Updates and Controversies in Abusive Head Trauma and Physical Abuse

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Definition of Child Maltreatment (CM)

The physical or mental injury, sexual abuse or exploitation, negligent treatment, or maltreatment of a child by a person who is responsible for the child's welfare under circumstances which indicate that the child's health or welfare is harmed or threatened thereby.

(Child Abuse Prevention and Treatment Act, 1974)

Child abuse as a pediatric issue

- *1882: Abraham Jacobi forms a committee to cooperate with the Society for the Prevention of Cruelty to Children (ASPCC) in New York City*
- *1946: John Caffey identifies infants with inflicted subdural hematoma and long bone fractures*
- *1953-5: Frederic Silverman, Paul Woolley & William Evans identify bone lesions resulting from unrecognized trauma*
- *1958: University of Colorado Hospital Child Protection Team begins*
- *1962: C. Henry Kempe: "The Battered Child Syndrome"*
- *1971-2: Guthkelch & Caffey describe "whiplash" & "shaking*
- *1977: Roy Meadow: "Munchausen Syndrome by Proxy: The Hinterland of Child Abuse"*
- *1990: Ray Helfer: "The Neglect of our Children"*




NOTES FROM THE ASSOCIATION OF MEDICAL SCHOOL PEDIATRIC DEPARTMENT CHAIRS, INC.

CHILD ABUSE PEDIATRICS: A NEW PEDIATRIC SUBSPECIALTY

ROBERT W. BLOCK, MD, AND VINCENT J. PALUSCI, MD, MS

- As of December, 2009: 191 pediatricians received a certificate of special qualifications in child abuse pediatrics
- 85% pass rate
- Next exam November, 2011

Objectives

1. Participants will recognize new diagnostic strategies for child physical abuse injuries
2. Participants will learn about forensic controversies surrounding abusive head trauma
3. Participants will understand new information about the causes and outcomes of child maltreatment

Exciting Developments…

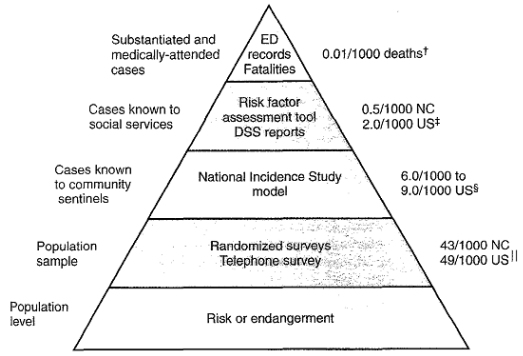
- Population-based studies
- New insights into the effects of violence on child development
- Mechanism and timing of inflicted injuries
- Prevention programs that work
- Improved legal and community response

Cost of Child Abuse[xxix]

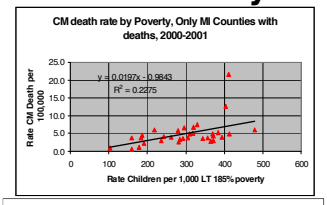
DIRECT COSTS		
Category	**Annual Total**	**Daily Total**
Hospitalization	$6,625,959,263	$18,153,313
Mental Health Care System	$1,080,706,049	$2,960,838
Child Welfare Services System	$25,361,329,051	$69,483,093
Law Enforcement	$33,307,770	$91,254
INDIRECT COSTS		
Category	**Annual Total**	**Daily Total**
Special Education	$2,410,306,242	$6,603,579
Juvenile Delinquency	$7,174,814,134	$19,657,025
Mental Health and Health Care	$67,863,457	$185,927
Adult Criminal Justice System	$27,979,811,982	$76,657,019
Lost Productivity to Society	$33,019,919,544	$90,465,533

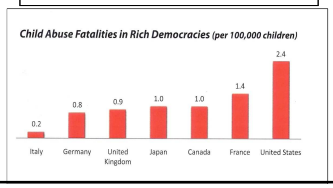
Population-based studies

- Adverse Childhood Experiences (ACEs)
- NCANDS
  - US: substantiations dropping; fatalities and cases with multiple concerns on the rise
  - Repeat physical abuse associated with DV and 'emotional problems' [Palusci, Smith, Paneth, 2005]
  - 23.2 per 1,000 infants were abused in 2006 and the majority were reported by medical professionals (CDC, 2008)
- LONGSCAN
- NSCAW
- NIS-4 -Race and poverty effects
- National Children's Study
- CFR and surveys of AHT incidence and shaking



