
# 9 Specific Organ Trauma

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**COLOR GUIDE:** • Females' Notes • Males' Notes • Important • Additional

# Objectives

1. Describe the anatomical regions of the abdomen.
2. Discuss the difference in injury pattern between blunt and penetrating trauma.
3. Identify the signs suggesting retroperitoneal, intraperitoneal or pelvic injuries.
4. Outline the diagnostic & therapeutic procedures specific to abdominal trauma.

# Overview of Multiple Traumas:

## Introduction:

- Good example of trauma is RTA.
- Trauma remains major cause of death after IHD and malignancy.
- Trauma is the leading cause of death in people aged 1-35 years.
- Trauma given a larger group of people per minute disability.
- Trauma care account up to 7% of all hospital care, which is a big budget.

Usually there is no specific single organ trauma, so abdominal trauma comes with multiple traumas.

## Classification of Trauma according to Mechanism

(A patient can either get one of these types or a combination of them):

1. Blunt such as RTA.
2. Penetrating.
3. Burns.
4. Blast.

***Note(s):***

*Blunt trauma: injury incurred when the human body hits or is hit by a large outside object (as a car).

*Blast trauma: injury caused by the explosion of a bomb (especially in enclosed spaces).

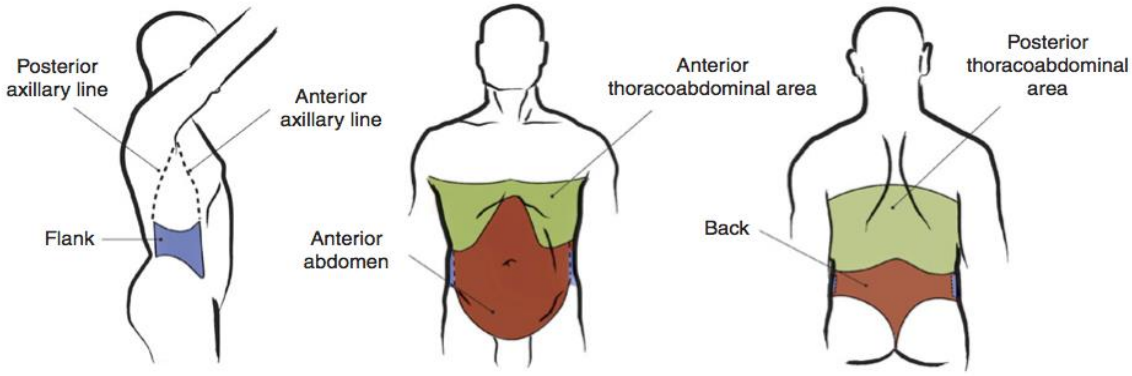
## Abdominal trauma:

The majority of abdominal injuries are due to blunt abdominal trauma (90%) secondary to high-speed automobile accidents.

***(The failure to manage the abdominal injuries accounts for majority of preventable death following multiple injuries. Also the primary management of abdominal trauma is the determination that an intra abdominal injury EXISTS and operative intervention is required)***

# Anatomical Regions of the Abdomen:

- Peritoneum:
  - Intra thoracic abdomen: It is under the costal margin. Contains the liver, spleen, stomach, and pancreas. Hard to examine it.
  - True abdomen: can be clinically examined.
- Retroperitoneal:
  - Pancreas & Duodenum.
  - Bowel.
  - Vascular (IVC, aorta).
  - Kidneys, ureter.
- Pelvic abdomen: bladder, female genital system. It is not accessible during physical examination, investigations are needed.




# Types of Abdominal Trauma:

Blunt abdominal trauma: (take about 90 % of trauma).

Sometimes doctors miss such cases because a patient with a blunt abdominal trauma can come walking to the ER. Some doctors take superficial history and physical examination and let the patient go home without admitting him. At the mean time, the patient would be bleeding slowly from the inside and in an hour he would collapse. Patients who come to the ER because of trauma should be examined from head to toe whether they came walking and conscious or not.

Penetrating abdominal trauma: It is to diagnose and manage.

- The recognition of the mechanism of the injury whether is penetrating or non-penetrating trauma is a greatest importance for treatment and diagnosis and workup therapy.

