ABDOMINAL TRAUMA
Objectives:

- Review the anatomy of the abdomen.
- Discuss signs and symptoms of abdominal injury.
- Discuss injury to specific abdominal organs.
- Review assessment and mechanism of injury.
- Identify treatment priorities.
Abdominal Trauma

- Most patients with abdominal trauma survive the initial insult and live long enough to reach a hospital.
- Factors that lead to death include:
  - Delayed resuscitation.
  - Inadequate volume.
  - Failure to identify a traumatic abdominal injury.
  - Delay in surgical intervention.
Abdominal Trauma

- Death results from increased hemorrhage due to:
  - Solid organ injuries.
  - Hollow organ injuries.
  - Abdominal vascular injuries.
  - Pelvic fractures.

- Additional injuries include:
  - Spillage of hollow organ contents.
  - Peritonitis.
The Abdomen

- Abdominal cavity bounded by pelvis, diaphragm, anterior abdominal muscles, vertebral column and ribs, and flank muscles.
The Abdomen

- **Peritoneum**: the serous membrane that lines the wall and covers the organs of the abdominal cavity.
  - **Parietal peritoneum**.
  - **Visceral peritoneum**.
    - The mesentery of the peritoneum fans out from the main membrane to suspend the small intestine.

- **Peritoneal cavity**:
  - Potential space between visceral and parietal pleura.
Anatomy

DIAPHRAGM
Spleen
Liver
Pancreas
Kidneys

Duodenum
Small intestine
Large intestine
Bladder
Abdominal Cavity

Anatomically, three spaces:

- **Retro-peritoneal space** – kidneys, ureters, bladder, reproductive organs, inferior vena cava, aorta, pancreas, duodenum colon, and rectum.

- **Peritoneal space** – bowel, spleen, liver, stomach, and gall bladder.

- **Pelvic space** – pelvic vascular plexus, femoral arteries, femoral veins, pelvic skeletal structures, and reproductive organs.
Referencing Abdominal Areas

- Right upper quadrant
- Left upper quadrant
- Right lower quadrant
- Left lower quadrant
- Right hypochondrium
- Left hypochondrium
- Right lumbar
- Left lumbar
- Right inguinal
- Left inguinal
- Umbilical
- Suprapubic
Anatomy of the Retroperitoneal Abdomen
Retroperitoneal Abdomen

- **Urinary**
  - Adrenal glands
  - Kidneys
  - Ureter
  - Bladder

- **Circulatory**
  - Aorta
  - Inferior vena cava

- **Digestive**
  - Part of the esophagus
  - Rectum (part, lower third is extraperitoneal)

- **Reproductive**
  - Uterus

Grey Turner’s Sign
Large capacity for bleeding. The cavity can contain 2000 – 4000 ml.

Bleeding in the retroperitoneal abdomen does not cause rigidity.

Diffuse abdominal pain is a common finding.

Most common mechanism is blunt trauma, but penetrating trauma due to knives and GSW occurs frequently.

Bleeding into the retroperitoneal space can be due to AAA, acute pancreatitis, or other medical causes as well as trauma.
Solid Organs and Hollow Structures

**Solid:**
- Liver
- Pancreas
- Spleen
- Kidneys
- Ovaries

**Hollow:**
- Stomach
- Small Intestine
- Appendix
- Large Intestine/Colon
- Gallbladder
- Bladder
- Uterus
- Aorta
- Common bile duct
- Fallopian tubes
Closed Abdominal Injury

- Bleeding is more commonly seen in blunt trauma.
- Fractures to lower ribs can cause abdominal injury.
- Seatbelts can injure internal organs.
- Unstable pelvic fractures can injure bladder, blood vessels, bowel, and reproductive organs.
Closed Abdominal Injury

- The anterior abdomen may become “distended” if there is blood, inflammation, or other contents in the cavity.
- The abdomen can be “distended” even if all the organs and vessels are intact!
The Open Abdominal Injury

- Ruptured hollow organs can spill contents into cavity causing, “peritonitis.”
- Any time the abdominal cavity is opened, anticipate infection.
- The key to treatment is the stabilization of organs and minimizing further blood loss.
S/S of Abdominal Injury

- Pain, tenderness
- Nausea, vomiting
- Guarding
- Fetal positioning
- Coffee-ground emesis
- Hematuria
- Melena
- Obvious trauma
- Lacerations, bruising, deformity or asymmetry
- Tachypnea
- Distention
- Rigidity
- Referred pain
- Hypovolemic shock
Injury to the Liver