CM Death Rates by Poverty





New understanding of the effects of violence on child development

- 'New' understanding of brain development
- A child's ability to get in trouble
  - 35% of children ages 10-18m can climb into a tub [Allasio, Fischer, 2005]
- Impact of domestic violence
  - 3% of families report DV during ped visits [Holtrop, Fischer, Gray, Barry, Bryant, Du, 2005]
  - Violence exposure affects IQ and reading [Delaney-Black, Covington, Ondersma et al, 2002]
  - Moderating effect of DV on home visiting programs [Eckenrode et al 1999]

Table 1. Comparison of Reviews by Different Child Death Review Systems

	Child Fatality Review Teams (CFRT)	Fetal-Infant Mortality Reviews (FIMR)	Fatality Citizen Review Panels (CRP)
Composition	Multidisciplinary professionals and community members (medical examiner, law enforcement, CPS, public health, prosecutors, others)	Medical and public health professionals (obstetricians, perinatologists, geriatricians, nurses, pediatricians, public health workers, others)	Multidisciplinary professionals and community members (medical examiner, law enforcement, CPS, public health, prosecutors, pediatricians, former clients, others)
Source of cases	All or selected child deaths (often homicides, accidents, suicides)	All infant deaths (<1 year), maternal deaths, and fetal demise	All child deaths among children known within the CPS or child welfare systems
Purpose of Review	To improve our understanding of how and why children die; to demonstrate the need for and to influence policies and programs to improve child health, safety, and protection; and to prevent other child deaths	To identify general community, social, economic, cultural and health systems factors highlighted by those infant deaths, to determine if they represent service delivery system or resource problems that require change, and to develop recommendations	To evaluate the effectiveness of the agencies charged with child protection responsibility and examining the policies, procedures, and where appropriate, specific child deaths handled by state and local agencies providing child protective services. Also to evaluate compliance with state CAPTA plans, standards, and other criteria as determined
Reporting and Implementation of Recommendations	Variable. CFRTs may report to specific agencies, the governor and/or legislators, and/or the public at large. There is no legal mandate for implementation.	Variable. FIMRs report to private and public organizations and the community. There is no legal mandate for implementation.	Federally mandated response by the state child protective services agency. CRPs are required to monitor the impact and implementation of their recommendations.

Table 2. Fatality CRP Findings Related to CPS and Significant Changes in CM Deaths			
CRP Finding	**Problem Area**	**Change in CM Deaths**	**CPS System Change**
Inappropriate screening out of reports and delays in assignment	Non-compliance	ˉ 85.1%	Systemwide peer review
Unacceptable delays between assignment and contact with families	Non-compliance	ˉ 82.5%	Systemwide peer review
Risk assessment completed incorrectly or not at all	Non-compliance	ˉ 86.3%	Statewide training and data system upgrades
Totality of case inaccessible to caseworker	Other issues	ˉ 90.0%	Data system upgrades

Source: Palusci et al., 2010.

New Developments in Prevention

- Hospital based parent education programs
- Office based programs with anticipatory guidance and responses to infant crying
- Parent child interaction training
- Raising community awareness through community programs
- Improved training for health professionals
- Child fatality review programs

NACHRI. *Children's Hospitals at the Frontlines:The Prevention of Child Abuse and Neglect*, 2007

Femur Fractures in the Pediatric Population

Abuse or Accidental Trauma?

Keith Baldwin MD, MPH, MSPT, Nirav K. Pandya MD,
Hayley Wolfgruber BA, Denis S. Drummond MD,
Harish S. Hosalkar MD, MBMS (Ortho), FCPS (Ortho), DNB (Ortho)

Results A history suspicious for abuse, physical or radiographic evidence of prior injury, and age younger than 18 months were risk factors for abuse. Patients with no risk factors had a 4% chance, patients with one risk factor had a 29% chance, patients with two risk factors had an 87% chance, and patients with all three risk factors had a 92% chance of their femur fracture being a result of abuse.
Conclusions Clinicians can use this predictive model to guide judgment and referral to social services when seeing femur fractures in very young children in the emergency room.

