Treatment of Post-Concussion Syndrome

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Presentation Outline

- Review
- Molecular Pathophysiology
- Risk Factors
- PCS
- CTE
- Active Rehab
- Algorithm
- Balance Master
Concussions: A Review

- 1.6-3.8 million athletes affected by concussions (mild TBI) per year
- Widely disseminated assessment tools & greater symptom awareness → more frequent diagnosis
- Brain is altered due to metabolic, hemodynamic, structural, and electrophysiologic changes
- Affects cognition and behavior
- Brain vulnerable for worse injury in event of a repeat insult (SIS)
Concussions: Molecular Pathophysiology

Mechanical trauma exerted on brain via acc & dec forces on neuronal structures

Cascade of neurochemical & neurometabolic events

Axonal stretching

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Mechanical trauma exerted on brain via acc & dec forces on neuronal structures

Axonal stretching

Unregulated efflux of ions through previously regulated ion channels

Release of NTs

Na/K ATP-dependent pump tries to re-establish ionic balance

Depleted energy stores

Alt energy stores in healthy post-concussive brains

Review | Molecular Pathophys | Risk Factors | PCS | CTE | Active Rehab | Balance Master
Concussions: Molecular Pathophysiology

- Effects are self-limited and transient, but could result in prolonged neurologic deficits with re-injury
- Cerebral blood flow (CBF) perturbations associated
- Increased neurocognitive symptoms with cumulative brain injury
- Pituitary dysfunction can occur after multiple concussions
Risk Factors for Prolonged Recovery

- H/O previous concussions
- Younger age
- Migraine HA symptoms
- Fogginess/dizziness
- Learning disability or attention deficit
- On-field mental status change
- Possible psychiatric comorbidities (depression, anxiety)
**Post-Concussion Syndrome**

- Most patients (80-90% of sports related concussions) recover within 7-14 days
  - Longer time-frame for children and adolescents
- Persistence of symptoms for SRC >2wks = PCS
  - Persistent symptoms >10 days = 10-15% of SRC
  - Non-SRC pts: PCS = symptoms >3mo
- PCS: not a single entity; group of disorders requiring therapy
Predictors of PCS

- H/O prior concussions
- Female sex
- Younger age
- H/O cognitive dysfunction
- Affective disorders (anxiety, depression)

- No study has identified injury severity as a factor contributing to the development of PCS
## Post Concussion Syndrome

### Symptoms of PCS
- HA
- Fatigue
- Sleep disturbance
- Vertigo
- Irritability
- Anxiety
- Depression
- Apathy
- Difficulty with concentration

### Differential Diagnosis
- Depression
- Somatization
- Chronic fatigue
- Chronic pain
- Cervical injury
- Vestibular dysfunction
- Ocular dysfunction
- Any combination of the aforementioned S/S
Physical Examination

- Assessment of concentration
- Memory
- Examination of CNs
- Romberg
- Vestibular testing
- C spine
Clinical Challenge

• Do prolonged symptoms reflect concussion pathophysiology OR manifestation of 2* process?

• Positive (+) PCS
  • If symptoms that were experienced early after the injury are exacerbated with exertion, but improved with rest → original concussion pathophysiology is likely persisting

• Negative (-) PCS
  • If ongoing symptoms are exacerbated by minimal activity and no longer respond to rest → may represent psychologic symptoms
Chronic Traumatic Encephalopathy

- Neurodegenerative disorder characterized by perivascular deposits of hyperphosphorylated tau in depths of cerebral sulci
- CTE = postmortem diagnosis
- Clinical syndrome = Traumatic Encephalopathy Syndrome (TES) ²,¹¹
Long-Term Effects of Concussions: Chronic Traumatic Encephalopathy

- H/O repetitive head impacts → increased risk for developing CTE
- Number of years exposed to contact sports > number of concussions associated with more tau abnormality
- Clinical presentation: 4 domains
  - Mood
  - Behavior
  - Cognition
  - Motor
- 2 distinguished courses of clinical presentation
CTE Debate
Causation vs Association

