ABDOMINAL TRAUMA IN BREIF

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Assessment

- **The assessment begins with the ABC's of trauma resuscitat- ion. As you obtain a history, begin looking for clues for possible intra-abdominal injury (which should be suspected with trauma to the chest or abdomen).**
- **When the wounding agent is a bullet, knife, or other penetrating agent, it is tempting to draw immediate conclusions from the presumed trajectory. Such conclusions may be incorrect if the bullet is deflected by bone or fascia, or embolizes, or if the patient was in a contorted position when injured.**
- **Even the simple act of respiration, by moving the diaphragm up or down, may be crucial in determining whether intra-abdominal injury has occurred after a penetrating wound to the chest. Suspect intra-abdominal injury whenever penetrating trauma to the chest, abdomen, flanks, back or buttocks has occurred.**
- **Do not forget to inspect the entire skin surface, including the back, buttocks, and flank**.

- **The single most important initial study is a chest x-ray. Hemo- or pneumothorax, widening of the mediastinum or air within the mediastinum, evidence of diaphragmatic trauma, and free air below the diaphragm are all significant findings.**
- **Additional studies should include cervical spine films (depending upon mechanism of injury) and x-rays of the pelvis. Until the cervical spine has been "cleared", immobilization and C-spine precautions should be maintained.**

Resuscitation

- **Resuscitation should follow the ABC's (airway, breathing, circulation). Clues to intra-abdominal injury include shock out of proportion to known external or estimated (e.g. from long bone fractures) blood loss.**
- **Blood in the urine, rectum, vagina, or nasogastric tube all suggest hollow viscus injury and intraperitoneal penetration.**
- **All mandate further investigation. Priorities during resuscitation include assuring adequate tissue perfusion and oxygen delivery.**
- **Diagnostic evaluation, based upon what is known of the mechanism of injury, should proceed simultaneously.**
- **Maintain a high index of suspicion for occult vascular and retro peritoneal injuries, which may be responsible for significant continuing hemorrhage.**

MAST (military anti shock trousers)

- **(PASG) trousers are rarely used. Indications listed in the ATLS protocols include *temporary splinting and control of pelvic fractures with continuing hemorrhage and hypotension, and temporary support of patients with intra-abdominal hemorrhage and severe hypovolemia who are en route to the operating room or another facility.***
- **MAST trousers are *contraindicated in patients with pulmonary edema, known diaphragmatic rupture, or bleeding or major trauma outside of the anatomic area covered by the trousers.***

Evaluation

The patient with a rigid distended abdomen, or other obvious signs of intra-abdominal injury should be taken straight to the operating room for control of hemorrhage. More commonly, the findings are subtle and the diagnosis of intra-abdominal injury uncertain.

Up to 20% of patients with significant hemoperitoneum have a lax abdomen upon initial assessment. Clouded sensorium due to trauma, alcohol, or drug abuse confound the possibility of accurate clinical assessment. Probability of injury can be estimated from the mechanism.

Work-up can then be tailored to the specific circumstances, e.g. fractures of lower ribs on the left side raise the suspicion of splenic injury. Confirmation by CT scan may allow observation if the patient is hemodynamically stable.

Laboratory studies

- **Basic laboratory studies include the Hct, WBC, serum amylase and lipase, urinalysis, drug and alcohol screens, and pregnancy test (for females of childbearing age). All laboratory studies must be evaluated in context.**
- **NB:** *A major intra-abdominal injury (for example, a colon injury without significant blood loss) may be associated with a normal Hct, minimal elevation of the WBC, and a normal amylase and lipase. Conversely, elevation of the serum amylase may be due to facial trauma (salivary amylase).*

Special studies

***Real-time ultrasound examination is emerging as a fast and noninvasive diagnostic modality that is especially applicable in blunt abdominal trauma. The study is considered abnormal if fluid is detected.**

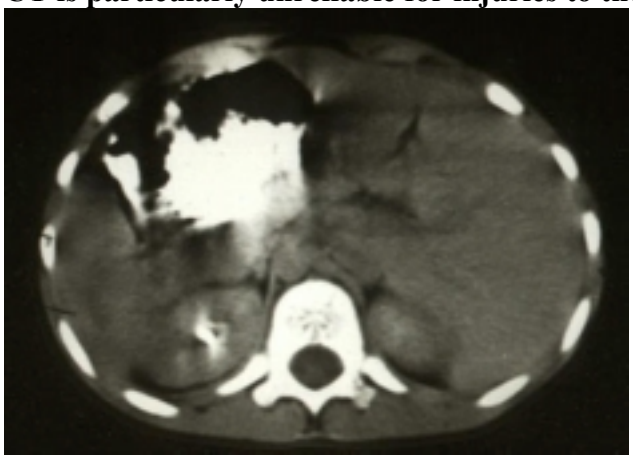
Strength: **Ultrasound is most useful when it can be performed rapidly in the resuscitation suite. The information obtained can be used to guide the subsequent workup.**

