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CONCUSSION

Baldwin Bone & Joint PC

Keeping You in the Game!

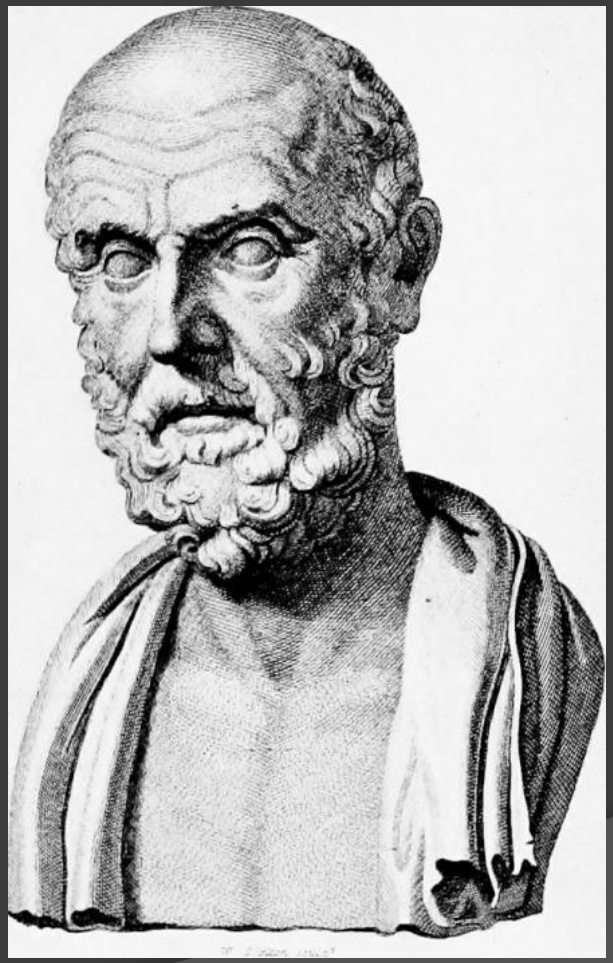
Disclosures

Outline

- Review sideline diagnosis and management of concussion and return to play protocols.
- When is a concussion not a concussion?
- Understand the current state of concussion research and what the future may hold for concussion diagnosis and management.

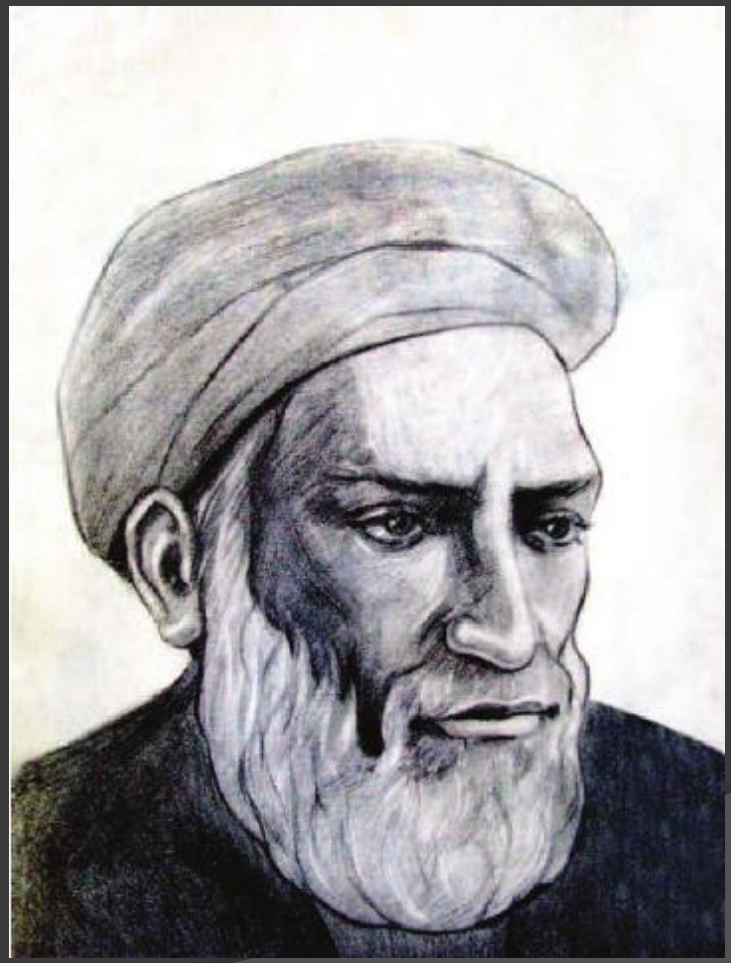
History

- Hippocrates described concussion 2500 years ago
- “In cerebral concussion whatever the cause, the patient becomes speechless, …falls down immediately, loses their speech, cannot see or hear”



