Specific organ trauma

Objectives:

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

Resources:

- Doctor's slides
- Doctor's notes
- Surgical recall
- 435 Teamwork

Done by: Allulu Alsulayhim, Abdulaziz Alsalem, Trad Alwakeel
Leaders: Heba Alnasser, Jawaher Abanumy, Mohammed Habib, Mohammad Al-Mutlaq
Reviewed by: Yara Aldigi

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Notes , Important , Extra , Davidson's

Editing file

Feedback

Overview

- Good example of trauma is RTA. blunt, penetrating or both.
- Trauma remains major cause of death after IHD and malignancy.
- Trauma is the leading cause of death in people aged 1-35 years. this is the active age, so you will lose them or they may become disable.
- Trauma given a larger group of people per minute disability. If they don't die they will be disabled.
- Trauma care account up to **7%** of all hospital care. Budget (an economic burden).
- The majority of abdominal injuries are due to blunt abdominal trauma secondary to high speed automobile accidents. So if the accident is there, abdominal trauma will happen. It may be a penetrating trauma due to an iron bar piercing through the insides.

NOTE:

How to reduce the incidence of trauma?

Primary: 1- you have to check your car before getting in (are the tires ok? Is there petrol in the car? Is the car working or not?) 2- you should fasten your seatbelt, the car should have an airbag, check the break before you go (unfortunately none of us do this though it prevents some accidents).

Secondary: The road should be good, well lit, clear signs on the road, clear directions, working traffic lights, signs for falls, if it's raining then drivers should be careful.

Tertiary: if there was an accident hospital care is very important. 1- good ambulance services (fast, trained) 2- well equipped ER (equipment, staff, good resuscitation).

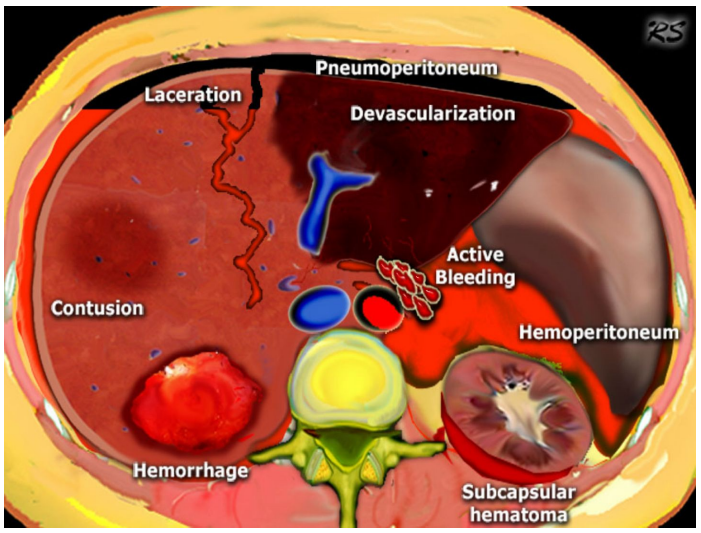
- The failure to manage the abdominal injuries accounts for majority of **preventable** death following multiple injuries.
- The primary management of abdominal trauma is determination that an intra abdominal injury EXISTS and operative intervention is required. If you put in your mind that an injury exists to all trauma patients and that they may need surgery then you can manage them properly. But if you said no in the history the patient was talking very nicely and they said there is nothing wrong with them, the patient may be bleeding slowly and after 2-3 hours they will end up in shock and now you can't manage them!!!!
- 2 minutes break ? video

Classification of l trauma according to mechanism:

1. **Blunt**
2. **Penetrating**
3. **Burns**
4. **Blast** can be blunt or penetrating.

A quick overview of specific organ injuries:

- If the injury is in the **liver, spleen or the kidney :** the type of injury will be either laceration, contusion or hemorrhage.
- But if you have an injury in a **major blood vessel:** the injury will be active bleeding (like the aorta or the inferior vena cava).
- If the injury is in the **bowel:** it can be one of two things, either perforation causing pneumoperitoneum, or there can be a cut in a blood vessel transversely (the mesentery will be cut) causing devascularization and necrosis.



