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Review

Etiology, Epidemiology, Assessment and Prognosis of Globe Rupture

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Abstract

Ocular trauma, which is a globe injury, is one of the most prevalent eye diseases, leading to hospitalization and severe eye deficits. The term globe rupture is used to describe a wide range of globe injuries. Globe rupture is defined as globe injury caused by the blunt object or due to an impact with inside-out mechanism. Globe injuries are expected to cause 3.5 eye injuries per 100,000 people worldwide, leading to about 203,000 new cases each year. Globe rupture is one of the most serious globe injuries resulting in lifelong blindness. The purpose of this research is to review the available information about the etiology, epidemiology, assessment, and prognosis of globe rupture. Globe rupture have a 27-fold high chance of development after previous intraocular surgery, myopia, age, among women, and a sudden collapse. Sharp objects trauma is a reason of globe rupture among children while accidents or injuries at work, assault, and car accidents are common causes for adults. The length of the wound and its location, both are important prognostic factors for primary care of globe rupture. Awareness of prognostic factors allows for more accurate and targeted interventions aimed at reducing vision loss caused by open ocular trauma. Literature has quite scarce epidemiological data regarding the globe rupture in future however, more population-based studies can significantly contribute. Early diagnosis and prompt treatment is essential for management of disease also awareness and use of protective equipment can also decrease the risk of globe rupture and injury.

Keywords: *globe, rupture, eye, injury*

Introduction

Globe rupture, globe laceration, globe perforation, and open globe injuries are all categorized under the umbrella of ocular trauma and require immediate diagnosis and treatment. Globe rupture includes wide range of open globe injuries. Penetration, perforation, laceration and blunt force rupture are the key methods that might compromise the globe's integrity. Prescence of an intraocular foreign body in the eye in certain circumstances is also noted. Cases of globe rupture are estimated to be 3 per 100000 in the United States (1). Mechanical ocular trauma, commonly termed as globe injury, is one of the most common ophthalmic diseases, resulting in hospitalization and significant vision deficits. Different factors will damage the globe in various ways depending on the mechanics of globe injury. Birmingham Eye Trauma Terminology System defines globe rupture as globe injury caused by the blunt object or due to an impact with inside-out mechanism, whereas globe injury induced by a sharp object or a laceration with an outside-in mechanism is categorized as either penetration, perforation, or intraocular foreign body (2).

Globe trauma or injury is still a leading cause of permanent vision loss and blindness around the world. Even with breakthroughs in eye surgery and equipment, vision loss may be unavoidable in a large majority of patients. Ocular injuries are significant because they can be avoided. Globe injuries are expected to cause 3.5 eye injuries per 100,000 people worldwide, resulting in around 203,000 new cases each year. Males are projected to have a 6 times higher rate of trauma than females. Eye injuries in young children and teenagers are usually penetrating or perforating, and they arise as a result of accidents, whether they are sports-related, automobile-related, or otherwise. In senior population, however, globe rupture is more prevalent than globe laceration and commonly caused by falls (3). While advancements in ophthalmic surgery procedures, instrumentation, and postoperative visual rehabilitation programs have reduced the risk of blindness, globe injuries remain one of the leading causes of visual morbidity and has a significant socioeconomic impact. Ocular injuries have a bimodal incidence pattern, with two peaks noted in the second and third decades of life, as well as in older individuals, according to published data in literature and common reported causes are sharp objects, blunt trauma, accidents and falls (4). The purpose of this research is to review the available information about the etiology, epidemiology, assessment and prognosis of globe rupture.

Methodology

This study is based on a comprehensive literature search conducted on May 26, 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the information about the etiology, epidemiology, assessment and prognosis of globe rupture. There were no restrictions on date, language, participant age, or type of publication.

Discussion

Globe rupture is among the most serious open globe injuries, causing lifelong vision loss or blindness. Globe rupture is 27 times more likely to develop after previous intraocular surgery, myopia, advanced age, among females, and sudden falls. Prominent subconjunctival bleeding with conjunctival edema can make it difficult to distinguish between an occult globe rupture and a serious ocular injury. After a severe traumatic ocular trauma, eyeball rupture should also be ruled out in case of any doubt. After 360° peritomy, limb and scleral exploration reveal the proper diagnosis. To avoid involuntary choroidal bleeding, persistent ocular hypotony, or epithelial ingrowth, the lesion must be closed immediately and completely. Posttraumatic endophthalmitis is more likely if wound closure is delayed. In the event of retinal damage and vitreal haemorrhage, tractional retinal detachment may be prevented by early vitrectomy. After an open globe trauma, silicone oil instillation stabilizes the central retina, while scleral buckling is questionable (5).

