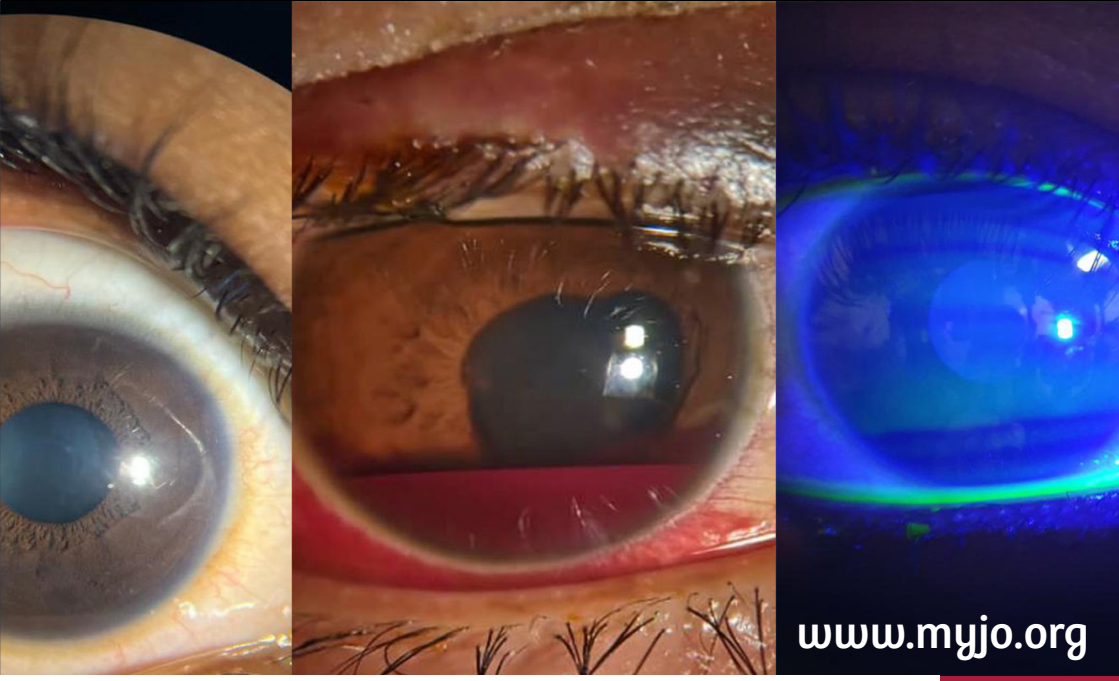

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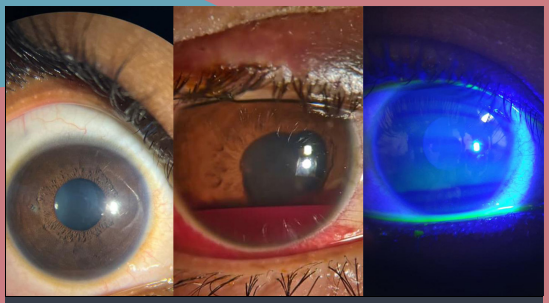

ABOUT THE COVER IMAGE

A collection of cases of traumatic hyphaema and chemical injury. The images belong to the personal collection of patients seen by Dr Liza Sharmini Ahmad Tajudin in the Department of Ophthalmology, Hospital Universiti Sains Malaysia, Kuala Lumpur, Malaysia.

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MyJO aims to provide a platform for ophthalmologists, clinicians, researchers, trainees, students, optometrists, and eye care providers to publish their work and to promote knowledge enhancement among ophthalmologists and eye care providers in Malaysia.

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Editorial
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Special issue on ophthalmic trauma

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Abstract

A prospective study on ophthalmic trauma at the Universiti Malaya Medical Centre in West Malaysia by Soong *et al.* in 2008 found work-related injuries to be a major cause of ophthalmic trauma. The majority of patients were males, typically of working age, and only a dismal 2.5% had eye protection.[1] Another prospective report from Kuching in East Malaysia by Mallika *et al.* reported similar patterns of ophthalmic trauma.[2] Thanigasallam and Reddy reviewed ocular injuries in Malaysia in 2017 and concluded that protective devices must be worn to prevent injuries and that health education to prevent injuries was crucial.[3]

These Malaysian reports set the stage for our highly anticipated and timely Malaysian Journal of Ophthalmology (MyJO) special issue on ophthalmic trauma, which aspires to showcase articles on ophthalmic trauma in order to combat vision loss in this area. Ophthalmic trauma comprises injuries to the eyeball and adjacent structures such as the eyelids, tear ducts, and orbit as well as the face. These injuries may not only cause blindness but also disfigure individuals, affecting their productivity and livelihood, and amount to considerable costs involved in the management, rehabilitation, and even significant financial compensation. The Asia-Pacific Ophthalmic Trauma Society (APOTS) was formed with the mission to build a network and team of eye care professionals with a special interest in ophthalmic trauma to advance clinical care, science, and research in ophthalmic trauma.[4]

In the article “Ophthalmic trauma: Are we doing enough?”, Grover highlighted the magnitude of ophthalmic trauma worldwide.[5] In this review, it was noted that while as many as 1.6 million people are blind from eye injuries, the number of eye injuries are as high as 55 million and comprise 38–65% of ophthalmic emergencies. More recent data from the International Globe and Adenexal Trauma (IGATES) Study shows the mean age of patients is similar to our local population at 31.1 ± 17.4 years, with a similar male majority of 78.3%. Again work-related injuries were prominent, followed by road accidents.[6]

We have compiled excellent articles with ophthalmic trauma as the theme for this special issue. This compilation echoes our commitment as a journal to reducing ophthalmic morbidity and vision loss caused by trauma in the Asia-Pacific region and around the world. From September 17 to 18 2022, Malaysia was proud to co-host the 11th COSC-APOTS Meeting in Kuala Lumpur, marked by the publication of the meeting abstracts in MyJO's joint supplement with APOTS in 2022.[4]

Articles on ophthalmic trauma commonly utilise retrospective reviews because the presentations are often sudden and unpredictable, making this type of study among the most feasible. Four articles included in this special issue report decades-long data on ophthalmic trauma. One of these is "Ten-year review of traumatic nasolacrimal duct obstruction: clinical profile, management and outcomes" by Zahar *et al.* In this article, the authors reported a retrospective analysis of 40 patients post-trauma in a single tertiary referral centre in Malaysia over a decade. The number of patients was higher than very similar studies in Turkey and India.[7,8] This article provides an important overview of post-trauma nasolacrimal duct obstruction management and outcomes in Malaysia, in which road accidents are a frequent cause as described by IGATES.[6]

Similar to findings reported in both previous studies, males were more than 3 times more commonly affected than females, with a mean age in the fourth decade. Motor vehicle accidents was the main cause of trauma (95%) and is higher than other studies (50–70%).[7,8] Similarly, the commonest presenting symptoms were epiphora and dacryocystitis, while the most common sign was telecanthus.

The authors reported 45% of naso-orbito-ethmoidal (NOE) fractures, very similar to the findings reported by Uzun *et al.* (47%).[8] Telecanthus invariably follows NOE fractures.[9] In this case series, most cases had traumatic telecanthus (70%), compared to 54% and 17% as reported by Mukherjee and Dhobekar and Uzun *et al.*, respectively.[7,8] This provides an interesting observation in a Southeast Asian heterogeneous population with more oriental facial features compared to the populations in both previous studies.

Scarring and fibrosis in cases with delayed referral makes the surgery more challenging due to altered structures, all of which contributes to failure of functional outcome and persistent tearing. Therefore, an important take-home message is that timing for traumatic NLDO repair within 6 months is imperative to achieve successful outcomes, both anatomically and functionally.

The article by Muhd Syafiq describes a 10-year review of traumatic hyphaema at a tertiary hospital on the East coast of Malaysia. Traumatic hyphaema is a common sequelae to blunt or lacerating ophthalmic injury. In this retrospective review, sports and recreational activities were the most common cause of traumatic hyphaema. Again, the authors advocate raising public awareness for protective eyewear for those pursuing such activities.

The study by Irawati *et al.* documents paediatric ophthalmic trauma cases at one of Indonesia's private tertiary eye hospitals over a decade beginning in 2012. This

study reviews the clinical presentation and predictive factors on final visual acuity, finding that trauma was most commonly sustained at home. Open-globe injuries were seen frequently and led to vision loss. Paediatric ophthalmic trauma deserves special mention. Madan *et al.* reported in 2020 that sport-related injuries were most common in their series in India, where paediatric eye injuries were a focus.[10] We look forward to sessions on paediatric ophthalmic trauma, which will be featured at the coming 5th World Congress of Paediatric Ophthalmology and Strabismus to be held in Kuala Lumpur hosted by the World Society of Paediatric Ophthalmology and Strabismus (WCPOS) and the Malaysian Society of Ophthalmology (MSO) July 11–13 2024. (https://www.wcposv2024.org).

Another article reviewing decade-long data on ophthalmic trauma is the article by Khoo *et al.*, which looks specifically at trauma cases requiring vitreoretinal surgery. Largely, these cases have more severe injuries, including both open- and closed-globe injuries, of which sport-related injuries were highlighted. This is another area of concern where blindness can be prevented through eye protection, and where legislation for mandatory protective eyewear can make a difference to the outcome in competitive sports events.

The issue also looks at specific causes of trauma such as firecracker-related eye trauma in a Malaysian town in the article by Ismail *et al.*, who report on the devastating injuries sustained to the eye and orbit from firecrackers. Firecrackers were also found to be one of 3 main causes of ophthalmic trauma in their paediatric series[10] and should be the focus of stricter legislation given that they have now been legalised in Malaysia. Meanwhile, the article by Bista *et al.* highlights cases of ophthalmic injuries in female victims of domestic abuse, a unique perspective and often overlooked cause of ophthalmic trauma.

The series by Yusri *et al.* on intraorbital foreign bodies serves as a good reminder of the great challenge in managing these cases, particularly those of organic origin that may be missed, thus resulting in orbital infections. However, those with globe involvement had the greatest impact on vision. Our local authors, Ho *et al.*, have previously reported two cases, highlighting that luck may sometimes play a role in the outcome of these conditions.[11] However, imaging is essential to the diagnosis and management.

Given the rising number of intravitreal injections that need to be administered worldwide, estimated to be over 20 million in 2016,[12] the article by Liow *et al.* is both imperative and timely given that even intravitreal injections can result in trauma, namely to the crystalline lens. This article reviews the complication rate when injections were given by medical officers, highlighting the need for structured training.

As for repair and rescue of these cases, the timing to surgical repair for cases of ophthalmic trauma during the COVID-19 pandemic is delved into by Subbiah *et al.* While the worst of the pandemic is behind us, it is worthwhile noting from this article that repair for ophthalmic trauma can be successfully conducted on time.

World Sight Day (WSD) 2024 with the theme of "Love Your Eyes at Work'' could not be a more timely occasion to publish this issue of ophthalmic trauma, given that the workplace remains the main location in which ophthalmic trauma occurs both locally and overseas.[1-4] This WSD 2024 theme will resonate with our special issue, including the need to prevent trauma at the workplace through the compulsory usage of protective and appropriate eyewear.

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Advocacy in action: preventing eye injuries in India

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Abstract

Purpose: To summarise key areas of ophthalmic trauma in India and propose prevention measures.
Study design: Descriptive review and expert opinion.
Methods: Key data presented by members and office bearers of the Ocular Trauma Society of India (OTSI), All India Ophthalmological Society, and Asia-Pacific Ophthalmic Trauma Society (APOTS) at a meeting of the National Human Rights Commission India on September 21, 2022 are summarised in this review. To study the incidence of eye injuries in India, the International Globe and Adnexal Trauma Epidemiology Study (IGATES) registry (a global web-based database platform for ophthalmic trauma developed by APOTS in collaboration with OTSI) was employed. IGATES makes use of cloud computing to collect and store data regarding ocular trauma worldwide.
Results: Eye injuries remain the leading cause of preventable monocular vision loss in India. In this study, 2,528 Indian patients presented with ocular trauma, 1,980 of which (78.3%) were males and 548 were females (21.7%). The mean age of the patients was 31.1 ± 17.4 years. Of all the cases, 281 (11.2%) were due to road traffic accidents (RTA), 70 (2.77%) were chemical injuries, and 43 (1.70%) were fireworks-re-

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lated. There is an association between the use of eye protection and final best corrected visual acuity ($p = 0.04$). In light of this, several strategies are suggested to prevent the incidence or reduce the severity of eye injuries.
Conclusion: Given the high prevalence of RTA-related cases and the wide use of fireworks in many festive celebrations such as Diwali, it is paramount to look into ways to reduce the incidence of such injuries.

Keywords: eye injury, India, injury prevention, vision loss

Tindakan advokasi: pencegahan kecederaan mata di India

Abstrak

Tujuan: bagi merumuskan bidang utama dalam trauma oftalmik dan mencadangkan langkah-langkah pencegahan.
Bentuk kajian: Ulasan deskriptif dan pendapat pakar.
Keputusan: Kecederaan mata masih menjadi penyebab utama kehilangan penglihatan monocular yang boleh dicegah. Dalam kajian ini, seramai 2,528 pesakit dari negara India terlibat dalam trauma ocular, 1,980 (78.3%) adalah lelaki dan 548 (21.7%) adalah perempuan. Umur purata mereka adalah 31.1 ± 17.4 tahun. Dari keseluruhan kes ini, 281 (11.2%) adalah akibat dari kemalangan jalan raya (RTA), 70 (2.77%) adalah kecedaraan akibat bahan kimia dan 43 (1.70%) adalah disebabkan kecederaan akibat mercun. Terdapat hubungkait yang signifikan diantara penggunaan pelindung mata dan ketajaman penglihatan selepas rawatan ($p = 0.04$). Berdasarkan dapatan ini, beberapa strategi telah dicadangkan bagi mengurangkan insiden dan juga keterukkan kecederaan mata di India.
Kesimpulan: Dengan kecederaan mata yang tinggi akibat RTA dan penggunaan mercun secara meluas terutama semasa musim perayaan seperti Diwali adalah amat disarankan supaya langkah terbaik diperincikan bagi mengurangkan insiden kecederaan mata.

Kata kunci: kecederaan mata, kehilangan penglihatan, India, pencegahan kecederaan

Introduction

Eye injuries in India remain a leading cause of monocular vision loss and result in significant social, economic, psychological, and personal consequences.[1-3] The Ocular Trauma Society of India (OTSI), chaired by Dr. Ashok Grover, and its members have made significant progress in understanding the causes of these injuries and improving management and access to care across India. The OTSI along with the Asia-Pacific Ophthalmic Trauma society (APOTS) are significant contributors to the activities in research, advocacy, and education in the field of ophthalmic trauma.

The social, economic, and psychological impact on the victims and their families is significant.[2-7] The primary causes of eye injuries in India include road accidents, sports and recreation, occupation related, domestic accidents, and games such as "tir-kamaan", bow and arrows, and "gulli-danda". The global burden of eye injury internationally is significant, with 6 million blind, 2.3 million visually impaired bilaterally, and 1.9 million having unilateral vision loss.[8]

The eyes are an important part of overall health. With 7% of all injuries affecting eyes, this emphasises the scale of the problem. Further, 5% of blind deaths are due to an eye injury, acknowledging that it is also a preventable cause of death. Ocular trauma impacts not only physical and mental health, but employment and livelihood. A regulatory framework with a pragmatic approach is needed.

At least 5% of Indians have ocular trauma at least once in their lifetime and 55% of the victims are below the age of 25 years. In 2008, the prevalence of eye injury in Delhi was 2.4%, and out of these, 11.4% were blind. Paediatric ocular trauma presents specific challenges, such as difficulty in assessment of visual acuity, amblyopia, and comorbidities, amongst others.

Up to 90% of eye injuries are preventable; thus, strategies for avoidance are critical.[9] On September 21, 2022, office bearers and members of OTSI, APOTS, and the All India Ophthalmological Society (AIOS) attended a meeting with the National Human Rights Commission of India (NHRC) to discuss modalities to prevent, minimise, and mitigate ophthalmic trauma in India. The meeting was chaired by NHRC's Justice Shri Arun Mishra, Honorable Chairperson, and was attended by all members of the NHRC and the joint secretary Shri H.C. Chaudhary. The aim of is this paper is to summarise the discussions and outcomes from the meeting, which served to highlight the impact of ocular trauma and provide an action plan for prevention in India.

Methods

Representatives from AIOS, OTSI, and APOTS gave commentary on the scale of eye injuries in India, supported in particular by the data of the International Globe and Adnexal Trauma Epidemiological Study (IGATES). The methods associated with IGATES have been published.[10] IGATES (www.igates.ocular trauma.com) has undertaken effective data collection through their web-based encrypted uniform platform. [4,11-13]

Results

A total of 2,527 eye injuries were identified from 15 sites in India. The distribution of eye injuries by age demonstrated 2 peak age groups for ophthalmic trauma, 2–30 and 30–40 years of age (23.7% and 23.3%, respectively). The majority of injuries occurred in the home (51.2%), with the workplace (20.8%) and then road traffic accidents (11.6%) the next largest contributors. Sharp (41.3%) and blunt (42.3%) were the leading mechanisms of injury, and metal (30.2%) and other (30.0%) the leading objects of injury.

A total of 30 patients were identified to be wearing some form of eye protection at the time of injury, which included safety spectacles (43.2%) as well as helmets and goggles (26.7% each). A total of 761 injuries were open globe injuries, with 606 (79.3%) of these resulting in best-corrected visual acuity (BCVA) of < 6/60. From a total of 1,433 closed globe injuries, 251 (17.5%) had a BCVA of < 6/60.

Discussion

Implementation requires a multidimensional approach that should include:

- Education and awareness at primary, secondary, and tertiary level of formal education.
- Regular updating of safety guidelines.
- Regular public outreach awareness programs via media such as television, radio, social media, and print.
- Warnings on chemicals.
- Proper packaging, moderate use, or ban on firecrackers.
- Higher road safety compliance,
- Availability and accessibility to early and appropriate treatment.

Every year 3% GDP is lost due to ocular trauma. This loss of vision not only affects the individual but leads to the cost of the need of rehabilitation, impacts their education and employability, loss of livelihood, social and economic impact on the family and larger community, and the emotional impact of suffering from mental

illnesses such as depression and stress.

Accurate data plays an important role in the development of prevention strategies for agencies, such as the National Programme for Control of Blindness and Visual Impairment (NPCBVI), ministries, institutions/hospitals, and community ophthalmology departments. The use of an eye injury prevention model comprising the 5 steps of Elimination, Substitution, Engineering Controls, Administration Controls, and Personal Protective Equipment, as well as the role of education, standards, policies, laws, and rules are all important elements in eye injury prevention.

Chemical agents are one of the most prevalent causes of eye injury in India, including from bursting firecrackers. Awareness from policymakers to teachers and children is key to prevention. Campaigns about safe packaging, safe handling of chemicals, and prevention of chemical injuries in the workplace must be initiated to educate policymakers, factory owners, teachers, and children to prevent chemical injuries. Regulatory measures such as double packaging of household chemicals, *e.g.*, Chuna lime and bleaching agents, should be developed in order to prevent chemical injuries. A checklist containing the 'dos' and don'ts' relating to the use of chemicals could be developed in order to successfully prevent eye injuries. Teaching awareness regarding the lethal effects of chemicals can be a first step, followed by a framework and measures for safety.

Standards for eye protection in occupational environments should be formulated and enforced, along with ensuring accessibility of personal protective equipment for workers. Social media can be utilized to disseminate information pertaining to prevention of ocular trauma, with a National Trauma Day around an appropriate theme every year to educate and create awareness on prevention and management of ocular trauma. The formation of an expert group to formulate standardised guidelines for management of ophthalmic trauma must be considered.

Road traffic accidents on highways account for 40% and the total loss of Indian GDP due to road accidents is 3%. It is important to address the gaps in regulations, mandatory vision certificates, and continuous review of passenger transport safety rules. A multipronged strategy should be adopted in order to combat ocular trauma by prioritising road safety and strict enforcement of laws and regulations, along with infrastructure and access to quality emergency care. Road accidents caused by drivers being either colourblind or having uncorrected visual acuity, sometimes even to the extent of monocular individuals driving, have been a significant factor. Equal importance to educational awareness, the need for sunglasses or protective glasses to protect the eyes from UV rays while driving, and wearing helmets and seatbelts in our respective vehicles should be highlighted.

Another common cause of ocular injuries in India is from industry**.** A program to successfully prevent such ocular injuries through raising awareness is needed. Meaningful slogans and QR codes containing key information and prevention measures could be employed. Eye protection should be readily accessible in industrial settings.

The eye-threatening and devastating nature of warfare has led to recommendation of deploying the National Disaster Response Force and emergency medical units in all vulnerable districts.

Agriculture-related eye injuries are often associated with environmental pollution, extreme temperatures, grinding work, and hammer work, amongst others. As per statistics, ocular foreign bodies account for the highest percentage of incidences in farming and rice-grain injuries account for the second highest percentage of incidences. Experts suggested avoiding facial exposure before opening containers or spraying chemicals such as pesticides and fertilisers. In addition to this, experts recommended careful handling of sharp instruments, frequent hand washing, and enhancing public awareness.

One of the key concerns identified is the delay in treatment due to a lack of ophthalmologists in many settings. An IGATES scorecard that can be made available in every clinic could be adopted as an efficient practice for diagnosing and treating eye injuries. A memorandum of understanding for the use of IGATES as a national database platform for ocular trauma has been signed with the AIOS and the OTSI.

Conclusion

Eye injuries are preventable causes of blindness with a potential to cause profoundly negative social, psychological, and economic impact to the various stakeholders. In India, chemical injuries, road traffic accident-related injuries, and fireworks-related eye injuries are commonplace. With the implementation of suitable strategies, a positive impact can be reaped by individuals, their families, and society at large.

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Appendix 1

Ocular trauma: measures to prevent, minimise, and mitigate its effects

1. Better implementation strategies and practices at primary, secondary and tertiary level that should include intervention in commonly identified places of injuries. Posting of Ocular Trauma Treatment Centres in the industrial areas and a better equipped 24-hour service of an ophthalmologist for emergency cases.
2. Paid low-vision development. The educational reservation and other reservations for blind individuals and those with low vision should be done and various government schemes must be devised in their favour. In order to gather data, help from the ICDS workers and teachers may be taken. Training programs for low-vision people.
3. Ministry of Labour and Employment emphasized that measures should be taken by people in the immediate vicinity to prevent the irreversible damage of the trauma from happening. Putting up screens with videos being played on loop in the hazardous locations so that people can see the course of action that has to be taken in case of an accident. Training to non-ophthalmologists should also be given on how to take care and what to do in preliminary stage in the situation of ocular trauma so that the basic care is provided to the victim/patient immediately.
4. The National Highway Authorities of India (NHAI) was set up in 1995 by the Act of Parliament and made functional in 1996. The main work of NHAI is maintenance of the NHAI network. NHAI is also responsible for construction of 2 to 4 lanes, reduce accidents, improve highway roads (short term and long term), construct over bridges, and traffic management, among others. Three days of eye testing camp was organized by NHAI in which several stakeholders such as NGOs and social entrepreneurs participated. In this camp, education and promotion was done regarding wearing of helmets, proper eye wear, seat belts, and reacting to hazards.
5. Loss of care in the 'golden hour' leads to preventable and non-preventable problems. Thus, time is extremely crucial in such cases and 24-hour emergency services should be set up to address such cases. Spreading awareness amongst the public about the need to go to a specialist and not a general physician in case of worry is extremely important. Regulatory mechanisms to prevent firecracker injuries by educating people not to use firecrackers in the crowded and residential areas.
6. The Confederation of Indian Industry (CII) drew attention towards the efforts of CII in this direction and highlighted the requirement of aid of other ministries and laid emphasis on dissemination of information. Further, the CII highlighted the multi-stakeholder initiative to tackle public health by Rd. Ran Deep Gulleria, Chairman, CII, Public Health Council and Director, All

India Institute of Medical Sciences. The CII recommended the need to reach out to children primarily in order to sensitise them as they are the carriers of information to their family. This will result in spreading awareness amongst people regarding ocular trauma.

7. Corporate social responsibility funds with companies which can be requested to be utilized towards helping this cause.

Appendix 2

Ocular trauma: key prevention recommendations

i. A standardised proforma or online registry to register all cases of ocular trauma.
ii. A regulatory authority or a regulatory framework for risk factor identification of firecrackers, especially in terms of quality and safety for the public.
iii. Regulations with respect to safe dual packaging for use of household chemicals, as well as risk management and safety norms at workplace must be formulated in order to prevent chemical injuries from *chuna* packets.
iv. Personal protective equipment must be made available to workers, sportspersons, and drivers at risk.
v. Low-cost eye protection such as goggles, spectacles, face shields, and helmets as well as proper washing areas must be ensured for industrial workers.
vi. Access to quality emergency care for ocular trauma must be ensured.
vii. Awareness campaigns such as slogans and QR code for information.
viii. Re-emphasising public education through media, including social media.
ix. Providing specialized fellowships on ocular trauma to train medical students.
x. Road safety measures must be strictly enforced. Safety standardisation certificate along with the driving license may be issued. Regular eye check-ups, *e.g.*, after every 2 years must be made mandatory for all driving license holders.
xi. Training to non-ophthalmologists regarding first aid in cases of ocular trauma must also be given so that the basic care is provided to the victim/patient immediately.
xii. Ocular Trauma Treatment Centres in industrial areas may be established with a 24-hour service of an ophthalmologist for emergency cases.
xiii. Assistive technology for rehabilitation and public education.
xiv. Adjustment training programmes for low-vision individuals must be made mandatory.
xv. Inclusive as well as special schools for low-vision individuals may also be developed along with schools for the blind and/or visually impaired.

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Ten-year review of traumatic nasolacrimal duct obstruction: clinical profile, management, and outcomes

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Abstract

Purpose: To evaluate the clinical profile, management, and outcome in cases of traumatic nasolacrimal duct obstruction (NLDO).
Methods: Retrospective analysis of 40 patients during a 10-year period in one of oculoplastic centre in Malaysia.
Results: Forty patients were included in this study, in which 31 patients were male (77.5%) and 9 were female (22.5%). Age ranged from 19 to 72 years, with a mean of 36.7 years of age. The most common aetiology was motor vehicle accident, accounting for 95%, while the remaining 5% was due to blunt trauma. A total of 32 patients underwent external dacryocystorhinostomy (DCR) with bicanaliculi intubation, 6 patients underwent DCR and another 2 were planned for external DCR but abandoned intraoperatively due to the presence of extensive scar tissue involving lacrimal sac and severe disruption of anatomical site. The surgical outcomes, anatomical success seen in 87% (n = 28) of cases. However anatomical success can be divided into anatomical and functional success seen in 82% (n = 26), while anatomical success with functional failure seen in 5% (n = 2) of cases.
Conclusion: The majority of traumatic NLDO occurred in males who were involved in motor vehicle accidents. External DCR with bicanalicular intubation provided anatomical and functional success of 82% in cases of traumatic NLDO.

