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FAMILY MEDICINE **RESIDENTS** + MEDICAL **STUDENTS**

Sports Medicine Emergencies / Concussion Update 2017

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Major Problems

- Unconscious Athlete / Neck Injuries
- Anaphylactic Shock
- Seizures
- Heat Illness
- Sickle cell disease
- Sudden Cardiac Death (HCM)
- Concussions

BE PREPARED!!!!!!

- A team leader
  - Team physician
  - Athletic trainer
- Appropriate health care personal
  - BCLS certified (minimum)
  - How to handle & move injured athletes
- Ambulance for transport +/- Paramedics
  - Hospital notified & ready
- Communications
  - Cellphone, radio

Equipment: Resuscitation

- Airway
  - Oro or Naso-pharyngeal airway
  - Advanced airways*
  - Football: Clip cutter or Electric screwdriver!
    - Newer helmets w/ air bladder
- Breathing
  - Oxygen, masks & nasal cannulas,
  - Bag-valve masks,
  - Albuterol inhaler (spacer)*
  - Epinephrine (EpiPen)*
- Circulation
  - AED
- Advanced supplies from ambulance / paramedics
  - ACLS supplies (Defib/monitor, IV fluid, medications)

* - Optional

Equipment: Trauma

- Transport
  - Spine board, stretcher
  - Sand bags, foam/velcro, rigid cervical collar
- Fractures
  - Splints, immobilizers
  - Ace bandages, elastic tape
  - Slings

Equipment: General

- Gloves!
- Stethoscope, Oto-opthoscope, Penlight
- Tongue blades, bandages, hemostats
- Alcohol, povidine, hand-gel
- Thermometer (endurance events)
  - Rectal most accurate for on field
  - Ear thermometers becoming more accurate
    - Over read low, Under read high
- "Eye kit" (wash, q-tips, shields or patches)

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Anticipating Casualties

- Marathons: 1 – 20%
  - Half Marathon: 1 – 5%
- Triathlon (Iron Man): 15 – 30%
  - Short: 5 – 20%
- Cycling / Skiing: 5%
- "30/10/1 Rule" (source unknown)
  - 30% of athletes will need some sort of minor medical attention
    - PO fluids for cramping
  - 10% will require moderate medical intervention
    - IV Fluids, Misting or Bath to cool down
  - 1% will require intense medical intervention
    - ACLS, Immediate transfer to hospital w/ IV's

Sideline Management of Sports Medicine; ACP 2003

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Assessment of an Unconcious athlete

ABC's

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Airway

- Check for spontaneous breathing
- Face down → Log roll*
- Football: can remove just facemask*
- Jaw thrust, chin lift with minimal head-tilt
  - ***Always Assume C-Spine Injury!!!!!!!!!!!!***
- Clear airway (tongue or turf)
- Oxygen
- Oral-pharyngeal airway (if unconscious)
- Bag-valve mask

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Log Roll

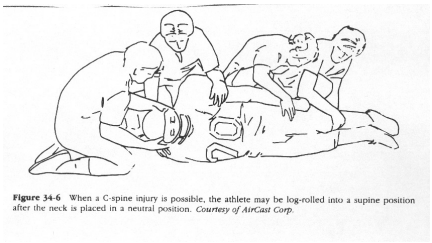

Figure 34-6 When a C-spine injury is possible, the athlete may be log-rolled into a supine position after the neck is placed in a neutral position. *Courtesy of AirCast Corp.*

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Protect C-Spine

- *ANY* unconscious athlete, assume cervical spine injury & protect
- Maintain neutral position
- Football helmets: can remove face mask *only!*
  - Use helmet to control head
  - SAFELY remove helmet if prevents airway control or suspect head injury
- *DO NOT* use ammonia capsules on *ANY* unconscious athlete
  - Extension reaction

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Stabilizing C-Spine w/ Helmet

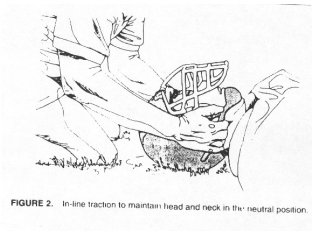

FIGURE 2. In-line traction to maintain head and neck in the neutral position.

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Helmets

- Football: designed to be used to stabilize C-spine along with shoulder pads
  - New NATA Consensus Statement looking into removal of helmet & other gear on field
- Lacrosse: allow 27 deg's of lateral rotation vs. football helmets.
  - Difficult to remove face mask
  - Do not keep C-spine straight with padding
- Hockey: offer no C-spine stabilization

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Lacrosse Helmet

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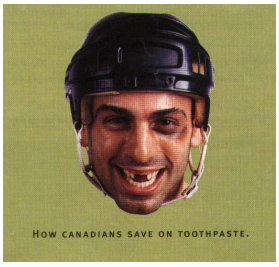
Hockey Helmet



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Breathing

- Artificial respiration (BCLS)
  - Mouth to mouth (not recommended)
  - Mask to mouth (various types)
  - Bag-valve mask
- Endo-tracheal & Naso-tracheal intubation very difficult on field
  - Oral airway in unconscious athlete
  - Naso-pharyngeal airway
- Most appropriate advanced airway intervention out-of-hospital is unproven
  - Significant complications and may reduce survival

(*Emerg Med J 2010;27:321-323 doi:10.1136/emj.2009.076737*)

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Respiratory Difficulties:

- Tension pneumothorax
  - Large bore needle thru 2nd intercostal space mid-clavicular line
- Open pneumothorax "Sucking" chest wound
  - Close off wound, Be "inventive"
- Flail chest
- Hemothorax
- Cardiac tamponade

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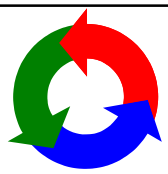
Circulation



- Check carotid pulse
- CPR if indicated (B & ACLS protocols)
- Defibrillation
  - 80% of circulatory collapse is Ventricular fibrillation
  - Portable and Automatic External Defibrillators

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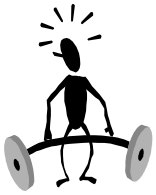
D = Disability

- Assess level of consciousness
  - Glascow coma scale
- Pupils for size, reactivity
- Motor response
- Verbal and tactile stimuli



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E = Exposure

- Check for Bleeding
- Check for Fractures
- Check for Contusions
  - Ecchymosis

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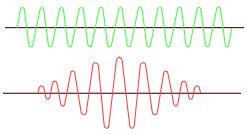

Goal with Unconscious Athlete

Stabilize and Transport!!!!

