Cognitive Assessment After Pediatric Traumatic Brain Injury (TBI): Inpatient to Outpatient Follow-up

SARAH TLUSTOS-CARTER, PH.D. AND CHRISTINE PETRANOVICH, PH.D.
CHILDREN’S HOSPITAL COLORADO, DEPARTMENT OF REHABILITATION
Disclosures

Christine Petranovich and Sarah Tlustos-Carter declare no conflicts of interest

We do not have any financial relationships to disclose
Agenda

Review of relevant literature
  ▪ Pediatric-specific considerations
  ▪ Inpatient rehabilitation cognitive assessment

TBI services at CHCO
  ▪ The value of a team approach
  ▪ Neurotrauma Unit
  ▪ Acquired Brain Injury (ABI) Clinic

Associations of inpatient factors with 1-year outcomes

Case example

Conclusions
Pediatric-Specific Considerations

Compared to adults – children’s brains still developing!

• More likely to have diffuse injuries and certain secondary complications, such as seizures

Diffuse damage may interrupt cerebral development

• Development of white and gray matter
• Abnormal circuitry results
• Young children have few ‘developed’ skills: less to “recover”
• Can interfere with future skill acquisition
Pediatric-Specific Considerations

Prognosis improves as age of injury *increases*
  • Can’t ‘recover’ what was never there in the first place!
  • Late-emerging deficits: *Growing into lesions*

Must also consider the *contextual demands*
  • Demands of school: Continual demands to acquire new information
  • What is the child being asked to do and when being asked to do it?
Functional Impact in Children: Education

Greater deficits in arithmetic than reading

Reading comprehension, written expression may be affected by other deficits (EF)

Standardized tests of academic achievement

- Significant differences not always apparent
- Adequate achievement scores in many cases
- Typical “LD” pattern not seen
Yet, clear educational (and vocational) problems

- Poor classroom performance
- Increased need for special education services
- Drop out of school early
- Trouble finding competitive employment
Starting Early: Inpatient Assessment
Inpatient Cognitive Assessment

- Limited adult research
  - Verbal memory and executive functioning associated with activities of daily living (Hanks, Jackson, & Crisanti, 2016; Hanks et al., 1999; Hanks et al., 2008)
  - Injury-related factors: GCS, Functional Independence Measure (FIM), and length of inpatient stay (Sandhaug et al., 2010)
- Literature even more sparse in children
  - Time to follow commands and time from injury to rehab admission predict functional status (Kramer et al., 2013)
Cognitive and Linguistic Scale (CALS)

- Developed by Beth Slomine, Ph.D. & Janine Spezio Eikenberg, M.S., CCC-SLP at Kennedy Krieger Institute
  - Children and teens age 2-19
  - Items range from basic responding to higher-level cognitive skills to be used across continuum of recovery
    - Structured observations + task performance
    - Good interrater reliability and internal consistency (Slomine et al., 2008)

- 20 items, rated 1-5 (total scores range from 20-100)
  - Significant change from admission to discharge
  - CALS is highly correlated with the WeeFIM, although potentially more sensitive as improvement was shown on the CALS even in patients with limited/ no change on the WeeFIM
TBI Services at CHCO and the Role of Neuropsychology
Value of Teamwork

- More than 80 randomized controlled trials have shown collaborative care to be more effective than usual care for common mental health conditions.
- Results in more effective communication among providers.
- Can increase initial costs, but reduces total medical expenditures in the long-run (Serrano, 2014).
  - Although this evidence is mixed (Ke et al., 2013; Kubu, 2016).
CHCO Rehab Process: A Team Approach

- Family and staff meetings of entire team
- Phases help guide progress toward discharge
- Return to school built in.
- Factors considered:
  1. Medical stability
  2. Fatigue
  3. Behavior
  4. Level of support required
What neuropsychology brings to a team

