

# Spleen

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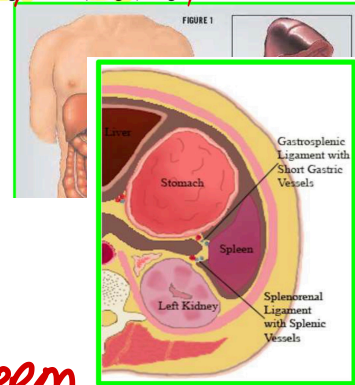
## ❖ Spleen

### ○ Location:

- Left upper quadrant (LUQ) of the abdomen
- Protected by the left 9<sup>th</sup> to 11<sup>th</sup> ribs**
- Neighboring structures of the spleen
  - Left kidney (inferior, medial, and posterior)
  - Left colic flexure (inferior)
  - Organ of mesodermal origin while liver is endoderm

### Spleen

- It is a **lymphatic organ** connected to the vascular system.
- \*\* Position:** It lies in the **left hypochondrium**
- N.B.; - always remember the odd numbers 1, 3, 5, 7, 9, and 11.
- 1 inch thick 3 inch broad 5 inch long 7 ounces (200 gm) weight & lies between 9 & 11 ribs.**
- \*\* Functions:**
  - 1- Storage of blood.
  - 2- Destruction of old RBCs.



### Vasculature and innervation of the spleen

	Structure	Course	Notable features
Arteries	<ul style="list-style-type: none"> <li>Splenic artery</li> </ul> <p><i>Retractor Art</i></p>	<ul style="list-style-type: none"> <li>Celiac trunk → superior border of pancreas → hilum of spleen → branches into central and penicillar arterioles</li> </ul>	<ul style="list-style-type: none"> <li>Vessels that arise from the splenic artery                             <ul style="list-style-type: none"> <li>Short gastric arteries</li> <li>Left gastroepiploic artery</li> </ul> </li> <li>Located inside the splenorenal ligament</li> <li>Supplies the pancreas while flowing superior to it (retroperitoneal course until the hilum of the spleen)</li> </ul>
Veins	<ul style="list-style-type: none"> <li>Splenic vein</li> </ul>	<ul style="list-style-type: none"> <li>Hilum of spleen → meets superior mesenteric vein to form the portal vein</li> </ul>	<ul style="list-style-type: none"> <li>Veins that empty into the splenic vein                             <ul style="list-style-type: none"> <li>Short gastric vein</li> <li>Left gastroepiploic vein</li> <li>Pancreatic veins from body and tail of pancreas</li> <li>Inferior mesenteric vein</li> </ul> </li> </ul>
Lymphatics	<ul style="list-style-type: none"> <li>Celiac nodes</li> </ul>	<ul style="list-style-type: none"> <li>Follow course of splenic artery</li> </ul>	<ul style="list-style-type: none"> <li>Efferent lymphatics only</li> </ul>
Innervation	<ul style="list-style-type: none"> <li>Celiac plexus</li> <li>Vagus nerve</li> </ul>	<ul style="list-style-type: none"> <li>Follow course of splenic artery</li> </ul>	<ul style="list-style-type: none"> <li>Sympathetic (celiac plexus) and parasympathetic (vagus nerve) innervation</li> </ul>

# Spleen

## Anatomy:

- Wt 75-250 gm, LUQ, along 10<sup>th</sup> rib, between gastric fundus & L hemidiaphragm.
- Hilum: In the angle between stomach & L kidney, In contact with tail of pancreas.
- Concave Visceral surface: impressions.
- Notch: infero lateral border, palpate in splenomegaly.

MCA (3)

diaphragm 1, 3, 5, 7, 9, 11 7th rib 7th space

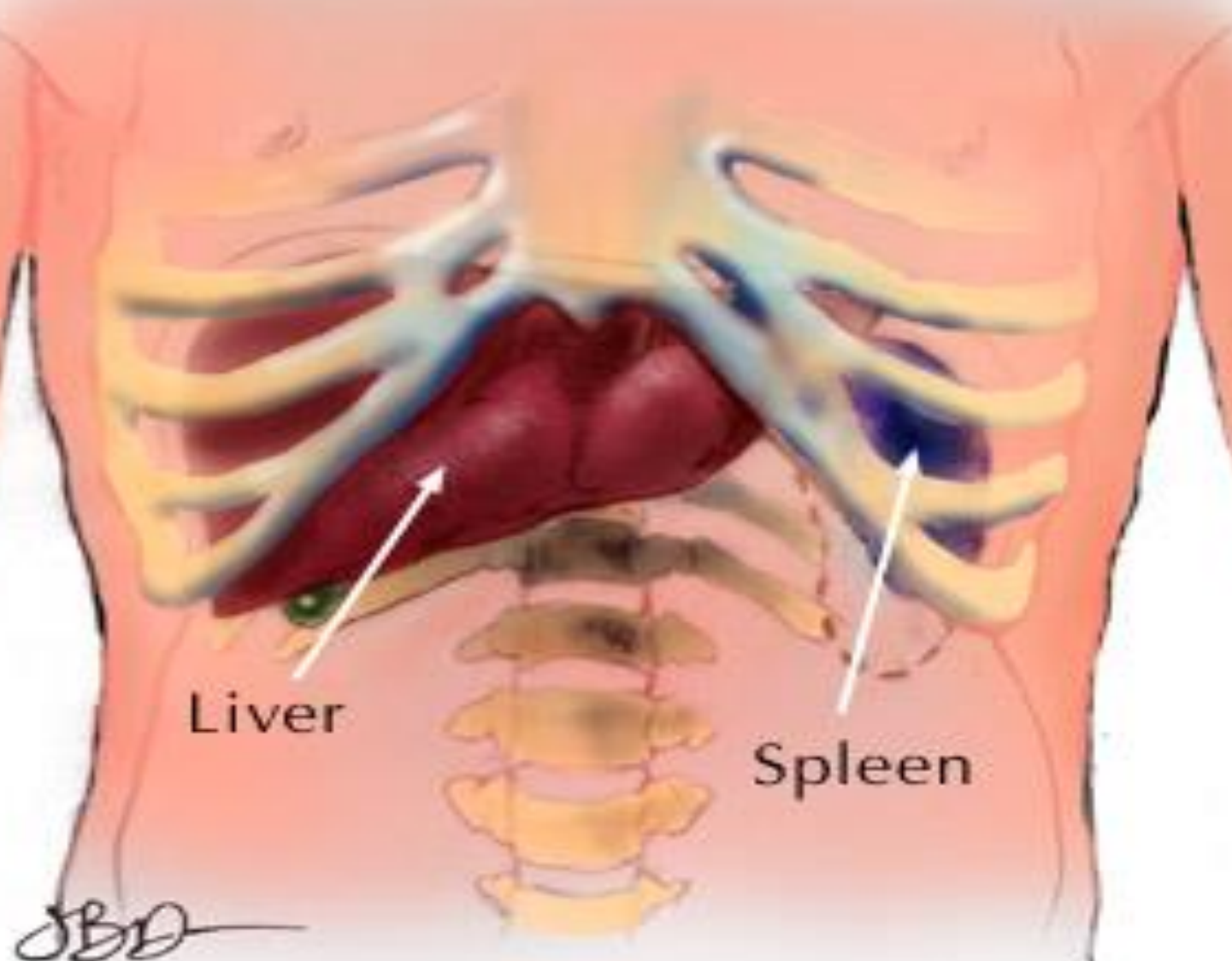
- **Arterial:** Splenic A. along upper border of tail of pancrease.

