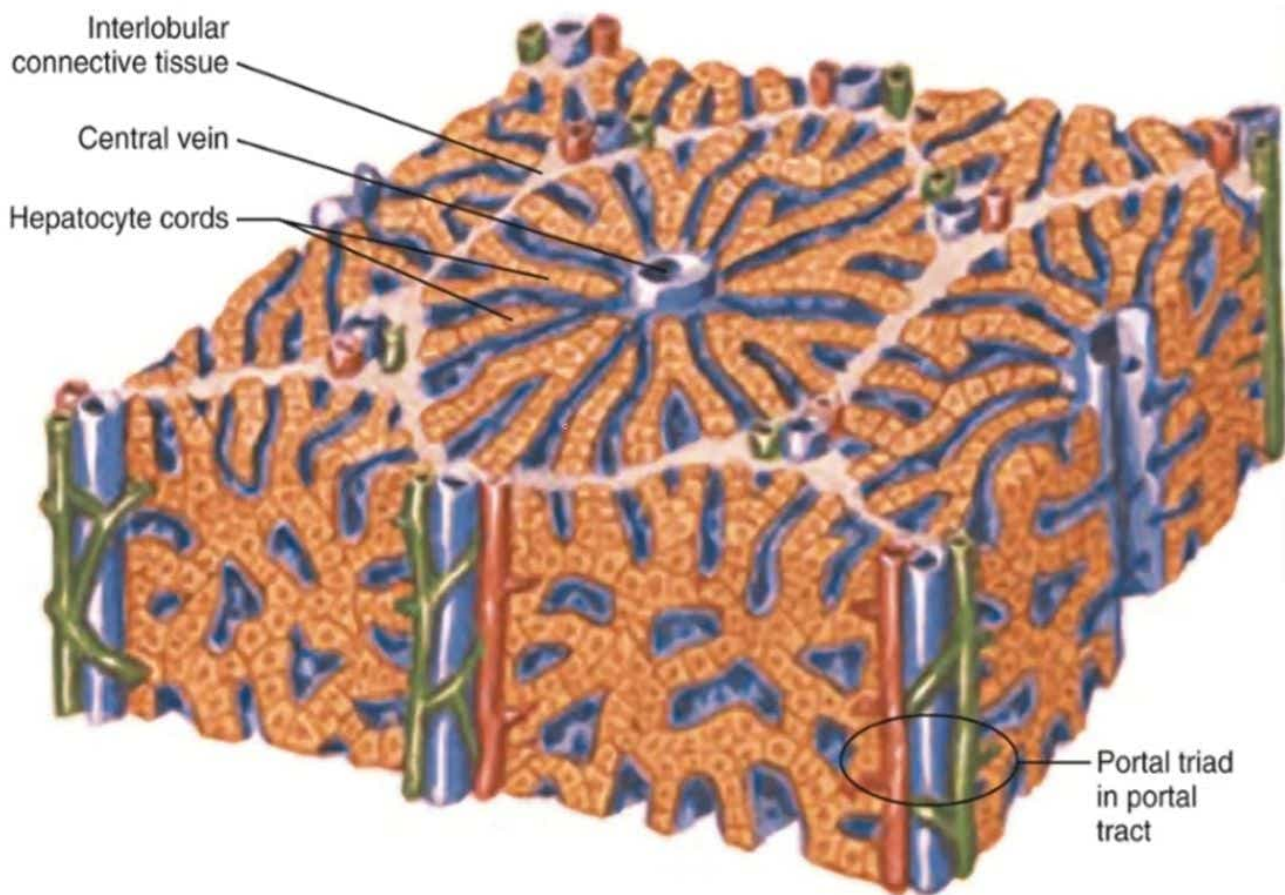


Liver surgery

E J Arteen
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SURGICAL ANATOMY

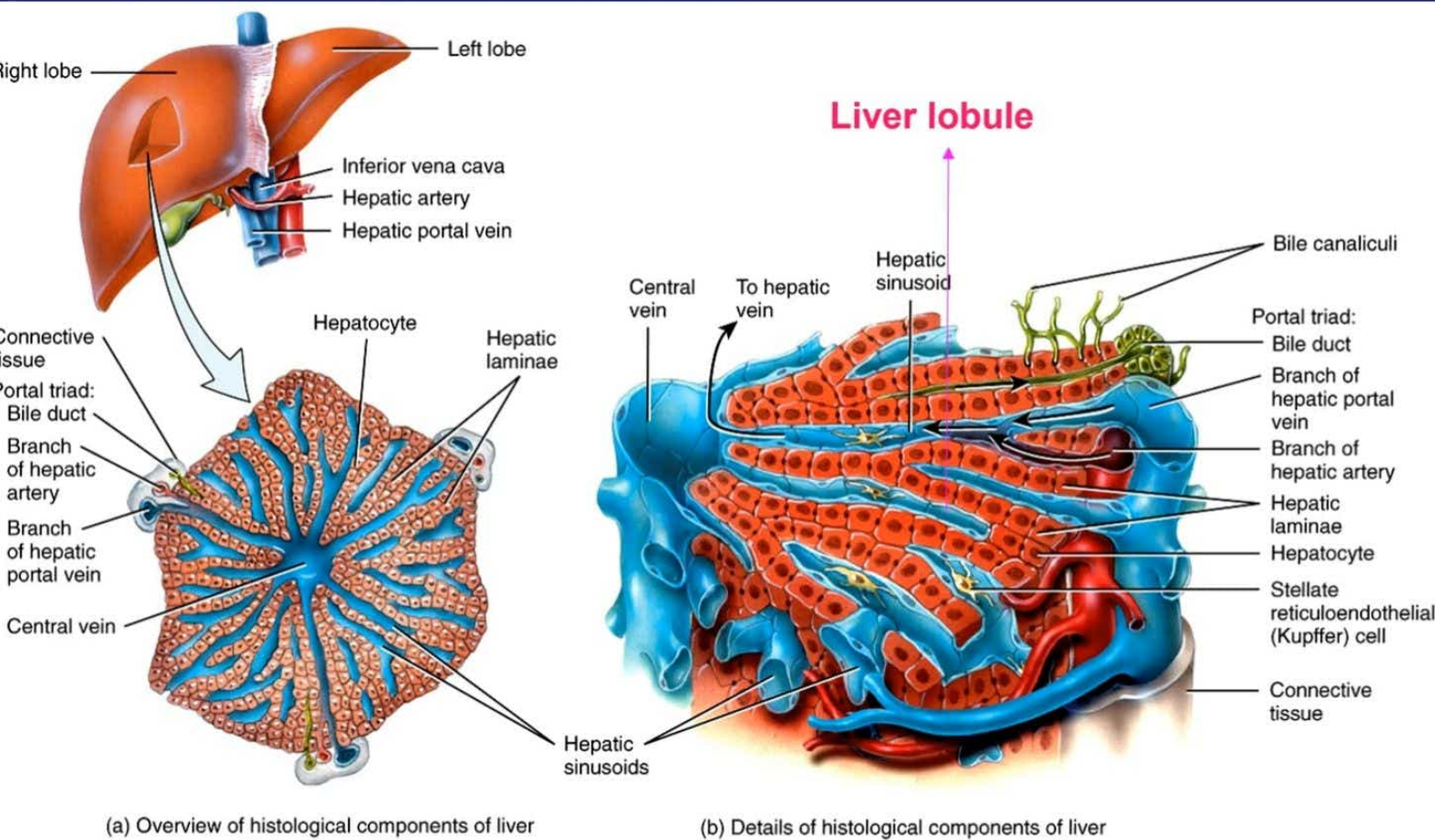
- liver is the largest gland in the body (1.5 Kg), essential for life .
- The functional unit is the *Liver Lobule*. (Hepatocytes around a Central vein separated by Blood Sinusoids).
- The sinusoids are wide fenestrated channels, contain large Kupffer cells.
- Rt. Lobe = $\frac{3}{4}$ the liver, Lt. lobe = $\frac{1}{4}$
- Covered by a CT sheath (*Glisson Capsule*).
- *Hepatic vascular system :*
 - 1.5 L / minute (27% of CO) , 1L from portal vein , 500ml from hepatic artery.
 - Rich lymphatic drainage.



JOHN A. CRAIG MD

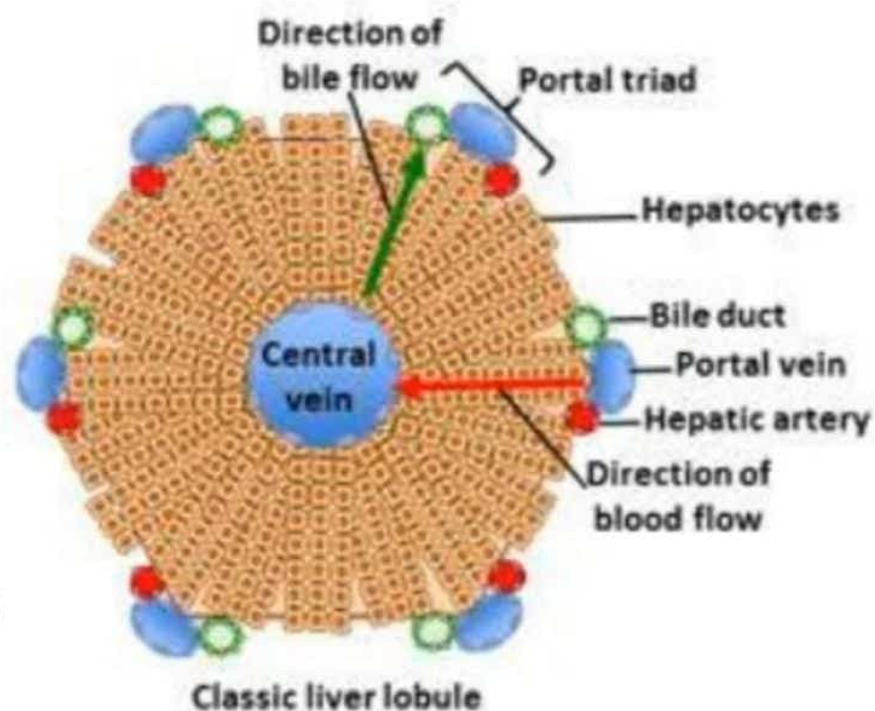
Hepatic Lobule. Liver arranged as series of hexagonal lobules, each composed of series of hepatocyte cords (plates) interspersed with sinusoids. Each lobule surrounds a central vein and is bounded by 6 peripheral portal triads (low magnification).

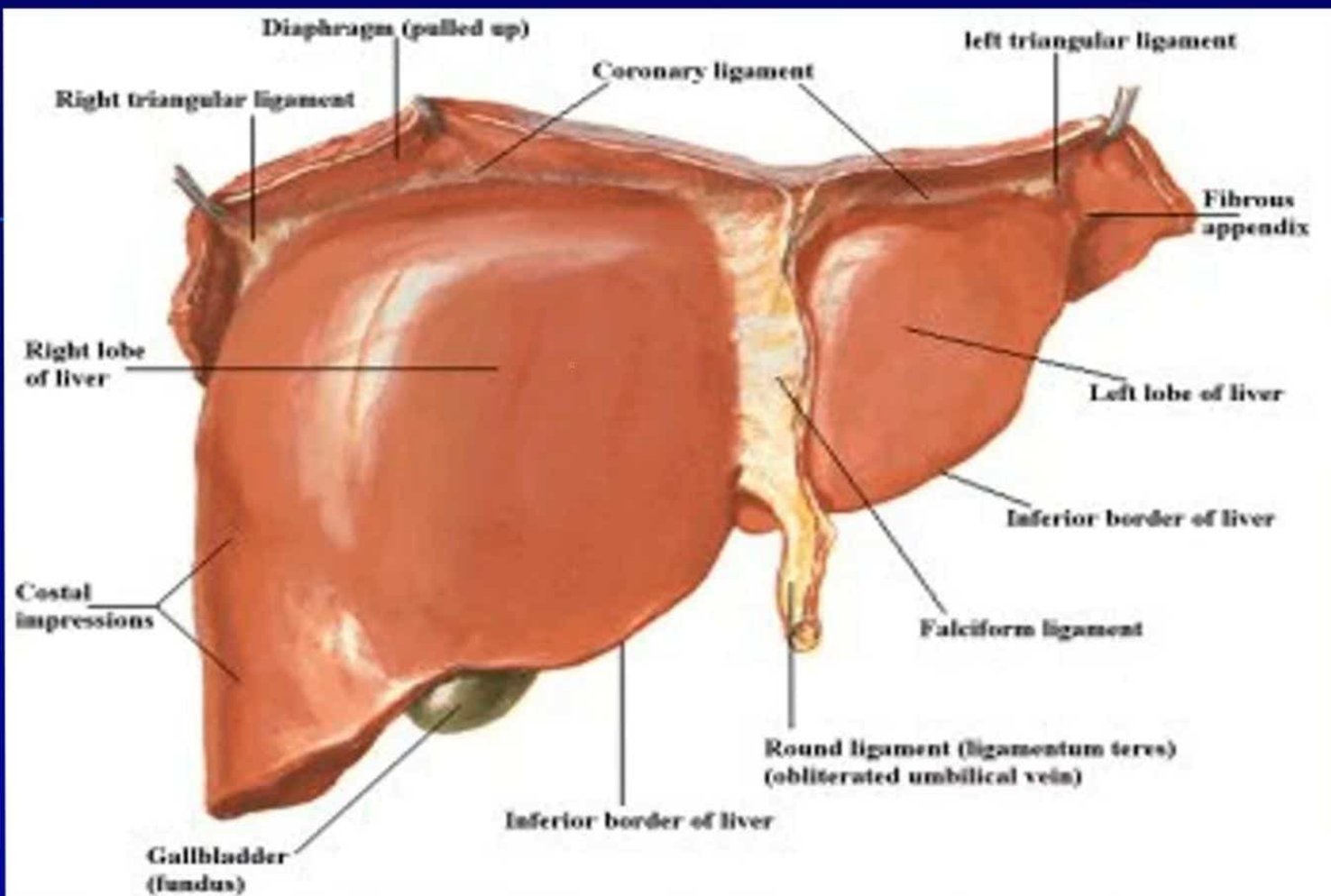
Histology of the Liver

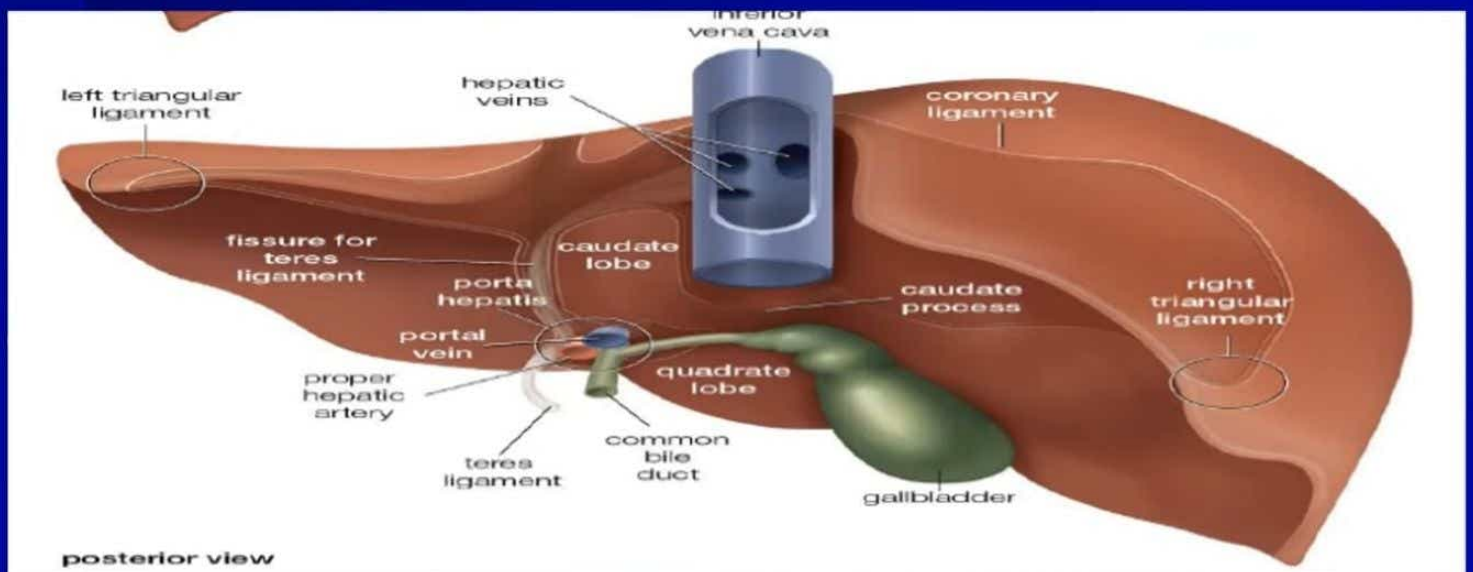
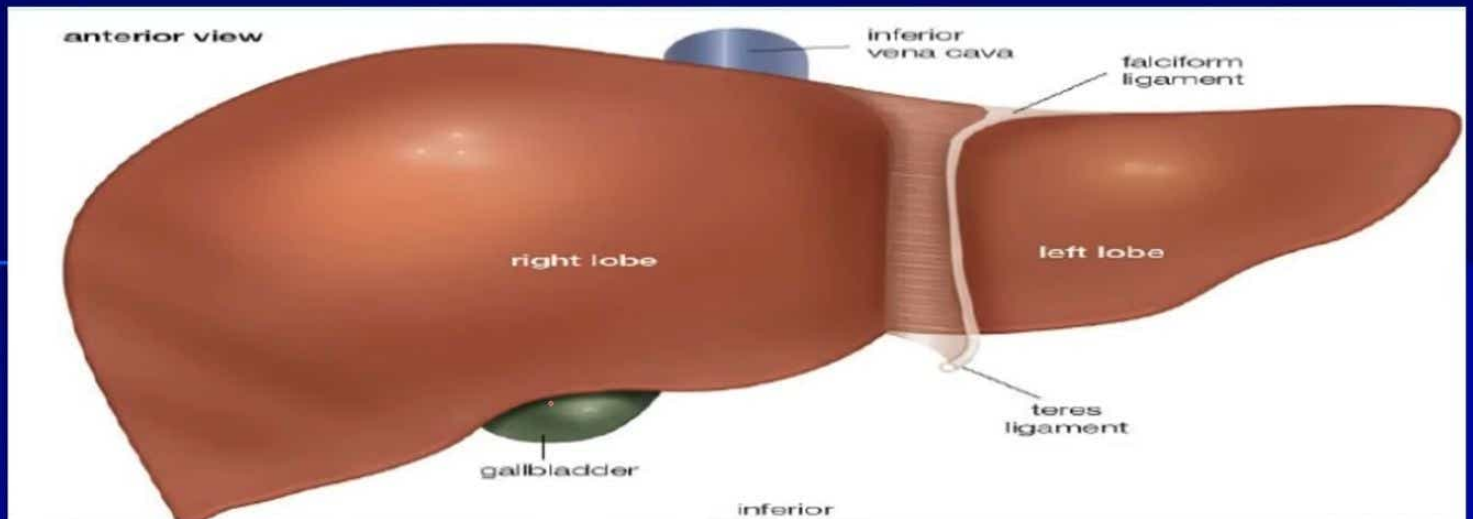


