

Specific organs trauma

We advise you to study trauma care lecture
before studying this lecture

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Color Index:

● Important

● Doctor's Notes

● Extra

● Davidson's

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Objectives:



Introduction:

- Solid organ injury is a leading cause of significant morbidity and mortality following injury.
- The abdomen has large surface area so the chances of it being injured is high. Also, this cavity has a huge potential space and this is vital when it comes to bleeding as there is less pressure to contain it so you can bleed most of your blood volume if no body interfered to stop the bleeding
- The most likely organs to be injured in the abdomen are the solid organ injuries which are the Spleen and the liver. It takes a greater force of trauma to injury the small bowel since it is mobile..
- Identification of serious solid organ injury may be challenging.
- Many injuries, however, manifest during the initial assessment and treatment period. Thus, early identification is essential.

Classification of trauma according to mechanism:

1. Blunt
2. Penetrating
3. Burns
4. Blast

Initial Assessment and Resuscitation:

Primary Survey: Identification and treatment of life threatening injuries.

- Airway with cervical spine precautions the patient is unconscious? If yes You intervene
- Breathing does he have hemothorax? Pneumothorax? You intervene
- Circulation (with hemorrhage control) in trauma if the patient is Hypotensive this means that he is bleeding, your job is to identify the site
- Disability
- Exposure /environment control

Adjuncts to primary survey (After primary survey is done):

- Vital signs
- ECG
- Urinary Output
- Catheter (unless contraindicated)
- Pulse Oximeter and CO2
- ABG

Abdominal assessment: (secondary survey)

Vital Signs for your blood pressure to drop, you must lose 40 to 50%. I.e 2~2.5 of your blood! What sites in the body in which someone can lose this amount of blood? Think of the chest, abdomen, pelvis and long bones (thigh fractures); or open wounds that bleed massively. Most of the times we think of the abdomen.

History:

Blunt abdominal trauma.

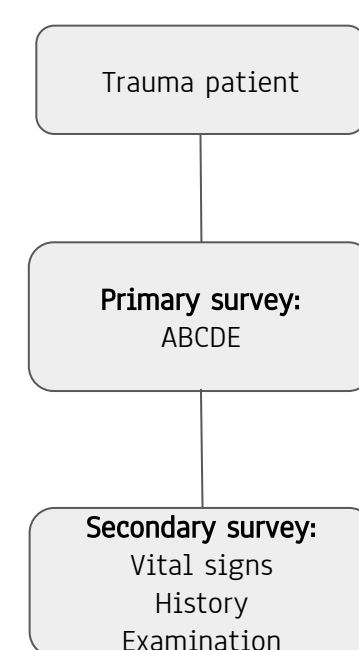
Penetrating abdominal trauma

Physical exam: In trauma the abdomen becomes distended because of bleeding (hemoperitoneum) not because of Ascites. However, the exact organ can't be determined by physical exam in most of the times

General physical Examination.

Examination of the abdomen:

- Inspection
- Palpitation
- Percussion
- Auscultation
- Rectal examination
- Vaginal examination



Diagnostic procedures for abdominal trauma:

- Blood tests
- Radiological Studies (Plain abdominal X-ray , CXR)
- **Diagnostic Peritoneal lavage (DPL/DPA) Most informative initial investigation. Used to be done previously.**
- FAST Focused Assessment with Sonography in Trauma (Abdomen Ultrasound) **has become the standard of care nowadays as the initial modality if the patient is unstable**
- Abdomen/Pelvis CT **gold standard!!! But can't be done if the patient is unstable**
- Peritoneoscopy (Diagnostic laparoscopy).

Extra

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 ex:penetrating injuries requiring immediate Surgery.

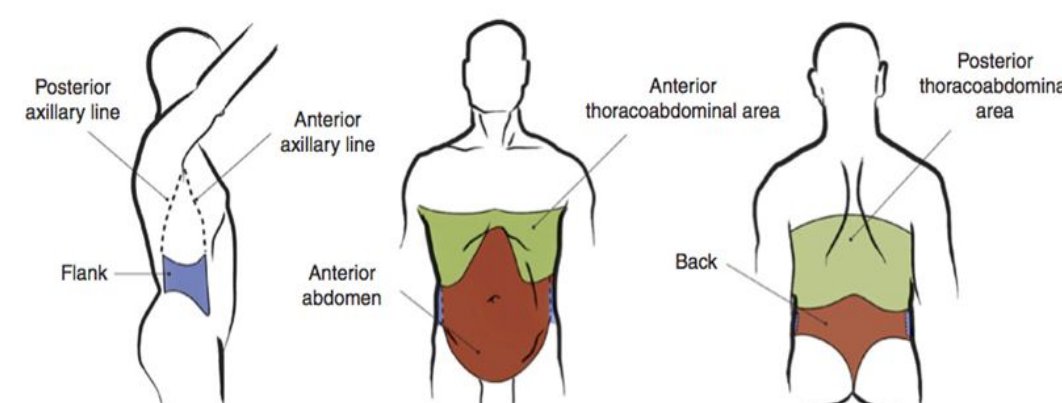
Types:

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



Anatomical regions of the abdomen (You have to know these areas because the blood in case of trauma will accumulate in these cavities +if you know the areas you can suspect which organ is damage)

- **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



When should we do a laparotomy

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

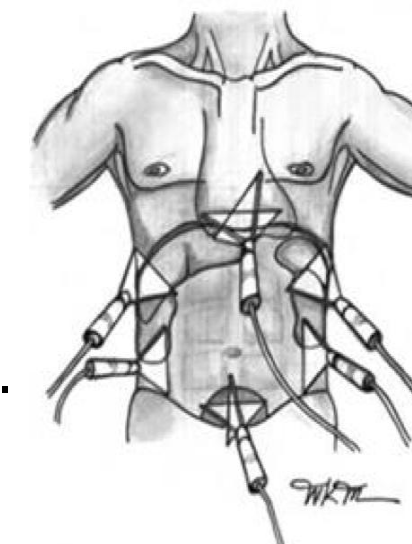
- **Signs of peritoneal injury (when you examine the abdomen and there is tenderness and rigidity).**
- **Unexplained shock (you give fluid and your patient is still in shock).**
- **Evisceration of viscous (the bowel is outside the body).**
- **Positive diagnostic Peritoneal Lavage (DPL) (More than or equal to 10 cc blood aspirated)**
- **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).**

These indications were in last year slides but the doctor said we mainly focus on the hemodynamics stability of the patient if he is not stable take him to the OR +presence of intra abdominal pathology which can be detect by Imaging (CT or US)

DPL: we put a catheter in and we insert 1 Liter of normal saline, then we take the sample and send it for biochemistry and they tell us about the amount of RBCs in the normal saline if **large amount of blood comes out then it's indicative of bleeding.**

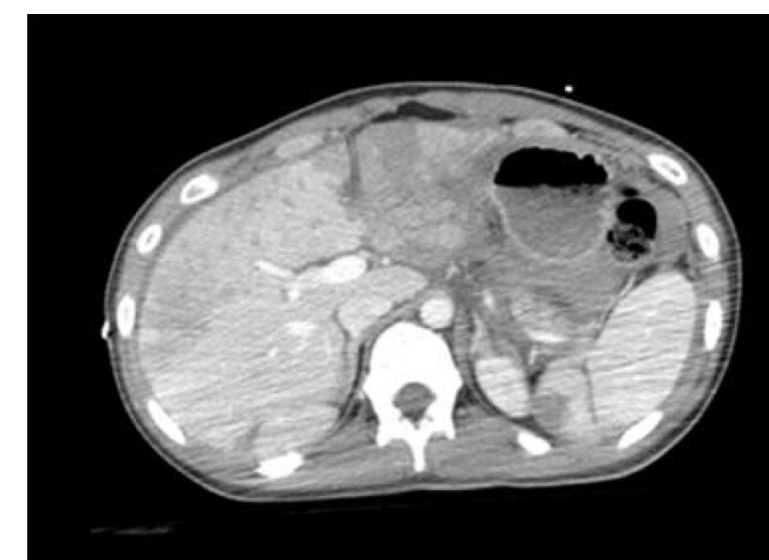
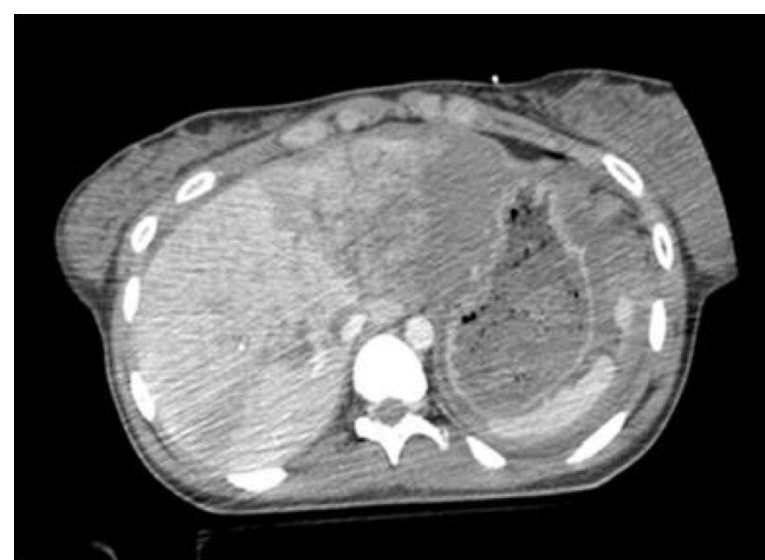
Focused Assessment with Sonography in Trauma (FAST)

