Patients who are Slow to Recover after Concussion
Conflicts

- Jennifer Parent-Nichols has no conflicts to disclose.
Overview of Concussion

- Concussion understanding continues to be modified
PCS: Post Concussive Syndrome

“It’s about the injury…and who comes with the injury.”

McCrea, 2016

10-20% of patients

Non-specific definition

Symptoms vary
Contributors to PCS

- Too much or too little rest
- Premorbid dx or family hx migraine, ADHD, mood disorder, other psychiatric disorder, LD
- Poor management of acute injury
  - Untreated vestibular or cervicogenic dysfunction
  - Exposure to re-injury prior to full recovery
    (Morgan, 2015)
- Repetitive injuries (literature conflicts concerning what this number might be)
- Younger patients
- Being female
- Type of hit or speed of hit does NOT appear to have an impact on length of recovery
New Research: HR at which sx are first provoked, seems to be a predictor of recovery.
Predictors of a Longer Recovery... Can We be More Objective? Zemek et al, 2015

- Persistent Post Concussion Sx:
  - Clinical Risk Score
  - Increased: female, >13 yos, hx of migraine, prior concussion c sx>1wk, HA, sensitivity to noise, fatigue, answering questions more slowly, 4+ errors on BESS tandem stance
Assessment of PCS
Can We See It to Assess it?

- Not by typical imaging
- MRI SWI, Yuh, 2012
  - Longer echo times sensitive to compounds
  - Can see micro hemorrhage
  - Amount seems to be correlated to longer recovery time

- CBF, Claussen et al, J HeadTraumaRehab, 2016
  - CBF is altered in acute concussion
  - See ~ 1mo p concussion
  - CBF is altered in PCS
What About Blood Biomarkers?

- Brain is the only organ without a blood test
- Need to be able to detect elements of the neurometabolic cascade
- Need right tool at right time
  - Challenge in mTBI
- ? Astrocytes
  - Glia predominate 10:1
- UCH- 1
- GFAP
Evaluation of PCS

Should Include:

• Specific History
• Post-concussion Symptom Inventory
• Cervical Screening
• Neurologic Exam: Coordination/Reaction Time
• Balance
• Vision/Vestibular
• Gait and Function: FGA, 3 meter tandem gait, DGI, Dual (cognitive-motor), Sports Specific
Cervical Screening

- May send conflicting proprioceptive/visual/vestibular info related to balance (Brandt 2001)
- Postural screening
- PROM, AROM
- Palpation of boney landmarks and soft tissue
- Dermatomes, Myotomes
- Neck strength/Motor control: 2mm Hg x 5 2-3 sec (Schneider)
- Provocation tests

- Note: neck pain is common, especially after trauma. Look for pain lasting longer than 7-10 day acute period.
**Neurologic Screening**

- Cranial nerve testing
- Reflexes
- Tone
- Global Strength
- Coordination/Reaction
Look for a >30% decrement in performance from the static to dynamic measure.
• Visual vergence: normal <5cm
• Visual pursuit: is it smooth?
• Visual saccades: moving from visual target to visual target. Is it smooth, is it well timed?
• Presence of strabismus
• Photosensitivity
Vestibular T&M

- VOR
  - Stabilize visual target with head turning
  - Dynamic visual acuity  **metronome 120 bpm (2 hz)**
  - 120 degrees/sec=typical ADL’s, can go up to 250 degrees/sec

- Head impulse/Head thrust
  - (VOR cancellation)
Vestibular T&M

- VMS: pt report
- BPPV: Roll tests/ Dix Hallpike
  - Otoconia dislodged = sx vertigo
  - Not typically seen in younger populations
  - head shaking nystagmus
VESTIBULAR/OCULAR MOTOR SCREENING (VOMS): Mucha, 2014

Ocular Function
1. Smooth Pursuits
2. Horizontal and Vertical Saccades
3. Near Point Convergence (NPC)

Vestibular Function
4. Horizontal VOR
5. Vertical VOR
6. Visual Motion Sensitivity (VMS)

Pts rate 0 (none) to 10 (severe) changes in: headache, dizziness, nausea and fogginess symptoms
Add in Some Vestibular Provocation Tests

- Even just a head shake with a Romberg
Treatment
First Steps: Treatment of Concussion

- Remove from play
- Limit cognitive and physical activity
- Encourage pt to not participate in activities that raise risk of second injury
- Monitor sleep and mood
- All subsequent activity is pt specific, based on sx presentation/resolution and requires consistent monitoring/evaluation by the team.
Choices...

