

Assessment of Risk Factors, Etiological Factors and Visual Outcomes of Infected Globe Injuries among Paediatrics and Adults – A Prospective Study

Balraj A¹, Seema Ramakrishnan², Thiruvengada Krishnan³

ABSTRACT

Introduction: Ocular trauma is the major cause of monocular visual impairment and blindness in the world. The aim of the present study was to assess the infected globe injury with reference to demography, etiology, clinical features and visual outcomes among paediatric and adult patients.

Material and Methods: The present study was a prospective study which was done among 92 patients. All patients who presented to ophthalmology department with mechanical globe injuries leading to ocular infection (see methodology for definition of ocular infection) were included in the study. Visual status assessment was done with a Snellen chart for all age groups except for children below 5 years of age where age appropriate tests will be used for VA assessment.

Results: The total number of patients in the study was 92 patients. Majority of which 77 were found to be males (83.7%) and females were 15 (16.3%). Majority of the patients were less than 20 years (39.5%). At 6 months follow up after management, we found that there was a significant improvement in BCVA level ($P < 0.001$) and there was also significant relationship of increase in the OTS score with better VA in our study. The factors such as Cornea infiltrate (OR = 7.37, 95%CI (1.13 – 47.96), $p=0.037$), Fundus good glow (OR = 0.02, 95%CI (0.001 – 0.23), $p=0.002$) and Dull glow (OR = 0.16, 95% CI (0.03 – 0.99), $p=0.049$) were found to be significant after multivariate analysis.

Conclusion: Corneal infiltrate was identified as the single most independent risk factor for poor outcome in our study. Children were the mostly affected group with males outnumbering females. Wooden sticks were the commonest insulting agent. Despite the late presentation and predominant zone I injury, eye could be salvaged in majority with visual recovery of 6/12 and better in 41 cases (44.6%).

Keywords: Risk Factors, Etiological Factors, Visual Outcomes, Globe Injuries

INTRODUCTION

Ocular trauma is one of the leading causes of ocular morbidity in children and adults. Ocular trauma is an important preventable public health problem worldwide. The WHO programme for the Prevention of Blindness, suggests that 55 million eye injuries restricting activities more than one day occur each year; 750,000 cases will require hospitalization each year, including 200,000 open-globe injuries; there are approximately 1.6 million blind from injuries, an additional 2.3 million people with bilateral low vision from this cause, and almost 19 million with unilateral blindness or low vision. Ocular trauma can occur in any setting may it be at the

workplace, at home, while at play, sports related, accidental or recreational. The Ocular Trauma Classification group classified mechanical injuries of the eye into open globe and closed globe injuries.^{1,2}

Ocular trauma, in particular open globe injury, is an important cause of monocular visual impairment and blindness in the younger and economically active age group. Besides loss of vision, earnings, job opportunities and productivity, it increases the cost to society because of increased healthcare spending. Although it affects all age groups, previous reports have indicated that ocular trauma victims are predominantly males and young, with the majority under 30 years of age.³

Management of infected globe injuries in children and adults remain complex in spite of significant advances in surgical techniques. Since penetrating ocular trauma causes significant visual impairment in younger, economically productive population, it is necessary to evaluate the damages caused by it and manage it with timely intervention to restore vision to the maximum possible, at the earliest.⁴

There is increase in magnitude of infected globe injuries occurs most commonly in our rural setting because of higher incidence of soil contamination. Moreover, there is delayed presentation of this patient to ophthalmologist due to poor access. The magnitude of infected globe injuries in our country has not been studied previously.⁵ Therefore, the aim of the present study was to assess the infected globe injury with reference to demography, etiology, clinical features and visual outcomes among paediatric and adult patients.

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MATERIAL AND METHODS

Total 92 patients were included in this study. We assumed 60% patients would achieve 6/18 or better visual outcome at final visit; 10% absolute precision error and 95% confidence interval were also used to calculate the sample size.

