# THE SPLEEN

## Imaging Techniques

- ***CT*** and ***US***: major techniques.
- ***Radioisotopes:*** → confirm the presence of functioning splenic tissue.
- ***MR***: CT is more important

## Anatomy

- **Functions*:* Formation** Fetus Blood - **Sequestration** Aged Cells – **Reservoir** R.B.Cs
- **Site:** left upper quadrant /below the diaphragm /, posterior & lateral to the stomach.
- **Surfaces:** 2 surfaces / ***Diaphragmatic*** → smooth and convex,
  - ***Visceral*** :Have concavities for the stomach, kidney, colon, and pancreas.

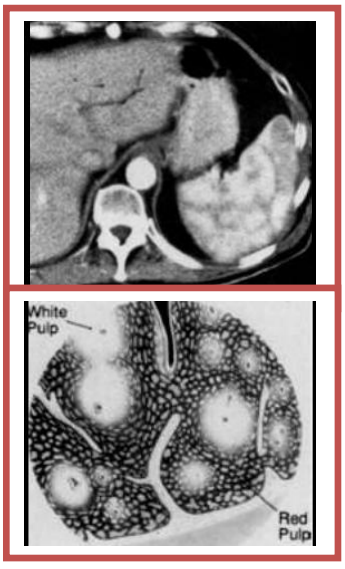
→ Size:

**Average dimensions**
(in adults)
**Length** : 12 cm,
**Width** : 7 cm,
**Thickness** : 3 to 4 cm.

| CHILD | |
|---|---|
| 6 + 1/3 Age in Years | |
| ADULT | |
| Splenic / Renal index | not > 1.2 |
| length x width x thickess | 120 : 480 $Cm^3$ |

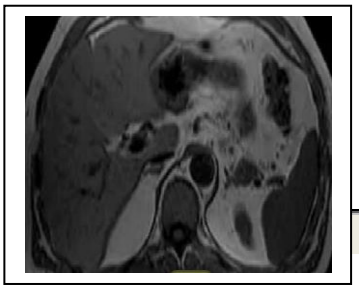
## Blood supply:

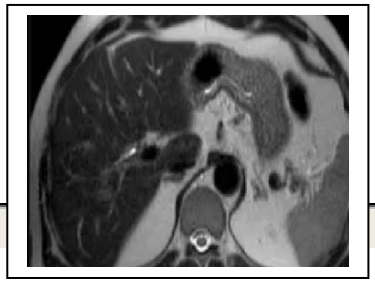
- The splenic artery and vein →course through the pancreas to the splenic hilum, → divide into multiple branches.
- *Splenic arteries*: are *end arteries* (no anastomoses or collaterals) → Occlusion of the splenic A. or its branches →**infarction.**
- Variable rates of blood flow through splenic parenchyma → ***Heterogenous Enhance*** ***"Transient pseudomasses"*** @ early arterial phase both CT and MR .



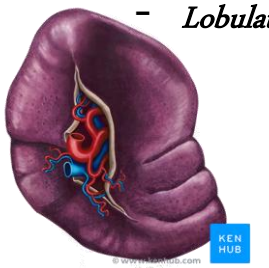

## Imaging:

- On all imaging studies, → **homogeneous** appearance.
- CE ***CT*** and ***MR***→ lesions are best demonstrated .
- On ***noncontrast CT***, *spleen density* is less than or equal *normal liver*.
- On ***MR***: intensity
  - T1WIs → is ***lower*** than hepatic parenchyma.
  - T2WIs → ***higher*** than liver parenchyma on.





- ***Arterial phase*** → irregular defects in parenchymal enhancement .
- *One or 2 minutes later*, →the entire spleen is homogeneously enhanced on both CT and MR.
- ***Lobulations and clefts*** : ***common*** / must not be mistaken for *masses* or *splenic fractures*.

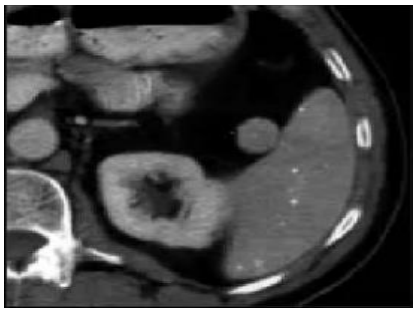



**Congenital variations**

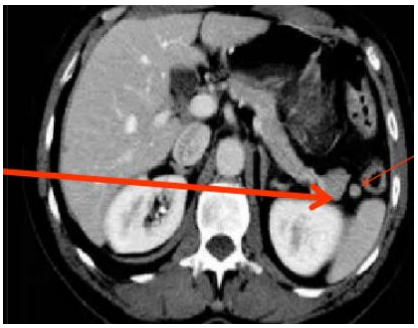
- **Accessory spleen**
  10-30% may enlarge dramatically after splenectomy
- **Polysplenia / asplenia**
  multiple spleens + cardiovascular and visceral anomalies
- **Wandering spleen**
  mobile or ectopic spleen
  Torsion⟶ symptoms

## Accessory spleens 10% to 16% of normal individuals

- *R*ound masses, Single or multiple.
- *S*ame as normal splenic parenchyma.
- *1 to 3 cm*,
- Usually near the splenic hilum.

