Management of Splenic injury following blunt abdominal trauma

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General Surgery
Discussion under the following headings

- Introduction to trauma
- Blunt injury abdomen - Introduction
- Most commonly involved organs
- Patho-physiology of injury
- Initial management
- General physical examination
- Classification based on hamodynamic status
- Major organ injuries
Splenic injuries:
Introduction
Types
General management
Clinical presentation
Diagnosis
Treatment
INTRODUCTION

WHAT IS TRAUMA?
- Trauma is the study of medical problems associated with physical injury, which is an adverse effect of physical force upon a person.

- Varieties:
  - Mechanical:
    1) Blunt
    2) Penetrating
  - Thermal
  - Chemical
  - Ionizing radiation etc..
“Golden Hour”

ACS concept that deaths & complications are reduced when trauma victims receive definitive treatment within the 1st hour after injury.
BLUNT INJURY ABDOMEN

Blunt abdominal injuries carry a greater risk of morbidity and mortality than penetrating abdominal injuries.
Most commonly involved organs:

- **Spleen (40-55%)**
- **Liver (35-45%)**
- **Small bowel (5-10%)**
Pathophysiology of injury
Crushing effect: Compression from crush between solid objects such as the steering wheel/seat belt & the vertebrae.

Seat belt injuries - “seat belt sign” = highly correlated with intraperitoneal injury.

Acceleration and deceleration forces → shear injury.
Initial management of blunt injury abdomen
Primary survey and resuscitation:

- A – Airway
- B – Breathing
- C – Circulation
- D – Disability
- E – Exposure
Secondary Survey

A – Allergy
M – Medication
P – Past medical history
L – Last meal
E – Events of the incident
Events of the incident

- Details about accident
- Damage to car
- Velocity
- Steering wheel damage
- Type of seatbelts used
- Air bags deployed
- All patients involved in deceleration injuries and bicycle injuries should be suspected of having intraabdominal injury
Secondary survey (cont)

 Subsequent physical exam
 Re-evaluation
 Analgesia
 Documentation & legal considerations
 Definitive care & transfer
Physical Examination

External injuries:
- Bruise or ecchymosis around umbilicus/flanks/hypochondriac regions
- Grey Turners sign & Cullens sign – indicative of retroperitoneal haemorrhage
- London sign – patterned abrasion of the abdominal wall – impression of the object causing the impact:
  - Tyre marks,
  - Pattern of clothing/
  - Seat belt
- Significance: if positive, then the initial impact is severe & the chances of having internal organ injury is more.
LONDON SIGN
CULLENS SIGN
GREY-TURNERS SIGN
Abdominal findings:
- Distension of abdomen
- Tenderness – suggests inflammation/haemoperitoneum
- Rebound tenderness
- Guarding, rigidity
- Fluid thrill
- Obliteration of liver dullness – suggests perforation of hollow viscera
- Increased hepatic/splenic dullness
- Free fluid in abdomen detected by shifting dullness
- Absent or decreased bowel sounds
Unstable vitals

- Hypotension in the acute stage results from hemorrhage that is most often from a solid visceral or vascular injury.

- Unexplained Hypotension associated with significant blunt abdominal trauma, one should exclude intraperitoneal hemorrhage with solid organ injury or vascular injury.
Abdominal injuries categorised into:

- Haemodynamically normal: Full investigations & planned treatment

- Haemodynamically stable: Limited investigations
  - Non-operative: Angio embolization
  - Operative: Which cavity?

- Haemodynamically unstable:
  - Immediate surgical correction
  - Trauma laparotomy
MAJOR ORGAN INJURIES
Hepatic Injuries

- 2nd most commonly injured intraabdominal organ
- Associated with R 8-12 rib fractures
- Subcapsular hematomas
- Lacerations
- Vascular injuries

Treatment
- Damage Control - Pack the liver to control bleeding & close at a later time
- Operative repair
Hollow Organ Injuries

- Small or large bowel, gastric injuries
- Perforation with spillage of contents into peritoneal cavity
- Signs & symptoms of peritonitis

**Treatment**

- Surgical repair
- Diversion of the injured bowel with re-anastomosis at a later time
- TPN
SPLENIC INJURIES
Introduction to splenic injuries

