by Chi-square test or Fischer's exact test, as appropriate. Mann–Whitney U test has been used for non-parametric data. Z-test (Standard Normal Deviate) was used to test the significant difference in proportions. The correlation was calculated by Pearson correlation analysis. Once a t value is determined, a p-value was found using a table of values from Student's t- distribution. A calculated p-value d" 0.05 was considered statistically significant

Results

This study consisted of 30 subjects. 23 cases (76.6%) were male and 7 cases (23.4%) were female. The age range of the patients was from 19 to 69 years, mean age being 41.55 with ±13.79 Standard Deviation (SD). The

statistical dispersion showed the interquartile range (IQR) to be 31.5 to 48.5 years, median age being 38 years (Fig. 1).

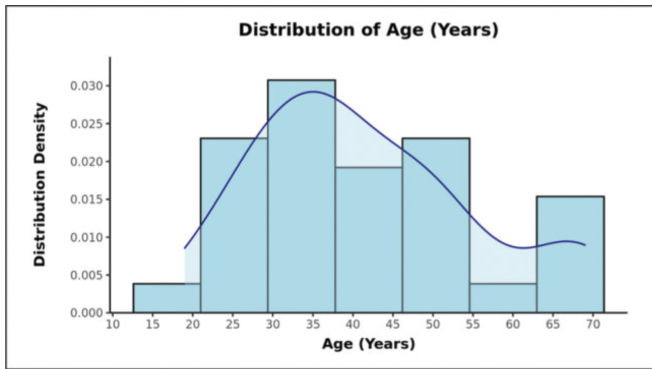

Fig. 1. Statistical dispersion of age

20 patients (67%) had sustained head injury in RTA. Head injury secondary to an accidental fall was seen in 6 cases (20%), whereas sports injury was the cause in 3 cases (10%) and seizure in one case (3%) (Fig. 2). There was no significant difference between the various groups in terms of distribution of mechanism of injury (MOI) (÷2 = 10.476, p value 0.121).

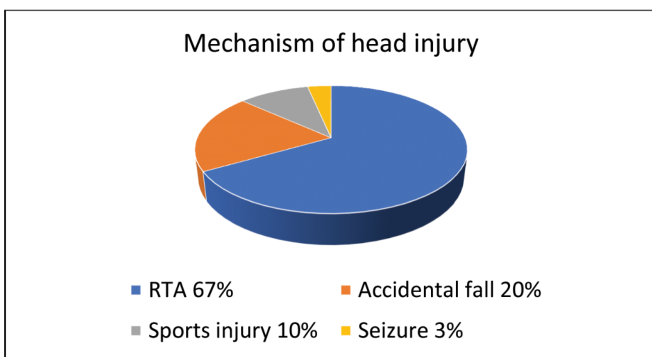

Fig. 2. Distribution of mechanism of injury

83.3% of the patients with longitudinal fracture of temporal bone had RTA while the remaining 16.7% had fall as MOI. 66.7% of the patients with transverse fracture had RTA and the remaining 33.3% had fall as MOI. 50.0% of the participants with oblique fracture had fall as MOI and rest 50% sustained fracture following seizures (Table I). Bias Corrected Cramer's V = 0.47 suggested moderate association between MOI and type of fracture.

Table I : Association of MOI with the type of TBF

MOI	TYPE OF TBF		
	LONGITUDINAL FRACTURE (N = 6)	TRANSVERSE FRACTURE (N=3)	OBLIQUE FRACTURE (N=2)
RTA	5 (83.3%)	2 (66.7%)	0
Fall	1 (16.7%)	1 (33.3%)	1 (50%)
Seizure	0	0	1 (50%)

Diagnosis of TBF was made on the basis of HRCT scans. Fractures were classified according to older method based on the relationship of fracture line with petrous bone, as well as according to the newer method of its relationship with otic capsule. 11 patients (36.7%) were found to have TBF in this study. Longitudinal TBF was seen in 6 cases (54.5%), transverse in 3 cases (27.3%) and oblique in in 2 cases (18.2%). There were 8 cases of Otic capsule sparing (OCS) type and 3 cases of Otic capsule violating (OCV) types of TBF. Based on HRCT mapping of fracture line, 2 cases (66.7%) of OCV fractures were seen in transverse fracture, while one case (33.3%) was seen in a longitudinal fracture (Fig. 3).

