VOLUME-9, ISSUE-1, JANUARY-2020 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Ophthalmology

OCULAR MANIFESTATIONS IN HEAD INJURY- A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Aims- To study the demographic profile, extent and severity of ocular involvement in head injury patients and to assess its correlation with Glasgow Coma Scale.

Design- A prospective observational study.

Methods- This study included 200 patients of head injury aged between 18-60 years who attended casualty or referred cases to ophthalmology department from Oct 2016 to Mar 2018. Detailed ocular examination including visual acuity, intraocular pressure, visual field analysis with all intra and extraocular findings were recorded in prescribed proforma. Ancillary investigations, emergency interventions, radiological and hematological tests were performed. Patients were followed-up till being discharged and further on outpatient basis.

Results- Most common affected age group was 18-30 years with 70(35%) patients with Road Traffic Accidents (RTA) being the cause in major

ity. Most patients, n=109(54.5%) had GCS between 13 to 15 at the time of admission. Injury to the lid was the most common finding with echhymosis in 88(44.0%) and lid laceration observed in 34(17.0%) patients. Among signs of neurological significance pupillary abnormalities were most common(n=35). There was a strong association between presence of neurodeficit, along with ocular signs and mortality of the patients($p<0.001$).

Conclusion- This study aims at pointing out the importance of prompt recognition of ocular involvement and early intervention in cases especially with signs of neurological significance to reduce the ocular morbidity and to ensure a better scope for rehabilitation.

KEYWORDS : Head injury, Ocular trauma, Neurodeficit, Early intervention.

INTRODUCTION

A head injury occurs every 15 seconds and a patient dies of it every 12 minutes.[1] Head injuries are a cause of hospitalization of 200-300 persons per 100,000 population per year [2]and over 50% of all trauma deaths are associated with head injury.[1] Modern world of industrialization and urbanisation has lead to drastic increase in the incidences of industrial and road traffic accidents. Mortality and morbidity of these trauma patients is even higher if there is an a associated head injury.

Head injuries can be defined as those in which there is injury to the brain or its coverings (scalp and skull) with evidence of involvement of the brain including concussion, with loss of consciousness or post-traumatic amnesia, neurologic signs of brain injury or skull fractures.[3,4]. A frequency of upto 84% ocular involvement in head injury has been reported due to its proximity to the brain and the neural interconnections.[5] Although the eyes represent only 0.27% of the total body surface area and 4% of the facial area, they are the third most common organ affected by injuries after the hands and feet.[6]

Many theories have been proposed of how the eye is injured in traumatic brain injury. In penetrating brain injury, there may be physical damage to the visual pathway, visual cortex, and/or other vision-related structures of the brain. In nonpenetrating or closed-head injury, displacement, stretching, and shearing forces may damage areas of the brain, including those associated with vision.[7] Direct ocular trauma also contributes to the visual dysfunction in patients with head injury.

As head injuries occur most commonly in productive age group, the socioeconomic impact of head injury and associated ocular trauma is grave. Those affected often have to face loss of career opportunities, major lifestyle changes and occasionally permanent physical and mental disability.[8] Hence, the role of ocular injuries secondary to head trauma in the causation of blindness and overall prognosis of patients has become a subject of immense importance.

According to estimates by WHO, about 55 million eye injuries restricting activities for more than one day occur each year, 750,000 cases requiring hospitalization which includes 200,000 open globe injuries.[9] Worldwide there are approximately 1.6 million people blind from eye injuries,[10] 2.3 million bilaterally visually impaired and 19 million with unilateral visual loss; these facts make ocular trauma the most common cause of unilateral blindness.[11] This significant incidence of associated ocular morbidities often goes unnoticed and untreated as the manifestations of head injury and its numerous other systemic complications are so compelling that damage to the visual system is most likely to be ignored.[12] Most of the patients present much later to specialist neuro-ophthalmic clinics when not very much can be done.

