Original Articles

Open Globe Injury in Hospital Serdang - An 8-year Retrospective Review

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ABSTRACT

Introduction: Open globe injury may lead to devastating visual outcome. Urgent management and subsequent follow-up is important to maximise recovery. More data on open globe injury in Malaysia is needed to identify risk groups and prognostic factors. This study was carried out to investigate open globe injury, the socio-epidemic profile, clinical characteristics and outcome of the open globe injury in the Hospital Serdang, Malaysia. **Methods:** All patients managed for open globe injury to Hospital Serdang from January 2006 to December 2013 were included in this retrospective case review. Student's T-test was used to determine difference between means and chi-square for categorical data. P value of less than 0.05 was regarded as statistically significant. **Results:** There were 155 patients managed for open globe injury with three of them had bilateral involvement. As such, there were 158 cases eligible for analysis in this study. The average age was 32.2 ± 16.5 years (mean ± standard deviation, SD). Male was at higher risk for open globe injury. Predictors for poor visual outcome were foreign nationality (p=0.047), lid laceration (0.008), type of injury (p=0.001), site of injury (p=0.008), RAPD (p<0.001), uveal prolapse (p<0.001), hyphaema (p=0.008), lens damage (p=0.010), vitreous loss (0.014), retinal detachment (p=0.011), intraocular foreign body (IOFB) (0.014) and poor presenting uncorrected visual acuity (UCVA) (p<0.001). **Conclusions:** Occupational injury was a main cause of open globe injury in Hospital Serdang. Although in general the visual outcome is good, effort should be put to prevent work-related injury.

Keywords: Open globe injury, Ocular injury, Cornea laceration, Sclera laceration, Globe rupture

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INTRODUCTION

Open globe injury is a major cause of permanent visual impairment and blindness. Less than three decades ago, there was probably 55 million eye injuries restricting activities more than one day occur each year including about 200,000 open-globe injuries. As consequences, 2.3 million people had bilateral low vision and almost 19 million had unilateral blindness or low vision (1). While the incidence of ocular trauma has been well-described in developed countries (2, 3), a relatively fewer reports have been published in developing regions but the amount of data is ever increasing (4-6).

In Malaysia, a few studies have been reported for ocular injury (**Table 1**) including community (7) or hospital based, prospective or retrospective case series or reports (8-12). In relation to open globe injury, Hooi *et al* reported that prognostic factors for visual outcome included presenting visual acuity, relative afferent pupillary defect, wound location, lens injury, retinal detachment and endophthalmitis (13). Thevi *et al* found that predictors of good visual outcome following open globe injury were good initial visual acuity, a corneal laceration wound of less than 5 mm in length, a deep anterior chamber at presentation and simple lacerations (14). Madhusudhan *et al* reported on open globe injury over a 10-year period and found that home was the most common place of injury followed by workplace (15).

The ophthalmological service in Hospital Serdang commenced in 2006 and mainly served Hulu Langat, Sepang and Petaling districts of Malaysia, with an approximate population of 1 million people. The occupational activities in this area were mainly related to public administrations, business, manufacturing industries and agriculture. Due to the presence of several industrial zones, there were many foreign workers residing in these districts in addition to the urban and suburban local populations. Min *et al* reported that work-related eye injury formed nearly half of all ocular injuries

Table 1. Ocular injury studies in Malaysia.

Author, year	Location	Design	Types of injury	No. of patient, eye
Hooi *et al*, 2003	Hospital JB	Retrospective	Open globe injury	152,156
Mallika *et al*, 2008	Kuching GH	Prospective	All	233, 257
Ulagantheran *et al*, 2010	UMMC	Retrospective	Hyphaema in blunt trauma	118, 118
Rashid *et al*, 2011	HUSM, HKB, Hospital K. Krai	Prospective	Fire-crackers burn	30, 34
Soong *et al*, 2011	UMMC	Prospective	All	546, 603
Thevi *et al*, 2012	UMMC	Retrospective	Open globe injury	52, 52
Madhusudhan *et al*, 2014	HUSM	Retrospective	Open globe injury	220, 222
Min et al, 2016	Hospital JB	Retrospective	Occupational eye injury	935, -

JB, Johore Bharu; GH, general hospital; UMMC, University Malaya Medical Centre; HUSM, Hospital Universiti Sains Malaysia; HKB, Hospital Kota Bharu; K., Kuala.

in their series (16). Additionally, the Occupational Safety and Health Administration reported that occupation-related eye injuries cost several millions USD annually in the USA due to lost productivity, medical treatment and worker compensation (17).

