

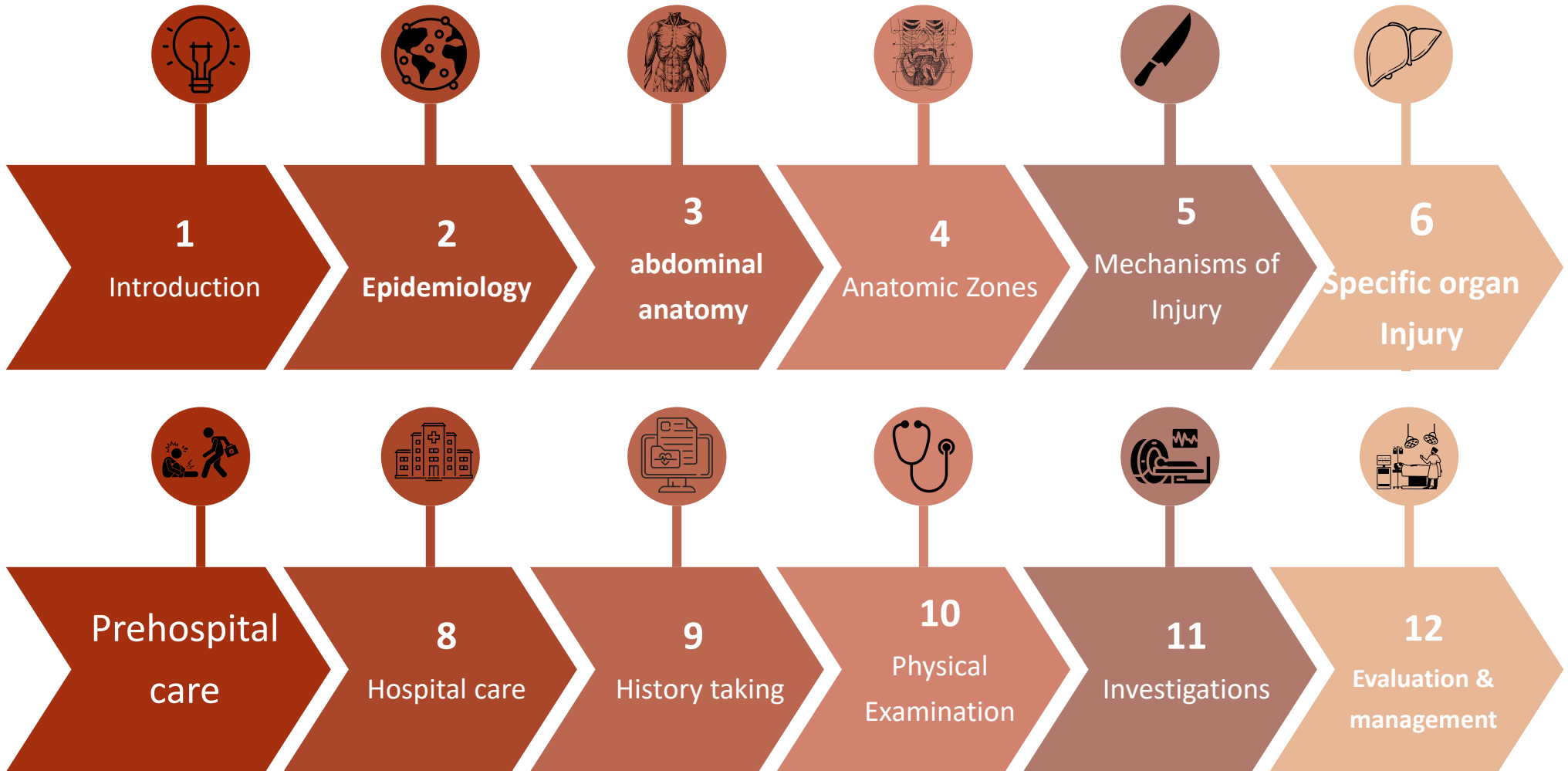
APPROACH TO PATIENTS WITH ABDOMINAL TRAUMA

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Definition of Abdominal Trauma

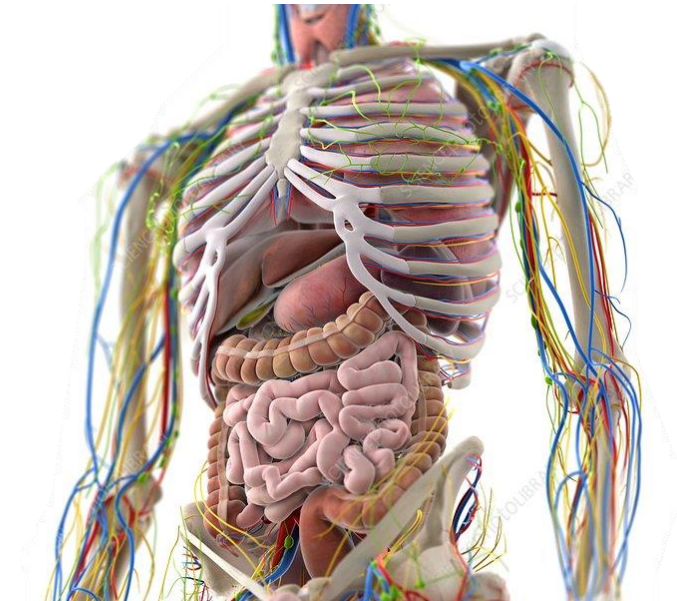
Abdominal Trauma: Any injury to the abdomen, involving organs like the liver, spleen, kidneys, intestines, or vascular structures.

Blunt Trauma: Caused by impact with no open wound (e.g., car accidents, falls).

Penetrating Trauma: Caused by objects piercing the skin (e.g., stab wounds, gunshots).

Why Is It Important?

- Abdominal trauma can be life-threatening due to potential damage to vital organs.
- Delay in diagnosis increases mortality.
- Accounts for **significant morbidity** and is a leading cause of **death in trauma cases**.





Blunt vs. Penetrating Trauma

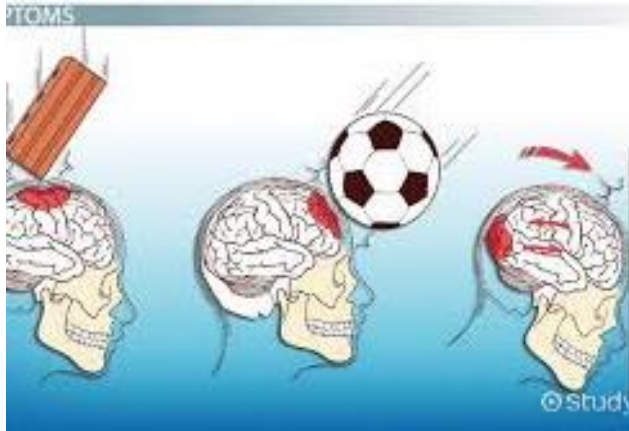
1-Blunt Trauma:

- **Mechanism:** Caused by non-penetrating forces (e.g., car accidents, falls).
- Commonly injures **solid organs** like the liver, spleen, and kidneys.
- Can lead to **internal bleeding** and organ rupture.



2-Penetrating Trauma:

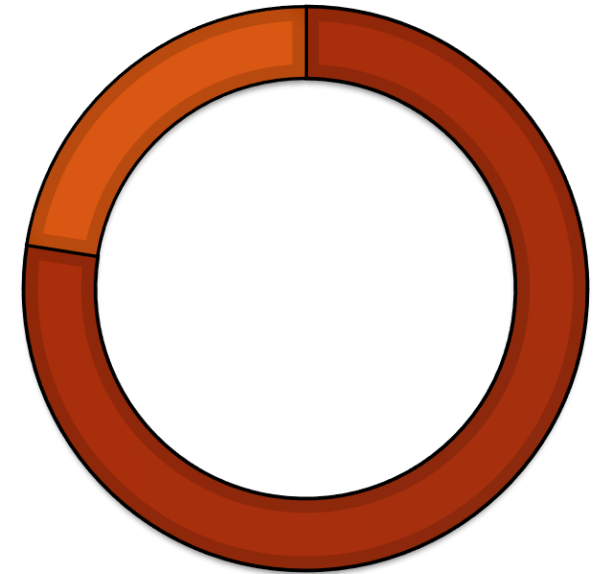
- **Mechanism:** Results from objects breaking through the skin (e.g., stab wounds, gunshots).
- Frequently injures **hollow organs** like the intestines and stomach.
- Risks include **infection** and **sepsis** due to contamination from gastrointestinal contents.



Epidemiology

- studies show that **blunt trauma** is the most prevalent form, accounting for about 77.5% of cases. The majority of blunt trauma is caused by motor vehicle accidents, making up over 61% of blunt trauma cases. Other significant causes include falls and physical assaults. **Penetrating abdominal trauma** is less common, occurring in around 22.5% of cases, with stab wounds being the most frequent cause (66.67%).
- The most affected age groups are those younger than 18 years and between 25-49 years old. Young males are the primary victims, especially due to occupational hazards and other high-risk activities. The **spleen** is the most commonly injured organ in abdominal trauma, especially from blunt impacts.
- This data reflects the significant impact of road traffic accidents on trauma incidence in Jordan, which is consistent with trends seen in other parts of the region
- Resources : https://applications.emro.who.int/imemrf/Al_Azhar_Assiut_Med_J/Al_Azhar_Assiut_Med_J_2016_14_1_24_28.pdf

epidemiology



- blunt trauma
- Penetrating abdominal trauma

Signs and Symptoms of Abdominal Trauma

1-Blunt Trauma:

- **Common Symptoms:**
 - Abdominal **pain** and tenderness.
 - **Bruising** or signs of external injury (e.g., seatbelt marks).
 - **Distension** (swelling of the abdomen).
 - **Shock:** Low blood pressure, rapid heartbeat (may indicate internal bleeding)

2-Penetrating Trauma:

- **Common Symptoms:**
 1. **Visible wounds** (e.g., stab, gunshot).
 2. **Evisceration:** Internal organs protruding through the wound.
 3. Signs of **peritonitis:** Severe abdominal pain, rigidity, and guarding.
 4. **Bleeding:** External or internal, depending on organ injury.



Abdominal Anatomy Overview

structures that are critical in assessment and management of trauma patients

The abdomen is divided into four quadrants:

Right Upper Quadrant (RUQ): Liver, gallbladder, kidney, pancreas (head), and part of the intestines.

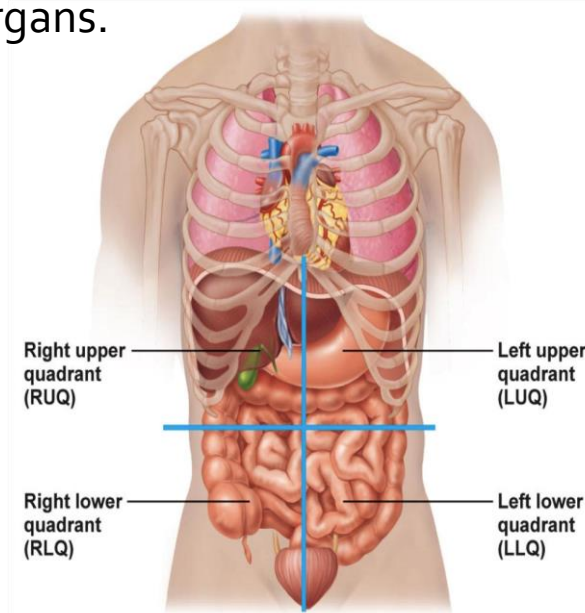
Left Upper Quadrant (LUQ): Stomach, spleen, pancreas (tail), kidney, and part of the intestines.

Right Lower Quadrant (RLQ): Appendix, intestines, reproductive organs.

Left Lower Quadrant (LLQ): Intestines, reproductive organs.

Commonly Affected Organs in Trauma:

- **Solid Organs** (e.g., liver, spleen, kidneys) are prone to **blunt trauma** injuries.
- **Hollow Organs** (e.g., intestines, stomach) are more often damaged in **penetrating injuries**.



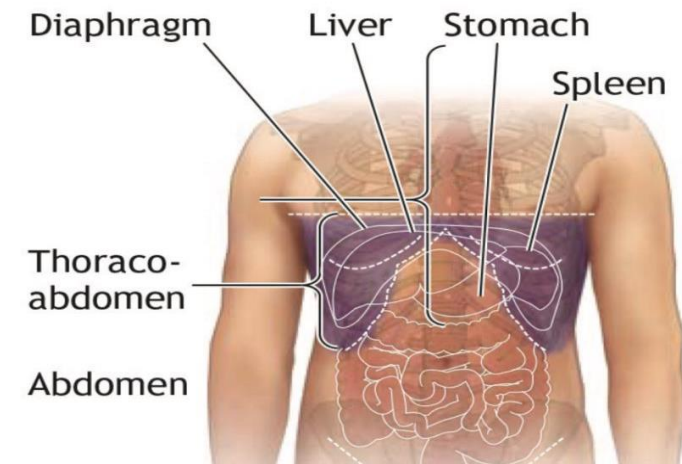
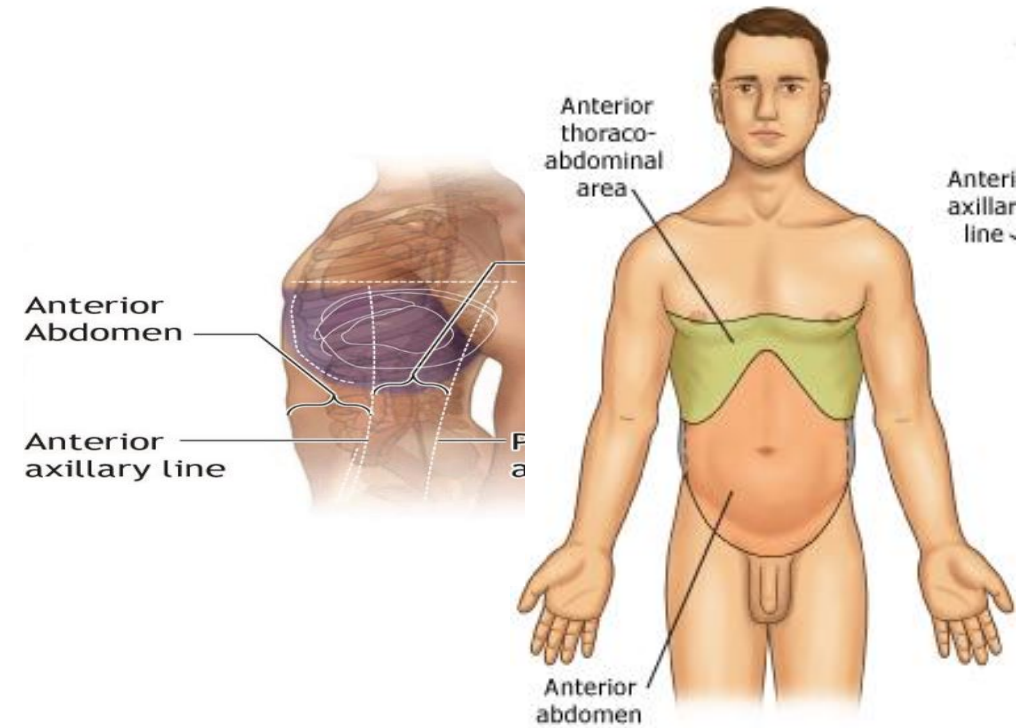
(c) The four abdominopelvic quadrants

