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CASE REPORT

Airbag induced facial and bilateral ocular injuries in a 14-year-old child

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Abstract Although air bags have reduced the incidence of fatal and severe injuries in automobile collisions, they have been shown to carry a risk of injury themselves. Ocular injury in particular can often be a direct consequence of air bag deployment.

We report a 14-year-old child who sustained facial burn and bilateral ocular injuries affecting both the anterior and posterior segments due to an inflated air bag in a low speed motor vehicle accident.

1. Introduction

Air bags have received widespread support as an effective means of enhancing automotive safety. They are becoming more common as standard automobile equipment on most new cars.

With the increasing number of air bag equipped vehicles, there has been a corresponding increase of air bag associated ocular and facial trauma (Kim et al., 2004). Articles documenting eye injuries related to air bag inflation began to appear in 1991, prompting Dr. Ferenc Kuhn and associates from the US Eye Injury Registry to editorialize, “Air bag: Friend or foe?” (Kuhn et al., 1993).

The air bag is a coated nylon bag housed within the steering column on the driver side and within the dashboard on the passenger side (National Highway Traffic Safety Administration, 1996). Sensors located within the vehicle structure are activated when a crash occurs at 12 mph or faster and within a 60° frontal arc. An electrical signal is sent to the air bag cartridge, which contains a combustible solid-state powder, usually sodium azide (NaN_3), and an oxidizing agent (Kuhn et al., 1993). The combustion of sodium azide produces mostly inert nitrogen gas, but other byproducts include ammonia, carbon dioxide, nitric oxide, carbon monoxide, an alkaline aerosol containing sodium hydroxide, and various metallic oxides. An inert talc powder used in packaging also is discharged. Heat is an additional by-product of the combustion process.

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The expanding bag splits the plastic casing and is propelled out of the storage compartment at 100–200 mph, depending on the manufacturer. The entire inflation sequence is completed within .05 s.

The air bag capacity varies widely, but most fully inflated bags contain 60 L of gas on the driver's side and 140 L on the passenger's side. The driver-side air bag expands to a depth of 25–30 cm. The passenger-side air bag expands to a greater depth. Some bags are tethered, others are not. A tethered bag contains one or more straps that limit its anterior–posterior expansion. The air bag quickly begins to deflate through vents directed away from the occupant. Systems vary widely between vehicle models.

The purpose of the air bag is to cushion the occupant from the rigid components of the vehicle interior. In order to provide the desired cushion, the air bag should expand with sufficient speed to be fully inflated before the occupant moves forward following impact.

We report a case of facial and bilateral ocular injury in a 14-year-old child which is believed to be the first case of such trauma reported in Kuwait.

2. Case report

A 14-year-old boy was involved in a road traffic accident. He was in the passenger seat, not using his seat belt, not wearing his glasses. While the car was parked it suddenly received a hit from behind to hit another car in front of it, and then received another severe hit from behind that turned it around itself and the airbag was deployed causing facial and bilateral ocular injuries to the child. Patient was stabilized and transferred to the eye casualty department of Al-Bahar Ophthalmic Center.

On general examination, patient had extensive grade II burns mostly around the face and extending to the neck and upper chest with severe lid edema and subconjunctival hemorrhage in both eyes (Fig. 1).

On examination, unaided visual acuity (VA) was counting fingers (CF) at 1 m distance in right eye and hand motion (HM) in left eye, and ocular motility was full in both eyes. The lids of both eyes were edematous with multiple areas of skin abrasions mostly in both upper lids. Conjunctiva was chemotic with extensive subconjunctival hemorrhages in both eyes. The right cornea showed 3.5×6.5 mm abrasion while the left one had subtotal abrasion with moderate stromal edema. The right pupil was round, mid-dilated and showing sluggish reaction to light and near vision but the left one was oval and non-reactive.

Figure 1 Face burn, lid ecchymosis and subconjunctival hemorrhage 4 days after presentation.

