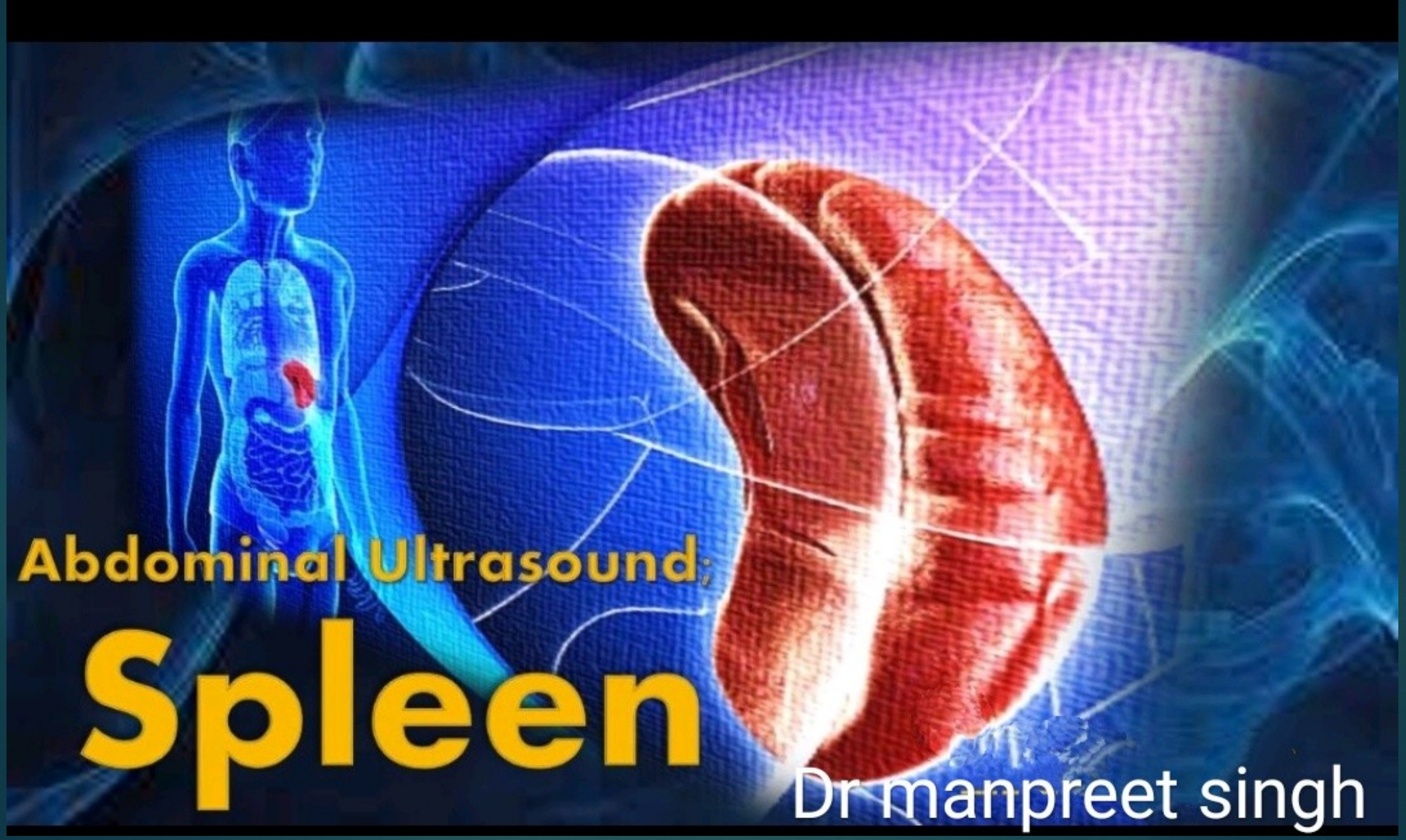

Abdominal Ultrasound:
Spleen
Dr manpreet singh

- Surgical Anatomy
-
- Functions of the Spleen
- Infection
- Splenunculi
-
- Splenic Injury
- Atraumatic Rupture of Spleen
- Splenomegaly
-
- Hereditary Spherocytosis
- Haemolytic Immune Anaemia
- Thalassaemia

Overwhelming Post splenectomy

Splenic Artery Aneurysm

Splenic Abscess-

Hypersplenism

Splenic Cyst

Sickle Cell Disease-

ANATOMY OF SPLEEN

- the spleen is an organ located in the upper left abdomen, roughly the size of a clenched fist.
- It is wedge shaped organ.
- The spleen in located mainly in the left hypochondrium and partly in epigastric region of the abdomen, under cover of the diaphragm and ribcage, so it cannot be palpated on clinical examination (except when enlarged).
- It is an intraperitoneal organ, entirely surrounded by peritoneum (except at the splenic hilum).
- The spleen is connected to the stomach and kidney by parts of the greater omentum
- Gastrosplenic ligament : Connects the spleen to the greater curvature of the stomach
- . Splenorenal ligament : Connects the hilum of the spleen to the left kidney. The splenic vessels and tail of the pancreas lie within this ligament