This study was conducted to identify the groups at risk, define the clinical profile and gauge the resultant visual burden for open globe injury in our local population. The data will be useful for the prevention and management of open globe injury for local and regional populations.

PATIENTS AND METHODS

This study was approved by the Medical Research Ethics Committee, National Institute of Health, Malaysia with registration no. NMRR-14-1320-19626. It was conducted with conformity to the tenets of Declaration of Helsinki for medical research.

Study design

In this retrospective case review, cases presented with and managed as open globe injury in Hospital Serdang over a period of eight years from Jan 2006 till December 2013 were identified through the clinic and ward admission registries. The medical records were retrieved from the system and data were collected.

Data collection

Patients' demographic data including age, gender, nationality, ethnicity and occupation was collected alongside mechanism of injury, wound profile, treatment and ophthalmic outcomes. Each open globe injury was described in term of the types, site and the severity of the injury. The **type** of injury was determined according to the Ocular Trauma Classification Group guidelines and the Birmingham Eye Trauma Terminology as penetration, perforation or rupture (18, 19). Penetrating injury was defined as a single laceration of the eyewall, usually caused by a sharp object. Perforating injury was defined as two full thickness laceration of the eyewall (entrance and exit) by the same usually sharp object or projectiles. The **location** of injury was classified according to the Ocular Trauma Classification Group guidelines into Zone I (wound involvement limited to the cornea), Zone II (wound involving the sclera not posterior than 5 mm from the limbus) and Zone III (wound extending more than 5 mm from the limbus) (20).

The **severity** of the injury was classified according to the Eagling classification system as Grade 1 (cornea or anterior sclera with or without iris prolapsed), Grade 2 (anterior segment injury with lens damage), grade 3 (posterior segment injury with vitreous loss) and grade 4 (extensive anterior and posterior involvement) (21). **RAPD** was determined and categorised as present or absent. The hospital stay was counted from the day of admission till discharged from the ward. The outpatient follow-up visit were given at appropriate interval to assess the patient progressed. Refraction was done by optometrists usually at six and 12 weeks following injury.

Data analysis and statistical tests

Data was analysed using PASW 21.0 software. Student t-test was used to compare means from continuous data. Paired-sample t-test was done to compare means of repeated measures. Chi square or Fisher's exact test was used to determine association between categorical variables. Multinomial logistic regression analysis was used to rule out interactions between multiple

categorical independent variables. A difference with a p value of less than 0.05 was considered as statistically significant.

RESULTS

There were 155 patients managed for open globe injury with three of them had bilateral involvement. As such, there were 158 cases eligible for analysis in this study. A total of 21 (13.3%) cases were referred, four were transferred while another case requested discharge against medical advice. As such, 132 (83.6%) cases continued treatment at our centre for their open globe injuries.

Socio-demography

The average age was 32.2 ± 16.5 (mean ± standard deviation, SD). The distribution of cases according to age group is shown in **Figure 1**. Male constituted 145 (91.8%) cases and female was 13 (8.2%). The male and female were significantly different with regards to the occupation (λ^2 = 54.287, df = 5, p<0.001), place of injury (λ^2 = 23.174, df = 5, p<0.001) and offending objects (λ^2 = 27.004, df =10, p= 0.003). Out of the 158 cases, Malaysians were 90 (57.0%) and the remaining 68 (43.0%) cases were foreigners from various countries such as Indonesia, Bangladesh and Nepal. The distribution of Malaysians according to ethnicity is show in **Figure 2**. Patients' demographic data such as occupations, place of injury and the offending objects is represented in **Table 2**.

