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Study of Pattern, Demographical Profile and Visual Outcome in Open Globe Injuries at Tertiary Eye Care Hospital in Central Rajasthan, India

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Abstract:
Aim: *To determine pattern, demographical profile and visual outcome in open globe injuries at tertiary eye hospital in central Rajasthan, India.*
Material & method*: Hospital based study conducted during a period of one year from April 2014 to March 2015. 50 subjects (50 eyes) were included in the study. None of these subjects had bilateral ocular trauma. The examination involved assessment of visual acuity and description of nature and extent of ocular injury along with sociodemographic profile. The visual outcome was taken to be the best corrected vision at 6 months post trauma. The chi-square test was used to statistically analyze the data.*
Result: *Of the 50 patients with open globe injuries were analyzed. All patients required hospital admission for surgical repair and management. Males had a higher rate of open globe injury than females (64% versus 36%). Mean age was 25.66±14.74 Years (median of 22 years, ranging from 6 years to 60 years). Fourty one patients (82%) were presented within 72 hours of injury. The visual outcome was good (visual acuity of more than 6/18 at 3 months post-trauma) in 32%. It was found that prognostic factors influencing the final visual acuity (VA) included initial visual acquity, relative afferent pupillary defect (RAPD), grade of injury, zone of injury, type of injury (sharp vs. blunt), presence of vitreous loss and anterior segment involvement (though more posterior injuries having poorer prognoses).*
Conclusions: *Young males are particularly vulnerable to ocular trauma.The most important prognostic factors influencing the final visual acquity were initial visual acquity , RAPD, and the zone of injury. Early intervention in patients with ocular trauma gives satisfactory visual results. OTS calculated at initial evaluation may have predictive value in patients with open globe injury.*
Keywords: *Ocular trauma, visual outcome, open globe injuries, visual acquity.*

I. Introduction

Ocular trauma is a major cause of visual impairment worldwide .Open globe injury, defined as a full thickness wound of the eye wall[1], is a major but preventable cause of permanent visual impairment and blindness in the world[2]. The World Health Organization programme estimated that approximately 750,000 cases of ocular trauma are hospitalized per year, and 200,000 cases are open globe injuries worldwide[3]. Worldwide the typical male to female ratio is 4:1[4,5] and Open globe injury is said to be more common[6,7]. Successful surgical repair of open globe injury and subsequent visual rehabilitation is a topic of great significance and challenge to the practicing ophthalmologists[8]. One of the important components in management of open globe injury is counseling of the trauma victim and his family[8]. To predict the vision outcome in ocular trauma patients, there have been numerous literature till date[9,10,11]. International classification of ocular trauma is based on some of the variables affecting the final visual outcome[11]. Ocular trauma score (OTS) system suggested by Kuhn *et al.*, is the current system to predict the vision outcome in patients with open globe injury[12]. The key factors involved in determining the Ocular Trauma Score are visual acuity at presentation, the presence or absence of a globe rupture, endophthalmitis, perforating injury, retinal detachment and relative afferent pupillary defect. The present study was aimed at evaluating the pattern, demographical profile and visual outcome in open globe injuries at tertiary eye care hospital in central Rajasthan, India.

II. Materials And Methods

This study included patients with mechanical ocular trauma admitted at tertiary eye hospital in central Rajasthan, India who underwent surgical repair of open globe injury (Figure 1) over a period of one year April 2014 to March 2015. Approval from local ethics committee was obtained to conduct the study. All patients were subjected to detailed ophthalmic evaluation to collect demographic data (age and gender), eye(s) involved, cause and place of injury, and type of injury. Initial VA, zone of injury, and other clinical signs (hyphema, lens injury, RAPD, endophthalmitis, retinal detachment, and vitreous hemorrhage) were recorded. Ocular Trauma Score was calculated from patient's initial visual acuity and tissue diagnosis of eye. Follow up was done on day-1, day-3, week-1, week-4, week-12 & week-24. We also utilized the OTS to evaluate the final VA. Type of injury was based on the Ocular Trauma Classification Group: rupture, penetrating injury, intraocular foreign body, perforating injury or mixed injury. Zone of injury was defined according to the Ocular Trauma Classification Group: zone 1 (the whole cornea, including corneoscleral limbus), zone 2 (corneoscleral limbus to a point 5 mm posterior into the sclera), and zone 3 (posterior to the anterior 5 mm of the sclera). Initial and final VAs were classified as no light perception (NLP) and light perception (LP)/hand motion (HM), 1/60–5/60, 6/60-6/18, and ≥6/12. A good visual outcome was defined as a final VA of 6/60 or better, while a poor visual outcome was defined as a final VA of less than 6/60. Patients with previous ocular surgery and preexisting ocular conditions affecting VA as well as those with less than 6 months of follow-up were excluded.

