

## CASE REPORT

Roland M. Kohr,<sup>1</sup> M.D.

# Inflicted Compressional Asphyxia of a Child

**ABSTRACT:** Compressional or traumatic asphyxia is a well recognized entity to most forensic pathologists. The vast majority of reported cases have been accidental. The case reported here describes the apparent inflicted compressional asphyxia of a small child. A review of mechanisms and related controversy regarding proposed mechanisms is discussed.

**KEYWORDS:** forensic science, asphyxia, compression, restraint, inflicted injury

Traumatic asphyxia is commonly thought of as a consequence of a sudden violent episode, yet gradual compression applied to the chest is also a well recognized mechanism. In children, traumatic asphyxia is most commonly seen in the case of overlying deaths, occasioned by bed sharing behavior between adults and small children. The most common association seen in such cases involves an adult who is sleeping and unaware, sometimes intoxicated, or infants of small size who may be unable to produce sufficient movement to arouse the adult, and are classified as accidental deaths.

The use of deliberate force against a child, in a manner sufficient to cause traumatic or compression asphyxia, appears to be highly unusual. As a result, forensic experts as well as authorities responsible for filing charges may be understandably reluctant to take such cases to court. The case presented below describes such a case, in the hope of encouraging further study and discussion of the subject.

### Case Report

A two year old, 13.5 kg female toddler was found non-responsive by employees of the licensed daycare center she attended, after having been put down for a nap several hours earlier. Because she had resisted lying down voluntarily during the nap period, she was taken into a hallway removed from the rest of the children, laid down on a soft rubber mat, and restrained by an adult until she appeared to have fallen asleep. Restraint was achieved by the adult resting her legs across the prone child's back for an estimated 30–40 min. The adult weighed approximately 60 kg and in addition had an orthopedic cast upon one leg. The cast was recovered when removed from the adult, and weighed 0.7 kg.

Rescue workers were dispatched to the scene, with bystander CPR initiated prior to their arrival. The child was subsequently transported to a local hospital emergency department, where aggressive and prolonged resuscitation efforts were unsuccessful.

Due to the nature of the death, the Coroner and police were notified and an autopsy authorized.

The autopsy was conducted approximately 18 h after the death. A large abrasion with drying was noted on the back, suggestive of either an artifact produced from prolonged resuscitation on a rough surface, or a direct contact abrasion from the cast which had been worn by the adult while restraining the child. Questioning of all involved emergency room personnel failed to identify with assurance whether the abrasion had been present upon arrival. A cotton t-shirt without any unusual cloth pattern was worn, with cotton panties and pants. Ambulance crews subsequently confirmed that the abrasion had been noted at the scene. The remainder of the autopsy revealed rare intra-thoracic petechiae, mild hepatosplenomegaly, and a discoloration in the mid pons Figs. 1–3.

Microscopic examination of the liver and spleen were unremarkable. The pontine lesion was found by a consulting neuropathologist to be an incidental vascular malformation involving the central basis pontis and tegmentum, composed mainly of large capillary-like blood vessels, with no evidence of recent or remote hemorrhage. No evidence of infectious disease of any type was identified, and toxicologic studies were negative. The cause and manner of death were both initially listed as undetermined.

### Discussion

Compressional or traumatic asphyxia of a child is uncommon, most often seen as an accident or as a consequence of overlaying. In a case such as this, where physical restraint was applied by an adult to a small child, the possibility of a criminal act must be thoroughly examined. The potential of a deliberate act presents several challenges to both death investigators and the legal system. As with any mechanism of inflicted trauma, it is desirable to be able to reference similar cases or reports. A review of the literature has revealed no similar cases for comparison.

Over the past several years, studies have been published regarding the potential for fatal asphyxia in adults when restrained in the prone position. In the typical reported case, an otherwise healthy male is placed in the back of a police car, hands restrained behind

<sup>1</sup> Vigo County Medical Examiner, 3901 S. 7th St., Terre Haute, IN.

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FIG. 1—Photograph of abrasion on back of child, taken approximately 16 h after child discovered.



FIG. 2—Photograph of cast surface.



