Confessed Abusive Blunt Head Trauma

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Abstract: It is generally accepted that terms referring to specific craniocerebral injury mechanisms must be replaced by the more general term *abusive head trauma* (AHT). Although blunt impact trauma remains an essential part of AHT, it has received far less attention in the literature than shaken-impact injuries. The current article presents 19 confessed cases of a series of 47 highly suspected AHT cases. Of these, 13 were confessed shaken-impact cases, and the other 6 confessed blunt trauma cases. There were no significant differences in the appearance of subdural hematoma, which was present in each case. Retinal hemorrhage, which was present in 10 of the 13 shaken-impact cases in which an ophthalmologic examination was conducted, occurred in 2 of the 6 blunt trauma cases. In 1 case, retinal hemorrhage probably had of metabolic origin. Skull fractures with an overlying subgaleal hematoma and a subdural hematoma below the fracture side were found in 5 of the blunt trauma cases but was also seen in the 2 shaken-impact cases with a skull fracture. The most important finding was a lucid interval (LI) in 3 blunt AHT cases. An LI does not seem to occur in shaking injuries because of the immediate and persistent effect of brain damage that such injuries involve. Therefore, LI makes it important to conduct a detailed investigation of the clinical course in time in suspected AHT cases.

Key Words: abusive head trauma, blunt abusive head trauma, lucid interval

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There has been a recent shift toward using a more general term—*abusive head trauma* (AHT)—to replace terms that refer to a specific mechanism. Discussions about shaking, shaking impact, or impact alone overlook the most important factor, which is protection of the infant. However, in diagnostics and in judiciary proceedings, technical discussion cannot be avoided when attempting to understand the development of injuries and when confronting suspects with detailed findings from forensic and pathologic investigations. It is generally agreed that there is no such thing as pure shaking but rather shaking with an impact component.[1,2] The terms *blunt trauma* and *impact trauma* in AHT are used interchangeably in forensic cases. Impact or blunt trauma covers slapping, stamping, and throwing a heavy object at the head of the infant and throwing the infant and striking its head on hard surfaces. Most studies deal with shaking or shaking impact or with the differences between accidental and nonaccidental head trauma.[3–5] Although blunt trauma is an integral part of AHT,[6] the term *abusive blunt trauma syndrome* does not exist, despite the considerable differences between shaking and blunt trauma.

This study only compares confessed cases, having said that the term *confessed* must be used with a degree of skepticism.[7]

Perpetrators who do confess often confess what the least socially reprehensible act is or provide the sort of confession that they expect to lead to the least criminal punishment. However, it is possible to assume with a high degree of probability that abuse actually did take place. This should not be regarded as a possible bias. Vinchon et al[4] considered that accidents occurring in public spaces or confession of abuse by the perpetrator provide the best possible assurances for the diagnosis of accidental trauma and inflicted head injury, respectively.

The purpose of this study was to identify the specific traits of blunt AHT that might differ substantially from shaking-impact AHT.

MATERIALS AND METHODS

The attorney-general of the Courts of Appeal of Ghent and Antwerp (Belgium) granted the authors permission to search and analyze criminal files regarding nonaccidental injuries. A review of the law enforcement records, expert reports, and court decisions revealed 47 cases of severe AHT of children. The files revealed detailed clinical and radiologic data, established lesions, autopsy findings, subdivision by 4 types of encephalopathy, and the outcome of the infants as well as the juridical aspects such as confession by the perpetrators, the perpetrator's profile, and eventual convictions; these were all carefully examined.

The selection of cases was based on confession. The classification in either shaken-impact or blunt AHT was made in accordance with the content of the medical and judicial files. The confession of the ultimate act of abuse was used when selecting the cases.

One example is the case of a 9-week-old infant who had been shaken several weeks before. Before the infant died, he was beaten, stamped, thrown on the cobblestones, and then further beaten and stamped lying on the ground. This was classified as a blunt trauma case. In another case, the perpetrator confessed a magnitude of cruel abusive acts, but the ultimate act of abuse before the infant died was not confessed. Therefore, this case was not included.

RESULTS

Confessions were obtained in 19 (40%) of the 47 cases. Of these, 13 (68% of the confessed cases) were confessed shaking-impact AHTs, whereas the other 6 (32%) were blunt trauma. The mean age was 5.25 months, with no significant difference between both categories of AHT.

The so-called classical triad of the shaken baby syndrome [subdural hematoma (SDH), retinal hemorrhage (RH), and encephalopathy] was found in 10 of the 13 shaken-impact cases and in none of the blunt trauma cases. In the other 3 shaken-impact cases, the RH was missing. An RH was found in 2 of the 6 impact cases. Subdural hematoma was present in all cases.

