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CASE REPORT

PATHOLOGY/BIOLOGY

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Craniocerebral Trauma Inflicted by Television Falls*

ABSTRACT: Accidents and inflicted trauma account for 33% and 5–8% of childhood deaths, respectively. Injuries secondary to falling televisions have been reported in the clinical literature. However, descriptions of such injuries at autopsy are limited. The severity and patterns of injury may mimic those considered "typical" of inflicted trauma. Thus, integration of data from clinical, scene investigation, and autopsy is necessary for determination of the cause and manner of death. We present autopsy findings from two cases which illustrate injuries sustained from falling televisions. Findings common to both cases include subscalpular hemorrhages, skull fractures, subdural hemorrhages, brain injuries, and optic nerve sheath hemorrhages. The first case showed postsurgical changes secondary to evacuation of a posterior fossa hematoma; three-dimensional reconstruction of the admission computed tomography scan demonstrated the extent of the preintervention skull fractures. In addition, the second case showed a right epidural hematoma. Only case two showed retinal hemorrhage.

KEYWORDS: forensic science, television, tipover, craniocerebral trauma, manner of death, accident, inflicted trauma, autopsy

Data from the Centers for Disease Control indicate that accidents and inflicted trauma account for 33% and 5–8% of childhood deaths, respectively (1). Blunt trauma secondary to falling televisions is occasionally reported in the clinical literature; however, descriptive reports of the patterns of such injuries as demonstrated at autopsy are limited in the forensic pathology literature. Data from the clinical literature indicate that under such circumstances, blunt head trauma is far more common that blunt chest or abdominal trauma. The severity and patterns of injury identified in such cases may mimic those considered "typical" of inflicted trauma. As such, careful integration of data collected from the death scene (including witness statements), hospital records, and the autopsy is mandated to ensure an accurate and defensible determination of cause and manner of death. Two cases are described which illustrate the types of injuries sustained when televisions fall on small children.

Case Reports

Case 1

A 13-month-old male infant was playing with two other children in the living area of his aunt's house and was witnessed pressing buttons on a television immediately prior to the television falling on him. A family member heard a loud crash, after which he observed the television lying on the child's head. The television had fallen from a height of approximately 28 inches from an unsecured stand. Emergency Services were summoned, and the decedent was brought to the Emergency Department and subsequently admitted to the Intensive Care Unit (ICU). A computed tomography (CT) scan revealed left-side calvarial skull fractures, left orbital plate fracture with slight proptosis, laceration of the left transverse dural venous sinus, and an expansile intracerebellar hematoma, for which he underwent suboccipital craniotomy. Despite the supportive measures, his neurologic condition worsened, and he expired 15 days after hospital admission.

At autopsy, the body was that of a male infant who measured 33.5 inches in length and weighed 22 lbs. Healing abrasions were noted on the posterior scalp. Internal examination revealed extensive frontotemporoparietal and occipital scalp and subgaleal hemorrhages. Complex, comminuted fractures of the body of the sphenoid bone, left temporal, and greater wing of the sphenoid bone were noted. A simple, linear, branching, minimally displaced fracture originated in the body of the paramedian left frontal bone, extended through the left orbital shelf, and terminated at the lesser wing of the left sphenoid bone. Examination of the brain revealed bilateral subdural hematomas, diffuse subarachnoid hemorrhage, marked cerebral edema, necrosis of the left cerebellar hemisphere, cerebellar vermis, midbrain and pons, and a left cerebellar hematoma that ruptured through the cerebellar cortex into the subdural space of the posterior cranial fossa (Fig. 1*D*). The optic nerve sheaths were hemorrhagic bilaterally, without associated retinal hemorrhages. Aside from spinal epidural and subdural hemorrhages, no spinal cord, vertebral, or spinal ligamentous injuries were identified. Additional autopsy findings included diffuse alveolar damage with hyaline membrane formation, congestive organomegaly, and cervical, periaortic, and mesenteric lymphadenopathy.

