

AIR BAG SAFETY: AN UPDATE



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CE Earn Up to 9.0 CE Hours. See page 461.

Air bags are one of the most important safety innovations of recent decades, providing crucial protection for people during a crash.¹ From 1987, when air bags were first installed in vehicles, through 2013, a total 39,886 lives were saved by frontal air bags.² Frontal air bags were designed to protect both restrained and unrestrained vehicle occupants. In the early 1990s, frontal air bags caused injuries to vehicle occupants who were sitting too close to the air bag module at the time of deployment.³ Since then, frontal air bags have gone through a series of modifications to improve safety. Since 2007, all motor vehicles are required to have advanced air bags (AABs). AABs are designed to either suppress the deployment of the air bag whenever the front seat is unoccupied or deploy at a lesser force if the seat is occupied by a light-weight passenger such as a child, a backpack, or a bag of groceries.⁴

Recent Air Bag Innovations

In addition to frontal air bags, newer motor vehicles are now equipped with side air bags (SABs), which include head- and chest-protecting side air bags, torso, rollover, rear window curtain, front center, and knee air bags (see Figure 1). Curtains and SABs are designed to protect occupants in crashes to the side of vehicles adjacent to where the occupants are seated.⁵ Head- and chest-protecting air bags inflate to prevent the occupant's head and chest from hitting the car's side structures or other structures like a tree or a pole. These air bags cushion and spread the load of the impact, thereby reducing the incidence of serious injury.⁶ Occupants are most vulnerable when their car is struck on the side by large and tall vehicles.⁷ An SAB is often the only barrier between the occupant and the striking vehicle or object outside the car. A torso-protecting SAB deploys from the seat back of both front and rear seats, providing a

cushion between the occupant's chest and the intruding side structure. In some early car models, these air bags deploy from the door trim. A head-protecting curtain SAB, typically located in the roof-rail of the vehicle, deploys downward to cover the window frame. A special type of side curtain air bag, the rollover air bag, has sensors that respond to a vehicle's sideways movement or tilting. Designed to cover a bigger portion of the window, rollover air bags are larger and stiffer than the frontal air bag and remain inflated longer.⁸ This feature protects the occupant's head and upper body from contacting the ground and keeps unbelted people from being ejected during the rollover crash. Located in the lower instrument panel, knee air bags not only reduce leg injuries but also reduce forces on the occupant's chest and abdomen by controlling movement of the occupant's lower body.

Some vehicles also contain rear-window air bags.⁹ The air bags deploy in front of the rear windshield and around the rear seat head restraints, which is intended to prevent direct contact of the back seat occupants with vehicle parts and broken glass in the event of a rear crash. In 2012, Ford introduced rear inflatable seat belts, which are designed to enhance protection for rear-seat occupants (see Figure 2).¹⁰ In a crash, the shoulder portion of the seat belt inflates and expands sideways across the occupant's body, distributing crash forces more widely across the torso and chest than with conventional seat belts. The inflated belt also provides more support for the head and neck to prevent excessive movement.¹¹ General Motors developed a front center air bag intended to maintain occupant position in far side and rollover crashes and prevent front passengers from colliding against each other during side-impact crashes.

Air bags are not only for occupants of vehicles. To protect pedestrians, Volvo developed an external airbag that deploys from under the hood, covering the hard parts of the windshield and the A-pillar of the car when a collision with a pedestrian is detected. Honda's Gold Wing touring motorcycle also offers a frontal air bag designed to deploy in severe frontal impacts and absorb some of the forward energy of the driver.

Air Bag Safety Considerations

Advanced air bag sensors for seat-mounted air bags may be located within the lower cushions or the seat track of the front passenger seat. These sensors are sensitive to pressure on one or both sides of the front passenger seats. Vehicle

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J Emerg Nurs 2016;42:438-41.