Abusive fractures

- Perpetrators:
  - Nashville males 73%, Denver 64% males
  - Males predominate (father>BF>stepfathers)
  - Mothers: Nashville 13%, Denver 17%
  - Mothers figure more in perpetration of fractures compared to AHT
  - 57.3% perps alone with the child prior to injury
  - Babysitters: 12-17%
  - Prior injuries 25-40%

TABLE 1 Complete Skeletal Survey Table[14]

Appendicular skeleton
Arms (AP)
Forearms (AP)
Hands (PA)
Thighs (AP)
Legs (AP)
Feet (PA or AP)
Axial skeleton
Thorax (AP and lateral), to include thoracic spine and ribs
AP abdomen, lumbosacral spine, and bony pelvis
Lumbar spine (lateral)
Cervical spine (AP and lateral)
Skull (frontal and lateral)

AP indicates anteroposterior; PA, posteroanterior.

TABLE 2 Imaging Recommendations for Thoracoabdominal Trauma

1.	Helical CT[a] of abdomen and/or thorax with intravenous contrast; nonionic is preferable; gastrointestinal contrast optional
2.	Ultrasonography of abdomen, usually as a follow-up examination
3.	Upper-gastrointestinal series

[a] Relative contraindication: strong history of allergy to iodine, severe shock, and renal failure.

TABLE 2 Reasons for SS ($N = 703$)

	No. (%)	
	Cases	Positive SS Results
Recognized fracture	257 (37)	24 (9)
Features of child abuse (eg, bruising, burns, sexual abuse)	135 (19)	12 (9)
Suspected abusive head trauma	88 (13)	20 (23)
Social concerns (eg, abused sibling, child protective services request, neglect)	88 (13)	4 (5)
Symptoms of injury	38 (5)	5 (13)
Nonspecific symptoms	30 (4)	3 (10)
ALTE	26 (4)	3 (12)
Unexplained death	23 (3)	4 (17)
Other	18 (3)	1 (6)

In cases in which there was >1 reason for the SS, the reason that raised the most concern regarding abuse (eg, bruising for an infant with bruising and vomiting) was recorded.

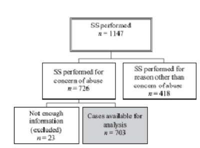


FIGURE 1
Flowchart for subject selection.

TABLE 3 Positive SS Results According to Age

Age	No. (%)	
	SS Performed	Positive SS Results
0–5.9 mo	292	48 (16.4)
6–11.9 mo	165	12 (7.2)
12–23.9 mo	135	9 (7.3)
24–59 mo	105	6 (5.7)
>60 mo	6	1 (16.7)

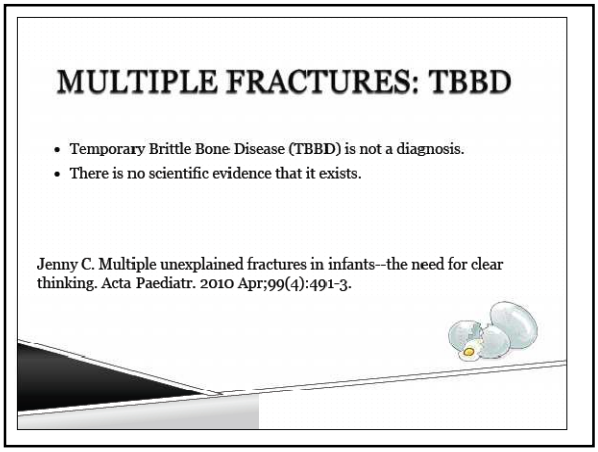
Use of Skeletal Surveys to Evaluate for Physical Abuse: Analysis of 703 Consecutive Skeletal Surveys
Shanna O. Duffy, Janet Squires, Janet B. Fromkin and Rachel P. Berger
Pediatrics published online Dec 13, 2010;
DOI: 10.1542/peds.2010-0298

