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Review

Minor Injuries

Management of traumatic eye injuries in the emergency department

M Güzel[1*], AK Erenler[1,2], L Niyaz[2,3], A Baydın[3,4]

Abstract

Introduction

Ocular trauma is a clinical challenge for emergency department physicians and, it is an important reason of visual impairment and loss of vision. In this review, we aimed to underline the importance of early diagnosis and treatment of ocular traumas seen frequently in the Emergency Department.

Conclusion

Initial interventions in the ED play an important role in the prevention of morbidity in patients with ocular trauma.

Introduction

Ocular trauma is an important public health problem which is preventable and its etiology, severity, and outcome depends on many factors in the changing environment[1]. Even eyes represent only 0.27% of the body surface area and 4% of the facial area, they are the third most commonly trauma-exposed area after the hands and feet[2]. It is estimated that, worldwide, there are approximately 1.6 million people blind from eye injuries, 2.3 million bilaterally visually impaired and 19 million with unilateral visual loss; these facts make ocular trauma the most common cause of unilateral blindness[3].

In population-based surveys, the percentage of monocular blindness due to trauma ranged from 20% to 50% and of bilateral blindness from 3.2% to 5.5%[4]. Ocular injuries vary with a broad range of severity and include simple subconjunctival injury, lid laceration, corneal abrasion, traumatic iritis, hyphaema, lens injury, vitreous haemorrhage, retinal detachment, traumatic optic neuropathy, retrobulbar haemorrhage, orbital fracture, and ruptured globes. Ocular injuries are classified into 2 groups as open and close globe injuries.

Ruptured globes fall into the category of open globe injuries, which are injuries resulting in a full-thickness laceration of the cornea and/or sclera. Wounds can be penetrating (with one entry wound and no exit wound), or perforating (a through-and-through injury with both entrance and exit wounds)[5]. Closed globe injuries resulting from blunt trauma can cause hyphaema, vitreous haemorrhage, retinal tears and detachment, choroidal rupture, macular oedema, and even globe rupture, retrobulbar haemorrhage and traumatic optic neuropathy[6].

Even in the lack of diagnostic equipment, appropriate assessment and referral of ocular traumas may be performed by obtaining a careful history and performing general observation and basic ocular tests[7]. In this review, our target is to remind algorythms for approaching and managing ocular traumas which are likely to be faced in the emergency departments (EDs).

Discussion

Penetrating Injuries

In developed countries, due to higher level of education and use of protective equipment, incidence of penetrating eye injuries is lower[8].

Penetrating injuries to the eye need a multidisciplinary approach and may cause serious complications[9]. The predictors of the damage and severity of the injury are size, velocity and the hardness of the object. While an object smaller than the orbit causes injury to the eyeball, an object larger than the orbit transmits force to the orbital walls and thus causes fracture of the bones[6].

In a study by Omolase et al., it was reported that penetrating eye injuries consisted of 12.1% of all ocular traumas (84.1% was blunt and 2.3% was chemical injuries)[10].

In a study including patients with superficial corneal foreign bodies, it was reported that only 10% of the eye injury patients required hospital admission, and long-term complications were seen in only 2.3% of the patients. It was also proposed that superficial corneal foreign bodies could be removed in the ED with minimal trauma in an aseptic method with adequate topical anaesthesia[11].

However, it was also reported that penetrating ocular injury is the most common aetiology of severe ocular injury[8]. Penetrating injuries usually require surgery and have poor prognosis resulting in long-term visual impairment[12].

If an intraocular foreign body is suspected, immediate ophthalmology consultation is required[13]. A visual acuity testing must be performed in all patients with an ocular problem and if tests are painful, topical anaesthetics must be administered. Examination must include eyelids, globes, orbits, forehead, and cheeks; evaluation of extraocular motility; pupillary reflex and visual field testing. If globe rupture is suspected or confirmed, an eye shield should be immediately placed over the affected eye and further direct examination should be deferred to avoid putting pressure on the eye.