## Management of Trauma Patients:

1. The primary management of abdominal trauma is determination that an intra abdominal injury exists and if an operative intervention is required or not.
2. Many deaths would have been preventable if there wasn't a failure in managing the abdominal injuries.

**Causes of the "failure of management" include:**

1. Delay in ambulance to arrive, traffic jam, wrong place of hospitals, no good qualified hospital, and non-well equipped hospitals.
2. Many patients die because doctors don't do ABC.

When you receive a trauma case always assume that there is injury even if the patient came walking to you until proven otherwise by history, clinical presentation and investigations.

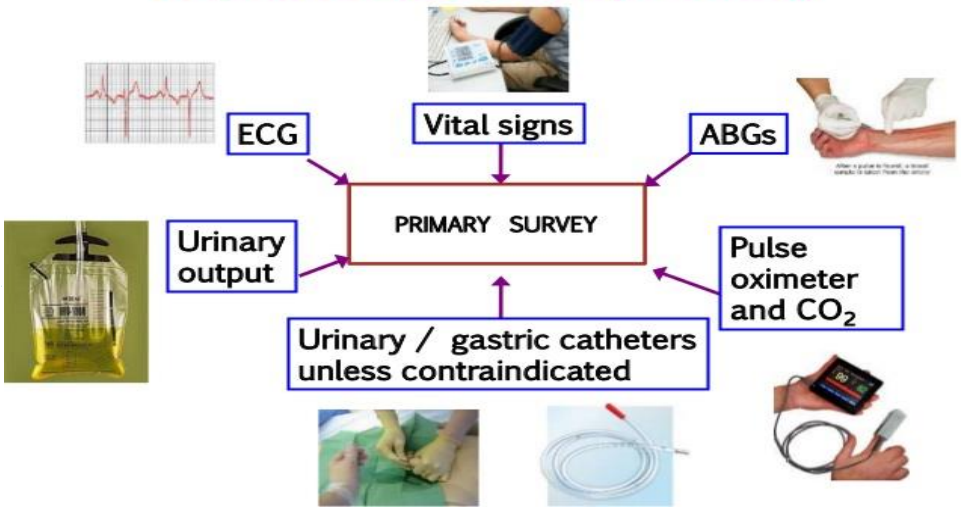
## Hospital Care and Diagnosis:

***PRIMARY SURVEY:***

- The resuscitation and management priorities of patient with major abdominal trauma are:

1) **ABCDE** of emergencies (must be done to all trauma patients):

- **Airway:** Intubation if the airway is damaged & C-Spine Immobilization.
- **Breathing:** If breath sounds were absent, insert a chest tube immediately.
  No $O_2$ for 15 minutes will cause a disability.
- **Circulation:** If there was bleeding (hemorrhage), control should be initiated. Give IV fluids (usually crystalloids and normal saline) and control the bleeding.
- **Disabilities** (Neurological disabilities)
- **Exposure:** cut the clothes.




2) Usage of Nasogastric tube. It is contraindicated if there was bleeding from the nose or mouth.

3) Usage of urinary catheter to monitor the urine output and input. It is contraindicated if there was bleeding from the urethra.

***SECONDARY SURVEY:***

1) **History:** History is taken from the patient himself, if he was conscious, if not it is taken from the person who attended or the paramedic.
   - Blunt trauma.
   - Penetrating trauma **(immediately to surgery).**

2) **Physical examination:** General and abdominal examination (Abdominal Examination: Inspection, Palpation, Percussion, Auscultation, Rectal Examination, and Vaginal Examination also examine the perineum region) Sometimes there is no time for Secondary survey.

# Investigation:

1. Blood Tests.
2. Radiological studies (Plain abdominal X-ray, CXR)
3. Diagnostic Peritoneal Lavage (DPL):

Indicated when the patient is in shock (unstable) or suffering from abdominal distention. It is extremely reliable; it can determine the presence of blood in the peritoneal cavity up to 98% of the cases. When positive take the patient to the OR immediately. If the results weren't so accurate and clear, insert a liter of saline and if fresh blood appears then it is positive.