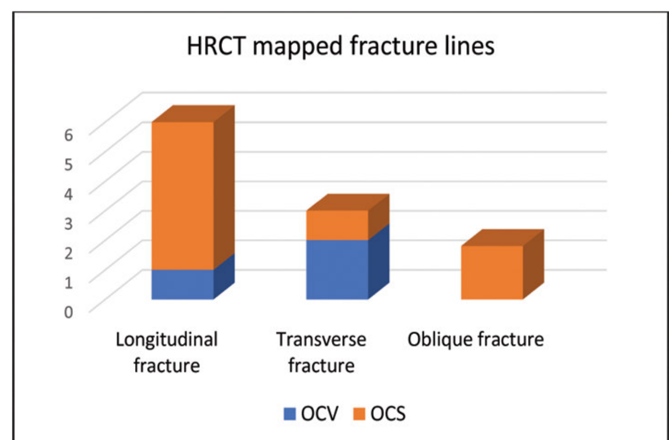

Fig. 3. Distribution of temporal bone fractures

27 patients in this study showed otological manifestations and 17 cases had nasal findings. However, there were no cases with throat manifestations. The spectrum of otological manifestations included 10 cases (33.3%) of bleeding from EAC, 2 cases (6.7%) of Battle sign, 5 cases (16.7%) of hemotympanum, 1 case (3.3%) of perforation

of tympanic membrane (TM), 16 cases (53.3%) of hearing loss, 18 cases (60%) of tinnitus, 4 cases (13.3%) of vertigo, 3 cases (10%) of nystagmus, 4 cases (13.3%) of facial palsy, and 1 case (3.3%) of CSF otorrhea (Fig. 4).

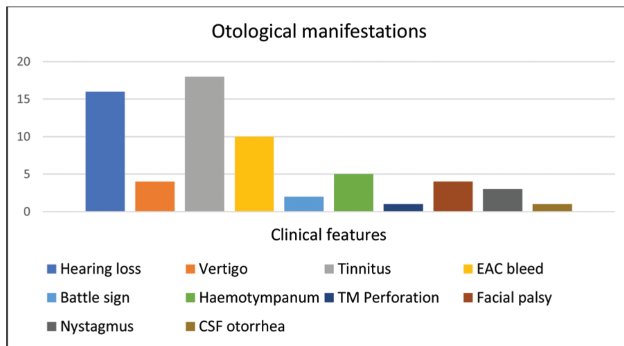

Fig. 4. Distribution of otological findings

Out of 16 cases of hearing loss, there were 6 cases with sensorineural hearing loss (SNHL) including 4 cases (25%) of severe, one case (6.25%) of profound and high frequency SNHL each. Remaining 10 cases with conductive hearing loss (CHL) included 6 patients (37.5%) with mild and 4 patients (25%) with moderate CHL. 75.0% of the patients with Severe SNHL were associated with RTA while remaining 25.0% had seizure as MOI. All the patients with Profound SNHL and High Frequency SNHL had RTA as MOI. A positive correlation ($p<0.005$) was seen between MOI and severity of hearing loss, suggestive of RTA to cause more severe type of hearing loss (Table II).

Delayed onset facial palsy was observed in 2 out of 6 cases (33.3%) of longitudinal fractures whereas immediate onset facial palsy was observed in 2 out of 3 cases (66.7%) of transverse fractures. No facial palsy was noted in cases of oblique fractures. Based on serial observation of cases of facial palsy in 90 days, recovery grading was done and out of 4 cases (13.3%), 50% cases showed complete recovery, both of which were longitudinal fractures. Partial recovery was seen in two cases of transverse fracture, where first case recovered from grade V to IV and second case showed recovery from grade IV to grade II (Table III).

All the 3 cases of OCV fractures were associated with SNHL (2 cases with profound and one with high frequency SNHL) and facial palsy (2 cases with immediate and one with delayed onset). 2 out of 3 (66.6%) were associated with tinnitus, vertigo and nystagmus (Table IV). The findings supported the fact that OCV fractures had higher incidence of otological findings.