A computed tomography (CT) scan is also recommended for further evaluation of related structures. The most common causes of endophtalmitis are Streptococcus species, Staphylococcus aureus, and

*Corresponding author
Email: drmuratguzel@gmail.com

[1] Department of Emergency Medicine, Samsun Education and Research Hospital, Samsun, Turkey
[2] Department of Ophthalmology, Samsun Ondokuz Mayıs University , Samsun, Turkey
[3] Department of Emergency Medicine, Ondokuz Mayıs University, Samsun, Turkey

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Staphylococcus epidermidis, so an appropriate antibiotherapy must be initiated[14]. In figure 1, we present you a CT scan of a patient with penetrating intraocular foreign body.

Hyphaema

Traumatic hyphaema is the entry of blood into the space between the cornea and iris following a blow or a projectile striking the eye[15]. Hyphaema occur as a result of blunt trauma to the eye[7]. In a study, it was reported that corneal abrasion was the most common ocular trauma, followed by ocular contusion, traumatic hyphaema and corneal foreign body[8].

In developing countries, the injuries leading to traumatic hyphaema occur mostly at home and school, and frequently affect children and young adolescents. Over one-third resulted in blindness in the affected eye[16]. However, in developed countries, sports injuries account for 60% of traumatic hyphaemas[15]. Hyphaema is not an ocular emergency; however, it can lead to further ocular complications notably an increase intraocular pressure due to obstruction of the outflow of aqueous.

Hospitalisation is required if the intraocular pressure is extremely high, the hyphaema fills greater than 50% of the anterior chamber, or if the patient is a child[7,17]. Generally blood is absorbed, but in some cases, secondary haemorrhage may occur which is likely to result in glaucoma, corneal bloodstaining, or damage to the optic nerve[15]. Management of hyphaema focuses on the measures in preventing complications such as re-bleeding, corneal blood staining, ocular hypertension/secondary glaucoma, and synaechia formation.

In uncomplicated cases, surgical intervention must be performed in order to reduce intraocular pressure[18]. Standard approaches for all patients with traumatic hyphaema include restriction of activities, administration of cycloplegic eye drops (Guttae Atropine) and corticosteroid eye drops, with patching of the affected eye with a rigid shield. Eyes with raised intraocular pressure may be treated with topical and systemic intraocular pressure-lowering agents, commonly Guttae Timolol maleate, and oral carbonic anhydrase inhibitor[16]. However, there are reports that corticosteroids, cycloplegics, miotics, and nonpharmacologic interventions such as bed rest and eye patching, have

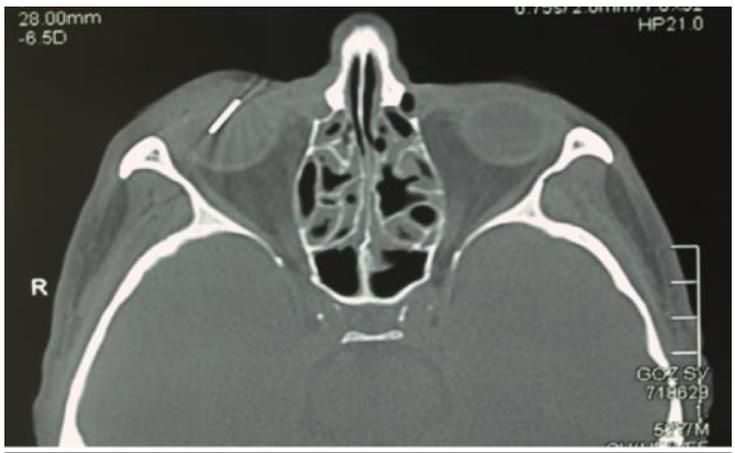

Figure 1: Intraocular foreign body in the right eye.