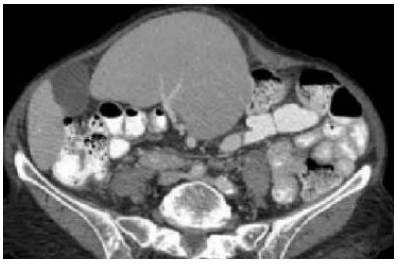


® If Near Tail of Pancreas → Misdiagnosed as pancreatic mass



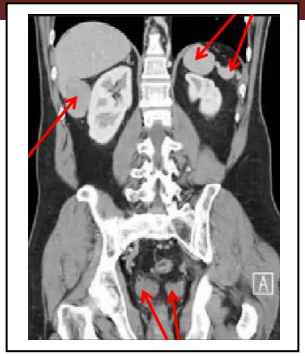
## Wandering spleen

- **Laxity of the splenic ligaments**
  → spleen to be wander anywhere in the abdominal cavity.
  - (+/- abnormalities of intestinal rotation,)
- ***C.P.:*** most cause → no symptoms. / Mass / pain ← Torsion
- **Complication** : Torsion



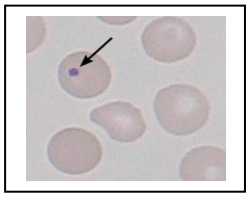
## Splenosis

- ***Def:*** multiple **implants** of ectopic splenic tissue , may occur after traumatic splenic rupture.
- **Pathology :** Splenic tissue can implant anywhere in the abdominal cavity , or (*even in the thorax if the diaphragm has been ruptured*).
  - Splenosis complicates 40% to 60% of splenic injuries.
  - Usually multiple & vary in size and shape.



- The tissue fragments enlarge over time → may simulate **peritoneal metastases**.

- After splenectomy,→ seeding of splenic tissue rupture → *remaining accessory spleens* or *splenules* →may enlarge and **resume the function** of the resected spleen.

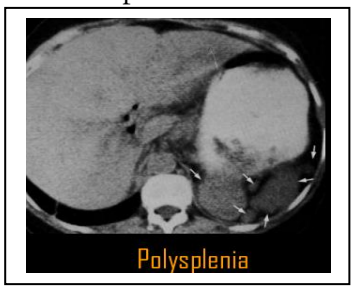


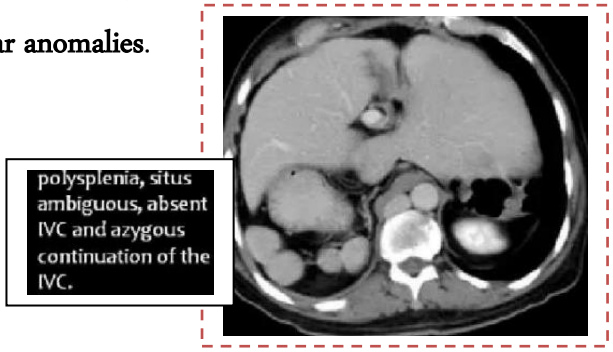
  - ***Howell-Jolly bodies***: bits of nuclear material seen in RBCs after spleenectomy.
  - *Disappearance of these Howell-Jolly bodies* → *sign of splenic regeneration.*

® ***Imaging studies*** → ***s***ingle or **m**ultiple *spleen-like* masses in the abdominal cavity + history of splenectomy.

## Polysplenia — Rare

- Multiple small spleens, usually located in the right abdomen + **situs ambiguous**.
- Most patients also have **cardiovascular anomalies**.



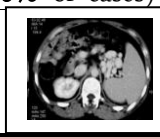




## Asplenia (Ivemark syndrome) — *Mostly die before 1 year of age*

- Congenital absence of the spleen.
- **Associated with:** bilateral right-sidedness + midline liver + bilateral three-lobed lungs.
- Major cardiac anomalies → in 50% of cases.