Statistical analysis was carried out using commercially available statistical software. The chi-square test was used to statistically analyze the data. Value of 0.05 or less (p value) was considered statistically significant.

Figure 1: Clinical photograph of a case of ocular trauma a). pretreatment (Up Left) & b). Just after repair of corneal tear (Up Right).

III. Results

Our study included data from 50 eyes (50 patients) of open globe injuries over a one year period. Thirty two (64%) patients were males and 18 (36%) patients were females. Males were more injured than females due to their increased mobility and outdoor activities.(X^2=3.92 p=0.047) Mean age was 25.66±14.74 Years (median of 22 years, ranging from 6 years to 60 years). Thirty (60%) patients presented in between 5–25 year old age group. Young age group was more prone to trauma due to increased outdoor mobility and playing habbits (X^2=19.09 p=0.0001). Right eye was associated with 32 (64%) patients and left eye with 18 (36%) patients. Not even a single patient had bilateral eyes involvement. Twenty seven (54%) patients took 24-72 hours (1-3 days) to look for medical care after their injuries; however, 14 (28%) patients took less than 24 hours. This delay in presentation was mainly due to ignorance of people, poor transport facilities and inaccessibility to eye care centers. The duration of follow-up was 6 months after repair of injury. Twenty five (50%) injuries happened at home or during playing, 15 (30%) happened at work place, and 10 (20%) on the road in road traffic accidents. Most of the injuries were occurred during playing caused by metallic objects (16, 32%) followed by injuries caused by stone (12, 24%) (Table 1 & 2).

Anterior segment was found to involved in 24(48%) eyes followed by involvement of both the segments (21,42%), whereas absolute posterior segment involvement was found in only 5(10%)eyes.(Table 2) Regarding type of injury, (type B) penetrating injury (30, 60%) accounted for the majority of open globe injuries(X^2=54.00 p=0.0001), followed by rupture (type A) (9, 18%). Intraocular foreign body (type C) (6, 12%) and mixed injury (type E) (5, 10%) accounted for the remaining open globe injuries. While grade 4 injury (4/200-PL) was found in 34(68%) eyes followed by grade 5 or No PL(7,14%). In terms of the zone of injury, 34 (68%) eyes had zone 1 injuries Isolated to cornea (including limbus), 15 (30%) eyes had zone 2 injuries (Limbus to a point 5 mm posterior into the sclera) and 01 (2%) eyes had zone 3 injuries (Posterior to anterior 5mm of Sclera. Uveal tissue prolapse was associated with 26 (52%) eyes followed by Hyphema (19,38%) and vitreous hemorrhage with 24 (48%) eyes. Lens injury was found in 34 (68%) eyes. Endophthalmitis was present in 5 eyes (10%). Retinal detachment was observed in 5 (10%) eyes. RAPD was noted in 09 eyes (18%). (Table3,4).

Table 1: Sociodemographic variables

Variables	No of cases	stastics
Age		
5 – 25 years	30	X^2=19.09
26 – 45 years	15	p=0.0001
46 – 60 years	05	
Gender		
Male	32	X^2=3.92
Female	18	p=0.047
Domicile		
Rural	43	X^2=25.92
Urban	7	p=0.0001
Occupation		
Student	19	X^2=0.523
Labour /farmer	15	p=0769
House wife/others	16	
Eye involved		
Right	32	X^2=3.92
Left	18	p=0.047

Table 2: Distribution of cases according object causing injuries, duration of presentation and segment involvement

