Epilepsy and Trauma: Childhood Perspective

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Outline

• Introduction
• Classification
• Data on childhood TBI
• Abusive head trauma
Traumatic brain injury (TBI)

- Each year, more than 470,000 children aged 0-14 yrs. visit to ED for TBI
- One of the leading cause of childhood morbidity and mortality

Traumatic brain injury in the US. CDC 2010
Statler KD. Dev Neurosci 2005
Childhood TBI and seizure/epilepsy

• The overall incidence is 5.5-21% (not specifying time, severity, types of seizure)
• Most seizures occur during the first 24 hr.
• 10-20% of patients have epilepsy after severe TBI

Statler KD. Dev Neurosci 2005
Suggested classification

EPTS
Early post-traumatic seizure

LPTS/LPTE
Late post-traumatic seizure

dEPTS

Impact PTS  Immediate PTS  Delayed EPTS

Impact PTS

- Occur on impact or within minutes post-injury
- Brief, generalized
- Rapid clearing of mental and neurologic exam
- More common in children
- Result of a concussion (concussive convulsions)
- Not associated with significant intracranial pathology or long-term outcome
- No treatment is needed

Immediate EPTS

• 12-24 hr. after injury (most in first 1-3 hr.)
• Nearly 100% of EPTS occur during period
• Increase incidence with severity
  – 2–6 % in mild TBI
  – 12–27% in moderately severe TBI
  – 13-35 % in severe severe TBI

Statler KD. Dev Neurosci 2005
Risk of pediatric EPTS

• Younger age (< 2 yr. old)
• Severe TBI (GSC 3-8) (2-6%, 12-27%, 23-35% in mild, mod., severe TBI)
• Intracranial hemorrhage
• Prolonged loss of consciousness
• Prolonged posttraumatic amnesia
• Depressed or open skull fractures
• Abusive head trauma (AHT) (50-65% in AHT to 15-17% in non-AHT)

Issues in management of EPTS

TBI with seizures

• Treatment with AED is warranted in those with seizure to prevent secondary injury

Prophylaxis

• PHT is recommended in children with severe TBI

Problems in children

• Studies of AED in preventing EPTS are not extensively investigated as adult
• The use of PHT use in severe childhood TBI is offered as extrapolation
Studies of EPTS in childhood

• RCT for seizure prophylaxis in children with PTS with PHT
• 122 patients with moderate to severe TBI received placebo and PTH
  – Primary endpoint PTS within 24 hr. and outcome in 30 days
  – Patient developed seizure 7% with PHT and 5% with placebo
  – No difference between groups in survival or neurological outcomes

Variation of prophylaxis

- 5 pediatric trauma centers in USA.
- 79% received seizure prophylaxis
- 2/5 institutes received 100%
- AEDs used: fosPHT, PHT, LEV, PB

Other AEDs

• PB, CBZ, VPA are not extensively studied due to side-effect profiles and pharmacodynamic properties
• LEV is increasing used in both adult and children with TBI
LEV in childhood EPTS

• 6/34 (17%) developed clinical seizure despite LEV prophylaxis (compared to 10-15% in PHT)

Newer AED

• Levetiracetam Versus Phenytoin for Seizure Prophylaxis: A Systematic Review and Meta-Analysis
  – 1614 patients from 11 studies, 1285 in controlled studies
  – LEV was not superior to PHT with regard to early seizure prophylaxis
LPTS

• Risk of LPTS followed severe TBI is 10-20%
  Statler KD. Devel Neurosci 2006

• Even mild TBI is found to increase risk of LPTS (3.7%) in long-term follow-up
LPTS

• Based on existing data, prevention of EPTS do not reduce development of LPTS
• Meta-analysis of highest quality studies fail to show benefit of AED prophylaxis
• This suggests that EPTS is not the sole risk factor for later epilepsy, but rather an association

LPTS in children

• 102 children with TBI with a follow up of 18-96 mo.
  – 9% developed PTE between 8 mo.-5 yr. after injury
  – Increase risk in patients with EPTS, and low GSC

• 321 TBI, 47(15%) developed LPTS
  – Increase incidence in severe TBI
  – Increase incidence in patient with AHT
  – All kinds of seizure have been encountered including infantile spasm
  – Increase risk of being on more than one AED and intractable epilepsy
Other issues in TBI in children

• In children with TBI, brain may not be injured by accident but from abusive behavior.