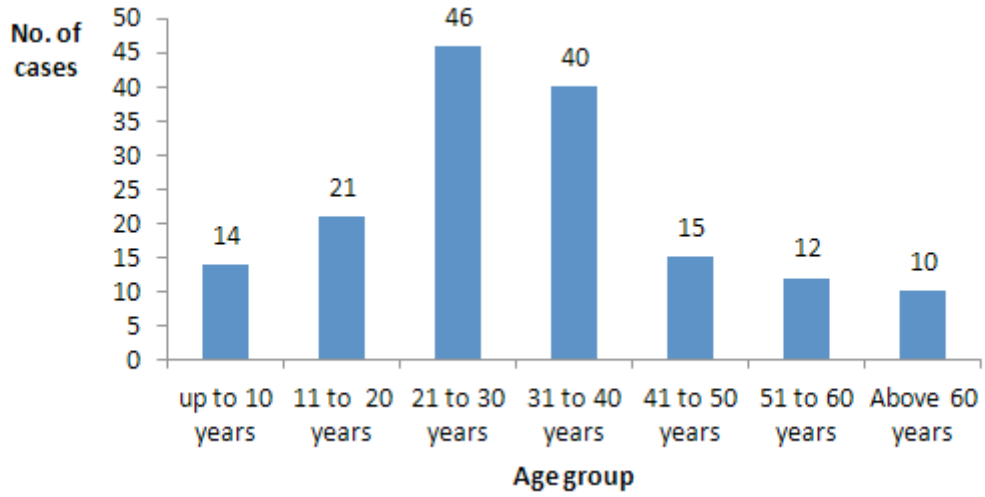

Fig. 1. Distribution of cases according to age group among the open globe injury cases in Hospital Serdang.

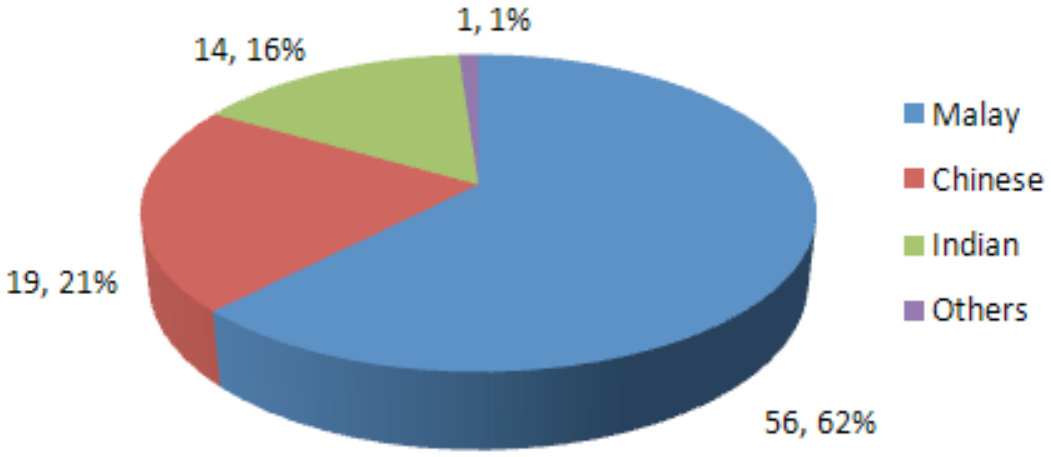

Fig. 2. Distribution of cases according to ethnicity among the Malaysian open globe injury cases in Hospital Serdang.

Table 2: Socio-demographic factors and clinical characteristics of cases with open globe injury in Hospital Serdang, Malaysia.

Socio-demographic factors	n (%)	
Gender		
Male	145 (91.8)	
Female	13 (8.2)	
Nationality		
Malaysian	90 (57.0)	
Non-Malaysian	68 (43.0)	
Occupation		
Industrial labour	19 (15.2)	
Construction labour	60 (48.0)	
Plantation labour	4 (3.2)	
Students	13 (10.4)	
Unemployed	11 (8.8)	
Others	18 (14.4)	
Place of injury		
Home	36 (22.8)	
Work place	86 (54.4)	
Road	24 (15.2)	
Sport/leisure area	6 (3.8)	
School	2 (1.3)	
Assaulted	4 (2.5)	
Offending objects (n=157)		
Scissors, knife	5 (3.2)	
Stick, wood	6 (3.8)	
Nail	65 (41.4)	
Projectiles	15 (9.6)	
Pen, pencils	3 (1.9)	
Tools	6 (3.8)	
Sport equipment	4 (2.5)	
RTA related	22 (14.0)	
Others	27 (17.2)	
Unknown	2 (1.30)	
Clinical characteristic		
	Mean	**SD**
Presenting interval, day	0.66	2.0
Wound length, mm	7.25	5.74
Presenting UCVA logMAR	1.05	0.67
Final BSCVA logMAR	0.65	0.70
Presentation interval category	n (%)	
Within 24 hours	141 (89.2)	
24 to 48 hours	8 (5.1)	
More than 48 hours	9 (5.7)	
Laterality (N=158)		
Right	77 (48.7)	
Left	81 (51.3)	

