Development Disrupted: Taking another Look at Pediatric Brain Injury

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Objectives of Presentation

- To understand current terminology and research on the plasticity of the young brain related to cognitive communicative function.
- To identify predictors of cognitive/communicative outcomes based on type, location, and severity of brain injury.
- To compare and contrast commonly held views about PTBI using current research regarding neuroimaging and development.

Terms

- Acquired Brain Injury (ABI) - injury sustained any time after natal period
- Traumatic Brain Injury (TBI) – any ABI sustained by a physical force
- Abusive Head Trauma (AHT) – an inflicted brain injury – only preventable brain injury
- Severity – Glasgow Coma Scale (GCS) Severe 8 or below, moderate 8 to 12, mild 13 – 15; Rancho Los Amigos Scale- Levels 1 (no response through Level 8 (purposeful-appropriate response)
- Diffuse axonal injury (DAI) - damage occurring over widespread area of the brain, extensive lesions in white matter
- Myelin – is a dielectric material that forms a layer around an axon of a neuron

Executive Functions*

- Response Inhibition – capacity to think before you act
- Working Memory – ability to hold information in mind while performing complex tasks
- Emotional Control – ability to manage emotions in order to achieve goals or complete tasks
- Sustained Attention – capacity to attend to task or situation despite distractibility, fatigue or boredom
- Task Initiation – ability to begin a task without undue procrastination
- Planning/Prioritization – ability to create a roadmap to reach a goal or complete a task
• Organization - ability to design and maintain systems for keeping track of information or materials
• Time Management – capacity to estimate how much time one has to complete a task and to stay within time allowed
• Flexibility – ability to revise plans in the face of obstacles
• Goal Directed Persistence – capacity to follow through to the completion of a goal in the face of other demands or competing interests
• Metacognition – ability to stand back and take a birds-eye view of self or situation

*Dawson, Peg and Guare, Richard

Myths
1: Falls are the main cause of pediatric brain injury.
   FACT: This is partially true – 56% of cases of serious brain injury of children younger than 1 year of age are due to inflicted injury. Some cases of reported falls are likely inflicted injuries.
   -24% of consecutively admitted children have inflicted injuries
   -32% are suspected inflicted injuries

2: Only babies as susceptible to abusive head trauma.
   FACT- All children (any age) may be victims of abusive head trauma (shaken impact syndrome).

3: Socioeconomic status and/or ethnicity are highly correlated with child abuse
   FACT- Children from all socioeconomic backgrounds and ethnicities are victims of abuse, including children from affluent and educated backgrounds

4: Children who sustain severe head injuries at a younger age have fewer sequelae and better functional outcomes.
   FACT- Children who sustain severe injuries at early ages experience developmental delays and lower IQ even 10 years post-injury.

5: Age at injury is not predictive of outcomes in children with mild to moderate brain injury.
   FACT- Age in and of itself may not predict outcomes in children, however, age of injury combined with processes that are developing at the age of injury may be predictive of outcome 10 years post injury.

6: Children do not need rehabilitation or habilitation after injury
   FACT- Creating more neural pathways is ALWAYS critical for continued growth and development

7: Cognitive recovery mirrors physical recovery in infants and young children
   FACT- The better the student looks, the harder it is to recognize other deficits that may impact function
8: TBI as a diagnosis means that students require special education
FACT- Some students with TBI require special education, others require a 504 Plan, and others are in general education with no accommodations

**Neuroplasticity**
The ability of the neurologic system to respond to extrinsic and intrinsic stimuli by reorganizing its structure, function and connections (Cohen et al., 1997)

Functional reorganization/compensation within residual neural tissue, mediated by changes in neural circuitry (Gonzalez et al., 2008) is:

- Viewed as “adaptive” plasticity when associated with gain or function
- Viewed as “maladaptive” when associated with negative consequences such as loss of function or increased injury

In neuroscience research, improved function after brain damage falls into two major categories:
1. Efforts to limit the severity of the initial injury to minimize loss of function
2. Efforts to reorganize the brain to restore and compensate for function that has already been compromised or lost

**Neuroplasticity Principles**
1. Use it or Lose It: Neural circuits not actively engaged in task performance for an extended period of time begin to degrade
2. Use it and Improve It: Increased biological activity = enhanced future functioning
3. Specificity: The only changes in neural substrates may occur in particular brain areas responsible for the behavior being trained.
4. Repetition Matters: Changes in neural substrates will occur only as a result of number of repetitions per session and the number of sessions in a time frame for a behavior to be consolidated.
5. Intensity Matters: If continuous training occurs, the likelihood of an increase in synaptic change is greater.
6. Time Matters: Different forms of neural plasticity may occur at various times in response to treatment.
7. Salience Matters: Neural plasticity is enhanced when activities are meaningful to the person.
8. Age Matters: It is clear that neuroplasticity responses are altered in the aged brain; however neural plasticity can occur over the entire lifespan.
9. Transference: Refers to the ability of plasticity within one set of neural circuits to promote concurrent or subsequent plasticity in other circuit sets.

10. Interference: Plasticity can impede behavioral change by interfering with the laying down or creation of new circuitry

**Bibliography**