Owing to the presence of postsurgical changes in the skull (Fig. 1*C*), three-dimensional reconstructions of the admission CT scans were obtained to characterize the preintervention skull fractures (Fig. 1*A*,*B*). These demonstrated mild separation along the

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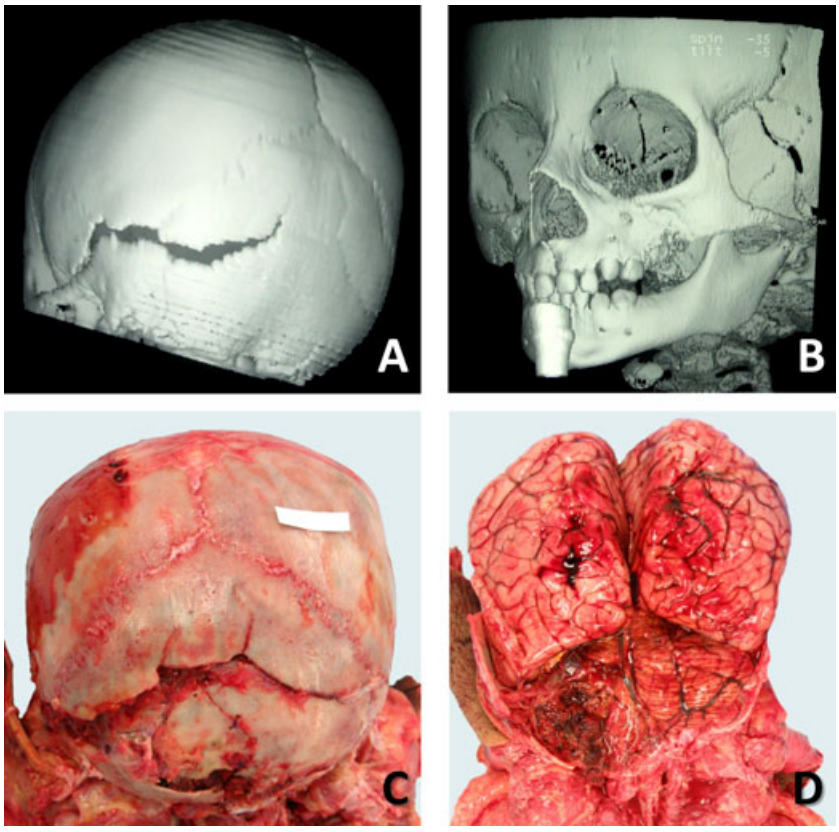

FIG. 1—*Patient 1. (A, B) Three-dimensional reconstructions of the admission CT scans demonstrating a gaping fracture extending anterolaterally from the left lateral aspect of the occipital bone across the temporal portion of the inferior parietal bone, squamous portion of the left temporal bone, and greater wing of the sphenoid bone, terminating at the left sphenofrontal suture. A simple linear fracture of the left frontal bone terminates after extending across the left orbital shelf. (C) Posterior aspect of the skull demonstrating the disruption of the preintervention injuries by postsurgical changes. (D) Posterior view of the brain, in situ, demonstrating subarachnoid hemorrhage, cerebral edema, and disruption of the left cerebellar hemisphere.*

proximal two-thirds of the sagittal suture. A gaping fracture extended from the left lateral aspect of the occipital bone anterolaterally across the temporal portion of the inferior parietal bone, the squamous portion of the left temporal bone, the greater wing of the sphenoid bone, terminating at the left sphenofrontal suture. Additionally, a simple linear, minimally displaced fracture of the left side of the frontal bone was identified, terminating after extending through the left orbital shelf.

Investigation of the scene revealed that the involved television was a 20-inch cathode-ray tube (CRT) unit that was inside an open and unsecured entertainment center. The television had been pulled from the entertainment center, which remained upright. According to the scene investigation, the entertainment center was unstable, requiring only minimal manipulation by the investigators to cause the television to fall. The cause and manner of death were certified *blunt head trauma* and *accident*, respectively.