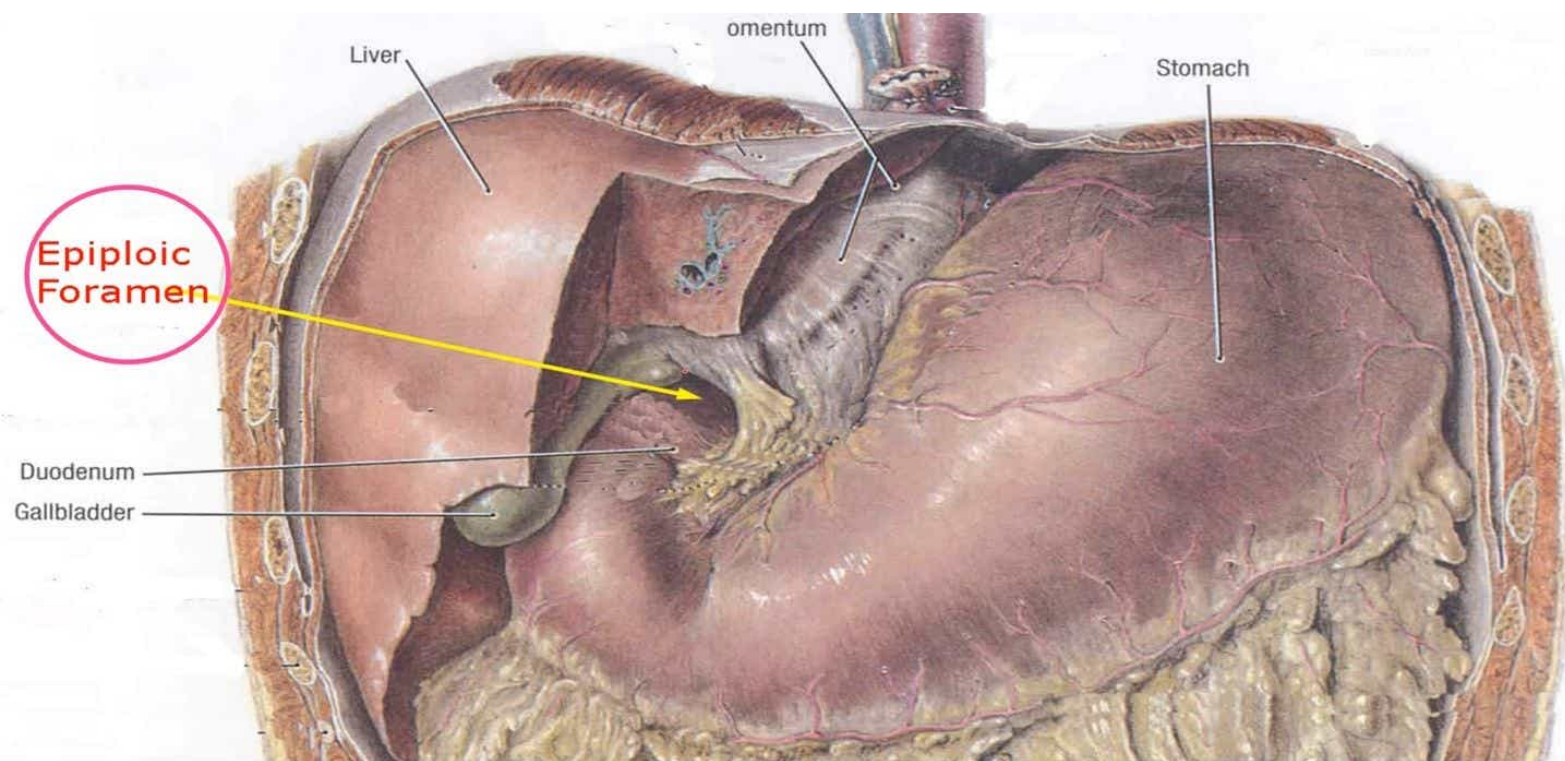
2. Hepatic Lobules

1. Hepatic lobule is the structural and functional unit of liver.
2. There are about 50,000 to 100,000 lobules in the liver.
3. The lobule is a **honeycomb-like structure** and it is made up of liver cells called hepatocytes.





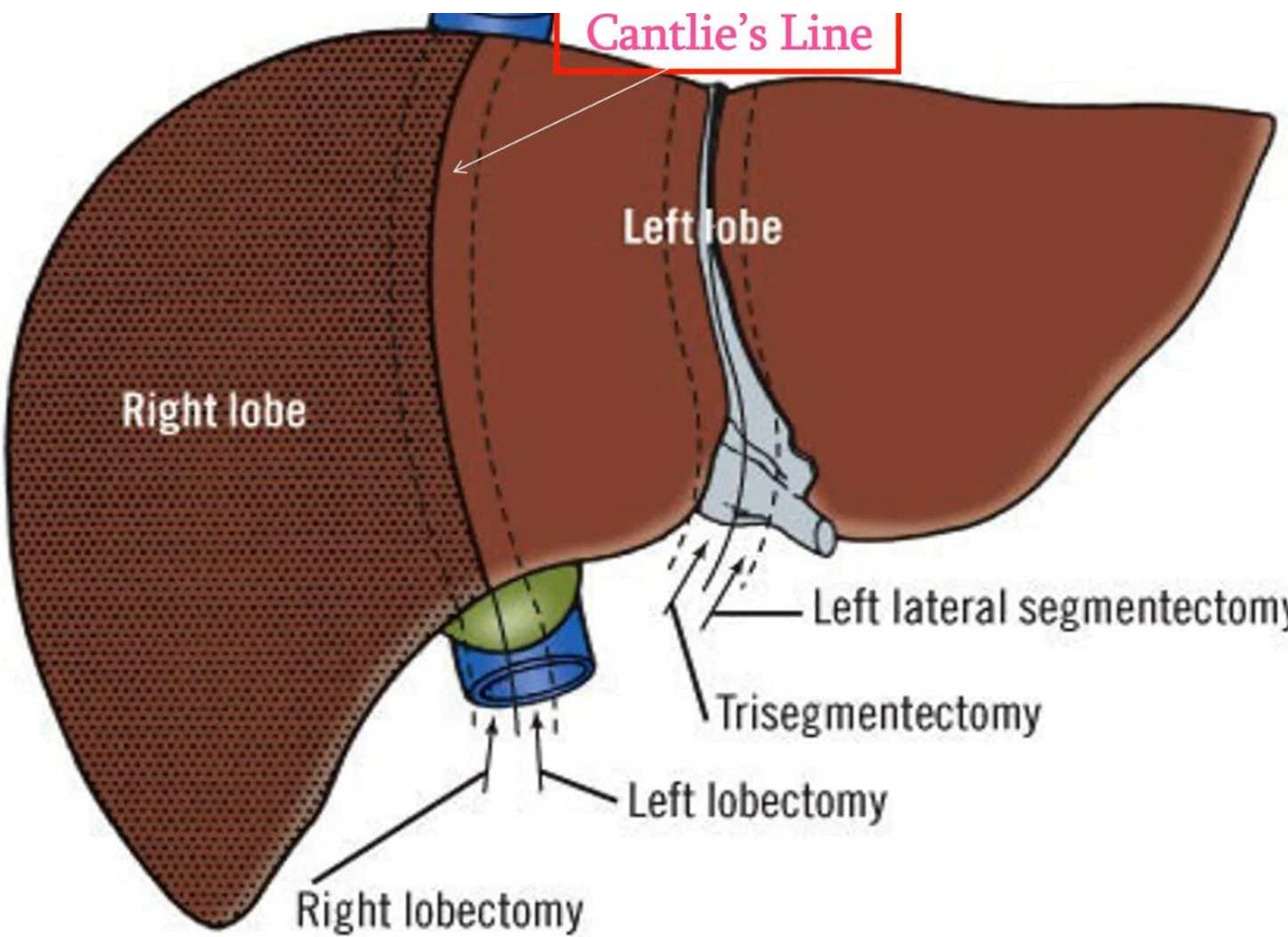




- The greater sac communicates with the omental bursa through the **Epiploic foramen (of Winslow)**.
- The epiploic foramen can be located by running a finger along the edge of the gall bladder to the free edge of the lesser omentum.
- The epiploic foramen usually admits two fingers.

SURGICAL ANATOMY cont...

- **Cantlie's Line:** The overall anatomy of the liver is divided into a **Functional Right and Left lobes** along the line *between the gall bladder fossa and the middle hepatic vein* (**8 Segments**).
- **Surgical segments :** Each of these segments can be considered as a **Functional Unit**, with a branch of the hepatic artery, portal vein and bile duct, and drained by a branch of the hepatic vein.



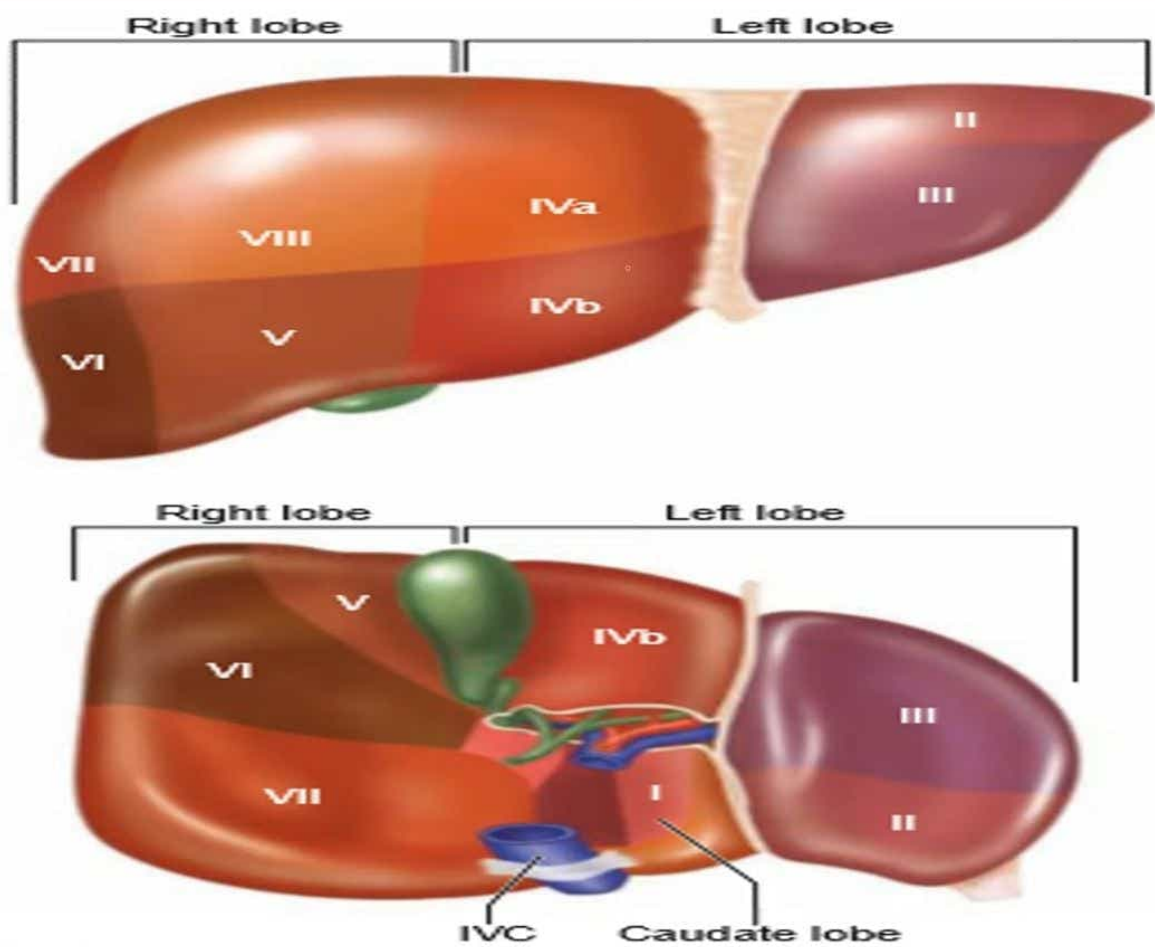
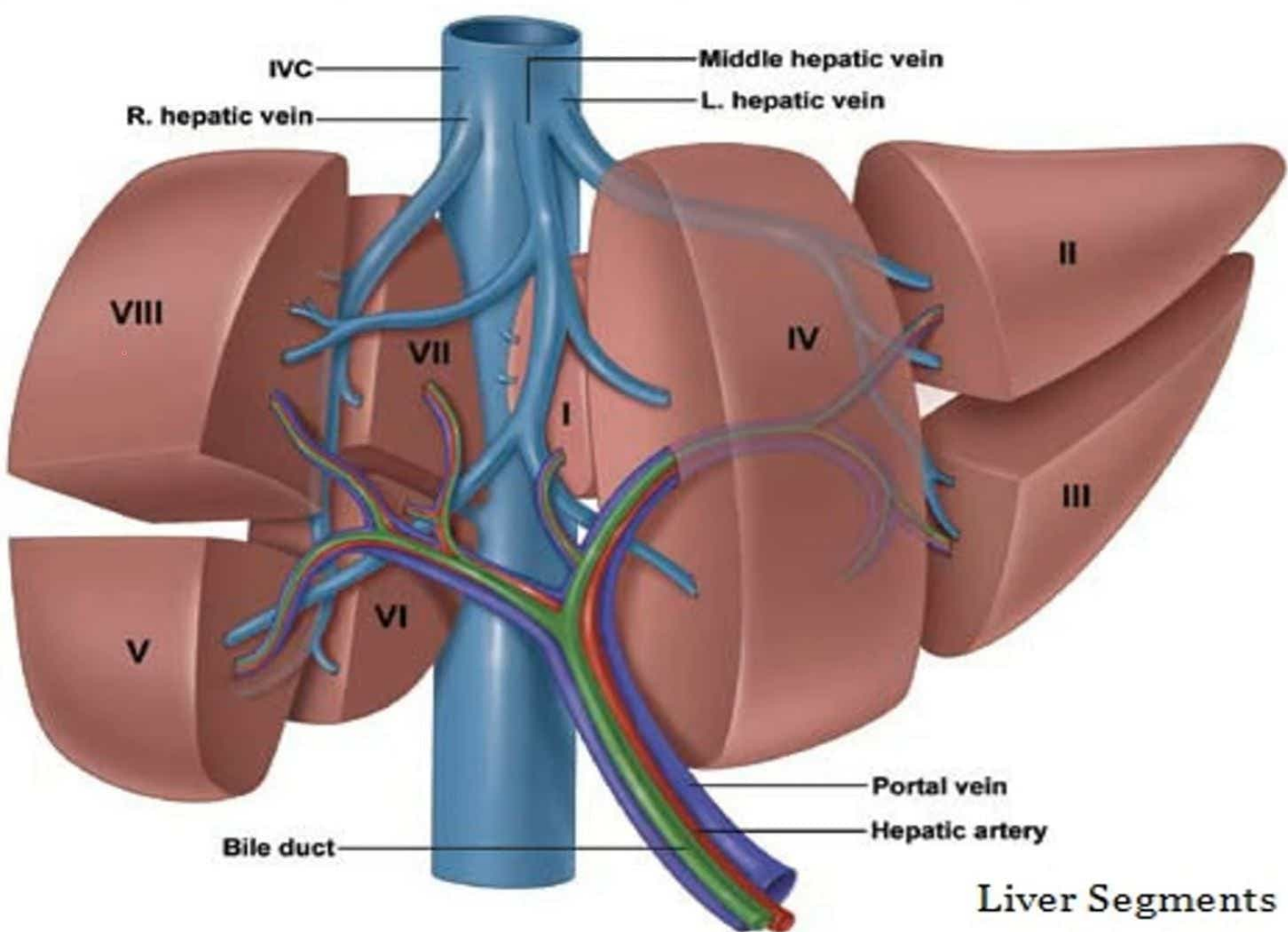
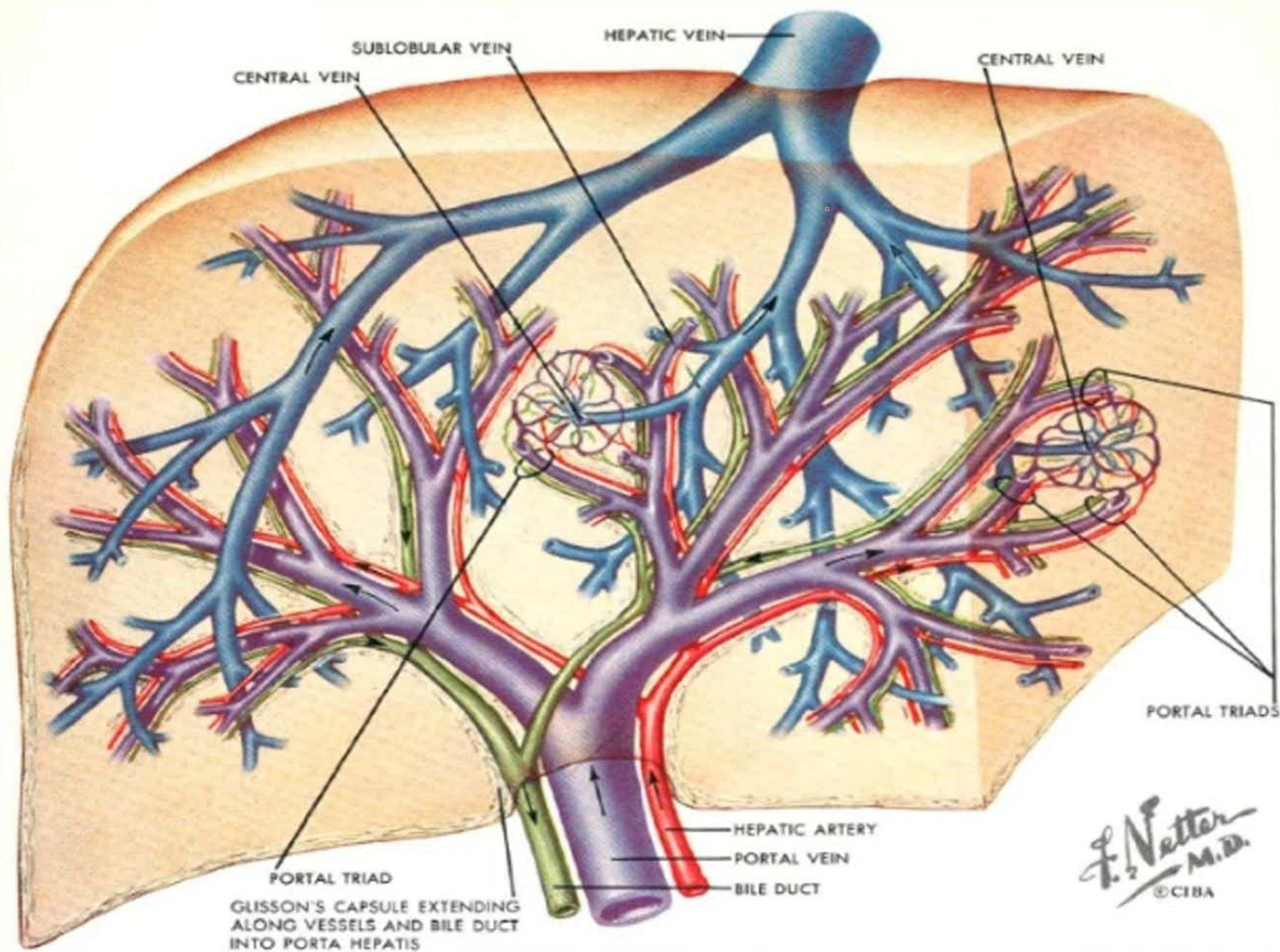


Figure 31-3. Couinaud's liver segments (I through VIII) numbered in a clockwise manner. The left lobe includes segments II to IV, the right lobe includes segments V to VIII, and the caudate lobe is segment I. IVC = inferior vena cava.