Abdominal trauma

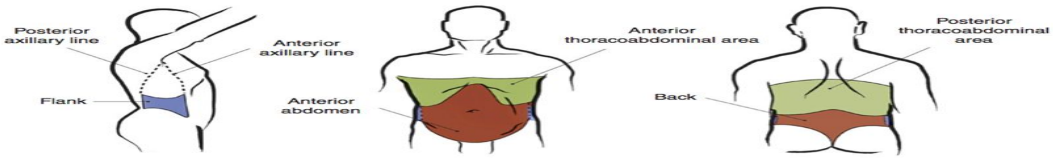
- The recognition of the mechanism of the injury whether is penetrating or non-penetrating trauma is a greatest importance for treatment and diagnosis and workup therapy. For example in the pic there is a penetrating trauma (stab), so you will do resuscitation when the patient arrives (ABCDE) and then immediately life management by taking the patient to the OR. It's important to leave the knife until you open the abdomen because the patient may bleed out more and also you want to know what is/are the injured organ/s and where the knife has reached.

Types:

1. **Blunt** abdominal trauma.
2. **Penetrating** abdominal trauma.

Anatomical regions of the abdomen (once we know it, we know what organ get damaged):

- **Peritoneum**
  - **Intrathoracic abdomen**
    - Contents: liver, spleen, and stomach, pancreas
  - **True abdomen (we can examine it by our hand)**
    - It is the accessible part during PEx (physical examination).
- **Retroperitoneum (difficult to examine)**:
    - Content: kidney, pancreas, part of colon (difficult to get injured. If injured, we call it a major trauma).
- **Pelvic abdomen**
    - Contents: bladder, genital system of female

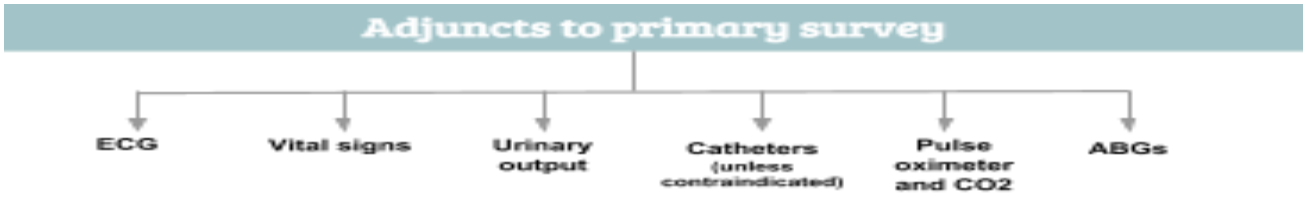


Hospital care and diagnosis:

Primary survey:

The resuscitation & Management priorities of patient with major abdominal trauma are[1]:

- The (ABCDE) of EMERGENCY resuscitations:
  1. **Airway** (& C-spine Immobilization)
  2. **Breathing**
  3. **Circulation** (with hemorrhage control)
  4. **Disability**
  5. **Exposure**/environmental control.
  6. Full **vital signs**
- Adjuncts to primary survey (use it after ABCDE).



Secondary survey:

- History:
  - Blunt abdominal trauma. Ask the patient or who brought them what was the trauma, where was it and so on.
  - Penetrating abdominal trauma (knife, iron bar, gunshot).
- Physical examination (you take the patient as one piece, examin from head to toe):
  - General physical Examination.
  - Examination of the abdomen:
    - Inspection
    - Palpation
    - Percussion
    - Auscultation
    - Rectal Examination
    - Vaginal Examination

Diagnostic procedures

- Blood tests (CBC, electrolytes, cross-matching).
- Radiological Studies (Plain abdominal X-ray , CXR).
- Peritoneal lavage (DPL)[2] Most informative initial investigation. (in non-stable patients).
- USG (Ultrasonography) abdomen (FAST in non-stable patients).
- CT abdomen in stable patients.
- Peritoneoscopy (Diagnostic laparoscopy). In stable patients (usually done in the OR to make sure what is the injured organ and the exact site of the injury).
- You don't need to do everything, just CBC, urea and electrolytes and crossmatching, unless you found something else.

