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<https://doi.org/10.15017/13241>

出版情報：福岡醫學雜誌. 99 (11), pp.225-229, 2008-11-25. 福岡医学会
バージョン：
権利関係：

Case Report

An Unusual Case of Fatal Airbag Injury

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Abstract We report an unusual case of fatal airbag injury. A woman in her forties was driving a light car when it was involved in an accident. When the car was found, the left front wheel had dropped into the gutter, the front bumper was dented and the airbag had deployed. Forensic autopsy revealed that the right subclavian artery and the left vertebral artery were ruptured and 1,570 ml and 360 ml of blood with clots were observed in the left and the right thoracic cavity, respectively. It was considered that the unusual collision produced by deployment of the airbag had caused these ruptures and massive hemorrhaging. Although an airbag is an effective tool for ensuring the safety of a driver and the passengers, it may injure and occasionally kill the occupants if they do not remain in the appropriate and restrained seating position.

Key words : airbag injury, vertebral artery injury, unusual collision

Introduction

Airbags were first designed by a United States Air Force engineer in 1952 and were introduced as a safety feature in the 1970's in the United States¹⁾. A number of studies have revealed that airbags reduce mortality in car collisions^{1)~6)}. According to analyses of data on traffic accidents by the Institute for Traffic Accidents Research and Data Analysis⁵⁾, airbags led to a drop in the number of deaths by 330, and reduced the number of severe injuries between 1995 and 2003 in Japan. The National Highway Traffic Safety Administration (NHTSA) stated that front-seat airbags have saved 13,967 lives between 1987 and 2003 in the United States⁶⁾. Conversely, some cases of airbag injury, including fatalities, have been reported^{1)7)~16)}. We report an unusual case of fatal airbag injury that caused rupture of the right subclavian artery and the left vertebral artery.

Case Report

A woman in her forties was driving a light car when it was involved in an accident at night. When the car was found, the left front wheel had dropped into the gutter and the front bumper was dented (Fig. 1A). The curb of the road had been struck by the car and was scraped. The driver was not wearing a seatbelt and the airbag had deployed (Fig. 1B). The car had supposedly hit the curb at less than 30 km/hr. The driver was unconscious, and on the way to the hospital, she suffered cardiopulmonary arrest and could not be resuscitated. A forensic autopsy was carried out at about 12 hr postmortem.

Autopsy Findings

The victim was 162 cm tall and weighed 51.5 kg. External examination revealed contusions and lacerations of both knees. Slight abrasions and subcutaneous bleeding were found on the chest (Fig. 2A, 2B).

Hematoma was observed between the sternum and the pericardium, and the left side of the

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A



B

Fig. 1 Scene of the accident and the car.

A : The left front wheel had dropped into the gutter and the front bumper was dented.

B : The airbag was deployed.

pericardium was ruptured. 1,570 ml and 360 ml of blood with clots from the arterial ruptures were observed in the left and the right thoracic cavity, respectively. Hematoma was observed around both common carotid arteries, but the arteries were intact. The rupture sites were bifurcation of the right subclavian artery from the brachiocephalic trunk and bifurcation of the left vertebral artery from the left subclavian artery (Fig. 3). There was no significant atherosclerosis either at the rupture site or in any other arteries.

No other severe injuries and no diseases were noted. Blood alcohol was measured and the concentration was found to be 1.76 mg/ml.

Discussion

Peterson et al.³⁾ stated that 4 collisions may occur during a car crash. The first collision occurs when the vehicle strikes another object. The second collision occurs when an unrestrained person strikes the interior of the vehicle. If the occupants are restrained properly¹⁷⁾, the number



A



B

Fig. 2 A : Slight abrasions were found on the chest.

B : Subcutaneous tissue hemorrhage was observed on the thorax (ellipse), but no injuries were found at the waist.

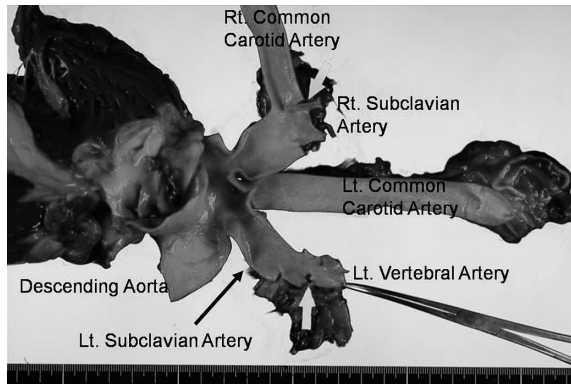


Fig. 3 Rupture sites (white arrows).

