

CRUNCH  **TIME**



TRAUMA

Abdominal Trauma Evaluation

Stuart Swadron, MD, and Mel Herbert, MD

Background

- Common traumatic injury

Clinical Findings

- Seat belt sign across abdomen:
 - One-third have hollow viscus injury
 - ↑ risk of chance fracture (distraction fracture of lumbar vertebrae)
 - Risk of mesenteric artery injuries → bowel ischemia/infarction
 - CT can be negative early on

Management

- Diagnosis:
 - No plain films of the abdomen
 - Ultrasound
 - Good for identifying blood/free fluid in abdomen
 - NOT good for retroperitoneum
 - CT scan
 - Only used for a hemodynamically stable patient
 - If concern for bladder injury (gross hematuria), must put contrast into bladder
 - CT misses
 - Diaphragm injuries
 - Hollow viscus injuries
 - MRI
 - Usually not used in trauma
 - May be used in spinal cord injury if patient is stable and has neuro deficits
- Straight to the operating room:
 - Evisceration
 - Peritonitis
 - Unstable patient with positive focused assessment with sonography in trauma (FAST) or positive diagnostic peritoneal lavage
 - Continued bleeding such as hematemesis or gastrointestinal bleed (concern for tear of vessel bleeding into lumen)
- If serious mechanism and CT negative:
 - Admit for observation

- Serial exams

How You Will Be Tested

- Never send an unstable patient to CT scan
- Know the injuries associated with abdominal seat belt signs

Diaphragm Injury

Stuart Swadron, MD, and Mel Herbert, MD

Background

- Major injury that is frequently missed
- Two types: blunt trauma (very rare) and penetrating trauma
- If missed, the patient can present later with a strangulated hernia

Clinical Findings

- Most common on left side (liver “protects” right side)
- Consider in patients with stab wounds between nipple and umbilicus

Management

- Surgical team may take the patient for laparoscopy just to evaluate diaphragm before discharge

How You Will Be Tested

- Diaphragmatic injuries are more common on the left side than the right side
- Know the presentation of a delayed diaphragmatic injury

Hollow Viscus Injury

Stuart Swadron, MD; Mel Herbert, MD; and Jessie Werner, MD

Background

- Includes injury to colon, intestines, bladder
- Difficult to diagnose, often present late

Clinical Findings

- Abdominal pain
- Evaluate for peritonitis, commonly a late presentation

Management

- CT is not accurate early on
- If CT is negative but still suspect:
 - Observation
 - Serial examinations
- Bladder injuries are broadly categorized as intraperitoneal injuries, which require surgical repair, and extraperitoneal injuries, which can be managed non-operatively with Foley catheter drainage

How You Will Be Tested

- If you suspect the diagnosis, know to admit for serial examinations

Retroperitoneal Trauma

Stuart Swadron, MD, and Mel Herbert, MD

Background

- Aorta, pancreas, parts of colon, kidney = common sites of injury

Clinical Findings

- Grey Turner's sign and Cullen's sign = retroperitoneal bleeding

Management

- CT is the diagnostic test of choice

How You Will Be Tested

- Know Grey Turner's sign and Cullen's sign
- Know the patient's presentation for a handlebar injury:
 - Vomiting after a bike accident
 - Abdomen is soft; bounceback next day with pancreatic injury and duodenal hematoma injury

Solid Organ Injury

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Spleen most commonly injured (in blunt trauma)

Clinical Findings

- Abdominal pain, nausea, vomiting
- Range from hemodynamically stable to unstable

Management

- Grade of splenic injury (I to V)
- Grade I = laceration
 - No treatment needed
 - Observe
- Grade V = completely pulverized
 - Operative management
- Many patients, particularly kids, do not require operative treatment
- Consider interventional radiology if there is a blush

How You Will Be Tested

- In blunt trauma, the spleen is the most common organ injured

Penetrating Abdominal Trauma

Stuart Swadron, MD, and Mel Herbert, MD

Background

- Liver is the most commonly injured organ

Clinical Findings

- Trauma to the abdomen (stab or gunshot wound)

Management

- Gunshot wound → operating room (OR)
- Stab wound
 - Stable → local wound exploration and observation acceptable
 - Unstable → to OR
 - Deep wound → to OR or observation as two-thirds won't have anything bad
- Stab wounds:
 - Rule of 1/3s
 - 1/3 don't go into peritoneum
 - 1/3 go into peritoneum
 - 1/3 go into peritoneum and hit something back

How You Will Be Tested

- Know which patients need to go to the OR

Amputations

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Amputation is an important traumatic injury
- Management depends on part of the body

Management

- How to care for an amputated part:
 - Wrap amputated body part in saline-soaked gauze
 - Place in a watertight container/bag
 - Place container in ice water
- Criteria for re-implantation
 - Pediatric patient (try extra hard for the kiddos)
 - Amputated thumb
 - Single digit severed between proximal interphalangeal joint (PIP) and distal interphalangeal joint (DIP)
 - Multiple digits
 - Hand and/or forearm amputations
- For distal fingertip amputations:
 - Consult hand specialist or
 - Consider bone rongeur to remove exposed bone, irrigate copiously, and close skin; then arrange close hand follow-up

How You Will Be Tested

- Do NOT place an amputated body part directly on ice

Bite Wounds

Jennifer Farah, MD, and Jessica Mason, MD

Background

- General rules
 - Some wounds are better to keep open
 - Delayed presentation
 - Hand wound
 - Puncture wounds
 - Consider X-ray for foreign bodies (stingers, teeth)
 - Don't forget tetanus!

