Part I: Abdominal Injuries

Andrews Institute:
Catastrophic Injuries Course
July 28, 2016

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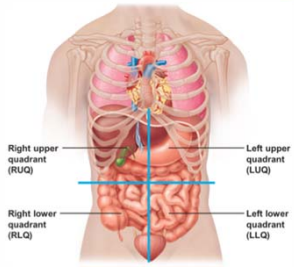
Abdominal Injuries

- Rare
- Potentially *life-threatening*
- Spleen
- Liver
- Abdominal wall
- Kidney
- Other abdominal viscera
  - Diaphragm
  - Stomach
  - Pancreas
  - Gall Bladder
  - Intestines
  - Bladder



Spleen

- LUQ, enclosed ant. & lat. by rib cage
- Most vascular organ in body
  - Splenic artery – 5 non-anastamosing branches, damage to 1 branch → segmental infarction
- Function
  - Mechanically filters RBCs (350L per day)
  - Active in immune system

Spleen Injury

- Blunt trauma (helmet to abdomen)
  - 25% BAT - **most commonly injured** organ
- Associated with *L 10-12th rib fractures*
- Laceration is life-threatening due to high volume blood loss

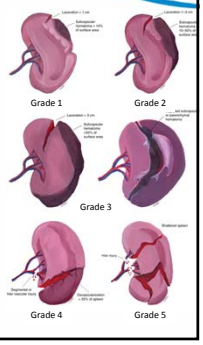
Spleen Injury

- LUQ & flank pain +/- referred L shoulder pain (**Kehr's sign**)

- Exam:
  - TTP LUQ, distention (50% cases)
  - Hypotension (20-30% cases)
  - Acute abdomen w/ guarding & rebound
  - Younger patients more able to accommodate hemodynamic losses → *more subtle presentation in younger athletes*

Spleen Injury

- Diagnosis & Treatment
  - CT <u>with IV contrast</u>
  - Inpatient – serial hematocrits
  - Surgery – splenectomy vs ligation of vasculature
  - Post-splenectomy precautions
    - H Influenza type B, pneumococcal, meningococcal (encapsulated bacteria) vaccines
    - SSD, Thalassemia, Cancer → daily PCN ppx for pneumococcal infection



Spleen Injury

- Return to play – controversial
  - Nonoperative tx: *2-6 months* based on severity
  - Surgical tx: ≥ *6 weeks* postop
  - Infectious mononucleosis
    - Splenic rupture reported at 4-21 days postinfection
    - Asymptomatic athletes w/ normal spleen size – gradual RTP at *21 days* postinfection

Liver

- RUQ, enclosed ant. & lat. by rib cage
- Largest solid organ in body
- Relatively fixed position, friable parenchyma, & thin capsule → prone to injury
- Function
  - Glycogen storage
  - Plasma protein synthesis
  - Decomposition of RBCs
  - Bile production
  - Detoxification

Liver Injury

- Blunt trauma (helmet to abdomen)
  - 15-20% BAT – **2nd most commonly injured** organ
  - **50% deaths** from BAT
- Shearing injury (rapid deceleration)
  - Sites of ligamentous attachment to diaphragm & posterior abdominal wall
- Associated with *R 8-12th rib fractures*
- More common in children
  - Increased flexibility of ribs, less developed framework of liver parenchyma

Liver Injury

- RUQ pain +/- referred R shoulder pain
- Nausea & vomiting
- Exam:
  - TTP RUQ → diffuse
  - Acute abdomen w/ guarding & rebound
  - Cannot stand upright (⇧ abd pressure)
  - ⇧Pulse, decr BP (hypovolemic shock)

Liver Injury

- Dx & Treatment
  - CT w/ contrast +/- DPL
  - Inpatient – serial hematocrits
  - 80% adults, 97% children resolve w/ observation
  - Unstable cases may req surgery