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Anaphylaxis

- Insect bites most common cause
- Drugs
- Pollens
- Exercise induced anaphylaxis
  - Cholinergic urticaria

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Signs & Symptoms

- Apprehensive
- Parathesias
- Generalized urticaria
- Cough / wheezing
- Laryngeal edema and closure
- Incontinence
- Dilated pupils
- Fever
- Shock
- Loss of consciousness
- Seizures

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Treatment

- Epinephrine 0.1 - 0.5mg SQ/IM (1:1000 sol) into a *NON*-occluded limb
  - Usual dose is 0.3mg
  - Peds: 0.01mg/kg
  - Can repeat every 5-15 minutes
- Epi-Pens, ANA-Kits (WATCH dose!!)
- Alt: 0.1-0.25mg (1:10,000 sol) IV q 5-15 minutes then 1-4mcg/min IV prn
  - Peds: 0.01ml/kg/dose IV then 0.1mcg/kg/min IV prn

***Dosing is subject to change

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Assess the Airway

- Oxygen via mask or nasal cannula
- Nebulized beta-2 agonist for wheezing
  - i.e.; albuterol w/ spacer
- Alternate: Aminophylline load 6 mg/kg IV then 0.7 mg/kg/hr IV x 12 hrs
- Fluid resuscitation
  - Ringers, Normal Saline

***Dosing is subject to change

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Seizures

- Familiarity with meds & side effects
  - Attention span & cognitive impairment
- Decreased potential for seizures w/ exercise
  - Metabolic acidosis due to lactate buildup & incomplete respiratory compensation
  - Decreased pH >> Stabilizes neuro-membranes
- Good control must be obtained prior to participation in activities

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Sports Specific

- Endurance activities (running)
  - Unlikely to induce a seizure
- Swimming / Rowing / Sailing
  - Nearby lifeguard
  - Life jacket
- Contact sports (football)
  - Usual precautions w/ helmets & pads
- Extreme contact (boxing)
  - Trauma can induce seizures
- Some sports too dangerous
  - Skydiving, scuba diving, ??diving

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Seizure Acute Treatment

- Monitor ABC's
- Remove from any dangerous settings
- Monitor activity and type
  - Absence
  - Partial
  - Tonic-Clonic (Gran Mal)
- >10 minutes → Status epilepticus

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Seizure Acute Treatment

- No IV access
  - Rectal or SL diazepam 2-4mg
    - Ped 0.05-0.15mg/kg
    - May repeat in 10-15 min
  - Fosphenytoin - 15-20 PE (phenytoin equivalent)/kg at 100-150 PE/kg IM
    - 1.5 mg of fosphenytoin is equivalent to 1 mg of phenytoin
- With IV
  - Lorazepam 0.1 mg/kg IV at 2 mg/min
    - Ped dosing 0.05 – 0.1 mg/kg/ IV x1
    - 2nd dose 10-15 minutes
  - Diazepam - 0.2 mg/kg IV at 2 mg/min up to 20 mg
  - Fosphenytoin (same dose)

***Dosing is subject to change

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Heat Injury: Hyperthermia

- Derangement of mechanism that control the body's core temp
- Most common in endurance events
  - Marathons, Triathlons (running stage)

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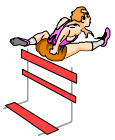
Risk Factors



- Fatigue
- Hypovolemia (waiting to feel thirsty)
  - Sodium depletion
- Previous heat illness (increased risk)
- Febrile illness or recent immunization
- Very young or old
- Hypertension
- Low aerobic fitness level

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Drugs

- Anticholinergic (antihistamines)
- Phenothiazines
- Antidepressants (tricyclics, MAOI's)
- Diuretics
- Alcohol
- Cocaine
- Supplements (#1 problem)
  - Creatine, Ephedra

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Prevention

- Adequate acclimatization & conditioning
  - Some athletes have poor tolerance
- *Hydration*
  - Controversial: "Waiting for thirst indicates you're already behind"
- Wet bulb / Black globe Temp Index
  - WBGT = 0.7(WB) + 0.2(BG) + 0.1(DB)
  - Developed in 1956 by the US Marine Corps at Parris Island

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Wet Bulb / Black Globe Index

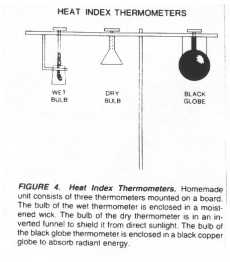

FIGURE 4. Heat Index Thermometers. Homemade unit consists of three thermometers mounted on a board. The bulb of the wet thermometer is enclosed in a moistened wick. The bulb of the dry thermometer is in an inverted funnel to shield it from direct sunlight. The bulb of the black globe thermometer is enclosed in a black copper globe to absorb radiant energy.

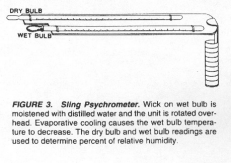

FIGURE 3. Sling Psychrometer. Wick on wet bulb is moistened with distilled water and the unit is rotated overhead. Evaporative cooling causes the wet bulb temperature to decrease. The dry bulb and wet bulb readings are used to determine percent of relative humidity.

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WBGT Index

WBGT READING	ACTIVITY GUIDELINES & REST BREAK GUIDELINES
UNDER 82.0	**NORMAL ACTIVITIES** -- Provide at least three separate rest breaks each hour of minimum duration of 3 minutes each during workout.
82.0 - 86.9	**USE DISCRETION** for intense or prolonged exercise; watch at-risk players carefully; Provide at least three separate rest breaks each hour of a minimum of four minutes duration each.
87.0 - 89.9	**MAXIMUM PRACTICE TIME IS TWO HOURS**. For Football: players restricted to helmet, shoulder pads, and shorts during practice. All protective equipment must be removed for conditioning activities. For all sports: Provide at least four separate rest breaks each hour of a minimum of four minutes each.
90.0 - 92.0	**MAXIMUM LENGTH OF PRACTICE IS ONE HOUR**, no protective equipment may be worn during practice and there may be no conditioning activities. There must be 20 minutes of rest breaks provided during the hour of practice.
OVER 92	**NO OUTDOOR WORKOUTS; CANCEL EXERCISE**; delay practices until a cooler WBGT reading occurs.