Bone Diseases

- Propensity to fracture (osteoporsis)
- Propensity to bend (osteomalacia, rickets)
- Skeletal matrix integrity (OI)
- Developmental deformity (skeletal dyplasia, achondroplasia)

Osteopenia

- Low bone mass but not necessarily rickets
- Steroid-induced
- Matrix issues (OI)
- Immunodeficiency or disease
- Idiopathic juvenile osteoporosis
  - Metabolic/inflammatory (Crohn's)
  - Malnutrition
  - Marrow replacement syndromes (Thal)
  - Secondary endocrine osteopenia (hypogonadism, hypothyroidism)



Rickets

- First complete description in 1600's
- Sir Francis Glisson considered it a result of "overnutrition"
- Actually results from insufficiency of calcium or vitamin D

Rickets

- Disintegration of growth plate at epiphysis
- Malformation of cartilage
- Osteomalacia
- Areas of rapid growth

Rickets

- Calciopenic vs. phosphopenic
- Decreased intake or decreased absorption of Ca or Vit D (IBD, short gut, CF)
- Decreased 25-OH D and 1,25-OH D synthesis (liver disease, 25-OHase def)
- Also: Decreased Vit D leads to Decreased 25-OH D, leased to decreased 1,25-OH D, leads to decreased ionized Ca, leads to decreased Ca in bone

Decreased Vitamin D

- Northern latitude
- Covered dress
- Sunscreen
- Atmospheric pollution
- Overcrowding
- Skin pigmentation
- Low Ca intake
- Malabsorbed Vit D

Measurement

- 25-OH D2 not important
- TOTAL D2 + D3 = 25-OHD2 + 25-OHD3 is important
- Don't need to measure 1,25(OH)2D initially
- Early changes elevated PTH follow by Alk phosphatase
- Later changes in measurable Ca levels
- (bone CA stores huge, used to maintain serum Ca)

Measurement

- 25-OH Vit D should be => 20 nanograms/milliliter
- Bone Density –lots of ways to measure
  - Conventional x-ray
  - DXA
  - Peripheral quantitative CT
  - Ultrasound
  - Biopsy
  - MRI (trabecular development)

DeXA

- Measuring bone "density" using calculation based on estimated GRAMS of bone material divided by SURFACE AREA measured
- Actually want to measure a density = GRAMS per VOLUME
- Standards not clear for prepubertal children.
- T scores derived from the population of post-pubertal patients not accurate
- Z scores derived from age and gender matched children more accurate

Chapman, et al.: Rickets

- 45 children (2-24 months), with only 4 younger than 7 months.
- The majority (32 had nutritional rickets), the rest were metabolic causes or secondary to other diseases.
- 40 children were included in the data (2 had elevated alk phos only, 3 with unknown causes of rickets were excluded, none of these had fractures).
- 7 children had fractures and all 7 had nutritional rickets.
- All 7 were mobile.
- All 7 had widespread rachitic changes.
- Fractures were all considered structural insufficiency fractures and did not resemble those seen in NAT

Chapman T, Sugar N, Jones S, Marnigan J, Wambold N, Feldman K. Fractures in institutionalized toddlers with rickets. Pediatr Radiol. 2010 Jul;40(7):1184-9. Epub 2009 Dec 9. Erratum in: Pediatr Radiol. 2010 Jul;40(7):1308.

Pediatrics. 2011 Apr 11. [Epub ahead of print]
Vitamin D Status in Abused and Nonabused Children Younger Than 2 Years Old With Fractures.
Schilling S, Wood JN, Levine MA, Langdon D, Christian CW.

"There was no association between vitamin D levels and any of the following outcomes: child abuse diagnosis (*P*.32), multiple fractures (*P* .24), rib fractures (*P* .16), or metaphyseal fractures (*P* .49)."