Lid laceration (N=146)	
Yes	30 (20.5)
No	116 (79.5)
Presenting UCVA (N=141)	
Good (6/12 or better)	15 (10.6)
Moderate (6/15 to 6/36)	33 (23.4)
Severe (6/45 to 3/60)	87 (55.1)
Blind (worse than 3/60)	6 (4.3)
Type (N=158)	
Penetrating	123 (77.8)
Perforating	12 (7.6)
Rupture	18 (11.4)
IOFB	5 (3.2)
Severity (N=158)	
Grade 1	83 (52.5)
Grade 2	42 (26.6)
Grade 3	6 (3.8)
Grade 4	27 (17.1)
Zones (N=158)	
Zone I (involves cornea only)	104 (65.8)
Zone II (up to 5 mm from limbus)	34 (21.5)
Zone III (extends more than 5 mm from limbus)	20 (12.7)
RAPD (n=153)	
Present	31 (20.3)
Absent	122 (79.7)
Associated injury	
Uveal prolapse (N=157)	117 (74.1)
Hyphaema (N=157)	83 (52.5)
Lens damage (N=157)	75 (47.5)
Vitreous involvement (N=157)	36 (22.8)
Retinal detachment (N=156)	16 (10.1)
Endophthalmitis (N=157)	5 (3.2)
IOFB (N=157)	16 (10.1)
Others (N=157)	10 (6.3)
Wound orientation (n=148)	
Linear, vertical	27 (18.2)
Linear, horizontal	22 (14.9)
Linear oblique/radial	37 (25.0)
Others	62 (41.9)
Wound cleanliness (n=128)	
Clean	101 (78.9)
Contaminated	27 (21.1)
Radioimaging modality	
X-ray orbit (N=158)	99 (62.7)
CT orbit (N=158)	22 (13.9)
MRI of the orbit (N=158)	1 (0.6)

Surgery	
Primary repair	158 (100)
Evisceration	6 (3.8)
IOFB removal	10 (6.3)
Cataract removal	32 (20.3)
Retinal detachment repair	5 (3.2)
Final BSCVA (N=68)	
Good (6/12 or better)	31 (45.6)
Moderate (6/15 to 6/36)	11 (16.2)
Severe (6/45 to 3/60)	25 (36.8)
Blind (worse than 3/60)	1 (1.5)

SD, standard deviation; RAPD, relative afferent pupillary defect; IOFB, intraocular foreign body; UCVA, uncorrected visual acuity; BSCVA, best spectacle-corrected visual acuity

Patients' clinical profile

Majority (n= 149, 94.3%) of our cases presented with the first 48 hours following of the injury. Only nine cases (5.7%) presented later than 48 hours following injury. The clinical data with regards to lid laceration, type, severity and zone, RAPD, ocular associations, wound profile and radiological and surgical management, is represented in greater detail in **Table 2**. Endophthalmitis was detected in seven (4.4%) of cases. The rates of endophthalmitis in the intraocular foreign body (IOFB) and no IOFB groups are shown in **Figure 3**.

Presenting vision

The presenting vision ranged from Snellen acuity 6/6 to no perception of light (NPL). The mean uncorrected visual acuity (UCVA) logMAR was 1.05 ± 0.66 (mean ± SD) which was approximately equivalent to Snellen acuity of 6/60 ± 6/36. Categorically, the cases were distributed to good, moderate, severe and blind visions (**Table 2**).

Final vision

The final best spectacles-corrected visual acuity (BSCVA) logMAR, which was recorded at last visit among cases who had a follow-up of at least 4 weeks (n=68), was 0.65 ± 0.70 (mean ± SD). Of this, 71% recorded improved vision while 29% showed unchanged or worsening vision. There was a statistically significant difference between the presenting UCVA logMAR and final BSCVA logMAR. Using the paired sample t- test, we found a significant improvement between the presenting and the final vision with mean difference of 0.38 ± 0.54 (MD ± SD, 95% confidence interval (CI), 0.24 to 0.52, t=5.45, df=61, p<0.001). **Figure 4** shows the distribution of cases (n=68) according to the presenting UCVA logMAR and final BSCVA logMAR (best fit regression line has a slope of 0.95 ± 0.13, 95% confidence interval, CI = 0.69 to 1.21, R^2 = 0.47).

Predictors for poor visual outcome were foreign nationality (p=0.047), lid laceration (0.008), type of injury (p=0.001), site of injury (p=0.008), RAPD (p<0.001), uveal prolapse (p<0.001), hyphaema (p=0.008), lens damage (p=0.010), vitreous loss (0.014), retinal detachment (p=0.011), IOFB (0.014) and poor presenting UCVA (p<0.001) (**Table 3**). Following the multinomial logistic regression analysis, it was found that only RAPD (likelihood ratio test, χ^2=10.029, df=3, p=0.018) and site of injury (likelihood ratio test, λ^2=12.213, df=6, p=0.047) were significantly associated with the final BSCVA.

