

## **Air bags and children: a potentially lethal combination**

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### KEY POINTS FROM THIS ARTICLE:

- 1) Air bags have been responsible for saving thousands of lives since their introduction. The lifesaving effects of air bags in high-speed collisions have been well documented since their introduction.
- 2) Yet, air bags have been the cause of needless morbidity and mortality in children.
- 3) The authors reviewed 13 children injured by air bags in Canada. Although 12 of the children sustained relatively minor air bag trauma, one child was killed by the air bag deployment, sustaining an occipital-C1 dislocation.
- 4) The pediatric population is at particular risk from air bag deployment, as many parents continue to place their children in the front seat and thus put the child in jeopardy of sustaining air bag-induced injuries should a collision occur.
- 5) Air bags reduce the risk of driver fatality by 13% when the driver is belted and by 12% when the driver is not restrained.
- 6) Air bag systems in the US are regulated based on a 48 km/h (30 mph) frontal barrier crash test that considers only the 50th percentile male dimensions [5 ft. 8 in. height, 168 lbs.] in a specific seating position and posture [driver]. "As a result of the explosive force with which they need to deploy to protect this category of the population, air bags have been responsible for numerous injuries and fatalities, primarily in small women and children."
- 7) Children younger than 10 years of age have a 21% increased risk of fatality when an air bag is present.
- 8) Most children killed by air bag deployment were seated improperly:
  - A)) Unrestrained children in the right-front seat. Pre-impact braking was thought to be a major factor in these unbelted children, moving them into the air bag's deployment zone before the actual collision.
  - B)) Infants placed in rear-facing infant carriers in the right-front seat, which places the child's head in close proximity to the air bag. In October 1996 it was documented that a child who was seated and belted properly in the front passenger seat and whose mother walked away from an otherwise minor 'fender bender' was killed by an air bag-induced injury.

9) Thirteen cases of air bag trauma in children were encountered at these author's hospital. The children, aged 2-12 years, were seated in the front passenger seat of vehicles during collisions that resulted in deployment of the air bag. All children were restrained with seat belts in some manner. The collisions were of relatively minor severity and 12 of the injuries were of a superficial nature consisting of lacerations, contusions, abrasions, or burns.

One case, a boy aged 4 years, was killed. The child's father had buckled the child's seat belt before beginning the trip with the torso portion of the seat belt behind the child's back. The case vehicle, a 1995 Hyundai Accent, rear-ended a 1992 Honda Civic, causing minor damage to the front bumper and hood of the Accent. The child sustained a dislocation of the cervical spine O-C1 with complete transection of the spinal cord resulting in instant death. His fully restrained father sustained a minor contusion to his left hand when his air bag deployed.

Pre-crash braking brought the child's head and chest forward so that he experienced the full force of the deploying air bag, which hyperextended and rotated his neck, resulting in O-C1 dislocation with complete transection of his spinal cord. "To appreciate the force with which this child was struck, it should be noted that the air bag propelled his head back with enough force to snap off the floor-mounted transmission shift lever."

10) Since the American government began phasing in an air-bag requirement in 1993, many people, most of whom have been children and short women have been directly injured by air bag deployment.

11) As of October 1997 in the US, 38 adults and 47 children had sustained fatal air bag induced injuries in low-severity collisions, including 12 infants in rear-facing infant carriers and 35 other children occupying the right-front passenger seat.

12) In most instances the children reported in this review would have been completely unharmed had the car not been equipped with a passenger-side air bag.

13) Air bags are designed to complement seat belts, which restrain the body, to protect the head from hard contact with the steering wheel or dashboard of the car. In serious collisions, the head is cushioned by the air bag so there is less danger of breaking bones in the face, head, and neck. A sensor in the car detects the sudden deceleration resulting from a crash and sends an electric signal that ignites a chemical compound, which transforms instantly into nitrogen gas and inflates the air bag at >200 miles an hour. For optimal protection, the occupant should impact the air bag when it is fully inflated, thus allowing the occupant's kinetic energy to be dissipated using the air bag as a cushion. However, if the occupant is in the path of an air bag as it is rapidly inflating, forceful contact may occur, which can result in more serious injuries than might otherwise be the case.

