Litigating Unvalidated Scientific Conclusions on Shaken Baby Syndrome and Abusive Head Trauma





NIVERSITY

SCHOOL







Keith A. Findley, Associate Professor

Anatomy of Science-Dependent SBS Prosecutions

- Expert medical opinion is used to prove all legal elements of the offense
 - Cause and manner of death or injury
 - Shaking, or shaking with impact
 - Mental state of perpetrator
 - Degree of force used so significant as to prove intent, recklessness, deliberate indifference to human life, etc.
 - Identity of perpetrator
 - Because death or collapse is instantaneous (no "lucid interval"), it had to be the last person alone with the child
- "Medically diagnosed murder" (Tuerkheimer 2009)



History of the SBS Hypothesis

- 1962 Henry Kempe
 "The Battered Child Syndrome"
- 1971 Norman Guthkelch
 "Infantile Subdural Haematoma and its Relationship to Whiplash Injuries"
- 1974 John Caffey's 3rd paper
 "The Whiplash Shaken Infant Syndrome..."





Whiplash Shaken Infant Syndrome is renamed **"Shaken Baby Syndrome"**

- 1980s SBS became widely recognized and accepted in medical field
 - No real questions by pediatric community as to HOW or WHY shaking could lead to these injuries
 - No real question as to whether SBS could be RELIABLY diagnosed
- 1990s Shaken Impact Syndrome
 - Shaking + Impact, even hitting the child's head against a soft object

Subdural hemorrhage + retinal hemorrhage \rightarrow *diagnostic* of abuse



The rise of the "Triad"

(1) Retinal hemorrhages (bleeding in the eyes)(2)Subdural hematoma (brain bleed)(3)Encephalopathy (brain swelling)

SBS usually produces a diagnostic triad of injuries that includes diffuse brain swelling, subdural hemorrhage, and retinal hemorrhages. This triad must be considered virtually pathognomonic of SBS in the absence of documented extraordinary blunt force such as an automobile accident. Blood dyscrasias, infections, ruptured intracranial vascular malformations, and other natural disease processes may rarely mimic SBS but are readily distinguished by appropriate diagnostic studies.







The SBS Hypothesis

- 1. The "triad": subdural hemorrhage, retinal hemorrhage, brain swelling (and absence of another explanation)
 - a. The hypothesis: *ruptured* bridging veins, retinal veins, axons
 - b. violent shaking provided the mechanism, physiology, mental state, and timing
 - c. being a parent/caretaker provided the motive and opportunity





2001

- SBS endorsed by AAP: "presumption" of abuse in child under 1 year with RH and SDH and no major traumatic event
- "The act of shaking leading to shaken baby syndrome is so violent that individuals observing it would recognize it as dangerous and likely to kill the child. Shaken baby syndrome injuries are the result of violent trauma. The constellation of these injuries does not occur with short falls, seizures, or as a consequence of vaccination."
- Also endorsed by AAO and NAME



THE CHALLENGES BEGIN



Clinical and Radiographic Characteristic for head trauma, inconsistencies in Associated With Abusive and Nonabusive Head Trauma: A Systematic Review

Limitations of the Review

The meta-analysis for this review was made difficult by inconsistencies in the criteria used to determine the etiology defining and reporting clinical and radiographic variables, and a moderate to high degree of statistical heterogeneity between studies. As there are no standardized criteria for the definition of abuse, most authors developed their own criteria and many of these are

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between studies. As there are no standardized criteria for the definition of abuse, most authors developed their own criteria, and many of these are fraught with circular reasoning. The di-

for those using high-quality criteria.

SYSTEMATIC REVIEW, PITEAU ET AL.

Published in the official journal of the AAP

Systematic review of "best available evidence" of SBS/AHT in an effort to "help front-line clinicians in the difficult task of distinguishing between AHT and nAHT."

Best available studies:

- > No consistent criteria and thus not replicable
- > Observational and thus cannot prove causation
- "Fraught with circular reasoning"

- Piteau S, Ward M, et al. *Clinical and Radiographic Characteristics Associated With Abusive and Nonabusive Head Trauma: A Systematic Review*. PEDIATRICS. 2012;130(2):1-9



SBS/AHT: What is the new science?

Shaking runs into trouble:

- **a**. biomechanics: shaking produces insufficient force to rupture veins or axons; would have neck injury (Duhaime 1987, Ommaya 2002)
- **b**. brain swelling is hypoxic, not traumatic (Geddes 2001)
- **c.** subdural hemorrhages have many causes (Frasier 2006)
- d. bridging vein rupture is improbable (Squier & Mack 2009)
- e. retinal hemorrhages have many nontraumatic causes (Lantz 2006, Matshes 2010, Lantz 2013)
- **f**. lucid intervals are acknowledged (Gilliland 1998)
- **g.** broad range of alternatives: accidental, birth trauma, natural disease processes, coagulopathies, lumbar puncture, genetic, etc. (Frasier 2006, Barnes 2011)



2006

- NAME declined to renew its 2001 position paper on SBS
- At its annual meeting, presentations were made with titles such as *"Where's the Shaking?: Dragons, Elves, the Shaken Baby Syndrome and Other Mythical Entities"*



State v. Edmunds, 746 N.W.2d 590, para. 15 (Wis. App. 2008)

"Edmunds presented evidence that was not discovered until after her conviction, in the form of expert medical testimony, that a significant and legitimate debate in the medical community has developed in the past ten years over whether infants can be fatally injured through shaking alone, whether an infant may suffer head trauma and yet experience a significant lucid interval prior to death, and whether other causes may mimic the symptoms traditionally viewed as indicating shaken baby or shaken impact syndrome."