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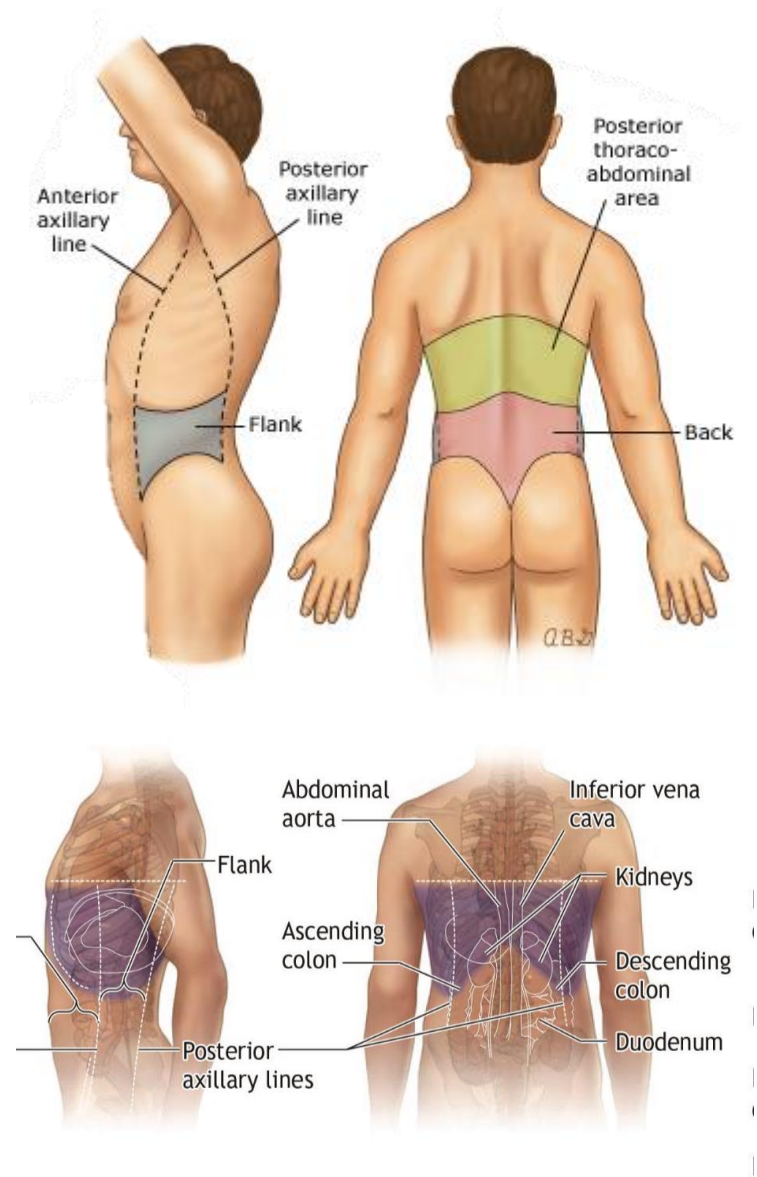
Anatomical Zones

- The abdomen is partially enclosed by the lower thorax
- **The anterior abdomen** is defined as the area between The costal margins superiorly, the inguinal ligaments and symphysis pubis inferiorly, and the anterior axillary lines laterally. Most of the hollow viscera are at risk when there is an injury to the anterior abdomen.
- **The thoracoabdomen** is the area inferior to the nipple line anteriorly and the infrascapular line posteriorly, and superior to the costal margins
This area encompasses the diaphragm, liver, spleen, and stomach, and is somewhat protected by the bony thorax.
Because the diaphragm rises to the level of the fourth intercostal space during full expiration, fractures of the lower ribs and penetrating wounds below the nipple line can injure the abdominal viscera.



Cont.

- The flank is the area between the anterior and posterior axillary lines from the sixth intercostal space to the iliac crest.
- The back is the area located posterior to the posterior axillary lines from the tip of the scapulae to the iliac crests, This includes the posterior thoracoabdomen.
- Musculature in the flank, back, and paraspinal region acts as a partial protection from visceral injury
- The flank and back contain the **retroperitoneal space**, This potential space is the area posterior to the peritoneal lining of the abdomen. It contains the abdominal aorta; inferior vena cava; most of the duodenum, pancreas, kidneys, and ureters; the posterior aspects of the ascending colon and descending colon.



Cont.

- Injuries to the retroperitoneal visceral structures are difficult to recognize because they occur deep within the abdomen and may not initially present with signs or symptoms of peritonitis.

ANATOMICAL REGIONS OF THE ABDOMEN

► Peritoneum

Intrathoracic abdomen

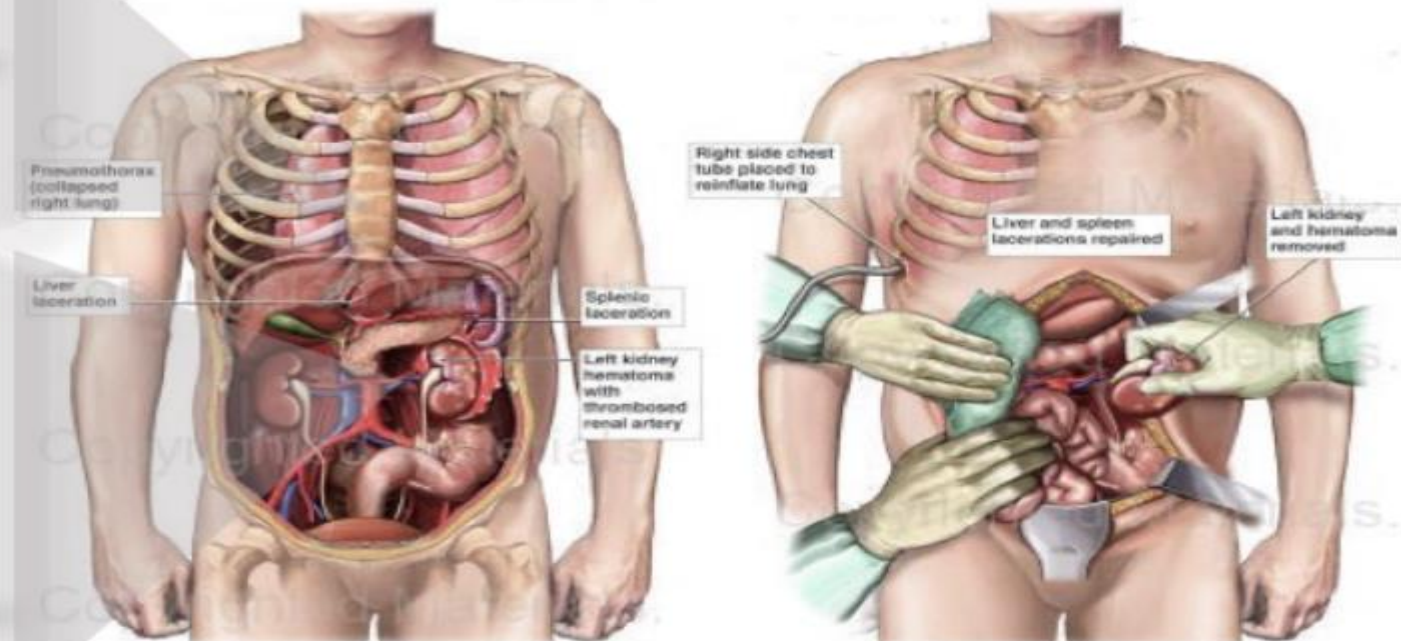
- It is under the costal margin. Contains liver, spleen, and stomach, pancreas.
- It is hard to examine it.

True abdomen

It can be clinically examined.

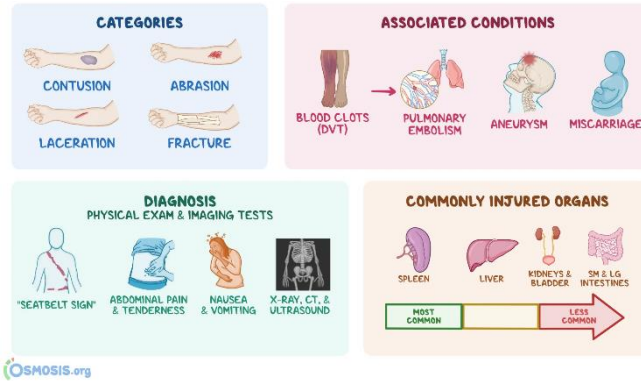
► Retroperitoneum

- Pancreas & Duodenum
- Bowel
- Vascular(IVC, aorta)
- Kidneys, ureter
- Pelvic abdomen: bladder, female genital system
- Not accessible during physical examination, investigations are needed.



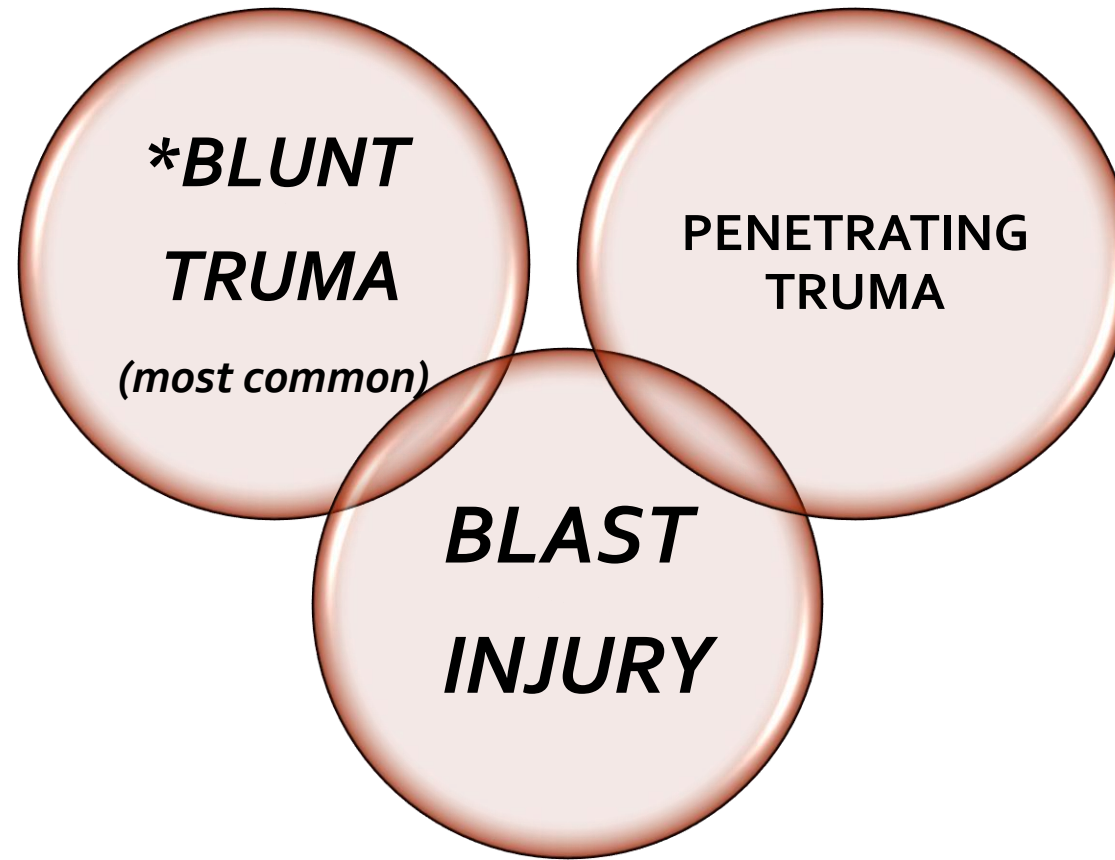
• Abdomen for trauma purposes is everything below the nipple line, inferior to pubic line.

Key Takeaways



- **Abdominal trauma** is a serious condition that can cause life-threatening injuries, especially if not diagnosed and treated quickly.
- Understanding the **mechanisms of injury** (blunt vs. penetrating) helps guide diagnosis and treatment.
- Rapid diagnostic tools like the **FAST exam** and **CT scans** are crucial for early detection of internal damage.
- Treatment often involves a combination of **surgical intervention** and **non-operative management**, depending on the patient's stability.
- **Early recognition and timely intervention** are essential for improving outcomes and reducing mortality.

Mechanism of Injury :



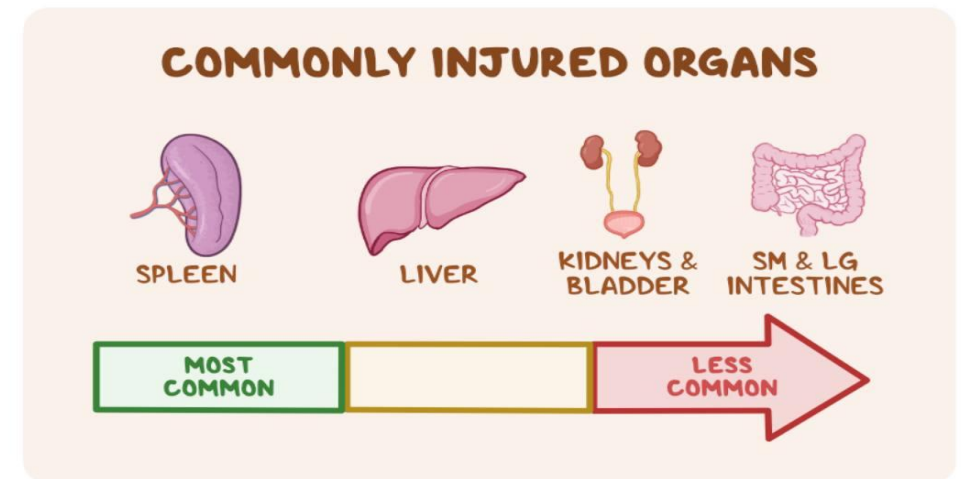
****Consideration of the mechanism of injury facilitates the early identification of potential injuries,**

1) **BLUNT TRUMA :**

- A direct blow, such as contact with the lower rim of a steering wheel, bicycle or motorcycle handlebars, or an intruded door in a motor vehicle crash.