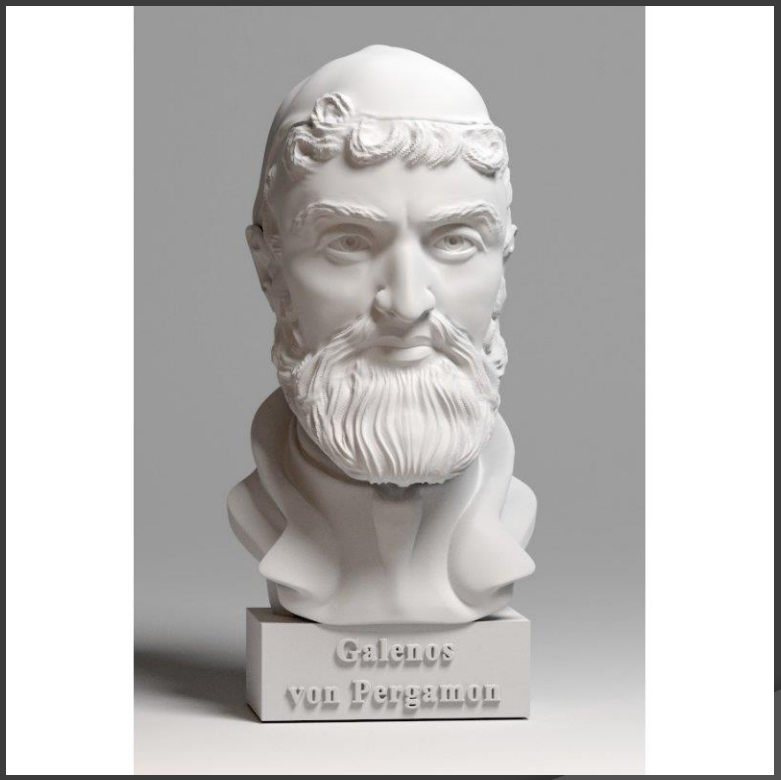
History

- Rhazes, in the first century, described concussion and differentiated it from a more severe head injury
- He described concussion as an abnormal physiological state without gross traumatic lesions of the brain



History - Sports

- The main sports of the time were combative sports. Galen of Pergamon documented numerous gladiator injuries.
- Described several post accident symptoms such as dizziness.



History

- In the middle ages sports were not well organized but revolved around jousts, duels, and fighting.
- Physicians further documented: the faltering of speech, impairment of memory, dullness of understanding, and short lived symptoms of tinnitus and photophobia.

Definition

- What I tell athletes and parents…
  - A hit to the head that's causes *temporary* neurologic symptoms
- What The 5th International Conference on concussion in sport held in Berlin 2016 says….

McCrory P, Meeuwisse W, Dvorak J, et al Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016 Br J Sports Med Published Online First: 26 April 2017. doi: 10.1136/bjsports-2017-097699

- *Sport related concussion is a traumatic brain injury induced by biomechanical forces. Several common features that may be utilised in clinically defining the nature of a concussive head injury include:*

- *► SRC may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an impulsive force transmitted to the head.*
- *► SRC typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, signs and symptoms evolve over a number of minutes to hours.*
- *► SRC may result in neuropathological changes, but the acute clinical signs and symptoms largely reflect a functional disturbance rather than a structural injury and, as such, no abnormality is seen on standard structural neuroimaging studies.*
- *► SRC results in a range of clinical signs and symptoms that may or may not involve loss of consciousness. Resolution of the clinical and cognitive features typically follows a sequential course. However, in some cases symptoms may be prolonged.*

- *The clinical signs and symptoms cannot be explained by drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction, etc) or other comorbidities (eg, psychological factors or coexisting medical conditions).*

