

Airbag-Related Burns

Hava Yastığı Yanıkları

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Abstract

Airbags have been shown to be a vital, supplemental restraining device that saves lives and reduces morbidity associated with motor vehicle crashes. Their usage is increasing with multiple airbags (driver, passenger and side curtain). Air bag deployment is not risk free. Airbags may cause severe injuries and burns. However, there have been few reports about airbag-related burns in the literature. Therefore, it is important that staff working in emergency departments need to be aware of the risk and incidence of airbag-related burns. The circumstances of airbag-related burns and preventive measures are discussed in this article. (*JAEM 2013; 12: 225-8*)

Key words: Airbag, chemical burn, sodium azide

Özet

Hava yastıkları, motorlu araç kazalarında hayat kurtarmakta ve morbiditeyi azaltmaktadır. Motorlu araçlarda hem sürücüleri, hem de yolcuları koruyan çeşitli hava yastıkları mevcuttur. Ancak hava yastıkları şiddetli travmalara ve yanıklara da sebep olabilmektedir. Literatürlerde bu tip travmaların rapor edildiği sadece birkaç yayın mevcuttur. Bundan dolayı acil serviste görevli olan sağlık personelinin hava yastıklarına bağlı olarak gelişebilecek çeşitli travmaların ve yanıkların bilincinde olmaları gerekmektedir. Bu makalede hava yastığına bağlı gelişen travmalar ve bu travmaları engellemek için alınması gereken tedbirler tartışılmıştır. (*JAEM 2013; 12: 225-8*)

Anahtar kelimeler: Hava yastığı, kimyasal yanık, sodyum azid

Introduction

It has been well documented in the literature that airbags have a significant impact in reducing mortality and serious injury from motor vehicle accidents (1). Recent research also suggests that airbag deployment might increase the risk of certain injuries, especially among occupants not wearing seat belts. However, these injuries still occur among airbag protected occupants. These associated injuries include upper extremity fractures, eye injuries, erythema, skin abrasions, and skin burns (2-5). The most common form of injury is abrasion (63.6%) (6). The incidence of burns following airbag deployment has been noted at 1.53% (7). Burns from airbag injuries may be thermal, chemical, or frictional (7, 8).

Sodium azide is a volatile compound used in the industrial setting and it is also a constituent of car airbags. Sodium azide decomposition is the source of the explosive expansion resulting in the inflation of the airbag. Approximately 70 g of sodium azide is ignited, releasing nitrogen (96%), carbon dioxide (3%) and miscellaneous gases and particulates (1%), as well as a small amount of alkaline aerosol containing sodium hydroxide, sodium carbonate and metal-

lic oxides (6). However, airbags may occasionally perforate, and this results in exposure to hot metal combustion pipes and spillage of sodium azide. Chemical burns may result from the release of alkaline chemicals, such as sodium carbonate and sodium hydroxide after airbag deployment (6). We report three patients who sustained chemical burns as the result of the activation of an automobile air bag.

Case Reports

Case 1

A 21-year-old girl was involved in a moderate speed, frontal impact road traffic accident. At that time, thair bag was expanded by the impact of the crash and pressed against her face. She immediately consulted the emergency unit in our hospital. She had sustained a chemical burn on her right cheek and neck where the bag had touched her face, but there was no sign of friction found on her face (Figure 1). The burn area margin was well circumscribed and a blister had formed across the wound surface. Treatment was performed conservatively. The burn areas epithelialized with no scar or pigmentation within 24 days (Figure 2).

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Case 2

A 39-year-old man was involved in a road traffic accident. He remembered the air bags being deployed before noticing white powder and smoke emanating from it. He had received a burn injury to his right forearm (Figure 3) and face (Figure 4). On arrival at our clinic the following day (2 days post injury), it was apparent that he had deep chemical dermal (second-degree) burns. In addition, his right eye became painful with blurred vision. There was no previous ocular trauma in his past medical history. The patient was reviewed by ophthalmology and diagnosed with a corneal alkali burn and epithelial defect. Suitable therapy was begun on consultation with ophthalmology. Burn areas were dressed every day. The burn areas epithelialized completely with conservative treatment by 4 weeks post injury and his vision had returned to normal.



Figure 1. Facial alkali burn caused by airbag deployment



Figure 2. Appearance at 24th days postburn



Figure 3. Alkali burn of forearm

Case 3

A 33-year-old man presented to the emergency department after a motor vehicle crash. He was restrained, and the driver's-side airbag deployed at the time of impact. Physical examination was unremarkable except for partial thickness burns involving the dorsum of the left hand (Figure 5). Blisters and erythema of the surrounding skin were also noted. The burn areas were irrigated, cleansed and dressed. At follow up the burn areas had epithelialized successfully by the 16th day (Figure 6). At 3 months post injury, there was no hypertrophic scarring but the burnt area was hyperpigmented.



