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Airbag Fatality: A Case Report From the Kingdom of Bahrain

الوفاة نتيجة انفتاح وسادة هوائية: تقرير حالة من مملكة البحرين

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Abstract

The main purpose of Airbags installed in automotives is to protect drivers as well as accompanying passengers during an accident. Despite their safety benefits, a considerable number of airbag-associated injuries are reported in the literature. Airbags are designed to open in head-on collisions when vehicle deceleration exceeds a specified threshold. Defective airbags deployment with metal projectiles launching and hitting passenger's head or neck have been reported.

Deaths from defective airbags are rarely reported in the Middle East. This article presents a case in the Kingdom of Bahrain of a driver whose car was in a head-on collision with another car resulting in in severe head trauma and death at the scene. Death scene investigation revealed that a fire has originated from the airbag compartment with a cylindrical metallic object found missing a part of it. Autopsy of the deceased showed an injury to the right side of the head similar to a firearm inlet. Examination of the head revealed a cylindrical metal object that did not resemble firearm projectiles. The object appeared to have come from the interior of the car upon impact. Laboratory analysis confirmed that the two metallic objects recovered from the deceased's body were actually the broken pieces of airbag compartment. each other.

Although airbags have greatly reduced morbidity and mortality in road traffic accidents, defective airbags highlight the need to increase awareness of their hazards and the importance of their regular inspection and replacement if found defective.

Keywords: Forensic Science, Forensic pathology, Airbags, Head Injuries, Road Traffic Accidents, Kingdom of Bahrain.

المستخلص

الوسائد الهوائية مصممة لتنفتح في حوادث السيارات ذات المواجهة المباشرة عندما يتجاوز تباطؤ السيارة عتبة معينة. هذا وقد تم الكشف عن وجود خلل في انفتاح الوسائد الهوائية مصحوب بإطلاق مقذوفات معدنية تصيب رأس أو عنق الراكب.

ونادرًا ما يتم الإبلاغ عن وفيات ناتجة عن خلل في الوسائد الهوائية في الشرق الأوسط، ويعرض هذا المقال حالة في مملكة البحرين لسائق متورط في اصطدام وجهاً لوجه مع سيارة أخرى تعرض لصدمة شديدة في الرأس وتوفي في الموقع. كشف التحقيق في موقع الحادث أن حريقًا نشأ من حجرة الوسادة الهوائية مع العثور على جسم معدني أسطواني مفقود جزءً منه. وأظهر تشريح جثة المتوفى إصابة في الجانب الأيمن من الرأس مشابهة لمدخل سلاح ناري، إلا أنه بعد فحص مساره داخل الرأس، تم اكتشاف وجود جسم معدني أسطواني لا يشبه مقذوفات، سلاح ناري. ويبدو أن الجسم المعدني جاء من داخل السيارة عند الاصطدام وأكد التحليل المخبري أن كلا الجزأين من الجسم المعدني المستخرج من المتوفى والجسم المفقود من حجرة الوسادة الهوائية مكمل بعضها لبعض.

وعلى الرغم من أن الوسائد الهوائية قد قللت بشكل ملحوظ من معدلات الاعتلال والوفيات في حوادث المرور على الطرق، فإن انتشار الوسادة الهوائية المعيبة يسلط الضوء على الحاجة إلى زيادة الوعي بمخاطرها وأهمية استبدالها.

الكلمات المفتاحية: علوم الأدلة الجنائية، علم الأمراض الجنائي، الوسائد الهوائية، إصابات الرأس، حوادث الطرق، مملكة البحرين.

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1. Introduction

Road traffic accidents and the occurrence of head injuries to passengers are indivisible. The brain region sustains the most severe injuries and is the most important determinant of resulting disabilities and fatalities. For diminishing the rate of head injury and complying with the protection guidelines, vehicle producers have introduced airbags to be utilized with seat belts. An airbag deployment brings a protective effect, by decreasing injuries resulting from deceleration force on the head and preventing contact with interior structures and maintaining proper uniformity of the spine. Airbags are designed to open in a head on collision when deceleration of the main vehicle exceeds a specified threshold [1].