- Mortality 4%-5%, increases to 73% with other visceral injuries.
  - Blunt liver trauma = 10X more fatal than penetrating trauma to the liver.
  - Traumatic hemophilia (can occur 4-6 weeks post injury).
    » Upper or lower GI bleeding.
    » Colicky abdominal pain.
    » Jaundice.
    » 100% mortality if untreated.
Injury to the Liver

- Largest organ in abdomen.
- Frequently injured organ.
  - May be due to blunt or penetrating trauma.
  - Ligament attachment (falciform ligament) causes shearing in deceleration injury.
- Often secondary to trauma to ribs 6 - 10 on right side.
- Bleeding.
  - Slow if contained inside capsule.
  - Exsanguinating hemorrhage with capsule rupture. Bleeds into peritoneal cavity.
Injury to the Spleen

- Mortality 18% for blunt trauma, 9% penetrating.
- 1/3 of all splenic injuries are delayed splenic rupture.
- Frequently associated with rib fractures.
- Often from trauma to ribs 9 – 11 on left side.
- Bleeds easily.
  » Capsule around spleen tends to promote slow development of shock.
  » Rapid onset of shock if capsule ruptures.
- May present with referred left shoulder pain.
  » Diaphragm irritation via phrenic nerve.
  » Called Kehr’s Sign.
Injury to the Pancreas and Duodenum

- 1-2% incidence in all abdominal trauma.
- Overall mortality of 16%.
- Difficult to diagnose:
  » Classic signs and symptoms of peritoneal irritation are dampened by retroperitoneal location.
  » Most common finding is minimal epigastric pain and tenderness which is immediately present, then decreases over next 2 hours, then increases within 6 hours.
Injury to the Pancreas

- Lies across lumbar spine.
- Usually due to penetrating trauma.
  - Also due to compression against vertebral column by steering wheel, handle bars, or other object.
  - Sudden deceleration produces straddle injury.
- Very little hemorrhage.
- Irritation to peritoneum.
  - Fluid loss from leakage of pancreatic enzymes.
  - Auto-digestion of tissue.
Injury to the Kidney

- 50% of all GU trauma.

- **Blunt:**
  - Direct blow to back, flank, upper abdomen.
    » Suspect in fracture of 10th - 12th ribs or T12, L1, L2.
  - Acceleration/Deceleration.
    » Shearing of renal artery/vein.

- **Penetrating:**
  - Rare, usually associated with GSW or stab wound.
S/S of Renal Injury

- Gross hematuria.
  - 80% of cases.
  - Absence of hematuria does not exclude renal injury.

- Localized flank/abdominal pain.
- Pain/tenderness of lower ribs, upper lumbar spine, groin, shoulder or flank.
- Hypovolemia.
Ureter Trauma

- Less than 2% of GU trauma.
- Usually secondary to penetrating trauma.
- Rupture.
  - Extraperitoneal.
  - Intraperitoneal.
Extraperitoneal Rupture

- Urine in umbilicus, anterior thighs, scrotum, inguinal canals, perineum.
- Dysuria.
- Hematuria.
- Suprapubic tenderness
- Induration.
  - Redness, inflammation secondary to tissue damage from urine.
Intraperitoneal Rupture

- Urgency to void, with the inability to void.
- Shock.
- Abdominal distention.
Bladder Injury

- Most often injured due to blunt trauma.
- Full bladder may increase risk of injury.
- Often associated with pelvic fractures.
  - Do not attempt urinary catheterization.
- Localized pelvic pain.
Urethra

- Usually due to pelvic fracture, deceleration or straddle injuries.
- Blood at the external meatus.
- Perineal bruising.
  - Butterfly bruise.
- Scrotal hematoma.
Urethra

- Urinary catheters should not be placed if pelvic fractures or trauma to the urethra is suspected.
Injury to the Stomach and Small Bowel

- Gastric perforations are common in penetrating wounds of the upper abdomen and lower thorax.
  - Blunt trauma is seldom the cause of significant stomach injury because of the protective location and relative mobility.
  - Most injuries are proximal jejunum and distal ileum.
  - May be due to a seatbelt injury.
Perforated bowel due to seatbelt injury.
Diaphragmatic Rupture

- Results from compression of the anterior abdomen.
- Abdominal contents herniate into thorax.
- Left side herniation more common and more serious.
- Viscera decreases lung expansion.
Injury/Aneurysm to the Abdominal Aorta

- 15% survive injury to the abdominal aorta long enough to be treated.
  - Very high mortality.
  - Retroperitoneal space can accommodate up to 4 liters of blood.
Inferior Vena Cava

- 50% present with no initial signs or symptoms of shock because of retroperitoneal hematoma which spontaneously tamponades bleeding.