2009

- American Academy of Pediatrics states that "advances in the understanding of the mechanisms ... associated with abusive head trauma compel us to modify our terminology"
- Recommends that physicians use the term "abusive head trauma"
- Removes language about the presumption of abuse, and the language stating that these injuries do not occur from short falls, and language saying the injuries can prove intent of the caregiver.
- Acknowledges that accidents and disease are other causes of the findings



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SHAKEN BABY SYNDROME, ABUSIVE HEAD TRAUMA, AND ACTUAL INNOCENCE:

GETTING IT RIGHT

Keith A. Findley, Patrick D. Barnes, David A. Moran, and Waney Squier



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The "Father" of SBS: Dr. A. Norman Guthkelch



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PROBLEMS OF INFANT RETINO-DURAL

from a high building or asks for an opinion on intent. Any medical expert who answers in the negative questions such as "Given the injuries that you have described in this case, doctor, have you any doubt that they were inflicted with intent to kill, or at least in total disregard of that possibility?" is exceeding his or her authority. New

controversy is a normal and necessary part of scientific discourse.



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imperfectly documented - cases explains some of this disparity. "Getting it right" requires that we distinguish between hypotheses and knowledge. SBS and AHT are hypotheses that have been advanced to explain findings that are not yet fully understood. There is nothing wrong in advancing such hypotheses; this is how medicine and science progress. It is wrong, however, to fail to advise parents and courts when these are simply hypotheses, not proven medical or scientific facts, or to attack those who point out problems with these hypotheses or who advance alternatives. Often, "getting it right" simply means saying, clearly and unequivocally, "we don't know."

> consideration—on a problem of potential child abuse which has caused a great deal of controversy since it was first described.¹ While controversy is a normal and necessary part of scientific discourse.



2014

Flawed Convictions

"Shaken Baby Syndrome" and the Inertia of Injustice

WISCONSIN LAW SCHOOL DEBORAH TUERKHEIMER

2014 Jennifer Del Prete, Petitioner, v. Sheryl Thompson, Respondent. 10 F.Supp.3d 907 (N.D. Ill. 2014)

Matthew F. Kennelly, J.

Holding: New scientific evidence challenging SBS hypothesis establishes that Del Prete meets the *Schlup v. Delo* "actual innocence" standard to permit her to raise otherwise procedurally defaulted constitutional challenges in federal habeas.

"[T]he ... recent [scientific] developments in this area ..., arguably suggest[] that a claim of shaken baby syndrome is more an article of faith than a proposition of science."



2014

MM v. Prosecutor-General

Supreme Court of Sweden (Oct. 2014)

SBS conviction based on the triad reversed and defendant acquitted by the Supreme Court of Sweden:

"21. It can be concluded that, in general terms, the scientific evidence for the diagnosis of violent shaking has turned out to be uncertain. It has not emerged that the facts in this particular case are such that it can be established, despite this uncertainty, that O's injuries were caused by violent shaking or other violence on the part of MM. On the contrary, certain facts, including the facts that O had previously had RS virus and that there were signs of older haemorrhaging under the dura mater, indicate that there is another explanation for the symptoms that O had.

The Supreme Court's conclusion

22. The conclusion is that it has not been shown beyond reasonable doubt that MM caused the injuries stated by the Prosecutor-General to 0. MM shall therefore be acquitted."



NEW EVIDENCE

First independent review of the evidence by experts

SBU ASSESSMENT • REPORT 255E 2016

Traumatic shaking

The role of the triad in medical investigations of suspected traumatic shaking

A systematic review

THE BACKGROUND OF THE SYSTEMATIC REVIEW PROCESS

This Swedish Agency is one of the oldest health technology assessment organisations in the world, and it employs a careful review process (12). The first step is to compose an expert panel with different expertise and without preconceived views of the forthcoming results. All six members of the SBS expert panel had clearly declared no possible conflict of interests. Two experts were paediatricians (GE, BH), including one specialising in neonatology (BH), and there was one expert each in forensic medicine (AE), radiology (PS), health technology assessment and epidemiology (MR) and medical ethics (NL).

