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Management of Traumatic Globe Rupture: Case Report

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Abstract

Purpose: A Case report of traumatic globe rupture. Globe rupture, an ocular emergency, is the most severe form of mechanical trauma to the globe because of the changes that occur to the tissue at the time of the injury. It is the most common cause of unilateral blindness worldwide; men being more commonly affected than women due to occupational and recreational preferences.

Case Report: The case reported is a 54- year old man presenting to the Accident and Emergency unit of our hospital due to a hit in the left eye by fireworks. The incident occurred an hour earlier on his way to church, resulting in loss of vision in that eye. The patient suffered significant trauma including rupture of the left globe.

Conclusion: Among the numerous causes of traumatic globe rupture, fireworks injuries constitute an important cause of preventable blindness worldwide. The diagnosis is usually easy because the wound is often obvious to the eye, though occult ruptures also occur necessitating the need for careful evaluation of every ocular injury. Due to the risk of expulsive choroidal haemorrhage, urgent surgical intervention is often required, the choice of surgery being determined by the degree of damage to the globe. Evisceration with a prosthesis is the preferred surgical management for severe traumatic injury. Protective eyewear and prevention education are key to reducing ocular morbidity from traumatic globe rupture.

Key words: Globe rupture, trauma, occult, blindness, fireworks, evisceration, prosthesis.

Introduction

Eye injuries are common and can occur either as isolated injuries or as part of head or facial injuries. Rupture is the most severe form of mechanical globe trauma because of tissue pathologies that occur at the time of injury and because of the post-injury destruction caused by scar formation as part of the body's normal healing process[1]. It is caused by a relatively large blunt object that initially compresses the eye, and once the resistance of the eye wall (cornea and sclera) is overcome, the eye wall opens at its weakest point[1,2]. According to the WHO, 1.6 million people are blind in both eyes while 2.3 million have low vision in both eyes, and almost 19 million with unilateral blindness or low vision, from ocular injuries[3,4,5]. Due to occupational and recreational preferences,

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the risk of ocular injuries is four times higher in men than in women[3,4,6], a high percentage occurring in adolescent boys. Men are more likely to experience penetrating injuries, whereas women present more with blunt globe rupture, mostly from domestic violence[7,8]. There is no racial predisposition. Mechanical injuries involving the eye ball can be classified using the Birmingham Eye Trauma Terminology System (BETTS)[2,9]. This is a practical guide which ensures that all the health workers involved in the care of the same patient have a consistent understanding of the type of injury[9]. In many middle and low income countries, trauma cases are often complicated by late presentation and/ or previous inappropriate intervention. It is therefore critical to have a well-trained first contact person for the correct assessment and management of an eye injury[3]. The diagnosis is usually easy because the wound is often visible, even to the naked eye, though occult ruptures also occur necessitating the need for careful evaluation of every ocular injury[1]. Globe rupture in adults may occur after blunt injury during motor vehicle accidents, sports activity, assault, while globe penetration or perforation may occur with gunshot and stab wounds, workplace accidents[4]. Fireworks injuries constitute an important cause of preventable blindness worldwide[10]. Due to the risk of expulsive choroidal haemorrhage urgent surgery is often required[1]. Evisceration, a surgical technique of removing a painful eye, is the preferred surgical management for severe traumatic injury. The surgery often includes placement of implant/prosthesis into evisceration cavity to maintain adequate orbital volume and improve cosmesis[11]. Eye health education and promotion sensitization by practitioners on use of protective eye wear while using fireworks are pivotal to reducing ocular morbidity from traumatic globe rupture.

Case Report

A 53 year old African male, named OX, reported at the Accident and Emergency (A and E) Unit of the hospital on 31st December, 2015 at about 9.00pm claiming that he had been hit in the left eye (L E) by fireworks an hour earlier on his way to the church, resulting in loss of vision in that eye. He was unable to identify the type of firecracker. The eye was very painful with blood draining from it. He claimed he had good vision in the eye before the injury. He had no previous trauma to the eye or surgery and was not on any medication. He had no significant medical history and had no known allergies to any medication.

