Science and the Shaken Baby

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“Child Abuse Experts”
Why there isn’t such a thing

- Understanding these problems in depth requires advanced knowledge of all of these highly complex scientific fields:

• Pediatrics	Board Certified MD
• Radiology	Board Certified MD
• Pathology (Forensic /Neuropathology)	Board Certified MD
• Neurology and/or Neurosurgery	Board Certified MD
• Orthopedics	Board Certified MD
• Psychology/Psychiatry	Board Certified MD
• Biomechanics	Ph.D or P.Eng
• Statistics	Ph.D
• Odontology (Dentistry)	DDS
• Dermatology	Board Certified MD

It should be apparent that no individual physician or scientist can gain or maintain proficiency in all of these fields and therefore there must be collaboration and consultation amongst the specialties to fully understand the problems associated with suspected child abuse.

IN OTHER WORDS

A three or four year residency in any single specialty and a one year fellowship will not provide in depth understanding of all of these complex issues.

Terminology

Previously referred to as “Shaken Baby Syndrome”, in 2009 the Committee on Child Abuse and Neglect (COCAN) of the American Academy of Pediatrics recommended that the term not be used and that it be replaced by “Abusive Head Trauma” (AHT) because it implied a mechanism that could not be proven or demonstrated scientifically.

BUT

The American Academy of Pediatrics neither gave a definition of Abusive Head Trauma nor did they state diagnostic criteria for this diagnosis. Therefore, it is up to the individual physician and some are very liberal in making the diagnosis.

Differential Diagnosis

- A procedure by which physicians list all the alternatives systematically prior to arriving at a diagnosis. Should be a routine procedure prior to making any diagnosis and ideally is written down in the medical record.
- A basic element of good medical practice. Commonly an issue in civil cases but seldom, if ever, argued in criminal cases. Has been held to be a means of complying with Daubert requirements by the 8th Circuit.
- Is virtually NEVER recorded in the evaluation of subdural hemorrhage in infants and children

History 1

Prior to 1970, pathologists classified subdural hematoma in children as either due to impact or as having no evidence of impact.

If impact was shown, then the pathologist needed to determine whether it was due to a blow with a hard object or whether the moving head struck a hard surface i.e. A Blow or a Fall.

If there was no evidence of impact, then a number of conditions could cause the subdural bleed and evaluation of multiple alternative explanations was required i.e. a Differential Diagnosis