Airbags have been responsible for reducing fatalities by 20% to 40% in frontal crashes, and when associated with using seat belts mortality risk is reduced further. Airbags are now considered a standard protective device in all vehicles [2].

Defective airbags have also been officially reported. When defective airbags are deployed, metal projectiles hit passengers. These may penetrate the neck, causing lacerations and transection of major neck structures including the carotid artery, parts of the upper respiratory tract, and vertebrae. [3] Other severe injuries reported are facial lacerations and contusions, ocular injuries, periorbital fractures, upper extremity injuries, brain damage, spinal injuries, rib fractures, pulmonary trauma, aortic tears, atrial disruption, cardiac arrhythmias, and laceration of intra-abdominal viscera [2].

This case report discusses a fatal injury caused by a defective airbag that was presented to the Directorate of Forensic Science Evidence in the Kingdom of Bahrain. The case shows how the integration of forensic findings from the autopsy, the death scene investigation, and laboratory tests collectively helped the investigators to identify the cause and manner of death.

2. Case Presentation

A case was submitted to the Directorate of Forensic Science Evidence stating that a 31-year-old male was involved in a road traffic accident and died at the scene. The deceased was driving his 2006 registered Honda City car, and had a head-on collision with another car. The driver of the other car left his vehicle with minor injuries in the form of bruises and abrasions to the face and both upper limbs. Eyewitnesses noticed that the Honda City driver did not exit the vehicle and that a fire was starting in the interior of the car. The people around quickly opened the car door and pulled the driver out of the car. They saw that he had sustained an injury to the face. Upon arrival, paramedics examined the injured driver and found no pulse. Cardio-pulmonary resuscitation was started but with no response. He was pronounced dead at the scene. They also noticed the presence of a severe injury to the face similar to firearm injuries, so they informed the police who started investigating the death for suspicion of homicide.

2.1 Death Scene Examination

The site where the incident took place was a two-lane road with no barriers on the sides or between the lanes. The road is used by cars to go to or come from a nearby residential area. Eyewitnesses who saw the accident said that both cars involved came from opposite directions and hit each other in a head-on collision and the speed of both cars did not exceed 40 kilometers per hour. Furthermore, the witnesses added that the driver of the Honda City had not responded to the other car's warnings such as the horn or the full-beam headlights. Upon examining both cars, crime scene investigators noticed that there was minor external damage caused

Figure 1- *[A] and [B] showing the site of entry of the projectile in the face*

to both cars. A close examination of the Honda City revealed that the fire in the car originated from the driving wheel and then spread to the dashboard. A small cylindrical capsule in the airbag compartment in the driving wheel was found with a part missing; when the car was examined the part was not found. A careful investigation excluded the presence of any evidence of firearm usage at the scene. No bullet holes were present in the car body, and no empty casings or weapons were found in the vicinity.

2.2 Autopsy Findings

The body of the deceased driver was transferred to the morgue for post-mortem examination.

The deceased was wearing a blue t-shirt with a longitudinal cut at the front caused by the paramedics during the process of resuscitation and black trousers which were burnt at the knee area with an attached burnt plastic material.

An injury was found on the right side of the nose and the inner part of the right cheek (Figure-1). It was irregular in shape with approximate dimensions of 3.5 cm in length and 3 cm in width with loss of tissues in the center. Its margins had burn marks and were inverted, resembling firearmentry wounds. Multiple first and second-degree burns were found at different sites on the face, chest, upper limbs, and the right knee.

Multiple X-rays of the head area were taken (Figure-2), which revealed the presence of a semicircular opaque object in the left posterior parietal area of the brain with multiple fissure fractures extending to the vault and base of the skull and comminuted fractures in the left maxilla.

An autopsy of the head region showed the presence of a cavitation injury starting from the right maxillary area through the base of the brain with its direction slightly upwards to the right, ending with a cylindrical metal object lodged in the posterior part of the right parietal region. Multiple laceration injuries associated with contusions and hemorrhage were found in the brain tissue close to the formed tract. Multiple fissure fractures were noticed in the vault (Figure-3) and base of the skull starting from the right parietal bone. Comminuted fractures were found in the right maxilla and nasal bones.