The health technology assessment process continues with the formulation of the research question and the inclusion and exclusion criteria. It then moves on to searching the literature, reading abstracts and full-text papers, grading the quality of the included studies and finally grading the strength of evidence according to the internationally



Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU)





Summary of the results

The systematic review showed the following graded results:

- There is limited scientific evidence that the triad¹ and therefore its components can be associated with traumatic shaking (low quality evidence).
- There is insufficient scientific evidence on which to assess the diagnostic accuracy of the triad in identifying traumatic shaking (very low quality evidence).

assessment of studies of high or moderate quality which disclose factors that markedly weaken the evidence. It is important to note that limited scientific evidence for the reliability of a method or an effect does not imply complete lack of scientific support.

Insufficient scientific evidence (very low quality evidence) represents either a lack of studies, or situations when available studies are of low quality or show contradictory results.

Evaluation of the evidence was not based on formal grading of the evidence according to GRADE but on an evaluation of the total scientific basis.



¹ Three components of a whole. The triad associated with SBS usually comprises subdural hematoma, retinal hemorrhages and encephalopathy.



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REVIEW ARTICLE

Shaken baby syndrome and the risk of losing scientific scrutiny

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Keywords

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THE ISSUE OF CIRCULAR REASONING

In most studies on the diagnostic accuracy of the triad, the classification of study cases and controls was performed by a child protection team. Child protection teams widely assume that when the triad is present, the infant has, by default, been violently shaken. As this assumption is used as the gold standard, the resulting, and extremely high, diagnostic accuracy of the triad is obviously based on circular reasoning and not scientific criteria (27). In other



Why is the research base so weak?

Circularity



Research Objectives & Challenges

- Randomized controlled trials are impossible
- Research typically is retrospective case studies of suspected abuse.
 - Depends on accurately sorting cases into abuse and non-abuse categories



Methodological Challenges: Sorting Cases of Suspected Abuse

- How do you determine which cases are abuse?
- The circularity challenge
 - Inclusion criteria: SDH, RH, encephalopathy—the very clinical findings being studied



CONFESSIONS Attempting to Overcome Circularity: The Typical Hierarchy of Certainty

- 1. Confessions
- **2.** Legal action taken (whether conviction obtained or not)
- **3.** Strong suspicions of staff (based on the medical signs and a "discrepant" explanation offered by caregiver)

--Suzanne P. Starling, James R. Holden, and Carole Jenny, *Abusive Head Trauma: The Relationship of Perpetrators to Their Victims*, 95 Pediatrics 259 (1995)



Confessions: The Gold Standard?

- "The analysis of perpetrators' admissions of ITBI can be used to evaluate the timing and mechanisms of injury." Starling et al., *Analysis of Perpetrator Admissions to Inflicted Traumatic Brain Injury in Children*, 158 Arch Pediatr Adolesc Med 454 (2004)
- "[A]n argument could be made that the perpetrators were coerced in some manner or that mechanisms were suggested to them. An analysis of the investigative techniques involved in eliciting the admissions is beyond the scope of this article." Id. (emphasis added)



"The reliability of confessions or acknowledgement by perpetrators of any sort of injury can be questioned and there are several reasons why the accused may admit to an unwitnessed episode of injury, **but there is no reason to believe that any of the above cases were anything but uncoerced confessions**."

 R.A. Minns, Shaken baby syndrome: theoretical and evidential controversies, General Medicine (2004)



"[C]onfessed shaking ... *is* the evidentiary basis for shaking."

Mark S. Dias, *The Case for Shaking*, *in* CHILD ABUSE AND NEGLECT: DIAGNOSIS, TREATMENT, AND EVIDENCE, 362, 368 (Carole Jenny, ed., 2011)



Confessions

- Not science
- False confessions present in nearly 25% of DNA exonerations
- SBS is especially susceptible to false confessions:
 - Extreme trauma/vulnerability
 - Convincing the suspect he or she is guilty
 - "coerced compliant false confessions"
 - "internalized false confessions"
- Innocent "shaking": jostling to alert child, etc.
 - Dr. Caffey's seminal 1972 article includes "burpings," a mother's "confession" that "she and her husband 'might have shaken [the infant] when he cried at night," and a case in which a mother said she yanked a child to prevent him from falling off a bassinet onto the floor.



Biron & Shelton's cases:

- Case 1: "he gave her a bit of a shake."
- Case 2: "He stated that he had shaken the infant 'out of anger' for 2-3 minutes, supporting his head with his hands, although it still 'rocked back and forth' (he later indicated that the shaking may not have taken that long)."
- Case 3: "gave him a little shake."
- Case 4: gave her "a bit of a shake to stop her crying." It was a "fairly vigorous shake."
- Case 5: father said he "often vigorously bounced the infant on his knee after feeding, causing her head to move 'up and down and back and forth."



Biron & Shelton's Conclusion:

 "Together, the medical and perpetrator evidence pertaining to all five incidents provides strong evidence of shaking in the absence of any type of impact trauma...."