DISCUSSION

Over the last decade, there have been a few reported series on ocular injury in Malaysia (8, 10, 11, 13-16, 22) which were either retrospective or prospective in nature. Some of them investigated all types of ocular injury (8, 9) while others examined specific form of ocular trauma (10, 11). Two prospective hospital-based studies but in locations well-separated geographically of all ocular trauma cases revealed open globe injury rates of between 20% and 23% (8, 9).

Socio-demographic profiles of cases

Socio-economic profile of patients in our series did not differ much from the other local (13-15) and regional (4-6) studies. The age group with highest risk for injury was the young adult. This could be explained by the relatively high proportion of occupation related injury and the presence of various industrial zones within the catchment areas Serdang Hospital. The male predominance in this study was consistent with other studies. Male forms the major workforce especially in the construction and manufacturing industries, and also more involved in outdoor physical activity, putting them at higher risk for open globe injury. None of the female cases in this study were occupation related but either occurred at home due to falls or on the road due to MVA. These findings parallel those reported by Koo *et al* (23).

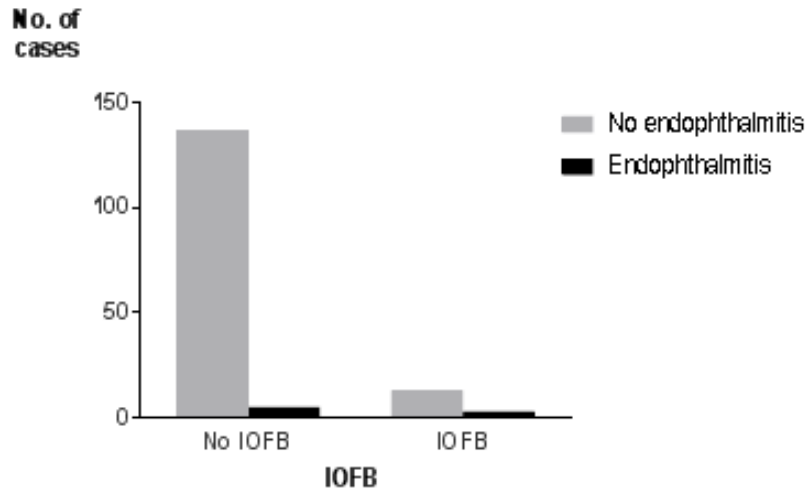

Fig. 3. Histogram showing a higher rate of endopthalmitis in IOFB group compared to no IOFB (18.8% vs 3.5%, X2=6.938, df=1, p=0.008). IOFB, intra-ocular foreign body.

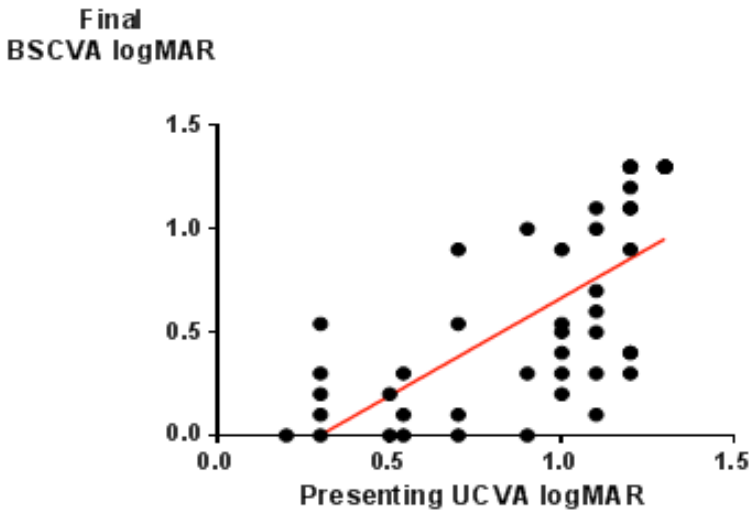

Fig. 4. Scatter plot showing the distribution of cases (n=68) according to the final BSCVA logMAR and presenting UCVA. Best fit regression line has a slope of 0.95 ± 0.13, 95% confidence interval, CI = 0.69 to 1.21, R2 = 0.47. UCVA, uncorrected visual acuity; BSCVA, best spectacle-corrected visual acuity.

