Contemplating Concussions

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Team Physician, St. Bonaventure University
Director of Sports Medicine
Cole Memorial Health System

Stanford Routt
Oakland Raiders

"You're never going to be totally safe from concussions in this game…This is the only place where you can actually legally assault people."

CDC / Amanda Mills

http://www.onlinesentinel.com/sports/some-nfl-players-would-still-hide-concussion_2011-12-25.html

The Definition:
Zurich 2012

"Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces."

http://bjsm.bmj.com/content/47/5/250.full

Another Definition:
Centers for Disease Control (CDC) and Prevention

"A concussion is a type of traumatic brain injury…caused by a bump, blow, or jolt to the head that can change the way your brain normally works. Concussions can also occur from a fall or a blow to the body that causes the head and brain to move quickly back and forth.**"**

http://www.cdc.gov/Concussion/

A couple of things to note

Everyone/every organization has his different definition of the word "concussion."

"Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces."

What happens to the brain?

- Even a mild jolt or blow may cause the brain to shift or rotate suddenly
- Brain structures are stretched and tear
- Damaged brain cells can take 2+ weeks to recover
- Damaged brain cells are at increased risk of further injury

Why the concern in youth?

- Compared to an adult the adolescent brain is more vulnerable to sustaining a concussion and takes longer to heal from a concussion
- **More observation and direction**
  - **Athletic trainers gaining in popularity**
  - **Physicians at high-risk games**

What does a doctor/PA/AT do when an athlete goes down?

- On the field.
- EMERGENCY MEDICINE
  - **BLS-->ACLS**
  - **ABCs-->ACBs**
- Is there a **neck/spinal** injury?
- Is ther**e an intracranial bleed**?
- Are any of the **skull/facial fractures**?
- *Then* evaluate for concussion
- On the sideline.

Why Concussions are a Hard Sell

- Complex brain trauma
- A broken arm you can see on x-ray
- A torn anterior cruciate ligament (ACL) you can see on MRI
- X-ray/MRI/CAT scan (CT) does not "see" a concussion
- But the consequences can be deadly

Which athletes?

CDC / Amanda Mills

- Football HIGHEST
- Boys Ice Hockey
- Girls Lacrosse
- Girls Soccer

- Boys Lacrosse
- Boys Wrestling
- Girls Basketball
- Girls Field Hockey
- Boys soccer
-
- Girls Softball
- Boys Basketball

http://www.nfhslearn.com/electiveDetail.aspx?courseID=15000
Concussion in Sports – What You Need to Know
NFHS/High School RIO 2008-09

Other Ways to Get Concussions

- Car and bike crashes
- PE/gym class
- Snowboarding
- Don't forget cheerleading

Anthea Siekin, Wellcome images

http://www.nfhslearn.com/electiveDetail.aspx?courseID=15000
Concussion in Sports – What You Need to Know

Evaluation for a concussion

SCAT3 (13+ years)

and

childSCAT3 (5-12 years)

Signs of a Concussion (What you notice)

- The player appears dazed or stunned ("Out of it")
- Is confused about assignment/forgets plays
- Unsure of game, score, or opponent
- Moves clumsily
- Answers questions slowly
- Loss of consciousness*
- Can't recall events prior to or after the injury

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Concussion in Sports – What You Need to Know

Symptoms
(What your athlete reports to you)

- The way an athlete feels
  - Examples: headache, fatigue
- How an athlete thinks
  - Examples: poor memory, poor concentration
- Change in emotions
  - Examples: irritable, depressed
- Problems with sleep
  - Example: trouble falling asleep

http://www.nfhslearn.com/electiveDetail.aspx?courseID=15000
Concussion in Sports – What You Need to Know

Wellcome images

More Symptoms

- Nausea/vomiting
- Balance problems or dizziness
- Double or fuzzy vision
- Sensitivity to light or noise
- Feeling sluggish
- Feeling foggy or groggy
- Confusion

http://www.nfhslearn.com/electiveDetail.aspx?courseID=15000
Concussion in Sports – What You Need to Know