Anterior chambers were deep with hyphaema which measured 2.6 mm on the right and 1 mm on the left with +2 cells in both eyes. Intraocular pressure (IOP) was 18 mmHg in both eyes. The right posterior segment was normal. There was left vitreous hemorrhage but the retina was flat as proved by B scan. X-ray orbit was done and showed no abnormality. Patient was kept on cold compresses, bed rest with head up at 45° and given topical antibiotics, steroids and 2 days mydriatics.

Four days later, VA improved to 20/40 in right eye, 20/200 in left eye. Examination showed healing face burn (Fig. 1), bilateral resolving subconjunctival hemorrhage, residual hyphaema, corneal abrasions and traumatic mydriasis (Fig. 2). Posterior segment examination showed mild residual vitreous hemorrhage and macular edema in the left eye.

Ten days after the accident, VA improved to 20/25 right eye and 20/40 left eye. Hyphaema was completely resolved; the retina was flat with no tear in both eyes. There were residual bilateral subconjunctival hemorrhage and traumatic mydriasis and vitreous hemorrhage OS (Fig. 3). On the tenth day, optical coherence tomography (OCT) was done for the left eye (Fig. 4) after the vitreous hemorrhage was cleared up. It showed resolved macular edema as proved by the normal central thickness with residual small cystic spaces.

The patient was discharged from the hospital on the 10th day with only topical lubricants, and he was seen after 1 week in the outpatient clinic. At that time facial burns were almost completely healed.

Visual acuity was 20/25 right eye and 20/40 left eye, unaided. Tension was 16 mmHg in both eyes. There were some remaining bilateral superficial punctate corneal erosions. There was residual traumatic mydriasis more in the left eye and some remaining vitreal blood clots in the left eye. The retina was flat and OCT was normal in both eyes.

In his last visit, 2 months after trauma, VA was 20/20 in both eyes. Examination showed bilateral clear cornea, anterior subepithelial lenticular opacities, and traumatic mydriasis more significant in the left eye (Fig. 5A and B). Intraocular pressure was 20 mmHg OD and 15 mmHg OS. Gonioscopy showed bilateral angle recession (Fig. 6A and B) and both fundi were normal.

3. Discussion

Motor vehicle accidents are a significant cause of morbidity and mortality (National Highway Traffic Safety Administration, 1997). Air bags have gained widespread popularity as an effective means of reducing severe injury and death during motor vehicle accidents since the late 1980s (McKay and Jolly, 1999). With the increased use of them, there has been a corresponding increase in the number of injuries attributable to these devices (Kim et al., 2004; Mohamed and Banerjee, 1998; Molia and Stroh, 1996).

Air bag induced eye injuries can be divided into two categories, the first stems from mechanical injuries such as periorbital

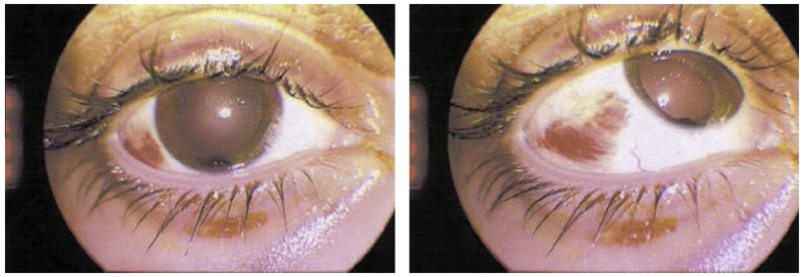

Figure 2 Anterior segment photograph, 4 days after admission, showing bilateral hyphaema, subconjunctival hemorrhage and traumatic mydriasis.