- Manipulation of hematoma can be rapidly fatal. Avoid overly aggressive fluid resuscitation.
High Index of Suspicion

- Mechanism of Injury:
  - Seat belts.
  - Steering wheel with the unrestrained.

- Trauma to abdomen, lower chest, back, flank, buttocks, and perineum.

- Pain in uninjured shoulder:
  - Kehr’s Sign.
  - Murphy’s Sign.
  - Turner’s Sign.

- Shock-like signs or symptoms, diffusely tender abdomen with no identifiable cause
  ⇒ think internal bleeding until proven otherwise.
Blunt Abdominal Trauma

- Mortality 10-30%.
  - Associated with injuries to other systems.
  - Internal bleeding may be severe.
  - Tenderness may not be present during early exam.
  - Early onset of signs and symptoms suggests severe injury.
- Watch for the development of shock.
Blunt Forces Cause:

- Fracture of solid organs.
  - Hemorrhage.
- Rupture of hollow organs.
  - High risk of peritonitis.
- Tearing of organs, blood vessels, and mesentery (attachments).
- Fractures of lower ribs associated with high incidence of liver or spleen injury.
Bicycle handlebar injury

Following 2 pages show repair of internal bleeding.
Ischemic bowel secondary to a seatbelt injury.
Penetrating Injury

- **Gunshot wounds.**
  - Have higher mortality (up to 15%) due to higher velocity and damage to abdominal viscera.

- **Stab wounds.**
  - Mortality 1-2%.

- All penetrating abdominal wounds are Step 2 trauma center criteria. They should be considered potentially critical injuries and evaluated at a trauma center.
Penetrating Injury

- Causes of mortality.
- Hypovolemic shock.
  - Injury to abdominal viscera.
  - Sepsis and/or peritonitis are late causes of death.
- Internal path of penetrating object may not be apparent from external wound.
  - Stab wound to the abdomen may penetrate the chest or vice versa.
  - A stab wound to the buttocks has 50% chance of significant intra-abdominal injury.
Knife Wounds Can Be Deceiving
Pain Origin

- Stretching/Distention.
  - Rapid distention = more severe pain.
    » Example: intestinal gas pain.
  - Gradual swelling may go unnoticed.
    » Example: liver cirrhosis.
  - Pregnancy swells the peritoneum to such a degree that acute distention of other organs (i.e. the appendix) may be masked due to lower sensitivity.
Pain Origin

- Parietal pain from the parietal peritoneum.
  - More intense, sharp and localized.
  - Increased with outstretched legs, palpation, movement.
  - Decreased somewhat by “fetal position.”

» Example: late appendicitis.
Abdominal Pain

- Pain from hollow viscera (visceral pain).
  - Crampy / paroxismal.
  - Poorly localized.
  - Related to peristalsis.

- Pain from peritoneal irritation.
  - Steady / constant.
  - Often localized.
  - Patient lies still with knees drawn up.
Assessing Abdominal Pain

- **Age:** Infants and children do not localize pain well; the elderly perceive less and tolerate more than average adults.
- **Mental states:** Hysteria heightens the perception of pain; emotional pain increases physical pain.
- **Pre-existing conditions:** Conditions such as neuropathy and pregnancy can mask abdominal pain; as can drugs such as alcohol and steroids.
Peritonitis

- Infection or inflammation of the peritoneum.