Epidemiology

- CDC estimates 3.5 million sport related concussions per year
- Represents 10% of all injuries sustained by high school athletes

Diagnosis - Signs

- Vacant stare
- Delayed responses
- Inattention
- Disorientation
- Slurred/Incoherent speech
- Perseveration

Diagnosis - Signs

- Incoordination
- Nausea/vomiting
- Inappropriate emotionality
- Memory problems
- Loss of consciousness

Diagnosis - Symptoms

- Headache
- Feeling slowed down
- Difficulty concentrating
- Dizziness
- Fogginess
- Fatigue
- Blurry or double vision
- Sensitivity to light
- Memory problems
- Balance problems

Diagnosis - Unusual

- Voice changing
- Sweating
- Right to left handed
- Heart rate and blood pressure changes
- Pseudo-seizure
- Increased urination
- Better math skills

Diagnosis – Headache

- Concussion
- Inter-cranial bleed
- Extra-cranial injury
- Cervical injury
- Previous headache issues

Concussion and Vision

- 67% of the neural connections within the brain are involved with some aspect of vision. Such as visual input, visual perception, and visual integration.

- Accommodative Insufficiency
- Blurry Vision
- Convergence Insufficiency
- Double Vision
- Light Sensitivity
- Ocular-Motor Dysfunction
- Reduced Visual Processing Speed

Sideline Evaluation

- First Aid, ABC's
- Any Athlete suspected of having a concussion should be removed from play and assessed by a physician or licensed health care provider
- State laws

Alabama Law requires

- each sports or recreational organization to create a concussion and head injury information sheet that athletes and parents must sign each year;
- requires local school systems to develop concussion guidelines;
- each sports or recreational organization to give coaches annual training on how to recognize the symptoms of a concussion and the proper medical treatment;
- a youth athlete who is suspected of sustaining a concussion or brain injury in practice or a game shall be immediately removed from participation and may not return to play the day of the injury and until he or she is evaluated by a licensed physician and receives written clearance to return to play from a licensed physician.

Sideline Evaluation

- SCAT5, Child SCAT 5
- Initiate Emergency Action plan
  - Glasgow coma scale < 13
  - Prolonged Loss of Consciousness
  - Focal Neurologic Deficits suggesting Intracranial trauma
  - Repetitive Vomiting
  - Spine Injury
  - Persistent diminished or worsening mental status

Sideline

- Athletes removed from play should not be left alone after injury
- Serial checks for delayed onset SRC
- Periodic checks are recommended for initial hours following injury

Management

- Initial Rest 24-48 hours
- Medications
- Reduced cognitive and exercise load
  - Sub Symptom levels
- Physical Therapy for concurrent injuries
- Occulo-Vestibular rehab
- Medical Clearance
- Graduated return to play

Management

- Look for concurrent cervical spine soft tissue injuries
- Frequently overlooked
- Benefit from early PT intervention

Management

- Occulo-Vestibular Rehab
- 5 minute screening test
- Consider screening
  - Chronic Headache
  - Fogginess
  - Dizziness when standing
  - Sensitivity to busy environments

Management

- Concussion symptoms typically resolve within
  - 14 days in adults
  - 4 weeks in children and adolescents
- Risk of re-injury may take much longer to normalize
- NCAA study(2003) 6.5% of athletes had a repeat injury
  - 9/12 were within first 7 days
  - 11/12 within the first 10 days

Management

- Return to learn
  - Accommodations in the classroom
  - Testing time
  - Cognitive impairment lasts longer than symptoms

Neurocognitive Testing

- Computerized
  - ImPact, CNS Vital signs, XLNTbrain Sport, CCAT,CRI, ANAM
- Formal pencil and paper
- Role, Cost?, Reliable
- Liability
  - WSJ April 2017
    - A 17-Year-Old's Death Points to Flaws in Concussion Test