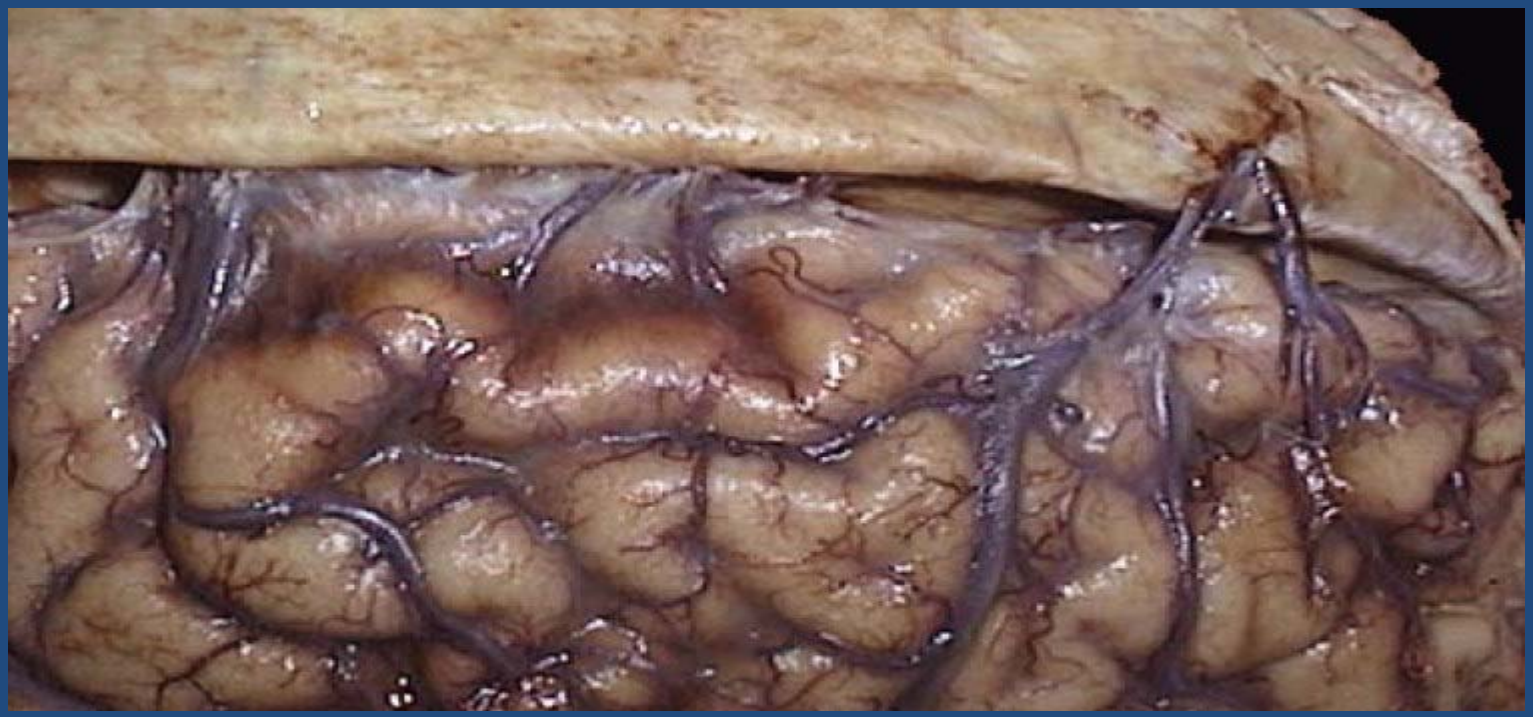
IMPACT

- Impact is extremely difficult to confirm in the living child as the only evidence may be on the internal surface of the scalp (galea)
- Do not confuse bruises and wheals. Bruises last hours to days, wheals last minutes to an hour or so

History 2

- In 1971, Guthkelch, a British neurosurgeon, described subdural hematoma in association with shaking in his area of England.
- 1972 Caffey, an American Radiologist studied a series of cases of head trauma in children in whom no impact could be shown. There is an anecdote, possibly apocryphal that Guthkelch drew Caffey's attention to his paper of the previous year. At the same time, a nurse (Virginia Jaspers) claimed to have killed 3 children by shaking.
- However, shaking as a sole cause of subdural hematoma was always a plausible but unproven hypothesis and remains so to this day.
- Note that in 2011 Guthkelch gave an interview with NPR in which he stated that he was concerned that his paper was being used in a way that he never intended and that he was concerned that innocent parents and caregivers were incarcerated as a result.
- His comments are on the npr.org website and are worth watching and downloading. Also, watch and download the case reported on in the Frontline program at pbs.org or propublica.org

Bridging Veins



History 3a

The early to mid 1980s saw the development of special techniques by neuropathologists to demonstrate axonal injury. The term “Diffuse Axonal Injury” came into vogue and was extremely useful to law enforcement because the concept effectively demanded a belief that loss of consciousness, coma, seizures or cessation of breathing would immediately result from the disrupted nerve cells.

History 3b

- This resulted in the simplistic belief that the person having care, custody and control of the infant MUST, a priori, have done something to cause the LOC, coma, seizures, etc
- Because of the above, it became widely assumed that the caregiver was lying to cover up their behavior.
- Physicians (ER, Pediatricians and Pathologists) decided that they knew what had happened, despite not having seen what went on. Law enforcement personnel naively made statements said “The doctors know…..” or “We know what happened…….” etc. etc.

History 3 c

Police interviewing techniques were often unfair, misleading to the suspect and based on faulty information from medical personnel. They were often poorly documented and not videotaped.
Unrepresentative rag dolls were given to suspects who frequently admitted to having gently shaken the child to see if he/she could be aroused. Such statements were usually taken out of context and interpreted as “confessions” that became the Gold Standard of abuse diagnoses. This continues until today.

