



# Haemorrhage (Splenic injury)

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# Etiology of splenic hemorrhage

- The primary disorder that causes splenic hemorrhage is trauma .
- Trauma can be classified into two main categories :
  - A. External trauma:
    - Blunt trauma.
    - Penetrating trauma.
  - B. Internal trauma:
    - Operative trauma.
    - Spontaneous.

## Blunt splenic injury

- External trauma is the most common disorder of the spleen, and is divided into either blunt or penetrating injuries.
- The spleen is more commonly injured by blunt trauma than any other abdominal organ. Usually, the blunt trauma causes a left upper quadrant injury with rib fractures or contusions of the left flank or lower left chest.
- The well-protected posterior position of the spleen causes blunt trauma with high energy to split or fragment the solid spleen.



## Penetrating Splenic injury

- Splenic injury can occur from a knife or gunshot wound of the left upper quadrant, the left flank, or the left lower chest. Any penetrating injury below the level of the nipple anteriorly, or the tip of the scapula posteriorly, can injure the spleen .
- Penetrating splenic trauma usually injures one or more adjacent organs, such as the stomach, colon, kidney, diaphragm, or pancreas .
- Because almost all of these penetrating injuries are explored, the surgeon is the one responsible for identifying other associated injuries and treating them in the operating room .

## internal Splenic injury

- Internal trauma accounts for 10% to 30% of splenic injuries and splenectomies. It is caused most often by intraoperative splenic injury, or, infrequently, by spontaneous rupture of an enlarged spleen .
- The most common form of left upper quadrant intraoperative splenic injury comes from traction on the greater omentum and avulsion of its attachment to the inferior pole of the spleen .
- Patients with spontaneous rupture have abnormal spleens and no history of trauma. The two most common causes are malaria and infectious mononucleosis.

# Pathology of splenic injury

## ■ Types of splenic injury:

The American Association for the Surgery of Trauma (AAST) developed a splenic injury grading scale through a consensus methodology:

Grade	Injury description
I Hematoma laceration	Subcapsular < 10% surface area Capsular tear, < 1 cm parenchymal depth
II Hematoma Laceration	subcapsular, 10% to 50% surface area; intraparenchymal, < 5 cm in diameter. 1-3 cm parenchymal depth that does not involve a trabecular vessel.
III Hematoma Laceration	Subcapsular, > 50% s.a. or expanding; ruptured subcapsular or parenchymal hematoma > 3 cm parenchymal depth or involving trabecular v.
IV Laceration	Laceration involving segmental or hilar vessels producing major devascularization (> 25% of spleen).
V Laceration Vascular	completely shattered spleen Hilar vascular injury that devascularizes spleen.

# Clinical picture of splenic injury

## Three clinical Types of rupture spleen:

### ■ *The fatal rupture:*

The tear is deep or the pedicle is ruptured and hemorrhage is so massive that the patient is severely shocked with rapid death occurring before any surgical intervention.

### ■ *Classical rupture:*

- general manifestation of internal hemorrhage.
- abdominal examination shows tenderness, rebound tenderness and rigidity in the left hypochondrium which becomes diffuse with shifting dullness.
- Special signs may be present:
  1. Balance's sign:

Shifting dullness on right side & fixed dullness on the left side.
  2. Kehr's sign:

The patients has pain in the left shoulder.
  3. Cullen's sign:

Brownish or bluish discoloration around the umbilicus.



# Clinical types of rupture spleen

## ■ *The Delayed rupture:*

The initial shock is followed by a long lucid interval, which may be few days or weeks. 2 weeks after the accident, which may be forgotten, the patient presents with the picture of internal he.

*This delay may be due to:*

1. The formation of subcapsular hematoma which may rupture later.
2. The greater omentum seals the region of the spleen from the general peritoneal cavity, and then retracts releasing blood.
3. A clot may form to block the tear and stop bleeding and is later on dislodge when the blood pressure rises or is digested by enzymes from the injured pancreas.

# Diagnosis of splenic injury

## ■ *The clinical picture:*

The history and physical examination continue to be the basis from which splenic injury is diagnosed .

## ■ *Investigations:*

### 1. Laboratory:

Hb%, HCV, leucocytosis & others.

### 2. Diagnostic Peritoneal Lavage (DPL):

results were interpreted from a grossly positive examination or from quantification of red and white blood cells in the large effluent .

### 3. Chest x-ray:

- Fracture of a rib on the left side.
- Obliteration of psoase line.
- Elevation of left copula of the diaphragm.
- Medial displacement of gastric shadow.

# Diagnosis of splenic injury

## ■ *Investigations:*

### 4. Abdominal ultrasonography:

- Ultrasound as a replacement for DPL. It appears to be as sensitive in detecting free intraperitoneal blood and is less invasive and rapid .
- The most important application is in evaluating the hemodynamically unstable patient with multiple injuries.