	No. of cases (%)
Objects	
Metal	16 (32%)
Stone	12 (24%)
Wooden	11 (22%)
Glass	05 (10%)
Thorn	04 (08%)
Others	02 (04%)
Duration presentation	
<1 day	14 (28%)
1-3 days	27 (54%)
4-7 days	06 (12%)
>7 days	03 (06%)
Segment involved	
Anterior segment	24 (48%)
Posterior segment	05 (10%)
Both segment	21 (42%)

Table 3: Distribution of cases according to grade ,type and zone of injury and RAPD

Variables	No of patients (%)	Statistics
Grade		
1	01 (02%)	X^2=74.00
2	03 (06%)	p=0.0001
3	05 (10%)	
4	34 (68%)	
5	07 (14%)	
Type		
A	09 (18%)	X^2=54.00
B	30 (60%)	p=0.0001
C	06 (12%)	
D	00 (00%)	
E	05 (10%)	
Zone		
I	34 (68%)	X^2=32.945
II	15 (30%)	p=0.0001
III	01 (02%)	
Presence of RAPD	09 (18%)	X^2=20.48
Positive	41 (82%)	p=0.0001
Negative		

Of all open globe injury eyes, Only one eye (2%) had grade I visual acuity followed by 3 (6%) eyes had grade II while after management 16 (32%) eyes had final VA of Grade I (>20/40) and 13 (26%) eyes had final VA of Grade II (6/12-6/36).(X^2=34.96p<0.0001)(Table5). In terms of management 02 cases were conservatively managed while 48 cases underwent various kind of surgical procedures (Table6). Of the total 50 cases, 50% cases were found of OTS 2, 34% cases were of OTS 3, 10% cases were of OTS 1, 4%cases were of OTS 4 and 2% cases were of OTS 5. (Figure 2)

Table 4: Distribution of cases according to clinical finding

Structure involved	Number of cases	Percentage
Traumatic cataract	34	68%
Uveal tissue prolapsed	26	52%
Vitreous hemorrhage	24	48%
Hypheama	19	38%
IOFB	10	20%
RAPD	09	18%
RD	05	10%
Endophthalmitis	05	10%

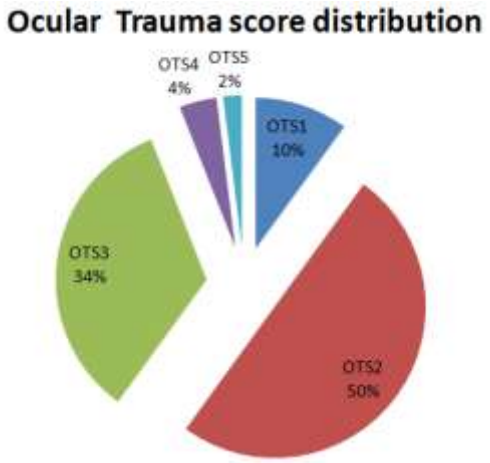

Figure 2: Distribution of patients according to Ocular Trauma Score

Table 5: Comparison of Visual acuity grades at presentation and after 6 month of the management

Visual acuity	At presentation	After management	Statistics
I(> 6/12)	01 (2%)	16 (32%)	
II(6/12-6/36)	03 (6%)	13 (26%)	X^2=34.96
III(6/36-2/60)	04 (8%)	05 (10%)	p<0.0001
IV(2/60-PL)	35 (70%)	09 (18%)	
V(No PL)	07	07	

Table 6: Modalities of management of mechanical ocular trauma

Modality	No. of cases	Percentage
Globe repair	11	22%
Globe repair with cataract extraction	22	44%
Cataract extraction	03	6%
Repair with removal of FB	04	8%
RRFB with cataract extraction	04	8%
PPV/RFB	02	4%
Conservative	02	4%
Enucleation/Evisceration	02	4%

