

Care of the Athlete after a Concussion



CTE Conference 2016: Long Term
Impacts of Concussion
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Disclosures

Dr. Jill Inouye had no relevant financial relationships with commercial interests

Objectives

- Define Concussion
- Pathophysiology
- Risk factors
- Concussion management program
 - Zurich Guidelines
 - NFL
 - NBA
 - US Soccer
 - Hawaii DOE



AMERICAN
MEDICAL
SOCIETY FOR
SPORTS
MEDICINE

Definition



AMERICAN COLLEGE
OF SPORTS MEDICINE
LEADING THE WAY

- According to AMSSM: “traumatically induced transient disturbance of brain function and involves a complex pathophysical process”
- 2012 Zurich Consensus statement defines concussion as “a complex pathophysiological process affecting the brain, induced by biomechanical forces.”
- Can also be defined as a “temporary disturbance of the brain function, which occurs without a permanent structural change in the brain following a blow to the head or body” according to ACSM

Definition

- May be considered subset of mild traumatic brain injury
- Self limited in duration and recovery
- Due to direct blow to the head, face, neck, or other body part with force transmitted to the head
 - May also be indirect injury
- Acute clinical changes reflect functional (not structural) disturbance so usually no abnormalities on imaging
- Results in graded set of clinical symptoms

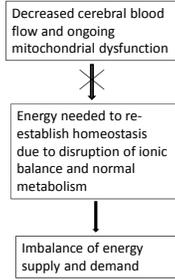
Pathophysiology

- Linear and/or rotational forces transmitted to the brain
- Concussed brain is less responsive to normal neural activation
 - May involve disruption of axonal and myelin sheath structures throughout the white matter of the hemispheres and brain stem
 - Petechial hemorrhages in periventricular regions
 - Cell loss throughout the cortical gray matter and brain stem nuclei



Pathophysiology

- Neurometabolic cascade: involves ionic, metabolic, and pathophysiological events accompanied by axonal injury
 - Glutamate, K, lactate, glucose, blood flow
- Concept that another injury (before brain has recovered) leads to worsening cellular metabolic changes → significant cognitive deficits



Pathophysiology

- The release of glutamate can cause ionic fluxes that disrupt the cell's use of oxygen
- With a head injury, the need for glycolysis increases but there is also a decrease in cerebral blood flow → glucose supply ≠ glucose demand

Pathophysiology

- Possibility that another blow to the brain, before fully recovered, can lead to worsening metabolic changes in cells
- Excessive physical or cognitive activities before brain is recovered can lead to prolonged dysfunction/recovery
 - May be more pronounced in youth
 - Immature brain more susceptible



Risk Factors

- Previous concussion
 - Associated with 2 – 5.8 times higher risk
- Higher number and longer duration of symptoms → prolonged recovery
- Females > males
 - Females also report higher number, severity, and longer duration of symptoms
 - Females have lower head-neck segment mass → possible greater angular acceleration of the head
 - Estrogen and cerebral blood flow may influence concussion severity and outcome
 - Females are more likely to report their symptoms
- May also predict probability of longer course

Risk Factors

- Strength of neck musculature may also play a part
 - If the neck muscles are more rigid, will need more acceleration to apply force to the skull
 - Therefore, football players or soccer players anticipating a hit may be at less risk for injury



Risk Factors

Factors	Modifier
Symptoms	Number
	Duration (>10 days)
	Severity
Signs	Prolonged LOC (>1 min); amnesia
Sequelae	Concussive convulsions
Temporal	Frequency (repeated concussions)
	Timing (injuries close together)
	“recency” (concussion or TBI)
Threshold	Repeated concussions with less impact; slower recovery
Age	Child and adolescents (<18 yo)
Comorbidities/premorbidities	Migraine, depression, ADHD, sleep d/o
Medications	Psychoactive drugs, anticoagulants
Behavior	Dangerous style of play
Sport	High risk activities, contact, higher levels

Risk Factors

- Certain sports, positions, and individual playing styles
 - High risk with contact sports and positions
 - Quarterbacks, wide receivers, running backs, and defensive backs; kick-offs
 - Checking in hockey
- Youth athletes typically have longer recovery
 - Younger brain have less cognitive reserves
- Previous mood disorders, learning disorders, ADHD, and migraines can complicate diagnosis
- ?Genes: APOE e4, APOE G-219T promoter, tau exon 6

