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
- Team 434

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Once you stop learning
you start dying.

Overview

- Good example of trauma is RTA major and most important cause
- Trauma remains major cause of death after IHD and malignancy ⅓ of the ED pts are trauma pt
- Trauma is the leading cause of death in people aged 1-35 years why? Because they're active in this age, young and healthy (the producing age)
- Trauma given a larger group of people per minute disability if they don't die they'll be disable
- 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.

NOTE:

How to reduce the incidence of trauma?

1. Prevention

Individuals: checking the car (tires, brake, oil, airbags)

Government: Providing and maintaining traffic lights

Registration: speed control ساهر "if you don't obey, you will pay'

2. After it happens

In the case of an RTA your job is to help by calling an ambulance, do not try to pull the passengers out unless they are trained to do so, otherwise they will cause more damage and I've seen this

3. The medical role

Ambulance:

-Well equipped car and trained paramedics

-It is the triage area

-They inform the hospital so that they are ready for the patients

Hospital:

Primary and secondary survey

- The failure to manage the abdominal injuries accounts for majority of **preventable** death following multiple injuries. A pt who comes to the ED walking after trauma and you think nothing's wrong with him and you didn't take a proper Hx of the trauma, PEx or investigate! You send the pt home and he'll come back after hours dead!!
- The primary management of abdominal trauma is determination that an intra abdominal injury EXISTS and operative intervention is required. If you stick to this statement you will save lots of lives!

True story: people fighting and got hit on the head and abdomen and comes walking with the police to the ED, you examined him and found a wound and stitched it up and discharged him. After 3 hours the police brings him dead!! He had an internal bleeding (hemorrhage) and you missed it!

*ALWAYS think that the trauma pt who's walking into you ER needs surgery! Until proven he's fine
If you keep this in your mind you'll prevent morbidity, mortality and disability.

Classification of trauma according to mechanism: blunt and penetrating are the most common

1. **Blunt** from crashes due to high speed (the commonest)
2. **Penetrating**
3. **Burns** chemical and fire
4. **Blast** in the war very rare now

Abdominal Trauma

No need for a diagnosis this patient is stabbed! But if you look there is no airway management and no oxygen he's breathing normally *ABC done*

What do we do for this patient?

1. Decide the possibilities: between right hypochondrium and right lumbar, what is likely to be injured? Liver? Bowel? Kidney?
2. CBC, electrolytes and cross matching, there is no need for further investigations
3. Immediately to the OR, open him and reach to the site of injury (the knife will be your guide), and only then you can take out the knife; because if it is blocking major vessels, (NEVER take out the knife) taking it immediately the patient may end up in shock

- 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

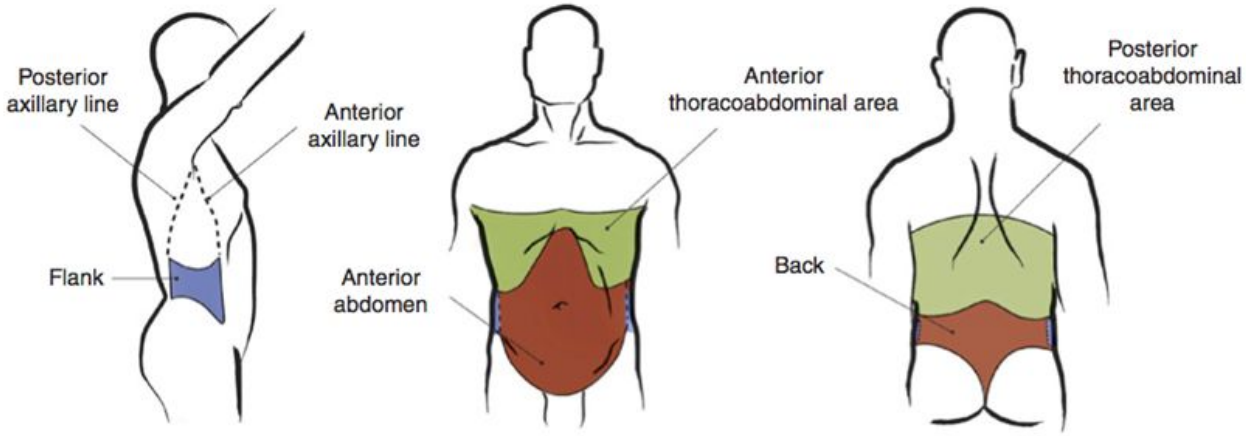
Types:

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

Anatomical regions of the abdomen:

- **Peritoneum**
  - **Intrathoracic abdomen**
    - Contents: liver, spleen, and stomach, pancreas
  - **True abdomen**
    - It is the accessible part during PEx.
- **Retroperitoneum**:
    - Content: kidney, pancreas, part of colon

  Retroperitoneal trauma is rare because it is difficult to reach
  Once it reaches the pancreas, it means that the patient is in a bad shape
- **Pelvic abdomen**
    - Contents: bladder, genital system of female

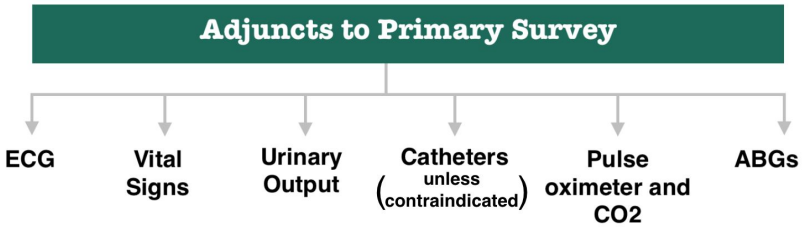


Hospital care and diagnosis:

Primary survey:

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

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



Secondary survey:

- History:
  - Blunt abdominal trauma.
  - Penetrating abdominal trauma could be by knife, gun or iron bar
- Physical examination:
  - General physical Examination most important, then go the region of priority
  - Examination of the abdomen:
    - Inspection
    - Palpation
    - Percussion
    - Auscultation
    - Rectal Examination
    - Vaginal Examination

Diagnostic procedures

- Blood tests for every pt
- Radiological Studies (Plain abdominal X-ray , CXR)
- Peritoneal lavage (DPL)[1]
- USG abdomen (FAST)
- CT abdomen
- Peritoneoscopy (Diagnostic laparoscopy)
- You don't need to do everything, just CBC, urea and electrolytes and crossmatching, unless you found something else

When should we do for a laparotomy[2]?

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 tenderness, rigidity or abdominal distention ⇒ take pt to OR
- Unexplained shock you gave fluid and blood but still pt is in shock ⇒ take pt to OR
- Evisceration of viscous stab wound and the bowel is out ⇒ take pt to OR
- Positive diagnostic Peritoneal Lavage (DPL) if you do DPL and blood comes out ⇒ take pt to OR
- Determination of finding during routine follow up stable trauma patient and you find hematoma on CT in spleen/liver, and admit him for conservative management, after 2-3 hours they call you and he's in shock ⇒ take pt to OR

[1]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.
[2] laparotomy is a surgical procedure involving a large incision through the abdominal wall to gain access into the abdominal cavity.

Specific Organ Trauma

Peritoneal
- Liver
- Spleen
- Bowels

*Liver, spleen and kidney are the solid organs of the abdomen

Retroperitoneal
- Pancreas
- Duodenum
- Bowel
- Vascular (IVC, aorta)
- Kidneys
- Ureters

Genitourinary
- Urinary bladder
- Urethra
- Female genital area

Liver Trauma

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

The pic: the knife is going very deep, this is a major penetrating injury in the RUQ

1. Looking at the possibilities, ureter, major blood vessels (since it is very deep), liver, kidney and bowel.
2. CBC, electrolytes and cross matching
3. Open IMMEDIATELY and very carefully (laparotomy)

Mechanism of injury

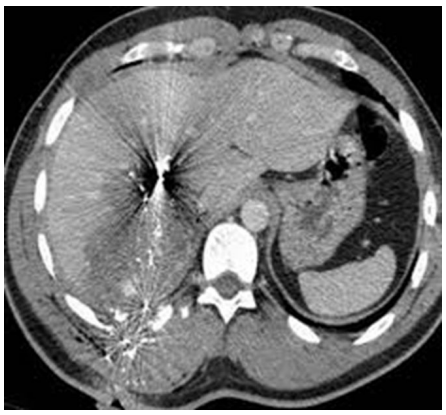
- Hepatic injuries result from direct blows, compression between the lower ribs on right side and the spine or shearing at **fixed points** secondary to deceleration
- Any penetrating gunshot, stab or shotgun wound **below the right nipple** on right upper quadrant of the abdomen is also likely to cause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

Diagnosis:

- Diagnosis is often made at laparotomy with penetrating injuries, often requiring immediate surgery
- Patients with blunt Trauma who remain in shock or present with abdominal rigidity <u>also require laparotomy</u>

- **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 (like the pic) →patient should be taken to the OR without delay. Most informative
     - If DPL is negative, we push 1L normal saline into the peritoneal cavity then suck it back, if it was red → it is +ve, if fecal material or bowel content is there → it is also +ve (bowel perforation)
     - DPL is <u>**not used**</u> when the patient is <u>**stable**</u>, we use CT instead
     - DPL is rarely done nowadays, we usually rely on US because it is easy, cheap and really good
     - **N.B:** DPL used in In patient with shock or abdominal distention (means pt is bleeding)
  3. **CT Scan abdomen** used for diagnosing intra peritoneal injuries in <u>**stable patients**</u> after blunt trauma.