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The medical officer on duty at the Accident and Emergency unit examined him as best as he could and made a gross assessment of Corneal Laceration on the LE. He immediately called the Consultant Ophthalmologist on phone who communicated to him what to do for the patient and instructed him to administer the following medications;

1. Gutt Ciprofloxacin 2hrly / LE
2. Gutt Atropine tds LE
3. IV Ceftriazone Ig stat
4. IM Tetanus Toxoid 0.5mls stat
5. Tabs Diclofenac 50mg bd x 5/7
6. Tabs Vit C- tds x 2/52
7. Eye shield LE

He was subsequently admitted in the male surgical ward for review by the Ophthalmic team the following day. He was also requested to carry out the following Laboratory investigations: PCV, HBS Ag, HCV, VDRL, HIV I & II.

Follow up #1 (1/1/2016)

Patient was seen in the male ward by the ophthalmic team comprising of the Ophthalmologist, Optometrist and Ophthalmic nurse. He had no fresh complaints. His bedside Visual Acuity was Right Eye (RE) Count Finger (CF) @ 6m , Left Eye (LE) No light Perception (NLP).

Pen light external examination with a head loupe, after instillation of Tetracaine Hydrochloride (0.5%) in the LE, revealed a quiet anterior segment in the RE with a deep anterior chamber (using shadow test). The lens was transparent as well as the vitreous. Direct funduscopy equally revealed there was no abnormality in the posterior segment of the RE, the retina was flat, the disc normal with a cup to disc ratio of 0.3, obeying the **Inferior Superior Nasal Temporal (ISNT)** Rule. In the LE there was marked periorbital oedema, marked sub conjunctival haemorrhage, near total hyphaema, corneal haze, scleral rupture temporally around the 3 o'clock position close to the limbus, with a foreign body in situ at the site of the rupture. The anterior chamber was flat (Shadow test) and there was nil view of the posterior structures in the LE.

Ocular motility using the Broad H test showed a restriction of movement in all quadrants of gaze. An assessment of Left Traumatic Globe Rupture 2^0 fireworks injury with entrapped foreign body, was made. He was advised to continue with his medication and prepare for Exploration and Repair ASAP for Possible Evisceration of the LE.

The following Differentials were considered;

1. Corneal Laceration: This is either a partial or full thickness injury to the cornea. A partial thickness injury results in an abrasion since it does not violate the globe while a full

thickness injury penetrates completely through the cornea and may cause a ruptured globe[12]. Typically, the patient presents with an intensely painful and profusely lacrimating eye. The bulbar conjunctiva will also be significantly injected. A full thickness injury will allow aqueous humor to escape the anterior chamber, resulting in a flat appearing cornea or an asymmetric pupil secondary to the iris protruding through the corneal wound.

2. Retinal Detachment (RD): A retinal detachment is a separation of the sensory retina from the retinal pigment epithelium by Sub Retinal Fluid (SRF)[13]. It is classified into;

1. Rhegmatogenous or Primary Retinal detachment which occurs due to a full thickness break or tear in the sensory retina which permits **Sub Retinal Fluid (SRF)** derived from liquefied vitreous gel to gain access to the sub retinal space and separate the sensory retina from the pigmentary epithelium. The etiology is not clear exactly[14,13].

2. Non-rhegmatogenous RD may be

a. Tractional, which occurs due to the sensory retina being mechanically pulled away from the retinal pigment epithelium by the contraction of fibrous tissue in the vitreous. Important causes include Proliferative diabetic retinopathy, Retinopathy of Prematurity, Sickle cell Retinopathy, and penetrating posterior segment trauma[13]

b. Exudative (Serous) where the retina is pushed away by a neoplasm or the accumulation of fluid beneath the retina following inflammatory or vascular lesions. Some causes include choroidal tumors, toxaemia of pregnancy, severe hypertension [14,13]

3. Vitreous Hemorrhage: This usually occurs from the retinal vessels and may present as pre-retinal or an intragel haemorrhage. Some causes include retinal tear, posterior vitreous detachment, retinal detachment, blunt or perforating trauma, diabetic retinopathy, hypertensive retinopathy.