Known False Confessions vs. SBS Confessions

	Known False Confession Cases	Shaken Baby Cases
Maximization	"If we don't find out exactly what happened they could charge you with"	"If they don't know exactly what happened, the doctors won't be able to save your baby"
Minimization	"Anyone in your position would have done the same"	"it's easy to see how anyone could get frustrated with a crying infant"
Evidence Ploys	DNA, fingerprints, eyewitness	Medical Opinion Fake Polygraph Results



Aleman v. Village of Hanover Park, 662 F.3d 897 (7th Cir. 2011):

Posner, J.: "Not being a medical expert, Aleman could not contradict what was represented to him as settled medical opinion. He had shaken Joshua, albeit gently; but if medical opinion excluded any other possible cause of the child's death, then, gentle as the shaking was, and innocently intended, it *must* have been the cause of death. Aleman had no rational basis, given his ignorance of medical science, to deny that he had to have been the cause."



"If a question has only two answers—*A* and *B*—and you tell the respondent that the answer is not *A*, and he has no basis for doubting you, then he is compelled by logic to "confess" that the answer is *B*. That was the vise the police placed Aleman in. They told him the only possible cause of Joshua's injuries was that he'd been shaken right before he collapsed; not being an expert in shaken-baby syndrome, Aleman could not deny the officers' false representation of medical opinion. And since he was the only person to have shaken Joshua immediately before Joshua's collapse, it was a logical necessity that he had been responsible for the child's death. Q.E.D. A confession so induced is worthless as evidence...."



People v. Adrian Thomas 22 N.Y.3d 629 (2014)

Confession to SBS/AHT was coerced:

"Every scenario of trauma induced head injury equal to explaining the infant's symptoms was suggested to defendant by his interrogators. Indeed, there is not a single inculpatory fact in defendant's confession that was not suggested to him."



Bottom Line: Without the Triad There Are No Standardized Diagnostic Criteria

SBS/AHT looks different to different health care providers



Diagnosis without Criteria

- "Gold standard definitional criteria for AHT do not exist. ...
 [I]n the absence of a gold standard, clinicians rarely confirm or exclude AHT with complete certainty and are compelled instead to adopt a probabilistic approach to the diagnosis."
 - Kent P. Hymel, *et al. Derivation of a Clinical Prediction Rule for Pediatric Abusive Head Trauma*, 14 (No. 2) PEDIATR CRITI CARE MED. 2013 Feb;14(2):210-20, 212.



Clinical Judgment

- Proponents of the hypothesis: In the absence of highquality research, must rely on clinical judgment. (Narang, A Daubert Analysis of Abusive Head Trauma/Shaken Baby Syndrome, 11 Hous. J. Health L. & Pol'y 505 (2011)).
- Introduces subjectivity that infects other forensic sciences
- Is different than clinical judgment in treatment contexts
- Barred by *Daubert*: "in circumstances when experience alone does not resolve the main doubts about reliability, it would be irrational, and therefore an abuse of discretion to rely upon it." (Risinger, *Defining the "Task at Hand": Non-Science Forensic Science after* Kumho Tire Co. v. Carmichael, 57 Wash. & Lee L. Rev. 767, 773 (2000).)



The *ipse dixit* of a proposed expert is not a methodology



- The number of cases a doctor has treated, however impressive, is not a valid method of diagnosis
- Method must rest upon scientific principles
- Method must be able to be tested
- Method should be articulable



Areas of New Consensus

- The triad is not pathognomonic of abuse
 - Encephalopathy and edema are ubiquitous—the brain's response to any insult is swelling
 - Subdural hematoma—not unique to SBS or AHT
 - Not even retinal hemorrhages, retinal folds, and retinoschisis in infants are alone pathognomonic of abuse (shaking)
- A differential diagnosis (really a differential etiology) is essential in all cases
- The list of "mimics" of abuse is extensive and growing
- Short falls can kill
- Lucid intervals can occur, making timing impossible



Remaining Disputes

- 1. Can shaking alone cause brain injury and death
- **2.** What is the diagnostic value of the triad
 - subdural hematoma?
 - retinal hemorrhages?
 - cerebral edema?
- **3**. What is the diagnostic value of other signs or symptoms, e.g., bone fractures?
- 4. When can we rule out alternative causes—e.g., short falls, disease, congenital conditions?
- **5.** When can we rule out the possibility of a lucid interval?



Issue 1:

Even if traumatic in origin, was it abuse, or something else, including accident?