- First used in 1996
- Rapid
- One of the major advantages of FAST or EFAST over other imaging is that it may be performed as part of the primary survey without interfering with the initial assessment and management of ABCDE issues.
- Sensitivity 86-99%
- May be able to detect as little as 100 ml of blood
- Cost effective
- Views: Pericardiac to rule out tamponade, perihepatic, perisplenic, and peripelvic spaces.
- User dependent with inherent limitations of ultrasound.
- Useful in unstable patient. Stable? Do CT scan
- Patient came to the ER after a car accident or after falling from a high floor, we did him FAST and we found fluids in the abdomen, is it Ascites? NO!! It's blood.. If there's no fluids yet the patient is unconscious, then the bleeding is somewhere else



CT Scan:

- Gold standard.
- Hemodynamically normal patients!
- Provides excellent imaging of solid organs (liver and spleen).
- Determines the source and amount of bleeding (angio phase).
- Reveals associated injuries: pancreas, genitourinary.
- Poor for hollow viscous injury. E.g stomach, small bowel, renal, and colon injuries can be missed by CT scan



There is bleeding between the stomach and the liver

Solid Organ Injuries:

- The most common organs to be injured in the abdomen
- Difficult to diagnose on physical exam
- May lead to significant blood loss
- Grading of solid organs dependent on degree of hematoma, laceration, or avulsion. Most grade 1's the bleeding may stop on its own thus you do not need to operate.
- The grade correlates with the level of treatment that we have to give.
- Injuries may present late, leading to further difficulty in assessment and management. Which creates a dilemma in whom to scan.
- The most common solid organs injured spleen and liver.
 - The commonest organ injured in case of penetrating trauma
- 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.

