International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391

Various Ocular Morbidity Following Concussion Injury of the Eye – A Clinical Study

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Abstract: ***Aim: To study the various ocular morbidities following concussion injury of the eye with respect to mode of injury, sites involved and visual outcome. Materials & Methods: The present study included 105 cases of blunt ocular trauma resulting in concussion injury. A detailed history and thorough ocular examinations were done. 0ptical coherence tomography (OCT), Fundus fluorescein angiography (FFA), Computed tomography (CT-scan), Magnetic resonance imaging (MRI) were also done whenever required. Results: Our study found that majority of cases were in the age group of 21-30 years (24.76%). Male were affected more with male to female ratio 3.2: 1. Most common mode of injury was the domestic accidents (44.7%). Common ocular morbidities of anterior segment were corneal edema (38.09%), hyphema (19.04%), traumatic cataract (14.28%) and subluxated lens (11.42%). Common posterior segment morbidities observed were Vitreous hemorrhage (15.23%), macular edema (7.61%), retinal detachment (5.71%) and traumatic optic neuropathy (6.66%). Visual outcome at 6 weeks [according to world health organization (WHO) definition] were (46.72 %) with normal vision, (16.82 %) with mild visual impairment, (9.34 %) with severe visual impairment, while (18.69 %) with blindness and (4.67 %) had no perception of light. Conclusion: The concussion injury of the eye is a major cause of ocular morbidities and can produce visual impairment of varying degree ranging from slight or no impairment of vision to permanent blindness. It is a complex, multi-structural involvement which requires specialized ophthalmic training to develop the expertise for corrective and reparative ocular surgeries.***

Keywords: ocular morbidity, concussion injury, hyphema, traumatic cataract, vitreous haemorrhage.

1. Introduction

Ocular trauma is a major cause of preventable visual impairment and unilateral visual loss worldwide. Every year nearly more than half a million people are blind monocularly as a result of ocular trauma[1].

Blunt trauma may result in Closed globe and Open globe injuries. Concussion or contusion is a closed globe injury caused by blunt trauma. Closed globe injury is the one in which eye wall (cornea and sclera) does not have a full thickness wound but there is intraocular damage[2].

Squash balls, stone, elastic luggage straps, fist, falls, champagne corks etc are the common causes of blunt ocular trauma[3]. A contusion is the injury that results from a concussion (i.e a violent jerk or shake) caused by external force[4].

Ocular trauma can occur during sport related activities, in the workplace, rural agricultural setting, industrial works, traffic accident, physical assault etc. Despite causing structural and functional visual loss, ocular trauma has profound social, economical, occupational and medico-legal consequences[5].

Concussion injury causes ocular damage by the coup mechanism, the conter coup mechanism or ocular compression. Few examples of coup injuries are corneal abrasions, subconjunctival haemorrhages, choroidal haemorrhages, retinal necrosis and the best example of counter coup injury is commotio retinae[6].

Concussion injuries may vary in severity from a simple corneal abrasion to an extensive intraocular damage. Moreover, in some cases, the changes are delayed or progressive. Therefore, in all cases a guarded prognosis should be given and the patient should be kept under review for months to years[7].

2. Materials and Methods

The present study was conducted at a tertiary care hospital for a period of one year from July 2015 to June 2016.One hundred and five (105) patients with blunt trauma resulting in concussion injury were taken up for this study. Informed and written consents were taken.

The inclusion criteria included the patients diagnosed as having concussion injuries among the patients of all age group of both sexes. Patients with other types of injuries and with previous ocular surgery and ocular diseases or disorders were excluded from the study.

Detailed history was taken and thorough ocular examinations including visual acuity, torch light examination, slit lamp examinations, direct and indirect ophthalmoscopy, Tonometry, Gonioscopy, B-Scan ultrasonography and routine x-ray orbit were done. OCT, FFA, CT-Scan orbit and MRI were done whenever required.