# Splenomegaly

*splenic length > 13 cm*

| Congestive | Myeloproliferative | Infection |
|---|---|---|
| -Portal hypertension (50% of cases)<br>-Portal vein thrombosis  | -**L**ymphoma (**30% of cases**)<br>-**L**eukemia<br>-**P**olycythemia<br>-**P**urpura **I**diopathic thrombocytopenia<br>-**S**ickle cell disease (in infants)<br>- **S**pherocytosis<br>-**T**halassemia major<br>- **H**ereditary -**M**yelofibrosis | **M**alaria (universal in endemic areas)<br>**S**chistosomiasis (endemic areas)<br>**I**nfectious mononucleosis<br>Subacute bacterial endocarditis<br>**A**IDS<br>IV drug abuse |
| **Infiltrative** | | |
| -Systemic lupus erythematosus<br>-Amyloidosis<br>-Gaucher disease | | |

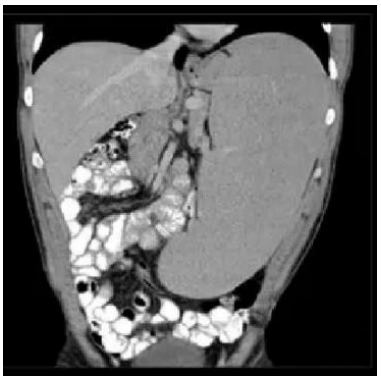
| CHILD | |
|---|---|
| ( 6 + 1/3 Age in Years ) | |
| **ADULT** | |
| Splenic / Renal index | not > 1.2 |
| length x width x thickess | 120 : 480 |

- *Diagnosis:*

– MR → no significant benefit in the differential diagnosis of splenomegaly.

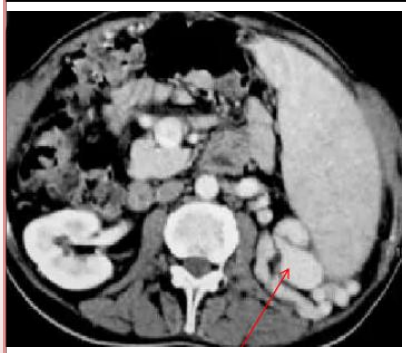
– ***Mild to moderate splenomegaly*** is seen with → portal hypertension, AIDS, storage diseases, collagen vascular disorders, and infection.

– ***More marked splenomegaly*** →usually associated with **lymphoma, leukemia**, infectious mononucleosis, hemolytic anemia, and myelofibrosis.



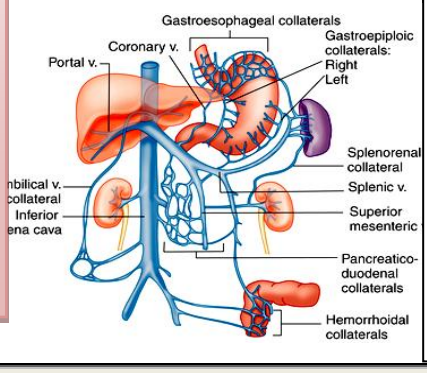
## Porto systemic collateral vessels

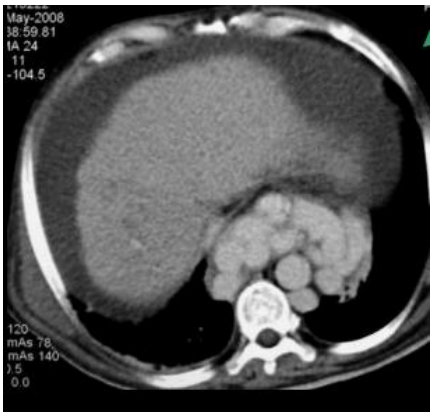
- **A WV** = abdominal wall varices
- **CV** = coronary venous collateral vessels
- **EV** = esophageal varices
- **GRV** = gastro renal shunt
- **IMV** = inferior mesenteric vein
- **LPV** = left portal vein
- **LRV** = left renal vein
- **MV**= mesenteric varices
- **OMV** = omental varices
- **PEV** = Para esophageal varices
- **PSV** = perisplenic varices
- **PUV** = Para umbilical collateral vessels
- **PV** = portal vein
- **RGV** = retro-gastric varices
- **RPPV** = retroperitoneal-Para vertebral varices
- **SMV** = superior mesenteric vein
- **SRV** = splenorenal shunt
- **SV**= splenic vein.



Dilated porto-systemic collaterals

In **portal hypertension**

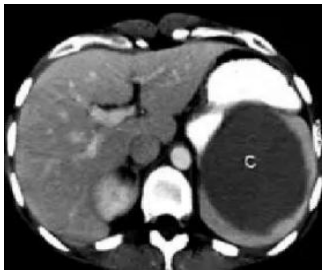


**Sever Para esophageal varices**

# CYSTIC LESIONS OF THE SPLEEN

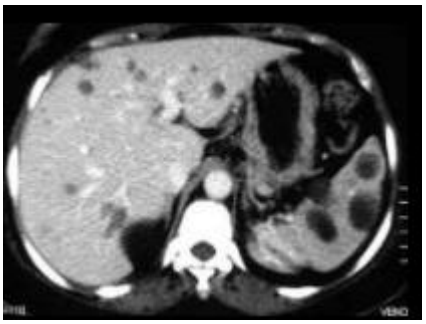
- Usually discovered accidentally
- Large or complicated cysts produce symptoms
- Complications : rupture , infection ,hemorrhage