STRUCTURE

- The spleen has a slightly oval shape. It is dark purple in colour.
- Spleen is 1 inch (2.5 cm) thick, 3 inch (7.5 cm) broad, 5 inch (12.5 cm) long, 7 ounces (200 gm) in weight and related with 9-11 ribs
- It is covered by a weak capsule that protects the organ, and allowing it to expand in size. The outer surface of the spleen can be anatomically divided into two:
- Diaphragmatic surface: In contact with diaphragm and ribcage.
- Visceral surface: In contact with the other abdominal viscera
- It has anterior, superior, posteromedial and inferior borders.

ANATOMICAL RELATION

- It lies in close proximity to others structures in the abdomen:

- Anterior : stomach Posterior : Diaphragm, left lung, ribs 9-11
- Interior : Left colic flexure (splenic flexure) Medial : Left kidney , Tail of the pancreas

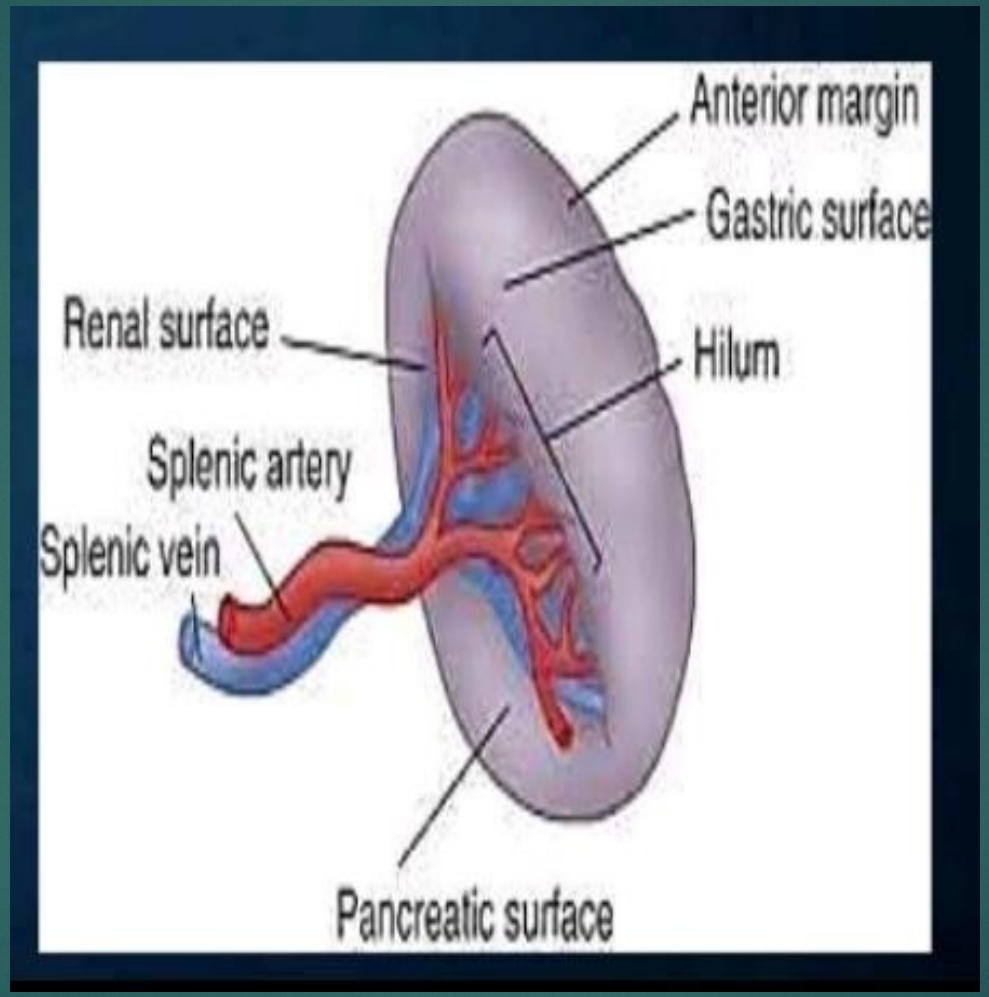
NEUROVASCULAR SUPPLY

- The spleen is a highly vascular organ. It receives its arterial supply from the splenic artery.
- This vessel arises from the coeliac trunk, running laterally along the superior aspect of the pancreas, within the splenorenal ligament. As the artery reaches the spleen, it branches into five vessels- each supplying a different part of the organ

.These arterial branches do not anastomose with each other. This enables a surgeon to remove one of these segments without affecting the others (a procedure known as a subtotal splenectomy).

venous drainage : Venous drainage occurs through the splenic vein. It combines with the superior mesenteric vein to form the hepatic portal vein

NERVE SUPPLY : The nerve supply to the spleen is from the coeliac plexus


Anterior margin
Gastric surface
Renal surface
Hilum
Splenic artery
Splenic vein
Pancreatic surface

FUNCTIONS OF SPLEEN

Immune function : The spleen processes foreign antigens and is the major site of specific immunoglobulin M (IgM) production. The non-specific opsonins, tuftsin and properdin, are synthesised. These antibodies are of Band T-cell origin and react with bacteria and fungi to render them more susceptible to phagocytosis.

