Current Anaesthesia & Critical Care 21 (2010) 184–188

Contents lists available at ScienceDirect

Current Anaesthesia & Critical Care

journal homepage: www.elsevier.com/locate/cacc

FOCUS ON: OPHTHALMIC ANAESTHESIA

Anesthesia for ocular trauma

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Keywords:
Eye injuries
Trauma
Anesthesia
Epidemiology

SUMMARY

Controversies exist regarding optimal anesthetic management of patients receiving surgery for ocular trauma. Ocular injuries are commonly encountered in clinical practice as an estimated 750,000 patients are hospitalized with eye injuries annually throughout the world. Many, particularly those with open globe injuries, require surgery, often under emergency conditions that make the patient's anesthetic management challenging. This paper reviews epidemiological data illustrating the prevalence and incidence of serious eye injuries and then presents a case study detailing the anesthetic management of a severely traumatized patient to illustrate a discussion of current options and recommendations for the management of such cases.

1. Incidence and prevalence of traumatic eye injuries

Traumatic eye injuries are a common problem which can occur in the workplace, at home, during leisure activities such as sports, or as a result of road accidents or assault.[1] Estimates of the incidence, prevalence, and seriousness of such injuries are imprecise because of the methodological limitations of the available epidemiological studies that usually rely on population surveys or reviews of hospital records. Eye trauma is generally believed to be more common and more serious in developing countries, but even the developed world is not spared. A survey of more than 5000 urban residents over the age of 40 in one American city revealed that 22.5% of black males, 20.3% of white males, 12.2% of black females, and 7.7% of white females recalled having experienced ocular trauma for a cumulative lifetime prevalence rate of 14,300 injuries for every 100,000 people.[2] A similarly sized survey of urban and rural residents of Australia over the age of 40 revealed that 34.2% of males and 9.9% of females reported having had an ocular injury that required medical attention.[3] These self-reported prevalence rates are even higher than those reported in a survey of almost 40,000 Nepalese that revealed that 1780 of every 100,000 people either had clinical evidence of traumatic eye injury or reported a history of ocular injury before age 60.[4,5] The World Health Organization (WHO) estimated that globally there were 55 million eye injuries annually that restricted the patient's activity for at least one day.[5] In the United States alone there were at least 2.5 million such traumatic eye injuries annually.[6] The incidence of ocular trauma can also vary dramatically over time as the introduction of new industries into a region can increase the risk of occupational injury while advances in injury prevention, such as seat belts and protective eyewear, can reduce the incidence of serious eye injury.[5,7–10]

In addition to the morbidity associated with these ocular injuries, there are also large financial costs. In the US, the total annual cost to society associated with ophthalmic trauma is estimated to be greater than $4 billion.[11] Fortunately, most eye injuries are minor or self-limiting and can be treated successfully in outpatient facilities,[12,13] but the WHO estimates that worldwide some 750,000 of these injuries resulted in hospitalization.[5] In the industrialized world, the estimated incidence of eye injuries requiring hospitalization was 13 per 100,000 population per year,[5] but methodological inconsistencies in the reported epidemiological studies contribute to rates of hospitalization that vary widely from country to country and even within countries. Studies have reported annual incidence rates for hospitalization due to traumatic ocular injury per 100,000 population of 12.6 for Singapore,[14] 15.2 for Sweden,[15] 8.1 for Scotland,[8] and 4.9 for Italy.[1] One Australian study[17] estimated an annual incidence of 15.2 admissions per 100,000 while another Australian study[3] reported an annual rate of 57 hospitalizations per 100,000. Estimates of admission for ocular trauma in the United States ranged from 4.1 to 13.2 per 100,000 population.[17,18] One Australian study[3] reported that 8% of ocular trauma required hospitalization in contrast to two British studies in which only 0.9% and 1.8%, respectively, of traumatic eye injuries required admission.[12,13]

Traumatic injuries resulting in hospitalization can be broadly categorized as either "open globe" injuries in which the integrity of the ocular wall is breached versus "closed globe" injuries in which

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0953-7112/$ – see front matter © 2010 Published by Elsevier Ltd.
doi:10.1016/j.cacc.2010.05.001

the ocular wall remains intact. Open globe injuries such as ruptures, lacerations or penetrating wounds are of particular importance to anesthesiologists because these injuries usually require surgery, often emergency procedures under conditions that complicate the anesthetic management of the patient.