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Keywords: bicanalicular intubation, epiphora, external dacryocystorhinostomy, traumatic nasolacrimal duct obstruction

Semakan sepuluh tahun kes penyumbatan saluran nasolacrimal akibat trauma: profil, pengurusan dan hasilan klinikal

Abstrak

Objektif: Menilai profil, pengurusan dan hasilan klinikal dalam kes penyumbatan saluran nasolacrimal akibat trauma.
Kaedah: Kaedah kajian retrospektif ke atas 40 orang pesakit selama 10 tahun di hospital utama memberi perkhidmatan okuloplastik di Malaysia.
Keputusan: Seramai 40 orang pesakit, di mana 31 pesakit adalah lelaki (77.5%) dan 9 perempuan (22.5%). Julat umur dari 17–72 tahun, purata umur 36.7. Punca utama adalah kemalangan melibatkan 95%, baki 5% adalah disebabkan trauma akibat objek tumpul. Seramai 32 pesakit menjalani pembedahan dakriosistorinostomi luaran dengan intubasi kedua-dua kanalikuli, 6 pesakit menjalani dakriosistektomi dan baki 2 pesakit dirancang untuk pembedahan namun di hentikan semasa pembedahan kerana parut yang besar melibatkan kantung lakrimal dan kerosakan teruk kawasan tersebut. Hasil pembedahan menunjukkan 87% berjaya secara anatomi. Kejayaan anatomi dibahagikan kepada kejayaan dan kegagalan fungsian, di mana kejayaan anatomi dan fungsian adalah 82%, manakala kegagalan fungsian melibatkan 5%.
Kesimpulan: Kebanyakan kes penyumbatan salur lakrimal akibat trauma melibatkan kaum lelaki yang terlibat dengan kemalangan. Pembedahan dakriosistorinostomi luaran dengan intubasi kedua-dua kanalikuli menghasilkan kejayaan anatomi dan fungsian dalam 82% kes penyumbatan salur lakrimal akibat trauma.

Kata kunci: dakriosistorinostomi luaran dengan intubasi kedua-dua kanalikuli,epifora, penyumbatan salur lakrimal akibat trauma

Introduction

Traumatic nasolacrimal duct obstruction (NLDO) is one of the causes of secondary nasolacrimal duct obstruction. Traumatic NLDO causes can be divided into iatrogenic and non-iatrogenic. Iatrogenic causes include injury during lacrimal probing, rhinoplastic surgeries, and any orbital and craniofacial procedures. Non-iatrogenic causes are mainly due trauma, especially motor vehicle accidents, which result in naso-orbital-ethmoidal (NOE) fracture.[1] NOE fracture is an important cause of traumatic NLDO.[1,2] Management of traumatic NLDO can be challenging, as the nasolacrimal anatomy is altered following trauma and fracture. Given that presence of oedema and fibrosis post-trauma may affect surgery outcomes, proper assessment should be done after resolution of oedema and soft tissue injuries. The aim of this study is to evaluate the clinical profile, management, and outcomes for post-traumatic NLDO in a main oculoplastic centre in Malaysia.

Methods

This retrospective study reviewed the medical records of 40 patients with post-traumatic NLDO managed at Hospital Serdang, one of the main oculoplastic centres in Malaysia. The study period encompassed 10 years from January 2011 to December 2020.

All patients who presented with persistent post-traumatic epiphora 3-6 months after initial trauma to Hospital Sedang during the study period were included in the study. Exclusion criteria were persistent epiphora secondary to primary NLDO including inflammation, tumour, or other causes of secondary NLDO.

The medical records were reviewed for a detailed history of duration of symptoms, mode of injury, and primary surgical repair. Assessment included lacrimal syringing to evaluate the patency of the nasolacrimal duct, where presence of regurgitation or any reflux during syringing was observed. Computed tomography (CT) scans of the brain, orbit and paranasal sinuses were reviewed to view the anatomical structure post-trauma and to identify the presence of any screws or plates used during primary surgical repair post-trauma.

Of the 40 patients included, 32 patients underwent external DCR with bicanaliculi intubation, 6 patients underwent dacryocystectomy, and surgery could not be completed in 2 patients due to intraoperative complications. All patients underwent surgery under general anaesthesia performed by 4 senior oculoplastic surgeons in Hospital Serdang. All patients who underwent external DCR had bicanaliculi intubation with a Crawford stent, as well as anterior and posterior flaps created and sutured. All patients were given antibiotics postoperatively. Postoperative follow-up was conducted at 2 weeks, 3 months, and 6 months. Syringing and stent removal was performed at 3–6 months. At each follow-up visit, patients

were questioned about symptoms of epiphora and discharge. Syringing was also performed postoperatively with normal saline irrigation of the lacrimal pathway to check the patency of the rhinostomy site.

The patency of the nasolacrimal duct pathway was defined as anatomically successful if syringing was patent and the patient was able to feel the presence of fluid in their throat. However, anatomical success was further categorised into those with functional success and functional failure. Anatomical success with functional success is defined by patent lacrimal syringing and no more symptoms. Anatomical success with functional failure is defined by patent lacrimal syringing but persisting symptoms, such as epiphora.

Results

A total of 40 patients were included in this study, of which 31 (77.5%) were male and 9 (22.5%) were female. The mean age of the patients was 36.7 years within a range from 16 to 72 years old. The main presenting complaints were epiphora 65% (n = 26), dacryocystitis 30% (n = 12), and medial canthal swelling 5% (n = 2). Patients with dacryocystitis mainly presented with recurrent dacryocystitis requiring antibiotics. The most common ocular feature was traumatic telecanthus, found in 70% of patients. Others presented with only scarring due to previous lacerations in the naso-orbital region. Thirty patients (75%) had intact both upper and lower canaliculi post-trauma. The remaining 10 patients (25%) had either one of the canaliculi blocked due to severe scarring.

Motor vehicle accident accounted for injuries in 38 patients (95%). The remaining 2 patients (5%) had injuries due to blunt trauma, which included work-related injuries involving hit by hammer and fish bomb injury causing panfacial fractures. Most patients underwent primary surgical repair at their respective hospitals, including laceration wound repair and maxillofacial fracture repair by the maxillofacial team, before they were referred to our centre. Table 1 presents the pattern of injuries.

Table 1. Pattern of injuries

Pattern on injury	Number of cases (%)
Pure NOE	14 (35%)
NOE with panfacial fractures	18 (45%)
Le Fort 3	3 (8%)
Le Fort 2	5 (12%)

NOE: naso-orbital-ethmoidal fracture

All 40 patients underwent surgical intervention. Thirty-two (80%) patients underwent external DCR with bicanaliculi intubation, 6 (15%) underwent dacryocystectomy (of which 4 had sac injury and 2 had mucocele), and surgery could not be completed in 2 patients (5%) due to intraoperative complications. Intraoperative complications included presence of extensive fibrosis and presence of plates obscuring surgical site. All surgeries were performed within 5 years of the initial trauma.

The surgical outcomes were calculated from those who underwent external DCR with bicanaliculi intubation, in which anatomical success was seen in 20 cases (87%). Anatomical success was further divided into anatomical and functional success, achieved in 26 patients (82%), and anatomical success with functional failure, seen in 2 (5%) cases.

The surgical outcomes of 6 patients underwent dacryocystectomy showed 5 patients (83%) with anatomical and functional success with no more tearing post-procedure, while 1 patient still complained of tearing. This patient was planned for revision of dacryocystectomy but later defaulted follow-up.

Discussion

In our study, the majority of patients who presented with post-traumatic NLDO were males involved in motor vehicle accidents. The predominant injury was NOE fracture with panfacial fractures. NOE fracture is an important cause of nasolacrimal duct obstruction.[1,2] As previously reported in other studies, post-traumatic NLDO can be observed in 5–21% of NOE trauma cases due to direct injury to the lacrimal sac and nasolacrimal duct or canaliculi.[2-4] Bony fractures also initiate an inflammatory and cicatricial reaction that leads to stenosis of the nasolacrimal duct. The distorted anatomy in the region as a result of traumatic fractures also contributes to stenosis, leading to epiphora and other symptoms.

The success rate of external DCR with bicanaliculi intubation in our study is comparable to those found in other studies, which range from 90% to 96%.[2,3,5,6] Challenges in managing traumatic NLDO include extensive fibrosis and severe anatomical disruption. Presence of screws and plates used by maxillofacial team to reconstruct the anatomical structure also may hinder the surgical site thus lead to failure of surgery.

One strategy used in our centre for managing traumatic NLDO is employing a larger incision during DCR for adequate exposure.[2,7] However, caution is advised to prevent injury to surrounding structures, including the angular vessel and cribiform fossa, which may lead to cerebrospinal fluid leak. Another strategy involves larger rhinostomies_of at least 12 mm to avoid scar formation at the osteotomy site,[8-11] provided there are no screws or plates that might interfere with the surgical site.

In our study, 2 cases achieved anatomical success but with functional failure, still presenting with persistent epiphora post-external DCR. Both cases had patent lacrimal syringing during follow-up. This might have been due to dry eyes and eyelid abnormalities, including ectropion and post wound laceration scarring.

In addition to external DCR, patients underwent dacryocystectomy with complete removal of the lacrimal sac. Of these 6 patients, 5 (83%) had anatomical and functional success with no more tearing post-procedure. The remaining patient still complained of epiphora during follow-up. He was planned for revision of dacryocystectomy but later defaulted. These patients underwent dacrycystectomy instead of DCR due to the presence of multiple bony fractures with screw and plates causing difficulty for the surgeon to perform DCR.

Presence of oedema and fibrosis post-trauma may affect surgery outcomes; thus, proper assessment should be conducted 1 to 3 months after the initial trauma, when oedema and soft tissue injuries have resolved, permitting a more accurate evaluation.[1] A study by Adenis *et al.* suggested surgery should be performed 6 months post-trauma due to risk of increased fibrosis. This study showed that success rate increased from 66% to 100% if done after 6 months.[12]

CT scans of the brain, orbit, and paranasal sinuses are highly suggested before surgical intervention to view the anatomical structures post-trauma, which may reveal orbital rim or maxillary fractures compressing the sac or duct.[13,14] CT scans can also identify the presence of any screws or plates used during primary surgical repair.

The main limitations of the present study were its retrospective nature and the fact that it was conducted in a single centre. There was no long-term data available, as patients usually were referred to their own hospital after surgery. Further research may benefit from conducting a multicentre, prospective study with longer follow-up duration to evaluate long-term surgical outcomes.

Conclusion

Most cases of traumatic NLDO in our study occurred among adult males involved in motor vehicle accidents. NOE fracture was the most common fracture seen in traumatic NLDO. External DCR with bicanaliculi intubation is the surgery of choice, although in certain cases dacryocystectomy may be necessary.

Declarations

Ethics approval and consent to participate
Not required, as this was a retrospective review of medical records.

Competing interests
None to declare.

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Ophthalmic injuries in female victims of domestic abuse

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Abstract

Purpose: Ophthalmic injuries in female victims of domestic abuse are not uncommon but are often underreported. The purpose of this study is to examine the occurrence of ophthalmic injuries in such battered women and note the pattern of injuries. We also aim to raise awareness among ophthalmologists that these injuries are more common than one might think and frequently go undetected.
Study design: Prospective cohort study.
Methods: A prospective cohort study of all ophthalmic injuries in female victims of domestic abuse was conducted in Geta Eye Hospital (Dhangadhi, Nepal) from April 2021 to September 2021 for a period of 6 months. Visual acuity, age, level of education, mechanism of trauma, ophthalmic findings, and Ocular Trauma Score were documented. Other physical injuries, past history of abuse, and denial of gender-based violence were also included. The data were collected via a questionnaire and exported to an Excel sheet. Analysis was performed using mean and standard deviation.
Results: The study included a total of 15 women with ages ranging from 22 to 58 years. Ocular findings of subconjunctival haemorrhage and ecchymosis were present in all cases; 1 case had lens dislocation, lid laceration was present in 1 case, commotio retinae, and hyphaema were present in 2 cases each. The ocular trauma score was 100 in 66.7 % cases. Sixty percent of the victims had a lower level of education than their male partners. History of similar abuse was present in 4 cases (26.7%). The abuser was under the influence of alcohol in 6 cases (40%).
Conclusion: Domestic violence can lead to serious ocular injuries. Considering that ophthalmologists frequently encounter such cases as primary caregivers, it is

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imperative to uphold a heightened level of vigilance. Our research findings indicate the recurrence of an abusive past, suggesting that ophthalmologists cannot only address eye injuries but also guide individuals toward a safer life.

Keywords: domestic violence, intimate partner violence, gender equality, Ocular Trauma Score, ophthalmic trauma

Kecederaan oftalmik di kalangan wanita yang menjadi mangsa keganasan rumahtangga

Abstrak

Tujuan: Kecederaan oftalmik di kalangan wanita yang menjadi mangsa keganasan rumahtangga bukan sesuatu yang jarang terjadi tetapi seringkali kurang dilapurkan. Tujuan utama kajian ini dijalankan adalah bagi melaporkan kadar kejadian dan mengenalpasti corak kecederaan pada mangsa keganasan rumahtangga serta memberi kesedaran kepada pakar oftalmologi bahawa kecederaan ini bukan suatu yang jarang berlaku walaupun sering diketepikan.
Bentuk kajian: Kajian prospektif kohot.
Kaedah kajian: Kajian ini melibatkan wanita mangsa keganasan rumahtangga semua yang mendapat kecederaan oftalmik di Hospital Mata Geta (Dhangadhi, Nepal) selama 6 bulan dari April 2021 sehingga September 2021. Ketajaman penglihatan, umur, tahap pendidikan, mekanisma kecederaan, kecederaan oftalmik dan skor trauma okular telah didokumentasikan. Selain dari itu trauma fizikal yang lain, sejarah keganasan rumahtangga yang lampau, dan penafian tentang keganasan terhadap jantina tertentu telah dijalankan melalui satu soalselidik. Hasil kajian telah dianalisakan secara pengiraan min dan sisihan piawai.
Hasil kajian: Seramai 15 wanita mangsa keganasan rumahtangga berumur di antara 22 dan 58 tahun terlibat dalam kajian ini. Pendarahan subkonjuktiva dan ekimosis di dapati pada semua mangsa, satu kes kanta terkehel, satu kes kelopak mata yang robek, dua kes commotio retinae dan dua kes pendarahan dalam mata dilaporkan. Sebanyak 66.7% telah mencapai 100 bagi skor trauma okular. Sebanyak 60% dari mangsa mempunyai tahap pendidikan lebih rendah dari pendera. Sejarah penderaan yang berulang dikenalpasti dalam 4 kes (26.7%). Enam kes melibatkan penderaan dalam keadaan mabuk.
Kesimpulan: Keganasan rumahtangga boleh menyebabkan trauma oftalmik yang teruk. Memandangkan pakar oftalmologi sebagai pemberi jagaan kesihatan primer sering menghadapi kes sebegini, adalah mustahak bagi mereka meningkatkan kewaspadaan mereka. Berdasarkan kajian, kadar yang tinggi keganasan

rumahtangga yang berulang, mereka bukan hanya merawat kecederaan mata tapi membantu dalam memastikan keselamatan mangsa.

Kata kunci: keganasan pasangan intim, keganasan rumahtangga, ketidaksamaan jantina, skor trauma okular, trauma oftalmik

Introduction

Violence is defined by the World Health Organization as "the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation".[1] Domestic violence is regarded as a public health problem of greater concern worldwide, especially in developing countries.[2]

This problem is not localized to a particular area or a group of people and is present worldwide.[3] Worldwide, one-third to three-quarters of women have been physically or sexually abused in their lifetime.[1] Domestic violence can take different forms with different negative outcomes including physical injuries, reproductive health issues, mental health issues, disability and even death.[4] Compared to non-abused women, abused women sustain injuries that require surgery by 2 to 3 times.[4] The impact of psychological trauma is high and suicidal rates are higher in female having history of abuse.[2]

Intimate partner violence is an important cause of death and maternal mortality in many Southeast Asian countries. Despite these mental and physical health consequences, one–fifth of victimised women do not report episodes of violence. Of the many abused, a few with some health issues can present to hospital for treatment, representing only the tip of an iceberg. Studies have found that women who experience violence learn to accept or rationalise the abuse. Therefore, a substantial number of abuse cases go unrecognized by the primary care physician due to lack of awareness.[3]

According to a study in Nepal by Lamichhane *et al.*, half of married women in Nepal experienced some sort of physical or sexual violence.[5] Head and neck injuries as well as ophthalmic injuries are common among the physical injuries associated with domestic violence. [6-8] Given that women tend to hide domestic abuse, ophthalmic injuries due to domestic violence are common but often go unrecognized in emergency departments. Therefore, ophthalmologists should be highly suspicious if the pattern of injury does not match the history given by the patient.

To date, no reports of ophthalmic injuries related to intimate partner violence have been reported in Nepal. Therefore, the aim of this study was to identify the occurrence of ophthalmic injuries related to intimate partner violence in our centre as well as the factors associated with it.

Methods

This was a prospective cohort study done in Geta Eye Hospital from April 2021 to September 2021 for a period of 6 months. All cases of ophthalmic trauma in women were further questioned about the cause. Among them, all the women who presented as ophthalmic trauma and confirmed the cause being domestic violence by intimate partner were included in the study. Women presenting with ophthalmic trauma due to other causes and those who did not consent to participate were excluded from the study. Ethical approval was obtained from the hospital and informed written consent was obtained from all the patients.

Women who agreed to participate in the study were interviewed alone using a predetermined questionnaire. Visual acuity, age, level of education, employment, mechanism of trauma, and ocular findings on ocular examination were noted. Both partners were asked about educational level, and compared as being equal, higher, or lower. Women were also asked if they had a source of independent income. Mechanism of injuries included were fists, hand and feet, and other objects. Presence of alcohol or drug abuse as well as previous history of similar abuse were noted. Variation in history stating domestic violence being the cause of trauma was also noted. Other physical injuries were ruled out by general examination. If there were other physical injuries, the patient was referred to a trauma surgeon and counselled for psychiatry consultation in a general hospital.

After proper management of the patient, all cases were also counselled and advised to take legal action if they wished. The number of cases that took further legal action was also noted. Further wellbeing of the patient was confirmed via telephone and ophthalmic examination was performed on review follow-up at 6 weeks. The data obtained was entered in Microsoft Excel 2010 and results were computed in mean and standard deviation.

Results

Fifteen cases who confirmed domestic violence by intimate partner were involved in the study, with an age ranging from 22 to 58 years and a mean age of 32.2 years. All the cases involved married women where the husband was the party responsible for inflicting the injuries.

Table 1 presents the mechanisms of injury, for which 12 were inflicted by body parts and 3 by external. Fist injuries caused echymosis in all 8 cases and commotio retinae in 1 case. Seven cases (46.7%) had soft tissue injuries in parts of the body other than the face and were therefore referred to trauma specialists for further treatment. There was 1 case of deep skin laceration caused by knife which required primary repair.

Table 1. Mechanisms of injury

Mechanism of injury	**Cases, *N* (%)**
Fists	8 (53.3%)
Body parts (hands, feet)	4 (26.7%)
Wooden plank	2 (13.33%)
Knife	1 (6.7%)

Table 2. Educational level and employment status

Educational level	Lower than husband	9 (60%)
	Higher than husband	5 (33.3%)
	Similar to husband	1 (6.7%)
Employment	Housewife Daily wage worker Government officer	11 (73.3%) 3 (20%) 1 (6.7%)

Table 3. Ophthalmic examination findings

Ophthalmic examination findings	**Patients, *N* (%)**
Subconjunctival haemorrhage	15 (100%)
Echymosis	15 (100%)
Hyphaema	2 (13.33%)
Commotio retinae	2 (13.3%)
Lid laceration	1 (6.7%)
Lens dislocation	1 (6.7%)

Table 2 presents the distribution of educational level and employment status among cases. Despite the level of education, 11 (73.3%) cases did not work in paid employment outside the home and were financially dependent on their partner.

Table 3 presents the ophthalmic examination findings. Subconjunctival haemorrhage and ecchymosis were present in all 15 cases, respectively. Lid laceration was found in 1 case, commotio retinae and hyphaema (Fig. 1) were found in 2 cases, respectively, and lens dislocation in 1 case (Fig. 2). The Ocular Trauma Score (OTS) is presented in Table 4.

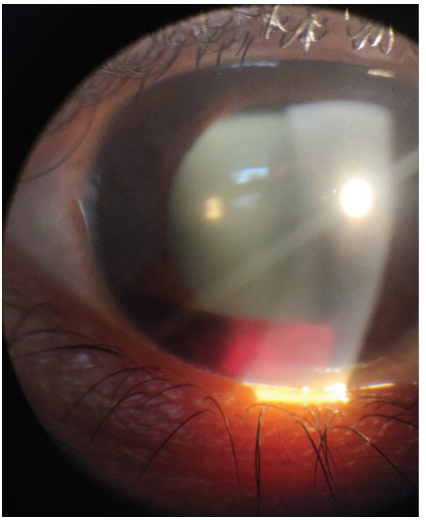

Fig 1. Traumatic hyphaema.

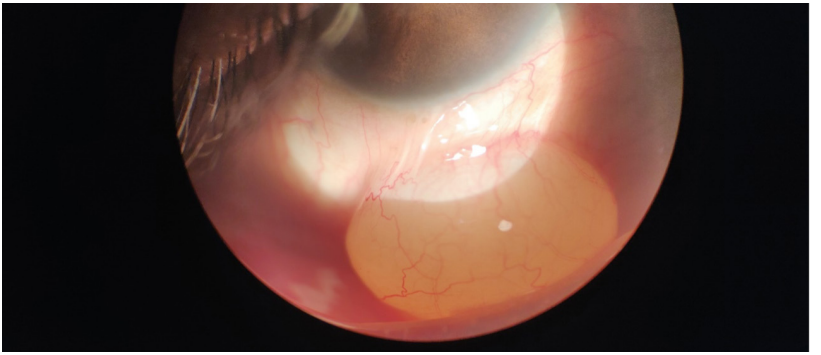

Fig 2. Traumatic dislocation of the lens.

Table 4. Ocular Trauma Score

Ocular Trauma Score	**Cases, *N* (%)**
100	10 (66.7%)
90	4 (26.7%)
70	1 (6.7%)

Table 5. Best-corrected visual acuity at presentation and follow-up

Best-corrected visual acuity	**Presentation *N* (%)**	**6 weeks follow up *N* (%)**
> 6/18	10 (66.7%)	14 (93.3%)
< 6/18-6/60	4 (26.7%)	0
< 6/60-3/60	0	1 (6.7%)
< 3/60 to light perception	1 (6.7%)	0
No light perception	0	0

Best-corrected visual acuity at presentation and follow-up is shown in Table 5. At the 6-week follow-up, BCVA improved for 93.3% of cases to > 6/18. One case with lens dislocation had BCVA of hand movement which improved to 4/60 at the 6-week follow-up. Two cases were admitted and received surgical intervention, with 1 undergoing treatment for a skin laceration and the other for a lens dislocation. The remaining cases were managed conservatively and treated as outpatients.

History of similar abuse was present in 4 cases (26.7%), which had not been previously reported. These cases did not present with any chronic ocular changes related to trauma. Even though all cases confirmed being abused, only 2 women (13.3%) took legal action. All these cases that took legal action had history of past abuse. Eight cases (53.3%) complained of ocular injuries due to violence by intimate partners at the time of presentation. The remaining 7 cases (46.7%) gave accounts other than domestic violence as the cause of trauma and only on further interview and counselling they admitted the cause being intimate partner violence. Nearly half of the participants did not acknowledge their abuse, highlighting the importance of our obligation to be vigilant in such cases. Alcohol was a major factor in initiating violent episodes, as 40% of the time the perpetrator had been under the influence of alcohol. None of the patients had history of any substance abuse.

Discussion

Intimate partner violence is prevalent all around the world.[1,2] The rate of such injuries presenting in emergency departments is also high. Since head and neck injuries are also common, ophthalmologists can be the first to recognise these cases. In our study, the number of cases observed in only 6 months in a single centre is substantial. Therefore, emergency physicians and ophthalmologists should be vigilant for these cases, especially in cases where the cause of injury is explained inadequately.

In our study, 46.7% of the cases denied history of abuse on presentation. Ophthalmologists should have a high degree of suspicion about abuse and ask further leading questions if suspicions arise. It is common for victims not to explain the cause of injuries as physical assault and evade direct answers questioned directly.[6,9,10] Hesitance to answer about the cause of injuries, as well as multiple injuries in the face and body that do not match the history given by the patient should raise concerns about possible domestic abuse.

Socioeconomic factors can play a major role in domestic violence. Educational levels and employment status play an important role in women's independence from their partners. In our study, 60% women experiencing violence had a lower level of education than the husband. Although it would appear that women with higher levels of education have lower chances of being victim of domestic violence, some studies have shown no correlation between educational level and intimate partner violence.[11] However, other studies have found the opposite, showing a direct link between women's education and violence: the higher the educational level, the lower chances of being abused.[12-14] The husband's age and education was found to be significantly associated with lifetime experience of violence.[5] Several studies have shown that unemployed women and women with low-income occupations are found to be at greater risk of experiencing violence.[5,12] We observed a similar pattern in our study, where most women were financially dependent on their husbands. This economic dependency is probably the main reason for women not to complain about the abuse. All the women who took legal action in our study were financially independent irrespective of their educational level. However, it is not possible to draw any substantial conclusions due to our small sample size.

In our study, the OTS was 100 in 10 (66.7%) patients at presentation. At the 6-week follow-up, 93.3% cases had BCVA of 6/18 with no long-term effects of trauma. This suggests a good visual prognosis during follow-up in our cases, but it is difficult to draw conclusion due to small number of cases and short follow-up period.

In many studies, ocular findings due to trauma were mostly blunt injuries with close globe injuries which is similar to our study.[7,9,15] In our study, all the cases presented with blunt ocular trauma and none with ocular penetrating injuries, which is similar to a study by Malhotra *et al.* where the majority of domestic abuse cases presented with contusion and abrasions.[7] In a study by Beck *et al.*, the most common injuries were periorbital contusion, which is similar to our findings.[9] The injuries observed in our study were different than those observed by Atipo-Tsiba *et al.*, where severe injuries such as globe rupture and orbital wall fractures were common.[15]

In several studies, alcohol abuse was shown to be a leading cause of intimate partner violence.[5,16,17] In our study, 40% of the abusers were under the influence of alcohol during episodes of violence. Our findings show that the perpetrators used

their body parts, mostly fists, similar to Beck *et al.* who found fists to be the most commonly used mode.[9] The perpetrators also used sharp or blunt objects to harm the victims in our study.

Another problem that we face in these victims is that they do not report the abuse. In our study, 26.7% of the women did not report their past history of violence, similar to previous studies.[2,16] Garcia- Moreno *et al.* found that more than one-fifth of the victims did not report their partner's violence.[1] Lamichanne *et al.* found that one-third of cases had past history of abuse.[5] These injuries also tend to escalate in severity on repetition. Women with a history of abuse have shown to have more severe injuries.[18]

Conclusion

Ophthalmic trauma in female victims of intimate partner violence is prevalent, yet these injuries may be underreported. Awareness of warning signs and a high level of suspicion among healthcare personnel about these situations is of paramount importance. As ophthalmologists, we may often be the first to encounter these cases. Beyond providing ophthalmic care, it is imperative that we engage with our patients, as many may conceal their history of abuse as reported in our study. We should be mindful that our role extends beyond ophthalmic care and can be a lifeline for those in need. While this study involved a limited number of cases, making it challenging to draw definitive conclusions regarding ocular findings and visual prognosis, it still imparts valuable information underscoring the prevalence of these unacknowledged acts of violence.

Declarations

Ethics approval and consent to participate
This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the hospital and informed written consent was obtained from all the participants prior to their enrollment in the study.

Competing interests
None to declare.