Available online 9 June 2016

0099-1767

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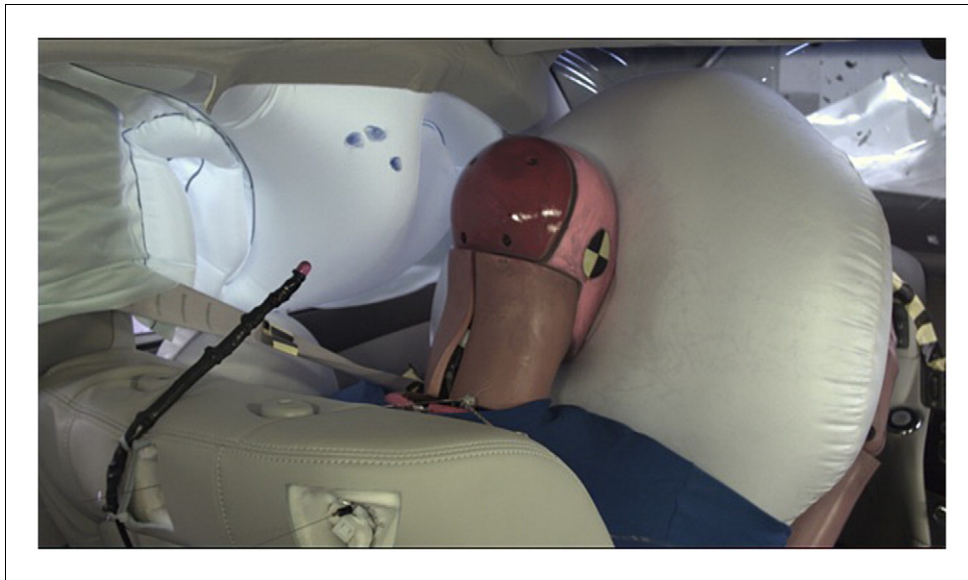


FIGURE 1

Driver front air bag and curtain air bag. Photo courtesy of the Insurance Institute for Highway Safety.

owner manuals warn that any pressure exerted on the front passenger seat back could cause the air bag to be inappropriately turned on or off. It is advisable to consult the vehicle owner's manual for specific instructions and warnings.

Injuries from Air Bags

The force necessary to quickly deploy the frontal air bags may result in unintended injuries to the occupants, especially to short and elderly drivers who tend to sit close to the steering wheel, children younger than 13 years in the front seat, unbelted drivers, and children in rear-facing car seats installed in the front seat. When a driver sits too close to the air bag, the expansion of the air bag is impeded by the driver's chest/torso, which may cause shearing forces that can lead to injuries such as sternal and manubrium fractures.¹² The expanding air bag is forced upward as a consequence, which can cause facial and neck injuries. Other injuries include skin abrasions and contusions or fractures to the face, fingers, hands or arms, lower legs, and feet, especially when perched on the top of the instrument panel when the passenger air bag deploys. Cardiac injuries such as aortic transection, tricuspid valve injury, right atrial rupture, and cardiac contusion can occur as a result of air bag deployment even with no visible injury at time of presentation to the hospital.¹³ One retrospective study suggested that splenic trauma may result from low severity

crashes involving vehicles equipped with seat-mounted SABs.¹⁴

Implications for Emergency Nurses

Emergency nurses and other health care providers need to be cognizant of the potential injuries from air bags.¹⁵ When receiving patients involved in a motor vehicle crash, emergency nurses should always ask EMS about the condition of the steering wheel under the deployed air bag. In a severe crash, a chest accelerating into the air bag and steering wheel may potentially bend the steering wheel and cause injury to the sternum, ribs, and underlying structures.

Emergency nurses play an important role in educating patients and caregivers to help reduce the frequency and severity of air bag injuries. Motor vehicle safety must be an integral part of the discharge instructions for every patient seen in the emergency department. Furthermore, emergency nurses should advocate for everyone to properly use seat belts and car seats. Drivers must sit at least 10 inches away from the center of the steering wheel where the air bag will deploy. To achieve maximum distance between the driver's chest and the steering wheel, shorter drivers should recline their seat back slightly. Pedal extenders are available for drivers who are unable to get far enough away from the steering wheel. Front-seat passengers should be advised not

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