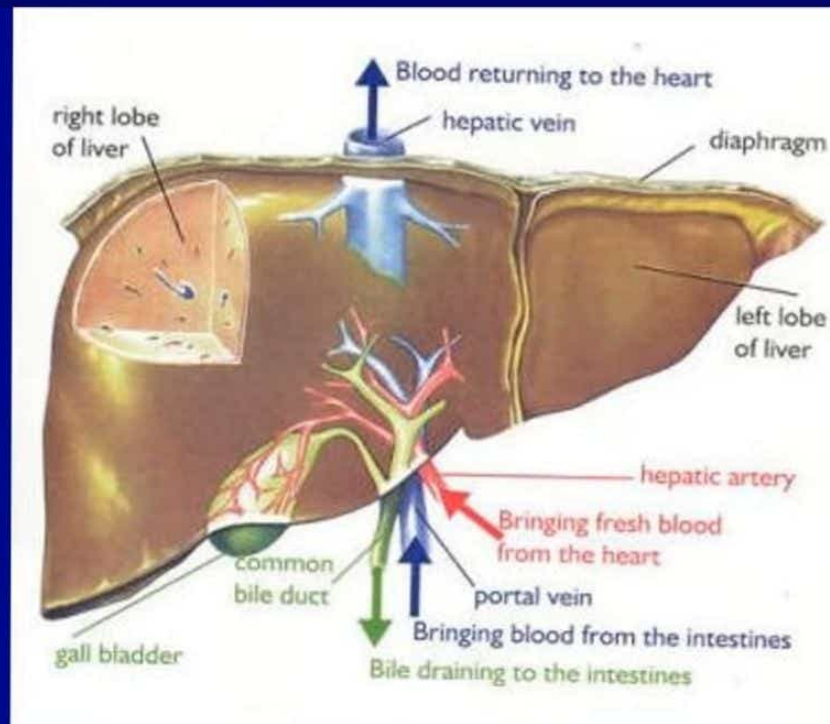




SURGICAL ANATOMY

cont...

- **Dual Blood supply**
 1. Hepatic artery **30%**
 2. Portal vein **70%**
 3. Hepatic veins
- **Regeneration ability.**



Functions of the liver

1. Formation of Bile , B salts & Bilirubin.
2. Synthesis of Albumin , Prothrombin & Fibrinogen.
3. CHO metabolism & storage of glycogen.
4. Formation of cholesterol & phospholipids
5. Formation of urea .
6. Heat production , maintaining core body temp.
7. Reticulo - endothelial activity Kupffer cells.

Functions of the liver cont.....

- 8. Storage of Vit B12 & Vita A & vit D.**
- 9. Storage of iron & copper.**
- 10. Detoxication of drugs.**
- 11. Destruction of bacteria specially Gam +ve cocci.**
- 12. PH balance and correction of lactic acidosis.**
- 13. Removal of gut endotoxins and foreign antigens.**

Methods of investigations

- S. Bilirubin T/D 5-17 $\mu\text{mol} / \text{l}$
- *Liver function tests (LFTs).*
- S. Alkaline phosphatase 35-130 IU / l
- S. Albumin 35-50 g / l
- Serum Aspartate Transaminase (AST)
& Alanine Transaminase (ALT) 5-40 IU/l
- Gama Glutamyl Transferees' 0-48 IU / l
- Prothrombin Time INR 12-16 sec

Methods of investigations cont...

- Alpha fetoprotein
- Specific tests hemochromatosis, Wilson's dis...

The standard method of Monitoring liver function in patients with Chronic liver disease is serial measurement of :

1. Bilirubin.
2. Albumin .
3. Prothrombin time .

Child's- Pugh classification of hepatocellular function

Clinical and Lab Criteria	Points*		
	1	2	3
Encephalopathy	None	Mild to moderate (grade 1 or 2)	Severe (grade 3 or 4)
Ascites	None	Mild to moderate (diuretic responsive)	Severe (diuretic refractory)
Bilirubin (mg/dL)	< 2	2-3	>3
Albumin (g/dL)	> 3.5	2.8-3.5	<2.8
Prothrombin time			
Seconds prolonged	<4	4-6	>6
International normalized ratio	<1.7	1.7-2.3	>2.3
Child-Turcotte-Pugh Class obtained by adding score for each parameter (total points) Class A = 5 to 6 points (least severe liver disease) Class B = 7 to 9 points (moderately severe liver disease) Class C = 10 to 15 points (most severe liver disease)			

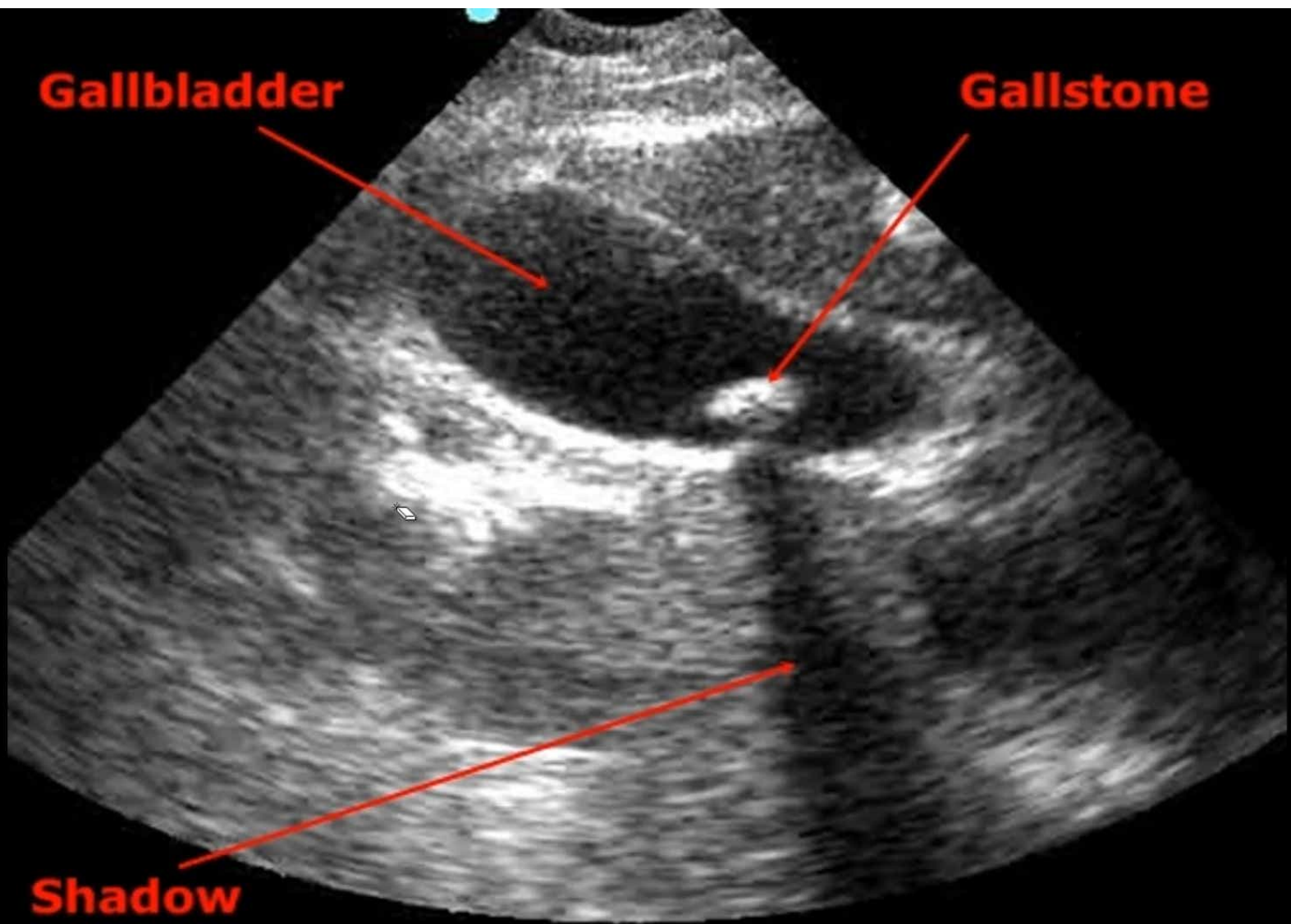
Imaging techniques

- **US**: first-line test owing to its safety & availability.
- It is excellent for diagnosing **Biliary Pathology** and **Focal liver lesions +FAST**.
- **CT + CT Cholonography**: current '**Gold Standard**' (*Triple-Phase, Multi-Slice, Spiral*) .
- **MRI**: *Alternative to spiral CT.*
- **MRCP**: *First-line, non-invasive cholangiography.*
- **ERCP**: *If Endoscopic intervention is anticipated.*
- **PTC** : *When ERCP impossible or failed .*
- **Angiography**: ? Vasc involvement by tumor.
- **Nuclear medicine scan: PET CT** diff. benign from malig.
- **Laparoscopy**: ? peritoneal tumor superficial mets.

Gallbladder

Gallstone

Shadow



Map 3
150dB/C3
Persist Med
Fr Rate Med
2D Opt:Gen

T S

ATL

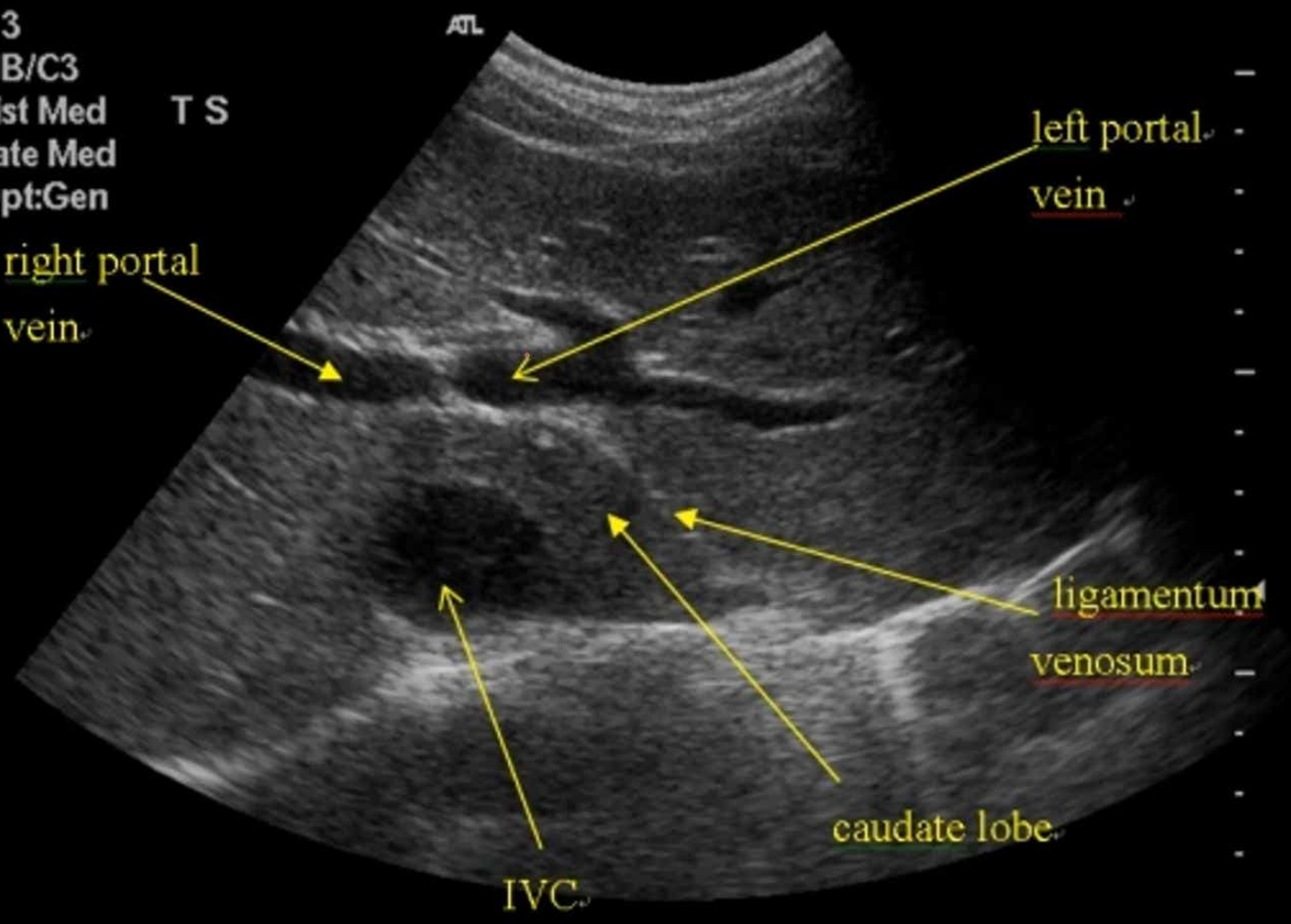
right portal
vein

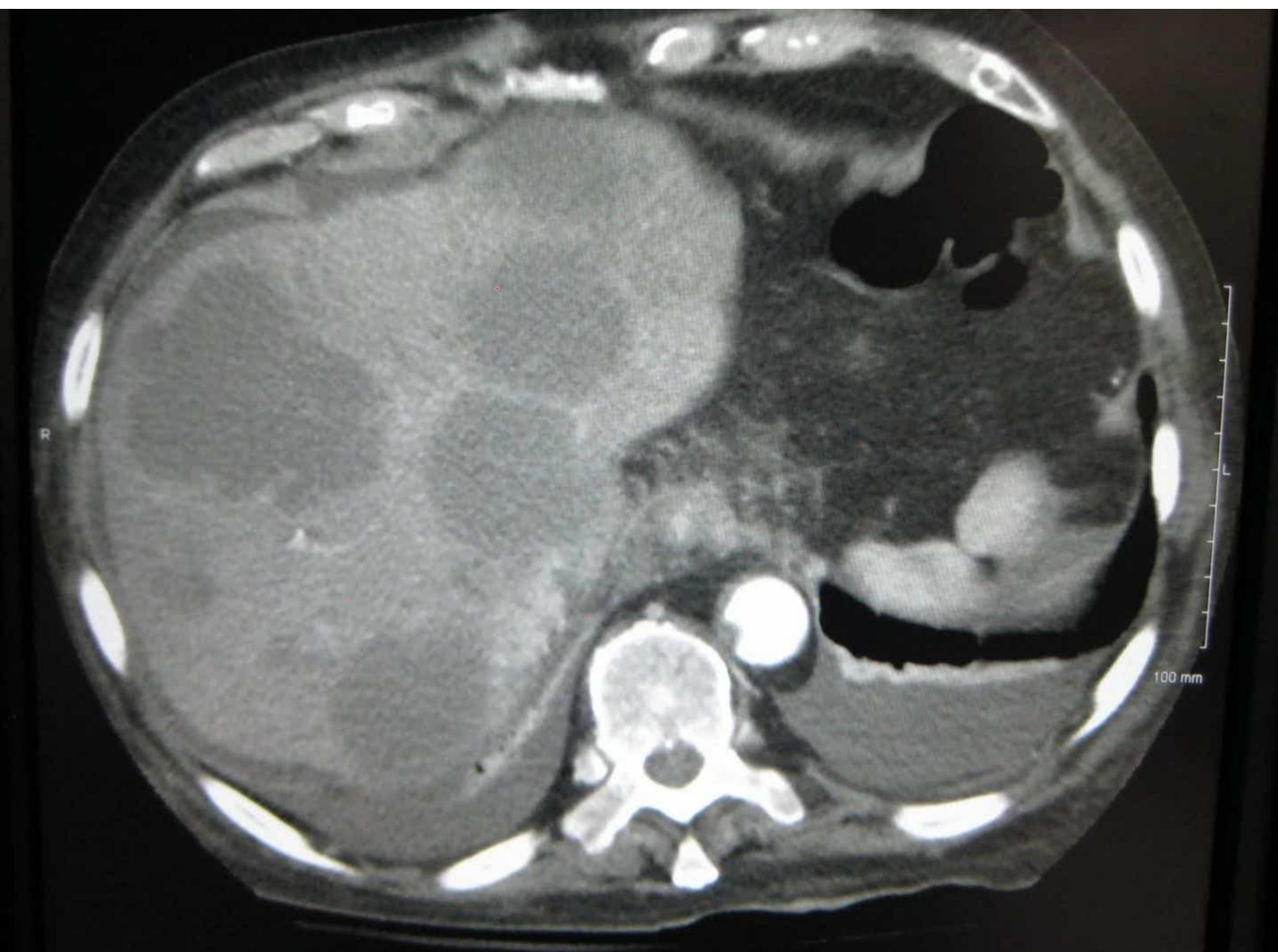
left portal
vein

ligamentum
venosum

caudate lobe

IVC

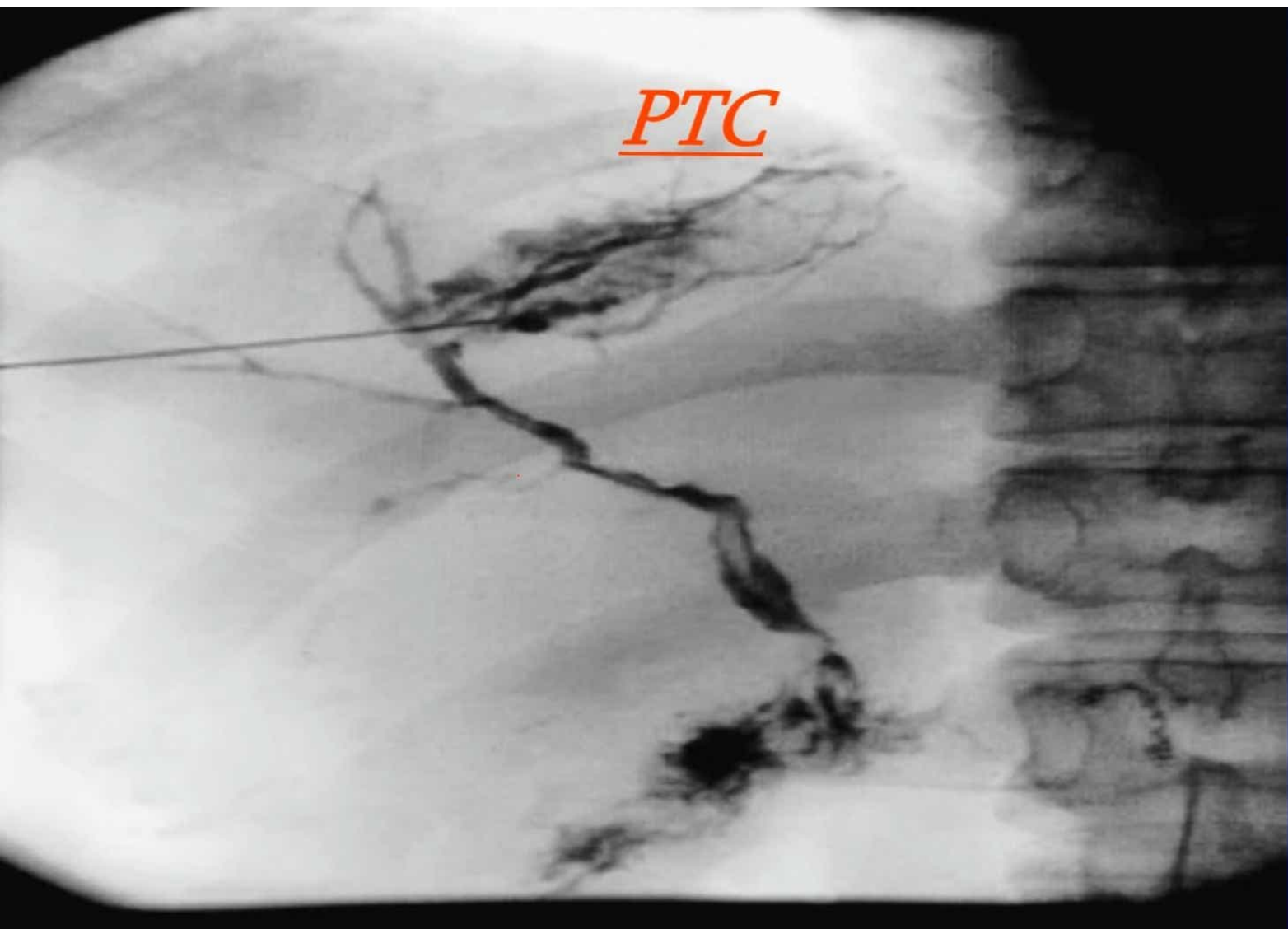






ERCP:

PTC



Jaundice

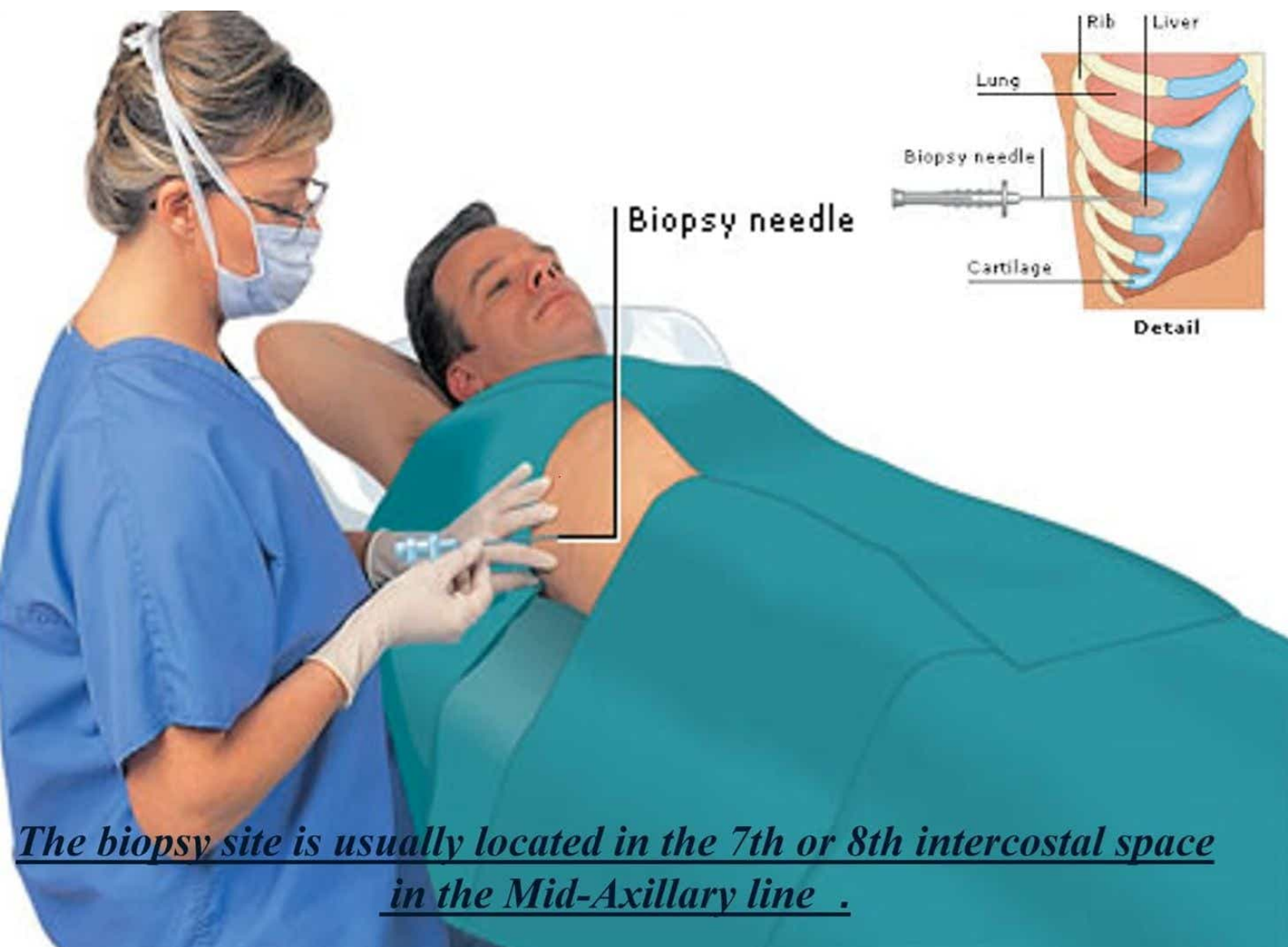
■ **Definition:** *Yellow discoloration of skin and mucus membranes due to presence of excess level of bilirubin (Free or Conjugated).*

	<u>Hemolytic jaundice</u>	<u>Hepatocellular J</u>	<u>Obstructive J</u>
Causes	Excessive hemolysis of RBCS Hemolytic anemia, drugs, Autoimmune disease	Liver disease Infection viral hepatitis Chemicals chloroform Drugs	Cholestasis Intrahepatic cirrhosis Extra-hepatic GBS Carcinoma stricture
Mechanism	↑ Production of free bill	Liver cannot uptake Conjugate and excrete bill	Liver conjugate but cannot excrete bill to intestine
Blood Bill	Haem billi ↑↑	Both	Chole bill
Bile salts	Absent	Present ↑	Present ↑↑
Urine Billi	Absent	Present Chole billi	Present Chole Billi
Color	normal	Dark brown	Very dark brown

Liver Biopsy

Indications

- Evaluation of Abnormal Hepatic lab test results.
- Confirmation of Diagnosis & Prognosis of the dis.
- Suspected hepatic Neoplasm.
- Diagnosis of Cholestatic liver disease.
- Evaluation of infiltrative or granulomatous disease.
- Following a case of liver transplant ? **Rejection**
- To evaluate **Unexplained Jaundice** or suspected drug reactions.



Liver Biopsy cont.....

Contraindications

- Increased prothrombin time , **INR > 1.6**
- Thrombocytopenia, **platelet count < 60,000**
- Ascites (transjugular route preferred)
- Suspected hemangioma.
- Suspected **Echinococcal** infection.
- Uncooperative patient.

Liver Biopsy cont...

Complications



- Rare but potentially are lethal , Mortality < 0.3%
- *The majority (60%) of complications occur within the first 2 Hours.*
- *96% occur during the first 24 hours.*
- Approximately 2% of patients undergoing biopsy require hospitalization.
- Pain, Bleeding , haem-obilia (biliary colic, GI bleeding & jaundice) bacteremia , pneumothorax...

LIVER TRAUMA

- **Aetiology**

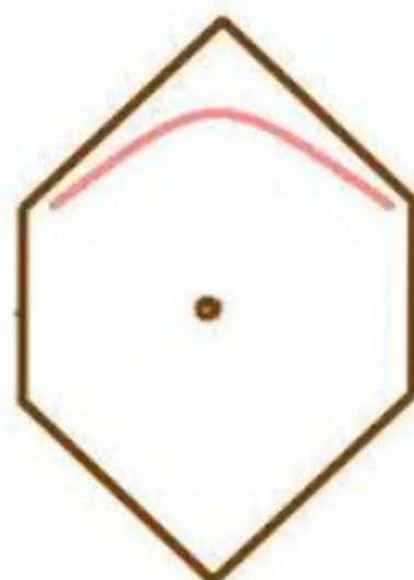
Blunt or penetrating

- **Mortality up to 20%**
- **Site : Rt. Lobe > Lt.**
- **Clinical picture**

Treatment of liver trauma

- Resuscitation , ABC, cross match & BI clotting factors transfusion
- Spiral CT if the patient is hemodynamically stable .
- **Penetrating Injuries:** *should be Explored, via Roof Top Incision :*
 1. Suture lacerations.
 2. Resect if major vascular injury.
 3. Packing if diffuse parenchymal injury.
- **Blunt injuries CT:** *? Treated Conservatively.*





DD cystic liver lesions

■ Infectious

● Parasitic

■ Hydatid cyst

■ Amoebic

● Non-parasitic

■ Pyogenic liver abscess.

■ Fungal abscess.

Non-Infectious

Cystic component

Simple cyst

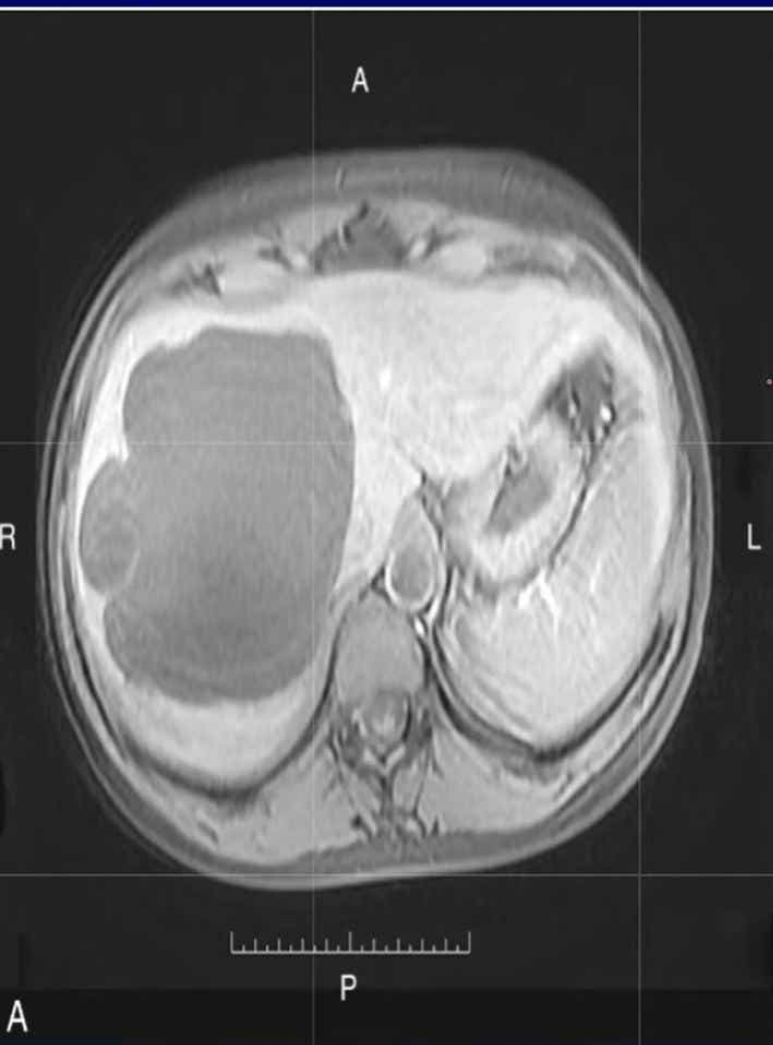
PCLD

Cyst adenoma

Liver cysts

- Simple cysts are the commonest cyst and found in 10% of the population.
- The majority of cysts are < 3 cm and asymptomatic single or multiple.
- No malignant potential.
- M:F 1:4 hormonal ?
- Early satiety can occur when cysts compress the stomach.
- Vague abdo pain.
- US clear cyst no septation.
- Treatment: Sclerotherapy Alcohol 95%.





Pyogenic liver abscess

- ❑ **Most common Abscess in liver in west .**
- ❑ **Single or multiple.**
- ❑ **More in Rt lobe.**
- ❑ **40% mono-microbial, 40% poly-microbial , 20% Sterile.**
- ❑ **Gram –ve bacteria, E.coli is found in 2/3 of cases.**

Pathophysiology

- **Biliary Duct System** : Ascending cholangitis 40% .
- **Portal Blood Flow** : Appendicitis, diverticulitis 20% .
- **Hepatic artery** : Septicemia: 12% .
- **Direct Extension**: Acute cholecystitis 6%
- **Trauma liver Directed therapy**: 4% .
- **Cryptogenic**: 20% .

Discovery of an hepatic abscess

Microbial Pathogens

- Gram-negative bacilli,
- Gram-positive cocci,
- Anaerobes
- Amebic infection
- Fungal infection

Hematogenous

- Portal vein (intra-abdominal infection, pyelephlebitis, abdominal abscess, amebiasis)
- Arterial (ENT, oral cavity)

Biliary

- Gallstones, obstructed bile duct
- Contiguous spread, ascending cholangitis
- Bile duct ischemia

Underlying lesions or anomalies

- Biliary cyst, hydatid cyst, cystadenoma
- Necrosis of a primary tumor
- Superinfection of metastases
- Caroli Disease
- Biliary stricture
- Sclerosing cholangitis
- Ischemic cholangitis

Particular cases

- Radiofrequency ablation/ chemoembolization in the presence of infected bile
- Pancreatoduodenectomy
- Liver transplantation
- Hepatic trauma ± arterial embolization

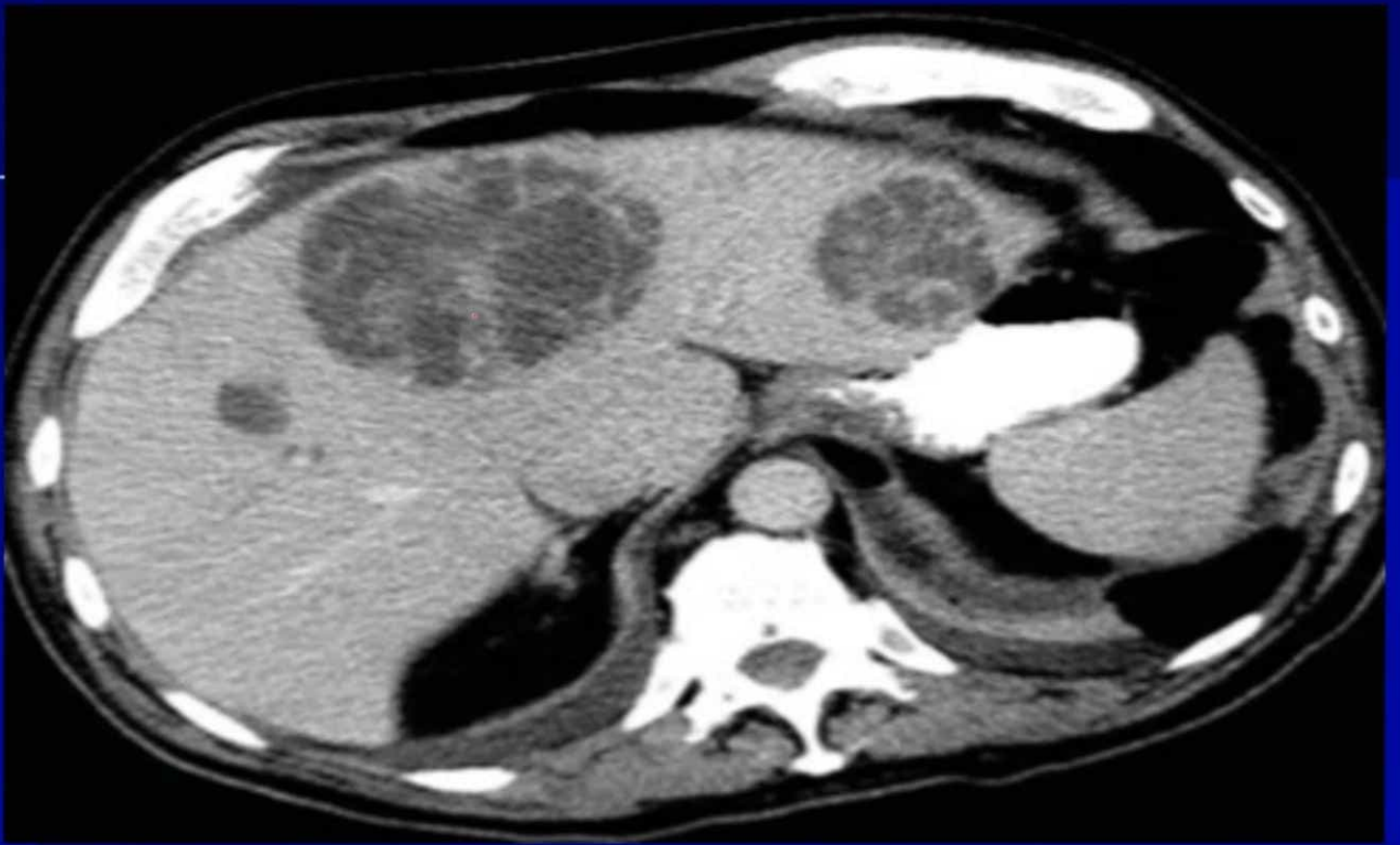
Pyogenic liver abscess

- **Incidence :** More in the Elderly, Diabetics and the Immunosuppressed (cryptogenic).

Clinical presentation

- Fever 90% continuous or hectic .
- Chills , Malaise .
- Anorexia, Weight loss .
- Nausea & Vomiting.
- Right upper pain, Pleuritic pain , cough diarrhea.
- jaundice in 1/3 of cases.
- PUO





Pyogenic liver abscess

- Diagnosis is suggested by the finding of a Multi-loculated cystic mass on ultrasound or CT and is *confirmed by aspiration for C&S*
- Most common organisms are *Escherichia Coli* klebsella.
- Rt. Lobe affected twice as Lt. lobe
- *Raised ALP is most common LFT abnormality.*

Treatment

Antibiotics and Ultrasound-Guided Aspiration (penicillin, aminoglycoside and metronidazole or a cephalosporin)

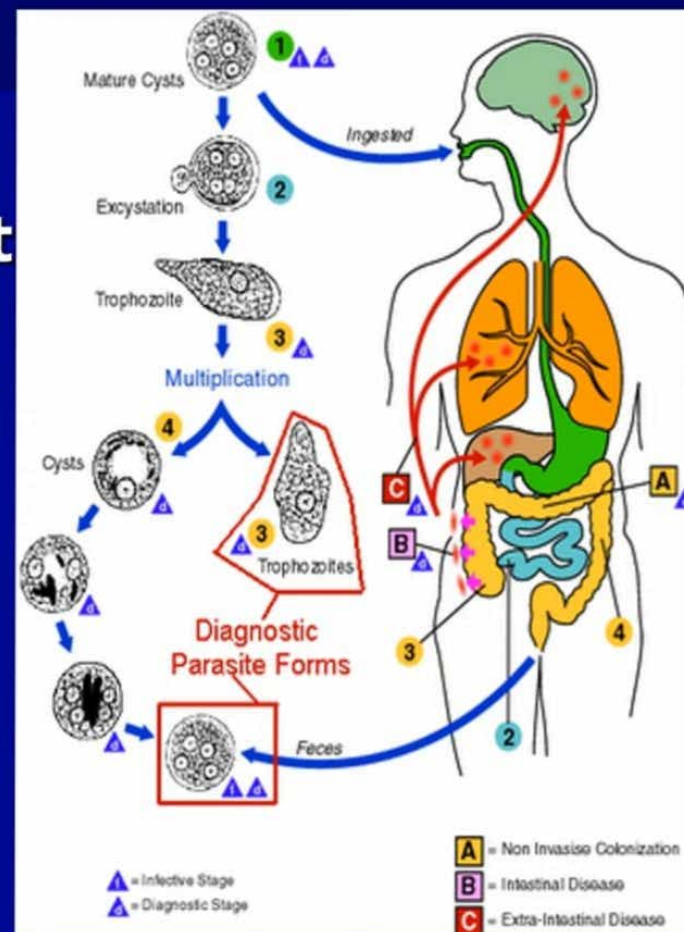
An abscess in the left lobe



AMOEBIC LIVER ABSCESS

Etiology:

- *Entamoeba histolytica* cyst
- Feco-oral Transimination
- Reach liver through portal circulation.



