DEFINING THE CHALLENGES: A CLINICIAN’S PERSPECTIVE

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MY GOALS FOR THIS PRESENTATION

- To briefly summarize what I perceive to be the prevailing impressions of pediatric clinicians regarding...
  - Active controversies surrounding AHT,
  - The available evidence that supports shaking as a causal mechanism for AHT, and...
  - Current challenges related to the neuroimaging of abuse.

CURRENT CONTROVERSIES

- A relatively small number of expert witnesses who testify frequently contend that...
  - Violent shaking of a baby is not dangerous;
  - Short distance falls are frequently fatal;
  - Infants and young children can sustain life-threatening traumatic brain injuries and yet remain asymptomatic for hours, days or weeks;
  - Infants delivered vaginally—though asymptomatic—are at significant risk for occult subdural bleeding and subsequent re-bleeding that can trigger sudden and unexpected, life-threatening, clinical deterioration weeks or months later; and that...
  - Hypoxia alone can explain subdural hemorrhage.

CURRENT CONTROVERSIES

- I suspect that an overwhelming majority of pediatric clinicians believe as I do, that...
  - Violent shaking of a baby is extremely dangerous;
  - Fatal short distance falls are both rare and unique;
  - The overwhelming majority of infants and young children who sustain severe or life-threatening traumatic brain injury become rapidly, clearly and persistently ill;
  - Occult, severe birth trauma in healthy newborns is rare and highly unlikely to cause delayed, life-threatening, clinical deterioration and acute subdural hemorrhaging weeks or months later; and that...
  - Hypoxia alone does not explain subdural hemorrhage.

DISCLOSURES

| Consultant/ Speakers bureaus | On behalf of my current and past employers, I have accepted honoraria for teaching and compensation for my professional time spent conducting medical-legal case reviews and/or providing expert testimony regarding child abuse. |
| Research funding | At the present time, a private family foundation (that requires anonymity) supports my current research at 0.2 FTE. |
| Stock ownership/Corporate boards-employment | No Disclosures |
| Off-label uses | No Disclosures |
THE CASE FOR SHAKING

Dias MS. The case for shaking.
In: Child Abuse and Neglect: Diagnosis, Treatment, and Evidence, First Edition; Jenny C (Editor); Elsevier Saunders, St. Louis, MO, 2011, pp 364-72
“A coherent and comprehensive argument in support of shaking as a causal mechanism for abusive head injury”

THE CASE FOR SHAKING: POINT #1
“Biomechanical data regarding various injury thresholds are based on experimental observations performed in adult primates.”
“There is no evidence to support that that these injury thresholds are applicable to infant brains.”
“Recent evidence suggests that injury thresholds in infant brains are considerably less than in adults.”

THE CASE FOR SHAKING: POINT #2
“The experimental primate studies used single-cycle rotational injuries with approximately 30-msec cycle times.”
“There is no evidence that the injury thresholds derived from these experiments are applicable to the biomechanical parameters (repetitive 250- to 350-msec cycle times) during violent infant shaking.”

THE CASE FOR SHAKING: POINT #3
“Recent studies suggest that secondary metabolic responses of infants to head injuries are both quantitatively and qualitatively different than in older children or adults.”
“Moreover, those injuries identified as abusive by clinical criteria seem to engender an even greater metabolic response.”

THE CASE FOR SHAKING: POINT #4
“These metabolic responses might reflect developmental critical periods during which the infant is uniquely susceptible to the effects of head injury and particularly to abusive head injuries.”
“The injury thresholds for initiating these cascades have not been determined.”
THE CASE FOR SHAKING: POINT #5

- "The clinical spectrum (both neurological presentation as well as neuroimaging and pathological findings) that follows accidental head injuries in infants and children has been well-described in the literature in numerous publications."
- "The extent, character, profile, and pattern of these accidental injuries are overwhelmingly consistent, and are wholly different from both the types and patterns of inflicted injuries."

THE CASE FOR SHAKING: POINT #6

- "A number of studies have addressed the clinical and pathological features of admitted (or confessed) cases of abusive head injury."
- "Although evidence of blunt force trauma (impact) is reported in 20% to 63% of these cases (even in those cases in which only shaking was admitted), violent infant shaking remains a strikingly common element in these confessions, with shaking admitted in up to 71%.
- "In addition, a well-documented case of 'shaken adult syndrome' having retinal and SDHs and AI has been described, suggesting that shaking can be injurious even beyond infancy."