Extra

Specific organ trauma

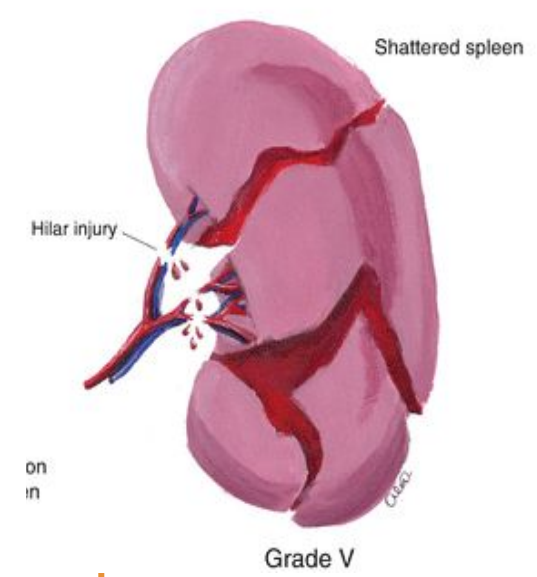
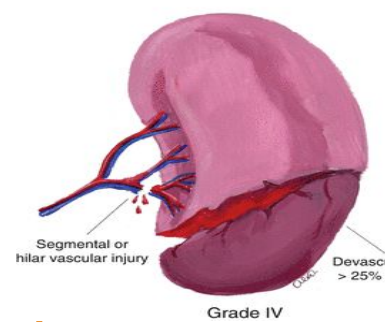
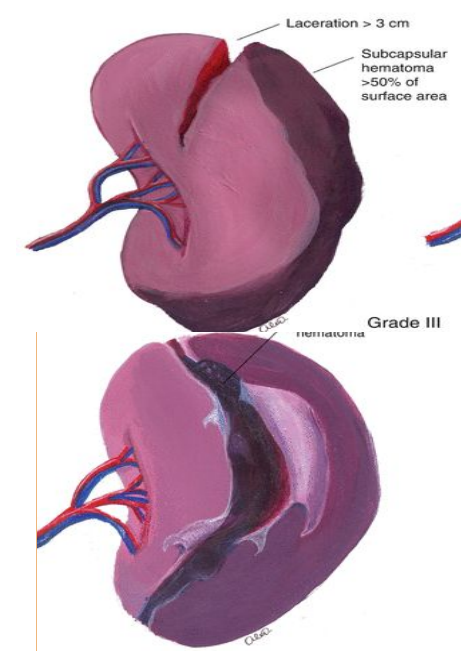
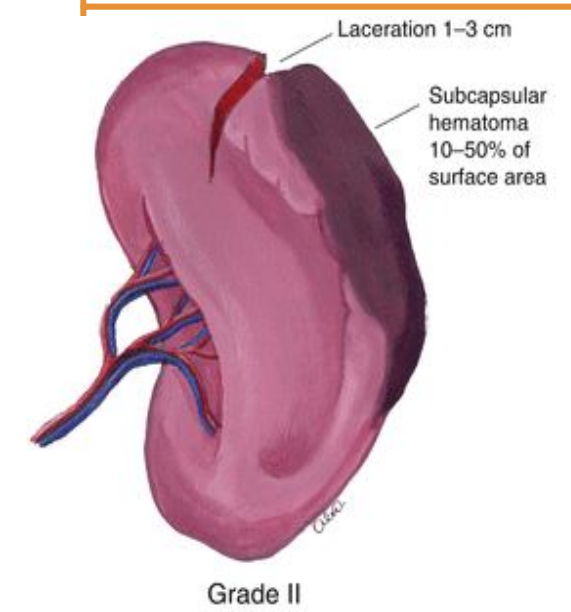
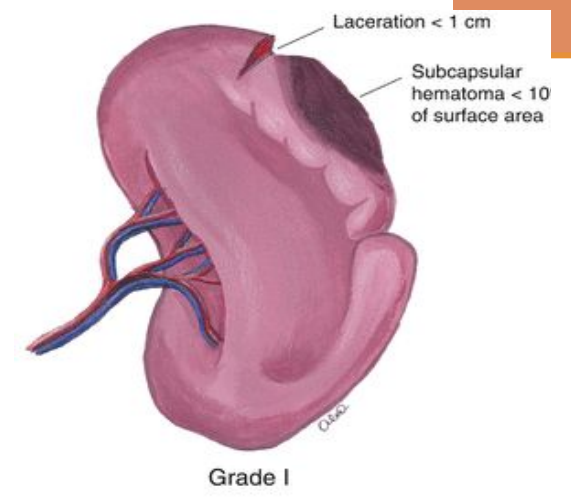
Type	Liver trauma	Splenic trauma	Renal Trauma
Mechanism of injury	<p>1.direct blows, compression between lower ribs on Rt side & spine or shearing at fixed points 2ndary to deceleration.</p> <p>2.gunshot, shotgun, stab wound below right nipple</p>	<p>1.blunt abdominal trauma</p> <p>2.Gunshots, stabs(laceration)</p> <p>3.LUQ Surgery (2%)</p>	<p>Displant kidney injury caused by: Rugby or An accident</p>
Diagnosis + investigation	<p>1.Clinical manifestations</p> <p>2.FAST (in Unstable patients)</p> <p>3.(DPL) if the patient in (shock, distention)</p> <p>4.CT abdomen (stable patient)</p>	<p>→ Patient History</p> <p>→ P.E:</p> <ul style="list-style-type: none"> ● LUQ bruising ● LL ribs fracture ● Kehr's sign(Shoulder tip pain) ● Ballance's sign(LUQ mass) <p>→Investigations:</p> <ul style="list-style-type: none"> ● Radiological Evaluation ● CXR,FAST ● Angiography (diagnostic and therapeutic as we can use it for embolization if the patient is bleeding before we take the patient for surgery). 	<p>Signs & symptoms: (3Fs)</p> <ul style="list-style-type: none"> ● Flank abrasion ● Fracture of the ribs ● Fracture vertebral-transverse process <p>Investigations:</p> <ul style="list-style-type: none"> ● IVU ● CT Scan
Initial management	<p>ABCDE (stabilize patient)</p>	<p>ABCDE (stabilize patient)</p>	<p>Minor injuries:</p> <ul style="list-style-type: none"> ● US, drainage, AB <p>Severe injuries:</p> <ul style="list-style-type: none"> ● Partial or total nephrectomy
Non operative approach	<p>CT in stable patient.</p> <p>Non operative Criteria for CT:</p> <ol style="list-style-type: none"> 1.Simple hepatic laceration 2.No active bleeding 3.Intraperitoneal blood loss<250ml 4.Absence of intraperitoneal injury requires surgery 	<p>(Practiced in Pediatric trauma)</p> <p>Criteria for the Approach:</p> <ul style="list-style-type: none"> ● Hemodynamically stable ● No peritoneal findings ● Requirement of blood < 2U 	
Operative approach	<ol style="list-style-type: none"> 1.Persistent hypotension despite Fluid resuscitation (blood loss). 2.Laparotomy for trauma explored through midline incision. 3.Major Intrahepatic injury 	<p>Decision for splenectomy is made after assessing + grading the injury.</p>	