**If the patient is stable you do:**

1) USG abdomen.
2) CT abdomen.
3) Peritoneoscopy (diagnostic laparoscopy).

## Indication For Surgery-Laparotomy:(Important)

1. Any signs of peritoneal injury such as tenderness, distention, rigidity, tachycardia, guarding, bruising and so.
2. Unexplained shock (If you give a lot of fluid or blood but your patient is still in a shock).
3. Evisceration of viscous (If the bowel was out).
4. Positive DPL – (diagnostic peritoneal lavage).
5. Determination of finding: During routine follow up on investigations.

Sometimes you need to admit the patient for observation or admit them to the ER for 6 hours then signs will start to appear.

Ex: Patient came conscious with injury for conservative therapy to the ER and got admitted, after 4-6 hours he went into a shock.

## Specific Organ Trauma:

### 1) Peritoneal:

a) **Liver:** protected by ribs.
b) **Spleen:** it is a mobile organ.
c) **Kidneys:** in the retroperitoneal, it is not easy to injure so if it was injured it will be a severe trauma.
d) **Bowel.**

### 2) Retroperitoneal:

a) Pancreas and Duodenum.
b) Bowel.
c) Vascular (IVC, aorta).
d) Kidneys, ureter.

### 3) Geneto-urinary system:

a) Urinary bladder, urethra (it is easy to diagnose if there was a fracture in the pelvis), penis.
b) Female reproductive system.

# Liver Trauma:

- Liver is the largest organ in the abdominal cavity (5th intercostal space).
- Any trauma under the nipple we expect liver; it means the liver is injured.
- Most commonly injured organs in all patients with abdominal trauma.
- Commonest organ injured in case of penetrating trauma.

**Rengal maneuver:** tie the right hepatic artery to stop blood flow.

***Note(s):***

If you found a gunshot or a stab in the fifth intercostal space, assume that the liver is injured.

# Mechanism of injury:

## In blunt trauma:

- Hepatic injuries result from direct blows.
- Compression between the lower ribs on right side and the spine.
- Shearing at fixed points secondary to deceleration.
- Any penetrating gunshot, stab or shotgun wound below the right nipple on right upper quadrant of the abdomen is also likely to cause a hepatic injury.

## Clinical manifestations:

Diagnosis and Investigation often made at laparotomy in patients presenting with penetrating injuries requiring immediate Surgery or in shock.

**Blunt Trauma:** patients who remain in a shock or present with abdominal rigidity, you do no further investigation and you take him to the **OR** immediately.

## Investigations:

1. Diagnostic peritoneal lavage (DPL)
2. CT Scan abdomen: used to diagnose intra peritoneal injuries in stable patients after blunt trauma.

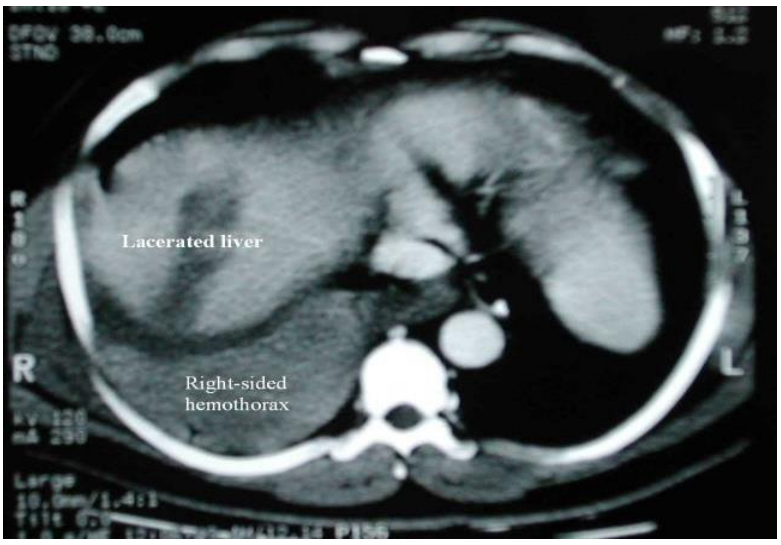




**Figure:** Gunshot below the nipple, Right side hemothorax, grade 3. The patient is stable; there is no blood in the peritoneal cavity. In this case the patient will go with conservative management, if he bleeds, he must be taken to the OR and if there was another injury take him to the OR and deal with all the injuries.