AMOEBIIC LIVER ABSCESS cont...

- Pathology** : Young age 20-40 > in males.
- Site** : 80% of cases in upper post surface of Rt. lobe .
- Affect** 1% of amoebic patients
- Solitary** in 70%
- **Aspirate**: Brown Anchovy-Paste-like fluid
 - **2ry Infection** in 50% of cases.



AMOEBIIC LIVER ABSCESS cont..

Diagnosis : Clinical picture , Imaging and Serology (Gel diffusion precipitative test + ve in 95%)

- Isolation of the parasite from the liver lesion or the stool & confirming its nature by microscopy

Treatment : Metronidazole : 750mg tds for 7-14 days

Guided ? Needle **Aspiration if :**

1. Lack of response to **5 days** treatment
2. Large abscess >10cm
3. Toxic patient



PYOGENIC VS AMEBIC LIVER ABSCESS

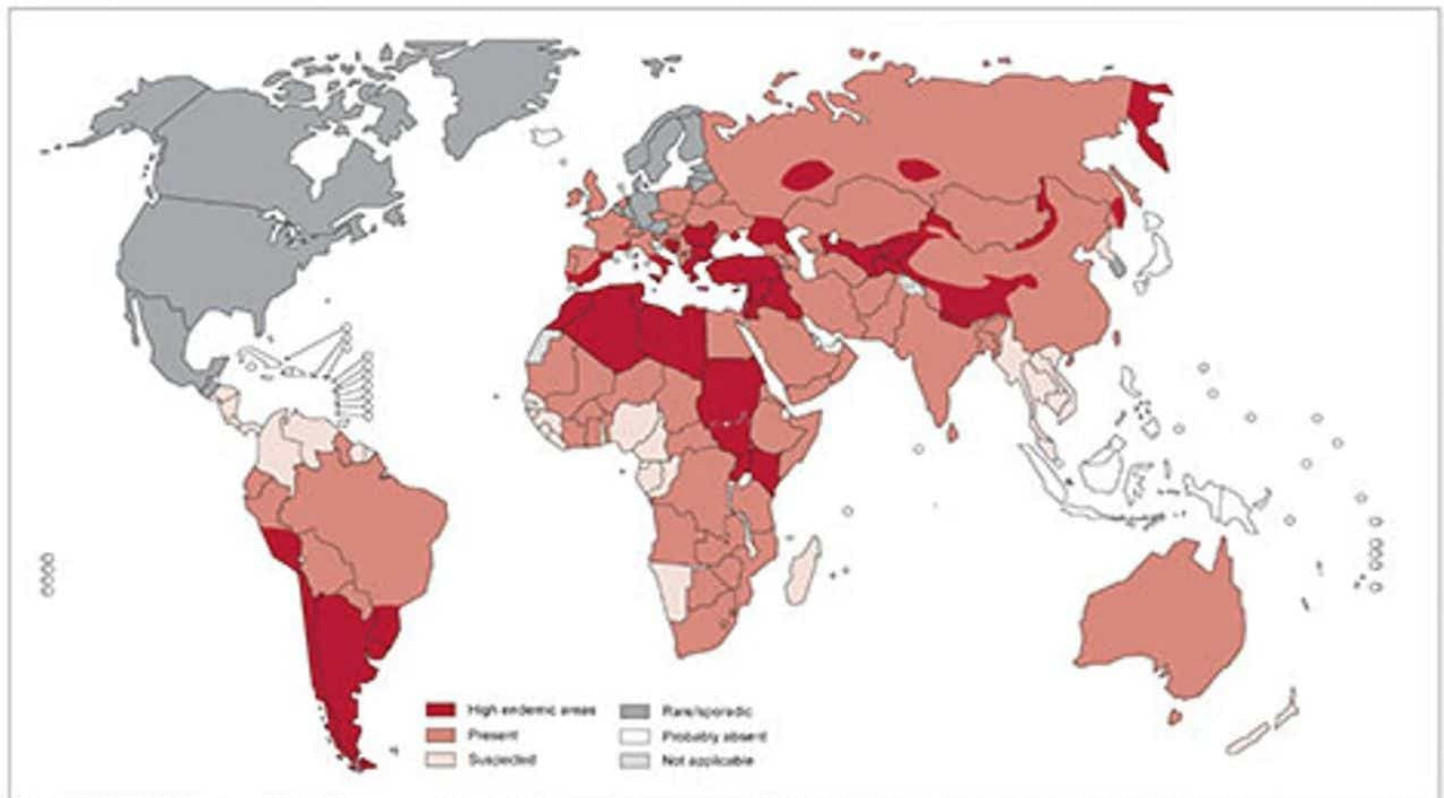
CLINICAL FEATURES	PYOGENIC LIVER ABSCESS	AMOEBIIC LIVER ABSCESS
AGE	>50	20-40
M:F RATIO	1.5:1	>10:1
SOLITARY VERSUS MULTIPLE	SOLITARY 50%	SOLITARY 80%
LOCATION	USUALLY RIGHT LOBE	USUALLY RIGHT LOBE
TRAVEL IN ENDEMIC AREAS	NO	YES
DIABETES	MORE COMMON	UNCOMMON
ALCOHOL USE	COMMON	COMMON
JAUNDICE	COMMON	UNCOMMON
ELEVATED ALKALINE PHOSPHATASE	COMMON	COMMON
POSITIVE BLOOD CULTURE	COMMON	POSITIVE AMEBIC SEROLOGY

HYDATID DISEASE OF LIVER

- Hydatid disease is due to infection by the tape worm *Echinococcus Granulosus* in its Larval or Cyst Stage equal male to female 45 y.
- Pathology : The liver is the most common site for Hydatid disease (75%), lungs (15%), the spleen (5%), and other organs (5%).
- 30% of infected people have multiple cysts
- Clinical picture :? Asymptomatic 50%.
- Right upper quadrant pain.
- Fevers, jaundice resulting from biliary obstruction, portal hypertension.
- secondary cyst infection leading to liver abscess

Epidemiology

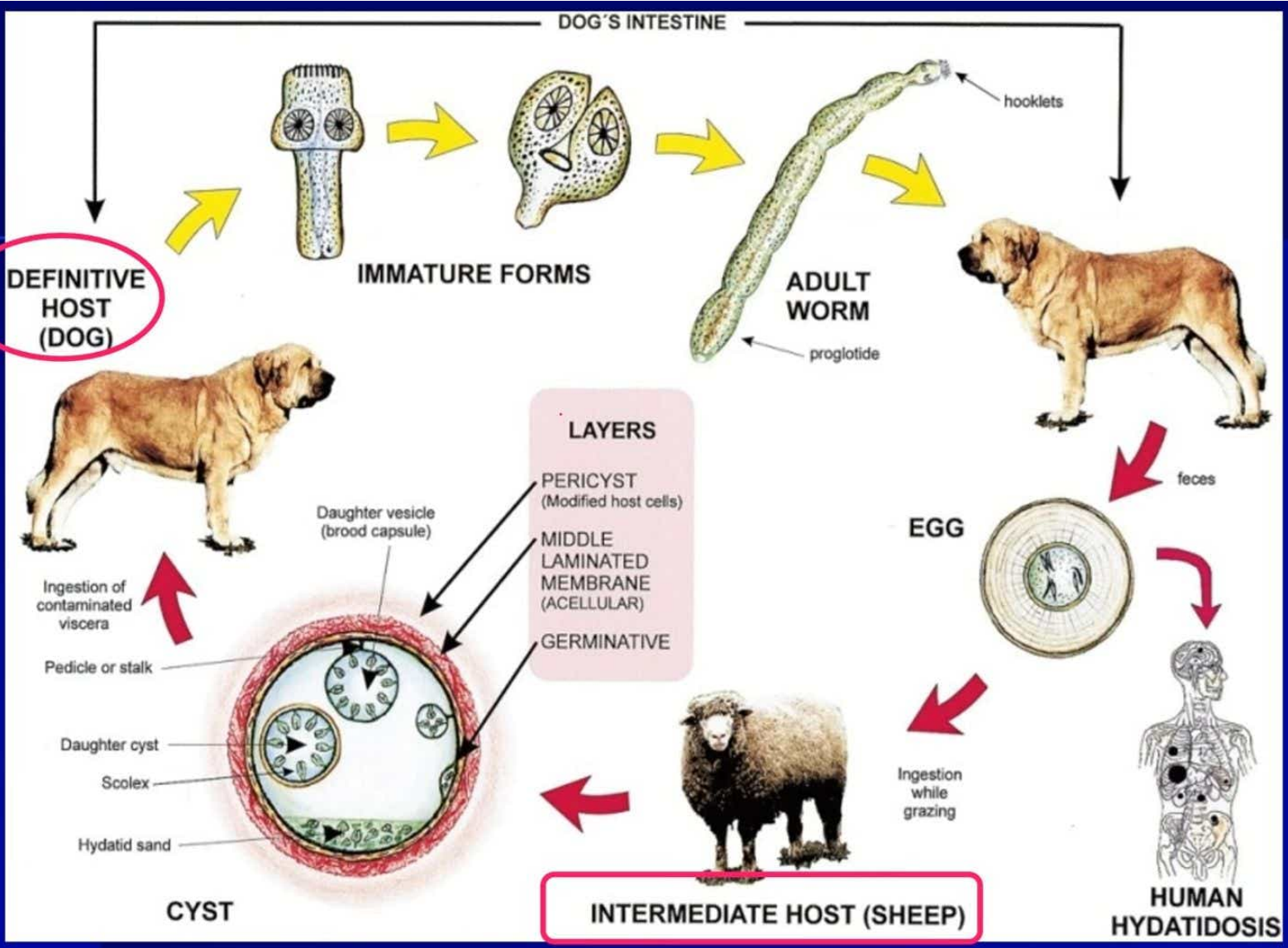
Distribution of *Echinococcus granulosus* and cystic echinococcosis, worldwide, 2011



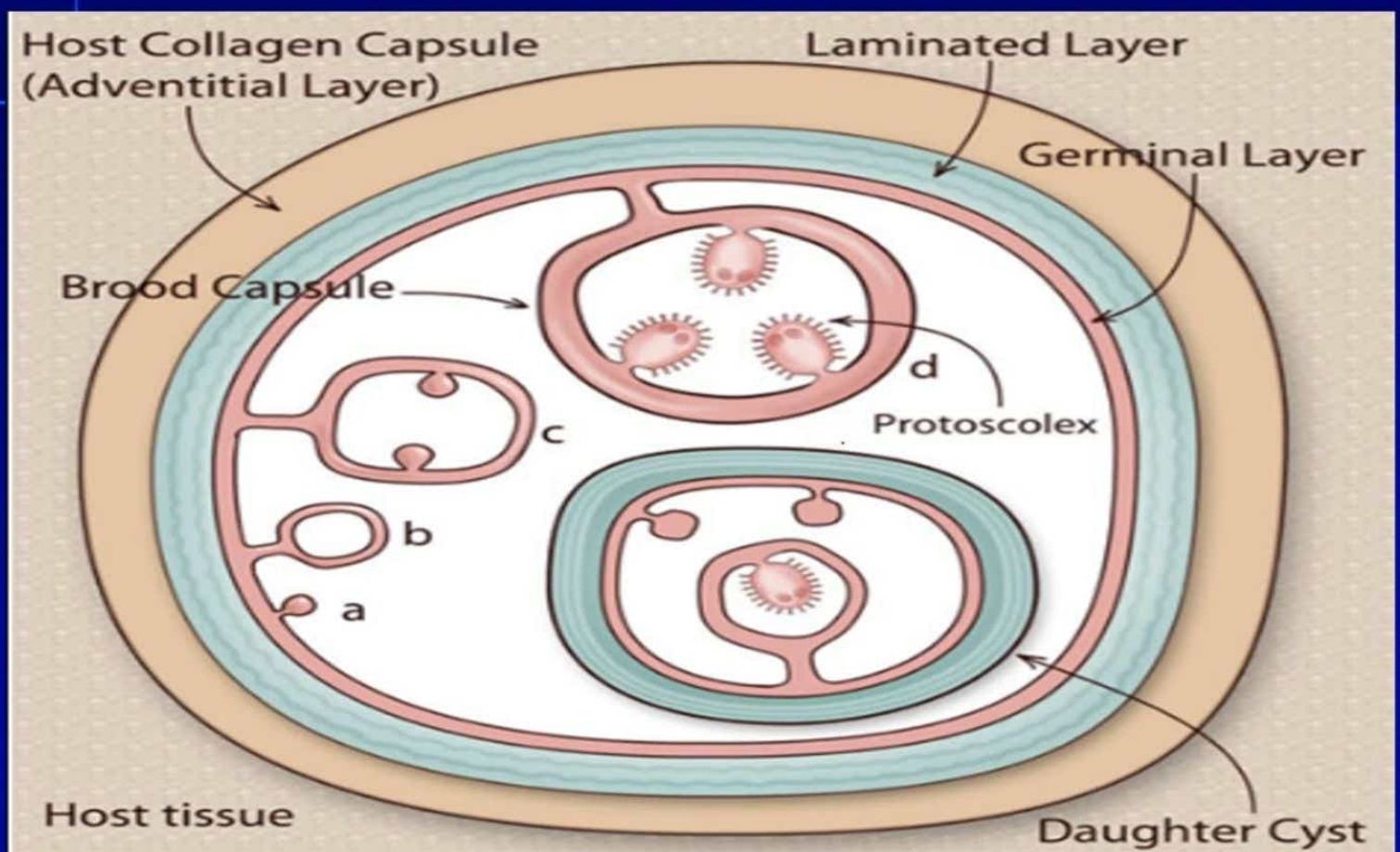
The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2012. All rights reserved.

Data Source: World Health Organization
Map Production: Control of Neglected
Tropical Diseases (CNTD)
World Health Organization