### 5. Computed Tomography (CT):

- CT permitted not only identification of intraperitoneal blood but also definition of individual organ injuries.
- have importance in better defining solid organ injury and minimizing failures of non-operative management

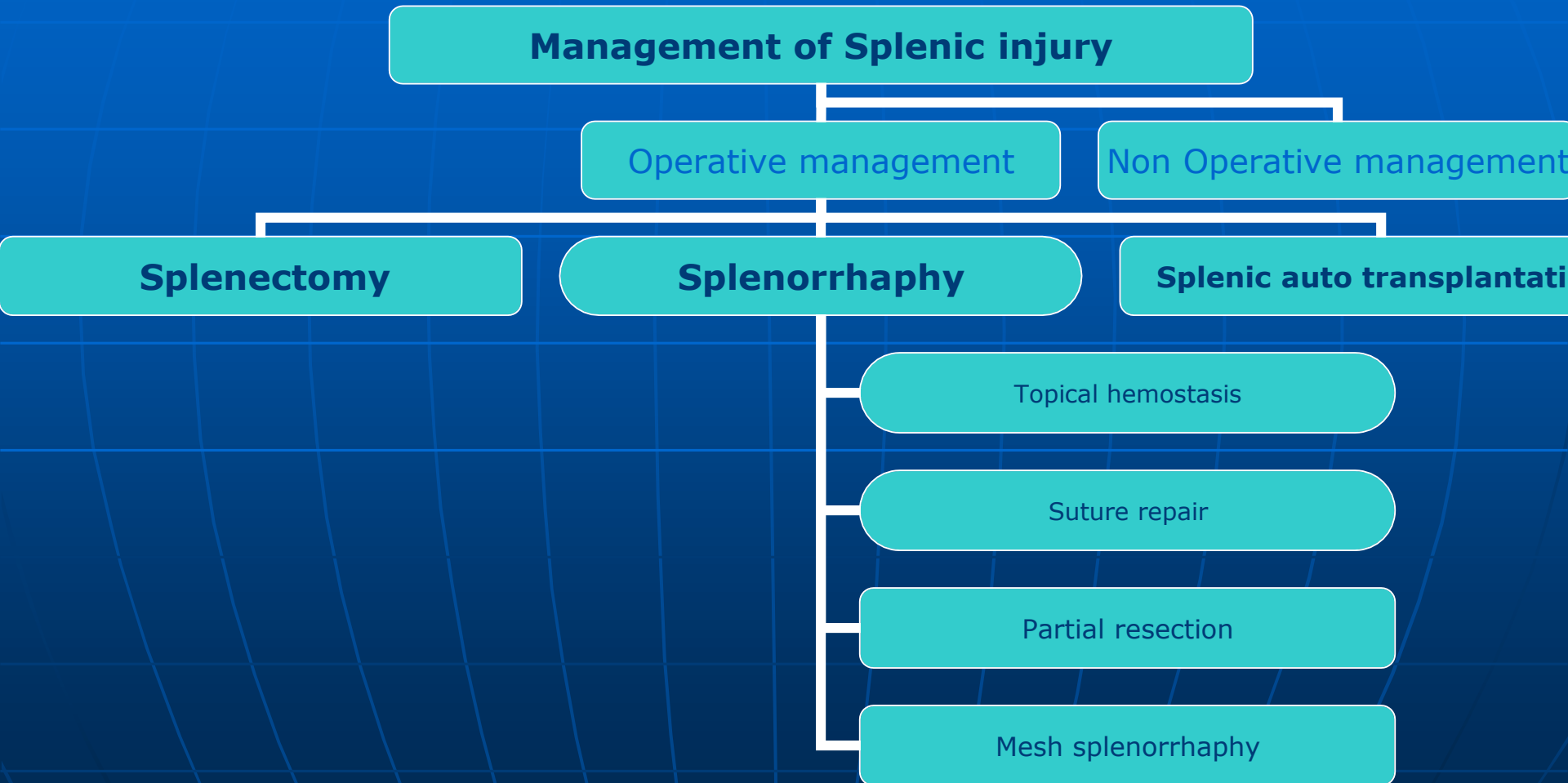
### 6. Laparoscopy:

- In doubtful cases.

# Management of Splenic injury



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# Management of Splenic injury

## **Splenic salvage procedures**

**Operative management**

**Non Operative management**

**Splenorrhaphy**

**Topical hemostasis**

**Suture repair**

**Partial resection**

**Mesh splenorrhaphy**

# Non-operative treatment of injured spleen

## **Indications:**

- hemodynamic stability.
- Absence of peritonitis.
- Computerized tomography scan:
  - Grade of splenic injury (GI &GII).
  - Absence of contrast extravasation.
  - absence of other injured organs.
- Transfusion requirement < 2 units of blood (PRBCs).