According to the radiology reports, there was no significant difference between an SDH in shaken-impact and blunt trauma in our series. As in blunt trauma, all but 1 of the shaken-impact cases had an SDH in the form of a collection. Only 1 had the SDH in the form of the thin blood film over the convexities extending to or in the falx and tentorium.

There was brain damage in all cases. With regard to mortality and morbidity, the outcome was comparable between both groups.

Skull fractures were found in 5 blunt AHT cases, 1 of which was bilateral; the shaking-impact cases included 2 skull fractures.

The confessed shaken-impact group included 4 cases with rib fractures and 1 with long bone fractures. In the blunt trauma group, a bucket handle and diaphyseal fracture of the tibia was found in 1 case, and another infant had an old rib fracture together with a humerus fracture. The rib fracture could have been birth related because the infant was only 6 weeks old.

Lucid intervals (LI) were found in the history of 3 impact cases but in none of the shaken-impact cases. Three illustrative cases with an LI in the clinical history are presented below.

Case 1: 6-Week-Old Male Infant

Irritated by the continuous crying of his 6 week-old-infant, the father confessed later that he took the infant's shoulders and tried to shake the baby a few times, with no effect. He then forcefully hit the infant's head against the edge of the bed. The infant continued crying after a short period of silence. The infant did not want to drink. Approximately 10 hours later, right-sided convulsions and a decline of consciousness occurred. Another 4 hours later, in the hospital, the infant was sleepy but arousable and had continuous seizures. The child was sedated and ventilated. Some bruises were found on the forehead and at the left eyelid. A computed tomographic (CT) scan showed a parietooccipital SDH at the left side and an extensive subarachnoidal bleeding. A left occipital skull fracture was visualized at the level of the lamboid suture with an overlying extensive subgaleal hematoma (SGH). There were no RH. Over the following 2 days, the neurologic condition deteriorated to a coma. The magnetic resonance scan at that time showed an ischemic left hemisphere. The infant remained severely neurologically disabled. The 10-hour interval period with continuously crying is seen as symptom free. The condition was seen as the result of blunt occipital trauma impact at the left side.

Case 2: 25-Month-Old Female Infant

Around 11: 00 AM after both parents had been smoking marijuana, the father was so irritated by the ceaseless crying of the infant that he forcefully threw a game device against the head of the infant. A large swelling appeared above the right eye. The infant continued crying harder and did not want to eat. Three and a half hours later, the infant had convulsions in 1 arm and did not open its eyes and was moaning. Around 1 PM, the infant started vomiting. Almost 14 hours after the initial traumatic event, the infant at the emergency department, the child was found covered with bruises all over its body and had a large parietoccipital swelling its right ear. The infant was somnolent and had a significant motor weakness at the left side. A CT scan showed an SDH on the right side, a limited edema in the right hemisphere, and a right parietoccipital skull fracture with an overlying large SGH. The SDH required evacuation, after which the initial hemiparesis disappeared. Because of increased seizures, the infant was ventilated. A unilateral RH was found some time later because the infant was in massive septic shock, so it could hardly be seen as part of the AHT. Funduscopy 2 weeks later showed vitreal bleedings. Consecutive CT scans showed the development of areas of partially hemorrhagic infarcts. The child remained neurologically and visually severely disabled. The 3.5-hour symptom-free interval before the convulsions is seen as an LI.

Case 3: 20 Weeks

This 20-week-old infant was aggressively treated during the 3 days before his death. In the weeks before, the infant fell hard against the floor 3 times because of the stumbling of his right-sided spastic handicapped mother. His father became aggressive by the ceaseless crying of the infant. He threw him several times to the floor or other hard surfaces. He twice threw the boy to his bed from a distance of more than 1.5 m. After each blow to the head the infant immediately regained consciousness. Eight hours after the last extremely violent throwing of the child against the furniture, the child collapsed neurologically and slowly deteriorated. He exhibited breathing difficulties then died despite resuscitation attempts. The postmortem examination showed an SDH, a skull fracture extending far through the skull base, and an extensive overlying SGH. All the lesions were found at the right side and at the same location. The brain was swollen by edema. No ocular examination was done. During the 8 hours after the last blow to the head, the infant remained symptom free before collapsing suddenly.

DISCUSSION

In our series, the ratio of blunt trauma cases in respect to shaken-impact cases is high. An older study points to an equal ratio between blunt trauma and shaking impact cases, with pure shaking occurring in a minority of cases. In a literature review of 324 cases, Leestma[7] found 54 cases in which shaking was admitted. Only 11 of these lacked evidence of impact and could, therefore, be considered as "pure" shakings.