4. Traumatic Globe Rupture: Globe Rupture forms part of open-globe injuries which are full thickness wounds of the eye wall. The choroid and retina may be intact, prolapsed or damaged [11,12,14]. It is caused by a blunt object impact which produces an inside-out force that ruptures the eye wall at its weakest point and can result in tissue herniation[11].It may also be caused by a laceration which is an outside-in mechanism caused by a sharp object and resulting in a full thickness wound at the impact site. A penetrating injury is a single laceration by a sharp object with only an entrance wound while a perforation consists of two full thickness lacerations caused by same object (entrance and exit wounds)11,14.

The patient was diagnosed with Traumatic Globe Rupture 2° perforating injury from fireworks.

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Follow up # 2 (2/1/16)

The results of the laboratory investigations were seen, prior to the surgery, all within normal limits: PCV 41%, HBSAg Negative, HCV Negative, VDRL Negative, HIV 1&11 Negative. A signed informed consent was also obtained from the patient prior to the surgery. The surgery was carried out by the Ophthalmologist in the minor theatre of the hospital following routine procedure. He noted that during the surgery he had noticed an exit wound around the 2o'clock position, making it a perforating injury.

His post –operative medication was as follows:

1.Gutt Maxitrol (Dexamethasone and Neomycin) 6x daily__LE
2.Gutt Ciprofloxacin 6x daily—LE
3.Oc Beoptic-N (Betametasone and Neomycin)
4.Tabs Diazepam 10mg stat
5.Tabs Diclofenac 50mg bd x 5/7
6.Tabs Ciprofloxacin 500mg bd x 5/7
7.Tabs Vitamin C ii tds x 2/52.

The patient was discharged home the following day on above medications, to be reviewed in the eye clinic four days afterwards.

Follow up #3 (6/1/16)

In the eye clinic his entry visual acuity was RE 6/12,LE NLP, with PH RE 6/6. Slit lamp examination of the RE showed a quiet anterior segment, deep anterior chamber with no cells, a clear lens, brownish coloured iris, clear vitreous, no relative afferent pupillary defect. Direct Funduscopy in the RE revealed no abnormalities in the posterior segment. There was mild blepharospasm in the eviscerated eye, though the socket was clean with minimal discharge. The sclera sutures were also in place.

Intraocular pressure (IOP) in the RE was 12.0mmHg at 10.24 am, using the Non contact tonometer (NCT) by NIDEK. An additional assessment of Refractive Error in the RE was also made. He was advised to continue with his post-operative medications and return to the clinic after one week for review.

Follow up #4 (13/1/16)

There were nil fresh complaints, examination was same as last visit. The IOP in the RE

remained normal. Patient was counselled about care of his eviscerated eye, and seeing eye as well. He was advised to continue treatment and return to the clinic after two weeks for refraction of the right eye.

Follow up #5 (27/1/16)

He returned with no new complaints. The eviscerated eye was clean and healing well. The RE was refracted with +2.00DS 6/5 ADD +2.00DS N5. A balance prescription was made for the LE. The IOP in the RE was 13.7mmHg @ 12.20pm with NCT. He was scheduled for a review in one month.

Follow up #6 (26/2/16)

Patient reported in the clinic looking calm and cheerful and wearing his pair of spectacles. He had no new complaints. His visual acuity was RE 6/18, aided with spectacles 6/5, LE-eviscerated. All other findings in both eyes remained same as last visit. He was counselled on the need to wear a prosthesis in the eviscerated eye, and was booked for clinic review in three weeks.