- Associated with left rib 10-12 fx, falls, contact sports, assaults
- Most commonly injured organ from blunt trauma
- 40% have no symptoms
- Bleeding may be contained by capsule
Types of splenic injury

- Subcapsular haematoma
- Laceration of spleen
- Polar tear
- Avulsion of splenic pedicle
General Management of Abdominal Trauma

- Scene survey for MOI
- Rapid evaluation of the patient
- Secure airway with spinal precautions
- Provide ventilatory support
- High concentration O2
- Stabilize – Direct pressure, compression mattress external sheet or pelvic binder for hemorrhage
- Wound management
- Vitals monitoring
- Manage shock
- Cardiac monitor
- Rapid and safe Transport
Clinical presentation

- Classical features of splenic injuries: seen in severe injuries and polar tear with symptoms and signs of intraperitoneal haemorrhage.

- Silent: There may be slight pain abdomen with no symptoms & signs.
Delayed rupture:
- seen in subcapsular haematoma
- Mild left hypochondriac pain with no symptoms or signs at initial presentation and the injury is often missed
- After 7-14 days the haematoma grows and ruptures and patient presents with symptoms & signs of intraperitoneal haemorrhage.
Classical features of major splenic trauma

General symptoms and signs of internal haemorrhage:
- Pallor
- Tachycardia
- Hypotension
- Restlessness
- Sweating
- Deep, sighing respiration
- Cold, clammy extremities
- Collapsed veins
Symptoms & Signs of splenic injury

- There may be cutaneous bruising in the left upper quadrant of abdomen.
- Increasing left upper abdominal pain & tenderness
- Increasing left upper abdominal guarding & rigidity
- Increasing abdominal distension
(cont)

- Diminished or absent bowel sounds.
- Kehr’s sign - Referred pain in the left shoulder on elevation of foot end due to irritation of the adjacent diaphragm.
- Ballance’s sign – fixed dullness in the left flank due to clotted blood around the spleen and shifting dullness in the right flank due to unclotted blood in the peritoneal cavity.
DIAGNOSIS

1. Laboratory tests
2. Radiological investigations
Lab tests:

- Complete haemogram –
  - May have ↓ Hct, ↑ WBC
  - Initially Hb% may be normal for 6 hrs,

- May have, ↑ lactate, LFTs, lipase, toxicology screen.
Radiological investigations

To determine if there is hemoperitoneum or organ injury requiring surgical repair

- X-ray abdomen erect
- FAST
- DPL
- CT
Plain abdominal film

Increase in splenic shadow with haziness
Obliteration of left psoas shadow
Indentation of fundic gas shadow
Left colonic gas shadow displaced downward
Free fluid between gas-filled intestinal coils
Left diaphragmatic elevation
Left lower lobe atelectasis
Left pleural effusion if as with fracture ribs

Radiograph demonstrates a left pleural effusion, left basilar atelectasis, and inferomedial displacement of the splenic flexure (arrow)
FAST

- Focused assessment with sonography for trauma (FAST)
  - To diagnose free intraperitoneal blood after blunt trauma
  - 4 areas:
    - Perihepatic & hepato-renal space (Morrison’s pouch)
    - Perisplenic
    - Pelvis (Pouch of Douglas/rectovesical pouch)
    - Pericardium (subxiphoid)
  - Sensitivity 60 to 95% for detecting 100 mL - 500 mL of fluid

- Extended FAST (E-FAST):
  - Add thoracic windows to look for pneumothorax.
  - Sensitivity 59%, specificity up to 99% for PTX (c/w CXR 20%)
FAST

Perisplenic view

trauma.org

Rosen’s Emergency Medicine, 7th ed. 2009
Fluid in the subphrenic space and splenorenal recess can be detected. The image shown demonstrates blood (arrow) between the spleen (S) and diaphragm (D).
Diagnostic Peritoneal Lavage

- Largely replaced by FAST and CT
- In blunt trauma, used to triage pt who is haemodynamically unstable and has multiple injuries with an equivocal FAST examination
Diagnostic Peritoneal Lavage