# Non-operative treatment of injured spleen

## Protocol for non operative ttt:

- Strict bed rest.
- Observe vital signs regularly.
- Hb level every 6 to 8 hours.
- Serial abdominal examination to detect signs of peritonitis.
- Grade I & II who remain stable after 48h
  - may perform ambulation with Hb level daily for 2 days.
  - if stable with benign abd. Ex. Discharged after 5 days of trauma & follow-up CT after 4ws.

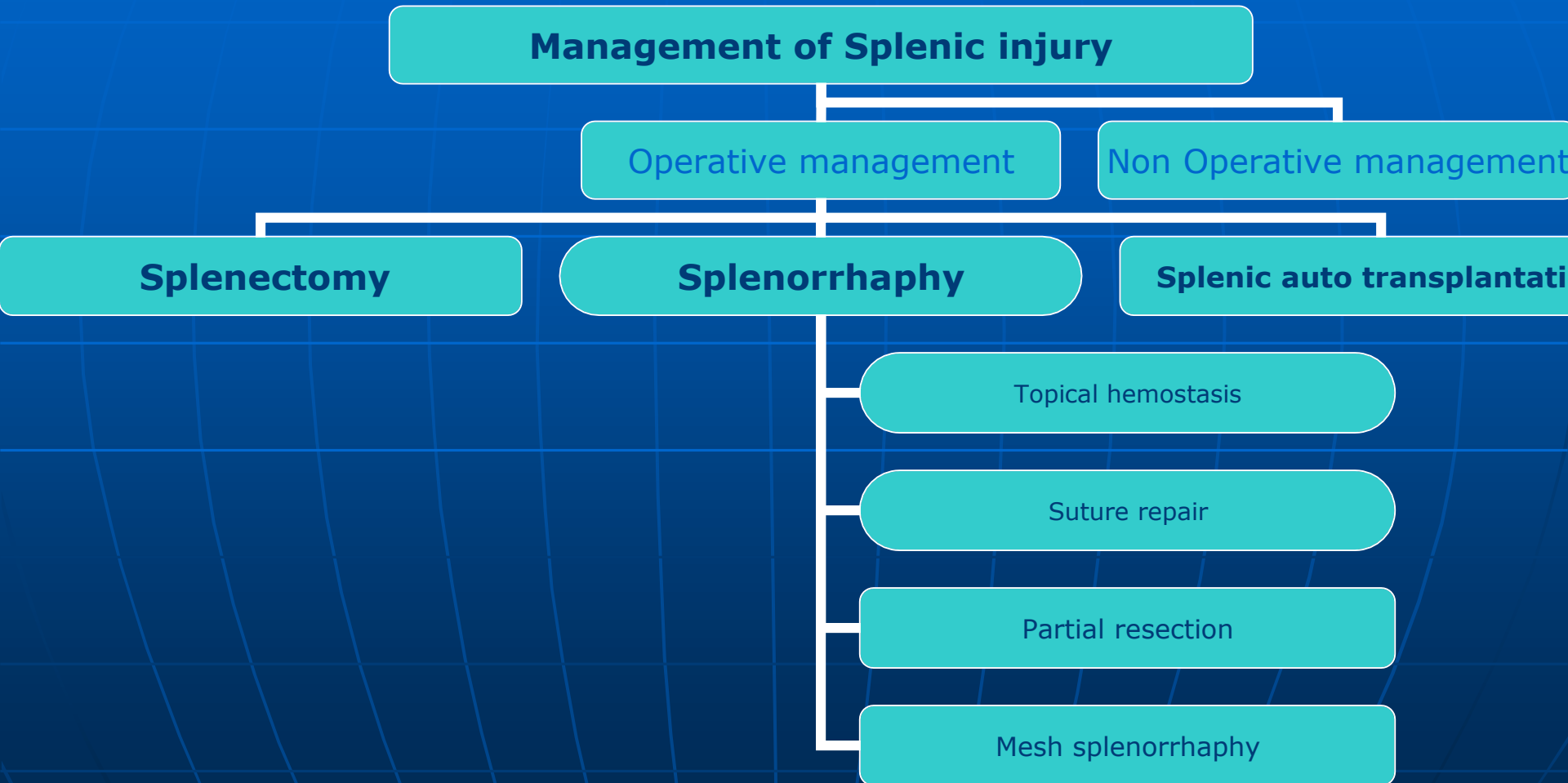


# Non-operative treatment of injured spleen

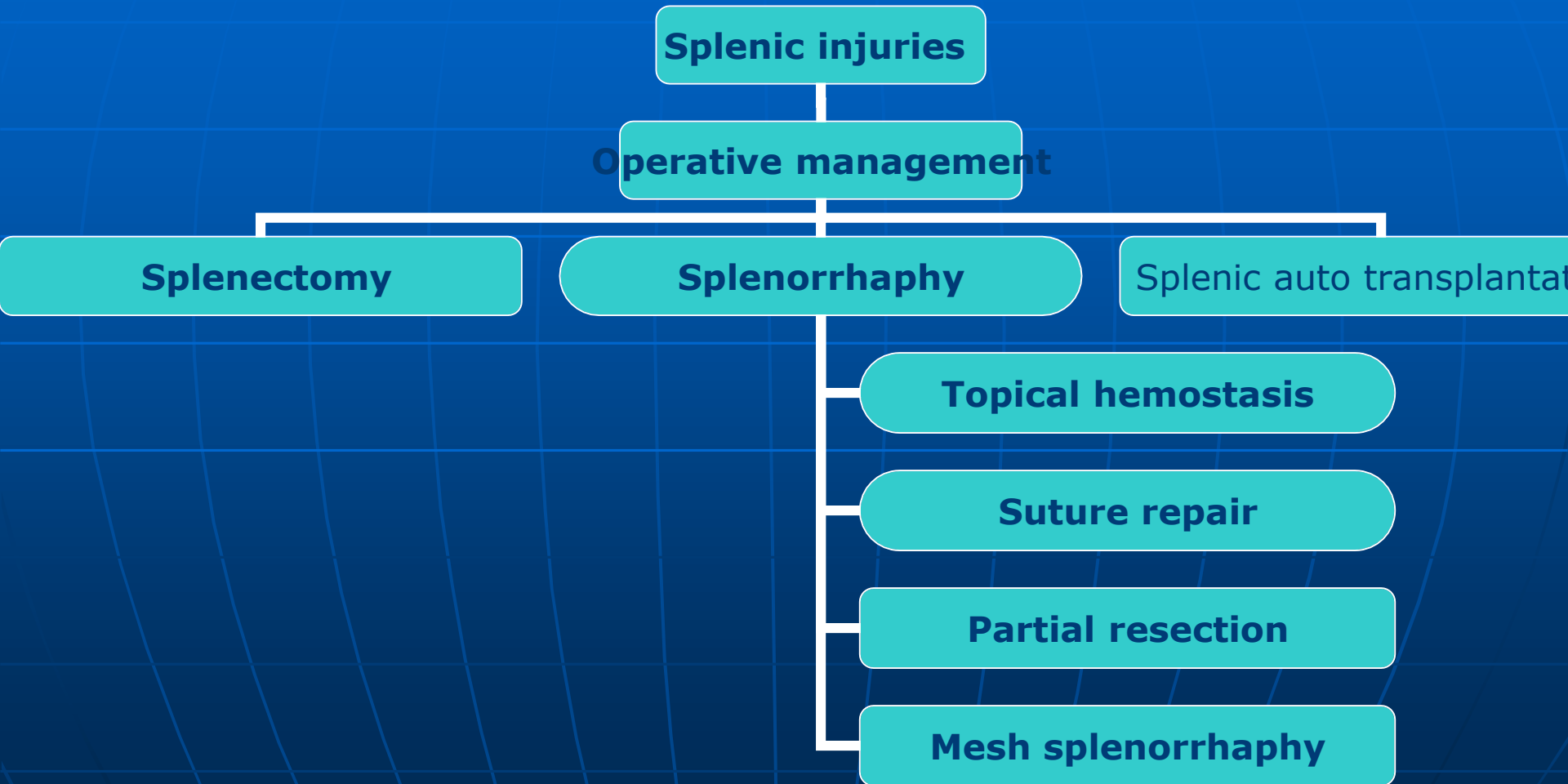
## Criteria for failure of non operative ttt:

- Persistent tachycardia.
- Hypotension.
- Decreasing Hb with increasing transfusion requirement (>2 units PRBCs).
- Peritonitis on Physical examination.
- Computerized tomography scan:
  - enlarged hemopritoneum.
  - New extravasation of I.V. contrast agent.
  - Expansion or rupture of subcapsular hematoma.

# Management of Splenic injury



## Management of Splenic injury



## **Splenic salvage procedures**

**Operative management**

**Non Operative management**

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**Topical hemostasis**

**Suture repair**

**Partial resection**

**Mesh splenorrhaphy**





## Splenic salvage procedures (Splenorrhaphy)

- Grade I injuries which are not actively bleeding require no specific therapy.
- Small, grade I and II injuries that are found to be actively bleeding respond well to a combination of direct pressure and a hemostatic agent..
- Larger injuries require suture repair, partial resection, or application of mesh wrap..

