

Improper use of child restraint seats as a sleeping environment: Two cases of childhood death

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A child restraint seat (CRS) is designed to keep infants safe inside motor vehicles while in motion. However, there have been a growing number of reports of injuries sustained as a result of CRS use outside the vehicle. These injuries commonly result from a fall from an elevated surface or an overturning of the CRS. The incidence of death from these events, however, is not well documented. The present report retrospectively analyzed the British Columbia Coroner Service Database to identify deaths involving CRS use outside the vehicle. Two such fatalities were identified. In both instances, infants had been placed in a CRS overnight and, in both cases, the CRS was found overturned, resulting in asphyxiation. The history and pathological findings of both cases are summarized.

Key Words: Child restraint seats; Coroner's inquiry; Paediatrics; Infant fatalities; Vehicle safety device

Previous studies have shown that a child restraint seat (CRS), when used appropriately, can minimize the risk of vehicular injury and death in infants and children (1,2). The frequency of injury resulting from the misuse of these safety seats outside the vehicle, however, is under-recognized. Previously, our research group demonstrated that injuries occurring outside the vehicle accounted for 88.8% (95 of 107) of all CRS-related injuries presenting to the British Columbia Children's Hospital (Vancouver, British Columbia) emergency department between January 1997 and December 2002 (3). This problem is especially pronounced due to a large number of potentially serious head injuries that the infant may incur as a result of CRS misuse (3-6). Reported mechanisms of injury include falls while being carried in a CRS, falls from the CRS when placed on an elevated surface, suffocation resulting from an overturned CRS on soft surfaces and increased risk of airway obstruction from the restraint straps (3,4,7). The large number of injuries resulting from misuse of a CRS outside of the vehicle represents a growing public health concern (8). The American Academy of Pediatrics has recently updated their recommendations regarding safe sleep practices, stating that "sitting devices, such as car safety seats, strollers....are not recommended for routine sleep" (9).

Although previous studies have alluded to a greater frequency of injury from use of the CRS outside the vehicle, the incidence of death is not well documented. A literature search identified only one study examining this issue that was part of a larger study investigating CRS-related injuries in general (7). In the current report, we present two cases of infant death from a search of the British Columbia Coroner's database for fatalities resulting from CRS use from 2000 to 2009. The Coroner Service of British Columbia is a

Les sièges d'auto utilisés à mauvais escient pour dormir : deux cas de décès d'enfant

Les sièges d'auto sont conçus pour maintenir les nourrissons en sécurité dans les véhicules automobiles en mouvement. Toutefois, on constate un nombre croissant de blessures subies dans le cadre de l'utilisation de ces sièges à l'extérieur de la voiture. Ces blessures découlent souvent d'une chute à partir d'une surface élevée ou du renversement du siège. Cependant, l'incidence de décès découlant de ces événements est mal étayée. Dans le présent rapport, les chercheurs ont procédé à l'analyse rétrospective de la base de données du service du coroner de la Colombie-Britannique pour repérer les décès liés à l'utilisation d'un siège d'auto à l'extérieur d'un véhicule. Ils en ont trouvé deux. Dans les deux cas, les nourrissons avaient été laissés dans leur siège d'auto toute la nuit, et le siège a été retrouvé renversé, entraînant l'asphyxie du bébé. Les antécédents et les constatations pathologiques des deux cas sont résumés.

government-mandated organization tasked with investigating all traumatic and unexplained fatalities, and conducts autopsies, investigations and formal coroner's inquiries when deemed necessary (10).

CASE PRESENTATIONS

Case 1

The first case involved a 2.5-month-old male infant with an unremarkable birth and antenatal history. He was receiving regular medical care and lived with his birth mother in a private home. The mother's social history was significant for substance abuse and domestic violence with many of her relationships.