FORMULA

$$n = \frac{Z_{1-\alpha/2}^2 P(1-P)}{d^2}$$

Where,

P : Sensitivity of the new test

d : Precision

$Z_{1-\alpha/2}$: Desired confidence level

$$n = \frac{(1.96)^2 * 0.60(0.40)}{(0.10)^2}$$

$$n = \frac{3.8416 * (0.24)}{0.01}$$

$$n = 92.1984 \approx 92 \text{ patients}$$

The present study was a prospective study which was approved by the institutional review board and ethics committee of Aravind Eye Hospital. Informed consent was obtained from all the patients participating in the study and choice to decline participation was made available. All patients who presented to ophthalmology department with mechanical globe injuries leading to ocular infection (see methodology for definition of ocular infection) were included in the study. Patients who underwent surgical intervention with associated chemical/thermal eye injury along with monocular patients and pregnant women were completely excluded from this study.

For purpose of our study, post traumatic ocular infection could be one or more of the following:

1. Corneal infiltrate seen clinically.
2. Anterior chamber (AC) exudate seen clinically.
3. Lens abscess seen clinically.
4. Scleral abscess seen clinically.
5. Endophthalmitis is defined as

Clinically visible vitreous exudate or poor red glow with USG showing signs of vitreous exudate when anterior segment allows view of fundus glow or a aforementioned signs of ocular infection (1 to 4) with USG showing signs of vitreous exudate when anterior segment precludes view of fundus glow.

Any patient who had signs of ocular infection by this definition was included in our study. For all included patients, demographic information such as name, age, gender followed by education and occupation were collected. History of details regarding trauma such as what patient was doing at the time of injury, what type of force (sharp/blunt), time of presentation of patient to the hospital after injury, any native treatment taken was mandatorily recorded.

Details of treatment taken elsewhere were recorded. Visual status assessment was done with a Snellen chart for all age groups except for children below 5 years of age where age appropriate tests will be used for VA assessment. Intraocular pressure (IOP) was recorded by non-contact tonometry if

possible.

Complete examination of anterior and posterior segment was done by torch light, slit lamp bio-microscopy and indirect ophthalmoscopy. Details regarding Zone of injury were also recorded. Ocular Trauma Score(OTS) consisting of initial vision, Rupture, Endophthalmitis, Perforating Injury, Retinal detachment and RAPD was assessed for each patient and was entered in case Proforma.

Findings of investigations such as USG B-Scan, X-ray and CT scan if done in case of opaque media and findings was noted down. Microbiological examination such as slide/ culture/ PCR of corneal scrapings, anterior chamber tap or vitreous tap if done for the patient were noted in the case proforma. Complete details consisting of history, examination, investigation and treatment (Medical/Surgical) were also noted.

Patients were followed up at 1 week, 1 month, 3 months and 6 months from their initial visit. During each follow up visit, Uncorrected Visual Acuity (UCVA), Best Corrected Visual Acuity (BCVA), Intraocular pressure (IOP), anterior and posterior segment findings and investigational findings were recorded at each study visit.

STATISTICAL ANALYSIS

The data collected was analysed and presented in the form of Mean (SD) or Frequency (Percentage). Chi-square test/ Fisher's exact test was used find out the association between categorical variables. Logistic regression analysis was done to find out the factors that associated with final visual acuity. Ocular trauma score was computed for all the subjects and the final visual outcome was associated with prediction based on international ocular trauma scoring system. P-value less than 0.05 were considered as statistically significant. All statistical analysis was done by STATA 14.0 (Texas, USA).