Clinical Findings

- Pain, abrasion, laceration, skin tear

Management

- Bite wounds = polymicrobial (*Staphylococcus* and *Streptococcus*) BUT a few specific bugs to know:
 - Human bites → *Eikenella*
 - Consider human immunodeficiency virus and hepatitis transmission risk
 - Cats → *Pasteurella*
 - No macrolides for *Pasteurella*
 - Can use macrolides for *Bartonella* (cat scratch fever)
 - Dogs → *Capnocytophaga* (can be lethal)
- Stingrays
 - Use **hot** water (toxin is heat labile)
 - X-ray to look for stinger
- Jellyfish
 - Use seawater or vinegar to remove the nematocysts (spring-loaded venom sac)
- Snakes
 - Crotalide (rattlesnakes, copperheads)
 - Triangular heads and elliptical pupils
 - Local wound care, platelets, and monitor coagulation
 - Crofab if coagulopathy or compartment syndrome
 - Elapidae (coral snakes, cobra)
 - Remember
 - “Red on yellow, kill a fellow” (for deadlier coral snakes)
 - “Red on black, venom lack” (king snake)
 - Note: This classic mnemonic is good for the boards but utility in real practice is questionable

- Venom causes various neuromuscular blockades
 - Range of symptoms
 - Ptosis → respiratory failure
 - If mild symptoms, observe for possible worsening
- Spiders
 - Black widows (*Latrodectus*)
 - Black spider, round body, red hourglass on abdomen
 - Presentation
 - Bite mark, sometimes with small target rash
 - Local diaphoresis
 - Pain and hypertension
 - Abdominal rigidity
 - Treatment
 - Tetanus
 - Analgesia
 - Benzodiazepines
 - Brown recluse (*Loxosceles*)
 - Violin shape on cephalothorax
 - Painless bite wound that can ulcerate
 - Often delayed symptoms
 - Treatment
 - Tetanus
 - Wound care
 - Poor evidence for dapsone

How You Will Be Tested

- Know the difference between black widows and brown recluse spiders
- Know the management for the specific creatures as listed above

Compartment Syndrome

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Tight compartments with pain out of proportion? → check pressure
- High-risk injuries
 - Fractures (tibia/fibula)
 - Crush injuries
 - Burns

Clinical Findings

- The 5 Ps
 - Pain out of proportion (happens earliest, the rest are late findings)
 - Paresthesia
 - Pallor
 - Paresis
 - Pulse deficit

Management

- When is compartment pressure high?
 - Delta pressure = diastolic BP – compartment pressure
 - Abnormal if <30 mm Hg
 - Absolute pressure >30 mm Hg
 - If high, fasciotomy

How You Will Be Tested

- Know the compartments of forearm and lower leg
- Know the definition of a delta pressure and what is considered abnormal

See EM:RAP HD 2017 May - Measuring Compartment Pressure

Lacerations, Avulsions, Puncture Wounds, & High-Pressure Injection Injuries

Jessica Mason, MD, and Mel Herbert, MD

Background

- All get washed out
- Update tetanus vaccinations

Clinical Findings

- Described in detail below

Management

- Lacerations
 - Check for tendon, vascular, nerve injuries
 - Check for foreign bodies visually +/- X-ray
 - Repair
- Avulsions
 - Management as above but may not be able to suture
- Puncture wounds
 - Higher risk of infection → prophylactic antibiotics
 - Ask about fight bite and consider possible associated boxer's fracture
- High pressure injection
 - High risk of compartment syndrome and tissue necrosis
 - Amputation risk = 40%
 - Needs surgery/washout
 - Prophylactic antibiotics

How You Will Be Tested

- Know that high-pressure injection wounds require surgery and antibiotics

Penetrating Extremity Trauma

Mel Herbert, MD, and Jessica Mason, MD

Background

- Important to evaluate for vascular (specifically, arterial) injuries

Clinical Findings

- Hard sign of arterial injury = straight to operating room or interventional radiology
 - Absent or reduced pulses
 - Obvious arterial bleeding
 - Expanding hematoma or pulsatile hematoma
 - Thrill or bruit
 - Distal ischemic signs
- Soft signs of arterial injury = watch closely
 - Small, stable hematoma
 - Proximity to artery
 - Nerve injury
 - Unexplained hypotension
- Ankle-brachial index (ABI)
 - <0.5 = severe arterial injury
 - 0.5 to 0.9 = probable arterial injury
 - >0.9 = probably no arterial injury (can still have incomplete injury or a flap)
 - Can be abnormal at baseline in peripheral arterial disease

Management

- CT angiogram if abnormal ABI and vascular surgery consult

How You Will Be Tested

- Know how ABIs change management
- Be able to identify hard and soft signs of arterial injuries

Traumatic Cardiac Tamponade

Mel Herbert, MD, and Stuart Swadron, MD

Background

- If blunt → patient is usually dead
- If penetrating → do focused assessment with sonography in trauma (FAST) and look at cardiac window first
 - Might NOT see cardiomegaly or pulsus alternans

Clinical Findings

- Look for Beck's triad:
 - Hypotension
 - Muffled heart sounds
 - Jugular venous distention (JVD)

Management

- IV fluids
- Thoracotomy
- Attempt pericardiocentesis if cannot do thoracotomy

How You Will Be Tested

- Be able to identify cardiac tamponade based on hypotension, muffled heart sounds, and JVD

Bony Chest Trauma (Clavicle, Ribs, & Sternum)

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Encompasses clavicle, rib, and sternal fractures

Clinical Findings

- Chest pain, bony pain

Management

- Clavicle
 - Most common fracture site = middle one-third
 - Majority can be discharged with sling and will heal well
 - Consult orthopedics if
 - Severely displaced
 - Skin tenting
 - >1 fracture
- Ribs
 - Flail chest = segmental fractures ≥ 3 adjacent ribs
 - If lower rib fractures, look for intra-abdominal injuries
- Sternal fractures
 - Classic - restrained driver striking steering wheel
 - Most are benign but can see cardiac contusions

How You Will Be Tested

- Know what defines a flail chest
- What is the most common fracture site in the clavicle?