1. attempt to aspirate free peritoneal blood
   >10 mL positive for intraperitoneal injury
2. insert lavage catheter by seldinger, semiopen, or open
3. lavage peritoneal cavity with saline
Positive test:
   RBC count > 100,000/mm³
Diagnostic Peritoneal Lavage

Closed Percutaneous Technique

Using controlled pressure, insert the catheter and stylet perpendicular to the skin along the anesthetized track using a twisting motion.
Diagnostic Peritoneal Lavage
Semi-Closed Technique

- Stylet
- Catheter
- Traction suture
- Linea alba
- Umbilicus
- Peritoneum

45°
CT abdomen with IV contrast

Noninvasive, highly accurate, easily identifies and quantifies extent of injury, for stable patient only

A: Hemoperitoneum with a liver laceration (arrow) and a shattered spleen is seen.
Splenic CT with Laceration & Blush
Contrast Extravasation Predicts the Need for Operative Intervention in Children with Blunt Splenic Trauma

Benedict C. Nwomeh, MD, Evan P. Nadler, MD, Manuel P. Meza, MD, Kerry Bron, MD, Barbara A. Gaines, MD, and Henri R. Ford, MD

Background: Although the presence of a contrast blush (CB) on computed tomographic (CT) scan is associated with an groups on the basis of the presence or absence of CB on the updated reading of the CT scan. Demographic variables ana- those without CB (22% vs. 4%; p = 0.0008). Among patients with CB, mean pulse rate at presentation was higher in those that re-
AAST Splenic Injury Scale

Spleen injury scale: (advance one grade for multiple injuries, up to grade III)

- **Grade I:**
  - Hematoma: subcapsular, < 10% of surface area
  - Laceration: capsular tear, < 1cm parenchymal depth

- **Grade II:**
  - Hematoma: subcapsular, 10-50% surface area; intraparenchymal, <5cm in diameter
  - Laceration: 1-3cm parenchymal depth which does not involve a trabecular vessel

- **Grade III:**
  - Hematoma: subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma >5cm or expanding
  - Laceration: >3cm parenchymal depth or involving trabecular vessels

- **Grade IV:**
  - Laceration: laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen)

- **Grade V:**
  - Laceration: completely shattered spleen
  - Vascular: hilar vascular injury which devascularizes spleen
17-yr-old boy injured on an ATV. Grade I injury with subcapsular fluid occupying less than 10% of spleen's surface area.
17-yr-old girl injured in an MVC. Grade II injury with laceration involving less than 3 cm of parenchymal depth.
18-yo boy injured playing football. Lacerations involving more than 3 cm of parenchymal depth radiating from splenic hilum - grade III laceration
16-yo boy injured playing hockey. Fractured spleen involving more than 25%, Grade IV splenic laceration
12-yo boy pedestrian struck by MV. Fractured spleen with hilar devascularization. Grade V injury.
Treatment
The unstable patient
Stabilizing the patient

- IVF (crystalloid, not colloid)
- Transfusion
  - PRBC/plt/FFP
- Recombinant activated factor VII
- Rewarming if hypothermic
- Correction of metabolic abnormalities
- Low tidal volume ventilation recommended (4-6 ml/kg)
Damage Control Surgery

- Patients with major exsanguinating injuries may not survive complex procedures
- GOAL OF DCS:
  - control hemorrhage,
  - limit GI spillage,
  - to prevent ischemia, infection, with abbreviated laparotomy followed by resuscitation prior to definitive repair
Damage Control

Table 1. Indications for damage control

1. Hemodynamic instability
2. Coagulopathy on presentation or during operation (clinical or laboratory)
3. Severe metabolic acidosis (pH < 7.2 or base deficit > 8)
4. Hypothermia on presentation (< 35°C)
5. Prohibitive operative time required to repair injuries (> 90 mins)
6. High-energy blunt torso trauma
7. Multiple penetrating torso injuries
8. Multiple visceral injuries with major vascular trauma
9. Multiple injuries across body cavities
10. Massive transfusion requirements (> 10 units packed red blood cells)
11. Presence of injuries better treated with nonsurgical adjuncts
Damage Control

0. Initial resuscitation
1. Control of hemorrhage and contamination
   - Control injured vasculature, bleeding solid organs
   - Abdominal packing
   - Autologous blood transfusion after collecting the blood in a cell saver which washes and collects RBCs.