Place of injury with highest frequency was the workplace (54.4%), more than double the rate for domestic injury (22.8%). There is a role of the employers and employment enforcement agency to increase training and eye safety regulation enforcement in the work place. Our findings was in agreement with those reported by Thevi *et al*, where majority of the open globe injury had occurred in the workplace, but it occurred with a higher proportion in our series (14). In contrast, Madhusudhan *et al* found that the most common place of injury was the home (51.8%), followed by the workplace (23.4%) and the street (18.5%). Workplace injury was more likely to occur among foreign workers. We found 70.9% of workplace cases occurred among the foreign workers. Likewise, Min *et al* reported that two-thirds of the occupation-related open globe injury which carried poorer prognosis had occurred among foreign workers (16).

Regarding the offending object implicated, nail and chipped hammered objects were the most frequently reported perpetrators for open globe injury in our study. Kanoff *et al* also reported nail as the commonest offending object, followed by other projectiles (17). This finding underlined the importance of safety goggles provision and enforcement at workplace as well as education for domestic home improvement enthusiasts. An additional finding of the observable RTA-related objects (22 occasions in 24 RTAs) especially windscreen glass pieces causing open globe injury warrant the

Table 3. Association factors for the final vision outcome for open globe injury cases in Hospital Serdang, Malaysia.

	Visual acuity				χ^2	df	p
	Good	Moderate	Severe	Blind			
	n (%)						
Socio-demographic factors							
Age group (N=68)					8.653	9	0.470
Pre-adult	4 (50.0)	1 (12.5)	3 (37.5)	0 (0)			
Young adult	21 (46.7)	8 (17.8)	15 (33.3)	1 (2.2)			
Middle age	6 (66.7)	1 (11.1)	2 (22.2)	0 (0)			
Elderly	0 (0)	1 (16.7)	5 (83.3)	0 (0)			
Gender (N=68)					0.731	3	0.866
Male	30 (46.2)	10 (15.4)	24 (36.9)	1 (1.5)			
Female	1 (33.3)	1 (33.3)	1 (33.3)	0 (0)			
Nationality (N=68)					7.960	3	0.047
Malaysian	20 (54.1)	2 (5.4)	14 (37.8)	1 (2.7)			
Non-Malaysian	11 (35.5)	9 (29.0)	11 (35.5)	0 (0)			
Ethnicity (Malaysian) (N=37)					8.003	9	0.534
Malay	14 (63.6)	2 (9.1)	5 922.7)	1 (4.5)			
Chinese	3 (37.5)	0 (0)	5 (62.5)	0 (0)			
Indian	2 (33.3)	0 (0)	4 (66.7)	0 (0)			
Others	1 (100)	0 (0)	0 (0)	0 (0)			
Occupation (N=52)					17.539	12	0.130
Industrial labour	5 (41.7)	1 (8.3)	5 (41.7)	1 (8.3)			
Construction labour	12 (48.0)	8 (32.0)	5 (20.0)	0 (0)			
Students	0 (0)	1 (100)	0 (0)	0 (0)			
Unemployed	2 (28.6)	1 (14.3)	4 (57.1)	0 (0)			
Others	6 (85.7)	0 (0)	1 (14.3)	0 (0)			
Presenting interval (N=68)					0.787	3	0.853
Up to 48 hours	28 (44.4)	10 (15.9)	24 (38.1)	1 (1.6)			
More than 48 hours	3 (60.0)	1 (20.0)	1 (20.0)	0 (0)			
Place of injury (N=68)					13.619	12	0.326
Home	4 (30.8)	2 (15.4)	7 (53.8)	0 (0)			
Work place	19 (48.7)	9 (23.1)	11 (28.2)	0 (0)			
Road	8 (57.1)	0 (0)	5 (35.7)	1 (7.1)			
Sport/leisure	0 (0)	0 (0)	1 (100)	0 (0)			
Assaulted	0 (0)	0 (0)	1 (100)	0 (0)			
Offending object (N=68)					18.635	24	0.771
Scissors/knife	1 (100)	0 (0)	0 (0)	0 (0)			
Stick/wood	1 (33.3)	0 (0)	2 (66.7)	0 (0)			
Nail, chipped metal/stone	12 (44.4)	8 (29.6)	7 (25.9)	0 (0)			
Pen, pencil	1 (50)	0 (0)	1 (50)	0 (0)			
Tools	1 (33.3)	0 (0)	2 (66.7)	0 (0)			
MVA-related object	7 (58.3)	0 (0)	4 (33.3)	1 (8.3)			
Source of referral (N=52)					18.100	12	0.113
Health clinic or general practitioner	7 (87.5)	1 (12.5)	0 (0)	0 (0)			
Other ophthalmologist	1 (33.3)	0 (0)	2 (66.7)	0 (0)			
Other specialty	17 (42.5)	4 (10.0)	18 (45.0)	1 (2.5)			
Other sources	1 (100)	0 (0)	0 (0)	0 (0)			