Cardiac & Pulmonary Contusions

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Cardiac contusions
 - Right ventricle most common (directly under sternum)
- Pulmonary contusions

Clinical Findings

- Cardiac contusions signs: tachycardia and arrhythmias
- Pulmonary contusions signs: hypoxia, often see 6 h post-injury

Management

- Cardiac contusions: perform an ECG and echocardiogram
- Pulmonary contusion: perform X-ray, ensure good pulmonary toilet to avoid pneumonia (most common complication)
 - Consider intubation if >28% of lung or >1 lobe is affected

How You Will Be Tested

- Know the delayed presentation of pulmonary contusions and when to consider intubation

ED Thoracotomy

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Indications:
 - Blunt trauma **and** arrested <10 min before arrival at ED
 - Penetrating trauma **and** arrested <15 min before arrival at ED

Clinical Findings

- Traumatic mechanism and cardiac arrest

Management

- Call surgery
- Incision at fifth intercostal space
 - Cut from sternum to posterior axillary line
- Blunt dissect into pleural space
- Rib spreaders
- Cross clamp aorta
- Open pericardium parallel to phrenic nerve
- Repair holes in heart with sutures or staples
- Ongoing care
 - Manual cardiac compressions
 - Internal defibrillation
 - Intracardiac epinephrine injected into ventricle

How You Will Be Tested

- Know the indications for a thoracotomy
- Know what nerve you should be thoughtful about when opening the pericardium

Hemothorax & Pneumothorax

Jennifer Farah, MD, and Jessica Mason, MD

Background

- An important consideration in traumatic injuries

Clinical Findings

- Hemothorax:
 - Decreased breath sounds
 - Dullness to percussion on affected side
 - Blunting of the costophrenic angles on chest X-ray (CXR)
- Pneumothorax:
 - Absence of breath sounds
 - Tension pneumothorax = jugular vein distension, tachycardia, hypotension, tracheal deviation

Management

- Hemothorax
 - Place a chest tube
 - Consider surgery if
 - Initial drainage >1.5 L
 - Ongoing bleeding >200 mL/h for 2-4 h
 - Persistent hypotension
 - Persistent air leak
 - Failure of the lung to re-expand
- Pneumothorax:
 - Do NOT wait for CXR if you suspect tension pneumothorax
 - Decompress with needle or chest tube
 - If open pneumothorax (“sucking chest wound”)
 - Cover with occlusive dressing on 3 of 4 sides
 - Watch for tension pneumothorax
 - Place chest tube at separate site

How You Will Be Tested

- Be able to identify a tension pneumothorax
- Know the surgical indications for a hemothorax

Traumatic Aortic Injuries

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Often fatal (most patients die on scene; of those who make it to the hospital, one-third die before intervention)
- Most common site = distal to left subclavian artery at ligamentum arteriosum

Clinical Findings

- Retrosternal or interscapular pain
- Shortness of breath
- Pulse deficits
- New murmur
- Imaging
 - Chest X-ray may show
 - Superior mediastinal widening
 - Tracheal/esophageal deviation
 - Indistinct aortic knob
 - Displaced left main bronchus
 - Left apical pleural cap
 - But one-third have a normal X-ray!
 - CT angiography = gold standard

Management

- Call surgery STAT
- Control blood pressure
 - Control with beta blocker and nitroprusside or nifedipine or labetalol
- Control tachycardia:
 - Make sure you control tachycardia first as you can get reflexive tachycardia with BP control

How You Will Be Tested

- Know the gold standard for diagnosing traumatic aortic injuries
- What is the most common site of a traumatic aortic injury?

Tension Pneumothorax

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Associated with penetrating **and** blunt (from rib fractures) trauma
- One-way valve effect: allows air into pleural space but not out
- High intrathoracic pressures can eventually collapse the heart

Clinical Findings

- Hypoxia and hypotension
- May not see jugular vein distension if there is hemorrhage
- May not detect decreased breath sounds

Management

- Treat initially with a rapid decompression (either by needle, finger thoracostomy, or immediate chest tube)
 - Boards answer is immediate needle decompression at third-fourth intercostal space in mid-clavicular line
 - Also acceptable (and preferred in real life) is fourth-fifth intercostal space in anterior axillary line (chest tube site)
- **Do not** wait for imaging

How You Will Be Tested

- Be able to identify a tension pneumothorax based on mechanism and vital signs
- Know to decompress immediately at third to fourth intercostal space in mid-clavicular line

Corneal Abrasions & Lacerations

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Involves abrasions, chemicals, and lacerations

Clinical Findings

- Pain
- Light sensitivity
- Decreased visual acuity
- Lacrimation

Management

- Corneal abrasions
 - Rule out
 - Infectious causes like herpes
 - Foreign body
 - Glaucoma
 - Treatment
 - Pain meds (topical +/- oral)
 - Antibiotics
 - No contact lenses until healed
 - If contact lens wearer → cover for *Pseudomonas*
- Chemical burns to cornea
 - Neutralize with copious irrigation until pH is 7.0
- Laceration
 - Evaluate with fluorescence stain and look under cobalt blue light
 - Waterfall coming out of the eye? = perforated globe
 - This is Seidel's sign

How You Will Be Tested

- Know what pH to neutralize the cornea to
- What bug should you cover for patients who wear contact lenses?