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A ten-year study of clinical presentation and predictive factors on final visual outcome in paediatric trauma patients

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Abstract

Purpose: To present the demographic and clinical presentation, and to evaluate the predictive factors for final visual outcomes in paediatric ophthalmic trauma.
Methods: A retrospective observational study was conducted in Indonesia's private tertiary eye hospital between 2012 and 2021.
Results: A total of 194 patients/201 eyes were included. Closed globe injuries (CGI) represented the most common injury (80/194, 41.2%), followed by adnexal injury (65/194, 33.5%), open globe injuries (OGI) (30/194, 15.5%), chemical injuries (13/194, 6.7%), orbital fracture (3/194, 1.5%), and fireworks injuries (3/194, 1.5%). The mean age was 8.60 ± 5.23 years, with children aged 11–18 years (69/194, 35.5%) comprising the majority of cases. The home (43/201, 21.4%) and blunt trauma (105/201, 52.2%) were identified as the most common setting and mechanism of injury, respectively. There were 78/201 (38.8%) eyes included in the visual acuity (VA) predictors analysis.

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The mean initial VA and final VA were 0.595 ± 0.775 logMAR and 0.461 ± 0.790 logMAR, respectively. A strong correlation between initial VA, final VA, and type of injury was found (r = 0.761, P < 0.001), with 13/78 (16.7%) patients having severe visual impairment and blindness. In multivariate analysis, initial VA (P = 0.003), scleral injury (P = 0.013), and hyphaema (P = 0.013) were statistically significant as visual outcome predictors.
Conclusions: CGI and adnexal injury show high incidence in paediatric ophthalmic trauma. The home is the most common setting for paediatric ophthalmic trauma. OGI causes visual impairment to blindness. Initial VA, scleral injury, and hyphaema are identified as visual outcome prognostic factors.

Keywords: Birmingham Eye Trauma Terminology, paediatric ophthalmic trauma, predictive factors, visual outcomes

Kajian selama sepuluh tahun ke atas manifestasi klinikal dan faktor mempengaruhi penglihatan selepas trauma dikalangan kanak-kanak

Abstrak

Tujuan: Mengkaji taburan demografi dan persembahan klinikal serta faktor prediktif ke atas penglihatan terakhir berikutan trauma okular dikalangan kanak-kanak.
Kaedah kajian: Kajian pemerhatian secara retrospektif telah dijalankan di hospital tertiari swasta, Indonesia di antara 2012 dan 2021.
Keputusan: Seramai 194 pesakit (201 mata) telah terlibat dalam kajian ini. Didapati kecederaan glob tertutup (closed globe injury-CGI) merupakan jenis kecederaan yang paling kerap (80/194, 41.2%), diikuti oleh kecederaan adnexal (65/194, 33.5%), kecederaan glob terbuka (open globe injuries-OGI) (30/194, 15.5%), kecederaan akibat bahan kimia (13/194, 6.7%), kepatahan tulang orbital (3/194, 1.5%), dan kecederaan akibat bunga api (3/194, 1.5%). Min umur kanak-kanak adalah 8.60 ± 5.23 tahun, dimana kebanyakannya adalah kanak-kanak berusia 11–18 tahun (69/194, 35.5%). Manakala rumah (43/201, 21.4%) merupakan tempat utama kejadian kecederaan berlaku dan kecederaan akibat benda tumpul (105/201, 52.2%) adalah merupakan mekanisma utama kecederaan. Sebanyak 78 mata (38.8%) dianalisakan dalam analisa prediktor (ramalan) ketajaman penglihatan. Min ketajaman penglihatan awal dan terakhir adalah seperti berikut 0.595 ± 0.775 logMAR dan 0.461 ± 0.790 logMAR. Terdapat korelasi yang kukuh di antara ketajaman penglihatan awal dan terakhir serta jenis kecederaan (r = 0.761, p < 0.001), di mana seramai 13 orang

pesakit (16.7%) menunjukkan kehilangan penglihatan yang teruk dan kebutaan. Dengan menggunakan analisa multivariat, didapati ketajaman penglihatan awal (p = 0.003), kecederaan pada sklera (P = 0.013) dan kehadiran hyphaema (P = 0.013) merupakan prediktor yang signifikan secara statistik.
Kesimpulan: Insiden yang tinggi bagi CGI dan kecederaan adnexa dilihat pada kanak-kanak yang mengalami kecederaan okular. Rumah merupakan tempat utama di mana kecederaan berlaku pada kanak-kanak ini. Kecederaan OGI merupakan penyebab utama kebutaan di kalangan mereka. Tahap ketajaman penglihatan awal, kecederaan melibatkan sklera dan hyphaema merupakan factor prognosis bagi ketajaman penglihatan di kalangan kanak-kanak ini.

Kata kunci: Birmingham Eye Trauma Terminology, faktor prediktif, hasilan penglihatan, kecederaan oftalmik dikalangan kanak-kanak,

Introduction

Ophthalmic trauma is known as the major cause of non-congenital monocular blindness in children.[1-3] Although paediatric ophthalmic trauma typically occurs accidentally, the majority of cases are preventable.[4,5] Every year, there are 2.4 million reported cases of ocular trauma in the United States.[6] From statistics, 35% of these traumas occurs in children aged 17 and under, and 16% of them causes permanent visual impairment.[6-7]

Orbito-facial trauma, such as cranio-orbital, orbital-facial fractures, and facial soft tissue injuries, might be related to all the spectrum of ophthalmic trauma, which includes ocular, adnexal (eyelid and lacrimal), and orbital trauma.[8] The Birmingham Eye Trauma Terminology (BETT) system classifies ocular trauma into closed globe injuries (CGI), defined as non-full-thickness wounds of the eye wall (cornea or sclera), and open globe injuries (OGI), defined as at least one full-thickness wound to the eye wall.[9-10] CGI are considered to be less frequent and less severe than OGI.[11-12] A previous study from the United Kingdom reported 76.7% of globe injuries,[5] whereas China documented OGI (54.1%) and CGI (38.8%) as the most common injuries.[11]

Owing to unreliable reporting, a variable medical history, and poor cooperation during the examination, initial assessment in children is quite challenging. In spite of major advancements in surgical techniques, the management of OGI in children remains complex.[14] Amblyopia is an additional consequence of monocular injuries in children, which makes its management more difficult.[13-15]

Even though there are several previous studies of ophthalmic trauma in Indonesia, this was the first study to focus specifically on numerous paediatric ophthalmic patients in Jakarta. This study aims to present the demographic and clinical presentation of paediatric ophthalmic patients. Furthermore, it also aims

to evaluate the predictive factors for final visual outcomes in paediatric ophthalmic trauma who were admitted to a private tertiary eye hospital in Jakarta, Indonesia.

Methods

Patients

A retrospective observational study was conducted in Jakarta Eye Centre (JEC) Eye Hospitals from 2012–2021. The medical records of 194 children aged 0-18 years who had ophthalmic injuries and were either hospitalized or visited the outpatient clinic were included. Ethical approval for this study was obtained from The Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health and Nursing Universitas Gadjah Mada – Dr. Sardjito General Hospital with reference number KE/FK/0161/EC/2021 and complies with the tenets of the Declaration of Helsinki.

Data collection procedures

The medical records of all paediatric ophthalmic trauma patients who presented to Jakarta Eye Centre (JEC) Eye Hospitals from 2012–2021 were collected. Consecutive sampling was conducted, then used for demographic and clinical presentation analysis. After the data had been reviewed, patients who had data on visual acuity (VA) for 6 months following initial trauma were included in the visual outcome predictive factors analysis.

Measures

The patients were identified through electronic medical records using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes which includes S04, S05 (S05.0-S05.9), and S09 codes. Demographic and clinical data were recorded, including additional information relating to the injury. The injuries were then classified with the BETT system and divided into six groups.[9,10] Visual outcomes were classified according to the the World Health Organization's (WHO) classification.[16]

Statistical analysis

All data were entered into Microsoft Excel for the initial calculation of descriptive statistics. Snellen VA was converted into logMAR equivalent for statistical analysis. Statistical analysis was performed using SPSS Statistics for Mac version 25 (SPSS Inc., Chicago, IL, USA). Univariate analysis of visual outcome predictors was evaluated using Pearson's chi-square and Fisher's exact test. Multivariate analysis used binary logistic regression. A value of $p < 0.05$ was considered statistically significant. Parameters of the normal distribution are reported as mean ± standard deviation (SD).

Results

Age, gender, laterality, occupation, clinical findings, primary diagnosis, complications, prior medical history, initial and final VA, and management were the demographic and clinical data gathered in this study. Additional information related to the injuries was also collected, such as cause of the injury, eye protection usage, place, mechanism, object, and nature of the injury.

A total of 897 ophthalmic trauma patients were admitted to our hospital, 194 (201 eyes) among them were children (21.6%). The mean age was 8.60 years with the number of male patients (66.5%) being almost 2 times that of female patients (33.5%) across all ages groups ($p = 0.760$). According to the BETT classification, the data divided into six groups consisting of OGI, CGI, adnexal injury, orbital fracture, chemical injury, and fireworks injury. CGI (80, 41.2%) was the leading cause of trauma, followed by adnexal injury (65, 33.5%), and OGI (30, 15.5%). Nearly all the patient demonstrated unilateral injury (96.4%). The patients' demographic data are summarized in Table 1.

The age group with the highest number of cases was 11–18 years (69, 35.5%), more than half (39, 20.1%) of whom suffered CGI. The age group with the second highest number of cases was 6–10 years (60, 30.94%), among which 23 (11.86%) suffered CGI. The distribution of type of injury by age group is presented in Figure 1**.**

Blunt trauma (105, 52.2%) was the dominant mechanism of injury, followed by projectile and chemical burn (each 25, 12.4%). According to the nature of injuries, accidental (192, 95.5%) was the most commonly reported, with a small number of self-inflicted injuries (3, 1.5%). The records for most patients (117, 58.2%) did not indicate the setting of injury. For those cases where the setting was recorded, the home (43, 21.4%) was the most frequent, followed by outdoor chores (12, 6.0%), and sports-related (10, 5.0%).

Traumatic agents of injuries were classified as blunt objects, sharp objects, chemicals, fireworks, sports-related, and some uncommon agents causing injury (dog bites, arrows, toothbrushes, curtains, melodicas, and hats). Blunt objects (90, 46.4%) predominated among the injuries, including other blunt objects (78, 40.2%), blunt wood (6, 3.1%), blunt body parts (3, 1.5%), and plastic toys (3, 1.5%). One in five injuries (41, 21.2%) were caused by sharp objects, including sharp metal (14, 7.2%), other sharp objects (9, 4.6%), sharp wood (8, 4.1%), and sharp body parts (5, 2.6%). Acid (9, 4.6%), alkaline (2, 1.0%), and super glue (2, 1.0%) were the chemicals that caused injuries (16, 8.0%). Fireworks (3, 1.5%) and sports-related objects (13, 6.7%), including airsoft guns, arrows, basketballs, badminton racquets, and shuttlecocks, were responsible for the remaining injuries. The materials that caused the injuries are displayed in Figure 2.

Most patients had anterior segment injury (107, 53.2 %), followed by posterior segment (16, 8.0 %), both segments (11, 5.5 %), and adnexal (67, 33.3 %) as their clinical presentation of trauma. Zone I (46, 57.5%) injuries comprised the most

Table 1. Demographic data of the patients

Description	Boys (n = 129, 66.5%)	Girls (n = 65, 33.5%)	Total (N = 194, 100%)
Age group (years)			
0–2	17	10	27 (14.0%)
3–5	23	15	38 (19.6%)
6–10	42	18	60 (30.9%)
11–18	47	22	69 (35.5%)
Type of injury			
CGI	54	26	80 (41.2%)
Contusion (n = 51, 71.3%)	40	17	
Lamellar laceration (n = 11, 13.7%)	9	2	
Superficial foreign body (n = 12, 15.0%)	5	7	
OGI	24	6	30 (15.5%)
Rupture (n = 15, 50.0%)	12	3	
Penetrating (n = 15, 50.0%)	12	3	
IOFB	N/A	N/A	
Perforating	N/A	N/A	
Adnexal injuries	40	25	65 (33.5%)
Orbital fracture	3	N/A	3 (1.5%)
Chemical injuries	6	7	13 (6.7%)
Fireworks injuries	2	1	3 (1.5%)
Laterality			
Unilateral	125	62	187 (96.4%)
Bilateral	4	3	7 (3.6%)

IOFB: intraocular foreign body; SD: standard deviation; N/A: not available
Data are presented as number (percentage).

frequent zone injuries in CGI, followed by Zone III (20, 25.0%) and Zone II (14, 17.5%). For OGI, Zone I (73.3%) injuries accounted for most cases, followed by Zone II (8, 26.7%), and an absence of Zone III injuries. The correlation between zone and type of injury was statistically significant (P = 0.010). Palpebral hematoma (46, 22.9%) as the predominant hallmark of adnexal damage, corneal rupture (25, 12.4%) and subconjunctival haemorrhage (20, 10.0%) were the most prevalent findings in OGI and CGI. Additionally, we identified patients who had endophthalmitis owing to OGI (3/201, 1.5%), all of whom presented to the hospital more than 48 hours after the injury and whose cause of injury were organic or unclean substances, including bottle openers, twigs, and pens. Their final vision was increased to 0.1 and 0.2, despite the fact that their initial VA was hand movement (HM). Details on clinical presentation are provided in Figure 3.

Most patients received conservative treatment with medication (148, 73.6%), and the remaining underwent surgery (34, 16.9%) due to OGI and adnexal injury (each 15, 44.1%). There were 3 patients with prior surgeries (1.7%) at a different hospital, including palpebral repair (1), corneal repair (1), and craniotomy (1), all as a result of blunt trauma. There were also several patients who declined any treatment or surgery (16, 8.0%). OGI repair (15, 44.1%) and palpebral repair (15, 44.1%) were the most frequently performed surgical procedures on patients, followed by CGI repair (2, 5.9%). Most surgeries were performed less than 12 hours (24/34, 70.6%) after the trauma event. The longest period between admission and surgery was approximately three months, found in one orbital fracture case. Table 2 presents detailed surgical data.

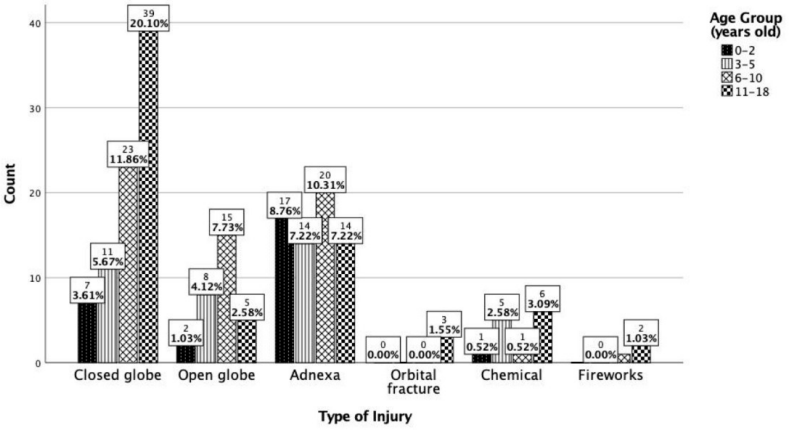

Fig. 1. Type of injury distribution based on age group.

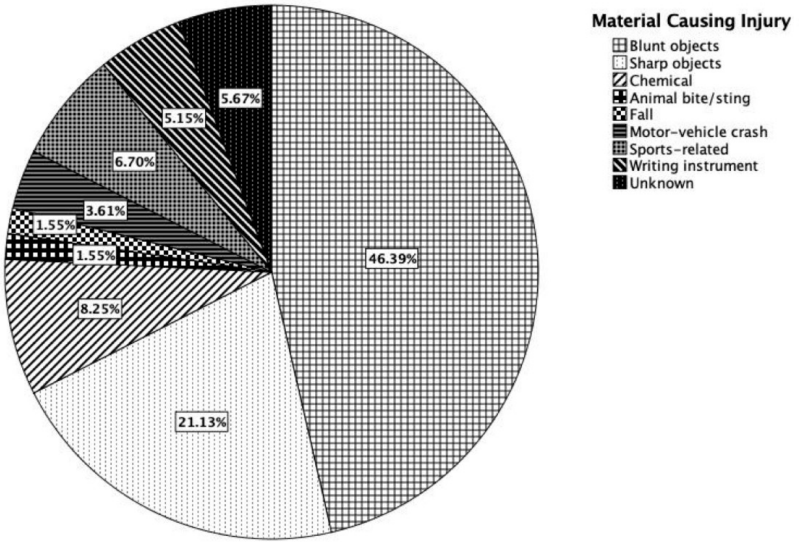

Fig. 2. Breakdown of materials that caused the injuries.

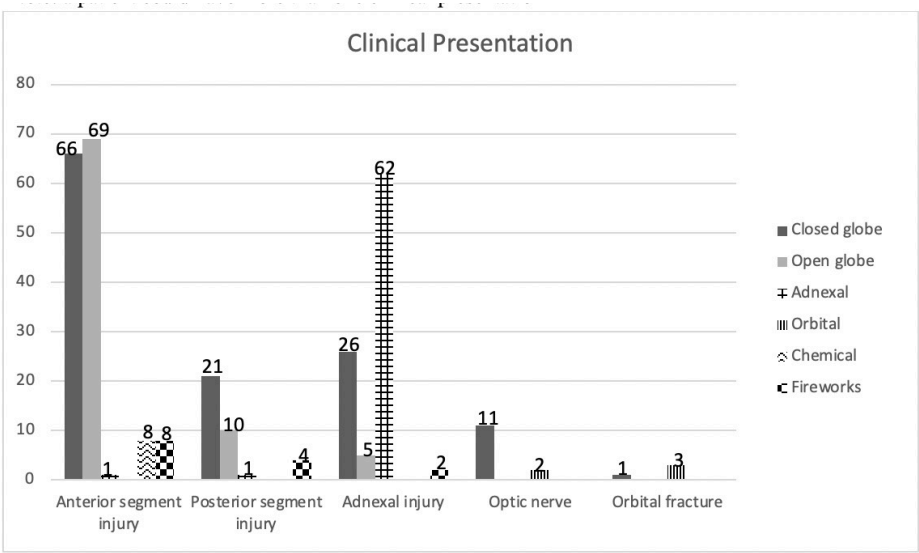

Fig. 3. Clinical presentation based on injury. ‡Note: a patient could have more than one clinical presentation.

Table 2. Type of surgery

Description	Total (n = 34, 100%)
Surgery	
Corneal repair	10 (29.5%)
Corneal-scleral repair	3 (8.9%)
Scleral repair	1 (2.9%)
Palpebral repair without canalicular involvement	9 (26.5%)
Palpebral repair with canalicular involvement	6 (17.7%)
Orbital fracture reconstruction	1 (2.9%)
ICCE	1 (2.9%)
Irrigation/aspiration hyphaema	1 (2.9%)
Vitrectomy, IOL phacoemulsification	1 (2.9%)
Symblepharon released, amnion graft, followed by anterior lamellar and cicatrix release, followed by keratoplasty	1 (2.9%)
Time from admission to surgery	
< 12 hours	24 (70.6%)
12–48 hours	5 (14.7%)
> 48 hours	5 (14.7%)

ICCE: intracapsular cataract extraction; IOL: intraocular lens

Initial VA was documented in 122 eyes (60.7%). Some data were unavailable (79, 39.3%) due to uncooperative patients, Final VA was documented for only 83 eyes. Therefore, only 78 (38.8%) eyes were included in the visual outcome analysis by combining the initial and final VA data. Mean initial VA was 0.595 ± 0.775 logMAR and final VA was 0.461 ± 0.790 logMAR ($p = 0.061$).

Compared to other injuries, most OGI patients had worse final VA (Fig. 4). We also documented 2 CGI patients who had poor visual outcomes caused by blunt trauma and fall. A strong correlation between initial VA, final VA, and type of injury was found using Spearman's correlation ($r = 0.761$, $p < 0.001$). As the outcome, 13 of 78 patients (16.7%) had severe visual impairment and/or blindness.

Univariate analysis was performed using Fisher's exact test and Pearson's chi-square test. The prognostic factors (gender, age groups, zone, time of injury, hypopyon, palpebral injury, retinal detachment, endophthalmitis, and optic nerve injury) were not statistically significant. However, other predictive factors were statistically significantly associated with visual outcomes, including initial VA ($p < 0.001$), corneal injury ($p = 0.016$), scleral injury ($p = 0.014$), iris injury ($p = 0.003$), hyphaema ($p = 0.016$), traumatic cataract ($p = 0.025$), and vitreous haemorrhage ($p = 0.031$). In multivariate analysis, initial VA ($p = 0.003$), scleral injury ($p = 0.013$), and hyphaema ($p = 0.013$) were statistically significant predictors for the visual outcome (Table 3).

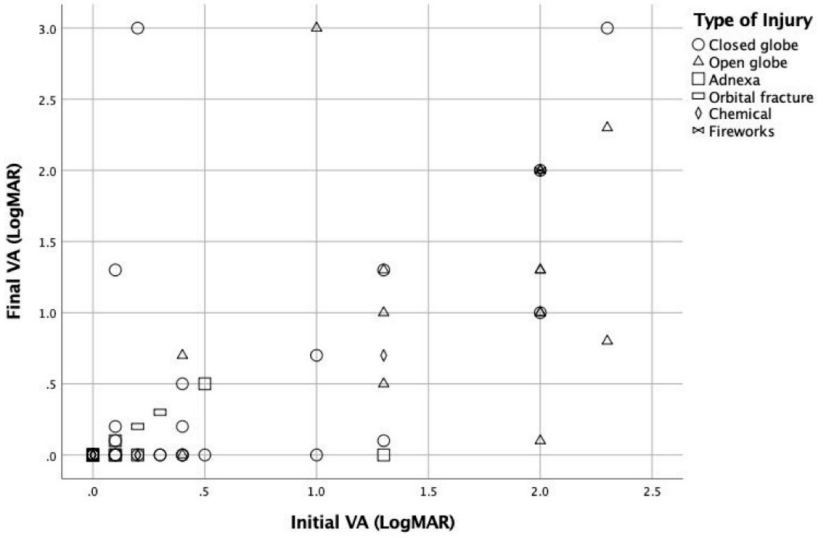

Fig. 4. Comparison of final VA and initial VA based on type of injury.

Table 3. Multivariate analysis of visual outcome predictors

Predictors for visual outcome	**Final VA**		**Odds ratio**	**95% CI**	***P*-value**
	> 3/60	**≤ 3/60**			
	***n* (%)**	***n* (%)**			
Initial VA (*n* = 78)					
Poor ≤ 3/60	10 (15.4)	10 (76.9)	38.88	3.43–440.75	0.003*
Good >3/60	55 (84.6)	3 (23.1)			
Corneal injury (*n* = 84)					
Yes	9 (12.9	6 (42.9)	0.14	0.009–2.37	0.177
No	61 (87.1)	8 (57.1)			
Scleral injury (*n* = 84)					
Yes	1 (1.4)	3 (21.4)	231.82	3.15-17052.23	0.013*
No	69 (98.6)	11 (78.6)			
Hyphaema (*n* = 84)					
Yes	6 (8.6)	5 (35.7)	16.54	1.79-152.94	0.013*
No	64 (91.4)	9 (64.3)			
Iris injury (*n* = 84)					
Yes	3 (4.3)	5 (64.3)	7.10	0.43-117.31	0.170
No	67 (95.7)	9 (35.7)			
Traumatic cataract (*n* = 84)					
Yes	7 (10.0)	5 (35.7)	0.50	0.03-6.53	0.602
No	63 (90.0)	9 (64.3)			
Vitreous haemorrhage (*n* = 84)					
Yes	2 (2.9)	3 (21.4)	1.48	0.06-36.72	0.808
No	68 (97.1)	11 (78.6)			

* Statistically significant. Data derived using binary logistic regression.

Discussion

Ophthalmic trauma is one of the leading causes of avoidable monocular blindness, and 90% of injuries are preventable.[17,18] The paediatric age group accounts for 20–59% of all ocular trauma.[18] From our findings, nearly a quarter (21.6%) of the 897 ocular trauma patients who reported to our hospital over the 10-year period were paediatric. This fact reflects how susceptible children are to trauma compared to adult patients, which is consistent with several previous studies.[3,19-21] Our findings revealed that CGI was the most prevalent type of injury, followed by adnexal injury, and OGI, while the most common setting of injury was the home.

From our findings, the most susceptible age group to ocular trauma is that between 11 and 18 years. Children aged between 11 and 18 years are at a stage of development that prepares them for adulthood. Because of their independence and lack of parental monitoring, they are more susceptible to trauma than younger children. Our results contradict those from earlier retrospective studies conducted in China[5] and Western Australia,[22] which identified children aged 0 to 2 years and 6 to 11 years as the most susceptible age groups, respectively.

Males were more susceptible than females in our study. This preponderance is consistent with previous studies.[5,14,23,24] This finding may be explained by the fact that males are more likely than females to engage in high-risk activities and to be left unsupervised. Furthermore, males are frequently more exposed to outdoor activities, including sports and activities associated with road traffic.[25]

More than 95% of the injuries in our study were unilateral, which is in line with previous studies.[11,17,26] Our findings reported CGI as the most frequent type of injury, followed by adnexal damage. This was in contrast with findings by Barry *et al.*,[11] Madan *et al.*,[26] and Cao *et al.*,[5] all of whom reported OGI as the most frequent type of injury. However, a study in Northern India showed a similar pattern to our study.[17] Since the eyelids act as the first line of protection for the eye, they are frequently injured.

Our results found that orbital fractures were related to motor vehicle accidents and blunt trauma, in line with a study by Salvin *et al.*[27] Stotland *et al.*[28] also revealed an extremely high relative frequency of orbital roof fractures occuring in males between the ages of 7 and 10. We found that our fireworks injuries found were associated with celebrations for both Eid Al Fitr and New Year's Eve. Similar patterns have been reported in other countries, also occurring as part of the celebrations throughout their festival week.[29,30] Different studies have shown that many common activities follow the patterns of each country.

The results of our study were consistent with those of Maurya *et al.*,[17] which found that blunt trauma caused more than half of all injuries, more than 95% of which were accidental. In contrast to Mac Ewen *et al.*,[4] who claimed that assaults represented 15% of injuries, only 0.5% of our patients had intentional/assault as the mechanism of injury. Syal *et al.*[31] conducted a study in India that found penetrating injuries as the

most frequent trauma in children. These differences in results might be attributed to variances in age groups, study samples, and methodology, alongside injury type and mechanism.

The setting of the injury was not documented in our data for most cases. This might be due to the children being unsupervised or unable to offer sufficient details. For the cases where setting was recorded, the most frequent in our study was the home, as was also reported in other findings.[5,32] The household environment being equally represented as sports activities, outside chores, and schools may have been a major contributing factor due to a lack of adequate adult supervision while children at home.

Eye protection use was reported during sports activities, which was consistent with prior studies from China[5] and northern India[17]. Despite the fact that eye injuries can be prevented in 90% of cases, safety procedures and the usage of eyewear protection should be followed.[33] Additionally, parental supervision also plays a vital role in paediatric ophthalmic trauma prevention.

It is well known that children take more risks than adults in terms of ophthalmic trauma. Our study found several trauma agents, causing trauma ranging from minimal to significant. Blunt objects were the most common agents of paediatric ocular trauma in our study. Ahmadi *et al.*[34] conducted a study in Iran that specifically found stationery as the most frequent traumatic agent in the paediatric population, especially school age children. Our findings also identified unusual trauma agents, including dog bites, arrows, toothbrushes, curtains, melodicas, and hats.