This study aims at establishing the magnitude of the ocular trauma associated with head injury. This will provide focus on need of thorough ophthalmological examination of head injury patients Clinical correlation of the ocular and head trauma findings is essential in the early localization of the site of injury, ongoing assessment, management, prognosis and to maximize the overall rehabilitation potential of the patients with head injury.

MATERIAL AND METHODS

200 patients of both sex between 18-60 years of age, admitted through casualty or referred to ophthalmology department of Ispat General Hospital, with recent history of head injury were assessed over 18 month period from October 2016 to March 2018. Proper history including cause of head injury, any previous history of ocular disorders and history of medications were taken to rule out bias. Complete workup included assessment of consciousness level with Glasgow Coma Scale scoring; a GCS score of 3-8 were by definition in coma, and were classified as having a severe head injury. Those with a score of 9-12 have had a moderate head injury and a score of 13-15 were classified into mild head injury. Visual acuity was tested using Snellen's visual acuity chart and hand-held Sloan's/Snellen's visual acuity chart where ever possible.

Near vision was recorded with Snellen's near vision chart and Ishihara colour plates were used to evaluate the colour vision. Visual field was assessed using confrontation method. Ocular motility was assessed by examining the movement of the globe through the nine cardinal gazes. Intraocular pressure was measured with Schiotz tonometer or Goldmann applanation/non-contact tonometer for ambulatory/non-ambulatory patients as needed. Examination of periorbita was done with diffuse light and any sort of abnormality (contusion, abrasions, lacerations, ecchymosis etc) was recorded in detail. Orbital rim and bones palpated for continuity in suspected cases of orbital rim fracture. Slit lamp examination was done with Carl Zeiss slit-lamp. Eyelid injury was described and documented as per Spinelli's zone of injuries in terms of location, size, depth and extent. Corneal/ scleral/ corneo-scleral tear cases were evaluated and were repaired on emergency basis. Necessary radiological investigations were advised to rule out any intraocular foreign body in these cases. Anterior chamber was examined for depth, reaction and hyphema. Pupillary reactions were noted in dim light using pen torch light and by swinging flashlight test for any abnormality like Hutchinson's pupil, RAPD etc. Lens apparatus observed with adequate pupillary dilatation for any traumatic injury to lens capsule or zonular fibres.

Vitreous and retina examination was done by slit lamp biomicroscopy using 78D/90D lenses and Indirect ophthalmoscopy using 20D lens. Vitreous hemorrhage if present was graded and documented. Evaluation of retinal periphery was done to look for any traumatic retinal tear, detachment, hemorrhage or macular edema. Papilloedema was observed in a few cases and was recorded. Ancillary investigations like Optical coherence tomography, Humphrey visual field analysis, anterior chamber angle evaluation along with radiological investigations were done as needed. All the patients were under regular follow-up till the time of discharge, and further evaluation was done on outpatient basis.

RESULTS AND DATA ANALYSIS

This study included a total of 200 patients of head injury admitted at Ispat General Hospital and were studied prospectively over a period of 1.5 years from Oct 2016-Mar 2018.

Various clinical methods were employed to document and standardize our findings which included slit lamp examination, stereoscopic fundus examination with photographic and radiological documentation, the information collected in the study was analysed following the statistical procedures.

Age and Sex Distribution

168 (84.0%) were males and 32(16.0%) were females. As expected males outnumbered females in total, mostly accounting for majority of outdoor work done by males and most vehicle drivers being males. The mean age of the patients was 36.29 years. Most common affected age group was 18-30 years with 70(35%) patients.

Causes of Head Injury

Road Traffic Accidents (RTA) was found to be main cause of head injury with 169(84.5%) of total cases. Industrial accidents accounted for 7.5%, assault accounted for 4.0% of total cases while other causes like accidental fall accounted for 3.5% of total head injury cases.

