Trauma, Part II
ConCert Board Review

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Primary survey
Secondary survey
Airway management
Shock
Head Trauma
C spine/Spinal cord trauma
Chest trauma
Abdominal/Pelvic trauma/GU trauma
Pregnant trauma
Facial trauma
Neck trauma
Soft tissue extremity/Orthopedic trauma
Pediatric orthopedic trauma
Cutaneous injuries
Ocular trauma
Otolologic trauma
Blast injuries

Penetrating chest trauma
- Stab wounds, Gun shot wounds, Shrapnel
- Maintain high suspicion for injury
- Vital structures in the thorax

ABCDE
- Airway compromise
- Dypsnea, Respiratory distress
- Stridor
- Hypoxia
- Decreased/Absent breath sounds
- Tracheal deviation

Disclosures
- Paid speaker/consultant
  - CSL Behring
  - Kcentra, 4 factor PCC

Lecture roadmap
**Tension PTX**

- PTX with instability
  - “One way valve” mechanism
  - Large PTX
  - Mediastinal shift
- S/S
  - Air hunger, SOB, Resp distress
  - Tachycardia, Tachypnea, Hypotension, Tracheal deviation, Absent breath sounds, Neck vein distension
- Diagnosis → Clinical!
- Treatment → Needle decompression, Tube thoracostomy

**Open PTX**

- Sucking chest wound
- S/S
  - Air hunger, SOB, Resp distress, Hypoxia, Hypercarbia
- Diagnosis → Clinical +/- CXR
- Treatment
  - Sterile occlusive dressing (3 sides secured)
  - Tube thoracostomy remote from wound
  - Antibiotics

**Simple PTX**

- Blunt/Penetrating trauma
- S/S
  - SOB, Respiratory distress, Chest pain, Hypoxia, Decreased breath sounds, Crepitus
- Diagnosis → Clinical, CXR, Ultrasound, CT scan
- Treatment
  - Observation
  - Needle aspiration
  - Pigtail catheters
- Tube thoracostomy is standard

**PTX and lung U/S**

- Lung sliding normal lung
- Comet tails normal lung
Hemorthorax

- Massive HTX (> 1500 cc) vs HTX
- Accumulation of blood in pleural space
- Similar symptoms to PTX; massive can also have circulatory collapse
- Diagnosis → CXR, CT scan
- Treatment
  - Observation
  - Tube thoracostomy
  - Thoracotomy (Massive or > 1500cc on tube insertion or 200 cc/ hr for 2-4 hours)

Cardiac tamponade

- More common with penetrating trauma
- Can occur rapidly or slowly
- S/S
  - Beck’s triad → Hypotension, muffled heart sounds, JVD
  - Kussmaul’s sign
  - Can present similarly to tension PTX
- Diagnosis → Bedside ultrasound, Echo
- Treatment
  - IVF
  - Pericardiocentesis vs Pericardial window
  - ED thoracotomy if unstable or cardiac arrest

Resuscitative thoracotomy

- Consider in penetrating and blunt cardiac arrest
- Surgical back-up desired
- Universal precautions
- Overall outcomes poor
- Penetrating trauma better outcomes than blunt trauma
Trauma part 2

18 centers, Prospective, 56 survivors of ED thoracotomy
77% thoracic injuries; 34% had pre-hospital CPR
Futile if: Pre-hospital CPR > 10 min for blunt, pre-
hospital CPR > 15 min for penetrating, or asystole is
presenting rhythm without tamponade

Aortic dissection/rupture

- Often results in sudden death
- Mechanism → MVA, Fall from height (deceleration injury)
- Incomplete tears may survive to hospital
- S/S
  - Shock, SOB, CP, Pulse deficits
  - Diagnosis → CXR, CT scan
  - Treatment
    - Medical vs Surgical

Blunt chest trauma

- Similar injuries to penetrating → Tension PTX, Cardiac tamponade, HTX, Simple PTX
- Other injuries to consider:
  - Aortic dissection/rupture
  - Blunt cardiac injury/Cardiac contusions
  - Pulmonary contusions
  - Flail chest/Rib fractures