Key elements in the identification of physical abuse

- Young age (<3y), late teens, SES issues
- Scene visits very important
- Independent movement and patterns of bruises/burns
- Potential bite marks and DNA
- Fractures in younger children (<18m)
- Type of fracture in addition to location
- Torn frena can be accidental
- Abdominal injury often without bruising and associated with head injury

Mechanisms and timing of inflicted injury

- Biomechanical modeling (auto models)
- Fractures (25% positive surveys in one study)
- Timing of injury (less certainty)
- Abusive Head Trauma
  - animations
  - dating of TBI (role of MR) [Arbogast, Marguilies, Christian, 2005]
  - long-term follow-up

Dating Bruises

- Maguire et al: 'Out of 6831 papers, only three met strict inclusion criteria. There was little consensus between studies about precise ageing of bruises on the basis of on colouration. Even bruises known to be of the same age can have different colours often associated with bruises of different ages. Their findings support the clinical suspicion that there is not enough solid evidence to age bruises accurately from colour alone.'
- Schwartz and Ricci confirmed this finding in their independent review.
- Bariciak et al evaluated accidental bruises of a known age in children with varying levels of experience of medical professionals (physicians, residents, etc) evaluating the bruises for age. Estimates by physicians were 'very inaccurate'.
- "Caution should be used in dating bruises".

Dating Fractures

- Radiologic dating of fractures is an inexact science. Most radiologists date fractures on the basis of their personal clinical experience, and the literature provides little consistent data to act as a resource. There is an urgent need for research to validate the criteria used in the radiologic dating of fractures in children younger than 5 years. (Prosser. AJR, 2005)

TABLE 3 Timetable of Radiologic Changes in Children's Fractures

Category	Early	Peak	Late
Resolution of soft tissues	2–5 days	4–10 days	10–21 days
SPNBF	4–10 days	10–14 days	14–21 days
Loss of fracture line definition	10–14 days	14–21 days	
Soft callus	10–14 days	14–21 days	
Hard callus	14–21 days	21–42 days	42–60 days
Remodeling	3 mo	1 yr	2 yr to physeal closure

Note.—Adapted from [21, 35] with permission. Repetitive injuries may prolong categories 1, 2, 5, and 6. SPNBF = subperiosteal new bone formation.

Kemp. Patterns of skeletal fractures in child abuse, BMJ 2008

Box 2: Features associated with possible child abuse

Physical abuse should be considered in the differential diagnosis when an infant (under 18 months) presents with a fracture in the absence of an overt history of important trauma or a known medical condition that predisposes to bone fragility. The following indicators can be used to inform decisions about the likelihood of child abuse:

- Multiple fractures are more common after physical abuse than after non-abusive traumatic injury
- A child with rib fractures has a 7 in 10 chance of having been abused
- A child with a femoral fracture has a 1 in 3-4 chance of having been abused
- Femoral fractures resulting from abuse are more commonly seen in children who are not yet walking
- A child aged under 3 with a humeral fracture has a 1 in 2 chance of having been abused
- Mid-shaft fractures of the humerus are more common in abuse than in non-abuse, whereas supracondylar fractures are more likely to have non-abusive causes
- An infant or toddler with a skull fracture has a 1 in 3 chance of having been abused
- Parietal and linear skull fractures are the most common type of skull fracture seen in abuse and non-abuse
- No clear difference exists in the distribution of complex skull fractures between the two groups

Serologic markers

- Hepatic transaminases rise rapidly after uncomplicated blunt liver injury, then fall predictably. Persistently stable or increasing concentrations may indicate complications. ALT >AST indicates subacute injury. (Baxter CA/N 2008)
- After controlling for time of venipuncture, long-bone fractures, and race, S100B levels were still higher in children with ICI than in those without ICI. However, the ability of serumS100Bmeasuments to detect ICI was poor. (Bechtel Pediatrics 2009)