In our study, 27 patients (90%) out of 30 were found

Table II: Correlation between MOI and SNHL

TYPES OF SNHL	MECHANISM OF TRAUMA		TOTAL NUMBER N = 6	P VALUE
	RTA	SEIZURE		
Severe SNHL	3	1	4	<0.005
Profound SNHL	1	-	1	
High frequency SNHL	1	-	1	

Table III: Recovery grade of Facial palsy at 90 days

RECOVERY GRADE OF FACIAL PALSY AT 90 DAYS	N = 4 CASES	TYPE OF FRACTURE
Complete recovery	2	Longitudinal #
Partial recovery from HB Grade V to IV	1	Transverse #
Partial recovery from HB Grade IV to II	1	

Table IV: Distribution of otological features along fracture lines

FEATURES	TOTAL NUMBER	OCS # (N=8)	OCV # (N=3)	P VALUE
EAC bleed	10	7	2	0.4909
Hemotympanum	5	4	0	0.2363
SNHL	6	3	3	0.0181
Conductive HL	10	6	0	0.0606
Facial palsy	4	1	3	0.0242
Tinnitus	18	8	2	0.2727
Vertigo	4	0	2	0.0545
Nystagmus	3	0	2	0.0545
CSF otorrhea	1	0	1	0.2727

to have nasal manifestations. One patient (3.3%) had nasal deformity, 4 patients (13.3%) had unilateral nasal bleed, 12 patients (40%) had bilateral nasal bleed, 4 patients (13.3%) had hyposmia, 3 patients (10%) had anosmia, and 3 patients (10%) had one sided CSF rhinorrhoea (Fig. 5).

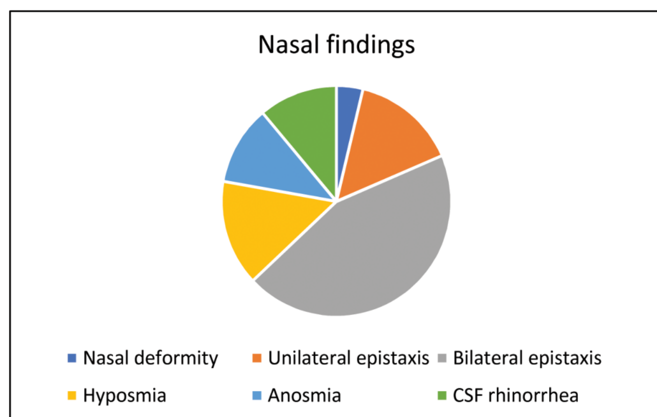

Fig. 5. Spectrum of nasal findings

All the 12 cases of bilateral epistaxis were found to have fracture of nasal bones, but only 2 patients (6.7%) had displaced fracture. CSF rhinorrhoea, which was seen in 3 patients (10%) was unilateral and 2 of these patients also had anosmia, thus establishing a positive correlation between anosmia and CSF rhinorrhoea ($\chi 2 = 11.933$, p value 0.008). Out of 4 cases of hyposmia, CSF rhinorrhoea was seen in only one patient. All the 4 cases hyposmia resolved after two months. However, out of 3 cases of anosmia, one did not show any recovery in our follow up over a period of 90 days.

Besides the ENT manifestations of the cases of head injury, some other injuries either singly or in combination, were also noted in 18 cases (60%) in our study. These included 7 cases (23.3%) of fracture zygoma-maxillary complex, 4 cases (13%) each of fracture mandible and fracture sphenoid, 3 cases (10%) of frontal bone fractures, 2 cases (6.67%) each of fracture tibia and fracture ribs, and one case (3.33%) of fracture radius-ulna. Extradural haemorrhage (EDH), subarachnoid haemorrhage (SAH) and subdural haemorrhage (SDH) were seen in a total of 7 cases (23.3%) whereas spinal injury was found in 2 cases (6.67%) (Fig. 6).