Epidemiology

- Increased annual concussion rates over the last decade
 - No clear cause but may be due to more education
- CDC estimates 1.6 – 3.8 million sports related concussions occur in the US every year
 - 5-9% of sports related injuries
- Highest incidence in football, hockey, rugby, soccer, and basketball
- Competition rates > practice rates

2012 Zurich Consensus

- Management = physical and cognitive rest until acute symptoms resolve
 - Need more research to evaluate the long term outcome of rest and optimal amount of rest
 - Low level exercise may be benefit for those who are slow to recover
- After asymptomatic, may start graded return to play
- No return to play on the same day of concussive injury



RTP Protocol (Zurich)

Rehabilitation Phase	Objective of Stage
No activity	Recovery
Light aerobic exercise	Increase heart rate
Sport specific exercise	Add movement
Non-contact training drills	Exercise, coordination and cognitive load
Full-contact practice	Restore athlete's confidence; coach staff assesses functional skills
Return to play	

- Protocols can vary depending on the organization
- Each phase is 24 hours
- Rest and hold the athlete if symptoms return – may resume at last asymptomatic level phase once asymptomatic for 24 hours
- May consider light activity for those who are slow to recover

Return to Class

- Concussion management includes cognitive rest so this may require absence from school
- Academic accommodations (reduced workload and extending time for tests)
- Cannot go back to physical activities without first going back to school



NFL Concussion Management

- NFL sideline concussion assessment is a standardized acute evaluation developed by the NFL's Head, Neck, and Spine Committee
- Preseason: education for the players and club personnel; baseline physical exam and neuropsychological testing
- Possible concussion: emergency action plan → sideline or locker room evaluation using the NFL Sideline Concussion Assessment Tool that is compared to baseline
 - Not able to return to same day practice or competition if have concussion
- During games, each team is assigned an Unaffiliated Neurotrauma Consultant

NFL Concussion Management

- Unaffiliated Neurotrauma Consultant: present on the sidelines
 - identifies concussion symptoms and mechanism of injury for possible further evaluation
 - works with head team physician to implement the Club's concussion evaluation and management protocol
 - observe the Sideline Concussion Assessment Exams
- Booth ATC: "spotter" for both teams from the stadium booth, where he or she can have multiple views of video



NFL Concussion Management

- Madden Rule: a player diagnosed with a concussion on game day must be removed from the field of play and observed in the locker room; not able to talk to the press until medically cleared
- NFL Sideline Concussion Assessment is done on the day of the injury and repeated prior to going home or to transportation home for an away game
- If a concussion is unclear or if player sustained a big hit and there is concern for concussion, the player is removed immediately for evaluation by the Team Physician (focused neuro exam, Maddock's questions)
 - If determines that the player did not sustain a concussion, a video replay must be reviewed prior to returning to the field
 - If there is still doubt, the full NFL Sideline Concussion Assessment is done

NFL Concussion Management

- Return to participation: must be examined in the training room daily or as decided by the medical staff
- Must return to baseline status of symptoms and neuro exam (cognitive and balance)
 - Repeat neuropsychological evaluation
- Exercise challenge after returning to baseline
- Must be cleared by the Team Physician AND Independent Neurological Consultant



NFL Concussion Management

- There is no set time frame for return to participation or progression through the steps (versus having 24 hours between each step)
- Recovery will vary player to player
- 1: Rest and recovery - may stretch and work on balance at the most; limit screen time, no team meetings
- 2: Light aerobic exercise - stationary bike, treadmill; can attend team meetings and film
- 3: start weight lifting - can also increase aerobic exercise
- 4: Football specific exercises/drills (no contact)
- 5: Full football activity/full clearance

NBA Concussion Management



- Each player and coach receive education prior to the start of the season
- Each player goes through baseline testing (neuro and cognitive) prior to the start of the season
- If suspect a concussion, the player is removed from participation and evaluated by the medical staff
 - If diagnosed with a concussion, the player may not return to participation on that same day
 - The player will rest while having symptoms