Eyelid & Lacrimal Trauma

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Important to rule out globe rupture and corneal lacerations with these injuries

Clinical Findings

- Laceration will be apparent
- Damage to the lacrimal drainage system may lead to stenosis and epiphora

Management

- Eyelid lacerations
 - Repair simple and superficial injuries if you feel comfortable
 - Consult ophthalmology or plastic surgery if
 - Laceration involves eyelid margin or tarsal plate
 - Laceration has fat extrusion
 - Laceration is full thickness
 - Concern for lacrimal involvement
- To check for lacrimal injury
 - Use fluorescein in the eye
 - Look for uptake in the laceration

How You Will Be Tested

- Know when to consult ophthalmology or plastics

Ruptured Globe

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Important not to apply pressure to the eye
- Disruption in the sclera or cornea

Clinical Findings

- Afferent pupillary defect (fail swinging flashlight test)
- Teardrop pupil
- Seidel sign
- Uveal prolapse (brown/black discoloration, uvea or iris is herniating)
- Subconjunctival hemorrhage (diffuse, bullous hemorrhage)
- Hyphema
- Causes blindness, enucleation, endophthalmitis

Management

- Urgent ophthalmology consult
- IV antibiotics
- Pain medications
- Tetanus shot

How You Will Be Tested

- Know the clinical findings associated with a ruptured globe

Lateral Canthotomy

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Perform if increased intraocular pressure (IOP) from retrobulbar hematoma

Clinical Findings

- Proptosis
- Limited eye mobility
- Increased pain with eye movement
- Decreased visual acuity
- Afferent pupil defect
- Increased IOP (don't check if potential globe rupture)

Management

- If concerned, do not order CT
- Call ophthalmology immediately
- Procedure
 - Anesthetize area with lidocaine
 - Devascularize area
 - Apply hemostat/needle driver from lateral canthus towards bony orbit for 30-90 s
 - Remove the instrument and cut this area laterally, about 1-2 cm
 - Use iris scissors to palpate the inferior canthal ligament (may feel like guitar string) and cut
 - Reassess IOP with tonometer
 - If IOP remains >40 mm Hg, decompression is inadequate
 - Use iris scissors to cut the superior canthal ligament
 - Recheck IOP to confirm that it has decreased

How You Will Be Tested

- Know the IOP at which you should be concerned for retrobulbar hematoma

See EM:RAP HD 2016 May - Lateral Canthotomy

Orbital Fractures

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Blunt force to eye → increased intraocular pressure → fractures weak part of orbit

Clinical Findings

- Inferior → herniates into maxillary sinus
- Medial → herniates into ethmoid sinus
 - Occurs with nasal and midface fractures
- Infraorbital anesthesia = infraorbital nerve damage
- Signs of inferior rectus entrapment
 - Diplopia on upward gaze
 - Eye movement limitation
- Exophthalmos → think retrobulbar hematoma
- Enophthalmos → think blowout fracture

Management

- Treatment
 - Antibiotics (orbital contents are in the sinus!)
 - Consult facial surgeon

How You Will Be Tested

- What muscle is entrapped if you note diplopia on upward gaze?

Retrobulbar Hematoma

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Retrobulbar hematoma is a vision-threatening emergency

Clinical Findings

- Presents with exophthalmos
- Proptosis
- Limited eye mobility
- Increased pain with eye movement
- Decreased visual acuity
- Afferent pupil defect
- Increased intraocular pressure (IOP) (don't check if potential globe rupture)

Management

- If IOP >40 mm Hg or decreased acuity → lateral canthotomy, recheck pressure

How You Will Be Tested

- Know the IOP at which you should be concerned for retrobulbar hematoma

See EM:RAP HD 2016 May - Lateral Canthotomy

Traumatic Iritis

Jessica Mason, MD, and Jennifer Farah, MD

Background

- May be referred to as “anterior uveitis” or “iridocyclitis”

Clinical Findings

- Direct and consensual photophobia
 - Ciliary body inflammation = pain with pupil constriction
- Ciliary flush (perilimbal injection)
- Pupil is small and does not dilate well
- Slit lamp will show cell and flare in anterior chamber

Management

- Long-acting cycloplegic (homatropine)
- Steroids
- Ophthalmology follow-up

How Will You Be Tested

- Know that “cell and flare” is pathognomonic for traumatic iritis

Le Fort Facial Fractures

Jessica Mason, MD; Jennifer Farah, MD; and Jessie Werner, MD

Background

- Several gradings of Le Fort fractures:
 - Le Fort I
 - Fracture above dental arch
 - Teeth pull forward
 - Think of these like “dentures”
 - Le Fort II
 - Fracture through nasal bone
 - Teeth and nose pull forward
 - Le Fort III
 - Fracture through zygomas
 - Whole face pulls forward

Clinical Findings

- Facial swelling
- Facial pain
- Often obvious facial injury or deformity

Management

- Antibiotics, as these are open fractures
- Monitor airway
- Urgent consult to facial surgeon

How You Will Be Tested

- Know what is unstable in each Le Fort fracture type
- Types II and III can be associated with cerebrospinal fluid rhinorrhea from involvement of the cribriform plate

Mandibular Trauma

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Over 50% of time there is >1 fracture when mandible is injured

Clinical Findings

- Malocclusion = patient's bite does not feel right to them
- Trismus
- Step-offs
- Intra-oral bleeding
- Ear pain
- Positive tongue blade test
 - Patient bites on tongue blade
 - If examiner can snap the tongue blade, then test is negative (unlikely fracture)
 - If patient cannot sustain bite and lets go, may have fracture
- Blood in mouth = open fracture

Management

- Obtain CT face imaging if
 - Tongue blade test is positive
 - Other signs of fracture
- Open fracture management
 - Antibiotics
 - Update tetanus
 - Ear, nose, and throat or oral and maxillofacial surgery (ENT/OMFS) consult
- Closed and non-displaced
 - Analgesia
 - Soft diet
 - Follow up with ENT/OMFS in 1-2 d