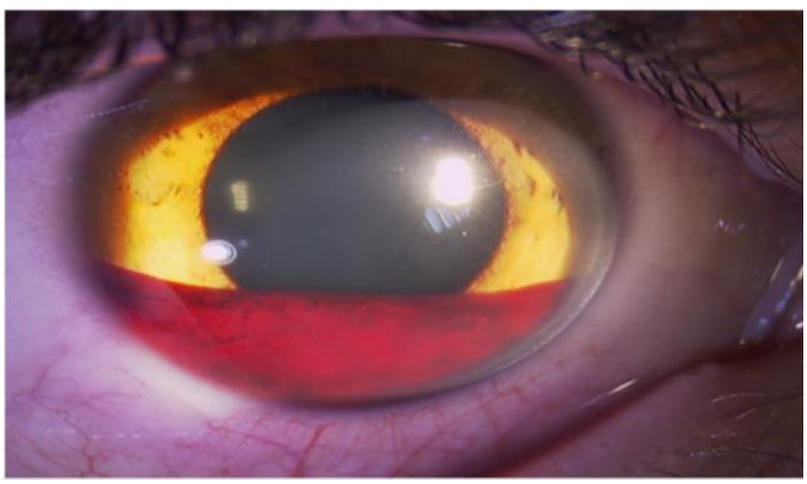

Figure 2: Traumatic hyphaema. The entry of the blood into the space between the cornea and iris is seen.

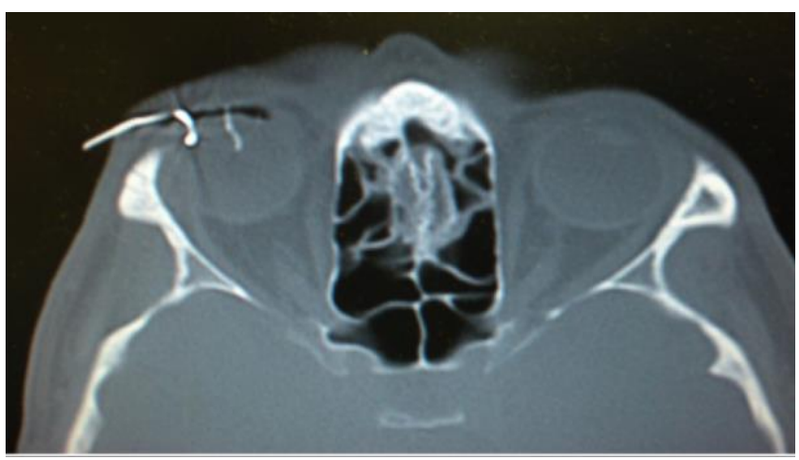

Figure 3: A CT scan of a patient with a foreign body in the eye causing corneal perforation.

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been recommended but not found to be beneficial[19,20].

Recently, antifibrinolytic agents such as aminocaproic acid and tranexamic acid have been reported to be beneficial, particularly for reducing the rate of secondary haemorrhage[21,22]. See figure 2 for traumatic hyphaema.

Ruptured Globe

The term globe rupture refers to compromised integrity of the cornea or sclera. In patients with eye injuries, it must always be suspected. Endophtalmitis, which is a serious intraocular infection with high potential of blindness may occur if not treated promptly and appropriately. Globe rupture causes pain, decreased vision, hyphaema, loss of anterior chamber depth, or deviation of the pupil toward the laceration[14].

Outcomes of this injury can vary from no change in visual acuity, to a blind painful eye that requires enucleation in order to prevent sympathetic ophthalmia or endophthalmitis[5]. See figure 3 for a CT scanning of a foreign body caused corneal rupture and figure 4 for a patient with corneal perforation and protrusion of intraocular structures after having a punch in the eye.

Orbital Cellulitis

Orbital cellulitis is an invasive bacterial infection of the postseptal tissues of the eye[23]. The most common etiological factor for its development is a preceding ethmoid sinusitis, which is in contrast to preseptal (periorbital) cellulitis, in which trauma or bacteremia are the most common predisposing causes[24].

Infection spreads from soft tissues as a result of trauma, foreign bodies, insect bites, skin infections (impetigo), eyelid lesions (chalazia, hordeola), and iatrogenic causes such as eyelid and oral procedures[25].