Biomechanics: Insufficient Accelerations

- Shaking an infant cannot alone generate acceleration sufficient to meet estimated injury thresholds.
 - A. C. Duhaime et al., *The Shaken Baby Syndrome: A Clinical, Pathological and Biomechanical Study*, 66 J. NEUROSURG. 409 (1987)
 - M.T. Prange, et. al, Anthropomorphic Simulation of Falls, Shakes and Inflicted Impacts in Infants, 99 JOURNAL OF NEUROSURGERY 143 (2003)
 - M.T. Prange et al., *Mechanical properties and anthropometry of the human infant head*, 48 STAPP CAR CRASH JOURNAL 279 (2004)



Biomechanics of Shaking Toddlers

- Shaking a toddler generates ten times *less* acceleration than shaking an infant.
 - N.G. Ibrahim, B. Coats, & S.S. Margulies, *The Response of Toddler and Infant Heads During Vigorous Shaking*, 22 J. NEUROTRAUMA 1207 (2005)



Biomechanics: Short Falls & Other Impacts

- Forces from shaking fall well below established injury thresholds and are 1/50th the force of impact, including impact on soft surfaces. A. C. Duhaime et al., *The Shaken Baby Syndrome: A Clinical, Pathological and Biomechanical Study*, 66 J. NEUROSURG. 409 (1987)
- The peak rotational accelerations for a shake are less than those in a 1 foot fall onto carpet. Prange et al., *Anthropomorphic Simulations of Falls, Shakes, and Inflicted Impacts in Infants*, 99 J. NEUROSURG. 143 (2003)



Short Falls

Falls of just a few feet exceed predicted injury thresholds

- M.T. Prange & B.S. Myers, *Pathobiology and Biomechanics of Inflicted Childhood Trauma-Response*, in INFLICTED CHILDHOOD
 NEUROTRAUMA: AMERICAN ACADEMY OF PEDIATRICS 237 (R.M. Reece & C.E. Nicholson, eds. 2003)
- N. Ibrahim & S. Margulies, *Biomechanics of Toddler Head During Low-height Falls: An Anthropomorphic Dummy Analysis*, 6 J. OF NEUROSURG. AND PEDIATR. 57 (2010)
 - measuring the accelerations from a known (videotaped) short fall that killed a toddler



Can Short Falls Kill?

John Plunkett, *Fatal Pediatric Head Injuries Caused by Short Distance Falls*, 22 AM. J. FORENS. MED. PATHOL. 1 (2001)

- 18 documented cases of child deaths from short falls, most presenting subdural hematoma, edema, and retinal hemorrhage (4 of 6 whose eyes were examined)
- Case study #5: 23 month old child from small plastic play structure and hit head on carpeted floor. <u>The fall was captured on videotape</u>. Child suffered subdural hematoma with midline shift and bilateral retinal hemorrhage.













Short Fall Deaths

- P. Steinbok et al., Early hypodensity on computed tomographic scan of the brain in an accidental pediatric head injury, 60 NEUROSURGERY 689 (2007) Barnes, P.D., et al., Traumatic Spinal Cord Injury, Accidental Versus Non-Accidental Injury, 15 SEMINARS IN PEDIATRIC NEUROLOGY 178 (2008)
- Van Ee et al., *Child ATD Reconstruction of a Fatal Pediatric Fall*, ASME INTERNATIONAL MECHANICAL ENGINEERING CONGRESS & EXPOSITION, November (2009)
- P.E. Lantz, & D.E. Couture, Fatal Acute Intracranial Injury, Subdural Hematoma and Retinal Hemorrhages Caused by Stairway Falls, 56 J. FORENS. SCI. 1648 (2011)



Biomechanics: Neck Injuries

- Shaking could not cause significant brain injuries without first causing massive injuries to the neck and cervical spine.
 - M.T. Prange et al., *Mechanical properties and anthropometry of the human infant head*, 48 STAPP CAR CRASH JOURNAL 279 (2004)
 - F.A. Bandak, *Shaken Baby Syndrome: A biomechanics analysis of injury mechanisms*. 151 FORENSIC SCIENCE INTERNATIONAL 71 (2005)



Problems with estimating infant injury thresholds

- Scaling from adults and animals
- Cadaver research
- Reconstructions of injuries
- Injury threshold: 50-160 G's
- Shaking alone produces no more than 15 G's
- Burden should be on prosecution to demonstrate match between injury thresholds and the force applied





STATE OF NEW YORKCOUNTY COURTCOUNTY OF MONROE

THE PEOPLE OF THE STATE OF NEW YORK

DECISION AND ORDER

-VS-

Ind. No.: 2001-0490

RENE BAILEY a/k/a RENEE BAILEY,

Defendant.



People v. Bailey, People v. Bailey, 47 Misc. 3d 355, 370 (N.Y. 2014)

The Court determines ... that the Defense established that the mainstream belief in 2001-2002, espoused by the Prosecution's expert witnesses at Trial, that children did not die from short falls, has been proven to be false. As more fully set forth in the Findings of Fact, the Court credited the testimony of the Defense experts that case studies have demonstrated that children have died from short falls, that biomechanical research has explained the force produced in falls, and that **advances in imaging have undercut the theory** that shaking causes fatal injury through the tearing of bridging veins.



People v. Bailey decision, cont.

"[T]he credible evidence adduced at the Hearing, which was supported by expert testimony from different disciplines and specialties – pediatrics, radiology, pathology, ophthalmology, and biomechanical engineering – established by a preponderance of the evidence that key medical propositions relied upon by the Prosecution at Trial were either demonstrably wrong, or are now subject to new debate."



