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The epidemiology of Open Globe Injuries presenting to a tertiary referral eye hospital in Australia

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ABSTRACT

Background: Open globe injuries (OGIs) account for 44% of the cost of ocular trauma within Australia. It is estimated that 90% of ocular trauma is preventable. However, there have been few epidemiological studies within Australia that have identified groups at risk of OGIs specifically. The aim of our study was to review the epidemiology of OGIs presenting to a tertiary referral eye hospital in Australia.
Methods: The Birmingham Eye Trauma Terminology (BETT) system was used to classify injuries as globe ruptures, penetrating eye injuries (PEIs), intraocular foreign bodies (IOFBs) or perforating injuries. Demographic data, past ocular history, mechanism of trauma, ocular injuries, and best-corrected visual acuity (BCVA) before and after treatment were recorded.
Results: The 205 OGIs included 80 globe ruptures, 71 PEIs, 48 IOFBs and six perforating injuries. Falls predominated in older age groups compared to the other mechanisms of injury ($p < 0.0001$). A fall was responsible for 33 globe ruptures and 82% of these had a history of previous intraocular surgery. Globe rupture and perforating injuries had poorer visual outcomes ($p < 0.05$), consistent with previous studies. Alcohol was implicated in 20 cases of OGI, with 11 of these due to assault. PEIs and IOFBs commonly occurred while working with metal. BCVA was significantly worse following removal of an intraocular foreign body. We found presenting BCVA to be a good predictor of BCVA at the time of discharge.
Conclusions: The causes of OGI varied in association with age, with older people mostly incurring their OGI through falls and younger adults through assault and working with metal. Globe ruptures occurring after a fall often had a history of intraocular surgery. The initial BCVA is useful for non-ophthalmologists who are unfamiliar with the ocular trauma score to help predict the BCVA following treatment.

Introduction

Although severe ocular injuries comprise a small percentage of all ocular trauma cases, they are by far the most costly, to the individual and their family, the health system and to society [1–3]. A study conducted by Fong (1995), demonstrated that although open globe injuries (OGIs) comprised only 2% of all ocular injuries, they were responsible for 44% of expenditure on ocular injuries, which are estimated to cost about $155 million per year, Australia-wide [1].

National and international registries, such as the United States Eye Injury Registry (USEIR), the Hungarian Eye Injury Registry (HEIR), and the World Eye Injury Registry (WEIR), have attempted to determine the epidemiology, clinical features and consequences of ocular trauma. Analysis of the USEIR in a study conducted in 2006, for example, showed that there are several risk factors for injury resulting in legal blindness (BCVA < 6/60). These included age over 60 years, injury by assault, and injury occurring due to fall or gunshot. Globe ruptures and perforating injuries are more catastrophic than PEIs, with or without a retained intraocular foreign body (IOFB) [4].

In Australia, recent data on ocular trauma is lacking. In 2002, Casson et al. showed that open globe injury (OGI) commonly occurs in the elderly population through rupture of an old, healed,

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Table 1
International Classification of Diseases (10th revision) diagnostic and procedural codes[a] used to identify cases of ocular trauma.

Diagnostic codes	Descriptions
S05.2	Ocular laceration and rupture with prolapse or loss of intraocular tissue
S05.4	Penetrating wound of orbit with or without foreign body
S05.5	Penetrating wound of eyeball with foreign body
S05.6	Penetrating wound of eyeball without foreign body
S05.7	Avulsion of eye

Procedural codes	Descriptions
162	Repair of perforating wound of eyeball
42551–00	Repair of perforating wound of eyeball with suture of corneal laceration
42551–01	Repair of perforating wound of eyeball with suture of scleral laceration
42551–02	Repair of perforating wound of eyeball with suture of corneal and scleral lacerations
42554–00	Repair of perforating wound of eyeball involving uveal tissue
42557–00	Repair of perforating wound of eyeball involving lens or vitreous

[a] *International Statistical Classification of Diseases and Related Health Problems 10th Revision*. 2016; Available from: http://apps.who.int/classifications/icd10/browse/2016/en.

cataract extraction wound [5]. Studies have also shown that OGIs occur disproportionately among children, particularly boys, and that initial visual acuity is an excellent prognostic indicator of outcome following treatment [5–9]. Other studies have highlighted that 90% of ocular trauma cases resulting in blindness or significant visual impairment are preventable [6,10,11]. To better inform measures to prevent trauma and visual loss from trauma, and for health service planning, we review the epidemiology of OGIs presenting to a large tertiary referral eye centre, the Sydney Eye Hospital over a six-year period.

