

## CASE REPORT

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# Fatal Injuries in a Minor Traffic Collision

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**ABSTRACT:** An elderly woman was the driver and sole occupant of a midsize car involved in a minor collision with a standard sized automobile. She was restrained with a lap and shoulder belt and the air bag was deployed. Yet she suffered fatal chest injuries. No injuries were sustained by the unrestrained driver and passenger of the larger vehicle. Despite maximum restraint in a fully functioning new model car, even a minor collision can be fatal.

**KEYWORDS:** pathology and biology, injuries, traffic collision, accidental death

Motor vehicle accidents are responsible for approximately 42 to 46 thousand deaths per year in the United States [1,2]. This number represents 50% of all accidental deaths in this country and two percent of deaths from all causes [1]. Improved safety features in automobiles including energy absorbing compressible steering wheel columns, shoulder/lap seat belts, and driver side air bags have considerably reduced the number of fatalities and serious injuries [3-9]. Seat belts have not been found to significantly reduce the number of chest injuries [8]. However, air bags are intended to reduce these injuries.

The heart is not commonly injured in motor vehicle accidents [8,10]. The degree of cardiac injury is related to the amount of external force [10]. However, when injuries do occur the most common are myocardial contusion, laceration of the pericardial sac, rupture of the right atrium, rupture of the right ventricle at the interventricular septum, rupture of the left atrium, and laceration of the interatrial septum [3]. Theories of the proposed mechanism have ranged from deceleration forces, direct blunt force impact to the chest, and abdominal compression with hydrostatic force transmitted via the inferior vena cava to the right side of the heart [11,12].

This case demonstrates a fatal cardiac injury sustained by an elderly woman driver due to an air bag deployed during a minor automobile accident. A review of the literature reveals no other reported fatalities due to air bags. A case presentation at the 45th Annual Meeting of The American Academy of Forensic Sciences described a single fatality due to an air bag [13]. This case is also discussed.

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## Case History

A 79-year-old white female was the driver of a 1991 Ford Taurus. She entered an intersection heading northbound on her green light at approximately 20 mph. An older model Buick Riviera heading westbound entered the intersection on the red light. This vehicle had been stopped at the traffic light then slowly entered the intersection.

The two automobiles collided with resulting minor damage to the Taurus' right front and the Riviera's driver door. Witnesses at the accident immediately responded to the vehicles. The unrestrained driver and passenger of the Riviera were uninjured. The subject was unresponsive and bystanders released the seat belt. They noted white particles inside the Taurus due to deployment of the air bag.

An ambulance arrived six minutes later and found the subject pulseless with agonal respirations. Cardiopulmonary resuscitation was attempted but was unsuccessful. The subject was pronounced dead in the emergency room 33 minutes later.

## Findings

A complete autopsy examination was performed. The subject measured 5 feet 2 inches in height and weighed approximately 140 pounds. Externally there were scattered abrasions on the left side of the face from the forehead to the chin. Contusions and abrasions were noted on the chest over the sternum and the lower and lateral left breast. Emergency medical personnel confirmed the bruising on the chest was present prior to cardiopulmonary resuscitation. A large diagonal contusion (7 by 3 inches) was noted on the anteromedial left arm that corresponded to the shoulder belt (Fig. 1). Contusions were also seen on the anterior left forearm, posterior left hand along the second metacarpal, and posterior right lower forearm.

Internally there was a small subgaleal hemorrhage at the left side of the forehead. There were massive rib fractures involving anterolateral left ribs 1 to 9 with second fractures of ribs 3 to 5 slightly more posteriorly, anterolateral right ribs 1 to 6 with second fractures of ribs 2 to 5 with the second rib fractured three times (Fig. 2). There were two fractures of the sternum—one at the first intercostal space with fragmentation of the end of the first rib. The second fracture was at the third intercostal space. There were bilateral hemothoraces of 500 mL on the right side and 250 mL on the left. During the attempted resuscitation, 4450 mL of blood was returned from the right pleural cavity through an emergently placed chest tube. There was a large laceration of the anterior pericardium and tip of the right auricle with an associated hemo-



FIG. 1—Left arm of victim demonstrating bruising due to shoulder restraint.

pericardium (Fig. 3). There were small lacerations of the lower lobe of the left lung and the hilum of the spleen with minimal associated hemorrhage.

X-ray examination revealed osteoporosis as well as the fractured ribs.