It occurs more commonly in children[26]. Orbital cellulitis is a condition that rarely causes complete loss of vision if treated in a timely fashion. A history of upper respiratory tract infection prior to the onset is very common especially in children[27]. The bacteria most commonly implicated in paediatric orbital cellulitis include Streptococcus pneumoniae, Haemo-philus influenzae, Moraxella catarrhalis, group A-haemolytic streptococci, Staphylococcus aureus, other streptococcal species, and anaerobes[28].

When orbital cellulitis is suspected, broad-spectrum antibiotics including gram negative and gram positive bacteriae must be started[27]. If the visual function is compromised, urgent surgical intervention is recommended. In conditions such as large orbital abscess causing discomfort, superior or inferior orbital abscess, evidence of intracranial extension, involvement of frontal sinuses, and a known dental source of the infection in patients older than 9 years, early surgery within 24 hours should be performed[29].

Chemical Ocular Injuries

Chemical Ocular Injuries (COI) are a true ocular emergency that must be treated immediately and intensely[30]. The most commonly effected are male patients working in mechanics, automobile battery charging and welding. However, it also may occur as a result of accidents at home or assaults. Even though COIs are not frequent among other ocular injuries, it has a high risk of blindness. Severity of COIs vary from mild irritation to complete destruction of the ocular surface epithelium, cornea preotective opacification, loss in vision and rarely loss of the eye and is closely related to contact surface and degree of penetration[31,32]. Acid injuries tend to be

Figure 4: Corneal rupture due to a punch in the eye.

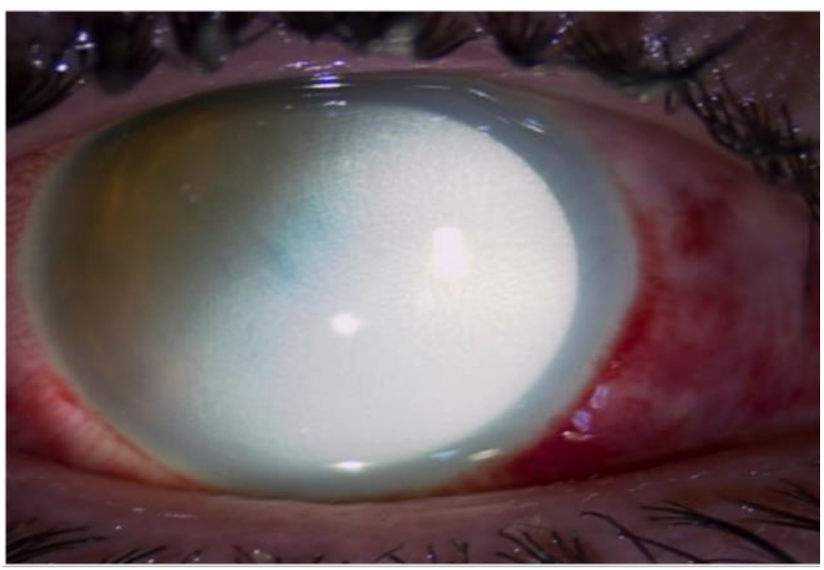

Figure 5: Chemical Ocular Injury.

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less severe than alkali injuries[30]. It is also known that alkali burns are seen more commonly when compared to acid burns[33]. Standard alkali burn treatment protocol includes intensive topical steroids, ascorbate citrate and antibiotics[34]. While mild burns frequently does not require surgery, moderate or severe burns commonly lead to entire damage of ocular surface tissue, requiring long-term medical treatment and multiple surgeries resulting in heavy economic burdens[35]. See figure 5 for chemical ocular injury.

Approach in the Emergency Department

Emergency departments are the first contact places for many patients with ocular traumas. Patient's history helps differentiate the diagnosis and lead to appropriate treatment. Whether the trauma is penetrating or blunt must be determined and further testing must be planned[7]. By the help of a bright light or pen torch, presence of foreign bodies, chemosis, corneal haze and the presence of blood or pus in the anterior segment of the eye must be determined[17]. To determine the extent of corneal injury, fluorescein staining and examination under a blue light may be performed.