Postmortem blood and urine samples were collected and sent to the toxicological laboratory for analysis. The metallic object found lodged in the

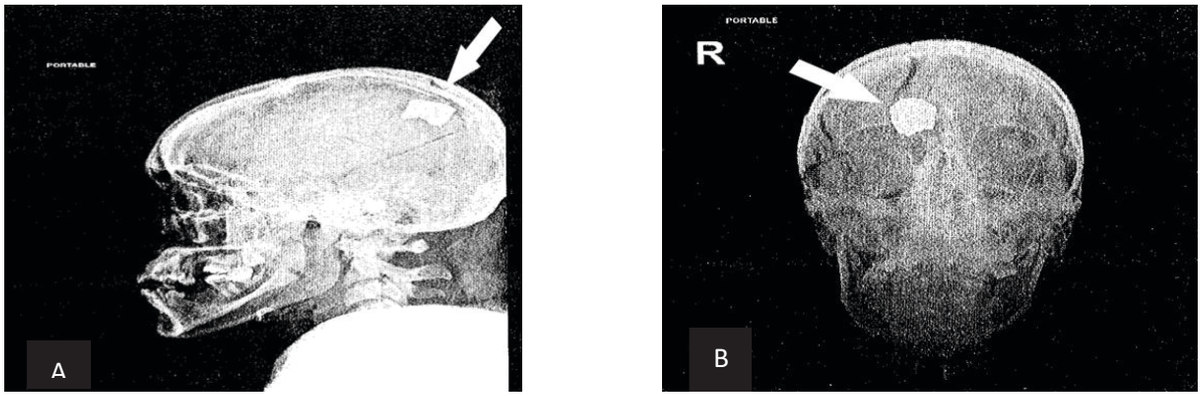

Figure 2- *Skull x-ray [A] lateral view [B] anterior – posterior view, both showing the site at which an opaque foreign body has settled, it also shows the presence of multiple fractures in the skull especially in the vault.*

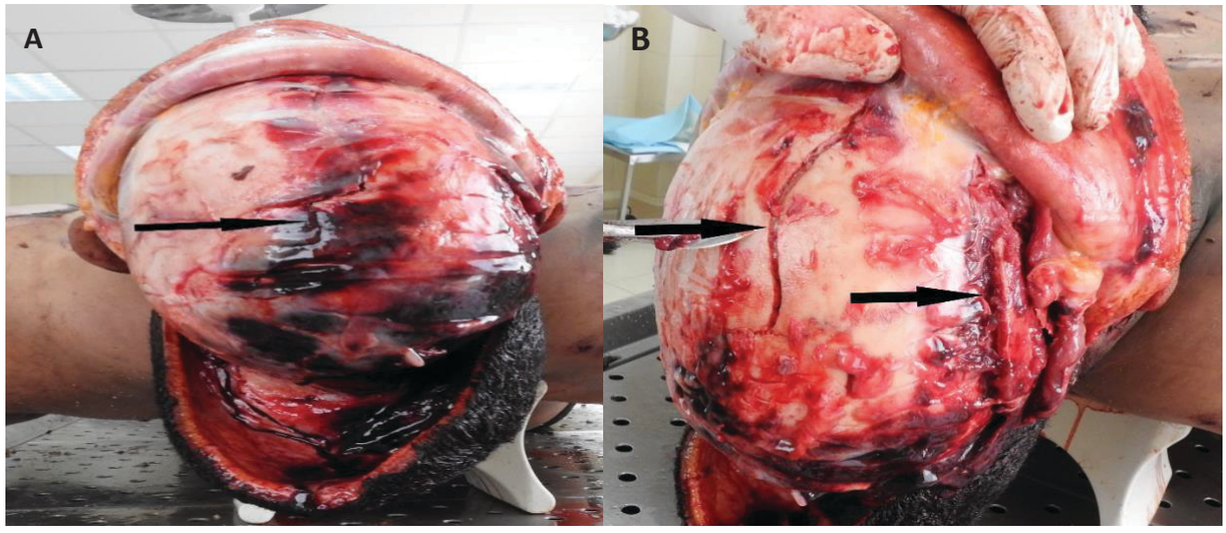

Figure 3- *[A] and [B] showing the site of fissure fractures noticed in the vault.*

brain tissue was sent to the laboratory for physical and chemical analysis.

