

Open globe eye injury characteristics and prognostic factors in Jazan, Saudi Arabia

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ABSTRACT

الأهداف: تقويم خصائص و عوامل تحسن إصابات العين المفتوحة التي تم معالجتها في مستشفى الملك فهد المركزي بجازان، بالمملكة العربية السعودية.

الطريقة: هذه الدراسة عبارة عن مراجعة استيعادية للسجلات الطبية للمرضى المصابين بإصابة العين المفتوحة الذين تلقوا العلاج الجراحي في مستشفى الملك فهد المركزي بجازان بالمملكة العربية السعودية بين يناير 2011 و ديسمبر 2013. تم جمع بيانات عن ديموغرافية المشاركين، إصابات العين، حدة النظر قبل و قبل الإجراء الجراحي. تم مقارنة حدة النظر قبل و بعد العمليات الجراحية للتحقق من مدى التحسن. تم استعمال تحليل الإنحدار اللوجستي للتحقق من الخصائص ذات العلاقة بتحسين حدة النظر.

النتائج: عدد الحالات التي تم شمولها في هذه الدراسة بلغ 120 حالة. أكثر مسببات الإصابة كان الإصابة بجسم غير حاد (20%) و الزجاج المتكسر (18.3%). ما يقارب من نصف الحالات كانت تعاني من إصابة القرنية و نزيف العين الأمامي. معظم الإصابات حدثت بسبب اختراق العين (37.5%). إصابات المنطقة الأولى كانت مصحوبة بتحسين لحدة النظر (معدل الترجيح: 2.44، معامل $p=0.036$). ضمن العوامل التي كانت مصحوبة لعدم تحسن حدة النظر، كانت حالات فقدان العدسة (معدل الترجيح: 0.180)، تضرر الشبكية (معدل الترجيح: 0.062)، النزيف الزجاجي (معدل الترجيح: 0.266) و إصابات المنطقة الثالثة (معدل الترجيح: 0.092) و كانت هذه العوامل مهمة إحصائياً (قيم $p<0.05$).

الخلاصة: تبين أن إصابات المنطقة الأولى ذو علاقة أكبر بمدى تحسن حدة النظر و أن إصابات المنطقة الثالثة مصحوبة لعدم تحسن حدة النظر.

Objectives: To evaluate characteristics and prognostic factors of open globe injuries (OGI) presented to King Fahad Specialist Hospital in the Jazan region, Saudi Arabia.

Methods: This study is a retrospective review of medical records of OGI patients who underwent operative repair of their injuries in King Fahad Central Hospital, Jazan, Saudi Arabia between January 2011 and December 2013. Demographic information, eye injury, preoperative, and postoperative visual acuity were collected. The initial and final visual acuity outcomes were compared to identify subjects who witnessed any improvement in their visual acuity. Logistic regression was used to assess characteristics associated with improvements in the visual acuity.

Results: Number of included cases was 120. Most frequently reported causes of injury were blunt trauma (20%) and shattered glass (18.3%). Approximately half of the cases were reported to have iris injuries or hyphema. Most cases suffered penetration (37.5%) of the eye globe. Only zone I injury was significantly associated with better visual acuity outcomes (odds ratio [OR]: 2.447, $p=0.036$). Among the variables that were associated with poorer prognostic outcomes, only aphakia (OR: 0.180), retinal damage (OR: 0.062), vitreous hemorrhage (OR: 0.266), and zone III injuries (OR: 0.092) were statistically significant ($p<0.05$).

Conclusion: Zone I injury appears to have a better prognostic effect on visual acuity where injuries related to Zone III were associated with worse prognostic outcomes.

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Ocular trauma has several clinical outcomes, which vary from mild visual effects to blindness. Data about the global prevalence of the condition is limited. However, a review conducted in 1998 indicated that ocular injuries are responsible for 19 million cases of blindness globally. Similarly, 55 million people suffered a restriction in their activities for a day or more on an annual basis.¹ There are different types of ocular trauma depending on the extent of the injury. According to the Birmingham Eye Trauma Terminology System (BETTS), an open globe injury (OGI) is defined as a full-thickness injury of the eyewall.² Additionally, OGIs are further classified according to the type of injury, such as a rupture or laceration. Although ocular trauma has been reported to be one of the important contributors of unilateral partial or total loss of sight,³ limited investigations have been conducted to investigate the effect of ocular trauma on visual loss patterns in Saudi Arabia. Two epidemiological investigations were conducted in Saudi Arabia to identify the prevalence and causes of visual impairment.^{4,5} However, none of these studies reported the prevalence of ocular injuries among the general Saudi population. Nonetheless, a study conducted in Dharan, Saudi Arabia investigated the visual and operative outcomes of 3 patients who were injured in a terrorist attack in 1996.⁶ Additionally, in another study, which was carried out on dental health care workers to study the prevalence of ocular injuries in work settings, only the prevalence of intraocular foreign bodies was reported as a type of ocular trauma.⁷ There is currently a lack of information about the characteristics and prognostic factors of OGI in Saudi Arabia. This investigation aims to evaluate the clinical characteristics of OGI patients presented to King Fahad Specialist Hospital in the Jazan region, Saudi Arabia. Additionally, this study aims to assess the prognostic factors influencing the visual acuity outcomes of treated patients.