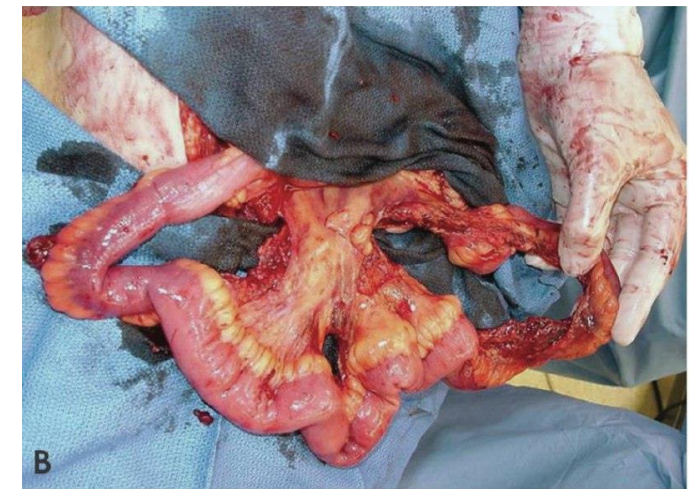
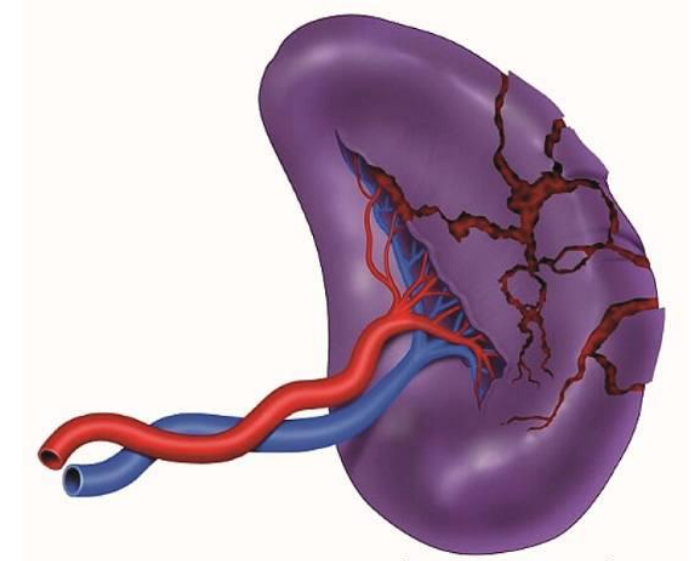


- can cause compression and crushing injuries to abdominopelvic viscera and pelvic bones.
- the organs most frequently injured are:
 1. the spleen (40% to 55%)
 2. liver (35% to 45%)
 3. small bowel (5% to 10%).



1) **BLUNT TRUMA :**

- Injury to intra-abdominal structures can be classified into 2 primary mechanisms of injury:
- A) Compression forces :
 - These forces may result from direct blows or external compression against a **fixed object**.
 - Most commonly, these crushing forces cause tears and subcapsular hematomas of solid organs like spleen , kidney,...etc
- B) Deceleration forces :
 - Deceleration forces cause stretching and linear **shearing** between **relatively fixed and free objects**.
 - These longitudinal shearing forces tend to rupture supporting structures at the junction between free and fixed segments
 - Examples include lacerations of the liver and spleen, both movable organs that are fixed at the sites of their supporting ligaments, Bucket handle injuries to the small bowel



2) ***PENETRATING TRUMA***

- Penetrating trauma occurs when a foreign object pierces the skin and enters the body, creating a wound.

It can be caused by violence and may result from:

A. Stab wound:

- Stab wounds traverse adjacent abdominal structures
- Most commonly involve the: **liver (40%), small bowel (30%), diaphragm (20%), and colon (15%)**

B. Gunshot wounds:

- Cause additional intra-abdominal injuries based on the trajectory, **cavitation effect**, and possible bullet fragmentation.
- Gunshot wounds most commonly injure the **small bowel (50%), colon (40%), liver (30%), and abdominal vascular structures (25%)**.
- The type of weapon, the muzzle velocity, and type of ammunition are important determinants of the degree of tissue injury.
- In the case of shotguns, the distance between the shotgun and the patient determines the severity of injuries incurred.



3) Blast injury :



Blast injury from explosive devices occurs through several mechanisms, including penetrating fragment wounds and blunt injuries from the patient being thrown or struck by projectiles.



The treating doctor must consider the possibility of **combined** penetrating and blunt mechanisms in these patients.



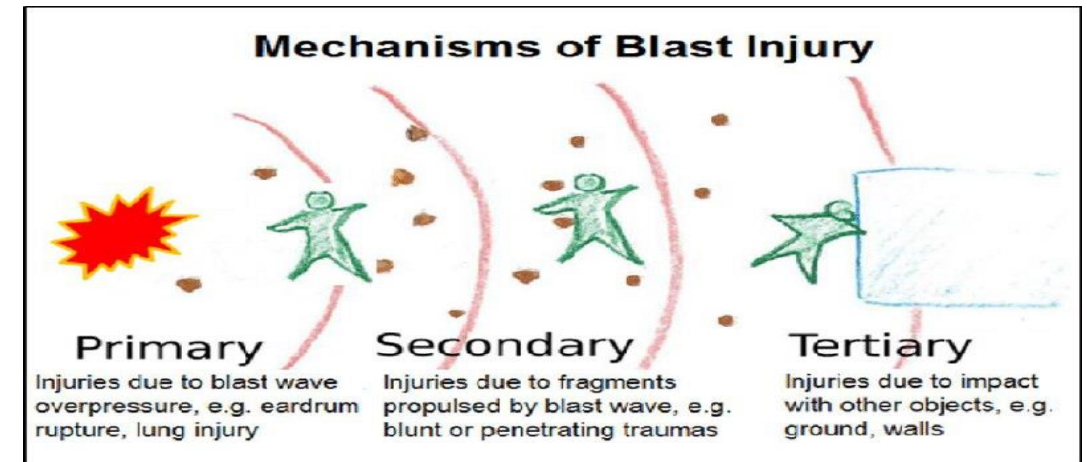
Patients close to the source of the explosion can incur additional injuries to the : **tympanic membranes, lungs, and bowel** related to blast overpressure.



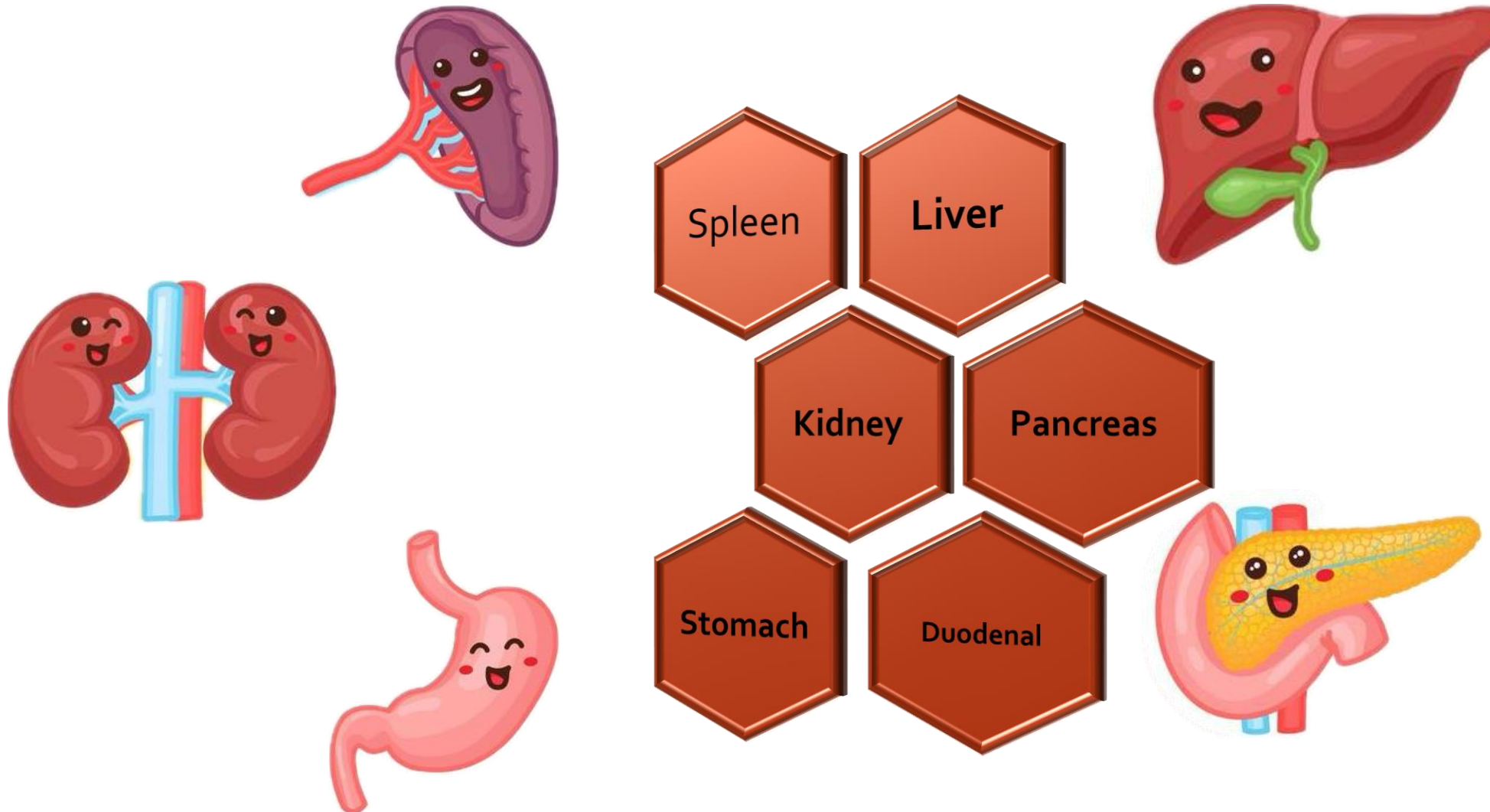
These injuries may have **delayed** presentation.



The potential for overpressure injury following an explosion should not distract the clinician from a systematic approach to identifying and treating blunt and penetrating injuries.



SPECIFIC ABDOMINAL ORGANS INJURIES:



SPECIFIC ABDOMINAL ORGANS INJURIES:

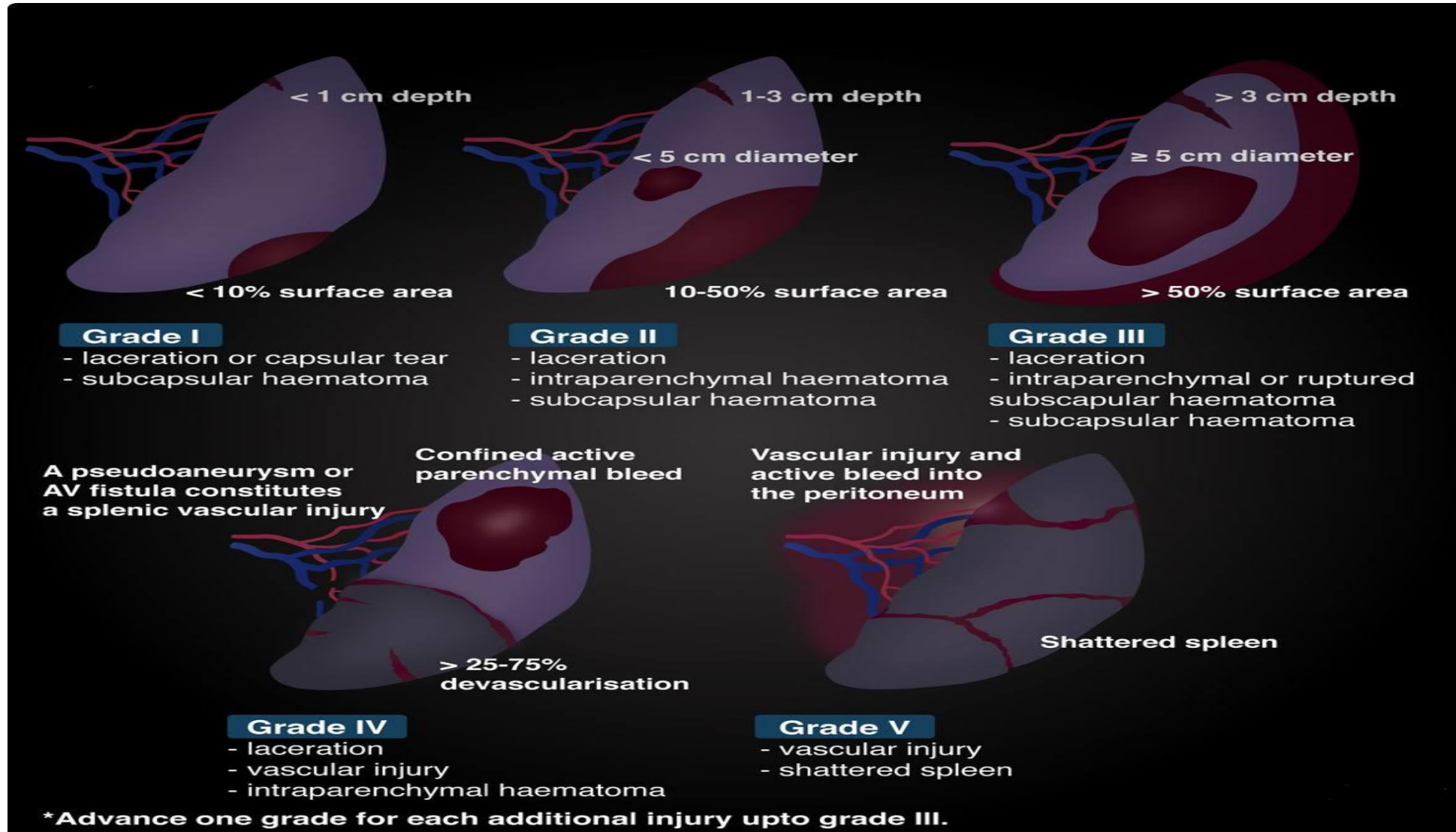
****The liver, spleen, and kidney are the organs predominantly involved following blunt trauma, although the relative incidence of hollow visceral perforation, and lumbar spinal injuries increases with improper seat-belt usage.**

- **Liver:** the most regularly injured organ in blunt abdominal trauma. Given its large size in the abdominal cavity, it can also be frequently injured with penetrating abdominal injuries.
- **Spleen:** most commonly injured in blunt trauma. Left upper quadrant bruising/abrasions. Lower rib fracture, shoulder tip pain.
- **kidney :** Renal trauma can result in injury to the parenchyma or the renal vasculature which can cause bleeding or injury to the collecting system with possible leakage of urine.
- **Pancreas :** Pancreatic injuries often result from a direct epigastric blow that compresses the pancreas against the vertebral column.
- **Stomach :** usually due to penetrating trauma S&S peritonitis, air under diaphragm, bloody NG aspirate.
- **Duodenal :** Duodenal rupture is classically encountered in unrestrained drivers involved in frontal-impact motor vehicle collisions and patients who sustain direct blows to the abdomen, such as from bicycle handlebars.

