

GASTROINTESTINAL SONOGRAPHY

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Chong Hua Hospital



CASE 1

DEMOGRAPHICS

Name: T. T.

Age: 60

Sex: M

CLINICAL HISTORY AND PRESENTATION

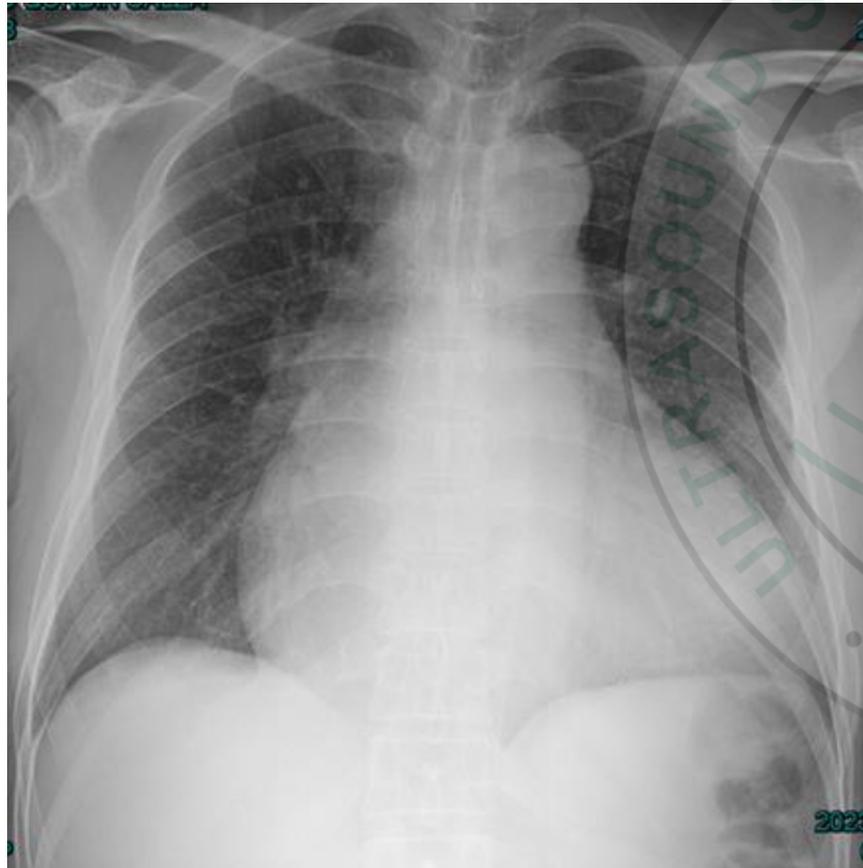
History of cardiomyopathy

Right upper quadrant pain

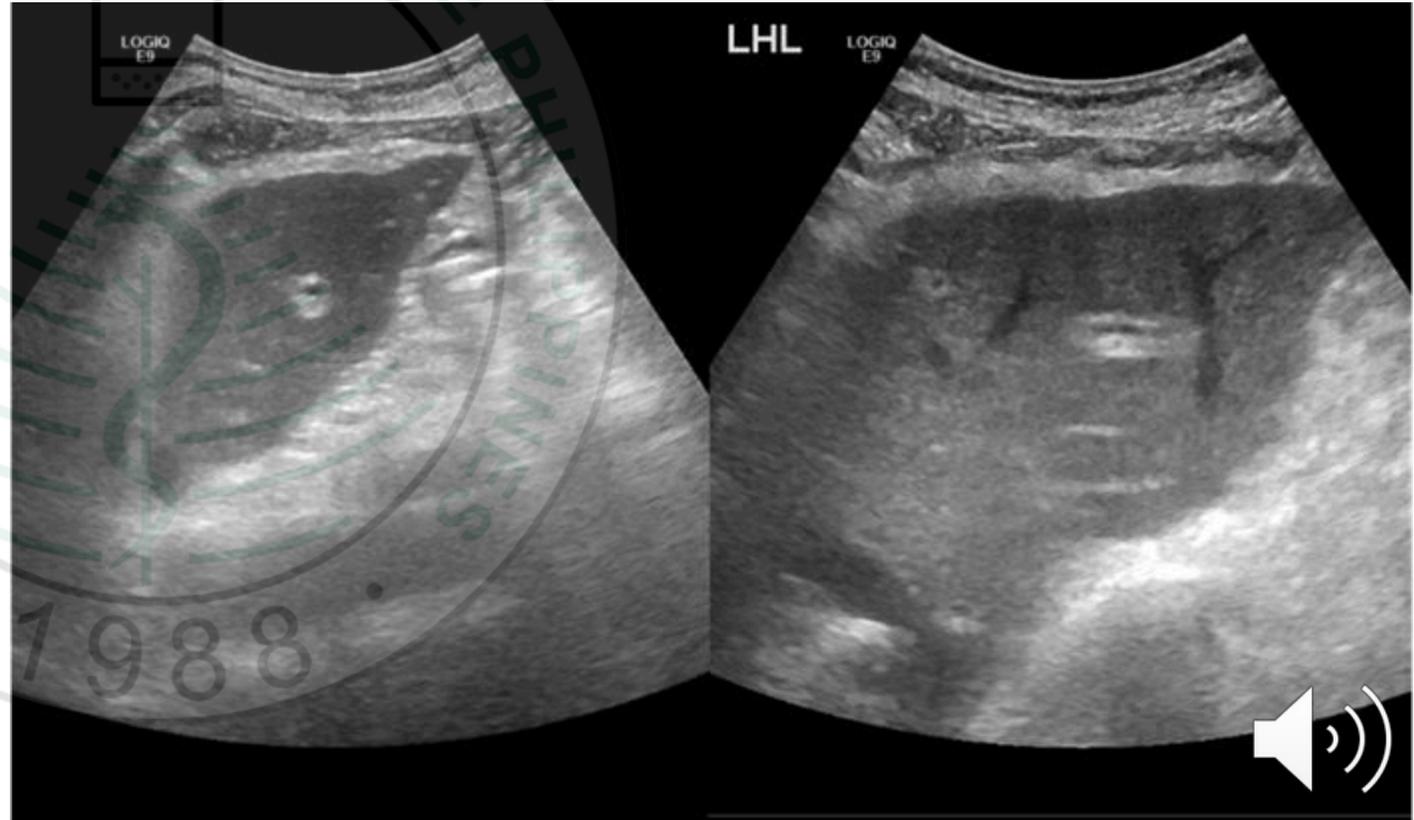


IMAGING FINDINGS:

- Cardiomegaly

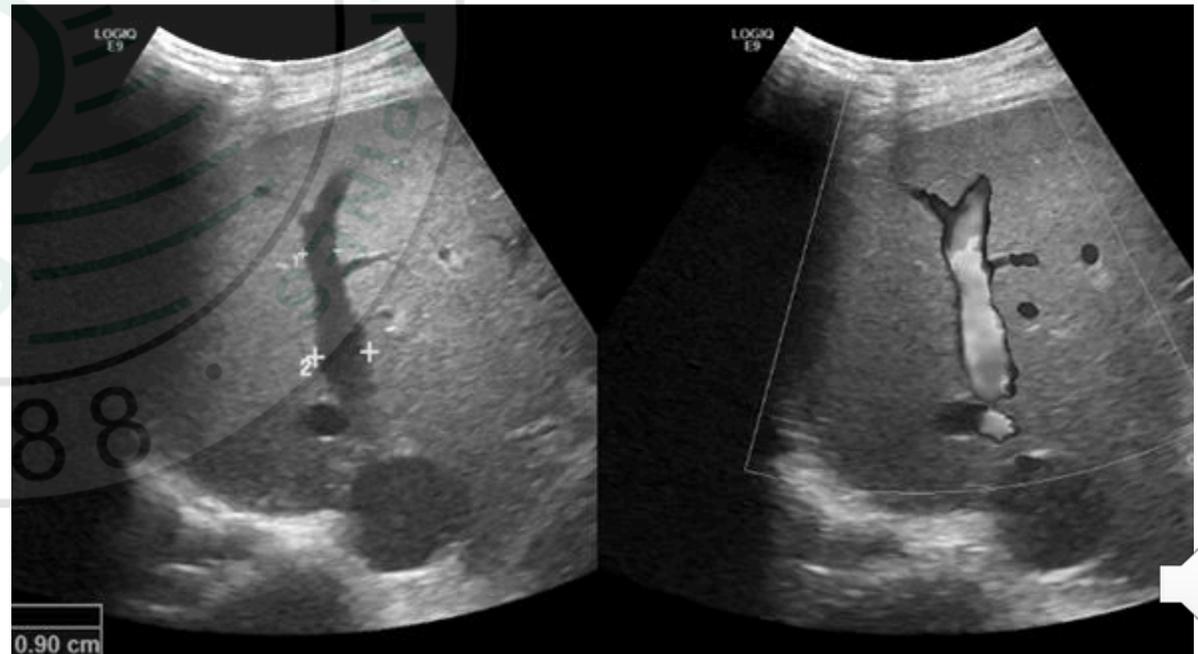
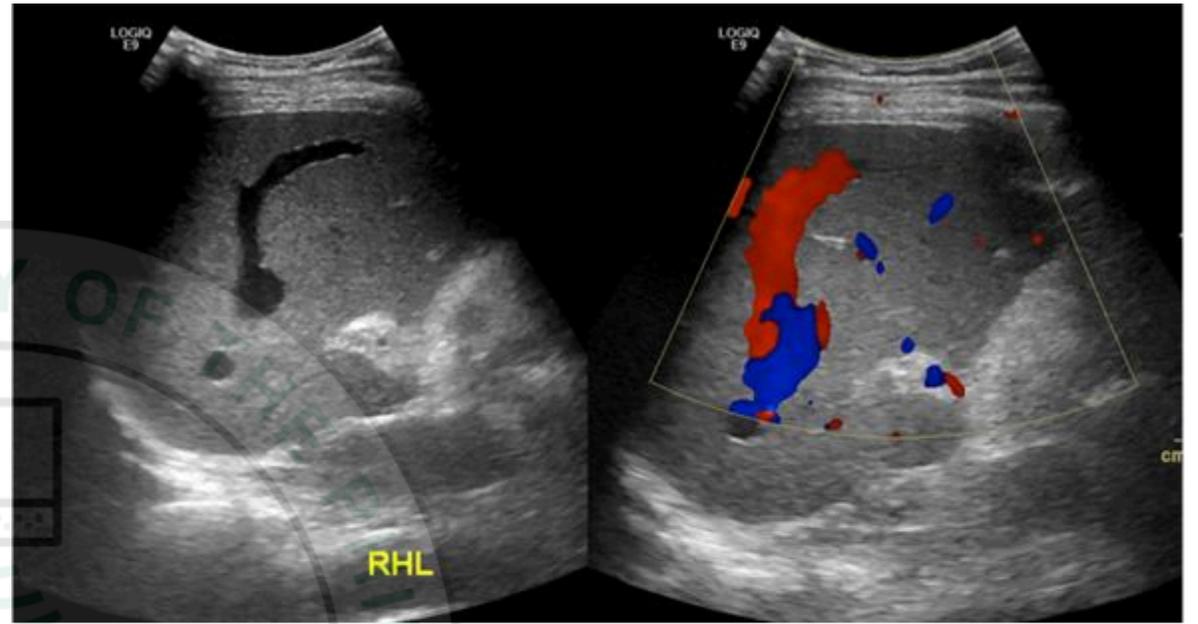


- Normal echopattern
- Irregular borders



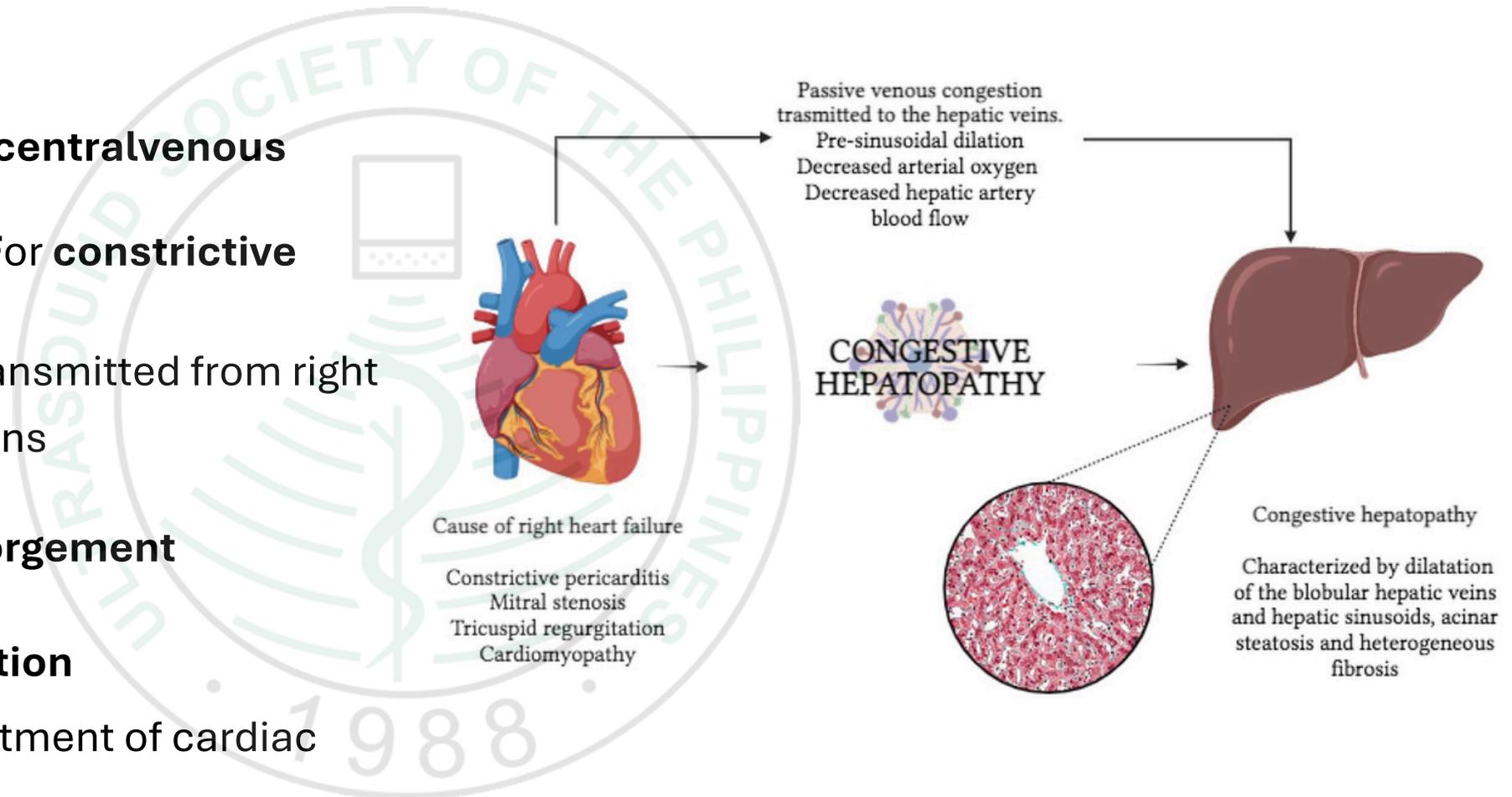
IMAGING FINDINGS:

- Dilated hepatic veins



PASSIVE HEPATIC CONGESTION

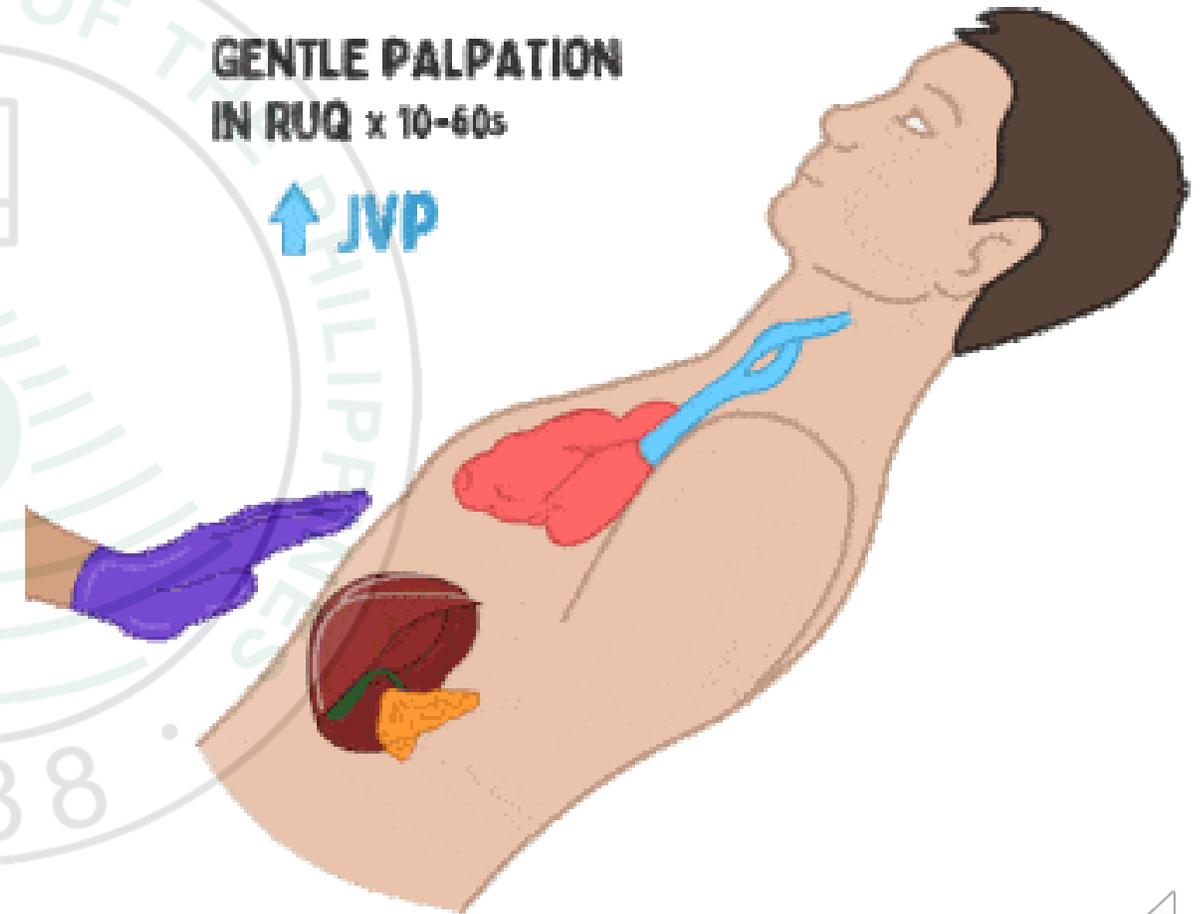
- Caused by elevated central venous pressure
 - Common in **CHF** or **constrictive pericarditis**
- Venous pressure transmitted from right atrium → hepatic veins
- Leads to:
 - **Sinusoidal engorgement**
 - **Hepatomegaly**
 - **Passive congestion**
- Reversible with treatment of cardiac condition
- Chronic cases → **Cardiac cirrhosis**



Clinical Findings

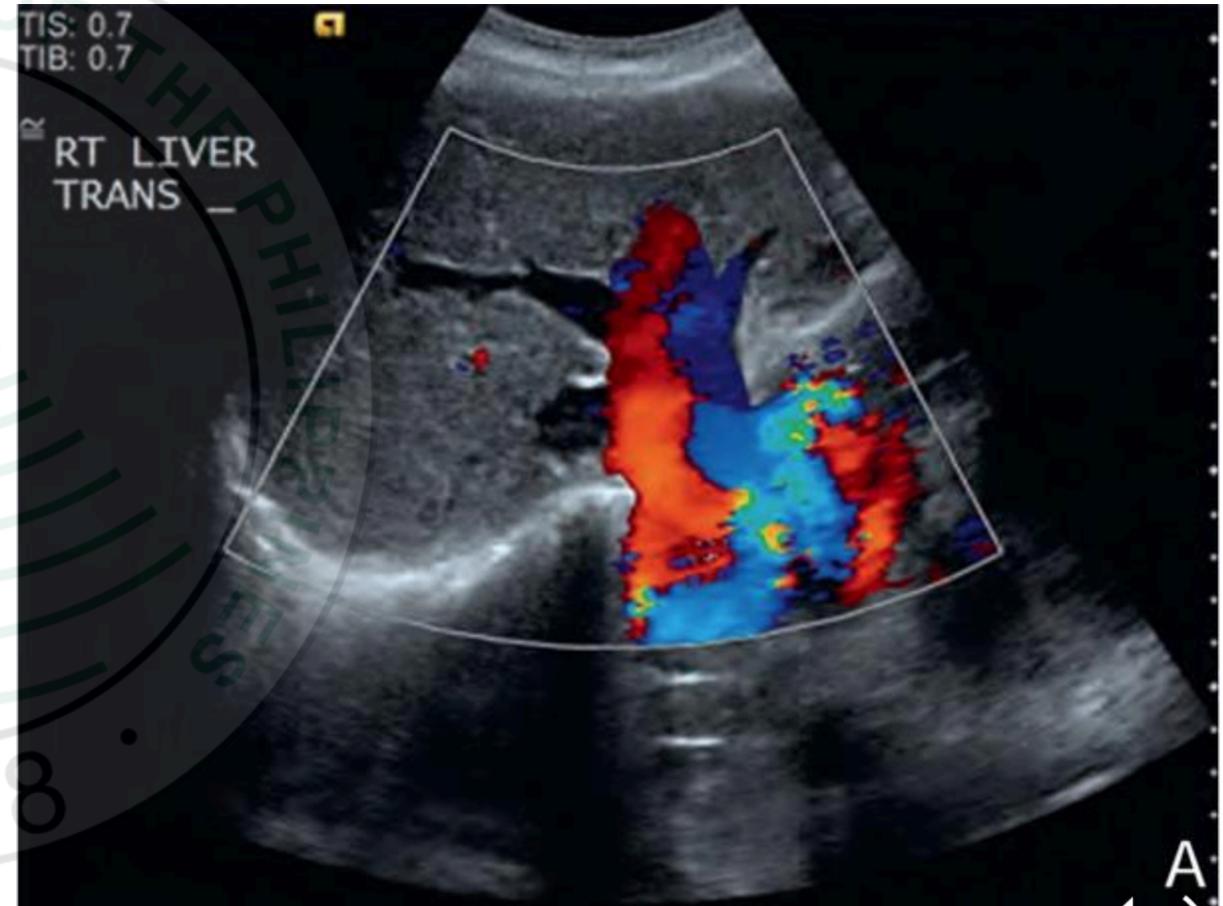
- **Acute congestion:**
 - Tender **hepatomegaly**
 - **RUQ pain** from stretching of Glisson's capsule
 - **Hepatojugular reflux**
- **Liver function:** often mildly abnormal
 - May mimic **acute hepatitis**
- In rare cardiomyopathies:
 - **Liver failure** may present **before** heart disease is diagnosed

HEPATOJUGULAR REFLUX

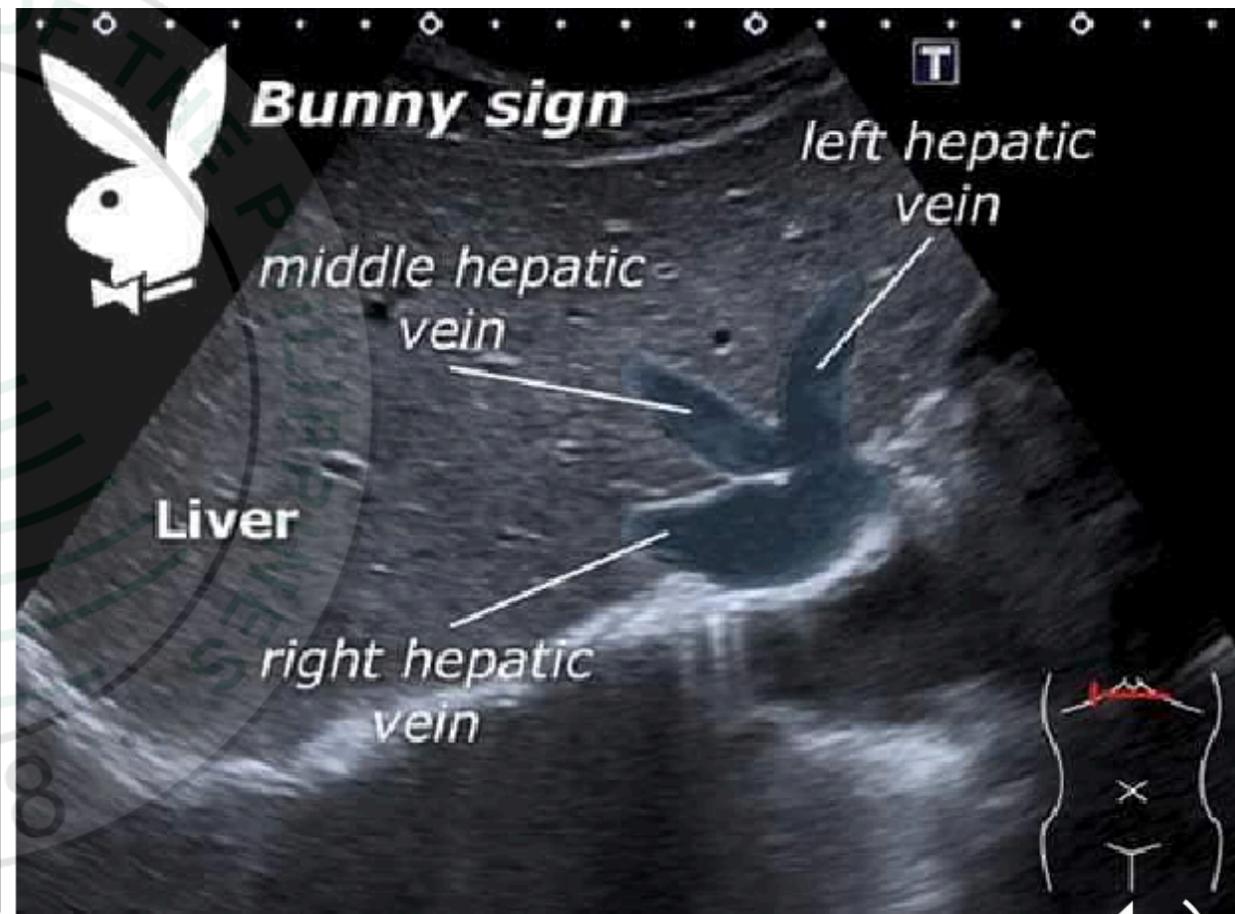
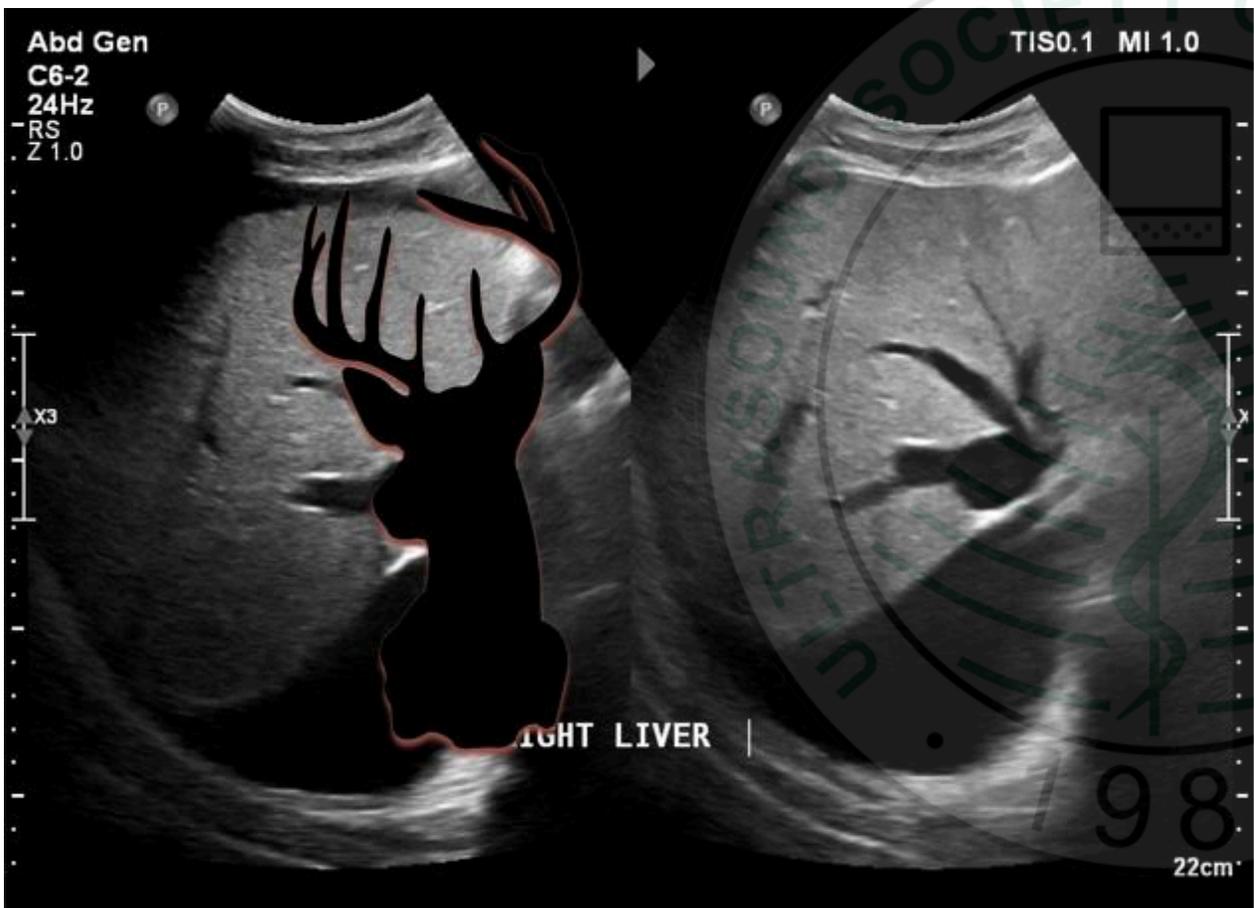