THE CASE FOR SHAKING: POINT #7

- "Although it is obvious that some of these confessions are erroneous, in order to accept the thesis that shaking alone cannot achieve injury thresholds for brain injury or intracranial hemorrhage, every case of admitted shaking would have to involve numerous and consistent lies, something that defies logic."

THE CASE FOR SHAKING: SUMMARY

- "Can injury thresholds derived from adult non-human primates undergoing a single acceleration on a sled be reliably extrapolated, using only mass scaling, to a human infant undergoing repetitive shaking?"

THE CASE FOR SHAKING: SUMMARY

- "It is clear that the metabolic response of the immature brain to TBI is both quantitatively and qualitatively different than that of the developed brain, and the thresholds necessary to initiate these metabolic cascades in the developing brain have never been examined properly."
- "Clinical studies confirm that although evidence of impact is certainly present in a proportion of cases of AHT, impact is significantly less common in AHT than in accidental injuries."
- "How then are we to explain the mechanics of these injuries?"
THE CASE FOR SHAKING: SUMMARY

“...the consistent and repeated observation that confessed shaking results in stereotypical injuries that are so frequently encountered in AHT—and which are so extraordinarily rare following accidental impact injuries—is the evidentiary basis for shaking.”

NEUROIMAGING CHALLENGES

- Sieswerda-Hoogendoorn T, Boos S, Spivack B, Bilo RA, van Rijn RR.
- Educational paper. Abusive Head Trauma Part II: Radiological aspects.
- DOI 10.1007/s00431-011-1611-6

NEUROIMAGING CHALLENGES

- Compelling bodies of evidence...
  - Support an association between AHT and subdural hemorrhages, hypoxic-ischemic brain injury, and cerebral edema; and...
  - Fail to support an association between AHT and subarachnoid hemorrhage(s), extradural (epidural) hemorrhage(s), focal parenchymal injury and linear skull fractures.
- Evidence is conflicting or inadequate to either confirm or exclude an association between AHT and diffuse axonal injury; complex skull fracture(s); and high, low or mixed attenuation subdural hemorrhage(s).

NEUROIMAGING CHALLENGES

- Routine cranial CT in physically abused children without signs of AHT or neurotrauma is controversial;
- We lack sufficient evidence to make clear recommendations regarding follow-up MR imaging if/when the initial CT reveals no abnormalities; and...
- International standards or protocols for follow-up MR imaging of acute pediatric neurotrauma are lacking.

AHT NEUROIMAGING RESEARCH Priorities
RESEARCH PRIORITIES

- Research is needed to measure and/or compare the diagnostic performances, risks and cost-benefits of...
  - Cranial CT in physically abused children lacking clinical signs of AHT or neurotrauma;
  - Various candidate MRI protocols for follow-up neuroimaging of acutely head-injured children without CT abnormalities;
  - Various candidate MRI protocols for follow-up neuroimaging of acutely head-injured children with CT abnormalities;

- Finally, research is needed to...
  - Identify neuro-radiological findings with high predictive values for abuse in the subpopulation of acutely head injured children who lack any and all noncranial injuries concerning or suspicious for abuse.

A CLINICIAN’S WISH LIST

- I wish that clinicians would routinely inform radiologists about the head injury events and mechanisms described by caregivers.
  - I wish that radiologists would...
    - Routinely and systematically document the presence or absence of radiographic findings compatible with underlying disease (e.g., wormian bones on skull x-rays in OI and Menke’s disease);
    - Routinely create standard 3-D reconstructions when CT reveals skull fracture(s); and...
    - Refrain from making unconditional statements on dating of intracranial pathology based only on radiological findings.

REFERENCES

- In support of a conclusion that violent shaking of a baby is extremely dangerous, points 1 and 2 ...
  - Shew S., Ichord R., Duhaime R., et al:
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32

- In support of a conclusion that violent shaking of a baby is extremely dangerous, points 3 and 4 ...
  - Raghupathi S., Ruppel J., Rhee M., et al:
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32

- Refrain from making unconditional statements on dating of intracranial pathology based only on radiological findings.
  - Ichord R., Berger A., Morgan J., et al:
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32

- In support of a conclusion that violent shaking of a baby is extremely dangerous, points 5 and 6 ...
  - Biousse V., Botscheller K., Ichord R., et al:
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32

- Refrain from making unconditional statements on dating of intracranial pathology based only on radiological findings.
  - Kochanek P., Silverstein M., need to:
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32
    - Critical mechanisms of secondary damage after inflicted head injury in infants and children.
    - Neurotrauma 2013; 11(1): 26-32