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Research Article

Visual Outcomes as a Result of Time Delays from Trauma to Surgery in Cases of Open Globe Injury at Groote Schuur Hospital

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Abstract

Background: Open globe injuries generally have a poor visual outcome. Some studies have shown no difference between cases that had prompt surgical intervention and those where surgery was delayed; whereas others have shown a difference.

Objectives: To determine the time elapsed from the occurrence of eye injury to the time of surgical intervention and establish whether a delay in treatment affects visual outcomes in patients with open globe injuries at Groote Schuur Hospital. Measure the delay in presentation and associated endophthalmitis.

Methods: Prospective case-series of all patients admitted with open globe injuries over two years. Delays were divided into 24 hour periods and injuries according to zones. Ocular findings were analysed after a minimum 3-month follow up.

Results: There were 249 open globe injuries. Only 169 of these completed the 3-month follow-up. The mean time from injury to surgical treatment was 80.14 hours. The primary procedures were 175 (70.3%) repairs, 61 (24.5%) eviscerations and 13 (5.2%) others. There were no statistically significant differences in outcomes, except in the Zone 1 group with injury to treatment times of more than 72 hours with most delays occurring while waiting to get into theatre. All Zone 1 cases that achieved final acuity of 6/5-6/12 were operated within 72hrs (p=0.022). Six patients were diagnosed with endophthalmitis at the time of presentation and the risk increased with delays beyond 24 hours.

Conclusion: The mean time from injury to surgical treatment was around 3.3 days for all cases (median 2.125 days). Only Zone 1 injuries with surgery delayed beyond 72 hours had worse outcomes. These corneal injuries usually have better prognoses and thus delays did affect the outcomes in these cases; whereas the more posterior injuries with poorer prognoses were not affected. The need for educating about urgent, early presentation and initiating early prophylactic treatment at primary care level are illustrated.

INTRODUCTION

Ocular trauma is known to be an important preventable cause of visual impairment. Penetrating eye (open globe) injuries generally have a poor visual prognosis and a large number of cases of open globe injuries are seen at Groote Schuur Hospital (GSH) every year [1]. There is anecdotal evidence that in these cases there are often delays in patient presentation and transfer from outlying hospitals despite their urgent nature. There are also delays before surgical intervention takes place due to crowded emergency lists and the fact that other life-threatening cases tend to take priority over eye injuries.

Previous studies have shown that delay in surgical intervention in cases of open globe injury results in an increased risk of endophthalmitis [2,3]. Patients are usually started on prophylactic antibiotics immediately on admission to our ward in order to reduce this risk of infection. Depending on a variety of factors, there may be a delay in surgical intervention in certain cases. Some studies have shown no difference in visual outcomes between cases that had prompt surgical intervention and those where surgery was delayed [4,5]; whereas others have shown a poorer outcome in cases with delayed surgical intervention [6,7].

It would be important to confirm the impression of delays in presentation and intervention in our cases. The time periods from injury and presentation through to surgical intervention in patients with open globe injuries thus needs to be established. We then need to determine whether the delay in surgery affects the final visual outcome by comparing the outcomes between patients who have had eye injuries of similar grades. In order to compare similar injuries to each other, the injuries can be grouped according to zones as recommended in the standardised Ocular Trauma Scoring (OTS) system [8].

OBJECTIVES

This study was aimed at determining the time elapsed from

the occurrence of eye injury to the time of surgical intervention and establishing whether a delay in treatment affected visual outcomes in adult patients who sustained open globe injuries of a similar grade at GSH. Time elapsed was broken down into 24-hour periods and further into times from injury to first presentation; presentation to ophthalmic consult; and ophthalmic consult to surgical intervention, to assess where most delays occurred and whether any of these significantly affected outcomes. A secondary aim was to determine whether delayed presentation or other factors, including the mechanism of injury, were associated with endophthalmitis in those patients who already had post- traumatic endophthalmitis at the time of presentation to the ophthalmologist.

METHODS

Data were prospectively collected on all patients admitted to GSH with an open globe injury over the 2-year period from the beginning of July 2009 to the end of June 2011. On admission, a standard assessment sheet was filled in by a resident ophthalmologist. The visual acuity at presentation, the OTS zone of injury and the mechanism of injury were noted in each case. The presence or absence of endophthalmitis was documented. The elapsed time from occurrence of open globe injury to surgical intervention was recorded. Times from injury to first presentation; presentation to ophthalmic consult; and consult to surgical intervention were also documented. The patients were followed up for a minimum period of three months and the visual acuity at three months was recorded.