On the evening of the incident, the infant's mother stayed at a neighbour's house. The infant was left in the care of his mother's 14-year-old brother and friend, who were both under the influence of alcohol and marijuana. The infant was last attended to at 02:00 and, at that time, he did not exhibit any unusual behaviour. The infant was then put to sleep in a CRS, which was placed on a twin mattress with no box spring where the caregivers slept. The coroner's report did not indicate if the CRS safety restraints were buckled. The caregivers awoke approximately nine hours later to discover that the CRS with the baby had fallen off the bed. The CRS was overturned and wedged between the mattress and a couch, and the infant was found underneath, unresponsive and not breathing. All efforts by paramedics to revive him were unsuccessful. The coroner's investigation determined that this sleeping arrangement was not an isolated incident; the mother often put the infant to sleep in the CRS overnight on the bed or couch. No information was provided on whether a crib was available in the home or the type of CRS used.

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TABLE 1
Risk factors associated with suffocation during child restraint seat (CRS) use outside the vehicle

Phases	Factors			
	Personal	Vector or agent	Physical environment	Socioeconomic environment
Pre-event	Lack of parental supervision; child exceeds limits of CRS	Car seat used regularly as a sleeping device	Child left unsupervised in closed room; CRS on unstable surface; CRS left on elevated surface (eg, bed) overnight	Limited number of caregivers; history of domestic abuse in family environment; lack of stable housing; caregiver unable to provide proper supervision of child due to drug and alcohol abuse
Event	Bed-sharing between infant and multiple adults; child able to slip body partially out of CRS harness	CRS overturned by caregiver during sleep; child's struggles causes overturning of CRS and obstruction of airway by car seat harness	Caregivers unable to hear child's cry for help; CRS overturned between mattress and sofa	Lack of proper sleeping arrangements in household
Post-event	Caregiver lacks basic paediatric cardiopulmonary resuscitation training	Asphyxia due to entrapment of infant beneath overturned CRS; external neck compression and complications of aspiration due to prolonged obstruction of airway by car seat harness	Lack of warning devices (eg, baby monitor) to alert caregivers to infant distress	Delay in caregiver response; lack of supervision or ability to rescue child is impaired by alcohol and drug abuse

Postmortem analyses revealed no signs of abuse or neglect, and toxicology was negative. Physical findings included a red mark on the infant's forehead, petechial hemorrhaging adjacent to the corpus callosum and a modest amount of subarachnoid hemorrhage. The cause of death was deemed accidental and attributed to asphyxia as a consequence of entrapment beneath an overturned car seat.

Case 2

A 15-month-old girl and her birth mother and a male friend were staying at a relative's apartment as a temporary residence. The baby was buckled into a CRS and left to sleep overnight in a supine position on the bedroom floor in an adjacent room. The CRS was a rear-facing, round-bottomed Easyflo Joyride (Evenflo Company, Inc, USA) with a latch system and three-point harness; the infant was 6 cm over the height limit. A bedframe and mattress were in the bedroom; however, no crib was reported to be present in the apartment.

The infant was fed in the evening by her mother who spent the remainder of the evening in an adjacent room. The next morning, the mother's cousin checked on the infant and discovered the CRS was tipped over sideways. The right shoulder strap lay across the infant's throat and her legs were out of the harness with the buckle still in place. The infant was cold and lifeless. The coroner's investigation speculated that the baby had partially twisted herself out of the CRS and, as a result, the CRS had overturned. On arrival of the paramedics, the child had developed rigor mortis.

Postmortem analyses revealed a previously healthy infant with no indications of pre-existing disease processes. Toxicology was negative. A skeletal survey was unremarkable. Physical findings included petechial hemorrhages on the scalp, cheeks and eyelids, and an indentation on the neck between the sternomastoid musculature. Furthermore, there was an area of perimortem-pressure indentation below the jaw on the right side. These findings were suggestive of the infant's struggle with the plastic device between the chest straps of the CRS. Internal examination revealed inhaled gastric contents in the air passages and in the lungs. This fluid was also found, in a small amount, on one of the seat straps. The cause of death was deemed accidental due to external neck compression and asphyxia, along with vomiting and potential aspiration. The coroner reported that this was a consequence of the CRS being used as a bed with the infant buckled in, and the subsequent overturning of the seat resulted in the safety strap restricting the infant's airway.