FIG. 3—Heel of cast with boot.

his back, and following transport is found to be non-responsive. One variation involves restraint of both the wrists and ankles with a connecting strap, to create a “hog-tie” position. In an attempt to recreate the functional impairment caused by this position, studies using healthy volunteers have been conducted, while measuring pulmonary function and tissue oxygenation. These studies have sup-

ported the hypothesis that the prone-restrained or hog-tie position can contribute to a form of positional or restraint asphyxia. At the same time, debate regarding position or restraint as the sole cause of deaths in such instances has been published. It has been suggested that a constellation of other factors, including catecholamine release, may contribute to a physiologic disturbance which results in a fatal outcome. Autopsies on deaths following this scenario are usually unremarkable, which has not assisted in resolving the controversy (1–8).

Death by overlaying and smothering involving children is also a well recognized entity, which may result in no discrete anatomic findings at autopsy. The application of weight resting on the chest of a much smaller child may limit the latter’s thoracic excursion so that respiratory exchange is either hampered or completely prevented (9). Cases such as the 1989 Hillsborough football stadium disaster, where 95 fatalities resulted from a crowd surge, also demonstrated few of the typical signs of traumatic asphyxia such as petechiae. The commission that studied this disaster hypothesized that the lack of typical findings of traumatic asphyxia was related to the fact that the compression force was gradual and prolonged rather than sudden (10,11). A study of deaths by overlaying found that for children between five months and two years of age, only 2/11 demonstrated ocular and 1/11 facial petechiae. Intrathoracic petechiae were found in 9/11 (12).

Traumatic or compressional asphyxia can also be seen following partial burial of construction workers or farmers. Most forensic pathologists are familiar with cases of the type seen in grain silos. In this scenario, a victim’s torso can be buried in grain with the head still completely exposed. As the victim struggles to escape there is shifting of the surrounding semi-solid medium and a tighter chest compression ensues. Eventually, there is no room for expansion of the chest, and inspiration is compromised, due to a tamponade like effect. Even the placement of an endotracheal tube by rescue personal is usually ineffective, as the external chest pressure exceeds the ventilating pressure that can be generated by manual ventilation. The process generally requires several minutes, during which time progressive hypoxia and hypercarbia develop (13).

Limited animal studies have examined the effect of thoracic compression by application of external weights across the thorax, and the degree to which this could result in death. It was demonstrated that the interval before death was a function of both the weight and the duration of compression. In studies using slightly etherized, supine guinea pigs, it was shown that large weights (500% of body weight) would produce death in less than 10 min in all subjects. However, smaller weights in some subjects required up to 30–40 min before sufficient respiratory compromise ensued. The mean lethal time in one portion of the investigation was slightly over 19 min, with a range of under 8 min up to nearly 40 min (14). A similar scenario is described in reported case studies of two children, where compressional events resulting in death have been documented, although neither the weights of the children nor the compressing items were provided (15). These included a child whose torso was run over by a delivery van weighing between 1533–2075 kg, and another found underneath an overturned empty chest of drawers.

There are apparently no published animal studies involving animals in the prone-restrained or “hog-tie” position for comparison to the human studies. However, combining the studies referenced above allow a reasonable working hypothesis to be formulated.

It is logical to state that both of the above factors contributed to the death described in this child. The history provided by the day care provider indicated that the child was both restrained and in a

prone position. In contrast to the partially anesthetized state seen with the guinea pig studies, but similar to several of the reported adult restraint deaths, agitation was present. This would have contributed to both struggle and increased oxygen consumption. In addition, this child had thoracic compression applied for an extended time period, well within the range reported in the animal model's lethal time range. The absence of stigmata of asphyxia is not at all unusual. The mechanism of gradual application has been reported to demonstrate petechiae in the upper body in only a portion of well documented compressional deaths. Mechanical or compressional asphyxiation deaths in children are often associated with minimal or no demonstrable injuries either internally or externally (10,11,16).

This case provides an undisputed history of prolonged chest compression of an agitated child by an adult, as the link between the putative risk factors and compressional asphyxia resulting in death.

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Additional information—reprints not available from author:

Roland M. Kohr, M.D.  
Medical Examiner  
3901 South Seventh St.  
Terre Haute, IN 47802  
E-mail: RKohr10612@aol.com