Splenic Injuries



" I do not expect you to memorize but you need to understand the concept ," Grades 4-5 are considered to be high level grades as opposed to 1,2,3 which are treated nonoperatively most of the time.

Grade	Type of injury	Description
I	Hematoma	Subscapular , < 10%
	Laceration	Capsular tear , < 1cm in depth
II	Hematoma	Subscapular , 10-50% , < 5cm diameter
	Laceration	Capsular tear , 1-3cm in depth
III	Hematoma	Subscapular , >50% , ruptured ; intraparenchymal hematoma > 5cm
	Laceration	> 3cm in parenchymal depth or involving trabecular vessel
IV	Laceration	Segmental or hilar vessels, major devascularization (>25%)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury that devascularizes the spleen

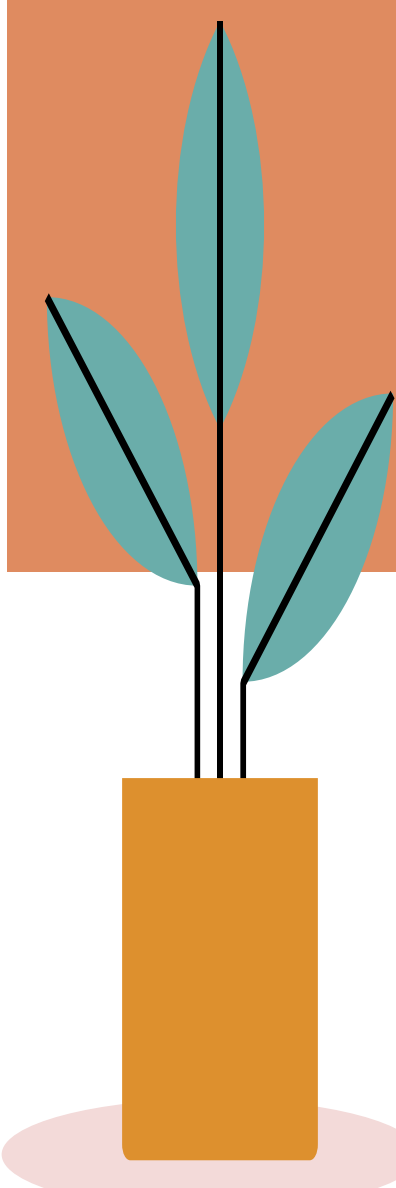
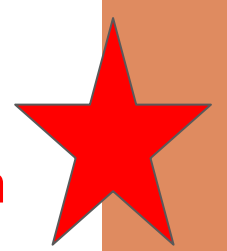


Non Operative management

- We do not depend on the grading to decide the appropriate treatment. We rely on the patient's stability.
- Post traumatic hemodynamically unstable patients having intra-abdominal pathology detected by FAST or physical exam require immediate laparotomy: Splenectomy.
- Non-operative management is an option in the hemodynamically stable patient ONLY. He is stable thus we can scan him by CT to know the site of the pathology then you treat them non-operatively.
- No patient should die as a consequence of non-operative management.
- Intensive monitoring the patient has to be monitored either in the ICU or High dependency unit.
- Serial clinical exam, Hgb level. A stable patient may start bleeding at any time thus serial (continuous test has to be done for them. Another reason is that the nonoperative management can fail in that case we will rush them to the OR.
- High grade injury patients may require angiography (could be done in the OR or alternatively by the interventional radiologists) +/- angioembolization to improve success rates.
- Patients are told to avoid contact sports for a period of time (up to 7 weeks). Until the organs heal which is a downside to NOM because the organs could get injured again after contact sports.
- If the patient becomes hemodynamically unstable, or requires multiple transfusions, then this is considered failure. You should never treat nonoperatively if there is no blood in the hospital.
- Failure of NOM > laparotomy and splenectomy.(The chance of NOM failure is higher in the first 24-48 hrs and with higher grade)