From splenic & its branches

- **Vein:** Splenic V. at hilum behind pancrease. join SMV to form portal V.

Neck

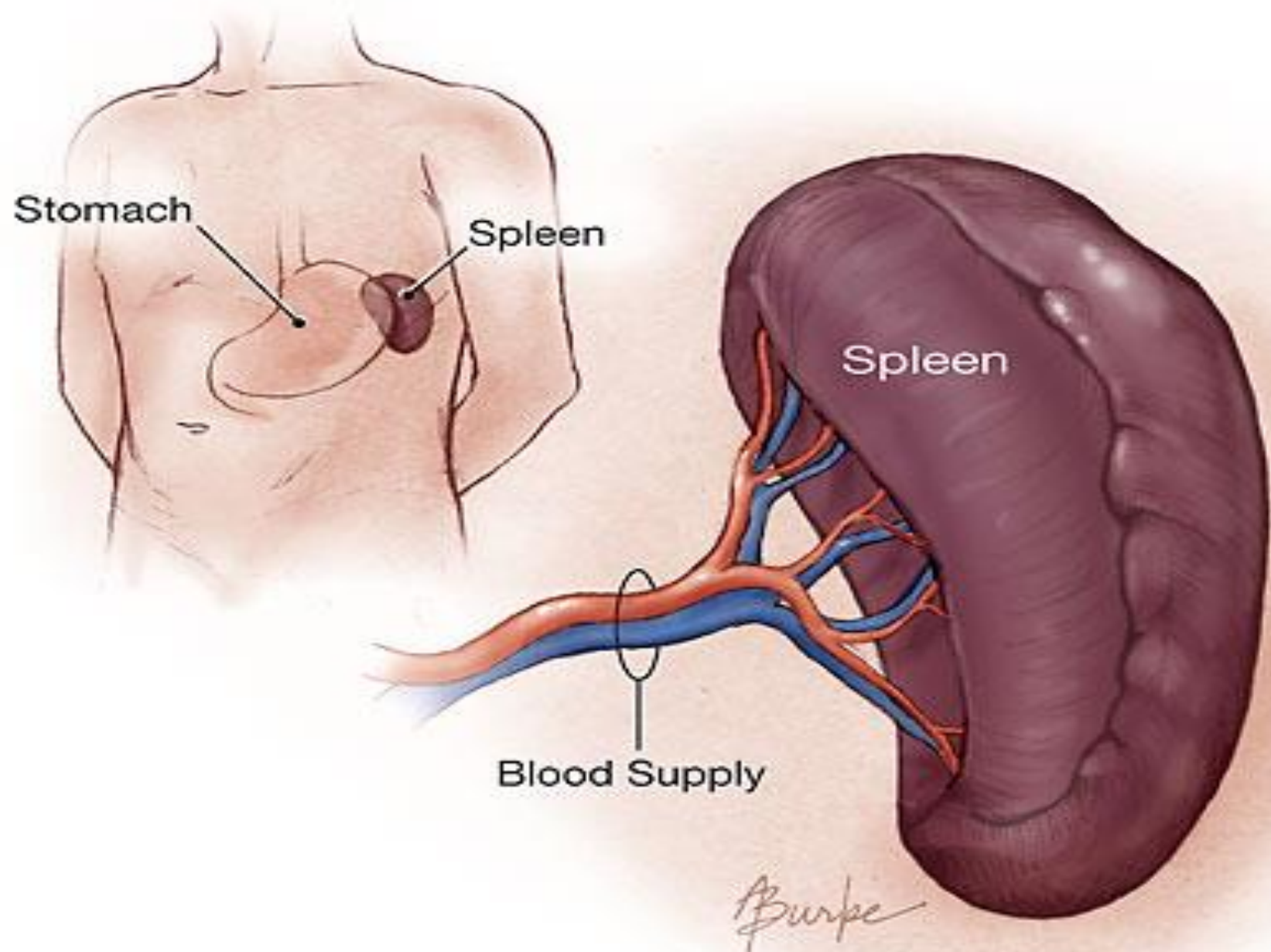
- **Lymphatics:** efferent vessels from white pulp to L N in hilum to retropancreatic to coeliac nodes.