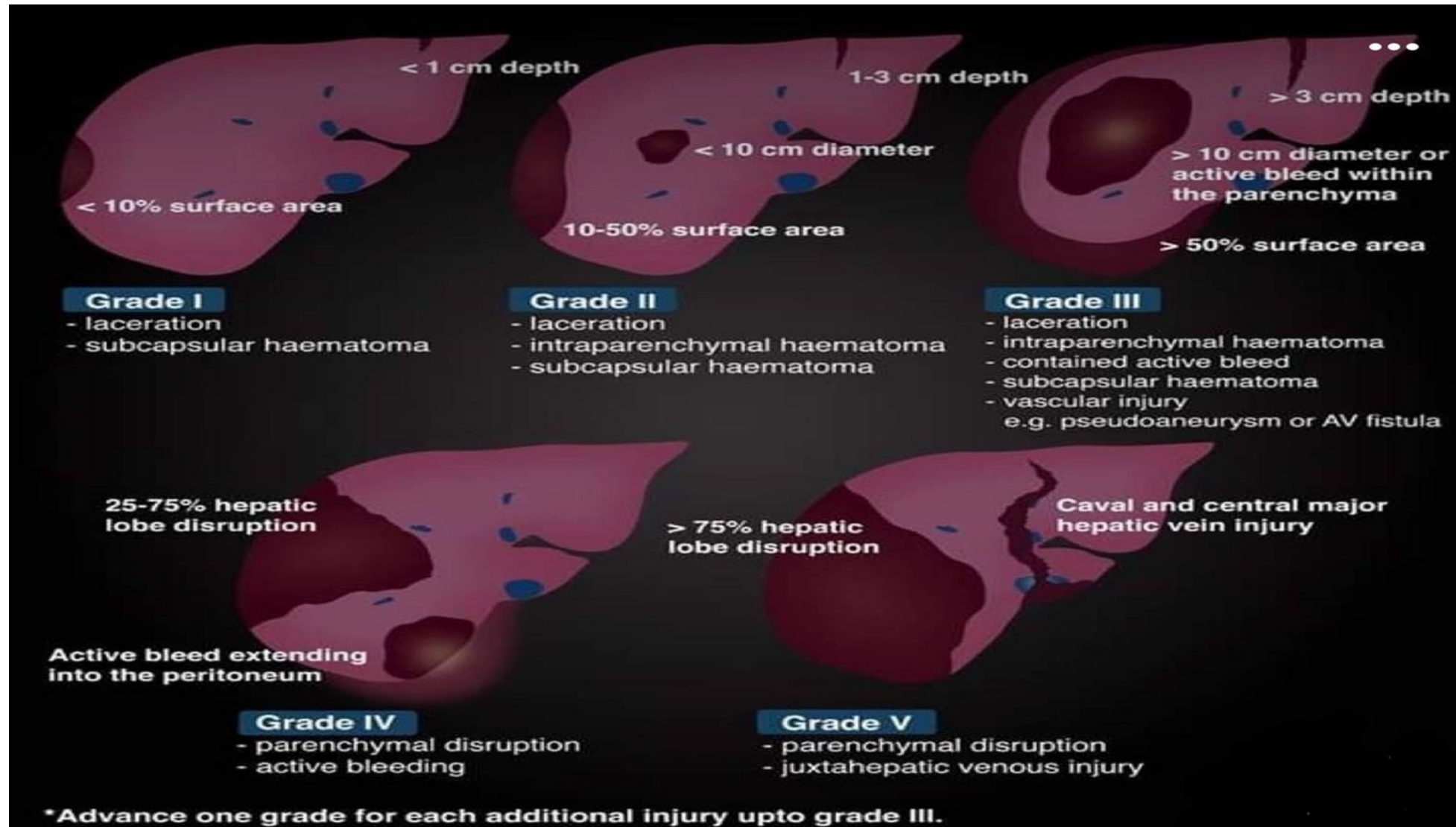
COMPARISON OF SPLEEN, LIVER, AND KIDNEY INJURY GRADES

GRADE	SPLEEN INJURY	LIVER INJURY	KIDNEY INJURY
1	- Subcapsular Hematoma < 10% - Laceration < 1 cm	- Subcapsular Hematoma < 10% - Laceration < 1 cm	- Subcapsular Hematoma
2	- Subcapsular Hematoma 10-50% - Laceration 1-3 cm	- Subcapsular Hematoma 10-50% - Laceration 1-3 cm	- Subcapsular Hematoma - Laceration < 1 cm
3	- Subcapsular Hematoma > 50% - Laceration > 3 cm	- Subcapsular Hematoma > 50% - Laceration > 3 cm	- Laceration > 1 cm
4	- > 25% Vascular Loss (Hilum Injury)	- Laceration: 25-75% hepatic lobe or involves 1-3 Couinaud segments - Ruptured intraparenchymal hematoma with active bleeding	- Partial Vascular Loss (Injury to Medulla)
5	- Complete Vascular Loss - Shattered Spleen	- Laceration: > 75% hepatic lobe or involves > 3 Couinaud segments - Juxtahepatic venous injuries (i.e., retrohepatic vena cava/central major hepatic veins)	- Complete Vascular Loss - Shattered Kidney

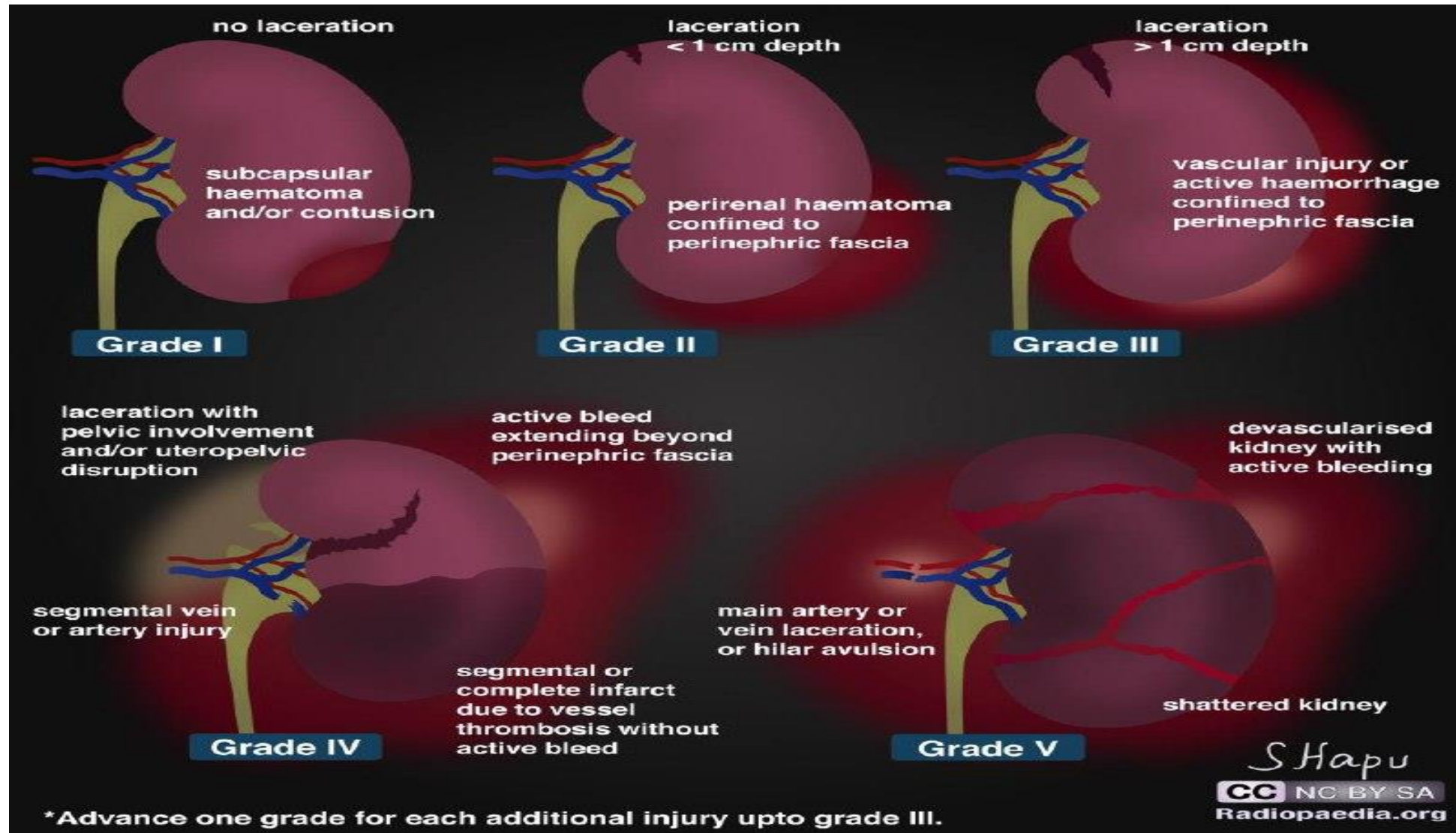
SPLEEN INJURY SCALE:



LIVER INJURY SCALE:



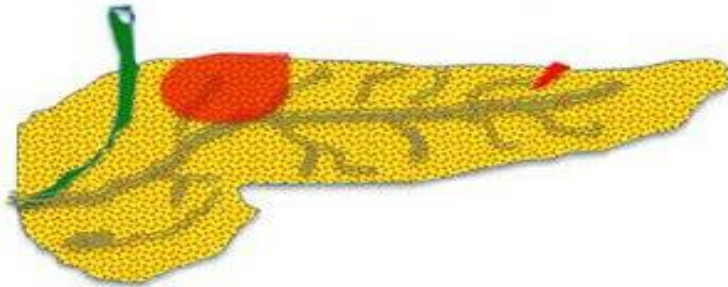
KIDNEY INJURY SCALE:



PANCREATIC INJURY SCALE:

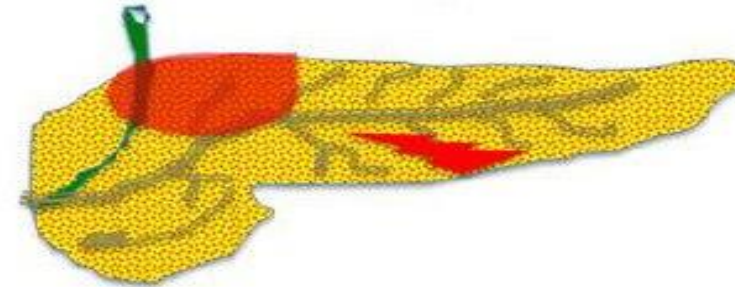
Grade I

Hematoma: Minor contusion without duct damage
Laceration: Superficial without duct damage



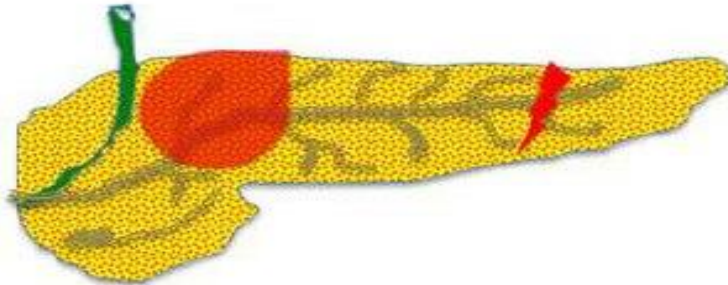
Grade II

Hematoma: Major contusion without duct damage or loss of tissue
Laceration: Superficial without duct damage or loss of tissue



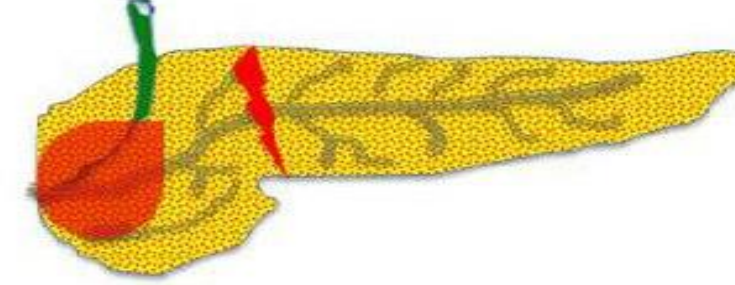
Grade III

Laceration: Distal division or parenchymal damage with ductal injury



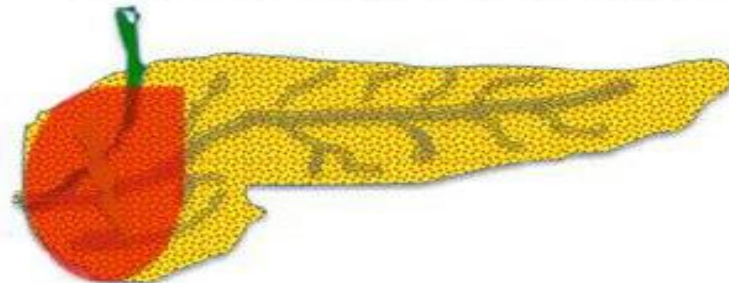
Grade VI

Laceration: Proximal division or parenchymal damage affecting the ampulla of Vater



Grade V

Laceration: Massive disruption of the head of the pancreas



Prehospital care

Coordination:

In the prehospital phase, personnel coordinate with hospital clinicians to prepare for trauma patients. Prehospital care focuses on airway management, control of external bleeding, shock management, immobilization, and rapid transport to the nearest trauma center.

Field Triage:

The Field Triage Decision Scheme is used to minimize scene time and ensure timely transport to the appropriate facility. This helps mobilize trauma teams before the patient's arrival .

Hospital care

a. Primary survey

b. Secondary survey



Primary survey

The primary survey encompasses the **ABCDEs** of trauma care and identifies life-threatening conditions by adhering to this sequence:

- **Airway maintenance with restriction of cervical spine motion**
- **Breathing and ventilation**
- **Circulation with hemorrhage control**
- **Disability (assessment of neurologic status)**
- **Exposure/Environmental control**



{Clinicians can quickly assess A, B, C, and D in a trauma patient (10-second assessment) by identifying themselves, asking the patient for his or her name, and asking what happened. }

—> An appropriate response suggests that there is no major airway compromise (ability to speak clearly), breathing is not severely compromised (ability to generate air movement to permit speech), and the level of consciousness is not markedly decreased (alert enough to describe what happened). Failure to respond to these questions suggests abnormalities in A, B, C, or D that warrant urgent assessment and management.