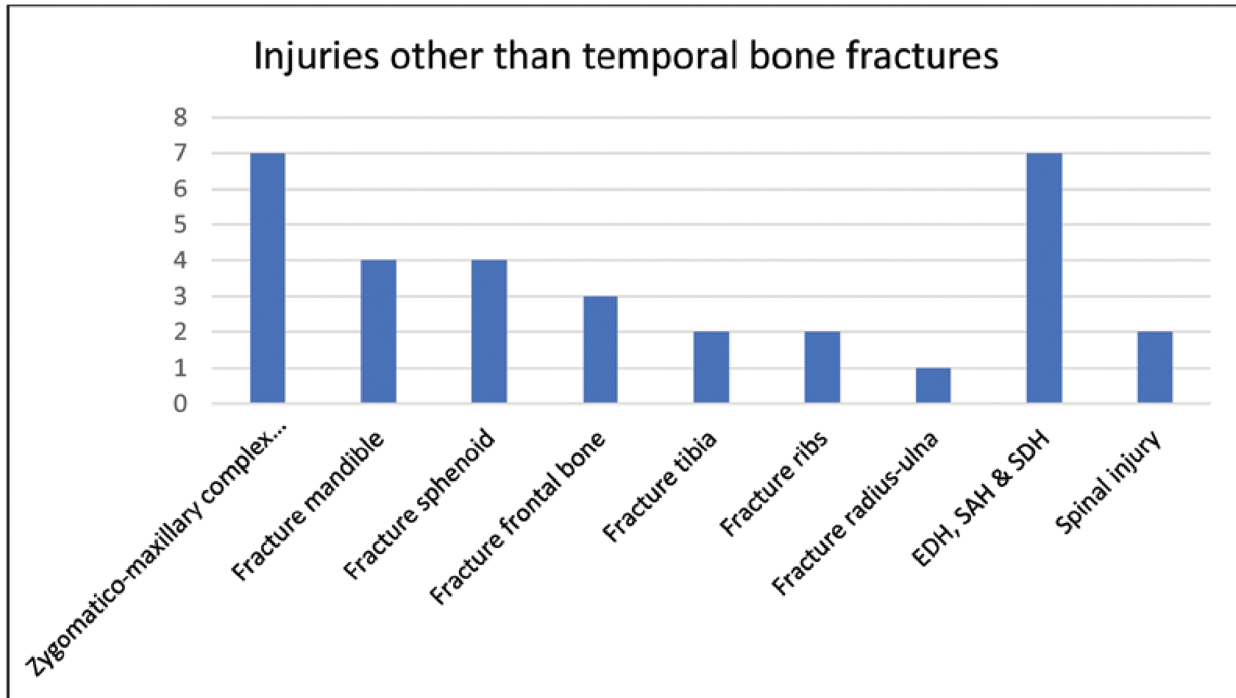

Fig. 6. Associated injuries

5 patients (17%) out of the total of 30, did not require ENT intervention, while the remaining 25 patients required management from ENT team. 22 of them were managed conservatively followed by observation. 3 patients (10%) underwent surgical intervention. Endonasal endoscopic repair of CSF rhinorrhea was done in two patients, while the third patient underwent tympanoplasty for traumatic perforation of tympanic membrane which failed to heal after three months of observation (Fig. 7).

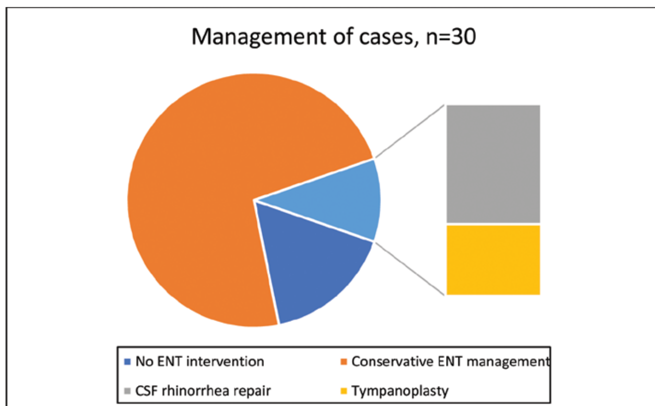

Fig. 7. Analysis of management of cases

Discussion

Head injury, which incorporates any injury to the head such as scalp abrasions, facial or dental injuries and skull bone fractures, are not only likely to cause brain injury but are also likely to be associated with ENT manifestations, maxillofacial and cervical trauma. Majority of them require a period of hospitalization, close observation, multidisciplinary clinical monitoring or surgical intervention. Head injury, associated with TBF, often merit ENT opinion and intervention due to damage to the structures housed within the temporal bone.

RTA, which was found to be the cause of head injury in 67% patients in our study, has also been reportedly blamed as the mechanism of head injury by most of the studies, including the studies by Costanza et al (67%),[4] Bouguila et al (39%),[5] Desai Esha et al (58.2%)[6] and Patil et al (58%)[7]. Whatever be the cause, male gender in the age group of 30 - 40 years is 3 to 4 times more prone to head trauma than female. Male preponderance has been noted in 67% our study, 80.61% by Desai et al[6]

and 80% by Das B et al.[8] Though the road condition, traffic load and vehicular safety design etc vary in various countries yet the bold assertive nature, indulgence in alcohol, risky job patterns may be the causes behind this demographic profile.