The cases were managed both conservatively and surgically. For assessment of the ocular morbidity and visual improvement, inpatient cases were daily observed till discharged and out-patient cases were reviewed after 1 week and follow up after 2 weeks & 6 weeks.

3. Results

The most commonly affected age group was between 21-30 years (24.76 %) followed by 31-40 years (20.95 %) and 41-50 years (20 %). The mean age was 35.19 ±15.61 years (Table 1). Out of 105 cases males were more affected 80(76.2%) than females 25(23.8%). The male: female ratio was 3.2: 01 (Table 2). Reason is because male patients at young age are more active and exposed to the environment.

Table 1: Age Distribution

Age (Years)	*No. of Cases*	*Percentage (%)*
0 – 10	5	4.7
11 – 20	15	14.28
21 – 30	26	24.76
31 – 40	22	20.95
41 – 50	21	20
51 – 60	10	9.5
> 60	6	5.7

Sex Incidence

Table 2: Distribution of male and female patients

Sex	*No. of Cases*	*Percentage (%)*	*Ratio*
Male	80	76.2	3.2 : 1.
Female	25	23.8	

Out of 105 cases males were more vulnerable to injuries. There were 80(76.2%) males and 25(23.8%) female. The male: female ratio was 3.2: 1. The present study showed that the maximum numbers of injuries occurred due to domestic accidents (household accidents/fall/playing) was 44.76 % followed by road traffic accidents (18.10%) (Table 3).

Table 3: Showing Different modes of blunt ocular trauma causing concussion injuries

Mode of Injury	*No. of Cases*	*Percentage (%)*
Assault	16	15.24
Occupational	16	15.24
Domestic accidents	47	44.76
Road traffic accidents	19	18.10
Others	07	6.66
TOTAL	105	100

Our study observed that the anterior segment structures were more commonly involved 259(77.3%) as compared to posterior segment structures 43(12.8%), Table 4.

Table 4: Different ocular structures involved during blunt ocular trauma.

Structures Injured	*No. of Cases**	*Percentage (%)*
Lid	76	72.38
Anterior segment		
Conjunctiva	92	87.61
Cornea	59	56.19
Anterior chamber	40	38.09
Iris and ciliary body	12	11.42
Pupil	09	8.57
Lens	47	44.76
Posterior segment		
Vitreous	17	16.19
Retina	18	17.14
Choroid	01	0.95
Optic nerve	07	6.66

*several cases had multiple involvement…. conjunctiva is under anterior segment.

Lids and conjunctiva were most commonly involved. In conjunctiva the common ocular morbidity were Tr. Conjunctivitis (45.71%), sub-conjunctival haemorrhage (33.33%). Corneal involvement were corneal edema (38.09%), Descemet's membrane fold (4.76%), corneal abrasion (5.71%), haemocornea (3.80%) and corneal opacities (3.80%).

Other anterior segment morbidities were hyphema (19.04%), Tr. Mydriasis (8.57%), iridodialysis (4.76%),and angle recession (2.85%), traumatic cataract(14.28 %) , subluxation (11.42 %), anterior lens dislocation (3.80 %) and posterior dislocation of lens(2.85 %), (Table 5).

Table 5: Ocular morbidities in anterior segment

Ocular Morbidity	No. Of Cases*	Percentage (%)
Conjunctiva		
Traumatic(Tr) conjunctivitis	48	45.71
Sub-conjunvtival haemorrhage	35	33.33
Chemosis	08	7.61
Conjunctival tear	01	0.95
Cornea		
Abrasion	06	5.71
Edema	40	38.09
Opacities	04	3.8
Descemet's membrane fold	05	4.76
Haemocornea	04	3.8
Anterior chamber		
Hyphaema	20	19.04
AC Reaction	18	17.14
Vitreous in AC	04	3.8
Iris and ciliary body		
Tr. Iridocyclitis	02	1.9
Iridodialysis	05	4.76
Sphincter tears	01	0.95
Angle recession	03	2.85
Cyclodialysis	01	0.95
Pupil		
Tr. Mydriasis	09	8.57
Lens		
Traumatic cataract	15	14.28
Pigments on lens/Vossius ring	06	5.71
Subluxation	12	11.42
Dislocation (anterior+posterior)	7(4+3)	6.66(3.8+2.85)
Post traumatic atrophy of lens	01	0.95
Traumatic aphakia	03	2.85

*Several cases had multiple involvement.