Patients were grouped according to the time from occurrence of injury to surgical intervention as follows:

- Less than 24 hours
- 24 – 48 hours
- 49 – 72 hours
- More than 72 hours.

Within each group, cases were divided according to the OTS zone of injury:

- Zone 1: Corneal
- Zone 2: Corneo-scleral (within 5 mm of the limbus)
- Zone 3: Scleral (extending greater than 5 mm beyond the limbus).

The exact surgical intervention for each case was documented and the visual acuity (VA) at three months after the injury measured. The best corrected visual acuity, recorded in logarithm of the minimal angle of resolution (logMAR), at three months was deemed to be the visual outcome. VA was converted to logMAR using the conversion table proposed by Holladay [9], with logMAR +2.5 for hand motions, +3.0 for light perception and the addition of +4.00 for no light perception [10]. Data were analysed using Stata (version 11.1). Means and standard deviations (SD) were reported for normally-distributed variables. The groups were compared using the appropriate statistical test to establish whether a difference in the mean visual outcome existed between the major time groups, as well as the subgroups, in the patients who were also allocated to the three different zones of injury. Proportions were compared using the t-test and, where appropriate, Fisher's exact test and regression analysis. Cases in each time group were further analysed to establish whether delay in presentation and/or mechanism of injury were significant in those cases with endophthalmitis. Factors were considered statistically significant if $p \leq 0.05$.

Ethical approval for the study was obtained from the Ethics Committee of the Faculty of Health Sciences, University of Cape Town.

RESULTS

There were 249 patients admitted with open globe injuries during the designated two- year period. These included 212 (85.14%) males and 37 (14.86%) females. The mean age for males was 32.6 (+/-11.7) years and females 34.5 (+/-14.8) years. Only 169 of these patients completed the three-month follow-up and were included in the analysis. The mean time from open globe injury to surgical treatment was 80.14 hours, with a range of 5 to 1202 hours (median of 51 hours and interquartile range (IQR) of 58 hours. Table 1 shows the details of all the cases that had surgery within 24 hours; between 24 and 48 hours; between 48 and 72 hours; and after 72 hours. For Zone 1 injuries, the mean time from open globe injury to surgical treatment was 93.22 hours, with a range of 8.5 to 1202 hours (median of 55.75 hours and IQR 61.5 hours). For Zone 2 injuries the mean time from open globe injury to surgical treatment was 44.5 hours, with a range of 9.25 to 134 hours (median of 32 hours and IQR 41.5 hours). For zone 3 injuries, the time was 72.97 hours, with a range of 1.6 to 592.5 hours (median of 48 hours and IQR 55.4 hours).

Patients with open globe injuries underwent primary surgery in all 249 cases. The primary procedures were 175 (70.3%) repairs, 61 (24.5%) eviscerations and 13 (5.2%) others. Corneal lacerations were repaired using 10-0 nylon interrupted sutures and scleral wounds using 9-0 nylon or 7-0 vicryl, with anterior vitrectomy and lensectomy where required. Secondary procedures within the 3-month period included (amongst others): 12 secondary eviscerations (4.8% of total) and four (1.6%) retinal detachment repairs. Primary eviscerations were performed in those cases in which VA of no light perception, an afferent pupil defect, a normal fellow eye and irreparable wounds were all present. Due to limited operating theatre capacity, retinal detachment repairs were only performed in those with compromised fellow eyes and injuries with reasonably good prognoses.

The presenting visual acuities and the final visual outcomes at three months for each group are shown in Table 2. The data was analyzed using the various times from injury to surgery as cut-off points to assess for differences in outcomes for each of

Table 1: Zone of injury and time from injury to surgery.

	< 24 hours	24-48 hours	49-72 hours	> 72 hours	Total no. (%)
Zone 1	8	15	16	17	56 (33.1)
Zone 2	6	7	9	8	30 (17.8)
Zone 3	11	24	20	28	83 (49.1)
Total no. (%)	25 (14.8)	46 (27.2)	45 (26.6)	53 (31.4)	169 (100)

Table 2: Mean presenting and final VA (logMAR).