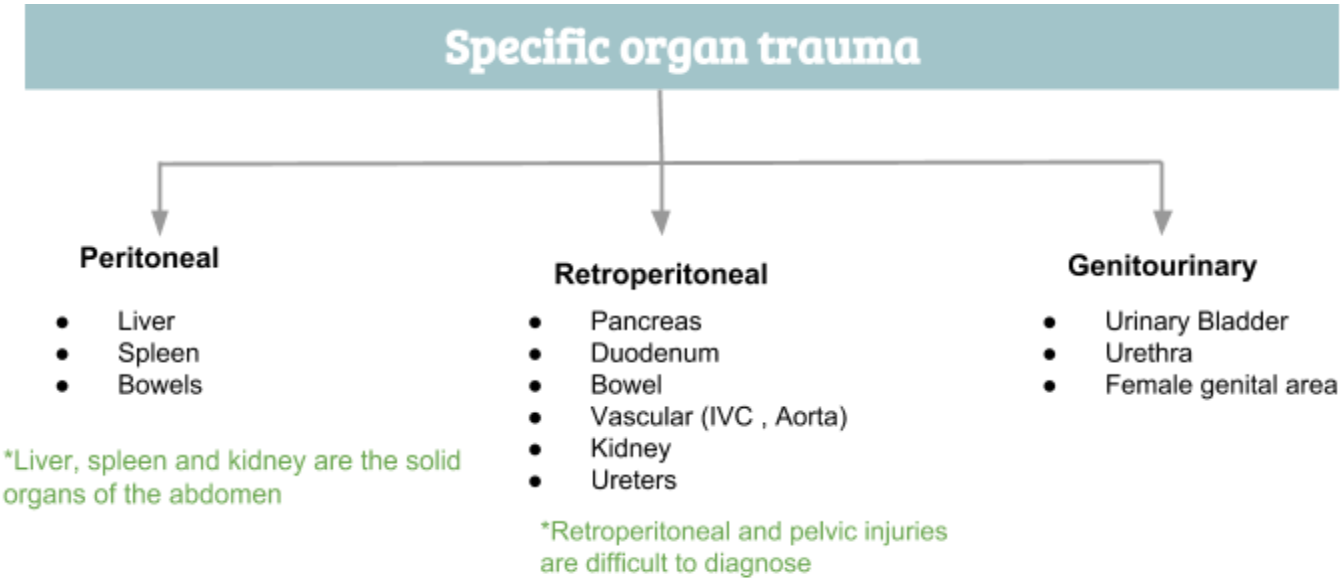
[1] Because the patient will not come with only abdominal injury, maybe there is head injury, fracture, chest

[2]DPL: a surgical diagnostic procedure to determine if there is blood in the abdominal cavity, we first apply local anesthesia, then insert a catheter in the cavity and try to aspirate using a syringe. More info will be discussed in next page.

When should we do a laparotomy[3]?

Exploratory laparotomy from its name a laparotomy (midline incision) done to explore and find the injury. Check this video if interested :)

- Signs of peritoneal injury (when you examine the abdomen and there is tenderness and rigidity).
- Unexplained shock (you give fluid and your patient is still in shock).
- Evisceration of viscous (the bowel is outside the body).
- Positive diagnostic Peritoneal Lavage (DPL)
- Determination of finding during routine follow up (suppose the patient is stable in the ER but you think there is bleeding, put them under observation and then after 3-4 hours the patient is in shock then you have to take the patient for laparotomy).



[3] laparotomy is a surgical procedure involving a large incision through the abdominal wall to gain access into the abdominal cavity.

Liver Trauma

- The liver is the largest organ in the abdominal cavity.
- Continues to be the **most commonly** injured organ in all patients with abdominal trauma.
- The commonest organ injured in case of penetrating trauma.

Mechanism of injury

- Hepatic injuries result from direct blows, compression between the lower ribs on right side and the spine or shearing at **fixed points** secondary to deceleration. Remember the liver is attached to the diaphragm, posterior abdominal wall, vertebral column. But if there is an injury it may get detached from them.
- 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.
- The pic: the knife is in very deep which means it is damaging a lot of things like liver, kidney, blood vessels, bowel. when you have this kind of injury:
    a. ABCDE
    b. Take the patient to the OR and open the abdomen. Leave the knife in its place until you open the abdomen and see what was cut then remove it. Why shouldn't you remove the knife? Bc sometimes it cause pressure preventing bleeding.