Weakness: **Ultrasound is not always available and is highly operator-dependent.**

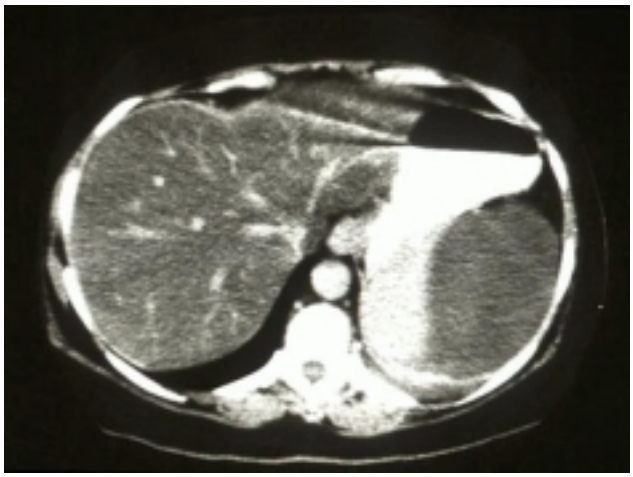
***CT scan with contrast is particularly convenient when head CT is required. It provides excellent imaging of solid organs (liver, spleen, kidneys) and retro-peritoneum. In the absence of identifiable injury to the liver or spleen, free fluid on CT indicates a hollow viscus injury until proven otherwise.**

***Strength*: especially useful for retroperitoneal injuries and to delineate solid organ injuries (liver, spleen).**

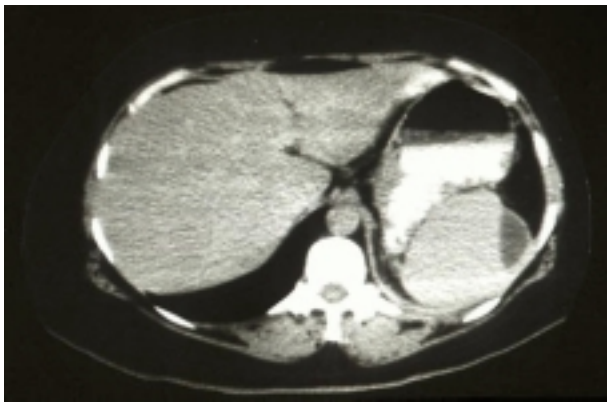
***Weakness*: Hollow viscus injuries and diaphragmatic injuries may be missed. CT is particularly unreliable for injuries to the small bowel.**



This CT shows a splenic injury. This was repaired at laparotomy.



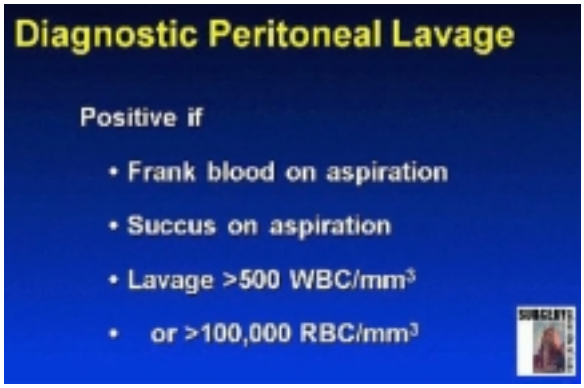
This CT shows a contained splenic hematoma. This was treated by observation and gradually resolved over several weeks (next photo).