	< 24 hours		24-48 hours		49-72 hours		> 72 hours	
	Presenting VA	Final VA	Presenting VA	Final VA	Presenting VA	Final VA	Presenting VA	Final VA
Zone 1	2.31	2.13	1.87	1.38	1.84	1.62	2.53	2.16
Zone 2	2.27	2.59	2.73	2.50	1.67	1.82	2.60	2.44
Zone 3	3.41	3.29	3.29	3.40	3.43	3.34	3.19	3.04

the different zones. Table 3 shows the acuities at three months in the different groups. There were no statistically significant differences in outcomes, except in the Zone 1 group with injury to treatment times of more than 72 hours when compared to those having surgery after 72 hours. Of note is that all Zone 1 cases that achieved final VA of 6/5-6/12 were operated within 72hrs (p=0.022). Table 4 indicates that most of the delay in this group occurred while waiting to get into theatre. The period from the "first ophthalmic consult to surgery" had a median delay (22.0 hours) and mean delay (28.84 hours) which were similar to each other. The highest mean delay, however, occurred in the group with the "time from presentation for medical help to ophthalmic consult" at 41.98 hours, but the median was only 7 hours – a discrepancy caused by a wide range in times (0-1165 hours).

Of the total 249 cases, there were 6 patients (2.4%) who were diagnosed with endophthalmitis at the time of first ophthalmic consultation. These were all males. Table 5 shows the times from injury to ophthalmic consult and endophthalmitis at presentation. In cases with delays beyond 48 hours, the relative risk of endophthalmitis was 3.82, but this was not statistically significant (p=0.36).

Interestingly, five out of the six cases of endophthalmitis were associated with injuries inflicted with metal objects – knife (2), screwdriver (1), nail (1) and metal bar (1).

DISCUSSION

As in many other studies on ocular trauma, the study population consisted mainly of young males[1,2,5-7]. The mean time from injury to surgical treatment at our institution was just over 3.3 days for all cases (median 2.125 days), with only 14.8% of patients having surgery within 24 hours. A study in India showed that the mean time lag between injury and surgery was 4.0 days (a retrospective series of 669 cases)[7]. In a study in Australia, the mean time from injury to surgery was 1.5 days (a retrospective series of 273 cases)[5]. These data suggest differences in delays between middle income and high income countries.

When our cases were broken up into groups according to the OTS zones, the only group which appeared to be affected by delays in treatment, with significantly poorer outcomes, was that in which the treatment of Zone 1 injuries had been delayed beyond 72 hours. This was mainly due to delays from the time of ophthalmic consult to surgical treatment. There is conflicting evidence regarding the prognostic value of delays in treating open globe injuries in the literature, with some authors suggesting that the elapsed time to surgery did not correlate with final VA [4,5]. On the other hand, Cruvinel-Isaac, et al.[6] demonstrated a 1.16-fold increased chance of worse visual prognosis with each day of delay to surgery and others showed a significant deleterious effect with time lag between injury and surgery. [7] Barr, et al. found that delaying the initial repair up to 36 hours had no effect

Table 3: Time to surgery and final VA.

	24-hour cut-off				
	24 hours or less		**> 24 hours**		
	Number	Mean final VA (logMAR)	Number	Mean final VA (logMAR)	p-value *
Zone 1	8	2.13	48	1.78	0.498
Zone 2	6	2.88	24	2.28	0.401
Zone 3	11	3.29	72	3.26	0.940
	48-hour cut-off				
	48 hours or less		**> 48 hours**		
	Number	Mean final VA (logMAR)	Number	Mean final VA (logMAR)	p-value
Zone 1	23	1.63	33	1.95	0.387
Zone 2	17	2.55	13	2.20	0.545
Zone 3	40	3.47	43	3.07	0.105
	72-hour cut-off				
	72 hours or less		**> 72 hours**		
	Number	Mean final VA (logMAR)	Number	Mean final VA (logMAR)	p-value
Zone 1	40	1.62	16	2.36	**0.0417**
Zone 2	22	2.32	8	2.61	0.650
Zone 3	58	3.37	25	3.03	0.260

* Wilcoxon-Mann Whitney test

Table 4: Delays in management of Zone 1 injuries.