Methods. This study is a retrospective review of medical records of OGI patients who underwent operative repair of their injuries in King Fahad Central Hospital, Jazan, Saudi Arabia. The medical records

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of patients who were admitted to the hospital over a period of 3 years between January 2011 and December 2013 were reviewed. Ethical approval to conduct the study was provided by the Research Ethics Committee of King Fahad Central Hospital.

Data was collected via a single investigator. Subjects were included in this study if their preoperative and postoperative visual data were detected in their medical records. Subjects for whom the visual outcomes data were missing were excluded. A data extraction sheet was developed to collect demographic data, and the mechanism, location, type and zone of the eye injury, preoperative and postoperative visual acuity data and initial clinical signs, including iris injury, hyphema, vitreous hemorrhage, retinal detachment, and endophthalmitis. Additionally, the number of operations and the length of time between the incidence of the injury and hospital admission, and the length of time between the initial and final visual acuity tests, were recorded. The initial and final visual acuity outcomes were compared to identify subjects who witnessed any improvement in their visual acuity.

Statistical analysis was performed using the IBM SPSS software version 22 (IBM Corp, Armonk, NY, USA). Frequencies and proportions were used to summarize binary and categorical variables. Means and standard deviations (SD) were utilized to summarize continuous variables. To investigate the effect of prognostic factors on visual acuity improvement, logistic regression was used to assess characteristics associated with improvements in the visual acuity. A p-value of 0.05 or less was designated as statistically significant for the statistical tests applied.

Results. One hundred and sixty cases of OGI were identified. However, 40 cases were found to have their data missing and were excluded. Only 120 cases were included in this study. Table 1 illustrates the demographic characteristics of the participants included. The mean age of the participants was 26.8 years. However, approximately 40% of the sample were below the age of 18. This indicates that children are likely to be vulnerable to OGI compared to other age groups. Additionally, the majority of cases were males, signifying the rule of gender susceptibility to OGI, which can be partially explained by higher risk exposure for males. The majority of the subjects were Saudis. Nonetheless, approximately 34% of the subjects included were expatriates, and most were Yemenis.

The type and cause of the OGIs, and the place of the injury occurred, are illustrated in Table 2. Most cases were accidental, followed by fall, assault, and unknown

reasons. The most frequently reported causes of injury were blunt trauma (20%), shattered glass (18.3%), and tree branches (10%). However, injuries due to sharp objects collectively constituted more than half of the injuries. Approximately 66% of the injuries occurred in home settings, the work place and road traffic accidents. As the country has a high incidence of road traffic accidents, shattered glass, which is likely to be

associated with car crashes, could partially explain the injuries of 18% of the sample.

Table 3 is a summary of the clinical characteristics of the OGI cases included. Unilateral eye injuries are almost equally distributed between the left and right

Table 1 - Demographic characteristics of 120 open globe injury cases admitted to King Fahad Central Hospital, Jazan, Saudi Arabia between 2011 and 2013.

Variables	n (%)
Age (mean±SD)	26.8±19.2
Gender	
Males	88 (73.3)
Females	32 (26.7)
Nationality: frequency (proportion)	
Saudis	79 (65.8)
None Saudis	41 (34.2)

Table 2 - Type and cause of the injury, and place where it occurred, for 120 open globe injury cases admitted to King Fahad Central Hospital, Jazan, Saudi Arabia between 2011 and 2013.