Diagnostic peritoneal lavage (DPL)

Diagnostic peritoneal lavage is a surgical procedure that can be performed in the trauma resuscitation room. ATLS standards list the indications as those situations in which the abdominal examination is equivocal (fractures of the

lumbar spine, rib fractures), unreliable (head injury, substance abuse), or impractical (planned prolonged surgical procedure for head injury).
***The only absolute contraindication* is an existing indication for laparotomy. Thus, the patient with a rigid distended abdomen does not require DPL for confirmation.**
***Relative contraindications* include morbid obesity, advanced cirrhosis, coagulopathy, and possibly advanced pregnancy.**



***Strength-* DPL is extremely sensitive. A negative diagnostic peritoneal lavage virtually excludes significant intra-abdominal injury (with the exception of retroperitoneal structures) and is especially useful when the patient will be inaccessible for a long period of time (for example during prolonged neurosurgical interventions).**
***Weakness-* Significant retroperitoneal injuries may be undetected with DPL. In a sense it compliments CT scan in this regard. DPL leaves fluid in the abdomen, making subsequent CT or ultrasound (even clinical examination) less reliable. DPL is highly invasive and should be considered a surgical procedure. Injuries sometimes occur during DPL and may mandate laparotomy in patients who would otherwise not require surgery. DPL should be performed by the surgeon who will be responsible for definitive treatment if positive.**
****However, the real limitation of DPL is its extreme sensitivity. Particularly with the increasing tendency to treat solid organ injuries non-operatively, the simple question "is there blood in the peritoneal cavity?" is not the relevant issue.**

Laparoscopy

***Still awaiting a true delineation of utility. Probably most useful in cases of penetrating trauma where significant intra-abdominal injury cannot be excluded, but appears clinically doubtful.**

***Strengths*: Complete visualization of peritoneal cavity can exclude penetration and avoid non-therapeutic laparotomy in some cases of penetrating trauma.**

***Weaknesses*: Retroperitoneal structures are not easy to visualize. Even a small amount of blood in the peritoneal cavity precludes adequate visualization and mandates laparotomy. In the uncooperative trauma patient, laparoscopy usually requires general anesthesia and a trip to the operating room. The**

effect upon intracranial pressure in cases of head trauma is not completely delineated.

Management of Specific Injuries

The patient should be positioned supine. A wide prep should include the lower neck, entire chest, and both groins. This allows an abdo- minal incision to be extended into the chest, or laterally. Access to the groins is important if major vascular injuries are encountered. Both arms should be out, to maximize access for resuscitation. The room should be warmed to maintain normothermia. Laparotomy is performed through a midline incision. Blood is scooped out and all four quadrants of the abdomen sequentially explored and packed. Hemostasis is obtained by pressure unless an obvious bleeder is seen. Resuscitation should continue. Constant communication between surgical and anesthesia teams concerning ongoing bleeding, and hemodynamic status must be ongoing. An autotransfusion device may be used if major vascular injury is suspected.

Spleen

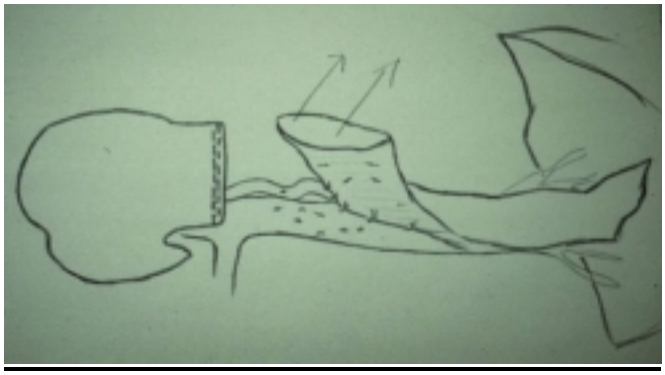
- **Isolated splenic injuries due to blunt trauma may be managed non-operatively, if bleeding has stopped and the surgeon is confident that no hollow viscus injury exists.**
- **At laparotomy, a variety of splenic preservation techniques (ranging from simple suture, through partial splenectomy, to wrapping) may be used if the patient is otherwise stable. All require more time and potentially more blood loss than simple splenectomy.**
- **When total splenectomy must be performed, intra-operative autotransplantation of splenic fragments in an omental pouch may result in successful growth of splenic fragments, but the immunologic benefits are less certain.**
- **Patients who undergo partial or total splenectomy should be immunized against S. pneumoniae, Neisseria meningotidis, and H. influenzae.**