- Two types of peritonitis:
  - Primary peritonitis is a bacterial infection without loss of integrity of the GI tract that often occurs in adolescent girls by *Streptococcus pneumoniae*.
  - Secondary peritonitis is an acute peritoneal infection due to hollow organ rupture, bowel perforation, pancreatic necrosis, etc. etc.
Referred Pain

- Patients may have referred pain:
  - Splenic pain may refer to left shoulder.
  - Liver pain to right shoulder.
  - Kidneys to the flank or buttocks.
  - Aortic pain to back and down legs, into testicles.
Extra-Abdominal Sources

- Diffuse abdominal pain without tenderness may be due to:
  - AMI.
  - Pneumonia.
  - DKA.
  - Drug withdrawal.
  - Sickle cell crisis.
Liver

- Possible steady, dull pain, bleeding tendencies/bruising, jaundice to skin or sclera.
- Inflamed (hepatitis): above, plus “flu-like symptoms” nausea, vomiting, diarrhea, chills/fever.
- Capsule rupture: severe pain referred to right shoulder.
- Cirrhosis: gradual swelling; SOB from ascites, diaphragm pressure, pulmonary edema.
- Severe liver dysfunction: ALOC from ammonia, white stools from bile disruption.
Gallbladder

- Stone formation: excessive peristalsis. Lodged stone = obstruction.
- Pain may radiate anywhere along the ducts, localized at gallbladder or hepatic duct, radiates to right scapula/between scapulae.
- Not affected by movement. Patient often pacing, unable to find comfortable position.
- Backup of bile: chemical irritation, inflammation, cholecystitis, nausea/vomiting, fever, jaundice.
- White or grey stool if bile blocked over time.
Stomach

- Gastritis, GERDS: “heartburn” type pain.
- Peptic ulcers: steady, severe localized pain.
- Perforated ulcer: peritoneal pain/acute peritonitis.
- Chemical or mechanical irritation of stomach with vomiting.
  - Persistent vomiting may indicate severe problems.
  - Look at the character of emesis:
    » Bright red/Coffee ground emesis: GI Bleeding.
    » Dirty yellow, fecal smelling: complete bowel obstruction.
    » Food contents/ green duodenal contents “normal”.
Pancreas

- Swelling: peritoneal-type severe pain, “boring through to the back.”
- Patient often prefers the fetal position.
- Severe cases can lead to toxicity, hypovolemic, and shock.
- Hyperglycemia may be present when tissue damage is extensive.
Spleen

- Irritation of capsule: dull and steady pain, often phrenic nerve irritation, referral to left neck or shoulder (Kehr’s sign).
- Swelling (as in mononucleosis) can cause rupture on contact or cough, severe pain that lets up and then recurs more intensely later with peritoneal irritation. Bleeding can be profuse. If capsule is partially intact, vital signs may be ‘normal’ with orthostatic hypotension.
Small and Large Intestine

- **Colitis/gastroenteritis:**
  - acute inflammation causes colicky, crampy, intermittent pain.

- **Crohn’s disease/inflammatory bowel disease:**
  - Chronic/recurring pain and inflammation.

- **Small bowel obstruction:**
  - Begins as colicky, then peritoneal irritation.
  - Ischemia or infarction causes extreme pain, vomiting, diarrhea. This can be a surgical emergency!

- **Diverticulitis:**
  - Early, poorly localized pain; later more localized often LLQ.
  - Diarrhea/fever/vomiting.
  - Bleeding can be massive.
  - Rupture of diverticuli = peritoneal irritation, sharp steady pain.
  - Eventually, a rigid abdomen.
Aorta

- AAA pain: pulsating or steady, deep, boring, tearing pain. Usually lumbosacral area, may radiate to abdomen, along renal arteries, down the legs, or into testicles.
- Rupture or dissection pain is steady and severe.
- May present with pulsating mass.
- May have diminished or unequal distal pulses.
- May describe the urge to defecate, caused by retroperitoneal leakage of blood.
- Immediate life threat.
Kidneys and Ureters

- Infection: dull steady pain.
- Dysuria if bladder and ureters involved.
- Ureter obstruction (kidney stone): hyperperistalsis, radiating pain to groin.
- Lacerations by renal calculi (kidney stone) may cause hematuria.
- Pain becomes extreme, unaffected by movement.
Appendix

- Early pain: intermittent, dull, referred to epigastric or umbilical area.
- Later: more localized, peritoneal irritation especially RLQ.
- Nausea, anorexia, vomiting, fever possible.
- Rupture: sudden release of pain – followed by severe, constant parietal pain as peritonitis sets in.
- Possibility of septic shock.
Ovaries and Fallopian Tubes

- Inflammation, infection, swelling. Dull, constant pain on affected side
- Cyst formation: gradual increase in dull pain which suddenly lessens, returning as more severe with peritoneal irritation.
- Can cause diaphragmatic irritation, referring to side of neck or shoulder.
- Fallopian tubes capable of peristaltic waves; in ectopic pregnancy, initial pain is hyperperistalsis.
- Rupture follows typical pattern: relief, followed by severe peritoneal pain.
Evaluation and Scene Size-Up

- Extremely important.
- Provides clues to:
  - Type of injury.
  - Path followed.
  - Forces involved.
- Important factors:
  - Weapon or object involved.
  - Distance.
  - Force applied.
Evaluation and Initial Assessment

- Initial Assessment:
  - ABCs.