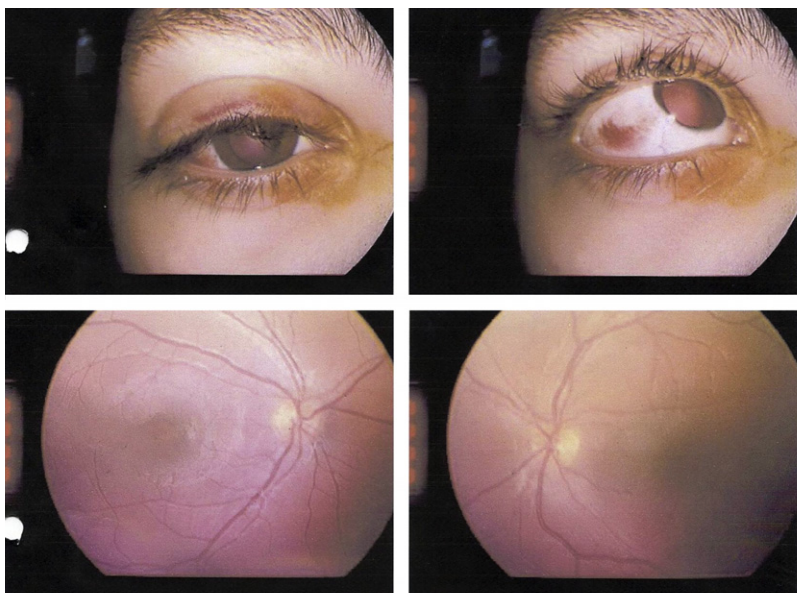

Figure 3 Anterior segment photograph, 10 days after admission, showing subconjunctival hemorrhage, traumatic mydriasis and left macular edema.

contusion, fracture, corneal abrasions, endothelial cell loss, hyphaema, angle recession, lens dislocation, vitreous hemorrhage, choroidal rupture, retinal tears, retinal detachment and globe rupture (Peariman et al., 2001; Raman et al., 2004). One case which deserves special attention is that of retinal sclopeteria due to air bag inflation 5 min after the accident (Asaria et al., 1999).

The second category is alkaline chemical keratitis caused by deposition of sodium hydroxide into the eye. Chemical burns to the face and hands have also been reported (Mohamed and Banerjee, 1998). Burns have been estimated to occur in about 7–8% of all injuries associated with air bag deployment (Antosia et al., 1995). Burns may be due to vented hot nitrogen gas or chemical in origin (Hallok, 1997).

Many of these accidents occurred at high speed, but a few occurred at relatively low speeds (Molia et al., 1996).

Significant eye injuries were found to occur even in relatively low speed crashes. Whereas traumatic cataract and vitreous or retinal hemorrhages generally occurred at speeds higher than 30 mph, other severe injuries as retinal detachment and rupture globe tended to occur at speeds less than 30 mph. Glasses were found to protect the eye in some air bag related ocular injuries but contributory to the injury in some other cases (Stein et al., 1999).

At present, there is no law governing the use of airbags in Kuwait but the use of seat belt has been mandatory by law since 1993.

The use of seat belt with air bag reduces mortality 45% and severe injuries 50% (US Department of Transportation NHTSA, 1999).

Because the air bag is designed to be used in conjunction with seatbelt, failure to use the belt might permit the occupant to strike the bag prematurely during rather than after, the deployment phase, thus accounting for an increased risk of facial and ocular injury.

This case report has documented a wide variety of ocular injuries associated with air bag deployment. Awareness of the spectrum of air bag associated ocular trauma will help physicians to recognize these problems early and optimize their management (Peariman et al., 2001).

Future advances in airbag technology will help to reduce injuries caused by these devices, but will need to be implemented in conjunction with advances in other restraint and sensing systems to be most effective. It is hoped that research-

