Rapid Mass Neuropsychological Testing

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Presentation Outline

- Rapid Neuropsychological assessment
  - Compared with traditional NP assessment

- Scope of the assessment

- Populations being assessed?

- Assessment Methods & Tools

- Issues & Challenges
Traditional vs. Rapid, Mass Neuropsychological Assessment

- The Fable of the Mercedes and the Maserati
Traditional Neuropsychological Assessment – the Mercedes

Everyday life → Injury → Recovery / Defining the post-injury me

NP Ax’t NP Ax’t
Traditional Neuropsychological Assessment

The Mercedes Version

- Cases of suspected/identified brain injury
- Various purposes:
  - identify strengths/weaknesses, treatment planning, estimation of long-term outcome,
- Careful review of available medical records
- 5-10 hours of individualized testing
- Preparation of a lengthy report (10-15 pages)
Room for the Maserati model
Why do we need a Maserati model?

- Who is at risk?
  - Risk as a result of **higher rates of occurrence than in the general population** owing to a specific activity in which an individual (routinely) engages
  - Risk as an **unacceptable resulting level of post injury performance** of regular duties/responsibilities because of the change in cognitive functioning
  - when can duties resume?

- The large size of the group membership
To what groups does this apply?

- Hockey players
- Football players
- Soccer Players
- Military
- Airline pilots
- Others…
What are we assessing?

- Whether there has been an injury
- The severity of the injury
- Fitness to resume activity
Rapid, Mass Neuropsychological Testing

Possible NP Baseline Ax’t*

Everyday life with high-risk activities

Injury

Comparative NP Ax’t

Recovery / Activity resumption decision

Comparative NP Ax’t

*baseline data need to be updated regularly
It’s really all about Concussion

- Isn’t this a good place to insert a

CONCUSSION PRIMER
Definition(s) of Concussion

- A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces;
- typically involves temporary impairment of neurological function which quickly resolves by itself;
- neuroimaging shows no gross structural changes to the brain?

(International Symposium on Concussion in Sport (2001))
# Concussion Classification/MTBI

<table>
<thead>
<tr>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
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</thead>
<tbody>
<tr>
<td><strong>Cantu</strong></td>
<td>No LOC</td>
<td>LOC &lt; 5 mins OR</td>
</tr>
<tr>
<td></td>
<td>PTA &lt; 30 mins</td>
<td>PTA 30 mins-24hrs</td>
</tr>
<tr>
<td><strong>Colorado</strong></td>
<td>Confusion, No LOC</td>
<td>Confusion, PTA, NO LOC</td>
</tr>
<tr>
<td>Medical</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AANG</strong></td>
<td>Confusion, SX &lt; 15 mins NO LOC</td>
<td>SX&gt; 15mins NO LOC</td>
</tr>
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</table>
Symptoms of Concussion

- Confusion
- PTA
- Headache/neck pain
- Nausea
- Concentration
- Memory
- Organization
- Slowed thinking / acting / speaking
- Decision-making / problem solving
- Dizziness
- Sleep (probs/more)
- Loss of balance
- Sensitivity to noise/light/ distrac’ns / ringing in ear
- Blurred/tiring vision
- Loss of taste/smell
- Sad/anxious/irritable
Concussion and the NHL
NHL Factoids

- Average concussions per year: 80
- Trend towards decreasing reports of concussion

**BUT**

- Increased time away b/c of concussion
  - Increased severity? (bigger players, equip)
  - More stringent rules for return to play?

*(Can J. Neurolog Sci; 2008 35(5) 647-51)*
NHL Criteria for testing

- <30 mins
- Culturally/linguistically diverse
- Repeatable
NHL Protocol

- Mandatory NP (Neuropsychological) Baseline Testing since 1997/8 season
- Each NHL team has their own NP
- Between 1997-2007 N=4000
- Initially used paper & pencil battery alone
- Now, combo of P & P and Computerized Testing
NHL Paper & Pencil Tasks

- Hopkins Verbal Learning Test
- Colour Trails
- Cancellation Task
- SDMT
- COWAT
- BVMT
NHL Computerized Testing: ImPACT

- Immediate Post-Concussion Assessment and Cognitive Testing
- 20 mins
- Contains the Post Concussion Symptom Scale
- Comprised of 6 modules assessing:
  - Attention Span and Working Memory
  - Sustained and Selective attention
  - Response Variability
  - Non-Verbal Problem Solving
  - Reaction time
  - 20 min Delayed Word Recall & design memory
...ImPACT

- Includes
  - symbol digit-substitution,
  - Choice reaction task
  - Sternberg 3-letter recall task
  - Visual working memory task

- Timed to 100th of a second precision
- Immediately scored:
  - Verbal Memory composite
  - Visual Memory composite
  - Visual Motor Speed
  - Reaction Time
  - Impulse Control
- Change Score (Reliable Change Index)
Return-To-Play

- NP testing occurs at baseline

- NP re-testing occurs when player reports he is ASYMPTOMATIC at rest & after exertion

- If NP testing passed then results reviewed independently and final decision rests with team physician after consulting with NP
Concussion and the NFL
The World of NFL Football

■ Scope of the population: high school / college Varsity athletes and pros
■ Concussion is legendary - >61% of players; nearly 1/3 report ≥ 3 concussions; 15% had ≥5
■ RTP decisions critical – second impact syndrome
  – Agreement that RTP once asymptomatic & NP & medical clearance
■ Historically, sideline assessment of symptoms and brief screening
  – how many fingers?
■ NFL using ImPACT
Self-report of symptoms with the Sport Concussion Assessment Tool-2 (SCAT2) (2009)