Grade		Injury Description
I.	Hematoma	Subcapsular, nonexpanding, < 10cm surface area
	Laceration	Capsular tear, nonbleeding, < 1cm parenchymal bleeding
II.	Hematoma	Subcapsular, nonexpanding, 10 to 50% surface area Intraparenchymal nonexpanding < 10cm in diameter
	Laceration	Capsular tear, active bleeding; 1-3cm parenchymal depth < 10cm in length
III.	Hematoma	Subcapsular, > 50% surface area or expanding; Ruptured subcapsular hematoma with active bleeding; Intraparenchymal hematoma > 10cm or expanding
	Laceration	> 3cm parenchymal depth
IV.	Hematoma	Ruptured intraparenchymal hematoma with active bleeding
	Laceration	Parenchymal disruption involving 25% to 75% of hepatic lobe
V.	Laceration	Parenchymal disruption involving > 75% of hepatic lobe
	Vascular	Juxtahepatic venous injury (i.e., retrohepatic vena cava)
VI.	Vascular	Vascular avulsion

Renal

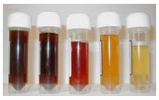
- Kidneys, ureters, bladder, urethra
- Retroperitoneal
- Function
  - Eliminate waste
  - Regulate blood volume & BP
  - Regulate blood pH
  - Control levels of electrolytes & metabolites

Renal Injury

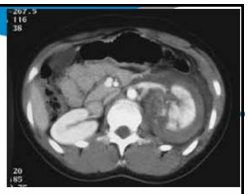
- Kidney > Bladder > Urethra
- Blunt trauma (helmet to flank)
  - 10% BAT
- Rapid deceleration
- More common in children
  - Increased flexibility of ribs, less developed framework of kidney parenchyma

Renal Injury

- Important indicators (absence of all 3 = renal injury very unlikely)
  - Hematuria
    - Not correlative with severity
    - Not present initially in 25-50% cases
  - Hypotension
  - MOI (blunt trauma / rapid deceleration)
- Moderate indicators
  - Flank hematoma or tenderness
  - Rib fractures
  - Penetrating injury

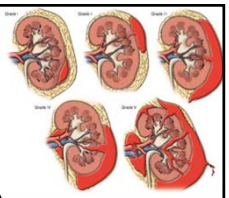


Renal Injury



- Diagnosis
  - Labs: UA, CBC, Lytes, LFTs, Cr, Glc, Amylase, Lipase, HCG
  - Chest X-ray (? rib fracture)
  - **CT <u>with contrast</u> – gold standard**

Renal Injury

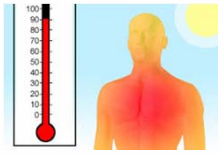


- Treatment (based on Grade)
  - **I-II: usually observation & supportive care**
  - III-V: surgery (repair vs nephrectomy)
- Return to play
  - Wait for complete resolution of hematuria
  - Recommendations vary, usually *2-6 weeks*
  - More severe (III-V), *6-12 months*

Take Home Points

- Abdominal injuries are rare, but potentially life-threatening
- *If concerned* on sideline → ***send to ED*** for CT & further management

Part II: Heat Illness



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Exercise Associated Collapse

- When the collapse occurs
  - **BEFORE** finish line or **DURING** competition
    - More likely an *ominous* source of collapse
  - **AFTER** finish line
    - More likely a *benign* source of collapse

Exercise Associated Collapse

- Differential Diagnosis
  - Postural hypotension (benign EAC)
  - Cardiac
  - Heat-related illness
  - Electrolyte abnormalities (hypoglycemia, hyponatremia)
  - Neurologic (seizure, head trauma)
  - Anaphylaxis/Respiratory

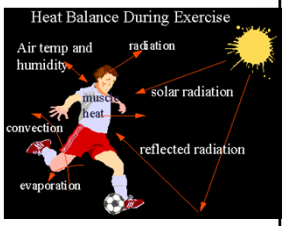
Collapse: What to do?

- CAB
- AED/EMS
- Assess for cardiac, asthma, drugs, DM, SS, seizure
- Transport to shade
- Disrobe
- Check rectal temp

Severe	Non-severe
Unconscious/AMS Confused, disoriented, aggressive Rectal temp >40˚C SBP <100 HR >100	Conscious Alert Rectal temp <40˚C SBP >100 HR <100

Heat Gain/Loss

- Heat produced endogenously (metabolism/muscle) + gained exogenously (environment)
- Heat *dissipation* ensues:
  - Vasodilation
  - Thermal sweating
  - Evaporation
  - Convection
  - Conduction
  - Radiation



↑ Humidity = ↑ water vapor = ↓ evaporation = ↓ cooling

↑ BMI = ↑ heat production + ↓ heat dissipation

Wet Bulb Globe Temp

WBGT = (0.7 x T_{hum}) + (0.2 x T_{rad}) + (0.1 x T_{amb})