Grouping the clinical features into otological, nasal and throat, we came across 27 cases (90%) with otological and 17 cases (56.7%) with nasal symptoms and signs. However, there was no case with throat manifestation. Contrasting findings have been reported by Das et al[10] with ear, nose and throat findings in 35%, 50% and 15% while Desai et al[6] reported ear, nose and throat findings in 38.8%, 32% and 6.1%.

Otological manifestations in our study included 33.3% of bleeding from EAC, 6.7% of Battle sign, 16.7% of haemotympanum, 53.3% of hearing loss, 60% of tinnitus, 10% of nystagmus, 13.3% each of vertigo and facial palsy, and 3.3% each of TM perforation and CSF otorrhea. The findings were compared with the findings published in three other Indian studies by Sakthignanavel et al,[9] Patil et al[7] and Singhai et al.[10] It was found that the incidence of various otological features varied widely between these studies, even where the sample sizes were comparable (Table V). The incidence of hearing loss and tinnitus was significantly higher in our study whereas that of TM perforation was lowest.

Table V: Comparative distribution of otological features

OTOLOGICAL FEATURES	OUR STUDY (n = 30)	PATIL (n = 50)	SAKTHIGNANAVEL (n = 58)	SINGHAI (n = 200)
Ear bleed	**33.3%**	**55%**	**72.4%**	**18%**
Hearing loss	**53.3%**	**24%**	**22.4%**	**25.5%**
Tinnitus	**60%**	**8%**	**3.4%**	**6%**
Vertigo	**13.3%**	**14%**	**1.7%**	—
Facial palsy	**13.3%**	**10%**	**24.1%**	**2%**
TM perforation	**3.3%**	**35%**	**8.6%**	**11.5%**
CSF otorrhea	**3.3%**	**10%**	**6.9%**	**3.5%**

Head injuries, resulting in TBF, often lead to hearing loss which may be of immediate onset or delayed. Hearing loss may be conductive, sensorineural or mixed. CHL resulting from EAC clots or haemotympanum may be transient, but CHL due to TM perforation or disruption of ossicular chain do not recover without tympano-ossicular plastic surgery. SNHL in such cases have been attributed to cochlear concussion due to microfracture in otic capsule,[11] avulsion or direct injury to acoustic nerve, disruption of membranous labyrinth, perilymph leakage as result of disruption of endosteum of round and oval window, labyrinthine vasospasm/thrombosis or hemorrhage, occlusion of vestibular aqueduct resulting in secondary hydrops.[12] The incidence rates for post-TBF CHL and SNHL have been reported to be 10 to 57% and 0 to 14% respectively. The incidence rate was 33.33% for CHL and 20% for SNHL in our study which grossly differed from the data of 18% for CHL and 6% for SNHL by Patil et al[7] and 15.5% for CHL and 6.9% for SNHL by Sakthignanavel et al.[9]

Injury to the facial nerve can be caused by compression, contusion, stretching, perineural or intraneural hematoma, and/or nerve transection.[13] The nerve has a long circuitous course in the temporal bone which makes it vulnerable to injury at multiple sites in the event of TBF. Facial palsy was seen in 13.33% of head injury cases in our study which was not comparable with 10% by Patil et al,[7] 24.1% by Sakthignanavel et al[9] and 2% by Singhai et al.[10] When the data was analysed for

facial palsy in cases with TBF, it was found to be 54.54% in our study which was significantly higher than the incidence reported in Western studies such as 1.6% by Schuble et al,[14] 7%, by Brodie and Thompson[15] and 12.3% by Yetiser S et al.[16] When the palsy is of delayed onset or is incomplete, systemic steroid is the mainstay of treatment, but in immediate onset complete palsy, the dilemma crops in whether to decompress or to proceed with conservative management. We followed the conservative path leading to complete recovery in 2 cases of delayed onset palsies and partial recovery in the remaining 2 cases of immediate onset palsies.

Kreuzer PM et al studied the symptom of tinnitus in 1604 post-trauma patients using a validated questionnaire and found that 241 patients blamed trauma to be the cause of their tinnitus, with only 28 patients (1.74%) considered head injury to be the isolated trigger for their tinnitus.[17] In our study, it was interesting to find 18 cases (60%) of tinnitus which was much higher than 8% by Patil et al,[7] 3.4% by Sakthignanavel et al[9] and 6% by Singhai et al[10] in their studies of head injuries. Though exact cause is not known but the factors contributing to post-head injury tinnitus may be cerebral/labyrinthine concussion, mild TBI, SNHL, labyrinthine fistula, otolithic displacement, endolymphatic hydrops and psychological stress.