The common ocular morbidities observed were vitreous haemorrhage (15.23 %), Berlin's / macular edema (7.61 %), retinal detachment (5.71 %), Tr. Optic neuropathy (6.66 %), macular hole (0.95%),and choroidal tear (0.95%). Raised intra ocular pressure was detected in 20 % cases, (Table 6).

Table 6: Ocular morbidities in posterior segment

Ocular Morbidity	*No. of Cases**	*Percentage (%)*
Vitreous		
Vitreous haemorrhage	16	15.23
Posterior vitreous detachment	01	0.95
Retina		
Macular edema	08	7.61
Macular hole	01	0.95

Retinal hole	01	0.95
Retinal detachment	06	5.71
Pre-retinal/retinal haemorhage	01	0.95
Pigment epithelial detachment	01	0.95
Choroid		
Choroidal tear	01	0.95
Optic nerve		
Optic neuropathy	07	6.66

*Several cases had multiple involvement

The present study showed that 40 (38.09%) patients attended hospital within 24 hours, 46 (43.80%) patients attended between 24 hours to 1 week and 19 (18.09%) patients presented very late (after 1 week).

In our study, according to WHO definition of blindness, at the time of presentation out of 105 cases (107 eyes) visual acuity of 6/18 or better was found in 37 eyes (34.57 %), mild visual impairment (< 6/18 – 6/60) in 13 eyes (12.14 %) , severe visual impairment (< 6/60 – 3/60) in 6 eyes (5.60 %) and blind (< 3/60 – PL) in 43 eyes (40.18 %). No perception of light was found in 4 eyes (3.73 %). In 3.73 % of eyes visual acuity was not recordable (patients were semi-conscious or drowsy).

Visual outcome in this study is defined as the visual acuity at 6 weeks, compared with initial visual acuity. Out of 105 cases (107 eyes) the visual outcome at 6 weeks was found that 50 eyes (46.72 %) had normal vision (according to WHO definition i.e. 6/18 or better visual acuity, 18 (16.82 %) eyes had mild visual impairment (< 6/18 – 6/60), 10 (9.34 %) had severe visual impairment (< 6/60 – 3/60), while 20 (18.69 %) eyes concluded with blindness (< 3/60 – PL) and 5 (4.67 %) had no perception of light. At 6 weeks, 3.73 % of eyes had lost follow up.

Visual acuity at presentation and at 6 weeks follow up is shown in table 6. Poor vision at presentation was seen in patients who presented after 24 hours to 1 week (20.56%), while poor vision at 6 weeks was in patients who presented within 24 hours.

Table 7: Distribution of visual acuity at presentation and at 6 weeks on the basis of time of arrival to the hospital

Time of arrival (No. of patients)	Visual acuity At presentation		Visual acuity At 6	
	6/36 or better	6/60 or less	6/36 or better	
Within 24 hrs (40)	22 (20.56%)	18 (16.82%)	28 (26.16%)	1
24 hrs – 1 week(46)	24 (22.42%)	22 (20.56%)	36 (33.64%)	
after 1 week (19)	4 (3.73%)	15 (14.01%)	6 (5.60%)	

This study observed that the patients who attended late in the hospital, most of them had poor vision at the time of presentation and the final vision of these patients at 6 weeks was also poor.