Filter function : Macrophages in the reticulum capture cellular and non-cellular material from the blood and plasma. This will include the removal of effete platelets and red blood cells. This process takes place in the sinuses and the splenic cords by the action of the endothelial macrophages. Iron is removed from the ingested degraded haemoglobin during red cell culling and is returned to the plasma. Removed non-cellular material may include bacteria and, in particular, pneumococci

Pitting : Particulate inclusions from red cells are removed and the repaired red cells are returned to the circulation. These include Howell-Jolly and Heinz bodies, which represent nuclear remnants and precipitated haemoglobin or globin subunits respectively.

Reservoir function :This function is less marked than in other species, but the spleen does contain approximately 8% of the red cell mass. An enlarged spleen may contain a much larger proportion of the blood volume

Cytopoiesis : From the fourth month of intrauterine life, some degree of "haemopoiesis occurs in the fetal spleen. Stimulation of the white pulp may occur following antigenic challenge, resulting in the proliferation of T and B cells and macrophages. This may also occur in myeloproliferative disorders, thalassemias and chronic haemolytic anaemias

SPLENIC TRAUMA (SPLENIC RUPTURE)

- The spleen is the most commonly injured organ following blunt abdominal trauma and the second most commonly injured organ after penetrating abdominal trauma (First is small intestine)
- Traditionally, injuries to the spleen were treated with prompt splenectomy. However, recognition of overwhelming post splenectomy infection (OPSI) reveals the immunological function of the spleen, so splenic preservation should be attempted in the hemodynamically.
- stable patient when feasible. In unstable patients. with ruptured spleens, prompt splenectomy remains the standard of care.

ETIOLOGY

- Blunt injury abdomen
- Injury to the left side of chest, left lower rib fractures, due to fall from a tree, road traffic accidents can be associated with splenic rupture
- Retroperitoneal haemorrhage , fractures spine and renal injuries may be associated with splenic injury.
- Penetrating injuries to the abdomen: shots, stabbings may cause rupture of spleen
- Spontaneous rupture of the spleen: It is s when spleen is pathological like in malaria, infectious mononucleosis, rarely in sarcoidosis, haemolytic anaemia and leukaemia
- Iatrogenic : Splenic capsule may be torn during surgical procedures such as vagotomy or gastrectomy due to traction on the stomach.

TYPES OF RUPTURE:

Mainly 3 types of rupture are seen in spleen

1. Acute splenic rupture

2. Delayed splenic rupture

3. Occult splenic rupture

1. Acute splenic rupture

It occurs mostly due blunt trauma and is featured by immediate intraperitoneal bleeding.

In this variety be types are seen, in first type the patient's condition deteriorates rapidly giving no chance to start proper treatment.

In the second type there is initial shock, from where the patient recovers by treatment revealing signs of ruptured spleen. Fortunately the second type is much more common.

2. Delayed splenic rupture:

It occurs after few days to injury and sudden intraperitoneal bleeding starts.

This delayed rupture is reported in 10 to 15% of the cases of blunt trauma. Such delayed type of rupture is probably due to:

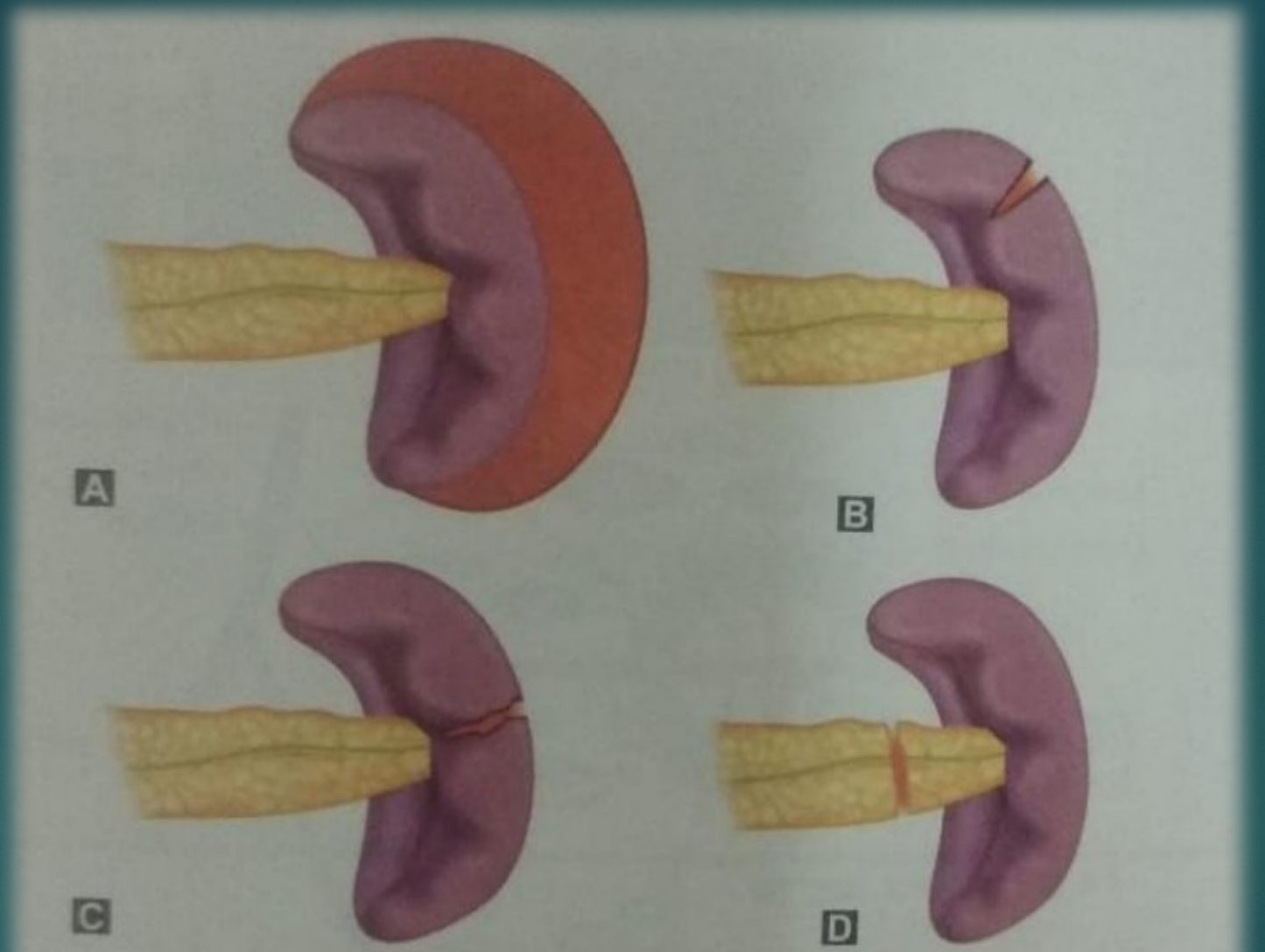
.Blood clot that temporarily stop the bleeding and becomes lysed by the pancreatic enzymes.

Slowly enlarging subcapsular hematoma which ultimately ruptures.

greater-omentum, which secures the injured site initially by shielding gradually moves off.

3. Occult splenic rupture:

- This condition is characterized by formation of traumatic pseudocyst of the spleen.
- This type is seen in less than 1% of patients sustaining injury to the spleen.
- It is caused by association of intrasplenic or para splenic hematoma.



Figs. 13.4A to D: Types of splenic injury. (A) Subcapsular haematoma; (B) Incised wound; (C) Lacerated wound; (D) Hilar injury.

CLINICAL FEATURES

Hypovolemic shock: Injury to spleen may cause severe haemorrhage and ultimately hypovolemic shock.