- Published with Consensus Statement on Concussion in Sport (Third Int’l Conference on Concussion in Sport – Zurich, 2009)
- Eight components (based on other scales)
- Assesses concussion symptoms, cognition, some neurological signs
- “Score card” format for tracking change
- Includes GCS
Soccer (Australian Footballers)

- Soccer – significant concussions

- Australian footballers include Aboriginal players with different linguistic/cultural background than white Australian players

- Need for baseline and injury-related testing

- Development of CogState-Sport Program
CogState

- Computerized assessment program
- Culture-neutral
- Not limited by education or SES
- Designed as a flexible battery (17 subtests) with various applications: diseases, disorders, healthy volunteers, clinical trials
- WEB-based: web-submitted & scored
- CogState-Sport is a particular arm of the larger system
CogState-Sport: Subtests

- All subtests based on playing-card stimuli
- All Yes/No responses
- Four subtests:
  - Simple Reaction Time
  - Choice Reaction Time
  - nBack
  - Visual Recognition Learning Task
Military Applications
The American Approach

- Concussion definition is the same
- Causal Mechanisms are the same but add:

Blast and Blast Wave Injuries
ANAM

Automated Neuropsychological Assessment Metrics

- Also referred to as NCAT (Neurocognitive Assessment Tool)
- Based on multiple computerized batteries developed since 1970s
- Initially developed to examine performance changes in healthy individuals such as effects of neurotoxicology
  - Iraq chemical weapons, antidotes, fatigue countermeasures (stimulants)
- Clinical applications: MS, Lupus, PD, AD
- Since 2007: US focus is TBI in military
ANAM...2

- Now 31 test modules + companion Utilities

- Military protocol: NeuroCog-13 modules (30mins)

  - Demog, sleepiness scale-r, mood scale-r,

  - Simple RT, coding substitution, matching grids, Delayed matching to sample, mathematical processing, logical relations-symbolic, Running Memory CPT, coding substitution (delayed), Memory Search (Stern6), Simple RT2

ANAM Sports Medicine Battery (ASMB)
ANAM...3

- Keyboard / mouse / voice-recognition responding
- Windows-based for IBM-compatible systems
- Handheld (Palm-OS) available: initially developed for Migraine Early Warning Tool for in-home monitoring
Baseline testing required of all Service members prior to next deployment

N=107,000 for norms on US military personnel
The Canadian Picture

- No Baseline Cognitive Testing
- If Injury suspected initiate Protocol that is in place
  - Includes screening tool
  - Return to duty if symptom-free on screening (even on exertion)
  - NP testing only if symptoms persist
MACE
Military Acute Concussion Evaluation

- Derived from the SAC (Standardized Assessment of Concussion) tool (well-validated sports-concussion assessment tool, but not validated on its own)

Two components
- Injury description and symptom identification
- Bedside test of attention, concentration, memory

- Total Score / 30
- Alternate forms
MACE - clinical decisions

- If Screening MACE (first component) is positive, entire MACE is administered.

- If MACE <25 administer full clinical exam.
Commercial Pilots
(Transport Canada Guidelines)
Commercial Pilots (Transport Canada Guidelines)

- 2% rule

- Two issues for Pilots:
  - Cognitive Change
  - SEIZURES
## Transport Canada Guidelines for Pilots with Head Trauma

<table>
<thead>
<tr>
<th>Minor Accident</th>
<th>Mild Concussion</th>
<th>Mild Concussion + PTA</th>
<th>Mod + PTA</th>
<th>Mod “+”</th>
<th>Severe TBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No LOC or concussion</td>
<td>- Brief LOC</td>
<td>- Sx &gt; 1 wk</td>
<td>- MRI WNL</td>
<td>Need NP Testing</td>
<td></td>
</tr>
<tr>
<td>- No PTA</td>
<td>- PTA &lt; 30 mins</td>
<td>- CT/MRI Normal</td>
<td>- Cog normal by 3 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SCAT2 = 0</td>
<td>- CT Normal</td>
<td>- SCAT2</td>
<td>- PTA &lt; 24h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return in 1 week</td>
<td>Fly in 1 month</td>
<td>Simulator/practice flt</td>
<td>Fly in 2 yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fly in 1 yr</td>
<td>No return to flying</td>
<td></td>
<td></td>
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</tbody>
</table>
Issues, Challenges and Strengths

This may be the “Geekazoid” part of the presentation!
Recurring Themes...

- Increasing attention to issue of concussions
  - Single and repeated

- Problems relying on self-report (alone) in these populations

- Return to Play/Duty only when symptom free and back to baseline (where available) in free-and exertion testing
The concept of “Value-Added”

- Repeatedly studies find NP testing adds more than self-report symptoms; computerized testing appears to test somewhat different aspects than P & P and a combo of P & P with computerized testing may be optimal

- Will be the standard to which future procedures will need to be upheld
Using Computerized tests: Requirements and strengths

- Multiple trials
- Dealing with practice effects
- Brief
- Fatigue/motivation (looking out the window during group testing)
- Test-item security as don’t release whole protocol, just the computerized report
Testing/Assessment Issues

- Assessment vs. testing: who administers and who interprets
- How many baseline measurements do you take?
- How often do you take baseline measurements?
  - E.g., maturation effects
- How matched must baseline and post-injury conditions be? (can they be matched?)
- Web-based normative data for comparison: can’t be used when need secure connection in military field – can you use group norms?
- Computerized Timing issues
Data Issues

- Who keeps the data?
- Who has access?
- Can the data be merged with medical data? (If so, who keeps it)
- Can the data be used to make other decisions? (e.g., player selection)
Psychometric Issues

- Lack of validated measures
  - Most tools are still based more on expert opinion than scientific rigor (esp. sports)

- Cannot rely on any single measure – what combination and how to combine them
Diagnostic Issues

- Concussion / mTBI vs. PTSD