Chemical eye injuries can develop under a variety of conditions.[35] In our study, acid was the major contributor, but alkaline agents were used more frequently in other studies.[35] Raising awareness about household chemicals may help create a safe environment to reduce the risk of potential injury.

According to BETT,[9,10] we observed a higher proportion of Zone I injuries for both OGI and CGI, in line with previous studies.[23,26] The ratio of anterior to posterior segment involvement in our results was 6:1, which was greater than the 3:1 ratio found by Barry *et al.*[11] Our findings imply that anterior eye structures are more susceptible to trauma. A review of the clinical presentations in our study found that the most frequent CGI findings were subconjunctival haemorrhage, followed by hyphaema and corneal abrasion, in alignment with Shah *et al.*[14] Corneal rupture and iris prolapse were identified as the most common findings in OGI, and this was also emphasized in prior research in the United Kingdom,[11] India,[17] and China.[5] Even though anterior structure involvement was common in our population, this finding is still important due to poor visual outcomes.

Since most injuries involved CGI, most patients were treated conservatively with medications, whereas 16.9% of patients needed surgery. Previous studies have reported that nearly 29.7% of eyes were managed by medication and the remaining 70.3% required additional surgeries due to OGI.[5] This different pattern was discovered due to environmental and cultural differences. We found 3 cases

of endophthalmitis due to OGI, all of which presented to the hospital more than 48 hours after injury. Patients who presented within 24 hours of the trauma event had better visual results than those who did not, which was consistent with an earlier study.[36]

Regardless a strong correlation between initial VA, final VA, and type of injury ($r = 0.761$, $p < 0.001$), OGI still potentially led to poor visual outcomes, which was in line with a study by Madan *et al.*[26] In accordance with the WHO definitions of visual impairment and blindness,[16] 16.9% of children were found to have severe visual impairment and/or blindness in our study. This was lower than research from the United Kingdom indicating a higher percentage of 29.1%.[11] Our findings revealed males had poorer visual outcomes than females, as previously reported by Abbott *et al.*[25]

We found initial VA to be the strongest predictive factor of visual outcome both in univariate ($p < 0.001$) and multivariate analysis ($p = 0.003$), which several other studies have also reported.[37,38] Multivariate analysis revealed that poor initial VA resulted in a 38.88-fold chance of attaining poor visual outcomes, a larger proportion than in previous studies.[37] Our univariate analysis also demonstrated that corneal injury ($p = 0.016$), scleral injury ($p = 0.014$), iris injury ($p = 0.003$), hyphaema ($p = 0.016$), traumatic cataract ($p = 0.025$), and vitreous haemorrhage ($p = 0.031$) were related to final VA, as seen in previous studies.[37-39] Because these prognostic factors are already described by univariate analysis, corneal and scleral injuries ($p = 0.013$ each) were statistically significant as predictive factors in multivariate analysis.

The range of ophthalmic injuries may result from the diversity of cultural and socioeconomic catchment areas at our facility, a private tertiary eye hospital in Jakarta, Indonesia. It also depends on the referral system in our nation. Patients who declined treatment and surgery owing to financial and insurance concerns chose to go to other public hospitals; these findings were also clearly documented in our study. Our cohort also included patients who arrived at our hospital after having surgery at another hospital. To improve visual outcomes, particularly in children, it is necessary to strengthen the referral system, make it more efficient, and provide physicians with greater training.

A significant limitation to the present study is that the recorded ocular trauma data were obtained from a single hospital rather than from a nationwide trauma cohort. Another limitation concerns the data constraints due to its retrospective nature. Although a large number of children were involved in this study, its data may not accurately reflect the clinical and demographic ocular trauma data for the country's entire paediatric population. In order to obtain more comprehensive demographic information, multicenter or nationwide cohort research must be conducted in the future.

Conclusions

CGI, blunt trauma, and a home setting were the most common findings in our paediatric ophthalmic trauma cohort. Males and the adolescent age group comprise the majority of injured patients. Open globe injuries lead to blindness or severe visual impairment in the long term. Initial VA, scleral damage, and hyphaema were significant predictors of a poor visual outcome in our multivariate analysis. It is important to encourage parents and elderly family members to reduce hazards at home. Increasing parental awareness about medical treatment immediately after an injury should be established.

Declarations

Ethics approval and consent to participate
Ethical approval for this study was obtained from the Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health and Nursing Universitas Gadjah Mada – Dr. Sardjito General Hospital with reference number KE/FK/0161/EC/2021 and complies with the tenets of the Declaration of Helsinki.

Competing interests
None to declare.

Funding
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Ten-year review of traumatic hyphaema cases in a tertiary hospital in the east coast of Malaysia

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Abstract

Purpose: Traumatic hyphaema is a common sequela following blunt trauma. The aim of this study was to analyse the demographics, complications, and visual outcome of patients presenting with traumatic hyphaema at a tertiary hospital in the East Coast of Malaysia.
Methods: Retrospective study based on medical records from 2011 to 2021.
Results: A total of 41 eyes from 41 patients were included in the study. The mean age of patients was 22.2 years (± 15.1 SD), with 39.1% within 25–59-years of age. The incidence was higher among males (90.2%). Sports and recreational activities were the most common causes (61.0 %), followed by occupational (12.2%) and domestic causes (12.2%). More than half the patients sought treatment within 24 hours of injury (56.1%). The majority of patients presented with grade 1 hyphaema (68.3%), while 2.4% came with severe hyphaema (grade 4). Re-bleeding was noted in 2 patients, both were below 12 years old, on day three and day eleven respectively. Six patients (14.6%) had presenting intraocular pressure IOP > 30 mmHg. Mean presenting visual acuity was 6/36 (± 0.89 SD) and mean visual acuity post-treatment was 6/7.5 (± 0.15 SD). There was a significant difference between mean presenting visual acuity and visual outcome ($p < 0.05$).

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Conclusion: Despite serving mainly a rural population, sports and recreational activities remained the most common cause of traumatic hyphaema in this centre. Raising public awareness for protective eyewear should be advocated in this population.

Keywords: east coast Malaysia, ocular blunt injury, ophthalmic trauma, traumatic hyphaema

Kajian semakan selama sepuluh tahun kes kes hyphaema akibat kecederaan di hospital tertiary yang terletak di Pantai Timur Malaysia

Abstrak

Tujuan: Hyphaema merupakan sekuela yang sering terjadi akibat kecederaan objek tumpul. Tujuan kajian ini adalah untuk menganalisa demografi, komplikasi dan tahap penglihatan pesakit yang mengalami hyphaema akibat kecederaan di salah sebuah hospital tertiari yang terletak di pantai timur Malaysia.
Kaedah: Kajian retrospektif berdasarkan rekod perubatan dari tahun 2011 hingga 2021.
Keputusan: Sebanyak 41 mata daripada 41 orang pesakit telah terlibat dalam kajian ini. Purata umur pesakit adalah 22.2 (± 15.1) tahun, di mana 39.1% daripadanya berumur antara 25–59 tahun. Kebanyakkan melibatkan pesakit lelaki (90.2%). Aktiviti sukan dan rekreasi merupakan penyebab utama (61.0%) berlakunya hyphaema traumatik diikuti oleh kecederaan akibat kecederaan sewaktu bekerja (12.2%) dan kecederaan domestik (12.2%). Lebih daripada separuh pesakit (56.1%) mendapatkan rawatan dalam tempoh 24 jam. Kebanyakan pesakit datang dengan hyphaema gred 1 (68.3%) sementara hanya 2.4% datang dengan hyphaema gred 4. Pendarahan berulang berlaku pada dua pesakit, kedua-duanya berumur di bawah 12 tahun. Seramai enam orang pesakit (14.6%) merekodkan tekanan intraokular (IOP) melebihi 30 mmHg. Purata tahap penglihatan sebelum rawatan adalah 6/36 (±0.89) dan purata tahap penglihatan setelah rawatan adalah 6/7.5 (± 0.15). Terdapat perbezaan ketara secara statistik antara tahap penglihatan sebelum dan sesudah rawatan ($p < 0.05$).
Kesimpulan: Walaupun kajian ini melibatkan penduduk luar bandar, aktiviti sukan dan rekreasi kekal menjadi penyebab terbesar hyphaema traumatik. Usaha untuk meningkatkan tahap kesedaran tentang kepentingan penggunaan alat pelindung mata seharusnya lebih digiatkan dalam masyarakat untuk mencegah terjadinya kecederaan ini.

Kata kunci: hyphaema traumatik, kecederaan tumpul pada mata, pantai timur Malaysia

Introduction

Hyphaema can be defined as the accumulation of red blood cells in the anterior chamber of the eye. Traumatic hyphaema is a common sequela following ocular blunt trauma and one of the most frequent causes of presentation to the emergency department.[1,2] To date, the annual incidence of traumatic hyphaema is 17 to 20 per 10,000. Approximately 38% of traumatic hyphaema is caused by blunt, non-penetrating ocular injuries.[3,4] Although it usually carries a good prognosis, the poor visual outcome of traumatic hyphaema is also related to the presence of complications such as secondary glaucoma, re-bleeding, and corneal blood staining, as well as the presence of associated ocular injuries, such as posterior segment involvement.[4-6] The aim of this study is to analyse the demographics, complications, and visual outcome of patients with traumatic hyphaema following blunt trauma at a tertiary hospital on the east coast of Malaysia.

Methods

This is a 10-year retrospective study of patients with traumatic hyphaema due to ocular blunt injuries who were referred to a tertiary hospital in the east coast of Malaysia from 2011 to 2021. Ethical approval for this study was obtained from by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (MOH). The data for this study was collected from medical records between January 2011 and December 2021. The collected data included demographic data (age, sex, cause of injury, history of bleeding diathesis or taking blood-thinning medication, ocular comorbidities), baseline clinical presentation including visual acuity, grade of hyphaema, intraocular pressure (IOP), interventions and complications during treatment (medical or surgical treatment, presence of secondary glaucoma, and re-bleeding), and follow-up (6 months).

The records of all patients that were referred to or sought treatment at this tertiary hospital from January 2011 to December 2021 were included in this study. Individuals with traumatic hyphaema who did not complete the treatment were excluded from the study. Completion of treatment was defined as total disappearance of hyphaema regardless of duration of treatment.

The mechanism of injury was classified into 5 major groups: sports and recreational, occupational, domestic injury, motor vehicle accident and assault-related injury. Sports and recreational-related injuries were then grouped into shuttlecock, football (field football and futsal), and others (including firecrack-

ers, stones or pebbles, toy guns, and rubber band injuries). Domestic injuries included injuries that happened at home such as a fall or accidents while doing daily activities.

The patients were grouped as children (≤ 14 years), adolescents (15–24 years), adults (25–59 years), and elderly (> 60 years) based on the age group standardised by the World Health Organization (WHO).[7] Visual acuity was documented using the Snellen notation and converted to logMAR units for statistical analysis.

Hyphaema levels were graded according to Edward and Layden:

- Grade 0: dispersed red blood cells with no visible layering (microhyphaema).
- Grade 1: layered blood occupying less than one third of the anterior chamber.
- Grade 2: layered blood occupying one third to less than the total of the anterior chamber.
- Grade 3: layered blood occupying half to less than total of the anterior chamber.
- Grade 4: total filling of the anterior chamber with blood or a blood clot.[8]

IOP at presentation was classified into:

- normal: less than 21 mmHg
- mild elevation: 21–25 mmHg,
- moderate elevation: 25–30 mmHg,
- highly elevated: more than 30 mmHg.

Re-bleeding was defined as a significant increase in the measurement of the level of blood in the anterior chamber, the appearance of fresh blood over an organised clot, or a recurrence of layering after the blood in the anterior chamber had completely cleared. In the setting of a Grade 4 hyphaema, re-bleeding was defined as the appearance of fresh blood over old clots in the anterior chamber.[9]

Medical treatment included bedrest and topical eye drops, such as topical dexamethasone for inflammation control and antiglaucoma eye drops for high IOP. Systemic antiglaucoma medications, such as oral acetazolamide and intravenous mannitol, were given to those whose IOP was uncontrolled. Surgical evacuation of the blood was performed when IOP reached 50 mmHg for more than 5 days or 30 mmHg for more than 7 days despite maximal antiglaucoma medications; when there was no sign of absorption of blood within 3–4 days after injury in patients with total hyphaema; and when there was impending corneal blood staining.[8]

Results

Of 52 patients who presented with traumatic hyphaema, only a total of 41 eyes from 41 patients were eligible for this study. Eleven patients who received initial treatment did not complete the treatment and were excluded from this study. The demographic distribution is shown in Table 1. None of the patients had history of bleeding diathesis. Two patients were on antiplatelet medication at the time of the injury.

An overwhelming majority of the injuries occurred in males and in the age group of 25–59 years. There were almost 4 times more injuries in male children compared to female children. The predominant mechanism of injury was sports-related (Table 2). Other types of injury included firecrackers (7.3%), stones or pebbles (7.3%), toy guns (4.9%), and rubber bands (2.1%). Palm field-related

Table 1. Demographics of the study population

Gender	**Age group**				
	< 14 years (children)	**15–24 years (adolescents)**	**25–59 years (adults)**	**≥ 60 years (elderly)**	**Total n (%)**
Female	3	0	0	1	4 (9.8)
Male	11	10	16	0	37 (90.2)
Total *n* (%)	14, (34.1)	10, (24.4)	16, (39.1)	1, (2.4)	41 (100)

Table 2. Mechanism of injury in the study population

Mechanism of injury	***n***	**(%)**
Sports and recreational	25	61.0
Shuttlecock	11	26.8
Football	4	9.8
Others	10	24.4
Occupational	5	12.2
Palm fruit/leaves	4	9.8
Wrench	1	2.4
Domestic	5	12.2
Motor vehicle accident	4	9.7
Assault	2	4.9

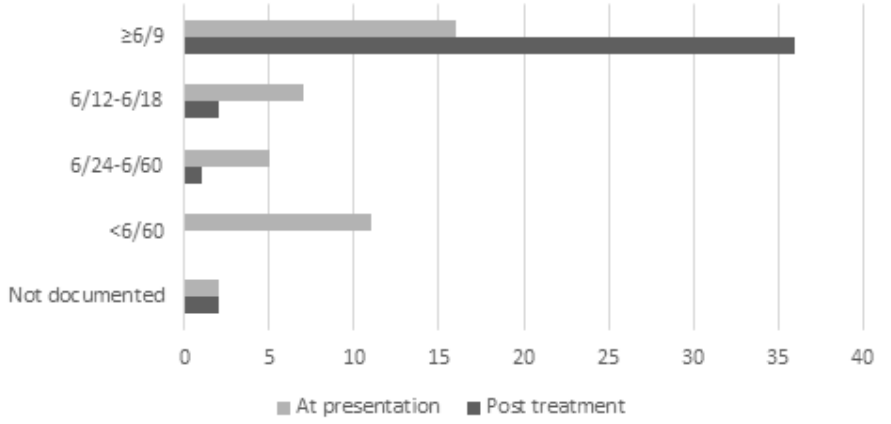

Fig. 1. Visual acuity at presentation and post-treatment.

injury occurred most frequent for hyphaema caused by occupational injury.

More than half the patients sought treatment within 24 hours of their injury (56.1%), and only two patients (4.8%) sought treatment after 72 hours. Most of the cases presented with Grade 1 hyphaema (68.3%), followed by Grade 0 hyphaema (19.5%), and only one patient with Grade 4 hyphaema. The mean presenting IOP was 19.6 mmHg (± 9.43 SD), with more than two-thirds having non-elevated IOP (n = 30). Six patients (14.6%) presented with IOP greater than 30 mmHg.

Mean presenting Snellen visual acuity was 6/36 (± 0.89 SD). Sixteen patients (39.0%) presented with moderate to severe visual impairment (less than 6/24). Most of them (n = 11, 68.8%) were caused by sports and recreational-related injury, while more than one-third of them were children (n = 6, 37.5%).

Two patients developed re-bleeding. A further two patients required surgical intervention (anterior chamber washout) due to IOP not returning to normal levels despite maximal medical treatment. Two patients developed secondary angle-recession glaucoma after four months of follow-up. Mean visual acuity post-treatment was 6/7.5 (± 0.15 SD). None of the patients had a worse visual outcome than 6/60, and 7.2% had mild to moderate visual impairment post-treatment (6/12 to 6/60, Fig. 1). There was a significant difference ($p < 0.05$) between mean presenting visual acuity and visual outcome. We found no statistical association between age, time of presentation, grade of hyphaema, presenting IOP, re-bleeding, and visual outcomes.

Discussion

Our study is the first to report the epidemiology of traumatic hyphaema in blunt ocular trauma in Terengganu, one of the states located on the east coast of Malaysia. The latest estimated population of the state is 1.19 million, with *bumiputera* (Malays and Orang Asli) comprising 95.4% of the population. The working age population (15–64 years of age) comprises 65.8% of the population and children below the age of 14 years comprise 28.4% of the population. There is only one tertiary hospital in this state, which serves mostly rural populations.[10]

Limited access to medical facilities and low awareness of eye care might be the reasons for the small number of subjects in this study. Approximately half the subjects sought treatment after 24 hours, and 4.8% sought treatment after 72 hours, which might reflect the low awareness of ophthalmic health care among the population.

The male-to-female ratio in this study was 9:1, almost similar to a study from Jakarta, Indonesia but higher than most other studies.[3,6,8,9,11] The high number of males involved in activities that are prone to ocular trauma reflects the imbalanced ratio. We also found that the incidence of traumatic hyphaema was highest in adults, similar to previous studies. This likely reflects the high engagement in sports and recreational activities in this age group.[6-8] Children aged less than 14 years ranked second, with an incidence 3 times higher in males. This gender bias likely reflects the more adventurous activities among boys.

Sports and recreational activities ranked first for the mechanism of injury for traumatic hyphaema in our centre. Shuttlecock-related injuries accounted for most of the injuries (11 of 25 cases). This finding is similar to that of the earlier study conducted in an urban area of Malaysia.[12] Like other studies, occupational-related injury placed as the second most common cause of traumatic hyphaema, with the majority occurring in the palm fields.[6,9] Theoretically, these two common causes of injury could be prevented by wearing protective eyewear. This could be due to a lack of awareness of preventive measures or a lack of access to protective eyewear.

While poor visual outcome could be linked to some factors in other studies, such as age, concurrent injuries, and complications, this study could not find any significant differences in factors that could cause poor visual outcome.[5,6,9] The limitations of this study are its small sample size and low incidence of complications, which made identifying associated risk factors challenging.

Conclusion

In conclusion, despite serving a mainly rural population, sports and recreational activities remained the most common cause of traumatic hyphaema in the east coast of Malaysia. Public awareness about the importance of protective eyewear should be promoted in this population.

Declarations

Ethics approval and consent to participate
Ethical approval for this study was obtained from by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (MOH).

Competing interests
None to declare.

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None to declare.

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None to declare.

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Time interval for emergency ophthalmic surgery in Hospital Kuala Lumpur during the peak of the COVID-19 pandemic

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Abstract

Purpose: The coronavirus disease 2019 (COVID-19) pandemic led to staff shortages and repurposing of health facilities, thus affecting the workflow of emergency ophthalmic surgery in Hospital Kuala Lumpur (HKL). The objective of this audit was to ensure that there was no time delay for emergency ophthalmic surgery in HKL during the peak of the COVID-19 pandemic.
Study design: Retrospective clinical audit.
Methods: Data of patients who underwent emergency ophthalmic surgery for a period of 8 months in HKL were collected from the operation theatre records and patient medical records of HKL.
Results: A total of 49 patients underwent emergency ophthalmic surgery from May 2020 to December 2020. There was male 34 male patients (69%) and the majority of patients belonged to the age group of 21–30 years. Most of the cases were sight-threatening (80%), which included ocular trauma, vitreoretinal cases, and evisceration. Meanwhile, non-sight threatening cases comprised eyelid/conjunctival laceration, iris repositioning, and glaucoma surgery. Most of the surgeries (36%) were performed within 6 hours of admission/decision for surgery. Only 4% of surgeries were delayed more than 24 hours. A vitreoretinal case was delayed for 26 hours due to presence of electrocardiogram changes and hypokalaemia. The second case was a case of planned for evisceration for panophthalmitis and was

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delayed due to syndrome of inappropriate antidiuretic hormone. Both patients were referred to the medical team for stabilisation prior to surgery.
Conclusion: The cause of the delay in both patients were not due to the COVID-19 pandemic but due to medical co-morbidities. Despite the limitation of staff and resources-during the COVID-19 pandemic, ophthalmic emergency surgeries were carried out on appropriate timing without delay.

Keywords: COVID-19 pandemic, emergency ophthalmic surgery, Malaysia

Selang masa bagi pembedahan kecemasan oftalmik semasa kemuncak pandemic Covid-19 di Hospital Kuala Lumpur

Abstrak

Tujuan: Terdapat masalah kekurangan staf dan mengguna semula fasiliti kesihatan semasa pandemic akibat dari jangkitan coronavirus 2019 (COVID-19) menyebabkan aliran kerja pembedahan kecemasan oftalmik t erganggu d i Hospital Kuala Lumpur (HKL). Tujuan utama audit ini adalah untuk memastikan tiada kelewatan pembedahan kecemasan oftalmik s emasa k emuncak p andemic Covid-19.
Bentuk kajian: Kajian audit klinikal secara retrospektif
Keputusan: Sejumlah 49 pesakit telah melalui pembedahan kecemasan oftalmik bermula dari Mei 2020 sehingga Disember 2020. Seramai 34 orang adalah lelaki dan kebanyakkan berada dalam lingkungan umur 21–30 tahun. Kebanyakkannya adalah kes yang melibatan kes yang mengancam penglihatan (80%) yang meliputi kes trauma ocular, vitreoretinal dan pembuangan mata. Sementara itu terdapat kes yang tidak mengancam penglihatan termasuk kes melibatkan luka pada kelopak mata/konjunktiva, membetulkan kedudukan iris dan pembedahan glaukoma. Kebanyakkan pembedahan ini (36%) dilakukan dalam masa 6 jam selepas kemasukkan pesakit ke hospital atau dari waktu keputusan dibuat untuk pembedahan. Didapati bahawa jankamasa menunggu melebihi 24 jam untuk 4% daripada kes kecemasan ini. Terdapat satu kes pembedahan vitreoretinal yang mengalami kelewatan sehingga 26 jam, Dimana pesakit ini mengalami perubahan elektrokardiogram dan hipokalemia. Kes kedua yang mengalami kelewatan adalah kes pembuangan mata akibat panoftalmitis, d i m ana p esakit m engalami sindrom rembesan hormon antidiuretik yang tidak sesuai (SIADH). Kedua-dua kes ini telah dirujuk kepada pakar penyakit dalam bagi menstabilkan keadaan fizikal sebelum pembedahan.

Kesimpulan: Kes kelewatan pembedahan bukan diakibatkan oleh pandemik Covid-19 tetapi akibat dari penyakit sistemik yang tidak dikawal. Secara keseluruhan pembedahan kecemasan oftalmik t idak m engalami k elewatan walaupun terdapat kekangan kekurangan staf dan kemudahan lain.

Kata kunci: Malaysia, pandemic Covid-19, pembedahan kecemasan oftalmik

Introduction

The novel severe acute respiratory syndrome corona virus-2 (SARS CoV-2) was first detected in the Wuhan City, Hubei Province, China in December 2019 and spread to the rest of the world. Hospital Kuala Lumpur (HKL), nestled in the heart of Kuala Lumpur, is the largest public tertiary hospital in Malaysia, consisting of 53 different departments and units. It is located on 150 acres of land with 83 wards and 2,300 beds.[1] HKL has a staff of 7000 workers, with 200 consultants and specialists, 500 medical officers and registrars, 32 matrons, and 3,101 registered nurses.[1]

The pandemic greatly impacted patient care and ophthalmologic workflow. The waves of COVID-19 infection led to shortages of operation theatre staff, ophthalmology medical officers, and anaesthesiologists, thus affecting HKL's workflow. A portion of the general operation theatres were converted into intensive care units, while ophthalmology wards were converted into COVID-19 wards/ medical wards or were shared with other disciplines such as the otolaryngology team depending on the number of COVID-19 cases.

Many factors delayed emergency ophthalmic surgery during the COVID-19 pandemic, such as the availability of operation theatres, anaesthesiologists when general anaesthesia was required, and hospital beds, as well as the turnover time of swab results which may have negatively affected patient outcomes.[2] It became necessary to modify standard operating procedures to ensure that patient care and health care worker safety were not compromised.[3-6] Although elective cases were postponed, we were able to proceed with emergency ophthalmic surgery.

It became important to stratify patients depending on their level of risk for visual loss; thus, treatment for patients with lower-risk conditions was deferred.[7] According to the guidance document for prioritisation of ophthalmic procedures (dated May 2020) by the Royal College of Ophthalmologists (RCO), emergency procedures are defined as procedures required to be conducted within 24 hours and urgent procedures were defined as those required within 72 hours.[7] The emergency procedures according to the RCO guidelines were similar to that of the "Guidelines for ophthalmologists during the COVID-19 pandemic in Malaysia" by the Malaysian Society of Ophthalmology.[8] Table 1 presents examples of emergency ocular surgery. We at HKL adapted the guidelines by the Malaysian Society of Ophthalmology.[8] However, we were not able to perform emergency

corneal transplants due to the unavailability of donor corneas, and procedures such as corneal gluing were performed in a designated treatment room under aseptic technique in the eye outpatient clinic.

The objectives of this retrospective audit were:

1) evaluate the impact of the COVID-19 pandemic on emergency ophthalmic surgery in HKL.
2) ensure that the timing of emergency ophthalmic surgery complied with current standards without delays.
3) To analyse whether the current practices were acceptable to handle emergency ophthalmic cases without delay during the COVID-19 pandemic.