2. back to the ICU for resuscitation
3. Definitive repair of injuries
4. Definitive closure of the abdomen
Definitive repair

1. Careful removal of packs
2. Inspection/identification of all injuries
3. Control of remaining errant bleeding points
4. Definitive gastrointestinal repair
5. Thorough abdominal washout
6. Avoid stomas and tube enterostomies, if possible
7. Nasoenteric feeding tube placement
8. Closed suction drainage, if needed
9. Temporary versus definitive abdominal wound closure
10. Tracheostomy, if needed
11. Radiographic evaluation of abdomen for retained packing
**Indications for Laparotomy**

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<th>Indication</th>
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<td>Unstable vital signs with strongly suspected splenic injury</td>
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<td>Unstable patients with known or positive FAST/DPL</td>
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<td>Unequivocal peritoneal irritation</td>
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<td>Minor splenic injury associated with other intra-abdominal injury requiring laparotomy</td>
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<td>Failure of conservative management</td>
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Haemodynamically stable patient
Treatment Recommendations based on CT findings

- Grade I and II injuries – admit for minimum of > 24 hours with serial exams and HCT – conservative management

- Grade III injuries – admit ICU/step down unit, serial HCTS (q4 -6 hrs) for a minimum of 3 times and until stable

- Grade III injuries with moderate to large hemoperitoneum - Splenic Artery Angio-embolization (SAE) ASAP with goal to be within 2 hours
Size of Hemoperitoneum

- Small Hemoperitoneum - perisplenic blood or blood in Morrison’s pouch
- Moderate Hemoperitoneum – blood in one or both pericolic gutters
- Large hemoperitoneum – blood in one or both gutters with additional blood in pelvis
✈ Grade IV injuries: Urgent SAE with goal to be within 2 hours

✈ Grade V injuries: to the operating room in most circumstances

✈ Grades I – IV: that show CT evidence of blush/pseudoaneurysm or extravasation – Urgent SAE or Laparotomy with goal to be within 2 hours
Initial Management of a Hemodynamically Stable Patient with a Blunt Spleen Injury

CT scan with IV contrast

- Grade V
- Blush, Extravasation, or Pseudoaneurysm
- Angio-Embolization (within 1-2 hours)

Grade I & II can admit to floor

- Grade III
- No or Small hemoperitoneum
- Moderate/Large hemoperitoneum

- ICU/Step-down unit* - q 4-6 hr HCTs until stable X 3
- Stable HCTs for 24 hours
- Dropping HCTs for 24 hours, or need to transfuse blood

Floor patients: should be mobilized, diet advance and daily HCTs until stable for two days.
- Grade 1 and 2: minimum of 1 floor day
- Grade 3-5: minimum of 3 hospital days
- Splenectomy patients require immunizations

Can mobilize patient, transfer to floor, and give diet pending other injuries

Consider the following options: OR, angio, Repeat CT scan
CONSERVATIVE MANAGEMENT
Conservative management

If there are no other injuries requiring laparotomy, isolated low grade splenic injury such as subcapsular haematoma of spleen may be managed successfully with conservative treatment:

- ICU
- IV fluids
- Parenteral antibiotics
- Blood requisitioned and reserved
- Intensive monitoring
- Clinically: Pulse, BP, respiration checked hourly
- Lab: serial haematocrit
- Radiologically: serial USG abdomen – every 24 hrs.
The patient kept under observation for 24-48 hrs.

If patient is stable, haematoma not increasing and shows signs of regression, conservative treatment may be continued.