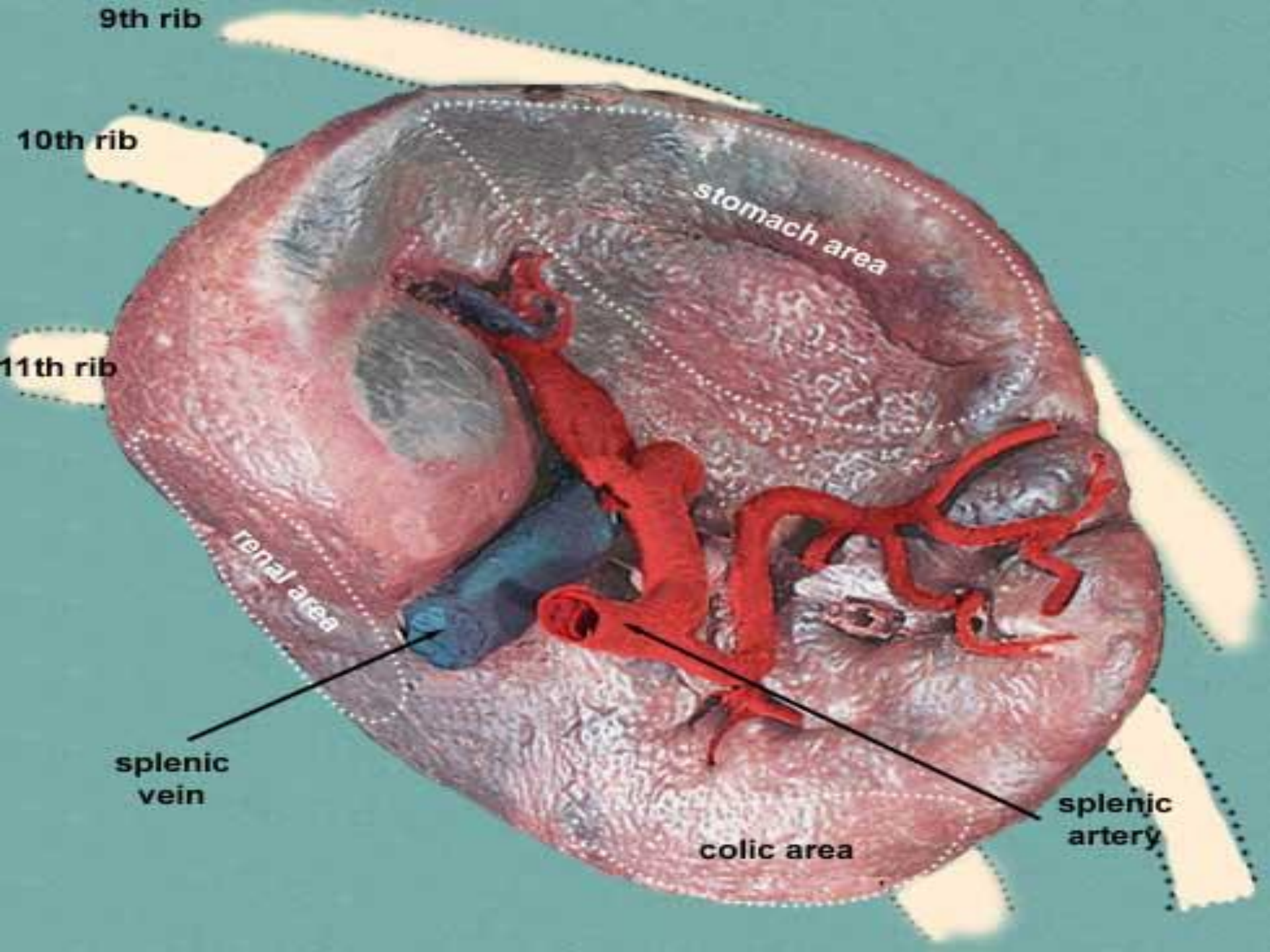


Liver

Spleen

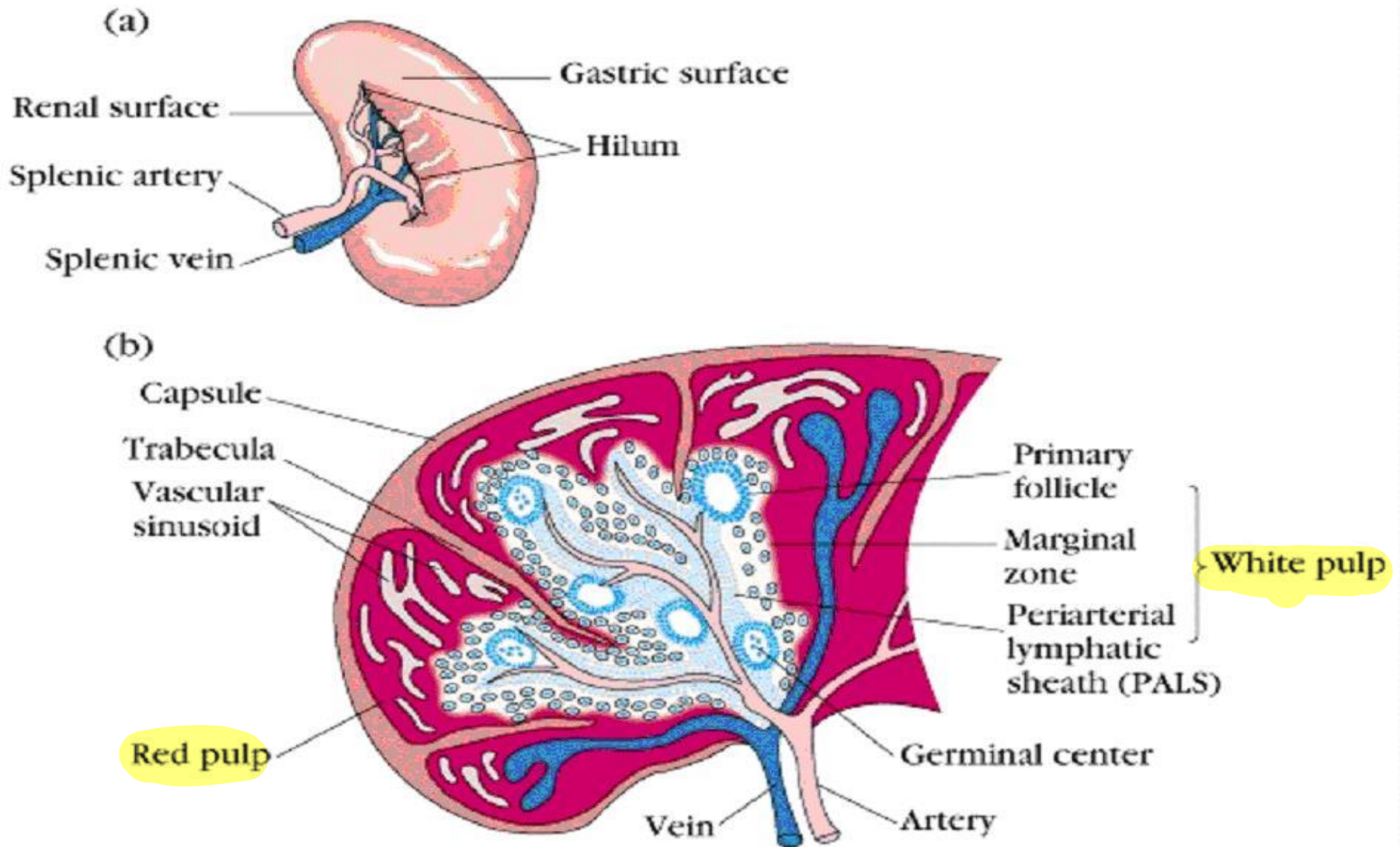
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# Spleen