Injury to 1st Presentation		First Presentation to Eye Consult		Eye Consult to Surgery	
	Time		Time		Time
Mean	23.99	Mean	41.98	Mean	28.84
Median	5	Median	7	Median	22
SD	46.98	SD	161.8	SD	24.23
IQR	18	IQR	16.5	IQR	30.5
Min	0.33	Min	0	Min	2
Max	252	Max	1165	Max	111

on visual outcome in 122 patients of which 70% had follow-up for six months [11]. Our study shows that, in general, a delay in treatment did not affect the outcomes, except in injuries limited to the cornea. This may be explained by the fact that corneal injuries usually have better prognoses and thus delays did affect the outcomes in thetse cases; whereas the more posterior injuries (as seen in Figure 1) with poorer prognoses were not affected by delays because the outcomes would have been poor anyway. Also, vitreoretinal surgery was only offered to selected cases and this limitation may have contributed to these poor outcomes. However, Feng, et al. found that even after vitreoretinal surgery in patients with complete monocular blindness after trauma, there was only a modest improvement in outcome to perception of light or better in some cases despite anatomical restoration. [12]

About 80% of patients in this study were found to have monocular blindness at three months after the injury. Trauma-induced eye injuries are the leading cause of monocular blindness in the United States. In a retrospective study on open globe injuries, 63% were reported blind in the affected eye.[13] The high rate of monocular blindness in our study and the higher evisceration rate (compared to other studies)[5] may explain why these injuries with poor prognoses were not affected by delays in treatment.

The number of patients with endophthalmitis at first ophthalmic consult increased from three to six with a delay in presentation of beyond 24 hours. Although there was a 100% increase in the number of endophthalmitis cases when presentation was delayed from 24 to 48 hours, the *p*-value was not significant due to the small number of cases. Delayed presentation is likely to be a risk factor in the development of endophthalmitis. Other studies have shown that delay in primary repair of more than 24 hours, is considered to be a risk factor for post-traumatic endophthalmitis.[14] Zhang and co-workers noted a protective effect against the development of endophthalmitis with primary repair performed within 24 hours of injury.[15] Of note, Rofail and colleagues, also found that endophthalmitis was present in 15 cases (6%) of their 273 patients who all had infection noted at the time of initial examination. They suggested that endophthalmitis was strongly correlated with a delayed presentation (eight of 15 cases with greater than 48 hours delay). The remaining seven cases developed endophthalmitis later, despite prompt surgery and prophylactic antibiotics.[5] The point to be made here is that delay in presentation is more relevant than a delay in surgery, since treatment cannot be instituted early and endophthalmitis cannot be prevented with prophylactic antibiotics (or primary repair) if the patient presents later or once endophthalmitis is already present. Educating the public about the perils of ocular trauma and the need for urgent, early presentation is thus of paramount importance. The need for initiating early prophylactic treatment at primary care level should also be stressed.

A strength of our study is that it was conducted prospectively. Most of the more recent studies on this subject were retrospective. [4-7] A limitation of our study is that despite the fairly large number of cases (249) overall, just over two-thirds (169) of these completed the three-month follow-up period and were included in the primary analysis. When these were further broken down into sub-groups according to zones, the numbers became even smaller. This problem with poor follow-up in our middle income setting is well-recognised [1].

CONCLUSION

The time elapsed from the occurrence of open globe eye injury to the time of surgical intervention in our institution is around three days. This is longer than the 24 hours recommended in the literature, but it would appear that the visual outcomes in open globe injuries of similar grades are not affected, except for Zone 1 injuries with delays of more than 72 hours. The delays occurred mainly from eye consult to surgery and this needs to be addressed at our institution.

Table 5: Time to presentation and endophthalmitis diagnosed at presentation **(n=249).**

12 hour cut-off			
Initial eye consult	**12 hours or less**	**> 12 hours**	***p*-value**
Endophthalmitis present	1	5	0.797
No endophthalmitis	51	192	
24 hour cut-off			
	24 hours or less	**> 24 hours**	
Endophthalmitis present	3	3	0.787
No endophthalmitis	135	108	
48 hour cut-off			
	48 hours or less	**> 48 hours**	
Endophthalmitis present	6	0	0.360
No endophthalmitis	187	56	

Figure 1 Typical severe 'Zone 3' injury with lid involvement and scleral laceration.

Delay in presentation of more than 24 hours was associated with an increased risk of developing endophthalmitis. The need for early presentation and early antibiotic prophylaxis at primary care level is thus evident.

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