# Splenic repair ( Splenorraphy) procedures

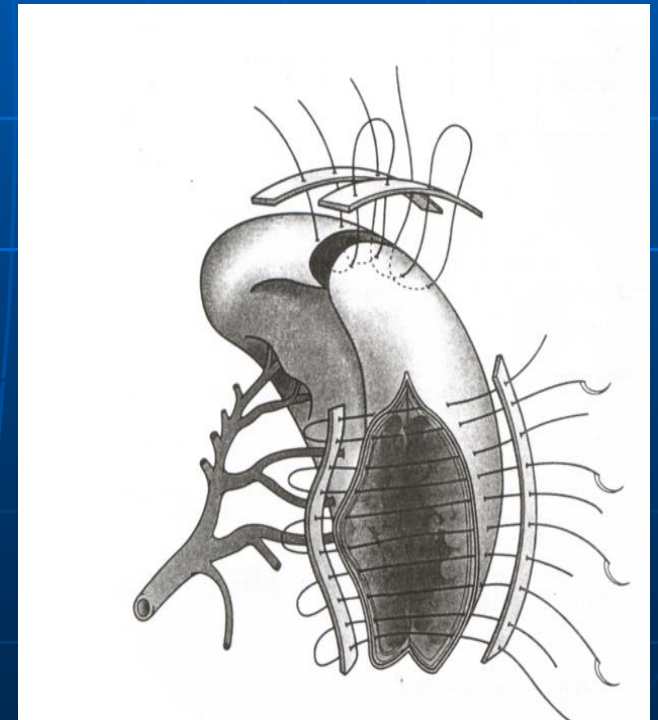
## **Topical hemostasis:**

Best suited for small splenic injuries

- Gelfoam (Upjohn co.), Surgicel (Johnson& Johnson), or Avitene (Alcon lab.) has been reported and successful with small grade I injuries..
- Fibrine glue, (a combination of topical thrombin, calcium gluconate, and cryoprecipitate) has been reported to have an 86% success rate.
- Laser, Argon beam coagulation is a technique that uses inert gas to conduct energy which is useful in grade II splenic injuries.
- Ultrasound, high intensity ultrasound was used successfully to control bleeding from splenic laceration up to 10 mm long & 5 mm deep in experimental rabbits..

## Suture repair:

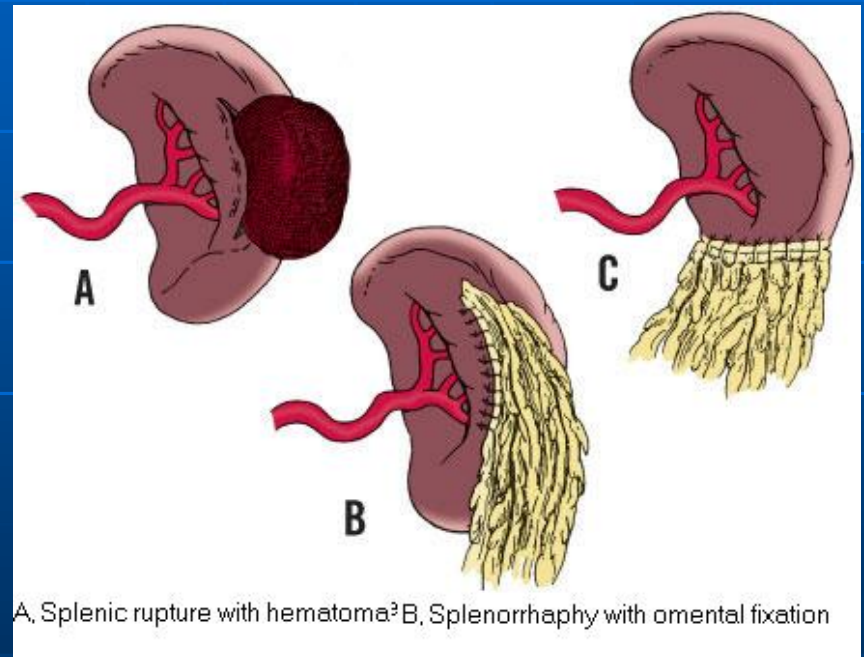
- Suture repair of long, deep splenic laceration may be carried out with permanent or absorbable monofilament suture.
- The thick capsule in a child allows firm suture placement. In adults, large, pledged horizontal mattress sutures are recommended.





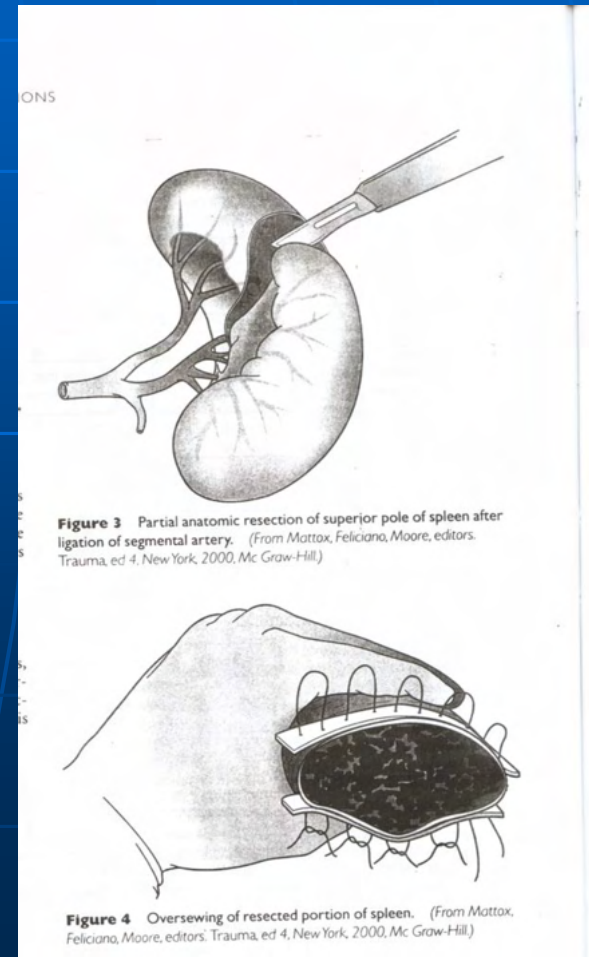
## Suture repair:

- Packing of deep laceration with Gelfoam, surgical, or omentum may be helpful to obtain hemostasis.



## Partial resection:

- Partial splenectomy is a feasible method of preserving immunologic function in the traumatized spleen .
- The blood supply to the spleen is segmental, which allows for partial resection of injured portions that run parallel to the blood supply or have a devitalized single splenic segment.



## Splenic repair ( Splenorraphy) procedures

### Partial resection:

Essential steps in the technique includes:

- Administration of polyvalent anti-pneumococcal vaccine before surgery, plus a broad-spectrum antibiotic administered in three doses — one prior to surgery and two after.
- Temporary occlusion of the splenic artery  
Preparation and isolation of segmental splenic arteries and veins and ligation of the vessels that supply the segment to be removed
- A check of the color, size, and consistency of the segment to be preserved.

## **Partial resection:**

Essential steps in the technique includes:

- Separation by non circumferential incision of the viable segment from the splenic part to be removed. The surgeon should proceed with careful intras-splenic dissection and ligation of bleeding vessels, using miniclips or regular hemoclips.
- If there are deep lacerations in the splenic remnant, an absorbable polyglycolic mesh should be used as a wrap .
- Observation of the segment for 5 to 10 minutes for color and bleeding .



## Splenic repair ( Splenorraphy) procedures

### Mesh splenorraphy:

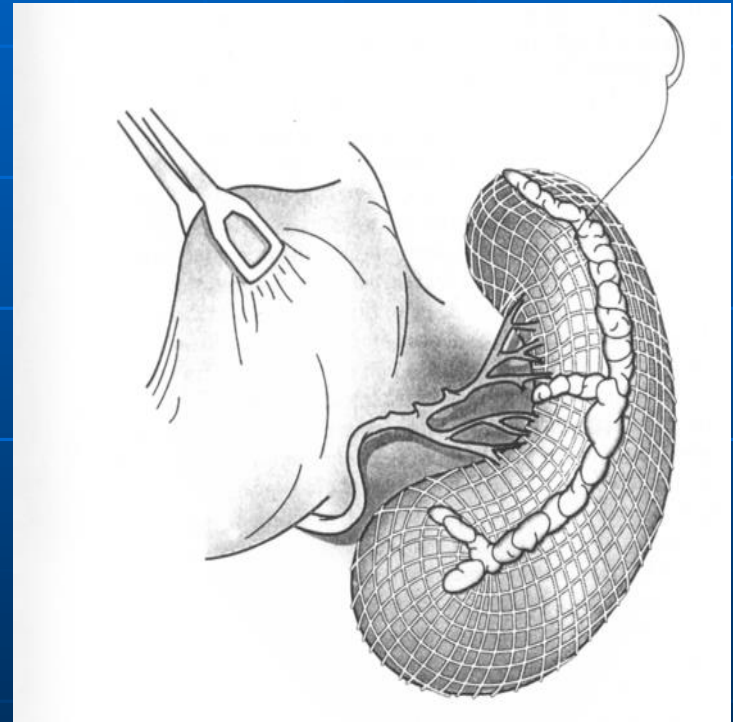
- This technique is suitable for stable patients with more extensive splenic lacerations or injuries involving the loss of a substantial amount of the splenic capsule.
- This technique involve the placment of a sheet of absorbable mesh around the spleen with the splenic hilum passing through a small keyhole cut in the center of mesh.



## Splenic repair ( Splenorraphy) procedures

### Mesh splenorraphy:

- The mesh is then sutured to itself and to splenic capsule along anterior surface of the spleen.
- This creates tension and compresses the spleen, resulting in hemostasis.