The Rarity of Short Fall Deaths (and other alternative causes)

- Chadwick et al., *The Annual Risk of Death from Short Falls of Young Children: Less Than One in a Million*, 121 PEDIATRICS 1213 (2008)
 - Based on flawed underlying data (subject to the circularity problem)
- Lyons & Oates, Falling Out of Bed, A Relatively Benign Occurrence, J. OF THE AMER. ACAD. OF PEDIATRICS (1993)



The Rarity of Short Fall Deaths (and other alternative causes)

- Chadwick et al., *The Annual Risk of Death from Short Falls of Young Children: Less Than One in a Million*, 121 PEDIATRICS 1213 (2008)
- Lyons & Oates, Falling Out of Bed, A Relatively Benign Occurrence, J. OF THE AMER. ACAD. OF PEDIATRICS (1993)



The Rarity Argument

- Some of these alternatives are rare
- But statistics embody averages, not individuals
- The chance that any given child will die from leukemia or in a motor vehicle accident is also very small, but some do.
- Nationwide, even small risks may translate into significant numbers.
- Can't tell us whether *this* is one of those rare cases



The Rarity Argument: Misuse of Statistics

- The denominator problem
- The missing comparison data
- Unreliable data sources
 - Cuellar M, Short fall arguments in court: A Probabilistic Analysis, 50 U. Mich. J. L. Reform 763 (2017).
 - Cuellar M; Causal reasoning and data analysis: Problems with the abusive head trauma diagnosis, Law, Probability and Risk, 2017; 16(4): 223–239.



Maria Cuellar*

I will be talking today about how statistical arguments are used in court, specifically in cases of Abusive Head Trauma in which the defendant has claimed that an accidental short fall, and not shaking or child abuse, has caused the child's injuries. So actually the *Johan* case¹ that Peter Aspelin was talking about leads perfectly into this. In particular, I will be talking about one specific paper by David Chadwick et al. from 2008.² In this paper, he and his colleagues calculate the risk that a child, a young child, will die from a



model to make an AHT diagnosis. The model estimates the probability that a child with certain clinical features was abused. We review the Maguire model and determine that it is an inappropriate foundation upon which to base an opinion that will be used in a criminal prosecution. It suffers from numerous



Issue 2:

What is the diagnostic value of the triad?

- Subdural hematoma?
- Retinal Hemorrhage?
- Cerebral Edema



What Causes Subdural Hematomas

- "The differential diagnosis (i.e., list of potential causes for subdural hemorrhages (SDH's)) is extensive." Narang (2012)
 - But SDH is still held to be highly diagnostic of intentional abuse (not just shaking)
 - Because numerous studies show a higher rate of SDH in abuse cases than in cases with other causes of death or injury
- Signs often associated with abuse, including SDH, are found in many other situations, including accidents, prenatal conditions, congenital malformations, disease, infection, birth injury, toxins, infections, and more
 - Kent P. Hymel, et al., Intracranial Hemorrhage & Rebleeding in Suspected Victims of Abusive Head Trauma: Addressing the Forensic Controversies, 7 CHILD MALTREATMENT 329 (2002)



What causes retinal hemorrhages?

- State will assert that presence of RH in an infant is powerfully suggestive of abuse & severe retinal hemorrhages are highly specific for AHT/SBS.
- Doctors make that claim because they often observe RH in situations where they believe there has been child abuse – in other words, they see a correlation.
- BUT since no one understands what causes RH, the state cannot claim that there is causation.
- Odds ratio (HT 1028)—is not proof.



What is happening in the brain to cause RH?

- The State's theory will be:
- In infants and young children, the adherence between vitreous and posterior pole and peripheral retina is particularly strong;
- Repetitive acceleration-deceleration produces shearing forces sufficient to allow vitreous to pull on the retina, leading to splitting of retinal layers (traumatic retinoschisis);
- The same vitreoretinal traction can produce perimacular folds elevated retinal ridges encircling the macula. "Retinal Hemorrhages in Children, the Role of Intracranial Pressure", Tiffany Shiau et.al. JAMA Pediatrics, 2012.



However - Cause of Retinal Hemorrhages Unknown

- "It has been supposed that RH arise from shearing forces between the vitreous and the retina. . . . "[But] there are no direct data supporting the role of the vitreous-retinal traction as the cause of RH in shaking."
- "Bungee jumping and rapid deceleration in a road traffic accident ... would be expected to generate some form of intraocular force, but ... accurate modeling studies are not available and, there are alternative, albeit equally speculative, explanations." P Luthert, Division *"Why do Histology on RH in suspected non-accidental injury* of Pathology, appended to, (2003) Histopathology



Changes in AAP Statements

The 2003 official position paper of the American Academy of Ophthalmology stated at pertinent part:

• When extensive retinal hemorrhage accompanied by perimacular folds and schisis cavities is found in association with intracranial hemorrhage or other evidence of trauma to the brain in an infant, *shaking injury can be diagnosed with confidence regardless of other circumstances*.