Follow up #7 (18/3/16)

The patient kept his appointment with the clinic. His corrected distance visual acuity in the RE was 6/5, near N5. The anterior and posterior segments in the RE were quiet and normal, while the eviscerated LE was also quiet and clean. The IOP in the RE was 12.0mmHg @11.04 am using NCT. An appropriate artificial eye matching the features in the RE was selected from the trial set of artificial eyes and fitted in the LE.

Extra ocular muscle movement was adequate in all directions of gaze. He practised the fitting procedure several times in the clinic until he got a hang of it. He was also educated on the proper wearing and cleaning regimen. He was scheduled to return to clinic after two weeks.

Follow up #8 (1/4/16)

Mr OX returned to the clinic as scheduled with nil fresh complaints. The vision and condition of the RE remained the same while the LE had the prosthesis properly in situ. Extra ocular muscle movements remained full in all quadrants. The patient was discharged and advised to visit the clinic in about two months for review.

Follow up #9 (2/6/16)

The patient attended the clinic as advised with no new complaints. He had adjusted well to wearing a prosthesis, he claimed he encountered no difficulties with the fitting or removal. The corrected visual acuity in the RE remained

6/5, the anterior and posterior segments also remained same as last visit. The LE had the prosthesis in situ, there was no discharge around the eye, ocular motility was also full. He was encouraged to visit the clinic whenever the need arose.

Discussion

Globe rupture occurs when the integrity of the outer membranes of the eye is disrupted by blunt or penetrating injury[4]. According to the Birmingham Eye Trauma Terminology System (BETTS)[14,2,9] any full thickness injury to the cornea, sclera or both is considered an Open globe injury. A closed globe injury may occur when a blunt object impacts the globe, compressing the globe along the anterior-posterior axis causing an elevation in intraocular pressure to a point that the sclera tears[12,13]. Once the resistance of the eye wall (cornea, sclera) is overcome ,the eyeball opens at its weakest point[15]. Ruptures from blunt trauma are most common at the sites where the sclera is thinnest, at the insertions of the extraocular muscles, at the limbus, the insertion of the optic nerve and at the sites of previous intraocular surgery[12,13,1]. Sharp objects or those travelling at high velocity, like bullets or fireworks, may perforate the globe directly. Small foreign bodies may penetrate the eye and remain within the globe.

According to the World Health Organisation(WHO), 1.6 million people are blind in both eyes while 2.3 million have low vision in both eyes from this cause, and almost 19 million with unilateral blindness or low vision[3,5]. In the United States of America more than 2 million eye injuries occur annually, with more than 40,000 resulting in some degree of permanent visual impairment[16]. In Nigeria, at the Eye Clinic of the Nigerian Navy Reference Hospital, Lagos, out of a total of 5,854 patients seen between March 2014 and March 2015, 85 (1.5%) were ocular trauma cases and more than 10 (6%) resulted in varying degrees of visual impairment including blindness[7,17]. Men are more likely to experience penetrating injuries because of occupational and recreational preferences, whereas women present more often with blunt globe rupture[7,8] mostly from domestic violence. Compared to women, the risk of eye injuries in men is 4 times higher. Globe rupture typically occurs at a younger age in men than in women with a higher percentage of occurrence in adolescent boys[8].

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Rupture is the most severe form of mechanical globe trauma and represents 32% of all open globe injuries, according to the US Eye Injury Registry (USEIR), and the surveillance arm of the American Society of Ocular Trauma (ASOT)[18,19]. Usually the offending object on impact with the eyeball compresses it and once the resistance of the eye wall (cornea and sclera) is overcome the eye wall opens up at its weakest point. The impact causes a rise in the intraocular pressure (IOP) of the eye with subsequent opening of the eye wall and resultant tissue extrusion, be it uvea, vitreous or retina. The loss of intraocular contents continues until a new equilibrium with atmospheric pressure is reached. This equilibrium is reached when the IOP drops to zero or a tissue tamponade the wound, preventing further tissue prolapse[19].