and severity of injuries and the likelihood of death are reduced. The third collision occurs when the occupant's organs continue to move and contact hard surfaces, such as the skull and the chest wall. A fourth collision occurs if loose objects within the vehicle continue in motion and collide with the occupant. In our case, the first collision occurred when the vehicle's left front wheel dropped into the gutter and struck the curb. The second collision occurred when the unrestrained victim struck the airbag. This airbag collision caused slight abrasions and subcutaneous bleeding on the victim's chest from the lower left to the upper right. The third collision occurred when the occupant's organs continued to move toward the lower left while the airbag pushed the victim's body toward the upper right. These forces tore the arteries at the position where they were firmly fixed to the body (Fig. 4). There were no injuries at the waist where some wounds would have been apparent if she had been wearing a seatbelt. It can thus be concluded that she was not wearing a seatbelt at the time of the accident. If the victim had been wearing a seatbelt properly, she would have benefited from the "ride down" effect and might not have been injured.

When the airbag system senses a crash, the bag is fully expanded in less than a tenth of a second. With this rapid inflation, the velocity of the extension may reach 320 km/hr¹⁸⁾. This means that airbags have enough power to wound an occupant, sometimes causing death. We concluded that the driver died of massive bleeding as

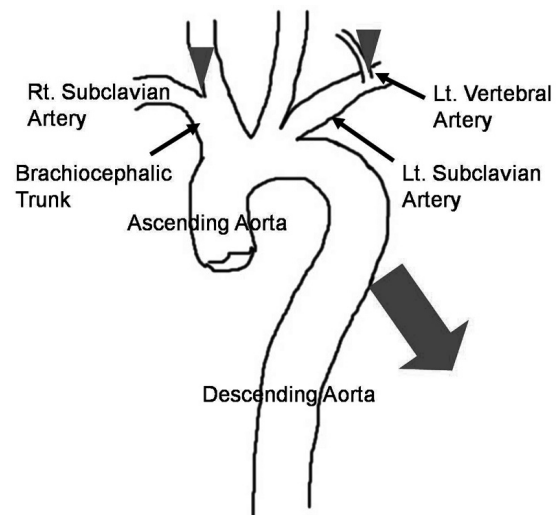


Fig. 4 Schema of the vascular system and the rupture sites (arrowheads). The organs continued to move toward the lower left (arrow), while the airbag pushed the victim's body toward the upper right.

a result of rupture of both the right subclavian artery and the left vertebral artery which were injured by the airbag.

Antosia et al.¹⁾ reviewed the data collected by NHTSA from 1980 to 1994 and reported that of 618 occupant injuries related to airbag deployment, 96.1% were classified as minor injury, such as abrasions (64%), contusions (38%), and lacerations (18%). Sato et al.¹⁵⁾ reviewed 79 articles and listed the airbag-related injuries observed in adults and children. They reported that severe injuries such as intracranial hemorrhage, cerebral contusion, brainstem laceration or transaction, cervical spine injuries, cardiac rupture, valve injury, and laceration or transaction of the ascending aorta and descending aorta are rare, but fatal. However, no previous cases of rupture of the bifurcation of the vertebral artery from the subclavian artery caused by an airbag have been reported.

Since the airbag is deployed when the system senses a crash, the velocity of the car is not the main factor affecting the severity of injuries. Accordingly, we need to take into consideration airbag injury in cases where an airbag was deployed, even though the occupants show few signs or symptoms⁷⁾, and even though the velocity

of the car was not so high⁸⁾. Although an airbag is a useful tool, warning should be offered to the public explaining that airbags can sometimes injure or kill an occupant if the occupant is not properly belted in the proper seating position.

Acknowledgement

The authors thank Miss K. Miller (Royal English Language Centre, Fukuoka, Japan) for revising the English used in this article.

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(Received for publication November 11, 2008)

(和文抄録)

特異なエアバッグ損傷の1例

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特異なエアバッグ損傷の1例を経験したので報告する。症例は40代女性。自家軽乗用車の運転席で、左前輪を側溝に落とし、バンパーが凹み、エアバッグが作動している状態で発見された。病院へ搬送されたが死亡が確認され、死因究明のため司法解剖が施行された。右鎖骨下動脈分岐部および左椎骨動脈分岐部が破裂し、左右胸腔内にそれぞれ1,570mlと360mlの凝血を含む血液の貯留を認めた。交通事故発生時、エアバッグが作動し前胸部を圧迫したことにより、加速度が作用する剪断外力が生じて動脈損傷をきたしたと考えられた。エアバッグは、衝突時にシートベルトの働きを補助して運転者および同乗者の受傷を防ぐ有効な装置であるが、シートベルト非装着や不適切な乗車姿勢では成傷器となりうることを周知させる必要がある。