Case 2

A 32-month-old female infant was at home with her father and four other children. The father, who was in a different room from the children, heard a crash. He went to the bedroom and found the child face up on the floor and a television on the floor next to the child. Emergency services were summoned, and the child was transported to the Emergency Department and subsequently admitted to the ICU. An admission CT scan demonstrated a complex comminuted left-sided skull base fracture involving the left superior orbital rim, a right-sided subperiosteal intraparenchymal hematoma, brain stem hemorrhages, right-sided temporal epidural and subdural hematomas, subarachnoid hemorrhage, marked cerebral edema, and midline shift. In addition to supportive therapy, the patient underwent ventriculostomy and drain placement. Despite the supportive measures, her neurologic condition rapidly declined. A do-not-resuscitate order was signed, and brain death was documented. Supportive therapy was withdrawn, and she subsequently expired after 2 days in the ICU.

Upon external examination, the body was that of a female child who measured 37 inches and weighed 22 lbs. A large fluctuant contusion was over the left side of the forehead. Bilateral superior palpebral ecchymoses, periorbital and conjunctival edema, and conjunctival hemorrhages were noted. Subgaleal hemorrhages covered the frontal and occipital aspect of the skull (Fig. 2*D*). Complex fractures of the left paramedian frontal bone, left orbital plate, olfactory plate, sphenoid bone, petrous portion of the left temporal bone, and right occipital bone were noted (Fig. 2*C*). A 100-g epidural hemorrhage was in the right parietal/occipital/temporal region (Fig. 2*B*). A smaller epidural hemorrhage was over the left orbital roof, and a scant right subdural hemorrhage was noted. Neuropathologic examination of the brain and spinal cord revealed a markedly softened brain with flattening of the gyri and narrowing of the sulci, grooving of the parahippocampal gyri, and fragmentation of the cerebellar folia. Coronal sections of the cerebral hemispheres showed blurring of the gray–white junction, hemorrhage into the left frontal semiovale, multiple foci of cortical and subcortical hemorrhage in the right frontal lobe, fragmentation of the subcortical white matter, and fragmentation of the right side of the

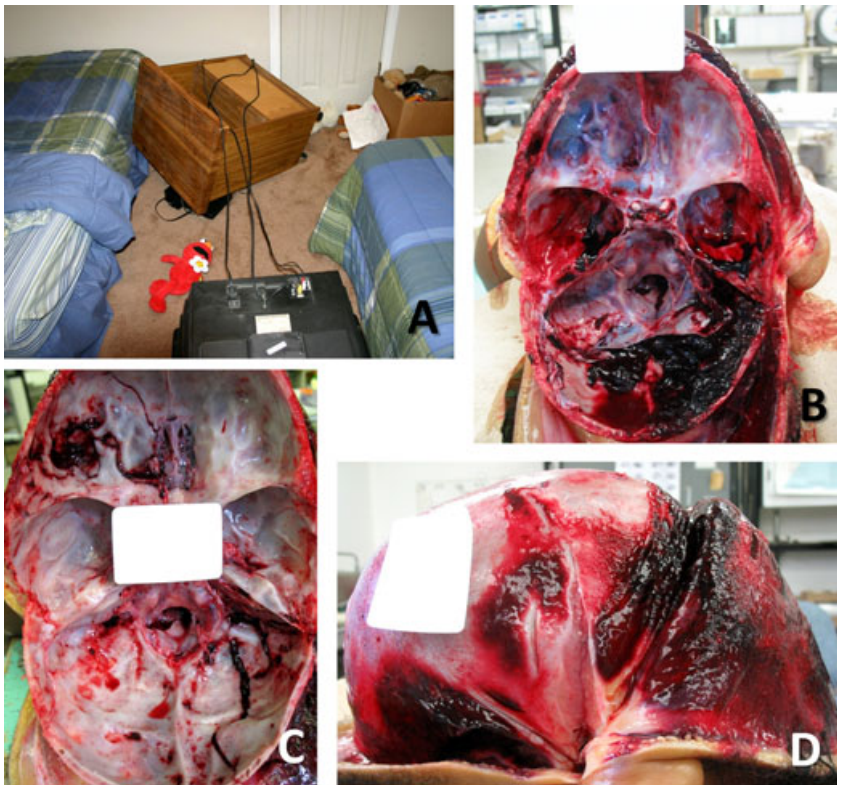

FIG. 2—*Patient 2. (A) Photograph from the scene investigation demonstrating the involved CRT-type television and the unsecured stand. (B) Skull base showing the large epidural hemorrhage in the right parietal/occipital/temporal region. (C) Skull base after removal of the dura, demonstrating the complex fracture of the left paramedian frontal bone, left orbital plate, olfactory plate, sphenoid bone, petrous portion of the left temporal bone, and right occipital bone. (D) Lateral view of skull and subscalpular area showing subgaleal hemorrhages covering the frontal and occipital aspect of the skull.*