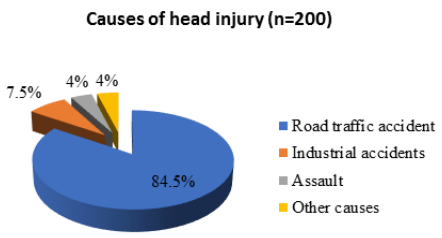

Figure-1: Cause of injury distribution

Glasgow Coma Scale distribution

Among the 200 patients, 5(2.5%) patients had GCS ≤5. 7(3.5%) patients had GCS between 6 – 8 and 79(39.5%) patients were in 9 – 12 GCS group. Most of the patients, n=109(54.5%) had GCS between 13 to 15 at the time of admission.

As expected cases with lower total GCS score had more ocular finding while those who had an overall higher GCS scores had fewer ocular findings.

Ocular involvement in head injury cases

Ophthalmic examination was carried out in all the head injury cases within the first few hours of admission. Ocular involvement was found in 155 cases (77.5%).

Best corrected visual acuity ≥6/9 was found in 76.5% while 4.75% cases presented with BCVA ≤6/60.

Ocular movements was normal in 178(89.0%) patients.13(6.5%) patients were unconscious or having low GCS and could not co-operate and 9(4.5%) patients had restriction of ocular movements due to neurological injury or orbital hematoma.

Similarly confrontation test could not be assessed in 11(5.5%) patients because of low GCS. 182(91.0%) and 7(3.5%) patients had normal and restricted visual field respectively.

26(13.0%) patients presented with elevated intraocular pressure due to intracranial/intraorbital lesions. Decreased intraocular pressure was observed in cases of corneo-scleral tear and retinal detachment [n=9(4.5%)].

RAPD was observed in 12(6.0%) patients and 10(5.0%) patients had traumatic mydriasis which subsided in subsequent follow-ups. 6(3.0%) patients presented with fixed dilated pupil suggesting probable damage to the brain stem and had grave chances of survival.

Distribution of extraocular injuries

Ptosis was seen in 15(7.5%) patients due to levator muscle trauma or neurogenic cause. Proptosis was observed in 8(4.0%) patients with most common pathology being intraorbital hematoma.

Injury to the lid was the most common finding in our study. 88(44.0%) patients presented with ecchymosis/black eye/lid edema. Lid laceration was seen in 34(17.0%) patients and lacrimal apparatus involvement was present in 3 cases requiring urgent repair.

Distribution of orbital fractures

Lateral wall was most commonly involved being present in 11(5.5%) cases. Medial wall, orbital roof and floor fracture were seen in 2%, 0.5% and 1.5% patients respectively.

Distribution of intraocular injuries

Following ecchymosis, subconjunctival hemorrhage was the second most common finding in our patients and was found in 50(25.0%) patients. Corneal abrasion/tear was seen in 6(3.0%) patients while 4(2.0%) patients presented with corneoscleral injury. Injury to iris was found in 5(2.5%) and hyphema seen in 5(2.5%) patients was graded and managed accordingly.

Lens and its zonules were found to be injured in 1.5%(n=3) patients. Vitreous hemorrhage was observed in 2(1.0%) patients.

12(6.0%) patients had swelling of the optic disc.8(4.0%) of these cases had papillodema(bilateral swelling due to

intracranial lesion while the other 4(2.0%) had only unilateral involvement due to retrobulbar compression of the nerve. Retina was involved in 2(1.0%) patients.

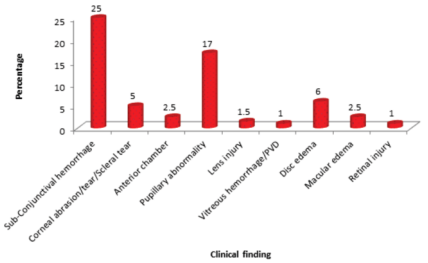

Figure-2: Distribution of intraocular injuries

Signs of neurological significance

Pupillary abnormalities were seen in 34(17.5%) patients. Disc edema was present in 12(6.0%) patients. Traumatic optic neuropathy and oculomotor nerve palsy was found in 3(1.5%) and 2(1.0%) patients respectively. Injury to trochlear and abducens nerve was observed in 1(0.5%) and 6(3.0%) patients respectively.