Liver and spleen contusion
No blood or air in the peritoneum
If the pt is stable admit and treat conservatively



Gunshot which fractured the rib and the bullet * stopped in the liver
No blood or air in the peritoneum
If pt stable admit and treat conservatively
Don't remove the bullet unless the pt is unstable

* High speed bullets are sterile due to its high speed (makes it so hot) which will burn the tissue around it and stop the bleeding (like a cautery), that's why we don't need to remove it.
When do we need to remove the bullet ?

- Bowel injury
- Splenic injury
- Other indications for opening the pt مره وحده احنا بنفتح المريض ونشيل الرصاصة

Treatment:

When patient arrives to 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:** conservative management
  - The hepatic injury diagnosed by CT in **stable** patient is now non operative approach practiced in many centers
  - **CT criteria for nonoperative management:**
    - Simple hepatic laceration OR intrahepatic hematoma
    - No evidence of active bleeding (no blood in the peritoneal cavity)
    - Intraperitoneal blood loss less than 250 ml
    - Absence of other intraperitoneal injuries required surgery don't open the pt if there's no other injuries except the liver

- **Operative approach:** you gave the pt enough amount of fluid but BP is still decreasing (Shock) & the abdomen is distended → OR على طول
  - Persistent hypotension, despite adequate volume replacement, suggests ongoing blood loss and mandates immediate operative intervention
  - All patients undergoing laparotomy for trauma should be explored through midline incision because you do not know where is the lesion

Classification of Injury:

Grade I	Simple injuries – non bleeding simple laceration or contusion
Grade II	Simple injuries managed by superficial suture alone if you open the patient
Grade III	Major intraparenchymal injury with active bleeding but not requiring inflow occlusion (Pringle maneuver[3]) to control haemorrhage
Grade IV	Extensive intraparenchymal injury with major active bleeding requiring inflow occlusion for hemostatic control
Grade V	Juxtahepatic venous injury (injuries to retrohepatic cava or main hepatic veins) portal vein injury rarely seen because they die in the spot

Managing different grades of injury:

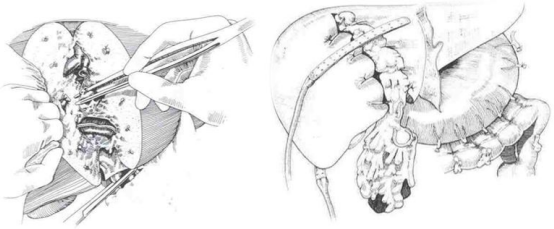
Overall grade 1 & 2 are treated conservatively unless opened for something else, grade 3 & 4 needs surgical intervention.

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 [4]

Grade III:

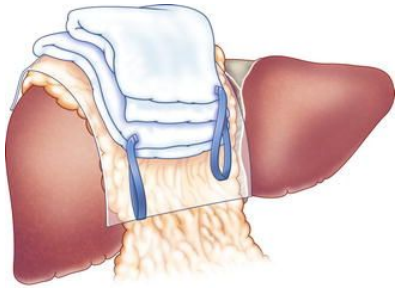
- Major intraparenchymal injuries with active bleeding can best be managed by **Finger Fracturing** the hepatic parenchyma and ligating or repairing lacerated blood vessels & bile ducts under direct vision, we open the liver more and start ligating blood vessels, we clean and put omentum (in case you can't use the omentum i.e. used in other surgeries, any hemostatic agent can be used (surgicel)) in the middle, as seen in the pictures



Grade IV:

- Extensive intra parenchymal injuries with major rapid blood loss require occlusion of portal trial to control hemorrhage
- Advanced Techniques of Repair are all performed with Pringle Maneuver in place
- You may need to debride the liver, or remove one lobe/ segment, A major surgery

Possible surgeries in this case:



- Extensive hepatorrhaphy liver repair -rrhaphy means suture
- Hepatotomy with selective vascular ligation
- Omental pack
- Resectional debridement with selective vascular ligation
- Resection
- Selective Hepatic Artery Ligation
- Perihepatic packing suppose the incident happened in حريملاء and the patient has grade III or IV injury and the small hospital isn't equipped for the surgery, what do they do? They pack (with pads) and close the patient's abdomen and patch the liver to stop the bleeding, then send him to the nearest equipped hospital in Riyadh

[3] 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.

