AIRBAG INDUCED OCULAR INJURIES: A SHORT REPORT.

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ABSTRACT

Airbag is one of the new innovations in automotive safety. It is being increasingly installed in motor vehicles by the car manufacturers to cushion the vehicle occupants in the event of a car crash. However, increased general morbidity and mortality have been recorded following auto crash involving vehicles fitted this facility. Eye injuries, in particular, have escalated leading to higher ocular morbidity. The mechanisms of ocular damage by the airbag include mechanical, thermal and chemical.

Two cases of airbag related ocular injuries involving two males aged 69 years and 55 years are presented. One was a driver while the other was a passenger. The former sustained globe rupture while the latter suffered thermal and chemical burns of the cornea.

In conclusion, airbag does not provide 100% safety but only helps to mitigate injuries following a car crash. On some occasions, it could be a source of injury especially when the victim is not wearing a seat belt. In some cases, airbag related eye trauma could be very severe with resultant significant ocular morbidity.

KEYWORDS: Airbag, Ocular trauma, Auto crash.

INTRODUCTION

Airbag is one of the new innovations in automotive safety. It is increasingly becoming more common as standard safety equipment in new cars.[1] The aim of this device is to give cushioning effect to the occupants and protect them from the rigid structures of the vehicle interior. In fact, the airbag has significantly lowered morbidity and mortality from auto crashes.[2,3] However, this gadget, like the seat belt, produces its own spectrum of injuries which has been on the increase.[4,5]

For the airbag, this ranges from relatively minor injuries such as abrasions and superficial burns to unexpected fatalities.[5] Appearance of articles documenting airbag-related eye trauma in the early 1990's prompted the United States Eye Injury Registry to editorialize, "Air bag: friend or foe".[6] North American literature have reported numerous fatalities from airbag injuries.[7,8]

The airbag is a coated thick nylon bag housed in strategic locations within the body of the vehicle.[9] Sensors located within the vehicle structures are activated when a crash occurs at speed even as low as 12mph and within a 60^0 frontal arc.[1] An electrical signal is usually sent to the airbag cartridge which contains a combustible solid state powder, usually sodium azide (NaN_3) and an oxidizing agent.[4] The combustion of sodium azide produces mostly inert nitrogen gas. Other products from the reaction include ammonia, carbon-dioxide, nitric oxide, carbon monoxide, an alkaline aerosol containing sodium hydroxide and various metallic oxides.[1] An inert talc powder used in packaging is also discharged. Heat is an additional by-product of the combustion process.[1] Therefore, chemical and thermal burns comprise mechanisms of airbag injuries.

Following a car crash, the expanding airbag is propelled out of the storage compartment at a speed of 100-200mph and the entire inflation sequence is completed with 0.05 seconds.[1] Fully inflated airbag contains about 60 liters of gas on the driver's side and 140 liters on the passenger's side.[1] The driver's airbag expands to a less depth than the passenger's airbag.[1] Some airbags are tethered to limit the anterior-posterior expansion and the airbag quickly begins to deflate through vents directed away from the occupants.[1]

We hereby present a short report of facial and unilateral ocular injuries in a 60 year old man who was involved in an auto crash while driving alone in a sports utility vehicle in Awka, (Anambra State), Nigeria and another 55 year old man who sustained right ocular and facial burns from an airbag following a car crash while traveling as a front seat passenger in another sports utility vehicle (SUV).

Authors elsewhere have categorized ocular injuries which could arise from airbags into two groups. The first group

comprises mechanical injuries such as periorbital contusion, fracture, corneal abrasions, endothelial cell loss, hyphema, angle recession, lens dislocation, vitreous haemorrhage, choroidal rupture, retinal tears, retinal detachment, and globe rupture.[10,11] The second category arises from alkaline chemical keratitis caused by deposition of Sodium hydroxide into the eye[1]. Chemical facial and hand burns have also been reported by others. About 7 – 8% of all injuries associated with airbag deployment are due to burns.[12,13]

CASE 1

A 69 year old man seen at the Accident and Emergency Unit of the Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Awka with history of having been involved in a road traffic crash of one day duration. The patient while driving in a sports utility vehicle (SUV) hit a concrete electric pole. He reported painful knees and slight bruises on the face particularly on the right peri-ocular region.