History 3 d

It was widely believed that falls from less than a second storey window never caused injury so anyone describing an infant slipping from the arms in a shower or on a staircase were commonly regarded as false. Therefore the defendant was presumed to have lied, further enabling prosecutors to bias the jury against the defendant.

History 4

- The late 1990s saw a sea change due to the following events:
- 1999 John Plunkett, a Minnesota Pathologist produced a series of cases of children who had sustained lethal short distance falls, one of which was videotaped, that resulted in death. Subsequently there has been general agreement that while most short distance falls are benign, some falls of as little as 2 to 3 feet may cause severe injury such as skull fractures (Arnholz & Jenny, Denton & Mileusnic) with or without death. Cases of delayed symptoms and delayed death were reported (Gilliland).
- Note: Death may occur in impact injuries with or without skull fracture. Skull fracture may occur in impact injuries with or without brain injury.
- In 2008 the Chadwick published a paper in the journal “Pediatrics” in which he attempted to calculate the annual deaths from falls in California children. Figures are questionable, but it’s recognition of the problem.
- 2000 Biomechanical engineers working on the thorny question of airbag deaths in infants and children became interested in pediatric head injury

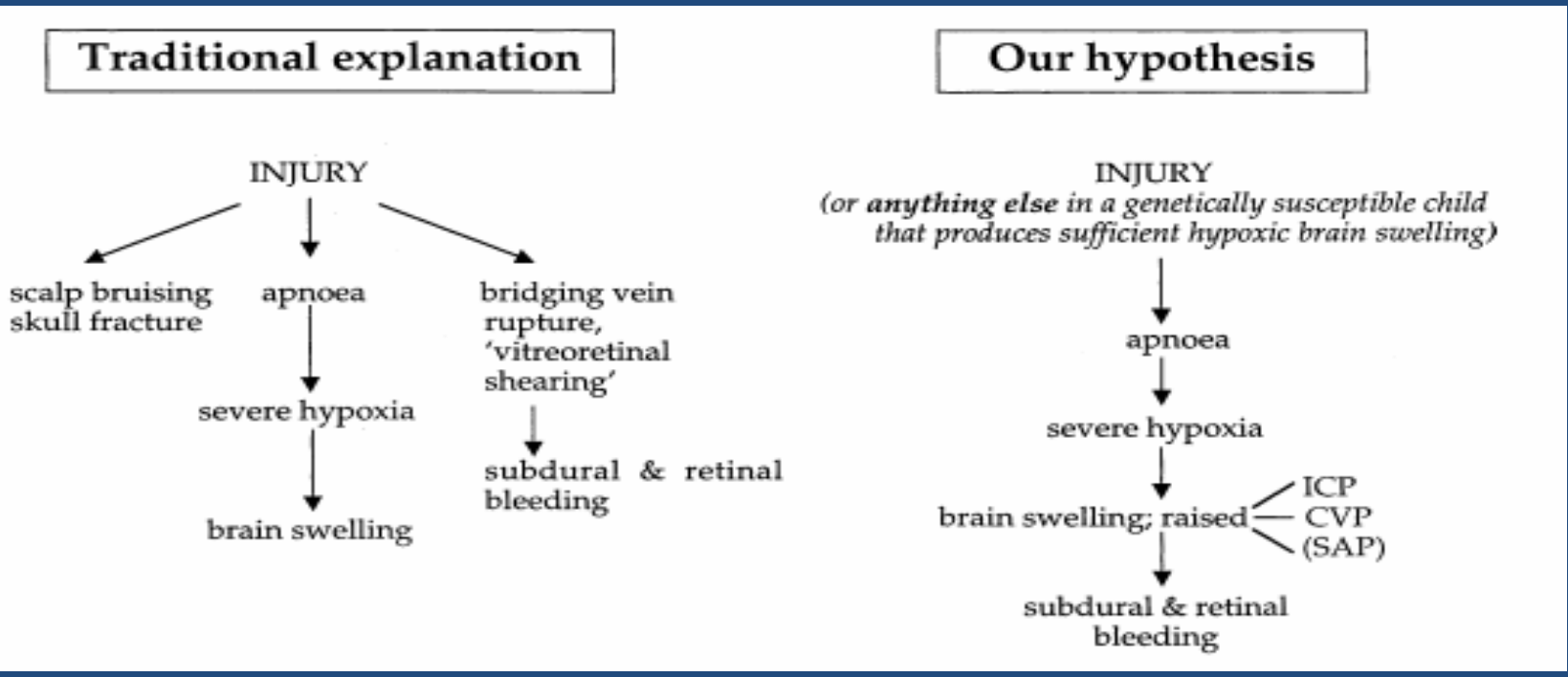
Geddes

- 2001 – 2003 A series of papers by Jennian Geddes, a British neuropathologist demonstrated that most axonal injury was not due to trauma but hypoxia/ischemia – simply blood and/or oxygen not reaching the brain. This has been confirmed and is now virtually universally accepted. This finding alone severely damaged the "Last person holding the baby was guilty" theory.

- While her first two papers have been accepted without significant argument, the third paper referred to as "Geddes 3" or "The unified hypothesis" is a landmark and has been controversial . It has been alleged, erroneously, that Dr. Geddes has withdrawn her hypothesis.

- She has not withdrawn the hypothesis, but clarified it both in court and out of court. A careful reading of what she said in the paper leaves no doubt that she intended it as a hypothesis

The Unified Hypothesis



What she said, among other things