2.3 Laboratory Findings

Postmortem blood and urine samples was toxicologically analyzed and were found to contain ethyl alcohol with concentration of (97.8 mg%) in the blood and (198 mg%) in the urine. The metallic object extracted during the autopsy underwent physical and chemical analysis, in addition to comparing it with the small cylindrical capsule found in the airbag compartment in the driving wheel (Figure-4). It was found that both objects had the same physical characteristics. Furthermore, they both had broken edges on one of their sides. A close examination revealed that these edges formed a perfect match, leading to the conclusion that both were a single object that had split due to exposure to extreme force. Further chemical analysis revealed the presence of ammonium, sodium, potassium, chloride and nitrate, which are common residues from explosive sand pointing that the extreme force that caused the splitting was an explosion.

3. Discussion

This report sheds light on a case of fatal injury

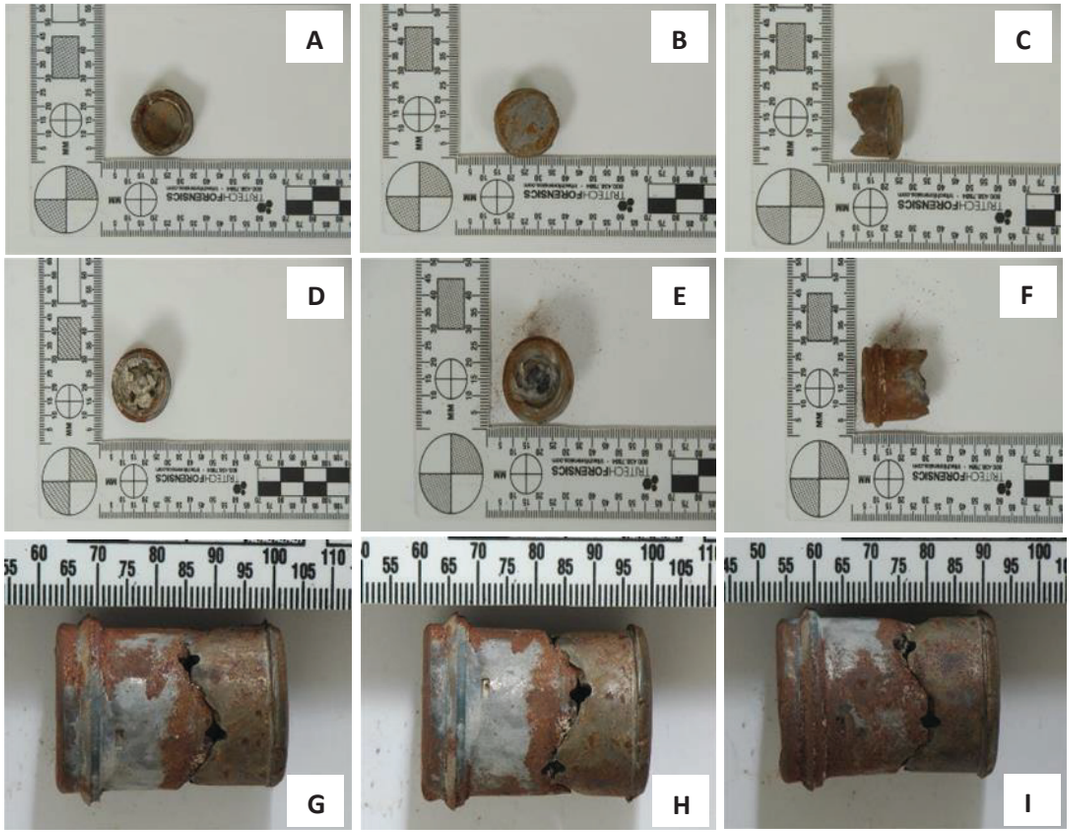

Figure 4- *[A, B, C] showing the foreign body extracted from the victim's skull; [D, E, F] showing the metallic part found in the airbag compartment; [G, H, I] showing perfect matching between the edges of both parts denoting that they are a single object that got split.*

due to airbag deployment in a motor vehicle collision. The discussion will address the analysis of all the forensic evidence provided, which eventually demonstrates a clear conclusion about the cause and manner of death.