Variables	Frequency (%)
Type of injury	
Accidental	98 (81.7)
Fall	11 (9.2)
Assault	9 (7.5)
Unknown	2 (1.7)
Cause of injury	
Blunt	24 (20.0)
Shattered glass	22 (18.3)
Tree branch	12 (10.0)
Hammer	10 (8.3)
Knife	10 (8.3)
Fall	10 (8.3)
Pen	7 (5.8)
Gun	3 (2.5)
Miscellaneous	19 (15.8)
Unknown	3 (2.5)
Place of injury	
Home	46 (38.3)
Work settings	19 (15.8)
Road traffic accidents	15 (12.5)
School	8 (6.7)
Sport activity	8 (6.7)
Children playgrounds	7 (5.8)
Unknown	17 (14.2)

Table 3 - Clinical characteristics of 120 open globe injury cases admitted to King Fahad Central Hospital, Jazan, Saudi Arabia between 2011 and 2013.

Variable	Frequency (%)
Injured eye	
Right	58 (48.3)
Left	62 (51.7)
Initial visual acuity	
6/6 – 6/12	5 (4.2)
6/15-6/60	16 (13.3)
CF	49 (40.8)
HM-LP	42 (35.0)
NLP	8 (6.7)
Final visual acuity	
6/6 – 6/12	6 (5.0)
6/15-6/60	52 (43.3)
CF	32 (26.7)
HM-LP	12 (10.0)
NLP	11 (9.2)
Missing	7 (5.8)
Iris injury (Present)	68 (56.7)
Hyphema (Present)	57 (47.5)
Vitreous haemorrhage (Present)	25 (20.8)
Aphakia (Present)	20 (16.7)
Retinal damage (Present)	14 (11.7)
Endophthalmitis (Present)	6 (5.0)
Zone of injury	
Zone I	62 (51.7)
Zone II	42 (35.0)
Zone III	16 (13.3)
Nature of injury	
Penetration	45 (37.5)
Rupture	39 (32.5)
Perforation	32 (26.7)
IOFB	4 (3.3)
Number of surgical procedures	
One	99 (82.5)
Two or more	21 (17.5)
Enucleation	
Performed	10 (8.3)
Not performed	110 (91.7)
Duration between onset of injury and hospital admission	
≤1 hour	86 (71.7)
>1 hour	34 (28.3)
Duration between initial and final test	
≤30 days	98 (81.7)
>30 days	22 (18.3)

eyes. The initial visual acuity test indicates that most cases were suffering from poor visual acuity; only 13% of cases had an initial visual acuity varying between 6/15 and 6/60. However, the visual acuity records indicate an overall improvement such as a three-fold increase in the number of cases with final visual acuity varying between 6/15 and 6/60 (43.3%).

Several clinical presentations were recorded for the OGI cases. About half of the cases were reported to have iris injuries or hyphema. Fewer cases suffered from vitreous hemorrhages, aphakia, retinal damage and endophthalmitis. Most cases had a zone I injury, which partially explains the high prevalence of iris injuries and hyphema in this study's sample.

Distribution of injury varied between penetration (37.5%), rupture (32.5%), or perforation (26.7%) of the eye globe. Most cases required one surgical procedure (82.5%) and only 8% of the subjects had an enucleation. The recorded time lag between the onset of the injury and hospital admission varied from less than one hour to 6 hours. However, 71% of the cases were recorded as being admitted within less than an hour of the injury onset. Additionally, the time between the initial and final visual acuity test varied between 2 days and 65 days; 81% of the cases had their final visual acuity test performed within 30 days of the initial test. Several factors, such as age, gender, time between initial and final visual acuity tests and time between injury onset and hospital admission, were presumed to

be factors that might influence the prognosis of visual acuity for the patients. A univariate logistic regression was performed to investigate the effect of these factors. Being older, female and admitted to hospital early on (within one hour) and a delay in the measurement of final visual acuity (>30 days) were all associated with better prognosis for visual acuity. However, none of these associations were statistically significant ($p>0.05$).

Testing the association between clinical prognostic factors and improvement in visual acuity was performed by controlling for potential confounding factors. The effects of these prognostic factors are illustrated in Table 4. Most of the variables are associated with poorer prognostic outcomes: only hyphema, zone I and zone II injuries, ruptures and penetration injuries are associated with better visual acuity outcomes. However, among these variables, only zone I injury was statistically significant ($p=0.036$), indicating that those who improved showed higher odds of zone I injury compared to those who did not improve. Among the variables that were associated with poorer prognostic outcomes, only aphakia, retinal damage, vitreous hemorrhage and zone III injuries were statistically significant ($p<0.05$), indicating that those who did not witness any improvement in visual acuity were likely to show higher odds of presentation of these conditions.

Discussion. This investigation is a retrospective assessment of the medical records of OGI patients

Table 4 - Multivariate analysis of the prognostic factors associated with improvements in the visual acuity of 120 open globe injury cases admitted to King Fahad Central Hospital, Jazan, Saudi Arabia between 2011 and 2013.