Etiology

Sharp objects, such as scissors, are the most significant reason for ocular globe rupture in children, and the majority of these injuries happen at home while accidents or injuries at the workplace, assaults, and car accidents are all common causes in adults (6, 7). Elderly populations experience globe rupture trauma commonly due to falls (8). According to a Chinese retrospective study in 2018 study, injury with an intraocular foreign

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body is more often due to an explosion in children under the age of ten, and more likely owing to a foreign body in children over the age of ten (9). Globe rupture can occur as a result of blunt or penetrating trauma and only early diagnosis and prompt treatment is beneficial (10). A radiopaque foreign body may be observed within the globe following penetrating trauma. Foreign bodies with a high density such as metal, stone, or glass can be observed on computed tomography scans as bright white intraocular densities. These can also be seen on x-ray, but a tomography scan provides a more precise location inside the globe instead of in the orbit. Wood and other low-density materials may be isodense with regular intraocular contents or blood (11).

Feng stated that the most common causes of ruptured globe requiring vitreoretinal surgery were violence, explosions, and traffic accidents (12). Globe rupture can be caused by trauma or an by any object invading the ocular tissues. Blunt trauma can induce an abrupt increase in intraocular pressure and a rupture in the weakest part of the eye. The rupture is most typically posterior to the extraocular muscles, where the sclera is weakest, in eyes that have not had surgery. The rupture is frequently at the previous incision site in eyes that have undergone prior intraocular surgery. In blunt trauma, the eye usually ruptures at the limbus. Globe rupture in the clinical model requires pressures of more than 7000 mm Hg (13). Presentation of a traumatic globe rupture **(Figure 1).**

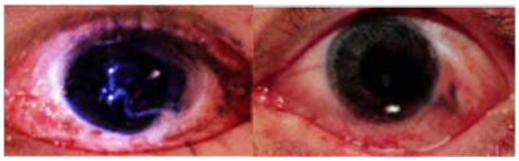

Figure 1 :Presentation of traumatic globe rupture (27).

Epidemiology

The prevalence of open globe injuries in United States is reported to be 3.49 per 100000 while in Australia the incidence is approximately 3.7 per 100000 (14). Batur reported in his retrospective study that adults had an open globe injury with rate of 3.40 per 100,000, with males having a rate of 5 per 100,000 and females having a rate of 1.67 per 100,000. Open globe trauma was most common in people aged 17 to 29. Males comprised 79.5% of the patients, while females constituted 20.5%. In 22.7% of the eyes, an intraocular foreign body was observed (15). Beshay reported in study findings in 2017 that there were 80 globe ruptures among which 33 ruptures were caused by falls while 82% accounted from previous intraocular surgery (16).

In Europe, epidemiologic data on open globe injuries is scarce. In Germany, the incidence is still low, with about 3 injuries per 100,000 people per year (17).Findings of a retrospective study in 2021 from Thailand revealed that traffic-related accidents accounted for 9% of all open globe injury cases. The 20–39-year-old age group accounted for over half of the injuries (51%) and 59% of automobile transportation were responsible for such injuries. The globe rupture was observed in 47% of the patients (18). Results of an Iranian retrospective study reported in 2021 that globe rupture was observed in 40.3% of patients, intraocular foreign body was observed in 7.3%. Three of the most common causes for these injuries were falls 25% followed by sharp objects 18.9% and tree branches 13.9% (19). Findings of another retrospective study from Saudi Arabia showed that the in most of the cases 37.5% penetration of the globe was observed and two of the common causes of injuries were blunt trauma 20% and shattered glass 18.3% (20). Results of retrospective study from Saudi Arabia in 2022 reported that 63 patients were admitted with traumatic globe rupture, males constituted 84.1% and 39.7% were children. In 4.8% of patients, delay in seeking medical care was noted. Blunt trauma was the most common mechanism (42.9%), followed by sharp trauma (38.1%) and projectile trauma (9.5%); 55.6% of the injuries were in zone 1. In 9.5% of patients, an intraocular foreign body was observed. Adults had a considerably higher rate of intraocular foreign bodies ($p = 0.018$) than children. On presentation, 77.8% of patients had poor visual acuity, and 60.3% had it on their previous visit (21). Literature is quite scarce regarding the epidemiological studies of globe rupture.