Treating a Concussion

- *"When in doubt, sit them out"*
- It really is that simple
- It's an injury we can't play around with

Image provided courtesy of CDC

http://www.nfhslearn.com/electiveDetail.aspx?courseID=15000
Concussion in Sports – What You Need to Know

Heads Up Football Program

Six main principles:

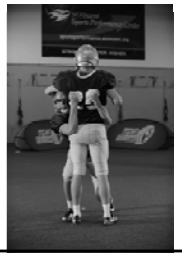
Heads Up Tackling	• USA Football's Heads Up Tackling technique, endorsed by medical and football experts, which teaches to keep the head up and reduces helmet contact for safer play.
Concussion recognition and response	• Coaches learn and are assessed on CDC concussion recognition and response protocols through USA Football's Level 1 Coaching Certification Course. • Coaches, parents and players are taught CDC concussion-related protocols.
Coaching education	• Coaches within a youth program are trained to teach the game's fundamentals by completing USA Football's nationally accredited Level 1 Coaching Certification Course. High school coaches will gain training through USA Football's High School Coach Certification course, developed in partnership with the National Federation of State High School Associations.

Image Courtesy of USA Football

Heads Up Football Program

Six main principles:

Equipment fitting	• Coaches, parents and players are taught proper helmet and shoulder pad fitting.
Heat and hydration	• Coaches, parents and players are taught heat and hydration safety measures set forth by the Korey Stringer Institute at the University of Connecticut.
Player Safety Coach	• Appointed by a participating Heads Up Football youth organization or high school, this individual ensures compliance with Heads Up Football's player safety protocols, coach certification, and the conducting of safety clinics for coaches, parents and players.



Images Courtesy of USA Football

Concussion Action Plan (CAP)

- Remove the athlete from play
- Have the athlete evaluated by a health care professional
- Inform the athlete's parent about the possibility of concussion
- Keep the athlete out of play AT LEAST THE DAY OF INJURY and until a health care professional says the player is ok to return to play

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Concussion in Sports – What You Need to Know

CAP Made Simple

- Step 1) the athlete
- Step 2) the health care professional
- Step 3) the parent
- Step 4) no play that day (at least)

Recovery

- Most players recover within 1 to 2 weeks
- Rarely (though up to 10%) symptoms can last weeks/months
- Remember symptoms include headaches/difficulty concentrating/poor memory/sleep problems
- School performance can suffer

http://www.nfhslearn.com/electiveDetail.aspx?courseID=15000
Concussion in Sports – What You Need to Know

Why early RTP is bad for the team:

- Poor athletic performance
- Ongoing athletic performance

Why early RTP is bad for an athlete's health:

- Repeat concussion
- Return too soon → increased risk of repeat brain trauma, brain bleeding, brain swelling, even death

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Concussion in Sports – What You Need to Know

Treatment

- It's done stepwise. It's done by the books.

Treatment: physical rest

- They are not competing, practicing, or working out
- That's only part of it

Treatment: mental rest

- At school
  - Stay home or do school part-time
  - Take naps/allow rest time
  - Extended time to complete assignments
  - Extended time to take tests
  - Allow for 1-on-1 teaching

Treatment: mental rest

- At home
  - Plenty of sleep
  - Limit phone
  - Limit computer
  - Limit music
  - Limit TV
  - Limit texting
  - Limit video gaming

It's hard to do

Treatment

- Stage 0: physical/school/home rest until symptom free
- Stage 1: exercise bike, light jog
- Stage 2: running, no equipment
- Stage 3: full uniform, no contact, light weights
- Stage 4: full contact drilling
- Stage 5: competition

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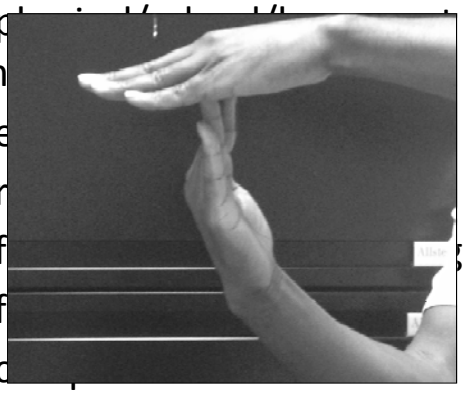
Concussion in Sports – What You Need to Know

Treatment

- Stage 0: p… until symptom…
- Stage 1: e…
- Stage 2: r…
- Stage 3: f… ght weights
- Stage 4: f…
- Stage 5: d…



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But what about…

Immediate Post-Concussion Assessment and Cognitive Testing.