Leak of aqueous humour may be observed if full thickness corneal injury is present. This is called the Seidel test. When positive, emergency ophtalmologist referral is required[7]. Before using dilating agents, pupillary reflex examination must be performed in order to evaluate afferent and efferent visual pathways and presence of a pupillary defect must be noted[36]. Because standard visual acuity testing is not possible to perform in the ED setting, particularly in trauma patients, more subjective evaluation of visual acuity by noting the ability to see signs across the waiting room or inability to count fingers or determine light perception at close range may be helpful[7].

Superficial corneal foreign bodies (SCFB) are common injuries presenting to the ED[37]. With adequate topical anaesthesia in an aseptic method, superficial corneal foreign bodies with minimal trauma can be removed in the ED. In a study, it was reported that 57.6% of the patients with superficial corneal foreign bodies were treated by emergency physicians without any complication[11].

In another study with patients with work-related eye injuries from Turkey, it was reported that emergency care and management was sufficient for 81.9% of the cases who were discharged from the ED, while 18.1% were admitted to the hospital[38]. The evaluation of a patient with ocular foreign body should focus on the answers of two important questions which are whether the foreign body is superficial or intraocular and whether it can be removed in the ED. If the presence of an intraocular foreign body is suspected, an immediate ophtalmology consultation must be performed[39].

Management of traumatic eye injuries must focus on preventing repeated eye trauma and rebleed, promoting the settling of blood away from the visual axis, controlling traumatic anterior uveitis, and monitoring in order to initiate early prophylaxis or treatment for both secondary glaucoma and corneal bloodstaining. Mainstays in the management of traumatic hyphaema are elevation of the head while sleeping, topical corticosteroids, and cycloplegic medications.

A controversy is reported in the literature on the use of antifibrinolytic agents such as epsilon-aminocaproic acid and tranexamic acid in traumatic hyphaema. They are reported to have potential for reducing the rate of recurrent haemorrhage, but are known to have several possible side effects, such as nausea, vomiting, muscle cramps, conjunctival suffusion, headache, rash, pruritis, dyspnoea, toxic confusional states, arrhythmias and systemic hypotension[15].

In a patient with ocular injury, if globe rupture is suspected or confirmed, an eye shield should be immediately placed over the affected eye and further direct examination should be deferred to avoid putting pressure on the eye. Computed tomography of the head and orbits (coronal and axial views) is recommended to evaluate for open globe injury, intraocular foreign body, or orbital wall fractures[40].

The only eye emergency in which treatment should not be delayed to evaluate visual acuity is chemical injury[14]. Immediate treatment should include copious irrigation prior to ophthalmic evaluation irrigation with isotonic saline or lactate ringer solution should be performed and sometimes irrigating volumes up to 20 L or more is required to change pH to physiological levels[30]. Topical anaesthetics such as tetracaine help to relieve pain and thus facilitate eye irrigation. Eye irrigation with normal saline or lactated Ringer's solution should be initiated as soon as injury from a chemical is suspected. It was also reported that nonsterile water could be used if no other options are available[41,42].

In the ED setting, the eye can be irrigated via an intravenous tube, nasal cannula, or Morgan Medi-flow lens. After about 30 minutes of irrigation, it is recommended to close the eye for approximately five minutes. Then the pH of the injured eye should be tested with litmus paper that is touched to the conjunctival fornix (the area between the eyelid and globe) inside the lower eyelid. Irrigation should be continued until a neutral pH level (7.0) is achieved and maintained for at least 30 minutes.

Once pH is stabilized, a cycloplegic agent (0.25% scopolamine [Isopto Hyoscine] eye drops) and a broad-spectrum antibiotic (ciprofloxacin, ofloxacin [Ocuflox], gentamicin, or tobramycin [Tobrex]) are recommended to be applied[14]. Up to 10 litters of an irrigant may be necessary to achieve neutral pH[43]. If pH paper is not available, the eye should be irrigated with at least 1 to 2 liters of eyewashing solution or for at least 30 minutes[14].