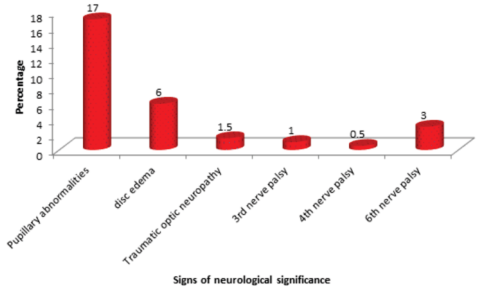

Figure-3: Ocular findings of neurological significance

Table-1: Outcome of ocular findings and GCS

GCS group	Expected outcome	Total cases	Cases with ocular findings	Final outcome	
				Death	Survived
≤5	Very poor	5	5(100%)	5(100%)	0(0%)
6-8	Poor	7	7(100%)	5(71.4%)	2(28.6%)
9-12	Fair	79	63(79.7%)	3(3.8%)	76(96.2%)
13-15	Good	109	81(74.3%)	1(0.9%)	108(99.1%)
P value	-	-	-	<0.001**	

Chi-Square/Fisher Exact Test

Association of GCS scale, neuro deficit and ocular signs with outcome

There was a moderately significant association between mortality and presence of neurodeficit signs(even in absence of ocular signs). There was a strong association between presence of neurodeficit, along with ocular signs and mortality of the patients. Association between GCS and final outcome was statistically significant with $p<0.001$** (lower GCS score significantly associated with more mortality).

DISCUSSION

Rapid industrialisation and geometrical growth in number of vehicles with sub-standard roadways, poor traffic control measures and lack of awareness regarding safety norms has led to exponential increase in head injury cases in recent years. Resultantly, this bulk of industrial or accidental mishaps increases the overall burden to the medical care of a developing nation like India.

The rationale behind the present study was meagre non conclusive information available on the magnitude of ocular findings in the acute stage of head injury. In this prospective observational study of 200 cases of head injury, 168(84.0%) were males and 32(16.0%) were females. This outnumbering of males is because of their higher indulgence in outdoor activities and these findings corresponds with the studies by Kumari R et al[13] and Masila F et al.[14]

The age of the patients ranged from 18 to 60 years, with a mean of 36.29±10.99 years. Road traffic accidents are responsible for the greater proportion of head injuries associated with ocular manifestations. In our study too, RTA was the most common mode of injury involving 169(84.5%) patients which is similar to the study by Rao IP et al [15] and Odebode TO et al[16] where they have reported road traffic accidents as the cause in 81.65% and 84.2% of head injury patients respectively. Many of these cases of road traffic accidents and assault were under alcoholic influence.

Ocular involvement was seen in 155(77.5%) cases in our study which is similar to the study by Sahasrabudhe V et al8 where they reported ocular involvement in 78% cases. A minor variation may be attributed to the differences in area and civilization covered by the study. Comprehensive ophthalmic evaluation was done for all patients but we faced problems in assessing few cases due to the fact that GCS is heavily weighted towards speech and eye opening. Some patients were unable to speak due to facial injury and eye opening was hindered by severe periorbital trauma/oedema.

In our study we found visual acuity ≤ 6/60 in 4.75% eyes and ≥ 6/18 in 84.5% of eyes. Most of the studies in the past have not specified the visual acuity at presentation, however in a study done by Rao IP et al[15] visual acuity at the time of presentation of ≤6/60 was seen in 29 eyes (21.48%) and 6/6-6/18 in 19 eyes (14.07%).This difference could be attributed to the easy accessibility of health services and prompt presentation.