In this case observe the patient for 24 h, and it is not necessary to take the bullet out. Or you can take it out while you are taking the shuttered lobe of the liver. However, if you leave the bullet it may cause inflammatory reaction.

# Management:

When the patient comes to ER, the initiate management should be uniform which is (ABCDE: regardless what injury you have)

***Non-operative approach:*** Not all patients with liver injury need operation. It is determined by CT scan.

Criteria for non-operative approach are:

1) Simple hepatic laceration or intra hepatic hematoma.
2) No evidence of active bleeding.
3) Intra peritoneal blood loss less than 250 ml.
4) Absence of other Intra peritoneal injuries “spleen, bladder...” that requires surgery.

***Operative approach:***

Persistent hypotension, despite adequate volume replacement, suggests ongoing blood loss and mandates immediate operative intervention.

## Classification of Hepatic injury: This classification is based on operative findings and management. So hepatic injury is classified into five grades:

**Grade I:** Simple injuries – non-bleeding. Conservative treatment if there is no bleeding or other injuries.

**Grade II:** Simple injuries managed by superficial suture alone if you opened the patient. Conservative treatment if no bleeding or other injuries.

**Grade III:** Major Intra parenchymal with active bleeding but **not** requiring inflow occlusion (Pringle maneuver) to control hemorrhage.
Some of the patients go for conservative treatment others go for OR.

***Note(s):***

The Pringle maneuver is a surgical maneuver used in some abdominal operations. A large hemostat is used to clamp the hepatoduodenal ligament interrupting the flow of blood through the hepatic artery and the portal vein and thus helping to control bleeding from the liver.

**Grade IV:** Extensive Intra parenchymal injury with major active bleeding requiring inflow occlusion for hemostatic control. Needs operation and do Pringle maneuver.

**Grade V:** Juxtahepatic venous injury (injuries to retrohepatic cava or main hepatic veins) portal vein injury. Patients in this grade are less likely to survive.

- All patients undergoing laparotomy for trauma should be explored through midline incision (from Xiphisternum to pubic" around the umbilicus go up or down) because you do not know where is the lesion.

Figure: Finger fraction: the injury in the liver is small, you will open the liver according to the injury, start ligating the blood vessels then ligating the ducts. Then omental packing: put omentum in between and suture it because it will cause hemostasis.

## Management according to classification:

Grades I & II: Simple injuries can be managed by any one of variety of methods: If we open it simple suture, electrocautery, tropical hemostatic agents, etc.. (It does not require drainage)

Grade III: Major intraparenchymal injuries with active bleeding can be managed best by Finger Fracturing the hepatic parenchyma and ligating or repairing lacerated blood vessels & bile ducts under direct vision.

Grade IV: Extensive intraparenchymal injuries with major rapid blood loss require occlusion of portal trial to control hemorrhage. It might need liver resection, lobe resection, and ligation of intrahepatic artery. It is rarely saved.

## Summary

**Simple techniques:** Simple techniques include drainage only of non-bleeding injuries, application of fibrin glue, sutures "hepatorrhaphy" and application of surgical (in grades I & II).

**Advanced techniques:** Advanced Techniques of Repair (III & IV) all performed with Pringle Maneuver in place.

Types of repair:

1) Extensive hepatorrhaphy
2) Hepatotomy with selective vascular ligation
3) Omental pack
4) Resectional debridement with selective vascular ligation
5) Resection
6) Selective Hepatic Artery Ligation "remember liver is regenerate"
7) Peri-hepatic packing: If you can't deal with a patient, just pack the patient and send him to a center where he will be treated. Also, if you did what you have to do but the bleeding didn't stop, pack your patient and send him to another hospital.


# Complications and Mortality:

1) **Recurrent bleeding.**
2) **Hematobilia:** blood will go to the bile duct and the patient will bleed per rectum.
3) **Perihepatic abscess** then **Biliary Fistula** later on.
4) **Intrahepatic Hematoma.**
5) **Pulmonary complications.**
6) **Coagulopathy:** due to massive blood transfusion.