Info.scientificgear.com. 2012-13

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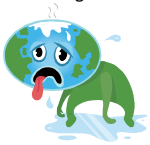
Heat Loss/Gain

- Generates
  - Exercise
  - Solar & sky radiation
  - Ground thermal radiation
  - Breathing: Insensitive loss of fluid
- Losses
  - Perspiration and evaporation
  - Breathing



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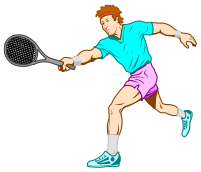
Types of Heat Illness

- Heat or Post event collapse
- Heat Cramps
- Heat Exhaustion
- Heat Stroke



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Heat Cramps

- Hot, flushed, sweating
- Clear mental status
- Rectal temp 100.4 - 103 (38.0 - 39.4) deg
- Prolonged muscle spasm
  - 1^{0}ly lower limbs
- +/- Edema
- Sodium depletion
- Treat: Oral fluids (Na+ replacement)
  - May need to look at Ca, Mg, & K

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Heat Exhaustion

- 2 types: usually mixed
  - Sodium depletion – milder
  - Water depletion – more symptoms
- Conscious, may be more confused
- Rectal temp 103 – 104 (39.4 – 40.0) deg
- Sweating +/-, nauseated, tachycardic
- Hypotension: Worse in water depletion
- Treat: Hypotonic oral fluids, IV fluids, Fan on misted blankets (gauze)

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Heat Stroke

- Disoriented, headache, slurred speech
- May be unconscious
- Rectal temp >105.1 (40.6) deg
- Flushed or pale, +/- Sweating!
- Total thermoregulatory failure!
  - Multiple metabolic & electrolyte abn's
- Treat: ***Medical Emergency!!***
  - IV fluids (NS), Wet down & fan, Cool water immersion (Ice/Ice water bath ??)
  - Transport to hospital

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Prevention

- Acclimatization of athletes 2 weeks prior
- Daily posting of temp & heat stress index
  - Combination of solar & ambient heat and relative humidity (WBGT Index)
- Systematic schedule of fluid intake
  - Before, during, & after events
- Weights (determine amount of fluid lost)
  - Before, during, & after practice
- Availability of resuscitative and transportation services

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Prevention

- ***Liberal hydration is KEY!***
- Using weight loss during practice, amount of fluid loss can be estimated and prevented
  - 1 lbs (0.453 Kg) in 175 lbs (79.38 Kg) = 0.57%
  - Approx ½ liter needs to be replaced

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Hydrate or Die!!

- Liberal hydration
  - < 1hr: water alone OK
  - > 1hr: think Na+ replacement
    - Not usually K+
- Use of Sport drinks
  - > 1 hr of activity
  - Intense exercise
  - Warm / humid conditions
- *Remember Sports Drinks contain CHO!!*

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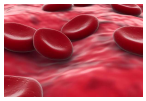
Sickle Cell Disease



- 1st described in 1910
- Most common single genetic disorder found in African Americans
  - Found in 1/375 to 1/500 of persons of African descent
  - 10% of African Americans have Sickle Cell Trait
  - Also 1/1000 of Hispanic descent
  - Also found in many others of Mediterranean, Arabic, Indian, and South American descent
- Various forms of the disease with varying severity

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Sickle Cell "Disease"

- "S" gene from both parents
  - Homozygous HgB-SS
- Most severe form of the disease
  - Limits athletic participation
- Discovered early in infancy due to onset of anemia & complication
  - 1st crisis can occur as young as 1 y/o
- Survival into the 40's with current diagnosis and treatment

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Sickle Cell "Trait"

- Various forms: Less severe symptoms
  - HgB-SA
    - 1 sickle gene with 1 normal gene
    - Can be asymptomatic until late adolescence or adulthood
  - HgB-SC
    - 2 forms of abnormal hemoglobin
    - Tend to have earlier onset of symptoms
  - HgB-SBeta
    - Sickle cell thallasemia
    - More severe symptoms

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Vaso-Occlusive Crisis

- RBC's assume sickle shape which causes occlusion of blood flow to various organs
- Triggers can include
  - Exercise
  - Extreme Hot or Cold temperatures
  - Dehydration
  - Infections
  - Etc……

- Acute treatment: Rest, Analgesia, Fluid, O2
- Multiple medications being used & tested for prevention of crisis

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Complications

- Splenic Sequestration
  - Severe enlargement of the spleen
  - Organ is usually infarcted in childhood earlier in SS-Disease vs Trait
  - High risk of infections (is athlete immunized?)
- Aplastic Crisis
  - Severe anemia
  - Related to infection with Parvo-B-19 virus
- Acute Chest Syndrome
  - Infarction with secondary infection of the lung

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Complications

- Gall bladder disease
  - Due to the high breakdown of RBC's
- Renal complications
  - Hematuria, Proteinuria
  - Eventual loss of function
- Stroke and infarction of other major organs

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Sports Participation

- Both the AAP – Committee on Sports Medicine and Fitness and National Athletic Trainers Assoc recommend FULL sports participation of athletes with Sickle Cell Trait
  - Athletes with Sickle Cell Disease are recommended NOT to participate in high exertion and collision / contact sports
- ALL require individual assessment!!

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Sports Participation

- Be aware that athletes with "Trait" may not present with symptoms until as late as college or even professional level sports!
- High profile cases
  - Ereck Plancher, Univ Central Florida '08
  - Aaron O'Neil, Univ Missouri '05
  - Devaughn Darling, Florida State '01

- Plancher had been diagnosed prior to participation but had NO symptoms prior to his death
- Various sources list as many as 15 deaths attributed to Sickle Cell Trait complications

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Acute Treatment

- FLUIDS!!!
  - IV if available (NS, Ringers)
- Oxygen 15 lit/min non-rebreather
- Cool athlete if core temp rising
- Emergency Action Plan / 911 ready
  - Equipment available (ie; AED)
  - Advise ER to look for rhabdomyolysis

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Prevention

- Pre-participation screening tests
  - In "high risk populations" if not screened before
- Close attention to vital signs
- Build athletes up slowly
  - Longer rest periods
- Hydration Hydration Hydration!!!
- Look for signs/symptoms of heat illness
  - Less symptoms of cramping in "Trait" athletes
- Hold from participation if athlete is ill

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Hypertrophic Cardiomyopathy (ex IHSS)

- Most common cause of sudden death in athletes
- Usually find:
  - Marked LVH (***Need to differentiate from normal LVH in conditioned athletes)
  - Significant L outflow obstruction & Arrhythmia's
  - Both increased by activity
  - PMHx of syncope or FHx of sudden death in a young relative