Complications of NOM:

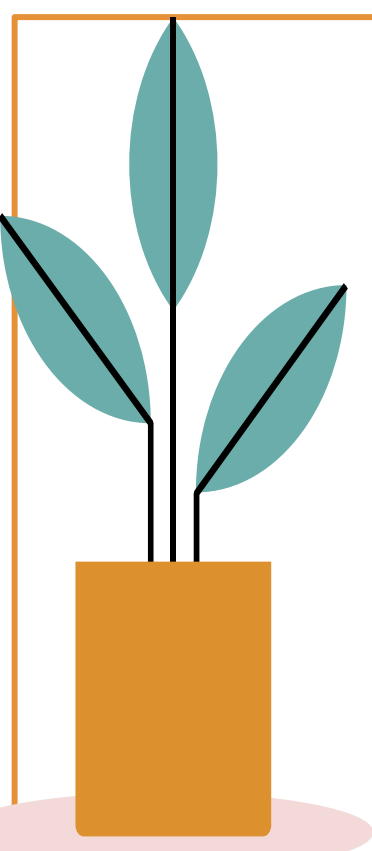
- Failure!
- Splenic ischemia, infection, abscess.
- Chronic pain



Liver Injuries

Unlike the spleen, the liver shouldn't be taken out because people can't live without their liver thus you have to spend time trying to stop the bleeding. The classification depends on the hematoma or laceration. As the hematoma gets bigger, the laceration gets deeper and the grade gets more. Worst are grades 5&6 ..

Grade	Type of injury	Description
I	Hematoma	subcapsular, <10% surface area
	Laceration	capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10-50% surface area. Intraparenchymal <10 cm diameter
	Laceration	capsular tear 1-3 cm parenchymal depth, <10 cm length
III	Hematoma	Subscapular, >50% surface area of ruptured subcapsular or parenchymal haematoma. Intraparenchymal >10 cm or expanding
	Laceration	capsular tear >3 cm parenchymal depth
IV	Laceration	parenchymal disruption involving 25-75% hepatic lobe or involves 1-3 Couinaud segments
V	Laceration	Parenchymal distruption involving >75% of hepatic lobe or involves >3 couinaud segments (within one lobe)
	Vascular	juxtahepatic venous injuries (retrohepatic vena cava / central major hepatic veins)
VI	Vascular	hepatic avulsion: the whole liver is avulsed from its connections. Very fatal..



- N.b. advance one grade for multiple injuries up to grade III.
- Similarly, regardless of grade, a trial of non-operative management is appropriate for stable patients:**
- Unstable patients laparotomy : packing, packing + angio, deep liver sutures, balloon tamponade, hemostatic agents, hepatic artery ligation.
 - **Laparotomy** for continued blood loss with hypotension, tachycardia, decrease urine output, and decreasing HCT.
 - **Operativerate rate :**
3-11% with multiple injuries , 0-3% when isolated. So if you only have liver injury you are less likely to be operated on. If you have more than one organ involved then the chances increase. These numbers come retrospectively so I don't depend on them to make the decision .



Biliary Tree Injury:

- The biliary tree and the liver are connected, so if you have injury to the liver the biliary system is probably injured as well
- 4% incidence of continued bile leak. Increased 10 fold in Grade IV and V injuries.
- ERCP with decompression and stenting may be both diagnostic and therapeutic.
- May require operative washout for delayed bile leak and peritonitis.
- **Minor injury to the small radicles? It will stop bleeding on its own and sometime we have to drain. However, if it did not stop on its own we have to do an ERCP and put to a stent to release the tension from the ampulla of vater and allow the bile to drain down the biliary tree to the duodenum . Otherwise the bile will escape into the abdomen.**

Other Complications:

- Failure! To the OR! Unstable? OR
- Liver ischemia, infection, abscess
- Biliary leak, biloma, peritonitis.