• This distinct feature is exclusively seen in small children (less than 5 yr. of age), in particular less than 2 years old.

• Abusive head trauma.
Abusive head trauma (AHT)

- Many names for this condition
  - Shaken baby syndrome
  - Abusive head injury/trauma
  - Inflicted traumatic brain injury

- **Abusive head trauma (AHT)** is a preferred name endorsed by AAP

- This injury is one of the most leading cause of death in non-accidental trauma
Definition: AHT

• An injury to the skull or intracranial contents of an infant or young child (<5 years of age) due to inflicted blunt impact and/or violent shaking. Excluding
  – Unintentional injuries resulting from neglectful supervision
  – Gunshot wounds / stab wounds / penetrating trauma

Pediatric Abusive Head Trauma, CDC 2012
Shaken baby syndrome

• One form of abusive head trauma with a characteristic pattern of injuries that may include retinal hemorrhages, certain fractures (in particular, ribs and the ends of long bones), and recognizable patterns of brain injury.

• AAP consider SBS as a subset of AHT
AHT

• Incidence: 21/100,000 (<1 yr. of age)
  12.8/100,000 (< 2 yr. of age)

• In children less than 2 yr. of age, AHT account for most cases of severe traumatic brain injury

• More than 20% mortality rate and adverse neurodevelopmental outcomes

  -Barlow K, Pediatr Rehabil 2004
Diagnosis

• Seizure is the most common presenting symptoms (40-70%) followed by lethargy and unresponsiveness
• Very rarely that the perpetrator would admit the action
• Diagnosis is based on clinical suspicious (not appropriate traumatic history, bruises or other body injuries, retinal hemorrhage) and Neuroimaging studies
Imaging

• Subdural hematoma is considered as a cardinal sign
• Present in almost 90% of the patients but of moderately specific to this condition
• Specificity of SDH for this condition increase when associated with retinal hemorrhage and underlying diffuse parenchymal injury
  Kelly P, et al. Arch Dis Child 201
Mechanisms of injury

• **Impulsive loading**: non-impact forces generated by alternating angular acceleration and deceleration of the cranial vault

• **Impact loading**: direct application of forces to the head

• Both result in distinct but overlapping injury
Seizure in AHT

• Clinical seizure are common as initial symptoms (40-70%), focal seizures are the most common
• It can be clinical (22%) or subclinical (47% in those who underwent EEG monitoring)
• Status epilepticus occur in 3-11%

Jennett B. Arch Neurol 1977
Arndt DH, et al. Epilepsia 2013
Electrographic seizure

• Electrographic seizures are common in children with AHT

• In one study, up to 57% of EEG monitoring cases have electrographic seizure and 67% of these have electrographic status epilepticus

• They have no clinical correlation

Electrographic seizure

• Identification of electrographic seizures direct and change the management in most cases
• These patients need prolonged EEG monitoring either by conventional VDO-EEG, aEEG, or limited channel EEG

Seizure and Epilepsy in AHT

• 404 patients with AHT (95% less than 1 yr.)
• Seizures are presenting symptoms in 73%
• Focal seizures are the most common
• Subclinical seizure in 25%
• 9% died of refractory SE and severe IICP

Epilepsy and other long-term complication

- Epilepsy occur in 20 - 38% in those who survive and are often intractable
- Infantile spasm in some patients
- Other serious complications
  - Chronic encephalopathies
  - Intellectual disability
  - Behavioral problems

Birca A, Journal of Child Neurol 2014
Summary

• Further studies of TBI exclusively in children are needed in order to delineate the appropriate management

• In children, especially in infant, abusive head trauma should be kept in mind when encounter a case of head trauma

• Appropriate seizure/epilepsy treatment is crucial to prevent further brain injury

• A long-term follow up in these children are necessary