Cargo areas of pickup trucks: an avoidable mechanism for neurological injuries in children

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Object. Falls from pickup truck cargo areas represent a unique mode of injury in children and adolescents. The goal of this study was to identify the neurological spectrum of injuries resulting from children riding in the back of pickup trucks.

Methods. The authors undertook a retrospective review of the University of New Mexico Hospital trauma registry of data compiled over a 7-year period. Their goal was to identify instances in which a fall or ejection from a pickup truck cargo area was the mechanism of injury. The charts of pediatric patients (≤ 16 years of age) with neurological injuries were reviewed and analyzed.

Seventy-three pediatric patients with injuries related to riding in the cargo areas of trucks were identified, of which 53 children (73%) had sustained neurological injuries. Among these 53 children, 64% sustained isolated head injuries, 15% isolated spine injuries, 9.4% combined spine and head injuries, 2% combined peripheral nerve, spine, and head injuries, 4% isolated peripheral nerve injuries, and 5.6% concussive events. In 53.4% of patients with neurological injuries, the results of computed tomography (CT) examination were abnormal. In 36% of patients with Glasgow Coma Scale (GCS) scores of 14 to 15 there was evidence of intracranial hemorrhage on head CT scans. Injury Severity Scores were similar in the patients who were ejected and those who fell from cargo areas, but patients who were ejected had a lower mean GCS score than those who suffered falls (GCS score 12.5 and 14.3, respectively).

Conclusions. Falls or ejections from pickup truck cargo areas result in a relatively high incidence of traumatic head, spine, and peripheral nerve injury. Head CT scanning should therefore be considered in pediatric patients with this mechanism of injury. Cargo area occupancy poses an unacceptable risk of injury and should be avoided.

Key Words • motor vehicle ejection • pickup truck • head injury • pediatric neurosurgery

Motor vehicle crashes are a major cause of death and injury in children. In 1998, 32% of all fatalities associated with pickup truck cargo areas involved children younger than 18 years of age. Although there are more falls or ejections from pickup truck beds in rural areas such as the desert southwest of the US, there is an increased incidence of children riding in cargo areas in urban vicinities, particularly during transportation to school or recreational activities and during the summer months.

Pickup trucks are an increasingly popular form of personal transportation in the US. Registrations for pickup trucks accounted for 17% of all vehicle registrations in the US in 2002. We conducted this study to offer insight into the pattern and severity of neurological injury in children riding in the cargo area of pickup trucks in an effort to identify opportunities for intervention and to optimize medical care.

Clinical Material and Methods

Using the University of New Mexico Hospital trauma registry, a retrospective review was completed of all trauma patients admitted from January 1996 to March 2003. Located in Bernalillo County, the New Mexico Health Science Center is the sole Level I trauma center for the state of New Mexico and also serves the regions of southern Colorado, western Texas, and eastern Arizona. A unique combination of cultural, climatic, socioeconomic, and geographic features makes injuries sustained in falls from pickup truck cargo areas relatively common in the American Southwest. The starting date of the study was chosen to correspond with the addition of a separate registry database parameter at the hospital specifically defined as any fall from a moving or stationary pickup truck bed. Seventy-three pediatric patients (≤ 16 years of age) were identified. Fifty-three of these patients (73%) sustained neurological injuries, defined as those involving the head, brain, spinal column, spinal cord, or peripheral nerves. These patients’ charts were reviewed further to characterize the injury pattern and severity based on age and sex, admission GCS score and ISS, head CT findings, and mechanism and type of injury.

Abbreviations used in this paper: CT = computed tomography; EDH = epidural hematoma; GCS = Glasgow Coma Scale; ISS = Injury Severity Score; SDH = subdural hematoma.
Results

Patient Population

Among the 53 pediatric patients with neurological injuries related to ejection or fall from a truck cargo area, there were 37 boys (70%) and 16 girls (30%) with an average age of 11.0 ± 4.2 years (mean ± standard deviation). The average presenting GCS score in this group was 13.5 ± 2.7 (range 3–15). The average initial ISS was 13.4 ± 9.7 (range 0–54). Table 1 gives a summary of the initial clinical presentation in these patients. The majority of injuries occurred in the summer with a peak incidence in July. Nineteen (36%) of the 53 patients with neurological injuries were reported on the initial emergency medical services evaluation to have lost consciousness.