- Rapid Trauma Survey:
  - Head, Neck, Chest.
  - Abdomen.
    » Look for wounds, bruises, distention.
    » Feel for guarding, tenderness, rigidity.
    » Pain may be masked by head injury, hypoxia, drugs, or alcohol.
Evaluation and Initial Assessment

- Signs of intra-abdominal injury usually develop late.
  - FAST scan with ultrasound can be done prehospital.
  - Computed tomography.
  - Diagnostic peritoneal lavage.
  - Surgical exploration.

- Abdominal pain or tenderness present at the scene suggests severe injury.

- Patients are likely to develop shock.

- Penetrating wounds to the upper abdomen may cause chest injury.
Abdominal Rigidity

- Do **not** rely on rigidity.
- Bleeding may not cause rigidity if free hemoglobin is not present.
- Bleeding in retroperitoneal space will not cause rigidity.
  - May cause bruising to flank (Grey Turner’s sign).
- The average size adult can accommodate 1500 ml in the abdominal cavity without causing distention.
Bowel Sounds

- Little value, if any, in pre-hospital assessment of trauma patient.
  - Absent if shock is present, regardless of abdominal injury.
  - Requires minutes for adequate assessment.
  - Does not provide any information you cannot get from some other way.
Looking for Life Threats

- Severe, sudden pain
- Syncope
- Shock
- Pulsations
- Positive orthostatics
- Altered LOC
- Significant bleeding (may be occult such as GI, vaginal, etc.)
- Rigid abdomen
- ST changes
- Hypoxia
Management of Abdominal Trauma

- Treat problems found in the initial assessment.
- Airway management with 100% oxygen.
- Abdominal tenderness = Load & Go.
- Dress wounds.
- Two large bore IVs en route.
  - NS or LR to maintain BP of 90 mmHg systolic.
  - Titrate to end-organ perfusion and LOC, not BP.
- Monitor ECG
- Check blood sugar
- Smooth transport!!!
Management of an Evisceration

- Always treat the ABCs first!
- Goal is to:
  - Stabilize organs.
  - Prevent further injury.
  - Control bleeding.
  - Prevent further heat loss.
- Cover protruding organs with moist sterile dressing and/or non-adherent material (no 4x4s).
- Do not try to put organs back into the abdomen.
- Load & Go.
Injuries to Genitalia

- Fractured Penis.
- Assault injuries.
- Self-inflicted amputation or mutilation.
- Burns.
- Lacerations, avulsed skin.
Caring for Injured Genitalia

- Discretion is the better part of valor.
- Ask before you do.
- Examining a sexual assault victim is not a good idea and may destroy evidence.
- Control bleeding, take parts and place in sterile, moist dressing, then in bag.
- Minimize movement. Cold packs?
Female External Genitalia

- Usually intentional, secondary to assault.
- Primarily soft tissue injury:
  - Hemorrhage likely.
  - Look for other injuries.
- Sexual Assault:
  - Emotional state requires compassion, empathy, and professionalism.
  - The patient may feel threatened by male care-providers. Use discretion.
- Managed as other soft tissue bleeding:
  - Control hemorrhage.
  - Transport to a facility with personnel trained in sexual assault.
Male External Genitalia

- **Penile/Scrotal:**
  - Zipper (cut the zipper from the bottom).
  - Foreign body.
  - Avulsion/amputation.
  - Fracture.

- **Scrotal/Testicular:**
  - Penetrating injury.
  - Blunt injury.
  - Avulsion/amputation.

- **Management:**
  - Control bleeding / indirect ice / analgesia.
  - Psychological and modesty concerns.
Summary

- Second leading cause of preventable death from trauma.
- Most deaths due to delayed treatment.
- Be alert to mechanisms of injury.
- Maintain a high index of suspicion.
- Abdominal pain = impending shock.
- Penetrating wounds of the abdomen or a tender abdomen means Load & Go.
QUESTIONS?