RESULTS

The total number of patients in the study was 92 patients. Majority of which 77 were found to be males (83.7%) and females were 15 (16.3%). The mean (SD) of age of the study participants (n= 92) is 31.1(22.07) years and it ranges from 3 years to 70 years. It was found that that the majority of the patients were less than 20 years (39.5%). There were 24.4%

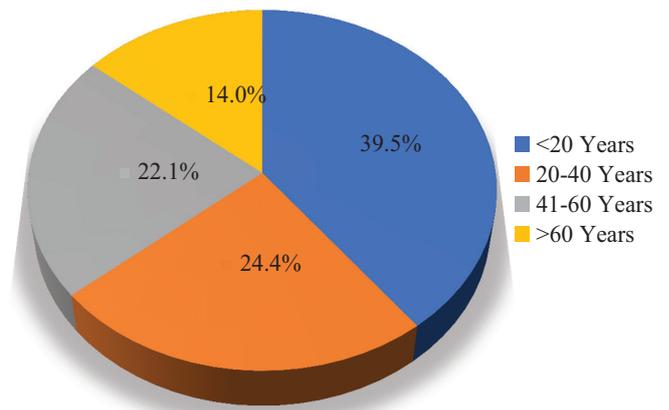
Sl. No	Microbiological species	Frequency	Percentage
1.	Gram positive cocci	5	33.5%
	Staphylococcus Aureus	1	6.7%
	Streptococci species	3	20.1%
	Micrococcus	1	6.7%
2.	Gram positive bacilli		
	Bacillus	4	26.8%
3.	Gram negative bacilli	5	33.5%
	Escherichia.Coli	2	13.4%
	Pseudomonas Aeroginosa	2	13.4%
	Klebsiella	1	6.7%
3.	Fungi		
	Aspergillus Terreus	1	6.7%

Table-1: Shows the distribution of patient according to microbiological species

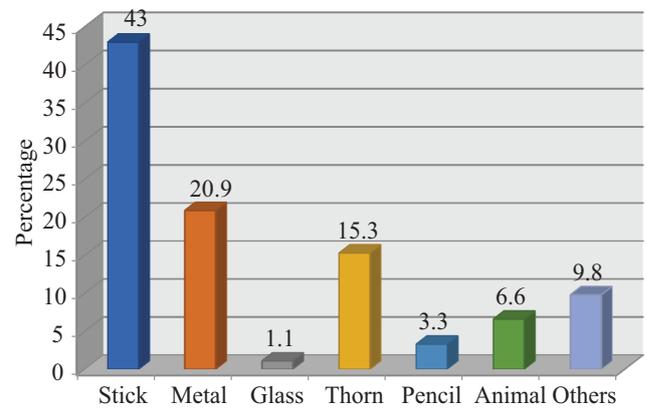
of patients who were between 20-40 years and 22.1% of patients who were between 41-60 years. Similarly there were 14% of patients who were more than 60 years old (Graph

Factors	Univariate analysis	
	OR (95% CI)	P value
Age >30	1.23(0.53 – 2.82)	0.628
Gender Female	1.20(0.40 – 3.66)	0.744
BCVA baseline >6/18	6.86(1.77 – 26.59)	0.005
Time interval of presentation		
Up to 24hrs	1.00	
24 to <48hrs	0.78(0.26 – 2.31)	0.647
48 to <72hrs	0.21(0.04 – 1.11)	0.066
>72hrs	0.61(0.21 – 1.75)	0.358
Zone of injuries		
1	4.00(0.82 – 19.57)	0.087
2	12.50(1.34-116.8)	0.027
Cornea infiltrate	5.03(1.94 – 13.06)	0.001
Hyphamea	5.83(0.62 – 54.38)	0.122
Hypopyon	1.88(0.76 – 4.61)	0.171
AC exudates	2.86(1.00 – 8.14)	0.049
ALC breach	1.50(0.56 – 4.04)	0.418
Lens abscess	2.46(0.71 – 8.58)	0.157
PCR present	1.55(0.09 – 25.68)	0.760
Fundus glow		
No glow	1.00	
Good glow	0.02(0.004 – 0.11)	<0.001
Dull glow	0.24(0.07 – 0.86)	0.028
Clinical endophthalmitis	13.53(4.89–37.43)	<0.001
Culture positivity	17.39(3.69-81.99)	<0.001
Medical treatment	2.43(1.02 – 5.80)	0.046
Vitreous prolapse	2.83(0.25 – 32.44)	0.402
FB removal	1.15(0.37 – 3.56)	0.807
Vitrectomy	0.19(0.08 – 0.47)	<0.001
Intravitreal Antifungals	0.27(0.05 – 1.48)	0.133
Intravitreal Antibiotics	0.12(0.05 – 0.31)	<0.001
Intravitreal Steroids	0.99(0.98 – 0.99)	0.007