- **Physiology:**



# Spleen

## Functions:

1. Response to antigenic challenge
2. Destruction of abnormally shaped or rigid red cells
3. Phagocytosis of foreign substance
4. Platelet reservoir
5. Erythrocyte production

# Investigation of the Spleen.

- FBC, Reticulocytes, tests for haemolysis.
- LFT & OGD in splenomegaly+portal hypertension in liver cirrhosis.
- Investigations for causes of splenomegaly including LN biopsy.
- Radiology:
  - 1-Calcification: splenic infarct, splenic a. aneurysm, hydatid cyst, TB.
  - 2-US, CT with contrast, MRI.
  - 3-Tc99: is spleen site of RBC destruction?.

# Congenital Abn of Spleen

1-Agenesis:rare.

2-Spleniculi:10-30% of population. (Accessory spleen)

Hilum (50%), splenic vessels & tail of pancreas (30%), mesocolon & splenic ligaments (20%) .

\*\*Failure to remove spleniculi during splenectomy.....persistant disease.

3-Hamartomas:rare

4-Non parasitic splenic cyst:

1-True,dermoid,mesenchymal.

2-False,trauma

3- Pseudocyst after pancreatitis.

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## Congenital Anomalies

**Complete absence** is rare associated with other congenital abnormalities such as situs inversus and cardiac malformations.

**Hypoplasia**: more common finding

**Accessory spleens (spleniculi)** are common Generally situated in the gastrosplenic ligament or the tail of the pancreas, omentum or mesenteries of the small or large intestine.

In splenectomy if an accessory spleen is overlooked, the benefit of removal of the definitive spleen can be lost

## Blunt trauma

spleen (normal spleen weight 150 g)

- Blunt trauma affect mostly ① spleen ② then liver
- 15% have delayed type of Blunt trauma manifest After 48 hours to months
- may cause hemoperitoneum

## splenomegaly

### Massive splenomegaly (weight > 1000 g)

- 1- Myeloproliferative neoplasms (CML, primary myelofibrosis);
- 2- certain indolent leukemias (CLL and hairy cell leukemia); many lymphomas;
- 3- infectious diseases (e.g., malaria); / schistosomiasis (visceral infection)
- 4- Gaucher disease.

### Moderate splenomegaly (weight 500-1000 g)

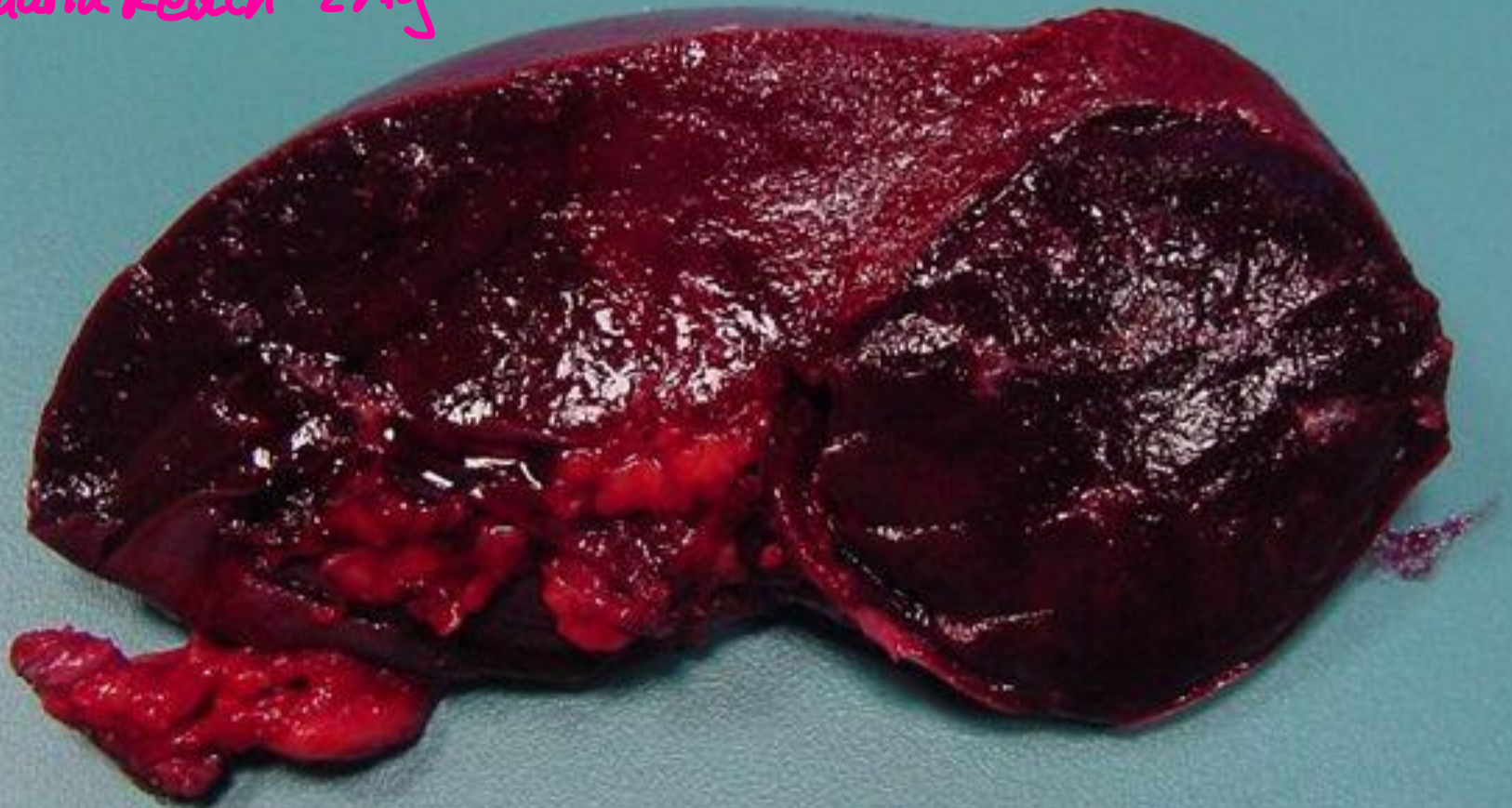
- 1- Chronic congestive splenomegaly (portal hypertension or splenic vein obstruction);
- 2- acute leukemias; (ALL/AML)
- 3- disorders with extravascular hemolysis (hereditary spherocytosis, thalassemia major, autoimmune hemolytic anemia);
- 4- amyloidosis;
- 5- Niemann-Pick disease;
- 6- many infections, including infective endocarditis, tuberculosis, and typhoid;
- 7- sarcoidosis;
- 8- metastatic carcinoma or sarcoma