(1) Airway maintenance with restriction of cervical spine motion

Initial Assessment:

- First assess the **airway** for patency, checking for obstruction (e.g., foreign bodies, blood, or facial injuries).
- If the patient is verbal, the airway is likely not at immediate risk, but continuous monitoring is essential.

Cervical Spine Protection:

- Assume a cervical spine injury in trauma cases until ruled out. Protect the spine with a cervical collar, and manually restrict cervical spine motion during airway procedures.
- When airway management is necessary, a team member should manually stabilize the cervical spine while the collar is opened .

Airway Management Techniques:

- Techniques like the chin-lift or jaw-thrust maneuver are recommended for establishing an airway without hyperextending the neck.
 - Definitive airway management (endotracheal intubation) may be necessary, especially in unconscious patients, or if a Glasgow Coma Scale score of 8 or less is observed .

2) Breathing and ventilation

Initial Breathing Assessment:

- Clinicians should assess for symmetry of chest movement, adequate air movement, and use pulse oximetry to measure oxygen saturation.
- A rapid respiratory rate (tachypnea) can signal respiratory distress, and asymmetry of chest movement may indicate conditions like pneumothorax .

Supplemental Oxygen:

- Every trauma patient should receive high-flow oxygen, usually administered via a mask with a reservoir to optimize oxygenation.
- Positive pressure ventilation might be necessary if spontaneous breathing is insufficient .

Ventilation Complications:

- Injuries like tension pneumothorax, hemothorax, or flail chest impair ventilation and require immediate interventions such as chest decompression .
- Mechanical ventilation may also be required for patients experiencing respiratory failure or compromised lung function .



3) Circulation with hemorrhage control

Managing circulation with hemorrhage control is crucial in trauma patients to prevent shock and ensure adequate blood flow to vital organs.

- Assessment of Circulation:
 - Clinicians rapidly assess pulse rate, blood pressure, skin color, and capillary refill time to determine if the patient is in shock.
 - Signs of shock such as a weak or rapid pulse, cool or clammy skin, and altered mental state indicate compromised circulation due to blood loss.
- **Hemorrhage Control:**
 - External bleeding is controlled using direct pressure, tourniquets (for limb injuries), or wound packing.
 - For internal bleeding, such as in the chest, abdomen, or pelvis, immediate interventions like fluid resuscitation, blood transfusions, and surgical procedures (e.g., laparotomy, thoracotomy) may be necessary to stop the hemorrhage.



3) Circulation with hemorrhage control

Fluid Resuscitation:

- IV fluids, such as crystalloid solutions, are initially administered to restore circulating blood volume. However, in cases of significant hemorrhage, blood transfusions may be needed early to restore oxygen- carrying capacity.
- Blood products (e.g., red blood cells, plasma) are prioritized if hemorrhagic shock is suspected.



Monitoring and Advanced Interventions:

- Continuous monitoring of vital signs, including heart rate, blood pressure, and oxygen levels, helps guide ongoing resuscitation.
- In severe cases, advanced techniques like damage control surgery or massive transfusion protocols are used to manage life-threatening hemorrhage.

(4) Disability neurological evaluation

A rapid neurologic evaluation establishes the patient's level of consciousness and pupillary size and reaction; identifies the presence of lateralizing signs; and determines spinal cord injury level, if present.

1- Initial Assessment – AVPU Scale:

- Use the AVPU scale to rapidly assess the patient's level of consciousness:
- A: Alert
- V: Responds to verbal stimuli
- P: Responds to pain
- U: Unresponsive

2- Glasgow Coma Scale (GCS)

3- Pupil Examination

4- Motor and Sensory Function

5- Spinal Cord Injury Consideration

Glasgow Coma Scale		
Response	Scale	Score
Eye Opening Response	Eyes open spontaneously	4 Points
	Eyes open to verbal command, speech, or shout	3 Points
	Eyes open to pain (not applied to face)	2 Points
	No eye opening	1 Point
Verbal Response	Oriented	5 Points
	Confused conversation, but able to answer questions	4 Points
	Inappropriate responses, words discernible	3 Points
	Incomprehensible sounds or speech	2 Points
	No verbal response	1 Point
Motor Response	Obeys commands for movement	6 Points
	Purposeful movement to painful stimulus	5 Points
	Withdraws from pain	4 Points
	Abnormal (spastic) flexion, decorticate posture	3 Points
	Extensor (rigid) response, decerebrate posture	2 Points
	No motor response	1 Point
Minor Brain Injury = 13-15 points; Moderate Brain Injury = 9-12 points; Severe Brain Injury = 3-8 points		

5) Exposure and environmental control

Exposure:

- The patient's body must be fully exposed to identify all injuries, including those that may not be immediately visible (e.g., hidden hemorrhages or fractures).
- Cut away clothing to assess for injuries, burns, or bleeding. However, this must be done while maintaining patient dignity and respecting privacy.

Re-Warming Techniques:

- If the patient is hypothermic, techniques like forced air warming systems and heated fluids are crucial in stabilizing core body temperature.
- Continuous monitoring of body temperature is essential to avoid complications associated with hypothermia.

Environmental Control:

- Trauma patients, especially those exposed to severe environments (e.g., after accidents), are vulnerable to hypothermia. Even in hospital settings, exposure during the exam can result in significant heat loss.
- To counter this, hospitals use warmed IV fluids, heated blankets, and ambient temperature control to prevent hypothermia, which can lead to **(death triad)** coagulopathy, acidosis, and hypothermia.





HISTORY

AND PHYSICAL EXAMINATION

Early Assessment



Goal: Rapid identification of abdominal or pelvic injuries causing hypotension.



Key Elements:



- History, Physical Exam, and Diagnostics are essential for assessment.



- Early identification is crucial for initiating urgent hemorrhage control.



Don't obtain detailed history until life-threatening injuries have been identified and therapy initiated

General elements of history

- 1-Allergy
- 2-Medications
- 3- Past medical history
- 4- Last meal
- 5- Events leading to presentation

To remember them use the mnemonic AMPLE

imp. Note

hypotension is a predicator of more significant intraabdominal injuries.



History in Motor Vehicle Crashes (MVCs)



Key Historical Data:



- Vehicle speed, type of collision



- Intrusion into passenger compartment, airbags, restraints



- Patient position, status of other occupants



Prehospital data is important: vital signs, injuries, response to treatment.

History in Falls

- Relevant Information:

1. - Height of fall, influences injury severity (deceleration injury).
2. -Impact point
3. -Type of surface
4. Consider **loss of consciousness** before or after the fall, as this could suggest neurological injury or a more serious underlying medical condition.
5. Imp: Ask whether the fall was **accidental**, related to a **medical condition** (e.g., syncope, seizures), or if it was due to **environmental factor** (after treating life-threatening injuries, start with the cause).

- Pre-hospital History:

- First responders may provide key information regarding **witness accounts**, the **mechanism of the fall**, the patient's condition on arrival, and response to initial treatment.



History in Penetrating Trauma

Important Factors:

- Weapon type: knife, handgun, rifle, shotgun.

- Distance from assailant (important for shotgun wounds).

- Number of wounds, site, dimensions, external bleeding, abdominal pain.

patient positioned during the stabbing

Note: Check for blood loss at the scene; it maybe substantial and not noticed at the emergency department due to temporary compensation of the body, consider obese skin folds may hide some injuries

Systematic Physical Examination Overview



Steps of Physical Exam:



1- Inspection



2- auscultation



3- percussion

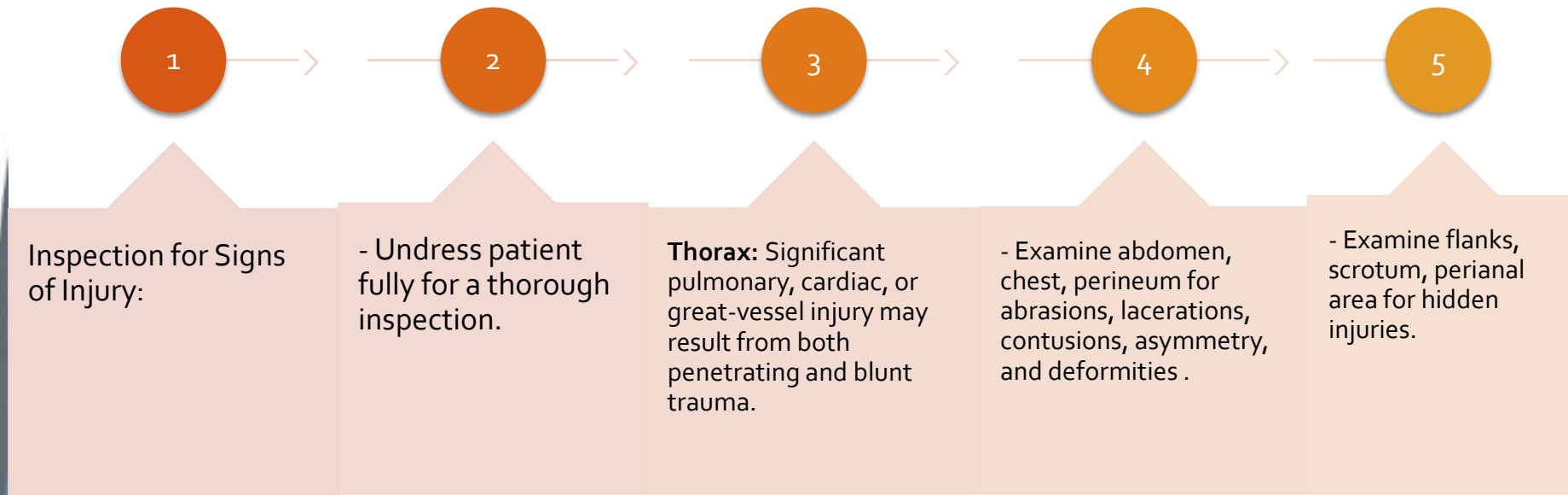


4- palpation.



- Comprehensive exam needed for abdominal and pelvic injuries.

Inspection Process



Pelvic Examination



- Key Examinations:
 - - Pelvis, urethral, perineal, rectal, and vaginal exams.
 - - Look for signs of open pelvic fracture in blunt trauma patients.
- Note: The pelvis should be assessed for stability by palpating (not rocking) ; fracture, Hemorrhage, retroperitoneal bleeding, pain.

Special Signs

1- Kehr's Sign:

- **Description:** Referred pain in the **left shoulder** due to **diaphragmatic irritation**, often from **splenic rupture** or intra-abdominal bleeding.
- **Mechanism:** Blood or other irritants in the peritoneal cavity irritate the diaphragm, causing referred pain in the shoulder

2- Grey-Turner Sign:

- **Description:** **Bruising of the flanks** (sides of the abdomen), indicating **retroperitoneal hemorrhage**, often seen in conditions like **pancreatitis** or **abdominal trauma**.
- **Time Frame:** Typically appears 24-48 hours after the initial injury

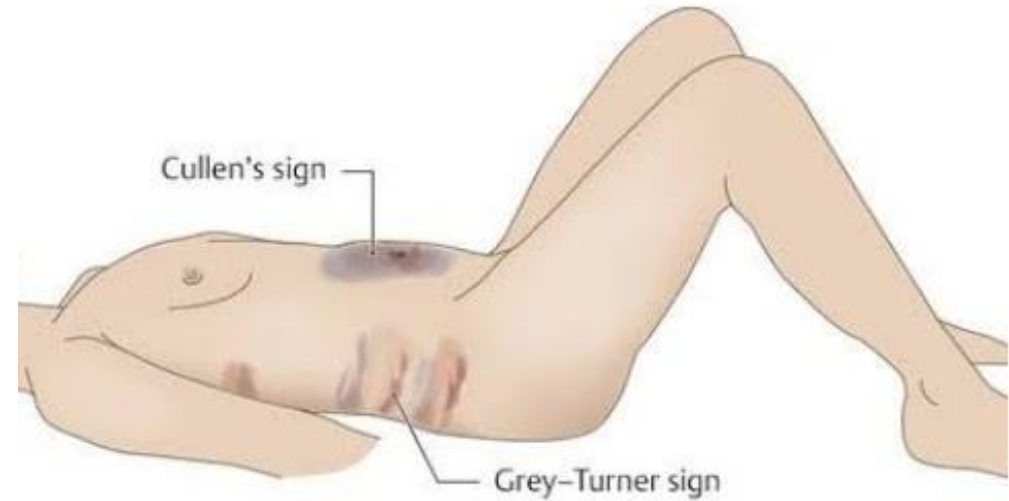
Kehr's sign



Special Signs

3- Cullen Sign:

- **Description:** Periumbilical bruising (around the belly button), which suggests intra-abdominal or retroperitoneal bleeding.
- **Common Causes:** Can be seen with **pancreatitis**, ruptured ectopic pregnancy, or abdominal trauma.



4- Seat Belt Sign:

- **Description:** Bruising or abrasions across the abdomen or pelvis from a **seat belt** during a motor vehicle crash, indicating potential **hollow organ injury**, **bowel perforation**, or **pelvic fractures**.
- **Significance:** The presence of this sign raises suspicion for underlying abdominal trauma, including internal bleeding.



SIGNS OF INTERNAL BLEEDING



Signs of internal bleeding include a drop in BP, a fast and/or thready pulse, a low CVP, and low urinary output.



Patients tend to be cold, pale, anxious, shivering, and thirsty.



These signs of shock occur when 25-30% of blood volume is acutely lost, ~1,500 ml in the average size adult.