ImPACT

- 20 minutes at a computer
- AFTER a kid get concussed (good)
- BEFORE a kid gets concussed (baseline, even better)

Just one tool in the toolbox

- "It must be emphasised…that NP assessment [e.g. ImPACT] should not be the sole basis of management decisions; rather it should be seen as an aid to the clinical decision-making process…"

  –Zurich 20**12**

National Federation of State High School Associations

- "As professionals [coaches]…, we put the student first and the athlete second, so the athletic experience becomes a vehicle to promote learning and a safe playing environment."

Image provided courtesy of the National Federation of State High School Associations

National Federation of State High School Associations

Courses

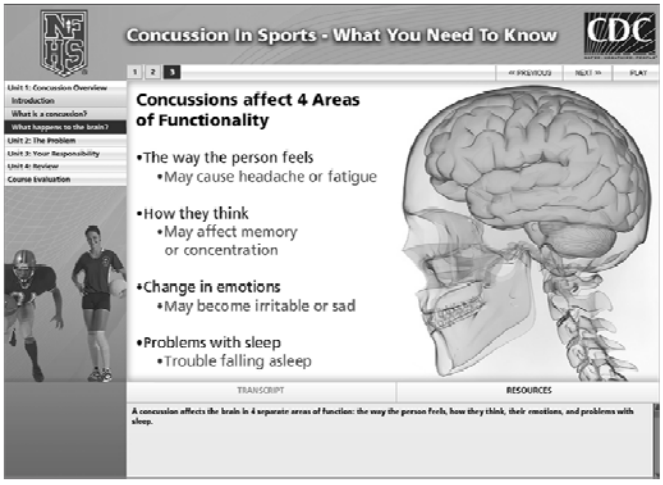

Image provided courtesy of the National Federation of State High School Associations

Centers for Disease Control and Prevention

- Don't hide it
- Report it
- Take time to recover

- It's better to miss one game than the whole season

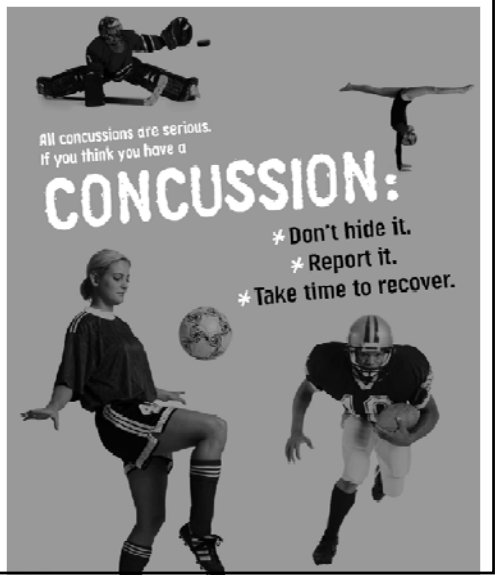

Image provided courtesy of CDC

Second impact syndrome (SIS).

- **Complication of mild TBI**

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- **When this happens after 2nd concussion->SIS.**

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- **Rare but fatal**
- **“disordered cerebral autoregulation causing cerebrovascular congestion and malignant cerebral edema with increased intracranial pressure”.**
- **Brain swelling in a confined space is bad**
- **When this happens after 2nd concussion->SIS.**
- **Does it exist?.**

Justin Smith
San Francisco 49ers

"It doesn't take a rocket scientist to figure out if [you have] a concussion, you're probably damaging your brain a little bit. Just like if you sprain your wrist a bunch, you're going to have some wrist problems down the road."

