Abdominal and Pelvic Injuries: Blunt and Penetrating Abdominal Traumas (Gunshot Wounds and more)

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Abdominal and pelvic traumas are characterized by disturbance or penetration of the abdominal wall and its contents by blunt or gunshot injuries. The signs and symptoms depend on weapon penetration status, the range of injury, organs that are traumatized, and the position and quantity of wounds formed. After physical examination of the injuries with a survey of the vital signs, level of consciousness, and loss of blood, immediate surgical intervention is necessary to stabilize the patient.

Epidemiology of Abdominal and Pelvic Injuries

Throughout the world, firearm mortality rates vary across different regions due to laws governing the use of firearms. The rate of mortality from firearms in Japan is 0.05% and in the USA is 14.24%.

In blunt injuries, the liver and spleen are the most commonly injured organs.

However, in penetrating injuries, one-half of the patients have their small bowels injured, followed by the colon, liver, and vascular structures.
Mechanism of Injury

It is helpful to know the anatomical regions of the abdomen and its contents for a better understanding of the mechanisms underlying the abdominal and pelvic injuries.

There are three distinct compartments, namely:

- **Peritoneal cavity**: Subdivided into the intrathoracic and abdominal segment. The intrathoracic segment is covered by the bony thorax, which includes the diaphragm, liver, spleen, stomach, and transverse colon.

- **Retroperitoneum**: This is a particularly difficult compartment because of its remote location rendering it less available for physical examination and peritoneal lavage. This region houses the aorta, vena cava, pancreas, kidney, ureters, and portions of the duodenum and colon.

- **Pelvic compartment**: Due to its anatomical location, injuries to the rectum, bladder, iliac vessels, and internal genitalia of women are difficult to diagnose.

Abdomen and pelvic trauma can occur due to blunt, penetrating, and explosive forces. In polytraumatic cases, blunt trauma injuries are the most common, while penetrating injuries are less common.

**Blunt injuries**

Three mechanisms explain the occurrence of blunt injuries:

- **Deceleration**: A differential movement between adjacent structures due to rapid deceleration. Shear forces can cause hollow or solid organs and vascular pedicles to tear along their lines and points of attachment. In classic injuries of the liver, tears along the ligamentum teres are common, as are mesenteric tears and bowel loops that injure the splanchnic vessels.

- **Crushing**: The solid organs trapped between the anterior abdominal wall and posterior thoracic cage are susceptible to crushing injuries.

- **External compression**: Compression could be a result of a direct blow or from external compression against a rigid fixed structure. In accordance with Boyle’s law, hollow organs are especially vulnerable as the compressive forces result in a sudden rise in intra-abdominal pressure.
Penetrating injuries

- **Gunshot wounds**: While a gunshot wound involves a high energy transfer giving rise to an unpredictable pattern of injuries, additional damage is done by the bullet and bone fragments. The severity of a gunshot varies according to the distance of the victim from the weapon.

- **Stab wounds**: Stab wounds have a more predictable pattern of injury wherein penetration of the abdominal wall is caused by a sharp object.

In both types of penetrating injuries, the mode of injury determines the underlying mechanism. While **homicide** is the predominant mode of injury in the adult population, children are more susceptible to **accidental penetrating injuries** at home.

Clinical History and Examination

A detailed history and careful examination remain the cornerstone of management of patients with abdominal and pelvic trauma.

- **Primary survey** includes assessment and concurrent resuscitation by following the **ABCDE protocol**. After initial resuscitation, level of consciousness and Glasgow Coma Score (GCS) are assessed.
- The patient should be completely undressed for a **head to toe examination**, including the back and perineum areas that are often skipped but are sources of significant bleeding.
- Abdominal distension, tenderness, obliterated liver dullness, and a deformed pelvis with tenderness are all indicative of an intra-abdominal and/or pelvic injury.
- Relevant investigations should be performed to confirm the clinical suspicion.

Patients with **altered mental status** or **pelvic and retroperitoneal organ injury** make examination difficult and are potential candidates for investigation.

Investigations

Diagnostic tools in the care of trauma patients have a specific role in:

- Confirmation of clinical suspicion
- A decision regarding the nature of the procedure to be performed
- Evaluating and monitoring the patient receiving nonoperative treatment

Never take an unstable patient to the radiology suite → go straight to the operating room or IR depending on the scenario.

Chest X-ray (Antero-Posterior and Lateral views)

- A chest x-ray is most commonly used to rule out chest involvement. It also provides information regarding **free intraperitoneal gas**, **herniation of abdominal contents**, etc.
X-ray Pelvis
- To rule out a pelvic bone fracture as a source of bleeding.

FAST (Focused Assessment with Sonography for Trauma)
In patients with polytrauma who are hemodynamically unstable and refractory to fluid administration and blood transfusion, bedside FAST is the only beneficial imaging method. Free fluid in the abdomen and pelvis suggest intra-abdominal hemorrhage.