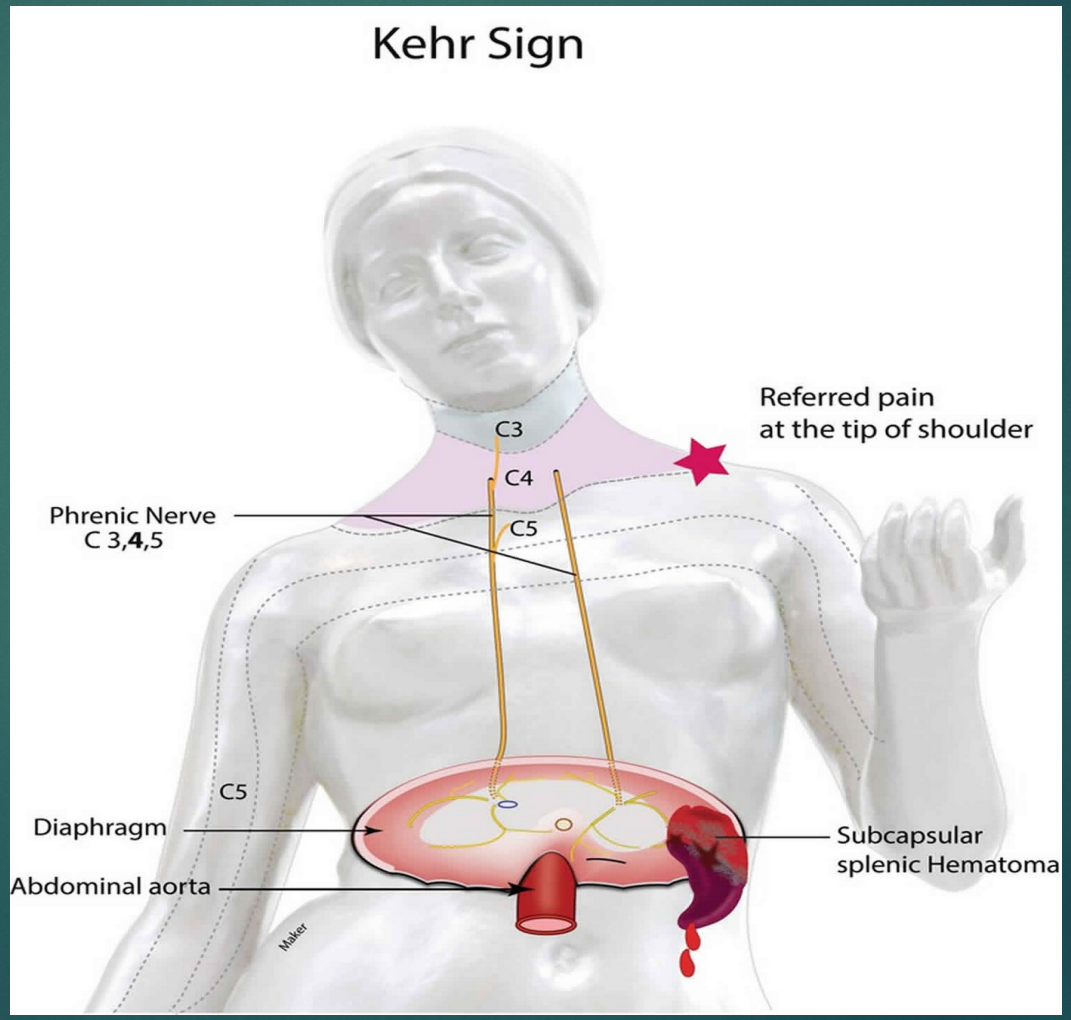
Death can occur within few minutes.

There is increased pulse rate, pallor, hypotension and cold clammy extremities

Abdominal distension.

Paralytic ileus develops gradually

Kehr's sign: Irritation of under surface of the diaphragm by the blood, it causes irritation of the phrenic nerve (C3, C4) So, the pain is referred to the tip of shoulder (Supra clavicular nerve C4)



Balance's sign: Blood from the ruptured spleen is coagulated and may present as a tender mass that causes dull sound on percussion in left side of abdomen is known as Balance's sign.

Balance's Sign

Dullness on percussion of the left upper quadrant

ruptured spleen

Splenic organ injury scale (1994)

Grade 1

Non-expanding subcapsular haematoma <10% surface area.

Non-bleeding capsular laceration with <1 cm depth.

Grade 2

Non-expanding subcapsular haematoma 10-50% surface area.

Non-expanding intraparenchymal haematoma <5 cm in diameter

Laceration capsular tear 1-3 cm in depth which does not involve trabecular vessel

grade III

Expanding subcapsular or >50% surface area or

ruptured bleeding subcapsular haematoma/ intraparenchymal haematoma.

Intraparenchymal haematoma >5 cm or parenchymal laceration >3 cm depth involving trabecular vessels

Grade IV

Laceration involving segmental or hilar vessels with >25% devascularization

Grade V

Shattered or avulsed spleen; hilar devascularization with entire spleen separation

.

Complications of Splenic Rupture/Trauma

- Blood loss
- Disseminated intravascular coagulation (DIC)
- Sepsis.
- Splenic artery pseudoaneurysm.
- Splenic arteriovenous fistula.
- Problems of associated injuries like of pancreas.

INVESTIGATIONS :

Routine blood tests: leukocytosis may present.

Straight X-ray: To see the obliteration of splenic outline, associated intestinal perforation and fractured ribs

USG abdomen.

CT scan of abdomen.

Treatment

Initial Management (Resuscitation)

- ABCD, resuscitation and primary assessment of acute critical care.
- Central venous line for perfusion and monitoring; urinary catheter, nasogastric tube aspiration : ICU care.
- Fluid resuscitation with crystalloids using Ringer's lactate or normal saline using two wide bore cannula.
- Blood transfusion either whole blood or packed cell, FFP, platelet in 1:1:1 ratio.
- Antibiotics coverage: vaccine for pneumococcal/meningococcal and Haemophillus bacteria should be given.
- Assess the patient for other injuries (head to toe examination)

MANAGEMENT:

- **Emergency splenectomy**: If there is large laceration on spleen and there is active haemorrhage with hypotension, emergency splenectomy should be performed because it is quick, easy to perform and life saving
- **Partial splenectomy:** It is performed when portion is devoid of circulation and blood supply of the remaining portion is preserved.
- **splenorrhaphy:** It is performed when there is small fear on the spleen and the general condition of the patient is good. This tear is sutured by catgut and flap of omentum can be wrapped to secure the tear
- **Conservative management:**
- It could be tried if there is parenchymal tear in stable adult or pediatric patient.
- The patient is admitted in I.C.U. and danger of delayed haemorrhage should be kept in mind.