NBA Concussion Management



- Return to Participation: held from participation until he is symptom free and back to baseline for neurological exam and computerized cognitive assessment test
- May return to participation once asymptomatic and completed the NBA concussion return-to-participation exertion protocol
 - Involves several steps to increase exertion
 - Must be symptom free at each step in order to progress
 - If not symptom free, the player stops until symptom free again at the previous step he was symptom free
- Final return-to-participation decision is made by the team physician, who discusses the process with the Director of the NBA's Concussion Program
- There is no time frame to complete the protocol – recovery time can vary in each case

U.S. Soccer Concussion Management

- U.S. Soccer Federation uses ImPACT for the National teams and Development Academy
 - All athletes have baseline testing
- If suspect concussion, the athlete is removed immediately and evaluated
 - Transport to ER if needed
 - Sideline post game evaluation (SCAT2 or SCAT3 and modified BESS)



U.S. Soccer Concussion Management

- Graded return to play
- See Neuropsychologist and Physician
 - ImPACT after symptom free for 24-48 hours
- Must be symptom free at rest for 24 hours before starting return to play protocol
- Symptom free after starting moderate activity for 24 hours
- Symptoms free after starting heavy activity for 24 hours
- Retake baseline tests (SCAT3, ImPACT, BESS)
- Neuropsychologist review ImPACT
- Health care provider confirms the player completed RTP protocol and make final return to play decision

U.S. Soccer Concussion Management

- Recommend players in U11 programs and younger not engage in heading
- Recommend players in U12 and U13 limit heading to maximum of 30 minutes per week with no more than 15-20 headers per player per week
- Coaches need to instruct on proper heading techniques



U.S. Youth Soccer

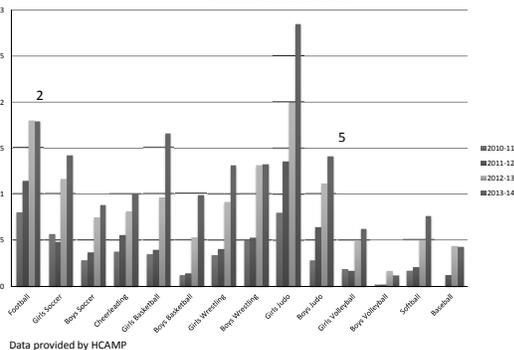
- Step 1: Evaluate if concussion occurred
- Step 2: ER?
- Step 3: Monitor player for symptoms
- Step 4: The player may only return to U.S. Youth Soccer after release from a physician specializing in concussions
- Step 5: If diagnosed with a concussion, the Concussion Notification Form should be filled out in duplicate and signed by a team official
 - Parent or legal guardian should also sign one of the copies
 - The team official must obtain the player's pass from the referee and attach it to the form in league play
 - In tournament play, the committee obtains the player's pass and keeps it until have proper medical release

Hawaii Epidemiology provided by HCAMP

- The DOE reported an increase in concussions from the SY 2007-2008 of 213 to SY 2013-2014 of 1,008
- Football players had the highest percentage of concussions for SY 2010-2014
 - Girl's soccer was 2nd highest percentage



Concussion Injury Rate per 1000 exposures for 14 Sports during School Years 2010-2014



Concussion Act 197

- Signed into Hawaii Law 2012
- Recognized that there is an increase in concussions, which may be related to increase awareness
- Therefore, legislature found that “a statewide concussion educational program is necessary to ensure that public and private high school students, school personnel, and parents are provided with consistent and up-to-date information on concussion and management of symptoms and injuries relating to a concussion”
- The Act required the DOE and Hawaii High School Athletic Association to develop a concussion educational program for students and student athletes who are 14 – 18 years old
 - Education of the signs and symptoms of a concussion and what to do if suspect concussion
 - Annual educational session for coaches and athletic trainers
 - Mandatory removal of a student from the activity if suspect concussion
 - Student needs to be evaluated by a physician or licensed health care provider
- Certified athletic trainer is to monitor the return to physical activity

Hawaii DOE and Athletic Health Care Trainers’ (AHCT) Program

- Instituted a concussion management program (CMP)
- Follows the rule from the National Federation of State High School Association (NFHS) set in 2010: “any player who shows signs, symptoms, or behaviors associated with a concussion must be removed from the game and shall not return to play until cleared by an appropriate health-care professional.”