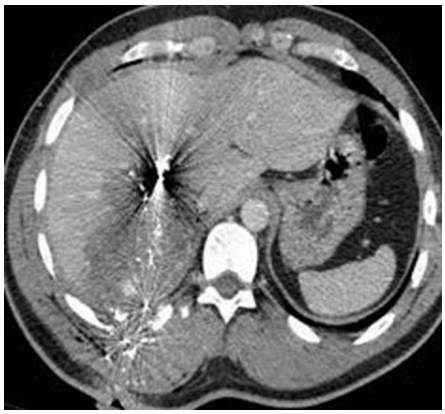
Diagnosis:

- Clinical manifestations.
- Diagnosis of hepatic injury is often made at laparotomy in patients presenting with penetrating injuries requiring immediate Surgery.
- Patients with blunt Trauma who remain in shock or present with abdominal rigidity and tenderness also require laparotomy.

- **Investigations:**
    1. Adjuvant diagnostic tests are necessary in the decision making process to determine whether or not laparotomy is necessary.

    2. **Diagnostic peritoneal lavage (DPL)** has been extremely **reliable 98%** in determining the presence of blood in the peritoneal cavity. If +ve → patient should be taken to the OR without delay. Most informative
        ○ DPL has a special needle, we insert it, if it is positive GO TO OR.
        ○ If DPL is negative, we push 1L normal saline into the peritoneal cavity then suck it back, if it was red → it is +ve, GO TO OR.
        ○ **N.B:** DPL is used in patients with shock or abdominal distention.
    3. Nowadays we do Focused assessment with sonography for trauma (FAST) instead of DPL.
    4. **CT Scan abdomen** used for diagnosing intra peritoneal injuries in **stable patients** after blunt trauma. N.B : CT used in stable patient **NOT IN SHOCK** bc the patient may get worse or die.

- Contusion of the liver (arrow on the left) due to blunt injury.
- Hematoma of the spleen (arrow on the right).



- Gunshot wound rupturing the rib cage
- No blood or air in the peritoneum
- If pt stable admit and treat conservatively
- Don't remove the bullet unless the pt is unstable

Treatment:

When patient arrives to the ER the initial management of the patient should be uniform regardless of organs system injuries. Hence, resuscitation is performed (ABCDE) in the standard fashion.

- **Non operative approach:**
  a. The hepatic injury diagnosed by CT in **stable** patient is now non operative approach practiced in many centers.
  b. **CT criteria for nonoperative management:**
     - Simple hepatic laceration OR intrahepatic hematoma.
     - No evidence of active bleeding.
     - Intraperitoneal blood loss less than 250 ml.
     - Absence of other intraperitoneal injuries requiring surgery (no bowel or splenic injury).

So if CT scan show us no indication for surgery, put the patient on conservative management, keep an eye for any changes that may occur.

- **Operative approach:**
  - Persistent hypotension, despite adequate volume replacement, suggests ongoing blood loss and mandates immediate operative intervention. If you give fluid and the patients still in shock and has a distended abdomen that means this patient needs to be opened to see what's happening.
  - Major intraparenchymal injury.
  - All patients undergoing laparotomy for trauma should be explored through midline incision because you do not know where the lesion is. You do a big line incision around the umbilicus if you feel the injury is up you make the incision up, if you feel the injury is down you make the incision down. But nowadays we have laparoscopy so we can see then we decide what to do.

Classification of Injury:

Grade I	Simple injuries – non bleeding (can be treated **conservative**).
Grade II	Simple injuries managed by superficial suture alone if you open the patient. If you didn't open the patient is treated **conservatively**.
Grade III	Major intraparenchymal injury with active bleeding but not requiring inflow occlusion (Pringle maneuver[4]) to control haemorrhage (you have to **operate**).
Grade IV	Extensive intraparenchymal injury with major active bleeding requiring inflow occlusion for hemostatic control (**needs surgery** and it is hard to treat, you may need to do either lobectomy, ligate the right or left hepatic artery).
Grade V	Juxtahepatic venous injury (injuries to retrohepatic cava or main hepatic veins) portal vein injury (injury to the major vessels, that means you need to transplant the liver again and fix it. **Usually the patient dies** on the spot unless they are lucky and there is a doctor on the field :(