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Symptoms HCM

- Most are ASYMPTOMATIC until Sudden Cardiac Death (can be the 1st symptom)
- Symptoms with activity:
  - Chest pain
  - Shortness of breath
  - Lightheadedness
  - Dizziness
  - Loss of consciousness
- Children often do not show signs of HCM
  - After puberty

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Incidence

- 0.2% to 0.5% of the general population
  - All types of HCM
- Appears in all racial groups
- Sarcomeres (contractile elements) in the heart replicate causing heart muscle cells to increase in size
  - Results in the thickening of the heart muscle
- Typically an autosomal dominant trait
  - 50% chance of passing trait

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Cardiovascular Risks

- SCD (ALL causes) per year in healthy patients
  - 1 / 133,000 Men (0.00075%)
  - 1 / 769,000 Women (0.00013%)
- AMI w/in 1 hour of exercise 2-10%
  - 2.1 – 10x higher than in sedentary patients
- SCD 6-164x greater than sedentary patients
- Recommend higher level of screening in high risk patients

- Circulation 2007: Exercise and Acute CV Events: Placing Risks Into Perspective

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Veneto Italy Study

- Claim 89% reduction in SCD by screening ALL athletes with ECG in the PPE
- Actual numbers:
  - 84 of 12,880 (0.65%) screened had any significant ECG abnormalities
  - Study was done between 1979-2001
  - 11 of that 84 (0.09% of the 12,880) had significant pathology
- US *athlete* population alone is ~15 million
  - Peliccia et al, *N Eng J Med* 2008 V358(2) pp152-61
- New findings higher familial incidence of HCM in Veneto Italy population
  - Pediatrics in Review November 2006; 27:418-424; doi:10.1542/pir.27-11-418
  - European Heart Journal (2011) 32, 983–990 doi:10.1093/eurheartj/ehq428

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Problems with Veneto

- ARVC (Arrythmogenic Right Ventricular Cardiomyopathy) conveys the 2nd highest risk of sports related sudden death (not HCM)
- Most common sport is Soccer vs US Basketball & American Football. Soccer may have higher cardiovascular demand
  - » Journal of Sports Medicine Vol 2013 (2013), Article ID 967183
- Annual death rate before the screening program began was 1 per 27 000 athletes, "which is high compared with other [US] studies."
  - » ECG screening slashes sudden cardiac deaths in young athletes - Medscape - Oct 03, 2006.

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ECG Screening??

- Retrospective study in Israel 1985-2009
- Mandatory ECG started 1997
- 24 deaths documented
  - 11 before legislation
  - 13 after legislation
- Incidence 2.6 / 100,000 athlete-years
  - 2.54 / 100,000 before legislation
  - 2.66 / 100,000 after legislation
  - p = 0.88 (difference not statistically significant)
- No apparent effect on risk for cardiac arrest

Steinvil et al *J Am Coll Cardiol* 2011 v57 pp1291-6

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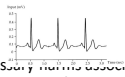
Harms from ECG Screening

- Up to 5% of healthy people can be suspected of having disease following ECGs, and up to 30% of those screened may be referred for additional cardiovascular testing (= False +)
  - Echocardiography
  - Stress testing (+/- imaging)
  - Cardiac catheterization



- Additional tests can lead to unnecessary harms associated with anxiety and psychological trauma, overdiagnosis and overtreatment. And athletes can be subjected to temporary or lifelong restrictions and exclusion from sport, and impediments to insurability or employment opportunities
  - BMJ Press Release 4/2016
- False-negative rates average 30% +/-
  - Allison ; J Pediatr 2011

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HCM Deaths (Athletes)

- 1 in 220,000 per year
  - 66-75 deaths per year
- Between 1994-2006
  - Blunt trauma w/ damage 416
  - Commtio cordis 65
  - Heat stroke 46

Circulation. 2009 Mar 3;119(8):1085-92

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Treatment HCM

- Limitation of extremely exertional activities
- Beta blockers and Calcium channel blocker (Verapamil)
  - Avoid diuretics
- Surgical myomectomy
  - Removal portion of interventricular septum
  - Mortality of 1%

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Treatment HCM

- Alcohol septal ablation
  - Alcohol ablation of the septal branches of LAD
  - Less invasive
- Implantable cardiac defibrillator
- Pacemaker
  - Induces asynchronous contraction of the left ventricle which reduces outflow obstruction

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Other changes

- Better cardiac screening for PPE's
  - Valsalva & Squat test for murmurs
  - AHA guidelines
- Close monitoring of athletes during ANY activity
- BCLS trained & AED availability at ALL events
- Withholding any athlete showing any signs of cardiac disease …. (Similar to concussions)
- Recommend physician coverage at broader range of athletic events
  - Basketball, Soccer, Track & Field……..
- ***Paradigm change: Injury focus > Medical focus***

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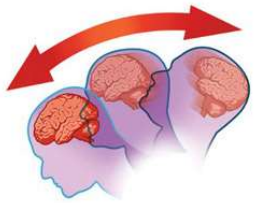
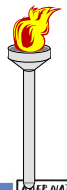
Concussion 2017

Update on Diagnosis and Treatment





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Family Medicine Residents + Medical Students

NFL head injuries prompt fines, brain concerns

The National Football League has fined three players $50,000 to $75,000 for violent helmet-to-helmet hits - which have been known to be devastating for players.

The league has been criticized for being too lax with head blows and the league's new medical committee members earlier this year vowed to change that culture.

After several players were injured Sunday in what some fans and observers perceived as a particularly violent weekend of football, the NFL pledged on Tuesday to be more vigilant about ejecting and/or suspending players who have made flagrant hits.

CNN Health

http://pagingdrgupta.blogs.cnn.com/2010/10/20/nfl-head-injuries-prompt-fines-brain-concerns/?hpt=Sbin

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House committee approves bill on concussion management in youth sports.