Sonographic Features

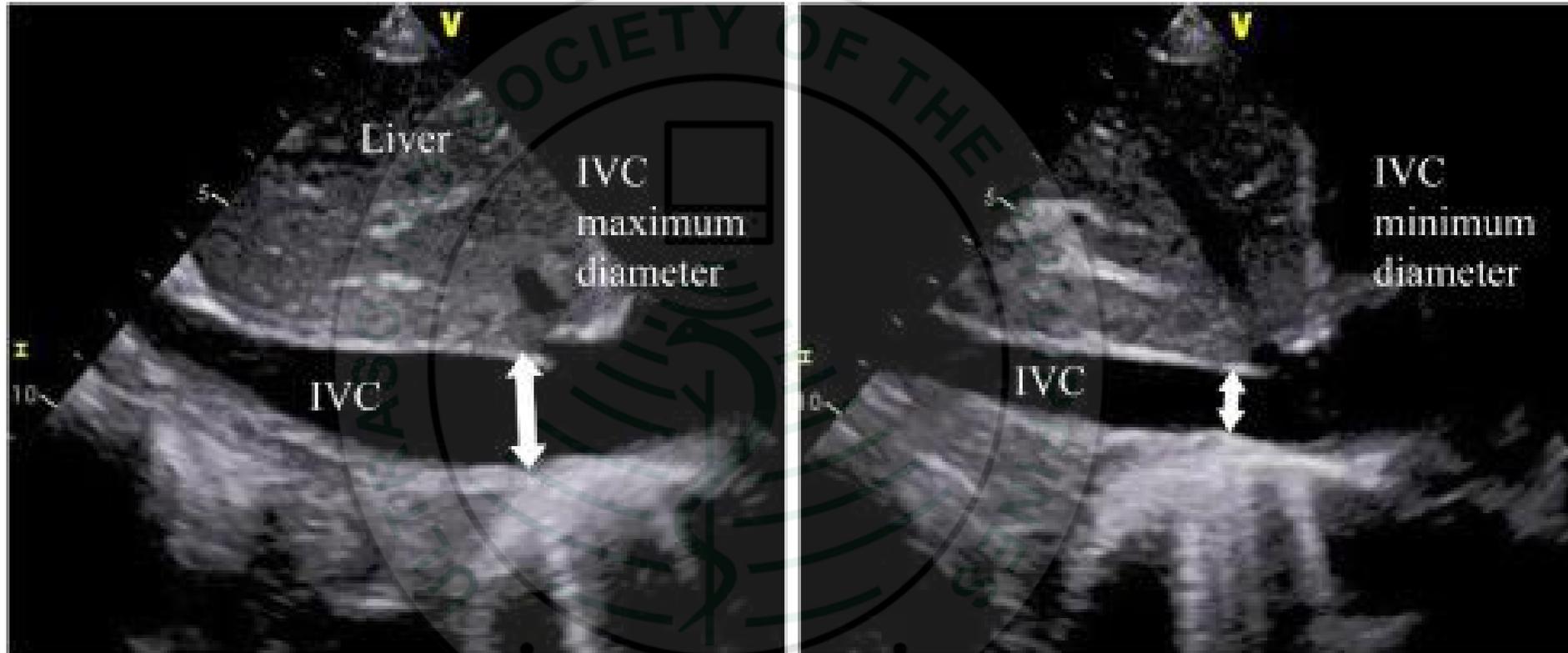
- **Hepatomegaly**
- **Dilated hepatic veins & IVC**
 - Normal RHV: 5.6–6.2 mm
 - CHF: ~8.8 mm
 - With pericardial effusion: ↑ to 13.3 mm



Sonographic Features



Sonographic Features



End-expiratory period

After brief sniff

- **Loss of respiratory variation** in IVC/hepatic vein calibers

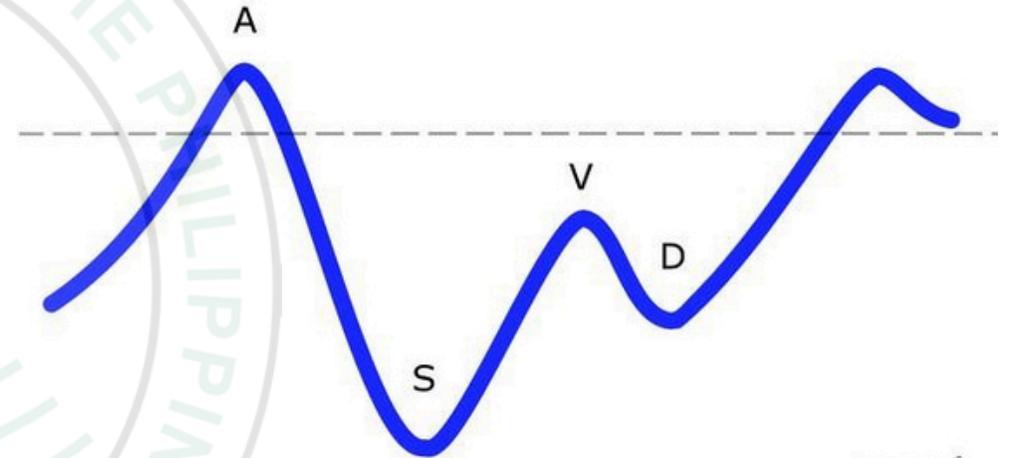


DOPPLER WAVE

- **S wave**–Forward flow in systole
- **V trough**–Small dip after S wave
- **D wave**–Forward flow in early

diastole

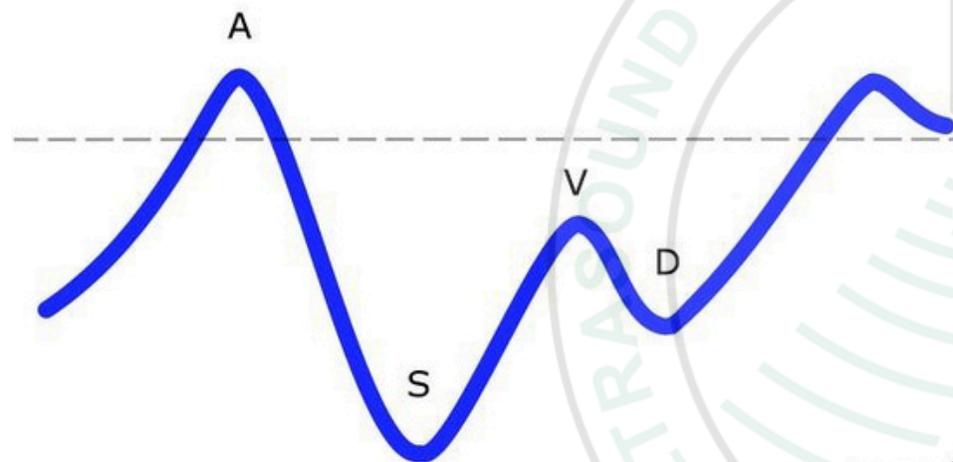
- **A wave**–Flow reversal with atrial contraction



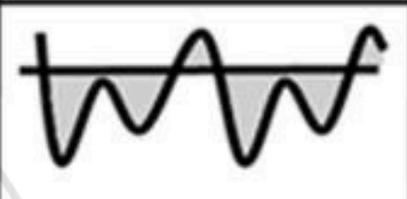
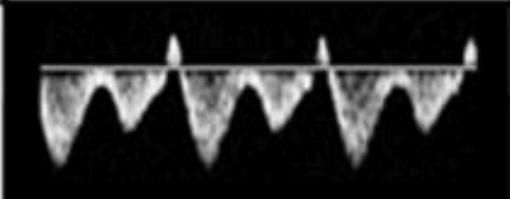
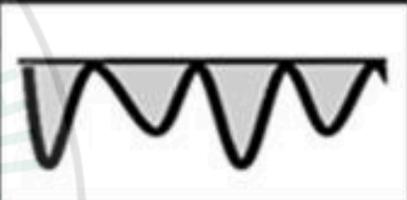
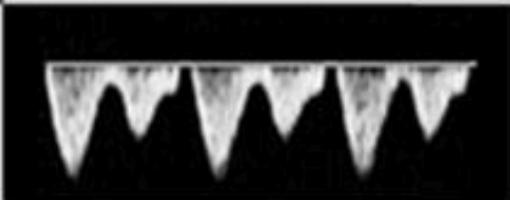
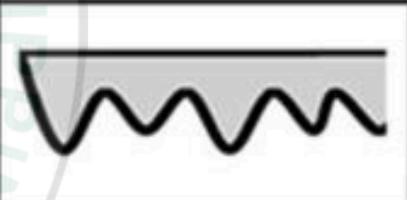
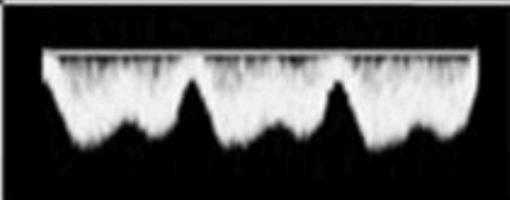
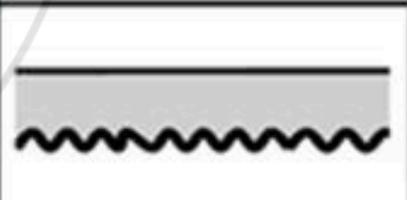
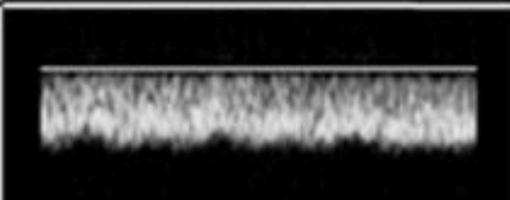
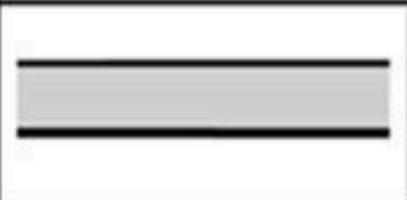

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DOPPLER WAVE



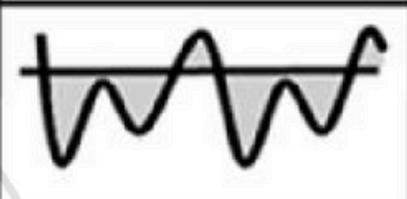
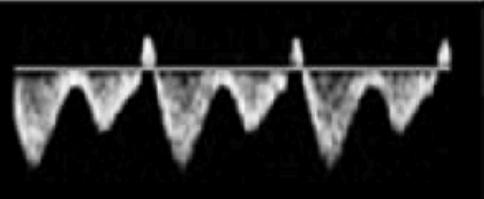
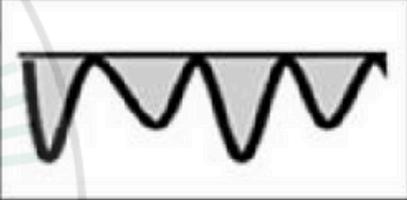
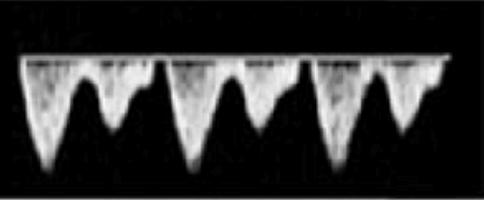
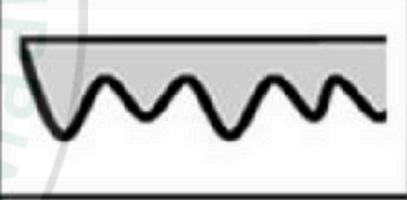
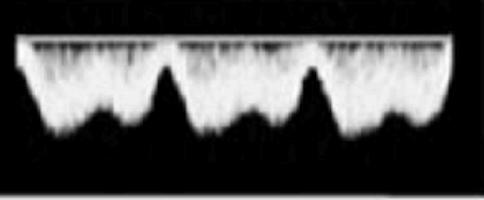
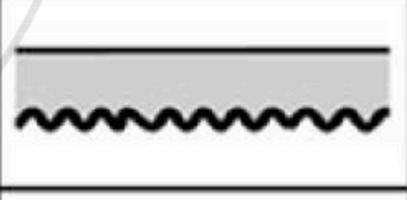
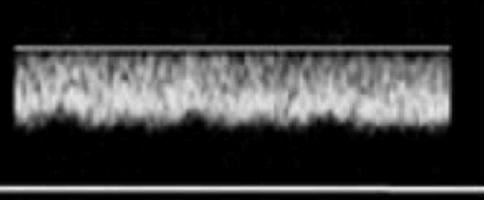
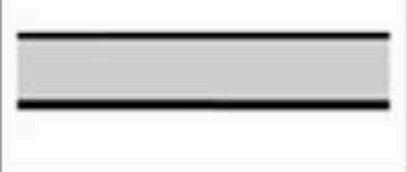

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Type	Schematic drawing	Doppler HV Waveform
Triphasic		
Biphasic		
		
Monophasic		
		



Sonographic Features

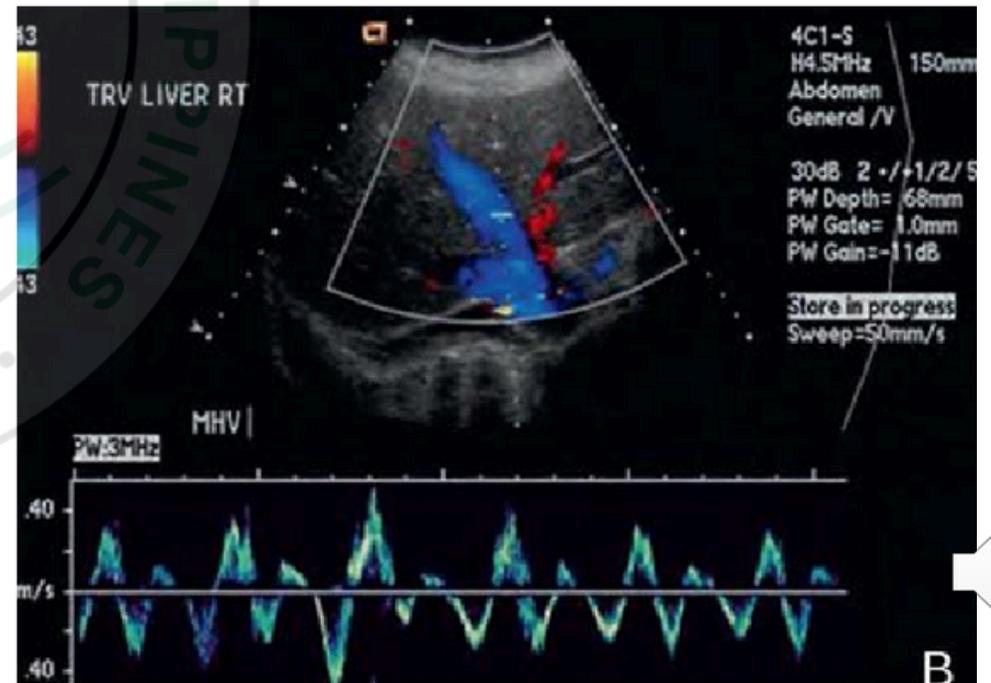
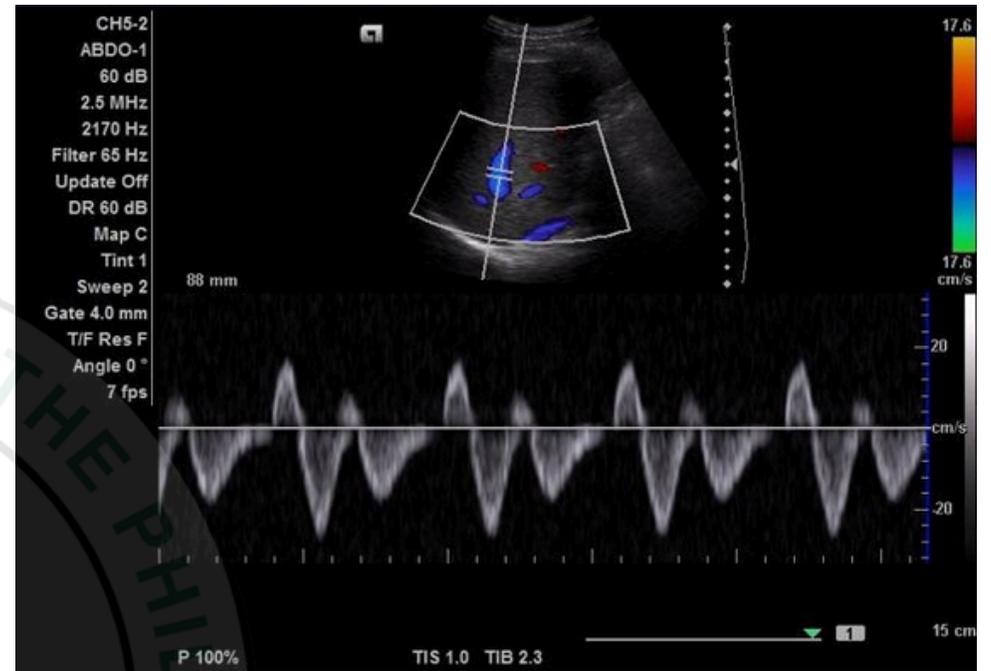
- **Hepatic veins:**
 - Normal: **triphasic** waveform
 - In congestion: **biphasic** or **monophasic**
 - M-shaped or continuous low-velocity flow
- **Portal vein:**
 - Increased **pulsatility**
 - May show **flow reversal** during **systole**
- **Tricuspid regurgitation:**
 - ↓ antegrade systolic wave
 - **S/D velocity ratio < 0.6** (normal > 4.0)

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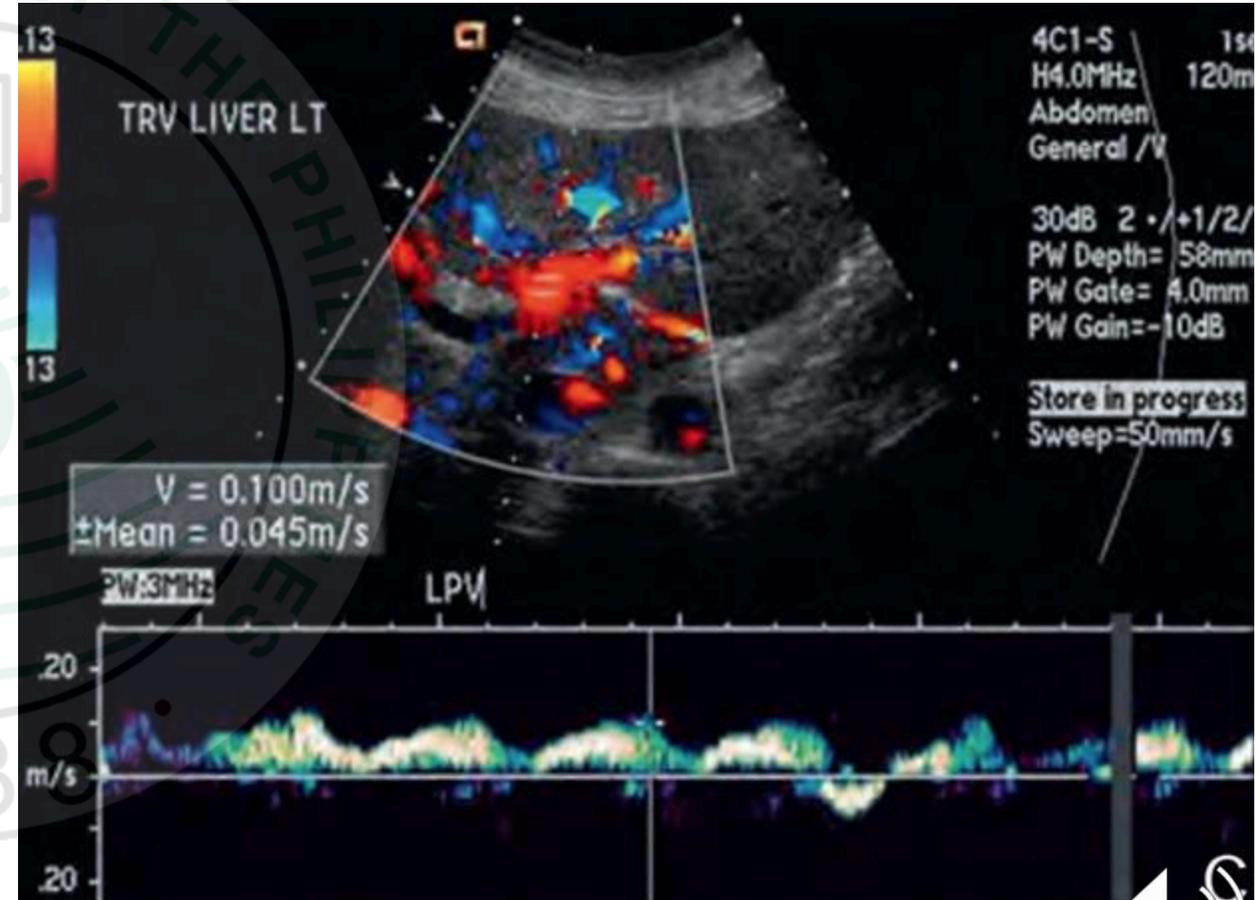
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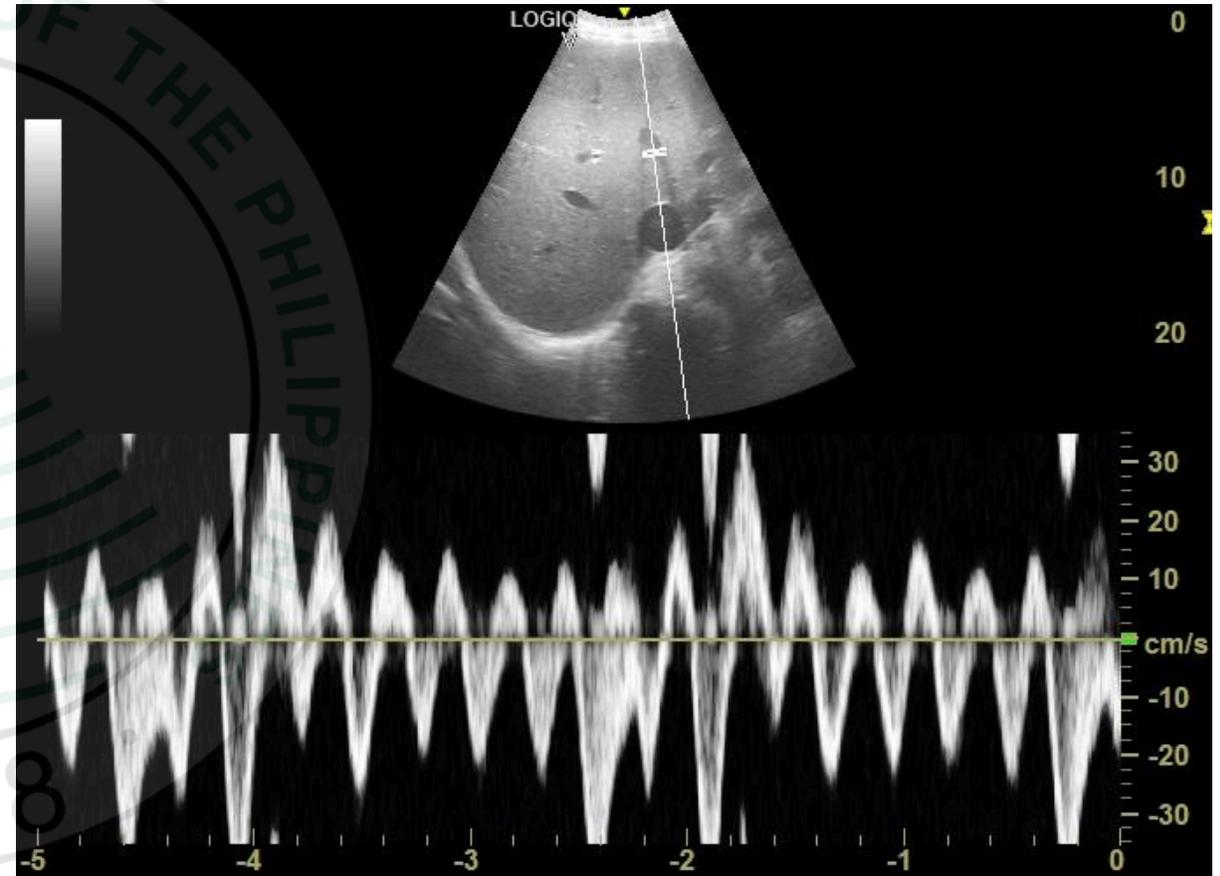
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- **Portal vein:**
 - Increased **pulsatility**
 - May show **flow reversal** during **systole**
- **Tricuspid regurgitation:**
 - ↓ antegrade systolic wave
 - **S/D velocity ratio** < 0.6 (normal > 4.0)



CASE 2

DEMOGRAPHICS

Name: A.L.