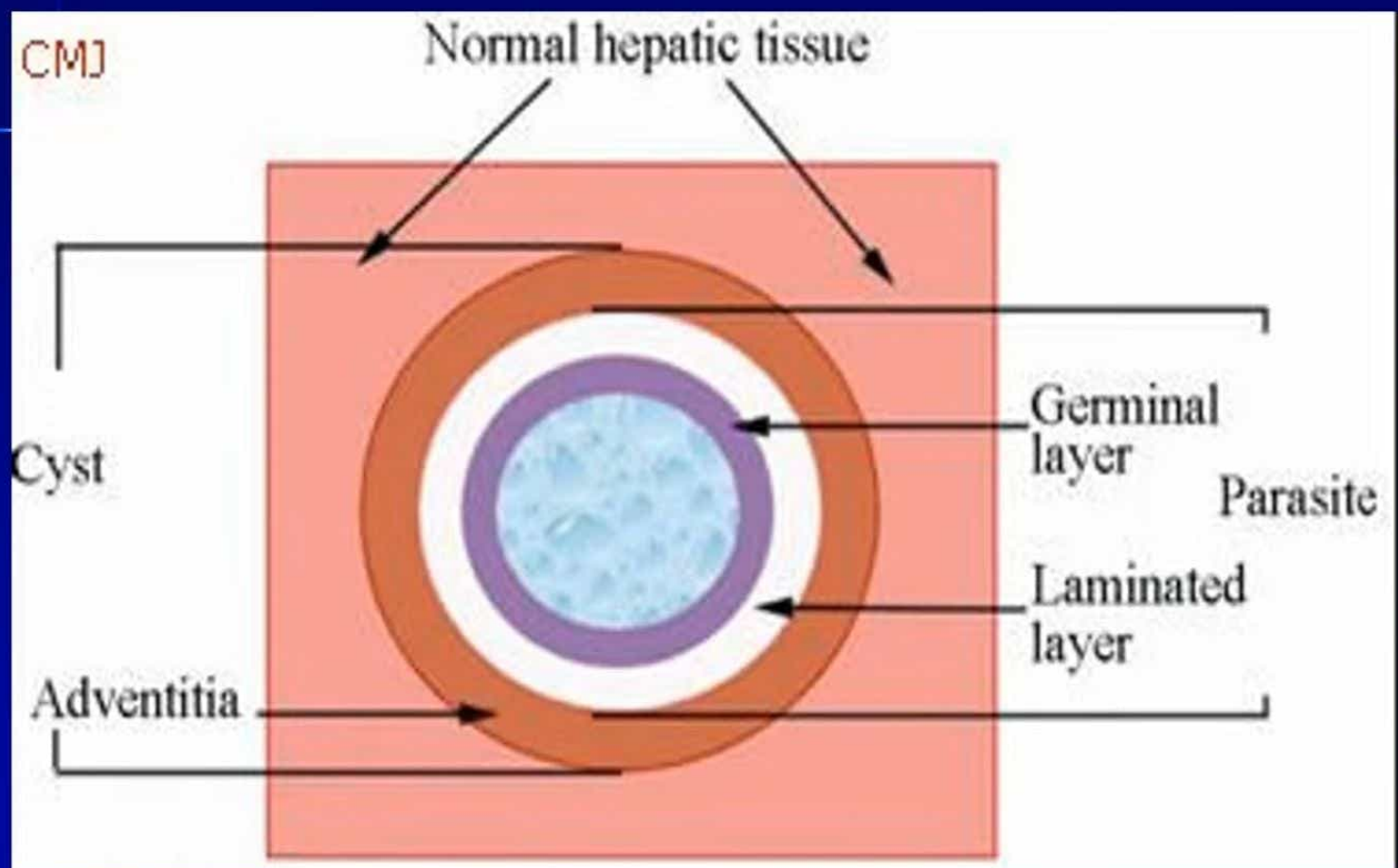


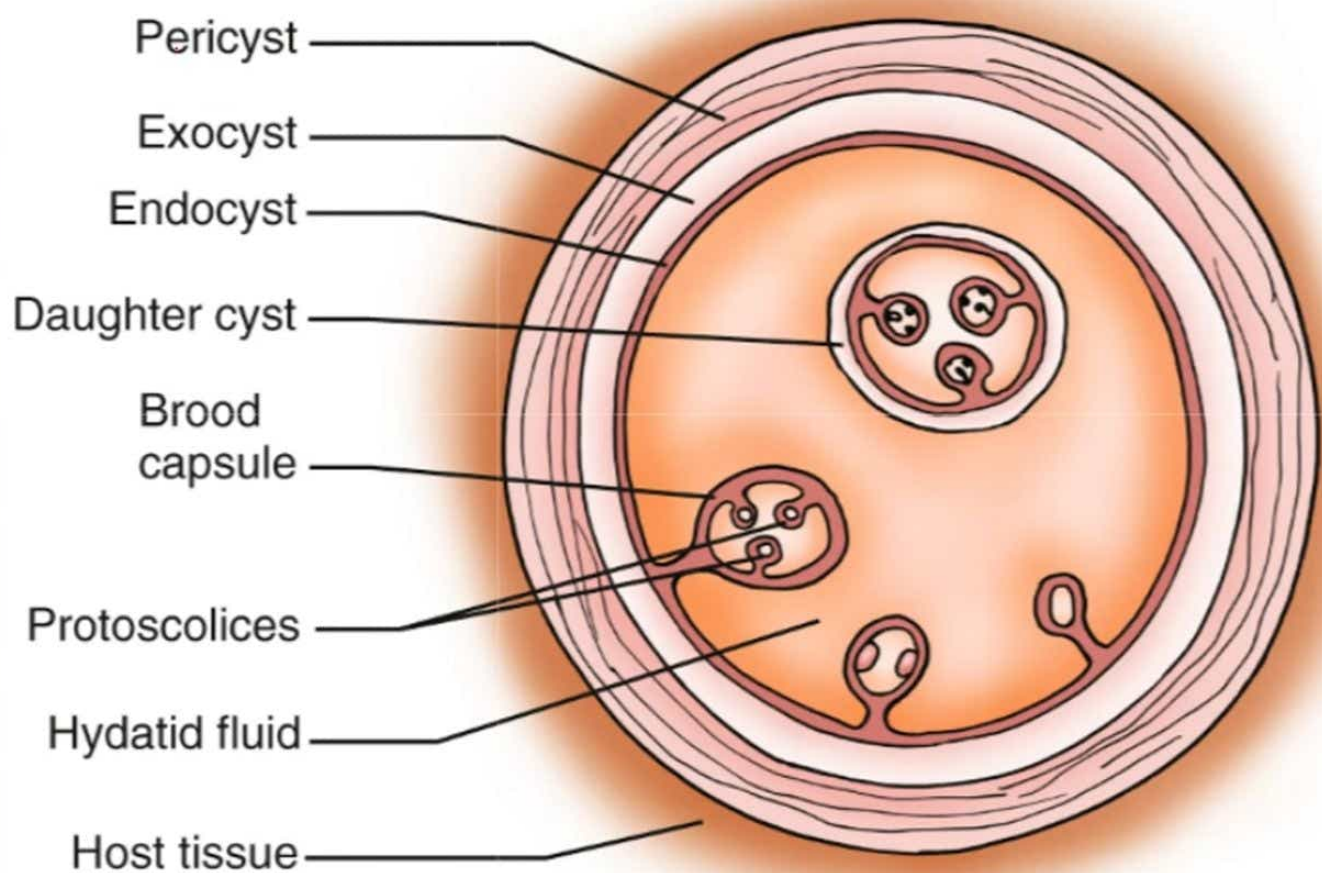


Layers of cyst



Layers of cyst



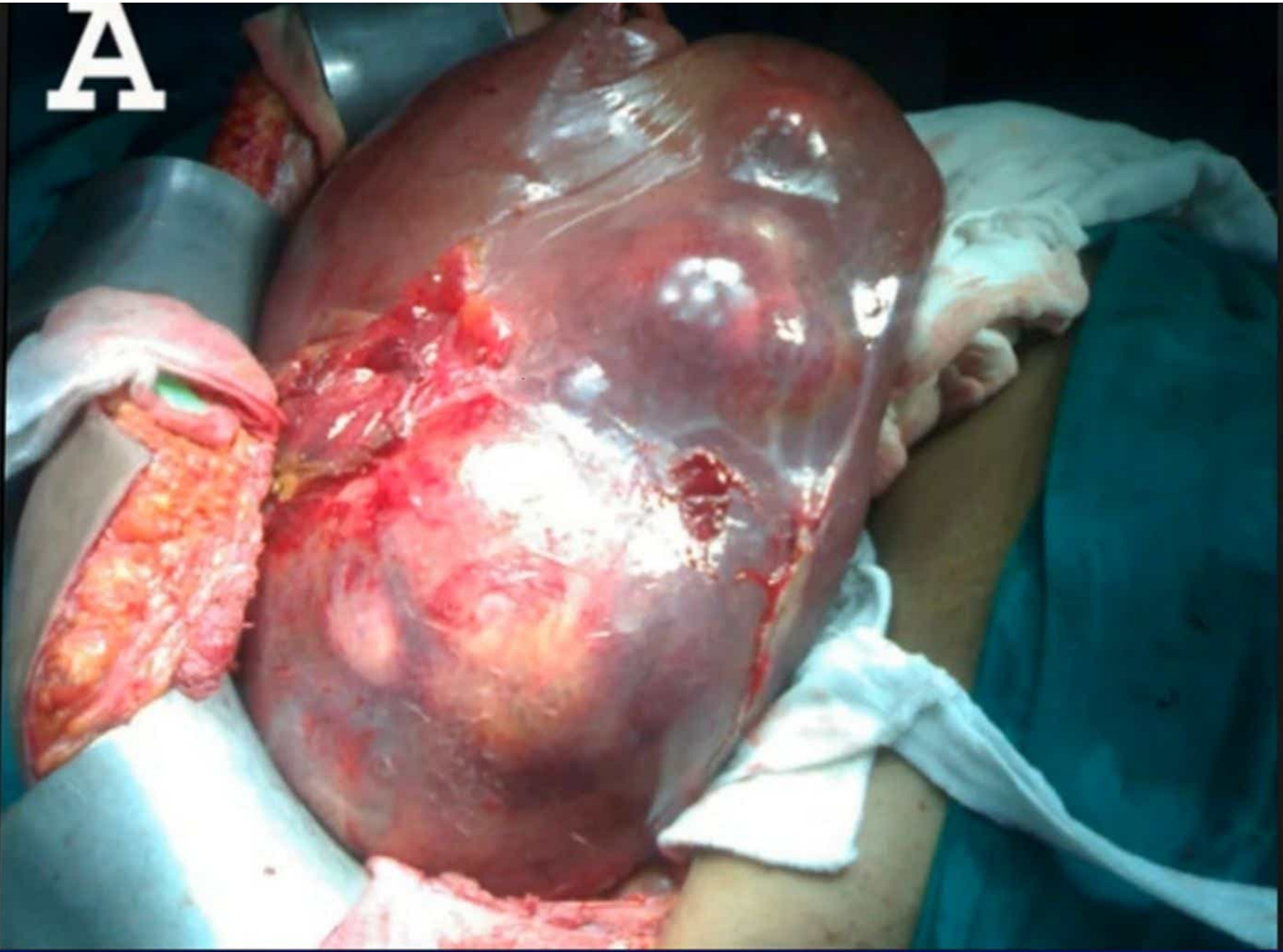


Hydatid cyst

Diagnosis

- **Radiology & Serology**
 1. Enzyme-linked immunosorbent assay **(ELISA)** (high sensitivity above 90%),
 2. Indirect Immunofluorescence Assay **(IFA)** is the most sensitive test (95%) in patients with hepatic disease.
 3. (? Casoni) skin test.

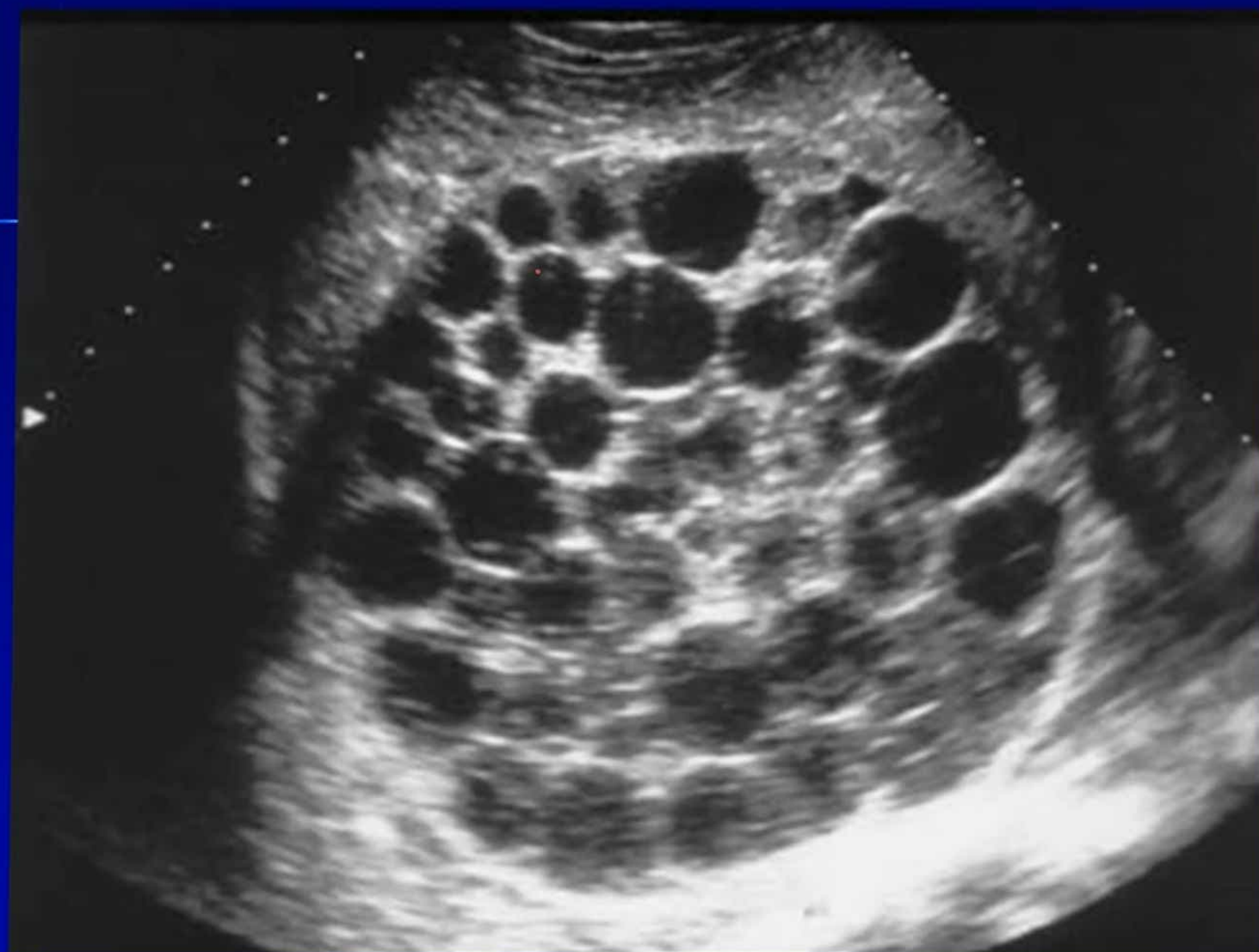
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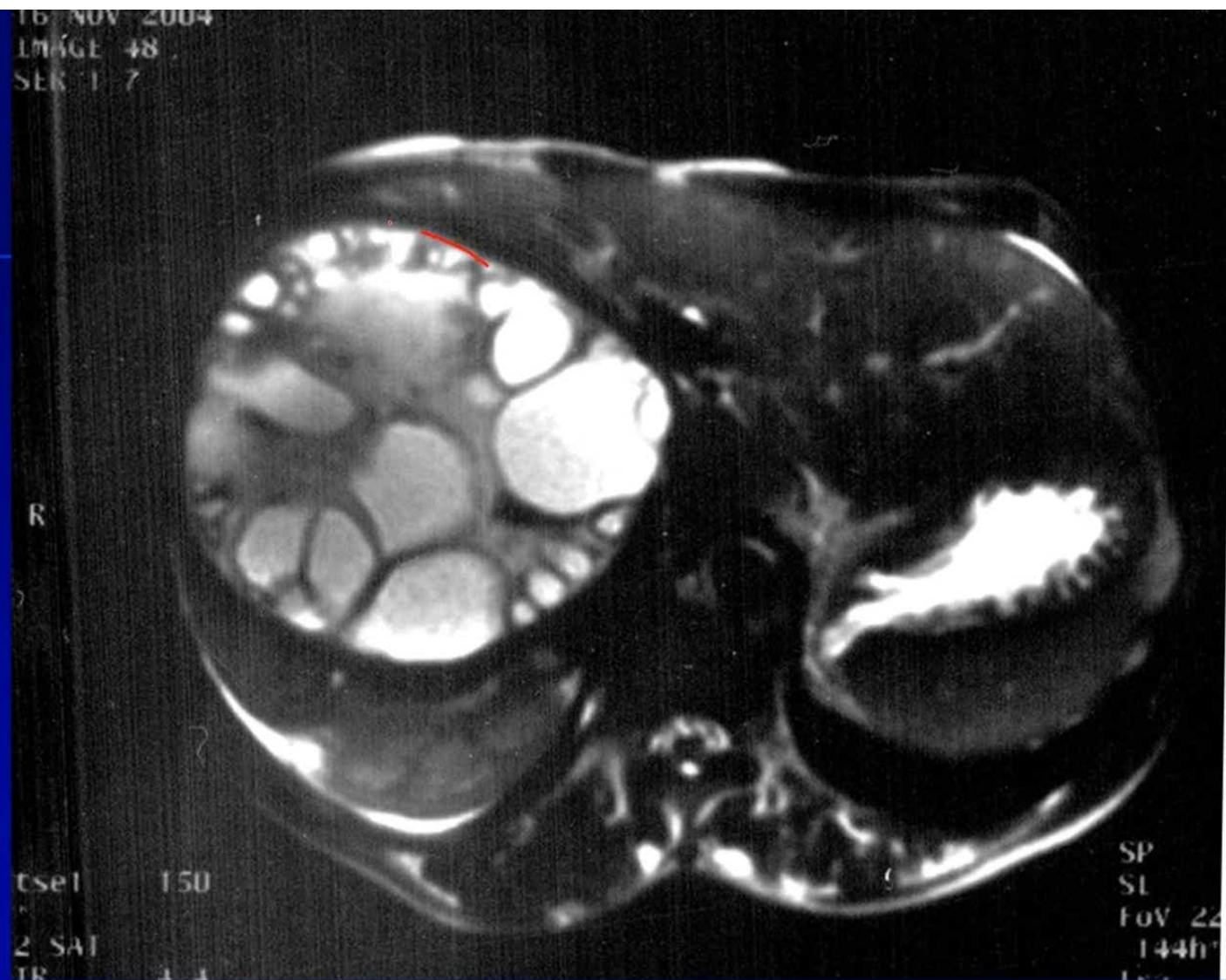


Hydatid disease





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IMAGE 48
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Complications

- Occur in about 40% of cases.
- The most common complications in order of frequency are:
 1. Infection (Abscess).
 2. Rupture to the:
 - A - Biliary tree.
(Causing Jaundice, acute cholangitis)
 - B- Rupture to the peritoneal cavity
:Anaphylaxis
 - C -Rupture to the pleural cavity.

Treatment

1. Medical :

Albendazol 10-15mg/kg/day for eight weeks in two divided doses.

if no response :

2. Surgery with Special Precautions

- Gold standard treatment for Hydatid liver disease.
- Marsupialization , Cystectomy ,Hepatic resections.

3. Percutaneous treatment PAIR

(Puncture, Aspiration, Injection& Re Aspiration)

▪

PORTAL HYPERTENSION

Definition:

Elevation of hepatic venous pressure gradient to
> 5 -7 mmHg

Clinically

- **No Symptoms in Early Cases**
- Variceal hemorrhage portal gastropathy.
- Ascites , Hepatic encephalopathy.
- Increased risk of spontaneous bacterial peritonitis .
- Increased risk of hepatorenal syndrome .
- Splenomegaly with mild pancytopenia .
- Porto - caval anastomoses .

Diagnosis

- Most commonly found in the presence of liver cirrhosis 90%.
- Subclinical cases are more difficult to diagnose
- **Duplex scan** : Findings of hepatic echogenicity , splenomegaly, portal vein dilation, thrombotic occlusion, collaterals, and gallbladder wall thickening are indicative of portal hypertension.
- Portal pressure measurement is not generally indicated (invasive).
- Gastrointestinal endoscopy.

Etiology of portal hypertension

- *Pre sinusoidal :*
 - Extrahepatic: splenic vein thrombosis
 - Intrahepatic: Schistosomiasis
- *Sinusoidal : Intrahepatic like Cirrhosis*
 - *HBV, HCV, Alcohol*
 - Autoimmune hepatitis
- *Post sinusoidal :*
 - *Intrahepatic : VOD*
 - *Post hepatic : BCS*

Management of bleeding varices

- Usually present with the *acute onset of a large-volume hematemesis in liver cirrhosis patient.*
- The lower esophagus being the most common site

Resuscitation and confirmation of diagnosis by endoscopy :

- 1. Central line ,CBC ,LFTS , INR .**
- 2. Cross match 10 units blood central line**

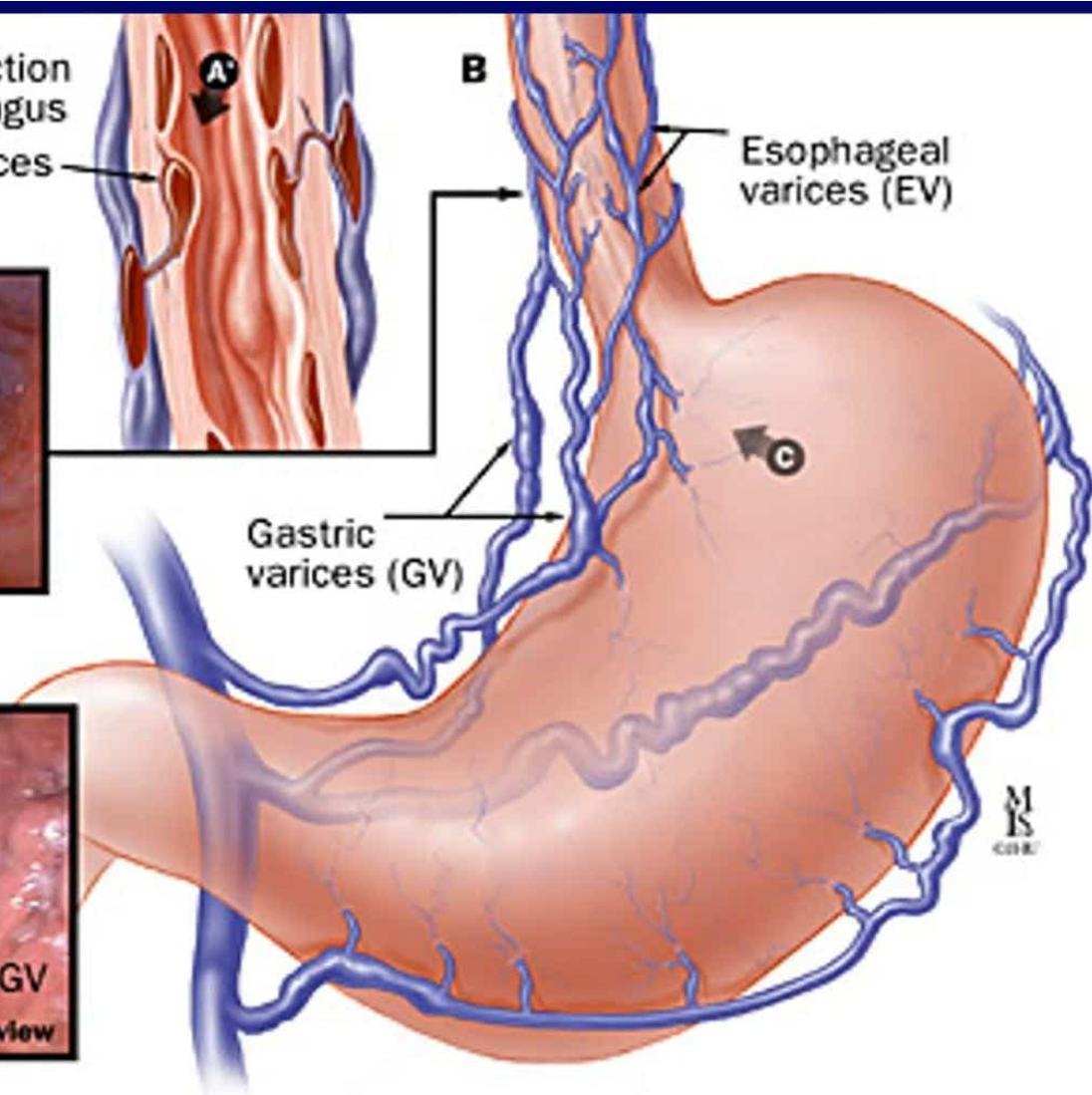
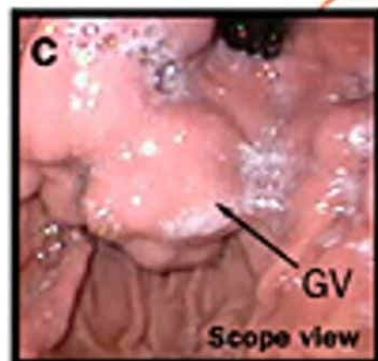
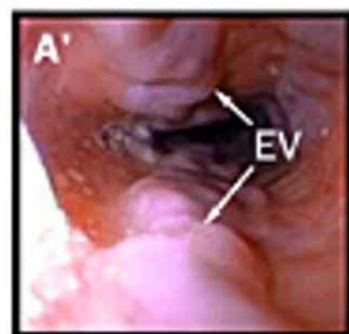
A Cross section of esophagus

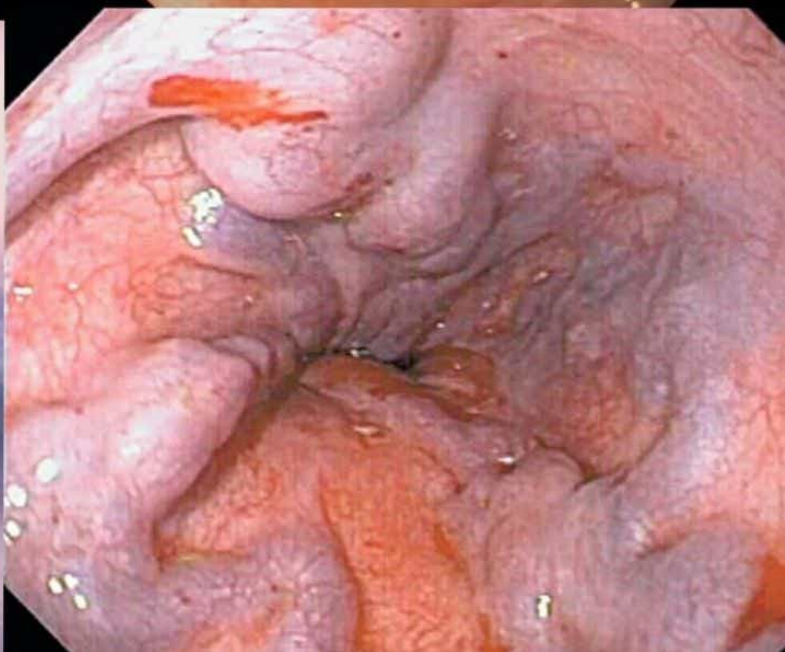
Varices

B

Esophageal varices (EV)

Gastric varices (GV)





Management of bleeding varices cont..