The state House of Representatives' Education Committee on Monday reported out legislation supporters say is intended to help Pennsylvania schools better manage concussions that happen in interscholastic sports. House Bill 2728

(http://www.legis.state.pa.us/CFDOCS/Legis/PN/Public/btCheck.cfm?txtType=HTM&sessYr=2009&sessInd=0&billBody=H&billTyp=B&billNbr=2728&pn=4274&Email=True&iRegionID=1&Dome=True)

sponsored by Rep. Tim Briggs, D-Montgomery, would require that any athlete exhibiting signs of a concussion or head injury be removed from the athletic activity in which they are participating. The student would not be allowed to return to participation until the student is evaluated and cleared for return in writing by a licensed or certified health care practitioner whose scope of practice includes the management and evaluation of concussions. Prior to the committee's final approval of the bill, the legislation was amended on a close 11-10 vote with changes offered by Rep. Paul Clymer, R-Bucks, the minority chairman of the committee. Clymer's amendment inserted language to ensure no additional civil liability for independent contractors, such as umpires and referees, if they fail to recognize the signs of a concussion.

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Sports Illustrated article highlights brain trauma caused by football collisions

Sound Bend Tribune Online

Published: October 28, 2010

In this week's November 1st issue of Sports Illustrated David Epstein's report "The Damage Done" takes a close look at brain trauma suffered by football players, not from concussive blows but rather from the hundreds of "minor" hits that are just as traumatic…….

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Cognitive Effect of One Season of Head Impacts

Posted: 07 Jun 2012 06:03 PM PDT

Cognitive effect of one season of head impacts in a cohort of collegiate contact sport athletes.

McAllister TW, Flashmasn LA, Maerlender A, Greenwald RM, Beckwith JG, Tosteson TD, Crisco JJ, Brolinson PG, Duma SM, Duhaime AC, Grove MR and Turco JH. Neurology. 2012. 78:1777-1784. http://www.neurology.org/content/early/2012/05/16/WNL.0b013e3182582fe7.abstract?sid=8ceb45be-aa45-463e-8487-f6dcb215f769

Recently in many media outlets, concerns have been raised over the long-term effects of head impacts on athlete's cognitive function. While many studies have looked at the effects of mild traumatic brain injuries, few studies have looked at repetitive head impacts and their long-term effects. Therefore, McAllister and colleagues completed a pretest/posttest cohort study to evaluate if repetitive head impacts sustained over 1 season would affect cognitive performance.

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Concussion

(Closed Head Trauma; Diffuse Brain Injury)

- **THANK YOU BEN!!!**
- **(He says *VERY* tongue in cheek)**

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The New York Times

N.F.L. Asserts Greater Risks of Head Injury

By ALAN SCHWARZ

Published: July 26, 2010

The National Football League is producing a poster that bluntly alerts its players to the long-term effects of concussions, using words like "depression" and "early onset of dementia" that those close to the issue described as both staggering and overdue.

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CONCUSSION

A Must Read for NFL Players

Let's Take Brain Injuries Out of Play

Concussion Facts

Concussion is a brain injury that alters the way your brain functions

Concussion can occur from a blow to the head/body:
- following helmet to helmet contact, and / or
- contact with the ground, object or another player

Most concussions occur without being knocked unconscious

Severity of injury depends on many factors and is not known until symptoms resolve and brain function is back to normal

All concussions are not created equally. Each player is different, each injury is different and all injuries should be evaluated by your team medical staff

Concussion Symptoms

Different symptoms can occur and may not show up for several hours. Common symptoms include:

- Confusion	- Feeling sluggish, foggy or groggy
- Headache	- Sensitivity to noise
- Amnesia / Difficulty remembering	- Sensitivity to light
- Balance problems	- Double / fuzzy vision
- Irritability	- Slowed reaction time
- Dizziness	- Feeling more emotional
- Difficulty concentrating	- Sleep disturbances
- Nausea	- Loss of consciousness

Symptoms may worsen with physical or mental exertion (e.g. lifting, computer use, reading)

Why Should I Report My Symptoms?

- Practicing or playing while still experiencing symptoms can prolong the time to recover and return to play.
- Unlike other injuries, there may be significant consequences of "playing through" a concussion. Repetitive brain injury, when not treated promptly and properly may cause permanent damage to your brain.

What Should I Do If I Think I've Had a Concussion?

Report it. Never ignore symptoms even if they appear mild. Look out for your teammates. Tell your Athletic Trainer or Team Physician if you think you or a teammate may have had a concussion.

Get Checked Out. Your team medical staff has your health and well being as its first priority. They will manage your concussions according to NFL / NFLPA Guidelines which include being fully asymptomatic, both at rest and after exertion, having a normal neurologic examination, normal neuropsychological testing, and clearance to play by both the team medical staff and the independent neurologic consultant.

Take Care of Your Brain. According to the CDC: "traumatic brain injury can cause a wide range of short- or long term changes affecting thinking, sensation, language , or emotions". These changes may lead to problems with memory and communication , personality changes, as well as depression and the early onset of dementia. Concussions and conditions resulting from repeated brain injury can change your life and your family's life forever.

Work smart. Use your head, don't lead with it. Help make our game safer. Other athletes are watching....

"For more information about traumatic brain injury and concussion, go to http://www.cdc.gov/concussion

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NFL players sue league over concussion health risks

Thursday, June 07, 2012

- LOS ANGELES (KABC) -- Over 2,000 NFL players filed a class-action lawsuit in a Philadelphia federal court Thursday against the league. The suit unites more than 80 pending lawsuits, claiming the NFL knew for years that concussions cause long-term brain injury.

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Judge blocks NFL concussion settlement, demands changes

- A U.S. Judge Anita Brody refused to accept a proposed settlement between the National Football League and thousands of retired players over concussions, saying some changes were needed before she would approve it.
- Included in those changes is an assurance that retired players who died of the brain disease chronic traumatic encephalopathy should be covered

Reuters Mon Feb 2, 2015 5:20pm EST

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Concussion

- "Diffuse brain injury"
  - TBI: Traumatic Brain Injury
- Focal brain injury: More severe
  - Epidural, subdural, intracerebral hematomas
- Most common in football, hockey, boxing, martial arts…..
- Acceleration / Deceleration injury

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Occurance

- 1.6 to 3.8 million sports-related TBIs occur each year
- Concussion accounts for 6-10% of all sport related injuries
  - Higher risk among high school athletes in contact sports
    - Langlois, 2006

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Other Factors

- "Silent Epidemic"
- Multiple injuries can have long term effects
- Over 50% of concussions may go unreported
- Athletes can (& will) hide the symptoms to remain in the game
- Coaches and parents want the athlete to play
  - Will down-play the severity
    - McCrea, 2004

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Key Points

- #1 symptom is confusion
- Level of consciousness
  - LOC seen only in 10% of concussions
- Assess memory
  - More sensitive parameter in conscious patients
  - Look for Retrograde and Anterograde amnesia
- If unconscious → A B C's
  - **Assume c-spine injury**