The 2010 statement by the same organization added an important clause and changed terminology, explicitly recognizing that alternative causes of retinal hemorrhages are possible:

• When extensive retinal hemorrhage accompanied by perimacular folds and schisis cavities are found in association with intracranial hemorrhage or other evidence of trauma to the brain in an infant, *without another clear explanation*, abusive head trauma can be diagnosed with confidence regardless of other circumstances.



What else besides shaking causes RH?

- Falls
- Increased Intracranial Pressure Brain Swelling and Hospital intervention
- Crush Injury
- Direct injury to the eye
- Disease, as in diabetes
- Conditions present at the time of birth or shortly after, like retinopathy of prematurity
- Medical treatment, like scleral depression



Retinal Hemorrhages – the literature

- Ommaya, A. et al., *Bio- mechanics and Neuropathology of Adult and Pediatric Head Injury,* BRITISH JOURNAL OF NEUROSURGERY, 16(3):220-42 (2002) (level of force for RH from shaking is biomechanically improbable; case studies confirm that RH and other ocular findings also found in accidental injury & natural disease processes)
- Leuder, G.T. et al., *Perimacular Retinal Folds Simulating Nonaccidental Injury in an Infant*, 124
 ARCHIVES OPHTHALMOLOGY 1782 (2006)(four month old child killed when a six year old fell on him. On examination, four month old had severe retinal hemorrhages
- Watts P. & Obi, E., *Retinal Folds and Retinoschisis in Accidental and Non-accidental Head Injury*, EYE ADVANCE, 18 July 2008; doi: 10.1038/eye.2008.224
- Matshes, E., *Retinal and Optic Nerve Sheath Hemorrhages Are Not Pathognomonic of Abusive Head Injury*, 16 PROC. OF THE AMER. ACAD. SCI. 272 (2010) (examined eyes at Dallas ME; RH linked to edema & life support.)


Retinal Hemorrhages

• Eye injuries previously presumed to be caused only by the rotational forces of shaking can be caused by other types of injury

Evidence based case report

Perimacular retinal folds from childhood head trauma

P E Lantz, S H Sinal, C A Stanton, R G Weaver Jr

Editorials by Geddes and Plunkett and Harding et al A previously healthy 14 month old child was transferred to our medical centre with a severe head injury. The father had collected the boy and his 3 year old brother from their mother at his workplace car park and taken

Postmortem evidence

A forensic autopsy showed no direct trauma to the orbits or eyes. There were prominent bilateral scalp

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Law, Child Abuse, and the Retina

There is a longstanding, widespread belief in pediatric medicine that a finding of retinal hemorrhages in an infant or young child is strong evidence of child abuse. This belief originated decades ago as a cornerstone of a now-controversial diagnosis known as Shaken Baby Syndrome ("SBS") or as Abusive Head Trauma ("AHT"). Decades of medical students have been taught that retinal hemorrhages in an infant or young child mean child abuse until proven otherwise.' This dogma has had and continues to have enormous legal implications: expert testimony about retinal hemorrhages is powerful courtroom evidence, which prosecutors and child protection agencies have offered in thousands of criminal and family court cases.

This article urges that the beliefs about retinal hemorrhages are unreliable for legal purposes and, it seems, altogether wrong, yet they are key to the SBS/AHT diagnosis. Most debate in the case law about the forensic reliability of retinal hemorrhages is embedded in a broader discussion about the multifactorial SBS/AHT diagnosis.² This article urges that the beliefs about retinal hemorrhages need to be addressed distinctly and head-on in the courts. Courts should not continue to admit expert testimony about the purported forensic value of retinal hemorrhages.

The Retina

The retina is a thin layer of brain tissue that lines the back of the eye. When light passes through the eye and onto the retina, it triggers electrical and chemical impulses that are transmitted through the optic nerve to the brain, which, in turn, translates such impulses into visual images. Our retinae work with our optic nerves and our brain to allow us to see.

The retina has several layers, yet is very thin only about 0.5 millimeter thick. At its widest point, a young child's retina is about three centimeters across. The retina receives blood primarily from the central retinal artery; after entering the back of the eye, the artery gives off branches that supply blood to capillaries throughout most of the retina. Its counterpart for returning the blood is the central retinal vein, which, too, has several branches that extend across the retina. When any of these retinal vessels bleed outside their structures, they form specks of blood referred to as retinal hemorrhages. Retinal hemorrhages are not visible simply by looking at someone; they need to be sought out via a clinical eye (ophthalmic) examination or via removal and dissection of the eyes at autopsy. As a general rule, with respect to infants, such eye examinations are performed only when SBS/AHT is suspected.

Origins of the Belief That Retinal Hemorrhages Indicate Child Abuse

The discovery of a potential association between retinal hemorrhages and child abuse occurred in the late 1960s. This timing was no accident. Physicians paid little attention to child abuse until the 1960s. This changed

BY EVAN MATSHES, M.D. AND RANDY PAPETTI, ESQ.