VI. Discussion

Ocular trauma is an important cause of visual loss and is frequently preventable. This study documents the nature of the ocular trauma and their outcome over one year period. In this study, only indoor patients were included. It was found that open globe injuries occurred predominantly in males, consistent with other studies[13,14]. This might be due to gender-based behavior and male involvement in higher risk of working activities and mobilities. Mean age was 25.66±14.74 Years (median of 22 years, ranging from 6 years to 60 years). Thirty (60%) patients occurred in aged 5–25 year old group. Most of the injuries occurred at home (in young childrens) followed by workplace. This is due to manual labour which was more than reflected in our study in terms of ocular trauma. Because in lower socioeconomic status group and in rural population most of the females have to do agriculture work, manual labor, construction work, cattle feeding, small scale industry work, arrangement of tree branches for wooden fuel to cook food along their other house hold work. That is the reason behind ocular trauma in childrens and females doing their routine work and playing. Better education

regarding safety at work place or during playing and use of protective eye wear at working hours will help in reducing the incidence of open globe injury in bulk. Out of total 50 cases, Forty three (86%) cases were from rural and seven (14%) from an urban background. In Rajasthan, most of the population resides at rural area and they are normally depending on public sector health care system

Majority of the patients (82%) could seek for medical care timely within 1-3 days. However, nine (18%) patients still took more than 4 days. It showed Poverty and a lack of awareness, ignorance of people, poor transport facilities and inaccessibility to eye care centers might hamper timely management of ocular injuries.

The System for classifying the open globe injuries has been proposed by the Ocular Trauma Classification Group. This system is based on four characteristics or variables of the presenting injury: Type of injury defined by mechanism of injury, Grade of injury defined by visual acuity at the time of initial examination, presence of RAPD and Zone of injury defined by the antero-posterior extent of injury (Table7). Pieramici et al[15] studied the prognostic significance of this system for classifying mechanical injuries of the Eye in open globe injuries and found all four classification variables were significant predictors of visual outcome. Apart from this Kuhn et al[11,12] were successful in listing six key factors which can predict the outcome of an injured eye. The factors were brought together to form the Ocular Trauma Score (OTS), which aims to provide a single probability estimate of the vision that might be achieved six months after the trauma. The key factors involved in determining the Ocular Trauma Score are visual acuity at presentation, the presence or absence of a globe rupture, endophthalmitis, perforating injury, retinal detachment and relative afferent pupillary defect (RAPD). A certain raw number has been assigned to each of the factors. The score can be calculated by use of the table (Table 8). To calculate the ocular trauma score, first determine the patient's initial visual acuity after the injury and their tissue diagnoses. Then assign a raw point value for initial visual acuity from row A from the Table. Then subtract the appropriate raw points for each diagnosis from rows B to F. Higher OTS scores tend to indicate a better prognosis. To provide an estimate of the patient's probability of attaining a specific visual acuity range at a six-month follow-up, locate the row in next Table corresponding to the patient's OTS. (Table 9)

Table 7: International Society for Ocular Trauma classification of an Open Globe Injury.

Type of Injury	**Grade of injury**
A: Rupture	1: > 20/40 (>6/12)
B: Penetrating	2: 20/50- 20/100 (6/15-6/30)
C: Intraocular foreign body	3: 19/100-5/200 (6/30-fc5mtr)
D: Perforating	4: 4/200-PL (fc4mtr-PL)
E: Mixed	5: NO PL
Pupil	**Zone of Injury**
Positive: RAPD	Zone I: Isolated to cornea (including limbus)
Negative: No RAPD	Zone II: Limbus to a point 5 mm posterior into the sclera Zone III: Posterior to anterior 5mm of Sclera

Table 8: Calculation of the raw ots score. (raw score = sum of raw points)

Initial visual factor	**Raw points**		
Initial visual acuity category	NLP	=	60
	LP to HM	=	70
	1/200 to 19/200	=	80
	20/200 to 20/50	=	90
	≥20/40	=	100
Globe rupture	-23		
Endophthalmitis	-17		
Perforating injury	-14		
Retinal detachment	-11		
Afferent Pupillary defect	-10		

Table 9: The OTS score and the patient's probability of attaining a specific visual acuity can be determined from the raw score.