Non-operative Management

- When facilities are available, splenic injury can be managed conservatively by non-operative management (NOM). 80% of blunt splenic injuries can be managed non-operatively (success is more in children).
- Clinically close observation, serial haematocrit evaluation and serial CT abdomen /US abdomen at regular intervals to assess

- the progress or regress of the bleeding spleen has to be done
- Absolute bed rest (for 2-3 weeks), sedation (initially)
- antibiotic coverage and proper monitoring are needed.

- It is often supported by angiographic selective embolisation using gelfoam coils and stents to improve the splenic salvage rate. But it may cause pain, splenic abscess or infarction.

Indications for non-operative treatment: (1) Only splenic injury-no other associated injuries

(2) Grade I, II and III injuries

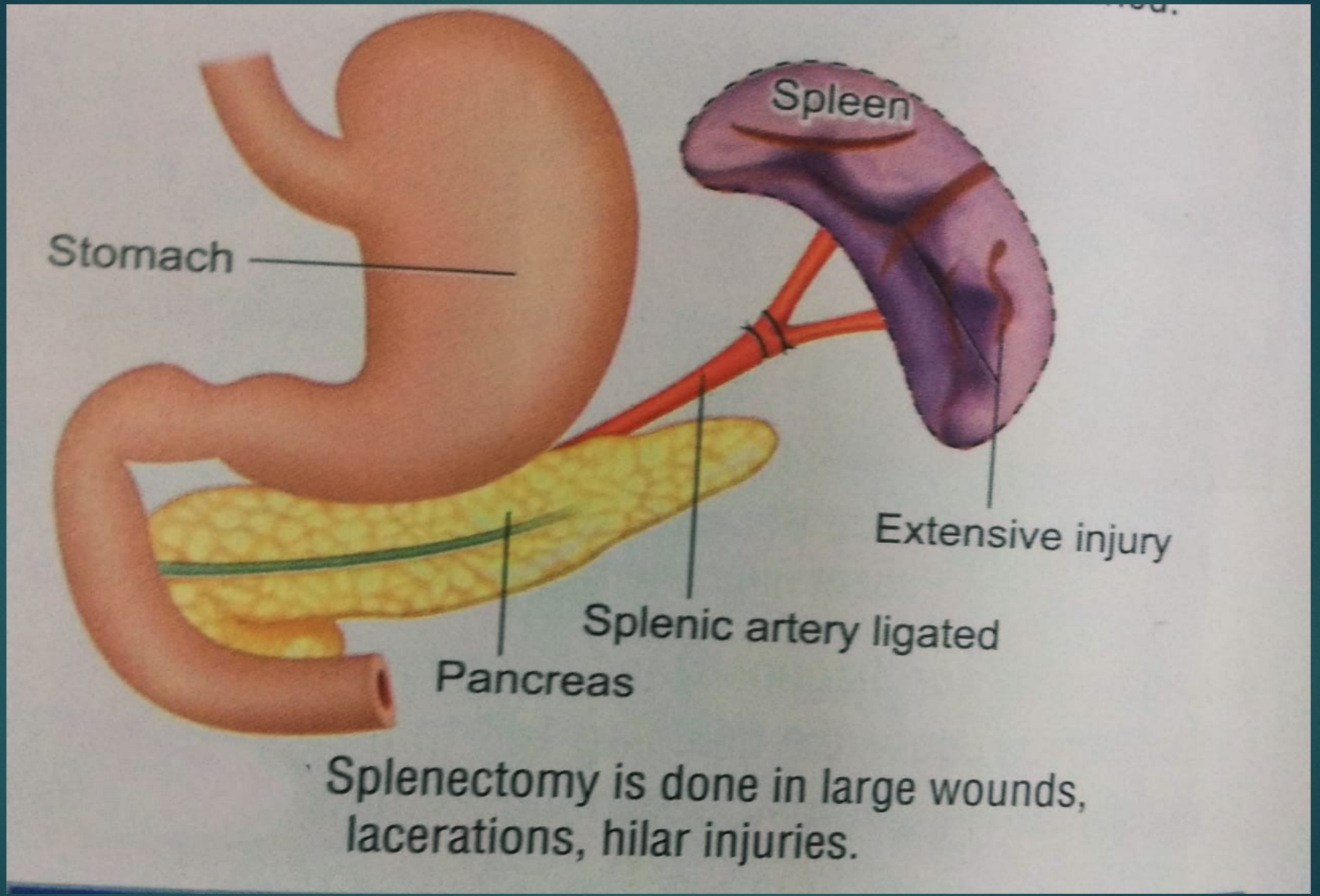
(3) Haemodynamically

Surgical Management

Surgical management is done whenever patient is haemodynamically not stable or there is associated injuries or hilar or shattered grade V injuries.