# Spleen Trauma:

## General considerations:

The spleen remains the most commonly injured organ in patients who have suffered blunt abdominal trauma and is involved frequently in penetrating wounds of the left lower chest and upper abdomen.

Management of the injured spleen has changed radically over the past decade.

The spleen is now recognized as an important immunological factory as well as a reticuloendothelial filter.

The problem is when spleen has a disease e.g. splenomegaly, malaria, portal hypertension makes it more susceptible to be damaged from simple trauma and you will find the patient collapsed.

Although the risk of overwhelming post-splenectomy sepsis (OPSS) is greatest in children less than 2 years, recognition of OPSS has stimulated efforts to (Conserve spleen) by splenorrhaphy (either by repair or leave according to grade).

## Mechanism of Injury:

- The spleen is commonly injured in patients with blunt abdominal trauma because of its mobility. Or in American Football
- Most civilian stab wounds and gunshot wounds cause simple lacerations or through and through injuries.
- It is of interest 2% of patient who are undergoing surgery LUQ of the abdomen can injured the spleen by the surgeon causing a small injury by any of the surgical equipment being used by the doctor using or the assistant. Usually in colon surgery.

## Classifications: (Important)

The Magnitude of splenic disruption depends on the patient's age, injury mechanism and presence of underlying disease.

Splenic injury has been classified according to its pathological anatomy into:

- **Grade I:** Subcapsular hematoma.
- **Grade II:** Sub segmental parenchymal injury (no bleeding only laceration).
- **Grade III:** Segmental devitalization (part of it)
- **Grade IV:** Polar disruption (complete pole)
- **Grade V:** Shattered or devascularized organ (autosplenectomy), Patient is in a shock but he can survive because of the blood supply.

## Treatment according to the classification:

**Grade I &II:** conservative treatment only.

**Grade III, IV and V:** need surgical intervention.

## Diagnosis and investigations:

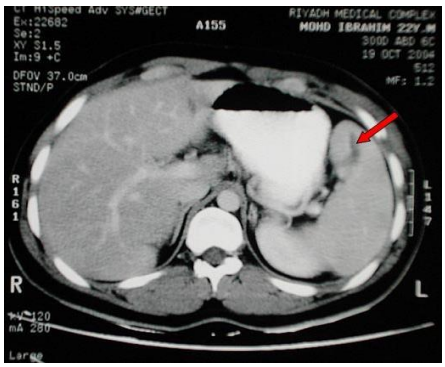
- **History**
- **Physical examination:**

  Sign & symptom: if you find any of these, you presume spleen and kidney injury:
  - LUQ bruising or abrasion
  - Left lower ribs fracture on CXR
  - Kehri's sign: shoulder tip pain (L shoulder)
  - Balance's sign: LUQ mass (hematoma)

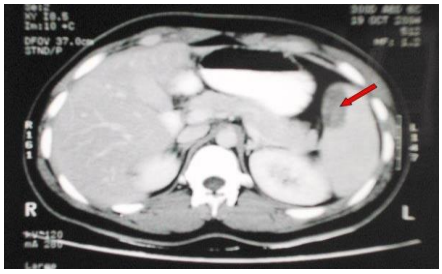
***Note(s):***

Kehri's sign is the occurrence of acute pain in the tip of the shoulder due to the presence of blood or other irritants in the peritoneal cavity when a person is lying down and the legs are elevated.

- **Radiological:**
  1. CXR " very important in case of spleen injury "
  2. Plain abdominal X-Ray.
  3. CT Scan: it is the most important investigation in spleen injury.
  4. Angiography: it is very important for grading. It can be used for diagnosis and therapy. (CT Scan and Angiography done if the patient stable).



**It shows grade 1 hematoma – patient is stable so go with conservative therapy.**



**Showing a grade 2 – laceration but the wall is not disrupted.**
**Go with conservative therapy.**

## Treatment:

- **Start with (ABCDE)**

***- Non-operative approach:*** Widely practiced in pediatric trauma

Criteria for non-operative approach are:

1. Haemodynamically stable children/adult.
2. Patients who do not have any peritoneal findings at any time (no rigidity, no tenderness, just bruising).
3. Those who did not need more than two units of blood (more than 2units→ OR).