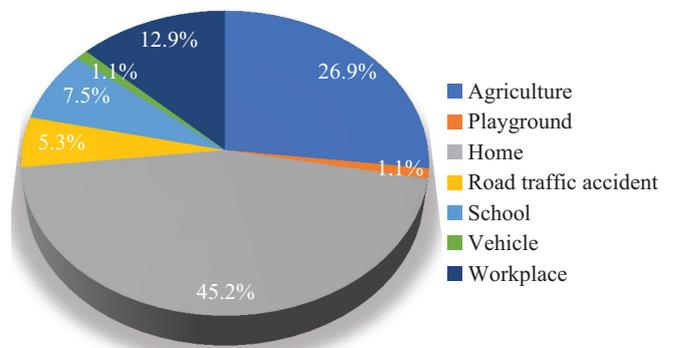
Table-2: shows the predicting the factors affecting the final visual acuity using logistic regression (univariate analysis) among the study subjects



Graph-1: Shows the distribution of data based on age group among the study subjects



Graph-2: Shows the distribution of data based on description of injury



Graph-3: Shows the distribution based on place of injury

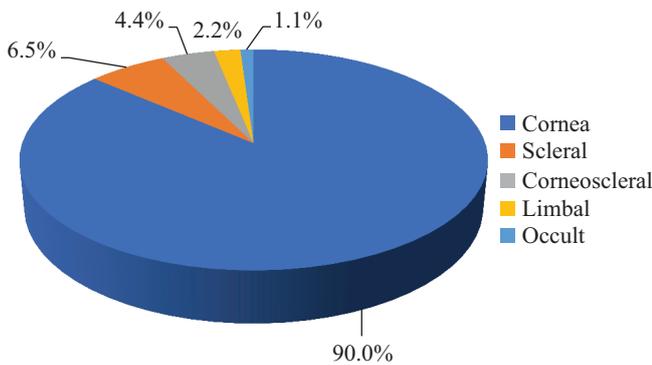
	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P-value	OR (95% CI)	P-value
BCVA baseline >6/18	6.86(1.77 – 26.59)	0.005	0.28(0.03 – 3.14)	0.303
Cornea infiltrate	5.03(1.94 – 13.06)	0.001	7.37(1.13 – 47.96)	0.037
AC exudates	2.86(1.00 – 8.14)	0.049	1.67(0.30 – 9.20)	0.556
Fundus glow				
No glow	1.00		1.00	
Good glow	0.02(0.004 – 0.11)	<0.001	0.02(0.001 – 0.23)	0.002
Dull glow	0.24(0.07 – 0.86)	0.028	0.16(0.03 – 0.99)	0.049
Medical treatment	2.43(1.02 – 5.80)	0.046	2.00(0.44 – 9.14)	0.370
Vitrectomy	0.19(0.08 – 0.47)	<0.001	0.52(0.11 – 2.42)	0.404

Table-3: Shows the predicting the factors affecting the final visual acuity using logistic regression: (Univariate analysis v/s Multivariate analysis)

Sl. No	Improvement in BCVA	At Present N (%)	3 rd Month N (%)	6 th Month N (%)
1	6/6 to 6/12	19 (20.7%)	42 (45.7%)	41 (44.6%)
2	6/12 to 6/60	20 (21.7%)	21 (22.8%)	24 (26.1%)
3	6/60 to HM	34 (37%)	10 (10.9%)	7 (7.6%)
4	PL+	13 (14.1%)	4 (4.3%)	3 (3.3%)
5	NO PL	3 (3.3%)	14 (15.2%)	16 (17.4%)
6	Not Available	3 (3.3%)	1 (1.1%)	1 (1.1%)

Chi- Square = 56.615; P Value <0.001; Significant

Table-4: Shows the improvement in BCVA among the study subjects



Graph-4: Shows the distribution based upon the site of involvement among the study subjects

No.1)

About 82.6% patients had open globe injury and 17.4% had closed globe injury. Majority of patients had stick injury 39(43%) in our study. Most of the patients suffered trauma at home 42(45.7%) followed by agriculture work 25(27.2%) (Graph no. 2,3).