Table 1. Examples of emergency ophthalmic surgeries according to the "Guidelines for Ophthalmologists During COVID-19 Pandemic in Malaysia"[8]

Paediatric ophthalmology	• Essential interventions: • Acute emergencies (e.g., penetrating injury, intraocular foreign body, lid lacerations, orbital abscess, retinal detachment) • Cataract in children under 8 months of age or where there is a risk of causing irreversible, severe amblyopia • High IOP which cannot be managed medically • Retinoblastoma and other tumour treatments • EUAs where it is critical to manage a potentially sight- or life-threatening disease • Surgery for imminently sight-threatening disease, e.g., orbital decompression • Treatment for ROP • Patients with corneal blindness in both eyes in their amblyopic period • Probing of nasolacrimal duct: dacryocystocele
Vitreoretinal surgery	• Scleral buckle • Vitrectomy: macular or retinal detachment, ocular trauma, intraocular infection, intraocular foreign body, misdirected aqueous, malignant glaucoma • Drainage of choroidal effusion: Appositional choroidal effusion, suprachoroidal haemorrhage, or flat anterior chamber • Pneumatic retinopexy

Glaucoma surgery	• Filtration surgery (XEN, iStent): Sight-threatening, uncontrolled IOP in poor candidates for trabeculectomy or aqueous tube shunts • Goniotomy (ab externo or ab interno): Sight-threatening, uncontrolled IOP • Insertion of drainage implant with or without graft: Catastrophic or rapidly progressive glaucoma • Repair of operative wound(s): Bleb leaks, wound leaks, overfiltration, underfiltration, bleb scarring, sight-threatening hypotony, or shallow anterior chamber
Oculoplastic surgery	• Orbit biopsy: Suspected intraocular malignancy or immediate sight- threatening conditions • Cantholysis: Sight-threatening conditions • Canthotomy: Sight-threatening conditions • Decompression of dacryocele: Neonate with obstructive respiratory compromise • Decompression of orbit: Orbital tumour with impending vision loss • Drainage of abscess: Orbital cellulitis • Enucleation: Ocular trauma, infection, intractable glaucoma, globe perforation, intractable pain, or intraocular malignancy • Evisceration: Sight-threatening infection, or intractable pain • Excision of tumours: Malignancy or sight-threatening tumour • Exenteration: Life-threatening infection • Exploration of orbit: Life-threatening or sight-threatening conditions • Fenestration of optic nerve sheath: Progressive vision loss • Repair of canalicular laceration: Injury or trauma to their canaliculus
Corneal surgery	• Corneal transplantation: corneal blindness in both eyes with/ without local donor availability • Reconstruction of ocular surface or other tectonic procedures: Acute chemical injury, or acute Stevens Johnson Syndrome • Removal of aqueous drainage implant: Endophthalmitis, corneal touch, corneal decompensation, or exposed plate • Repair of anterior segment or cornea: Lacerations, blunt rupture, or deeply embedded corneal foreign body • Repair of dehiscence of corneal graft or other anterior segment wound: Wound dehiscence or other wounds, including dislocated LASIK flaps • Repair of extrusion or complication of keratoprosthesis: Complications with implanted devices in their cornea or anterior segment

Miscellaneous	• Brachytherapy: Intraocular malignancy • Cataract surgery: Congenital cataract in the amblyopic period, monocular patients with documented vision loss precluding driving, reading or self-care, lens-induced glaucoma, angle-closure glaucoma, acute lens complications, or severe anisometropia of fellow eye post recent lens extraction in first eye • Closure of cyclodialysis cleft: Sight-threatening hypotony due to trauma • Frontalis sling: Sight-threatening congenital ptosis • Laser photocoagulation: sight-threatening proliferative retinopathy • Repair of eyelid/face: Lacerations of eyelid or face • Repair of facial fractures: Displaced facial bone fractures • Repair of open globe: Ocular trauma • Intravitreal injection of anti-VEGF /steroids/antibiotics

IOP: intraocular pressure: EUA: examination under anaesthesia; ROP: retinopathy of prematurity

Methods

This study is a retrospective clinical audit that included all emergency ophthalmic surgeries (Table 1) conducted at HKL from May 2020 to December 2020. The data was collected from operation theatre records and patient medical records of HKL for a total of 49 cases of emergency ophthalmic surgeries.

Surgery waiting time was calculated from the time of admission/time of decision for surgery to the actual time the surgery was performed. The standard was set as 100% for an acceptable waiting time of 24 hours, without delays, between the time of admission/time of decision for surgery to the time the surgery was performed. To our best knowledge, there are no established standards available in literature. As such, we used an arbitrary standard as we did not want any delay in emergency ophthalmic surgery.

Results

A total of 49 patients underwent emergency ophthalmic surgery from May 2020 to December 2020. Patient ethnicity was as follows: Malay (*n* = 26;54%), Chinese (*n* = 6; 12.5%), Indian (*n* = 14.5%), and foreigner (*n* = 9; 19%). As shown in Figure 1, male patients (34, 69%) outnumbered female patients (15, 31%). Table 2 presents the cases divided into age groups, with the highest number of cases in the age group of 21–30 years (13), followed by the age group of 31–40 years (12) Only 1 patient was under 10 years old.

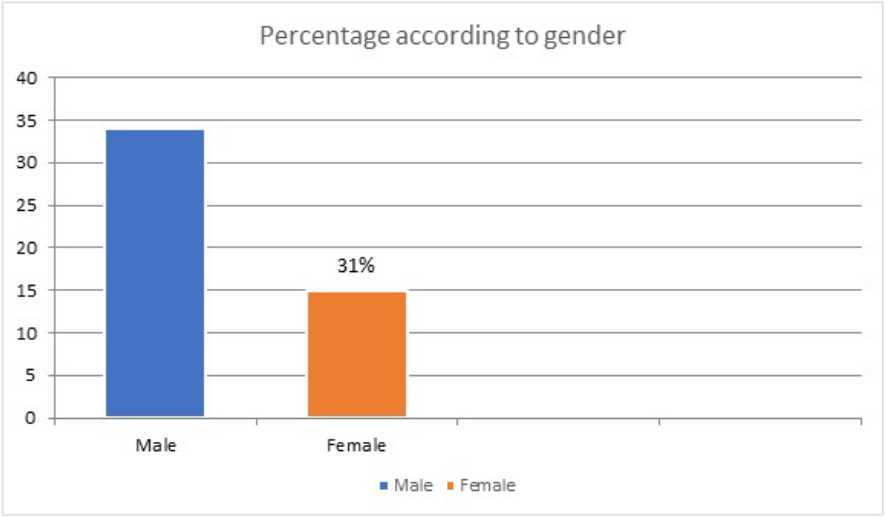

Fig. 1. Percentage of patients according to gender.

Table 2. Age of patients who underwent emergency ophthalmic surgery in HKL

Age group (years)	**Number of patients**
≤ 10	1
11–20	2
21–30	13
31–40	12
41–50	4
51–60	7
61–70	5
> 70	5
Total	49

There were 39 (80%) sight-threatening cases and 10 (20%) non-sight threatening cases. As seen in Figure 2, sight- or life-threatening cases consisted of trauma cases (corneoscleral laceration, globe rupture), vitreoretinal cases (vitrectomy for giant retinal tear, retinal detachment, endophthalmitis), and evisceration for panophthalmitis. The non-sight threatening cases (Fig. 3) consisted of lid laceration with or without canalicular cut, conjunctival laceration, iris repositioning, intraocular lens repositioning, and glaucoma surgery, such as reimplantation of Xen Gel stent implant. A total of 32 cases required general anaesthesia, while 17 patients required local anaesthesia.

Vitreoretinal cases and corneoscleral laceration cases each comprised 45% of the sight-threatening cases, followed by globe rupture with 8% and panophthalmitis with 2%. Most of the sight-threatening and non-sight threatening cases in HKL were due to trauma, accounting for 26 cases out of 49 emergency ophthalmic cases.

As described in Table 3, most surgeries (18 cases) were performed within 6 hours of admission/decision for surgery. Only 2 surgeries were delayed more than 24 hours. A vitreoretinal case had a waiting time of 26 hours due to electrocardiogram changes and hypokalaemia. The second case was a case of planned for evisceration for panophthalmitis that was delayed due to syndrome of inappropriate antidiuretic hormone. Both patients were referred to the medical team for stabilisation prior to surgery. The cause of the delay in both patients was not due to the COVID-19 pandemic but to their medical comorbidities.

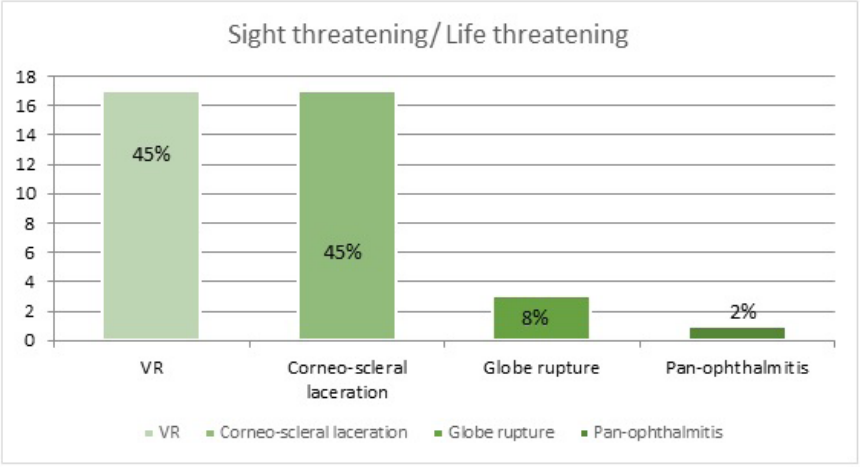

Fig. 2. Sight-threatening and life-threatening ophthalmic emergencies.

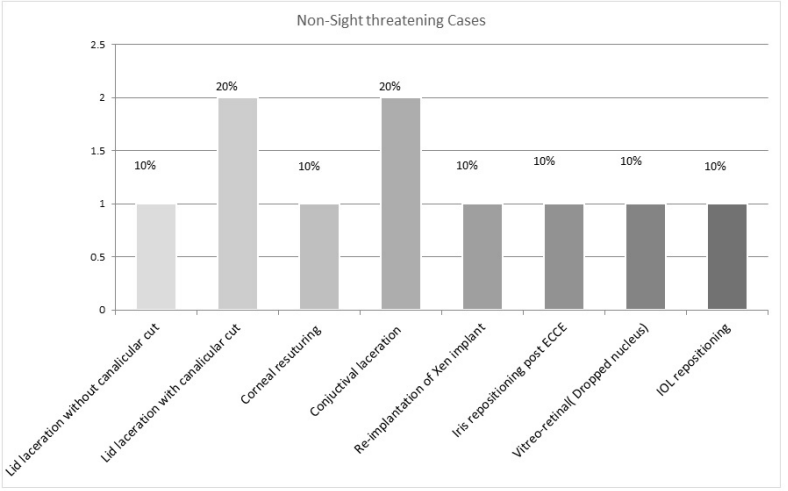

Fig. 3. Non-sight threatening ophthalmic emergencies

Table 3. Waiting hours for emergency ophthalmic surgery

Hours from admission/decision for surgery to surgery (hours)	**Number of surgeries**
≤ 6	18
7-12	13
13-18	3
19-24	13
> 24	2

Discussion

To reduce the COVID-19 cases, Malaysia enacted a movement control order (MCO) beginning March 18, 2020.[4] During the 1–4 phases of movement control order, elective surgeries were placed on hold. However, patients requiring emergency ophthalmic surgery were not diverted to other centres due to the hybrid status of the hospital, which handled both COVID-19 and non-COVID-19 patients. To cope with the increasing COVID-19 patient load, HKL repurposed its wards and converted its operating theatres into intensive care units for patients who needed ventilators.[4] Health services and personnel were redistributed and surgical wards, including ophthalmology, were affected.[4] To ensure an adequate number of medical officers and staff for on-call duty, they were redistributed on a rotation basis. The vacant Maternity Block and Paediatric Institute, whose services had been recently transferred to Hospital Tunku Azizah, were reopened as non-COVID and transition wards.[4]

The purpose of this audit was to identify whether there were delays in the waiting time for emergency ophthalmic surgery at HKL due to the COVID-19 pandemic, with its attendant the lack of staff and operation theatre time. The waiting time was calculated from the time of admission/time of diagnosis to the time of surgery. The standard was set as 100 % for acceptable waiting time of 24 hours. According to our results, a total of 47 cases out of 49 cases were performed within 24 hours.

The delay of more than 24 hours in the remaining 2 cases were due to the patients' systemic comorbidities. The vitreoretinal case had a waiting time of 26 hours due to electrocardiogram changes and hypokalaemia. This patient was diagnosed with proliferative diabetic retinopathy, rhegmatogenous retinal detachment, and vitreous haemorrhage in the left eye, and scheduled for vitrectomy, endolaser, and tamponade. The second case was a case of planned evisceration for panophthalmitis that was delayed due to syndrome of inappropriate antidiuretic hormone. Both patients were referred to the medical team for stabilisation prior to surgery. We are not able to say whether there was a delay in the management of this patient's medical comorbidities due to the COVID-19 pandemic. According to the RCO guidelines, evisceration for risk of sepsis is considered an urgent case with an acceptable waiting time of 72 hours.[7] Evisceration for our second patient was performed within 48 hours, so our team was able to adhere to the international standards despite the pandemic.

We performed COVID-19 diagnostic testing for all patients requiring emergency ophthalmic surgery. Since most of our patients performed the rapid test kit (RTK) antigen, they were able to undergo surgery in less than 24 hours. Fortunately, all 49 patients who underwent emergency ophthalmic surgery at HKL were COVID-19-negative. HKL's infection control team mandated COVID-19 diagnostic testing for all admitted patients to prevent intra-hospital transmission to other patients as well as HKL staff. Even though or management algorithm for emergency cases was similar

to that of Yeoh *et al.*, we did not routinely perform chest X-rays for all patients and most of our patients underwent rapid COVID-19 testing instead of PCR.[1]

The preponderance of men (69%) and patients aged 21–30 years might have been due to occupational factors. More than half our cases (53%) were caused by trauma, which is similar to the results found by Tang *et al.* These trauma cases could have been easily avoided if personal protective equipment had been used. Although there might have been a general reduction in ocular trauma due to the MCO itself, further studies are needed to confirm this. While in China Hao *et al.* reported mostly emergency glaucoma cases, our ophthalmic emergency team had only one glaucoma case.[5-6] The majority of our cases (65%) need general anaesthesia, similar to Tang *et al.*, for which 73% of cases also needed general anaesthesia.[6]

This retrospective audit has three main limitations. First, the management algorithm for emergency ophthalmic cases varied slightly during the pandemic. Second, the data for this audit was collected from the operation theatre record book. As this is a retrospective study, there may have been variations in the timings documented. Third, there might have been a generalized reduction in the total number of emergency ophthalmic cases during the COVID-19 pandemic compared to previous years due to the MCO, which might have made it easier to manage.

Conclusion

The cause of the delay in both patients were not due to the COVID-19 pandemic but due to medical co-morbidities. Despite the limitation of staff and resources during the COVID-19 pandemic, ophthalmic emergency surgeries were carried out on appropriate timing without delay.

Declarations

Ethics approval and consent to participate

Competing interests
None to declare.

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Establishing a safe, medical officer-led intravitreal injection clinic: minimizing inadvertent crystalline lens injury

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Abstract

Purpose: To study the incidence of iatrogenic crystalline lens injury in a medical officer-led intravitreal (IVT) injection clinic and to evaluate the effect of a structured training programme designed to teach medical officers how to safely administer IVT injections.
Study design: Clinical audit.
Methods: The first phase of the clinical audit comprised a retrospective analysis of the consecutive numbers of IVT injections between January and December 2020. Outcome measures included incidence and risk factors of lens injury. Target incidence rate of iatrogenic crystalline lens injury was set at < 0.06%. Intervention was implemented in the form of a structured training programme over the course of 4 months. The programme encompassed a lecture and video on proper administration techniques, as well as a handout detailing the key points. Medical officers were guided, directly supervised, and assessed by a single ophthalmologist and were required to complete a logbook before being sanctioned to perform IVT independently. Re-audit was done on the consecutive numbers of IVT injections in the following year, between May 2021 and April 2022.
Results: Out of 1,952 IVT injections performed by medical officers pre-intervention, 3 cases of iatrogenic lens injuries were reported, corresponding to an incidence rate of 0.15%. One patient was uncooperative. No other risk factors were identified.

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Post-intervention, our target was achieved with zero injection-related lens injury out of 2,118 consecutive IVT injections.
Conclusion: A structured training programme results in highly skilled medical officers delivering a well-rounded service that improves the quality of care and reduces the rate of adverse events in a large overburdened tertiary centre. Training must be conducted on a regular basis due to the entry of new medical officers periodically.

Keywords: anti-vascular endothelial growth factor therapy, iatrogenic lens injury, intravitreal injection, structured training programme

Abstrak

Tajuk: Penubuhan klinik suntikan intravitreal yang selamat di bawah pantauan pegawai perubatan: mengurangkan kecederaan tidak sengaja kepada kanta mata.
Tujuan: Menyelidik kejadian kecederaan tidak sengaja kepada kanta mata di dalam klinik suntikan intravitreal (IVT) yang dikendalikan oleh pegawai perubatan dan menilai kesan program latihan berstruktur yang direka untuk mengajar pegawai perubatan cara untuk memberikan suntikan IVT dengan selamat.
Reka bentuk kajian: Audit klinikal.
Kaedah: Fasa pertama audit klinikal terdiri daripada analisis retrospektif bagi jumlah suntikan IVT berturut-turut antara Januari hingga Disember 2020. Pengukuran hasil termasuk kejadian dan faktor risiko kecederaan kanta. Kadar kejadian sasaran bagi kecederaan kanta kristal iatrogenik ditetapkan pada < 0.06%. Intervensi dilaksanakan dalam bentuk program latihan berstruktur selama empat bulan. Program ini merangkumi ceramah dan video mengenai teknik pentadbiran yang betul, dan bahan rujukan yang mengandungi butiran penting disebarkan. Pegawai perubatan diberi arahan, diawasi secara langsung dan dinilai oleh seorang pakar oftalmologi, dan dikehendaki menyiapkan log buku sebelum dibenarkan menjalankan IVT secara bersendirian tanpa diawasi. Audit semula dilakukan pada jumlah suntikan IVT berturut-turut pada tahun berikutnya, antara Mei 2021 hingga April 2022.
Keputusan: Daripada 1,952 IVT yang dilakukan oleh pegawai perubatan sebelum intervensi, 3 kes kecederaan kanta mata dilaporkan, yang sepadan dengan kadar kejadian 0.15%. Satu pesakit tidak bekerjasama. Tidak terdapat faktor risiko lain yang dikenal pasti. Selepas intervensi, sasaran kami dicapai dengan tiada kecederaan kanta mata berkaitan dengan suntikan daripada 2,118 IVT berturut-turut.
Kesimpulan: Program latihan berstruktur menghasilkan pegawai perubatan yang sangat mahir memberikan perkhidmatan yang menyeluruh yang meningkatkan kualiti penjagaan dan mengurangkan kadar kejadian yang tidak diingini di hospital tertiari yang besar dan sibuk.. Latihan harus dijalankan secara berkala

kerana kemasukan pegawai perubatan baru berlaku dari masa ke semasa.

Kata kunci: kecederaan kanta mata, program latihan berstruktur, suntikan intravitreal, terapi anti faktor pertumbuhan endotelium vaskular

Introduction

Treatment options for retinal eye diseases have expanded over the years and intravitreal (IVT) drug delivery has emerged as the gold standard for treating many retinal disorders, especially after the introduction of anti-vascular endothelial growth factor (anti-VEGF) therapy. The benefit of IVT drug delivery is that it minimises systemic toxicity by targeting drug delivery directly to the posterior pole.[1] The several common retinal disorders treated by IVT injection include neovascular age-related macular degeneration (AMD), diabetic macula oedema (DME), retinal vein occlusions, and choroidal neovascularisation.

These procedures are conventionally performed by ophthalmologists. In some developed countries, these procedures are only performed by retinal specialists. However, with the increasing number of patients that have to undergo this treatment, it is slowly being delegated to medical officers or non-medical ophthalmic health professionals.[2] In the United Kingdom (UK), two-thirds of ophthalmic departments already have non-medical ophthalmic health professionals delivering IVT injections, according to a Royal College of Ophthalmologists paper from 2017 titled *The Way Forward*.[3] Increasingly, Michelotti *et al.* reported that many ophthalmology departments in the UK are already training ophthalmic nurse injectors to undertake the procedure, which was previously only performed by ophthalmologists.[4]

In a similar vein, there is a significant rise in the number of patients in our public healthcare system who require IVT anti-VEGF therapy to treat retinal diseases. The Department of Statistics Malaysia reported that, the percentage of Malaysians 65 and older is expected to rise from 5.0% in 2010 to 14.5% by 2040.[5] In addition, the country's aging population structures and rising life expectancy are expected to drive up the number of IVT injections.

Patients treated with anti-VEGF for wet AMD and DME require numerous injections and follow-up visits. Oftentimes, the limiting factor is an issue with capacity within the public hospital eye services to treat patients due to the large number of patients requiring injections and the high number of injections required per patient.[6] There are simply not enough ophthalmologists to meet the demand. This necessitates training medical officers in the ophthalmology department to administer the injections to cater to a large number of injections and to ensure the smooth-running of the daily IVT injection clinic. Additionally, it is essential for trainees to attain proficiency in administering injections prior to their graduation

as ophthalmologists. Simulation can be a valuable training tool for IVT injections to increase safety. It provides a standardised training experience for all trainees and allows practitioners to familiarise themselves with the procedure in a controlled environment before performing it on actual patients, helping to mitigate the many inherent risks of IVT injection. This consistency ensures that practitioners are well-prepared and follow best practices, which ultimately enhances patient safety.

Even though IVT injections improve vision in a variety of retinal diseases, each IVT injection poses the risk of adverse events. Repeated and long-term injections may lead to ocular and systemic complications. In a comprehensive systematic review, Jager et. al evaluated the prevalence of the most common serious adverse events associated with IVT injection and reported endophthalmitis, retinal detachment, iritis/uveitis, intraocular haemorrhage, ocular hypertension, cataract, and hypotony as some of the complications of the procedure. Retinal vein occlusions, anaphylactic reactions, and iatrogenic traumatic lens injury are among the other uncommon complications that have been identified.[7]

Iatrogenic crystalline lens injury is a rare complication of IVT which occurs due to contact or penetration of the lens by the needle tip. Although it is uncommon, it should not be ignored because it can have significant visual consequences and can complicate future cataract surgery. Meyer *et al.* reported the overall incidence of traumatic lens injuries at 5 high-volume centres in Europe and South America over 36-months to be 0.006% (2/32,318).[8] In the International IVT Bevacizumab Safety Survey, Fung et. al. mentioned only 1 lens injury among 7,113 IVT injections (0.014%).[9] Similarly, the VISION study observed that this complication is rare with only 5 lens injuries during 7,545 injections (0.067%).[10]

This study was conducted to determine the incidence of this rare IVT complication and to assess the efficacy of a designed structured training programme to prepare medical officers to become competent in administering IVT injections safely and effectively while minimizing the complication of iatrogenic lens injury in a high-volume injection clinic operated by medical officers.

Methods

Before the audit, recently joined medical officers typically observe and assist senior medical officers during IVT injection sessions. Following this observational period, they are entrusted with the responsibility of conducting IVT injections themselves after participating in 2 to 3 sessions as observers.

A retrospective audit of the consecutive number of IVT injections between January and December 2020 was conducted. Outcome measures were the incidence and risk factors of lens injury. The progression and management of each respective case were also studied in detail. A target incidence rate of iatrogenic crystalline lens injury was set by our department at < 0.06%.

Following the first audit, a structured training programme for the medical officers was designed and implemented over a period of 4 months. Training of medical officers consists of the following components (Fig. 1):

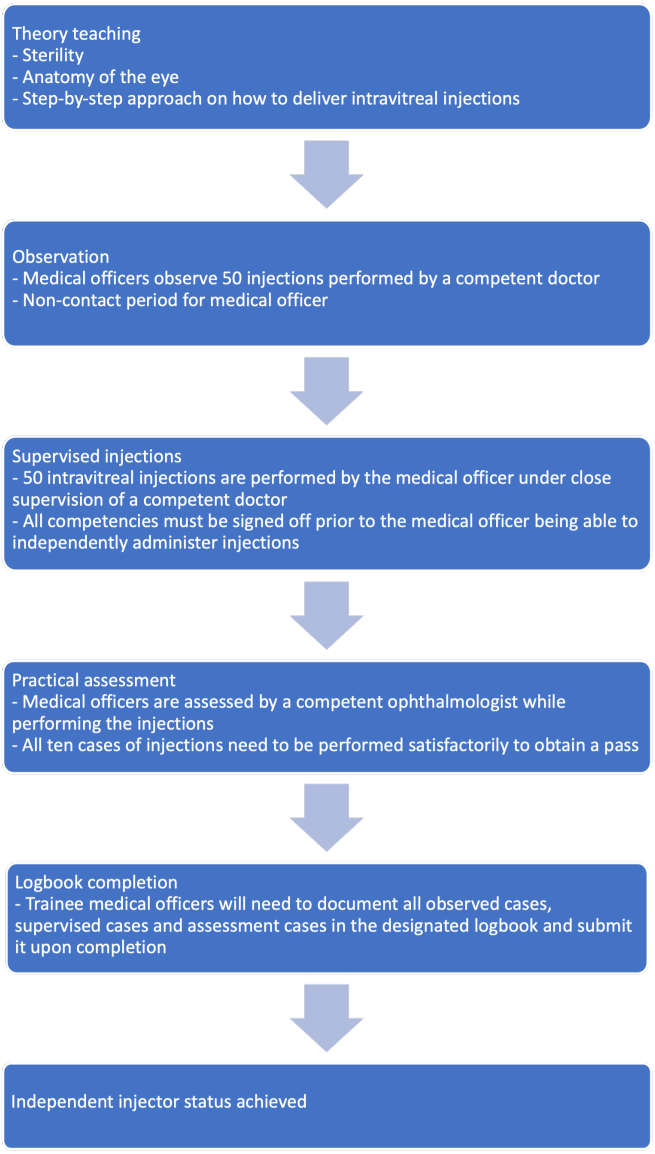

Fig. 1. The Hospital Pulau Pinang medical officer training pathway to become independent practitioners.

- Theory course: The trainee medical officer was provided with a handout that contains fundamental information about the procedure. The course also included a lecture that covered fundamental information regarding the eye's anatomy and the theoretical aspects of delivering the injections (Appendix, Fig. 1). A video demonstration was also included.
- Observation: The trainee medical officer observed a minimum of 50 IVT injections administered by a competent doctor over 4 to 5 injection clinics.
- Injecting under supervision: A minimum of 50 injections were administered by the trainee medical officer under the supervision of a competent doctor. When this part of training was successfully completed, the trainee medical officer proceeded to the final evaluation.
- Practical assessment: The trainee medical officer performed 10 injections under observation of an ophthalmologist. Only when the medical officer had achieved 10 satisfactory cases, the practitioner was signed off to carry out injection sessions independently.
- Logbook completion (Appendix, Fig. 2): The trainee medical officer documented all observed cases, supervised cases, and assessment cases in the designated logbook and submitted it upon completion.

A re-audit was done on the consecutive number of IVT between May 2021 and April 2022. Outcome measures were the incidence of lens injury and risk factors of lens injury.

Results

Over a period of 12 months from January to December 2020, a total of 1,952 IVT injections were performed by medical officers. From those, 3 cases of iatrogenic lens injury were reported, corresponding to an incidence rate of 0.15% (3/1,952).

The breakdown of the 3 cases of iatrogenic lens injury were as follows (Table 1):

- Case 1: Iatrogenic lens injury was detected upon ophthalmic examination during follow-up. There was an evident track-like superotemporal posterior subcapsular cataract which corresponded with the site of IVT injection. The cataract remained quiescent on follow-up.
- Case 2: An ocular examination revealed iatrogenic lens damage during follow-up. There was an evident track-like superotemporal posterior subcapsular cataract that corresponded with the site of IVT injection. The patient developed a significant visually impairing cataract and underwent phacoemulsification with lower fluidic settings, anterior vitrectomy, and sulcus intraocular lens implantation.
- Case 3: Iatrogenic lens injury was only detected intraoperatively. The patient developed a white cataract 3 months post-IVT injection and was scheduled to undergo a cataract operation. Posterior capsule puncture was only discovered

Table 1. Summary of reported cases of iatrogenic lens injury

Case number	Case 1	Case 2	Case 3
Case detection	During follow-up	During follow-up	Intraoperatively
Signs of lens injury	Track-like superotemporal posterior subcapsular cataract correlating with the site of injection	Track-like superotemporal posterior subcapsular cataract correlating with the site of injection	During cataract surgery for white cataract, pre-existing posterior capsule rupture was noted
Progress	No obvious progression, quiescent	Developed visually significant dense diffuse posterior subcapsular cataract	Nucleus drop occurred intraoperatively
Management	Observation and watchful waiting	Phacoemulsification with lower fluidic settings, anterior vitrectomy, sulcus intraocular lens implantation	Pars plana vitrectomy, lensectomy

intraoperatively as the nucleus dropped. The patient subsequently underwent pars plana vitrectomy and lensectomy.