How You Will Be Tested

- Know that multiple fractures are likely: if you see one fracture, look for another
- Know that "malocclusion" is highly suggestive of mandibular fracture
- Know that blood in mouth is concerning for an open fracture

Nasal Trauma

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Most nasal trauma on its own is benign
 - Associated hematoma is concerning

Clinical Findings

- Often clinically obvious
- Look for septal hematoma
 - Bulging grape-like structure on nasal septum

Management

- Often diagnosed clinically
- Confirmed with CT or X-ray
- If nasal septal hematoma is present:
 - Anesthetize and do incision and drainage
 - Place drain as needed
 - Pack both nares with pressure
 - If not packed, can lose blood supply to septal cartilage→ potential septal perforation→ necrosis or infection
 - Possible discharge home with ear, nose, and throat (ENT) follow-up in 2 d
 - If concerned, can have ENT evaluate in ED

How You Will Be Tested

- Look for associated injury
 - Septal hematomas require drainage/packing

Dental Trauma

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Several concerns regarding dental trauma:
 - Subluxed teeth
 - Avulsed teeth
 - Dental fractures
 - Grading system

Clinical Findings

- Subluxed tooth
 - Loose tooth that you can usually brace against another
- Avulsed tooth
 - Tooth is knocked out of the socket
- Fractured tooth
 - Ellis 1 = through enamel
 - Ellis 2 = through dentin (yellow middle layer)
 - Ellis 3 = exposes pulp (pink blush or drop of blood)
 - Can have a blue-ish hue

Management

- Subluxed tooth
 - Splint to normal tooth on either side with periodontal paste
 - Soft diet
 - Urgent dental follow-up
- Avulsed tooth
 - Rinse and immediately replace in socket
 - While awaiting placement in socket, store tooth in
 - Milk
 - Hanks' solution
 - Inside the patient's cheek
 - Splint to normal tooth on either side
 - Urgent dental follow-up
- Fractured tooth
 - Ellis 1
 - Nothing to do
 - Ellis 2
 - Apply calcium hydroxide paste over exposed dentin
 - Next-day follow-up

- Ellis 3
 - High risk of infection and necrosis of pulp
 - Cover with moist cotton
 - Dental consult for pulpectomy or extraction
 - Treat pain (consider block)

How You Will Be Tested

- Know what solution to store tooth in
- Know grading system of dental fractures
- Know that Ellis 3 fractures should be covered with moist cotton

Ear Trauma

Jessica Mason, MD, and Jennifer Farah, MD

Background

- Trauma may include:
 - Lacerations
 - Obvious injury
 - Auricular hematoma
 - Key injury to not miss
 - Caused by blunt trauma

Clinical Findings

- Auricular hematoma
 - Tense fluctuant mass in pinna
 - If not treated → develops to “cauliflower” ear
 - Cartilage necrosis and permanent deformity

Management

- Small
 - Needle aspiration
- Large (>2 cm)
 - Incision and drainage
 - Block with auricular block
- Apply pressure dressing to prevent reaccumulation
- Daily follow-up until healed

How You Will Be Tested

- “Boxer” and “cauliflower ear” are buzzwords for auricular hematoma
- Know that pressure dressing prevents reaccumulation

Head Trauma Imaging & Concussions

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Canadian Head CT rule:
 - Obtain CT if any of the following:
 - Glasgow Coma Scale score <15 at 2 h post trauma
 - Suspected skull fracture
 - Signs of basilar skull fracture
 - Two or more episodes of vomiting
 - Age >65 y
 - Retrograde amnesia >30 min
 - Dangerous mechanism

Clinical Findings

- Concussion
 - Headache
 - Nausea
 - “Foggy” thinking
 - Drowsiness
 - Labile mood

Management

- Do not usually need CT
- Do not return to activities/sports that could cause repeat head injury until cleared
- Require follow-up usually in 1 wk

How You Will Be Tested

- Know Canadian head CT rules
- Patients with concussions can likely be sent home but need reassessment in 1 wk before returning to activities

Traumatic Intracranial Hemorrhage

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Head injury presentations can range from mild deficits to significant altered mental status
- Cerebral perfusion pressure = mean arterial pressure – intracranial pressure (ICP)
 - Elevated ICP can lead to herniation

Clinical Findings

- Suspect a head bleed if
 - Altered mental status
 - Lateralized weakness
 - Abnormal pupillary function
- May develop Cushing response to elevated ICP
 - Hypertension
 - Bradycardia
 - Bradypnea
- Uncal herniation syndrome: 1 pupil fixed and dilated or “down-and-out” pupil
- Diffuse axonal injury
 - No lesion on CT but patient comatose with autonomic dysfunction
 - Patient can be in prolonged coma and have autonomic dysfunction
- Cerebral contusion
 - Similar to concussion presentation but more profound neurologic dysfunction
 - Generally affects frontal and temporal lobes
 - “Coup/contrecoup” lesions on CT
- Epidural hematoma
 - Classic history/exam of head injury → loss of consciousness → lucid interval → coma
 - Often due to middle meningeal artery bleed
 - CT shows lens-like biconvex bleeding pattern outside of the dura
 - Associated parietal/temporal bone fractures
- Subdural hematoma
 - Common in elderly and alcoholic patients
 - Due to injury of bridging veins
 - CT shows a crescent-shaped bleed
 - Worse prognosis than epidural hematoma

Management

- Severe bleed (particularly with signs of herniation)
 - Airway management (ie, intubation)
 - Elevate head of bed 30° (improves venous drainage from brain)

- Hyperventilate with goal partial pressure (P)CO₂ 30-35 mm Hg
- Administer 1 g/kg of mannitol
- Reverse anticoagulation
- Call neurosurgeon
- Admission