Pattern and Mechanism of Injury

Ejection from a moving vehicle was the cause of injury in 27 patients, and nearly as many sustained falls from stationary vehicles (26 patients). The average GCS score in patients ejected from moving vehicles was 12.5 with an average ISS of 14.8. The sole patient death was associated with ejection in a high-speed motor vehicle crash; this patient had an ISS of 54 and a GCS score of 3 at presentation. The head was the most frequently injured body region (in 74% of the patients), followed by injuries to the extremities (40%) and the spine (23%). Injury to the thorax and abdomen had an equal incidence (5%).

Neurological Injuries

Of the 53 patients with neurological injuries, 34 (64%) had isolated head injuries, eight (15%) had isolated spine injuries, five (9.4%) had combined spine and head injuries, one (2%) suffered combined peripheral nerve, spine, and head injuries, two (4%) suffered isolated peripheral nerve injuries, and three (5.6%) had concussive events (Fig. 1). Forty-eight (91%) of the 53 patients in this study underwent head CT scans in the emergency department. The five patients who did not undergo neuroimaging had initial GCS scores of 15. Head CT scans revealed abnormalities in 39 (81%) of the 48 patients who underwent imaging. The types of head injuries based on CT findings in these 48 patients are shown in Fig. 2. Nine patients had no evidence of intra-cranial injury on imaging—three of these patients had concussive events alone, whereas the rest were stratified into other injury groups. Based on CT findings in the remaining 39 patients, 15 had isolated skull fractures, four had isolated EDHs, three had isolated SDHs, three had isolated traumatic subarachnoid hemorrhages, and two had cerebral contusions. The remaining 12 patients had combinations of these injuries. Six patients required surgery—two for EDH evacuation, one to treat an EDH combined with an open depressed skull fracture, one for evacuation of an EDH and an SDH, one for an isolated open depressed skull fracture, and one for an acute SDH.

Fourteen of the 53 patients suffered spinal injuries (Fig. 3). No patient sustained a cervical spine fracture, although cervical spine ligament injuries were demonstrated on magnetic resonance imaging in four patients, defined by evidence of tectorial membrane, transverse, or alar ligament disruption with or without adjacent soft tissue swelling, edema, or hemorrhaging. Of the remaining 10 patients, six had thoracic spine fractures, three had lumbar spine fractures, and one presented with combined thoracic and lumbar spine fractures. The isolated thoracic fractures included a spinous process fracture at T-1, a compression fracture at T-4, two patients with compression fractures at T-7, and one

<table>
<thead>
<tr>
<th>Injury Severity Level</th>
<th>Scale</th>
<th>GCS (no. of patients)</th>
<th>ISS (no. of patients)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>mild (GCS Score 14–15)</td>
<td>37</td>
<td>49</td>
<td></td>
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<tr>
<td>moderate (GCS Score 9–13)</td>
<td>11</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>severe (GCS Score 3–8)</td>
<td>1</td>
<td>1</td>
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</table>

* The ISS is an anatomical trauma severity scale computed as the ordinal sum of the three most injured body regions. Range 1–75: at ISS < 25, risk of death is minimal; mortality rate is 50% at ISS = 50; at ISS > 70, mortality rate is near 100%.
with a compression fracture at T-9. The sixth patient with an isolated thoracic spine injury presented with paraplegia and was found to have a complex burst fracture at T-11 and adjacent anterolisthesis at T-10 which required surgical intervention for decompression and stabilization. Two patients presented with compression fractures at L3–4, and one presented with L1–2 anterior wedge fractures. The remaining patient presented with a complete spinal cord injury. On imaging a T-12 burst fracture with an L-2 compression fracture and associated transverse process fractures from T-7 to T-11 were identified. This patient underwent surgery for stabilization and early mobilization.