In majority of the patients, cornea 81(90%) was the most frequent site of involvement in the study group followed by scleral (6.5%) and corneoscleral (4.4%)

Gram positive organisms (60.3%), gram negative organisms(33.5%) and fungi(6.7%). Out of which, Bacillus species (26.8%) was the most common organism in our study. (Table No.1)

In the Table no. 2 which is based on univariate logistic regression analysis, corneal infiltrate (OR:5.03, 95% CI:1.9-13.0;P=0.001); followed by AC exudate (OR:2.86, 95% CI:1.0-8.14;P=0.049); Clinical endophthalmitis (OR:13.53, 95% CI:4.9-37.4;P<0.001); Culture positivity (OR:17.39, 95% CI:3.7-81.9;P<0.001) and fundus glow good (OR:0.02, 95% CI: 0.004 – 0.11;P<0.001); Fundus dull glow (OR:0.24, 95% CI: 0.07 – 0.86;P=0.028); Medical treatment (OR: 2.43, 95% CI:1.02 – 5.80;P=0.046); Vitrectomy (OR: 0.19, 95% CI: 0.08 – 0.47;P<0.001); Intravitreal antibiotics (OR: 0.12, 95% CI: 0.05 – 0.31;P<0.001) and Intravitreal steroids (OR: 0.19, 95% CI: 0.98 – 0.99;P=0.007) were found to be statistically significant for predicting final visual outcome.

The significant factors which were found on univariate logistic regression such as Baseline VA, clinical endophthalmitis, culture positivity, corneal infiltrate, AC exudates, fundus glow, medical treatment, vitrectomy, intravitreal antibiotics and steroids were included in the Multivariate model to further evaluate their associations with final VA. The

factors such as cornea infiltrate (OR = 7.37, 95%CI (1.13 – 47.96), p=0.037), fundus good glow (OR = 0.02, 95%CI (0.001 – 0.23), p=0.002) and dull glow (OR = 0.16, 95%CI (0.03 – 0.99), p =0.049) were found to be significant after multivariate analysis. Corneal infiltrate was found to have 7 times to affect the final visual acuity in our study (Table no. 3).

Visual acuity at time of presentation was more than 6/60 in 34 (37%) eyes whereas only 3 (3.3%) had visual acuity of no light perception. At 6 months follow up after management, 41 (44.6%) of the patient attained visual acuity better than 6/12, whereas visual impairment was seen in 24 (26.1%) eyes. Adverse visual outcome was seen in 16 (17.4%) eyes in which visual acuity was no perception of light. The p value <0.001 shows that there is a significant improvement in BCVA level (Table no. 4).

Spearman rank order correlation was used to find out the relationship between OTS score and BCVA. The p-value less than 0.05 considered as statistically significant. The correlation coefficient (rho = -0.63, p-value <0.001) shows that there is a significant relationship of increase in the OTS score with better visual acuity in this study.

DISCUSSION

Our study describes etiology, risk factors and visual outcomes of infected globe injuries in a consecutive series of 92 eyes of 92 patients. Children and young adults were the most common group susceptible to trauma. Mean age of our study participants was 31 years in our study. 39.5% were aged less than 20 years in our study which was comparable to other studies, owing to the fact that the subset of patients is very active and hence prone for injury.⁶

Majority of patients were Males (83.7%) in this study. Males are most commonly affected both in adults and children with reference to globe injuries in most of the studies. Because most of the males with reference to adults are more involved in agriculture work or as employees/labourers compared to females. In case of paediatric population, male children are more affected because they were somewhat more likely to have been exposed to domestic violence.⁷