It has been observed that delayed in the arrival time to the hospital, delayed in treatment, involvement of vital ocular structures (cornea, lens, vitreous, retina, macula, choroid etc), raised IOP, secondary infection, low socio-economic status, lack of education, poor compliance were the common risk factors for poor visual recovery.

Various causes of for poor visual outcome at 6 weeks (anterior segment and posterior segment morbidity) is shown in table 7. Bleeding in the eye (hyphema, 21.05% and vitreous haemorrhage, 28.94%) was the most common cause followed by secondary glaucoma (15.78%) for poor visual outcome in the present study.

Table 8: Ocular morbidities in cases of poor visual outcome at 6 weeks

Visual acuity at 6 weeks	Ant. Segment Morbidity* n (%)	Post. Segment Morbidity* n (%)
6/60 or less (38 cases)	Corneal opacity/ edema – 4(10.5%) DM fold/Endo. staining- 2(5.26%) Iridodialysis – 5 (13.15%) Cyclodialysis–01 (2.6 %) Hyphema – 8 (21.05%) Tr. Aphakia – 2 (5.26%) Subluxation of lens – 6 (15.78%) Dislocation of lens – 5 (13.15%) Tr. Cataract – 4 (10.5%) Ant. Uveitis – 2 (5.26%) Vitreous in AC – 01(2.6%) Vossius ring/ iris pigment over lens capsule – 01(2.6%)	Macular edema – 3 (8.89%) Macular hole – 01 (2.6%) Vit. haemorrhage – 11(28.94%) Retinal detachment – 5(13.15%) Optic neuropathy – 3 (8.89%) Choroidal tear – 01 (2.6%)
	Increased IOP (sec. glaucoma) – 6 (15.78%)	

*Several cases had multiple involvement

4. Discussion

In the present study, the age incidence was found to be highest in the third decade (21 – 30 years) 24.76 %. Shukla and Verma[8]reported the incidence in the third decade to be highest (29.5%).Karki et al[9], and Ulagantheran et al[10] also reported the highest incidence in third decade with 26.60 % and 43.2 % respectively., which is similar to our study.Males were involved more 80 cases (76.20 %) as compared to females 25 cases (23.80 %). The male: female ratio has found to be 3.2: 1. The other studies by Pai et al[11],Wali and Kulkarni[12] also showed a similar finding.
Regarding the different modes of trauma, in our study the domestic accidents (44.76 %) were found to be the most common mode of injury followed by road traffic accidents (18.10 %), occupational and assault (15.24 % each) which were almost similar to studies done by Canavan et al[13] where most injuries followed sports or domestic accidents (58.5%) and by Badrinath[14] where domestic accidents were responsible for the majority of injuries (65%). Titiyal et al[15]

found that about 44.76 % of cases had ocular injury following domestic accidents.

Present study found, the domestic accident as common mode of blunt trauma. The less number of industrial causes of blunt ocular injury can be explained by the observation that the latter tend to lead to penetrating injuries which were excluded from our study.

In the present study, it has been observed that the anterior segment structures were more commonly involved as compared to posterior segment structures. Shtewi etal[16] in their study on 276 traumatised eye of 248 patients reported that anterior segment structures commonly involved and Sana Nadeem[17] also reported involvement of the anterior segment in. 55(66.3%), the posterior segment in 5(6%) cases and both anterior and posterior segment in 23(27.7%)

Lids and conjuntiva were most commonly affected with Tr. Conjunctivitis (45.71%) and subconjunctival haemorrhage (33.33%).In Cornea, common ocular morbidities included corneal edema (38.09%), Descemet's membrane fold (4.76%), corneal abrasion (5.71%), haemocornea (3.80%), corneal opacities (3.80%). Wali & Kulkarni[12] reported a higher incidence of corneal edema (24%), abrasion (14%),and DM Fold (04%).