Factors, similar to the ones causing post-head injury tinnitus, may also be responsible for vertigo. Sakthignanavel et al[9] reported only 1.7% such cases, where as our finding of 4 cases (13.3%) cases was similar to 14% by Patil et al.[7] Two of our cases had OCV fracture of temporal bone, SNHL and facial palsy, while the remaining 2 cases had no fracture, facial palsy or hearing loss. Tinnitus was a constant symptom whereas CSF leak was detected in only one of these cases (Table VI).

Whenever facial trauma is associated with head injury, epistaxis is the commonest feature in the spectrum of nasal manifestations. Epistaxis in head injury with nasal trauma or LeFort I type fracture is often mild and can be managed with conservative measures, but it can be life threatening in LeFort type II and III fractures resulting from intense force. However, a LeFort I type displaced fracture resulting from low force trauma may also pose danger to life if there is an arterial injury, as was reported by Kotoh et al.[18] Epistaxis was seen in 53.3% cases in our study, whereas it was only 16.5% in the study by Singhai et al.[10] Our cases were managed successfully with Trotter's manoeuvre and local ice packs in all but four cases requiring nasal packing.

Olfactory impairment can result from virtually any cause of head injury, and is estimated to occur in 23.6%

Table VI: Association of vertigo with other otological features

CASES OF VERTIGO	ASSOCIATED OTOLOGICAL FEATURES					
	TINNITUS	HEARING LOSS	FACIAL PALSY	NYSTAGMUS	CSF OTORRHEA	TYPE OF TBF
Case 1	Present	Bilateral severe SNHL	Immediate onset complete	Spontaneous 1st degree left beating	Absent	OCV
Case 2	Present	No hearing loss	No facial palsy	Positional rotatory fatigable	Absent	No fracture
Case 3	Present	No hearing loss	No facial palsy	Spontaneous 2nd degree left beating	Absent	No fracture
Case 4	Present	Profound SNHL	Immediate onset complete	Spontaneous 3rd degree	Present	OCV

and 26.6% of motor vehicle accidents and domestic falls, respectively.[4] Head injury does not always cause anosmia but the severity of TBI and longer duration of cognitive impairment predispose to impairment of chemosensory function of olfaction. Prerequisite for a functional olfactory system are non-obstructed nasal airway and intact neuronal pathway. The system may malfunction following obstructed sinonasal airway, traumatized olfactory nerve fibers at the cribiform plate or contusion of olfactory bulb or cortex. Ensuring early sinonasal patency promises a good recovery from hyposmia or anosmia, but traumatic neurosensory deficit makes the impairment non-reversible. Anosmia was seen in 1% cases in the study by Singhai et al,[10] we found hyposmia in 13.3% cases and anosmia in 10% cases in our study.

Head injury, caused by RTA, seldom occurs in isolation but is often associated with injury to the structures in ENT, faciomaxillary region, or even ribs and limbs. The comprehensive evaluation and management of these patients merits a team work among otolaryngologists, trauma surgeons, neurosurgeons, radiologists, and intensivists. Injuries to structures other than ENT were seen in 60% cases in our study, while Singhai et al[10] and Das et al[8] reported 27% and 11.8% respectively. Fracture of zygomatico-maxillary complex was noted in 23.3% cases in our study which was similar to 25% by Desai E et al.[6] Interestingly the incidence of SAH, SDH and EDH in 23.3% in our study was similar to 22.5% reported by Sakthignanavel et al.[9]

Conclusion

Head injury, which is often caused by RTA, may not only result in TBI but may also cause ENT complications, maxillofacial fractures and trauma to other body parts. Majority of them require a period of hospitalization, multidisciplinary clinical monitoring or surgical intervention. Head injury, associated with TBF, often merits ENT opinion and intervention.

TBF may cause significant morbidity by injuring the important structures housed inside. Yet, since medical attention is primarily directed to the life-saving management of critical intracranial injuries, ENT manifestations often go unnoticed or are over looked. Patients subsequently present with delayed manifestations and functional impairment following hearing loss, vestibular deficit, facial palsy, CSF leak and disturbed olfaction causing significant distress to these patients.

It is, therefore, important to identify and treat the ENT complications in the cases of head injuries at the earliest in order to avoid the long-term morbidity associated with functional handicaps. It is equally important to recognize the necessity of team work among otolaryngologists, trauma surgeons, neurosurgeons, maxillofacial surgeons and radiologists for the comprehensive evaluation and management of these patients.

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