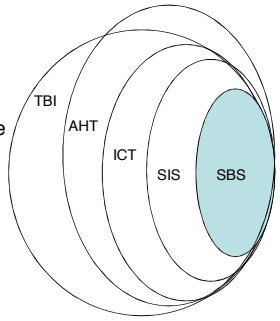
New York Times

- Diagnosis of Shaken Baby Syndrome based on the triad of subdural bleeding, retinal bleeding and brain injury has been overapplied in the legal system and has resulted in erroneous conviction and imprisonment.
- Shaken-baby theory is in a state of flux: previous "truths" are now known to be untrue or unproved, and new "truths" arise on a regular basis. Biomechanical modeling and the absence of neck injury or grip marks cast doubt on the "shaking" mechanism and may disprove it entirely. In light of these changes, innocence clinics at many law schools are beginning to review past convictions and, in some cases, to seek exoneration.
- Commentary: This article oversimplifies the current medical diagnostic process, overestimates the role of medical diagnosis in legal determinations of criminal guilt and inappropriately places blame on the medical system's state of knowledge rather than its application within the legal system (V.Palusci, 2011)

TBI / AHT / ICT / SIS / SBS

TBI= traumatic brain injury
AHT= abusive head trauma
ICT= inflicted cerebral trauma
SIS= shaken impact syndrome
SBS= shaken baby syndrome

MBFI (SBS)= multiple blunt force injuries with SBS
SBSii= SBS with impact injury



- **Shaken baby syndrome** is a term often used by physicians and the public to describe abusive head trauma inflicted on infants and young children.
- Although the term is well known and has been used for a number of decades, advances in the understanding of the mechanisms and clinical spectrum of injury associated with abusive head trauma compel us to modify our terminology to keep pace with our understanding of pathologic mechanisms.
- Although shaking an infant has the potential to cause neurologic injury, blunt impact or a combination of shaking and blunt impact cause injury as well. Spinal cord injury and secondary hypoxic ischemic injury can contribute to poor outcomes of victims.
- The American Academy of Pediatrics recommends that pediatricians develop skills in the recognition of signs and symptoms of abusive head injury, including those caused by both shaking and blunt impact, consult with pediatric subspecialists when necessary, and embrace a less mechanistic term, **abusive head trauma**, when describing an inflicted injury to the head and its contents.
- Christian, Block, COCAN. Pediatrics 2009;123(5):1409-1411

Retinal Hemorrhages

- Seen in 85% of AHT, one or both eyes
- Absence does not rule out abuse
- Associated with bleeding disorders
- Pre-retinal, nerve fiber, larger, deep (dot & blot) or sub-retinal hemorrhages are more indicative of trauma
- Resolve over days to weeks
- Cannot be dated with any precision

American Academy of Ophthalmology, Position Statement, June 2010

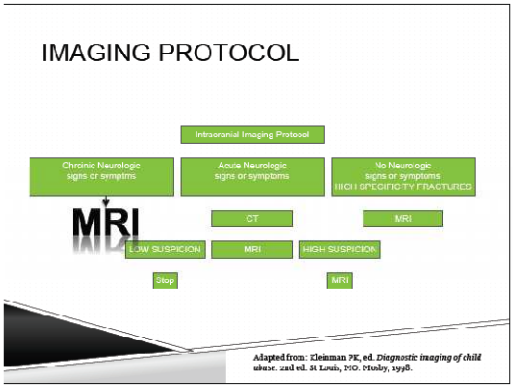
Common clinical misdiagnoses

- "Viral syndrome"
  - viral gastroenteritis
  - influenza
- Accidental head trauma
- Meningitis / Sepsis
- Apparent Life Threatening Event (ALTE)
- Sudden Infant Death Syndrome (SIDS)

Abusive Head Trauma - Missed Cases

- Among 173 children, ages 0-3 years, during 1990-1995 in Denver, CO:
  - 54 (31.2%) were seen by physicians and diagnosis of abusive head trauma (AHT or SBS) was not recognized.
  - Mean time to correct diagnosis: 7d (0-189d)
  - Risk: white, young infants with "intact" families
  - Reason: radiologic, other diagnosis, failure to suspect
  - 15 were re-injured; 22 had complications because of the missed diagnosis.
  - 4 of 5 later deaths were considered preventable.

Jenny, C et al. JAMA 1999;281:621-626.