Need to choose the right treatment at the right time...
**PT Intervention: In General**

Always monitor and assess symptoms

- Must have objective baseline measurements for comparison

Process is SLOW: decreased speed, decreased reps, decreased sensory stimulation

Use good sense: early exercise is monitored. Too much=bad, Too little=bad.

Always education

Br J Sports Med 2014, Schneider: intervention with PT

Rx group 10x more likely to be returned to sport than in the control group.
Cervicogenic Symptoms and Headache

- Melatonin
- Meds
- Biofeedback
- Sleep hygiene
- Sun exposure

- MSK!
  - ROM
  - TPI
  - Mobs
  - STM
  - Dry needling
  - Taping
Visual/Vestibular Intervention

- Oculomotor Training
- Progressive VOR training (vertical and horizontal)
- Progressive visual sensitivity training
  - Can change speed, number of reps, complexity
  - Pt symptoms will be the guide
Vision and Vestibular...some ideas

- Pursuit: tracking tubes
- Saccades: Suduko, crossword puzzles, increase font size, line grids
- Convergence: Brock String
- Eye Strain/HA: apps for rest breaks, colored tints for computer screen
- Vestibular
  - Progressive accommodation
- Moving toward function.
Exercise Timing Matters

- Early exercise after mTBI = noted decrease in plasticity (Greisbach, 2004)
- BUT…
- Strict Rest=No benefit, sx influenced by rest (Thomas et al, 2014)
- Well timed ex = decrease in recovery time, improved sx, and increased tolerance to ex over time. (Leddy et al, 2010, Gagnon et al, 2015)
Active Rehab

- Restriction of activity NOT removal
- Sx should be manageable, not necessarily abolished

- Historically: rx at 4 weeks post
- Now: data suggesting potential benefits from beginning at 2 weeks post.
Active Rehab: Symptom Driven

• Aerobic component: Use of BCTT
  • 5 min warm up
  • Exercise to 80% max HR 20 min/day
  • Increase HR by 5 bpm every week.

• Sports Specific Activity

• Mental Imagery

• Education
  • Prolonged sx can be anxiety provoking and isolating

• Time to sx provocation recorded

In Short...

• Return to Play = Return to Risk
  • Significant increase in time to recovery if 2\textsuperscript{nd} injury before 1\textsuperscript{st} resolved

• Look at Sx burden
  • determine where we are and where we’re going

• PRACTICAL AND LOGICAL

• Stratified care: look at degree of disability and determine strategy
Recovery
Are Your Patients Really Recovered?
Clinical vs Physiologic

- Use exercise tolerance as proxy
- Brain Function is DIFFERENT in concussed individuals.

Wang Y et al., J Neurotrauma 2015 epub

Meier TB, et al.,
JAMA Neurol 2015
What About the Future?
Cis Tau: Kondo et al, 2015

• Abnormally phosphorlated/degenerates
• Seems pathogenic/different from aging
• Makes tau sticky
• Dose dependent
• Seen with concussion
• Correlates with axonal injury
  • But eventually seen all over
• Administration of antibody targeting of cis tau seems to prevent/limit functional deficits...in mice
What’s Next...

- The better is the enemy of the good. Voltaire
- Berlin...2016


• Leddy et al. (2016). In press.
Appendices
Tests and Measures that May be Useful

- CTSIB/SOT: clinical test of sensory integration on balance
- BOT-2: Bruininks-Oseretsky test of motor proficiency 2
- BESS: balance error scoring system
- DHI: dizziness handicap inventory
- DGI: dynamic gait index
- FGA: functional gait assessment
- 5 Times Sit to Stand/ 30 seconds sit to stand
  - (Alsalaheen2010)
- Romberg/ sharpened Romberg
- Single leg stance
- Star Test
- Line walking
- Timed up and go
- Berg Balance Scale
Buffalo Concussion Treadmill Test
- Ex to sx tolerance
- RPE>18=RECOVERED
- Push to increase sx, then back off
- Ask pt every 60 seconds if increase in sx or new sx= 1 point
- 3 points=stop
- ? Starting RTP from here

Baseline Symptom Assessment

- ImPACT, HeadMinder, CogSport
  - Above are baseline and for comparison
- Post Concussion Symptom Inventory
- King Devik
- Rivermead Post-Concussion Symptoms Questionnaire

[Image of diagram and oscilloscope]