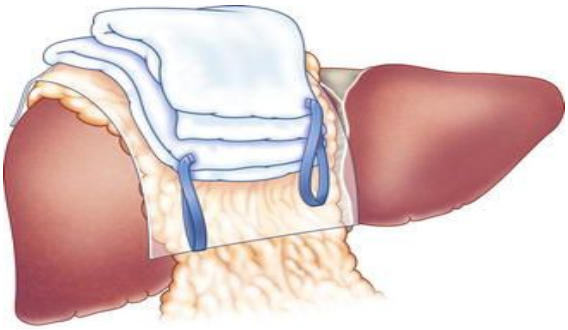
Managing different grades of injury:

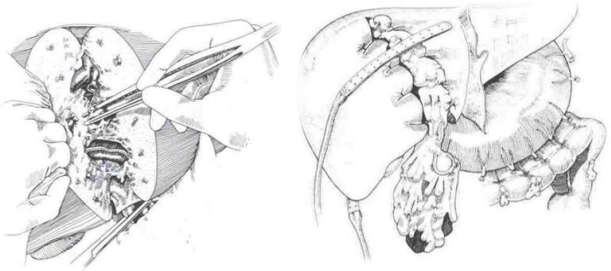
Grades I & II:

- Simple injuries can be managed by any one of variety of methods (simple suture, electrocautery or topical hemostatic agents) This type of injury like Liver biopsy does not require drainage.
- Simple techniques includes drainage only of non-bleeding injuries, application of fibrin glue, and sutures hepatorrhaphy and application of Surgicel [5].

Grade III:

- Major intraparenchymal injuries with active bleeding can best be managed by **Finger Fracturing** the hepatic parenchyma and ligating or repairing lacerated blood vessels & bile ducts under direct vision.
- With the laceration, we open more and we start fracture (open the liver more) by our fingers so the blood vessel will decrease then we will ligate or clip it and ligate + clip the bile duct. Then we can put Omental pack which will cause hemostasis or we can use artificial material like surgicel.





[4] The Pringle maneuver is a surgical maneuver used in some **abdominal** operations. A large atraumatic hemostat is used to clamp the **hepatoduodenal ligament** (free border of the lesser omentum) interrupting the flow of blood through the hepatic artery and the portal vein and thus helping to control **bleeding** from the liver. Now we use vascular clamp instead.

[5] a hemostatic agent (blood-clot-inducing material)

Grade IV:

- Extensive intra parenchymal injuries with major rapid blood loss require occlusion of portal trial to control hemorrhage. In this case you need to take the left lobe, right lobe or whatevers damaged of the liver.
- Advanced Techniques of repair(III & IV) are all performed with Pringle Maneuver in place.

Possible surgeries in this case:

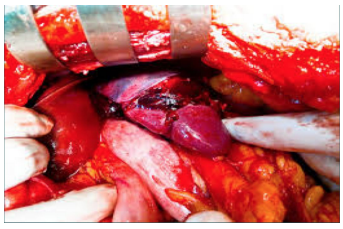
- Extensive hepatorrhaphy (repair all injured parts of the liver) -rrhaphy means suture
- Hepatotomy with selective vascular ligation (take part of the liver and resuct it).
- Omental pack.
- Resectional debridement with selective vascular ligation (ligating left or right hepatic artery).
- Resection.
- Selective Hepatic Artery Ligation.
- **Perihepatic packing** suppose the incident happened in قويعية and the patient has grade III or IV injury and the small hospital isn't equipped for the surgery, the surgeon will pack and close the patient's abdomen and patch the liver to stop the bleeding, then send him to the nearest equipped hospital in Riyadh.

Complications & Mortality:

- Recurrent bleeding.
- Hemobilia bleeding into the biliary tree.
- Perihepatic abscess bc of infection from dirty knife.
- Biliary Fistula.
- Intrahepatic Haematoma.
- Pulmonary Complications (because they can't breathe).
- Coagulopathy (bc we give lots of blood) and hypoglycemia.

Splenic Trauma

Incidence:



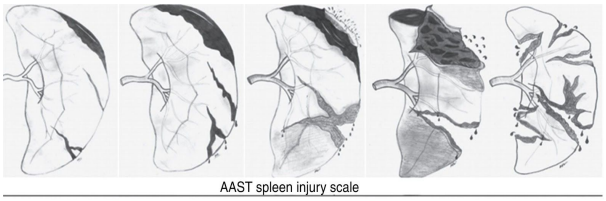
- The spleen remains the most commonly injured organ in patients who have suffered **blunt abdominal trauma** and is involved frequently in penetrating wounds of the left lower chest and upper abdomen.
- Management of the injured spleen has changed radically over the past decade. (due to new treatment)
- Now recognized as an important immunologic factory as well as reticuloendothelial filter. Although the risk of overwhelming postsplenectomy sepsis (OPSS) is greatest in children less than 2 yrs recognition of OPSS has stimulated efforts to (**Conserve** spleen) by splenorrhaphy (save spleen).

