Concussion

Objectives
The learner will be able to:
• Describe the pathophysiology of concussion
• List the various components of concussion assessment
• Incorporate appropriate examination techniques when examining individuals post concussion
• Recognize the importance of a team approach in the management of individuals post concussion
• Describe typical examination findings post concussion

Concussion

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

Mechanism of Injury
• Mechanical trauma to the brain as a result of acceleration/deceleration forces
  • Direct blow to the head, face or neck
  • Direct blow elsewhere on the body with an impulsive force transmitted to the head
  • Blast Injury

Pathophysiology of Mechanical Trauma
• Acceleration/Deceleration forces cause axonal stretching and deformation of the cell membrane
• May or may not involve LOC (4-10%)
• Rapid onset of short-lived impairment of neurological function that resolves spontaneously
• Symptoms due to a functional disturbance, not structural
• Normal imaging
Pathophysiology

Axonal stretching causes:
- Influx of Ca++/Efflux of K+ causing vasoconstriction and ↓ blood supply
- Na+/K+ pump works overtime to restore neuronal membrane potential increasing the demand for adenosine triphosphate (ATP)
- Increased ATP demand triggers an increase in glucose metabolism
- Increased demand for glucose in setting of reduced blood supply creates a supply and demand disparity

**METABOLIC CRISIS**
Giza & Hovda, 2001, J Ath Trng

Symptoms Post - Concussion

- Headache
- Nausea
- Vomiting
- Balance Problems
- Dizziness
- Fatigue
- Trouble falling asleep
- Sleeping more than usual
- Sleeping less than usual
- Drowsiness
- Sensitivity to light
- Sensitivity to noise
- Irritability
- Sadness
- Nervousness
- Feeling more emotional
- Numbness or tingling
- Feeling slowed down
- Feeling mentally foggy
- Difficulty concentrating
- Difficulty remembering

Post Concussion Symptom Scale, Lovell, Collins 1998

Reticular Formation

- Arousal
- Attention
- Wake-sleep cycles
- Sensory integration
- Posture
- Equilibrium
- Autonomic Function
- Control of Gaze
- Eye Movements

**ASCENDING**
**DESCENDING**
**LOCAL BRAINSTEM CIRCUITS**

Symptom Clusters

Collins MW, Emerging Frontiers in Concussion; June 2013

Multidisciplinary Team

- **CORE TEAM**
  - Neuropsychology
  - MD (w/ training in mTBI)
  - Physical Therapy (Vestibular, Orthopedic and/or Exertional)

- **ADDITIONAL MEMEBERS**
  - Neuro-Otology
  - Neuro-Ophtalmology
  - Neuro-Optometry
  - Psychology/Psychiatry
  - Cognitive Therapy

In cases of young athletes:
- Athletic Trainer/Coach
- School
Examination

- Medical Work-Up / Diagnostic Tests
- Patient / Client History
- Systems Review
- Tests and Measures

Medical Work-up/Diagnostic Tests

- MRI/CT
- X-rays Typically Normal

- Neurocognitive Assessments
  - ImPact - Immediate Post - Concussion Assessment and Cognitive Testing
    http://www.impacttest.com

Physical Therapy

- Vestibular Therapist
  - Oculomotor Control
  - Vestibular Function
  - Postural Control
- Orthopedic/CVP/Sports Therapist
  - Cervical Spine
  - Activity tolerance/Exertional Training

Vestibular System

- Peripheral Vestibular System
  - Semicircular Canals
  - Otoliths: Utricle and Saccule
  - Vestibular Ganglia
  - Vestibular Nerve
- Central Vestibular Projections
  - Vestibular Nuclei
  - Cerebellum
  - Autonomic Nervous System
  - Thalamus
  - Cerebral Cortex

Function of the Vestibular System

- Vestibulo Ocular Reflex (VOR)
- Vestibulo Spinal Reflex (VSR)

STABILIZE VISION WHILE HEAD MOVES
BALANCE CONTROL

Postural Control

VOR
VSR
Dizziness and Concussion

- Dizziness
- Imbalance
- Blurry Vision, difficulty focusing
- Motion discomfort
- Difficulty in busy environments

Physical Therapy Examination

- Patient History
  - Mechanism of injury
    - Anticipated
    - Unanticipated
  - LOC (duration)
  - Amnesia
    - Retrograde
    - Post Traumatic
  - Removed from/Continued play
  - Symptoms
    - "On-field"
    - Current
  - Medications

Physical Therapy Examination

- Patient History
  - Migraines
  - Personal history
  - Family history
  - Prior Concussions
    - Length of recovery, ? Complete recovery
  - Mood Disorders
  - Learning Disabilities
  - Oculomotor Problems
    - "Lazy eye", strabismis, amblyopia

Ocular Motor Exam

- Pursuits
- Saccades
- Gaze Holding
- Convergence
- Alignment

Watch for symptom provocation!

Oculomotor Control

Vergence: Adjusts eyes for different viewing distances
Convergence

- Near Point of Convergence
  - Point at which target doubles as it moves closer to the individual
  - Point at which eyes stop converging
  - 6-10 cm

Ocular Misalignment

Abnormal eye deviation
Troopia
- Always present
- Phorias
  - Not always there
  - Test
    - Cover – Uncover
    - Cross-Cover

Vestibular Ocular Reflex (VOR)

- Ability to maintain focus on stationary object while moving head without blurriness or dizziness?
- “Do you get dizzy or do things get blurry when you move quickly?”

Assessing VOR Function

- Head Thrust Test
  - Tests are typically normal unless the peripheral receptor is damaged
  - May provoke symptoms
- Dynamic Visual Acuity Test
  - Typically abnormal with regard to tolerance for repetitive head movement and ability to stabilize gaze

Head Thrust

- Flex the patient’s neck 30°
- Have the patient look at your nose
- Turn the head quickly to each side ~30°
- Make thrusts unpredictable

Head Thrust
ABNORMAL FINDINGS IN CONCUSSION

Oculomotor Disturbances

- Blurred vision
- Double vision
- Jumping images (oscillopsia)
- Eye strain

*Intervention is often helpful!*

Oculomotor Problems & Concussion

- Ocular issues following traumatic brain injury are common
- Convergence insufficiency
- Ocular misalignments
- End range nystagmus
- Decompensation of pre-existing problem
- Presence of ocular issues have a negative impact on vestibular rehab

*Eye movement coordination impairments impact eye-head coordination*

Abnormal Findings
Gaze-Evoked Nystagmus
Abnormal Findings

Ocular Misalignment

Convergence Insufficiency

- A patient with normal convergence should be able to converge to at least 10 cm (4 inches) from their nose.

Balance: Impaired Sensory Organization

- Symptom provocation when vision or somatosensation are manipulated
- Increased sway/loss of balance in more challenging postures

Space and Motion Discomfort

- Uneasiness created by situational stimuli
  - Moving crowds, supermarkets, busy patterns, etc
  - Heightened awareness of normal motion

  
  Jacob et al, 1993

  
  Exam
  - Oculomotor Exam
  - CTSIB

Whiplash

- Acceleration / Deceleration

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Activity Tolerance

- Assess response to:
  - Cognitive stress
    - School
    - Work
  - Emotional Stress
    - Anxiety
    - Depression
  - Physical exertion

Summary

- Symptoms are many and varied
- Central processing of sensory information is dysfunctional
- Requires careful evaluation by a coordinated team

Thank You