genu of the corpus callosum. Scattered hemorrhages were distributed through the cerebellar white matter. Examination of the brainstem revealed a hemorrhage into the right side of the basis pontis. The soft tissues surrounding the left eye were hemorrhagic, and there was scant right-sided optic nerve sheath hemorrhage. The left optic nerve was free of hemorrhage. Rare, small retinal hemorrhages were identified in both eyes.

According to the scene investigation, the involved television was a 27-inch CRT-type unit which weighed approximately 60–70 pounds. The unit was placed upon an unsecured television stand at a height of approximately 2.5 feet (Fig. 2*A*). The cause and manner of death were certified *blunt head trauma* and *accident*, respectively.

Discussion

These two cases represent dramatic examples of accidental death because of blunt force injuries sustained from television tipovers. Common findings between the two cases include extensive skull fractures, intracranial hematomas, cerebral edema, cerebral and cerebellar parenchymal injuries, peri-ocular hemorrhage, and scalp injury indicative of point of impact. Thoracoabdominal injuries were absent in both cases.

From 2000 to 2005, the Consumer Product Safety Commission (CPSC), the federal agency responsible for tracking injuries sustained from consumer products, received reports of 36 television tipover-related deaths (2). More than 80% of these deaths involved young children. Additionally, the CPSC estimates that in the year 2005, at least 3000 children under the age of 5 years were treated in U.S. hospital emergency rooms because of injuries associated with television tipovers.

Blunt force injuries because of television tipovers are occasionally reported in the clinical literature. Children are most commonly affected, ranging from <1 year old to 16 years old, with a mean of 2–3 years. Many cases are not fatal, as the reported mortality rates range from 0% to 37% (Table 1). The vast majority of cases occur in the primary residence (2). Nearly all incidents occur while the child is unsupervised (2).

Televisions involved in tipover incidents range in size from 13 inches to 40 inches, and the average height of fall ranges from 2.5 to 3.7 feet (3,4). According to Bernard et al. (5), a 36-inch television, which typically weighs 78 kg, falling from 1 m has the same momentum as a 10-kg 1-year-old child falling from 10 stories (60 m). Even a smaller 19-inch television, with a typical weight of 18 kg, has the same momentum as a 1-year-old falling from 10 feet (3.2 m).

With the recent popularity of liquid crystal display and plasma flat-panel televisions, it is unclear how the statistics concerning television-related injuries will change. One could argue that flat-panel, light weight screens (compared to the weight of CRT television) that are not wall mounted would have less tendency to cause television stands to collapse. However, the light weight and shape of these newer screens may lead to more tipovers from direct manipulation of the television itself, with the stand or table remaining in place.

Table 1 lists the sites and types of injuries sustained by television tipovers reported in the clinical literature. The most frequently reported injuries are those to the head and neck. Head injuries are

TABLE 1—*Blunt force injuries because of television tipovers reported in the clinical literature.*

Reference	*N*	Age (years)	Mortality (%)	Reported Injuries
Bernard et al. (5)	78	1–11	37	Isolated head injuries (72%), skull fractures, single femur fracture
DiScala et al. (6)	183	1–7	2.7	Isolated head (31.7%), extremity (15.3%), multiple (43.7%)
Jea et al. (9)	7	1.5–3	–	Skull fracture (86%), subarachnoid hemorrhage, pneumocephalus, and scalp hematoma
Ota et al. (3)	26	1–7	0	Head injuries (54%), including scalp hematomas, lacerations, lip lacerations, forehead laceration, skull fractures, subdural hematomas, epidural hematomas, and subarachnoid hemorrhage. Chest wall contusions (8%). Abdominal injuries (4%) including liver lacerations and an adrenal hematoma. Extremity injuries (35%) including contusions and fractures
Scheidler et al. (4)	43	0–16	11	Head, abdomen, extremity. Rare thoracic injuries and pelvic fractures
Sikron et al. (7)	116	0–13	3	Head/neck injuries (73%), extremity injuries (22%), and multiple sites of injury (3%)
Yahya et al. (8)	19	1–10	5	Single skull fracture (47%), multiple skull fractures (37%), epidural hematomas (17%), subdural hemorrhage (18%), and dural laceration