- Understanding of brain-based influences on behavioral and emotional presentations
- Objective information about current functioning
- Highlights risks and protective factors
- Integration to school and community
- Ability to track recovery of function over time
- Can be therapeutic to patients and their families
CHCO Inpatient Neuropsychology Service

**Acute recovery phase**

Serial assessments
- Baseline, progress monitoring
- “recovery” vs. response to intervention

Single point assessments
- Developing initial treatment goals
- Understanding strengths and weaknesses
- Integrated case formulation
- Informs needed adaptations to traditional treatment approaches
Inpatient Cognitive Monitoring

- Initial assessment
  - Orientation, Emergence from Post-traumatic Amnesia (PTA)
  - Mental Status (basic screening of language, visual-spatial, basic attention, immediate memory)
  - Cognitive and Linguistic Scale (CALS)
  - Other, as indicated

- Serial monitoring: Repeat CALS every 1-2 weeks and prior to discharge
Discharge Assessment

- Complete abbreviated neuropsychological battery (~1.5-2 hours)
- Purpose is to inform transition back to home and school
- Reintegration
  - Need specialized educational program or supports?
  - Need specific home-based supports (structure / routines)?
  - Inform cognitive abilities for ongoing therapies
  - How will current abilities impact participation in psychological therapies or response to behavioral management?
- Still recovering. Abilities expected to change throughout recovery and development
Neuropsychological Assessment

Domains Assessed:
- Intellectual capacity
- Sensory-Motor
- Language
- Visual-Spatial
- Memory
- Attention
- Processing Speed
- Executive Functions
- Emotional Functioning
- Social Functioning
- Academics – Pre-injury estimate
Rehab Discharge Checklist
CHCO Acquired Brain Injury (ABI) Clinic

- Goal: long-term, multidisciplinary follow-up care after acquired brain injuries

- The team:
  - Speech/ language therapy
  - Occupational therapy
  - Physical therapy
  - Rehabilitation medicine and nursing
  - Rehabilitation psychology and neuropsychology
  - School/ education coordination
  - Social work
ABI Clinic

Cognitive Recovery on a continuum....

CO Brain Injury Steering Committee: Adapted from Miller, 2007; Reitan and Wolfson, 2004; Hale and Fiorello, 2004
CHCO Follow-up care after TBI

Inpatient

1 month: Emotion inventory and review discharge testing

3 months: Academic screening

6 months: Screening focused on attention, speed, and memory

12 months: Comprehensive evaluation
Comprehensive Neuropsychological Assessment: Cognitive measures

- Typically 5-6 hours of cognitive testing
- Based on the patient’s history, injury characteristics, and current concerns
- A core battery based on the Common Outcomes Measures in Pediatric TBI (McCauley et al., 2012)
  - IQ
  - Academic skills
  - Attention
  - Processing speed
  - Executive functions, both performance-based and standardized report
  - Fine motor
  - Memory
  - Behavior and emotional functioning
  - Quality of life
Outcomes after inpatient rehabilitation: Preliminary findings

<table>
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<tr>
<th></th>
<th>Full-Scale IQ</th>
<th></th>
<th>BASC Adaptive Functioning</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Unstd $\beta$ (SE)</td>
<td>$t$ ($p$)</td>
<td>Unstd $\beta$ (SE)</td>
<td>$t$ ($p$)</td>
</tr>
<tr>
<td>Length of stay</td>
<td>-.40 (.12)</td>
<td>-3.20 (.01)*</td>
<td>-.20 (.22)</td>
<td>-.09 (.93)</td>
</tr>
<tr>
<td>Lowest GCS</td>
<td>-2.10 (.96)</td>
<td>-2.19 (.06)</td>
<td>-1.84 (1.15)</td>
<td>-1.16 (.29)</td>
</tr>
<tr>
<td>Initial CALS</td>
<td>.24 (.11)</td>
<td>2.07 (.07)</td>
<td>.12 (.18)</td>
<td>.65 (.54)</td>
</tr>
</tbody>
</table>
Longer length of stay  |  Shorter length of stay
---|---
Lower GCS  |  Higher GCS
Case Example

