Pediatric Traumatic Brain Injury

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Modules

- Module 1: Overview
- Module 2: Cognitive and Academic Needs
- Module 3: Psychological/Psychiatric Consequences and Needs
- Module 4: Family and Social Consequences and Needs
Module 1: Overview

- Incidence & Prevalence
- Nature of Injury
- Predictors of Outcome
Incidence of Pediatric TBI

- 180 per 100,000 children per year (Kraus, 1995)
- Boys 1.3 to 2.0 times the rate of girls (Rivara, 1994)
- Cause changes with age (Donders, 2006)
  - TBI from child abuse primarily below age 3
  - Younger children more likely to sustain injury in falls
  - Older children more likely to sustain injury in motor vehicle crashes
  - Transportation and falls account for more than 50% of pediatric TBI
- 80-90% mild TBI
For every death due to pediatric TBI, there are 32 children hospitalized for TBI, and 152 children getting medical attention for TBI.

Kraus, 1995
Changing sex ratio

At older ages, TBI is more common among boys than girls.

Figure 2-3. Incidence of pediatric head injury by age; female on left in each case (San Diego County, CA).
Severity of TBI

- Depth of Coma
  - Glasgow Coma Scale (Teasdale & Jennett, 1974)
  - Mild TBI: GCS 13-15
  - Moderate TBI: GCS 9-12 or GCS >12 but evidence of brain lesions
  - Severe TBI: GCS < 9

- Duration of Impaired Consciousness
  - Number of days until follows simple commands

- Duration of Post-traumatic Amnesia
  - Children’s Orientation and Amnesia Test (COAT; Ewing-Cobbs et al., 1990)
Neuropathology of TBI

- Primary Injury
  - Intracranial contusions and hemorrhage
  - Shear-strain injury
- Secondary Injury
  - Brain swelling
  - Cerebral Edema
  - Elevated intracranial pressure
  - Hypoxia-ischemia
  - Mass lesions
- Neurochemical

Yeates (2010)
Predictors of Outcome

- Medical Predictors
- Nonmedical Predictors
Medical Predictors of Neurobehavioral Outcomes

- Depth of coma (GCS)
- Length of coma
- Duration of impaired consciousness
- Pupil response abnormalities
- Cerebral Perfusion Pressure
- Focal lesions
- Early medical intervention?
Nonmedical predictors

- Age
- Pre-injury learning and behavioral characteristics
- Socioeconomic Status
- Pre- and post-injury family status
Age at Injury

- Evidence that younger children are more vulnerable to effects of TBI than older children and adolescents.
- Vulnerability is most notable in those injured below age 7, and particularly those injured in infancy/preschool.
- Effect of age at injury on risk depends on the skill; for example,
  - Reading decoding outcomes poor if TBI before age 6.5
  - Reading comprehension outcomes poor if TBI before age 9.
Bases for age effects

- Greater susceptibility of immature brain
- Greater effects on subsequent brain development
- Damage to brain systems responsible for skill acquisition
- Negative effects on ability to interact with the environment – which then affects ability to learn from those interactions
Intelligence (I.Q.)

- Injury in infancy or preschool results in lower IQs
- In older children, the effects on IQ vary
- Children with average IQs after a moderate to severe TBI can, and often do, have cognitive impairments.
- The greatest effects are on portions of the IQ tests that measure processing speed.
The Process of Recovery: IQ (Isle of Whyte)

- Cognitive recovery is most rapid in the first six months after TBI
- IQ tends to plateau with the first year or two
Slowed Processing Speed

- Bradyphrenia (slowed thinking)
- Bradykinesia (slowed movement)

The higher the speed demands of a task, the worse the performance of children with severe TBI.

Bawden et al. (1985)

Fig. 1. Severity of head injury and summeray measures of speeded performance.
Attentional Impairments

- Sustained attention: paying attention/focusing for a period of time.
- Selective attention: Paying attention to some information while ignoring other information.
- Divided attention: Paying attention to more than one thing at a time.
- Secondary Attention-deficit/hyperactivity Disorder (SADHD)
  - Six months after injury, SADHD is noted in 15-16% of children hospitalized for TBI
  - 12-24 months after TBI, 21% exhibited SADHD
Executive Dysfunction

- Working memory: Holding information in mind while manipulating it (e.g., say your telephone number backwards)
- Inhibition: “Putting on the brakes”, holding back from doing things upon impulse.
- Planning difficulties
- Executive dysfunction is associated with damage to frontal portions of the brain
Memory impairments

- Memory difficulties after pediatric TBI are a common complaint; e.g., memorizing a list.
- Nature of difficulties
  - Explicit memory (the ability to consciously recall information) often more impaired than Implicit memory (demonstrating acquired skills without conscious recall; e.g., driving with a stick shift)
  - Prospective memory (remembering to do something later) is often impaired.
Language and Communication

- After an initial period of recovery, children with TBI rarely are aphasic, unable to speak or understand.
- Impairments in high level language functions
  - Discourse: The ability to express a message as a cohesive set of ideas
  - Pragmatic communication: The normal give and take in a conversation
- Vocabulary and other basic skills are not as affected by TBI.
Level of Independence after TBI

- Children with severe TBI have lower levels of independence.
- They can fall further behind peers over time.

Fletcher et al. (1990)
Mild TBI

- Glasgow Coma Scale rating 13-15
- Neuroimaging findings negative
- Post-traumatic Amnesia <1 Hour
Post-Concussive Complaints from Children with Mild TBI vs Orthopedic Injury

- Headaches
- Photosensitivity
- Dizziness/balance
- Anxiety**
- Inattentiveness
- Typically largely resolves within 3 months

(Mittenberg et al., 1997)
While it is common for children with TBI to need special education support, needs vary.

There is not a specific learning disability associated with TBI.