Aortic dissection/rupture

- CXR findings
  - Widened mediastinum
  - Obliteration aortic knob
  - Obliteration of aortopulmonary window
  - Depression L mainstem bronchus
  - Widened paratracheal stripe
  - Right tracheal deviation
  - Elevation right mainstem bronchus
  - Deviation esophagus to right (NG tube)
  - Presence pleural/apical cap
  - Left hemothorax

Cardiac contusions (blunt cardiac injury)

- Can present along spectrum of symptoms severity
- Muscle contusion → Chamber or valve rupture
- RV most susceptible
- S/S
  - Chest pain, SOB, Tachycardia, Dysrhythmias
  - Diagnosis → EKG, Trop, 2D Echo (WMA)
  - Treatment → Monitoring, Supportive care, Balloon pumps (rare)
Blunt cardiac injury (screening)

- EAST (2012)
  - EKG (I)
  - Abnormal EKG—admit for cont. monitoring (II)
  - Normal EKG and normal trop I → BCI ruled out (II)
  - HD instability or persistent arrhythmia → Echo (II)
  - Presence of sternal fracture alone does not predict BCI (II)

Pulmonary contusion

- May occur with or without rib fractures
- Can progress over time
  - S/S
    - Chest pain, SOB, Resp distress, Hypoxia, Resp failure
  - Diagnosis → CXR, CT scan
- Treatment
  - Oxygen
  - Pain control
  - Pulmonary toilet
  - Mechanical ventilation

Rib fractures

- Upper ribs (1-3)
  - High energy
  - Suspect other injuries (head, C-spine, lungs, great vessels)
- Lower ribs (10-12)
  - Suspect solid abdominal organ injury
  - Suspect PTX, HTX
  - Diagnosis → Clinical, CXR, CT scan
  - Treatment → Supportive care, Pain control
Flail chest

- > 2 rib fractures in 2 or more places
- Significant underlying lung injury → Pulm contusions
- S/S
  - Resp distress, Pain, Hypoxia
- Paradoxical movement of chest
- Diagnosis → CXR, CT scan
- Treatment → Pain control, Supportive care, Mechanical ventilation

Sternal fractures

- Direct blow (classically steering wheel to chest)
- Associated injuries → Cardiac contusion, Pulmonary contusion, PTX
- S/S
  - Chest pain, SOB, Skin changes
- Diagnosis → X-ray, CT
- Treatment → Pain control, Treat complications

Abdominal trauma

- First clue → Abnormalities during primary survey (hypotension)
- Mechanism of injury
  - Blunt vs penetrating
- eFAST
- Anatomy
  - Peritoneal cavity
  - Retroperitoneal space
  - Pelvic cavity

Abdominal trauma--evaluation

- Primary survey
- History—mechanism
- Exam → Skin changes, Abd tenderness, Pelvic instability, GU abnormalities
- Seat belt sign
- Serial exams
- eFAST
- DPL
- CT scan of abd/ pelvis

Abdominal trauma--OR

- Blunt trauma + Hypotension
  - + FAST or +DPL
- Penetrating trauma + Hypotension
- Evisceration
- Peritonitis
- GSW traversing peritoneal cavity
- Free air, Retroperitoneal air, or Diaphragmatic rupture
- Ruptured vicus, Intraperitoneal bladder injury, or Severe solid organ injury
Trauma part 2

### eFAST and DPL

- **eFAST**
  - Free fluid (Morrison's pouch, Splenorenal view, Bladder, or Surrounding heart)
- **DPL**
  - Gross blood
  - > 100,000 RBCs/mm³
  - > 500 WBC/mm³
  - Food particles
  - Gram stain showing food fibers or bacteria

### Diaphragmatic injury

- Blunt or penetrating
- **Left postero-lateral most common site**
- **S/S**
  - Respiratory symptoms (decreased bs, resp distress)
  - Often with concomitant injuries
- **Diagnosis** → CXR, CT scan, **Often missed**
- **Treatment**
  - Treat associated injuries
  - Surgical repair

### Diaphragmatic injury

- Diagnostic tests with decreased sensitivity
- **CXR**
  - “Blurring of hemidiaphragm
  - Elevation of hemidiaphragm
  - Bowel pattern in chest
  - NG tube in chest
  - Other injuries
- **CT scan**
  - Bowel herniation into chest
  - May see actual diaphragmatic injury