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Cause and Manner of Death: Mimics of Child SBS/Abusive Head Trauma

 Accidental trauma (e.g., short falls), congenital malformations, metabolic disorders, hematological diseases, infectious diseases, autoimmune conditions, birth effects, rebleeds, hypoxia, childhood stroke, genetic conditions, etc. Patrick D. Barnes & Michael Krasnokutsky, Imaging of the Central Nervous System in Suspected or Alleged Nonaccidental Injury, Including the Mimics, 18 TOP. MAGN. RESON. IMAGING 53, 65-70 (2007); Andrew P. Sirotnak, Medical Disorders that Mimic Abusive Head Trauma, IN ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN: A MEDICAL, LEGAL, AND FORENSIC REFERENCE 191 (Lori Frasier et al., eds. 2006)



Issue 3:

Timing: Can the child experience a lucid interval?



Identity: Lucid Intervals

- Lucid Intervals are real; cannot time these brain injuries. Lucid Intervals documented of several hours to 72 hours or more; child may have flu-like symptoms in meantime. M.G.F. Gilliland, *Interval Duration Between Injury and Severe Symptoms in Nonaccidental Head Trauma in Infants and Young Children*, 43 J. FORENSIC SCI. 723 (1998).
 - See also Aleman v. Village of Hanover Park, 662 F.3d 897 (7th Cir. 2011).
- "The lucid interval is a distinct discomforting but real possibility." Dr. Robert Huntington, State's pathologist testifying that research caused him to change his understanding in this way, in *State v. Audrey Edmunds*.



The Changing Science: The Bottom Line

- Scientific advances have undermined the theory that nothing can cause the triad except abuse (mechanism of death)
- Scientific advances have undermined the theory that shaking alone can cause serious brain injury and death with SDH and RH (mechanism and cause of death)
- Scientific advances have undermined the theory the last person with the child must have been the abuser—the injuries cannot be timed (identity)
- Scientific advances have undermined the folklore that the injuries had to have been caused by force equal to a multi-story fall or car crash; can be caused accidentally by short falls (state of mind)
- Scientific advances have established many natural causes for medical findings previously attributed to shaking or abuse



Reviewing Additional Materials





Randy Papetti, Esq

Edited by Christopher Milroy, MD



The Latest in the Battle of the Experts

Pediatric Radiology (2018) 48:1048–1065 https://doi.org/10.1007/s00247-018-4149-1

REVIEW



Consensus statement on abusive head trauma in infants and young children

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Abstract

Abusive head trauma (AHT) is the leading cause of fatal head injuries in children younger than 2 years. A multidisciplinary team bases this diagnosis on history, physical examination, imaging and laboratory findings. Because the etiology of the injury is multifactorial (shaking, shaking and impact, impact, etc.) the current best and inclusive term is AHT. There is no controversy concerning the medical validity of the existence of AHT, with multiple components including subdural hematoma, intracranial



Responses to the "Consensus Statement"

- Randy Papetti, et al., Outside the Echo Chamber: A Response to the "Consensus Statement on Abusive Head Trauma in Infants and Young Children," 59 SANTA CLARA L. REV. 299 (2019)
- Keith A. Findley, et al., *Feigned Consensus: Usurping the Law in Shaken Baby Syndrome/Abusive Head Trauma Cases*, 2009 WIS. L. REV. ____, available at

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3328996

 Statement of the Innocence Network on Shaken Baby Syndrome/Abusive Head Trauma, available (soon, if not already) at www.innocencenetwork.org



NEW AUTHORITY ON INADMISSIBILITY: ALI RESTATEMENT

(American Law Institute, Children and the Law, Pt. I, Ch. 3, § 3.20, at 83 (2018))

- Determining whether a caregiver "has physically abused a child is a legal determination to be made by the factfinder"
- "Determinations regarding the external forces that may have caused the child's condition exceed the scope of a diagnostic determination, however, and therefore the court must separately ascertain that the medical expert has appropriate expertise to render an opinion on such issues and that the opinion is adequately grounded in science."
- *Reporter's Comment*: "The conclusion that the child's diagnoses were the result of abuse is a decision that should be left solely to the trier of fact."



NEW CASE LAW - INADMISSIBILITY

State v. Jacoby, No. 15-11-0917-I, 2018 WL 5098763 (Super. Ct. N.J. Aug. 17, 2018)

- Challenged just retinal hemorrhages
- Court found subdural and retinal hemorrhaging inadmissible

"[T]he Court finds that presently there is no sufficiently reliable evidence and no general consensus in the scientific and medical community as to both the age and causation of retinal hemorrhages to satisfy the *Frye* standard."



Getting Help

- Kate Judson, National Shaken Baby Syndrome/Abusive Head Trauma Litigation Coordinator & Executive Director, the Center for Integrity in Forensic Sciences <u>kate@cifsjustice.org</u> 608-736-2437
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