### Mild splenomegaly (weight < 500 g)

- 1- Acute splenitis;
- 2- acute splenic congestion;
- 3- infectious mononucleosis; (EBV)
- 3- miscellaneous disorders, including septicemia, systemic lupus erythematosus. (SLE)

Rupture of spleen

in malaria Reach 2Hg





# Splenic Rupture

## Consider it :

- 1-Bunt abdominal trauma LUQ (RTA, Fall,...).
- 2-High Risk: diseased or enlarged spleen (rupture of a malarial spleen in trivial injury).
- 3-Fractures of 9<sup>th</sup>, 10<sup>th</sup>, 11<sup>th</sup> left ribs. *140-150cc Bleeding in this case*
- 4-Iatrogenic.

## Presentation:

- 1-Succumbs rapidly from massive haemorrhage
- 2-Initial shock, recovery, signs of late bleeding:  
Blood loss+tamponade+further bleeding. Reminder are, general signs of internal haemorrhage, local LUQ peritonitis signs, Kehr's sign+FAST US & CT.
- 3-Delayed rupture: uncommon with these days scan use In ER.

# Splenic rupture

## Management:

### 1-Conservative: <sup>تقليدي</sup>

1-minimal or no abdominal findings+stable haemodynamically .

2-CT,isolated injury,no hliar injury,no massive distrupcion of spleen.

### 2-Immediate Laparotomy:

1-continuingblood loss despite adequate resuscitation.

2-associated abdominal organ injuries with blunt splenic trauma is up to 25-50%.

\*\*\*\*\*Consider splenic preservation\*\*\*\*\*

# Splenic Trauma

- **Spleen**

- Is one of most vascular organs , pass through it 350 liter of blood / day , contain 1 unit of blood at any moment !

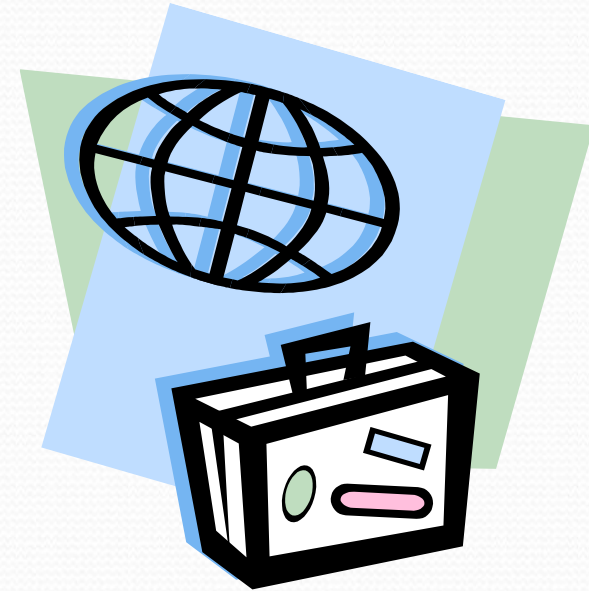
- **Types of trauma :**

- 1- Blunt *misdiagnosed Bcz Asymptomatic*

- 2- penetrating : Easily diagnosed , because patient almost always referred to Surgery .

# Blunt Trauma of Spleen

- 25% of all blunt trauma of abdominal viscera
- More in male 3:2
- Most common cause is RTA
- Presentation :
  - Asymptomatic
  - abdominal pain (50%) , abdominal Distention , Hypotension (25%)



# Diagnosis

- For stable patient :

1. *UltraSound*
2. *CT*
3. *Angiography*



## 4. Plain radiography / chest and abdomen

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- The radiography signs of rupture are:-

1. Obliteration of the splenic outline
2. Obliteration of the psoas shadow
3. Indentation of the left side of the gastric air bubble  
→ Action:- flexion of rib
4. Fracture of one or more lower ribs on the left side (present 27 % of cases)
5. Elevation of the left side of the diaphragm
6. Free fluid between gas filled intestinal coils .

## 5. CT

- Modality of choice
- Used with contrast .