The patient, Mr OX, was rushed to the Accident and Emergency (A and E) Unit of the hospital with a severely painful LE, blood draining from it. The first priority usually is to manage the anxiety and pain of the person with an eye injury. Such patients need a gentle, reassuring and sympathetic approach[3]. The medical officer on duty at the A and E Unit promptly called the Ophthalmologist on phone who guided him on the appropriate emergency management for the patient. Patients may need admission even if they are not having surgery, if they must be sent home then they must be made to understand how to take care of their injured eye. Our patient needed to be admitted because of the severity of his injuries[3].

Most patients with a ruptured eye rapidly seek medical help because of the severe, sudden loss of vision, usually due to vitreous hemorrhage[1]. The attending doctor on duty was unable to measure the presenting visual acuity because of unavailability of a Snellen Chart at the A and E unit, however the following day the ophthalmic team recorded a vision of NLP in the LE in the ward where he had been admitted. The eye was still draining blood. According to the United States Eye Injury Registry (USEIR) data, in about ¾ of the eyes the wound is scleral or corneoscleral[1]. There is also usually a conjunctival wound, but if the conjunctiva is intact (occult rupture) the rupture may initially remain undetected. A Slit lamp examination could not be immediately carried out on him for logistic reasons[9] but a penlight external examination, using a head loupe, was done after instillation of a few drops of 0.5% Tetracaine Hydrochloride. This revealed severe periorbital oedema but no lid laceration. There was also marked subconjunctival haemorrhage with corneal haze but no obvious laceration. There was a scleral rupture temporally around the 2o'clock position, with a foreign body in situ. Using the Shadow test the anterior chamber was flat. The pupil was obscured, there was, however, no appearance of an iris prolapse, the retinal reflex was equally dark. Digital tonometry indicated a mildly rigid eyeball. He was given an Ocular Trauma Score (OTS) of 1 which is associated with a 90% predicted outcome of between NLP and LP vision [19].

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A diagnosis of Globe Rupture may be established with the following signs which may not all be present at once;

- Presence of a thick sub conjunctival haemorrhage
- Abnormal anterior chamber depth, a shallow anterior chamber may be the only sign of occult globe rupture and is associated with a worse prognosis[4] .
- Peaked pupil or irregular pupil
- Loss of the iris, crystalline lens or red reflex(due to vitreous haemorrhage)
- Low intraocular pressure.

Globe rupture in adults may occur after blunt injury during motor vehicle accidents, sports activity, assault[4]. Fireworks injuries also constitute an important cause of preventable blindness worldwide[10]. Fireworks injuries are common on New Year's eve in China, the Prophet's birthday in Libya and the 4th of July in the United States of America[20]. They occur in most societies and usually affect boys[21]. Although there are no documented studies yet fireworks are also commonly used in Nigeria during festivities with resultant ocular injuries. Injuries to onlookers also abound, the patient under review was injured on New Year's Eve while walking to the church.

A careful and detailed ocular examination should be followed by appropriate diagnostic studies. A computed tomography of the orbit and its adjacent structures is often the diagnostic procedure of choice[4,22] . This was not ordered for the patient under review because of the unavailability of the equipment at the medical facility. The time of arrival of the patient at the hospital precluded the possibility of his being referred to do it at another centre, also bearing in mind the high cost of the procedure. However, the following laboratory investigations were carried out on his blood sample at the Laboratory department of the hospital: PCV, HBS Ag, HCV, VDRL, HIV 1 and 11. The results were all within the normal limits.

Once the diagnosis is made or the possibility of an occult rupture cannot be excluded, the ophthalmologist must arrange for immediate surgery. As a general rule the sooner the wound is closed the better because any delay risks an expulsive choroidal haemorrhage which is the most devastating complication of an open globe injury [1,4]. However this must be balanced by the availability of the facility and its infrastructure (material, equipment, personnel)[1]. The severity of the injury and the wishes/circumstances of the patient must be taken into account.