The Ophthalmology unit was invited to review and manage the eye injury. Further history revealed that the airbag was responsible for most of the facial lesions sustained by the patient. It was also found that he was diabetic and asthmatic. The diabetes mellitus was well controlled (the fasting blood sugar was 90mg/dl).

Ocular examination showed facial bruises which were more on the right side. There was also oedema of the right lids. The visual acuity was light perception only (could see light) for the right eye but $^{6}/_{9}$ on the left side. The right eye showed conjunctival injection, corneal haziness, inferio-lateral full thickness corneal laceration at the limbus with uveal prolapse and incarceration, hyphema, shallow anterior chamber and irregular pupil. The lens was opaque with no fundal glow (fig. 1).

Fig. 1: Right eye showing corneal laceration and traumatic cataract.

The affected eye was padded and the patient was put on the following medications: chloramphenicol, flurbiprofen and atropine eye drops, tablets paracetamol, metronidazole, ciprofloxacin and vitamin C. He was equally given a single dose of 0.5ml tetanus toxoid intra-muscularly and 1 gram of ceftriaxone intravenously twice daily for 3 days. The laceration was repaired and he was discharged one week later with a visual acuity of light perception only.

The visual acuity remained at light perception alone up to four consecutive visits at two weekly intervals post corneal repair while the lens opacification increased in density. Ocular B scan ultrasound was requested but the patient defaulted from follow up.

Case 2

A 55 year old man presented at Cradle Eye Specialist Clinic Awka with history of visual loss in the right eye following an airbag ocular injury in a different car crash about seven months previously. He had been healthy and seeing well with both eyes until the sports utility vehicle (SUV) he was travelling as front seat passenger lost control and hit a shuttle bus from the rear. The airbag was deployed and sprayed some powder on his right eye. His vision dimed instantly. The driver of the SUV was said to have suffered a left shoulder dislocation. Both were the only occupants and none was on seat belt at the time of impact. The patient reported he could only see light after the accident and was told the black of his right eye (cornea) was white. He had no preexisting medical comorbidities.

He was taken to a hospital where he was treated by a general practitioner with some oral and topical eye medications which he could not identify. After about one week, he came to an eye centre where he was treated with Dexamethasone eye drops, Beoptic-N eye ointment and some vitamin supplements.

Ocular examination showed facial scar suggestive of burns, right lid oedema and visual acuity of light perception on the right eye and $^{6}/_{9}$ on the left side. The right eye showed conjuctival injection, sloughed off cornea with uveal tissue plastered onto it (anterior staphyloma). Other structures were not accessible either with pen torch or ophthalmoscope (Fig. 2).

Fig. 2: Right eye showing sloughed cornea with plastered uveal tissue

B-scan ocular ultrasound was requested but he did not comply. He was equally directed to stop topical steroids therapy and was placed on the following medications: chloramphenical eye drops, chloramphenicol eye ointment, tablet vitamin C and 1% atropine eye drops.

Two weeks later, the right eye became cleaner but the visual acuity remained at light perception only. The left eye was essentially normal and vision was improved to $^{6}/_{6}$ with refraction. He was therefore given spectacle for

correction of the refractive error on the left side (Fig. 3).

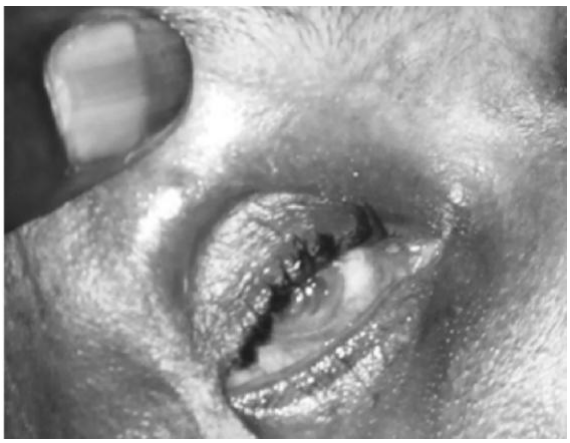

Fig. 3: The cornea becomes clearer with treatment but visual acuity remained light perception only.