- 14) In the United States, 35% of young children ride unrestrained. On braking, an unbelted child can be thrown forward against the car's dashboard, placing the child in the dangerous area of where the air bag will deploy.
- 15) The NHTSA has identified three specific injury patterns from close proximity air bag traumas:
- A)) Basilar skull fractures and cervical spine injuries associated with brainstem lacerations, subdural and subarachnoid hemorrhages.
- B)) Multiple rib fractures, usually bilateral and often with associated injuries to the underlying thoracic and abdominal organs. Injuries, including lacerations, have been found mainly in the heart, spleen, liver, and aorta.
- C)) Cardiac and pulmonary injuries that occur without rib fractures. Injuries from this mechanism include contusions and hemorrhages of the heart and lungs.
- 16) The force of the air bag deployment can drive the child against structures in the vehicle, causing additional injuries.
- 17) It is recommended that infants ride in a rear-facing child seat until they weigh 20 pounds or are approximately 1 year of age. However, rear-facing child restraints pose a hazard in vehicles with a passenger-side air bag because their backs are close to the vehicle dashboard and can therefore be struck by a rapidly inflating air bag. The resulting force of deployment then can be transmitted directly to the infant's head through the safety seat, throwing the infant's head against the vehicle seat.
- 18) "A child seated in a forward facing safety seat is less likely to be struck by an air bag because these seats are positioned with greater distance between themselves and the point of air bag deployment. However, because they usually place the child at least several inches closer to the dashboard than adults in the standard sitting position, and because there generally is no anchor available in the right front seat for the top tether strap, all child safety seats should be placed in the back seat of the vehicle to ensure that the child is not injured needlessly."
- 19) Concern has been raised regarding the air bag's potential to chemically or thermally burn an occupant. The main propellant in an air bag system is the burning of sodium azide. Women's blouses have been reported to have melted as air bags deployed against them.
- 20) "The hot gases that inflated the air bag then escape through exhaust ports facing the windshield, allowing the air bag to deflate immediately. These gases have been responsible for burns to the hand, particularly about the base of the thumb or the dorsum of the wrist or hand."

21) Also, small amounts of aerosols containing sodium hydroxide, sodium carbonate, and metallic oxides are formed, and if the sodium hydroxide is allowed to go into solution (e.g., sweat, tears), it can chemically burn the occupant.

22) The U.S. federal safety standard requires that air bags protect an unbelted 168-lb male in a head-on collision at 48 km/h (30 mph) into a concrete barrier. Yet, the threshold to initiate inflation of an air bag is much lower than this and many vehicle riders weigh less than 168 lbs. Consequently, air bag deployment occurs with too much force for many collisions and for much of the population.

23) Summary of air bag induced fatalities as of October 15, 1997:

Adults

Drivers	35
Passengers	3
Total adults	38

Children (passengers)

Not in rear-facing child-restraint seat	35
Rear-facing child-restraint seat	12
Total children	47

Total occupants 85

24) Air bags are not been designed to accommodate the needs of a small child seated in the front passenger seat of a vehicle in a minor collision. Consequently, many children have been injured or killed by the explosive force with which air bags need to deploy to satisfy the safety requirements for saving a large adult human male in a collision. Children should ride in the back seat of the vehicle to avoid the possible adverse effects of an air bag deployment.

25) Recommendations to improve the safety of airbag deployment for children:

A)) Strong warning labels in new vehicles.

B)) Consideration for the deactivation of current airbag systems with manual cutoff switches.

C)) Introduction of "second-generation" airbags that will deploy less aggressively.

D)) Development of "smart airbag" technology. These airbags would deploy differently depending on the occupant to be protected.

E)) Children should always ride in the rear of a vehicle equipped with an airbag system.