Intracranial Hemorrhage (ICH)

Wells (Arch Ped Adol Med 2002;156:252-7) examined head imaging studies for 293 children less than three years of age with ICH, excluding meningitis, coagulopathy, prior surgery and birth trauma, and compared intentional (abuse) to unintentional injury to calculate the probability of abusive head trauma

Inter-Hempisheric SDH	Hygroma	Convexity SDH (no hygroma)	Skull Fx	Probability of abuse
Yes	Yes	No	No	0.993
	Yes	No	Yes	0.971
	No	Yes	No	0.930
	No	Yes	Yes	0.756
	No	No	No	0.753
	No	No	Yes	0.415
No	Yes	No	No	0.975
	Yes	No	Yes	0.900
	No	Yes	No	0.781
	No	Yes	Yes	0.453
	No	No	No	0.450
	No	No	Yes	0.160

NYC AHT Fatalities

- Design.—In a review of 59 deaths, there were 46 homicides, 8 accidents, and 1 undetermined death from blunt-impact injury of the head.
- In 10 (22%) of the homicides, there was no impact injury to the head, and the cause of death was certified as whiplash shaking.
  - In 4 (40%) of these 10 deaths, there was a history of shaking.
  - In 5 (83%) of the other 6, there was no history of any purported accidental or homicidal injury.
  - All 8 accidental deaths had impact sites.
- The autopsy findings and circumstances are diagnostic of a nonimpact, shaking mechanism as the cause of death. Fatal, accidental head injuries in children younger than 2 years are rare.
- (Gill. Arch Pathol Lab Med. 2009;133:619–627)

Need to consider and 'rule out' non-abusive injuries & conditions

- Birth Issues
- Accidental falls, MVAs
- Pre-existing anatomic conditions
  - Hydrocephalus
  - Benign extra-axial fluid of infancy
- Coagulation disorders
- Neurometabolic processes
  - Glutaric aciduria type 1

Abuse vs. Accident

1. SDH is far more likely to occur in abusive head trauma than accidental head trauma in children under 2, to a very high degree of statistical significance
2. The same is true of retinal hemorrhages, and especially for specific patterns of RH, once again to well-replicated, very high degrees of statistical significance
3. The only groups of accidentally injured infants/toddlers to have significant likelihood of SDH and/or head trauma were those in motor vehicle collisions. The presence of SDH or RH was not used in any of these studies to differentiate abuse from accidental injury
4. Caution, caution, caution: This DOES NOT MEAN that no case of SDH with/without RH could be caused by another type of accidental head trauma. But such history should be forthcoming early on, be consistent in description, and match the type of injuries found.

References

- 1. Duhaime AC et al. Head injury in very young children: mechanisms, injury types, and ophthalmologic findings in 100 hospitalized patients younger than 2 years of age. Pediatrics. 1992 Aug;90(2 Pt 1):179-185
- 2. Bechtel K et al. Characteristics that distinguish accidental from abusive injury in hospitalized young children with head trauma. .Pediatrics 2004; 114(1):165-168
- 3. Vinchon M et al. Accidental and nonaccidental head injuries in infants: a prospective study.J Neurosurg. 2005 May; 102(4 Suppl):380-4 Note that all 3 of these articles come to very similar conclusions.

Perpetrators and Outcomes

- The median age for female perpetrators (34 years) was higher than that for males (27 years) in NY. Six categorical variables were associated with male perpetrator gender: acute presenting symptoms of cardiopulmonary or respiratory arrest, worse clinical outcome, neurosurgical intervention, death, perpetrator confession, and conviction. There were significant perpetrator gender differences of AHT in children. Male perpetrators were younger and more likely to confess and be convicted. Victims of male perpetrators had more serious acute presentations and neurosurgical intervention and suffered worse clinical outcomes (Ersenio-Jenssen. .Pediatrics, 2011)
- The most frequent original and final charge in NC was the lowest-class felony child abuse charge. The child's death was predictive of higher felony charges. Sentences ranged from probation to life in prison. Severe sentences were associated with perpetrator race. (Keenan. Pediatrics, 2008)

Confounders

- "Benign" extra-axial fluid in survivors of neonatal intensive care (Lorch. APAM, 2004)
- "Chronic" subdural bleeding may start prenatally and not be associated with trauma (Galaznik. J Perinatology, 2011)
- Secondary brain injury from hypoxia and ischemia similar in trauma and non-trauma
- Dating time of injury based on blood degradation and tissue damage often insufficiently accurate