Figure 4. Facial alkali burn



Figure 5. Hand burn caused by airbag deployment



Figure 6. Appearance at 16th days postburn

Discussion

Air bags have no doubt been beneficial in decreasing the mortality and morbidity in roll-over accidents and high-velocity frontal impact scenarios. Airbags in motor vehicles consist of a nylon bag and an inflator unit with a triggering device. They are designed to inflate when a significant deceleration force triggers a sensor. The inflated bag is designed to protect the vehicle occupant's upper body and head from striking some part of the vehicle's interior. Nevertheless, despite the apparent benefits of airbags in most situations, the necessary force involved in their deployment poses some risk (9). The majority of airbag-related injuries have been abrasions, contusions, and lacerations, upper limb fractures, thoracic injuries, ocular injuries, and asthma. These injuries usually involved the upper extremities, because exhaust vents are located on the rear of the bag. Small adults and children may be at significant risk of cervical spine injury from airbag deployment and this risk is significantly higher if the person is unrestrained by a seat belt (10). Recommendations are that children should ride in the back seat of vehicles, restrained by seat belts, and away from airbags.

The air bag is inflated by the oxidation of a sodium azide pellet. After activation of the airbag, the 60-liter airbag is filled with alkaline aerosol, which is produced when about 70 to 80 grams of sodium azide is detonated in about 0.01 s (6). The reaction produces an alkaline aerosol consisting of sodium hydroxide, carbon dioxide, sodium bicarbonate, nitrogen, and metallic oxides. Due to these gases, temperatures within the air bag may reach up to 500°C. Burns from airbag injuries may be thermal, chemical, or frictional (7, 8, 11). The heat of the gas released has melted lightweight polyester blouses and gloves causing thermal burns to the respective parts of the body. Friction burns due to airbags are commonly found on the face and neck. It has been shown that these injuries are primarily the result of high velocity fabric impact, the inflation is forceful and the face is often the point of maximum airbag impact (11). By-products of combustion of sodium azide create an alkali aerosol containing sodium hydroxide, sodium carbonate and other metallic oxides. Sodium hydroxide and sodium carbonate are strong bases. They may cause alkaline chemical keratitis, facial erythema and contact dermal burns by coagulation necrosis, alkalis dissolve and damage keratin, and saponify fats (12, 13). Although the risk of burn injury increases with

airbag rupture, this risk must be considered with the fact that airbags have significantly reduced the risk of serious injuries and fatalities in motor vehicle accidents. Occupants who sustained airbag-induced burn injuries sustained the majority of the injuries to the upper extremity (82.5%). The next two most frequently injured regions were the face (7.7%) and the chest (2.9%) (8). However, in their fourteen years of retrospective review of data, Antosia et al. reported that the body region most commonly affected was the face (42%) due to airbag injuries. Other high-risk areas were the wrist (16.8%), forearm (16.3%), and chest (9.6%) (9). In addition, in their analysis of 618 airbag injuries cases, Antosia et al. reported that most occupants sustained abrasions, contusions, and lacerations.

Chemical burns may result from the release of alkaline chemicals, such as sodium azide and sodium hydroxide after airbag deployment. A chemical burn may be minor or life threatening, but proper treatment may reduce the chance of infection and the damage caused by contact with the chemical. Basic first aid should be administered as soon as a chemical burn has occurred. This should include removal of contaminated clothing and prompt irrigation of the affected area with copious amounts of water. Subsequently, the chemical burn areas should be managed by through irrigation for 20 min and conservative dressings should be applied. The air bag-induced burns are generally not serious and usually require only conservative ointment treatment. However, proper diagnosis for the patient and correspondence for the further improvement of the air bag system is desirable (6, 9). In addition, of all burns related to airbags, special emphasis should be placed on alkali keratitis. An ocular alkali burn may be detected by testing the pH with litmus paper. It is a vision-threatening injury if not treated properly and promptly (14).

Conclusion

The injuries are preventable and therefore, some basic measures may reduce the incidence, morbidity and mortality of accidental burn injuries due to airbags.

- 1) The airbags on every car should be tested to increase their safety. The devices should be switched off in low-velocity city traffic, and only activated when driving at high speed.

- 2) The car manufacturers have to post warnings in their owner's manuals of the danger of potential burns due to airbags.

- 3) This case reports points towards the need for more research into possibly modifying the design of air bags with the increasing use of air bags today. The airbag manufacturers should attempt a search for non-corrosive materials and non-thermal inflation.

- 4) The staff working in emergency departments who treat these injuries need to be aware that the burn areas may be deeper than expected and refer as appropriate. In addition, treating clinicians should be suspicious of an underlying severe injury in the burn area such as maxillofacial injuries, dental traumas, thoracic injuries.

- 5) The alkali burns of the eye may result in permanent visual impairment. Immediate diagnosis and treatment (ophthalmologic consultation) is essential for a good prognosis.

We hope that this article will succeed in raising awareness of the dangers involved in airbag use.

Conflict of Interest

No conflict of interest was declared by the authors.

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Informed Consent: Written informed consent was obtained from patients who participated in this case.

Author Contributions

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Yazarlar herhangi bir çıkar çatışması bildirmemişlerdir.

Hakem değerlendirmesi: Dış bağımsız.

Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.

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