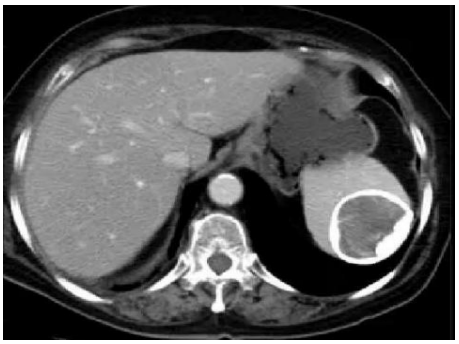
## SPLENIC CYSTS

| PRIMARY | SECONDARY |
|---|---|
| True Epithelial Lining | No Epithelial Lining "False" |
| Parasetic "Hydatid" | Post Traumatic (80%) |
| Cong. Simple | Infectious |
| Epidermoid 5% | Infarction |

Multiple Simple Hepatic & splenic Cysts

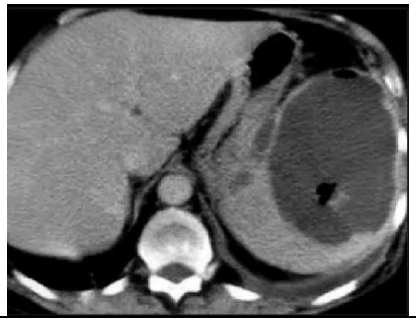


**Hydatid Cyst**

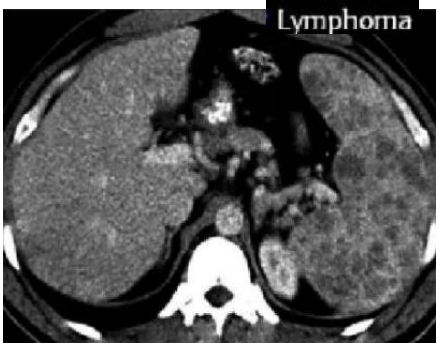


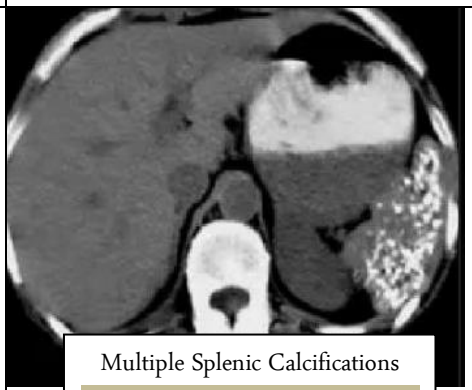
**Abscess**

"Enh. Margins & Air less common"



Splenic Sarcoidosis D.D. Metastases Abscesses Lymphoma



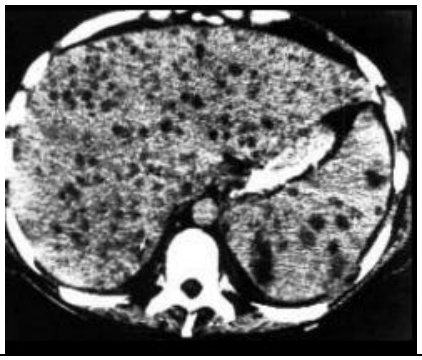


Multiple Splenic Calcifications

(TB or Histoplasmosis)

**Multipple Fungul Abscess**

**"Immunocompromised"**



**MULTIPLE SMALL CYSTS**

**LIVER**
Metastases
Abcesses
Simple

**SPLEEN**
**FUNGAL ABCESS**

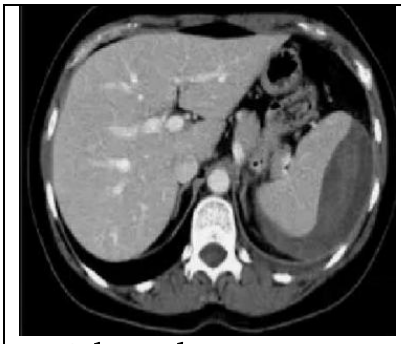
## SPLENIC TRAUMA (Blunt / Penetrating)

- Commonest Abdominal organ to be injured. +/- Other organs Injury
- CT → Best Modality to Diagnose. " accuracy 98% "
- Staged by Rule of 3