Variables	Odds ratio*	95% confidence intervals	P-value
Iris injury	0.909	0.410 - 2.212	0.678
Hyphema	1.715	0.756 - 3.889	0.215
Aphakia	0.180	0.051 - 0.631	0.007
Retinal damage	0.062	0.007 - 0.555	0.013
Vitreous haemorrhage	0.266	0.90 - 0.787	0.017
Endophthalmitis	0.236	0.025 - 2.266	0.121
<i>Injury zones</i>			
Zone I	2.447	1.062 - 5.640	0.036
Zone II	1.095	0.169 - 1.377	0.838
Zone III	0.092	0.018 - 0.460	0.004
<i>Injury nature</i>			
Rupture	1.686	0.701 - 4.055	0.244
Penetration	1.432	0.615 - 3.336	0.405
Perforation	0.652	0.262 - 1.621	0.357

*Controlling for age, gender, time between initial and final visual acuity tests, and time between injury onset and hospital admission.

admitted to King Fahad Specialist Hospital, in Jazan, Saudi Arabia between 2011 and 2013. Most recorded injuries were accidental. A frequently recorded type of injury was blunt injury and most of the injuries occurred in home settings. An overall improvement in visual acuity after surgical procedures was witnessed. Improvement in visual acuity was found to be statistically associated with the presence of zone I injury, and with the absence of zone III injury, aphakia, retinal damage, and vitreous hemorrhage.

Several investigations throughout the world have assessed the prognostic factors influencing final visual acuity among OGI patients. Overall, a higher risk of OGI among male subjects and among the younger population is reported.^{3,8-10} This is consistent with the findings of the current study, where most cases were males and 40% of them were below the age of 18. This indicates the vulnerability of these groups due to work, sporting activities, or school-related activities.

The current study reported that most of the injuries occurred in home settings. This contradicts the findings of other studies conducted in Turkey,⁹ UK,¹¹ and Italy,¹² where most cases occurred in work settings. The higher occurrence of OGIs in home settings in the Jazan region might indicate the presence of factors increasing the risk of OGIs in home settings in the region. However, the current study was not able to investigate the factors constituting a higher risk of OGI in homes in the Jazan region.

Injuries due to sharp objects constituted half of the causes of the OGIs in the current investigation. This is similar to what was observed in other studies.^{9,11} However, another study conducted in south Spain reported that most cases were injured by wire used in greenhouses.¹⁰ This variation in causes of injury depending on area calls for a mandatory tailoring of preventive and precautionary procedures suitable for each area.

The current study did not find a statistically significant association between prognosis and age, gender, time between injury onset and hospital admission and duration between initial and final visual acuity. However, other studies found that age has an important influence on visual acuity prognosis.^{13,14} Additionally, a study by Agrawal et al¹³ reported that the time lag between the injury onset and hospital admission was significantly associated with the final visual acuity of the patients. It appears that involvement of the posterior part of the globe is associated with poorer visual outcomes. The findings of the current study indicated that retinal damage and vitreous hemorrhage were related to a worse prognosis. This finding is supported by several

other investigations, where the occurrence of zone III injuries was associated with poor visual prognosis.^{9,14-16}

This investigation has several areas of strengths and weaknesses. Knowledge of OGI characteristics and prognostic factors is lacking in Saudi Arabia and this investigation helps to fill this gap in the knowledge pertaining to one region in the Kingdom. King Fahad Central Hospital is the only tertiary hospital in the region that is equipped with facilities and expertise to treat OGI patients. Therefore, this investigation can be assumed to be representative of the Jazan region. The weaknesses of this investigation are mainly related to the reliance on medical records. The limited retrospective study period was due to the change in patients filing system where an electronic system was introduced in 2011 in King Fahad Central Hospital. This hindered inclusion of patients' records before this date. Therefore, the quality of this investigation is strongly dependent on the quality of the medical records of this health facility. Further investigation is needed to identify reasons behind high occurrence of OGIs within houses and work settings in Jazan. Identifying these factors might aid in better development and implementation of preventive services. Population at risk, such as children and high risk workers, should be identified and exposed to appropriate preventive measurements.

In conclusion, this study illustrated characteristics of OGIs in Jazan regions and associated prognostic factors of visual acuity. Preventive measures should be applied to high risk groups such as children and workers with high risks. Zone I injury appears to have a better prognostic effect on visual acuity where injuries related to Zone III were associated with worse prognostic outcomes.

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