Conclusion

Traumatic ocular injury is an important, frequent and preventable public health problem which causes visual impairment, lower life quality and loss of working capacity. Its

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aetiology, severity and outcome depends on environmental and socio-cultural factors. In conclusion, initiation of appropriate treatment in the ED and timely referral of the patient to ophtalmologist may help decrease morbidity.

References

1. Wong TY. Epidemiological characteristics of ocular trauma in the US Army. Arch Ophthalmol. 2002; 120 (9): 1236.
2. Nordber E. Injuries as a public health problem in sub-Saharan Africa: Epidemiology and prospects for control. East Afr Med J. 2000; 77: 1-43.
3. Negrel AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemiol. 1998; 5: 143-169.
4. Lewallen S, Courtright P. Blindness in Africa: present situation and future needs. Br J Ophthalmol. 2001; 85: 897 –903.
5. Burstein ES, Lazzaro DR. Traumatic ruptured globe eye injuries in a large urban center. Clin Ophthalmol. 2013; 7: 485-488.
6. Yulish M, Reshef N, Lerner A, Pikkel J. Sport-related eye injury in northern Israel. Isr Med Assoc J. 2013;15: 763-765.
7. Hodge C, Lawless M. Ocular emergencies. Aust Fam Physician. 2008;37: 506-509.
8. Oum BS, Lee JS, Han YS. Clinical features of ocular trauma in emergency department. Korean J Ophthalmol. 2004;18: 70-78.
9. Havens S, Kosoko-Lasaki O, Palmer M: Penetrating eye injury: a case study. Am J Clin Med. 2009, 6: 42–49.
10. Omolase CO, Omolade EO, Ogunleye OT, et al. Pattern of ocular injuries in owo, Nigeria. J Ophthalmic Vis Res. 2011; 6: 114-118.
11. Yiğit O, Yürüktümen A, Arslan S. Foreign body traumas of the eye managed in an emergency department of a single-institution. Ulus Travma Acil Cerrahi Derg. 2012; 18: 75-79.
12. El-Sebaity DM, Soliman W, Soliman AM, Fathalla AM. Pediatric eye injuries in upper Egypt. Clin Ophthalmol. 2011; 5: 1417-1423.
13. Glynn RJ, Seddon JM, Berlin BM. The incidence of eye injuries in New England adults. Arch Ophthalmol. 1988;106:785-9.
14. Pokhrel PK, Loftus SA. Ocular emergencies. Am Fam Physician. 2007; 76: 829-836.
15. Gharaibeh A, Savage HI, Scherer RW, Goldberg MF, Lindsley K. Medical interventions for traumatic hyphema. Cochrane Database Syst Rev. 2013; 12: CD005431.
16. Ashaye AO. Traumatic hyphaema: a report of 472 consecutive cases. BMC Ophthalmol. 2008; 8: 24.
17. Kanski J. Clinical ophthalmology: a systematic approach. 3rd edn. Oxford, England: Butterworth-Heinemann Ltd, 1994.
18. Chuka OM, Obizoba OL. Paracentesis as surgical intervention in traumatic hyphaema: opinions and practices of nigerian ophthalmologists. Ophthalmol Eye Dis. 2012; 4: 71-78.
19. Edwards WC, Layden WE. Monocular versus binocular patching in traumatic hyphema. Am J Ophthalmol. 1973; 76: 359-362.
20. Read JE, Goldberg MF. Blunt ocular trauma and hyphema. Int Ophthalmol Clin. 1974; 14: 57-97.
21. Crouch ER Jr, Williams PB, Gray MK, et al. Topical aminocaproic acid in the treatment of traumatic hyphema. Arch Ophthalmol. 1997; 115: 1106-1112.
22. Romano PE, Robinson JA. Traumatic hyphema: a comprehensive review of the past half century yields 8076 cases for which specific medical treatment reduces rebleeding 62%, from 13% to 5% (p_.0001). Binocul Vis Strabismus Q. 2000;15:175-186.