Signs of Internal Bleeding



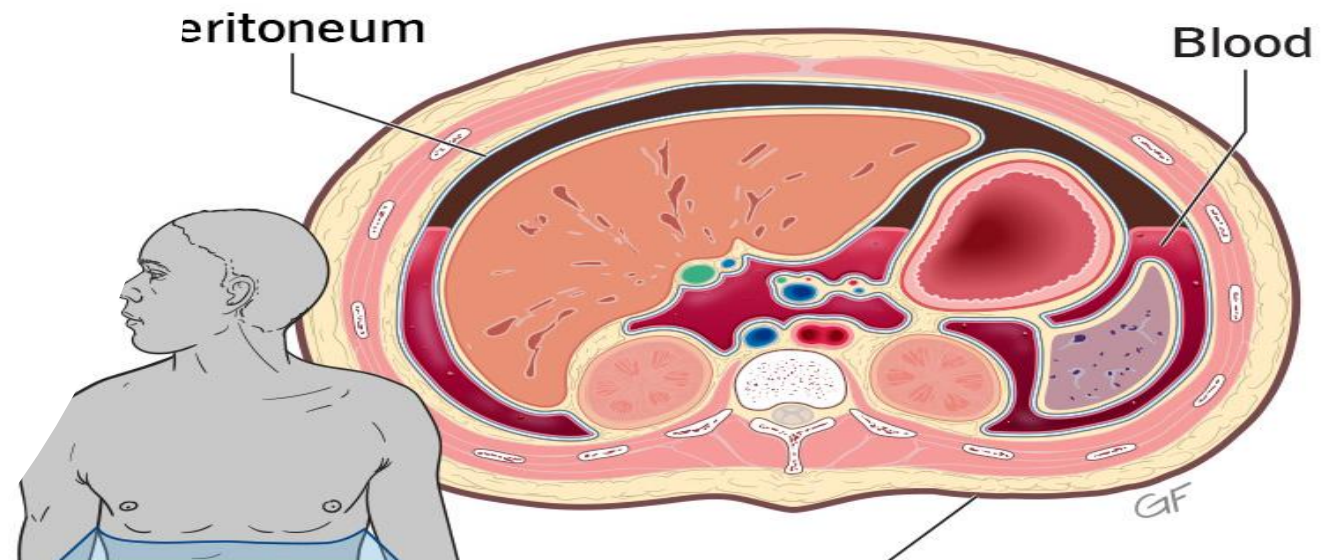
**swollen, tender
rigid abdomen**



Blood in vomit



**Wounds that have
penetrated the chest
or abdomen**



Hidden Sites of Major Blood Loss in Trauma



Head: Can only hold a small amount of blood before causing **intracranial pressure**, making large volume blood loss unlikely without noticeable neurological symptoms.



Neck: While it could hold a significant amount of blood, a **hematoma** in the neck would be clearly **visible on physical exam**.



Pericardial Sac: Cannot hold much blood without causing **pericardial tamponade**, which leads to **rapid clinical deterioration** and would be quickly noticed.



Pleural Cavities: Can accommodate **several liters of blood** with minimal symptoms, but a **hemothorax** would be detected on a **chest x-ray**, routinely performed in trauma evaluations.



Arms and Legs: Significant blood loss in these areas would result in **visible deformities** from large hematomas, making it easy to identify on physical exam.

Documentation of Findings



Critical Documentation



Document all findings (positive and negative) from the physical exam.



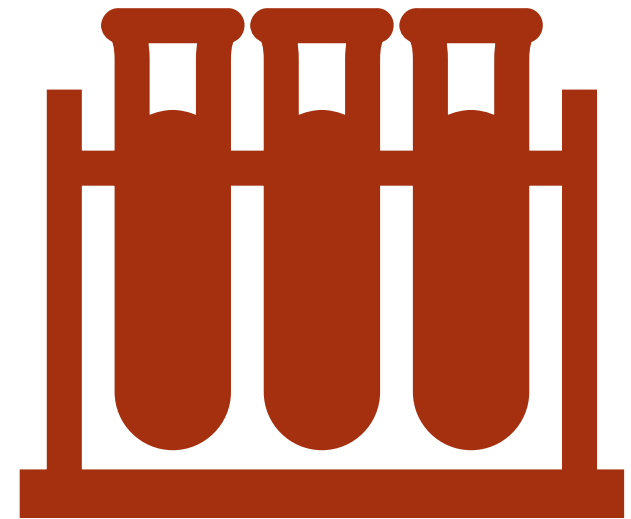
Accurate records are vital for trauma management.

A large, stylized magnifying glass graphic in a dark red color. The handle is at the bottom left, and the lens is a large circle that occupies the right half of the image. The word "INVESTIGATIONS" is centered within the lens area.

INVESTIGATIONS

ASSESSMENT AND TEST

- Laboratory studies : the "trauma panel" usually consists of some constellation of the following studies: a complete blood count (CBC), electrolytes, BUN, creatinine, amylase, protime (PT), prothrombin time (PTT), blood type and screen (T&S) or type and crossmatch (T&C), urinalysis (UA), ethanol level, urine toxicology screen, arterial blood gas (ABG), lactate, LFT , and an electrocardiogram (ECG).
- In patients with hemodynamic abnormalities, rapid exclusion of intra-abdominal hemorrhage is necessary and can be accomplished with either FAST or DPL. (The only contraindication to these studies is an existing indication for laparotomy).
- Patients with the following findings require further abdominal evaluation to identify or exclude intraabdominal injury:
 1. Altered sensorium
 2. Altered sensation
 3. Injury to adjacent structures, such as lower ribs, pelvis, and lumbar spine
 4. Equivocal physical examination
 5. Prolonged loss of contact with patient anticipated, such as general anesthesia for extraabdominal injuries or lengthy radiographic studies
 6. Seat-belt sign with suspicion of bowel injury



X-RAYS



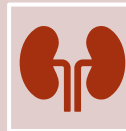
An AP chest x-ray is recommended for assessing patients with multisystem blunt trauma .



Hemodynamically abnormal patients with penetrating abdominal wounds do **not** require screening x-rays in the emergency department (ED).



If the patient is **hemodynamically normal** and has penetrating trauma above the umbilicus or a suspected thoracoabdominal injury, an upright chest x-ray is useful to exclude an associated hemothorax or pneumothorax, or to determine the presence of intraperitoneal air.

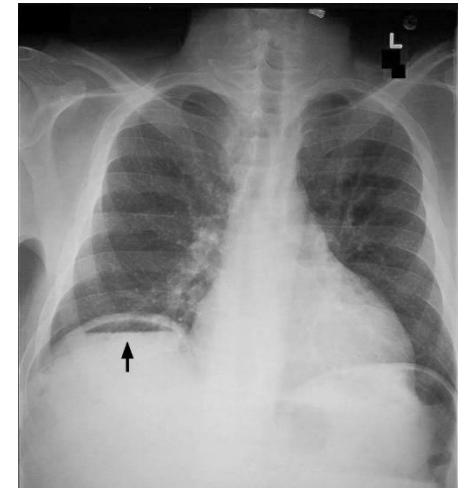


With radiopaque markers or clips applied to all entrance and exit wounds, a supine abdominal x-ray may be obtained in **hemodynamically normal** penetrating trauma patients to demonstrate the path of the missile and determine the presence of retroperitoneal air.



Obtaining two views (i.e., AP and lateral) may allow for spatial orientation of foreign bodies.

Pneumoperitoneum



Focused Assessment with Sonography for Trauma (FAST)

- FAST is an accepted, rapid, reliable , repeatable and noninvasive study for identifying **intrapertoneal fluid** and **pericardial tamponade** .
- FAST can be performed at the bedside in the resuscitation room at the same time other diagnostic or therapeutic procedures are performed.

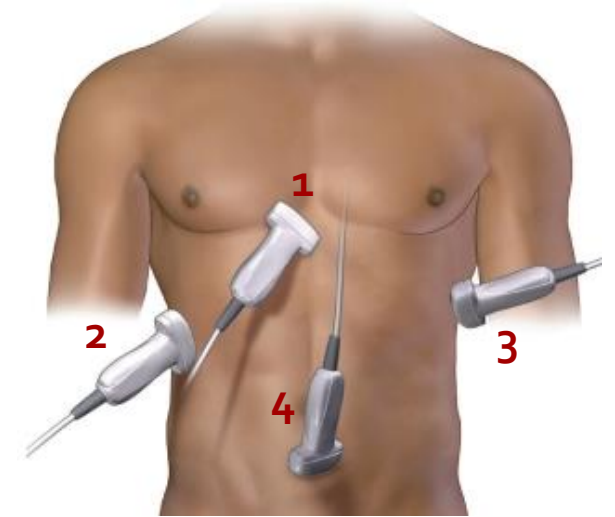


In FAST, ultrasound technology is used to detect the presence of hemoperitoneum.

Indications:

- Abnormal hemodynamics in blunt abdominal trauma
 - Penetrating abdominal trauma without other indications for immediate laparotomy
-

- FAST includes examination of four regions:



- After doing an initial scan, clinicians may perform a single or multiple repeat scans to detect progressive hemoperitoneum.
- Disadvantages :** Operator-dependent , Bowel gas and subcutaneous air distort images , Can miss diaphragm, bowel, and pancreatic injuries , Does not completely assess retroperitoneal structures , Does not visualize extraluminal air , Body habitus can limit image clarity and obesity can degrade images.

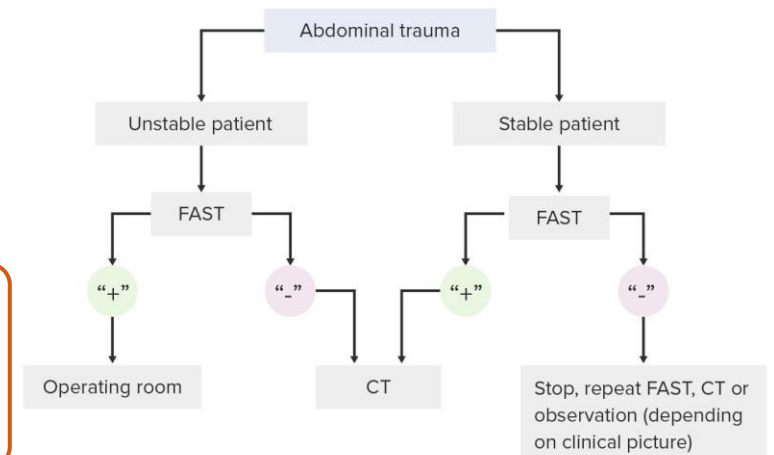
False-negative FAST examination prevention:

- Recognize that obesity can degrade images obtained with FAST.

- Maintain a high index of suspicion.

- Use alternative diagnostic testing and/or repeat evaluation(s).

- Recognize that FAST is **insensitive** for the diagnosis of hollow visceral injury



View

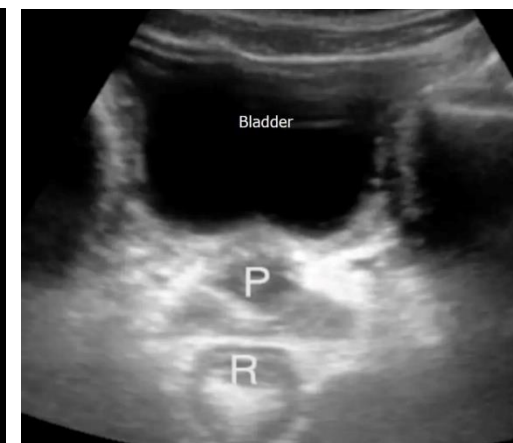
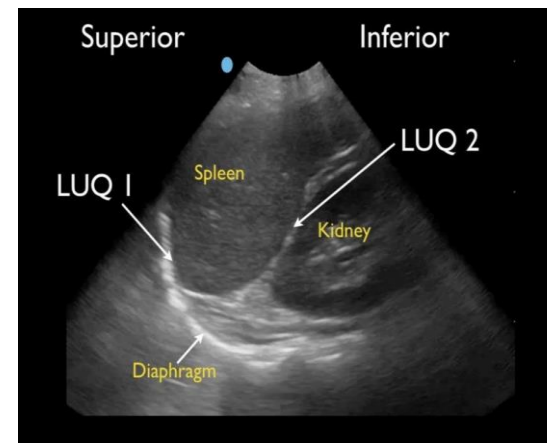
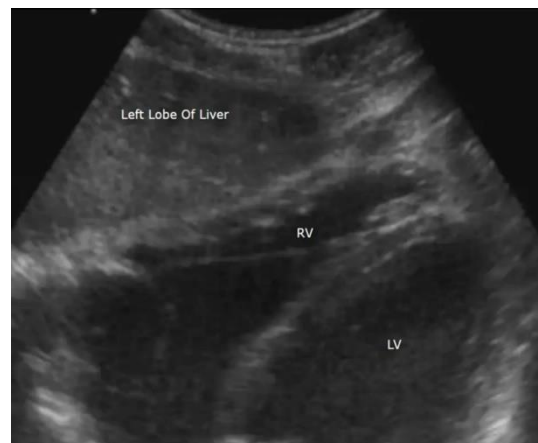
Pericardial

Hepatorenal
fossa

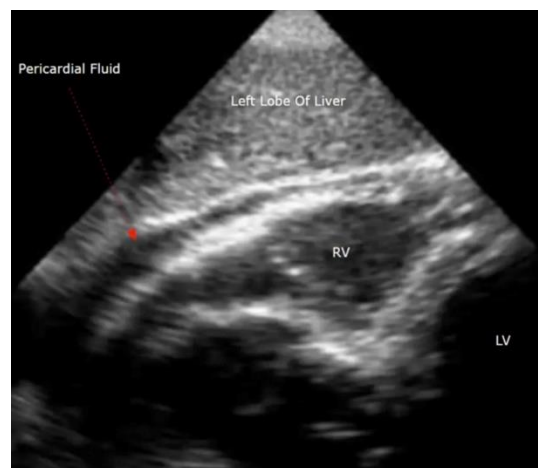
Splenorenal
fossa

Pelvic

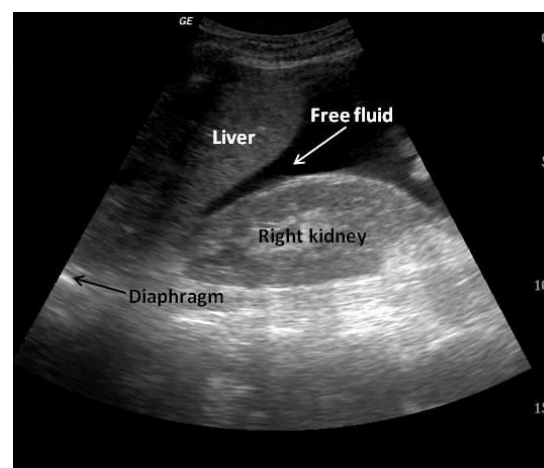
Normal



Presence of
free fluids



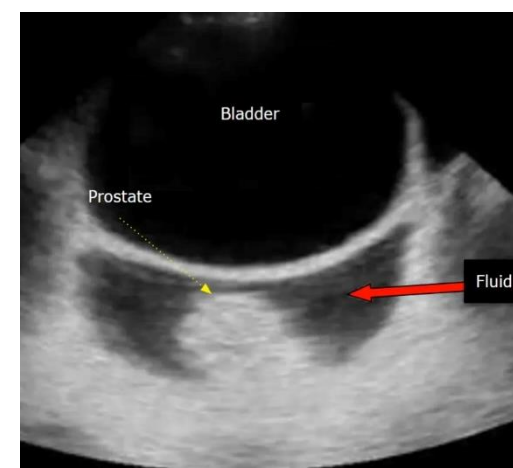
Pericardial Fluid



Fluid in Morrison's pouch



Splenorenal fluid



Fluid in rectovesical pouch

Diagnostic Peritoneal Lavage (DPL)

- DPL is another rapidly performed study to identify **intrapertoneal hemorrhage** as it can detect **bowel injuries**.
- It can significantly alter subsequent examinations of the patient, the surgical team caring for the patient should perform the DPL.
- No need for transport from resuscitation area.