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Diagnosis of Concussion

- Physical examination, central nervous system imaging, and other neuropsychological tests cannot diagnose concussion accurately,
- Clinicians must rely upon the self-report of symptoms
- Athletes will:
  - 1) Under-report symptoms
  - 2) Intentionally fail to report symptoms
    - Parental, peer, & coach pressure

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Consensus Statement: Zurich

- #1 Vienna 2001
- #2 Prague 2004
- # 3 - May 2009
  - *Clin J Sports Med, Vol 19, Num 3*
- # 4 – Nov 2012
  - *Br J Sports Med 2013;47:250-258 doi:10.1136/bjsports-2013-092313*
  - *http://bjsm.bmj.com/content/47/5/250.full*
- Currently under review
  - Lack of diagnostic specificity
  - Management strategies that are not evidence based
  - Rehabilitation goals that are not attainable
    - Clinical Journal of Sport Medicine: March 2014 - Volume 24 - Issue 2 - p 93–95

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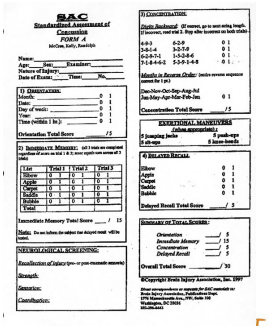
Neuropsych Testing

- Standardized Assessment of Concussion
  - Brain Injury Association of America
  - 1608 Spring Hill Road
  - Suite 110
  - Vienna, VA 22182
  - 703-761-0750 / 800-444-6443
- Cost ??



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SCAT: Sideline Concussion Assessment Tool

- Developed by Prague Group 2005
- Symptom score sheet post-injury
- Mental function assessment in several areas
- Not a full neuro-psych test
- Does have some baseline to compare with post-injury
- SCAT 3 released 2012
- SCAT 5 released 2017
  - From Zurich consensus paper

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SCAT 5

- In use since 2005 mainly for sideline assessment
- For athletes 13 & older
  - Child SCAT for 5-12
- Measures
  - Symptoms
  - Orientation
  - Memory
  - Balance / Gait

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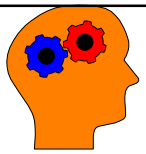
Neuropsych Testing



- Administer before starting any sports
  - Not just contact
  - Baseline to compare to
- Most athletes returned to baseline in 2-4 weeks

➔Can ***help*** with determining safe return to play

➔Use in addition to patient report of symptoms

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ImPACT: Univ of Pittsburgh

- Computerized system to ***aid*** in evaluating concussion management and safe return to play
- Battery of scientifically validated neuro-cognitive testing on large populations
  - ?Does not require baseline testing for individual athlete
- Newer studies question the reliability of the test
  - Athletes purposely doing poorly on the pretest to make post injury test scores seem higher
  - ***Noting a 37-46% False Positive and False Negative testing rates***
    - Journal of Athletic Training 2013;48(4):506–511

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Traumatic Brain Injury

- TBI classified by
  - #1 Symptoms w/ activity and at rest
    - Both physical and mental function
  - #2 Amnesia
  - #3 Loss of Consciousness
- Neuropsych testing
  - Pre-participation
  - Post-injury
- NUMBER of events
  - Damage can be cumulative in some athletes

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Traumatic Brain Injury

- Need to be aware of Post TBI Syndrome & Second Impact Syndrome
  - Pay close attention to subtle neuro signs and complaints of headache, poor concentration, dizzy
  - Athlete *must be* symptom free w/ activity and at rest and back to baseline Neuropsych testing before being allowed to play
- Minor trauma can lead to rapid cerebral edema
  - More common in younger / pre-adolescent athletes

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Post Concussive Syndrome

- Symptoms are:
  - Headache
  - Irritability
  - Memory loss
  - Fatigability
  - Dizziness/vertigo
  - Impaired concentration
  - Sleep disturbance
- ***May take weeks months to resolve!!***

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Second Impact Syndrome

(Email from Sports Medicine Listserv)

Sent: Fri, Oct 29, 2010 11:52 am
Subject: second impact syndrome

Had a young man here in Kansas City area who had a concussion last week that was cleared by his doc. Then last night had an interception, tackled, came to the sideline complaining of wheezing, and collapsed, convulsed and was lifeflighted to KUmed. He died at 4 AM this morning. most likely second impact syndrome. Already getting phone calls this AM from reporters to comment on story. Very sad.

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October 29, 2010 Friday

"It was just a routine play. I don't think there was anything special," Orrick told the Miami County Republic after the game. "I think he just hit the ground pretty hard with his head. He came on the sideline and told one of my assistants, 'my head is really hurting.' He sat down on the bench. He then stood up, but his legs went underneath him and collapsed there."

AP / PEC Sports

NBC Action News also reports that Stiles was taking part in his first game since returning from a concussion suffered in early October. Stiles' father confirmed this to the Kansas City Star, noting that his son suffered a concussion during the homecoming game earlier in the month, but was cleared to play Thursday.

Spivak AOL News 10/30/2010
http://www.fanhouse.com/2010/10/30/nathan-stiles-kansas-high-school-football-player-dies-after-in/

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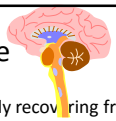
Second Impact Syndrome



- Athlete receives second minor head injury before fully recovering from previous concussion
- Can lead to rapid & catastrophic cerebral edema and swelling
  - Mortality is not uncommon!
- Rare, but more common in younger / pre-adolescent athletes
- ***Do NOT ignore post-concussive symptoms!!***

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All brains recover at different paces

- Some athletes can recover completely from a concussion
- Others retain some residual damage
- *Repeated concussions, even minor especially starting at young ages, make patients susceptible to more damage*

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Owen Thomas brain autopsy reveals disease

Repeat head trauma may have led to Thomas' suicide last spring

by Calder Silcox | Tuesday, September 14, 2010
Daily Pennsylvanian

A brain autopsy of Penn football player Owen Thomas, who committed suicide in the spring, revealed that the standout lineman had developed a disease caused by repeated head trauma. Commonly experienced by football players, the disease has also been linked to depression.

Thomas, then a Wharton junior, hanged himself in his off-campus apartment in April, shortly after being elected captain of the football team for the 2010 season. The event took family, friends and teammates by surprise.