• Previously healthy, right-handed male

• No preexisting developmental, cognitive, or learning problems

• Some pre-injury conduct and behavioral issues that likely contributed to the circumstances around the injury

• 14 years old at the time of injury
  • TBI resulting from an assault
  • GCS = 7 upon arrival to the hospital, reflecting that it was a severe injury
  • CT: mild asymmetry in the prominence of cerebral sulci greater on the left than the right. There is slightly prominent pretemporal subarachnoid space on the left compared to the right
  • Seizures
Case Example: Inpatient Data

• Inpatient CALS showed expressive language, attention, and organization
  • Story formulation: tangential, run-on sentences, poorly organized
  • Difficulty with problem-solving, identifying steps to complete a complex task
  • Fairly good insight, but often off-topic and easily frustrated by challenge
Case Example: Discharge Testing

- Discharge testing:
  - Average overall IQ, *slightly weaker verbal* (low average) than nonverbal (average)
  - Average single-word reading and brief attention/working memory
  - Severely impaired to low average *processing speed*
  - Executive functions: Planning average, verbal fluency average for categories and mildly impaired for letters, *cognitive set shifting* mildly impaired
  - Verbal and visual learning and memory: *immediate and delayed impaired*, recognition intact
  - *Fine motor skills* impaired bilaterally
Case Example: ABI Follow-Up

- Healthy since the injury
  - Outpatient physical and occupational therapies after discharge
- Word finding most notable concern
- Mild concerns about organization, attention, and distractibility
- Per mother, “speaks his mind, but isn’t aware that he may be rude or disrespectful”
  - Briefly received mental health therapy 2x after the TBI
- Fatigue and poor sleep
- IEP implemented after the TBI
  - Accommodations in general education setting
  - Difficulty making up missed credits
  - Teacher concerns about missing assignments and not participating in class
Case Example: ABI Follow-Up

• Affect mostly neutral, friendly and socially engaged
• Notable frustration on challenging tasks (“I will walk out of here”)
• Word finding problems (“I can’t think of what it’s called”)
• Attention and activity level normal
Case Example: ABI Follow-Up

• Low average overall intellectual ability

• Expressive language, visual-spatial skills, attention/working memory, and fine motor coordination broadly normal

• Processing speed ranged from mildly impaired to average

• Memory:
  • Impaired immediate and delayed recalls on verbal memory, average recognition
  • Low average immediate and delayed recalls on visual memory, impaired recognition

• Executive functions:
  • Mildly impaired cognitive flexibility and inhibition
  • Variable verbal fluency
  • Mother denied concerns on standardized rating
Case Example: Conclusions

- Multiple improvements, most notably fine motor coordination
- Areas of weakness were consistent across evaluations
  - CALS seemed to pick up executive/organizational weaknesses early in the course of recovery
  - Executive functions, processing speed, and memory improved, but persisted as areas of weakness across evaluations
- Pre-injury history + TBI places him at risk for behavior and emotional difficulties moving forward
- Will likely require moderate accommodations in school and in jobs settings
- Recommended another neuropsychological follow-up in 1-2 years to continue to monitor progress
Conclusions and Future Directions
Conclusions

• Nationally, there is greater interest in early assessment to help guide treatment

• A collaborative approach that includes cognitive assessment is valuable for patients

• Early cognitive assessment may help to better predict longer-term outcome
Program Goals

- Establish standards for inpatient cognitive assessment for rehabilitation
- Better understand the relationships of inpatient factors with 1-year outcome
- Within our program, increase consistency in measures and procedures
- Better support transition from hospital to home
Thank you!

Sarah.Tlustos@childrenscolorado.org

Christine.Petranovich@childrenscolorado.org