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

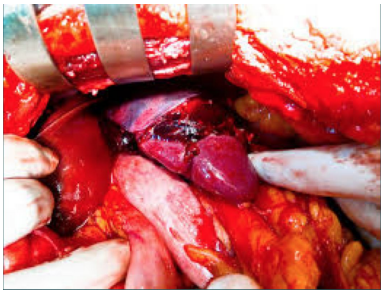
Complications & Mortality:

- Recurrent bleeding
- Hemobilia bleeding into the biliary tree
- Perihepatic abscess
- Biliary Fistula
- Intrahepatic Haematoma
- Pulmonary Complications
- Coagulopathy 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 because now the functions (immunology and reticuloendothelial system) of the spleen are well recognized, so we try to salvage it as much as we can.
- Now recognized as an important immunologic factory as well as reticuloendothelial filter. Although the risk of overwhelming postsplenectomy sepsis (OPSS) is greatest in child less than 2 yrs recognition of OPSS has stimulated efforts to (**Conserve** spleen) by splenorrhaphy



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 injured the spleen for example the surgeon is operating on the stomach and he injures the spleen
- The Magnitude of splenic disruption depend on patient age, injury mechanism and presence of underlying disease

Classification according to pathologic anatomy:

Grade I	Subcapsular hematoma
Grade II	Sub segmental parenchymal injury
Grade III	Segmental devitalization
Grade IV	Polar disruption
Grade V	Shattered or devascularized organ

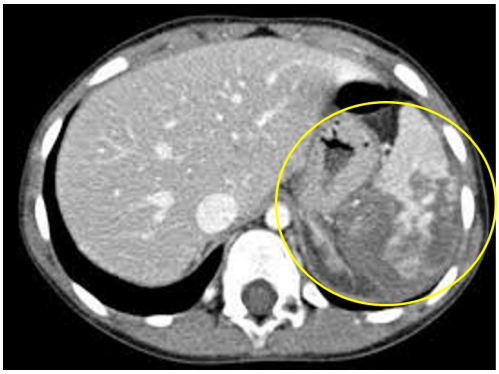
AAST spleen injury scale

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
        - Balance's sign : LUQ mass hematoma
- **Diagnostic tests:**
    - Radiological Evaluation necessary
    - CXR necessary
    - Plain abdominal X-Ray necessary
    - CT Scan for grading the injury (if the patient is stable)
    - Angiography best, both diagnostic and therapeutic

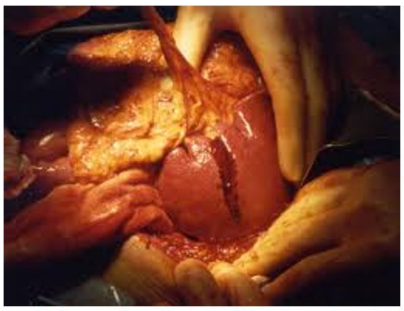
If CT or US shows a splenic injury we do angio to block the vessel



Treatment:

Initial Management: Resuscitation (ABCDE)

- **Non operative approach:** conservative
    - Widely practiced in pediatric trauma
    - The criteria for nonoperative approach:
        - Hemodynamically **stable** children or adults
        - Patients **without** peritoneal finding at anytime no tenderness or rigidity.
        - Those who did **not** require greater than two unit of blood.



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

- **Contraindications to splenic salvage:** (remove the spleen)
    1. The patient has protracted hypotension suppose you opened the patient and found liver, spleen and bowel injuries, you start then the anesthetic tells you they already gave 6 units, if you don't hurry the patient will die. What do you do? You remove the spleen to save time and the patient's life
    2. Undue delay is anticipated in attempting repair the spleen
    3. The patient has other severe injury

- **Operative approach:**
    - Decision to perform splenectomy or splenorrhaphy is made after assessment and grading of the injury

Post splenectomy and splenorrhaphy complications:

- **Early complications:**
    1. Bleeding
    2. Acute gastric distention
    3. Gastric necrosis short gastric arteries might be injured during ligation
    4. Recurrent splenic bed bleeding
    5. Pancreatitis remember that the tail lies in the hilum
    6. Subphrenic abscess

- **Late complications:**
    1. Thrombocytosis liable to have DVT
    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 occur, can be treated by **conservative** therapy. • If hematuria presence, a poor indicator of severe renal injury.