Age: 41

Sex: F

CLINICAL HISTORY AND PRESENTATION

Abdominal Pain

Jaundice



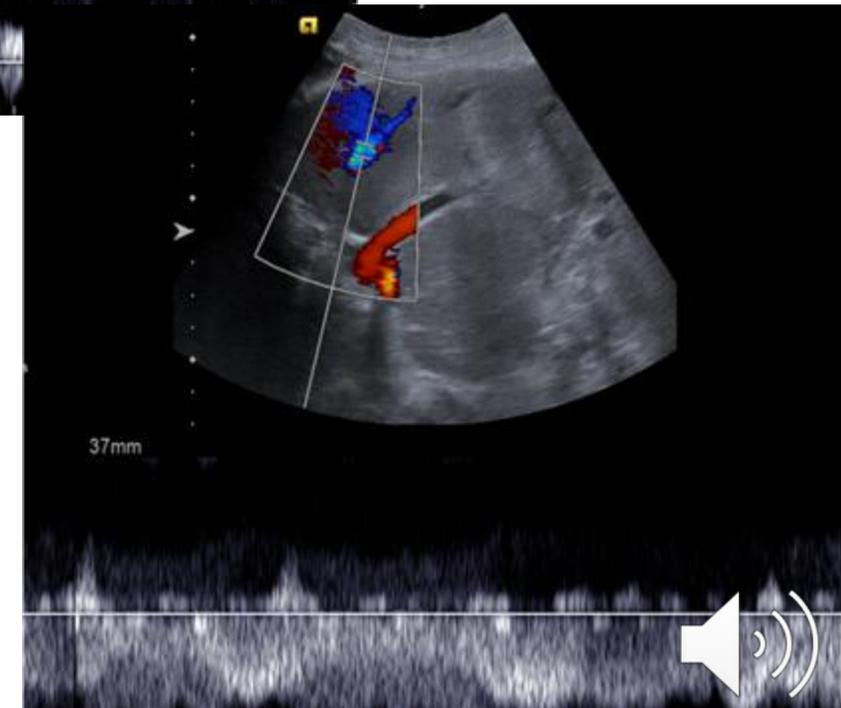
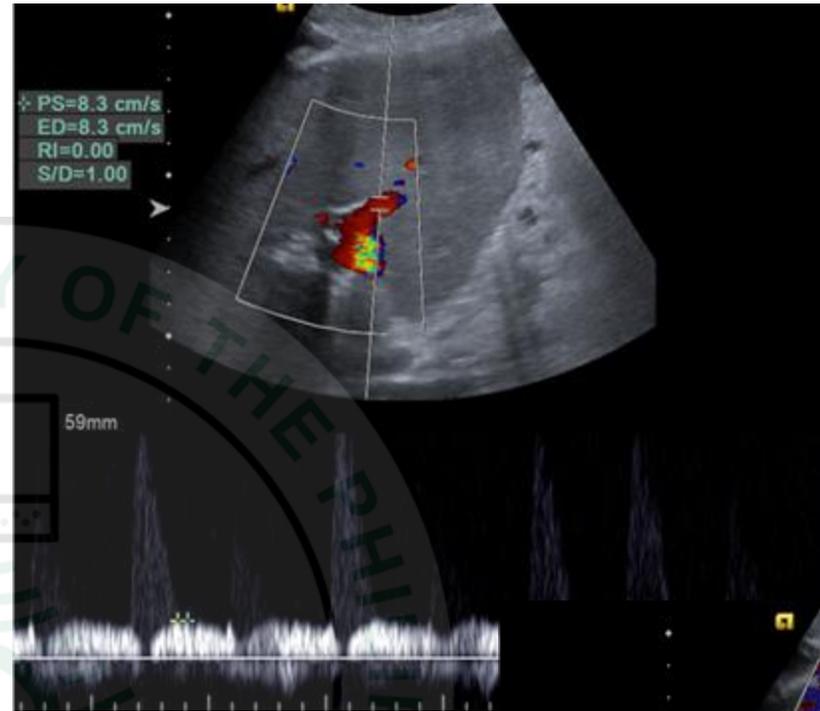
IMAGING FINDINGS:

- Hepatomegaly
- Inhomogenous parenchyma
- Nodular borders



IMAGING FINDINGS:

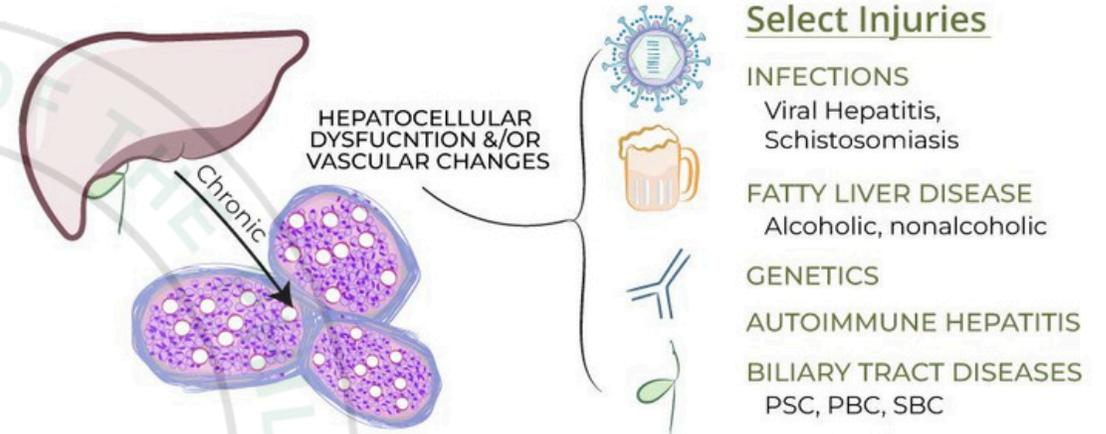
- Left portal vein
 - Prominent = 0.8cm
 - Low, monophasic waveform
 - Low forward flow
(peak systolic velocity of 8.3cm/s)
- Main hepatic artery
 - Dilated = 1.09cm
 - Good forward flow with restrictive spectral waveform
 - Peak systolic velocity = 77.0cm/sec
 - Peak diastolic velocity = 12.2cm/sec



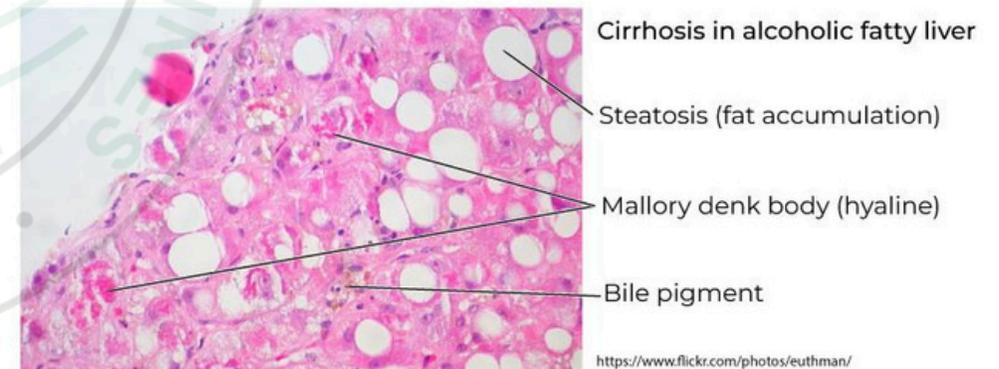
LIVER CIRRHOSIS

- **Definition:** Diffuse liver disease with fibrosis + abnormal nodules
- **Pathophysiology:** Cell death → Fibrosis → Regeneration
- **Types:**
 - Micronodular (<1 cm) –Alcohol
 - Macronodular (>1 cm) –Viral hepatitis
- **Other Causes:** PBC, PSC, Wilson disease, Hemochromatosis

Liver Disease



CIRRHOSIS = Fibrosis + Regenerative nodules w/fatty changes.
PORTAL HYPERTENSION = Increased hepatic BP.

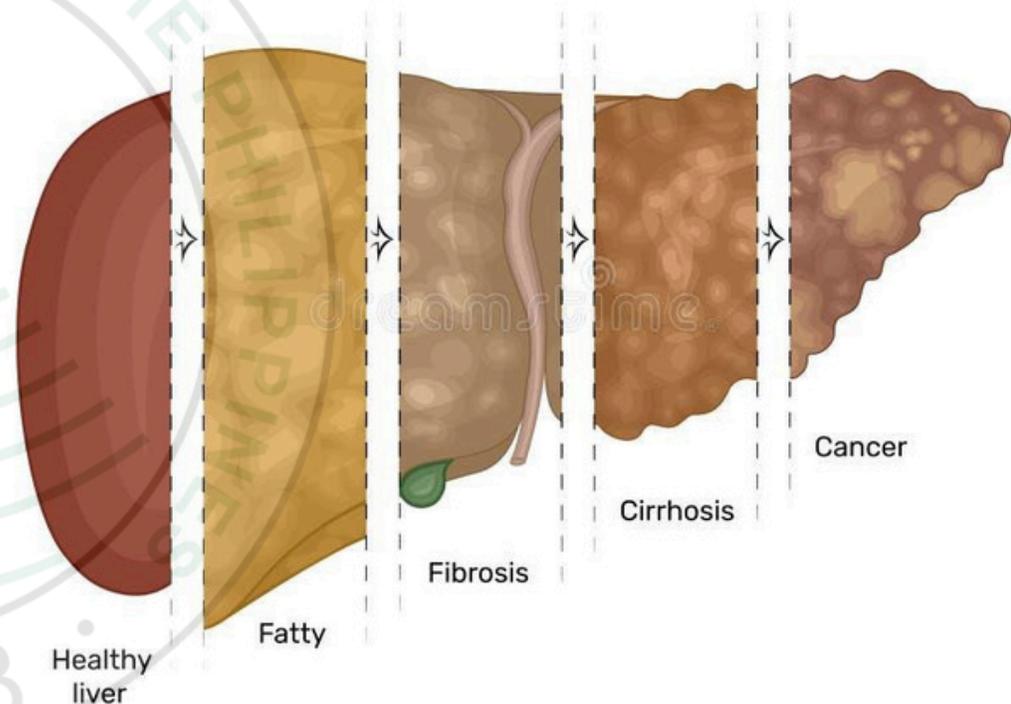


Clinical Features

- **Classic triad:** Hepatomegaly, Jaundice, Ascites
- Asymptomatic in ~40%
- **Complications:**
 - **Portal hypertension:** Ascites, Splenomegaly, Varices
 - **Liver failure:** Encephalopathy, Coagulopathy,
 - Hypoalbuminemia
 - **HCC risk:** Requires ultrasound

surveillance every 6 months

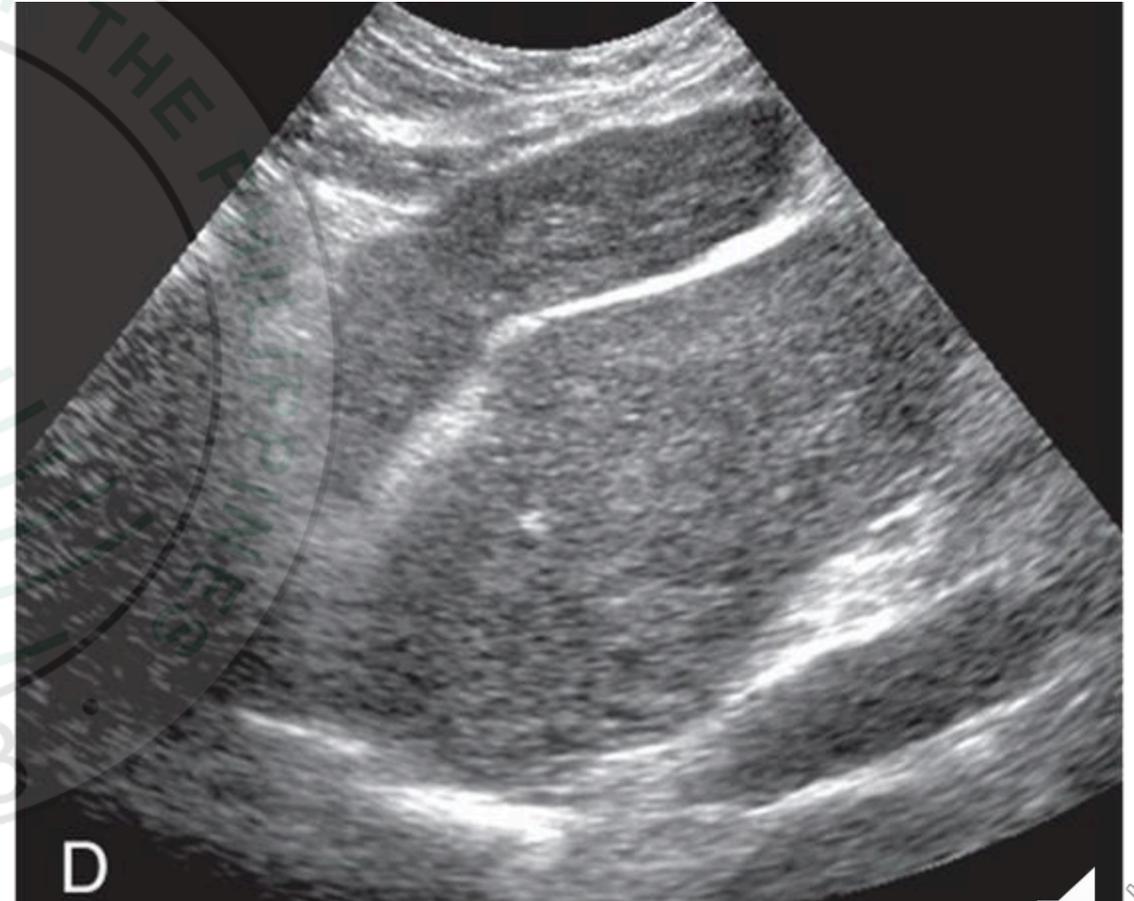
Stages of liver damage



Sonographic Features

VOLUME REDISTRIBUTION

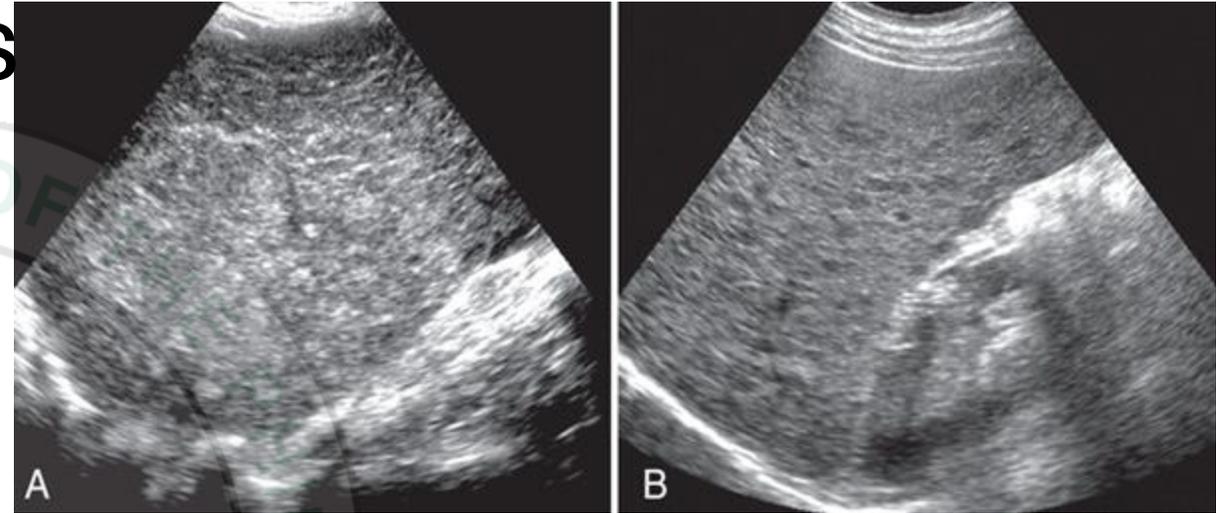
- **Volume Redistribution:** ↑
Caudate/left lobes, ↓ Right lobe
 - **C/RL ratio >0.65** = Specific for cirrhosis
- **Liver Parenchyma:**
 - Coarse echotexture
 - Nodular surface
- **Nodules:**
 - Regenerative: Iso/hypoechoic, rimmed
 - Dysplastic (>10 mm): Premalignant
- **Portal hypertension:**
 - Ascites, splenomegaly and varices



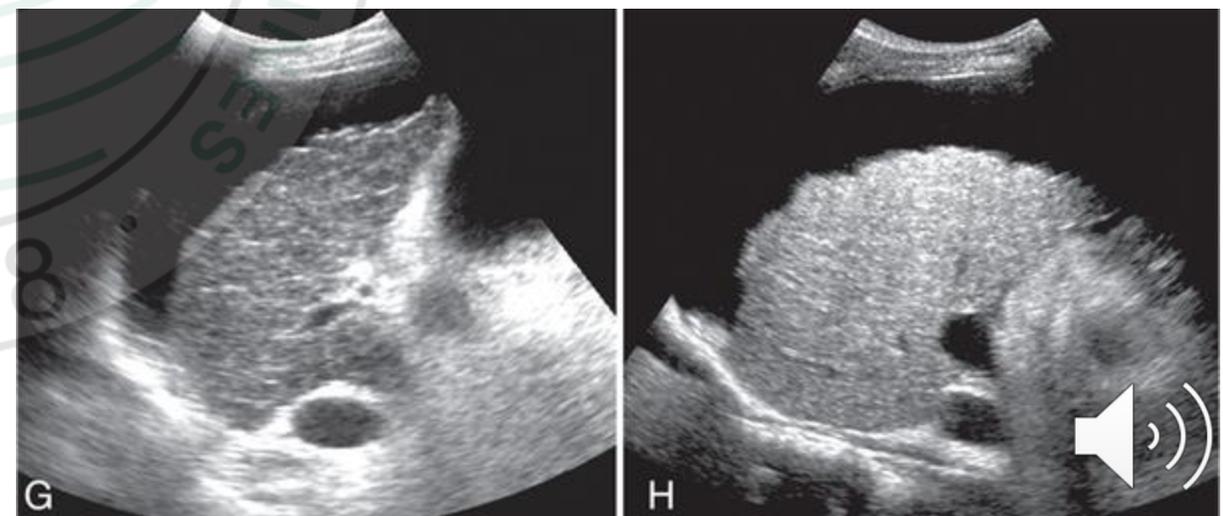
COARSE ECHOTEXTURE

Sonographic Features

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NODULAR SURFACE

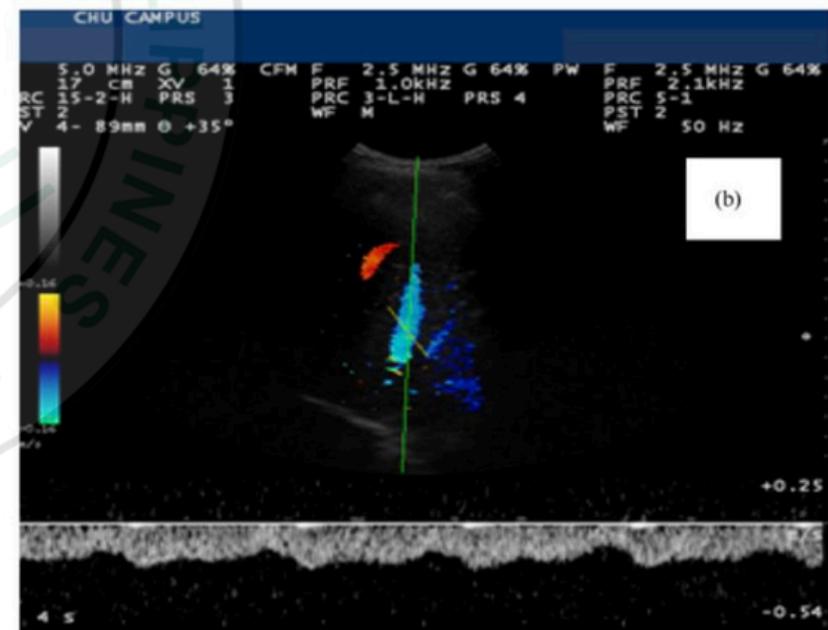


• Doppler US:

- Hepatic veins: Flattened or dampened waveform
- Hepatic artery: Elevated RI; Blunted postprandial RI change

• Elastography:

- Measures stiffness (SWE, ARFI)
- Expressed as shear wave speed (m/s) or kPa
- Reliable if IQR/median <15% (m/s) or <30% (kPa)
- Cannot directly report METAVIR stage—detects fibrosis likelihood

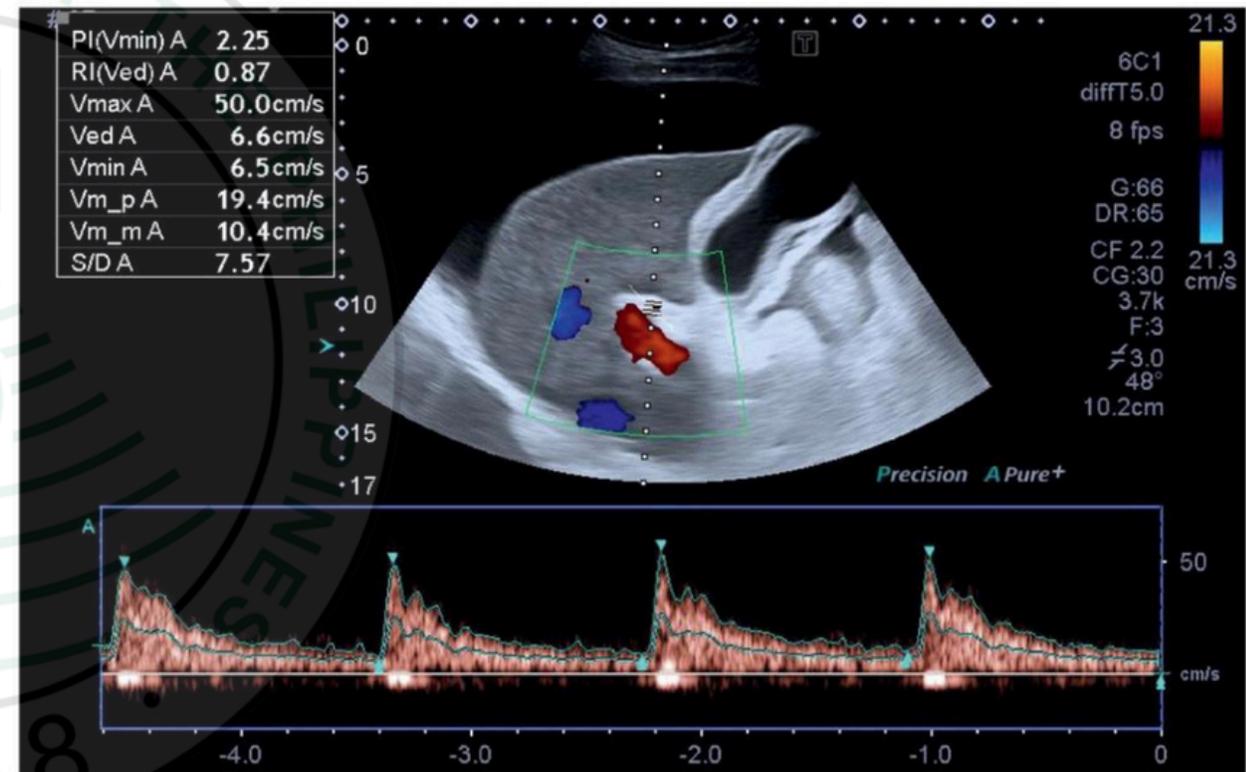


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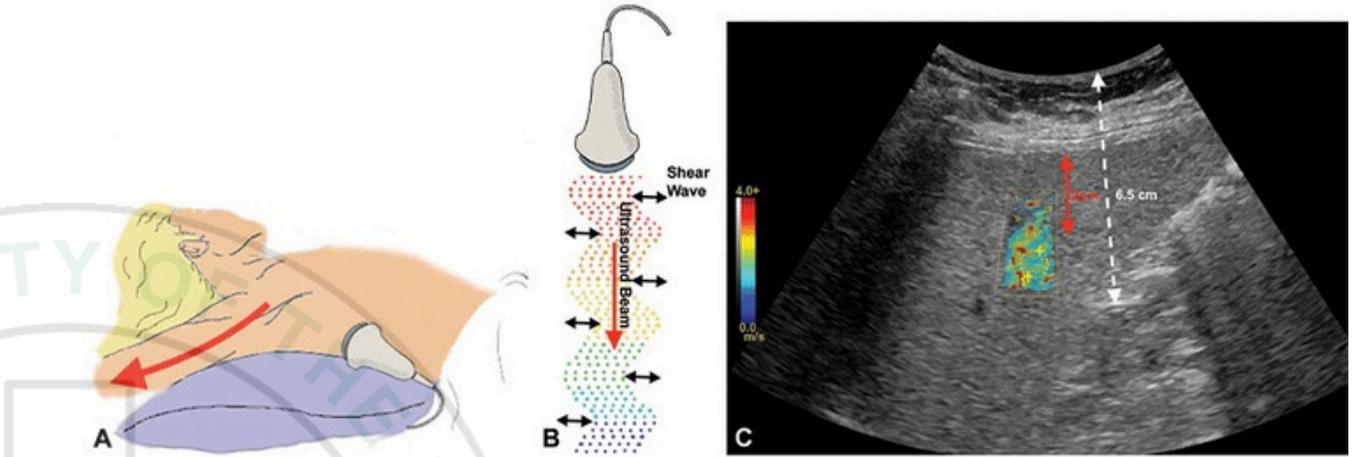


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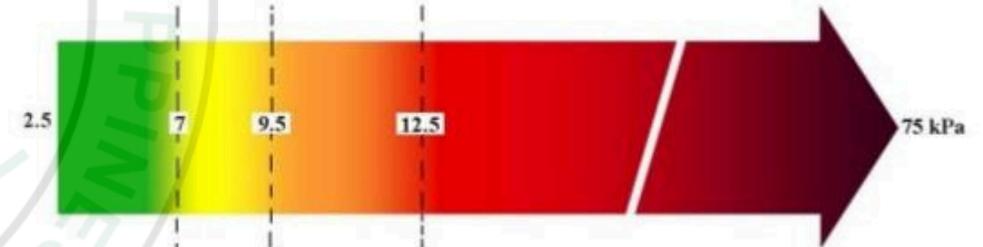
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Liver stiffness cut-offs in chronic liver diseases



Metavir	F0-F1	F2	F3	F4
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Fibrosis	Mild	Sign	Severe	Cirrhosis
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CASE 3

DEMOGRAPHICS

Name: S.P.