How You Will Be Tested

- Know the Cushing triad
- Know different management techniques as above
- Recognize epidural vs subdural hematoma on CT
- Know buzzwords of “crescent-shaped” vs “lens-shaped” bleed

Skull Fractures

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Several different fracture patterns

Clinical Findings

- Basilar skull fracture
 - Signs
 - Battle's sign
 - Raccoon eyes (tarsal plate sparing)
 - Hemotympanum
 - Cerebrospinal fluid (CSF) rhinorrhea or otorrhea
 - Ring sign or halo sign seen when a drop of CSF falls on filter paper/sheet - clear CSF extends out beyond the blood
- Linear, non-depressed skull fractures
- Depressed skull fracture
- Eggshell skull fractures
 - Looks like sutures but in the wrong places

Management

- Basilar skull fracture
 - Consult neurosurgery
- Linear, non-depressed skull fractures
 - Consult neurosurgery
 - Usually not dangerous if isolated
- Depressed skull fracture
 - Urgent neurosurgery consult
- Eggshell skull fractures
 - Think non-accidental trauma (NAT) and do full NAT workup

How You Will Be Tested

- Be able to identify different fracture types on imaging
- Know clinical signs associated with a basilar skull fracture

Neck & Laryngotracheal Trauma & Strangulation

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Injury to platysma muscle is concerning for deep injury
- Evaluation and management varies by zone involved:
 - Zone 1
 - Sternal notch to cricoid cartilage
 - Zone 2
 - Cricoid cartilage to angle of mandible
 - Zone 3
 - Angle of mandible to base of skull
- Particularly concerning injuries include
 - Strangulation injury
 - Can lead to
 - Crushed larynx
 - Fractured hyoid
 - Carotid-intimal injury
 - Vascular injury
 - Carotid is most common artery injured
 - Laryngotracheal injury
 - Caused by direct blow to anterior neck

Clinical Findings

- Signs of possible deep injury:
 - Hemoptysis/hematemesis
 - Dyspnea
 - Dysphonia/dysphagia
 - Subcutaneous air
 - Focal neuro deficits
 - Expanding hematoma
 - Bruit or thrill
- Vascular Injuries
 - May have neurologic deficits
 - Eg, Horner's syndrome = ptosis, miosis, anhidrosis
- Laryngotracheal injuries
 - Dysphonia
 - Hoarse voice
 - Stridor
 - Subcutaneous air

- Tracheal deviation (commonly at cricoid area)

Management

- Dependent on injury location
 - Zone 1: imaging (CT angiography [CTA] neck)
 - Zone 2: surgical exploration
 - Zone 3: imaging (CTA neck)
- If platysmal injury, suspect injury to deeper structures
 - Call surgery
- Vascular injuries
 - Image vertebral artery if neurologic deficits are present

How You Will Be Tested

- Know that injury to platysma suggests a deeper injury
- Know signs and symptoms of deep injury
- The most commonly injured artery is the carotid
- Know the zones, particularly zone 2, which requires surgical exploration

Spinal Trauma (Cervical, Thoracic, & Lumbar)

Jennifer Farah, MD, and Jessica Mason, MD

Background

- Spine trauma consists of unstable and stable injuries
- Unstable injuries
 - Jefferson's fracture
 - C1 ring blowout from axial loading
 - May have associated C2 fracture
 - Hangman's fracture
 - Bi-peduncular fracture at C2
 - Hyperextension injury
- Mixed stable-unstable injuries
 - Odontoid fracture
 - Type I (tip of dens)
 - Stable
 - Type II (base of dens)
 - Stable
 - Type III (extends to body of C2) from flexion
 - Unstable
 - Bilateral/unilateral facet dislocation
 - Facets are the articulating surfaces of the spine
 - Flexion injury
 - Bilateral dislocation more unstable than unilateral
 - May be associated with spinal cord injury
- Stable injuries
 - Burst fracture
 - Expulsion of vertebral body from axial loading
 - Chance fracture
 - Related to lap belt injury and hyperflexion
 - Lower thoracic to upper lumbar
 - High risk of associated abdominal injury
 - "Bucket handle injury"
 - Clay shoveler's fracture
 - Avulsion of cervical-spine spinous process

Clinical Findings

- Neck pain after traumatic injury
- May have signs of associated spinal cord injury
 - Weakness, paresthesias, loss of sensation

Management

- Maintain spine precautions
- Immobilize cervical spine
- Spine surgery consult
- Unstable fractures typically require surgical intervention

How You Will Be Tested

- Know how to distinguish stable vs unstable fractures
- Recognize Jefferson's fracture on odontoid view of X-ray
- Know the unstable odontoid fractures

Penile & Testicular Trauma

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Two key injuries to know:
 - Penile fracture
 - Rupture of tunica albuginea
 - Blunt testicular trauma
 - Usually blunt force trauma

Clinical Findings

- Fractured penis
 - Erect penis that gets bent/cracks
- Testicular trauma
 - Range of injuries
 - Contusion
 - Hematoma
 - Laceration, fracture, disruption, dislocation

Management

- Fractured penis
 - STAT urology consult
 - Surgical repair
- Testicular trauma
 - Ultrasound to determine injury extent and vascular integrity
 - May lead to incidental finding of tumor or torsion
 - Contusion
 - Non-operative
 - Hematoma
 - Usually not severe
 - Expectant management
 - Laceration, fracture, disruption, dislocation
 - Surgery

How You Will Be Tested

- Know that penile fracture requires STAT consult

Renal Trauma

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Suspect in deceleration injury
- Graded from I to V (bruised to pulverized)