Emergency splenectomy

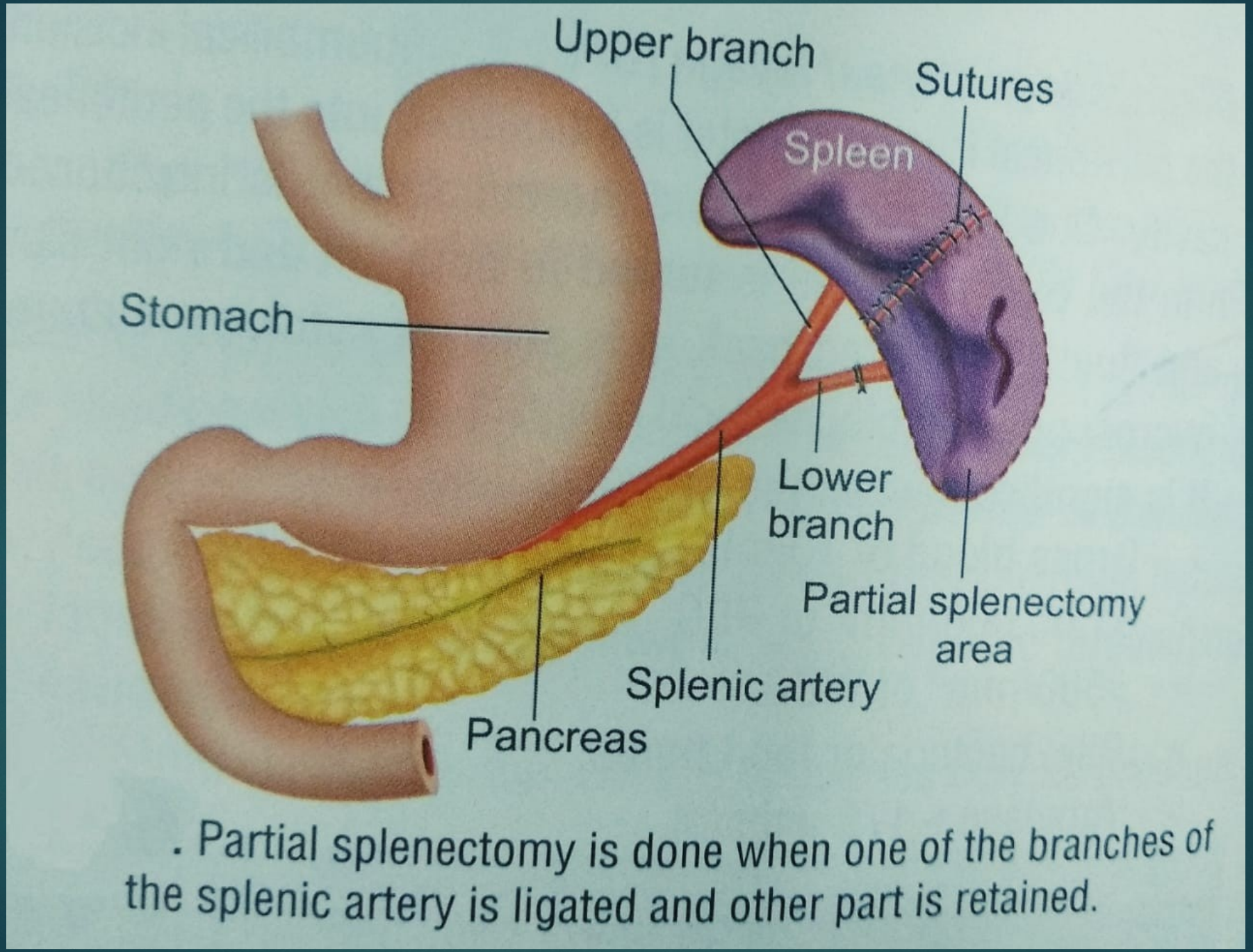
- It is done through midline/left subcostal incision. Thoracoabdominal extension of incision may be needed for rapid control of bleeding for injury to a large tropical spleen with severe bleeding. Other associated injuries should be looked for and dealt with (injury to left lobe liver/pancreas/intestine/colon)



Splenectomy is done in large wounds, lacerations, hilar injuries.