The goal of drug treatment for Traumatic Globe Rupture is to prevent infections and pathophysiologic complications as stated earlier. Prophylactic systemic antibiotics should be given to cover organisms commonly associated with post traumatic endophthalmitis, these

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include Bacillus species, Pseudomonas species, Staph aureus, Staphylococcus epidermis, gram-negative bacilli, anaerobes, streptococci, and so on[4,23]. Topical antibiotics are also commonly given pre and post operatively. Third generation cephalosporins are recommended for treatment of susceptible organisms. The ultimate choice of antibiotics is based on the individual characteristics of the injury and patient, the determination of the degree of risk of infection, and the likely organisms involved[4,24]. The use of topical and systemic steroids is controversial [25]. The patient was given Ceftriaxone injection 1g stat preoperatively, and Ciprofloxacin eye drops pre and post operatively, he also got a shot of Tetanus toxoid 0.5mls stat. Diclofenac tablets were equally given to manage the pain. The use of topical and systemic corticosteroids is controversial[26], though our patient was given topical steroids post operatively to treat the resultant inflammation.

The risk factors for developing post traumatic endophthalmitis were thought to include delayed primary repair, delay in initiating therapy, breach in the lens capsule, and retained foreign body[26,27]. The ophthalmologist took the decision to do an outright evisceration for the patient in order to reduce the risk of post traumatic endophthalmitis. Evisceration is the preferred surgical technique for the removal of all intraocular contents (cornea, iris, lens, vitreous and retina) while preserving the remaining scleral shell, extraocular muscle attachments and surrounding adnexa[28]. The optic nerve is also spared. The surgery may include placement of an inert implant into the evisceration cavity to maintain appropriate orbital volume before a prosthesis is fitted over the implant. The prosthesis improves the appearance of the affected socket, it is preferable to wearing an eye patch[11]. The indications for evisceration include endophthalmitis, penetrating ocular trauma and a painful blind eye[2,22,24,11]. The surgery was carried out on Mr XO following routine procedure, though without an implant.

Evisceration was chosen over enucleation for his surgery because it is a less complex surgery with less disruption of orbital tissues. It is also less painful, results in improved motility and has a less chance of spread to nervous system in cases of infection[24,25]. However, some of its known complications are retro bulbar haemorrhage, orbital oedema, dissemination of unexpected intraocular neoplasm and extrusion of implant [24,11,25].

He was fitted with a readymade prosthesis some weeks later. The unavailability of an Ocularist made it impossible to fit him with a customised one. The prosthesis was made from hard, plastic

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acrylic. He also received counselling to help him adjust physically and psychologically. Some of the complications of traumatic globe rupture include delayed post-operative or exogenous endophthalmitis, and infection involving the deep structures of the eye[4,29]. Infection may occur in hours to months following ocular trauma depending on the organism involved[30].

Esmaeli et al1[7] after studying 176 cases of ruptured globe identified initial visual acuity of 20/200 or better, wound location anterior to the plane of insertion of the four rectus muscles, wound length of 10mm or less, and sharp mechanism of injury, as predictors of excellent final visual acuity (20/60 or better). Conversely, an initial visual acuity of light perception or no light perception, wounds extending posterior to rectus muscle insertion plane, wound length greater than 10mm, and blunt or missile injury were predictors of poor visual outcome. The prognosis should be guarded until after surgical evaluation[30]. Our patient had all the odds against him, so a poor prognosis was expected. Protective eye wear and prevention education are key in reducing ocular morbidity from traumatic globe rupture[31].

Conclusion

Traumatic globe rupture is a main cause of unilateral blindness worldwide. People with eye injuries are in pain and have been through very difficult experiences, they will invariably be anxious about their vision. It is therefore important that ocular trauma patients are handled by specialist who can skilfully manage their condition in a way that aims to restore vision and prevent further loss of vision and/or reduce the effect of secondary complications. Protective eye wear and prevention education are important in reducing the devastating effects of ocular injuries. Prevention messages and education certainly increase people's knowledge about avoiding and protecting themselves against risks. Public awareness by print and electronic media during festivities can decrease fireworks related ocular injuries significantly.

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