Clinical Findings

- Bruising to flank
- Hematuria
 - Frank
 - Minor

Management

- Frank hematuria
 - Imaging to better define injury
 - CT
 - Cystoscopy
- Minor hematuria
 - Let the overall picture guide workup
 - No clear guidelines
 - Often can be managed conservatively with observation

How You Will Be Tested

- Know that deceleration injuries can lead to blunt kidney trauma

Urethral, Bladder, & Ureter Trauma

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Workup and management varies depending on location of injury in the genitourinary (GU) tract
- Urethral injury is more common in males given longer length of urethra
- Bladder injuries
 - Intraperitoneal (worse)
 - Mechanism: full bladder when in a motor vehicle accident
 - Extraperitoneal rupture
- Ureter injury
 - Rare
 - Usually from penetrating injury

Clinical Findings

- Urethral injury
 - Bruising in GU area
 - Blood around genitals or thighs
 - Blood at the urethral meatus
- Bladder injury
 - Urine ascites
 - Hematuria
 - Difficulty voiding

Management

- Consult urology for assistance with management
- Urethral injury
 - Obtain retrograde urethrogram (RUG)
 - If partial laceration of urethra
 - Might be able to gently pass a Foley
 - Expectant management
 - If complete laceration
 - Suprapubic catheterization (cath)
 - If concerned about degree of urethral injury
 - Place suprapubic cath
- Bladder injury
 - Obtain retrograde cystogram before Foley if
 - Frank blood
 - Large perineal bruising

- Penetrating injury
- Bladder contusion
 - Expectant management only
- Intraperitoneal rupture
 - Surgical treatment
- Extraperitoneal rupture
 - Foley drainage until healed
 - Only place Foley if urethral path is intact
- Ureter injury
 - Surgical treatment

How You Will Be Tested

- If difficult to pass Foley, don't hesitate to place a suprapubic catheter
- Recognize signs on exam that would be concerning for a GU injury

Hemorrhagic Shock

Stuart Swadron, MD; Mel Herbert, MD; and Jessica Mason, MD

Background

- If a trauma patient is in shock, assume it is hemorrhagic shock
- Classically, there are 4 stages of hemorrhagic shock:
 - Class I
 - <15% blood loss
 - Normal vital signs
 - Class II
 - 15%-30% blood loss
 - Tachycardia 100-120 beats/min
 - Class III
 - 31%-40% blood loss
 - Hypotension
 - Class IV
 - >40% blood loss
 - Altered mental status

Clinical Findings

- Vitals are **not** a good predictor of degree of shock:
 - Labs may show changes before vital signs
 - Polytrauma patients may become acidotic or have base excess on labs despite being tachypneic
 - Early lab findings of acidosis suggest a critically ill patient
- Blood in abdomen can cause bradycardia
- Beware narrow pulse pressure (eg, 110/90)
 - Sign that patient is vasoconstricted and clamped down

Management

- Bleeding control
 - Direct pressure on bleeding if possible
 - Tourniquets
 - Suture bleeding skin wounds
- Initial fluids
 - Standard adult dose = 20 mL/kg saline
 - Pediatric dose = 10 mL/kg saline
 - Massive transfusion (6-10 units predicted required)
 - Give 1:1:1 (blood:plasma:platelets)

- Give Rh+ in men, Rh- in women

How You Will Be Tested

- Recognize that a patient can be in shock without having vital sign changes
- Recognize narrow pulse pressure in shock

Joint Trauma

Mel Herbert, MD, and Jessica Mason, MD

Background

- Joint trauma can present in several ways

Clinical Findings

- Penetrating trauma near joint
 - Clinically apparent with bleeding or injury to skin
- Laceration over metacarpophalangeal (MCP) joint
 - Assume closed fist injury + penetrating injury to MCP until proven otherwise
 - “Fight bite” due to contamination with oral flora
- Knee dislocations
 - Risk of delayed vascular injury

Management

- Penetrating trauma near joint
 - Rule out joint injury
 - Image joint
 - Explore wounds
 - Inject saline into joint and look for bubbling out of laceration
- Closed fist injury
 - Antibiotics (high risk of infection due to oral flora)
 - Orthopedics consult
- Knee dislocations
 - If ankle-brachial index (ABI) <0.9
 - CT angiography for popliteal injury
 - If dislocated joint with loss of peripheral pulse
 - Immediate reduction

How You Will Be Tested

- Recognize that knee dislocations are at high risk of vascular injury
- Recognize that a potential closed fist injury requires antibiotics and orthopedics consult

Neurogenic & Spinal Shock

Stuart Swadron, MD, and Mel Herbert, MD

Background

- Rule out hemorrhagic shock **first** in trauma patient
- Neurogenic shock
 - Distributive shock (eg, sepsis, anaphylaxis)
 - Blood pools due to cord injury and causes loss of tone
 - Classically seen in cervical spine injury with loss of sympathetic tone
- Spinal shock (“spinal stun”)
 - Transient stunning of the cord with global loss of function
 - Often improves, at least partially, with time
 - Return of spinal cord reflexes represents the end of spinal shock
 - Neurologic deficits that are present when spinal cord reflexes return may be permanent

Clinical Findings

- Neurogenic shock can present with
 - Priapism
 - Due to parasympathetic/sympathetic mismatch
 - Warm skin
 - Hypotension
 - Bradycardia
 - Loss of neurologic function in arms or legs
- Spinal shock (“spinal stun”):
 - Initially patients **do not** have spinal reflexes or function
 - Patients may even lack the bulbocavernosus reflex, which is still intact in spinal cord injury

Management

- Resuscitate with fluids and pressors to maintain appropriate blood pressure
- Steroids are not currently routine treatment

How You Will Be Tested

- Classic case for neurogenic shock is a young man with no cervical spine fracture on CT, but still has neurologic deficits and hypotension