Partial splenectomy (upper/lower)

- It can be done by retaining either of the upper or lower polar branches of the splenic artery.
- Retained cut end (half) is sutured with haemostatic agent like surgical using polyglactin

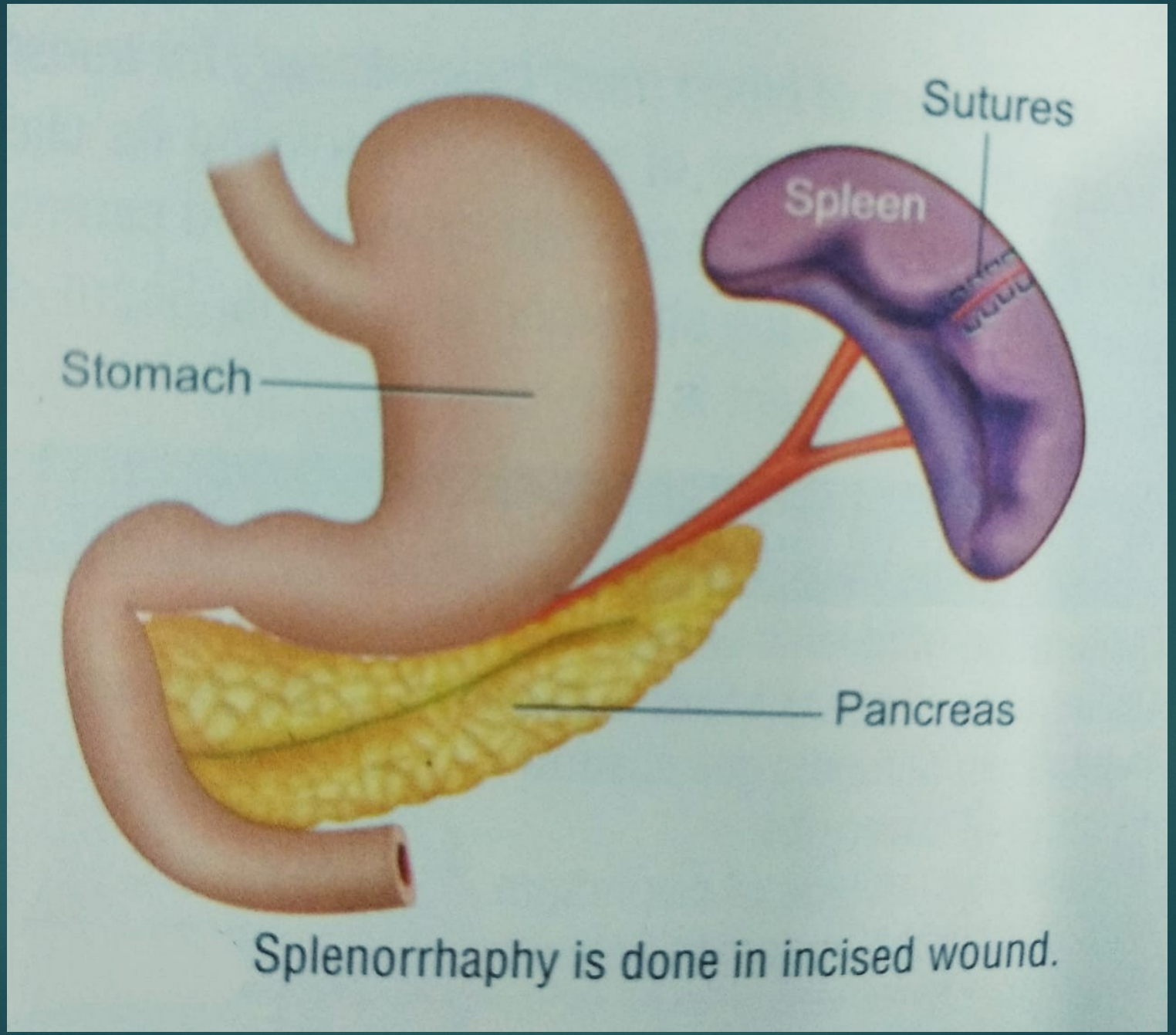


. Partial splenectomy is done when one of the branches of the splenic artery is ligated and other part is retained.

Splenorhaphy

- In especially clean incised wound, spleen can be salvaged by suturing the wound carefully with placement of gelfoam, topical thrombin, absorbable mesh wrap over the wound. Suture repair, oxidised cellulose, debridement of lacerated spleen-are other methods used.
- Temporary occlusion of splenic artery is often needed during splenorrhaphy. 10% of splenic injuries undergo splenorhaphy.
- Its application is getting reduced due to non-operative approach in such patients

But in grade IV or V injuries splenorrhaphy is not possible.



Splenorrhaphy is done in incised wound.

Advantages of spleenorrhaphy

- It avoids OPSI
- it avoids dead space and so prevents potential space for subphrenic abscess
- cellular components of blood are better maintained

Splenic mesh wrap

- In stellate and multiple lacerations, specialized mesh bag is wrapped around the spleen which is fixed to spleen with sutures.
- It controls the bleeding and also promotes rapid healing.

Thanks