Return to Play

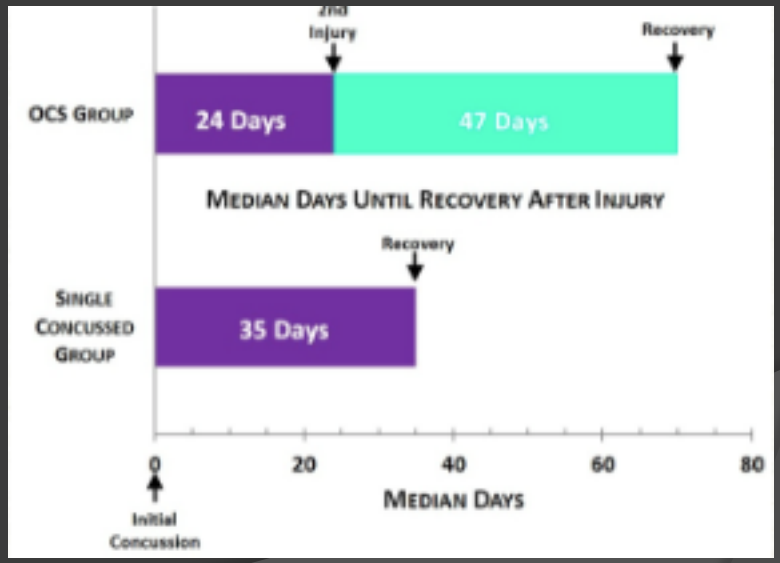
Table 1 Graduated return-to-sport (RTS) strategy

Stage	Aim	Activity
1	Symptom-limited activity	Daily activities that do not provoke symptoms
2	Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training
3	Sport-specific exercise	Running or skating drills. No head impact activities
4	Non-contact training drills	Harder training drills, eg, passing drills. May start progressive resistance training
5	Full contact practice	Following medical clearance, participate in normal training activities
6	Return to sport	Normal game play

- Each Step 24 hour minimum
- Symptoms guide progression

Too Early – What are the risks?

- Second Impact syndrome
- Overlapping Concussion Syndrome
  - Meta review 419 patients, 19 had OCS
  - 36 days longer
    until recovery



Concussions not getting better

- Occulo-Vestibular Issues
- Other chronic conditions
- Psychosocial issues
- Post concussion syndrome
  - Symptoms lasting > 4 weeks

Concussion ‘Tests’

- Imaging
  - CT Scan
  - MRI
    - fMRI
    - Arterial Spin Labeling
    - MR Spectroscopy
    - MR Elastography
    - Diffuser Tensor Imaging

The nerdy stuff

- Cellular Metabolism
  - Animal studies: Acute neurometabolic cascade involving extracellular K+, accelerated glycolysis and increased lactate production immediately following concussion
- Leads to a dissociation of metabolism and cerebral blood flow, resulting in a state of metabolic depression

Cellular Metabolism

- Increased lactate is believed to leave neurons more vulnerable to secondary ischemic injury, may predispose to repeat injury
- Later steps in the cascade involve ⬆ intracellular Ca++, mitochondrial dysfunction, impaired oxidative metabolism, decreased glycolysis, axonal disconnection, neurotransmitter disturbances, and delayed cell death

Cellular Metabolism

- Decreased cerebral blood flow lasts approx 10 days in animal models
- This is consistent with an apparent 7-10 day period of susceptibility to recurrent injury in a prospective cohort study by Guskiewicz et al.

Oh the Chemistry……

- S-100
- Neuron-specific enolase (NSE)
- Myelin basic protein (MBP)
- GFAP
- SNTF (Brain enriched protein calpain-cleaved alpha II-spectin N-terminal fragment)
  - High levels of SNTF after brain injury corresponds to persistent symptoms after injury (axonal injury)

Even more....

- Tau – the CTE one
  - Several sub types
  - Higher Tau A levels associated with longer recovery
  - Many Tauopathy's – Alzheimer's, Pick's
- Apoprotien E

Research

- Biomarkers
- CARE Study
  - NCAA & DoD
  - 33,000 patient cohort
  - As of June 2017, 2083 concussions documented
  - Premorbid factors, Injury Biomechanics, Acute injury effects and Neurobiologics

Where are we going?

- Sport restriction
- Prevention
- NCAA global guidelines
- Genetics
  & Biomarkers

Conclusion – My Best practices

- Baseline evaluation
  - BESS, ImPact, Concussion history
- Education
- Sideline
  - EAP
- Physician
- RTP Protocol
- Understand every patient is unique

References

- 5th International Conference on Concussion, Berlin 2016
- SCAT 5
- NATA position Statement
- NCAA Concussion Fact Sheet
- http://concussionawarenessprogram.org
- VOMS Screening