Thermal Burns

Mel Herbert, MD, and Jessica Mason, MD

Background

- Thermal burns can be associated with
 - Other traumatic injuries
 - Inhalation burns
 - Carbon monoxide (CO) and cyanide
- Different grading systems
 - Traditionally, 4 different degrees of burns
 - Newer terminology by American Burn Association:
 - Superficial partial thickness
 - Deep partial thickness
 - Full thickness

Clinical Findings

- Circumferential burns
 - High risk of compartment syndrome
- First-degree burns
 - Involves epidermis
 - Skin redness, no blisters
- Second-degree burns
 - Extends into dermis
 - Red, tender, and blisters
 - Superficial second degree (aka superficial partial thickness)
 - Glands and hair follicles spared
 - Deep second degree (aka deep partial thickness)
 - Glands and hair follicles involved
- Third-degree burns
 - Entire epidermis and dermis are involved
 - Pale, leathery, “no pain”
- Fourth-degree burns
 - Down into muscle and bone
- Burn percentage (for adults, does not include first-degree burns)
 - Surface of hand = roughly 1% of body surface area (BSA)
 - Head = 9%, each arm = 9%
 - Front of torso = 18%, back of torso = 18%
 - Genitals = 1%, back of hand = 1%
 - Each leg = 18%

Management

- Circumferential burns
 - Fasciotomy
- First-degree burns
 - Symptomatic treatment
- Treatment for second- to fourth-degree burns
 - Airway, breathing, circulation for resuscitation
 - Fluid replacement
 - Parkland formula:
 - Lactated Ringer's
 - $4 \text{ mL/kg} \times \% \text{ burn}$
 - Give half of that fluid in the first 8 h, half in next 16 h
- Burn center criteria
 - Second-degree burn $>10\%$ BSA
 - Third-degree burn
 - Face, hands, feet, genital burn
 - Chemical burn
 - Electrical burns
 - Inhalation injury
 - Poor underlying medical condition

How You Will Be Tested

- Know how to calculate Parkland formula
- Know indications to transfer to a burn center

Pediatric Trauma

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Trauma = most common cause of death in kids >1 y of age
 - Motor vehicle accident and head injury = most common mechanism
- Non-accidental trauma more common in pediatric patients than in adults

Clinical Findings

- Pediatric trauma is different from adult trauma
 - Shock is compensated for longer before deterioration
 - Smaller airway
 - Obstructs more easily
 - Cervical (C)-spine injuries are less common
 - Injuries occur at higher C-spine levels (C2-C3) than in adults (C6-C7)
 - Don't perform cricothyrotomy (cric) in patients under 8 y
 - Do needle jet ventilation instead
- Down syndrome: features to remember during trauma
 - Larger tongues
 - Instability of C1-C2 level

Management

- Fluid resuscitation uses the same principles but different dosing:
 - 20 mL/kg normal saline to start (10 mL/kg blood)
 - Fentanyl 1 µg/kg to start
 - Burn formula modified for kids (head is much bigger)
 - Head: 18%; front of torso: 18%; back of torso: 18%; each arm: 9%; each leg: 14%
 - Pediatric patients go to operating room less often than adults

How You Will Be Tested

- Know the differences between pediatric and adult trauma
- If pediatric patient is stabilizing after blunt trauma, observation rather than operation is likely the answer

Trauma in the Elderly

Mel Herbert, MD, and Stuart Swadron, MD

Background

- Falls = most common cause of trauma in elderly
 - High mortality rate
- Falls = poor long-term prognostic sign
- Normal vital signs don't rule out serious injury
- Elderly patients have decreased ability physiologically to respond to trauma

Clinical Findings

- Features and injuries related to falls
 - Central cord syndrome
 - Arms weaker than legs
 - Cervical spine fractures
 - Hip fractures
 - Lethal
 - Operate early
 - Subdurals
 - Much more common than epidural
 - Rib fractures
 - Look closely for them

Management

- Normal trauma management
- Ensure that hip fractures get surgical intervention early
- Evaluate and consider risk of falling in elderly patients

How You Will Be Tested

- Make sure to consider why the patient fell (ie, consider a medical cause)

Trauma in Pregnancy

Jennifer Farah, MD, and Jessica Mason, MD

Background

- ↑ Risk of abdominal injuries in blunt trauma, including motor vehicle accidents, falls, assault during pregnancy
- ↑ Rates of intimate partner violence during pregnancy
- Trauma, particularly abdominal, causes:
 - Uterine irritability
 - Preterm labor
 - Placental abruption
 - Fetal-maternal hemorrhage (up to 30% of trauma cases)

Clinical Findings

- Physiologic changes in the second trimester make it harder to identify shock:
 - Increased heart rate
 - Decreased BP
 - Increase in plasma volume (might lose 30% blood volume before showing signs)
- Second trimester and beyond = greater risk
 - Uterus out of pelvis, more susceptible to injury
 - Uterus can compress inferior vena cava (IVC)

Management

- When assessing second or third trimester pregnant patient post-trauma
 - Roll onto left side (relieve pressure on IVC)
- Observe for at least 4 h to check patient's vitals and fetal heart tracing (rate and pattern)
- Provide RhoGAM if patient is Rh-
 - RhoGAM dosing:
 - 50 µg when <12 wk
 - 300 µg when >12 wk
- Consider perimortem cesarean section
 - If at least 24 wk or fundus is at umbilicus
 - Within 4-5 min of loss of pulses
- Best treatment of the fetus is to stabilize mother

How You Will Be Tested

- Boards may suggest Kleihauer-Betke test to quantify amount of fetomaternal hemorrhage
- Know to roll patients to left to relieve pressure on IVC
- Know RhoGAM dosing