SBSDefense.com

- The theory of Shaken Baby Syndrome and current diagnosis of nonaccidental trauma rests on 5 erroneous assumptions:
- Subdural hematomas and retinal hemorrhages can only be caused by shaking, even in the absence of other injuries.
- Short distance falls can not kill infants or toddlers.
- Chronic subdural hematomas cannot rebleed with lesser degrees of trauma.
- All subdural hematomas will be immediately symptomatic.
- Retinal hemorrhages can only occur in cases of nonaccidental trauma.

Theoretical and evidential controversies

- Can shaking injure the infant brain and what degree of shaking would be necessary? (Minns. J R Coll Physicians Edinb, 2005)
  - Perpetrator acknowledged cases [yes]
  - Physiologic factors predisposing the infant to shaking injury [yes]
  - Experimental animal models [yes]
  - Computer modeling [yes]
  - Biomechanical models [yes]
  - Neuroimaging [yes]

Theoretical and evidential controversies

- Can we diagnose SBS? (Minns. J R Coll Physicians Edinb, 2005)
  - SBS should not be used for legal purposes without eyewitness corroboration
  - Common presentations:
    - Hyperacute encephalopathic presentation with cervico-medullary syndrome (6%)
    - Acute encephalopathic presentation with decreased mental status, increased ICP, shock, other injuries (53%)
    - Less acute brain injury, non-encephalopathic, with SDH, RH, other injuries
    - Chronic SDH, increased ICP (20%)

Theoretical and evidential controversies

- Can accidental injuries or other non-traumatic conditions simulate AHT? (Minns. J R Coll Physicians Edinb, 2005)
  - Isolated SDH [yes] and RH [yes]
  - "Second impact" and "rebleed"
  - Short "minor" falls [no]
  - Playground injuries with RH
  - Accidental causes generally do not cause full pattern of injuries and can be excluded clinically

Overview of Medical Assessment

- Presentation
- Evaluation
- Testing
- Assessment
- Treatment / Referral

Presentation

- Acute injury, disclosure or physical symptoms
- Subacute concerns (parent, guardian, report)
- Behavior (inappropriate, sexualized, emotional)
- Incidental result (lab test, xray)

Evaluation

- Medical History
  - Family
  - Child (+/1 forensic interview)
  - Others
- Appropriate examination
  - Trauma, pediatric, specialty
  - Height, weight, VS
  - Preparation, explaining, positioning
  - Look for key findings
  - Defer certain exams as appropriate

Testing

- Depends on concern and local practice
  - Bloodwork for coagulation, CBC, vWF
  - Cultures/Urine for STIs
  - Blood/urine for toxicology
  - Xrays/Ca/PTH/VitD for fractures
  - CT, MR for head / abdomen
  - US in selected cases
  - Forensic specimens (“rape” kit)

Assessment

- Confirm key findings / results
- Assess consistency of history with injuries
- Don’t forget delay in care / neglect in supervision / physical neglect and malnutrition
- Consider differential diagnoses specific to concerns and order appropriate workup
- Assess social and mental health needs (“SW”)
- Assess need for consultants and referral to child abuse center/specialty care
- Assess safety/protection issues (“imminent” danger, other children, others)
- Assess need for CPS / police reporting

Treatment / Referral

- Follow established protocols to treat identified illness and injuries
- TEST before TREATING if possible
- Lower threshold for admission
- Refer for mental health assessment and treatment as appropriate
- Refer for outpatient follow-up at child abuse center, primary care and specialty care
- Get input from CPS and police (if involved) before discharge
- Create a mechanism to assure follow-up occurs

Summary

- There are continuing updates and controversies in the evaluation of Abusive Head Trauma and physical abuse
- Timing and mechanisms for injury continue to be hotly debated legally
- Clinicians need to continue to further develop their understanding of:
  - Epidemiology and risk factors
  - Identifying, reporting and referral of cases
  - Collaborating with multidisciplinary teams