Age: 55

Sex: Male

CLINICAL HISTORY AND PRESENTATION

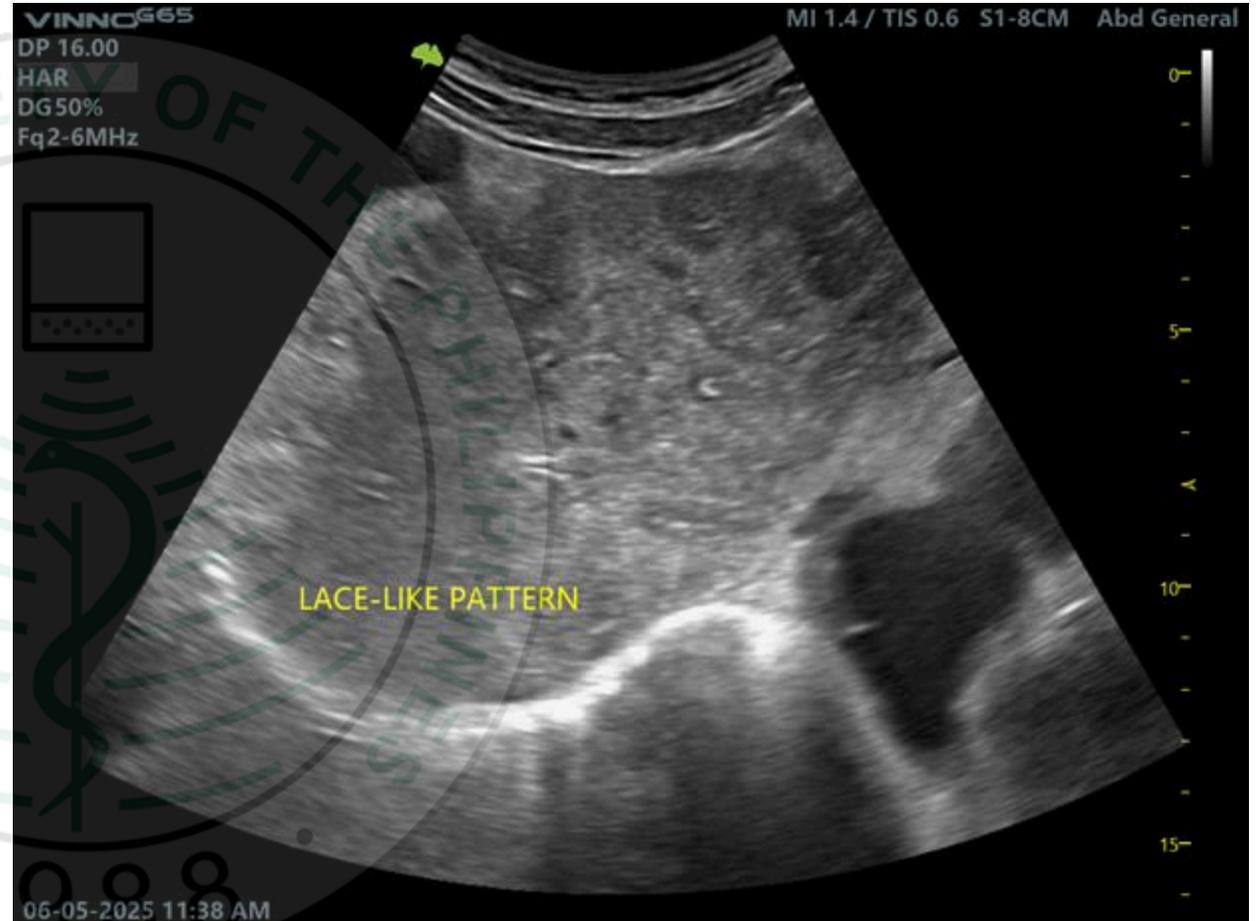
Abdominal pain

Fever and Lethargy



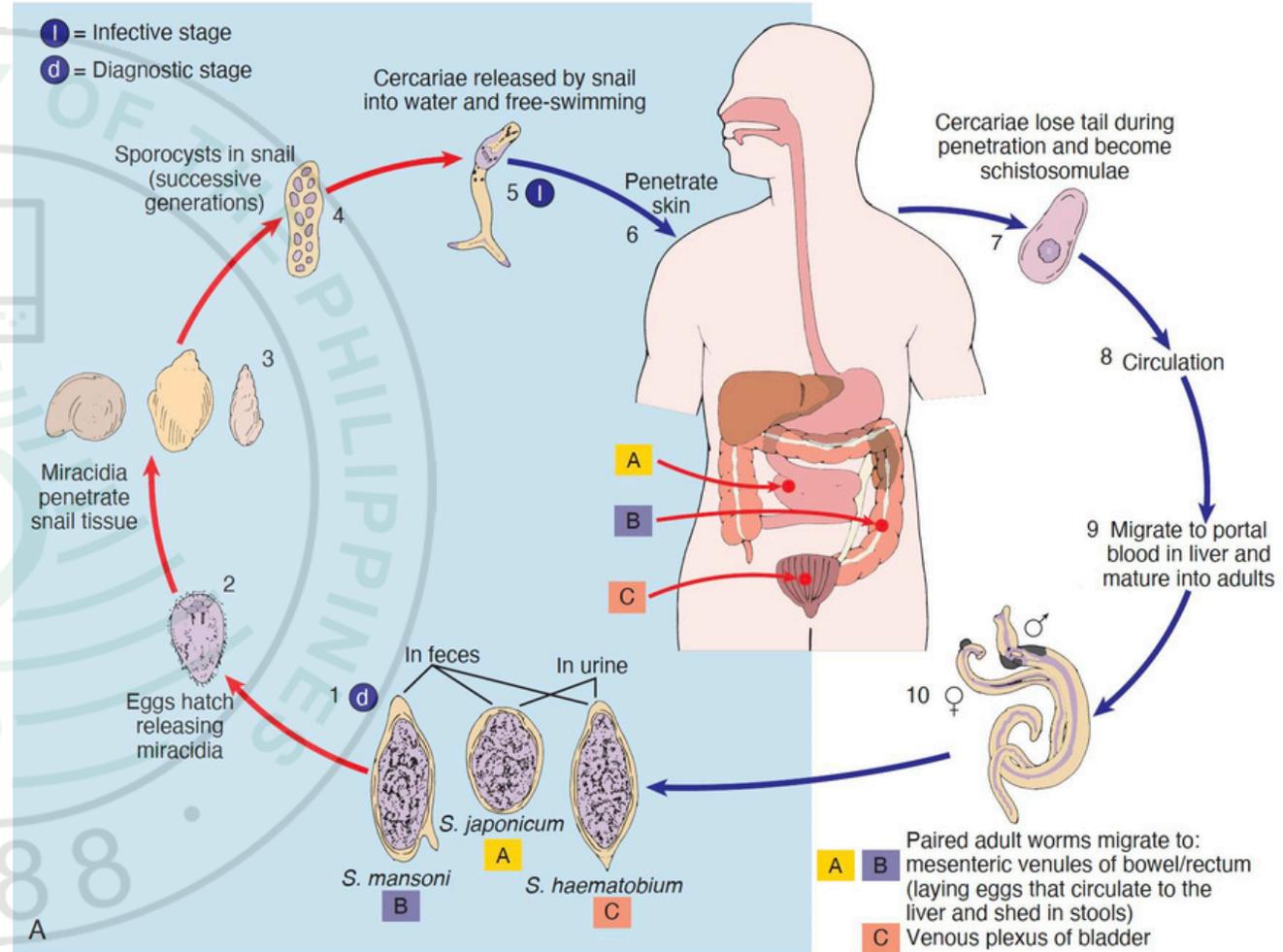
IMAGING FINDINGS:

- Heterogenous lace-like echopattern of the hepatic parenchyma
- Septa and capsular calcifications.



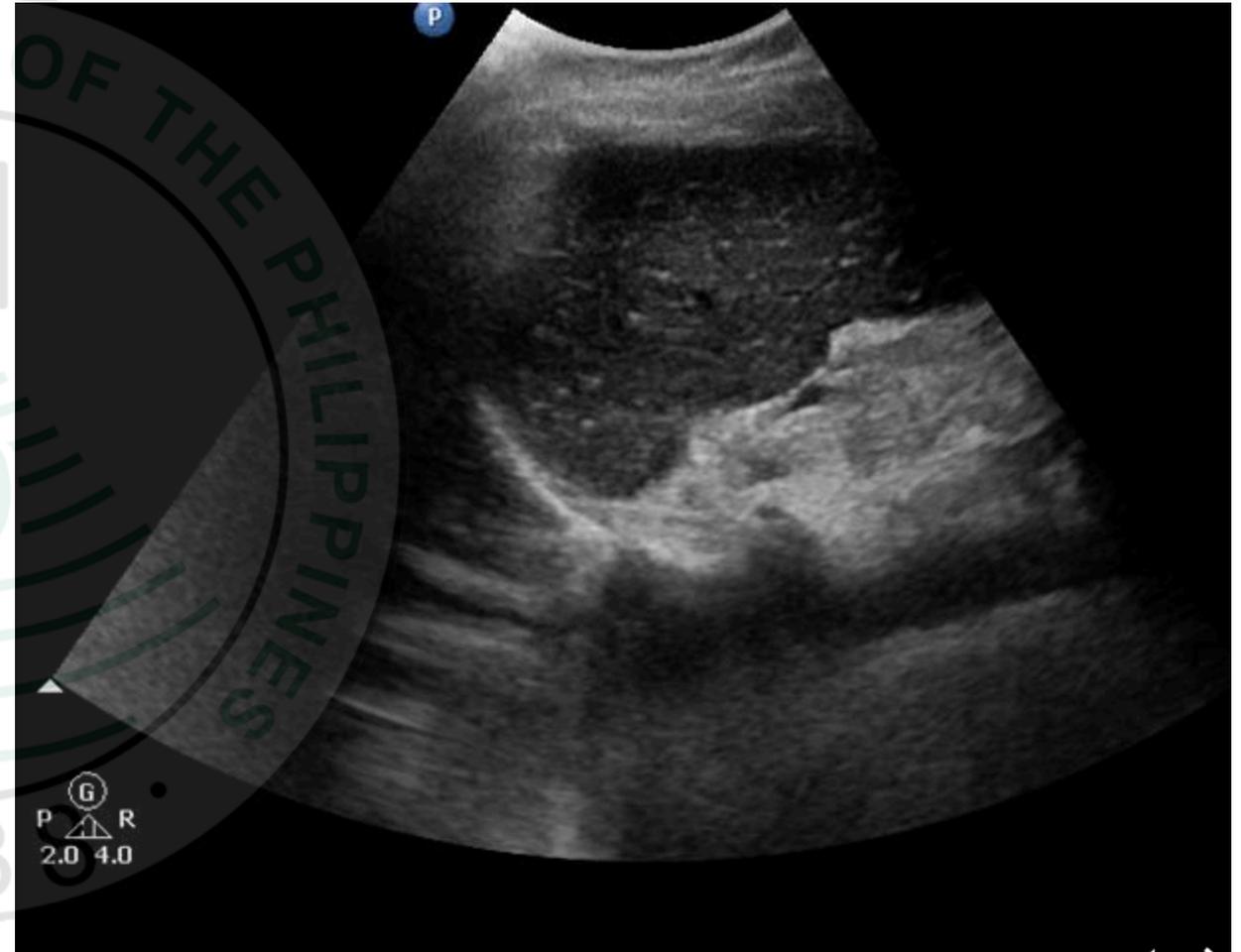
SCHISTOSOMIASIS

- ~200 million people affected worldwide
- Caused by **Schistosoma** species:
 - *S. mansoni* (severe hepatic involvement)
 - *S. japonicum*, *S. mekongi*, *S. intercalatum*
- **Endemic regions:**
 - *S. mansoni*: Africa (esp. Egypt), South America (Brazil, Venezuela)
- **Pathophysiology:**
 - Ova reach liver via portal vein
 - Cause granulomatous inflammation → fibrosis
 - Described as "**clay-pipe stem fibrosis**" (Symmers, 1904)



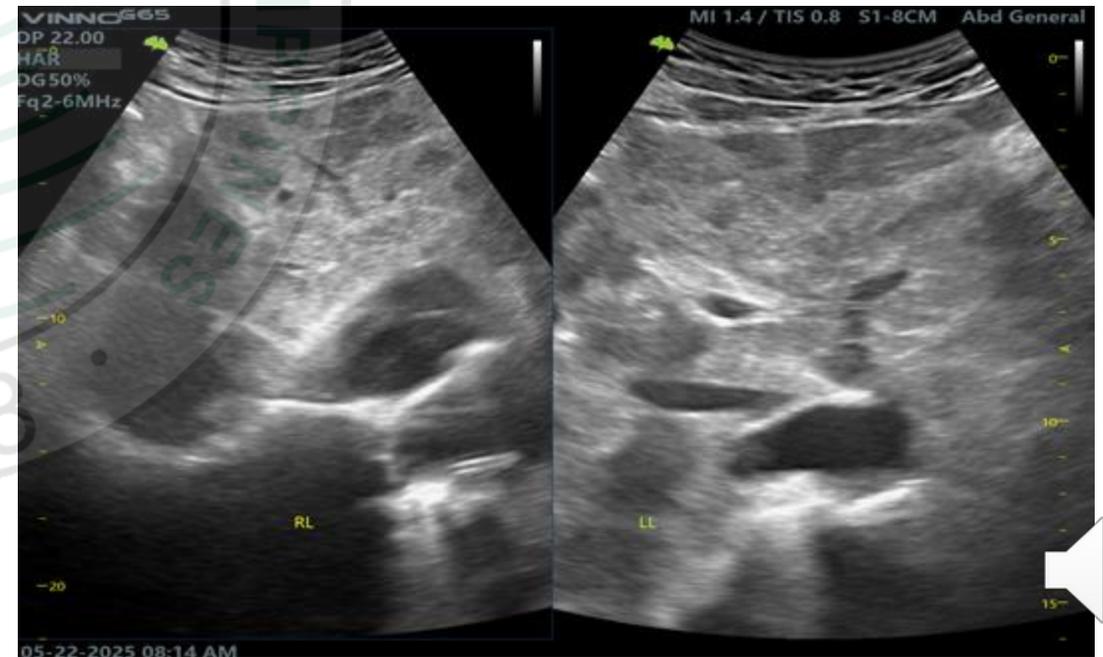
Clinical Features

- **Fibrosis of terminal portal veins leads to:**
 - **Presinusoidal portal hypertension**
 - **Splenomegaly**
- **Liver size changes:**
 - **Early: Hepatomegaly**
 - **Late: Contracted fibrotic liver**



Sonographic Features

- **Widened echogenic portal tracts**
 - May reach up to **2 cm** in thickness
 - Most pronounced at the **porta hepatis**
- **Advanced signs:**
 - **Contracted liver**
 - **Signs of portal hypertension** on imaging



CASE 4

DEMOGRAPHICS

Name: C. Y.

Age: 70

Sex: M

CLINICAL HISTORY AND PRESENTATION

Jaundice

Chronic diarrhea and vague
abdominal pain

Weight loss



IMAGING FINDINGS:

PANCREAS

Head: 5.2 cm

Body: 3.1 cm

Tail: 2.7 cm

- Diffusely enlarged pancreas
- Heterogeneous echotexture.
- No focal lesion or adjacent fluid collection.

Pancreatic duct is

obliterated



IMAGING FINDINGS: COMMON BILE DUCT:

1.0 cm

- Dilatation of the CBD measuring 1.0 cm in its widest transverse diameter.
- Intrahepatic ducts are not dilated.
- Portal vein is normal in diameter.



JAUNDICE

- most common presenting symptom

PERIAMPULLARY TUMORS

- **2/3 Pancreatic ductal adenocarcinoma**
- 15-25% Ampullary carcinoma
- 10% Duodenal carcinoma
- 10% Distal cholangiocarcinoma



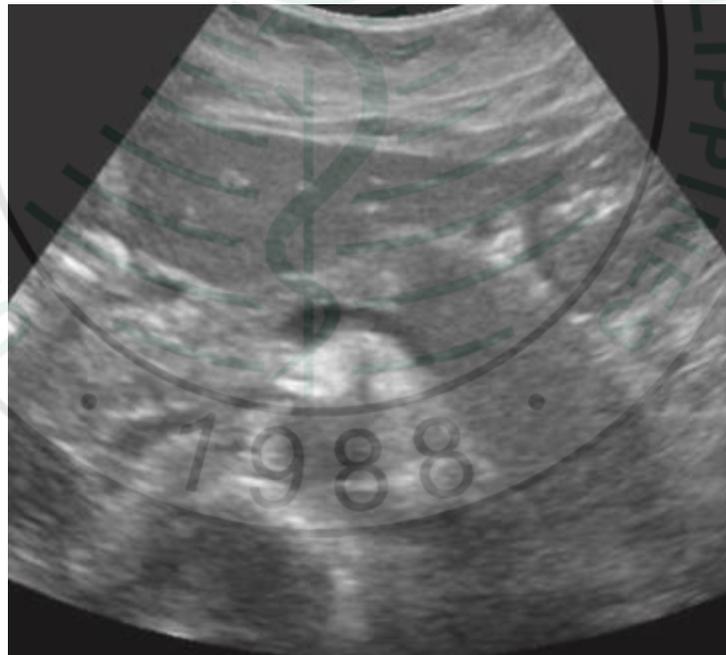
Sonographic Features

- **Localizations:**

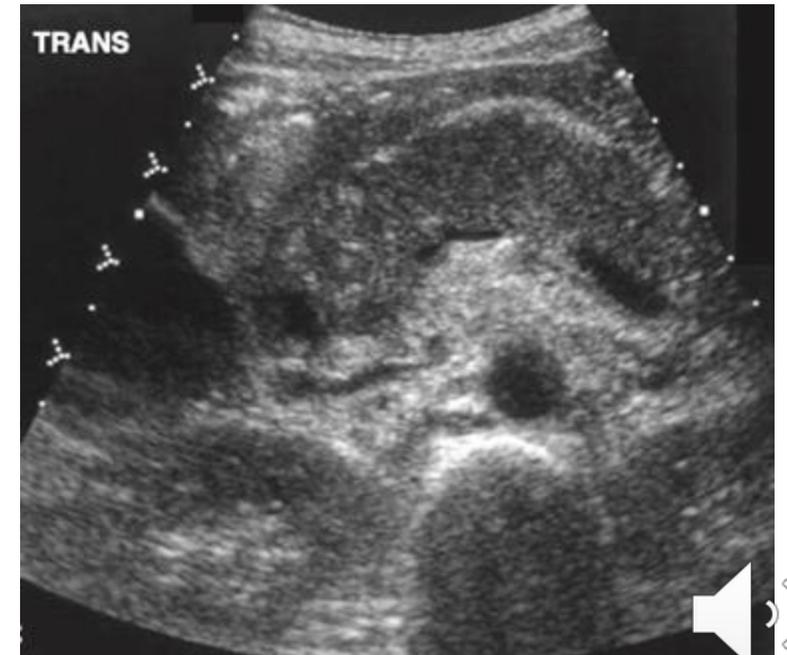
Head (70%)



Body and Tail (25-35%)



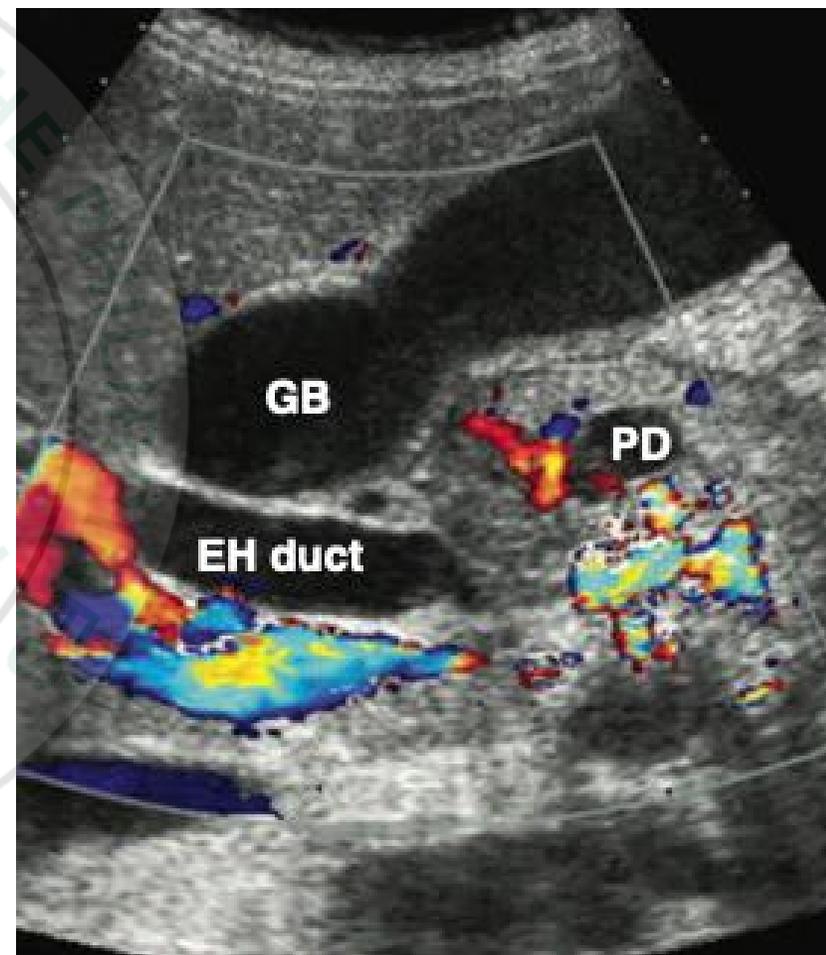
Diffuse (5%)



Sonographic Features

- **Locations:** Head (70%), body/tail (25–35%), diffuse (5%)
- **Double duct sign:** Dilated bile and pancreatic ducts
- **Sonographic features:**
 - Hypoechoic/heterogeneous mass
 - Gland atrophy or pseudocyst
 - Poor internal flow on Doppler

DOUBLE DUCT SIGN



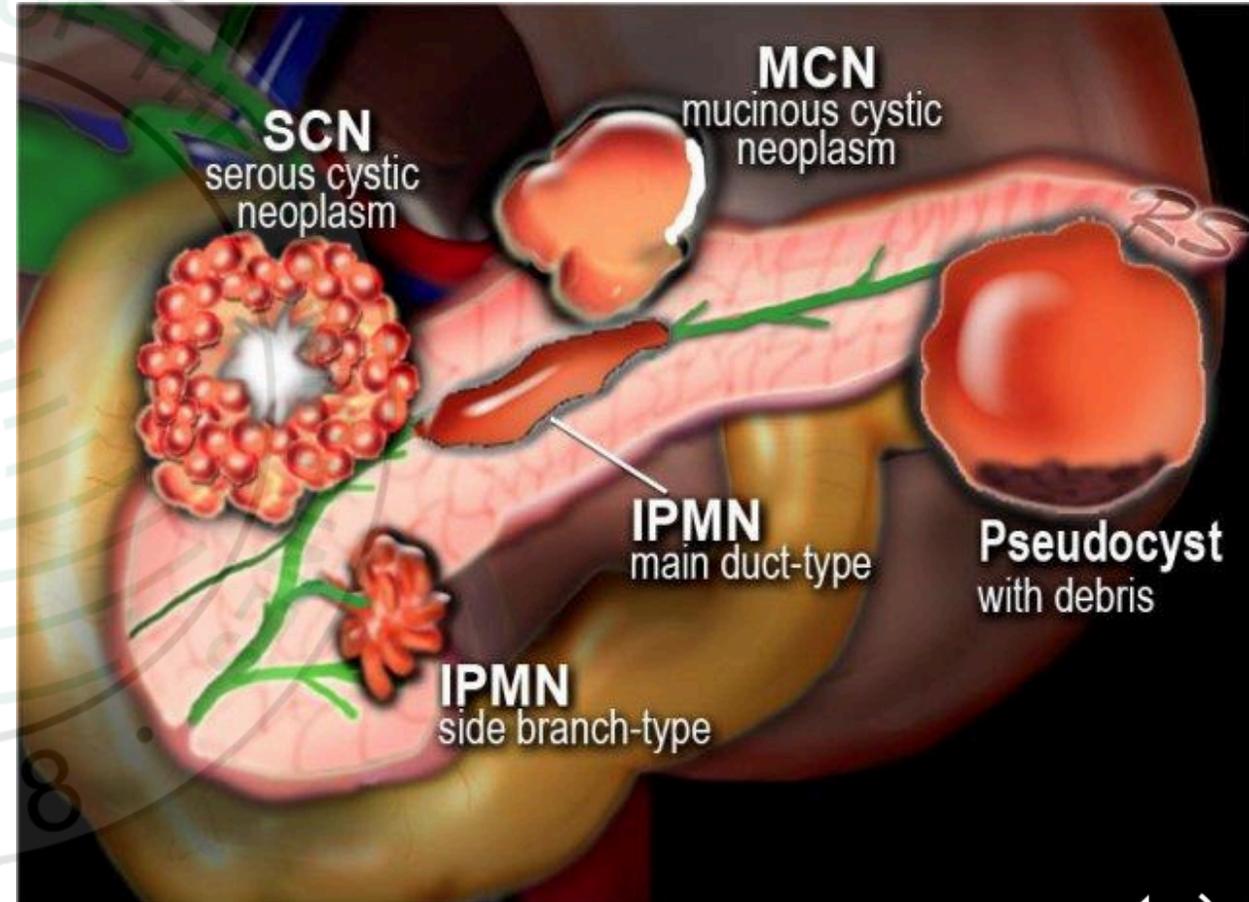
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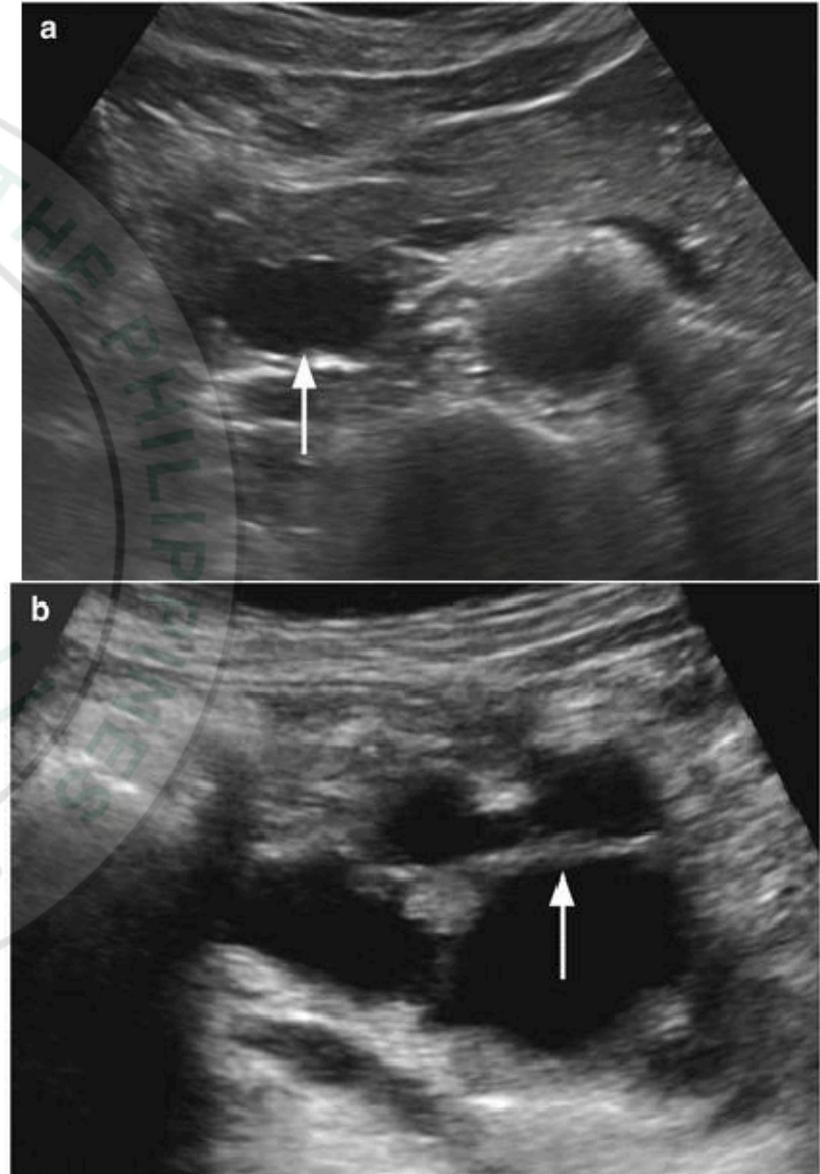
Cystic Pancreatic Neoplasms