Diagnosis	• Symptoms and signs (3 Fs): If theses 3 are positive then the kidney is injured.
	  ○ Flank abrasion. Laceration around the flanks
	  ○ Fracture of the ribs at least 3 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.

Left kidney shattered but the pt is stable! Why? The kidney is retroperitoneal (paced) so he won't bleed but he'll need a nephrectomy eventually

Contrast should not be used

Pancreatic injury:

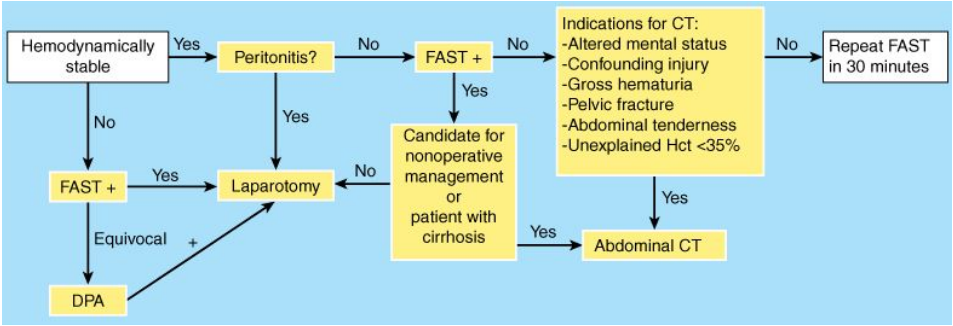
A major trauma to the pancreas is the surgeons worst nightmare, hell need to do a whipple procedure (pancreaticoduodenectomy)

Bowel injury:

Blood supply affected → ischemia → gangrene → bowel resection and anastomosis
A small bowel perforation → suture it

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 :

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

MCQS

1) A trauma patient presented with a blood pressure of 80/60 mmHg. The trauma team has done a DPL and it was positive. What is the next step?

A. FAST
B. Laparotomy
C. Plain x-ray
D. Observation

2) In abdominal injuries, the most informative initial investigation is?

A. CT
B. Ultrasound
C. Diagnostic peritoneal lavage
D. Abdominal x-ray

3) 32 year old man injured in motor vehicle accident with sustained trauma to the left-upper quadrant. He was brought to the ER from the site of accident in an ambulance. He complaints of pain left upper abdominal with increase in intensity when in erect position. He has sustained lacerations to both arms, left knee and ankle. No signs of fracture in arm or leg.
On examination: Patient is conscious and oriented, afebrile with pulse rate of 112/minute, blood pressure: 100/50 mmHg (IV fluids were transfused on way to the ER), b/l pupil reactive to light.
On palpation of abdomen: tenderness and slight guarding were noted in the left upper quadrant.
What is the appropriate next line of evaluation in this patient?

A. Plain radiograph abdomen
B. Focused Assessment with Sonography in Trauma (FAST)
C. Diagnostic peritoneal lavage
D. Observe the patient for the next 24 hours.

4) A 10-year-old boy was the backseat belted passenger in a high-speed motor vehicle collision. On presentation to the ER, he is awake, alert, and hemodynamically stable. He is complaining of abdominal pain and has an ecchymosis on his anterior abdominal wall where the seatbelt was located. Which of the following is the best next step in his management?

A. Discharge him home without any other workup
B. Discharge him home if his amylase level is normal.
C. Discharge him home if his abdominal plain films are negative for the presence of free air.
D. Discharge him home if an abdominal computed tomography (CT) scan is negative.
E. Observe him regardless of negative test results

5) 36 year old man who was hit by a car presents to the ER with hypotension. On examination, he has tenderness and bruising over his left lateral chest below the nipple. An ultrasound examination is performed and reveals free fluid in the abdomen. What is the most likely organ to have been injured in this patient ?

A. Liver
B. Kidney
C. Spleen
D. Intestine
E. Pancreas

6) A 56-year-old woman sustains blunt abdominal trauma from an assault. Her blood pressure is 107/56 mm Hg and her pulse is 92. She complains of abdominal pain. She undergoes CT scanning of the abdomen and pelvis, which demonstrates a splenic injury. Which of the following would preclude an attempt at nonoperative management of the patient?

A. Presence of a subcapsular hematoma involving more than 25% of the surface area of the spleen
B. Presence of a subcapsular hematoma involving more than 50% of the surface area of the spleen
C. Evidence of a blush on CT scan
D. A red blood cell (RBC) count of 120,000/μL on diagnostic peritoneal lavage
E. Peritoneal signs on abdominal examination

Answers: 1- B 2- C 3- B 4- E 5- C 6- E