Discussion

Traffic accidents involving pickup trucks result in a higher mortality rate than those involving cars. This may be explained in part by the increased risk that the cargo area poses to its occupants. The occupants of the cargo area are eight times more likely to die in a crash compared with cab occupants. Despite these findings, fewer than 50% of states have passed laws restricting transport of passengers in the cargo area, and only one state prohibits occupancy travel in cargo areas. In addition, there is great variability from state to state regarding enforcement of laws concerning the age of occupants and modifications of restrictions for trucks with covered cargo areas. Up to 30% of accidents involving occupants of the cargo area are classified as noncrash or noncollision events in which the victims either fall or are ejected during sudden turns, stops, or swerves at relatively low speeds.

The results of our study support the conclusion of Woodward and Bolte that cargo area occupancy injuries are “a particular risk to the pediatric population.” The average age of the 73 patients who sustained falls or ejections from pickup truck cargo areas in this study was 10.7 years. Consistent with previous studies, we found a high incidence of neurological injuries in these patients: 73% (53 of 73 patients). Despite improvements in emergency medical services systems and imaging technology since the studies by Woodward and Bolte and Bucklew et al., this figure remains nearly unchanged from their respective findings of 70 and 68%, respectively. Furthermore, 53.4% of the patients in our study (39 of 73) had CT findings of head injury requiring neurosurgical management.

In this study 15% of patients injured in this manner (11 of 73) presented with a GCS score of 15 and were subsequently found to have abnormalities on head CT scans. The frequent finding of traumatic brain injury in association with cargo area occupancy suggests that head CT studies should be used to evaluate this subset of patients, even those who seem to have sustained only mild head injuries based on GCS scores at admission. Nagy and colleagues reviewed the use of head CT scanning in patients with admitting GCS scores of 15 but a history of loss of consciousness, and found that there were abnormalities in 3.3% of these patients on CT scans. Based on these results, the authors recommended routine use of head CT studies in this patient population.

Wang et al. noted a 27% incidence of abnormal head CT findings in pediatric patients with GCS scores of 13 or 14. We found a 36% incidence of intracranial hemorrhage on CT scans obtained in patients with GCS scores of 14 or 15 after suffering cargo area-related injuries, suggesting that this mechanism of injury may be associated with a higher incidence of intracranial injury. Identification of these patients is essential to providing appropriate hospitalization in an intensive care or intermediate care unit where frequent serial neurological examinations can be performed.

A surprising finding in our study is the similarity in ISS between patients ejected from the cargo area and those suffering simple falls. This emphasizes that the cargo area is hazardous whether the vehicle is in motion or stationary. Despite evidence that occupancy in these areas poses unacceptable risks of injury or death, no passenger safety requirements apply to the open cargo space in pickup trucks.

The frequency and severity of traumatic brain injury and its inherent lethality suggest that head CT studies are prudent with this mechanism of injury, even in patients with apparently mild injuries based on the admitting GCS score. Prompt CT scanning would allow early neurosurgical consultation if needed. Our results show that occupancy of the cargo area for children is unsafe whether the vehicle is moving or stationary. Prospective gathering of information as demonstrated in this study is necessary to identify and characterize the hazards of cargo area occupancy and, perhaps, influence safety legislation.

Conclusions

Falls or ejections from pickup truck cargo areas involving children result in a relatively high incidence of traumatic head, spine, and peripheral nerve injury. Therefore, head CT studies should be considered in pediatric patients with this mechanism of injury, even for those with apparently mild injuries based on admitting GCS score. Cargo area occupancy, whether the vehicle is in motion or stationary, poses an unacceptable risk of injury and should be avoided. Because pickup trucks are an increasingly popular form of personal transportation in the US, particularly in rural areas, educational efforts in the community as well as in schools and at home should be directed toward limiting or avoiding occupancy of cargo areas in pickup trucks. Consideration should also be given to passing further safety legislation.

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Neurological injuries in children due to falls from pickup trucks

limiting or prohibiting children from occupying or traveling in cargo areas of pickup trucks.

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References


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