***- Operative approach:***

- Decision to perform splenectomy or splenorrhaphy is usually made after assessment & grading the splenic injury.
- Contra indication for splenic salvage: (perform splenectomy).
- The patient has protracted hypotension (Everything is done but there is no response and the patient is still bleeding)
- Undue delay is anticipated in attempting repair the spleen (if we put a needle patient will bleed).
- The patient has other severe injuries (in the liver, bowel, or bladder).

## Complications of Surgery:

**Early complications occur such as:**

- Bleeding.
- Acute gastric distention.
- Gastric necrosis (short gastric vessels are close to each other so when you ligate them, it might lead to necrosis).
- Recurrent splenic bed bleeding.
- Pancreatitis (remember the tail of pancreas ends at the pelvis of the Spleen).
- Subpherinic abscess.

**Late complications occur such as:**

- Thrombocytosis.
- Overwhelming post-splenectomy sepsis (OPSS) (1 – 6 Week).
- DVT.

# Renal Trauma:

## General Considerations:

- The commonest organ prone to injury in the urinary system.
- If contusion (under the skin) occurs, it can be treated by conservative therapy.
- If hematuria is present, it means there is a poor indicator of severe renal injury (complete or partial kidney damage).

## Diagnosis:

By Measurement of mean arterial pressure.

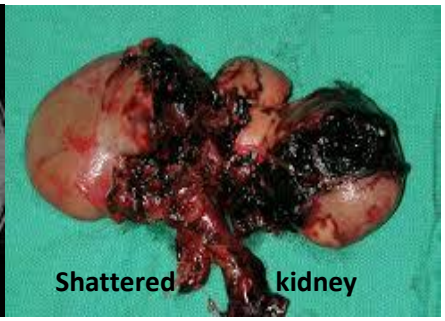
**Symptoms and signs (3 Fs):** Flank abrasion, Fracture of the ribs and Fracture vertebral transverse process.

**Investigation:** Intravenous urography (IVU) + CT scan.

## Management:

**For minor injuries:** (such as hematoma) US scan, percutaneous drainage, antibiotic use


Renal Trauma/Injury


Shattered kidney

# SUMMARY

## Surgical Recall

**-What are the three main elements of the ATLS (Advanced Trauma Life Support) protocol?**

1. Primary survey/resuscitation
2. Secondary survey
3. Definitive care

**-How and when should the patient history be obtained?**

It should be obtained while completing the primary survey; often the rescue squad, witnesses, and family members must be relied upon.

**-What are the five steps of the primary survey?**

Think: "ABCDEs":

- Airway (and C-spine stabilization)
- Breathing
- Circulation
- Disability
- Exposure and Environment

**-What principle is followed in completing the secondary survey?**

Complete physical exam, including all orifices: ears, nose, mouth, vagina and rectum.

**-What is the best way to diagnose or rule out aortic injury?**

CT angiogram

**-What must be considered in every penetrating injury of the thorax at or below the level of the nipple?**

Concomitant injury to the abdomen: Remember, the diaphragm extends to the level of the nipples in the male on full expiration.

**-What physical signs may indicate intra-abdominal injury?**

Tenderness; guarding; peritoneal signs; progressive distention (always use a gastric tube for decompression of air); seatbelt sign

**-What is the seatbelt sign?**

Ecchymosis on lower abdomen from wearing a seatbelt (10% of patients with this sign have a small bowel perforation!)

**-What must be documented from the rectal exam?**

Sphincter tone (as an indication of spinal cord function); presence of blood (as an indication of colon or rectal injury); prostate position (as an indication of urethral injury).

**-What physical signs indicate possible urethral injury, thus contraindicating placement of a Foley catheter?**

High-riding ballotable prostate on rectal exam; presence of blood at the meatus; scrotal or perineal ecchymosis.

**-What are the common trauma labs?**

Blood for complete blood count, chemistries, amylase, liver function tests, lactic acid, coagulation studies, and type and cross-match; urine for urinalysis

**-What studies are available to evaluate for intra-abdominal injury?**

FAST, CT scan, DPL

**-What is a FAST exam?**

Ultrasound: Focused Assessment with Sonography for Trauma

**-What does the FAST exam look for?**

Blood in the peritoneal cavity looking at Morison's pouch, bladder, spleen, and pericardial sac.