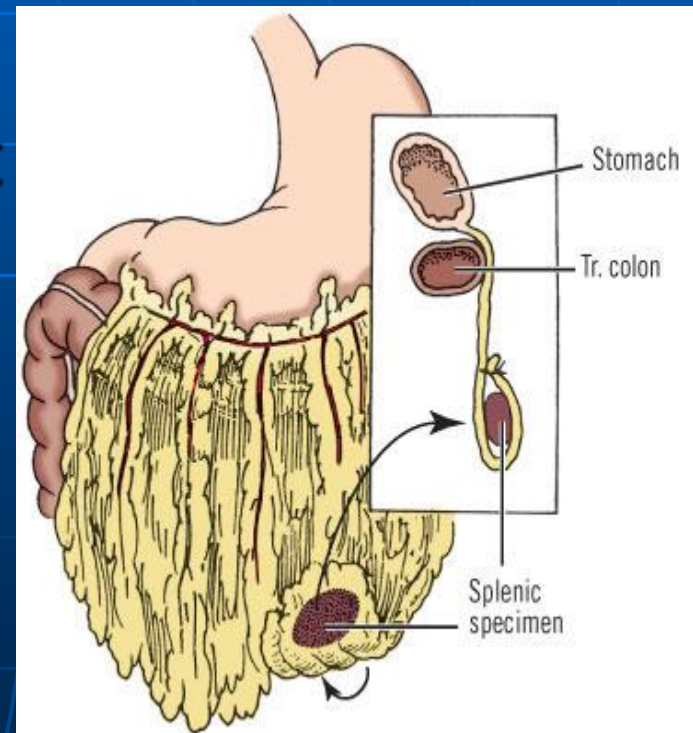




## Splenic preservation procedures

# Splenic autotransplantation:

- Autotransplantation of splenic remnants has been attempted in an effort to prevent the asplenic state..
- Most reports suggesting that 30% to 50% of normal tissue is required to maintain immune function.
- the technique is very controversial.

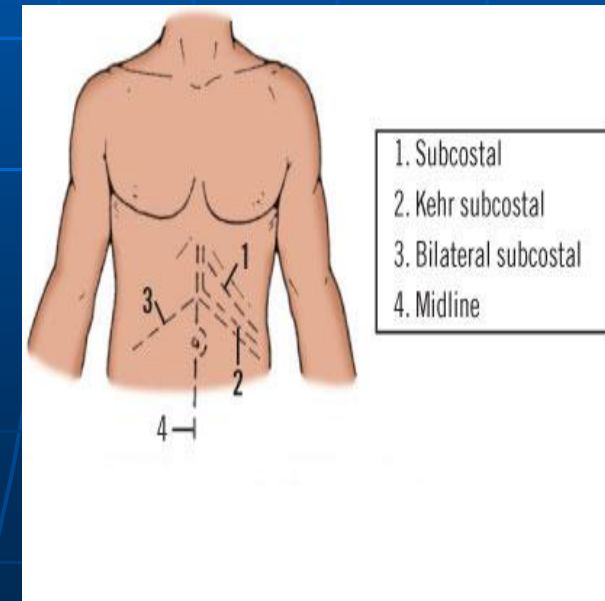


# Total open Splenectomy

# Total open Splenectomy

## Incisions:

- **Midline incision:** The midline incision is the incision of choice for most indications, such as trauma, hypersplenism with coagulation problems, staging laparotomy for Hodgkin's disease, and massive splenomegaly .
- **Left subcostal:** The left subcostal incision, also, can give adequate exposure for a splenectomy .
- **Thoracoabdominal incision:** may make removal of a massive spleen with many adhesions safe and easy