- Air temp, humidity, solar/ground radiation, & wind speed = WBGT
- No endurance events WBGT > 82º F

- <65°F Low Risk
- 65-73°F Moderate Risk
- 73-82° F High Risk
- 82°F Extreme Risk
- >90°F Dangerous

- Familiarize yourself with local/governing policies on heat limits
- Be prepared to make individual decisions

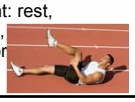
Acclimatization

- ↑ Blood volume
- ↑ Venous tone
- Earlier sweating onset
- ↑ Amount of sweating
- ↑ Dilution of sweat (↓ Na^+ concentration)

- Results in ↑ heat dissipation (↓ rise in core temp)
- Ideal length of time? 2 weeks? May take longer in pre-pubertal athletes

Heat-related Illness

- **Exercise associated cramps or "heat cramps"**
  - Muscle pain & spasm, & persistent muscle contractions in setting of exercise
  - Risk Factors
    - Sweating, dehydration, insufficient electrolyte intake, lack of acclimatization
  - Treatment: rest, hydration, restoration



- **Heat exhaustion**
  - Athlete looks very tired/fatigued, has difficulty continuing exercise
  - Rectal temp 101-104º F (38.3-40.0º C)
  - No significant CNS dysfunction
  - Treatment: remove from competition, cooling, fluids, consider replacing Na^+

Heat Stroke

Rectal temp > 104º F (40º C) + CNS abnormalities

- Nausea
- Headache
- Dizziness
- Confusion
- Disorientation
- Hallucinations
- Irrational behavior
- Seizure
- Reduced level of consciousness

Exam:
- Pale & often sweaty
- ↑ HR & RR, ↓ BP

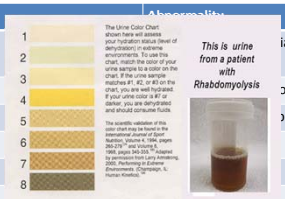
Treatment:
- **Immediate RAPID cooling**
  - submerse in ice bath
  - stop once <38.9 (102 F) or once starts shivering
- **Then transport to hospital** for labs/monitoring

Risk Factors

- Prior heat illness
- Age (children)
- Obesity
- Poor fitness
- Lack of acclimatization
- Prolonged exertion
- Illness
- Skin disease
- Medications
- Sleep deprivation
- Heavy equipment/clothing
- Supplements: "If it revs you up, it heats you up. If it works, it's probably banned. If it's not banned, it probably don't work"
- Caffeine: colas, energy drinks
- Alcohol

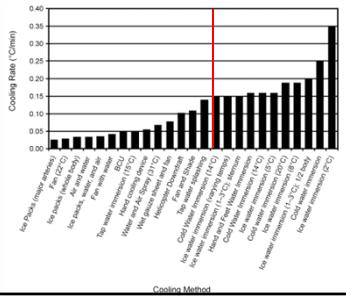
Heat Stroke Complications

System	Abnormality
CV	ial infarction,
Neuro	oke
GI	bleeding
Heme	
Muscular	
Renal	



Heat Stroke

Treatment – monitor rectal temperature with whole body immersion cooling (CPR & defibrillation)

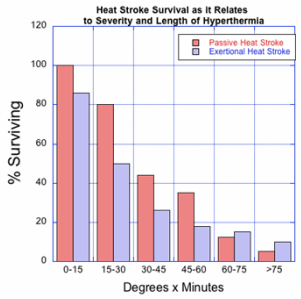


Heat Stroke

Stop cooling at around **102º F** (38.9º C)

Cool first, transport second

Heat Stroke



Return to Play

- **Cramps**: return <u>as tolerated</u> if isolated to 1-2 extremities
- **Heat exhaustion**: should be withheld from further activities on the same day, may return <u>next day</u> if normal hydration status & no other symptoms
- **Heat stroke**: slow graduated return to activity <u>after 1 week off & normal labs</u>… if prolonged cooling period needed/rhabdo, may consider avoidance of further exercise in inciting environment

Summary

- Heat injury is highly preventable!!
- Educate players/parents/coaches
- Avoid extreme conditions
- Wear appropriate clothing
- Adequate conditioning/acclimatization
- Drink, especially to thirst, before, during, & after activity
- Appropriate trained personnel and equipment…have a well rehearsed plan!

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