- Detected increasingly as **incidental findings**
- **High-risk features:**
 - Symptomatic, growth, >3cm, mural nodules, septations
- **Types:**
 - **IPMN**
 - **Serous cystic neoplasm**
 - **Mucinous cystic neoplasm**
 - **Solid-pseudopapillary tumor**



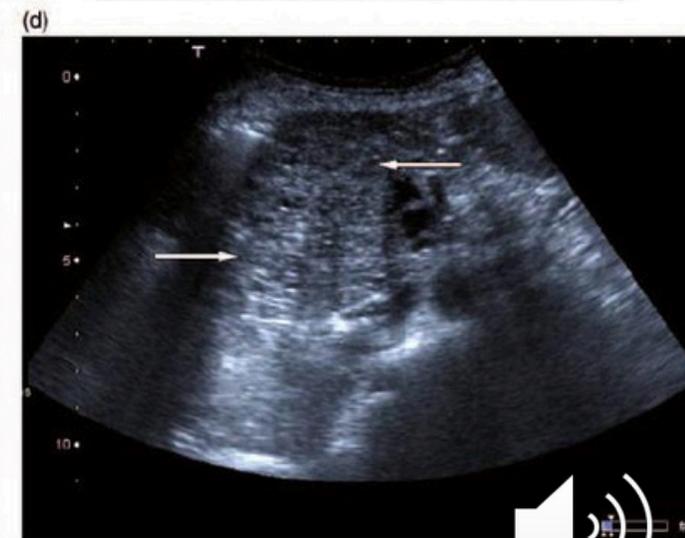
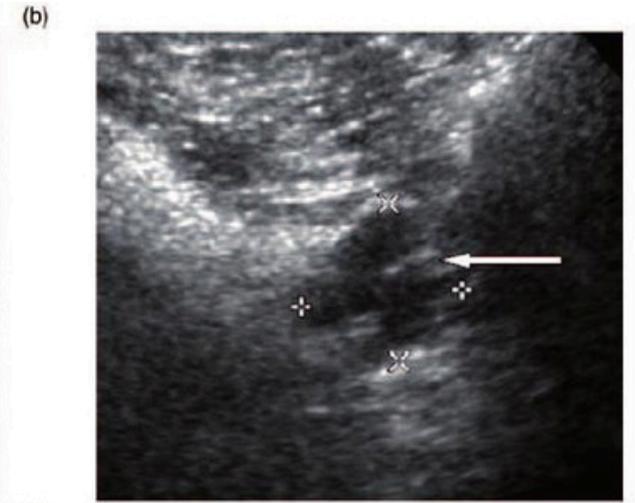
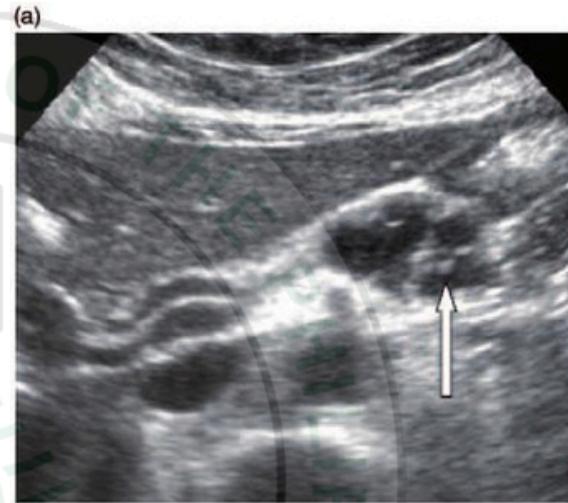
Intraductal Papillary Mucinous Neoplasm (IPMN)

- Originates from **main or branch ducts**
- Main duct IPMN: **diffuse ductal dilation**, mucin-filled
- Side-branch IPMN: **multiloculated cysts**, often in head
- **30–70% malignant potential**, especially in main duct lesions
- May cause **biliary obstruction** or present with pancreatitis



Serous Cystic Neoplasm (Microcystic Adenoma)

- Benign, more common in **fe ma le s**
- Typically arises in the **pancreatic head**
- Composed of **numerous microcysts** → echogenic mass
- May show **central scar/calcification** (30–50%)
- **Oligocystic variant** may mimic simple cyst on US/CT



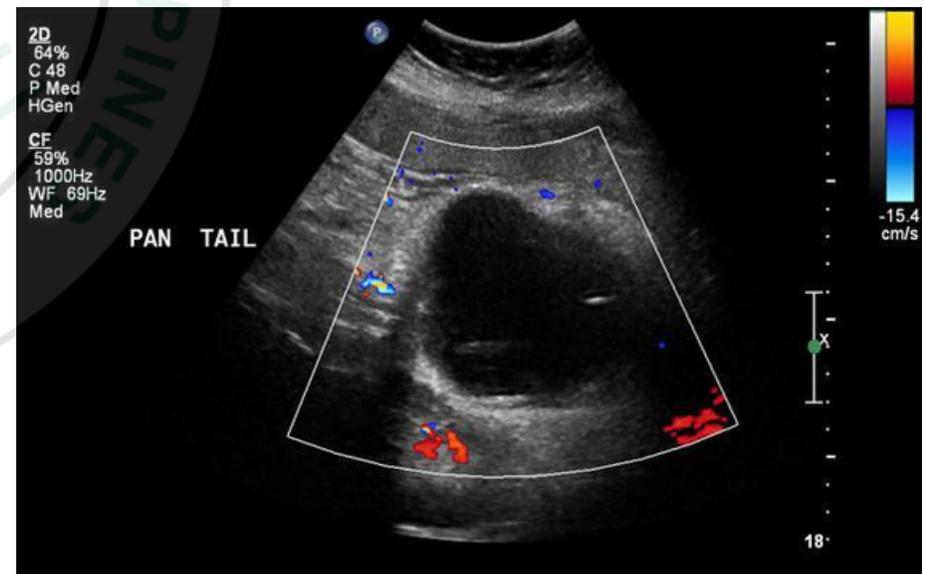
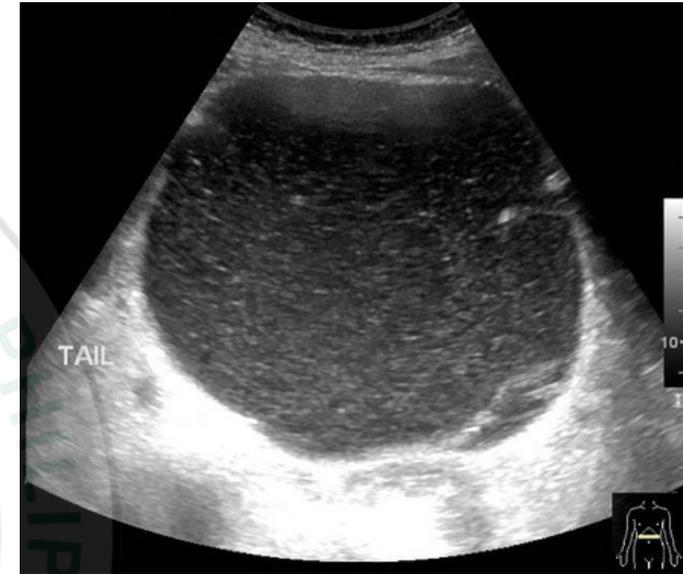
Mucinous Cystic Neoplasm (MCN)

- **De novo** origin; no ductal

connection

- Almost exclusively in **perimenopausal women**
- Location: **body and tail** of pancreas
- **Thick-walled, multilocular** cystic lesion with septations
- Peripheral **calcifications** in ~15–20%

Managed as **pre-malignant/malignant**

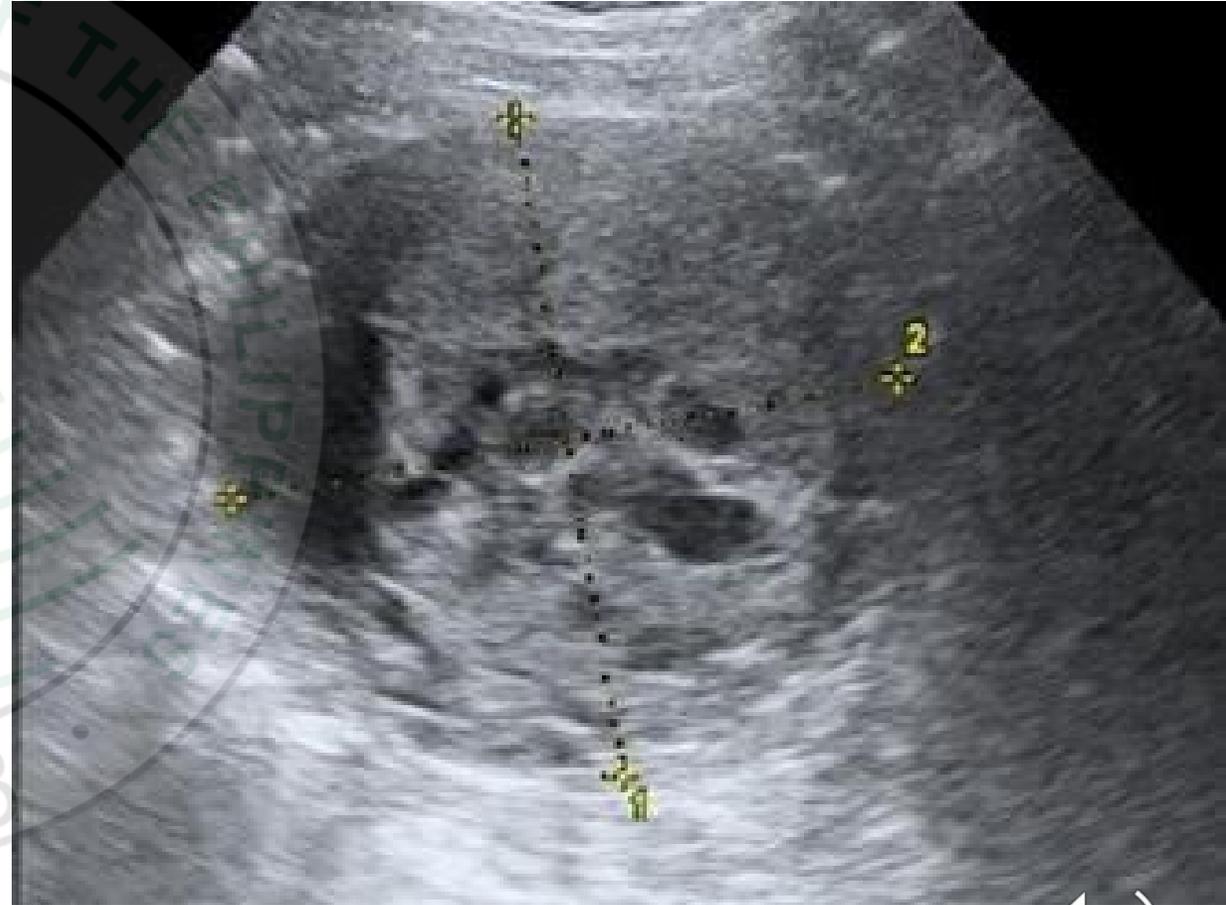


Solid-Pseudopapillary Neoplasm (SPN)

- Occurs in **young women**, tail >

head

- **Encapsulated mass** with solid and cystic elements
- Central/rim **calcification** in ~30%
- Cystic areas represent **necrosis or hemorrhage**
- **Low-grade malignant potential**; resection is curative



CASE 5

DEMOGRAPHICS

Name: R.M. P.

Age: 23

Sex: M

CLINICAL HISTORY AND PRESENTATION

Body weakness

Icteric sclerae

Jaundice

Distended abdomen

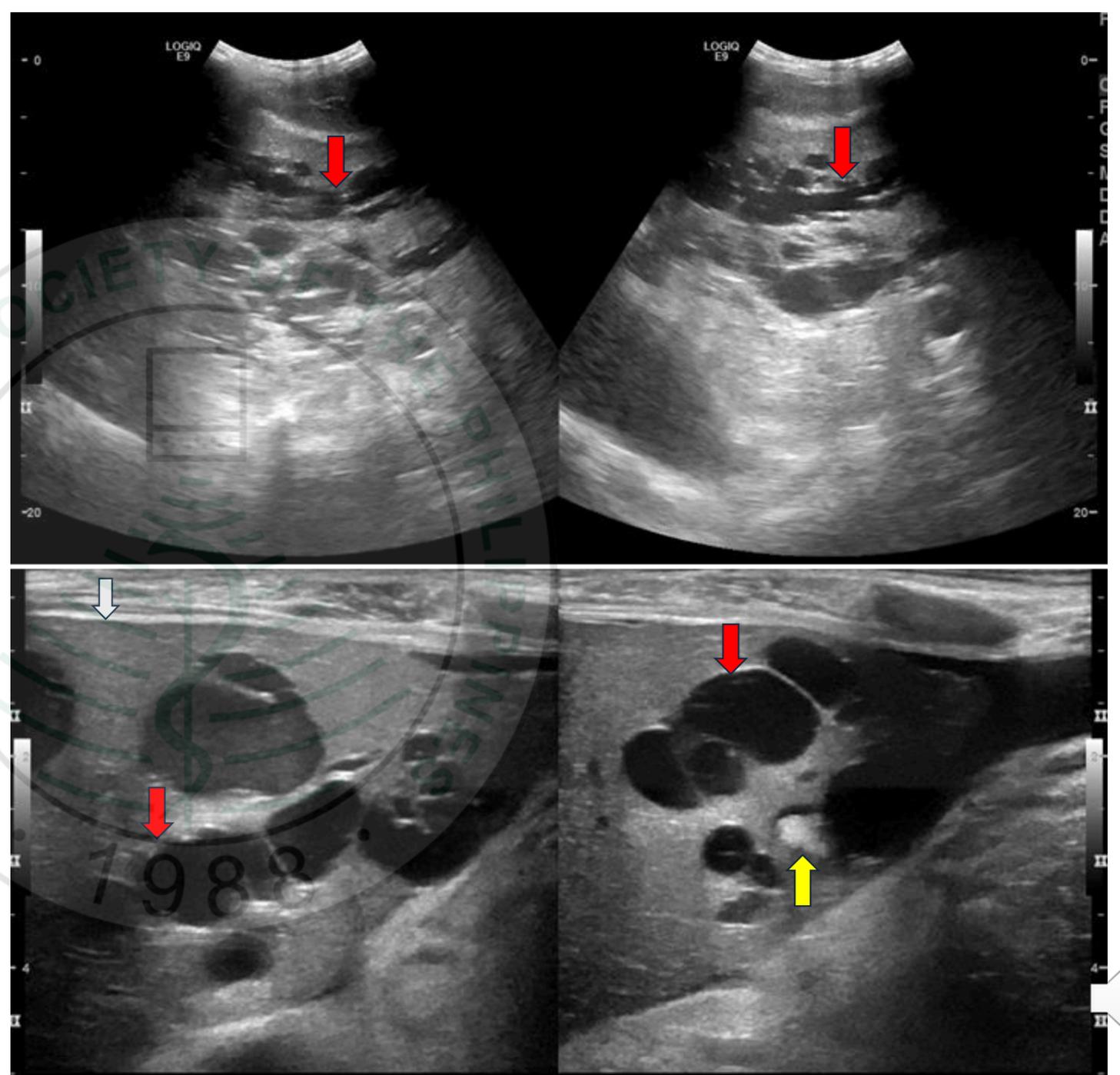
(+) Fluid wave

Grade 3 bipedal edema



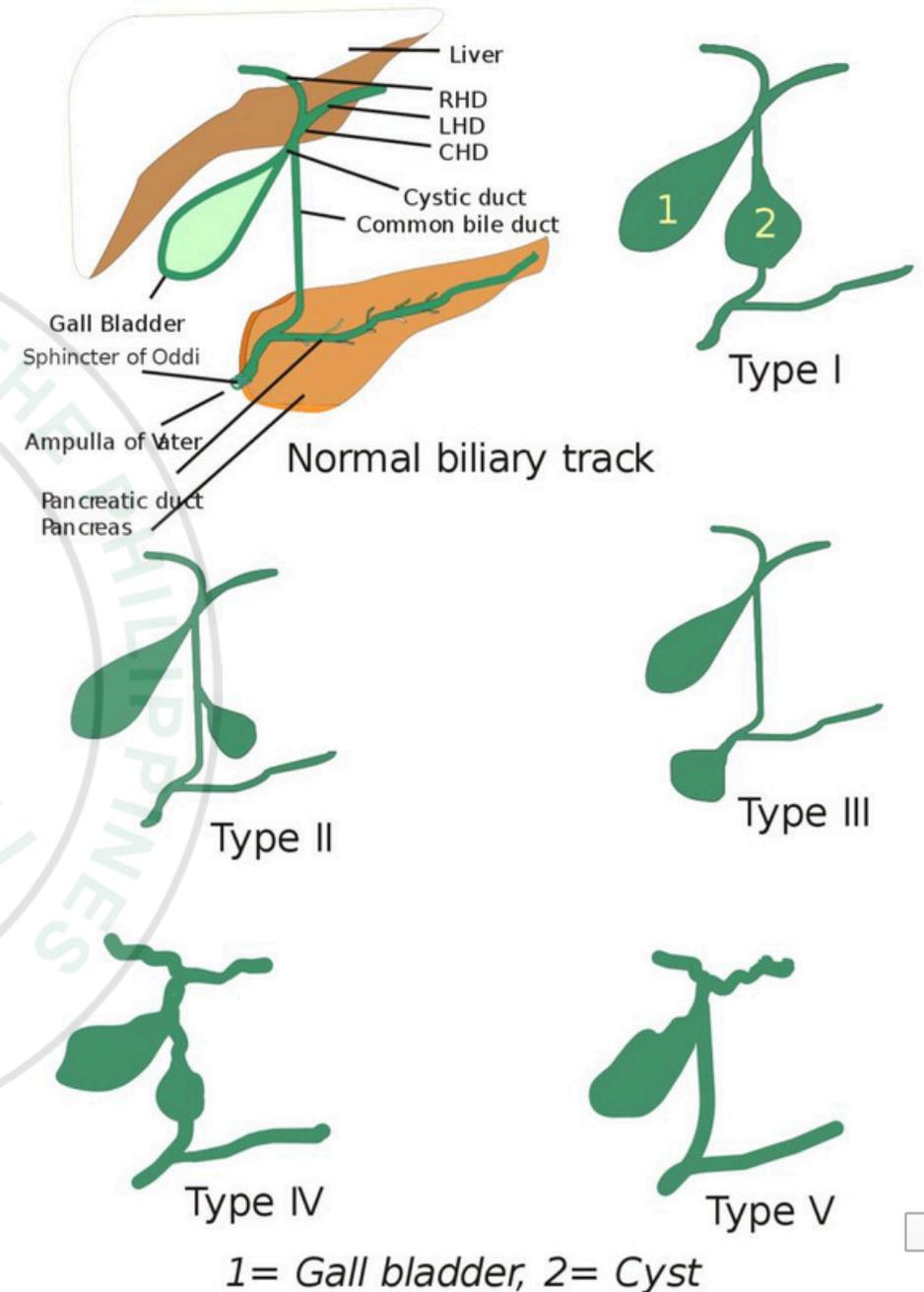
IMAGING FINDINGS:

- Increased echogenicity of liver parenchyma with nodular border (white arrow)
- Cystic dilatations (red arrow) with intraluminal calcifications (yellow arrow)

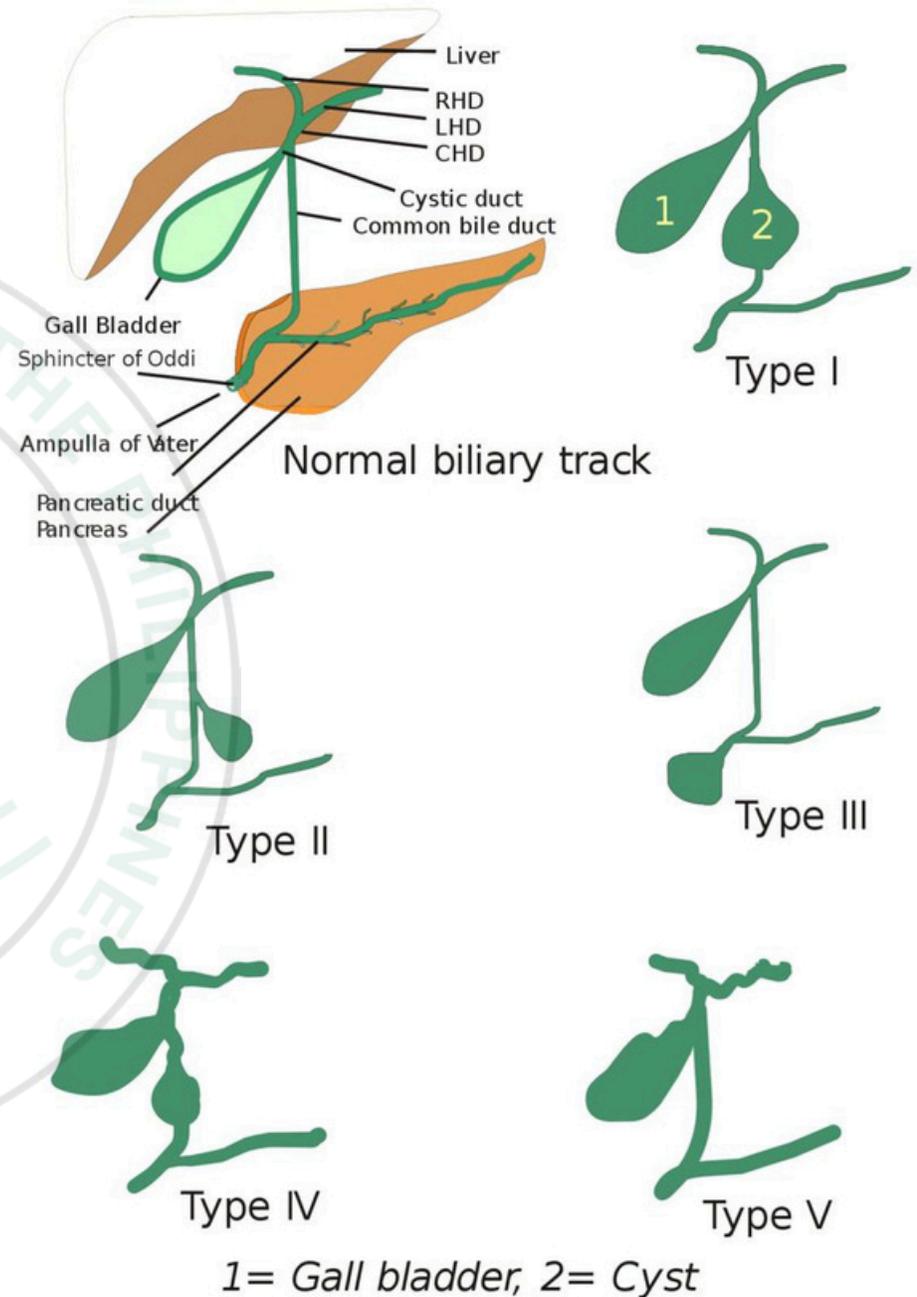


CHOLEDOCHAL CYSTS

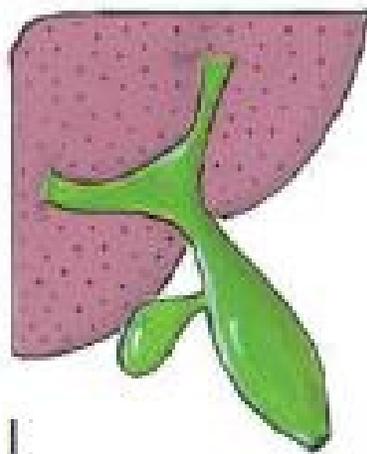
- Congenital cystic dilation of biliary tree
- Higher in East Asians (Japan: 1 in 1,000)
- Female:Male = 3–4:1
- 20% present in adulthood
- Often found incidentally on ultrasound



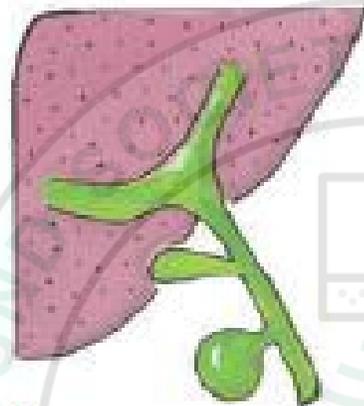
- Often seen as cystic structure near porta hepatis
- May contain **sludge, stones, or solid mass**
- Use contrast US, MRCP, ERCP for further evaluation
- **Risks:**
 - Pancreaticobiliary maljunction
 - ~10% risk of **malignancy** (esp. Type I & IV)
- Management: **Surgical resection recommended**



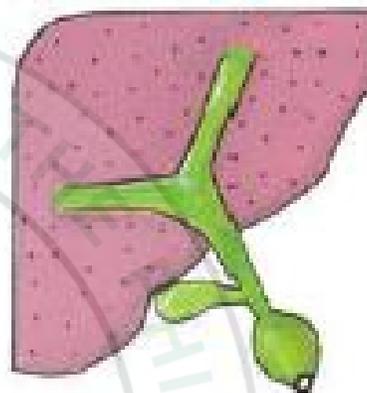
Modified Todani System



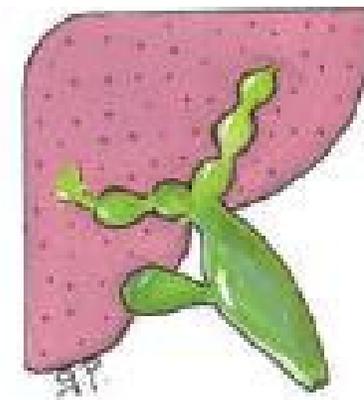
I



II



III

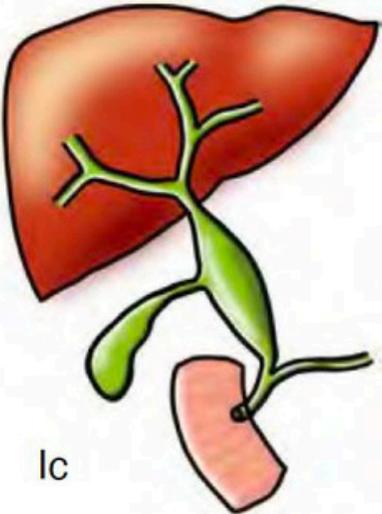
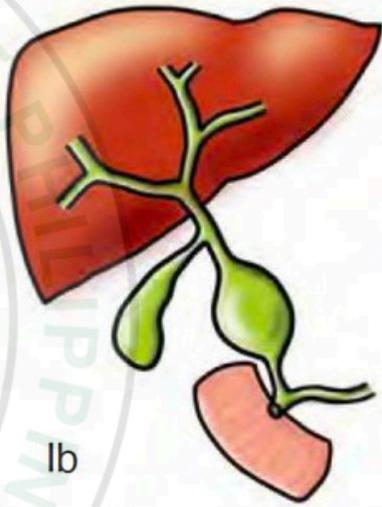
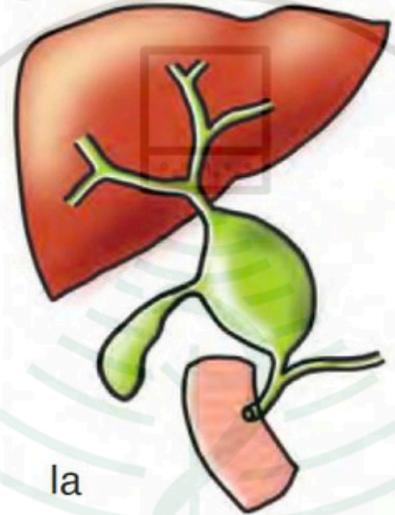
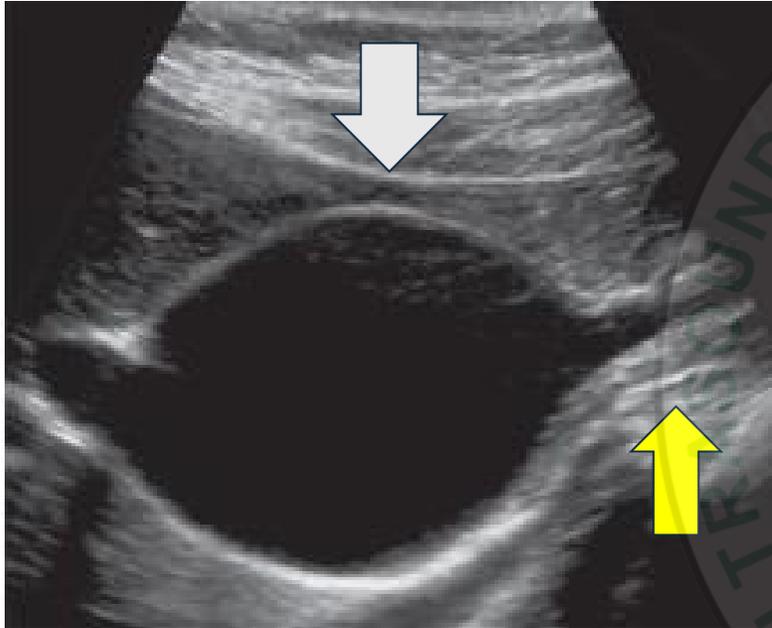