The brain autopsy was performed by researchers at Boston University, The New York Times reported Monday [2]. The autopsy showed early stages of chronic traumatic encephalopathy, which has been ***found in over 20 deceased National Football League players***. Thomas' case is the first to be confirmed in a non-NFL player, and Thomas is the youngest known football player to develop the disease.

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Researchers find brain trauma in Henry

By Peter Keating ESPN The Magazine June 29, 2010

Chris Henry, the Cincinnati Bengals wide receiver who died in a traffic accident last year, had chronic traumatic encephalopathy (CTE) -- a form of degenerative brain damage caused by multiple hits to the head -- at the time of his death, according to scientists at the Brain Injury Research Institute, a research center affiliated with West Virginia University.

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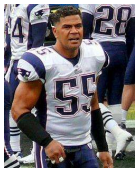
Junior Seau Suicide Shows How Little We Know About Head Trauma



The Daily Beast, May 6, 2012

The suicide of NFL linebacker Junior Seau has reignited the debate over head trauma's long-term effects. But as Casey Schwartz reports, concussions remain a perplexing medical mystery.

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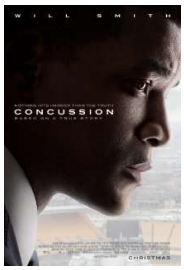
Concussion Movie



- "In Pittsburgh, accomplished pathologist Dr. Bennet Omalu uncovers the truth about brain damage in football players who suffer repeated concussions.."
- Actually about CTE
- CTE known since the 1920's, Dr Omalu noted the relation ship between football & CTE

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Chronic Traumatic Encephalopathy

- Found most commonly in athletes with multiple head "injuries"
  - Can be an accumulation of multiple small "hits" & not all causing symptoms
- 73% of pro-football players with CTE died in middle age (mean 45 y/o)
- 64% of deaths have been from
  - Suicide
  - Abnormal erratic behavior
  - Substance abuse

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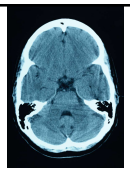
Pathological Changes



- Cerebral atrophy
- Medial temporal lobe atrophy
- Mammillary body atrophy
- Thinning of the hypothalamic floor
- Marked dilation of II and III ventricles
- Cavum septum pellucidum with fenestrations
- Pallor of the substantia nigra
- NOT equal to Alzheimer's, changes deeper down in 5th later of cortex
  - CTE is more superficial near blood vessels & no beta amyloid deposition

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Symptoms CTE

- Cognitive changes 69%
  - Memory loss / Dementia
- Personality / Behavioral changes 65%
  - Aggressive / Violent behavior
  - Confusion
  - Paranoia
- Movement abnormalities 41%
  - Parkinson's (Dementia pugilistica)
  - Gait / Speech problems
- Sleep disturbance is an early & EXTREMELY important sx

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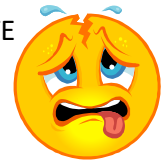
Treatment CTE



- ***NONE!!!!!!!!***
  - Treat symptoms
- Prevention is currently the only available treatment option
- Boston Hospital is working on various pharmacological approaches to prevent progression of CTE

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Treatment of Concussions

- ***PREVENTION!!!!!!!!!!***
- New NFL rules regarding helmet hits
  - Need to be a role model for younger athletes
- Air bladders in football helmets.
  - Absorb linear forces so they DO prevent focal injuries (eg, skull fractures).
  - ***Do NOT absorb rotational forces!!***
  - Could cause increase in concussion rate because athletes have a false sense of security.
  - Older helmets with air bladders extended lower on the neck, causing brachial plexus injuries

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Helmets & Prevention

- Most studies indicate helmet designs do NOT prevent concussions
  - Effective in reducing the number of skull fractures and brain contusions,
  - Not effective in reducing the shear forces involved

    http://www.sportsafetyinternational.org/new-football-helmet-study/

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Helmets & Prevention

- Impact sensing helmets monitor when an athlete has sustained a potentially serious hit
- No specific standards yet
- Various types:
  - Lights on back of helmet
  - Linked to system on the sideline

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Treatment.. Other sports

- Soccer headers
  - Sports organizations are considering rule changes for younger players.
  - Hitting a ball with an immature skull puts athlete at risk of concussion.
  - Protective head gear will not decrease risk of concussion.
  - *Young athletes should avoid headers*

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Treatment……. Headaches

- Acetaminophen
- NSAID's
  - Caution: Bleeding
- Narcotics
  - Caution: Addiction
- Antidepressants
  - Tricyclics
    - Low dose useful for pain
- Anti-seizure medications

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Waking during the night

- VERY controversial!
  - Most evidence is currently against
  - Mostly relates to looking for signs of an intracranial bleed
- Have observer look for
  - Unusual breathing patterns
  - Atypical movement
  - Convulsions
  - Bleeding
- If there is concern…… admit

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Clinical Assessment

- Symptom assessment
  - Headache, confusion, blurred vision, nausea
- Physical assessment
  - *Ocular Vestibular testing
    - Pursuits, Saccades, Convergence
  - *Balance testing
- Tests to determine mental status.
  - 3-5 word recall (usually 3x)
  - Serial 7's (count backward from 100 by 7's)
  - Recite months in reverse order
- Neuro-psych testing
  - SCAT3

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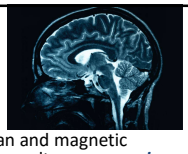
Imaging



- Computed tomography (CT) scan and magnetic resonance imaging (MRI) study results are ***normal*** in concussions.
- Recommended ***ONLY*** if focal symptoms present, looking for:
  - Epidural bleed
  - Skull fracture
- Be mindful of amount of radiation to which the athlete is exposed with CT scans
- MRI - Useful for suspected smaller lesions and aneurysms.