Other anterior segment morbidities which were found in this study includes hyphaema (19.04%), Tr. Mydriasis (8.57%), iridodialysis (4.76%), angle recession (2.85%). Shtewi et al[16] reported a high incidence of hyphema (50%) and angle recession (10.3%). Wali and Kulkarni[12] also reported hyphema in (28%) cases, Tr. Iridocyclitis in 26% cases, iridodialysis in 10% cases and Tr. Mydriasis in 32% cases.

Morbidities of lens were traumatic cataract (cortical cataract/subcapsular cataract/ complicated cataract) in 14.28 % cases, subluxation in 11.42 % cases, anterior lens dislocation in 3.80 % and posterior dislocation in 2.85 % cases. Shtewi et al[16] found Tr. Cataract in 31.9% cases and lens dislocation in 7.6% cases. Kumar Sambhav[18] found subluxated lens in 18.5%, traumatic cataract in 12.3%.

In posterior segment, the common ocular morbidities observed were vitreous haemorrhage (15.23 %), Berlin's / macular edema (7.61 %), retinal detachment (5.71 %), Tr. Optic neuropathy (6.66 %), macular hole (0.95%), choroidal tear (0.95%). Our study was similar to studies done by Kumar Sambhav[18] and Wali and Kulkarni[12] who also reported the high incidence of vitreous haemorrhge. Optic neuropathy (6.66%) and secondary glaucoma (20%) were also common in our study. Kumar Sambhav[18] also reported similar findings. The slightly higher incidence of secondary glaucoma and optic neuropathy is probably because in our study many of the patients presented late with uveitis, secondary infection which leads to increased IOP and optic neuropathy. And also the anterior dislocation of lens and hyphema were reasons for more secondary glaucoma.
Only 38.09 % patients presented within 24 hours, 43.80 % patients presented between 24 hours to 1 week. The rest 18.9 % patients presented after 1 week from the time of injuries. Our findings were similar to the study done by Tsedeke Asaminew et al[19] who also reported that only 31.6 % traumatized patients presented within 2 days, 39.8 % patients presented in 2 to 7 days, while 28.6 % after 7 days of injuries.

The time interval to report emergency department depends on multiple factors like degree of damage, distance from hospital, intelligence of the patient, low socioeconomic status, care given by local doctors and system problems including unclear referral systems.

Analysis of visual acuity at presentation shows that out of 105 cases, 5 eyes (4.67%) had no perception of light. Poor vision (6/60 – HM) was found in 30.84% of eyes, 18 cases (16.82%) had only perception of light. Following treatment the final visual acuity at 6 weeks was 6/9 or better in 45 eyes (42.05 %), 6/12 – 6/36 visual acuity in 19.62 % of eyes, 6/60 – HM in 25.23 % eyes. Only perception of light was found in 5.60 % of eyes and No perception of light was seen in 3.73 % of eyes. The visual outcome could not be determined in 3.73 % of eyes due to lost of follow up.

Titiyal et al[15] in their study about the visual acuity at presentation, 54(32.7%) had visual acuity of 6/6- 6/18 while 93(56.5%) patients were blind at presentation i.e., visual acuity <3/60. Visual acuity was NPL in 24(14.5%) cases.

Canavan and Archer[13] found a final visual acuity of 6/36 or better in 80.2% cases and 12.7% had a visual acuity of 6/60 or worse & total no perception of light was 6 % out of which 1.2% had due to extensive fundus injury or optic nerve damage.

5. Conclusion

The anterior segment structures are more commonly involved as compared to posterior segment structures. But the ocular morbidities of posterior segment are more vision threatening than anterior segment morbidities.Timely arrival and management have great impact on visual prognosis.

Efforts must be taken to prevent or to minimize ocular injuries by improving certain domestic habits, wearing protective goggles while working, supervising children while playing. Ocular health education also plays an important role.Visual impairment following concussion injury of the eye is a complex multi-structural involvement which requires specialized ophthalmic training to develop the expertise for corrective and reparative ocular surgeries (both anterior and posterior segment surgeries).

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