If haematoma is expanding and there is evidence of intraperitoneal rupture, immediate laparotomy is to be done.
SURGICAL MANAGEMENT

• Splenectomy
• Partial splenectomy
• Spleen salvage
Splenectomy

- Extensive laceration or
- Avulsion of splenic pedicle:
Steps of splenectomy

1. Mobilization of the spleen to the midline by division of the splenophrenic ligament superiorly and the splenocolic and splenorenal ligaments at the lower pole
2) The short gastric vessels are then divided between ligatures or clips.
Spleen medialized and hilar dissection performed carefully with isolation of splenic vessels
Splenic hilum clamped en bloc and divided and doubly ligated proximally and once distally or splenic artery and vein are individually ligated.
Splenic slice graft

A portion of the spleen – 6 pieces of 40 * 40 * 3mm may be reimplanted within the leaf of greater omentum
Splenic slice graft
Splenic salvage

- Being practised from 1980, in view of development of
  - Post splenectomy syndrome &
  - OPSI, following splenectomy.

- Splenorrhaphy (repair of spleen)

- The importance of spleen with regards to its immune function started the recent trend to conserve the spleen unless it is,
  - extensively shattered and bleeding is uncontrollabe
Types of splenorrhaphy

- Topical methods
- Envelopment in mesh
- Pledged suture repair
Indications

**Small capsular tear:**
- Bleeding controlled with local haemostatic agents like:
  - Oxidized regenerated cellulose (surgicel)
  - Fibrin glue
  - Electrocautery
  - Argon beam coagulation
  - Application of thrombin soaked gelatin foam sponges
- If it fails: – bleeding from the splenic tear controlled with a series of mattress sutures - Pledgeted suture repair
FIGURE 62.25 Approaches to preserving a traumatized spleen. Depending on the degree of splenic injury, one of these techniques can be used.
Polar tear managed with splenorrhaphy or partial splenectomy followed by approximation of edges with a series of mattress sutures.
Placement of the spleen in a mesh

Envelopment of the injured spleen in absorbable mesh, and to compress the splenic tissue and capsule back together, aided by purse-string sutures.
Envelopment of the injured spleen in absorbable mesh
Envelopment of the injured spleen in absorbable mesh,
Role of Laparoscopy

Most useful to evaluate penetrating wounds to thoracoabdominal region in stable pt

Not a substitute for open laparotomy.
Mechanism of injury -

Blunt

Hemodyn. Unstable

Yes

FAST exam or DPL

Negative

Search for other cause of hypotension. Eventual CT scan

No

Abdominal CT

No Splenic injury

Treat other injuries

Splenic injury

Contrast blush?

Yes

Angiography and embolization

Successful

No

Explore abdomen. Splenectomy vs. Splenorrhaphy
Laparotomy

Splenic injury identified

- Hemodynamically stable
- Isolated splenic injury
- Minimal concomitant injury

Low grade splenic injury (capsular tear)

- Topical hemostasis
- Argon beam/cautery
- Surgicel, Avitene, Fibrin
- Capsular suture (pledgetted)
- Compression

High grade injury

Polar injury
Pledged suture repair +/- topical hemostasis

- Complex capsular injury
- Stellate
- Wrap with absorbable mesh
- Consider splenectomy
Post operative complications

**Immediate:**
Bleeding from the remaining spleen

**Early:**
- Haematemesis
- Sub-diaphragmatic abscess
- Left basal atelactasis
- Left pleural effusion
- Thrombocytosis
- Pancreatitis/abscess/fistula
- Gastric fistula

**Late:**
- Post splenectomy sepsis with *S.pneumoniae*, *N.meningitides*, *H.influenzae*, *E.coli*
- OPSI – opportunist post – splenectomy infection
In-Hospital Recommendations

- DVT prophylaxis
  - Sequential compression devices upon admission
  - Stable HCT for 48 - 72 hours and no other contraindications- Strongly consider starting chemoprophylaxis (Low molecular weight heparin is preferred)
Post operative prophylaxis

Pt requires vaccinations prior to discharge

- Streptococcus pneumoniae
  - Pneumovax 23

- Haemophilus influenzae type B
  - Hib vaccine

- Neisseria meningitidis
  - Quadravalent meningococcal/diphtheria conjugate

- Prophylactic antibiotics controversial
  - Most centers use penicillin
Follow up and discharge advise

- Avoid contact sports for 2-4 months
- Immediate treatment of infections
- Pneumococcal and meningococcal vaccinations every 5 years
- Hib every ten years
- Yearly influenza vaccinations
- Regular followups (weekly) for those who were placed on conservative treatment.
THANK YOU
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