- Sensitivity: 73-88%
- Specificity: 98-100%

Drawbacks:
- Grading of solid organ injury not possible.
- Mild hemorrhage may be missed.
- May cause injury to retroperitoneum.
- Operator dependent.

CT Scan Abdomen with Contrast
This is the investigation of choice for hemodynamically stable patients.

- Provides information regarding injury to retroperitoneal structures, diaphragm, and solid abdominal organs.
- Grading of injuries can be obtained.
- Presence of free fluid in the abdomen in the absence of solid organ injury is suggestive of bowel, mesenteric, or urinary tract injuries.
- Accuracy: 92-95%
- Highly sensitive and specific for hepatic and splenic injuries

If there is a question if the peritoneum is violated, you can offer diagnostic laparoscopic or local wound exploration.

Diagnostic peritoneal lavage (DPL)
- When encountered with blunt trauma, DPL is reserved for patients with spinal cord injury or multiple injuries with unexplained shock, especially if the mental status of the patient is altered. Intoxicated patients with suspicion of abdominal injuries or those who will undergo prolonged anesthesia are other candidates.
- A viable alternative in institutes where CT scan and FAST facilities are not available.
- It is an invasive procedure wherein a soft catheter is introduced into the peritoneal cavity for aspiration of lavage fluid or content that is then evaluated.
- Accuracy: 92-98%. Considered to be more accurate than contrast-enhanced computed tomography (CECT) in early diagnosis of bowel and mesenteric...
injuries.

- Operative intervention indicated when:
  - At least 10 ml of free-flowing blood is aspirated
  - Presence of:
    - Red blood cells (RBC) > 100,000/mm³
    - Leukocyte count > 500/mm³
    - Amylase level > 175 U/dL
    - Bile, bacteria, or food particle

**Drawbacks:**

- Difficult to perform in patients with prior surgeries
- Pregnant women
- Obesity

### Specific Types of Injuries

#### Splenic injury

**Clinical presentation**

- A detailed history regarding the anatomical location of the injury gives a clue to splenic damage.
- **Lower left rib fractures** must not be ignored as they are often associated with splenic rupture.
- Severe chest or neurological damage makes an assessment of minor splenic trauma difficult.
- History of **malaria**, **lymphoma**, and **hemolytic anemia** is important as even minor trauma can cause excessive damage to an enlarged spleen.

**Investigations**

- While all basic laboratory tests may be performed, a **complete blood cell count** is the most useful in pointing towards deteriorating hemodynamic stability.
- The most specific and sensitive study for splenic injury is a **CT scan of the abdomen** (triple helical scan). It is up to 98% sensitive for splenic injuries when IV contrast is given. While it can detect small quantities of blood in the abdominal cavity, it is **contraindicated in hemodynamically unstable patients**.
- Other investigations include **FAST**, **diagnostic peritoneal lavage**, and **angiography**, but these have a limited role to play.

**Management**

- **Immediate splenectomy** indicated in:
  - Patients with severe multiple injuries
  - Splenic avulsion
  - Fragmentation or rupture
  - Extensive hilar injuries
  - Failure of hemostasis
  - Peritoneal contamination from the gastrointestinal tract

All patients are to be administered **polyvalent pneumococcal vaccine** postsplenectomy.
**Conservative approach**

- In patients younger than 55 years of age with no other associated abdominal injuries, a conservative approach may be used given their hemodynamic stability.
- Patients are kept under observation for 10-14 days; delayed rupture and hemorrhage may occur, usually in the first 48 hours. This is followed by bed rest for a week.
- They are advised not to indulge in any strenuous activity for 6-8 weeks nor to engage in sports activities for at least 6 months.

**Hepatic injury**

It is a common injury encountered in the emergency department, yet the most frequently missed injury in trauma deaths. An abdominal examination may provide vague clues to an injury, but these are often missed. For this reason, diagnosis is usually made at laparotomy or CT scan.

**Investigations**

Basic laboratory tests:

- Complete blood cell count (CBC)
- Coagulation profile: Along with CBC, these two basic lab tests are done to obtain baseline levels of PT, APTT and platelet count as dilutional coagulopathy and thrombocytopenia are common after hepatic repair.
- Clotting factors
- Liver and kidney function tests
- Electrolytes

**Imaging studies**

- **Chest X-ray** to rule out chest involvement.
- **CT scan of the abdomen** is considered to be the most specific and sensitive test for liver injury.
- **Diagnostic laparoscopy**: Hepatic injuries are often associated with an injury to the diaphragm. Thus, a diagnostic laparoscopy is a good test for ruling out such related injuries.
- **Angiography** is less valuable as a diagnostic tool, but transcatheter embolization is used in the management of persistent hepatic bleeding that is not stopped by surgery.

**Management**

- **Packing and limited surgery** is a viable option when coagulopathy and hypothermia develop.
- Conservative management is more often used for hemodynamically stable patients with no other associated abdominal injuries and peritoneal signs.

**Pelvic injury**

It is caused by high energy blunt trauma following a fall, road traffic accident, or crush injury. Pelvic injuries account for 13-23% of deaths.