### Hollow viscus injury (HVI)

- Stomach, Duodenum/Small bowel, Large Bowel, Bladder
- Blunt → Deceleration injuries, MVA,
  - **Handlebar injuries in peds**
- Penetrating → Most common for HVI
- **Seat belt sign → Think HVI**
- **Chance fracture → Think HVI**
- **S/S** → Abd pain, Abd tenderness, Vomiting, Abd distension, Hypotension
- **Diagnosis** → CT scan (consider d/t contrast)
- eFAST, DPL ?
- **Treatment** → IV antibiotics, Surgical repair

### Retroperitonem

- Pancreas, Kidneys, Ureters, Aorta, IVC, Duodenum, Esophagus, Colon (asc, desc), Rectum
- **Pancreatic trauma**
  - Direct blows, **Handle bar injuries**
  - Normal early amylase, lipase do not exclude injury
  - Serial enzymes which elevate suggest injury
  - **CT suggests injury; Not diagnostic**
  - Delayed recognition of pancreatic ductal injury increases morbidity

_EAST 2009_
### Retroperitoneum
- **S/S**
  - Abd pain/Back pain/Flank pain, Hypotension, Shock, Signs of trauma
- **Diagnosis** → CT scan
- **eFAST, DPL insensitive**
- **Treatment**
  - Supportive care
  - Surgical intervention

### Solid Organ
- **Most common abdominal injuries**
- Spleen > Liver > Kidneys
- **Dx** → CT scan, eFAST
- **Management**
  - Solid organ injury + HD instability → OR
  - Solid organ injury, stable → Non-op
  - Angioembolization → e.g. “Blush” on CT and stable
- **Trend towards non-operative management (esp pediatrics)**

### Kidney
- **Blunt trauma > Penetrating trauma**
- **S/S**
  - Abd pain/flank pain, Gross hematuria, Microscopic hematuria
- **Diagnosis** → CT scan gold standard, FAST may see free fluid
- **Renal contusions** → most often stable
- **Renal lacerations (perinephric hematomas)**
- **Renal pedicle injuries**

### Vascular
- **High morbidity/mortality**
- Portal vein, Hepatic artery—anterior structures
- Rest of vascular—posterior structures
- **S/S**
  - Abd pain, Shock
- **Diagnosis** → CT scan if stable
- **Treatment**
  - Supportive care
  - Surgical care

### Penetrating abd trauma
- **Mechanisms** → Stab wounds, GSW
- **Consider thoracic, retroperitoneal, and diaphragmatic injuries**
  - **GSW → often requires ex lap**
- **Local wound exploration**
- **CT scan (double or triple contrast)**
- **Serial exams**
- **ED thoracotomy, Surgical repair**
Trauma part 2

Pelvic fractures

- > 100,000/year in U.S.
- High risk injuries
- Often high energy
- Associated with significant hemorrhage

Pelvic fractures

- Bony anatomy, Ligaments
- Pelvic trauma → Often significant force
- Associated injuries → Vascular, Peritoneal, Retropertoneal, GU
- Neuro injuries
- Vascular trauma secondary to pelvic fractures
  - Bones, Venous plexus, Arterial injury, Extrapelvic injuries
Pelvic fractures

- **S/S**
  - Pelvic pain, Shortened extremity
  - Gross hematuria
  - **Unstable pelvis on AP compression (Do not repeat)**
  - GU exam
- **Diagnostics**
  - Clinical exam
  - X-ray
  - CT scan

Pelvic fractures

- **Treatment**
  - Supportive care – IVF, Blood, Pain control
  - Identify and treat concomitant injuries
  - **Unstable pelvis → Binder or sheets**
  - Vascular injury → Angioembolization
  - Unstable → OR
  - Ortho and IR consults as needed
GU trauma
- Kidneys, Bladder, Urethra, Ext Genitilia
- Blunt and penetrating mechanisms

Bladder
- Blunt trauma > Penetrating trauma
- Associated with pelvic fractures (10%)
- Distended bladder → higher chance of injury
- S/S
  - Abd pain/Suprapubic pain, Hematuria, Difficulty urinating, Associated injuries
  - Dx
    - CT scan
    - Cystography or CT cystography → Can help to define intraperitoneal vs extraperitoneal injuries
- Treatment
  - Urology consult, Conservative vs OR management