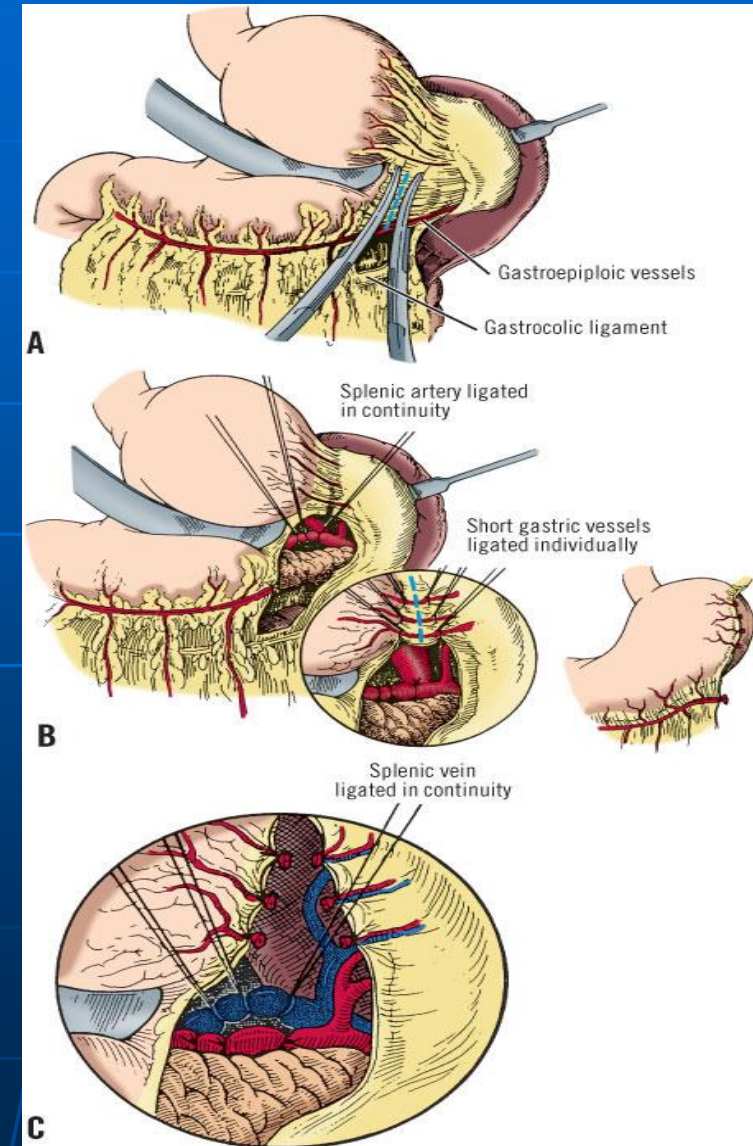


## Approaches:

Total open splenectomy (the removal of the spleen in toto) can be performed by :

### ■ ***Anterior splenectomy:***

-In the anterior approach, the surgeon first incises the gastrocolic ligament, allowing entry to the lesser sac, and then ligates the splenic artery.

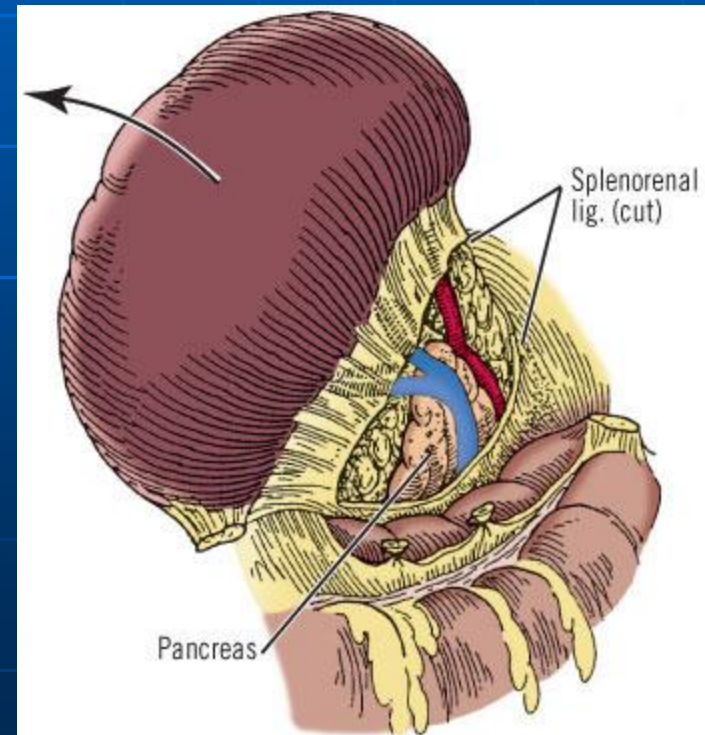




## Approaches:

### ■ *Posterior splenectomy:*

-In the posterior approach, the surgeon ligates the splenic artery after incising the posterior layer of the splenorenal ligament and mobilizing the spleen to the right, thereby working within the greater peritoneal cavity .



# Laparoscopic Splenectomy



# Post-splenectomy complications

# Post-splenectomy complications

- General complications.
- Anatomical complications (local).
- Functional complications.

# Anatomical complications

- Vascular injuries: Hemorrhage from polar arteries; retrograde from branch of splenic artery. Ischemia to greater curvature .
- Organ injury: Diaphragm, tail of pancreas, stomach, transverse colon, left kidney, etc. .
- Inadequate procedure: Preservation of accessory spleen in splenectomy for hemolytic disease .

# Functional complications

- Thromboembolism:

the blood platelet count may rise, and if this exceeds one million per millilitre prophylactic aspirin is recommended to prevent axillary or other venous thrombosis .

- Overwhelming postsplenic sepsis: The increased incidence of overwhelming infection after splenectomy i.e. Opportunist postsplenectomy infection (OPSI).

# Opportunist postsplenectomy infection (OPSI)

- Splenectomised patients show reduced antibody production when challenged with particulate antigens.
- Splenectomised patients are at increased risk of septicaemia due to *Streptococcus pneumonia*, *Neisseria meningitides*, & *Haemophilus influenzae*
- Antibiotic prophylaxis (e.g. penicilline or amoxicillin) is recommended in the first 2 years after splenectomy.

# Opportunist post-splenectomy infection (OPSI)

## ■ Vaccination:

If elective splenectomy is planned, vaccination against *Pneumococcus*, *Neisseria meningitidis*, & *Haemophilus influenzae* should be given 2 weeks preoperative.

- *Pneumococcal* vaccination is recommended in those patients aged over 2 years.
- *Haemophilus influenza* type b is recommended irrespective of age.
- *Meningococcal* vaccination is not recommended routinely.
- *Influenza* vaccine should be given to asplenic patients





**THANK YOU**