Bowel injury: it's the third organ in the abdomen that we care about.

<p>Bowel injury Can be resulted from</p>	<ol style="list-style-type: none"> 1. Blunt Trauma (difficult to identify) 2. Penetrating Trauma : Stab ,Gunshot (immediately take the pt to the OR!) 3. Operative
<p>Mechanism of Injury can be Either</p>	<ul style="list-style-type: none"> • Crushing: Compression in blunt injury The bowel is like a balloon. The walls become stretched then rupture • Shearing: Sudden Deceleration Happens when you have one organ is fixed like the duodenum while the other organ is mobile such as the small bowel. If you're going at a high speed and you suddenly stop, The fixed organ will stop earlier and the mobile organ will keep moving until it become torn. • Bursting: ↑ Abdominal Pressure goes high and it ruptures 
<p>Causes</p>	<ul style="list-style-type: none"> •Motor - Vehicle: 75% most common •Fall from Heights •Seat Belt increases your chance of survival by 50% but it puts you at a little bit higher risk of having a bowel injury •Penetrating Object once it penetrates the rectus fascia we send him to the OR.
<p>Symptoms and Signs They are unreliable and late. You have to wait until the patient develops peritonitis then you identify. Sometimes the symptoms are masked thus you must have a high level of suspicion.</p>	<ol style="list-style-type: none"> 1. Ecchymosis & Abrasions 2. Tender ribs indication of the severity of the force 3. Peritonitis <ol style="list-style-type: none"> a. Tenderness and Guarding : 75% b. Rebound and Rigidity: 28% 4. DRE : Blood from NG (watch out for oral injury), DRE. sometimes could be the only way to detect rectal involvement. Also, this helps you to know if there is a pelvis fracture <p>Symptoms and Signs: Unreliable because can be Often Masked By :</p> <ol style="list-style-type: none"> 1. Head Injury he may be unconscious thus you will not be able to detect peritonitis 2. Major Fractures 3. Alcohol it's like having anesthesia they don't feel or complain of <p>Unrecognized Bowel injury : Is a frequent cause of preventable death</p>
<p>Management (check next slide)</p>	<ul style="list-style-type: none"> • Needs operative management because you have to close it otherwise they will have peritonitis • If <50% (of the diameter of the bowel is opened) and non destructive, primary repair. Meaning that i could close it with a stitch • If >50% or destructive, resection and anastomosis



Cont.

- The problem is that it's very long because it includes the lower esophagus, stomach, small bowel, colon, and rectum. If any of these gets a **blunt** injury, the presentation will be mostly the same which makes it difficult to identify the organ involved. Thus they have to open the whole abdomen to inspect everything in the abdomen. CT scan here is less effective as it's difficult to see bowel wall to say it's injured. CT scan tells you that there is an injury only if there are other signs such as contrast leak or clear air in the abdomen. Sometimes the mentioned signs are not present. In this case if my suspicion is high I have to take him to the OR or observe the patient until he develops signs.
- However, if it's a penetrating trauma then the site of injury is clear.

Surgical 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 Im
2. AP pelvis Im

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

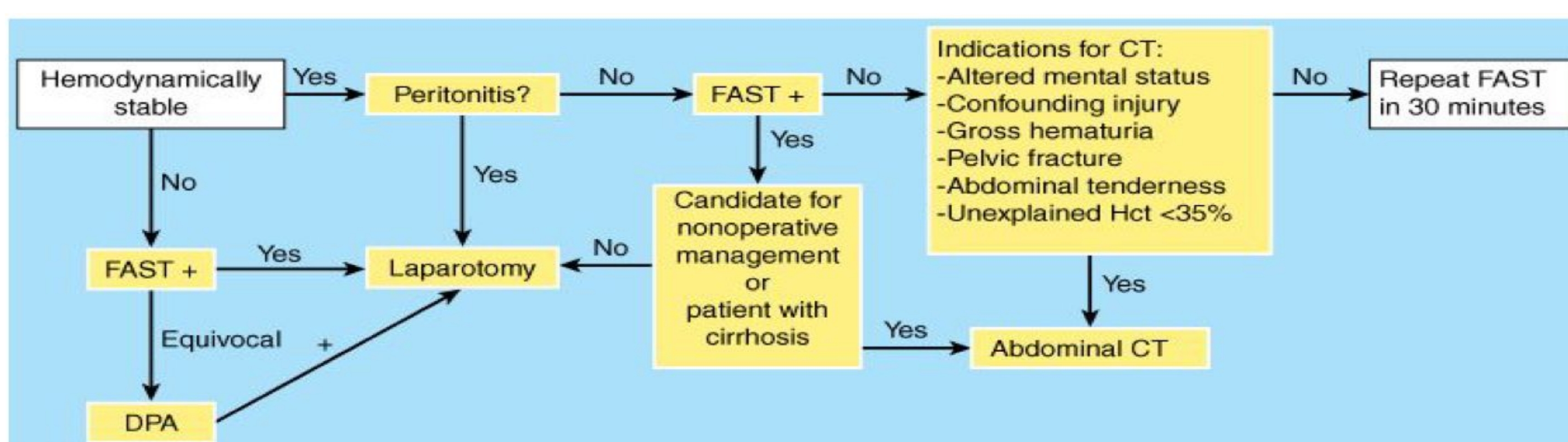
What is the evaluation of a **stab wound** to the belly?