### ● Findings :

1. Lacerations : irregular hypodense area with no enhancement .
2. Sub-capsular hematoma : regular shape , crescentic .
3. Intraparenchymal hematoma .
4. Fragmentation with autosplenectomy .

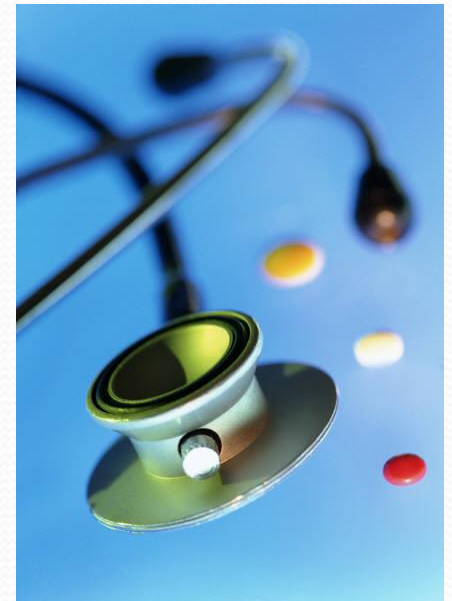
# Diagnosis

- Unstable patient :
  - Open and See !
  - Peritoneal lavage
  - FAST



# Spleen injury grading scale :

- Stage 1 : *wait and see*
  - Subcapsular Hematoma  $< 10\%$  of surface area .
  - Capsular tear depth  $< 1\text{ cm}$  .



# Spleen injury grading scale :

- Stage 2 : *wait and see*
  - Subcapsular hematoma of 10 – 50 % of surface area .
  - Laceration depth :
    - 1-3 cm
    - Not involving trabecular vessels
  - Intraparenchymal Hematoma < 5 cm in Diameter .

# Spleen injury grading scale :

- Stage 3 : *surgical intervention must*
  - Sub-capsular Hematoma  $> 50\%$  , or Ruptured spleen .
  - Laceration depth :
    - $> 3$  cm
    - Involving the trabecular Vessels .
  - Intraparenchymal hematoma  $> 5$  cm in diameter .

# Spleen injury grading scale :

- Stage 4 : *surgical intervention must*
  - Laceration involving hilar or segmental vessels with devascularization of  $> 25\%$  of spleen



# Spleen injury grading scale :

- Stage 5 : *surgical intervention must*
  - Shattered spleen



# Treatment

## 1. Conservative:

- Admit patient to ICU
- Repeated ultrasound
- For those with stage 1  
or 2 . *wait and see*



## 2- splenectomy

## 3- conservative splenoraphy .

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suturing of spleen to prevent further bleeding .

## 4- splenic artery Embolization .

- less mortality and morbidity than splenectomy

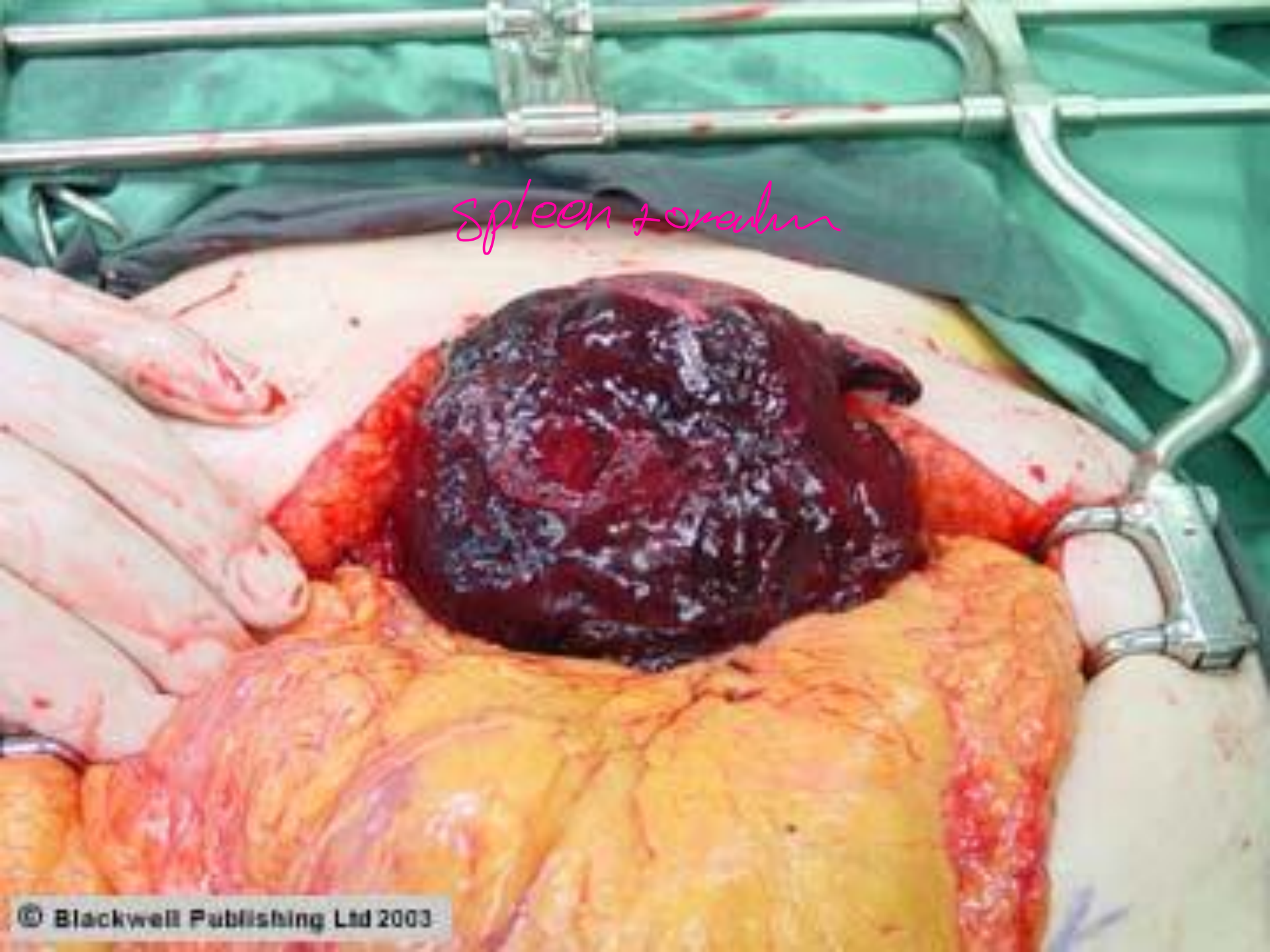
- mortality is related to % of splenic tissue Embolized .