Identification of risk factors was categorised into patient factors, procedural factors, and physician factors (Table 2). For patient factors, patients received a range of 3 to 12 injections before the complication occurred. None of the patients were hyperopic, with spherical equivalent ranging from plano to -1.25 and axial length of 23.37 mm to 24.20 mm. None of the patients had a narrow palpebral fissure. All the patients were in the supine position for the procedure. Only 1 of the 3 cases was documented to be anxious during the procedure and had significant head motion during the injection. None of the 3 did not report any pain during the injection. In all 3 cases, the injection was at the superotemporal quadrant of the left eye, 4 mm from the limbus, measured with a calliper. For the procedure, the size of the needle used was a standardised 31-gauge insulin needle, 8 mm in length. All 3 had 0.05 ml of medication injected into the eye. For physician factors, in all 3, the physician was standing at the head of the table while performing the procedure and all had a cumulative experience of at least 100 injections prior to the event.

Following an intervention period of 4 months, the re-audit conducted over a period of 1 year from May 2021 to April 2022 did not reveal any cases of iatrogenic lens injury out of a total of 2,787 IVT injections, corresponding to an incidence rate of 0%. The target incidence rate of iatrogenic crystalline lens injury of < 0.06% was achieved.

Table 2. Analysis of possible risk factors

Patient	**Case 1**	**Case 2**	**Case 3**
Number of previously received injections (*n*)	7	3	12
Patient's refraction spherical equivalent (dpt)	Plano	-1.25	-0.50
Axial length (mm)	23.54	24.20	23.37
Small lid margin	No	No	No
Patient position during injection	Supine	Supine	Supine
Anxious patient	No	Yes	No
Head motion during injection	No	Yes	No
Pain during injection	Not reported	Not reported	Not reported
Injected eye	OS	OS	OS
Location of injection	Superotemporal	Superotemporal	Superotemporal
Procedure			
Size of used needle (gauge)	31G	31G	31G
Applied volume (mL)	0.05	0.05	0.05
Physician			
Position of treating physician	Standing	Standing	Standing
Experience of medical officer in terms of number of injections (*n*)	> 100	> 200	> 200

Discussion

During IVT injection, the IVT needle path is in close proximity to the crystalline lens. This confers an increased risk of iatrogenic lens injury.[11] Iatrogenic lens injury brings many consequences. It can be localised and quiescent, likely because a small lens wound could heal spontaneously due to the proliferation of the subcapsular epithelium, which would seal the wound before the intraventricular passage of ions and fluid.[12] On the other side of the spectrum, cataract progression could occur and be visually significant, necessitating cataract extraction. Some signs to look out for include retroillumination to highlight any marks indicating injury from IVT, a visible capsular channel perforation on the posterior capsule of the lens, focal or diffuse posterior subcapsular opacification, progressive opacification of lens, and total white cataract due to liquefaction of the cortex.[13]

Iatrogenic lens injury poses important surgical concerns that surgeons should be aware of. Hahn *et al.* reported a higher rate of intraoperative and postoperative complications in eyes with prior IVT injections, likely due to unidentified injury during IVT.[11] Therefore, deliberate attention should be given to the posterior capsule during preoperative cataract assessment and intraoperatively in eyes with a prior history of IVT.

The structured training programme guides the medical officers to be well-versed in the safe execution of the procedure. Some important tips pointed out by Su *et al.* include an accurate selection of needle entry points and angles, appropriate anaesthesia, the importance of stable head fixation, and a comprehensive understanding of the patient's condition before carrying out the procedure.[13] The programme also provides the medical officers with adequate exposure during the initial observation period prior to performing the procedure itself. The other positive ramification is that medical officers play a more active role in the patients' treatment.

We acknowledge a few study limitations. First and foremost, the study is limited by its retrospective design. The initial challenge of setting up the training programme was that time must be set aside to provide training and to conduct assessments amidst an overburdened, busy clinic. There may also be the possibility of under-reporting of case morbidities. Among the 3 case morbidities reported pre-intervention, 2 of the eyes did not have documented lens trauma in the patient records, so it is very likely that this inadvertent interaction generally occurs unknowingly. Some cases might not be picked up during follow-ups, especially cases that are quiescent. There may also be cases where the patient does not notice changes in vision due to pre-existing poor vision. Longer post-intervention surveillance might be more reflective of the impact of the intervention.

Conclusion

The indications and need for IVT injections continue to grow, and the burden of treatment is beginning to extend beyond ophthalmologists to trainees. Streamlining the training process allows for maintaining high-quality standards and allows medical officers in training to establish a safe, efficient, and cost-effective medical-officer-led IVT injection clinic. The structured training programme is effective in reducing the rate of adverse events in a large overburdened tertiary centre. Nevertheless, it is ideal if a competent ophthalmologist or a senior medical officer could be available for consult while medical officers are performing the procedure should the need for help or urgent complications arise.

Declarations

Ethics approval and consent to participate
This study is registered with NMRR, ID-22-01536-QK4. Retrospective studies do not require ethics approval nor informed consent.

Competing interests
None to declare.

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None to declare.

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Appendix

INTRAVITREAL INJECTION TECHNIQUE

1) Confirm consent and correct eye.
2) Instil topical Alcaine into fornix of eye being injected.
3) Instil 5% povidone-iodine into fornix of eye being injected.
4) Clean around eye with 10% povidone. Dry.
5) Drape the eye.
6) Prepare solution in syringe with a 30G needle in correct volume and make sure air bubble expelled prior to injection.
   - **Ranibizumab 0.5mg/ 0.05ml**
   - **Aflibercept 2mg/0.05ml**
7) Apply lid speculum.
8) Measure 4.0mm (phakia)/ 3.5mm (pseudophakia/ aphakia) posterior to limbus with caliper.
9) Keep caliper in place to stabilize the globe.
10) Inject anti-VEGF at superotemporal/ inferotemporal quadrant into intravitreal cavity by inserting needle perpendicular, aim towards centre of the globe.
11) Keep syringe in place, replace caliper with cotton tip applicator and cover injection site upon removal of syringe.
12) Instil a drop of topical ciprofloxacin immediately post-injection.
13) Check that patient has at least CF vision post injection.
14) Clean eye and discharge patient with topical antibiotic eyedrops and warning signs of infection/ RD.

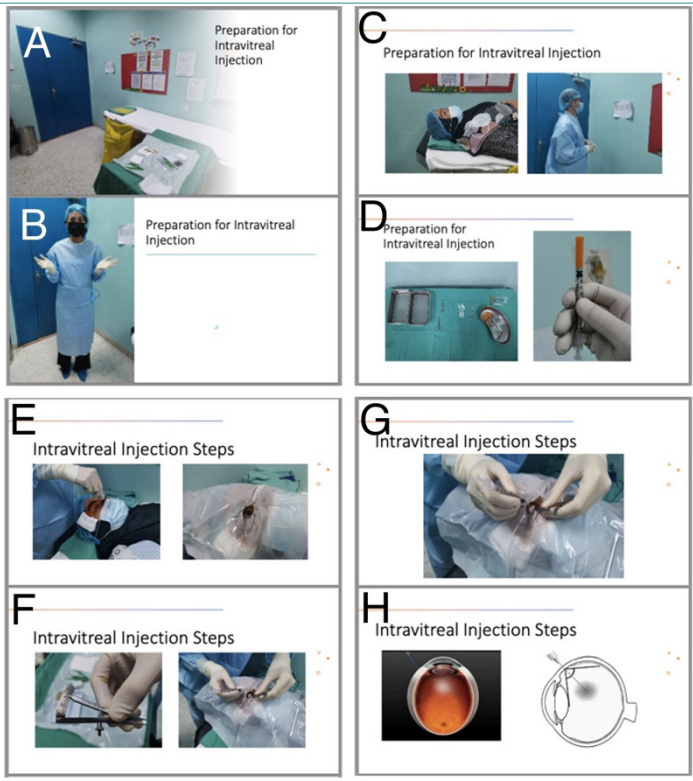

Fig. 1. (*A-H*) The handouts for theory teaching and compilation of CME slides.

INTRAVITREAL INJECTION LOGBOOK

A
OBSERVED (50 cases)

No.	Date	Diagnosis	Procedure	Complications	Remarks	Supervised by (Sign)
1						
2						
3						
4						
5						

B
PERFORMED UNDER SUPERVISION (50 cases)

No.	Date	Diagnosis	Procedure	Complications	Remarks	Supervised by (Sign)
1						
2						
3						
4						
5						

C
PERFORMED UNDER SUPERVISION (10 cases)

No.	Date	Diagnosis	Procedure	Complications	Remarks	Supervised by (Sign)
1						
2						
3						
4						
5						

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Traumatic angle-recession glaucoma: a literature review

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Abstract

Ocular trauma is a main cause of ocular comorbidity worldwide. Cornea or lens injury, secondary glaucoma, vitreous haemorrhage, retinal or choroidal detachment, and endophthalmitis are the sequelae of ocular injury causing vision loss. Many articles have been published identifying the common sequelae of closed globe injuries, including the risk of developing secondary glaucoma from angle recession. This review article aims to cover the sequelae of closed globe ocular trauma, the definition of traumatic angle-recession glaucoma (TARG), and the natural course, detection, management, and prophylactic treatment of TARG.

Keywords: angle recession, closed-globe trauma, traumatic angle-recession glaucoma

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Glaukoma sekunder kemelesetan sudut akibat trauma: tinjauan literatur

Abstrak

Kecederaan pada mata adalah penyebab utama masalah komorbid melibatkan mata di seluruh dunia. Kecederaan pada kornea atau kanta, glaukoma sekunder, pendarahan pada vitreous, lekangan retina atau koroidal adalah kesan kecederaan pada mata yang boleh menyebabkan hilang penglihatan. Terdapat banyak artikel yang dibentangkan untuk mengenalpasti kesan kecederaan bola mata tertutup ataupun kecederaan akibat benda tumpul, termasuklah risiko terbentuknya glaukoma sekunder akibat daripada kemelesetan sudut (angle recession). Artikel ini bertujuan untuk meninjau literatur berkaitan dengan kesan kecederaan akibat bola mata tertutup termasuk mengenai definisi glaukoma kemelesetan sudut akibat trauma (GSKT atau TARG) serta kesan jangka panjang, cara pengesanan, rawatan dan profilaksis.

Kata kunci: glaukoma sekunder akibat daripada kemelesetan sudut, kecederaan bola mata tertutup, kemelesetan sudut

Introduction

Ocular trauma is a common cause of ocular comorbidity with 19 million people suffering from trauma-related monocular blindness or low vision worldwide.[1] Approximately three-quarters of a million patients are hospitalized every year due to eye injuries throughout the world.[2] In Australia, The National Eye Health Survey (NEHS) for 2016 reported approximately 2.4 and 7.9 per 1,000 nonindigenous and indigenous adults suffered monocular vision loss as a result of eye injury.[3] Several studies have shown that 90% of ocular trauma is preventable.[1-4] Agriculture related injury contribute among the most important causes of visual loss in developing countries.[1-4]

In many population-based studies, there is a higher incidence of ocular trauma in males compared to females.[5] This has been also reported in a study in Kuching, Malaysia, where the percentage is greater in males, 85.8% (n = 200), with a male-to-female ratio of 6:1.[6] The highest percentage occurs is young adults in the third decade of life and the second peak is in the elderly.[5,6] There are a variety of causes of ocular trauma, mainly work related injury, while others include home-related injury, violence-related injury, and road related injury.[7] While the greater incidence in males is likely multifactorial, *e.g.*, aggressive behaviour, work or sports related, assault, and alcohol and drug abuse, the incidence of ocular trauma in the elderly

occurs as a result of poor vision probably secondary to other ocular conditions such as cataract, diabetic retinopathy, glaucoma, and age-related macular degeneration.

Ocular trauma has increasingly become a public health burden worldwide. It is estimated that the hospital charges in the United States were between USD 175 million and USD 200 million per year in 1986, which required 227,000 days of hospital care.[8] In Australia, open-globe injuries are responsible for 44% of the expenditure on ocular injuries, with an estimated cost of USD 155 million per year.[9]

For individuals, ocular injuries have a huge psychologic and economic impact due to absence from work, frequent hospital visits, and treatment and rehabilitation costs, especially in the reproductive age group.[8] In younger age groups, ocular trauma affects school performance and family dynamics, in addition to its psychologic and social impact.[10]

Impact of trauma

Ocular trauma has several aetiologies and differs between urban areas and other settings, as well as between countries, world regions, and demographic and socioeconomic classes. It ranges from minor injuries to major injuries resulting in vision loss or loss of the eye. Initial eye assessment and early diagnosis, appropriate first aid from a primary team with prompt referral to an ophthalmology team, and early treatment is very important as ocular trauma can lead to sight-threatening complications. The Birmingham Eye Trauma Terminology (BETT) classification system provides a consistent and comprehensive system for ocular trauma which classifies injuries as closed or open globe.[11] The modified BETT classification system includes periocular injuries with or without retained foreign bodies.[12] However, ocular trauma also can be broadly classified based on the causative object and extent of the injury, such as blunt or penetrating ocular injury.[13] The diagnosis and treatment of various ocular traumas differs depending on the underlying aetiology, severity of the case, and potential complications.

Ocular trauma may result in pathology of the eyelids, lacrimal drainage system, ocular surface and adnexa, extraocular muscles, orbital walls, eyeball, and optic nerve. The ocular structures in the anterior segment, *i.e.*, conjunctiva, cornea, trabecular meshwork, crystalline lens, and iris, are commonly affected by direct trauma compared to the structures within the posterior segment, *i.e.*, optic nerve, choroid and retina.[14] Combined anterior and posterior segment injuries cause worse prognosis and poor visual outcome.[15-17]

Although protected by the bony orbit, the structures around the globe are also prone to traumatic injuries. Orbital compartment syndrome, globe laceration, eyelid laceration, and damage to the lacrimal drainage system are among the injuries reported around the globe.[18] While the anterior segment is commonly

exposed to minor trauma, with corneal abrasion as the most common injury presenting at primary care,[19] other type of injuries also commonly seen, including corneal foreign bodies, corneal laceration, hyphaema, lens dislocation, and traumatic cataract.

Local or systemic injuries may cause abnormalities in the posterior segment. They may be asymptomatic or worsen to cause vision loss. Blunt trauma can cause local injury and may damage the retina (commotio retina), choroid (choroidal rupture), and optic nerve (optic nerve avulsion). Systemic trauma may result in diffuse retinopathy (Purtscher's retinopathy), shaken baby syndrome, or localized retinal abnormalities (whiplash retinopathy, fat embolism syndrome).[20]

Closed-globe ocular trauma

According to Khokhar *et al.*, open-globe injuries occur more frequently than closed-globe injuries; however, other studies have found that closed and open-globe injuries occur at rates of 41.9% and 59.4%, respectively.[21,22] The BETT classification system broadly classifies closed-globe ocular trauma as contusion injury or lamellar laceration involving partial-thickness wounds of the eyeball.[11] The location of injury is further classified into 3 zones base on anteroposterior anatomic location of the injury:

- Zone 1: Superficial injuries limited to the bulbar conjunctiva, sclera, or cornea, including corneal abrasion and subconjunctival haemorrhage.
- Zone 2: Injuries involving anterior segment structures up to and including the lens apparatus, the lens zonules, and the pars plicata.
- Zone 3: Posterior injuries involving the pars plana, choroid, retina, vitreous, and optic nerve.[23]

The location and extent of the ocular injury are significantly determined by the different eye structures exposed to the injury and the mechanism of injury.

Sequelae of closed-globe ocular trauma

In closed-globe injuries, the ocular manifestations can be impacted by a wide range of closed-globe damage. In general, the anterior segment is the most injured structure in an ocular contusion. Traumatic cataract and glaucoma resulting from ocular trauma can also occur in the setting of both open- and closed-globe injuries. In closed-globe injury, the risk of developing secondary glaucoma has been associated with angle recession, hyphaema, iris injury (iridodialysis), lens injury, corneal injury, and vitreal injuries (intravitreal haemorrhage, vitreous loss)[24,25]

Various posterior segment abnormalities have been reported as result of closed-globe injury. The sequelae of closed-globe injury in the posterior segment include traumatic retinal tear, detachment, or dialysis, traumatic macular hole, commotio retina, contusion of the retinal pigment epithelium, choroidal rupture, chorioretinitis sclopetaria, and optic nerve avulsion.[20,26]

In a study among 122 cases of closed-globe contusion injury, 89 (73%) had traumatic hyphaema with 8 of the eyes (8.9%) had re bleeding. One eye out of that eyes complications including secondary glaucoma, cataract and posterior segment injuries that necessitated surgical intervention.[24] Poor visual outcomes are seen in globe ruptures, zone 3 injuries, poor initial visual acuity, wound length > 10 mm, and lens trauma.[24] In another study, closed-globe injury with severe vitreous haemorrhage was associated with a high incidence of retinal defect (retinal tear and dialysis) and retinal detachment.[25]

Visual outcomes appear to depend on the severity of the closed-globe injury. In a study by Shah *et al.*, among 1,010 individuals in the paediatric age group (0–18 years) with closed-globe injury with involvement of 1-6 tissues in all cases, 649 eyes (64.3%) regained > 6/24 visual acuity, whereas 247 eyes (24.5%) did not regain more than 1/60.[21] However, in a study reported by Edita *et al.*, most closed-globe injury (81.7%) cases did not cause any final visual impairment in the affected eye as compared to open-globe injury.[27] However, these findings must be understood the study's retrospective nature, which contained a large number of underreported ocular trauma associated with other multiple head injuries and difficulty in determining visual acuity from the ophthalmic examination.[27]

Definition of traumatic angle-recession glaucoma

Angle recession is a common finding after blunt traumatic injury and is usually associated with traumatic hyphaema. Although it can also occur without haemorrhage in the anterior chamber, the presence of traumatic hyphaema has been reported in 71–100% of eyes.[28] Other conditions also associated with angle recession include iridodialysis, iris sphincter tears, and transillumination defects with pigmented dispersion.[29]

Generally, angle recession is defined as the separation of the longitudinal and circular muscle fibres of the ciliary muscle, which can be seen by gonioscopy at the slit lamp following trauma.[30] Histologically, angle recession is detected by a tear between the longitudinal and circular fibres of the ciliary muscles. It was first described in 1982 by Colin, who observed the deformity in anterior chamber angles of enucleated eyes after nonpenetrating trauma.[31] Later, the correlation between traumatic angle recession and late-onset glaucoma was established in 1962 by Wolff and Zimmerman.[30] The proposed mechanism of angle recession after closed-globe injury is the sudden force in anteroposterior compression causing sudden equatorial expansion, and resultant outward movement of the ocular wall causing the injury.[30] Angle recession may develop into secondary glaucoma in a small percentage of eyes months or years after the trauma.[32] In a 10-year prospective study of 31 eyes by Kaufman and Tolpin, glaucoma developed in 6% of cases of angle recession.[32]

Natural course of traumatic angle-recession glaucoma

The incidence of glaucoma in angle recession after trauma appears at two peaks: early (less than 1 year) and late (after 10 years).[28,32] Some cases have reported traumatic angle-recession glaucoma more than 50 years after the initial injury.[33] In early onset of traumatic angle-recession glaucoma, the intraocular pressure (IOP) can be normal and the decreased outflow facility compensated by ciliary body hyposecretion, increased uveoscleral outflow, small cyclodialysis cleft, or trabecular tear causing communication between Schlemm's canal and the anterior chamber.[31] The IOP may be elevated after these factors are normalized. After a period, the trabecular meshwork regains its function with normal outflow facility and IOP; however, the IOP may be persistently elevated.[31] A small percentage of these individuals go on to develop glaucomatous optic neuropathy and vision loss. This late-onset angle recession glaucoma detection is important as it always presents late. Other causes of secondary open angle glaucoma must be ruled out as it always present unilaterally and years after the injury. In one study , elevated IOP was detected in the contralateral injured eye and this increased the risk of open angle glaucoma.[34] This has led to the hypothesis that angle recession glaucoma accelerates the predisposition to developing open angle glaucoma bilaterally.[34,35]

Detection of traumatic angle-recession glaucoma

Traumatic angle recession is diagnosed based on the history and clinical findings. Angle recession must always be considered in cases of unilateral glaucoma or traumatic hyphaema after blunt trauma.[28,32] Clinically, angle recession is detected by slit lamp gonioscopy examination using indirect gonioscopy lenses (*e.g.*, Zeiss or Goldmann lens).[33]

In 1962, Wolff and Zimmerman described angle recession in 17 of 300 eyes which had been enucleated post-contusion injury.[30] The inner circular muscles of the ciliary body appeared to be separated while the longitudinal muscle remain attached to the scleral spur, thus forming a new boundary to the recessed angle. The circular muscles fibre later became atrophied and advanced degenerative changes were seen in the trabecular meshwork. These degenerative changes showed predominantly atrophy, with or without presence of fibrosis or a hyaline membrane covering the inner surface of the trabeculum. This correlation explained the late onset of glaucoma with angle recession.[36] These changes damage the angle and trabecular meshwork, causing chronic lOP elevation with subsequent optic nerve damage. This rise in pressure may occur many months, years, or even decades after the ocular injury. Similar findings in a study by Melamed *et al.* suggested that collateral damage to the trabecular meshwork and Descemet-like membrane extension from the cornea over the trabecular meshwork results in elevation of IOP.[36]

According to the findings of Wolff and Zimmerman, there may be different gonioscopic findings in early or late cases. The appearance of the ciliary body in angle recession varies depending on the degree and extent of the injury.[37] Soon after the injury, the cleft into the face of the ciliary muscle is sharply demarcated while later the healing process causing fibrosis or development of hyaline membrane makes the cleft less defined. Small peripheral anterior synechiae seen at the lateral limits may extend into the peripheral area of angle recession, which may hide the angle recession from view. Comparison with the uninjured eye is helpful, especially in cases of minor ciliary body damage or in 360° recession, as these signs are occasionally hard to describe precisely. Frequently, the examiner must always change the lens from one eye to the other eye to look for subtle changes.[38] Minor recession appears as a disruption of the regular pattern of insertion of the iris fibres into the ciliary body or scleral spur.[37] For more severe injuries, the cleft extends into the ciliary body, the light grey portion of the ciliary band is broadened, and the scleral spur is more prominent.[37,39]

Howard and coworkers have proposed a classification of angle recession based on the depth of ciliary muscle tears.[37] In shallow tears, there is a separation of the uveal meshwork's processes, making the ciliary body band and the scleral spur more obvious than in the contralateral eye. Pigmented tags are seen at anterior surface on the peripheral iris, on the ciliary body band, on the scleral spur, and on the posterior portion of the trabecular meshwork. Compared with the contralateral eye, the ciliary body band seems darker and wider, and the scleral spur appears whiter. In shallow tears, no cleft is seen in the face of the ciliary body. In moderate tears, a definite cleft appears in the fibres of the ciliary muscle, and the angle looks deeper than that of the contralateral eye. Deep tears are characterized by ciliary body fissure, and the apex of the fissure cannot be seen by gonioscopy.

In moderate to severe angle recession, ultrasonographic biomicroscopy is useful when visualization of the angle structures is limited due to corneal opacity or other associated injury.[40] Angle recession may also be confused with cyclodialysis, in which the ciliary body is separated from scleral spur. It appears as visible white sclera posterior to the scleral spur and is associated with hypotony. Other differential diagnoses for angle deformity include iridodialysis, trabecular tears, and angle abnormalities secondary to previous ocular surgery.[35] Other causes of unilateral or asymmetrical glaucoma, such as uveitis, anterior segment tumours, lens induced glaucoma, pseudoexfoliation glaucoma, and glaucoma secondary to elevated episcleral venous pressure, should also be ruled out.

In a retrospective study by Razeghinejad *et al.* comparing 40 eyes with traumatic glaucoma after closed-globe injury and 52 eyes with no evidence of glaucoma after closed-globe injury, the features that were significantly associated with traumatic glaucoma included hyphaema, angle recession > 180°, lens displacement, and trabecular pigmentation.[29.] All these factors could be attributed to ciliary body

damage. An inflammatory response can occur not only at the site of injury but also throughout the ciliary body, iris, and trabecular meshwork. In the same study, IOP > 21 mmHg or more for at least 3 months was diagnosed as traumatic glaucoma.

Management of traumatic angle-recession glaucoma

The initial treatment for angle recession glaucoma is medical therapy that decreases aqueous formation, *e.g.*, beta-blockers, alpha2-agonists, or carbonic anhydrase inhibitors.[38,41,42] Cholinergic agents may not be beneficial to the patients, as they may paradoxically increase IOP probably by reducing the uveoscleral outflow while the angle recession compromises the trabecular outflow.[43] Treatment with miotics can cause increased vascular permeability and lead to fibrin clot formation at the anterior chamber in the acute phase, which increases the chances of posterior synechiae formation and later secluded pupil.[44] Prostaglandin analogues, which increase the uveoscleral outflow, are a choice after inflammation has resolved in the acute phase. The cases with immediate increased IOP after trauma are usually self-limiting and can be controlled with medication alone.[28,31,44]

Although several studies have demonstrated the efficacy of selective laser trabeculoplasty in treating various types of secondary glaucoma,[31,46] laser trabeculoplasty has had some success in the short term[31,33] and is not effective in the long term, especially for patients with angle recession greater than 180°.[31,46] Good outcomes were observed in 3 of 4 patients in a case series cases early in the post-treatment period and maintained for years after selective laser trabeculoplasty.[47] However, it was suggested that larger studies should confirm the safety and effectiveness of selective laser trabeculoplasty. Laser trabeculoplasty for angle-recession glaucoma was also reported as unsuccessful in cases where maximum tolerable medications failed to control IOP.[46]

Some success has also been observed with Nd:YAG laser trabeculopuncture.[31,48] Argon laser trabeculoplasty led to failure in 7 of 11 patients within 3 months, but patients had controlled IOP with Nd:YAG laser trabeculopuncture over 15 months of follow up.[48] In another study, however, Nd:YAG laser trabeculopuncture was not very effective, and the authors suggested offering it only in eyes where at least part of the trabecular meshwork maintains its normal anatomy without angle recession on gonioscopy.[35]

Surgical intervention in angle-recession glaucoma is more challenging than in primary open angle glaucoma. Trabeculectomy remains the first surgical choice, although failure rates are higher in angle recession (74%) compared to primary open angle glaucoma (43%) as reported in one study.[41] The use of adjunctive antimetabolites with trabeculectomy appears to be successful as first surgical procedure and Molteno implantation as a secondary procedure in angle recession

glaucoma. However, bleb associated infection rates are greater in angle recession patients.[41] The risk factors for surgical failure may be related to younger patients and comorbid trauma related to ophthalmic damage. It is also noticeable that fibrosis at the bleb develops earlier after trabeculectomy and requires additional medical or surgical therapy. The low success rate of glaucoma surgery is probably due to the high tendency for fibroblast proliferation and/or changes in aqueous humour properties.[39,49] This may be due to the absence of fibroblast growth inhibitory factors in the aqueous or the presence of stimulatory growth factors in these eyes.[34,49]

Prophylactic treatment of traumatic angle-recession glaucoma

Glaucoma in angle recession typically develops after 6 months to many years. In patients with angle recession > 270° degrees it often develops earlier. Mooney *et al.* found that angle recession < 180° does not develop late-onset glaucoma.[39] Lifelong annual examination in patients with angle recession > 180° has been suggested for late-onset glaucoma detection. Patients at high risk for developing late-onset glaucoma should be identified through careful evaluation to receive appropriate treatment.