• Indications:



1. The technique is most useful in patients who are **hemodynamically abnormal** with blunt abdominal trauma



2. penetrating trauma patients with multiple cavitory or apparent tangential trajectories without other indications for immediate laparotomy.

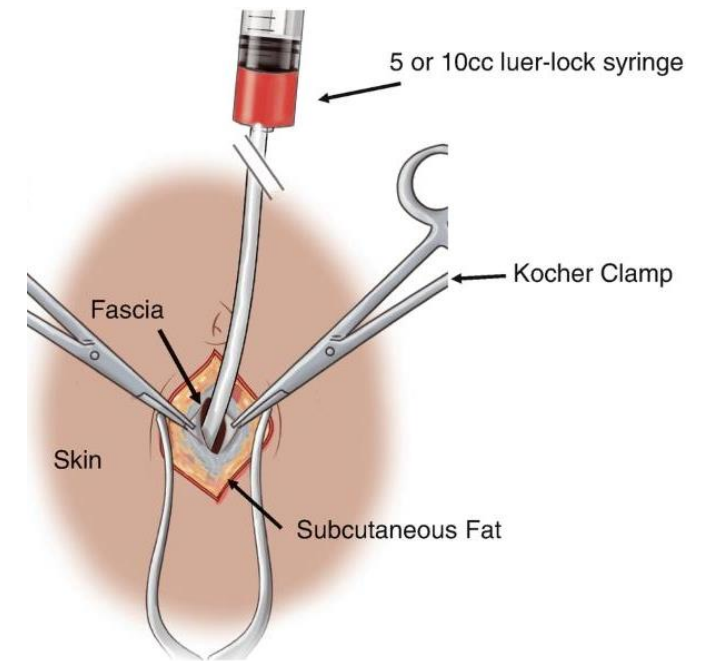


3. hemodynamically normal patients who require abdominal evaluation in settings where FAST and CT are not available may benefit from the use of DPL.



In settings where CT and/or FAST are available, DPL is **rarely** used because it is invasive and requires surgical expertise

- **Relative contraindications to DPL** include previous abdominal operations, morbid obesity, advanced cirrhosis, and preexisting coagulopathy.
- open, semiopen, or closed (Seldinger) **infraumbilical** technique is acceptable in the hands of trained clinicians.
- Open **supraumbilical** approach is preferred in patients with **pelvic fractures** (to avoid entering an anterior pre-peritoneal pelvic hematoma) and in n patients with **advanced pregnancy** (to avoid damaging the enlarged uterus).
- **Disadvantages** : Invasive , Risk of procedure-related injury , Requires gastric and urinary decompression for prevention of complications , Not repeatable , Interferes with interpretation of subsequent CT or FAST ,Low specificity , Can miss diaphragm injuries.



Computed Tomography (CT)

CT is a diagnostic, noninvasive, repeatable procedure that provide information relative to **specific organ injury** and extent, and they can diagnose **retroperitoneal** and pelvic organ injuries that are difficult to assess with a physical examination, FAST, and DPL and it can visualizes extraluminal air.

CT scan is the gold standard method for identifying intra-abdominal injuries in hemodynamically normal patients experiencing blunt trauma, especially those with high-energy trauma.

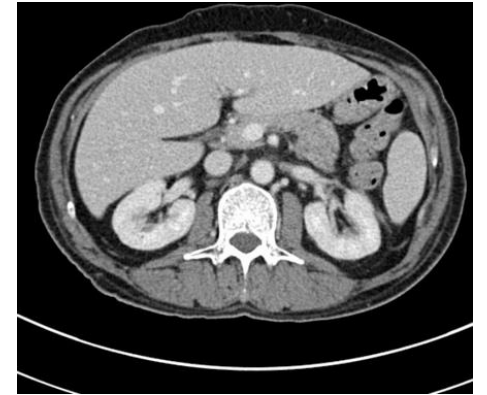
Indications: • should be used only in hemodynamically normal patients with blunt or penetrating abdominal trauma or back/flank trauma without other indications for immediate laparotomy.

Disadvantages : requires transporting the patient to the scanner (i.e., removing the patient from the resuscitation area), administering IV contrast, radiation exposure , cost & time consuming procedure and it can miss diaphragm injuries , bowel and pancreatic injuries.

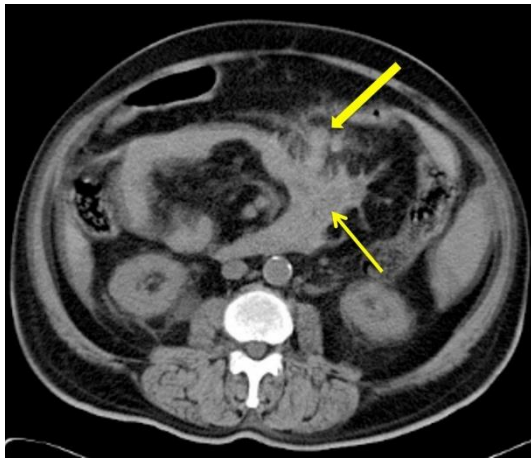
Contraindications : delay until the scanner is available, an uncooperative patient who cannot be safely sedated, and allergy to the contrast agent

Do not perform CT scanning if it delays transfer of a patient to a higher level of care.

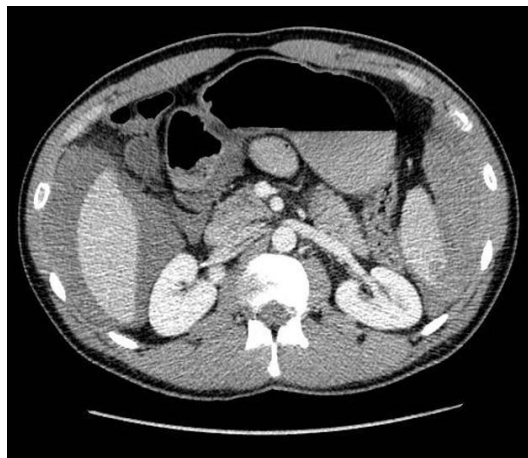
- In the absence of hepatic or splenic injuries, the presence of free fluid in the abdominal cavity suggests an injury to the gastrointestinal tract and/or its mesentery, and many trauma surgeons believe this finding to be an indication for early operative intervention.



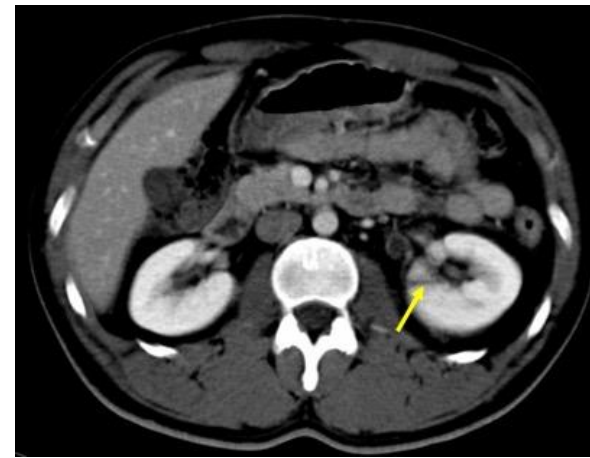
Normal abdominal CT



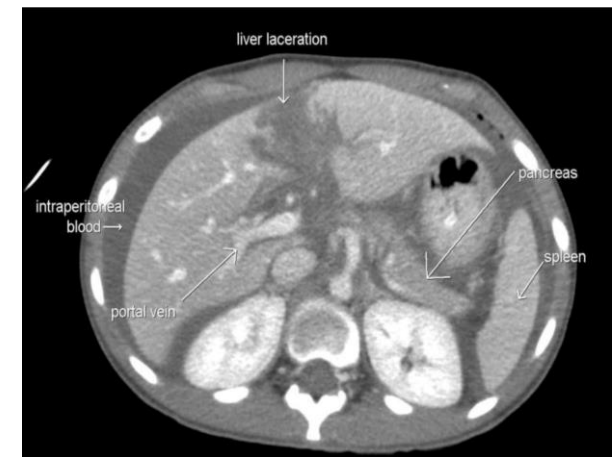
Blunt trauma: abdominal mesenteric injury



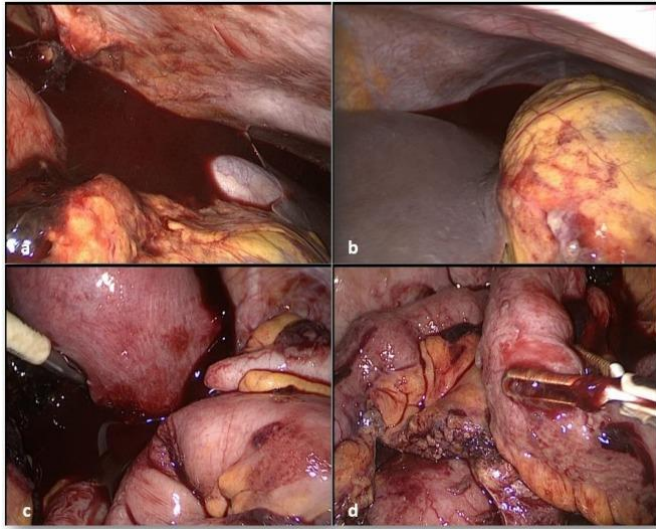
Hemoperitoneum post traumatic splenic injury



Blunt abdominal trauma: Grade II renal injury

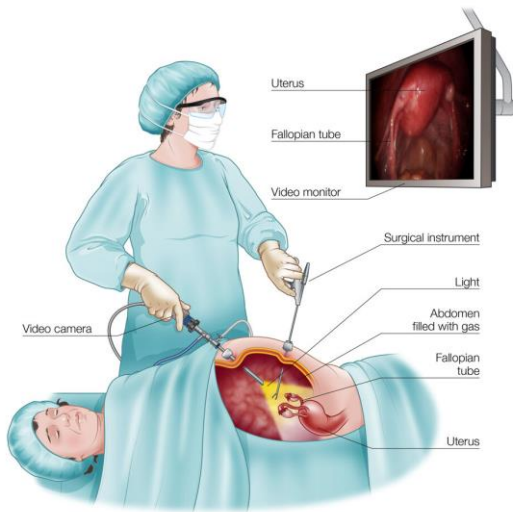


liver laceration with intraperitoneal bleeding



Diagnostic Laparoscopy or Thoracoscopy

- Diagnostic laparoscopy is an accepted method for evaluating a **hemodynamically normal**, penetrating trauma patient with potential tangential injury and without indication for laparotomy.
- Laparoscopy is useful to diagnose diaphragmatic injury and peritoneal penetration.
- The need for general anesthesia limits its usefulness

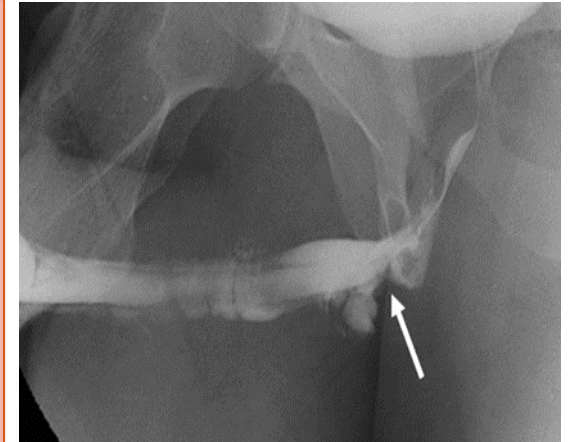


Contrast Studies

- Contrast studies can aid in the diagnosis of specifically suspected injuries, but they should not delay the care of hemodynamically abnormal patients.
- These studies include : Urethrography , Cystography ,Intravenous pyelogram , Gastrointestinal contrast studies.

Urethrography

- should be performed before inserting a urinary catheter when a urethral injury is suspected.
- The urethrogram is performed with a urinary catheter secured in the meatus, contrast material is instilled with gentle pressure .
- In males, a radiograph is taken with an anterior-posterior projection and with slight stretching of the penis toward one of the patient's shoulders.
- An adequate study shows reflux of contrast into the bladder



cystogram or CT cystography

- the most effective method of diagnosing an intraperitoneal or extraperitoneal bladder rupture.
- A syringe barrel is attached to the indwelling bladder catheter and held 40 cm above the patient. Then 350 mL of water-soluble contrast is allowed to flow into the bladder until either the flow stops, the patient voids spontaneously, or the patient reports discomfort. An additional 50 mL of contrast is instilled to ensure bladder distention.
- Anterior-posterior pre-drainage, filled, and post-drainage radiographs are essential to definitively exclude bladder injury.
- CT evaluation of the bladder and pelvis (CT cystogram) is an alternative study that yields additional information about the kidneys and pelvic bones.



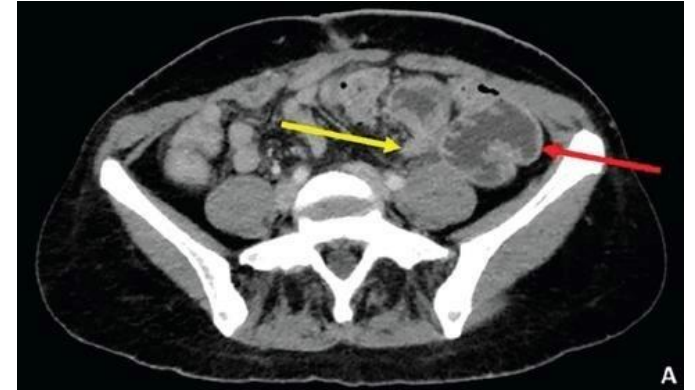
intravenous pyelogram (IVP)

- Alternative for CT when urinary system injuries are suspected.
- A high-dose, rapid injection of renal contrast ("screening IVP") is performed using 200 mg of iodine/kg body weight. Visualization of the renal calyces on an abdominal radiograph should appear 2 minutes after the injection is completed.
- Unilateral renal nonvisualization occurs with an absent kidney, thrombosis, or avulsion of the renal artery, and massive parenchymal disruption. Non-visualization may warrant further radiologic evaluation.



gastrointestinal intravenous

- When Isolated injuries to retroperitoneal gastrointestinal structures (e.g., duodenum, ascending or descending colon, rectum, biliary tract, and pancreas) is suspected, CT with contrast, specific upper and lower gastrointestinal intravenous contrast studies, and pancreaticobiliary imaging studies can be useful.