IV

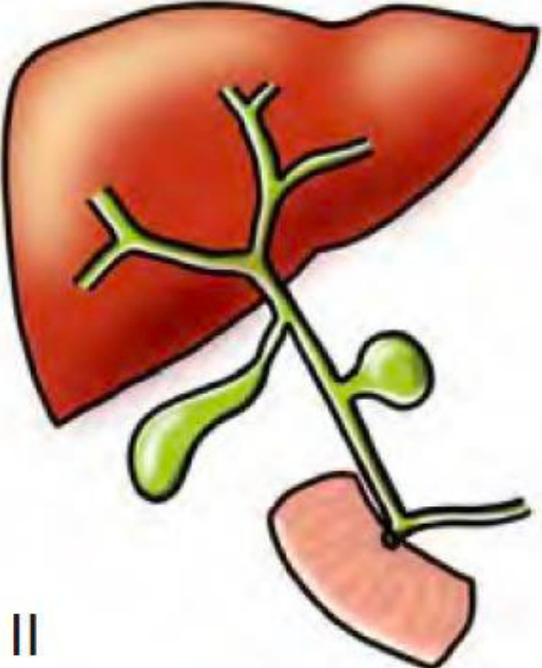
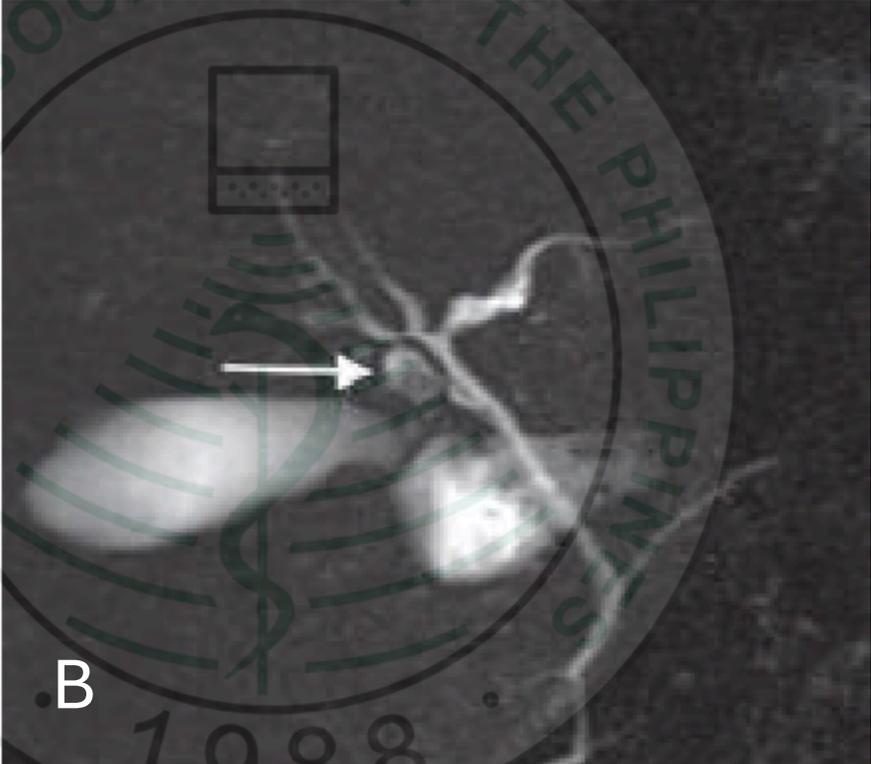
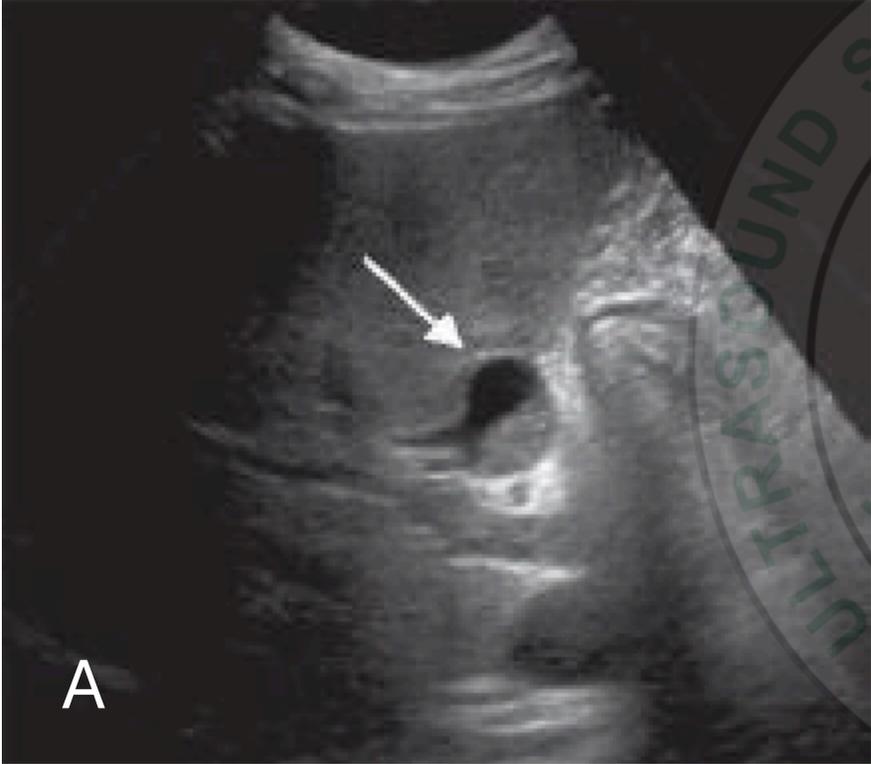
Type I	Type II	Type III	Type IV a/b
<p>(most common 50–80%):</p> <p>Ia: Diffuse CBD dilation</p> <p>Ib: Segmental CBD dilation</p> <p>Ic: Fusiform CBD dilation</p>	<p>Saccular diverticulum (rare)</p>	<p>“c hole do cho ce le s”</p> <p>Diffuse dilatation of the very distal (intraduodenal) CBD</p>	<p>Multiple</p> <p>IVa - Intra- and Extrahepatic</p> <p>IVb - Extrahepatic Only</p>



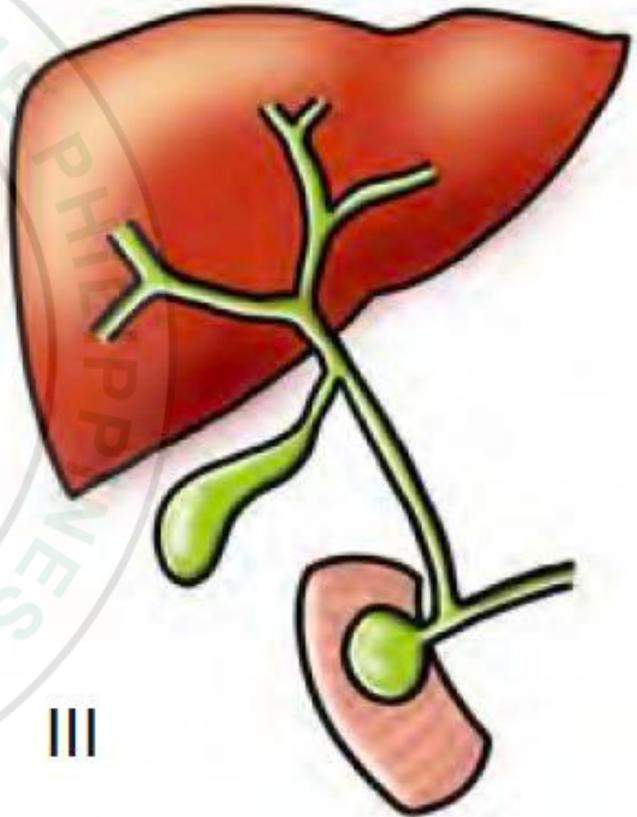
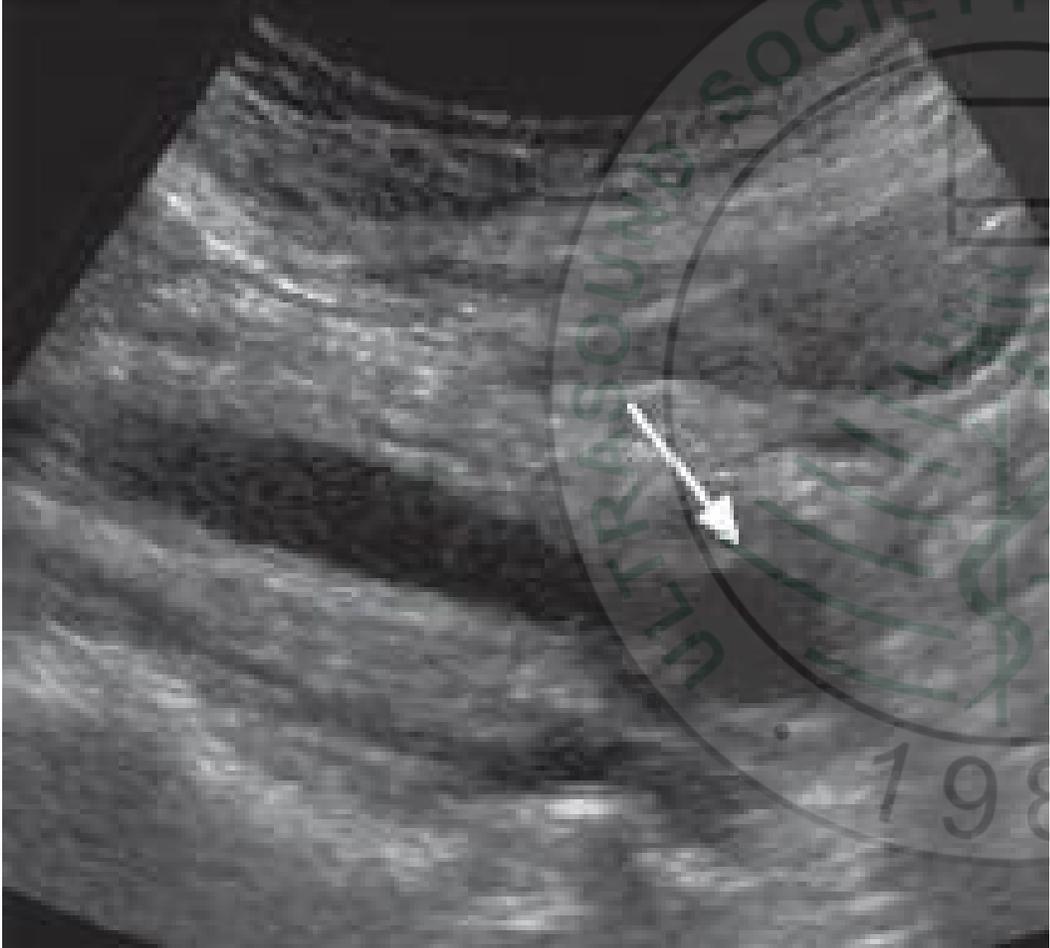
Type I



Type II

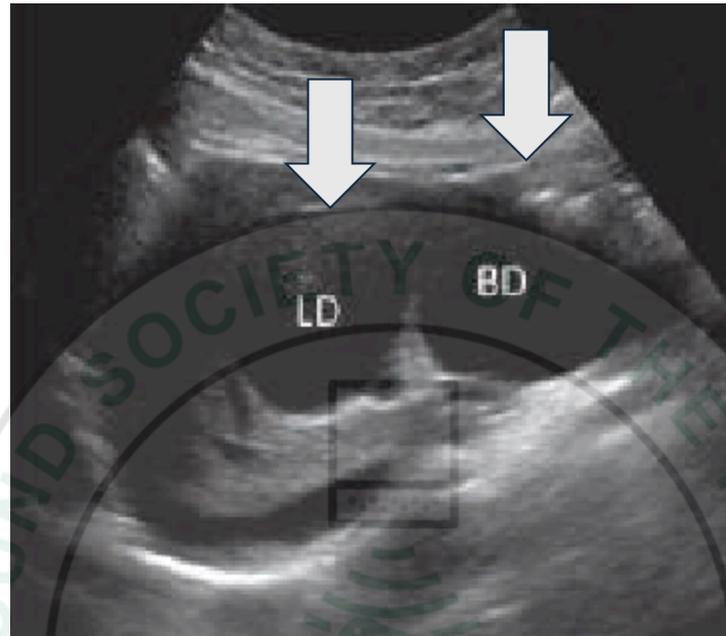


Type III



Type IV

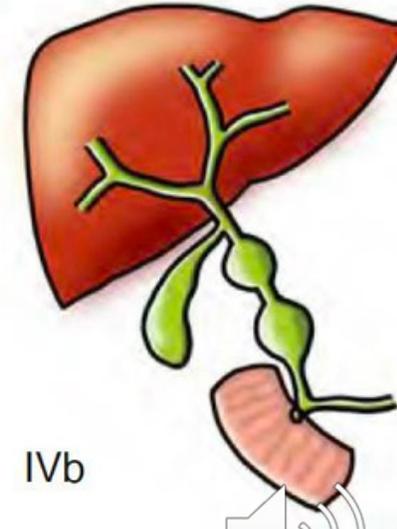
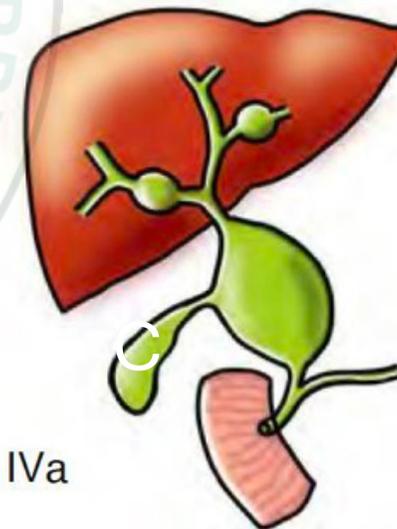
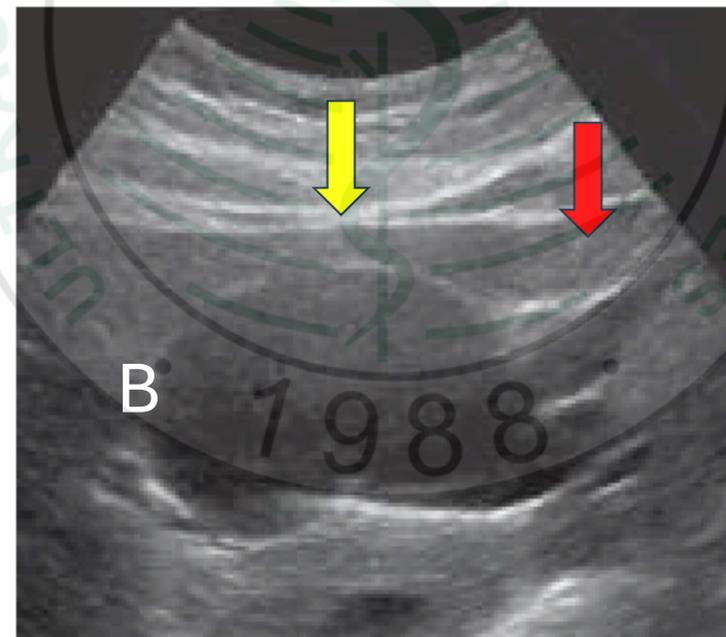
Sagittal



MRCP

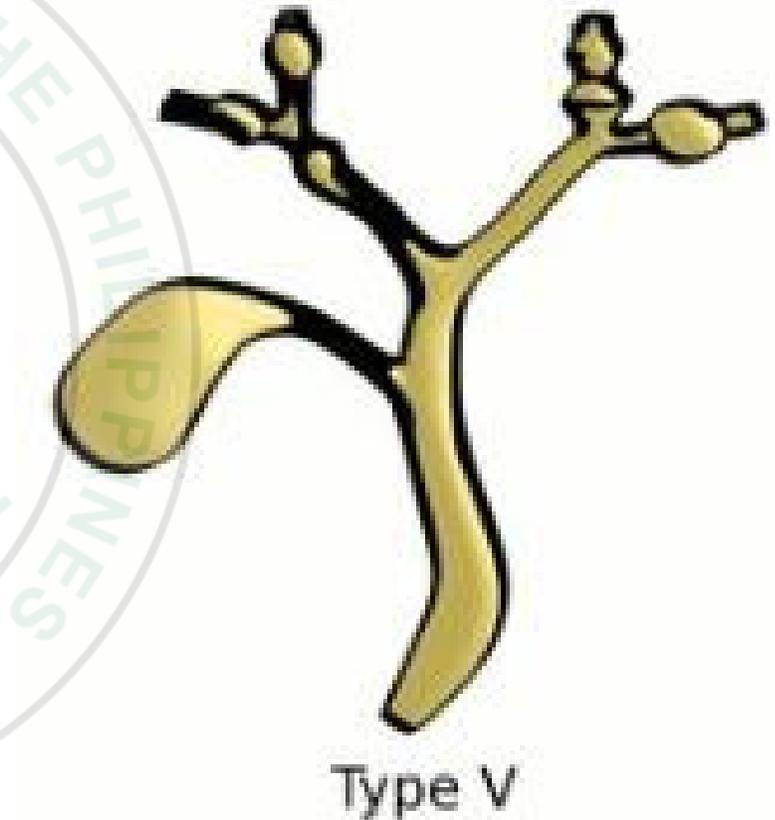


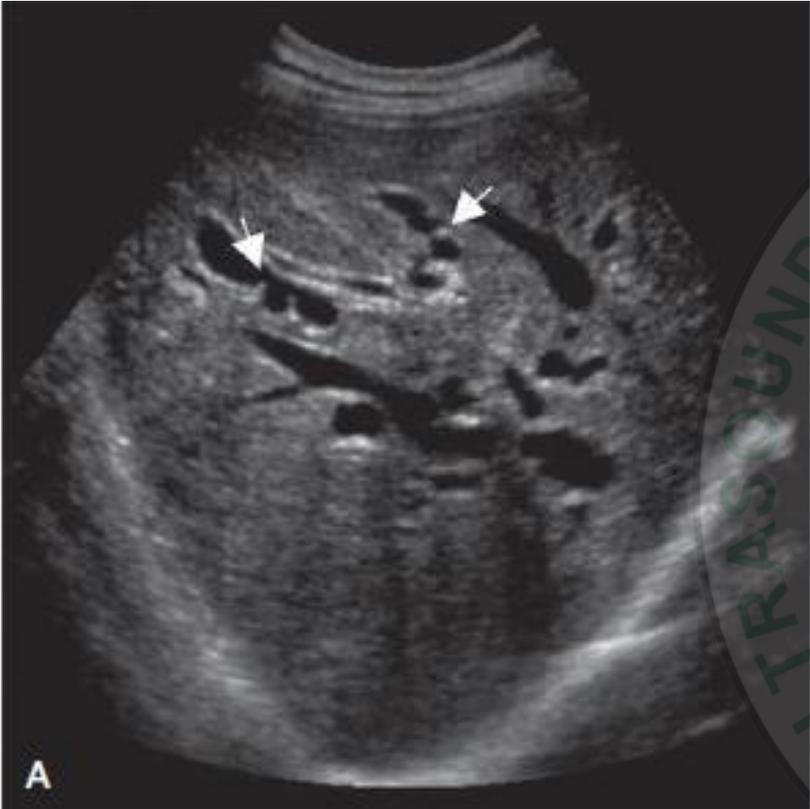
Transverse



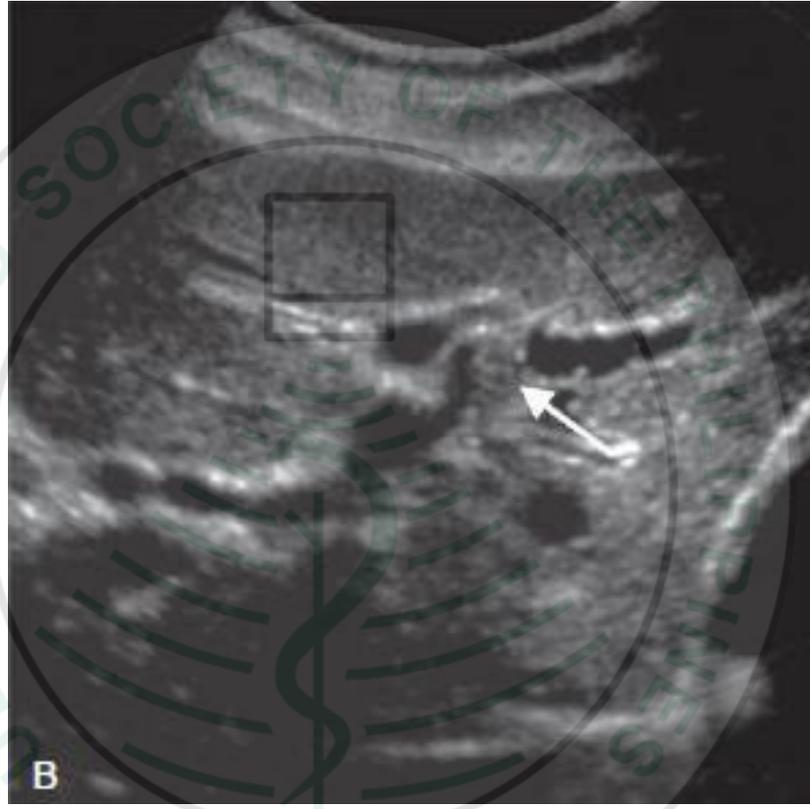
Type V/ Caroli Disease

- Congenital intrahepatic bile duct disease
- **Two forms:**
 - Simple
 - Caroli syndrome = + congenital hepatic fibrosis
- **Imaging:**
 - Saccular intrahepatic duct dilation
 - Stones/sludge but no ductal casts
 - Echogenic septa, portal veins within dilated ducts
- Associated: **ARPKD, medullary sponge kidney**
- Complications: **Cholangitis, sepsis, cholangiocarcinoma (7%)**

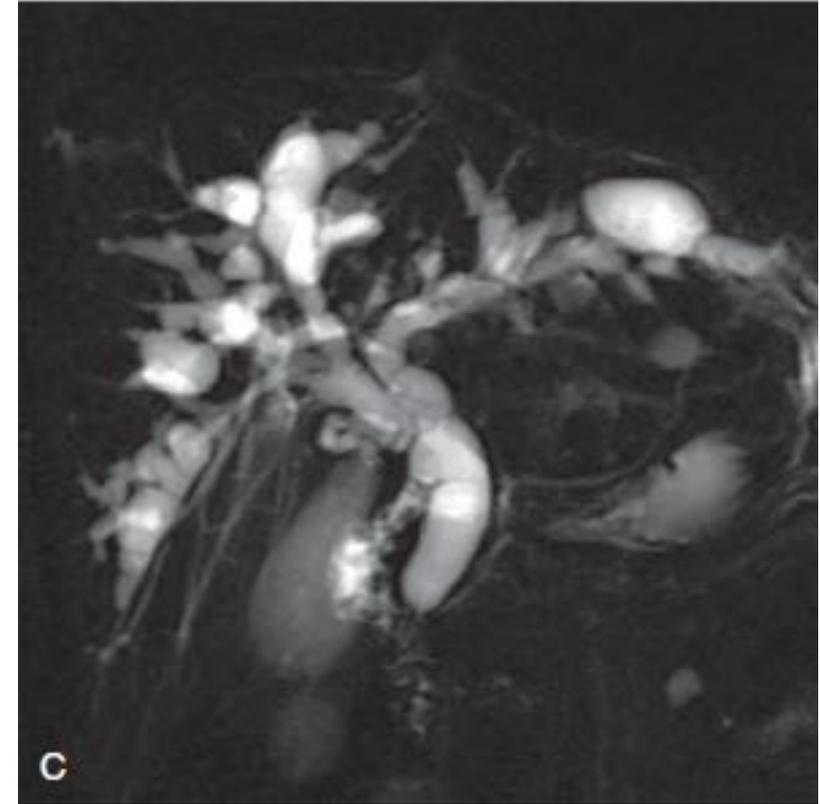




Oblique - Right hepatic lobe



Transverse - Left hepatic lobe



MRCP



CASE 6

DEMOGRAPHICS

Name: A.S.