In the current study, most of the patients were injured at home (45.7%) which is similar to some of the studies; followed by workplace injury (agricultural=27.2% and other workplace=13%). The aetiology of work-related injury, however, appears to be related to the level of socio-economic development of the setting.⁸

In most rural poor communities the main cause is farm-related whereas in more developed communities, it is more likely to be related to industrial activities. Some of the studies concluded that workplace injury as the most common place of injury. In our study, majority of our patients had stick injury (43%) as the predominant injurious agents which is quiet similar to some of the studies reported before. This could be due to the fact that majority of the population are subsistence farmers and work in the farms; and also the young boys prefer to play with wood sticks and other wooden toys.⁹ Broom stick injury (8.7%) is the most common agent to cause infected globe injury which is also reported in a study done by Rishi E et al. Likewise, the second commonest agent for ocular injury was metallic objects (20.9%) which was common in some of the studies. The resulting injury might be due to the practice of working without protective glass wares.¹⁰

The penetrating eye injury involved the zone one (79.3%) in predominant cases in our series. The cornea being vulnerable in ocular trauma may be due to its anatomical position of anterior most ocular structure.¹¹ The more cases with endophthalmitis with perforating eye injury with corneal perforation could be due to the concomitant lens rupture due to its proximity like in the studies by Essex et al, which was considered a risk factor for endophthalmitis. The other possible factor for endophthalmitis in our subjects could be due to contaminated injurious agents.¹²

Gram positive organisms(60.3%) was the most common organism in our study which was similar to the posttraumatic endophthalmitis series done in both adults and children.¹³⁻¹⁶

At 6 months follow up after management, there was significant improvement in visual acuity (p-value <0.001). 41(44.6%) of the patient attained visual acuity better than 6/12 which was more in our study compared to other studies. In a study conducted by Rishi E et al,¹⁰ they studied 143 eyes of 143 patients with open globe injury. VA of $\geq 3/60$ or better was seen in 38 (27%) eyes with 14 eyes having best corrected VA of 6/18 or more.

In a study conducted by Vedantham et al,¹³ they found that Thirty-one (32%) eyes out of 97 eyes had a best corrected visual acuity better than 6/60 at final follow-up.

In a study conducted by Thapa R et al,¹⁷ they found that final BCVA at last follow-up, visual recovery was light perception in 17 (34.7%), no light perception in 8 (16.3%) and 6/60 and better in six cases (12.24%).

Using multivariate regression analysis, we found having corneal infiltrate significantly increases the odds of having poor visual outcome by 7.37 (OR = 7.37, 95%CI (1.13 – 47.96), P=0.037).

In a study done by Essex RW et al¹¹ concluded that delay in primary repair, ruptured lens capsule, and dirty wound were each independently associated with the development of post-traumatic endophthalmitis and study concluded that patients with 2 of these 3 risk factors had a particularly high frequency of infection.

Zhang Y et al¹⁸ found Early primary repair, intraocular tissue prolapse and self-sealing of wounds were

independent protective factors against the development of endophthalmitis.

In a study done by Rishi E et al,¹⁰ they concluded that corneal abscess and retinal detachment were identified as independent risk factors for poor outcome in their study.

In 2002, Kuhn et al., developed a prognostic model, the ocular trauma score (OTS), to predict the visual outcome of patients after ocular trauma.¹⁹ We attempted to compare and stratify our study subjects into the same scoring system. In most of the table, there was complete agreement between OTS in our study with USEIR OTS

In series from Agarwal R et al⁹ and Han and Yu et al²⁰ had suggested that OTS possibly has predictive value in open globe injuries in Asians. Our study also suggests that OTS possibly has predictive value in infected globe injury patients.

The limitations of the present study were that due to smaller sample size, large number of patients would have added more statistical power to the study.

CONCLUSION

Corneal infiltrate was identified as the single most independent risk factor for poor outcome in our study. Children were the mostly affected group with males outnumbering females. Wooden sticks were the commonest insulting agent. Despite the late presentation and predominant zone I injury, eye could be salvaged in majority with visual recovery of 6/12 and better in 41 cases (44.6%).

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