- Complications :

1. Pancreatitis
2. Splenic Abscess
3. Pleural Effusion ( most common )



*spleen + omentum*





## Causes of splenomegaly

Rea

### Infection

- Acute (viral) EPV
- Subacute
- Chronic (malaria)

### Immunological inflammatory disorders

- Felty syndrome (with rheumatoid arthritis and granulocytopenia)
- Systemic lupus erythematosus
- Sarcoidosis
- Amyloidosis
- Thyroiditis

### Haemolytic anaemia

### Immune thrombocytopenia

### Portal hypertension

- Thrombosis of the portal vein
- Liver cirrhosis

### Primary metastatic neoplasms

- Leukaemia (in particular, chronic lymphocytic leukaemia)
- Lymphoma/Hodgkin's disease
- Myeloproliferative syndromes
- Sarcoma

### Storage diseases

- Gaucher's disease
- Niemann–Pick disease

# Splenomegaly & Hypersplenism

**Hypersplenism**: *Clinical syndrome*

- 1-Splenic enlargement.
- 2-Any combination of anaemie,leucopenia or thrombocytopenia.
- 3-Compensatory bone marrow hyperplasia.
- 4-Improvement after splenectomy.

# Splenectomy for Blood ds

## 1-ITP:

- 15-50 y female.
- CP: Ecchymoses purpuric patches of skin & MM.  
Post traumatic skin petechial haemorrhage.  
Epistaxis, Menorrhgia.  
10% palpable spleen.
- Investigations: B.T increased. C.T & P.T normal.  
Thrombocytopenia.

# Treatment

1-75% regress after 1<sup>st</sup> attack in paediatrics.

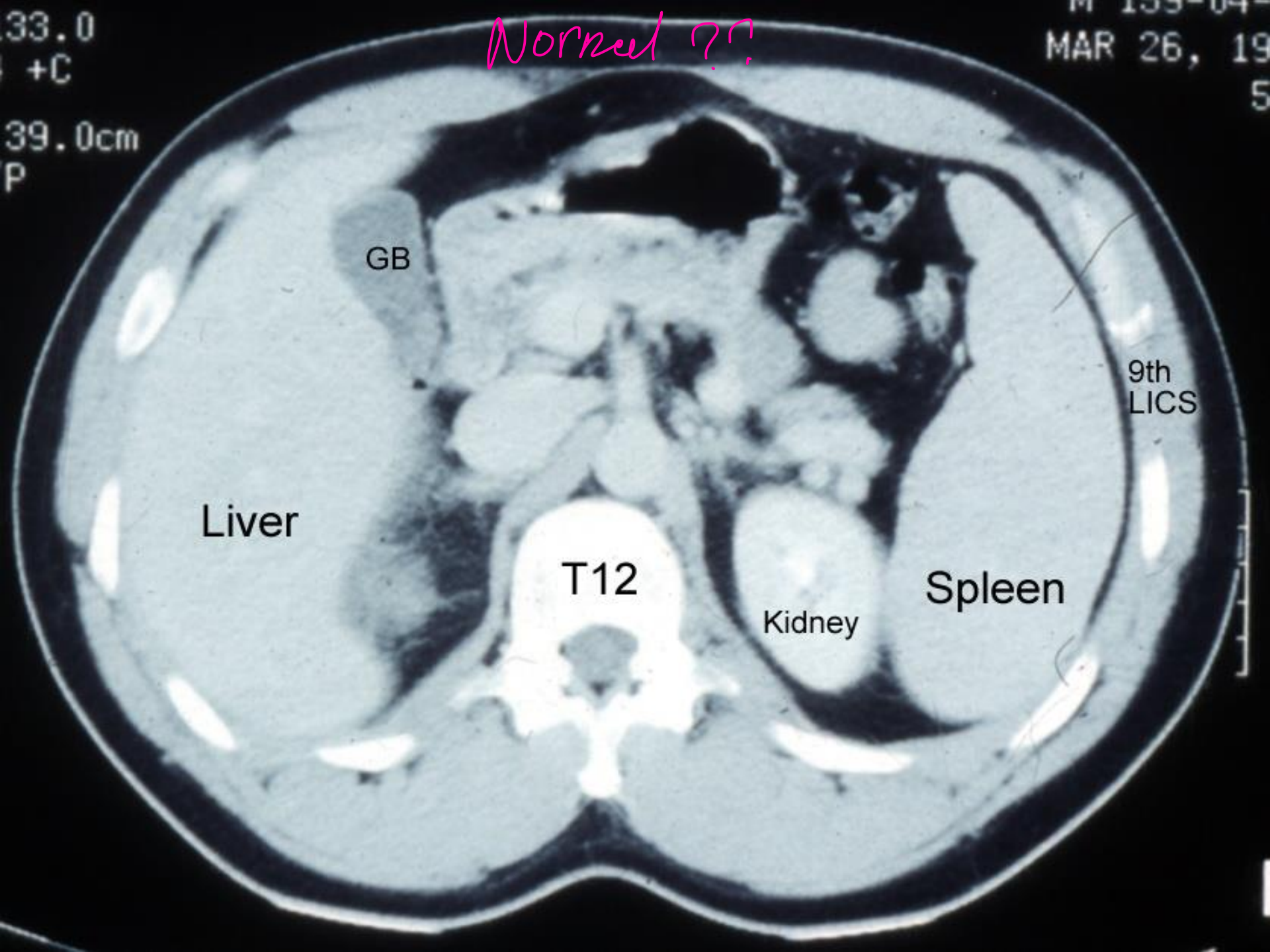
2-Steroid for short course in adult & children...recovery

3- Surgery: Refractory (more than 9 months+low platelet+ 2 relapses).Two thirds cure.