- Is CTE a distinct neurodegeneration or are repetitive head impacts causal to its development?
Rest vs Active Rehab for PCS

Too much rest → Adverse physiological & psychological consequences → Worse neurocognitive performance
Rest vs Active Rehab for PCS

- Rest = mainstay treatment for concussion and PCS
  - Physical and cognitive rest allows brain to recover from acute metabolic crisis
  - Acute symptomatic period = 24-48hrs rest, then gradual return to school and social activities without significant exacerbation of symptoms

- Exercise within 1st week = impaired cognitive performance

- Cardiac and autonomic regulation of temperature compromised during exercise in first 2wks
Rest vs Active Rehab for PCS

Recent research = active approach
- Physical inactivity = negative impact on CBF control
- Regular physical activity = enhances CBF control
- Exercise 14-21 days after = improved performance

Active treatments = subthreshold aerobic exercise; cervical, vestibular, cognitive behavioral, and vision therapy

Intolerance = sign of physiological dysregulation

Voluntary exercise > forced exercise
- Motivation and circumstances play a role in effect of exercise
Active Rehab – Other Areas of Focus

- Cervicogenic and oculomotor disturbance
- Postural stability
- Cervicogenic dizziness
- C spine manual therapy
- Neuromotor training
- Sensorimotor retraining
- Vestibular treatment: vestibulo-ocular system AND vestibulospinal system
Active Rehab

- Symptom limited exercise
- Avoid RTS until full participation can occur without symptoms
- Subthreshold aerobic treatment improves symptoms in PCS in association with improved fitness and autonomic dysfunction (better HR and BP control)
Return to Activity Algorithm

Concussion

Rest and Information

Symptoms Persist ≥ 3 Weeks

- Treadmill Test**
  - Pass
  - Fail

  - Alternate Diagnoses
    - Cervicogenic, Migraine, PTSD, Depression...
    - RTA After Treatment for Specific Problem

- Controlled Aerobic Exercise Rehabilitation for Physiologic PCS
  - RTA When Asymptomatic During Peak Exertion

Symptoms Resolve*

- Treadmill Test + NP Test³
  - Fail
  - Pass

  - More Time to Recover⁴
  - RTA

Fail Treadmill Test or Abnormal NP Test⁶

Pass Treadmill Test and Normal NP Test⁶

RTA
Balance Master

- Stability testing: important, useful tool for objectively assessing motor domain of neurological functioning
- Impaired postural control common in athletes with PCS
- Disruption of ability to utilize and process visual and vestibular information
- SMART Balance Master assessments
  - Dynamic posturography
  - Sensory Organization Test
  - Clinical Test for Sensory Interaction in Balance
Intervention Techniques

- Sensory integration exercises
- Balance training
- Oculomotor training
- Eye-head coordination training
- Visual motion sensitivity training
- Neuromuscular control
- Body mechanics
- Posture
Other Balance Measures

- **Balance Error Scoring System**
  - Inexpensive assessment of postural dysfunction compared to BM
- **DGI**
- **FGA**
- **HiMAT**
- **Dual Cognitive Task paradigms**
- **5x STS**
• Neurocognitive deficits mildly affected
  ○ Concentration
  ○ Working memory
  ○ Immediate memory recall
  ○ Rapid visual processing

• Composite balance score may exhibit small to moderate correlation to scores from Head Injury Scale (HIS)
Neurocognitive function and postural stability often affected initially, BUT not necessarily related or to the same degree.

Testing used/considered to make RTP decisions:
- Battery of stances (DLS, SLS, tandem) & on foam
- Subjective symptoms
- Objective measures
- Cognitive testing

Can consider using normative data in lieu of individual baseline if resources are limited or unable to capture baseline measurements.
References