"This constellation of events, severe hypoxic damage to immature blood vessels, exacerbated by raised ICP, central venous and systemic arterial hypertension, is not proposed to be the cause of all infantile subdural haemorrhages: for example, traumatic rupture of one or more bridging veins would be a more likely explanation of significant unilateral bleeds. Nor is it necessarily the sole mechanism of retinal haemorrhages".

More

"That I am very sorry about. It is not fact; it is hypothesis. But, as I have already said, so is the traditional explanation. I have never sought -- I would be very unhappy to think that cases were being thrown out on the basis that my theory was fact. We asked the editor if we could have Hypothesis Paper put at the top and he did not, but we do use the word "hypothesis" throughout."

History 5

- Throughout the first decade of the 21st century a re-evaluation of the science took place that essentially represented a return to the forensic pathology approach of the 1960s.
- The last ten years has seen a re-evaluation of the radiological features of pediatric head trauma AND ITS MIMICS. Barnes and Krasnokutzky.
- Although there's a long way to go, pathologists became more likely to look for evidence of impact and/or alternative explanations. Many changed their views on the shaking theory.

“Resuscitative” shaking

- It is a universal reflex to gently shake an infant or child when he/she is found unresponsive.
- There is general agreement that such shaking is NOT harmful and that in order to cause the severe injury of the Shaken Baby Syndrome, the shaking must be forceful, as shown in the next slide.
- Demonstrations such as this frequently use totally non-representative “Dolls”. The weight of any demonstrative exhibit such as this MUST be compared with the weight of the child in question. Watch for this during police interrogations as well as in court

The classical diagnosis of SBS

Classically, the diagnosis of SBS rested on three findings, known as "The Triad":

1. Brain Swelling
2. Subdural hematoma
3. Retinal hemorrhages that were thought to be able to differentiate intentional from accidental injury. Some still believe this.

The death of the Triad

- Since 2009, it has been recognized that a VERY large number of other conditions can mimic the Triad. Some involve trauma, many do not.

- Organizations that now question the significance of the Triad in the absence of additional evidence include:

  - The American Academy of Pediatrics in their 2009 policy change, by implication
  - The Royal College of Pathologists in the UK
  - The Crown Prosecution service in the UK
  - Many writers and commentators on child abuse topics

What is additional evidence?