DISCUSSION

There is a small but growing literature on CRS-related injuries resulting from its use outside the vehicle (3-5,7,11). The present report contributes to this literature by reporting on two deaths attributable to CRS misuse. These events are rare, accounting for only one of the 1659 infant (<1 year of age) and 278 child (one to four years of age) deaths in British Columbia from 2000 to 2009 (12), but nevertheless highlight the possible devastating consequences of leaving an infant unattended in a CRS overnight. Both cases shared a common mechanism of injury: infant suffocation from sleeping in a CRS used improperly outside the vehicle. The risk of suffocation from a fallen or overturned CRS is a recognized hazard of car seat misuse (7,8). Pollack-Nelson (7) reported 15 suffocation deaths of infants, attributable to overturned baby carriers or car seats in the United States, over an eight-year period. Parikh and Wilson (8) noted three deaths "related to car seat use" but did not report any other details regarding the circumstances. An increased risk of infant suffocation has also been reported for other nonconventional sleeping locations (13,14).

The high frequency of injuries occurring outside the vehicle suggests that this may be common practice among new parents (3). This may result from an unawareness of the hazards of this practice, or an inability to anticipate that the infant may move or wiggle within the CRS, causing it to overturn or fall off an elevated surface. In the Haddon matrix (Table 1), two key themes emerge: a lack of adequate parental supervision and use of a CRS during sleep. It may be that a caregiver's perception of the CRS as an absolutely safe sleeping environment contributes to these tragedies.

A CRS, however, is only designed to protect the infant from forces resulting from a motor vehicle collision. Certain design features, such as the curved base, enhance safety when a CRS is used as intended; however, these features may increase the risk of injury when used inappropriately, for example when it is placed on a flat surface. Furthermore, potential safety concerns may be overlooked due to the convenience of keeping an infant in a CRS. Advertising promotions appear to target the convenience factor of these devices, implying that they can be used to transport infants between the vehicle and home, as well as to restrain them while the caregivers go about their activities. Caregivers should therefore be educated on the limitations of these devices, in keeping with safe sleep practices endorsed by the American Academy of Pediatrics (9), and should be encouraged to find alternatives to keeping the infant in a CRS in an effort to limit its unsafe use.

Encouraging the use of a CRS for infants and young children should be continued, but with the caveat that improper use when not in the vehicle may represent a significant risk (3). The Canadian Paediatric Society recommends that parents avoid using a car seat or infant carrier as a sleeping surface (15). The present report supports the notion that prevention of CRS-related injuries remains a priority.

Limitations exist, however, in the present study. First, the identification of patients depends on referral to or notification of the coroner's service. Although, by statute, infant trauma deaths must be reported to the coroner's office, it is possible that some were not. In theory, we could be underestimating the extent of the problem. Second, we were dependent on information collected by the coroner's service, which is not necessarily uniform or has a limited amount of detail from a research perspective. Third, details regarding risk factors are dependent on the recollection and evidence from witnesses, some of whom were admittedly under the influence of illegal drugs or alcohol. Finally, it would be useful to examine databases in other jurisdictions throughout Canada to determine how widespread this issue may be, and with proper ethics and permissions from other jurisdictions, this might represent a reasonable area for future investigation.

CONCLUSION

Current parental practices involving leaving infants in a CRS while at home, especially when the infant is sleeping, represent a public health concern that must be addressed. Efforts to raise public awareness about these dangers should be undertaken to prevent the growing number of preventable injuries that result from the improper use of these devices. Manufacturers should be engaged in prevention efforts, either through engineering and design improvements, or by pursuing strategies to educate parents on the risks. Parents frequently take guidance from health professionals, particularly paediatricians, in safety matters pertaining to children (16). With increased reports of this hazard, national professional groups must provide this necessary guidance.

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