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

Don't skip this its really helpful figure



Summary

Specific organ trauma

Initial assessment: Primary survey

Airway	Breathing	Circulation (Hypotensive? >Bleeding)	Disability	Exposure
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Abdominal assessment

Vital signs and physical exam	Investigational studies	
	Focused Assessment with Sonography in Trauma (FAST): Rapid, sensitive, Useful in unstable patient, Views: Pericardiac, perihepatic, perisplenic, and peripelvic spaces	CT Scan: Gold standard, Hemodynamically normal patients, Determines the source and amount of bleeding, poor for hollow organs.

Splenic Injuries

Immediate laparotomy - splenectomy: Hemodynamically unstable

Non-operative management: Hemodynamically stable

- Intensive monitoring, Serial clinical exam, Hgb level. High grade injury patients may require angiography +/- angioembolization to improve success rates.
- Patients are told to avoid contact sports for a period of time (up to 7 weeks).
- If the patient becomes hemodynamically unstable, or requires multiple transfusions, then this is considered failure.
- Complications: Failure, splenic ischemia, infection, abscess, chronic pain.

Liver injuries

- Unstable patients: continued blood loss with hypotension, tachycardia, decrease urine output, and decreasing HCT.
>laparotomy (packing, packing + angio, deep liver sutures, balloon tamponade, hemostatic agents, hepatic artery ligation)

regardless of grade, a trial of non-operative management is appropriate for stable patients.

Biliary Tree Injury

- ERCP with decompression and stenting may be both diagnostic and therapeutic.
- May require operative washout for delayed bile leak and peritonitis.

Complications: Failure, Liver ischemia, infection, abscess, Biliary leak, biloma, peritonitis.

Bowel Injury

1. Blunt	2. Penetrating: Stab, Gunshot	3. Operative
Mechanism	-Crushing: Compression - Shearing: Sudden Deceleration - Bursting: Abdominal Pressure	
Causes	Motor - Vehicle: 75%, Fall from Heights, Seat Belt, Penetrating	
Symptoms and Signs:	Echymosis & Abrasions, Tender ribs - Peritonitis 1. Tenderness and Guarding : 75% 2.Rebound and Rigidity: 28% - Blood from NG, DRE. Often Masked: 1. Head Injury 2. Major Fractures 3. Alcohol	
Management	<ul style="list-style-type: none"> • Needs operative management • If <50% and non destructive, primary repair. - If >50% or destructive, resection and anastomosis. 	

Quiz

1- Generalized abdominal pain following rupture of a hollow organ is MOST suggestive of:

- A. gas accumulation in the peritoneum.
- B. diffuse peritoneal contamination.
- C. severe intraabdominal bleeding.
- D. inflammation of deep nerve endings.

2- Intraabdominal bleeding may produce few signs and symptoms of trauma because:

- A. the abdominal musculature can sustain massive blunt force without bruising.
- B. the intraabdominal cavity can accommodate large amounts of blood.
- C. it takes approximately 4 L of blood loss before signs of shock manifest.
- D. blood in the peritoneum can compress the aorta and maintain perfusion.

3- What is the most informative initial investigation in abdominal trauma?

- A. Diagnostic Peritoneal lavage
- B. CT scan
- C. Focused Assessment with Sonography in Trauma

4- In hypotensive patient you always think of compromised:

- A. Airway
- B. Breathing
- C. Circulation

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-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

1.B
2.B
3.A
4.C
5.A
6,B