Hawaii CMP

- All 9th and 11th grade athletes participating in contact or collision sports, in addition to 10th and 12th grade athletes participating in contact of collision sports for the first time, will be administered a baseline test
 - Athletes who had a concussion in the last year will also have to do another baseline test
 - Graded symptom checklist baseline assessment
 - Immediate Post-Concussion Assessment and Cognitive Test (ImPACT) or Standard Assessment of Concussion (SAC) baselines
 - Postural stability baseline assessment
- Educational sessions for coaches, parents, and students prior to the season starting

- Study done by T. Kanaoka et al. showed the days of restricted participation post-concussion were significantly increased with ImPACT (mean 26.25) versus SAC (mean 22.50)
 - ImPACT may lead to a more conservative approach and possibly provide more cognitive rest before starting the RTP (steps 3-7)
 - No significant difference between duration of the Graduated RTP between ImPACT and SAC

- ### Hawaii CMP
- After sustaining a concussion or even if just suspect a concussion, the athlete fills out the graded symptom checklist and receives the medical referral form (guardian)
 - Record symptoms again at 2-3 hours after the injury and then the next day
 - May monitor symptoms more frequently depending on the situation
 - Can also administer SAC if suspect concussion

- ### Hawaii CMP
- Once diagnosed with a concussion, the athletic trainer and/or sideline physician decides if the patient needs to go to the ER or see their physician
 - Multidisciplinary team approach to get the athlete back to competition
 - Athletic trainer can work with the athlete's physician or neuropsychologist to determine when the athlete is ready to start the return to activity plan (RAP) or return to play (RTP)

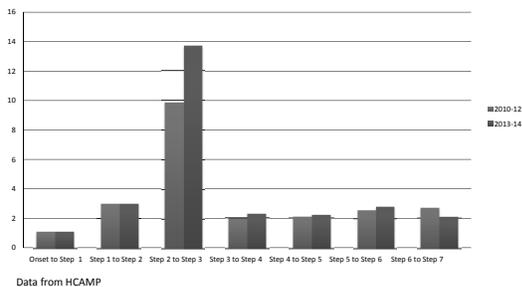
Steps of the Gradual RTP in Hawaii

- 1: complete cognitive and physical rest
- 2: return to school full time
 - Retake IMPACT
- 3: light activity – usually requires physician clearance but may start light activity (bike) if have minimal symptoms and no red flags on IMPACT
- 4: running in the gym or on the field (without helmet or other equipment)
- 5: non-contact training drills in full equipment; may start lifting weights
- 6: full contact practice or training
- 7: play in a game/competition

Hawaii RTP

- Athletes fill out symptom checklist daily, before each step/activity
- IMPACT tests are sent to the appropriate physicians
- If IMPACT is not back to baseline but no red flags, athletes may go up to non-contact on the return to play protocol

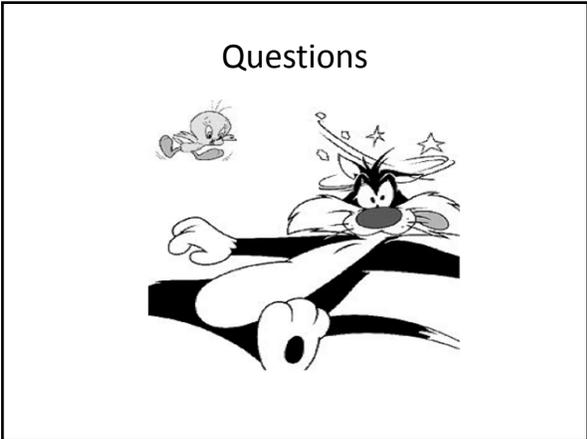
Average Days of School Missed in Each Step of the Gradual RTP Protocol SY 2010-2014



- Study done by A. Shimizu et al. showed that concussed athletes spent the most time going from step 2 to step 3 (which made up 70% of the total days missed)
- The longer the athlete spent going from step 2 to 3 lead to longer time to full sport participation
 - May be related to adequate cognitive rest and in-school adjustments.
 - The athletes need to be cleared by a physician before starting step 3

Hawaii Concussion Awareness and Management Program (HCAMP)
Report from August 1, 2011 to July 31, 2014
of Days Missed

Days Missed	MEAN	SD
August 1, 2013 – July 31, 2014 (n=1370)	26.15	25.17
August 1, 2012 - July 31, 2013(n=1140)	26.2	18.98
August 1, 2011 - July 31, 2012 (n=845)	23.5	16.5



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