Conclusion

Traumatic angle recession is a common finding in eyes with closed-globe trauma. The sequelae of blunt ocular trauma can be devastating and may cause monocular blindness. Understanding the underlying natural course of traumatic angle recession is important in choosing appropriate treatment approaches. Since it is not common and may be difficult to manage, clinical guidelines on management of traumatic angle recession are needed for early detection of glaucomatous changes. Early recognition and identification of individuals at risk of developing traumatic angle recession glaucoma is critical to ensure follow up examinations and treatment at an early stage before vision becomes seriously impaired.

Declarations

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Clinical features of ocular trauma requiring vitreoretinal surgery: a case series

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Abstract

Background: Ocular trauma is a significant cause of monocular blindness and visual impairment worldwide. This report describes the clinical characteristics of ocular trauma requiring vitreoretinal surgery presented to the vitreoretinal unit of Hospital Canselor Tuanku Muhriz, Kuala Lumpur, Malaysia.
Case presentation: A retrospective case series study of all traceable records of ocular trauma from the surgical logbook of a single vitreoretinal surgeon from January 1, 2008 to December 31, 2019 was performed. Demographics, causes of injury, types of ocular trauma, presenting visual acuity (VA), and postoperative VA were recorded and analysed. All patient data were collected from the medical records system. Of all the ocular trauma cases requiring vitreoretinal surgery, 63.6% were contusions. The most common cause of injury in our group of patients was sports injury (28%). Patients with open-globe injury had poorer preoperative and postoperative VA (logMAR) when compared to those with closed-globe injury (preoperative VA: 1.55 versus 1.39; postoperative VA: 0.93 versus. 0.67, in open- and closed-globe injury respectively, $p = 0.467$).
Conclusion: Specific injury prevention strategies, which include the use of protective eyewear, must be advocated in the workplace and during sports to reduce the incidence and severity of ocular trauma.

Keywords: clinical characteristics, ocular trauma, vitreoretinal surgery

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Ciri-ciri klinikal trauma okular yang memerlukan pembedahan vitreoretina: satu pengumpulan kes

Abstrak

Latar belakang: Trauma okular merupakan punca utama kebutaan monokular dan kecacatan penglihatan di seluruh dunia. Laporan ini menerangkan ciri-ciri klinikal trauma okular yang memerlukan pembedahan vitreoretina di unit vitreoretina Hospital Canselor Tuanku Muhriz, Kuala Lumpur, Malaysia.
Pembentangan kes: Kajian siri kes retrospektif ini melibatkan semua rekod trauma okular daripada buku log pembedahan yang dilakukan oleh seorang pakar bedah vitreoretina dari 1 Januari 2008 hingga 31 Disember 2019. Data deemografi, punca kecederaan, jenis trauma okular, tahap penglihatan sebelum, dan selepas pembedahan telah direkodkan dan dianalisa. Semua data pesakit diperolehi daripada sistem rekod perubatan. Daripada semua kes trauma okular yang memerlukan pembedahan vitreoretina, 63.6% adalah akibat kontusi. Sebab kecederaan utama dalam siri kes ini adalah kecederaan semasa bersukan (28%). Pesakit yang mengalami kecederaan glob terbuka mempunyai tahap penglihatan sebelum pembedahan dan selepas pembedahan yang lebih rendah (logMAR) jika dibandingkan dengan mereka yang mengalami kecederaan glob tertutup (sebelum pembedahan iaitu 1.55 berbanding 1.39 sebelum pembedahan dan selepas pembedahan adalah 0.93 berbanding 0.67 ($p = 0.467$).
Kesimpulan: Strategi khusus bagi pencegahan kecederaan perlu dititikberatkan, termasuk penggunaan cermin mata pelindung wajib digalakkan di tempat kerja dan semasa bersukan untuk mengurangkan kejadian dan keterukan trauma okular.

Kata kunci: ciri-ciri klinikal, pembedahan vitreoretina, trauma okular

Introduction

Ocular trauma is a preventable cause of visual loss. It is a major contributor to monocular blindness worldwide.[1] Vitreoretinal involvement is present in almost half of all severe eye injuries secondary to blunt or penetrating trauma.[2] In addition to vision loss, ocular trauma also results in a significant economic burden to families and countries. Improved surgical techniques, especially in the field of vitrectomy, have helped surgeons salvage and restore vision to eyes following injury. Despite constant refinements in the management of ocular trauma, the

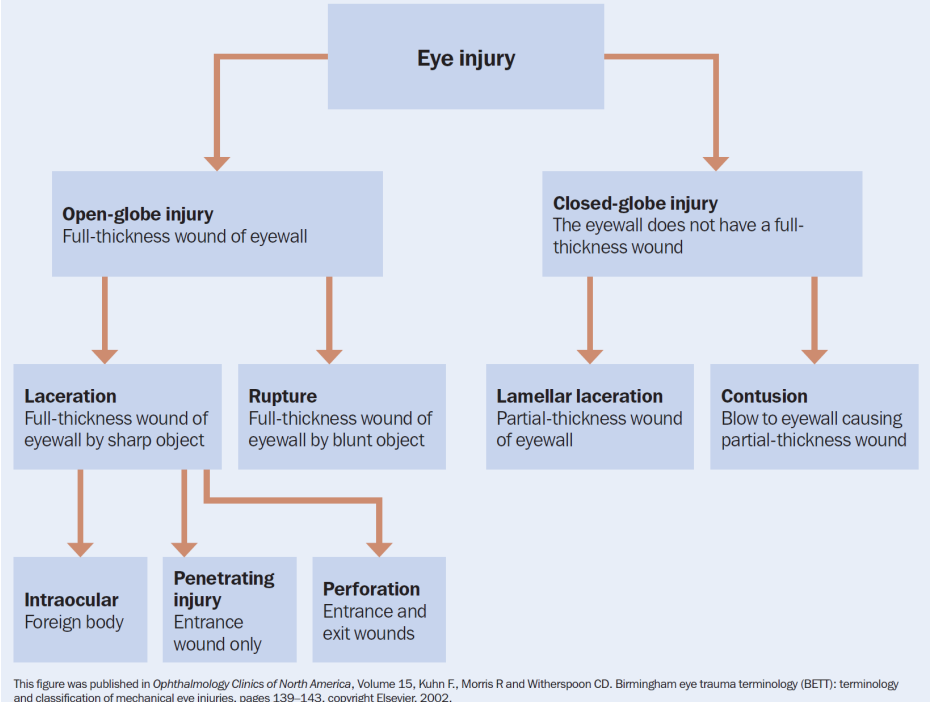

Fig. 1. Birmingham Eye Trauma Terminology (BETT) system.

visual prognosis of severe ocular trauma remains poor.

Based on the Birmingham Eye Trauma Terminology (BETT) system (Fig. 1), ocular trauma is broadly divided into open-globe injury and closed-globe injury.[3] Open globe injuries are subdivided into penetrating injury, perforating injury, intraocular foreign body (IOFB), and rupture. Closed-globe injuries are further divided into lamellar lacerations and contusions.

The epidemiology of ocular trauma in developed countries has been well described. However, there is limited data in developing countries such as Malaysia. The primary purpose of this report is to describe the epidemiology of ocular injuries treated by the vitreoretinal unit in the Department of Ophthalmology of Hospital Canselor Tuanku Muhriz, Kuala Lumpur, Malaysia.

Table 1. Clinical data of the patients

Case	Gender	Age (years)	Occupation	Location of injury	Cause of injury	Main complaint	Clinical presentation	Diagnosis	Preop VA	Postop BCVA	Complication
1	Male	47	Workshop foreman	Workshop	Metal	Blurred vision	Conjunctival laceration	IOFB	6/36	6/9	-
2	Male	13	Badminton coach	Badminton court	Shuttlecock	Pain	Cataract	Contusion	6/9	6/6	-
3	Male	11	Student	Field	Fireworks	Redness	Macular hole	Contusion	1/60	1/60	Angle-recession glaucoma
4	Male	61	Retired police	Roadside	Fall	Blurred vision	Dislocated intraocular lens	Contusion	1/60	6/12	Angle-recession glaucoma
5	Female	42	Nurse	Roadside	Unknown object	Blurred vision	Cataract	Contusion	6/24	3/60	Rhegmatogenous retinal detachment
6	Male	81	Retired dean	Golf course	Golf ball	Floaters	Hyphaema	Contusion	CF	6/9	Secondary glaucoma
7	Male	38	Labourer	Construction site	Metal	Pain	Corneal laceration	Penetrating	HM	HM	Endophthalmitis
8	Male	69	Retired construction worker	Roadside	Assault	Blurred vision	Dislocated lens	Contusion	6/18	6/18	Angle-recession glaucoma
9	Male	12	Student	Field	Football	Blurred vision	Cataract	Contusion	PL	6/24	Secondary glaucoma
10	Male	66	Labourer	Roadside	Motor vehicle accident	Blurred vision	Corneal laceration	Rupture	HM	6/24	Angle-recession glaucoma
11	Male	54	Businessman	Roadside	Unknown object	Blurred vision	Retinal detachment	IOFB	6/36	6/24	Angle-recession glaucoma

RE: right eye; LE: left eye; Preop: preoperative; Postop: postoperative; VA: visual acuity; BCVA: best-corrected visual acuity; IOFB: intraocular foreign body; CF: counting fingers; HM: hand movement; LP: light perception

Case presentation

This case series investigates 11 ocular trauma patients who underwent vitreoretinal surgery at our centre from January 1, 2008 to December 31, 2019. Keywords used to search for relevant cases in the surgical logbook of a senior vitreoretinal consultant ophthalmologist included ocular trauma, ocular injury, giant retinal tear, IOFB, and traumatic vitreous haemorrhage. Cases included in this study were those that required at least one vitreoretinal surgery. Twenty-one ocular trauma cases in the surgical logbook were initially identified. However, of these, the medical records of 10 patients had been deleted by the medical record department as the medical records are kept for a maximum of ten years from the end date of the patient's treatment.

Data collected from the medical records included age, gender, occupation, cause of injury, classification of ocular trauma, presenting and postoperative visual acuity (VA), accompanying symptoms, and management. Table 1 summarises the clinical data, including the cause of injury, clinical presentation, preoperative and postoperative best-corrected VA, diagnosis based on BETT classification, and complications for all 11 patients.

Patient demographics are presented in Table 2. The majority of patients were male (90.9%). The mean age of patients was 45 years (range 11–81 years). All cases had unilateral involvement. Most of the injured eyes (72.7%) were right eyes. Seven patients suffered contusion (63.6%) due to blunt trauma, while three sustained penetrating injuries (27.3%), two of which had IOFB.

As shown in Figure 2, three patients had sports-related ocular injuries, while two patients sustained work-related injuries. Other causes of injury include foreign body of unknown material, motor vehicle accident, fall, fireworks, and assault. Our data also shows that 6 of 11 patients presented to our ophthalmology clinic within one day after injury. None of the patients used protective eye gear during the injury. Almost all patients (90.9%) complained of blurred vision upon presentation. Other presenting symptoms included eye redness (27.3%), eye pain (27.3%), and floaters (18.2%).

The intraoperative procedures performed (Fig. 3) were analysed. All the patients required vitrectomy. Endolaser was performed in 91% of patients, while 72.7% of the patients required cataract removal. Intraocular tamponade was inserted in 54.5% of the patients. Other vitreoretinal procedures included cryotherapy, scleral buckle, and membranectomy. We also analysed the correlation between the time from trauma to surgery and the improvement in VA after surgery, which showed a statistically significant linear relationship ($r = 0.792$, $p = 0.004$). It means that the sooner the patients receive treatment after injury, the greater their VA gain.

Table 2. Demographics of patients

Demographic variables	Number	%
Total patients	11	
Age		
< 20	3	27.3
20–39	1	9.1
40–59	3	27.3
> 60	4	36.4
Gender		
Male	10	90.9
Female	1	9.1
Ethnicity		
Malaysian		
Malay	7	63.6
Chinese	3	27.3
Non-Malaysian	1	9.1
Laterality		
OD	8	72.7
OS	3	27.3
Type of ocular injury		
Contusion	7	63.6
Penetrating	3	27.3
IOFB	2	18.2
Rupture	1	9.1

OD: oculus dexter; OS: oculus sinister; IOFB: intraocular foreign body

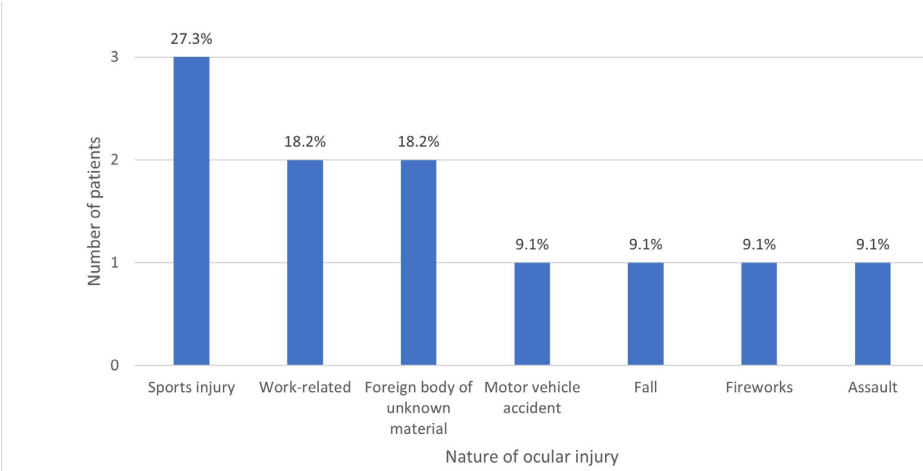

Fig. 2. Nature of ocular injury.

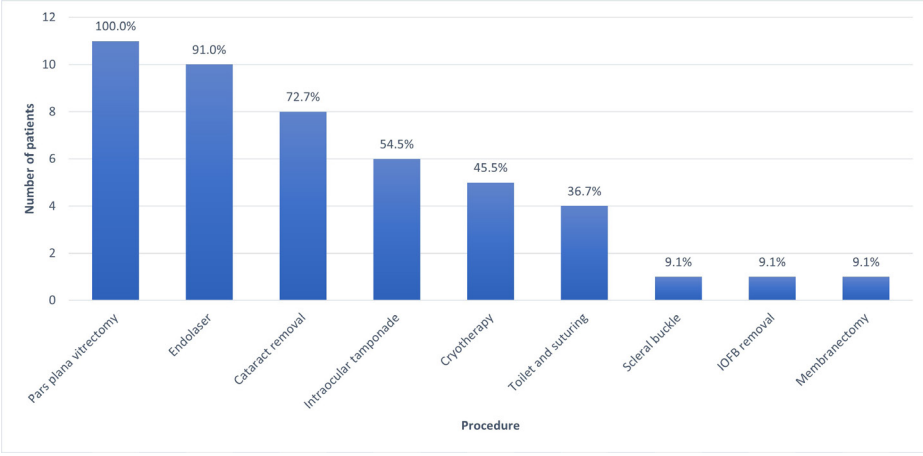

Fig. 3. Intraoperative procedures performed.

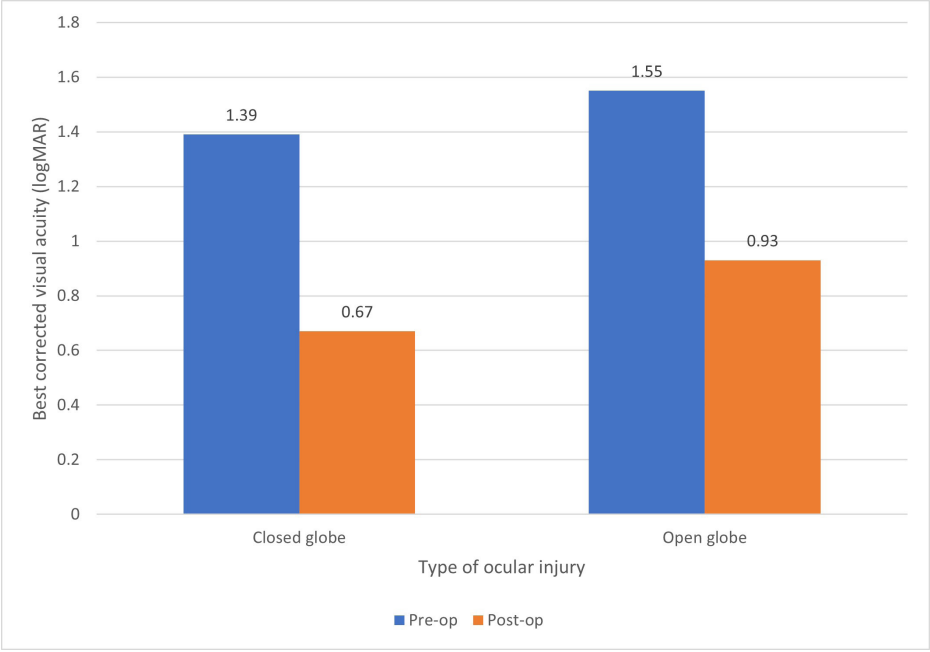

Fig. 4. Mean visual acuity (logMAR) according to the type of ocular injury.

We also analysed the preoperative and postoperative VA of these patients according to the type of ocular injury (Fig. 4). The patients were divided into closed-globe and open-globe groups. The baseline VA of patients varied from 6/9 to light perception based on the Snellen chart. In the seven eyes with closed-globe injury, VA in logMAR (logarithm of the minimum angle of resolution) improved from 1.39 ± 0.96 preoperatively to 0.67 ± 0.65 ($p = 0.137$) postoperatively. The remaining 4 patients with open-globe injury had poorer preoperative and postoperative VA with less improvement in VA after surgery (1.55 ± 0.87 to 0.93 ± 0.94, $p = 0.198$) than the closed-globe group.

According to our data, all the patients required secondary procedures. These included the removal of silicone oil and secondary intraocular lens implantation. In addition, 5 patients (45.5%) developed angle-recession glaucoma (ARG) during follow-up.

Discussion

Males (90.9%) were the group at highest risk for ocular trauma in our case series. This concurred with the universal pattern that ocular trauma mainly occurs in young adult males, irrespective of the severity of ocular trauma and country of origin.[4-6] The higher risk in young men could be due to high-risk activities related to work, assault, sports, and motor vehicle accidents. However, the precise size of the population at risk is not known. This is because our hospital is only one of several tertiary referral centres for ophthalmic emergencies in the city. Thus, the data from our study cannot be generalised to the whole population.

Sports injury was the main cause (28%) of ocular trauma in our patients. A literature review revealed that sports-related trauma contributes to 37–52% of ocular injuries, mainly affecting young children in 58–70% of cases.[7,8] Badminton being one of the most popular sports in Malaysia, the impact of the shuttlecock often causes high-velocity eye injuries. The second most common nature of injury in our study was work-related. This is a significant concern in our community as most ocular injuries are related to workers in the manufacturing and construction industry, which is one of the fastest-growing industries in Malaysia.[9] Furthermore, previous studies have found that the incidence of work-related ocular trauma in developing countries is higher than in developed countries.4,5,10 (4,5,10)644 injured eyes from 3,559 patients over the 10-year period: 2,008 (55.1% Fire-works-related injury is also a genuine concern in Malaysia, especially during the festive seasons.

Our analysis shows that patients with open-globe injuries had poorer preoperative and postoperative VA when compared to those with closed-globe injuries. This is consistent with results from previous studies.[4,6,10] Open-globe injuries often destroy the global structure, causing severe damage and prolapse of the intraocular contents, thus leading to poorer visual recovery. Fortunately, all the patients in our report sustained unilateral injuries, and none were deemed legally blind after treatment.

Among the long-term consequences of ocular trauma is the development of angle recession and subsequently ARG. Almost half (45.5%) of our patients developed ARG throughout follow-up. A study reported that 80.5% of patients who suffered a blunt ocular injury may have some degree of angle recession.[11] Glaucoma is a major concern because many cases may go unnoticed and are diagnosed only when there is irreversible optic nerve damage. Medication and financial burdens severely impair a patient's quality of life, and some patients may even require glaucoma surgery in case of uncontrolled intraocular pressure. Ocular features associated with traumatic glaucoma include poor baseline visual acuity, hyphaema, an angle recession of more than 180°, traumatic cataracts, displacement of the lens, and iris injuries.[12]

The initial assessment of ocular trauma is vital. Early recognition of vision-threatening conditions and immediate ophthalmologic consultation can prevent blinding complications. Any ocular trauma with poor presenting VA warrants urgent management. The most significant adverse prognostic factor in open-globe injuries is presenting VA < 5/200, as reported by Rao *et al.*[13] Vitrectomy is a crucial treatment in severe ocular trauma. Three published randomised controlled trials conducted in China, which included a total of 173 participants, revealed that earlier vitrectomy in open-globe injuries resulted in better final VA and lower rates of complications.[14-16]

The use of protective eyewear needs to be advocated at high-risk workplaces as well as during contact or racquet sports to prevent blinding ocular trauma. Fong and Taouk identified the lack of eye protection as a risk factor for ocular trauma, with at least 22% of patients with open-globe injuries and 9% with closed-globe injuries failing to wear eye protection.[17] Another study in Canada showed that after wearing protective eye gear was made mandatory, the incidence of eye injuries in amateur hockey players was significantly reduced.[18]

Conclusion

This study highlights the impact of visual loss and long-term complications following ocular trauma despite timely vitreoretinal intervention. Sports injuries and work-related injuries were prevalent in our case series. Open-globe injury had a poorer visual prognosis than closed-globe injury. These injuries may be prevented through proper training and education about protective eye gear. Protective eyewear should be made mandatory at the workplace with higher risks of ocular injury.

Declarations

Informed consent for publication
The patients and/or their guardians have provided informed consent for the publication of the clinical data contained in the case series.

Competing interests
None to declare.

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Case series
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Intraorbital foreign bodies: a case series of unfortunate events

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Abstract

Background: Intraorbital foreign bodies (IOrbFB) are a common result of trauma and can cause significant ocular morbidity. When left in the orbit, they can remain asymptomatic or cause serious complications such as the loss of an eye.
Case presentation: We report 6 cases of IOrbFB treated in Hospital Serdang and their surgical outcomes. Two cases involved organic foreign bodies (wood) and 4 involved inorganic foreign bodies (3 cases of metal and 1 of glass). Both cases with organic foreign bodies had surgical removal in a delayed setting, while the inorganic foreign bodies were removed within 3 days of initial presentation. Five patients had a good visual outcome and only 1 patient had resultant blind eye due to involvement of the globe.
Conclusion: Loss of vision due to IOrbFB is usually a result of globe involvement. Early surgical exploration and foreign body removal affects the visual prognosis and outcome. Organic IOrbFBs pose a great challenge due to their diverse manifestations, thus tends to be missed during the initial visit. Delayed diagnosis can cause higher risk of orbital infections.

Keywords: intraorbital foreign body, ocular trauma

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Benda asing intraorbital: satu pengumpulan kes peristiwa malang

Abstrak

Latar belakang: Benda asing intraorbital (IOrbFBs) di mana kehadiran bahan asing di dalam ruang orbital akibat trauma yang bertanggungjawab dalam morbidity mata yang teruk. Kehadiran benda asing ini di dalam orbit sama ada tidak menghasilkan sebarang gejala ataupun menyebabkan komplikasi yang serius termasuk kehilangan penglihatan.
Pembentangan kes: Kami membentangkan 6 kes yang dirawat dan dibedah di Hospital Serdang. Dua kes melibatkan bahan organik iaitu kayu manakala bahan bukan organik adalah besi (3 kes) dan kaca (1 kes). Kedua-dua kes yang melibatkan bahan asing organik rawatan pembedahan dijalankan agak lewat manakala kes melibatkan bahan bukan organik pembedahan dilakukan dalam masa tiga hari. Lima pesakit berjaya dikekalkan penglihatan yang baik tetapi seorang pesakit kehilangan penglihatan yang kekal.
Kesimpulan: Kehilangan penglihatan akibat kehadiran benda asing di dalam orbit adalah akibat kecederaan pada bola mata. Rawatan dan pembedahan yang awal membantu dalam pengekalan penglihatan yang baik. Kehadiran benda asing yang organik di dalam orbit merupakan cabaran utama dalam rawatan disebabkan kepelbagaian manifestasi klinikal dan mungkin terlepas pandang dari menerima rawatan awal. Kelewatan membuat diagnose yang tepat boleh menyebabkan risiko jangkitan kuman.

Kata kunci: benda asing intraorbital, trauma okular

Introduction

Ocular trauma poses a significant risk of blindness. Intraorbital foreign bodies (IOrbFBs) are an uncommon result of ocular trauma. Although typically caused by a high-velocity injury, it may also be a result of trivial trauma. The composition and nature of IOrbFBs present as a challenge since misdiagnosis and delay in management may lead to devastating ocular morbidity. For a better understanding, we present the presentation and management of 6 cases of IOrbFB treated in our tertiary hospital.

Case presentation

This is a retrospective review of 6 patients diagnosed with IOrbFB following a history of ocular trauma. They all presented to our tertiary hospital in Serdang, Malaysia.

Case 1

A 23-year-old man presented with pain and blurred vision in the left eye following a history of being hit by a metal ball while playing with a slingshot 6 days prior. Relative afferent pupillary defect (RAPD) was negative with bilateral vision of 6/9. Examination of the left eye noted a sutured laceration wound over the medial aspect of the upper lid with presence of subconjunctival haemorrhage and chemosis medially. Fundus examination showed presence of commotio retina. Computerised tomography (CT) scan of the orbit revealed a round metal foreign body at the medial aspect of orbit towards the posterior medial wall (Fig. 1). The patient underwent anterior orbitotomy and removal of the metal foreign body, measuring 1 cm in diameter and located extraconal of the left medial orbit. Postoperatively, RAPD in the left eye was positive with visual acuity (VA) of 6/12.

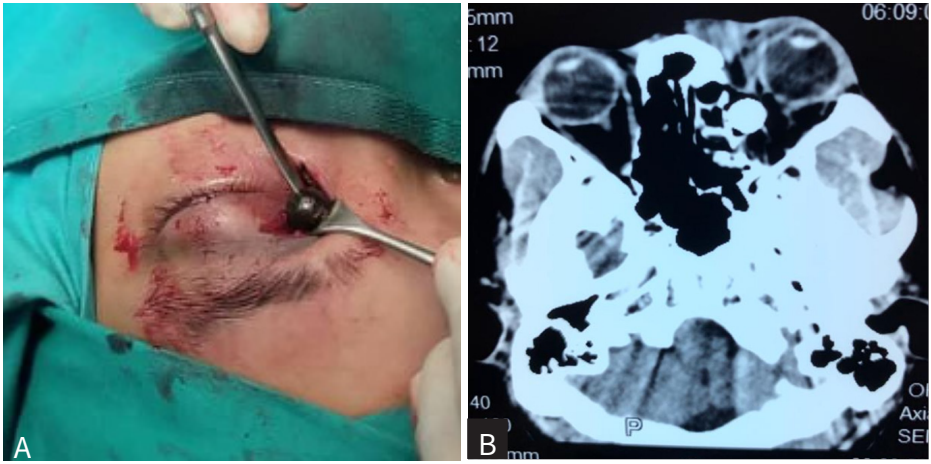

Fig. 1. (*a*) Intraoperative finding of a metal ball removed from the orbit. (*b*) CT scan finding of a round foreign body located at the medial aspect of the left orbit towards the posterior medial wall.