Chronic Traumatic Encephalopathy (CTE)

- **More head trauma = more bad.**

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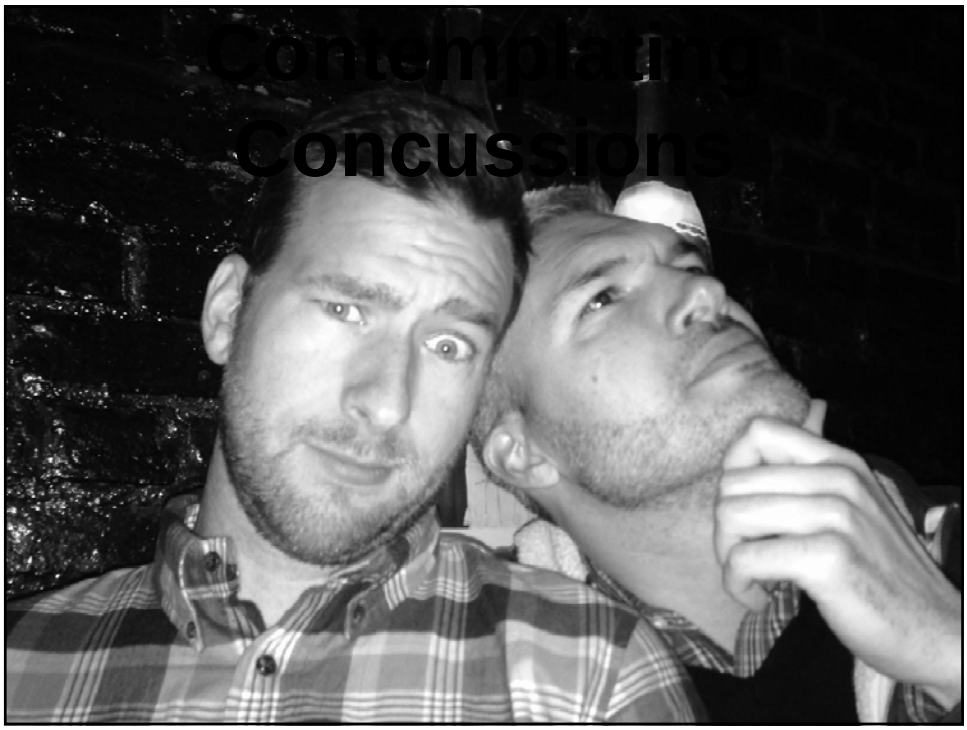
- CTE in the military..



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SCAT3: Sport Concussion Assessment Tool--3rd Edition

American Medical Society for Sports Medicine position statement: concussion in sport

Concussion (Mild Traumatic Brain Injury) and the Team Physician: A consensus Statement--2011 Update

When "Good" Hits Go Bad

Diagnosing & Treating Post-Concussion Syndrome

Michael Jonesco, DO
Team Physician, Capital University
Assistant Clinical Professor
Department of Internal Medicine
Division of Sports Medicine
The Ohio State University Wexner Medical Center

Case: *Willie Haze*

- 15 year old baseball player presents to office 2 months after injury
- Initial injury: head vs knee, diving to make catch
- He was seen initially in ER for HA, nausea, amongst other symptoms
  - Labs, CT negative
  - Discharged home w/ anti-emetic, naproxen rx, and f/u w/ PCP
- He returned to school after the weekend
- Immediately developed symptoms of HA, which increase throughout the day
- He has been unable to finish school and reports to RN office almost daily
- Over next 2 weeks, his grades (A student) have dropped and he has failed last 3 exams
- Mood declines, threatens family with violence

Case 1, continued

- He eventually presents to his PCP
- He is pulled from school and educated on "Absolute Rest"
- He is compliant for 6 more weeks
- Despite this, his symptoms score increases and Mom tells PCP he is having new symptoms, including hypersomnia (14hrs/d), reading, falling, slurring speech, rapid mood swings
- He was sent for MRI, which was normal
- He was referred to Concussion Clinic at OSU Sports Med and diagnosed with Postconcussion Syndrome (PCS)

Beyond the Basics:

Answering Questions on Complicated Concussion Management

- Defining "Post Concussion Syndrome"?
  - Testing
  - Time
  - Symptoms
  - Deviation from "normal" recovery
- Can we grade? Or classify? Predict?
- Treatment:
  - Medications?
  - Therapies?
  - Exercise?