Mechanism of Injury:

- The spleen is commonly injured in patients with blunt abdominal trauma because of its mobility.
- 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 injure the spleen when you are working on stomach or colon you may injure the spleen and may need to do splenectomy.
- The Magnitude of splenic disruption depends on patients age, injury mechanism and presence of underlying disease. Splenic injury have been classified as mentioned below.

Classification according to pathologic anatomy:

Grade I	Subcapsular hematoma (Conservative treatment).
Grade II	Sub segmental parenchymal injury (Conservative treatment).
Grade III	Segmental devitalization (need surgery).
Grade IV	Polar disruption (need surgery).
Grade V	Shattered or devascularized organ (you remove it and control the bleeding)

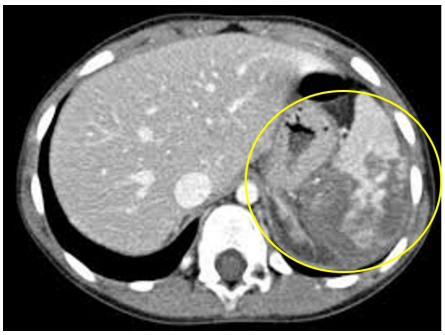


AAST spleen injury scale

Criteria	I	II	III	IV	V
Haematoma					
Subcapsular (surface):	<10%	10-50%	>50%, expanding, ruptured	---	---
Intraparenchymal (diameter):	---	<5 cm	>5 cm, expanding, ruptured	---	---
Laceration (depth):	<1 cm	1-3 cm	>3 cm	Produces infarction >25% of spleen	Completely shattered
Vascular injury:	---	No damage to trabecular vessels	Damage to trabecular vessels	Damage to hilar or segmental vessels	Hilar damage producing devascularisation of the spleen

Diagnosis:

- Patient History
- Physical Examination
  - Symptoms and signs
    - LUQ bruising or abrasion
    - Left lower ribs fracture
    - Kehr's sign : shoulder tip pain (the patient tells you they have shoulder pain).
    - Ballance's sign : LUQ mass
- **Diagnostic tests:**
  - Radiological Evaluation
  - CXR
  - Plain abdominal X-Ray if there is perforation.
  - CT Scan to diagnose
  - Angiography (diagnostic and therapeutic as we can use it for embolization if the patient is bleeding before we take the patient for surgery).



Simple laceration that could've been treated conservatively but the pt was opened for something else, so we put surgical and close it

Treatment:

Initial Management: Resuscitation (ABCDE)

- **Non operative approach:** Widely practiced in pediatric trauma
    - The criteria for nonoperative approach:
        - Hemodynamically **stable** children/adult
        - Patients **without** peritoneal finding at anytime (rigidity or tenderness)
        - Those who did **not** require greater than two units of blood.

- **Contraindications to splenic salvage:** (remove the spleen)
    1. The patient has protracted hypotension (uncontrolled hypertension)
    2. Undue (excessive) delay is anticipated in attempting to repair the spleen.
    3. The patient has other severe injury (bc splenorrhaphy take time and you don't have time, the patient may will die!!!).

- **Operative approach:**
    - Decision to perform splenectomy or splenorrhaphy is made after assessment and grading of the injury (assess after opening the patient).

Post splenectomy and splenorrhaphy complications:

- **Early complications:**
    1. Bleeding
    2. Acute gastric distention
    3. Gastric necrosis
    4. Recurrent splenic bed bleeding
    5. Pancreatitis
    6. Subphrenic abscess

- **Late complications:**
    1. Thrombocytosis
    2. OPSS (week 1-6) Overwhelming Post-Splenectomy Sepsis
    3. DVT

Renal Trauma

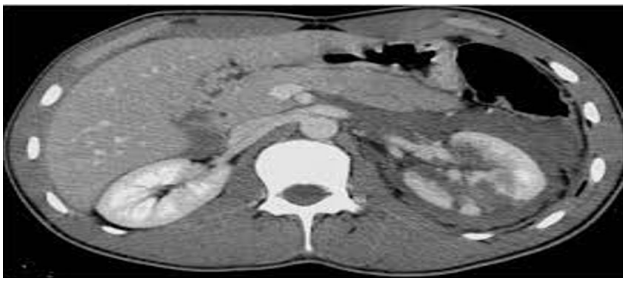
Overview	• The commonest organ prone to injury in urinary system. • If contusion occurs, it can be treated by **conservative** therapy. • If hematuria is present, it's a poor indicator of severe renal injury.
Mechanism	• Usually during Rugby or accidents, so they hit the renal area which will cause kidney injury.