3. Vit k 10 mg IV

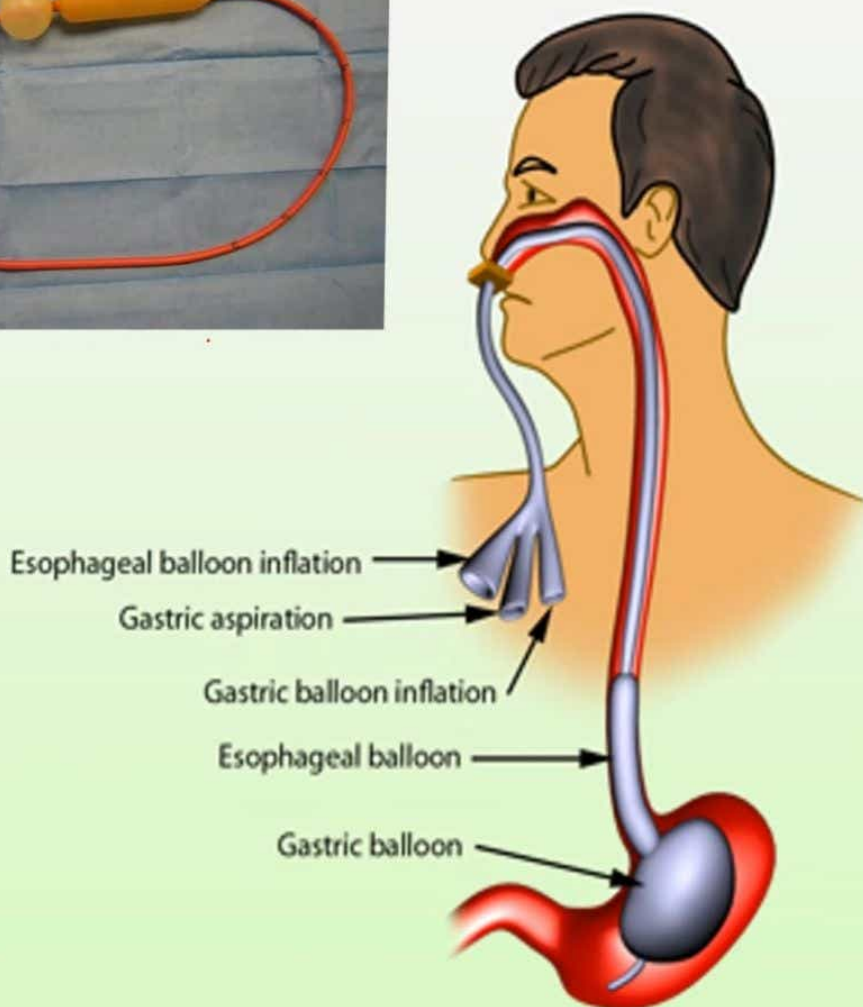
4. ? Platelets if count <50

5. FFP

6. Sengstaken–Blakemore tube if severe bleeding for

12 hours then deflate it

7. Drugs : **Vasopressin** is the most extensively used drug for initial control of variceal Hg (*20 U in 10 ml of 5% dextrose i.v. over 10 min*).



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Management of bleeding varices cont..

Octreotide : the long acting somatostatin analogue, may be equally effective.

8. Endoscopic sclerotherapy is the initial treatment in most centers using ethanolamine oleate.

9. *Transjugular intrahepatic porto-systemic stent shunts* **(TIPSS)** If no response to sclerotherapy

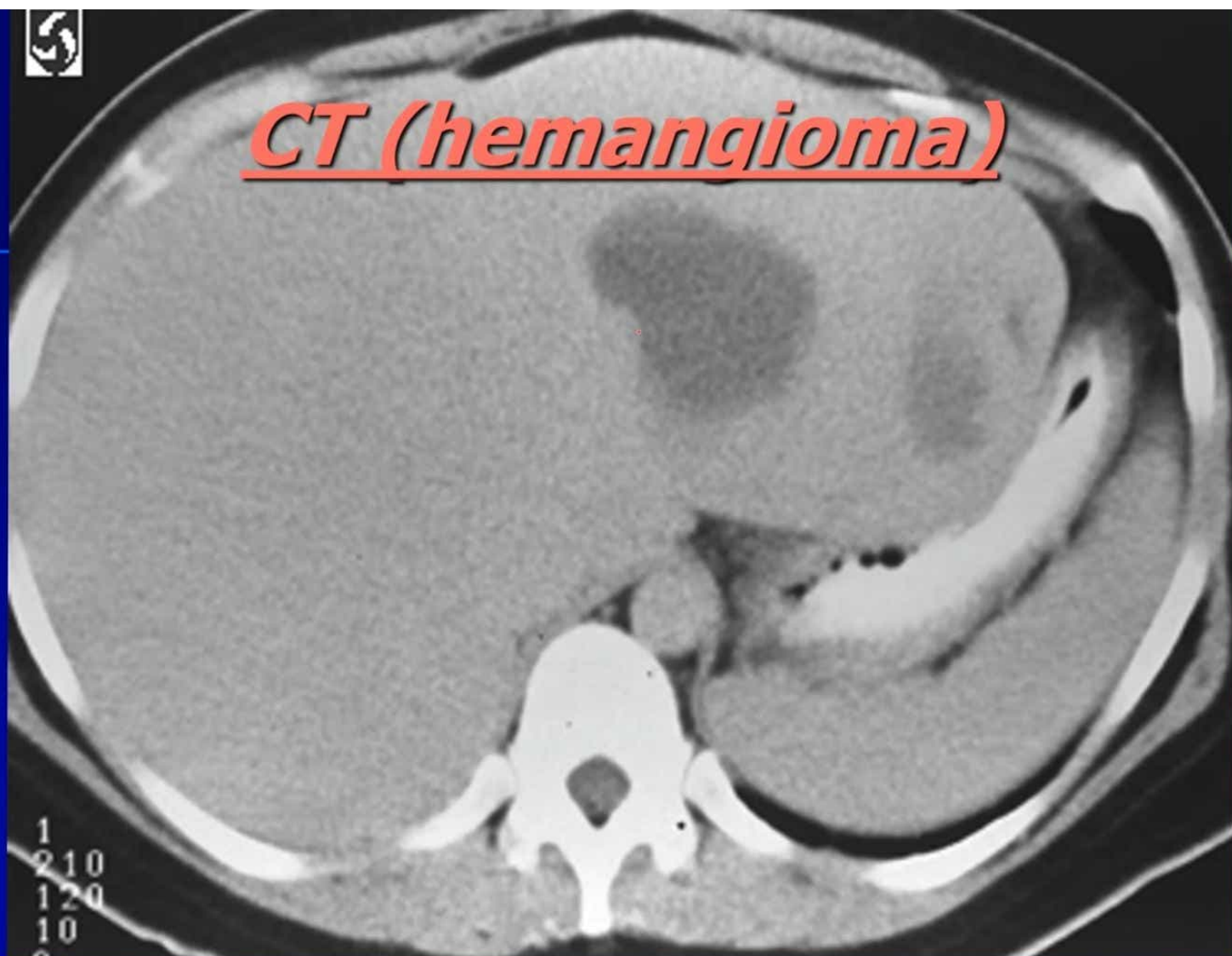
10. Surgical shunts rarely indicated in acute cases

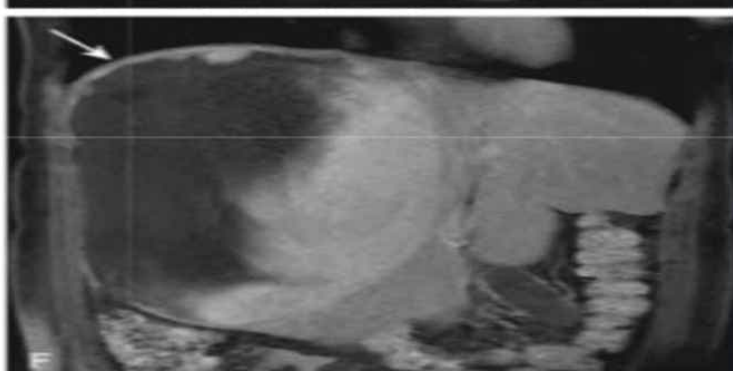
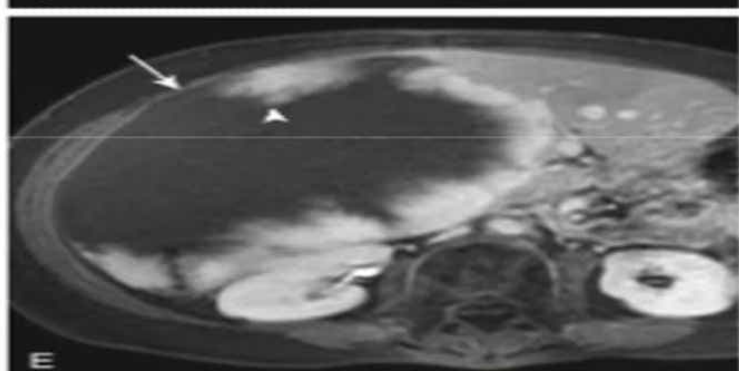
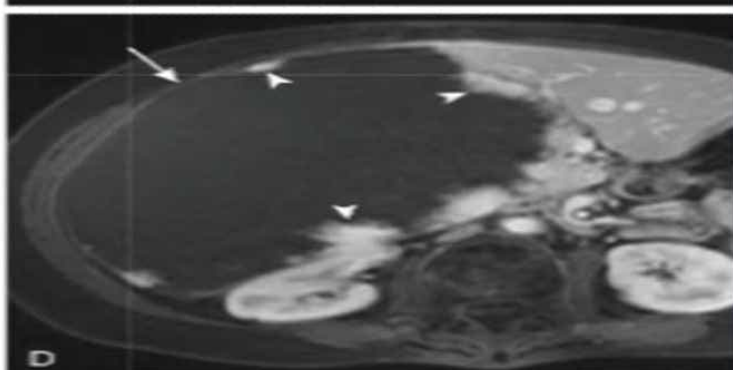
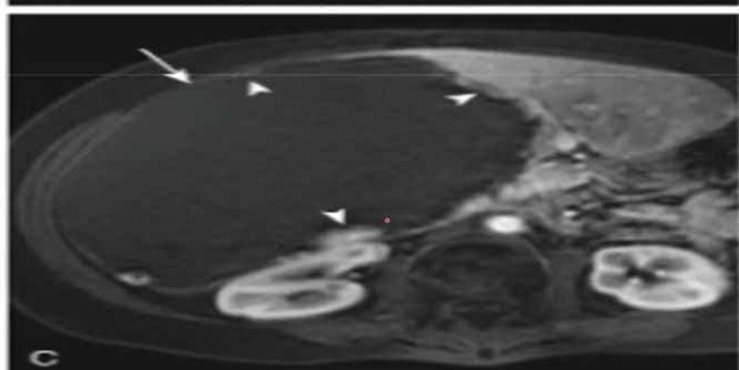
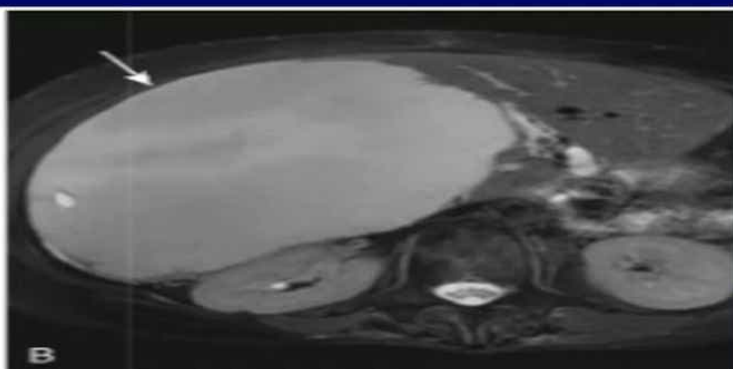
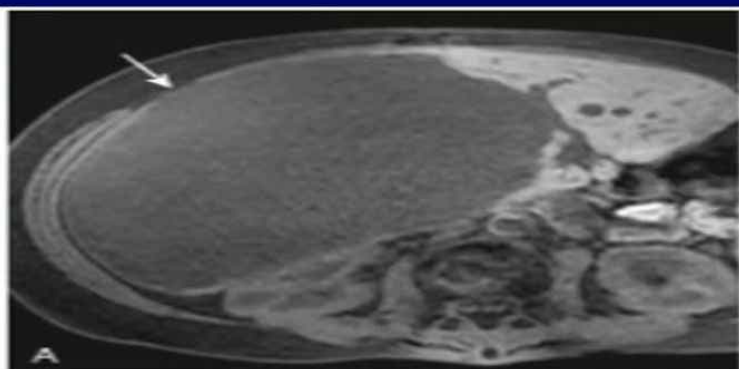
Selective (spleno-renal) & non-selective (porto-caval) 11. Oesophageal stapled transection

BENIGN NEOPLASMS OF LIVER

Haemangiomas

- Most Common Solid Benign Masses in the liver 7-15 % of population are affected , > 5 cm is giant form .
 - Male: female 1:4 hormonal association?? multifocal 50% of cases .
 - Usually solitary, 30-50 y, usually stable over time.
 - Clinically: Usually Asymptomatic (50-90) %
 - Non specific abdominal pain.
 - No malignant potential.
 - Haemangiomas > 5 cm are called Giant form.
 - Diagnosis : US , (contrast CT) ,MRI
- Usually no treatment , ? Embolization, Resection.





Hepatic Adenoma

- Rare benign liver tumors , 10% multiple.
 - More in females , age 20-40y ? Contraceptive pills hormonal treatment.
 - Size: 4-30 cm
 - Upper abdominal pain 50-70%
 - Risk of rupture is 30% , Bleeding .
 - Risk of malignancy is related to size >5cm HCC 4% Male sex , Symptomatic .
- Diagnosis :** CT demonstrates a well circumscribed & vascular solid tumor , *Angiography* shows peripheral arterialization.

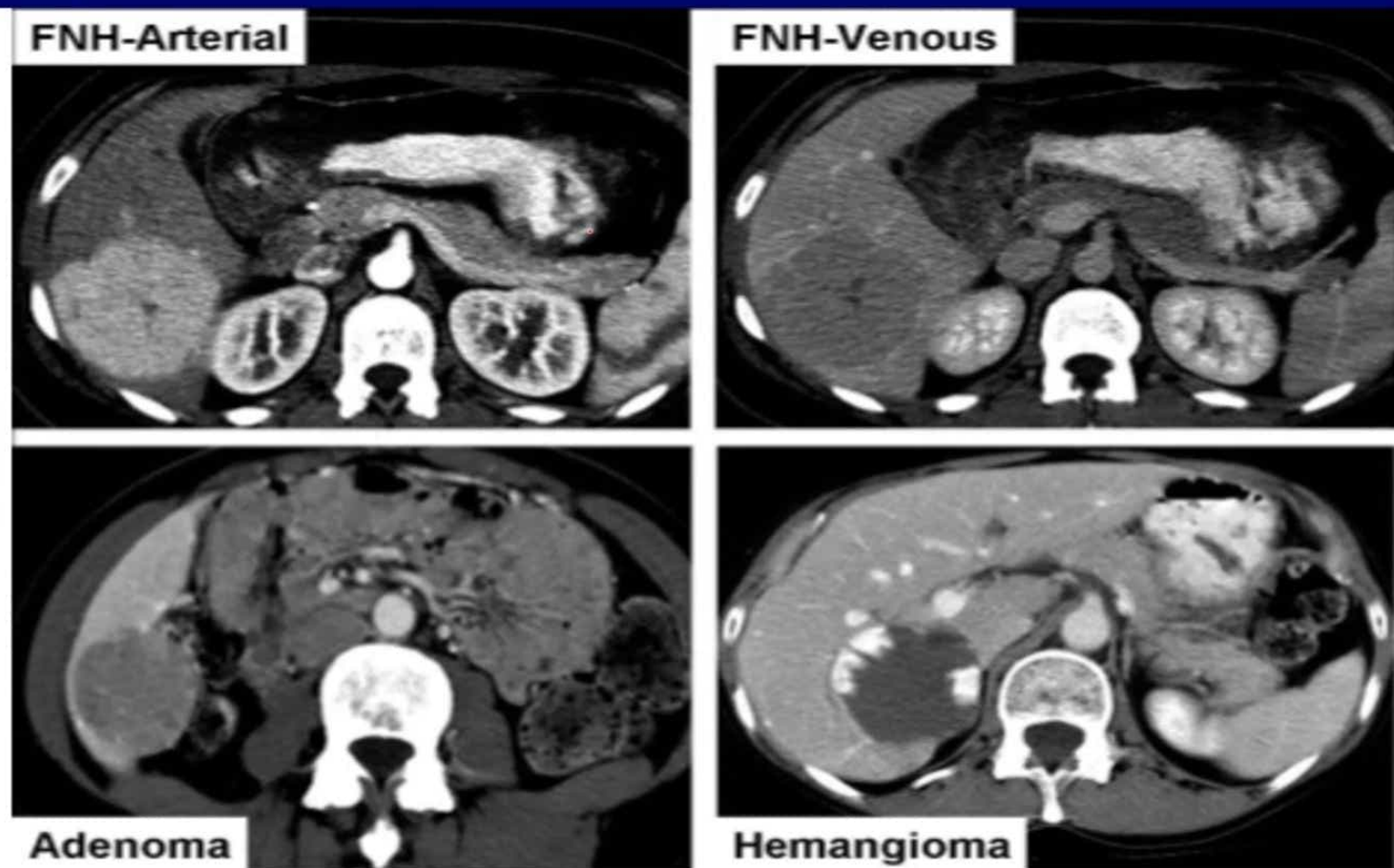


Figure 31-18. Computed tomographic scans showing classic appearance of benign liver lesions. Focal nodular hyperplasia (FNH) is hypervascular on arterial phase, isodense to liver on venous phase, and has a central scar (*upper panels*). Adenoma is hypovascular (*lower left panel*). Hemangioma shows asymmetrical peripheral enhancement (*lower right panel*).