Image Courtesy of USA Football

Defining "Postconcussion Syndrome"

- Trauma
  - Either TBI or concussion (including Sports-related)
- Prolonged symptoms
  - "Normal" resolution <10 d
  - Weeks or months?
  - Peds take longer
  - Vague and rather broad, generalized complaints
  - No one is truly "asymptomatic"
    - Lovell et al. Appl Neuropsychol 2006
- Examination/Imaging
  - Neuro exam nor Imaging do not often reveal significant findings
  - *Functional*, not anatomical
- Further details poorly defined
- DSM IV
  - 3 symptoms for > 3 months
- WHO
  - Syndrome must have > 3 symptoms, > 1 m
- Zurich Guidelines –
  - Deal specifically with Sports-Related Concussion (SRC)
  - >10 days (10-15% of SRC)
- AMSSM Position Statement 2013
  - "weeks, months, or years"
  - Mentions 6 weeks

What it is NOT !

- **Must remember it is a diagnosis of EXCLUSION**
  - **TBI**
  - **Depression**
    - **Pulled from sport**
    - **Pulled from normal socialization**
    - **Reduced sense of self and identity**
  - **Underlying LD**
    - **ADHD**
    - **Dyslexia**
  - **“Teenager Disease”**
    - **“I got moods, man!”**

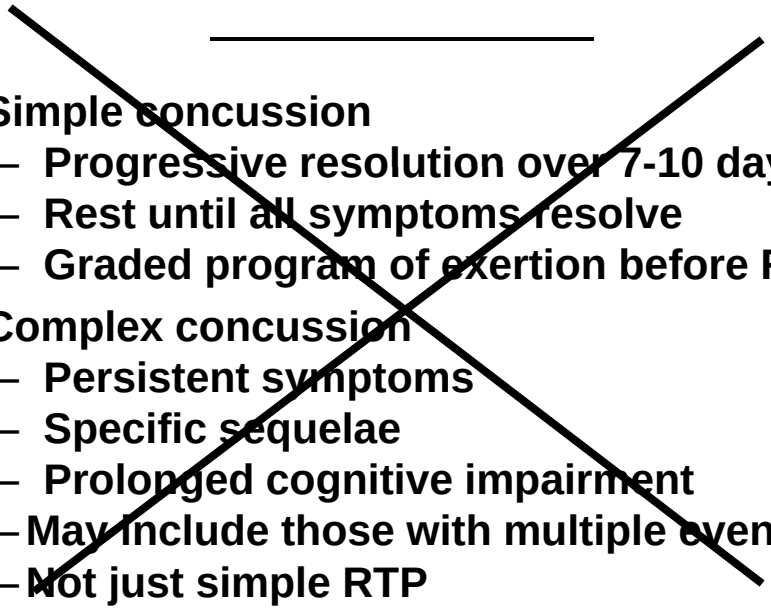
PCS

- **Pathophysiology**
  - **Greatly unknown**
  - **Related to dysregulation of neurotransmitters, including dopamine**
- **Incidence**
  - **30-80% following concussion** *- Bazarian 1998*
    - **Wide range, consistent with inconsistent diagnostic criteria**
- **Risk Factors**
  - **HA, Adolescent, Admission Babcock et al 2013**
  - **Headache Apslund et al 2004**
  - **Amnesia Apslund et al 2004**
  - **Memory Lovell et al 2003**
  - **Processing speed Lau et al 2011**
  - **History of concussions Guskiewicz et al 2003**
  - **Gender (>female) Barnes et al 1998**
- **No correlation with *severity* of initial injury -**

Concussion Classification and Grading Scales

- Simple concussion
  - Progressive resolution over 7-10 days
  - Rest until all symptoms resolve
  - Graded program of exertion before RTP
- Complex concussion
  - Persistent symptoms
  - Specific sequelae
  - Prolonged cognitive impairment
  - May include those with multiple events
  - Not just simple RTP