Urethral/Ext genitilia
- Hematuria, Difficulty voiding
- High riding prostate, Blood at meatus, Blood in vaginal vault → No Foley
- Dx
  - Retrograde urethrogram
- Treatment
  - Urology consult
  - Conservative vs OR management

Trauma in Pregnancy
- Common cause of non-obstetrical maternal death
- Maternal stabilization is key
- Physiologic changes of pregnancy mask injury
  - ↑ HR, ↑ Circulating volume, ↓Hb
  - Respiratory system changes
  - Enlargement of uterus
- Consideration to fetus and specific injuries

Trauma in pregnancy: Approach
- Primary survey
- Secondary survey
- Remember compression of IVC by uterus > 20 weeks → Tilt uterus to left
- Oxygen
- GU exam
- eFAST + Ob U/S
- Consider feto-maternal hemorrhage
  - Kleihauer-Betke test
  - RhoGAM
### Trauma in pregnancy

- **Fetal monitoring**
  - Placental abruption
  - PROM
  - PPROM
  - Contractions/abd pain

### Placental abruption

- Separation of placenta from uterus
- Minor trauma (1-5%)
- Major trauma (20-50%)
- Abdominal pain, Vaginal bleeding, Uterine irritability
- Dx → Clinical suspicion, Ultrasound (decreased sensitivity), Fetal monitoring, Assess for coagulopathy
- Treatment
  - Maternal stabilization, Supportive care
  - Obgyn consult
  - Delivery

### Perimortem C/S

- Data limited
- Consider in maternal cardiac arrest
- Viable fetus (> 23 weeks)
- Complete within 5 minutes of cardiac arrest
- Continue maternal resuscitation
- Neonatal resuscitation

### Premature labor

- Common
- Lower abd pain/cramping
- Treatment
  - Rule out other injuries
  - Ultrasound
  - Obgyn consult
  - Fetal monitoring

### Uterine rupture

- Abd pain, Bleeding, Hypotension, Peritoneal signs
- Treatment
  - Obgyn consult
  - Ultrasound
  - IVF, Blood
  - Surgical management
Facial trauma

- Multiple injury types, usually blunt
- Rarely life threatening
- Life threats
  - Airway compromise
  - Uncontrolled bleeding
- Swelling, Bleeding, Fractures, Cosmetic issues

Dental fractures

- **Ellis classification**
  - **Ellis I** → Enamel only ("Chipped" tooth)
  - **Ellis II** → Enamel, Dentin (see yellow)
  - **Ellis III** → Enamel, Dentin, & Pulp (see red/pink)
- **Root fractures** → Abnormal mobility, pain
- **Dentoalveolar fractures** → Abnormal mobility, pain, malocclusion

Dental fractures

- Diagnosis → Clinical, X-rays
- Treatment
  - **Ellis I**: Refer for non-emergent cosmetic treatment
  - **Ellis II**: Cover dentin with zinc oxide or calcium hydroxide paste, then dental foil, refer
  - **Ellis III**: Same as Ellis II
  - Root, Dentoalveolar fractures: Splinting, referral
**Dental avulsion**
- Avulsion → hypoxia and necrosis of pulp
- **Goal**: Preserve periodontal ligament
- Re-implant within 20 minutes; > 60 minutes periodontal ligaments die
- Do not re-implant primary teeth
- Can use Hank’s solution, milk, or saline to preserve tooth

**Le Fort fractures**
- **Le Fort I**
  - Horizontal maxillary fracture
  - Fracture passes through alveolar ridge, lateral nose, and inferior wall maxillary sinus
- **Le Fort II**
  - Pyramidal fracture
  - Fracture passes through posterior alveolar ridge, lateral walls maxillary sinus, and inferior orbital rim/nasal bones
- **Le Fort III**
  - Craniofacial disjunction
  - Fracture passes through naso-frontal suture, maxillo-frontal suture, orbital wall, and zygomatic arch

**Blunt trauma**
- S/S
  - Soft tissue swelling, Bleeding, Ecchymosis, Hematomas, Facial tenderness, Instability
  - Visual acuity, EOM’s
- Diagnosis → Clinical, CT scan
- Treatment
  - ABCs, Supportive care, Antibiotics
  - Treat concomitant injuries
  - Consultation OMFS
  - Surgical treatments