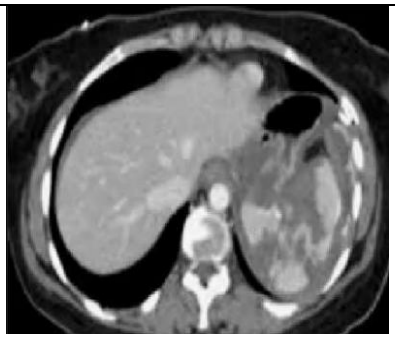
  I:II → Heal in 4 m

  III → " " 6 m

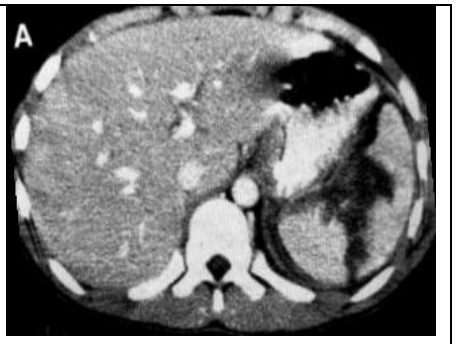
| | | | |
|---|---|---|---|
| I | < 1 cm | Superficial laceration | subcapsular hematoma |
| II | 1: 3 cm | Deep laceration | subcapsular hematoma |
| III | >3cm | Deep laceration | subcapsular hematoma |
| IV | | Fragmentation >3 pieces | no enhancement |



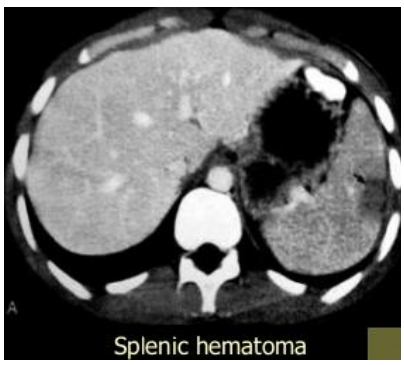
Subcapsular Hematoma

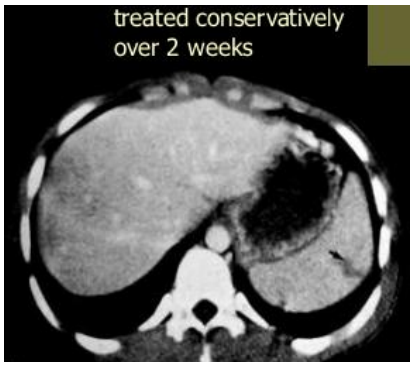


Shuttered Spleen




Deep Laceration



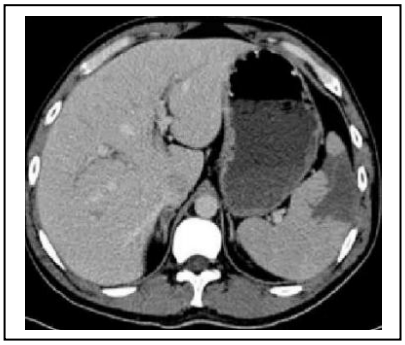



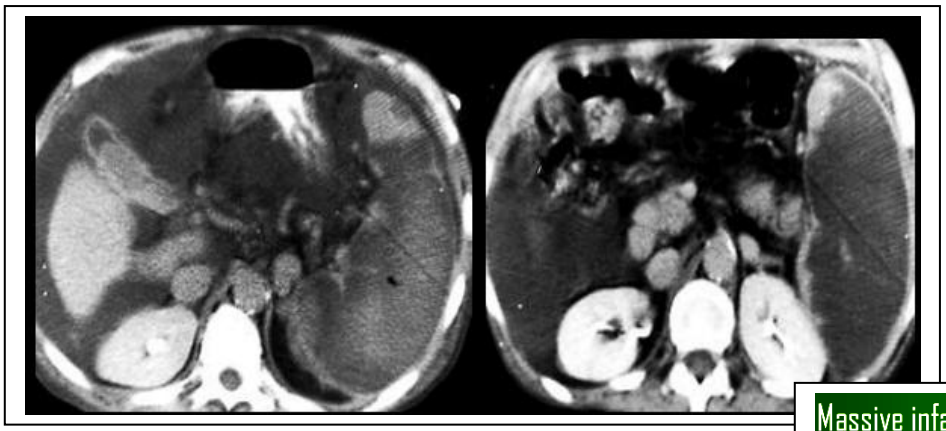

## SPLENIC INFARCTION

- Single or multiple wedge shaped hypodensities based to the splenic capsule +/- Ca
- Causes include :
  - Embolic in cardiovascular diseases

(endocarditis , AF، Local thrombosis )

  - splenic Torsion ← wandering spleen –
  - pancreatitis
  - AIDS,
  - sickle cell disease (when Chronic → Fibrosis → Volume loss)






## SICKLE CELL DISEASE


- Hereditary (autosomal recessive)
- formation of abnormal haemoglobin (haemoglobinopathy)

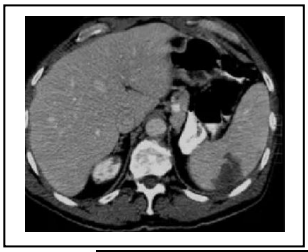
→ Abnormal shape RBCs "Sickle like" → Aggregation in Blood vessel