Toxicology examination was negative for carboxyhemoglobin and ethanol in the blood. Evaluation of the Taurus by an accident reconstructionist for the National Highway Traffic Safety Administration revealed no defects in the restraint or air bag system. There was facial powder on the air bag indicating contact with the deceased's face. The amount of crush sustained by the Taurus was minimal (Fig. 4).

### Discussion

Why then did this seemingly minor accident cause fatal chest injuries in this woman? She was elderly and, as evidenced in her X-rays, suffered a common malady of older women—osteoporosis. This would predispose her to fractures with mild trauma. However this is not the entire explanation. This woman was petite in height and had her seat pulled far forward with only a distance of approximately 10 inches between her chest and the steering wheel. On reconstructing the accident, it is clear that she must have contacted the air bag at its maximum point of inflation and firmness rather than a millisecond later as the bag begins to deflate and soften. The airbag is deployed at a speed of 144 to 211 mph with full inflation occurring in  $\frac{1}{20}$ th of a second (50 milliseconds) and

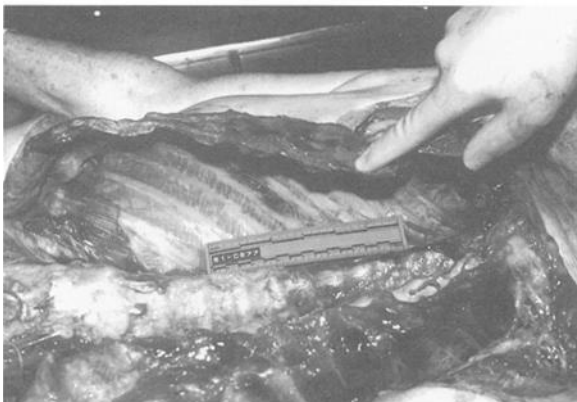


FIG. 2—Right pleural cavity with numerous rib fractures.

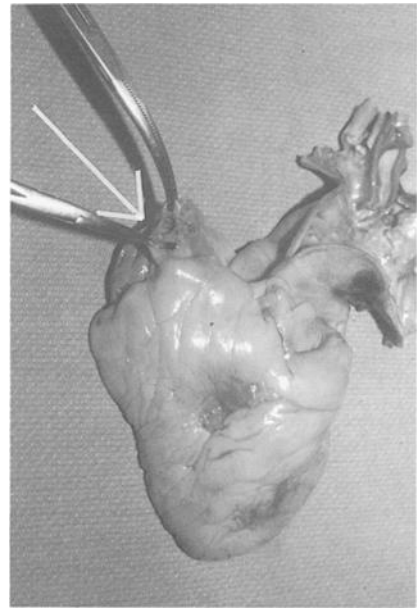


FIG. 3—Heart with clamps adjacent to laceration of right atrium.

deflation complete in one second [13,14]. This force is sufficient to cause eye and hand injuries including corneal abrasions, periorbital fractures, and avulsion of the thumb and is responsible for a case of fatal head injury [13,15,16]. In this case, the blunt trauma occurring on impact with the air bag resulted in massive rib fractures, chest wall deformity, and fatal lacerations of the pericardium and heart.

The number, extent, and location of the rib fractures cannot be explained by cardiopulmonary resuscitation (CPR) alone. These fractures were more extensive and more laterally located than those typically associated with resuscitative efforts. Rib fractures are a common complication of CPR occurring in 11 to 47% of cases [17–20]. However when the location of the fracture is described, it is closer to the sternal border [21]. The number of ribs fractured from CPR ranges from two to eight, much less than the 23 fractures seen in this patient [17,19].

Despite maximum restraint in a fully functioning new model car, even a minor collision can be fatal. Air bags can minimize driver injuries but may at times prove deadly themselves. This



FIG. 4—Victim's car showing minor frontal damage.

occurred in another case involving a fully restrained 35-year-old female driver, 5 feet 2 inches in height. The seat was in the full forward position. Minor crush damage to the car resulted in lethal head trauma [13]. Her injuries consisted of cerebral edema, a left subdural hematoma, mid face swelling and corneal abrasions. The risk factors in these two air bag related casualties appear to be the short stature of the victim and the full forward driver's seat position. Interestingly both fatalities involved the same make, model, and year automobile [13]. The General Motors Corporation warns about the danger of having the seat in the far forward position because "if an occupant is very close to an inflating air bag, the force of deployment could cause serious injury or even death" [22]. Drivers should be warned about the danger of the full forward seat position.

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