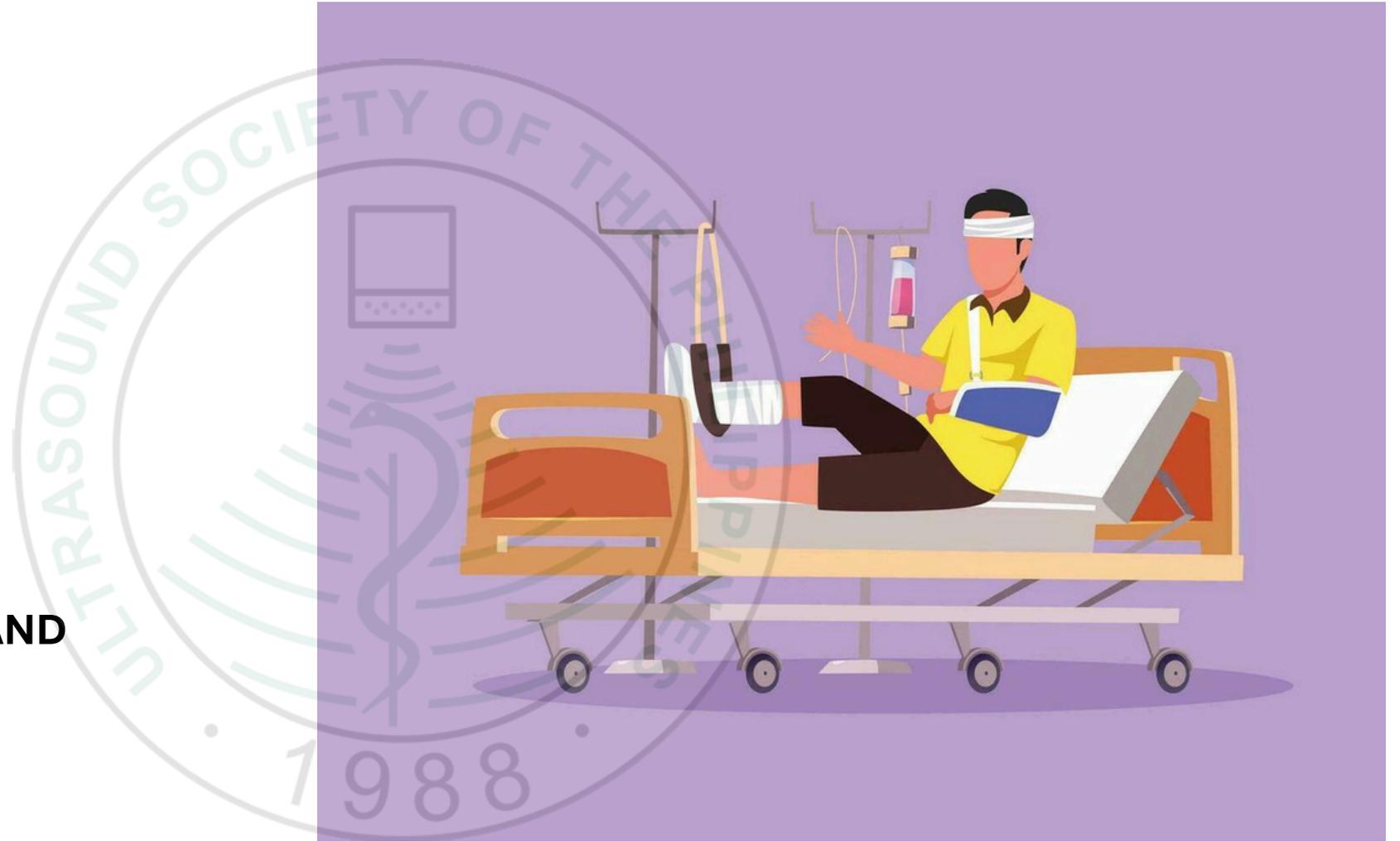
Age:19

Sex:M

CLINICAL HISTORY AND

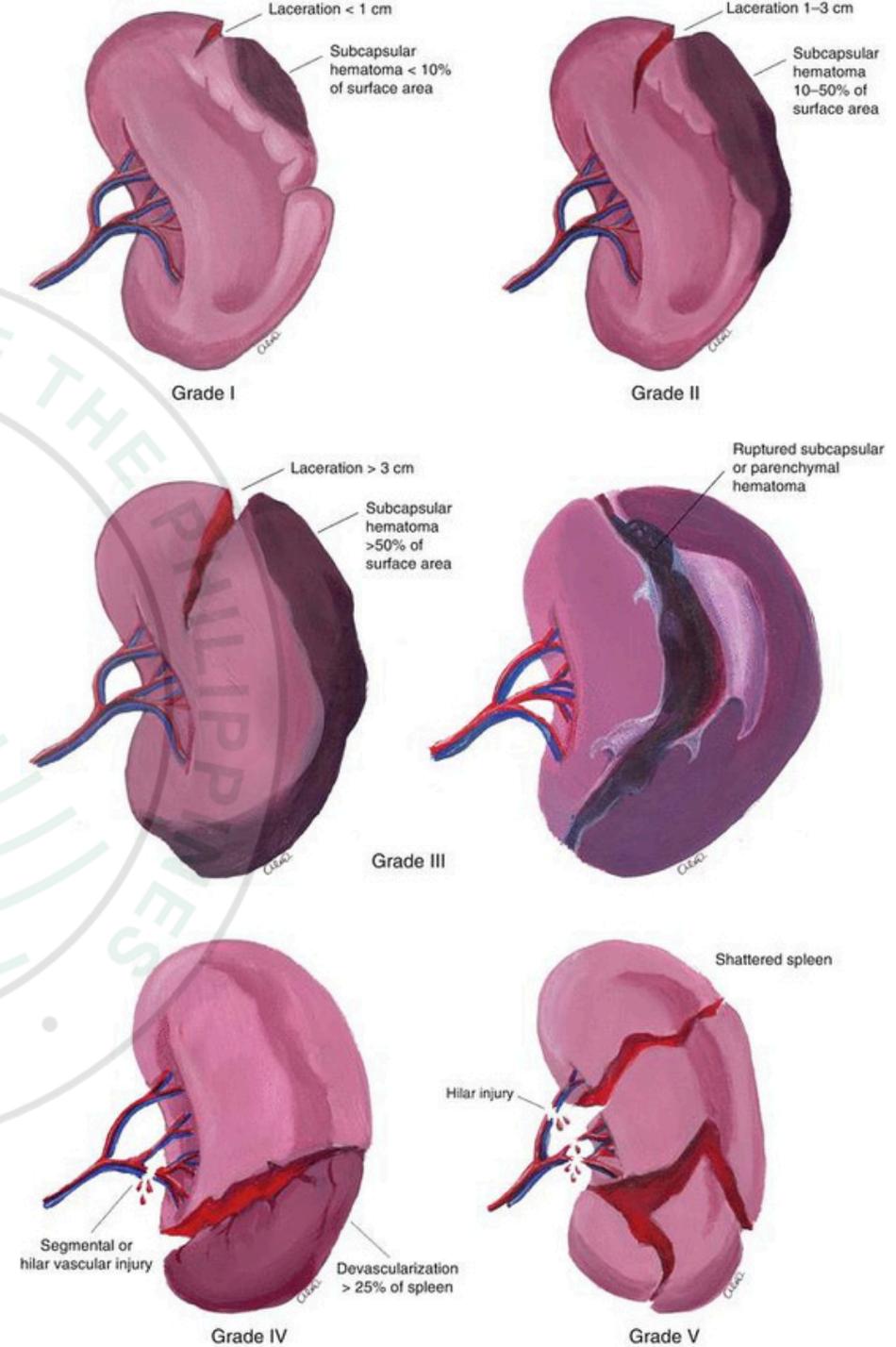
PRESENTATION

Trauma



SPLENIC TRAUMA

- Spleen = **most commonly injured solid organ** in blunt trauma
- Injury spectrum: **Contusion** → **Shattered spleen**
- **AAST grading scale** used to score injury severity
- **Management** depends on:
 - Hemodynamic status
 - Imaging findings
 - Options: **Conservative, embolization, or surgery**

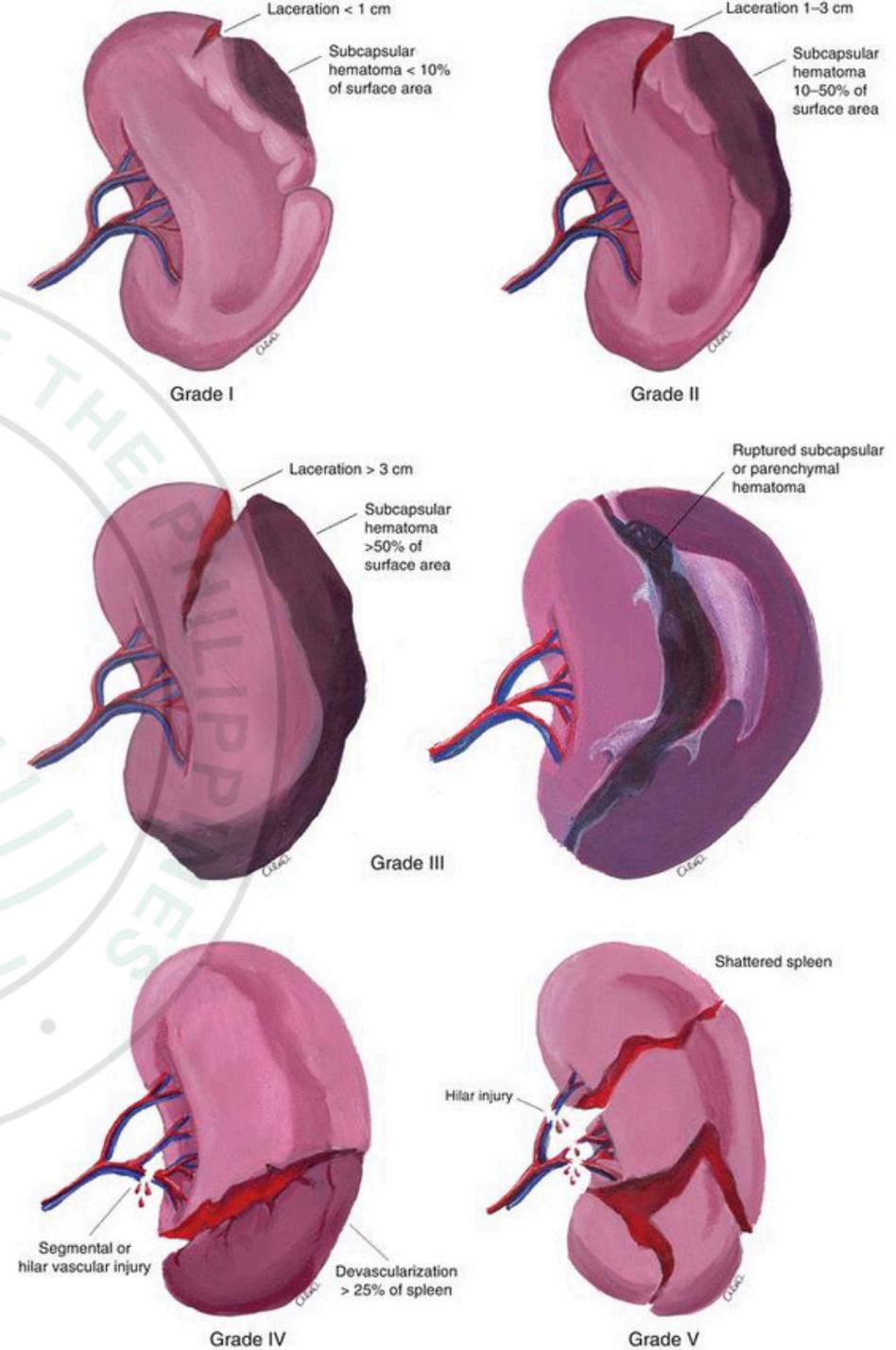


• **Ultrasound (US):**

- Fast, portable, bedside
- Ideal in unstable patients
- Focus: free fluid + solid organ evaluation

• **CT scan:**

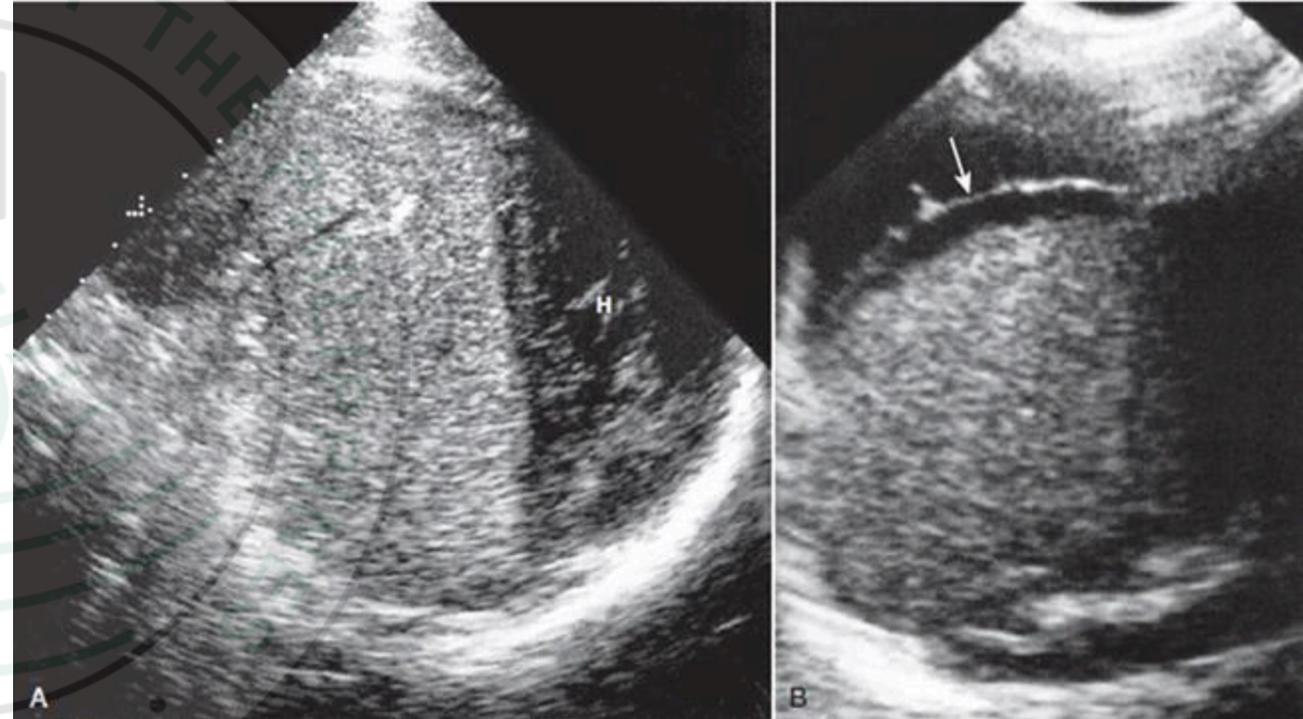
- Better for grading, detecting vascular injury



Sonographic Findings

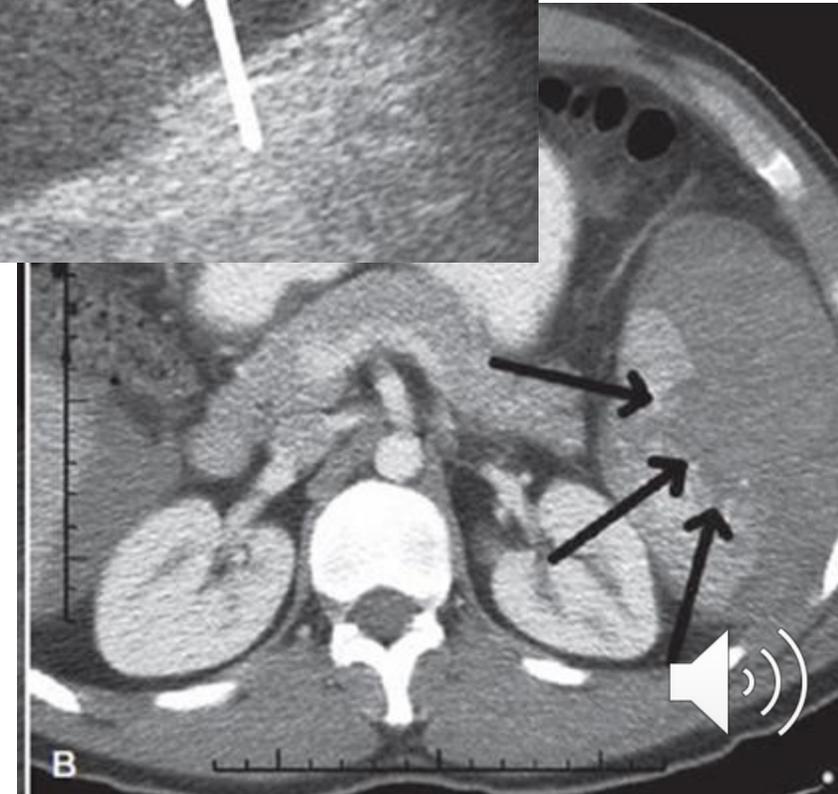
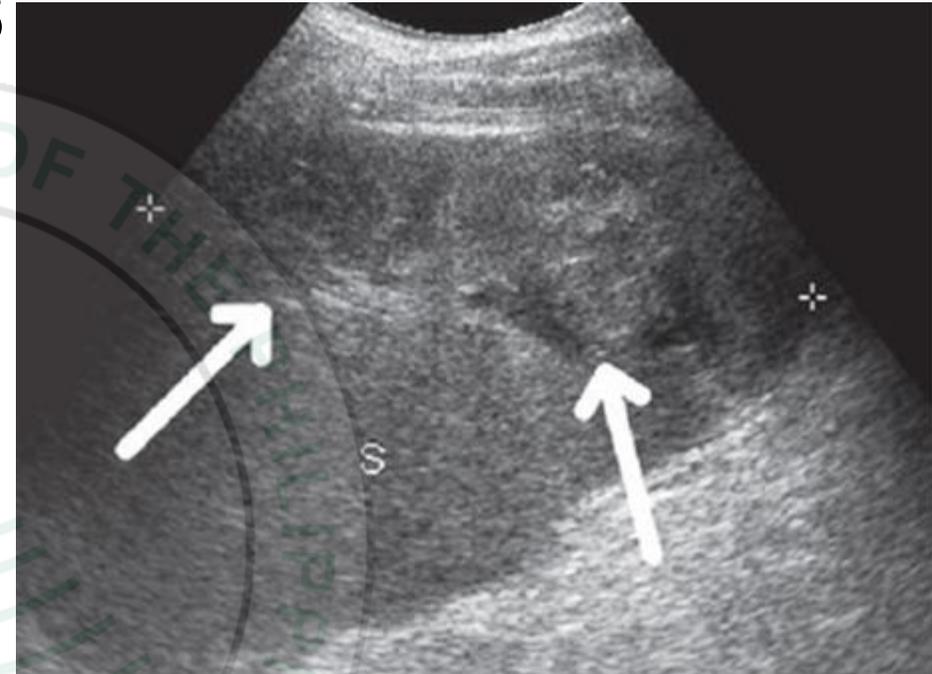
- **Subcapsular hematoma:** crescentic, follows spleen contour
- **Perisplenic hematoma:** irregular shape
- **Intraparenchymal hematoma:** focal heterogeneity
- **Capsular rupture:**
 - Free fluid in LUQ, Morison pouch, pelvis
 - May be walled off initially
- **Chronic phase:** cystic change at injury site

SUBCAPSULAR HEMATOMA INTACT CAPSULE



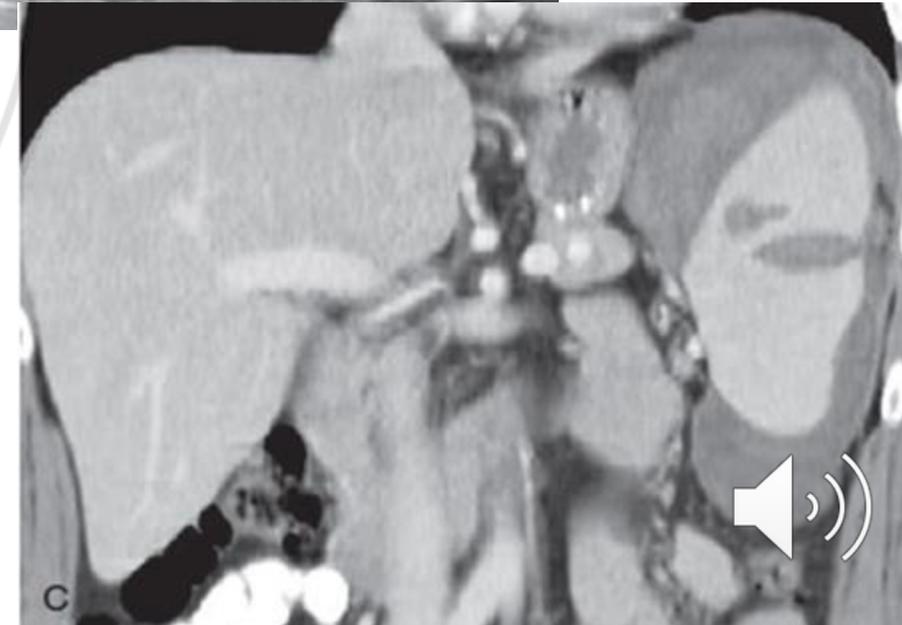
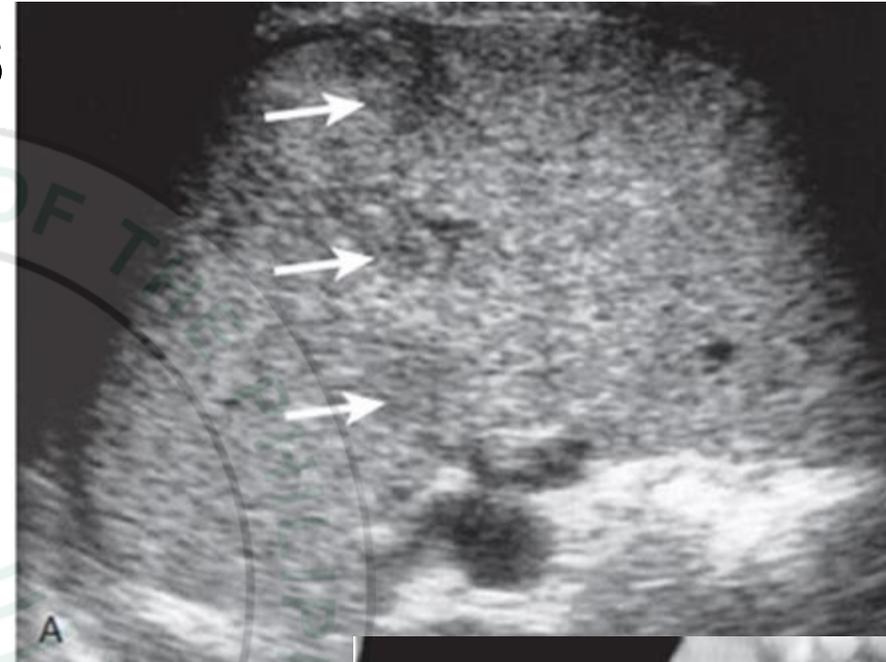
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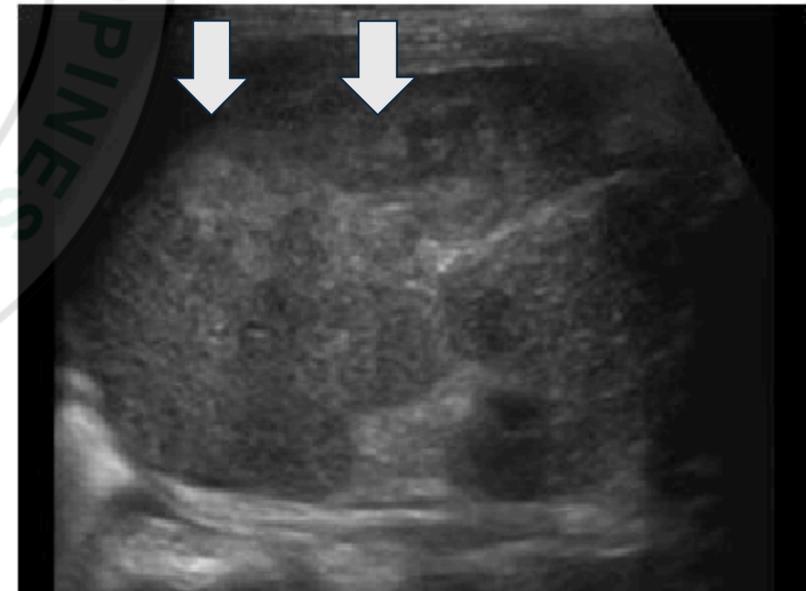
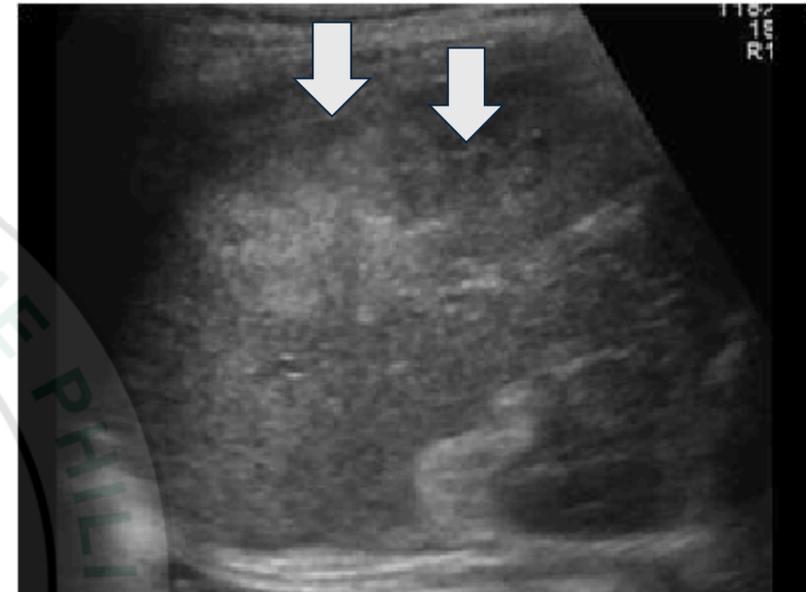
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- **Capsular rupture:**
 - Free fluid in LUQ, Morison pouch, pelvis
 - May be walled off initially
- **Chronic phase:** cystic change at injury site



Timing and Pitfalls

- **Timing affects echogenicity:**

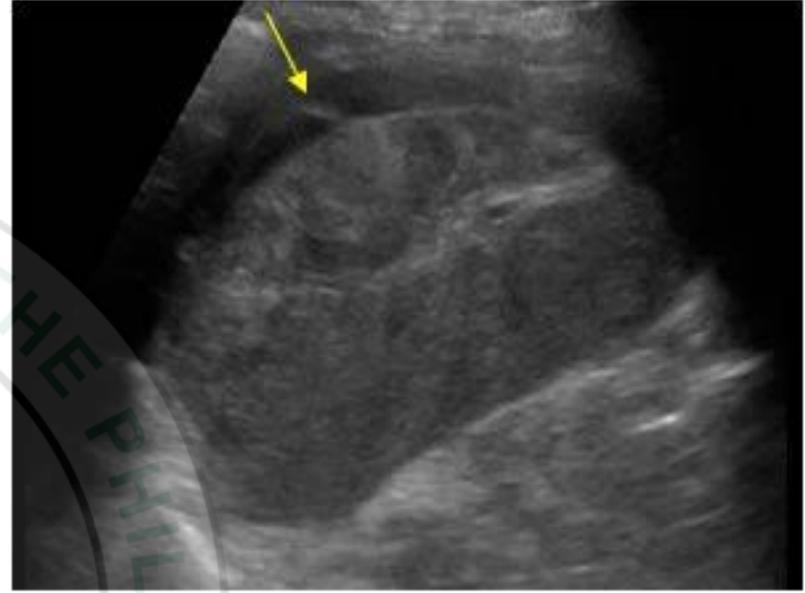
- Early: anechoic (liquid)
- 24–48 hrs: echogenic (mimics splenomegaly)
- Late: hypoechoic/cystic

- **Delayed rupture:** from liquefied hematoma

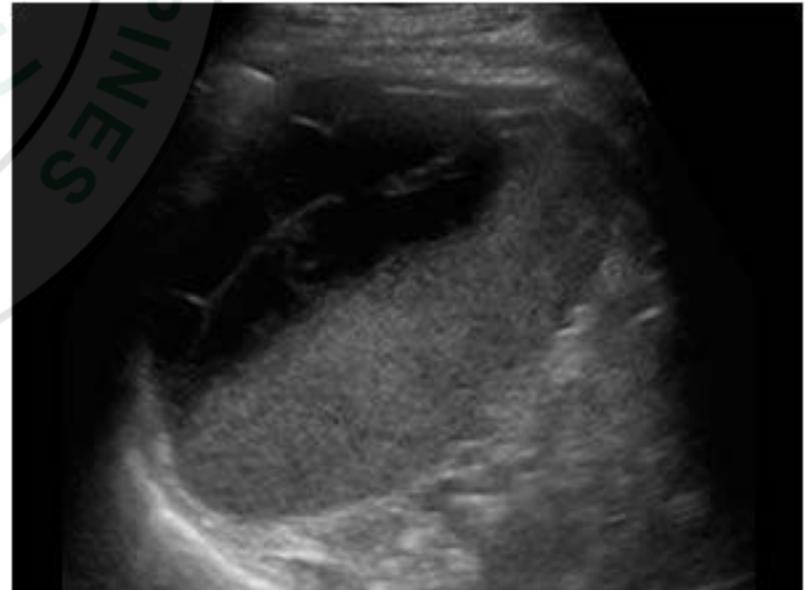
- **Pitfalls:**

- Hematoma may mimic **abscess**
- **Infected hematoma** → left subphrenic abscess
- **Fine needle aspiration** may be required

ACUTE HEMATOMA



CHRONIC LIQUEFIED HEMATOMA



INTERESTING CASE 1

DEMOGRAPHICS

Name: R. A.