# Splenectomy for Blood ds

## 2-Haemolytic Anaemias:

- 1-Hereditary Spherocytosis.
- 2-Sickel cell anaemia.
- 3-Thalassaemia.
- 4-Acquired autoimmune haemolytic anaemia





# Hereditary spherocytosis

- Autosomal dominant.spherocytic RBC.
- Present in childhood.haemolytic  
jaundice+splenomegaly+pigment gall stones.
- Fragility test RBC haemolyse in stronger saline  
solution 0.6%(normally in 0.47% saline solution).
- Reticulocytes increase.
- Radioactive Cr 51 labelling RBC..RBC destruction.

# Splenectomy for neoplasms

- 1-**Haemangioma** :Most common benign tumour of spleen  
Haemangiosarcoma (rare).
- 2-**Lymphoma**:<sup>هاد القراه</sup>most common cause of neoplastic enlargement.  
---Splenectomy is for..
  - 1-management.
  - 2-diagnosis& staging.(CT is alternative for staging).
- 3-**Myelofibrosis**: Abnormal proliferation of mesenchymal elements in BM,spleen,liver & LN.
  - Over 50,gross splenomegaly with LUQ pain.
  - Splenectomy reduces the need transfusion & may relieve the pain.



## Indications for splenectomy

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### Traumatic

- Rupture after blunt injury to the abdomen
- Iatrogenic injury during another procedure (particularly mobilization of the splenic flexure of the colon)

### Haematological

- Immune thrombocytopenia
- Hereditary spherocytosis
- Autoimmune haemolytic anaemias
- Malaria
- Schistosomiasis
- Leishmaniasis
- Staging of haematological malignancies (e.g. Hodgkin's disease)

### With other viscera

- Radical gastrectomy
- Pancreatectomy

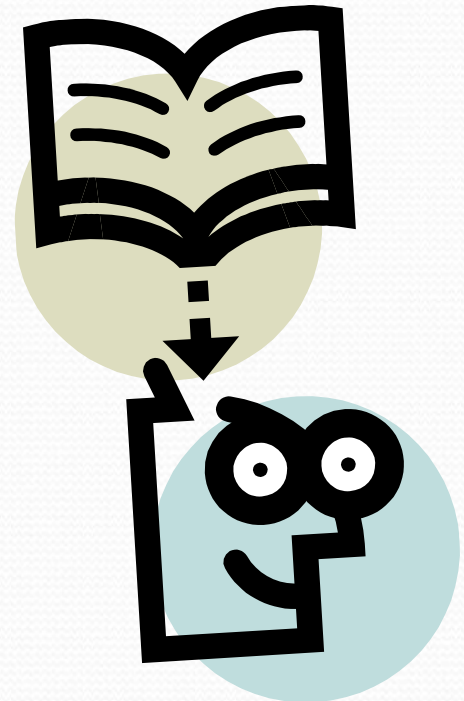
### Miscellaneous

- Treatment for gastric varices
- Treatment of splenic artery aneurysms
- Treatment of splenic cysts/tumours

# Splenectomy

## Preop. Investigations:

- 1-Blood, FFP, Cryoprecipitate, platelets.
- 2-Coagulation profile.
- 3-Antibiotic prophylaxis



# Splenectomy

## Post operative complications:

- 1-Slipped ligature from splenic a...Haemorrhage.
- 2-Haematemesis(gastric mucosal damage)
- 3-Gastric dilatation.
- 4-Left basal atelectasis & Pleural effusion.
- 5-Injury to tail of pancreas.pancreatitis,abscess,fistula.
- 6-injury to greater curvature of stomach during ligation short gastric vessels...fistula.

# Splenectomy

## 7-Venous Thrombosis.

\*Prophylactic aspirin if platelets more than 1 million\*

## 8-Post splenectomy septicaemia: *no*

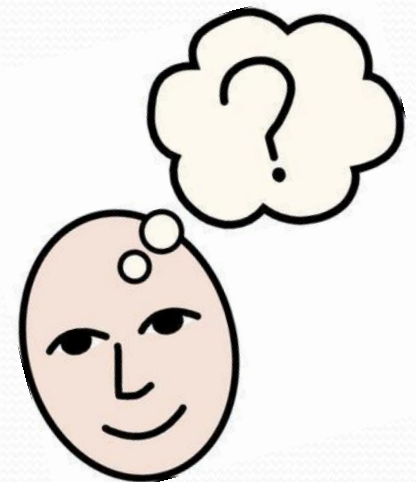
1-Strep pneumonia.

3-H influenzae

2-N meningitides.

4-E.coli.

*Capsulated Bacteria*



## Higher Risk Groups:

- 1-Young.
- 2-Chemoradiotherapy.
- 3-Splenectomy for blood dss.



9- OPSI (*overwhelming post splenectomy infection*) is a real clinical danger.

# Splenectomy

## OPSI:

1-Prophylactic daily **penicillin** if under 5 y until they are 10.

*if there's Allergs Erythromycin*

2-prophylaxis for 2-3 years if older than 5y.

Oral Penicillin, Erythromycin, Amoxicillin, Co-Amoxiclav.

I.V same A.B above or Cefotaxime, Ceftriaxone or chloramphenicol if allergic to Penicillin or Cephalosporine

# Splenectomy

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## Immunization and antibiotic prophylaxis

### Vaccinations

- Pneumococcal vaccination before surgery and repeated at intervals of five years
- *Haemophilus influenzae* and meningococcal vaccination before surgery if not previously received
- Influenza vaccinations given every year
- Giving vaccines minimum of two weeks before surgery or as soon as possible after emergency surgery

### Antibiotics

- Lifelong penicillin should be offered (250–500 mg b.d.)
- Urgent admission to hospital and antibiotic administration on development of infective symptoms
- Written patient information and a health alert card

**\* Post operative vaccination give less than 50% antibody levels of those with preoperative vaccination.**

Thank You ☺



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