Laterality (N=68)					1.419	3	0.701
Right eye	18 (48.6)	6 (16.2)	13 (35.1)	0 (0)			
Left eye	13 (41.9)	5 (16.1)	12 (38.7)	1 (3.2)			
Lid laceration (N=64)					11.763	3	0.008
Yes	3 (21.4)	1 (7.1)	9 (64.3)	1 (7.1)			
No	27 (54.0)	10 (20.0)	13 (26.0)	0 (0)			
Type of injury (N=68)					28.237	9	0.001
Penetrating	28 (58.3)	11 (21.2)	13 (25.0)	0 (0)			
Perforating	1 (20.0)	0 (0)	3 (60.0)	1 (20.0)			
Rupture	2 (20.0)	0 (0)	8 (80)	0 (0)			
IOFB	0 (0)	0 (0)	1 (100)	0 (0)			
Site of injury (N=68)					17.224	6	0.008
Zone I (involves cornea only)	19 (46.30	9 (22.0)	13 (31.70	0 (0)			
Zone II (up to 5 mm from limbus)	11 (61.1)	2 (11.1)	5 (27.8)	0 (0)			
Zone III (extends more than 5 mm from limbus)	1 (11.1)	0 (0)	7 (77.8)	1 (11.1)			
Severity (N=68)					11.228	9	0.260
Grade 1	23 (54.8)	6 (14.3)	13 (31.0)	0 (0)			
Grade 2	5 (35.7)	3 (21.4)	6 (42.9)	0 (0)			
Grade 3	1 (33.3)	1 (33.3)	1 (33.3)	0 (0)			
Grade 4	2 (22.2)	1 (11.1)	5 (55.6)	1 (11.1)			
RAPD (N=68)					23.343	3	<0.001
Present	1 (6.3)	1 (6.3)	13 (81.3)	1 (6.3)			
Absent	29 (58.0)	10 (20.0)	11 (22.0)	0 (0)			
Wound orientation (N=60)					5.342	6	0.501
Liner, vertical	6 (60.0)	0 (0)	4 (40.0)	-			
Linear, horizontal	3 (30.0)	3 (30.0)	4 (40.0)	-			
Linear, oblique	9 (45.0)	4 (20.0)	7 (35.0)	-			
Others	8 (40.0)	2 (10.0)	10 (50.0)	-			
Uveal prolapse (N=68)					18.828	2	<0.001
Present	19 (38.8)	4 (8.2)	25 (51.0)	1 (2.0)			
Absent	12 (63.2)	7 (36.8)	0 (0)	0 (0)			
Hyphaema (N=68)					11.705	3	0.008
Present	10 (28.6)	5 (14.3)	19 (54.3)	1 (2.9)			
Absent	21 (63.6)	6 (18.2)	6 (18.2)	0 (0)			
Lens damage (N=68)					11.334	3	0.010
Present	6 (22.2)	5 (18.5)	15 (55.6)	1 (3.7)			
Absent	25 (61.0)	6 (14.6)	10 (24.4)	0 (0)			
Vitreous loss (N=68)					0.636	3	0.014
Present	3 (21.4)	1 (7.1)	9 (64.3)	1 (7.1)			
Absent	28 (51.9)	10 (18.5)	16 (29.6)	0 (0)			
Retinal detachment					11.137	3	0.011
Present	2 (28.6)	0 (0)	4 (57.1)	1 (14.3)			
Absent	28 (46.7)	11 (18.3)	21 (35.0)	0 (0)			

IOFB (N=68)					10.541	3	0.014
Present	3 (42.9)	2 (28.6)	1 (14.3)	(14.3)			
Absent	28 (45.9)	9 (14.8)	24 (39.3)	(0 (0)			
Presenting UCVA (N=61)					51.087	9	<0.001
Good (6/12 or better)	8 (100)	0 (0)	0 (0)	0 (0)			
Moderate (6/15 to 6/36)	11 (64.7)	4 (23.5)	2 (11.8)	0 (0)			
Severe (6/45 to 3/60)	9 (26.5)	6 (17.6)	19 (55.9)	0 (0)			
Blind (worse than 3/60)	1 (50)	0 (0)	0 (0)	1 (50)			

SD, standard deviation; RAPD, relative afferent pupillary defect; IOFB, intraocular foreign body; UCVA, uncorrected visual acuity; BSCVA, best spectacle-corrected visual acuity.

enforcement of safety restrain device with airbags system regulation, in addition to road motorists awareness and educational campaigns (24, 25).