**Mandibular fractures**
- Blunt >> Penetrating
- U shaped bone with articulation at TMJ
- **Fractures → 2 or more locations**
- Most open (communication with oral cavity)
Mandibular fractures

- **S/S**
  - Pain, Swelling, Trismus, Malocclusion
  - **+ Tongue blade test**
- **Diagnosis**
  - X-ray, Panorex, Townes view, CT scan
- **Treatment**
  - Antibiotics, Pain Control, Tetanus
  - Consult OMFS
  - Surgical vs Conservative management

Orbital fractures

- **Inferior orbital wall → Blowout fracture**
  - **Check for inferior rectus entrapment**
  - Medial orbital wall (lamina papyracea)
  - **Nasal or lacrimal duct injury**
  - **S/S**
    - Pain, Swelling, Ecchymosis, Hypoesthesia, Tenderness, EOM compromised
  - **Diagnosis → CT scan**
  - **Treatment**
    - Supportive care, Sinus precautions, Pain control
    - Antibiotics
    - Possible surgical management

Nasal fractures

- **Direct blows**
- **S/S**
  - Pain, Swelling, Deformity, Epistaxis, Ecchymosis
- **Diagnosis**
  - Clinical
  - Nasal X-rays: Inensitive
  - CT scan
- **Treatment**
  - **Assess for septal hematoma**
  - Supportive care, Pain meds, Referral

Zygomatic arch fractures

- ZMC—zygomaticomaxillary complex
- Zygoma—4 attachments to skull
  - Tetrapod fractures
  - Tripod fractures
  - Isolated zygomatic arch fractures
  - **S/S → Pain, Swelling, Trismus, Flattening**
  - **Diagnosis → CT facial bones, Also r/o concomitant injuries**
  - **Treatment → Conservative vs Surgical**
Neck trauma

- Penetrating > Blunt
- Penetrating
  - Stab wounds, GSW, Shrapnel
- Blunt
  - MVCs, Direct blows, Clothesline injury, Stangulation, Hanging, Ligatures, Chokeholds
- Multiple important structures in neck

Zone I—Base of neck
- Mediastinum, Lung, Trachea, Esophagus, Proximal vessels

Zone II—Mid neck
- Larynx, Trachea, Esophagus, Vessels, Nerves

Zone III—Upper neck
- Distal vessels, Nerves, Glands, Spinal Cord

Aerodigestive injury
- Uncommon
- Mechanism → Blunt or penetrating
- S/S
  - Dyspnea, Resp. distress, Dysphonia, Stridor, Subq emphysema, Soft tissue swelling/hematomas, Bruising/ecchymosis, Hemoptysis
  - Diagnosis → CT angio, Bronch
- Treatment
  - Airway management
  - Early consultation

Penetrating neck trauma

- Violation of platysma → Consider potential for serious injury and work-up
- Consider vascular injuries (arterial, venous) and aerodigestive injuries (airway and esophagus)
- S/S
  - Dyspnea, Resp distress, Stridor, Swelling, Hematoma (expanding), Bleeding, Subq emphysema, Hemoptysis, Hematemesis

Laryngotracheal injuries
Penetrating neck trauma

**HARD SIGNS**
- Bruit or thrill
- Expanding or pulsatile hematoma
- Pulsatile or severe hemorrhage (shock)
- Pulse deficit
- Hemoptyysis, Hematemesis, Visually injured trachea

**SOFT SIGNS**
- Hypotension
- Stable, non-pulsatile hematoma
- Central or peripheral nervous system ischemia
- Proximity to major vascular structure

Penetrating neck trauma

**EAST (2008)**
- Selective management recommended to minimize operations on Zone II injuries (I)
- High resolution CT angio offers appropriate diagnostic accuracy (II)
- CT angio or duplex U/S can be used in lieu of arteriography to rule out vascular injury (II)

Vascular injuries (carotid, IJ)

- Hard signs → OR
- Soft signs, other symptoms → CT angio
  - CT negative → Observe
  - CT positive → OR
- Equivocal CT
  - OR vs Further work-up vs Obs

THANK YOU