**Clinical features**
The patient presents with a typical history of **pain on movement** and **gross hematuria**.

- **A quick observation reveals structural instability with peri-pelvic ecchymoses.**
- **A digital rectal examination** is important to identify injury to the rectum and locate the prostate.
- **Hemoperitoneum** may lead to hypotension.

**Investigations**

**Basic laboratory tests:**

- **Complete blood cell count** has an important role in the management of pelvic bleeding.
- **Urinalysis**
- **Electrolytes**
- **Liver and kidney function tests**
- **Coagulation profile**

**Imaging studies**

- **X-ray** to rule out pelvic bone fractures and associated abdominal injuries.
- **Diagnostic peritoneal lavage** performed at the earliest convenience in hemodynamically unstable patients as it is a good modality to identify **hemoperitoneum**.
- **Laparotomy**: If gross bleeding is seen, this should be followed by **external fixation** and **angiography**.

**Management**

The main goal of pelvic injury management is the **assessment and control of bleeding**.

- **Hemodynamically unstable patient**: Early open DPL should be performed.
- **Gross bleeding on laparotomy**: External fixation helps to minimize bleeding from veins and small arterioles near fracture sites. It also adds to the tamponade effect by shrinking the volume of an open pelvic cavity. This is followed by **angiography with embolization**, which is often effective in controlling arterial bleeding but is difficult to perform.
- **Large vessel bleeding**: Surgical control.
- If low blood cell counts are the only indication of bleeding, the risk of **major intra-abdominal hemorrhage** is low.

**Penetrating injuries**

**Clinical presentation**

- **A detailed history** regarding the anatomical location of the wound and the type of weapon used is important.
- The number of gunshots heard or the number of times the patient was stabbed, the position of the victim and the environment under which the incident took place help to assess the severity and extent of the damage.
- **Additional information** regarding allergies, current medications, history of any prior illness or surgery, and last meal had by the victim help in providing the best management possible.
Signs and symptoms

- **Primary survey**: Initial examination for assessment of ABCDE should be done in the emergency department:
  - ABC – Airway, Breathing, and Circulation
  - D – Disability: Level of consciousness and neurological deficits should be assessed
  - E – Exposure: Inspect all body surfaces for wounds and injuries
  - Amount of blood loss
  - Type of weapon or object used

- **Secondary survey** includes a complete head to toe examination (in hemodynamically stable patients).
  - A rapid abdomen examination for **distension, dullness to percussion**, and **bowel sounds** coupled with a digital rectal and genitourinary examination should be done.
  - In life-threatening cases, a secondary survey may be reserved for after the operative therapy.

![Image: “Multiple small bowel perforations, indicated by arrows.” by K. Naidoo, S. Mewa Kinoo, B. Singh – Small Bowel Injury in Peritoneal Encapsulation following Penetrating Abdominal Trauma Case Rep Surg. 2013; 2013: 379464. License: CC BY 2.5](image-url)

- **Indications for immediate surgical exploration**:
  - Hypotension
  - Narrow pulse pressure
  - Tachycardia
  - High or low respiratory rate
  - Peritoneal signs (pain, guarding, rebound tenderness)
  - Diffuse or poorly localized pain that fails to resolve

**Investigations**

- **Basic laboratory tests** for patients undergoing immediate surgery:
  - Blood type and crossmatch
  - Complete blood cell count
  - Liver and kidney function tests
  - Blood glucose
  - Coagulation profile
  - Arterial blood gas
  - Urinalysis
  - Electrolyte levels along with calcium, phosphate and magnesium
levels

- Toxicology screen

- **Imaging studies:**
  - **Chest X-ray:** Initial investigation to rule out the involvement of the chest cavity.
  - **Abdominal radiography:** Both anteroposterior and lateral views taken.
  - **Chest and abdominal ultrasonography:** Focused assessment with sonography for trauma (FAST).
  - **CT scan abdomen:** Most sensitive and specific study in cases of liver or spleen injury

Management of Abdominal and Pelvic Injuries

A multi-faceted approach is used to manage the patient, which can be described under the following headings:

**Diagnostic/therapeutic procedures**

These include procedures that are used for monitoring the status of the patient and also help in the management of the patient.

- Gastric decompression
- Foley catheterization
- Peritoneal Lavage
- Tube thoracostomy
- Local wound exploration

**Surgical management**

- Gunshot wounds are almost always associated with intra-abdominal injuries that mandate **laparotomy**.
- Stab wounds, in contrast, have a lower incidence of intra-abdominal injuries and hemodynamically stable patients may be provided expectant treatment.

**Medical management**

It is very much palliative in nature with obvious choices:

- Analgesics: morphine, fentanyl
- Anxiolytics: lorazepam, midazolam
- **Antibiotics:** metronidazole, gentamicin, vancomycin
- Neuromuscular blocking agents: succinylcholine
- Immune enhancement: tetanus toxoid
- IV fluids

**References**


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