Image 1131 - Uploaded By: Schaber, medical student :: :: ::



MedPix™

Hepatoadenoma cont...

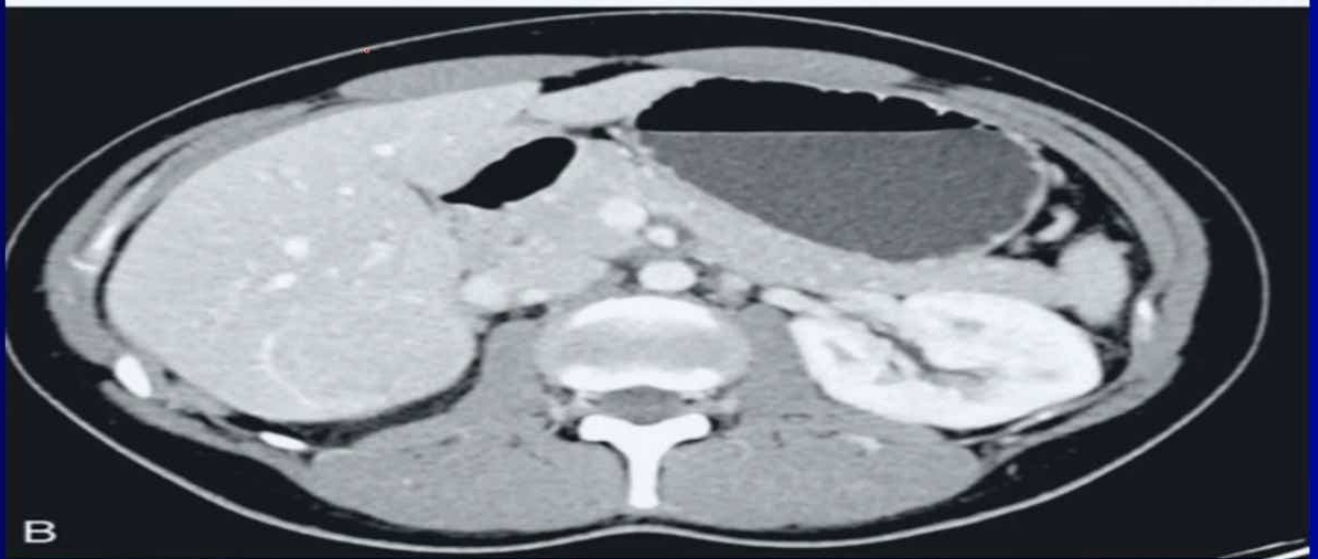
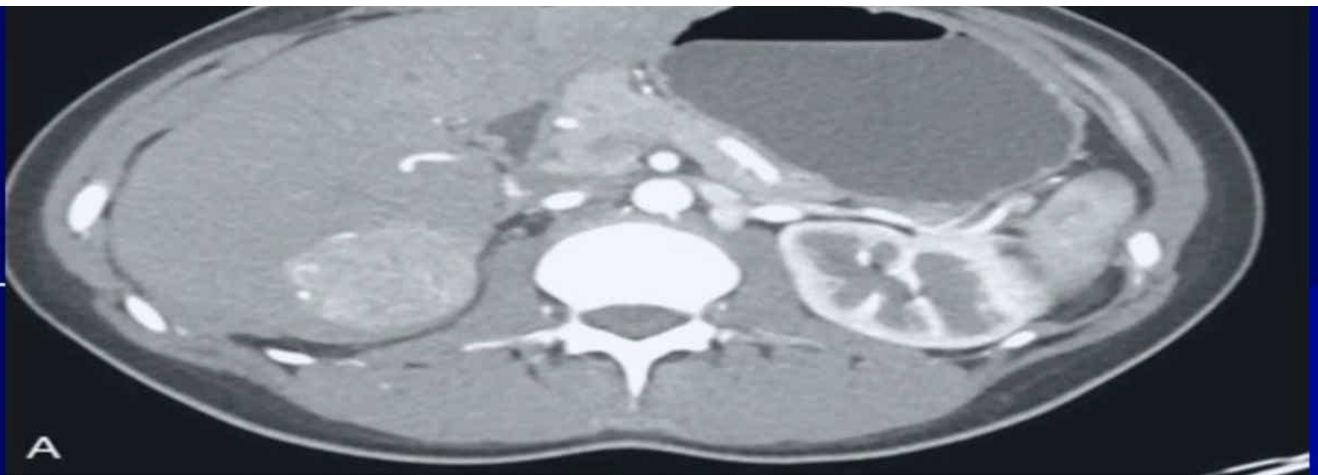
- Confirmation of the nature of these lesions is required by either percutaneous biopsy or resection with histological confirmation
- *Adenomas have malignant potential*

Treatment

- Hge hepatic artery embolization.
- Resection is the treatment of choice.

Focal Nodular Hyperplasia (FNH)

- 2nd commonest benign liver lesion after hemangioma.
- *No malignant potential no hemorrhage*
- *Central stellate scar in 80 %.*
- More common in young and middle age women solitary in 80%.
- No relation with sex hormones or CSP.
- *Usually asymptomatic.*
- May cause minimal pain
- Diagnosis by US, CT.
- No treatment necessary.



Focal Nodular Hyperplasia (FNH)

MALIGNANT TUMORS

Primary or secondary

■ Primary :

Is one of the Commonest world wide tumor.

Types

1. Hepato-carcinoma.
2. Intra hepatic Cholangio-carcinoma .
3. Metastasis from CRC

Hepatocellular carcinoma HCC

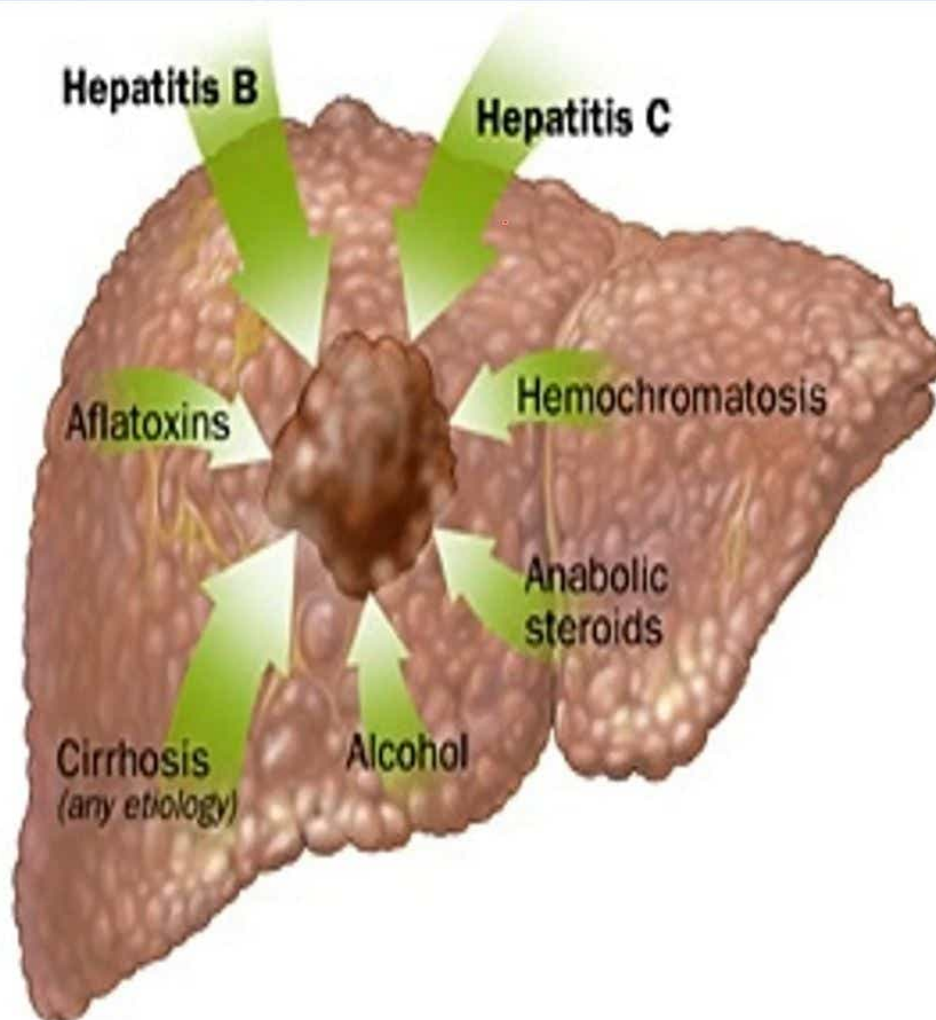
Epidemiology

- 5th cancer world wide , 3rd cause of cancer death.
- Most common primary malignant liver tumor world wide .
- World wide metastatic liver tumors are more common.
- HCC is Four to Eight times more common in men
- *Rarely occurs before the age of 40 years and reaches a peak at approximately 70 years of age.*
- Fibro lamellar HCC, occurs in patients with no underlying liver disease 30% .

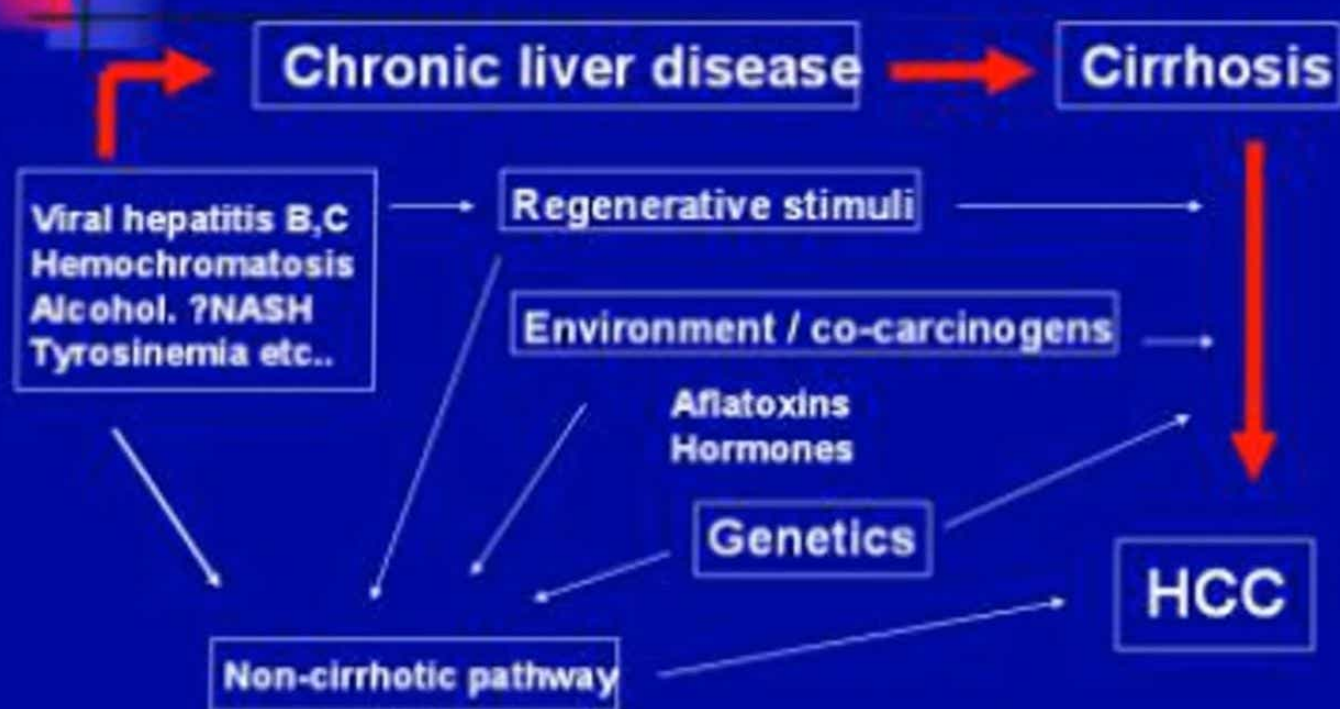
Aetiology & Risk factors

- Develop on top of cirrhosis, 70-80% of cases globally, **Commonest** cause.
- In a person with Cirrhosis, the annual conversion rate to HCC is **2% to 6%.**
- Hepatitis B-C virus.
- Alcoholism.
- Auto immune chronic active hepatitis
- Hemochromatosis .
- Wilson's disease , DM .
- Obesity.

Causes of HCC



Hepatocellular carcinoma: Pathobiology



Stem cell biology: hepatocyte, cholangiocyte

Clinical presentation

- **Most people don't have signs and symptoms in the early stages .**
- **Patients often present in middle age .**
- **Either because of the symptoms of chronic liver disease (malaise, weakness, jaundice, ascites, variceal bleed, encephalopathy).**
- **Anorexia & wt. loss of an advanced cancer.**

**Hepatocellular
Carcinoma
on top of HBV**



Hepatocellular carcinoma cont...

Pathology

- In cases of chronic liver disease multifocal by the time of diagnosis.

Metastasize within liver , HLN, mediastinum , lungs, and bones ,peritoneum.

-

Pathology



Diagnosis

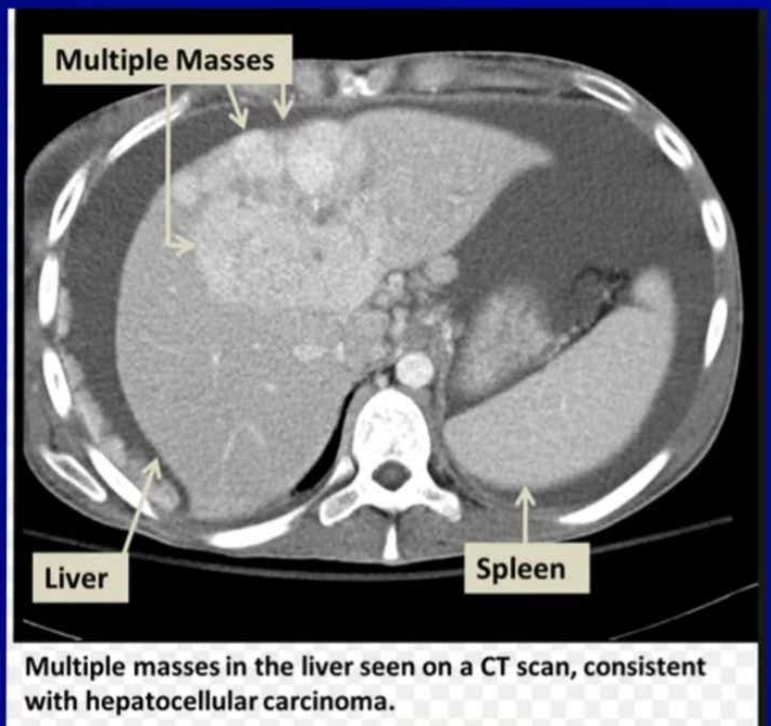
Radiology :

- US: is often the 1st imaging & screening modality.
- *Spiral CT scan & contrast MRI.*

Tumor markers :

- **Alpha-Fetoprotein .**
- **Image-Guided Biopsy:** Should be considered for focal hepatic masses with *atypical imaging features* or discrepant findings on CT and MRI, or for lesions detected in the absence of cirrhosis.

HCC



Pathology

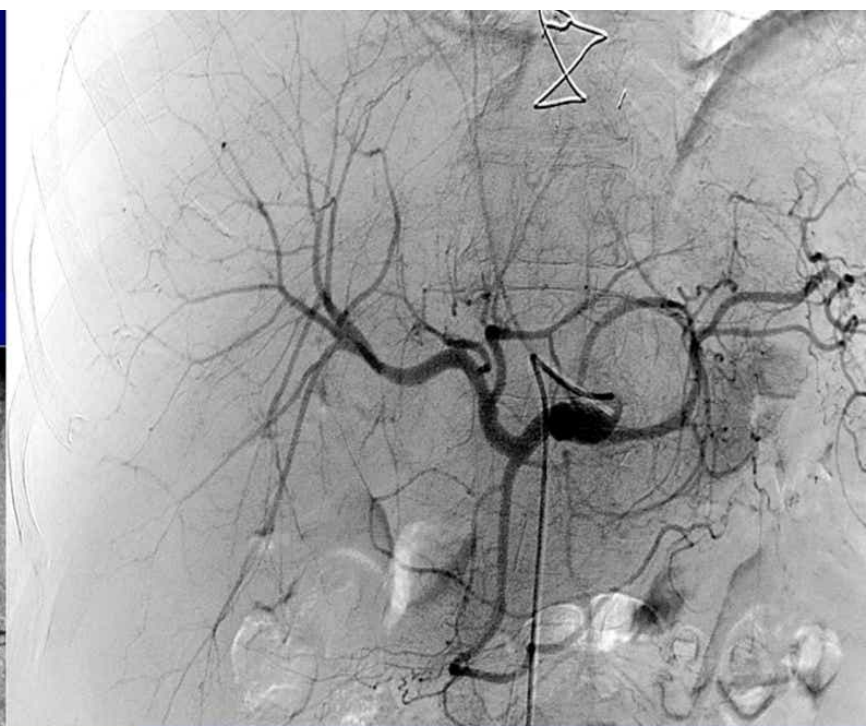


Treatment of HCC

1. Surgical resection with 2cm safety margin.

- The majority of patients diagnosed with HCC will not be amenable to surgical resection (85%) because of the advanced stage of the cancer or the severity of the underlying liver disease.
- Recurrence rates up to 70% in 5 years.
- liver transplant .

2. Trans arterial embolization (TAE), **transarterial chemo-embolization.**



Treatment of HCC cont..

3. Radiofrequency ablation

- Has become the most frequently used form of local ablation therapy.
- It is the best treatment alternative for patients with early-stage hepatocellular carcinoma who are not eligible for surgical resection or transplant .
- No systemic chemotherapy was shown to be consistently efficacious in treatment of HCC

Prognosis : : 31% in localized HCC
11% in regional disease

Secondary tumors

- The *most common types* of cancer that spread to the liver are:
Bowel, Breast, Pancreas, Stomach, Lung, Ovary & Malignant Melanoma .
- *CRLM is more common than PLT.*
- Multiple , Most resistant.
- Mild cholestatic picture (ALP, LDH)
- Dx imaging or FNA
- *Treatment* : Depends on the primary cancer
In some cases resection or chemoembolization