Evaluation of specific penetrating injury

The evaluation of penetrating abdominal trauma depends on :

- Etiology of injury (stab wound or gunshot)
- Anatomical location of the injury (anterior , posterior and flank)

A commonly used tests for trauma injury :

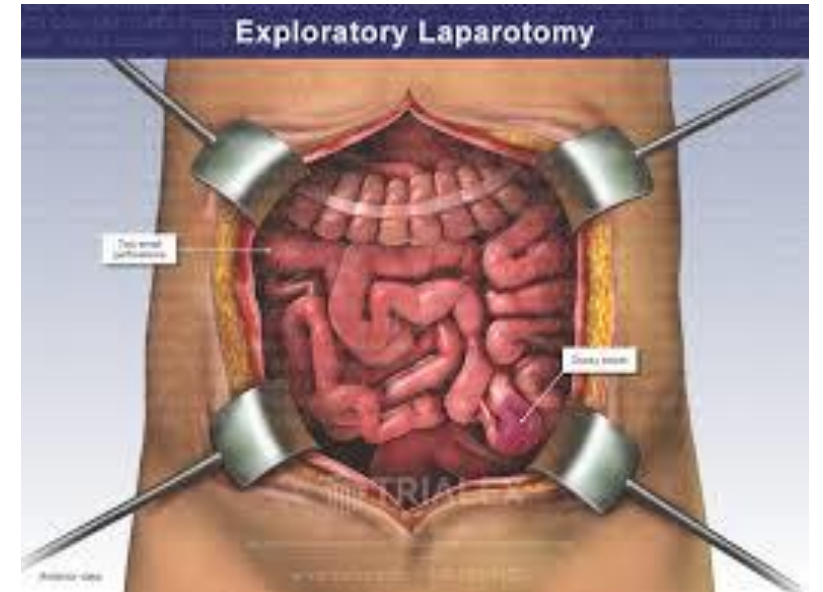
- FAST
- DPL
- CT

Procedure	Advantages	Disadvantages	Indications
DPL	Early diagnosis, Performed rapidly, 98% sensitive, Detects bowel injury, Transport: No	Invasive, Specificity: Low, Misses injuries to diaphragm and retroperitoneum	Unstable blunt trauma, Penetrating trauma
FAST	Early diagnosis, Noninvasive, Performed rapidly, Repeatable, 86-97% sensitive, Transport: No	Operator-dependent, Bowel gas and subcutaneous air distortion, Misses diaphragm, bowel, and pancreatic injuries	Unstable blunt trauma
CT Scan	Most specific for injury, 92-98% sensitive, Non- invasive	Cost and time, Misses diaphragm, bowel, and pancreatic injuries, Transport: Required	Stable blunt trauma, Penetrating back/flank trauma

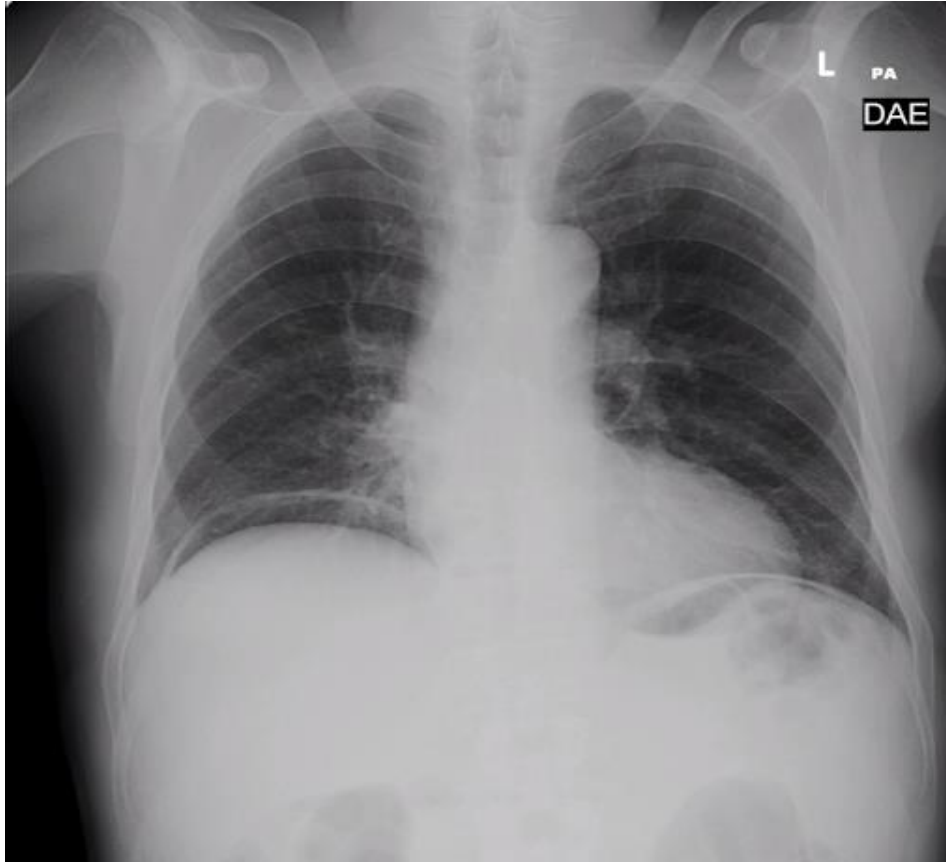
- * Indication for laparotomy in patient with penetrating abdominal wounds include :
- -Hemodynamically abnormally
- Gunshot wound with transperitoneal trajectory (bullet pass via peritoneal cavity and make a damage to the internal organ
- -Signs of peritoneal irritation
- - Evisceration (when organ protrude out due to penetrating wound)
- Most abdominal gunshot wounds are managed by exploratory laparotomy (a big cut in abdomen to gain access to the peritoneal cavity . The incidence of intraperitoneal injury approach 98% when peritoneal penetration is present .

Indications for laparotomy :

- 1- blunt abdominal trauma or gunshot with hypotension with an positive FAST or clinical evidence of intraperitoneal bleeding
- 2- hypotension with an abdominal wound penetrate superfascial fascia
- 3- evisceration
- 4- bleeding from stomach ,rectum ,GUT following penetrating trauma
- 5- peritonitis
- 6- Free air ,retroperitoneal air ,or rupture of hemidiaphragm
- 7- Contrast – ct demonstrate ruptured GIT , renal pedicle (hillum)
- 8- Blunt or penetrating abdominal trauma with aspiration of GI contents or aspiration of 10cc or more of blood in hemodinamically abnormal patients



Free air under diaphragm



Rupture of the hemidiaphragm



EVALUATION OF TRAUMA INDUCE INJURY

- Thoracoabdominal wounds :
- Patient with injury in the diaphragm and upper abdominal need a thoroscopy, laparoscopy and CT .
- Anterior Abdominal wounds : Nonoperative management
- Hemodynamically normal patient without peritoneal signs or evisceration can make an serial physical exam over 24 – hours (with or without FAST exam) 94% accuracy ,DPL , CT (DPL AND FAST for earlier diagnosis) and the diagnostic laparoscopy
- Although a positive FAST may be helpful , a negative FAST does not exclude the possibility of visceral injury

Flank and back injury : Non operative management

Because of the thickness of flank and back muscle We will make less invasive diagnostic options as serial physical exam ,double (OP and IV) or triple (OP , IV and rectal) contrast and DPL .

In patient with wounds posterior to the anterior axillary line , physical exam is very accurate for detecting retroperitoneal and intraperitoneal injuries essentially .Also, after 24 hours of in- hospital

** double or triple CT is a time consuming for fully evaluation of retroperitoneal injury . The accuracy is comparable to that of physical exam .

**Positive DPL is an indication for an urgent laparotomy . However , negative DPL may not exclude retroperitoneal colon injury

Evaluation of other specific injury

- **Diaphragm injuries :**

Although the left hemidiaphragm is most often injured. A common injury is 5 to 10 cm in length and involves the posterolateral left hemidiaphragm. Abnormalities on the initial chest x-ray include elevation or “blurring” of the hemidiaphragm because of penetrating injury to the diaphragm , hemothorax, an abnormal gas shadow that obscures the hemidiaphragm, or a gastric tube positioned in the chest (Nasogastric tube)

- **Duodenal injuries :**

Commonly happen in unrestrained drivers and in direct blows to the abdomen such as from bicycle handlebars . A bloody gastric aspirate or retroperitoneal air on CT should arise suspicion to duodenal injury

- **Pancreatic injuries :**

Often result from epigastric blow epically the pancreas can be compressed between the esophagus and vertebrae leading to injury .

Cont

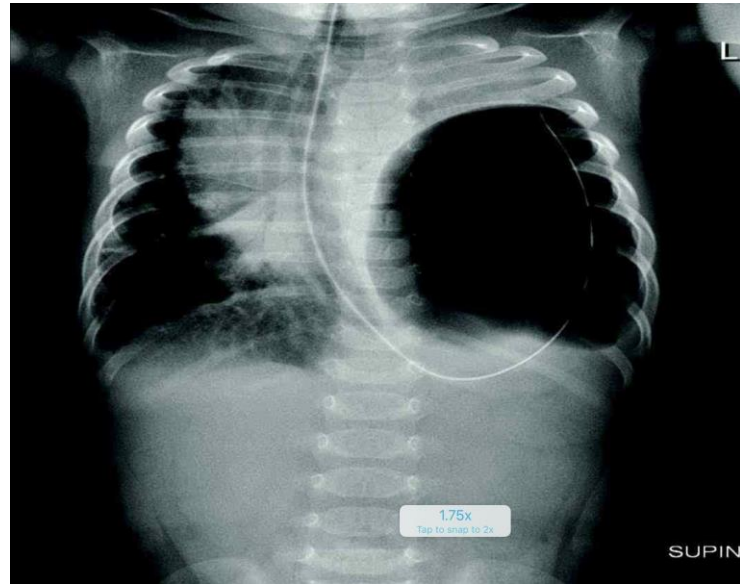
- An early normal serum amylase level does not exclude major pancreatic trauma. Double-contrast CT may not identify significant pancreatic trauma in the immediate postinjury period (up to 8 hours). It may be repeated, or other pancreatic imaging performed, if injury is suspected. Surgical exploration of the pancreas may be warranted following equivocal diagnostic studies.
- Genitourinary Injuries :
 - hematomas, and ecchymoses are marker of potential underlying renal injury and want an evaluation with (CT or Intravenous -pyelogram ' IVP ' by giving contrast) of urinary tract .
 - Gross and microscopic hematuria in patient with shock increased risk for renal abdominal injury .
 - An abdominal CT SCAN with IV contrast can document the presence of blunt renal injury which can be treated nonoperatively . Thrombosis in renal artery without hematuria doesn't exclude renal injury and more investigation is needed .
 - Urethral disruption are divided into posterior urethral injury which is usually associated with pelvic fracture and anterior urethral injury that results from straddle impact (during hoarse riding) and can be isolated injury

Hollow viscus injuries :

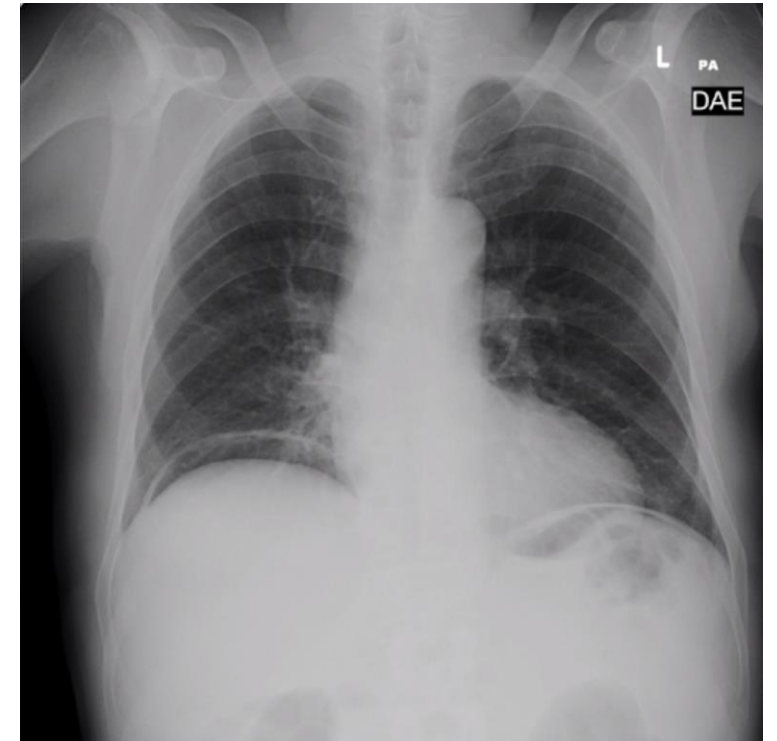
- Blunt injury to the intestines generally results from sudden deceleration , particularly if the patient's seat belt was positioned incorrectly. A transverse, linear ecchymosis on the abdominal wall (seat-belt sign) or lumbar distraction fracture (i.e., Chance fracture) on x-ray should alert clinicians to the possibility of intestinal injury
- Although some patients have early abdominal pain and tenderness, the diagnosis of hollow viscus injuries can be difficult since they are not always associated with hemorrhage.
- solid organ injury :
- Injuries to the liver, spleen, and kidney that result in shock, hemodynamic abnormality are indications for urgent laparotomy. Solid organ injury in hemodynamically normal patients can often be managed nonoperatively.



Normal IVP



Left hemidiaphragm
Tearing demonstrate
A stomach protrude
With gas filling



Retroperitoneal Air

PITFALL	PREVENTION
Transfer is delayed to perform ct scan	When patient requires transfer to a higher level of care, CT must not delay transfer
Missed diaphragmatic injury in penetrating thoracoabdominal injury	Exclude the diagnosis with laparotomy
Delayed diagnosis of intra-abdominal injury in a patient with a tangential gunshot to the abdomen	Tangential GSW may not be truly tangential (peritoneal penetration), high velocity penetrating wound can cause injury without peritoneal penetration

pitfall	Prevention
Concussive and blast (blunt) injuries can cause intraperitoneal injury without peritoneal penetration.	• Perform evaluation for abdominal/pelvic injury in victims of concussive and blast trauma, even when no exterior wounds are present.
Assessment with physical exam, ultrasound, and x-rays is compromised in the obese patient.	Maintain a high index of suspicion for abdominal/ pelvic injury in the obese patient regardless of mechanism. CT scan may represent the best potential imaging modality. In some cases operation required to diagnosis
Delayed exploration of hemodynamically abnormal patient with abdominal stab wounds .	All hemodynamically abnormal patients should undergo laparotomy. Serial physical examinations are not an option in hemodynamically abnormal patient



THANK YOU