Case 2

A 69-year-old woman from Sarawak was referred to our centre for IOrbFB in the right eye. She had fallen on a wooden shelf 2 months prior and had sustained a laceration wound of the upper lid that was treated by a general practitioner. The patient then developed preseptal cellulitis 1 week post trauma. Culture and sensitivity test of the pus collected from the wound showed *Enterobacter xiangfangensis*. The patient

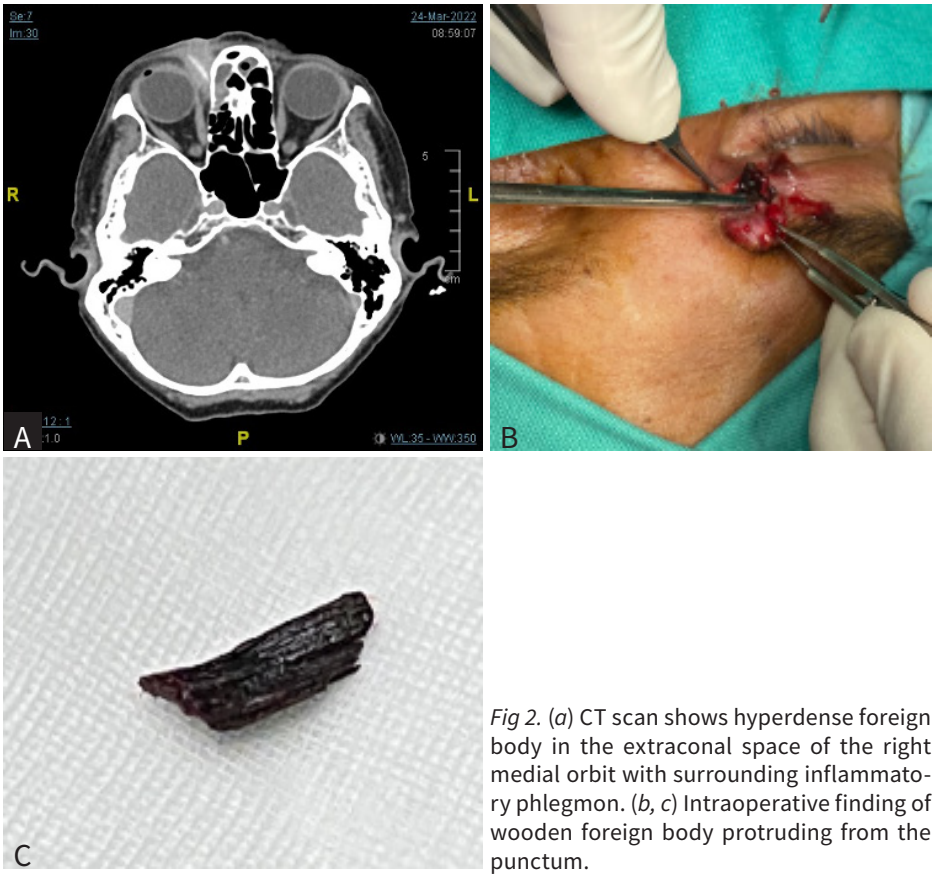

Fig 2. (*a*) CT scan shows hyperdense foreign body in the extraconal space of the right medial orbit with surrounding inflammatory phlegmon. (*b, c*) Intraoperative finding of wooden foreign body protruding from the punctum.

was treated with intravenous antibiotic for 1 week. The preseptal cellulitis resolved, but the right upper lid remained swollen at the 1-month follow-up. CT of the orbit showed a suspicious hyperdense foreign body in the extraconal space of the right medial orbit with surrounding inflammatory phlegmon and possible adjacent osteomyelitis.

The patient was treated with another week of antibiotics and sent to our centre for surgical intervention. Examination showed negative RAPD in the right eye with a VA of 6/18. There was mechanical ptosis and a medial mass in the right upper lid, which was fluctuant with presence of punctum. The surrounding upper lid skin was erythematous. The patient underwent anterior orbitotomy of the right eye and foreign body removal. Intraoperatively, a wooden foreign body, 2 cm in length x 1 cm in diameter, that had penetrated the ethmoid sinus protruded from the punctum (Fig. 2). No pus discharge was noted. Postoperatively, VA remained at 6/18.

Case 3

A 44-year-old man was referred from Ipoh to our centre for IOrbFB in the right eye. The patient had a history of cutting grass with a mower 2 days prior to presentation. He sustained a corneoscleral laceration wound and vitreous haemorrhage in the right eye which had been treated at his primary hospital. CT scan of the orbit noted a superotemporal IOrbFB in the right eye. Vision upon arrival to our centre was light perception. The patient underwent lateral orbitotomy, orbital exploration, and IOrbFB removal. Postoperatively, RAPD was positive with VA of hand movement.

Case 4

A 35-year-old man was referred for IOrbFB removal in the left eye. The patient had a history of upper lid laceration, traumatic mydriasis, and traumatic optic neuropathy in the left eye due to self-inflicted trauma 3 months prior. Initial CT of the brain noted retro-orbital collection with large/mottling air pockets compressing/stretching the left optic nerve, causing oedema/optic neuritis. He was initially treated with intravenous steroids but had subsequent recurrent admissions for repeat orbital decompressions and was therefore treated with intravenous antibiotics.

Subsequently, an MRI of the orbit showed an intraorbital lesion noted in the inferior aspect of the left orbit with retro-orbital extension to the orbital apex (3.5 x 2.7 x 1.5 cm). The left optic nerve was displaced medially. There was a non-enhancing linear, tubular-like hypointense lesion (2.3 cm in length) surrounding a rim of hyperintensity traversing in lateral orientation within the intraorbital lesion. The patient presented to our centre with VA 6/60 and positive RAPD. The left eye showed non-axial proptosis with slight esotropia and swelling of the lower lid. Extraocular movement was restricted in all gazes. Surgical removal the intraorbital foreign body found a lower lid mass measuring 2.0 cm x 1.5 cm, with thin wood material measuring 2 cm in length. There was necrotic and fibrotic tissue between the skin and septal area extending up to the apical region. Postoperative VA was 6/36.

Case 5

A 25-year-old mechanic presented with pain and blurred vision in the right eye following foreign body entry while hammering beneath a car. The patient presented to our centre within 2 hours of injury with VA of 6/12 and no RAPD. Examination noted the right eye chemosed nasally with a metal rod embedded superonasally at 1 o'clock. The patient underwent surgical removal of IOrbFB in the right eye. Intraoperatively, a metal rod measuring 1.2 cm was found embedded just before the insertion of medial rectus. The metal rod was removed with partial indentation of sclera. Postoperative VA was 6/12 and the patient defaulted follow-up.

Case 6

A 28-year-old man was referred to our centre for IOrbFB in the right eye following a motor vehicle accident a few hours prior. He sustained severe bleeding from facial injuries and was intubated at the primary hospital for airway protection. VA could not be obtained. There was a large laceration wound extending vertically from the forehead to the right alar region involving the medial half of the eyebrow, upper lid, medial canthal tendon, and lower lid. CT scan of the brain at the primary hospital noted an IOrbFB in the right eye. The patient underwent surgical IOrbFB removal, whereby a glass measuring 3 cm x 2 cm shard was noted to be embedded just medial to the right globe. Postoperative VA was 6/12.

Discussion

Diagnosing and managing IOrbFBs is frequently challenging. The presenting features of retained IOrbFBs include clinical signs of orbital cellulitis, orbital haematoma, proptosis, impaired motility, diplopia, orbital abscess, and optic neuropathy/atrophy.[1] Moreover, in high-velocity injuries, penetrating lid or orbital injuries should always raise a suspicion of IOrbFB.[2]

The most common presentation in our cases was the presence of eyelid lacerations following trauma, which serve as an entry point for foreign bodies. These cases may often be regarded as simple laceration wounds and treated by the emergency department or general practitioner, leading to a delay in diagnosis as demonstrated by Case 2 with a wooden IOrbFB.

The nature and composition of the foreign body also plays a crucial role in diagnosis and management. IOrbFBs can be metallic (*e.g.*, iron, aluminium, lead), inorganic non-metallic (*e.g.*, plastic, glass, rock, concrete), or organic (*e.g.*, wood, thorns, bones).[3] Although the patient's history may be helpful, radiological imaging plays a vital role. CT is considered the gold-standard imaging technique for acute IOrbFB[4] due to its high sensitivity for foreign body detection and null risk of dislodging a ferromagnetic foreign body.[5]

However, plastic, wood, and fish bones are radiolucent on CT, which poses a challenge.[4] One clue to detect organic foreign bodies (*e.g.*, wood) on CT is the presence of inflammatory reaction surrounding the foreign body, which appears as a hyperdense signal on T2-weighted images.[4] This was demonstrated in Case 2 with wooden IOrbFB, whose CT scan showed hyperdense foreign body with surrounding inflammatory phlegmon.

Wooden matter can also be mistaken for air on CT.[6] This occurred in Case 4 with wooden IOrbFB, whose initial CT scan noted retro-orbital collection with large air pockets. The diagnosis of IOrbFB was delayed for 3 months post trauma given that repeated CT scans were unable to identify the wooden foreign body. Therefore, MRI may prove to be valuable in cases of organic foreign bodies, as

wood is hypointense to orbital fat on MRI.[7]

Surgical removal of IOrbFBs is not without careful consideration of its benefit and risks of iatrogenic injury to orbital structures. Organic IOrbFBs cause marked inflammatory response and cause severe secondary orbital infections at higher rates compared to inorganic IOrbFBs.[3,8] Therefore, organic foreign bodies should always be removed. This was the case in both of our wooden IOrbFB patients, who developed complications such as preseptal cellulitis and orbital abscess causing compartment syndrome.

On the other hand, inorganic foreign bodies have a lower rate of infection, especially metal, which is often inert to the orbital soft tissues. Therefore, surgical removal of inorganic foreign bodies depends on their composition and location. The decision to remove may be weighed by early infection, inflammation incited by copper, migration/extrusion, and toxicity such as siderosis from iron.[6] Metallic foreign bodies should be removed when the patient requires an MRI in the future which was demonstrated in all of our metallic IOrbFB cases. Location also plays a role. Posteriorly located inorganic foreign bodies may be treated conservatively since surgery may incite significant ocular morbidity.

The risk of complications from surgical intervention is low, as shown in a review by Finkelstein *et al.* that found no decrease in vision related to 18 patients who underwent surgical intervention.[9] Fulcher *et al.* also concluded that surgical intervention had minimal visual consequences in a study where 33 out of 34 patients maintained their vision. Visual loss only occurred in 1 patient after removal of a metallic foreign body from the optic nerve sheath to prevent siderosis.[3] However, in both reports surgical removal was performed mostly for anteriorly located foreign bodies. In our case series, only 1 patient had resultant blind eye due to involvement of the globe, while the remaining 5, who had anteriorly located IOrbFBs, had good visual outcome.

Conclusion

Detail management and appropriate imaging is required in all suspected cases of IOrbFB. Organic IOrbFBs pose a great challenge due to their diverse manifestations and low detection rate on CT scan, which tend to be missed during the initial visit. Delayed diagnosis can cause higher risk of orbital infections.

Surgical removal has low risk in anteriorly located IOrbFBs. Loss of vision is usually a result of globe involvement. Posteriorly located inorganic IOrbFBs can be managed conservatively. Therefore, management strategies should be tailored to each patient.

Declarations

Informed consent for publication
The patients and/or their guardians have provided informed consent for publication of the clinical data and images contained in this case series.

Competing interests
None to declare.

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Case series
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Spectrum of firecracker eye trauma in Batu Pahat

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Abstract

Background: Fireworks are small explosive devices used primarily to create a large amount of noise, usually for celebration or entertainment, especially during the holidays. Fireworks can cause chemical trauma as well as explosive trauma to the ocular tissue and orbit.
Case series: We report the spectrum of eye injuries in a district hospital on the Hari Raya Festival in 2022. In just 4 days during the Hari Raya Festival, a total of 6 patients were referred to us. We observed a variety of ocular injuries, such as hyphaema, angle recession, traumatic cataract, corneal abrasion, commotio retinae, and even traumatic optic neuropathy. Some patients were admitted for closer monitoring and intravenous administration of methylprednisolone, as is the case with patients with traumatic optic neuropathy. Some of them are treated only as outpatients.
Conclusion: Fireworks are dangerous and can cause severe blast injuries to the eyes. Early and prompt treatment is critical. However, primary prevention is also of utmost importance.

Keywords: corneal abrasion, firecracker, hyphaema, traumatic cataract, traumatic optic neuropathy

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Spektrum kecederaan mata akibat mercun di Batu Pahat

Abstrak

Latarbelakang: Mercun ialah alat letupan kecil yang digunakan terutamanya untuk menghasilkan bunyi kuat, biasanya untuk perayaan atau hiburan, terutamanya semasa cuti. Mercun boleh menyebabkan kecederaan kimia serta kecederaan fizikal kepada mata dan orbit.
Siri kes: Kami melaporkan pelbagai kecederaan mata yang dilaporkan di sebuah hospital daerah semasa perayaan Hari Raya pada tahun 2022. Selama hanya empat hari semasa musim perayaan, sebanyak enam pesakit dirujuk kepada kami. Kami merawati pelbagai kecederaan mata, termasuk pendarahan di bahagian dalam mata, sudut mata merekah, katarak traumatik, pencalaran kornea, retina bengkak, dan juga kes-kes yang teruk seperti kecederaan traumatik kepada saraf optik. Tahap parah kecederaan sangat berbeza dalam setiap kes. Bagi sebilangan pesakit yang agak teruk, kami memasukkan mereka ke dalam ward untuk pemantauan yang lebih rapi. Dalam kes kecederaan kepada saraf optik traumatik, rawatan metilprednisolon intravena dimulakan. Bagaimanapun, untuk pesakit yang lain, mereka hanya memerlukan rawatan pesakit luar kerana kecederaan ringan.
Kesimpulan: Mercun adalah merbahaya dan berpotensi menyebabkan kecederaan parah pada mata. Rawatan awal dan segera adalah kritikal. Walau bagaimanapun, pencegahan utama juga sangat penting.

Kata kunci: bunga api, hifema, lelas kornea, mercun, traumatik katarak, traumatik saraf optik

Introduction

Fireworks are small explosive devices used primarily to create a large amount of noise, usually for celebration or entertainment, especially during the holidays. Fireworks can cause chemical trauma as well as explosive trauma to the eye tissue and orbit.

Table 1. Visual outcomes in 7 eyes of the 6 cases

Vision	At presentation (number of eyes)	Latest review (number of eyes)
> 6/12	3	4
6/12 to 6/60	2	0
6/60 to CF	0	1
HM	1	1
LP	1	1
NLP	0	0

CF: counting fingers; HM: hand movement; LP: light perception; NLP: no light perception

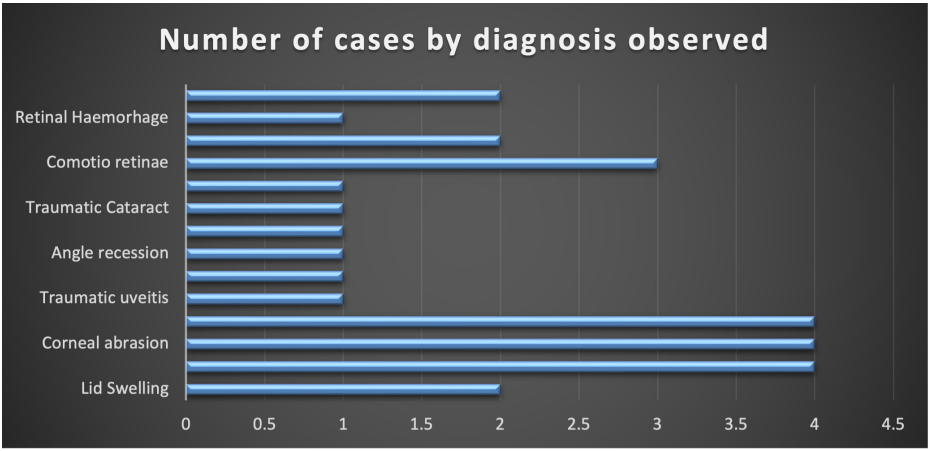

Fig. 1. Number of cases by observed diagnosis.

Case series

We report a series of 6 ocular injuries caused by fireworks in Batu Pahat during the Hari Raya Festival in 2022. The severity of the patients was classified using the Ocular Trauma Score (OTS). Visual acuity (VA) at presentation varied from 6/6 to light perception (LP) (Table 1 and Fig. 1). While the majority of cases were treated as outpatients, 2 cases of traumatic optic neuropathy were admitted for intravenous methylprednisolone treatment.

Case 1
A 23-year-old male with no known medical illness allegedly was hit in both eyes by fireworks. After the trauma, he bilateral ocular pain and blurred vision in the left eye. His vision at presentation was 6/6 in the right eye and 6/9 in the left eye. The patient suffered bilateral corneal abrasions and traumatic uveitis. He sustained commotio retinae in the left eye and Berlin oedema. The patient was treated with dexamethasone and chloramphenicol eye drops. One month after the trauma, all injuries had resolved, and the best-corrected visual acuity (BCVA) was 6/6 for both eyes.

Case 2
A 4-year-old boy presented with firecracker injury to his right eye. He was pillion rider riding motorbike with his father when a piece of exploded firecracker fell from sky and hit his right eye. Visual acuity at presentation was hand movement and relative afferent pupillary defect (RAPD) was positive. The patient sustained traumatic optic neuropathy (TON), hyphaema, extensive Berlin's oedema, commotio retinae, and preretinal and subretinal haemorrhage in the right eye. The patient was treated with high-dose intravenous methylprednisolone for 3 days. However, there was not much visual improvement after completion of treatment. One month post-trauma, BCVA was counting fingers (CF).

Case 3
A 29-year-old man sustained an injury to his left eye while lighting a firecracker that suddenly exploded near his face. VA at presentation was light perception (PL) and RAPD was positive. He suffered eyelid swelling, corneal abrasion, hyphaema, phacodonesis with iridodialysis, and TON in the left eye (Figs. 2 and 3). The patient was treated with high-dose intravenous methylprednisolone for 3 days. However, there was no significant improvement in vision after completion of treatment. Visual acuity remained unchanged (LP).

Case 4
A 31-year-old Malay man alleged firecracker blast injury in his right eye. After the trauma, he suffered from pain, lacrimation, and blurred vision in the right eye. The right eye tested negative for RAPD and VA was LP. The patient sustained conjunctival haemorrhage, corneal abrasion, periorbital hematoma, and dispersive hyphaema in the right eye (Figs. 4 and 5). After the hyphaema resolved, VA improved to 6/12. Examination revealed that the lens was subluxated and there was a traumatic cataract with an angle recession of more than 180°. The patient was treated with dexamethasone and chloramphenicol eye drops, cycloplegics, and preservative-free artificial tears. Intraocular pressure remained normal during treatment. At the seventh week after trauma, vision decreased to hand movement (HM) and examination revealed a mature cataract. The patient was scheduled for cataract surgery.

Fig. 2. Eyelid swelling with skin excoriation and corneal and conjunctival abrasions seen in Case 3.

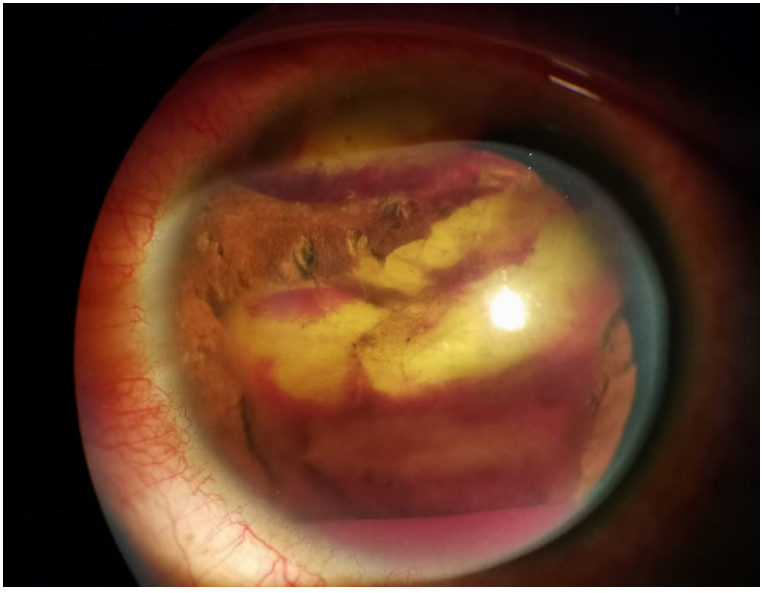

Fig. 3. Traumatic cataract, hyphaema, and iridodialysis seen in Case 3.

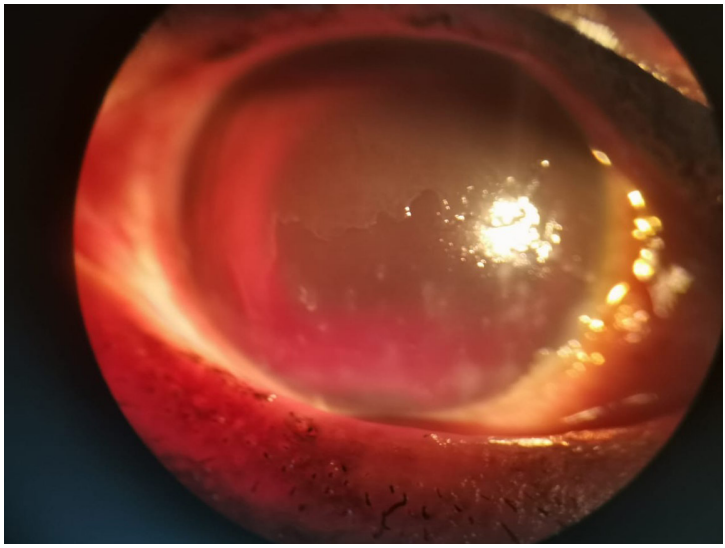

Fig. 4. Left eye traumatic hyphaema seen in Case 4.

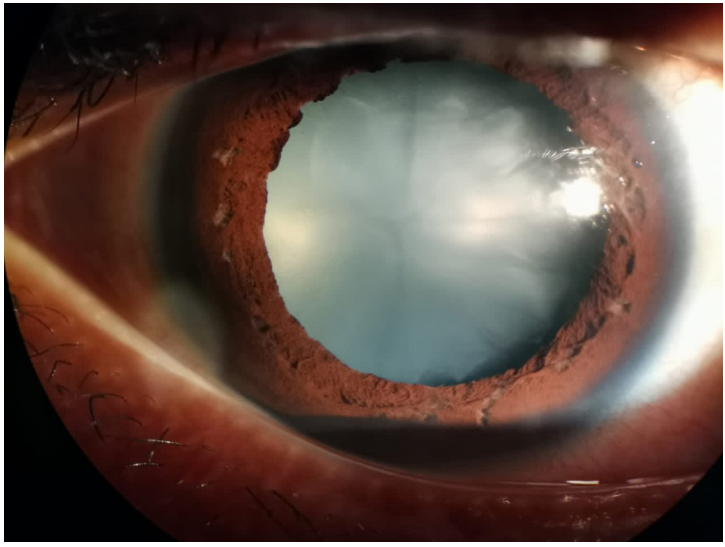

Fig. 5. Traumatic cataract seen in Case 4.

Case 5
A 20-year-old man sustained a firecracker injury to his left eye after his friend threw a firecracker at his face. Following the trauma, he experienced pain in his left eye but denied any blurriness of vision. Bilateral VA was measured at 6/9. There was a periorbital haematoma in the left eye with minimal skin excoriation and the conjunctiva was injected with chemosis. Fundus examination showed a normal optic disc, no commotio retinae, no vitreous haemorrhage, and no retinal tear. The patient was treated with chloramphenicol eye drops. A review 1 week post-trauma revealed improving periorbital haematoma, and all other ocular examinations were normal.

Case 6
A 40-year-old gentleman suffered a firecracker blast injury to his left eye. The incident occurred shortly after he ignited a firecracker, causing the blast to impact his left eye. Upon presentation, VA was measured at 6/18, and RAPD was negative. The patient had sustained periorbital swelling, corneal abrasion, hyphaema, angle recession of less than 180°, traumatic cataract, and commotio retinae in his left eye. Treatment included the administration of dexamethasone eye drops, chloramphenicol eye drops, cycloplegics, and preservative-free artificial tears. One month after the trauma, there was noticeable improvement in his injuries, and BCVA had improved to 6/6.

Discussion

Firecracker-related ocular injuries are a significant concern, especially during festive seasons and celebrations where firecrackers are commonly used. These injuries can range from mild to severe and can lead to permanent visual impairment. The Malaysian government has banned recreational firecrackers since 1955 according to the Minor Offences Act of 1955. Individuals who are caught igniting fireworks illegally may be fined or imprisoned. Furthermore, firecrackers are considered explosive devices and governed under Section 4(2) of the Explosives Act of 1957, in which any person who is caught manufacturing, possessing, or importing them may be fined or imprisoned. However, all the cases in our series sustained ocular injuries from firecrackers obtained from illegal routes.

Our series includes a spectrum of firecracker-inflicted ocular injuries, which vary from mild corneal abrasion to permanent visual loss, as illustrated by the OTS. The following injuries are the most common: corneal abrasion, corneal burn, lid burn or laceration, corneoscleral laceration, hyphaema, vitreous haemorrhage, retinal haemorrhage, traumatic cataract, ruptured globe, iritis, iridodialysis, and choroidal rupture.[1-3]

Our patients' injuries were graded according to the OTS. The OTS is a system used to predict the visual outcome of patients who have suffered ocular trauma. It is a tool that helps ophthalmologists and healthcare professionals assess the severity of an eye injury and provides a rough estimate of the potential visual outcome for the patient.[4] The OTS considers various factors related to the eye injury, including:

1. Initial visual acuity: The patient's visual acuity at the time of the injury.
2. Ocular injury: The type of injury sustained by the eye, categorised as blunt or penetrating.
3. Presence of ruptured globe: Whether or not the globe (the eyeball) is ruptured.
4. Endophthalmitis: The presence of inflammation within the eye's internal structures.
5. Retinal detachment: Whether a retinal detachment has occurred.

Calculating the OTS is a straightforward process and holds significant importance for the injured individual, the attending ophthalmologist, and other public health experts concerned with eye injuries.

None of our patients were wearing protective eye gear while igniting the firecrackers. In a retrospective review by Kuhn *et al.* conducted in Alabama, most patients were bystanders and were not wearing any protective eye gear while playing with firecrackers. Protective eye gear is important for the ignitors and for the bystanders as protects from firecracker blast ocular injury.[5]

One paediatric patient from our series sustained TON with a visual outcome of LP. Visual loss in children is of great concern as it affects their learning capability and lifestyle, thus leading to significant psychological and physical burdens to both child and their caretakers.[2]

Conclusion

Firecrackers can cause serious ocular injuries. Early and prompt management is crucial but primary prevention is of utmost importance. Public education regarding the proper use of firecrackers and the devastating effects of firecracker inflicted ocular injuries may help in reducing significant morbidity.

Declarations

Informed consent for publication

The patients and their guardians provided informed consent for the publication of the clinical data and images contained in this case report.

Competing interests
None to declare

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