Liver

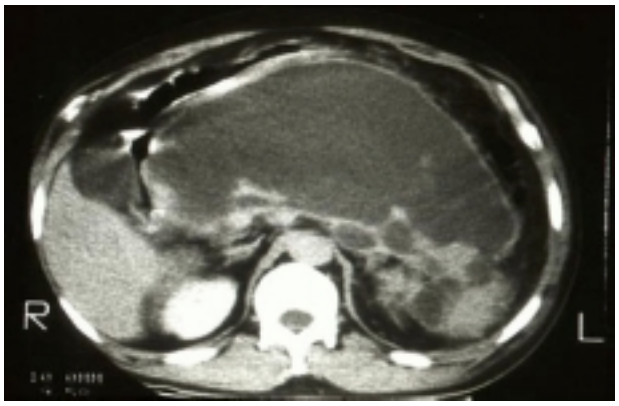
Selected liver injuries may be managed expectantly. As with splenic trauma, the surgeon must be confident that no other injury exists. At laparotomy, hepatotomy (by finger fracture) and careful suture or clip ligation of bleeders and bile ducts has eliminated many of the complications associated with mass suture techniques. It requires a skilled assistant capable of maintaining bimanual compression of the liver as the organ is mobilized and until suture control has been obtained. The Pringle maneuver will stop bleeding unless there is an injury to the retrohepatic vena cava or hepatic veins. Many complex liver lacerations are best managed by packing ‹if this can be accomplished without hemodynamic compromise. Continued resuscitation, correction of hypothermia and coagulopathy, can be followed by re-laparotomy and removal of packs 24 to 36 hours later.

Pancreas

Distal pancreatectomy with or without splenic preservation is a relatively safe way to manage injuries of the main pancreatic duct in the body or tail of the pancreas. Staple closure of the pancreatic remnant usually suffices. External drainage of injuries not amenable to distal pancreatectomy is prefered over resection or roux-en-Y loop drainage. Complex injuries of the head of the pancreas and duodenum occasionally require pancreatoduodenec-tomy. This procedure has a high complication rate in the trauma patient, where reconstruction may be extremely difficult (as the common duct is small in calibre and the pancreas soft) and should be avoided wherever possible. Anastomosis of the gallbladder (rather than common duct) to jejunum is a "bail-out" maneuver when the CBD is tiny. Untreated pancreatic injuries may result in pancreatitis or pancreatic pseudocyst.



Distal pancreatectomy with splenic preservation



This CT scan shows a pancreatic pseudocyst

Duodenum - Repair is generally possible unless the ampulla or pancreas are involved. Duodenal diverticulization or pyloric exclusion may allow suture lines to heal. Paired jejunostomies (one fed upstream into the duodenum and placed on suction, the second fed downstream and used for feeding) are sometimes useful.

Diaphragm - Diaphragmatic injuries are notoriously difficult to diagnose. Return of DPL fluid through a chest tube is a classic sign. Small diaphragmatic injuries on the right side may heal without incident, and the liver protects against potential hernias. Small injuries on the left side may result in symptomatic diaphragmatic hernias. Acute diaphragmatic defects are best approached through the diaphragm. Laparoscopic repair may be feasible for delayed repair.

Colon/Rectum - In contrast to classic teaching, an increasing number of surgeons utilize primary repair for simple colon injuries without associated shock or significant fecal soilage. Even a small missed colon injury may be lethal. Injuries of the extra peritoneal rectum require diversion and drainage. Washout of the distal segment may be helpful.

Pelvic fractures - "Bad" pelvic fractures should undergo external fixation prior to laparotomy, as significant bleeding may result when the abdomen is opened (and the pelvis spreads open like a book). External fixation controls a significant amount of bleeding; angiography and embolization may occasionally be required. Direct surgical exploration of pelvic hematomas is generally followed by disaster.

Genitourinary tract - Perinephric hematomas should be entered only after vascular control has been obtained. Repair of many renal injuries (including partial nephrectomy) is now possible. When nephrectomy is required, it is reassuring to know that the contralateral kidney is functioning.

Vascular injuries - Exposure of specific vascular injuries emphasizes adequate exposure and proximal and distal control.

Closure of the difficult laparotomy

***Prolonged resuscitation, difficult surgery, and administration of large quantities of fluid and blood lead to retroperitoneal and bowel wall edema, making it difficult to close the abdomen. Closure under tension produces an abdominal compartment syndrome, with compromise of respiration and impaired venous return. Oliguria, decrease in pulmonary compliance, refractory shock, and death can result.**

****It is far better to temporize with a "patch" that can be removed later when edema has subsided. In several days, a return to the operating room for washout and removal of the prosthesis when the edema has subsided and third-space fluids have been mobilized usually allows closure in the normal fashion.***

****Temporary closure of the abdomen with towel clips, running suture has been described when re-laparotomy is intended within 24-36 hours.***