23. Yen KG, Chilakapati MC, Coats DK, et al. Ocular infectious diseases. In: Feigin RD, Cherry JD, eds. Textbook of Pediatric Infectious Diseases, 6th edn. Philadelphia: Lippincott Williams & Wilkins; 2009:811-35.
24. Fanella S, Singer A, Embree J. Presentation and management of pediatric orbital cellulitis. Can J Infect Dis Med Microbiol. 2011l; 22: 97-100.
25. Cox NH, Knowles MA, et al., Pre-septal cellulitis and facial erysipelas due to Moraxella species. Clin. Exp. Dermatol. 1994; 19: 321– 323.
26. Lee S, Yen MT. Management of preseptal and orbital cellulitis. Saudi J Ophthalmol. 2011; 25: 21-29.
27. Chaudhry IA, Al-Rashed W, Arat YO. The hot orbit: orbital cellulitis. Middle East Afr J Ophthalmol. 2012; 19: 34-42.
28. Nageswaran S, Woods C, Benjamin D, Givner L, Shetty A. Orbital cellulitis in children. Pediatr Infect Dis J. 2006; 25: 695– 699.
29. Harris GJ. Subperiosteal abscess of the orbit: age as a factor in the bacteriology and response to treatment. Ophthalmology. 1994; 101: 585-595.
30. Singh P, Tyagi M, Kumar Y, Gupta KK, Sharma PD. Ocular chemical injuries and their management. Oman J Ophthalmol. 2013; 6: 83-86.
31. Pfister RR. Chemical Injuries to the eye. Ophthalmology. 1983; 90: 1246-1253.
32. Le Q, Chen Y, Wang X, Li Y, Hong J, Xu J. Vision-related quality of life in patients with ocular chemical burns. Invest Ophthalmol Vis Sci. 2011; 52: 8951-8956.
33. Adepoju FG, Adeboye A, Adigun IA. Chemical eye injuries: presentation and management difficulties. Ann Afr Med. 2007; 6: 7-11.
34. Brodovsky SC, McCarty CA, Snibson G, et al. Management of alkali burns: an 11-year retrospective review. Ophthalmology. 2000; 107: 1829-1835.
35. Le Q, Chen Y, Wang X, Hong J, Sun X, Xu J. Analysis of medical expenditure and socio-economic status in patients with ocular chemical burns in East China: a retrospective study. BMC Public Health. 2012; 12: 409.
36. Eye emergency manual. An illustrated guide. NSW Department of Health February 2007. Available at: www.health.nsw.gov.au/gmct/ophthal mology/pdf/eye_manual.pdf.
37. McGwin G Jr, Owsley C. Incidence of emergency department- treated eye injury in the United States. Arch Ophthalmol. 2005; 123: 662-6.
38. Serinken M, Turkcuer I, Cetin EN, et al. Causes and characteristics of work-related eye injuries in western Turkey. Indian J Ophthalmol. 2013; 61: 497-501.
39. Babineau MR, Sanchez LD. Ophthalmologic procedures in the

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emergency department. Emerg Med Clin North Am. 2008; 26: 17-34.
40. Joseph DP, Pieramici DJ, Beauchamp NJ Jr. Computed tomography in the diagnosis and prognosis of openglobe injuries. Ophthalmology. 2000; 107: 1899-906.
41. Trobe JD. Ophthalmic trauma. In: The Physician's Guide to Eye Care. 3rd ed. San Francisco, Calif. American Academy of Ophthalmology. 2006: 75-92.
42. Lubeck D, Greene JS. Corneal injuries. Emerg Med Clin North Am. 1988; 6: 73-94.
43. Shields SR. Managing eye disease in primary care. Part 3. When to refer for ophthalmologic care. Postgrad Med. 2000; 108: 99-10.

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