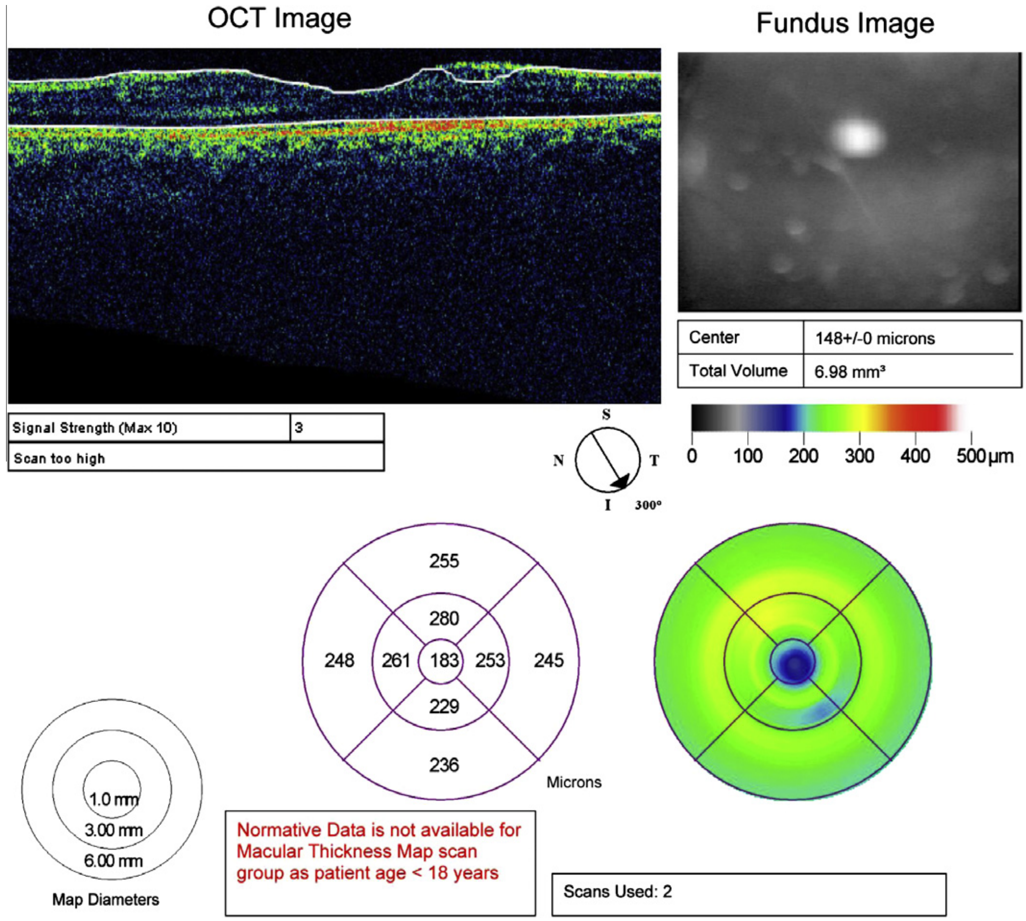

Figure 4 Optical coherence tomography of the left eye, 10 days after trauma, showing macular edema.

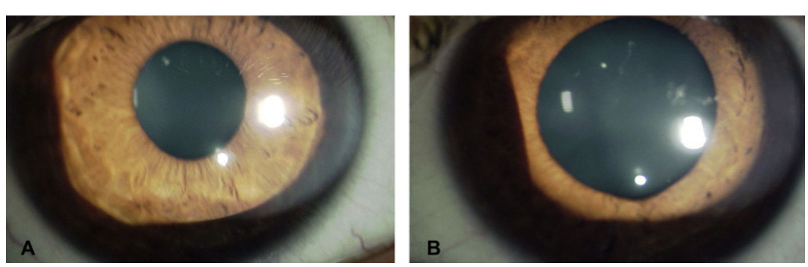

Figure 5 Mild traumatic mydriasis with anterior subepithelial lens opacities in the (A) right eye; (B) left eye.

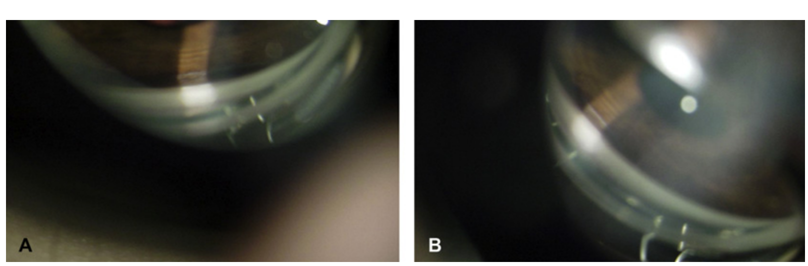

Figure 6 Gonioscopy showing angle recession in the (A) right eye; (B) left eye.

ers can develop modifications that continue to save lives while minimizing additional harm.

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