Prognosis

Wound length as well as its location, are both important prognostic factors in basic care of globe rupture. It is necessary to establish whether the wound is anterior or posterior, whether the sclera or the limbus or the cornea is injured, and whether the incision is posterior or prior to the muscle insertion. Additional factors that influence the final anatomical and functional outcome include age, the origin of the trauma, the development of endophthalmitis, bone fractures, initial visual acuity, lens trauma, and retinal detachment during the initial consultation (22). Awareness of prognostic factors allows for more precise and targeted interventions aimed at minimizing vision loss caused by open ocular trauma. The majority of the determinants are associated with the

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severity and nature of the trauma, which might be enhanced by educational measures and counselling on how to utilize personal protective equipment in the workplace and during recreational activities (23).

Different characteristics of the ocular damage point to a poor visual prognosis. Poor final visual acuity has been linked to poor initial visual acuity, longer wound length, horizontal midline wound, presence of hyphaemia, vitreous haemorrhage, and retinal detachment at presentation in scleral rupture. Longer wound length, greater rate of ocular adnexa injury, higher evisceration rates, and worse visual outcomes have all been observed in patients who were alcohol consumers. Those with low initial visual acuity, traumatic injuries associated with adnexal trauma, a relative afferent pupillary defect or retinal detachment, and the absence of a red reflex have a higher rate of enucleation (7). Results of an observational study in 2021 showed that the repair of the globe in three cases was found to be ineffective intraoperatively. Within two weeks of presentation, a fifth of the cases required evisceration or enucleation. Evisceration or enucleation was related with visual acuity that was worse than hand motion. However, visual acuity improved to the range of counting fingers and 20/200 at 6 months after surgery (P= 0.01). High ocular trauma scores were linked to a decreased risk of evisceration or enucleation, and 12% of patients had retinal detachment, with 90% occurring within one month of globe repair (24).

Assessment

Diminished visual acuity, intraocular bleeding, low intraocular pressure, uneven pupil shape, and a reduced or enlarged anterior chamber are all clinical manifestations of globe rupture however they vary with the intraocular pressure. Because of poor patient compliance, altered consciousness, and the evidence of head trauma and periorbital soft-tissue edema, diagnosing globe rupture in an emergency department can be difficult. For defining soft-tissue structures of the injured eye or displaying the extent of bone abnormalities and fractures, radiography and is insufficient. Computed tomography scan is quite useful for the purpose of diagnostic evaluation globe rupture. Magnetic resonance imaging is contraindicated especially when foreign bodies are suspected as it can lead to further trauma. Globe deformity or wall irregularity, lens destruction or dislocation, intraocular haemorrhage, intraocular foreign body, and intraocular gas are the primary characteristics of a computed tomography scan of a ruptured globe. However, the diagnosis rate of globe rupture based on computed tomography findings can be improved by referring to ophthalmologic tests and avoiding misinterpretations. (25). Computed tomography scan findings of globe rupture are illustrated in **(Figure 2).**

Figure 2 : CT Scan findings of globe rupture in a 75-year-old patient showing hematoma of eyelid along with dislocation of lens, vitreous haemorrhage and an irregular scleral wall (25).

Assessment of the patient's eye after the globe injury is possible after the examination of patient's airway, respiration and circulation has been conducted. Visual acuity is usually reduced in patients, which can be measured with a Snellen chart or a nearby card. The ability to count fingers, to see a moving hand, or to see a flash of light is used to test the comprehension of people with severe visual impairment. Detection of penetrating foreign bodies, scleral or corneal lacerations, uveal prolapse, and iris anomalies including peaked, or tear-drop pupils can be evaluated by slit lamp examination. When fluorescein staining of the cornea and sclera, the Seidel sign may appear as a stream of clear fluid flowing out of the globe wound, although the globe can remain open even if the mark is negative (26). Globe rupture despite a disease of concern has less epidemiological data reported in literature, in future more population-based studies can not only significantly contribute to literature but will also play role in designing better management and prevention strategies for the globe rupture.

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Conclusion

Globe rupture is a disease of prime concern which severely impacts the visual acuity. Early diagnosis and prompt treatment is essential in management of the disease to avoid further complications. Awareness campaigns among public are needed to educate on prevention of globe trauma and injuries and also encourage the use of protective equipment at workplace.

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Authors' contribution:

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