Concussion Classification and Grading Scales



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- **Cantu: grades based on presence/length of LOC and amnesia**
- **CMS: grades based on presence of LOC**
- **AAN: grades based on presence of LOC and length of symptoms**

- ***Classify and Grading Systems Provide NO Reliable predictive or prognostic value***

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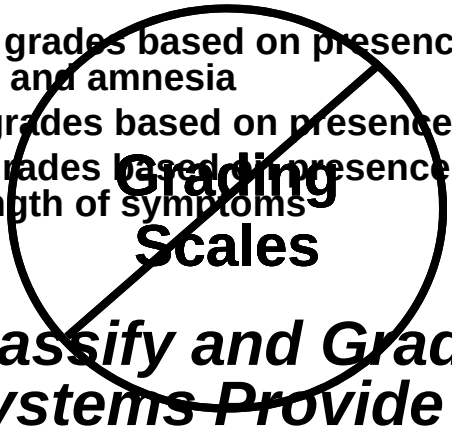

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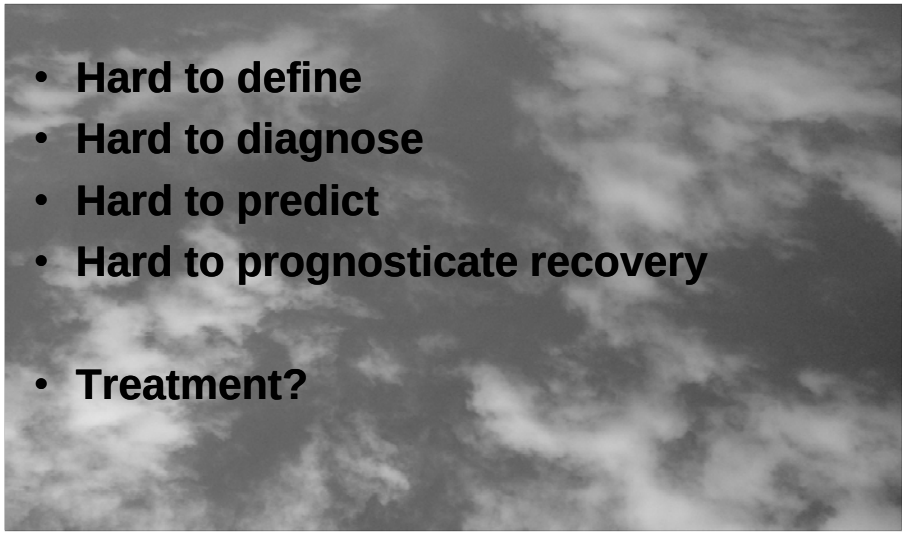
So far…Postconcussion Syndrome



- Hard to define
- Hard to diagnose
- Hard to predict
- Hard to prognosticate recovery

- Treatment?

Treatment of Concussion

- For Sports-Related Concussion (SRC), REST!
  - From cognitive and physical exertion
  - ~90% improve in 7-10 days in adults -
    - *4 weeks for pediatric population – Zuckerman, 2012

- PCS, ???
  - No accepted protocol or treatment plan
  - Unclear if treatments work due to paucity of EBM
  - Should be managed by someone with comfort and experience in the area

Medical Therapeutics

- **The Search for neuroprotective agents**
  - **Hormones, calcium channel blockade, bradykinin inhibition, NSAIDs, immunomodulators, vitamins, minerals, antioxidants**
  - **May work by limiting glutamate toxicity, free radical damage, or minimizing BBB disruption**
  - **Unfortunately, NONE of these completed trials have demonstrated significant clinical benefit in humans**
  - **PCS *should be* considered a series of overlapping syndromes and management directed at individual needs/complaints of the athlete**

"In reality, PCS is not truly 1 clinic entity or diagnosis -
Rather, a series of syndromes related to brain trauma and failure of the brain to adapt or recover"

- Leddy

- **Postconcussive physiologic syndrome**
- **Postconcussive cognitive deficit syndrome**
- **Postconcussive vestibular syndrome**
- **Postconcussive ocular syndrome**
- **Post concussive sleep syndrome**

Trust your exam to help guide your treatment, referrals!