Clinical profiles of open globe injury.

Majority of the cases presented within the first 48 hours leaving only 5.7% of them presented later than 48 hours. Late presenters were more like to be foreign nationals compared to Malaysians with odd ratio of 5.049 (95% CI, 1.104 to 25,135). Nevertheless, we found that there was no significant association between presenting interval and the final BSCVA.

Nearly all of the cases were unilateral and affected the right and the left eye equally. Bilateral injury was identified in three (1.9%) patients and all had occurred in relation with RTA and associated with glass-piece injury. Although they seemed to present with severe presenting UCVA, the small sample size precluded us from conducting intra-group analysis and make meaningful conclusion. Nevertheless, compliance to vehicle seat restraining devices is much recommended to limit ocular injury (26).

The role of lid laceration in predicting the poor outcome has been reported previously (27). We found that the relative risk (RR) for poor visual outcome with lid laceration was 2.747 (95% CI, 1.549 to 4.873) compared to without lid laceration. Cases categorised into Zone 1 were more likely to gain good final BSCVA compared to Zone III as previously reported by Thevi *et al* and Madhusudan *et al*. This reflected the irreversible damage as the wound extended posteriorly to involve the retinal or optic nerve. Our RAPD rate of 20.3% was relatively low compared to 41.9% in a series reported by Agrawal et al (28). Presence of RAPD not only predicts poor vision but also carry higher risks for eventual enucleation of the open globe injured eye (27, 29).

In clinically obvious open globe injuries, CT played important role in localising retained radio-opaque or metallic IOFB (30). In an occult open globe injury, it was suggested that CT scan is not a sensitive stand-alone tool to diagnose but it complements the clinical suspicion. Arey *et al* reported on the role of CT scan in the detection of occult open globe injury, with sensitivity and specificity of 56% to 68% and 79 to 100%, respectively. Important radiological signs included change in globe contour, globe volume loss, absent or displaced lens and vitreous haemorrhage (31). Should the CT scan found inconclusive, it is recommended to subject the cases to surgical confirmation in operating theatre.

Endophthalmitis is a devastating complication of open globe injuries and has been reported in 4% to 8% of cases (32). At primary repair, five (3.2%) cases showed evidence of endophthalmitis. An additional two cases had developed endopthalmitis subsequently making altogether seven (4.4%) cases of endophthalmitis in our series. Our endopthalmitis rate when associated with IOFB was significantly higher compared to when there was no IOFB (18.8% vs 3.5%, χ^2=6.938, df=1, p=0.008). This finding was similar to that reported by Andreoli *et al* who found 0.9% endophthalmitis rate among 675 open globe injury treated over 7.5 years. The rate was 3.2% when associated with IOFB as compared to 0.4% when not associated with IOFB (33).

Our rate of enucleation was relatively low (n=6, 3.80%) compared to other studies. Mansourri *et al* reported on a large series of open globe injuries in Iran and found that the rate of enucleation or evisceration was 5.3% (126 out of 2,340 cases) while the rate of sympathetic ophthalmia was a low 0.08% (34). Savar *et al* reported enucleation rate of 8.3% and sympathetic ophthalmia of 0.3% among 660 cases of open globe injury cases (35).

Visual outcome

We demonstrated that although the vision generally improved after the management of the open globe injury, the BSCVA remained impaired. In nearly 30% of cases, the vision remained unchanged or worsened. The patients might need further intervention including surgeries such as corneal transplantation and refractive laser procedures to improve the vision. These findings, together with the revelation that open globe injuries were preventable, serve strong drive toward educating and training the target groups and enforcement relevant regulations pertaining aspects such as safety eye protection and vehicle restraining devices.

CONCLUSIONS

Open globe injury is an important ocular emergency seen in Hospital Serdang. High risk group for open globe injury includes young male industrial workers of foreign nationality. Following treatment, majority of cases improved in final vision but approximately one-third remained unchanged or worsened. Effort should be directed toward inculcating high standard of safety in work place, home and among motorists.

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