DISCUSSION

Two cases of facial and ocular airbag injuries following separate car crashes are presented. The victims were males aged 69 and 55years old respectively. The former was the lone occupant (driver) of the vehicle while the later was a passenger in another car.

Airbag as a safety measure has been employed in most motor vehicles to mitigate and prevent injuries and/or death in the event of accidents. However, with the increasing installation of airbags in motor vehicles, reports began to appear in the medical literature in the early 1990's of injuries related to airbags.[1,4,13] In the above presented cases, the injuries noted included facial bruises, abrasions and ocular injuries. These were also documented in other studies.[14,12]

In our reports, Case 2 suffered severe right ocular burns involving the cornea in particular. The burn component has been speculated to be due to vented hot nitrogen gas or chemical in origin.[15] However, no burn was noted in the Case 1 apparently due to the non-entrance of the hot gas or chemical into his eyes. Low speed and the position of the victims in the vehicle at the time of impact could also have accounted for the differences in the pattern of their respective ocular injuries. The first case was the driver and on low speed while the second patient was a passenger on the front seat of the SUV travelling at speed. Some authors have reported that many of these accidents occurred at high speed but quite a few did occur at relatively low speed.[16]

The use of seat belt in conjunction with airbag reduces mortality by 45% and severe injury by 50%.[2] The airbags are designed to be used with seatbelt for effective protection. Failure to use the belt might make the occupant strike the airbag prematurely thus giving rise to increased facial and ocular injuries. In the present report, the occupants were not on seat belt during the deployment phase of the airbags and this may have accounted for the severe injuries they sustained in the form of globe rupture and ocular burns respectively. Ordinarily, the most commonly observed injuries are minor bruises and abrasions especially to the face, neck and upper limbs, which are often referred to as bag slap injuries.[12]

Corneal abrasions have been reported in the fully deployed airbags but more serious injuries such as retinal detachment and orbital blow- out fractures have also been noted by other authors.[17,18,19]

Although the medical literature has reported the causes of chemical ocular injury to include domestic accidents, agricultural trauma, chemical laboratory accidents, deliberate chemical attacks, chemical warfare injuries and self inflicted chemical injuries, the increasing incidence of auto crash related chemical eye injury qualifies it as a new mode of sustaining ocular chemical injury.[21]

Non application and/or the improper use of seatbelt may increase the severity of eye injuries sustained during a car crash while the correctly worn seat belt may mitigate the extent of ocular injuries and prevent the involvement of the posterior segment thereby giving better visual outcome.[22,23,24,25,26]

In case 2, there was prolonged use of topical steroids which may have contributed to the corneal melting and sloughing. The beneficial effect of decreasing ocular tissue destruction by reducing inflammation with corticosteroid when properly used is well documented.[27]

Intensive use of corticosteroids after a chemical injury indirectly facilitates re-epithelialization by reducing the inhibitory effect of ocular surface inflammation. It minimizes the incidence of subsequent corneal ulceration by limiting the stromal inflammatory response and the severity of late sequelae.[27] About 14 days after alkaline injury, stromal repair processes become important as both collagen and collagenase synthesis begin.[27] The continued use of topical corticosteroid beyond this period may limit the repair processes and result in complications (such as corneal dissolution) because of the imbalance between repair and the debridement.[28,29,30,31,32,33]

Conclusion

Automotive safety gadgets such as airbags and seatbelts installed in cars mitigate injuries incurred by the motor vehicle occupants in the event of a car crash. Their use, though seriously encouraged, is not a complete panacea to auto crash injuries. Avoidance of car crash is safer and more cost effective than repair after injury no matter how minor. Injudicious use of steroids, both systemic and topical, should be discouraged. Airbag-related ocular and bodily injuries, which could result in severe morbidity and even fatality, are here with us. The earlier it is realized that this safety device does not provide wholesome safety, the better for both the motorists and their passengers. Furthermore, the use of seat belts in combination with airbags provide greater protection than either alone.

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