Postconcussion Syndrome: Treatment, Exercise?

- **Current recommendation on concussion treatment is rest until symptom free**
- **Still consensus for initial rest periods…**
  - **Supported by 2 recent systematic reviews →**
- **However, >3 days rest not shown to improve recovery in adults**
  - **Silverberg and Iverson, 2012**
- **Increasing support for sub-symptom threshold activity for prolonged symptoms *after* initial period of rest**
  - **Leddy, Buffalo Protocol**
  - **Unclear when to initiate, intensify**

- **"***Low-level exercise and multimodal physiotherapy may be of benefit for those who are slow to recover. There is a strong need for high level studies evaluating the effects of rest and treatment following SRC"*
  - **Schneider, British Journal of Sports Medicine, 2013**
- *"Light exercise, or daily exercise after a 2-week baseline period, appeared to encourage return to physical activity in children and adults"*
  - **Brolinson, Clinical Journal of Sports Medicine, 2014**

A proactive approach to prolonged exercise intolerance

- **Buffalo Concussion Treadmill Test (BCTT)**
  - **Leddy, 2012**
- **Concussion patients with prolonged symptoms with activity**
- **Need to establish exertional level in which symptoms provoked**
- **Threshold is represented by the HR at symptom exacerbation**

A proactive approach to prolonged exercise intolerance

- Submaximal symptom-limited threshold = not recovered
- Maximum exertion without symptom limit = recovered

- Exercise Prescription
  - 20 min/day at target HR using bike, then run
  - ~6 d/wk
  - Increasing HR 5-10 bpm q 1-2 wks
  - Goal is 80-90% max HR
  - May indicate recovery and aid in return to play decisions

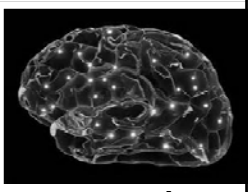
BCTT

- 4/4 exercise treated subjects had symptom resolution v. stretching placebo control
  - Leddy, Clin J Sport Med, 2010

- 12 patients w/ > 6 wks symptoms at rest (PCS)
  - 12/12 reduction in symptom score
  - All able to return to levels of previous activity
    - Leddy et al. Jl Head Trauma Rehabil 2013)

- 77% of P-PCD (n=65) treated with aerobic exercise returned to full sport or work
  - Baker et al. Rehabilitation Research and Practice. 2012)

Treatment: Cognitive Deficits, Medications?



- Amantidine –
  - Dopaminergic agent, NMDA antagonist
- Pro
  - Has been linked to improved attention, concentration, processing time, fatigue, psychomotor speed
  - Beers, J Head Trauma Rehab 2005
  - Green, Am J Phys Med Rehab, 2004
  - Mehthaler, J Head Trauma Rehab 2002
- Con
  - Schneider, Brain Inj 1999
  - Many of above citations were small sample size, lacked DB RCT
  - Limited by side effects, cost
  - Most deal w/ TBI, not SRC

Amantidine

- Reddy, et al – J Head Trauma Rehab, 2012
  - After 3 wks of non-response to cognitive rest
  - Amantidine 100 mg po bid
  - Measured symptom and ImPACT scores (pre and post med initiation)
  - Statistically sig't improvement in symptoms reported, verbal memory, reaction time
  - No difference in visual memory, motor
  - Small sample size, not blinded
  - Both groups improved

Treatment: Cognitive Deficits Medications? Or Supplements?

