

Nonambulatory "Pedestrians": Infants Injured by Motor Vehicles in Driveways

Martha S. Wright, MD

Introduction

Motor-vehicle-related injuries are the leading cause of death in children.¹ Approximately one third of deaths occur in pedestrians,² individuals defined by the *International Classification of Diseases, Ninth Revision* External cause codes (E-codes) as "person(s) involved in a [motor vehicle] accident who were not at the time of the accident riding in or on a motor vehicle. . . ."³ Research into child pedestrian injuries reveals that the circumstances surrounding these events differ by age.^{2,4} Preschool and school-aged children are most commonly struck by cars during midblock "dart-out" events, while toddlers are more frequently injured by vehicles traveling in reverse in driveways and other non-traffic locations. The details of injury events in which infants are struck by motor vehicles are less well described. While not pedestrians in the literal sense, infants are categorized as such in injury surveillance databases by the ICD-9

external cause code (E-code) definition noted above. These incidents are uncommon, with 69 infant "pedestrian" deaths occurring in the United States between 1990 and 1994,⁵ and the death rates are ten times lower than those seen in toddlers and older children.^{4,5} It is therefore likely that these injury events have unique characteristics that would have implications for age-appropriate prevention recommendations. To date, most reports specifically describe the experience of older ambulatory children and toddlers, outlining prevention strategies relevant to that population.^{2,6,7} This report details recent experience with two nonambulatory, infant "pedestrians" who were seriously injured by motor vehicles in nontraffic settings.

Patient Reports

Patient 1

A 3-month-old infant girl was transferred to the Pediatric Trauma Center from a local hospital after sustaining a crush injury to her right lower extremity.

The infant had been placed in the shade on the driveway of the family's home in a fabric, metal framed, infant "bouncing" chair while her mother cleaned the porch. Her father moved the car out of the garage and backed the left rear tire over her foot. Evaluation of her injury revealed a markedly swollen right foot with barely palpable pulses. Radiographs of the extremity showed no fractures, but measurement of pressures in the plantar compartment were found to exceed 60 mmHg, consistent with compartment syndrome. She was taken to the operating room for a three-incision fasciotomy. The infant was discharged in good condition on the fifth hospital day following debridement and closure of the fasciotomies.

Patient 2

A 3-month-old infant boy was transported by helicopter to the Pediatric Trauma Center from a local urgent care center after he was backed over by the father's pickup truck in the driveway of the grandmother's home. The infant had been placed on the driveway in an infant car seat next to the front passenger side of the truck when his father inadvertently backed over the infant, crushing his head under the right front wheel while moving the truck to a more convenient location. The family took the infant to the urgent care center where he was resuscitated and transported

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Department of Pediatrics, Case Western Reserve University School of Medicine; Pediatric Emergency Medicine, Rainbow Babies and Children's Hospital, Cleveland, Ohio.

Reprint requests and correspondence to: Martha S. Wright, MD, Pediatric Emergency Medicine, Rainbow Babies and Children's Hospital, 11100 Euclid Ave., Cleveland, Ohio 44106.

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to our facility. A computed tomography scan demonstrated multiple skull and midface fractures with significant subarachnoid and intraventricular hemorrhage and a large frontal subdural collection. He was taken to the operating room where he died of brain herniation from massive cerebral edema and brain injury.

Discussion

Pedestrian injuries in ambulatory children less than 3 years of age have been well characterized.^{2,4} Occurring commonly in locations other than public streets like driveways, sidewalks, or parking lots ("nontraffic" sites), these events frequently happen while the child is playing in the driveway and is backed over by a vehicle driven by a family member. These nontraffic injury events disproportionately involve vans, trucks, pickups, and four-wheel-drive vehicles. The injuries sustained most often involve the head and face, torso, and lower extremities. While the available studies on injuries in young pedestrians include children less than 1 year of age, some exclude those who were nonambulatory² and others do not distinguish the infants from the other children in their samples.^{4,7,8-10} Therefore, it is not known if the injury event characteristics attributed to toddlers accurately describe those events involving nonambulatory infants.

The injury circumstances experienced and injuries sustained by our two infant patients do share some common characteristics with the patterns observed in toddler pedestrians. In both instances, family vehicles backed over the infants, causing head and extremity injuries. One event in-

volved a pickup truck. Unlike toddlers, however, who are frequently hit when they run onto or are playing on driveways,² these infants were placed on the driveways in infant seats by caretakers and run over by individuals unaware of the infants' locations.

Various prevention strategies for driveway pedestrian injuries in toddlers have been suggested previously.^{2,7,8} Environmental modifications such as fencing driveways, providing fenced play areas away from the driveway, and driveway redesign (circular) that would preclude the need for backing up^{2,8} have been recommended as the methods most likely to be successful. Automobile modifications including back-up warning alarms, similar to those on industrial vehicles, or the placement of mirrors or sensing devices (especially on trucks and vans) that would alert drivers to out-of-sight objects could also be effective.^{2,7} These would require the development of additional automobile safety features and regulations to enforce compliance. Car seats, infant seats, and strollers could be designed to "alarm" when approached by a reversing vehicle. Counseling caretakers about adequate supervision and reminding drivers to look for children before backing up could be effective if those behaviors could be altered consistently.

Those interventions that might have prevented the injuries in our two patients, including mirrors or sensing devices, improving the adequacy of caretaker supervision, and changing driver behavior, involve remedies least likely to be reliably effective or easily implemented. It is possible that one of the injuries might have been prevented by infant car seat modifications that would have prevented the seat from be-

ing set down on the driveway or that would have provided additional protection during the run-over event. How reasonable or feasible these strategies would be is unknown, but they seem unrealistic. Since these events are uncommon, it is unlikely that prevention campaigns specifically targeting these injuries would be adopted. However, incorporating information about these types of incidents into the broader context of anticipatory guidance on motor vehicle safety and the proper use of infant safety restraints would raise awareness of these potential dangers.

For the present, both infant and child motor vehicle safety programs should alert parents and caretakers to the driveway-related risks of injury from motor vehicle run-over events. In the future, more effective approaches may be identified by use of data from ongoing injury surveillance. To enable this effort, injury cause coding systems (E-codes) should be modified to distinguish between ambulatory pedestrians and those nonambulatory children who are injured when placed in the path of a motor vehicle in both traffic and nontraffic settings. With more specific descriptions of these injuries, strategies aimed at altering their unique characteristics can be developed and incorporated into ongoing motor vehicle safety programs.

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