- Eye witness
- Surveillance video ("Nannycam"). **RARE**
- Possibly signs of bruising or gripping on the chest or upper torso. Most experienced forensic pathologists find these are very hard to substantiate.
- Fractures of any upper torso bone (ribs, arms etc) **unless Metabolic Bone Disease can be excluded.**

Differential Diagnosis of SDH

1. Trauma or no trauma?
2. Accidental trauma (falls, birth) or inflicted?
3. Congenital diseases (i.e. present at birth, BESS/BEH)
4. Coagulopathies (Blood clotting disorders)
5. Infections, mostly viral but also bacterial
6. Cortical (CVT) or Sinus (SVT) thrombosis
7. Vascular abnormalities (Aneurysms, AVM)
8. Genetic diseases (e.g GA, NN, Translocations
9. Pregnancy related (GALD)

DDX of Brain Swelling

The brain has limited ways of responding to any insult, be it mechanical or chemical trauma or infection. Swelling is virtually universal in any kind of insult to the brain.

1.Physical trauma

2.Chemical trauma as in poisoning (alcohol?, Carbon Monoxide)

3.Infection, as in viral encephalopathy from RSV or influenza infection.

4.Metabolic imbalances (Hypernatremia, etc)

Investigation of Brain Swelling

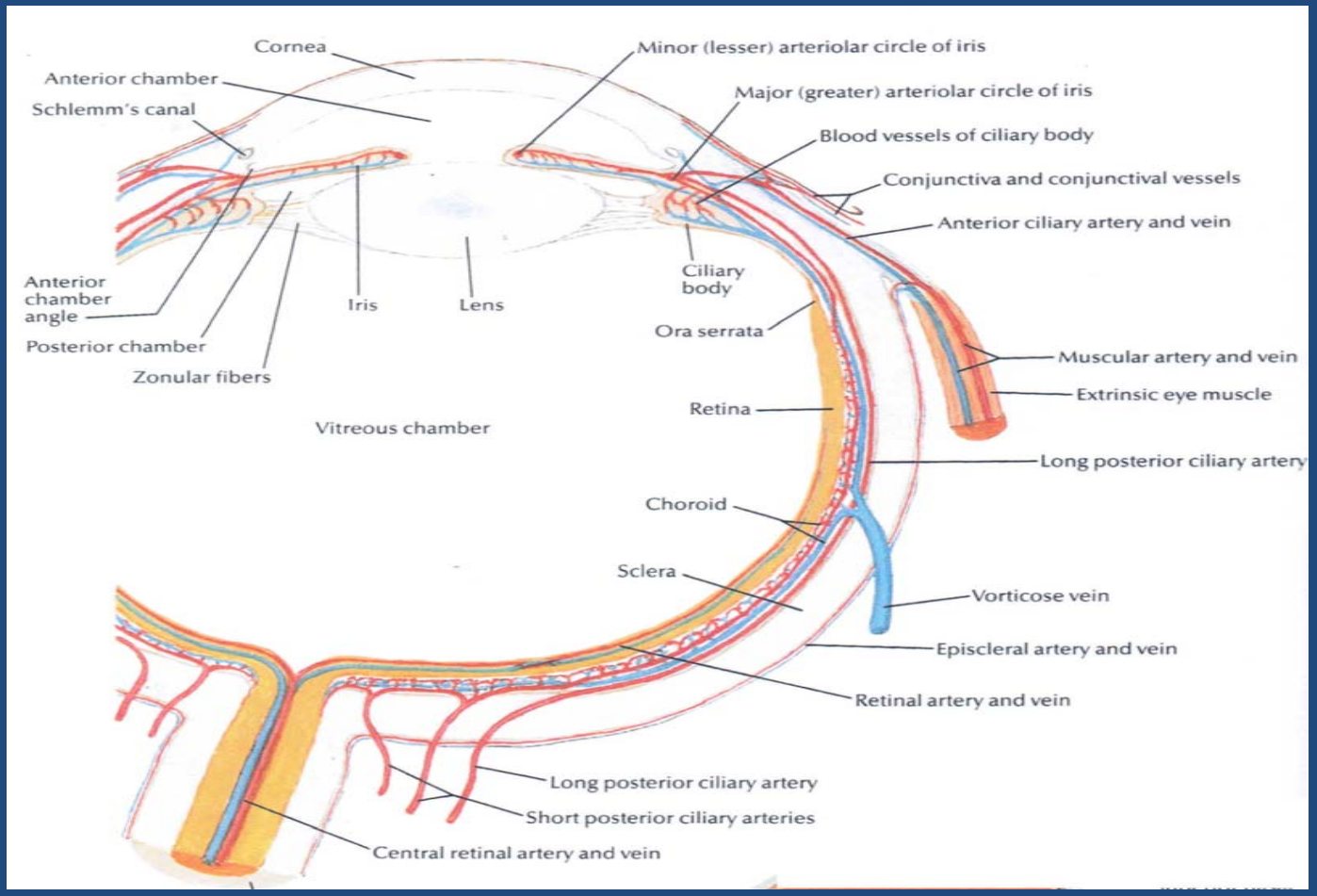
- In the living:

Neuroradiology is a distinct subspecialty and you should always evaluate the certification status of the prosecution's radiologist and your own.

Remember that the optimal radiological workup requires CT scan PLUS MRI, both done as soon as possible after the child arrives in the emergency department.

- In the deceased:

Neuropathology is likewise a subspecialty and the same evaluation requirements exist. Autopsy artifacts must be borne in mind.


Cornea
Anterior chamber
Schlemm's canal
Anterior chamber angle
Posterior chamber
Zonular fibers
Iris
Lens
Vitreous chamber
Minor (lesser) arteriolar circle of iris
Major (greater) arteriolar circle of iris
Blood vessels of ciliary body
Conjunctiva and conjunctival vessels
Anterior ciliary artery and vein
Ciliary body
Ora serrata
Retina
Choroid
Sclera
Muscular artery and vein
Extrinsic eye muscle
Long posterior ciliary artery
Vorticose vein
Episcleral artery and vein
Retinal artery and vein
Long posterior ciliary artery
Short posterior ciliary arteries
Central retinal artery and vein

DDx of Retinal Hemorrhages

- Anything that raises the intracranial pressure (pressure inside the skull) especially if the rise is rapid, will cause retinal hemorrhage.

Prematurity
CPR (rarely)
Meningitis
High altitude
Diabetes in older children
Retinal Diseases
Sickle Cell disease
Coagulopathy

DDx of Retinal Hemorrhages 2

- "But these hemorrhages are different. They are larger, involve all layers and extend to the periphery of the eye"

WRONG

1. No validated or published study to support this position

2. Type and distribution of the hemorrhages are likely more related to the severity of the process i.e. the degree of intracranial hypertension, whatever the cause. Since retinal hemorrhages have not been adequately studied in accidental injuries or in medical conditions causing raised ICP, there is no scientific basis for this statement.

3. There are reports of accidental injuries and medical conditions (gastroenteritis) showing just such patterns.

4. Patrick Lantz' studies, due in print sometime in 2012

Confessions?

- Leestma, a Chicago neuropathologist, has analyzed this and has concluded that they are commonly unreliable.

- Starling, a Virginia pediatrician, has written a paper that is often quoted by prosecution witnesses. It is worthless because the penultimate paragraph states, in effect, that it wasn't their job to evaluate the reliability of the confession – thereby eliminating any scientific validity.

Intimidation of Defense Experts

- For academic physicians: University politics
- For clinical specialties: Loss of referrals
- For all specialties:
  - Denigration of qualifications or Ad Hominem attacks:
    - You don't treat children in the ICU on a daily basis
    - Adult doctors don't understand pediatrics
    - You only see dead adults and are not a pediatric pathologist.
    - When did you last do an autopsy?
    - You are getting paid for your testimony, aren't you?
    - Implications that you don't believe child abuse exists
    - Psychological and social retribution

- Intimidation extends to negative comments by family and friends:

  “What, you don’t believe this child was shaken, Everyone knows SBS exists.”

  “If the police charged him/her, they’re guilty of something”

  “Those testifying for the prosecution are the good guys while those testifying for the defendant are the bad guys and are trying to help the abusers”

  Finally, it should be noted that in some countries threats to the expert’s medical license are routinely made and some have lost their licenses.

The reality

- Child abuse exists and the entire medical community has declared war on Child Abuse.
- Every war has associated collateral damage
- Your clients (our patients) represent collateral damage in this war.