Ten years ago the WHO estimated that there were 200,000 annual admissions worldwide for such open globe injuries.[5] In the United States, as in the rest of the world, the problem is particularly common among males whose risk ranges from 6 to 9 times higher than the risk for females.[1,8–10,15] In the US Eye Injury Register database, 81% of serious trauma cases were males.[19] Risk peaks for males between ages 15 and 24 with some evidence of a secondary increase in incidence for older males,[8,18,20] possibly because of an increased risk of blunt trauma globe rupture as a result of a prior history of having had a large-incision cataract extraction, corneal transplant, glaucoma filtering procedures, or LASIK.[7,21,22] In contrast, the risk of trauma peaks for females between ages 5 and 14.[8]

Epidemiological studies suggest that the annual incidence of open globe traumatic injuries is approximately 3.5 cases per 100,000 population.[23] An annual incidence of 3.6 per 100,000 was reported from Australia[16] while a rate of 3.0 per 100,000 per year was reported in a two decade retrospective hospital-based study in Germany.[7] Researchers in Stockholm reported an annual incidence of 6.0 per 100,000 males and a corresponding incidence of 1.2 for females.[15] Review of hospital records for well defined populations in the United States found the incidence of perforating eye traumas per 100,000 population to be 2 in Wisconsin[17] and 3.8 in Maryland.[20]

Ocular traumas, particularly open globe injuries, are a source of serious morbidity. A WHO survey estimated that 1.6 million people worldwide have been blinded in both eyes by trauma. An additional 2.3 million individuals have bilateral low vision while 19 million people have monocular blindness or low vision caused by traumatic injuries.[5] In the United States, estimates are that the prevalence of bilateral blindness from trauma is 9 per 100,000 population, affecting at least 19,400 individuals.[6] The same study estimated that nearly 1 million Americans had permanent visual impairment from trauma with more than 75% of these having monocular blindness. Trauma was second only to cataracts as a cause of visual impairment in the U.S. population with 50,000 new cases of traumatic visual impairment reported each year.[6] In a population survey from an American city, 21.2 of every 1000 black males over age 40 had monocular blindness from prior trauma,[2] a prevalence even higher than that observed in Nepal where 8.6 of every 1000 residents had traumatic monocular blindness.[4]

Open globe injuries are often associated with concurrent injuries to the head, orbit, and adnexa, especially in cases of blunt force trauma.[24] In a study of 300 patients with open globe injuries, orbital and adnexal injuries were observed in 25.7% of patients, with periocular lacerations, orbital fracture, and retrobulbar hemorrhage the most common.[25]

These open globe injuries can often be managed successfully with surgery, which is more commonly performed in the community hospital setting rather than in trauma centers.[26] The definitive therapy for such injuries is rapid primary closure, usually within 24 h of the injury, with antibiotic treatment to prevent endophthalmitis.[23] Surgery is able to preserve vision in up to 75% of patients, the outcome primarily dependent upon the degree of injury to the posterior segment of the globe.[24] The introduction of pars plana vitrectomy and improved antibiotic management of potential infections has increased the probability of functional success with surgical intervention.[27] Even for patients lacking any light perception in the traumatized eye, the US Eye Injury Register reported that 16% improved and 2% even achieved 20/40 or better visual acuity. The same survey found that among patients who still had light perception after their injury, 69% improved with surgery with 19% achieving normal visual acuity.[19] The prognosis for vision in ruptured globe or for those with severe penetrating injuries is more disappointing with more than half of these eyes remaining blind,[19] and 12–21% requiring enucleation.[10,24] There is some hope for salvaging vision even after relatively severe injuries as a recent review reported that 40% of 109 eyes with penetrating injuries or ruptured globes had a good outcome with surgical intervention, achieving a final visual acuity score of 6/12 or better on the Snellen scale.[23]

2. Case study of the anesthetic management of a severe ophthalmic trauma

The following case study illustrates the approach to some of the many challenges in the anesthetic management of patients with severe ocular injuries.

Patient XX, an 18 year old female, presented with a severe globe injury due to lacerations caused by shards from a helmet that shattered in a motorcycle accident (Fig. 1). After examination in the emergency room, she was scheduled for an emergency exploration of her wound. General anesthesia was induced using lidocaine (1 mg/kg), fentanyl (2 μg/kg), propofol (2 mg/kg) and succinylcholine (2 mg/kg) to achieve a rapid-sequence induction. Prior to the administration of succinylcholine, a defasciculating dose of vecuronium (0.01 mg/kg) was given. A size 7 endotracheal tube was placed uneventfully. After spontaneous recovery from succinylcholine, a paralyzing dose of vecuronium was administered (0.1 mg/kg). Anesthetic state was maintained with desflurane (6%) in a mixture of oxygen and air.

Following completion of the 4-h procedure, which included enucleation and placement of an ocular prosthesis (Fig. 2), paralysis was reversed in the presence of one twitch out of four with neostigmine (0.07 mg/kg) and glycopyrrolate (7 μg/kg). An IV dose of lidocaine (1 mg/kg) was administered prior to extubation to attenuate the sympathetic response to extubation. After the patient regained spontaneous ventilation, she was kept in the lateral head down position to decrease risk of aspiration, and the endotracheal tube was removed uneventfully.

Five months after her emergency surgery, she presented for additional sinus surgery. Her anesthetic management was handled routinely, and the case was completed uneventfully (Fig. 3).

Fig. 1. Severe globe injury.