Diagnosis	• Symptoms and signs (3 Fs):
	  ○ Flank abrasion.
	  ○ Fracture of the ribs.
	  ○ Fracture vertebral transverse process.
	• Investigations:
	  ○ Intravenous urography (IVU).
	  ○ CT scan.

Management	• **Minor injuries:** US scan, percutaneous drainage , antibiotic usage. • **Severe injuries:** Partial nephrectomy or total nephrectomy.

Shattered kidney

the surgeons are not able to save it, so they have to take it out.



Bowel injury:

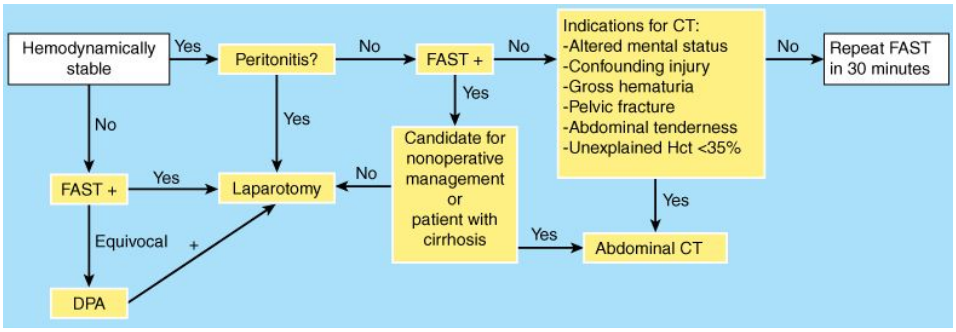
It could be devascularization or perforation. The patient will be in shock, do ABCDE or close the perforation. Most of the time they get ischemia and they die.

Pancreatic injury:

You have to do major surgery, you will have to do whipple procedure (pancreaticoduodenectomy) and take the pancreas and the spleen and other involved organs. it is a surgeons worst nightmare, you will stay 6-8 hours in the OR.
Once you get pancreatic or bowel injury it is a major trauma.

Don't forget :

- Unstable pt with blunt trauma > **FAST or DPL** (not used anymore)
- Stable pt with blunt trauma > **CT**
- **Lacerations and contusions are managed conservatively**



Recall (EXTRA):

Most common abdominal organ injured in blunt abdominal trauma?

Liver (not the spleen, as noted in recent studies!)

Most common abdominal organ injured in penetrating abdominal trauma?

Small bowel

What are the classic blunt trauma ER x-rays?

1. AP (anterior-to-posterior) chest lm
2. AP pelvis lm

What are the common trauma labs?

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

What does DPL stand for?

Diagnostic Peritoneal Lavage

What does the FAST exam look for?

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

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

FAST

How is a DPL performed?

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

What is a "grossly positive" DPL?

More than or equal to 10 cc blood aspirated

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

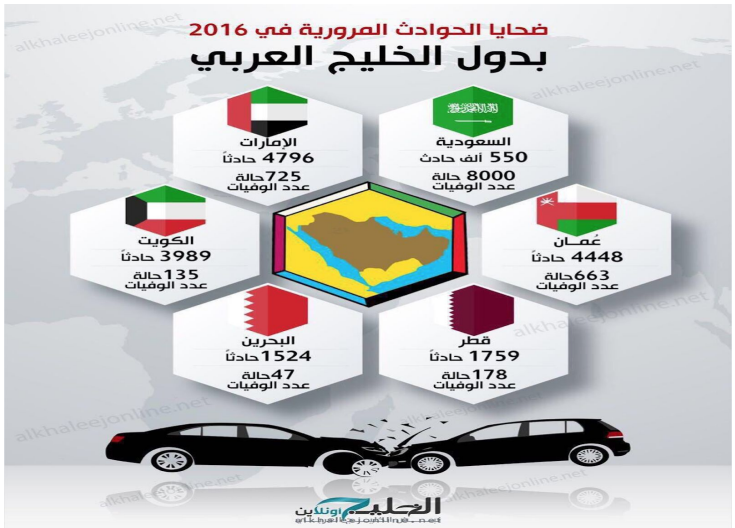
Exploratory laparotomy

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

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



Summary

- Trauma remains major cause of death after IHD and malignancy and the leading cause of death in people aged 1-35 years mentioning that trauma care account up to 7% of all hospital care.