Ethics approval was obtained from the South Eastern Sydney Local Health District Human Resources Ethics Committee (approval number: HREC 15/018).

Patients and methods

A retrospective case series was conducted. Consecutive patients presenting to the Sydney Eye Hospital, Sydney, Australia with a diagnosis of an OGI from 1st January 2010 to 31 st December 2015 were included. The Sydney Eye Hospital is a tertiary referral eye hospital. Patients were identified from hospital diagnostic and procedure coding data using the International Classification of Diseases, 10th Revision (ICD-10) (Table 1) [12]. Review of the medical records was used to confirm the diagnosis of an OGI and obtain demographic and clinical details. An OGI was defined as a full thickness wound of the eye wall (cornea and/or sclera) [13].

A literature review was conducted, which included an analysis of the information collected by the WEIR and USEIR, to determine the scope of data collected when recording an injury on the database developed for the study. Demographic data included patient age, sex, date of injury, race and postcode. History of the trauma, use of alcohol or recreational drugs at the time of the trauma, previous ocular surgery, and the conditions, location and details of injuries were collected. Where available, best-corrected visual acuity (BCVA) before and after treatment was recorded and converted into logMAR units. Using the available data, the ocular trauma score (OTS) for each individual case was calculated [14].

All injuries were classified according to the Birmingham Eye Trauma Terminology (BETT) system [15]. Each term within this system has a unique definition so that no one term may be used to describe more than one pattern of injury. For example, a PEI is defined as an injury caused by a sharp object that produces a full thickness entrance wound into the globe. A perforating injury, on the other hand, is caused by a sharp object but results in both entrance and exit wounds. Globe rupture results when a blunt object causes a full thickness wound. The history for each OGI was reviewed and an ICD-10 code was assigned to each case (Table 4), supplementary to the diagnostic/procedural code (Table 1), to classify the environmental events and circumstances which caused the OGI [12].

Statistical analysis

Statistical and inferential analyses were performed using SAS software, Version 9.4 (Cary, NC: SAS Institute). Continuous data were compared between BETT classification or age groups using a one-way ANOVA with Bonferroni correction for multiple comparisons and categorical data compared using Chi-Squared tests. A paired *t*-test was used to compare presenting visual acuity to visual acuity following treatment, stratified by the BETT classification. Linear regression was used to model best-corrected visual acuity (BCVA) following treatment in logMAR units. Candidate predictive factors of interest included presenting visual acuity, globe rupture and OTS. The overall strength of these associations was gauged using the R-squared statistic.

Results

205 OGIs in 205 patients presenting to Sydney Eye Hospital between 1st January 2010 and 31 st December 2015 were identified. Patient characteristics are shown in Table 2. The diagnostic and procedural codes listed in Table 1 yielded a total of 433 medical record numbers. One hundred and eighteen of these were duplicates as the same patient was often assigned more than one diagnostic and/or procedural code. The remaining 315 files were reviewed and 110 of these were excluded from our study as there was no evidence of open globe injury, either on examination, imaging studies or intra-operatively. The inclusion/exclusion process is illustrated in the flowchart shown in Fig. 1.

The 205 OGIs included 80 globe ruptures, 71 penetrating eye injuries, 48 intra-ocular foreign bodies and six perforating injuries (BETT classification). There were 90 (44%) initial presentations to Sydney Eye Hospital and 113 (55%) tertiary referrals from other hospitals or clinics to the Sydney Eye Hospital. The most common mechanism of injury was 'exposure to inanimate mechanical forces' (e.g. via use of a hand tool) accounting for close to two-thirds of the injuries. There were 21 OGIs due to assault and alcohol was implicated in the majority (11, 52%) of these cases. There were six cases for which the mechanism of injury was not recorded.

The mean age of patients sustaining a globe rupture was 60 years, 39 years for PEI, 36 years for IOFB and 34 years for perforating injury. Patients with a globe rupture were significantly older than the other BETT classification groups ($p < 0.05$, Fig. 2) and only 65% male compared to 83–100% for the other cases. In 60% of the globe ruptures (48/80), there was a record of previous intraocular surgery; this was predominantly cataract surgery