**-What does DPL stand for?**

Diagnostic Peritoneal Lavage

# SUMMARY

## Surgical Recall

**-What diagnostic test is the test of choice for evaluation of the unstable patient with blunt abdominal trauma?**

FAST

**-What is the indication for abdominal CT scan in blunt trauma?**

Normal vital signs with abdominal pain/tenderness/mechanism

**-What is the indication for DPL or FAST in blunt trauma?**

Unstable vital signs (hypotension)

**-How is a DPL performed?**

Place a catheter below the umbilicus (in patients without a pelvic fracture) into the peritoneal cavity Aspirate for blood and if 10 cc are aspirated, infuse 1 L of saline or LR Drain the fluid (by gravity) and analyze.

**-What is a "grossly positive" DPL?**

>10 cc blood aspirated

**-What injuries does CT scan miss?**

Small bowel injuries and diaphragm injuries

**-What injuries does DPL miss?**

Retroperitoneal injuries

**-What study is used to evaluate the urethra in cases of possible disruption due to blunt trauma?**

Retrograde urethrogram (RUG)

**-What findings would require a celiotomy in a blunt trauma victim?**

Peritoneal signs, free air on CXR/CT scan, unstable patient with positive FAST exam or positive DPL results.

**-What is the treatment of a gunshot wound to the belly?**

Exploratory laparotomy

**-What is the evaluation of a stab wound to the belly?**

If there are peritoneal signs, heavy bleeding, shock, perform exploratory laparotomy; otherwise, many surgeons either observe the asymptomatic stab wound patient closely, use local wound exploration to rule out fascial penetration, or use DPL.

# Questions

1. In abdominal injuries, the most informative initial investigation is:
    a. CT Scan
    b. Ultrasound (US)
    c. Diagnostic peritoneal lavage (DPL)
    d. Abdominal X-ray

2. Blunt trauma to the abdomen most commonly injures which of the following organs?
    a. Liver
    b. Kidney
    c. Spleen
    d. Intestine
    e. Pancreas

3. Which of the following conditions is most likely to follow a compression type abdominal injury?
    a. Renal vascular injury
    b. Superior mesenteric thrombosis
    c. Mesenteric vascular injury
    d. Avulsion of the splenic pedicle
    e. Diaphragmatic hernia

**Explanation Q2:** The diagnosis of injuries resulting from blunt abdominal trauma is difficult; injuries are often masked by associated injuries. Thus, trauma to the head or chest, together with fractures, frequently conceals intra-abdominal injury. Apparently trivial injuries may rupture abdominal viscera in spite of the protection offered by the rib cage. The structures most likely to be damaged in blunt abdominal trauma are, in order of frequency, the spleen, kidney, intestine, liver, abdominal wall, mesentery, pancreas, and diaphragm. Abdominal paracentesis is a rapid, sensitive diagnostic test for patients with suspected intra-abdominal injury and may be extremely helpful in the management of patients with associated head, thoracic, or pelvic trauma in whom signs and symptoms of the abdominal injuries may be masked or overlooked. Abdominal CT scans which should be done promptly and rapidly, are being used more frequently to evaluate these injuries.

**ExplanationQ3:** In the rapid deceleration injury associated with automobile crashes, the abdominal viscera tend to continue moving anteriorly after the body wall has been stopped. These organs exert great stress upon the structures anchoring them to the retro-peritoneum. Intestinal loops stretch and may tear their mesenteric attachments, injuring and thrombosing the superior mesenteric artery; kidneys and spleen may similarly shear their vascular pedicles. In these injuries, however, ordinarily the intra-abdominal pressure does not rise excessively and diaphragmatic hernia is not likely. Diaphragmatic hernia is primarily associated with compression-type abdominal or thoracic injuries that increase intra-abdominal or intra-thoracic pressure sufficiently to tear the central portion of the diaphragm.


**Answers**:

1st Questions: C

2nd Questions: C

3rd Questions: E