Subdural hematoma was found in all cases. Leakage from intradural venous plexus and sinuses inside the double-bladed dural expansions tentorium and falx[8,9] is hypothesized as another origin of subdural bleeding than bridging veins. The most characteristic occurrence of SDH in shaking-impact should be the filling of the thin spaces over the paramedian convexity of the cerebral hemisphere, coming from or extending into the area of the falx and tentorium. In clinical practice, cases of blunt trauma may involve a space-occupying blood mass. This is not necessary the case because impact causes head motion, which may result in inertial SDH, which is thin layer. In our series, SDH presents as a collection in all but 1 of the shaken-impact cases. The other shaken-impact case showed a thin blood film SDH, which is thought to be more specific for shaken lesions although certainly not exclusive. Of the 4 infants who were still alive at arrival at the hospital, 3 had the SDH surgically removed due to compression of the intracranial content. In the confessed shaking-impact series, 3 of the 9 infants who were still alive when they arrived at the hospital were operated on. In this limited series, the appearance of the SDH looks nearly identical in shaken-impact and blunt head trauma cases.

Retinal hemorrhage was found in 10 of the 13 confessed shaking-impact cases. In the 3 other cases, there had probably been no ophthalmologic examination. There is a strong association between RH and nonaccidental injuries,[10,11] but this item is the subject of many discussions and controversies. Retinal signs should not exclusively belong to nonaccidental head injury and should be seen—even after—minor accidents or falls from lower height, although this vision is highly controversial.

In our series of AHT by blunt violence, RH was found in 2 of the 6 cases. However, a closer look at these 2 cases shows that the RH in both cases is unusual. In 1 case, the examination was conducted after the infant was hospitalized, but 17 hours after the collapse of the infant who was in a deep septic shock at that particular moment. There were severe metabolic disturbances such as a strong rise in potassium and glycemia. These conditions might explain the presence of the RH rather than the trauma.

In the second case, there were 5 spots to the right and 1 spot to the left of the retina, which is not the kind of RH that would be expected in shaking-impact cases.[11] The study of Margolin et al[12] of confessed perpetrator cases found that only

12% had fewer than 5 RHs in each eye. However, in the case of the 2-year-old infant discussed here, additional bleeding around the optic nerve was found at the postmortem examination. Bleeding in the optic nerve sheath accompanied by RH is common in shaking cases. It has been described by Selahi-Had[13] in AHT in 4 older children (2.5–7 years old), 2 of whom were victims of blunt trauma but not confessed cases. Television tipovers[14] are a significant cause of severe trauma in children, with significant mortality. The most common injuries reported are blunt force injuries to the head, with associated scalp injuries, skull fractures, intracranial hemorrhage, brain injury, periorbital hemorrhage, and optic nerve hemorrhages. Hence, optic nerve bleeding is not specific for neither shaking-impact nor blunt AHT nor accidental trauma.

In a meta-analysis,[3] skull fractures were considered in studies representing 1014 children and were documented as being present or absent in 916 children. Skull fractures are more strongly associated with noninflicted brain injury than inflicted brain injury. In cases of nonaccidental trauma, skull fractures represent 8% to 13% of all fractures, although that percentage can be as high as 33% in children younger than 2 years.[15] There are no precise numbers for skull fractures in blunt AHT cases. In our series, the number of skull fractures in blunt AHT outnumbered those of shaken-impact cases, but the numbers are too low to be significant. It is notable that the configuration of a SDH lying under the fracture below a SGH, known as a focal impact, was seen in 4 of the 6 blunt AHT cases but also in 2 of the shaken-impact cases. In 1 blunt trauma case, the occipital fracture below an SGH was at the opposite side of the SDH. Apart from the much lower occurrence of a skull fracture in shaken-impact cases, the appearance may be identical.

An LI was found in 3 of the confessed blunt head trauma cases after detailed analysis of the clinical history. An LI may be due to delayed swelling of the brain after a contusional lesion that becomes symptomatic when brain swelling occurs. It also may coincide with the expansion of a SDH collection before it compresses the brain.

No LI was observed in any of the shaking-impact cases. This corresponds to the knowledge that shaking has no effect or an immediate effect and is never followed by a symptom-free interval.[16–19] Shaking may be followed by deterioration, but the period between the shaking and the delayed onset of deterioration is never asymptomatic. There is at least an altered state of consciousness.[17] A true LI does not follow a shaking event.[17,18,20] This is an important factor to consider during police interrogation of suspects. The magnetic resonance may be of additional value[21] when assessing the kind of brain lesions, especially when the difference between shaking-impact and blunt AHT in case of a LI is debated.

CONCLUSIONS

The combination of an SDH, neurologic disturbances, a skull fracture, and an SGH, as well as the absence of a RH, make a blunt injury slightly more likely than a shaken-impact injury. A lucid interval in the history of the infant is the only specific feature of blunt trauma in cases of suspected abuse because a true LI does not follow a shaking incident. Police interrogators should be aware of this feature when interrogating suspects.

It is important for police interrogators to outline in great detail the timeline of potential symptoms to allow forensic investigators to better evaluate the actual condition of infants who might be victims of AHT.

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