Age: 48

Sex: M

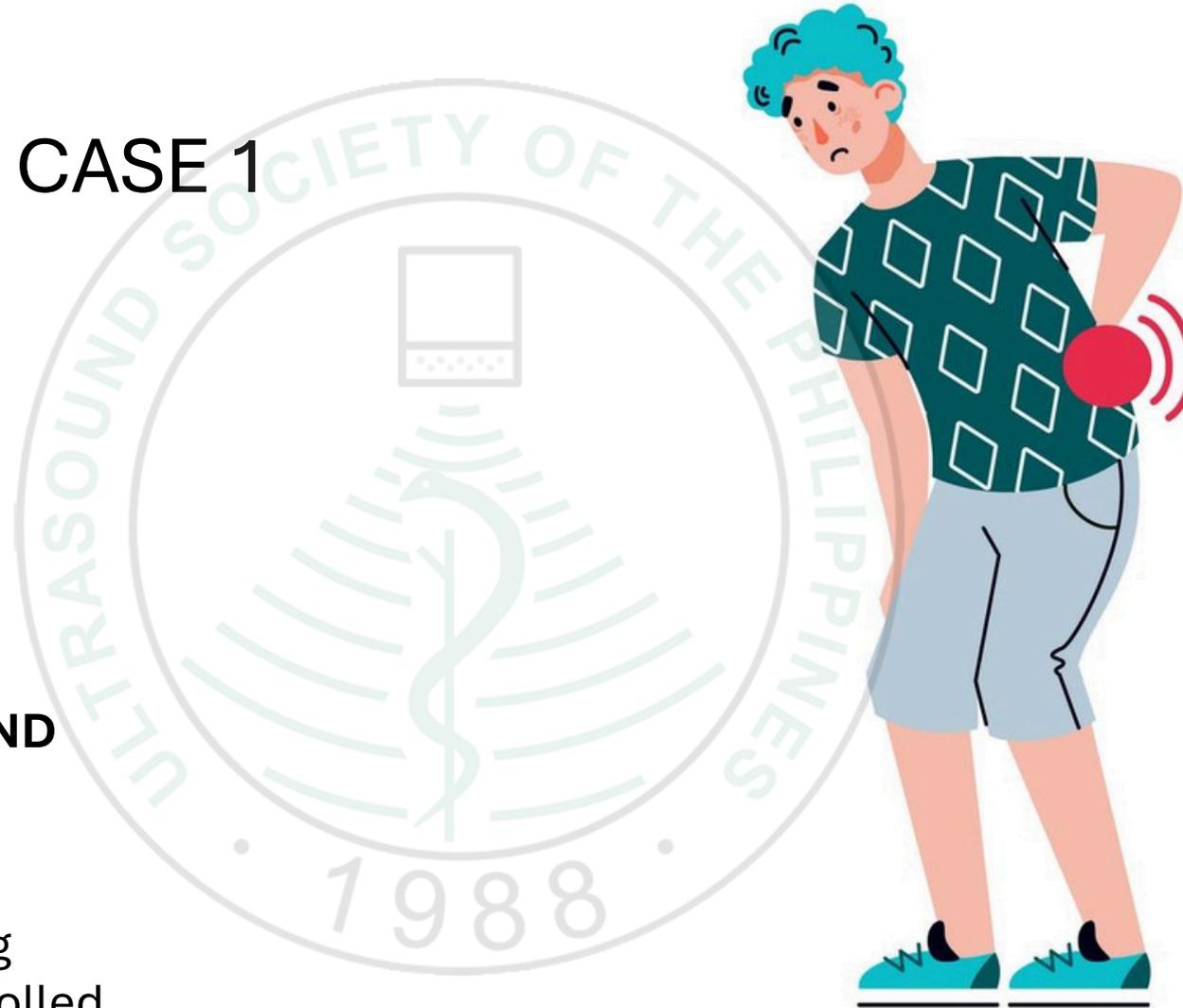
CLINICAL HISTORY AND PRESENTATION

Bilateral flank pain

Back pain

nausea and vomiting

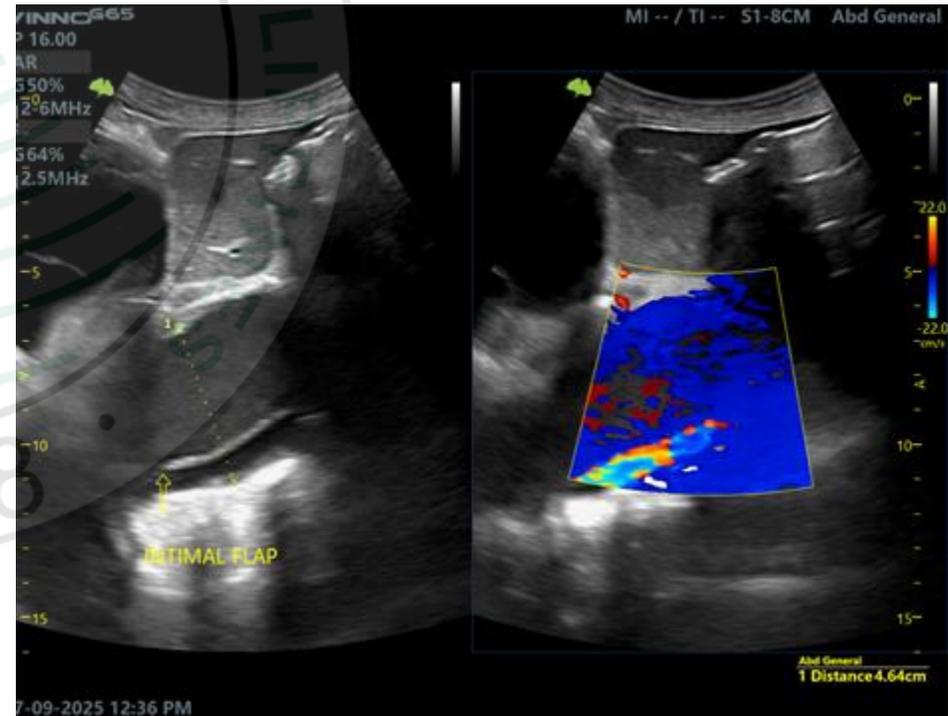
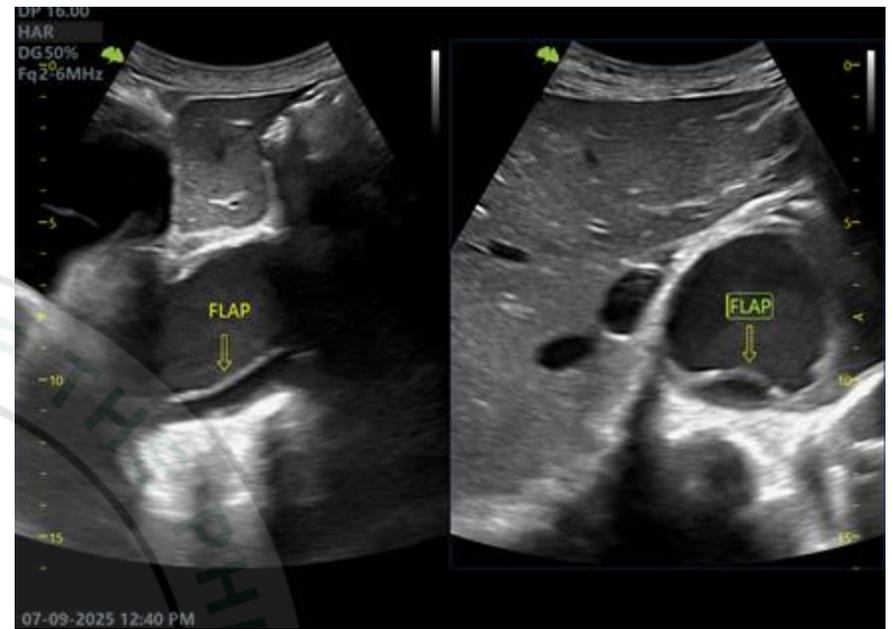
HPN & DM- Uncontrolled



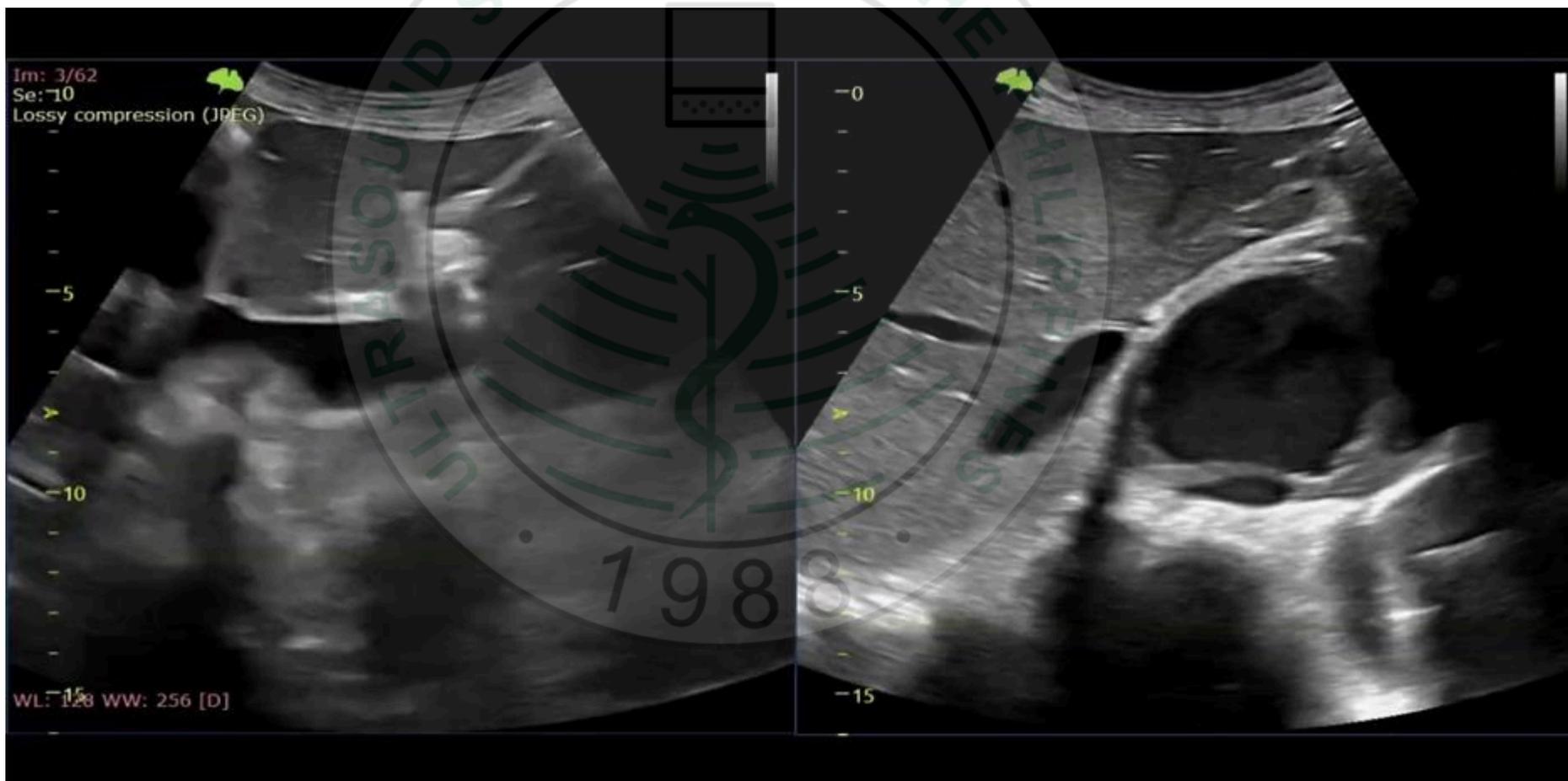
IMAGING FINDINGS

Aorta:

- Markedly dilated measuring 4.6 cm with a linear echogenic dissecting intimal flap demonstrated in both transverse and longitudinal planes.
- Color doppler interrogations shows flow in both true and false lumen.



IMAGING FINDINGS



Clinical Features

Pathology

- Intimal tear allows blood to enter the **medial layer** of the aortic wall
- Creates a **false lumen** (2nd blood-filled channel)

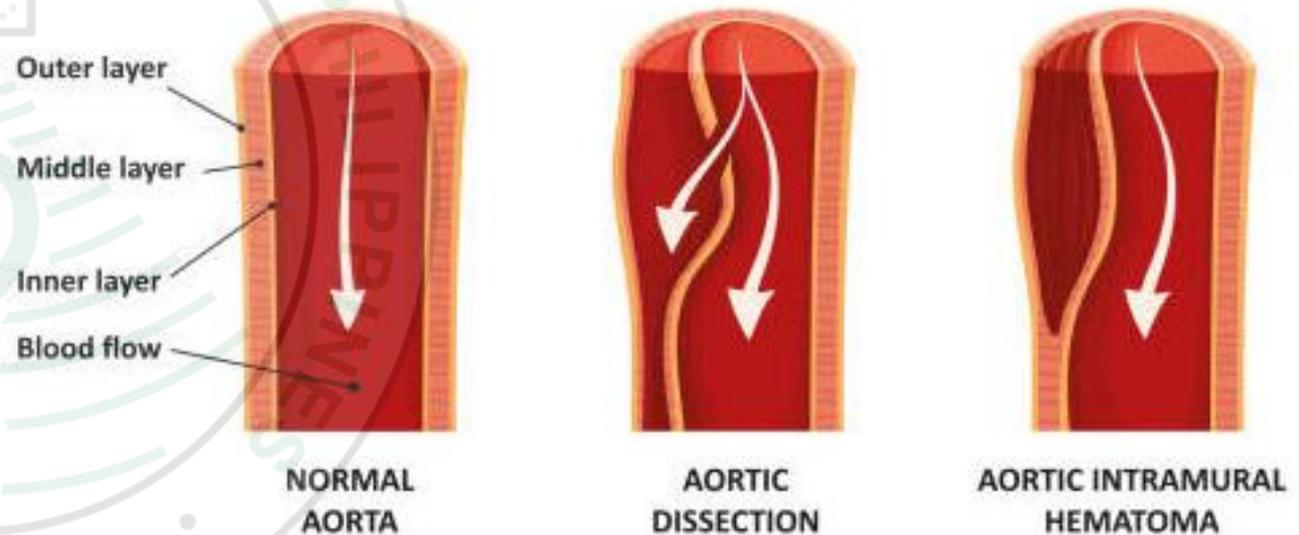
Epidemiology

- **> 40 years old:** Associated with **hypertension, atherosclerosis**
- **< 40 years old:** Linked to **connective tissue disease** (e.g., Marfan)

Clinical Presentation

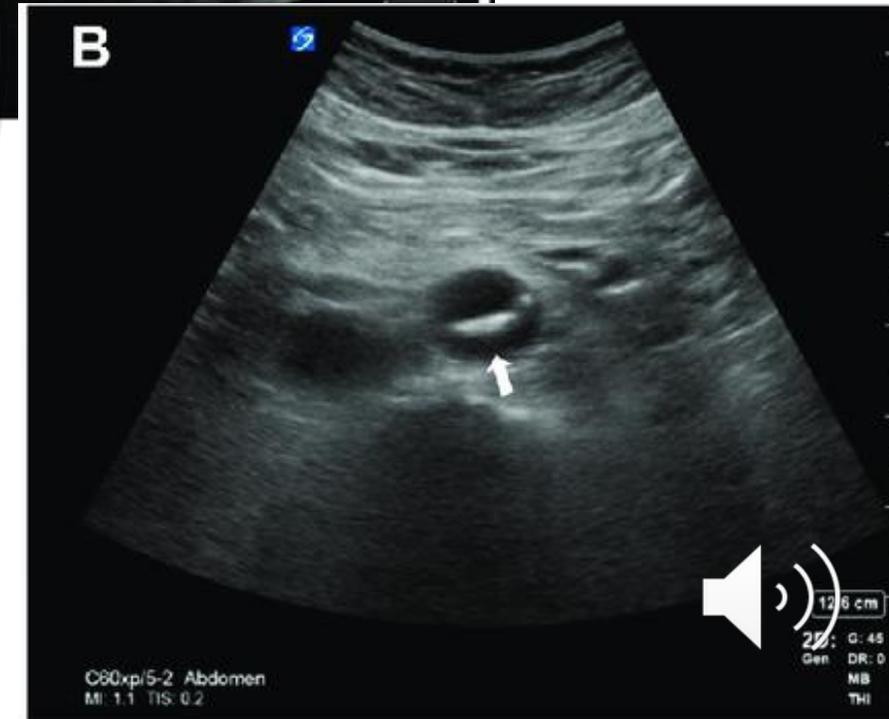
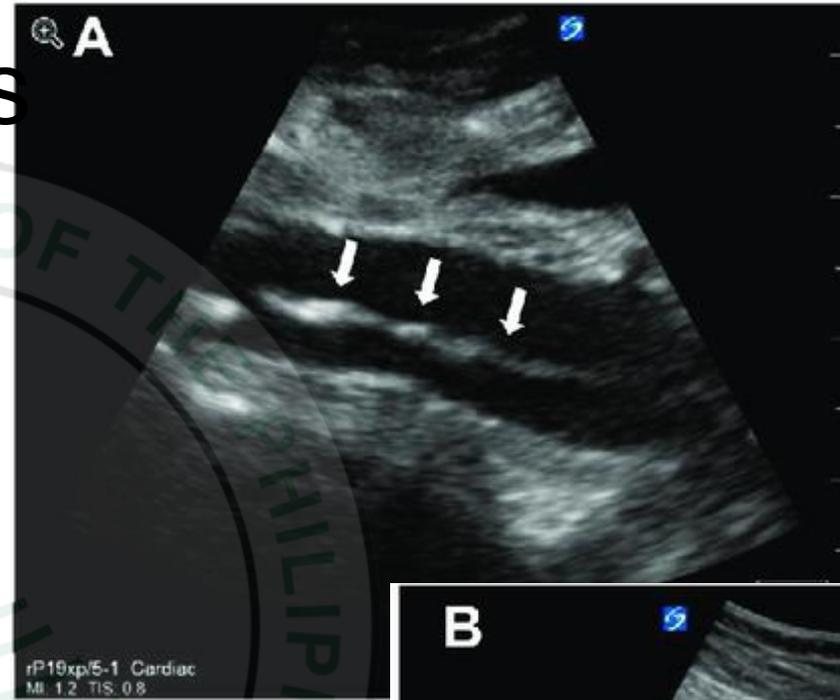
- **Sudden onset** of severe chest pain
- **Back pain**
- **Pulsatile abdominal mass**
- **Shock**

AORTIC DISSECTION AND AORTIC INTRAMURAL HEMATOMA



Sonographic Features

- **Intimal Flap**
 - Most important finding
 - Thin, linear, mobile **hyperechoic line** within the lumen
- **Aortic Enlargement**
 - Dilated aorta, typically **> 4 cm**
- **Intramural Hematoma**
 - Blood within the wall seen as an **echogenic area**
- **False Lumen**
 - Second lumen, may show **different flow** from the true lumen



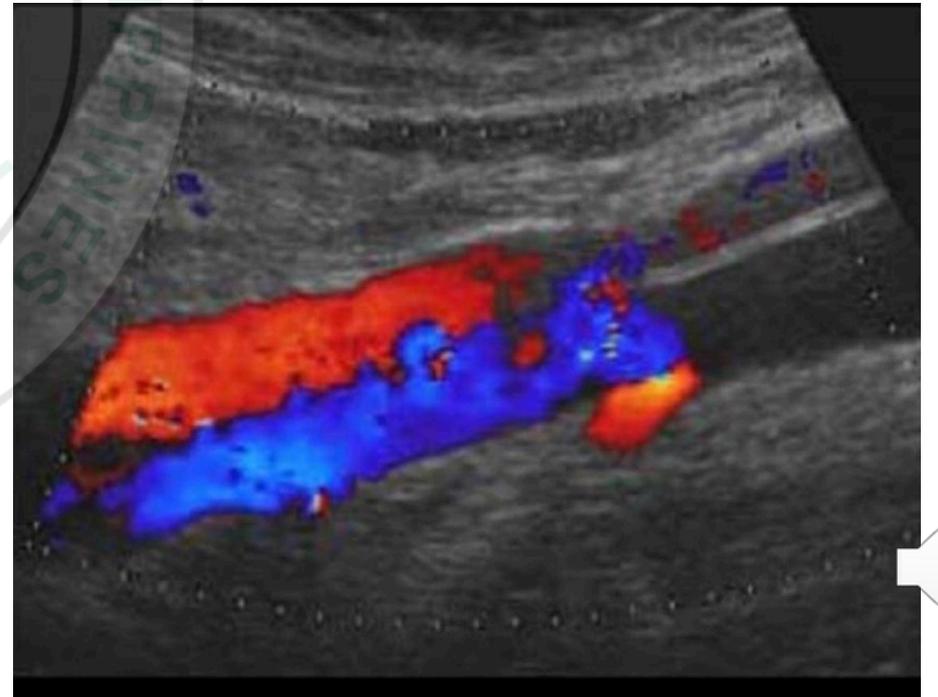
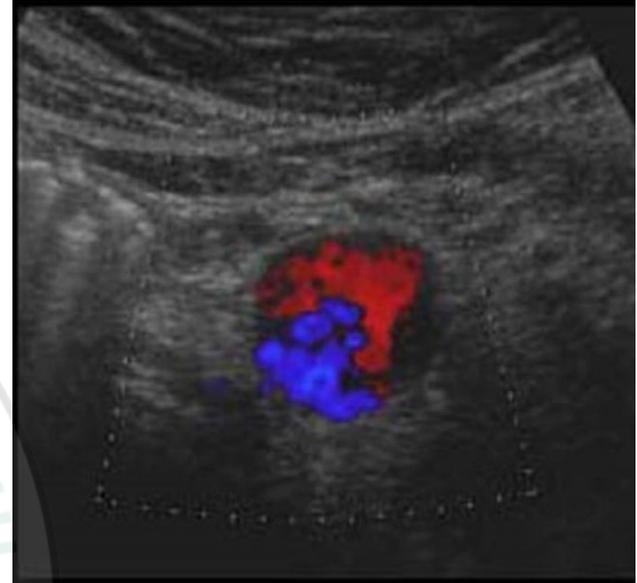
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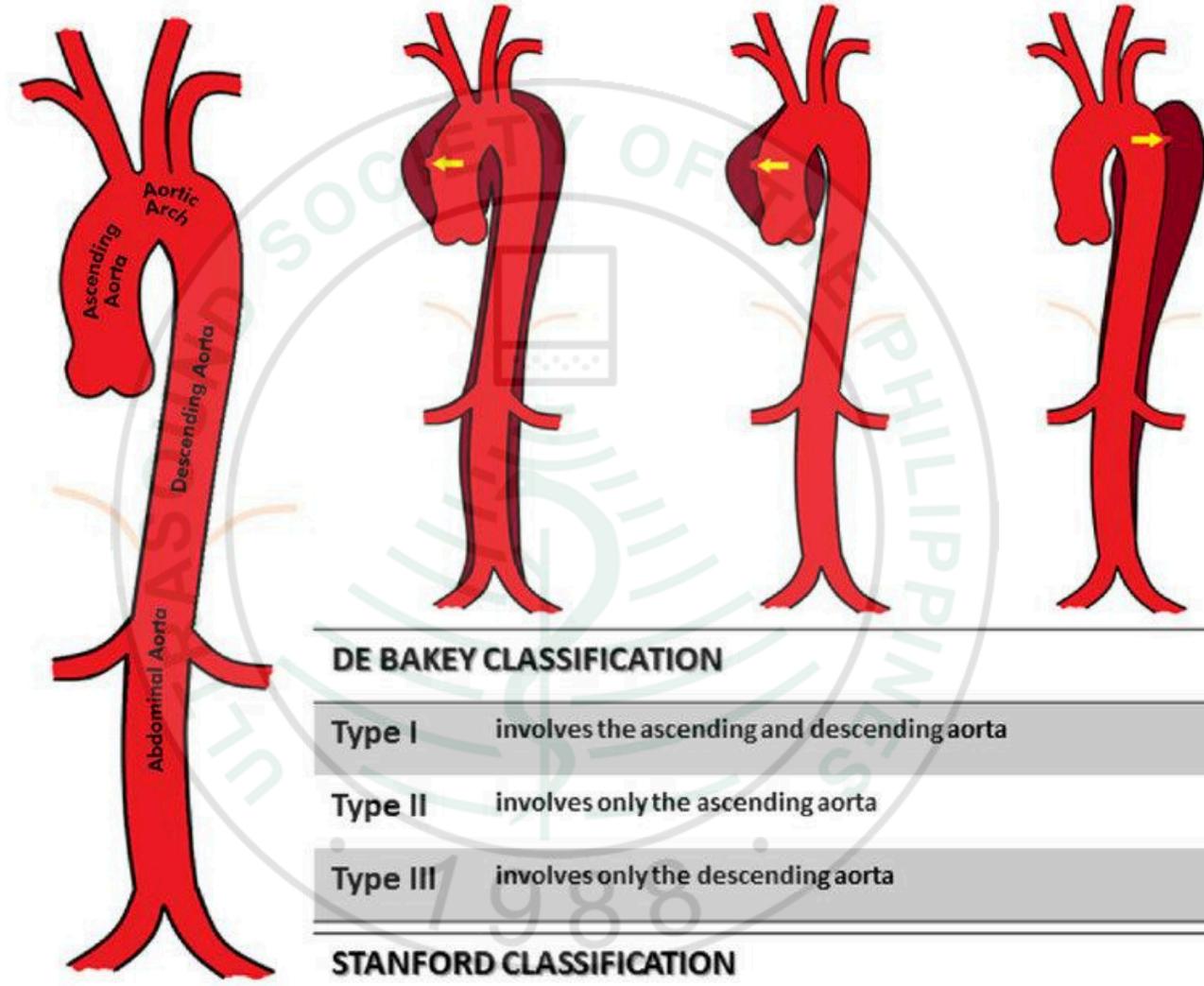


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 - Most important finding
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- **Aortic Enlargement**
 - Dilated aorta, typically **> 4 cm**
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 - Blood within the wall seen as an **echogenic area**
- **False Lumen**
 - Second lumen, may show **different flow** from the true lumen



STANFORD	TYPE A		TYPE B
DE BAKEY	TYPE I	TYPE II	TYPE III



NORMAL

DE BAKEY CLASSIFICATION

- Type I involves the ascending and descending aorta
- Type II involves only the ascending aorta
- Type III involves only the descending aorta

STANFORD CLASSIFICATION

- Type A involves the aorta proximal to the origin of left subclavian artery
- Type B involves the aorta distal to the origin of left subclavian artery



END