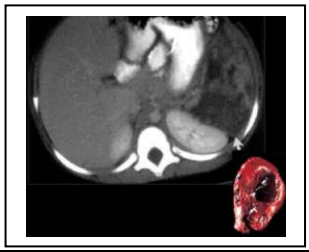
↘ At small arteriole → **INFARCTION**

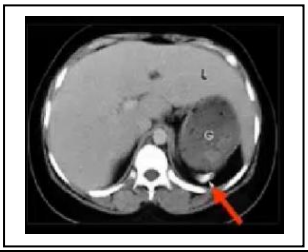
↘ At splenic vain → blood trapping → **SQUESTRATION** / **RUPTURE**

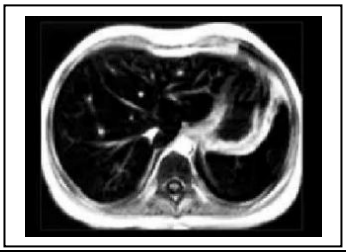
↘ At splenic A. → **AUTO-SPLENECTOMY**

↘ Abnormal iron Accumulation "Haemosedrin" → **2RY HAEMOSEDROSIS**

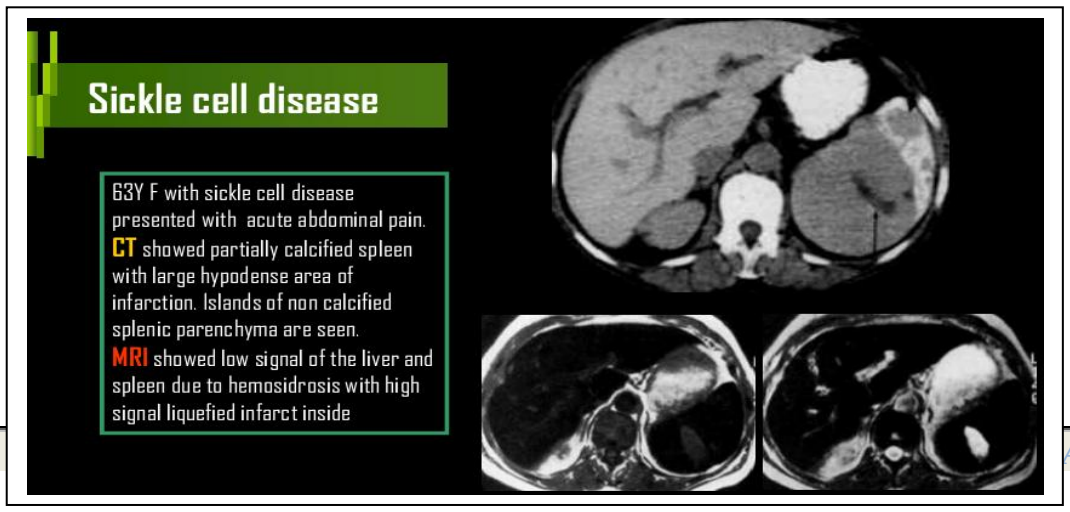








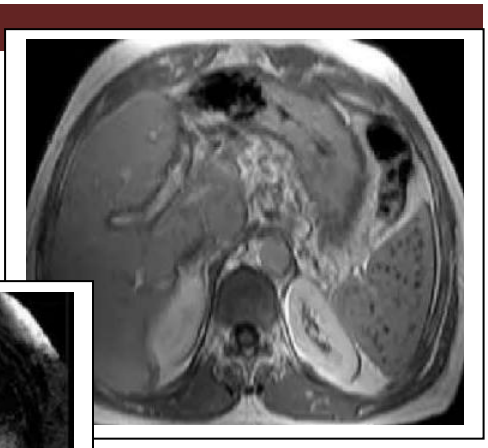
| Infarction | SQUESTRATION | AUTO-SPLENECTOMY | 2ry Haemosedrosis |
|---|---|---|---|
| Peripheral wedge shape Hypodensity | Infant or child **Enlarged** heterogenous spleen +/- Rupture | Total gradual Infarction → Small calcefied spleen | iron overload disorder → the accumulation of hemosiderin "Diffude loss of signal in MRI & incease density in CT. |

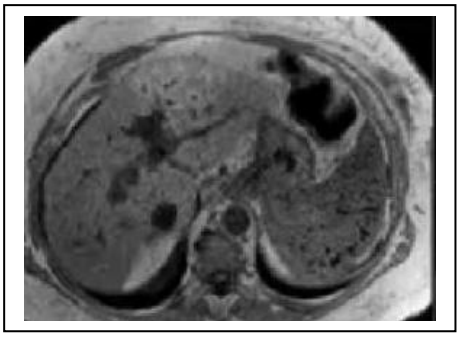


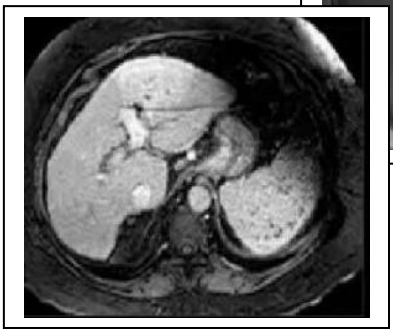
## GAMNA GANDY BODIES

Only seen in MRI

- **Multiple small Foci of low signal**
- = Organizing foci of haemorhage
- Seen 10 % of portal hypertension / Not related to spleen size.
- Only seen by MRI "Not by CT"