- Fish Oil
- Omega-3 fatty acids
  - Studied mostly in animal TBI models
  - Improved blood flow, reduce the toxic effects of glutamate, and stabilize membranes
  - No long-term phase III trials have been completed with O-3 FAs
  - No optimal dosing regimen has been defined
  - Low Risk/SE
  - Some authors recommend high-dose fish oil in the 2- to 4-g/day range in PCS
  - No RCT has shown support to date

Sleep Deficits – 30% - 70% of patients experience sleep disturbance post TBI

- Ouellet, 2004

- Hypnotics (Zolpidem)
  - Not effective long term
  - Cloud clinical picture
- Amitriptyline
  - Can cause orthostasis, mood disturbance, N/V, drowsiness, etc
- Trazodone
  - HA, confusion, ataxia

- Melatonin
  - TBI linked to lower melatonin production in evening
    - associated with less REM
  - 5 mg Melatonin
    - Can cause daytime sleepiness
- Stimulant
  - Excessive fatigue, daytime somnolence
  - Trouble focusing w/ cognitive tasks (school)

Treatment in PCS

Rehabilitation

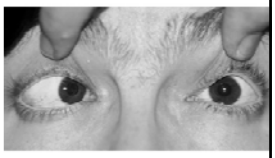
- Vestibular rehab
  - Can be done through occupational or TBI referral
  - Directed at reducing symptoms
    - HA, Neck stiffness, dizziness, nausea
  - Growing evidence, including RCT
  - Schneider, et al. 2010, 2012
  - Alsalaheen, 2010
  - Gottshall 2011
- Cervical manipulation may be effective
  - If exam/history suggestive of cervicogenic headaches
  - Jull G et al. Spine 2002)

Psychological

- Cognitive Behaviorial therapy
  - Predominantly studied in TBI in the military
  - Well-supported in this population, but
  - NOT specifically in SRC

Treating PCS: A Personal Algorithm ~Weeks 1-4

- Must consider PCS after 7-10 days, but NOT necessarily diagnose
- Ensure compliance w/ rest weekly over next 3-4 wks
  - Regulate diet, sleep
  - Modifying school/work load
    - Not JUST sport/physical activity
  - ENCOURAGE socialization* to prevent isolation and depression

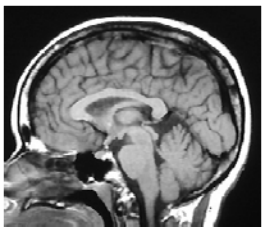


- Re-examine patient at EVERY visit
  - Know you comfort zone!
  - Focus on symptoms, orthostatics, HR variability, vestibular, and cranial nerves
    - Referral to vestibular, speech rehab, ophthalmology

Treatment Algorithm Weeks 2-6

- If symptoms are worsened with mental activity
  - Alter school and/or work load
  - Consider referral to speech therapy
- If symptoms are worsened with any physical activity
  - Consider referral to occupational/physical therapy (vestibular rehab and symptom-limited sub-maximal threshold exercise)
    - Buffalo Protocol? - Leddy
- Re-evaluate at ~ 6 wk time period
  - Have symptoms resolved?

Treatment Algorithm



- If still suffering from symptoms
- REFER!?
- MRI Brain
  - To r/o alternative diagnosis for symptoms
- Formal neuropsychological testing
  - To r/o underlying depression, ADHD, LD
- Initiate symptom directed therapies at your discretion

Follow Up: Willie Haze

- 15 year old baseball player follows up to your office after being diagnosed with postconcussion syndrome
- Normalized sleep schedule
- Taken out of school
  - Home school and open book testing
- Schedule lunches at school, observe practice to encourage social interaction
- On examination, abnormal saccadic and accommodation prompted referral to ophthalmology, therapy

Follow Up: Willie Haze

- Significant balance issues addressed in vestibular therapy
- Amitriptyline qhs for sleep, mood disturbance
- Over next several weeks symptoms improve
- Advanced physical activity gradually under PT supervision
- Patient able to return to school next fall
  - But has taken up golf

Take Home Points to Consider

- ***Early*** **symptoms are generally best managed by cognitive and physical rest**
- **Beyond the initial rest period (? duration), an observed sub-symptom threshold activity plan may aid in improved symptoms and activity levels**
- **Other commonly used medications/supplements have an unclear role in symptom management at this point**
- **Care should be taken not to cloud the return to play decision by masking post-concussive symptoms**
- **Treatment should be individualized and directed to manage athlete's specific needs**
- **Obviously, every effort should be made to prevent the initial injury!**

- ~~The End~~

- **THE BEGINNING!**