Specific organ trauma			
Type	**Liver trauma**	**Splenic trauma**	**Renal Trauma**
Mechanism of injury	1. direct blows, compression between lower ribs on Rt side & spine or shearing at fixed points 2ndary to deceleration. 2. gunshot, shotgun, stab wound below right nipple	1. blunt abdominal trauma 2. Gunshots, stabs(laceration) 3. LUQ Surgery (2%)	Displant kidney injury caused by: Rugby or An accident
Diagnosis + investigation	1. Clinical manifestations 2. Laparotomy (**penetrating**) 3. **(DPL)** if (**shock, distention**) 4. CT abdomen (**stable patient**)	➔ Patient History ➔ P.E: • LUQ bruising • LL ribs fracture • Kehr's sign • Ballance's sign ➔ Investigations: • Radiological Evaluation • CXR, Plain AXR • Angiography	Signs & symptoms: (**3Fs**) • **F**lank abrasion • **F**racture of the ribs • **F**racture vertebral-transverse process Investigations: • IVU • CT Scan
Treatment + management	ABCDE (**stabilize patient**)	ABCDE (**stabilize patient**)	Minor injuries: • US, drainage, AB Severe injuries: • Partial or total nephrectomy
Non operative approach	CT in stable patient. Non operative Criteria for CT: 1. Simple hepatic laceration 2. No active bleeding 3. Intraperitoneal blood loss<250ml 4. Absence of intraperitoneal injury requires surgery	(**Practiced in Pediatric trauma**) Criteria for the Approach: • Hemodynamically stable • No peritoneal findings • Requirement of blood < 2U	
Operative approach	1. Persistent hypotension despite Fluid resuscitation (blood loss). 2. Laparotomy for trauma explored through midline incision.	Decision for splenectomy is made after assessing + grading the injury.	

Questions

1- 36 years old male involved in a road traffic accident, which of the following retroperitoneal organ can be affected ?

A. Liver
B. Spleen
C. Urinary bladder
D. Duodenum

2- At which of the following cases should we perform a laparotomy ?

A. A patient with hematemesis
B. A patient with hypovolemic shock that responds to fluids.
C. A patient with evisceration of viscous
D. A patient with metastatic kidney tumor

3- After a fight, a 24 years old female patient came to the ER with a knife in the right side of her abdomen. Which of the following organ is the most likely organ to be affected ?

A. Right kidney
B. Right hemicolon
C. Liver
D. Right ovary

4- A 47 years old male patient came to the ER with left hypochondrial injury, after performing US, it showed that he has a splenic injury. Which of the following can be used as a diagnostic and therapeutic test ?

A. CT with contrast
B. Angiography
C. Laparoscopy
D. MRI with contrast

5- A 41 years old male patient presented to the ER with a blunt injury after falling from the 3rd floor for a suicidal attempt. Which of the following organs is the most common organ to be affected ?

A. Spleen
B. Kidney
C. Liver
D. Uterus

6- Which of the following will increase the risk of both complications & mortality in a patient with traumatized liver ?

A. Extrahepatic hematoma
B. Hyperglycemia
C. Hypoglycemia
D. Enterocutaneous fistula

7- which of the following can be considered as a Grade IV in liver trauma ?

A. Extensive intraparenchymal injury requiring inflow occlusion
B. Juxtahepatic venous injury
C. Major intraparenchymal but not requiring inflow occlusion
D. Injury that can be managed by superficial suture

8- Which of the following can be used adjunct to primary survey ?

A. Echocardiography
B. Electrocardiography
C. Chest X-Ray
D. O2 supply

ANSWERS :

1: D 2: C 3: C 4: B 5: A 6: C 7: A 8: B