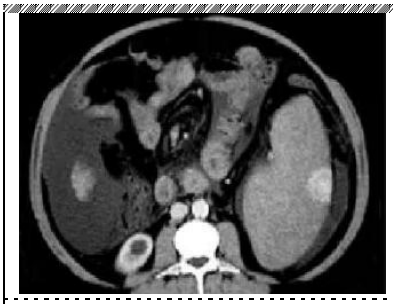


## NEOPLASMS OF THE SPLEEN

**Any solid lesion in the spleen is considered malignancy until proved**

**Normal spleen imaging → Not exclude Metastasis**

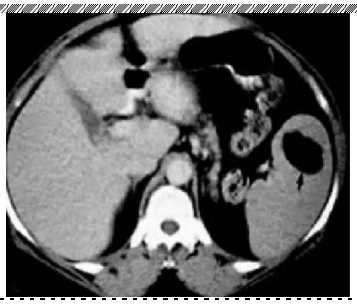
- Primary : Rare
- Secondary: Uncommon



**Hemangioma**

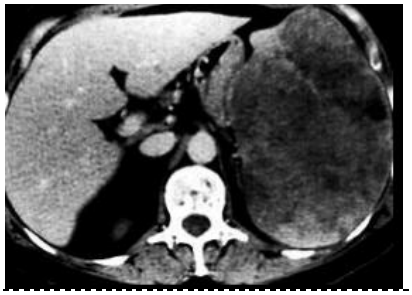
-Commonest bening (14%)

May involve hole spleen → Hemangiomatosis



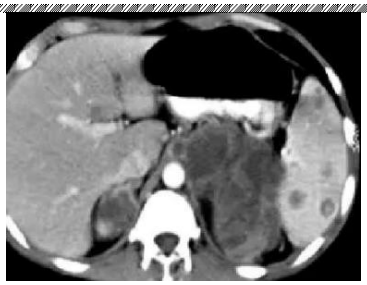
**Lipoma**

Well defined – Fat density



**Angiosarcoma**

**Mass heterogenous /Rare – Primary**



**Mets**

Uncommon

Hematogenous spread

Breast , lung , ovary , stomach ,melanoma

* Calcification is rare

**LYMPHOMA**

**The most common malignant lesion of the spleen**

Splenic involvement in HD = 27% / NHL =35%

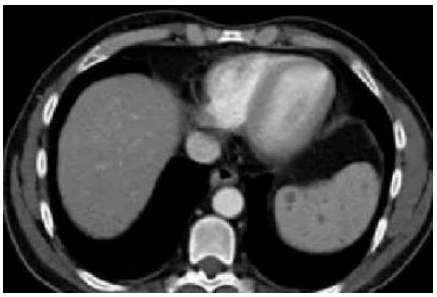
**Lymphoma** "4 patterns"

- Enlarged spleen with homogenous CT
- Solitary focal lesion
- Multiple Splenic lesions
- Diffuse infiltration

## SPOTTED SPLEEN

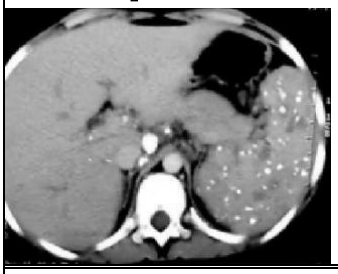
- Multiple low attenuation nodules
- Uncommon Finding / But common in Immunosupresed "Infectious"

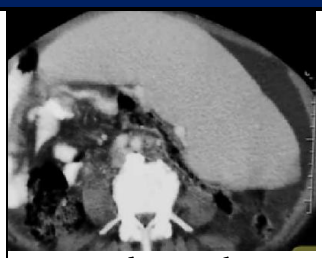
| Neoplasm | Infections |
|---|---|
| - **Lymphoma** "coomonest" | - Fungul |
| - Metastases | - Mycobacterial |
| - Hemangioma | - Parasetic |
| | **Sarcoid** |