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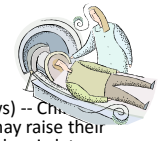
Childhood CT scans are found to raise cancer risk



By Steven Reinberg
Associated Press Fri, June 8, 2012

- WEDNESDAY, June 6 (HealthDay News) -- Ch… who undergo CT scans of the head may raise their risk of developing brain cancer or leukemia later in life, a new study says.
- Although multiple CT scans could triple the risk, the absolute risk remains small -- one case in 10,000 scans of the head, the researchers said.
  - http://www.philly.com/philly/health/topics/HealthDay665501_20120607_Child_CT_Scans_Might_Up_Risk_of_Brain_Cancer__Leukemia.html?ref=more-like-this#ixzz1xCTSUFyO

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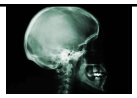
Other Imaging



- PET + CT & new PET + MRI radioactive tracers & cost
- Blood Oxygen Level Dependent (BOLD) more sensitive to small hemorrhages
- Susceptibility Weighted Images (SWI) also more sensitive
- MR Spectroscopy – biochemical info
- DTI – diffusion of isotopes, shows direction of flow
- fMRI – shows increased activation

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New Paradigm for Diagnosis

- Examination for autonomic dysfunction, including orthostatic hypotension and exercise intolerance with symptom exacerbation (e.g., the Buffalo Concussion Treadmill Test).
- Assessment of cranial nerve abnormalities, especially in olfaction.
- Examination for injuries of the head, neck, and, especially, cervical spine, which can produce dizziness, headaches, and abnormalities in balance. Assessments include cervical proprioception and [temporomandibular] joint problems.
- Balance/coordination examination. Tests include motor coordination and dual tasks (e.g., solving math problems while undergoing the Timed Up and Go test).
- Vestibulo-ocular and ophthalmologic examinations. Vestibulo-ocular impairments are tested with the Head Thrust Test; dynamic visual acuity is also examined. Also assessed are smooth pursuits, horizontal and vertical saccades, near point of convergence, horizontal vestibulo-ocular reflex, and visual motion sensitivity.

- *Jonathan Silver, MD reviewing Matuszak JM et al. Sports Health 2016 Mar 28.*

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Return to Play

- Professional level ***ONLY***
  - Athlete sits out of play for 15 minutes.
  - Retest – Baseline testing required!!!!
  - If athlete at baseline and asymptomatic, could possibly return to play
- Not recommended!!!
- Not allowed at college, high school levels

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Return to Play

- ***Current return-to-play standard of care does not allow an adolescent athlete to return to play the same day a concussion was sustained or suspected!***

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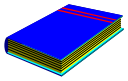
Return to Activity



- Athlete should NOT be allowed full activity until symptoms have resolved
- Treatment is mainly rest and not only includes physical activity but ***MENTAL*** activity as well
  - Good evidence that trying to continue full mental functioning, such as school, will prove to be difficult for the patient and may even *SLOW* recovery!
  - Medical leave….. slow making up missed work

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Complete Mental Rest Unnecessary

- Prospective cohort study of patients presenting to a sports concussion clinic at Boston Children's Hospital
  - Patients sorted into 4 groups: most to least levels of cognitive activity
- Patients in the highest quartile of cognitive activity days took significantly longer to recover
- Those in the lower three quartiles had similar recovery curves

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Return to Activity

- Athlete must close to baseline Neuro-psych symptoms / testing w/ SCAT3
  - ImPact – falling out of favor
  - Symptom testing: balance, ocular-vestibular
- Serial evaluations
  - Athlete performs exertional tests
  - Rest for 24 hours
  - Re-test exertional, balance, ocular-vestibular
- Adolescents: must be symptom free before returning to full activity

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Balance assessment in the management of sport-related concussion.

Matthew Alan Gfeller Sport-Related Traumatic Brain Injury Research Center, Department of Exercise and Sport Science, University of North Carolina at Chapel Hill

Clin Sports Med, 2011 Jan;30(1):89-102

- Although neuropsychological testing has proven to be a valuable tool in concussion management, it is most useful when administered as part of a comprehensive assessment battery that includes grading of symptoms and clinical balance tests. A thorough sideline and clinical examination by the certified athletic trainer and team physician is considered an important first step in the management of concussion. The evaluation should be conducted in a systematic manner, whether on the field or in the clinical setting. The evaluation should include obtaining a history for specific details about the injury (eg, mechanism, symptomatology, concussion history), followed by assessing neurocognitive function and balance, which is the focus of this article. The objective measures from balance testing can provide clinicians with an additional piece of the concussion puzzle, remove some of the guesswork in uncovering less obvious symptoms, and assist in determining readiness to return safely to participation.

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Disconjugate Eye Movements

- Eye tracking test may detect and help quantify the disruption of ocular motility associated with concussion
  - Pursuits, Saccades, Convergence
- Eye tracking device distinguished patients with concussion from healthy controls
- Helps separate concussions from other conditions
  - Journal Neurotrauma; Samandi et al; Volume: 32 Issue 8: April 7, 2015

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Return to Activity

- No symptoms reported with/without exertion
- Neuropsych affected by effort & motivation
  - Feel threatened
  - Feel inconvenienced
  - Fake lower baseline score to try to get RTP sooner
- Is NOT as "cookbook" as with orthopedic injuries
- ***"Can play safely with a below the neck injury…. Cannot with a brain injury"***
  - **Robert Cantu, MA, MD, FACS, FACSM**
  - **Clinical Professor of Neurosurgery at BUSM**

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Complete Rest NOT Indicated

- Guidelines are shifting toward exercise earlier in the recovery period
- Athletes should become gradually and progressively more active while staying below their symptom-exacerbation thresholds
  - Activity level should not bring on or worsen symptoms
    - Br J Sports Med. Published online 04/2017

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Zurich Graduated RTP Protocol 2012

Rehabilitation Level	Functional exercise at each stage of rehabilitation	Objective of each stage
1. No activity, minimum 24 hours following the injury where managed by a medical practitioner, otherwise minimum 14 days following the injury	Complete physical and cognitive rest without symptoms	Recovery
2. Light aerobic exercise during 24-hour period	Walking, swimming or stationary cycling keeping intensity, <70% maximum predicted heart rate. No resistance training. Symptom free during full 24-hour period.	Increase heart rate
3. Sport-specific exercise during 24-hour period	Running drills. No head impact activities. Symptom free during full 24-hour period.	Add movement
4. Non-contact training drills during 24-hour period	Progression to more complex training drills, e.g. passing drills. May start progressive resistance training. Symptom free during full 24-hour period.	Exercise, coordination, and cognitive load
5. Full Contact Practice	Following medical clearance participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6. After 24 hours return to play	Player rehabilitated	Recovered

ALL athletes should start on Step 2 immediately!!

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Return to…

- School
  - Symptomatic students may require active supports and accommodation
  - Gradual decrease as functioning improves
- Work
  - May initially need to reduce both physical and cognitive exertion
  - Restricting work during initial stages of recovery may be indicated
- Repeated evaluation of both symptoms and cognitive status is recommended
  - CDC December 2015

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Q&A

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