The installation of airbags in motor vehicles has led to a remarkable reduction in the number of injuries and fatalities resulting from motor vehicle crashes. However, like seat belts, car airbags may cause a number of injuries ranging from minor abrasions and burns to unexpected fatalities [4]. Injuries have been described as resulting from all stages of airbag deployment and all elements of the airbag system including malfunction, unplanned deployment, the pyrotechnic inflator device, spontaneous deployment, inappropriate contact with the airbag and over-rapid deflation [5].

The victim in the present case was driving a 2006 Honda City and was involved in a head-on collision with another car. He suffered a severe head trauma and died at the scene inside his car. At first glance, it was suspected that the deceased had sustained a firearm injury to the face due to the similarities between his injury and known firearm injuries. However, evidence gathered during the death scene investigation and autopsy excluded firearms as the cause of the injury.

The death scene investigation revealed that a fire had started in the car, which originated from the driving wheel and in particular from the airbag compartment. A metallic cylindrical object was found in the airbag compartment with a part missing. Furthermore, meticulous scene investigation excluded

the presence of any evidence of weapon usage at the site.

Upon autopsy, a severe injury was found in the right side of the nose and the inner part of the right cheek with its margins showing similarities to an entry wound caused by firearms. A cylindrical metal object that did not resemble any known firearm projectiles caused cavitation and tunneling and was lodged at the base of the brain. It was suspected to be an object originating from the car upon impact during the accident. In a similar case, a 34-year-old female died in the state of Florida while driving a 2002 Honda Accord. A faulty air bag ruptured and fired shrapnel into her head during a crash when another car slammed into the side of car. She was struck by metal pieces that burst through the Takata airbag, causing a 6x3 inch gaping wound to her left temple, a fractured skull, and bruising and bleeding in her brain. The medical examiners concluded in their autopsy report that injuries resulting from the defective airbag caused her death, as her other injuries were not fatal [6].

A formal study of airbag deployment injuries was conducted for the United States National Highway Traffic Safety Administration [NHTSA] in which data was collected from 1980 to 1994. This study revelaed 618 injuries, 42% of which affected the face, 33% the upper limbs, and 9.6% the chest [5].

Toxicological analysis of blood and urine samples taken from the deceased revealed the presence of Ethyl Alcohol with levels of 97.8 mg% in the blood and 198 mg% in the urine. This can explain why eyewitnesses said that the deceased was not responding to the other car's warnings, as he was suffering from euphoria, sedation, impaired coordination, decreased sensory responses to stimuli, and decreased judgement [7].

Physical and chemical laboratory analysis of the metallic object extracted from the deceased and those recovered from the airbag compartment revealed that both objects had the same physical characteristics and that their edges formed a perfect match. In addition, explosive residue was found on them when performing chemical analysis. It was therefore concluded that both were a single object that had split due to an explosion.

Airbags work when deployed within 10 milliseconds of impact, utilizing an exothermic chemical reaction that produces hot gas that rapidly inflates the bag. This creates a cushioned impact point, as well as absorbing energy and decelerating the occupant. The area protected from injury by airbags ranges from just the torso to both the head and torso [3].

The Independent Testing Coalition group, formed from 10 well-known automakers, conducted a year-long review into the Takata airbag incident. They concluded that the airbag explosion was due to exposure to humidity, design and manufacturing problems, and the use of the volatile chemical ammonium nitrate [8].

4. Conclusion

With the introduction of airbags and their availability in almost all recently manufactured vehicles, several reports have shown a marked reduction in morbidity and mortality associated with RTAs. Yet, this case and other similar reported fatalities from defective airbags highlight the need to be aware of potential hazards associated with travelling in automotives with damaged or defective airbags. Furthermore, information about the presence of defective airbags in certain vehicles must be revealed to the public so that measures are taken to prevent morbidity and mortality resulting during their deployment.

Ethical considerations

Written consent to publish information was ob-

tained from the next of kin under the appropriate circumstances. Also, the approval to publish the information was obtained from the Office of the Attorney General. Data are available from the authors upon reasonable request and with permission from the Office of the Attorney General.

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Conflict of Interest

The authors declare that they have no competing interests.

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