Injuries to the face and ocular adnexa were more commonly associated with head injuries than the posterior segment, bony orbit or ocular nerves. This was mainly due to direct impact of traumatic force on the rigid facial bones and orbital margins, producing periorbital ecchymosis, lid laceration, subconjunctival haemorrhage, and chemosis. Ecchymosis/lid edema was the most common finding in our study involving 88(44.0%) patients. Malik A et al[17] in 2016 also reported ecchymosis as the common finding in 45.5% of head injury patients in their study.

Eyelids being the outermost and exposed part is more prone to trauma. Sub-conjunctival hemorrhage was the second most common finding after lid ecchymosis in our study population being present in 25% of patients which is comparable with the results by Kumari R et al[13] and Kulkarni R et al.[18]

Vitreous hemorhage and retinal injury were found in 2(1.0%) patients. However studies by Abbasi KZ et al[19] and Odebode TO et al[16] reported vitreous hemorrhage in 3.33% and 9.1% of patients respectively. Both vitreous hemorrhage and retinal injury being rare finding in most of the studies, a minor variation in frequency had led to significant deviation in the percentage of involvement.

Pupillary signs are of grave importance in indicating the site and severity of injury and prognosis of the patient. Pupillary reaction was abnormal in 34(17%) patients in our study, it was a general observation throughout the study that the patients with relatively poor GCS had some sort of pupillary abnormalities. Fixed dilated pupil suggestive of brainstem injury and poor prognosis was observed in 6 patients and all of them died within few hours or days of admission.

Injury to the optic nerve can occur anywhere along its intraorbital to intracranial course. The presence of dural

haemorrhage, interstitial nerve haemorrhage, shearing lesions, as well as localized ischaemia and oedema, which are considered as secondary events to initiate neuropathy had been confirmed by radiological investigations. According to Rush et al[20], such injuries are more often self-limiting and gets improved in 3-4 days. Disc edema either unilateral or bilateral/papilloedema was present in 5(2.5%) patients in our study.

In our study abducens nerve was most commonly involved cranial nerve, being observed in 6(3.0%) cases. The mechanism behind involvement of abducens nerve in head injury and basilar skull fracture cases has been well described relating to its anatomical position beneath the Gruber's ligament at the posterior clinoid process, which is the most common site for its avulsion/contusion. Similar pattern was reported in studies by Abbasi KZ et al[19] and Odebode TO et al.[16]

Lateral orbital wall inspite of being a stronger bone was most commonly involved in our study (n=11) due to the direction of impact of force in cases of RTA, which usually comes stronger from the sides unlike blowout fractures where impact is from the front. This fracture usually occurs at the articulation site between greater wing of sphenoid and zygomatic bone. In our study,12 patients had GCS ≤8, out of which ocular findings were present in 75% (n=9) patients while signs of neurological significance were noticed in 100% (n=12) of these patients. There was a significant association between neurodeficit and the final outcome of the patient with $p<0.001$. Ocular signs, GCS and neurodeficit contributed significantly to the prediction of outcome which progressively deteriorated as the GCS worsened.

CONCLUSION

This study was undertaken to observe the ocular manifestations in patients with head injury and to compare the results with the studies done in the past. Ocular involvement in head injury patients accounted for 155(77.7%) cases among 200 study patients. Neuroophthalmic manifestations and injury to the eye were more common in patients with severe head injuries and with low GCS scores and most of these patients had fatal outcome ($p<0.001$).

Thus, every patient of head injury must be evaluated thoroughly for ocular injury and neuro-ophthalmic involvement as it will reduce the rate of ocular morbidity and blindness in patients with head trauma. In addition, legislative policies and public health education aimed at increasing awareness among general population regarding the road traffic rules and necessary safety measures at workplace is urgently needed in order to reduce ocular morbidity due to ocular trauma.

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