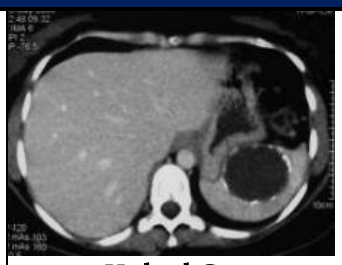
## CASES

**Splenic TB**

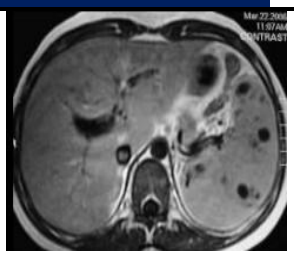




**Wandering Spleen**

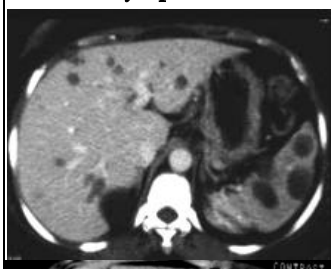


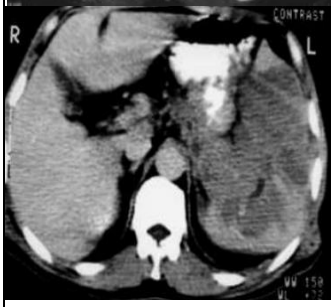
**Hydatid Cyst**

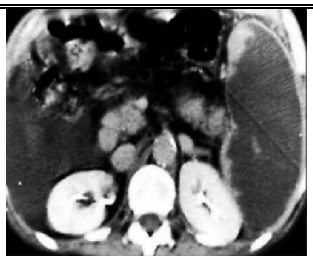


**Splenic Cysts**

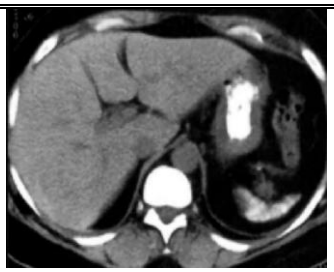
**Lymphoma**



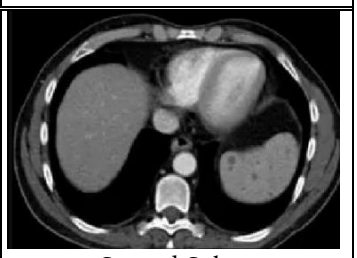




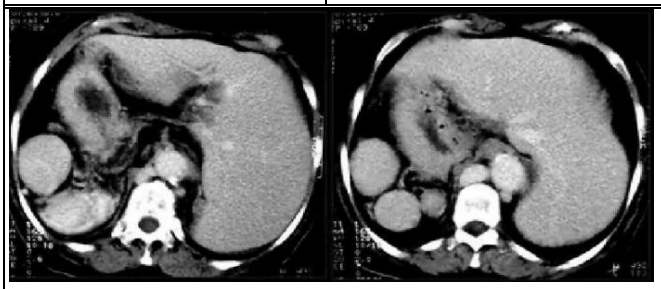
Massive Infarction



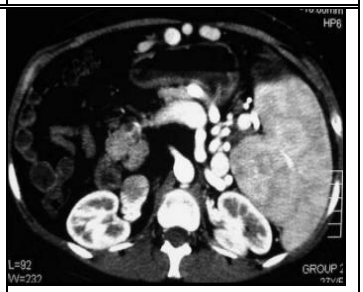
**Auto-splenectomy**



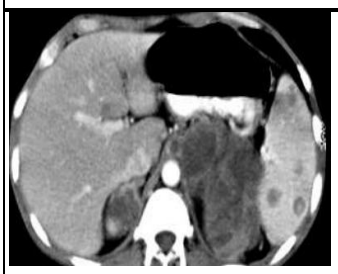
Spotted Spleen



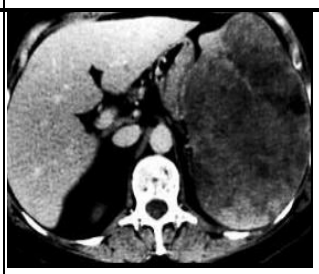
Polysplenia – Situs Inversus



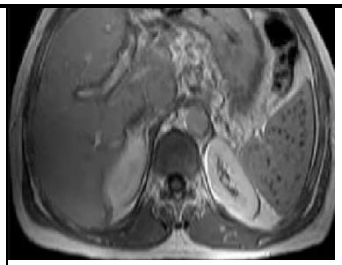
Portal Hypertension



**Mets**

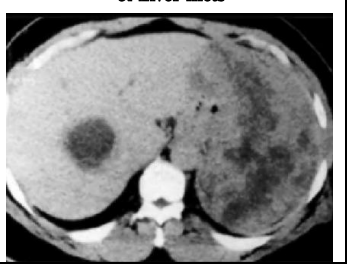


**Angiosarcoma**



Gamna Gandy Bodies

**Leiomyosarcoma**
**& Liver mets**




## →Sources


- **Fundmentals Sec VII -CHAPTER 28 -**
- **Primer of Diagnostic radiology 6th**
- **Lecture of Prof. Mamdouh Mahfouz**
- **https://radiopaedia.org**