Raw score	**OTS Score**	**NLP**	**LP/HM**	**1/200-19/200**	**20/200-20/50**	**□ 20/40**
0-44	1	73%	17%	7%	2%	1%
45-65	2	28%	26%	18%	13%	15%
66-80	3	2%	11%	15%	28%	44%
81-91	4	1%	2%	2%	21%	74%
92-100	5	0%	1%	2%	5%	92%

In our study 16 eyes ended up with final visual acuity (VA) of more than 6/12, 13 eyes with a result of final VA of 6/12-6/36 , 5 eyes with a result of final VA of 6/36-2/60, 9 eyes with a result of final VA of 2/60-PL and 7 eyes with end result of No PL(No perception of light). Of the 7 eyes found with initial VA of NLP, for these 7 eyes we found with final VA of NLP, 2 eyes were as a result of primary enucleation, or Evisceration and 5 were as a result of phthisis bulbi. Of 43 eyes, one eye presented with grade I visual acuity, 3 eyes with grade II , 4 eyes with grade III and 35 eyes presented with grade IV visual Acuity. After attaining last follow-up, all 43 eyes ended with improved vision (Table5). Schmidt et al have demonstrated that initial VA was found to correlate significantly with the final VA in open globe injuries[16]. Our study showed similar results that patients who had initial VA of 20/200 or better had improvement in final VA; however, majority of patients with initial VA of Light Perception/Hand Movement or worse had poor final VA. Pieramici et al.[15] found that if RAPD was present, final VA was significantly worse. In our study, 9 patients had RAPD positive. Retinal detachment, induced by direct trauma or traction of proliferative vitreous in open globe injuries, was found to be a significant prognostic factor by Hutton and Fuller[17] and Thompson et al[18]. When it occurs, photoreceptor cells are probably seriously injured and may lead to limited final VA. In our study, 5 (10%) patients with retinal detachment had poor final VA of less than 6/60, confirming its importance as a prognostic factor.

Vitreous hemorrhage, caused by rupture of blood vessels in the ciliary body, retina, urea, or sclera, was found to be a prognostic factor . When it occurs, it may be related to serious damage of eye tissues. In our study, 24(48%) patients presented with vitreous hemorrhage, and after last follow up final VAs that were less than 6/60 was present in 14 eyes. Hyphema also played a role in final VA .Madhusudhan et al. found that patients who did not have hyphema were twice less likely to have the final VA of less than 3/60 compared with patients having hyphema[19] .Lens injury, caused by direct lesion or the development of cataract, was also an important factor of the final VA. In our study, 34 (68%) eyes had traumatic cataract .Although lens injury had no effect on the final VA because of its association with zone 1, the possibility of performing lens surgery quickly after injury, and recent improvements in cataract surgery and lens technology.

Endophthalmitis has been mentioned as a prognostic indicator by Williams et al[20]. Endophthalmitis is associated with special spectrum of organisms such as Bacillus, Staphylococcus and streptococcus species. In our study, endophthalmitis developed in 5 (10.0%) eyes.

Hutton and Fuller [17] found that wounds involving zone 2 or 3 resulted in significantly higher rates of poor final VA than those involving zone 1 in open globe injuries. Similarly, Madhusudhan et al. also found that patients whose wounds involve zone 3 had 20 times the risk of having poor final VA when compared with those whose wounds involve zone 1[19]. This could be explained by the fact that posterior wounds could cause irreparable damage to photoreceptors such as retina and optic nerve; despite anatomic correction, hence final VA might remain limited. OTS study stated that a patient with OTS category one will have a higher risk of poorer final VA as against a patient with OTS category five who will have a higher probability of better final VA[21]. In our study, we found that only 10% of patients with OTS category one had final VA of 6/18 or worse, Of the patients with OTS category five, 100% had final VA of 6/18 or better. Another study by Man and Steel also suggested that OTS possibly had predictive value of the final VA in open globe injury[22]. Therefore OTS is of great importance for patients and ophthalmologists.

V. Conclusions

Young patients especially students group are particularly vulnerable to ocular trauma. Primary preventive approaches such as close observation during playing, promoting safe riding practices and strict implementation of traffic rules and use of preventive measures at work place like protective goggles may prevent road traffic accidents associated ocular morbidity. Early intervention in patients with ocular trauma gives satisfactory visual results. OTS calculated at initial evaluation may have predictive value in patients with open globe injury and hence should be more widely used by ophthalmologists across the world for counselling of trauma victim and family.

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