CASE REPORT

A life saved at the cost of hand injury - A case of hand burn due to airbag deployment

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SUMMARY

According to the Malaysian Department of Statistics motor vehicle accidents are the third leading cause of death in Malaysia and accounts for 7.4% of premature deaths in 2016. With the invention of the airbag, the number of serious injuries and fatalities have been reduced significantly. However, there has also been a corresponding increase in the number of injuries attributable to these devices. The patient narrated in this case report sustained a mixed dermal thickness burn over the upper limb as a result of an airbag deployment. She recovered without other life threatening injuries.

INTRODUCTION

Airbags have been shown to significantly reduce the number and severity of injuries, as well as the number of mortalities, in head-on automobile collisions. However, it has also been found to be the source of a multitude of injuries as reported in the literature. Burn injuries constitute 7.8% of minor injuries sustained by car occupants as a result of airbag deployment and they are caused by either frictional, thermal or chemical burns.[1] This is a case of a burn injury to the upper limb after airbag deployment.

CASE REPORT

A 26-year-old women was referred from the emergency department for superficial burns of the right hand. She was involved in a motor vehicle accident while sitting in the front seat passenger in a car that was rear-ended before crashing head on into a tree. Upon impact, the driver's airbag deployed and exploded. The patient, in the attempt to shield the driver's face from injury, instinctively covered it with her right hand. As a result, she sustained a mixed dermal thickness burn injury to the dorsum of the right hand and wrist. Upon review, the wound was assessed, and gentle bedside debridement was performed before it was dressed with hydrocolloid dressing that was changed every 5 days. She was discharged and followed-up on an outpatient basis. The wound healed expectantly by the third visit at day 16 post-trauma without the need of surgical intervention. As she had sustained injuries to her dominant hand, she was referred early to the occupational therapist for hand exercises and pressure garments. She regained full use of the right hand and wrist without any limitations to the movement and function.

DISCUSSION

The airbag was first invented in 1952 but was only made compulsory in the United States in 1997. It was designed to act as a supplemental safety device in addition to the seat belt. Its introduction has led to significant reductions in driver fatalities as well as severity of injuries.[2]

Airbags protect vehicle occupants by providing a cushion that decreases the force of the body from directly hitting the steering wheel or dashboard and by spreading the force of impact over a larger area of the body which leads to less severe injuries.[3] The cushion is generated by decomposition of sodium azide (NaN^3) at 300^{o}C which produces rapid inflation of nitrogen gas.[3]

While airbags have obvious benefits, their use have also been subsequently implicated as a source of injury to car occupants. A retrospective review of United States National Highway Traffic Safety Administration (NHTSA) data from 1980 to 1994 conductedby Antosai et al., detected 614 airbag injuries which included lacerations, abrasions, contusions, ruptures, retinal detachments or separations, burns, and fractures.[2]

The body region most commonly affected was the face (42%), followed by the wrist (16.8%), the forearm (16.3%), and the chest (9.6%). The percentage of patients who sustained burn injury was 7.8% according to the study.[2]

Hallock described in detail the mechanisms of burn injury secondary to airbag deployment.1 He divided them into three main categories, which were frictional, thermal, and chemical burns. Friction burn is attributed to the physical contact along the surface of the airbag.[1] Thermal burns can either be directly caused by expelled high-temperature gases from the combustion process or indirectly by the melting of clothing. Chemical injuries which are less common, is the result of direct contact with sodium hydroxide in the aerosol created during inflation.

Most airbag-related burn injuries described in published reports are of superficial in nature and are usually treated conservatively without the need for surgery.[1] However, full thickness burns occasionally do occur as described by Vitello et al. and in that case the wound was managed by debridement and delayed skin grafting.[4]

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Fig. 1: Wound at postburn day 1.

Fig. 2: Healed wound at postburn day 16.

In our case, airbag deployment was initiated after the vehicle crashed head on into the tree. Instead of normal deployment, the airbag exploded, sending hot fumes and corrosive chemicals into contact with the patient's hand when she shielded the other car occupant. The possible mechanisms of injury therefore, could either be from a thermal or chemical burn or a mix of both. However, a report by Heimbach[5], found that chemical burns are rare as no strong alkali has ever been produced during quality control tests. Furthermore, chemical burns tend to be poorly circumscribed splash marks which causes massive tissue destruction.[5] The injury in our patient was well demarcated and superficial hence it properly fits the description of a thermal burn injury. Early detection of the burn injury led to the prompt expert care which resulted in the patient's early rehabilitation.

Recognising the potential burn injuries that might arise with its usage is important, as it helps to improve airbag safety design and technology. Safety measures that have been taken include moving the ventilation holes to safer positions to prevent likelihood of direct contact, finding nontoxic alternatives to achieve inflation, cooling systems for the expelled gases and usage of silicone-coated airbags to ensure smooth deployment.[1]

Early diagnosis is essential for good prognosis. Hence, medical personnel dealing with these injuries should to be made aware of their mechanism so as to provide early expectant care. Patients can then be sent to well-equipped burn centers for further management. Educating the general public could also help reduce airbag related injuries. General safety advice such as not to sit too close to the steering wheel, avoiding highly flammable synthetic clothing while driving and seatbelt harness should be made common knowledge.

CONCLUSION

Although there has been a corresponding increase in the number of injuries seen as a result of airbag deployment, its efficacy in reducing the number of severe injuries and fatalities should not be overlooked. In most instances, airbag-related burn injuries are minor but the severity could occasionally be underestimated. These injuries should be detected and reported frequently so that necessary actions could be taken by all parties involved. Physicians should be aware of this and be vigilant at diagnosing and treating the injuries when they do occur. Our patient was able to return to work three weeks post injury as the wound was treated early and efficiently.

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