reported in 68–89% of cases (5–7). Skull fractures occur in 86–89% of cases. Of these fractures, 44% are multiple (8,9). Injuries to the extremities, chest, and abdomen are much less common.

The major difficulty of these cases for the forensic pathologist is in distinguishing accidental head trauma from inflicted injury. According to Dolinak and Matshes (10), skull fractures that occur as a result of relatively minor accidental head trauma are generally simple linear fractures without associated severe brain injury. Complex skull fractures, such as wide gaping linear, branching, comminuted, basilar, depressed, or multiple fractures are generally associated with severe injuries, such as motor vehicle accidents, falls from great heights, or inflicted injuries. Additional markers of severe head injury include subdural and subarachnoid hemorrhages, cerebral edema, diffuse axonal injury, and/or retinal and optic nerve hemorrhages.

One of the two cases presented showed rare, small bilateral retinal hemorrhages. The relationship between ocular pathology and the underlying mechanism of injury remains controversial (11–13). Conflicting data in the literature underscore the importance of interpreting ocular pathology in the context of the entire case, and draw attention to the potential hazard of determining the manner of death based solely upon ocular findings.

Our cases highlight the difficulty in determining manner of death based solely on autopsy findings, particularly in television tipover incidents. Injuries in the first case included scalp abrasions, scalp and subgaleal hemorrhages, multiple skull fractures (one of which was basilar), subdural and subarachnoid hemorrhage, cerebral edema, a cerebellar hematoma, and bilateral optic nerve hemorrhages, and spinal epidural and subdural hemorrhages. Injuries in the second case included a large epidural hemorrhage, numerous basilar skull fractures, extensive subgaleal hemorrhage, scalp contusion, and hemorrhage into the periorbital soft tissue. Rare retinal hemorrhages were identified in the second case. An additional finding present in both cases was cerebellar parenchymal injury with associated hemorrhage. By virtue of its protected location, posterior fossa hematomas are uncommon. Posterior fossa hematomas nearly always occur as a result of direct impact and may be seen with or without associated supratentorial lesions (14).

Postsurgical artifact can confuse the assessment of head injuries. In the first case, the skull at autopsy showed a defect that appeared much more complex than the true injury because of a craniotomy and subsequent reconstruction. In that case, evaluation of the reconstructed three-dimensional CT images taken prior to surgery was extremely valuable in assessing the characteristics of the original fracture. Aside from assessment of the assessment of fractures, the antemortem radiologic studies may also be useful in the assessment of the point of impact, particularly with imaging modalities that are sensitive to changes in soft tissue, such as magnetic resonance imaging. Despite the availability and utility of antemortem imaging, it must be emphasized that nothing can replace the direct visualization and careful inspection of the skull and galea at the time of autopsy.

In cases of severe injury, such as these two cases, the history and scene investigation are of utmost importance in determine the manner of death. The first case was investigated by Child Protective Services (CPS) and the Medical Examiner's office, including interviewing those involved in the incident and investigating the scene of the accident. Of note, there was no history of prior CPS investigations in either case. The second case was investigated by a detective from the local police agency. Both investigations concluded that the incidents were accidental in nature. No further actions were taken.

In summary, accidental injuries caused by television tipovers 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. Injuries to the chest, abdomen, pelvis, and extremities are less frequent. There is significant overlap between the postmortem findings of accidental injuries because of television tipovers and inflicted injury. As such, there are no autopsy findings that are pathognomonic for injuries because of television tipovers. Thus, a thorough scene investigation, review of the history, and thorough postmortem examination are necessary to correctly determine the manner of death.

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