Children injured at younger ages are more likely to show impairments in academic achievement.

However, there is a special education Traumatic Brain Injury rule, that allows children to receive support.
Special Education Category: TBI

• “...acquired injury to the brain which is caused by an external physical force and which results in total or partial functional disability or psychosocial impairment, or both, that adversely affects a student’s educational performance.”

• Impairment in (one or more): Cognition, language, memory, attention, reasoning, behavior, physical functions, information processing, speech
Needs when returning to school after pediatric TBI

- Fatigue/Headaches: Partial days usually quite limited but base recommendation on parent/teacher observations.
- Slowed Processing Speed: Relaxation of time constraints/modified length of assignments
Returning to School (Cont.)

- **Attentional difficulty**
  - Environmental modifications
    - Strategic seating
    - Quiet study area
- **“Patchy” recall**
  - Typically improves
  - Copies of class notes
- **Anxiety**
  - Return to routine
  - Psychological services, as needed
Module 3: Psychological/Psychiatric Consequences and Needs
TBI entails greater risk for psychiatric difficulties

Compared to groups of children with other conditions, children with structural brain damage have greater risk for psychiatric disorders

| TABLE 4-1. Psychiatric Disorder and Physical Illness in an Unselected Population |
|---------------------------------|-----------------|
| General population              | 6.7%            |
| Chronic non-CNS illness         | 12%             |
| Peripheral sensory deficits (deaf/blind) | 18%         |
| Idiopathic epilepsy             | 28%             |
| Structural brain damage         | 35%             |
| Structural brain damage with epilepsy | 54%         |

Source: From Rutter et al., 1970.
Risk for Behavioral Difficulties

- More severe TBI associated with greater risk for behavioral problems (Schwartz et al., 2003)
- While cognitive problems can improve over time, behavioral difficulties can get worse
- Persisting personality change due to severe TBI in approximately one third of children two years after injury (Max et al., 2000)
Depression, Anxiety and PTSD

- Not a well-studied area
- Risk for depression, particularly in adolescents
- Obsessive-Compulsive Disorder
- Generalized Anxiety Disorder
- Separation Anxiety
- Post Traumatic Stress Disorder?: Greater symptoms, though few children meet all the criteria for PTSD after TBI.
Aggression after TBI

- Oppositional Defiant Disorder is one of the most common psychiatric difficulties after TBI.
- However, there is less known about the risk for increased aggression towards others after pediatric TBI (Cole et al., 2008)
  - Some evidence from parent reports, of increased risk for physical aggression towards people and objects.
  - Aggression after TBI predicted by preinjury child behavior problems and preinjury family adversity, as well as child’s level of disability after TBI.
Challenges to Psychosocial Interventions

- In rehabilitation, accurate assessment of causes of “noncompliance” with therapies
- Accurate assessment of depression and anxiety
- Developing behavior modification plans in specific settings, such as the hospital
- Family ability to monitor behavior and implement a structured intervention in the community
Challenges to Collaborative Interventions

- Obtaining adequate consultation for teachers and other school professionals
- Dynamic nature of recovery requires careful monitoring and frequent revision of interventions
- Relatively few child neuropsychologists or neuropsychologically-informed professionals
Empirically Supported Psychological and Behavioral Interventions after TBI

- “Possibly efficacious”
- Major focus has been on externalizing or acting out behaviors with evidence of that types of behavior therapy are effective; e.g., operant conditioning
- No outcome studies address internalizing features
- Family intervention
Module 4: Family and Social Consequences and Needs
Impact on Family of Pediatric TBI

- Injury-related stress and family burden
- Family difficulties can become more prominent during developmental transitions (e.g., starting Middle or High School, graduating)
- Needs identified by the families
  - More information about the injury, recovery and outcome
  - Resources
  - Communication with families who have been through similar trauma
Factors that predict long-term family difficulties

- Socioeconomic status: Family education and income
- Preinjury family resources
- Preinjury family stress
  - Stress and conflict
  - Lack of family support
- Parent coping strategies
  - Acceptance and humor
  - Denial

- Reciprocal relations between family and child difficulties: Each influences the other

Wade (2006)
Family Intervention

- Families with greater resources, lower general stress and healthy coping strategies may require limited intervention
  - Information
  - Anticipatory guidance

- At risk families
  - Information, resources and support
  - Intensive skill building interventions

- Needs will change over time
Family intervention

- Education alone is not sufficient to reduce family stress
- Stress management programs reduce parent anxiety and depression
- Family problem-solving intervention (Wade et al., 2006)
  - Decrease in depression in children with milder and more recent injuries
  - More effective when the child is older
  - Less effective when the injury is less recent, more severe, and the child is younger
Social behavior and Peer relations

- Pediatric TBI entails risk for lower social competence and loneliness

- Social difficulties
  - Understanding emotion
  - Understanding others’ reactions or state of mind
  - Social problem-solving: Difficulty figuring out what to do in certain situations and how to be assertive

- Social outcomes tend to be worse in families that are lower functioning and have fewer resources
Social Skill Interventions

- There are specific interventions for deficits in understanding others’ emotions and states of mind
- There are promising school-based interventions for social skills
- Generalization strategies, ways of cueing the child to practice and use new skills in different setting, are very important
- Maintenance strategies also are needed to continue to reinforce skills
Guidelines for Neuropsychological Referral

- In general, not necessary to refer if:
  1) Mild Injury
  2) No focal neurological findings
  3) No evidence of change in Cognition/Personality

- Refer for neuropsychological screen or full evaluation if:
  1) Focal neurological findings
  2) Persisting attention, processing speed, memory, or academic difficulties

- **Screening** evals occur approximately two weeks post-injury

- In general, **Full** evals do not occur until a minimum one month post-injury
Summary

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