Beth Israel Deaconess Medical Center
Sergio Alfaro, HMS III
Gillian Lieberman, MD

June 2015

Portal Venous Thrombosis: Tumor VS Bland Thrombus

SERGIO ALFARO, HARVARD MEDICAL SCHOOL YEAR III
GILLIAN LIEBERMAN, MD

Beth Israel Deaconess Medical Center
Sergio Alfaro, HMS III
Gillian Lieberman, MD

Overview

- Index Patient History
- Portal Venous Thrombosis (PVT)
- Imaging
- Associated Diseases
- Malignancies
- Thrombus Extent and Age
- Portal Cholangiopathy
- Long Term Management

INDEX PATIENT HISTORY

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Index Patient

- 66 year old man with history of hepatitis C (HCV), alcoholism and a cirrhosis
- HCV was treated with Pegylated Interferon and Ribavirin
  - Viral loads remain undetectable
- Recent diagnosis of hepatocellular carcinoma (HCC) and portal venous thrombosis
  - Incidental finding during Torso CT of spine for nerve pain

PORTAL VENOUS THROMBSIS

Sergio Alfaro, HMS III
Gillian Lieberman, MD

What is Portal Venous Thrombosis?

1) Presence of clot in portal vein lumen

OR

2) Permanent obliteration of portal vein with replacement by cavernoma

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Normal Hepatic Anatomy

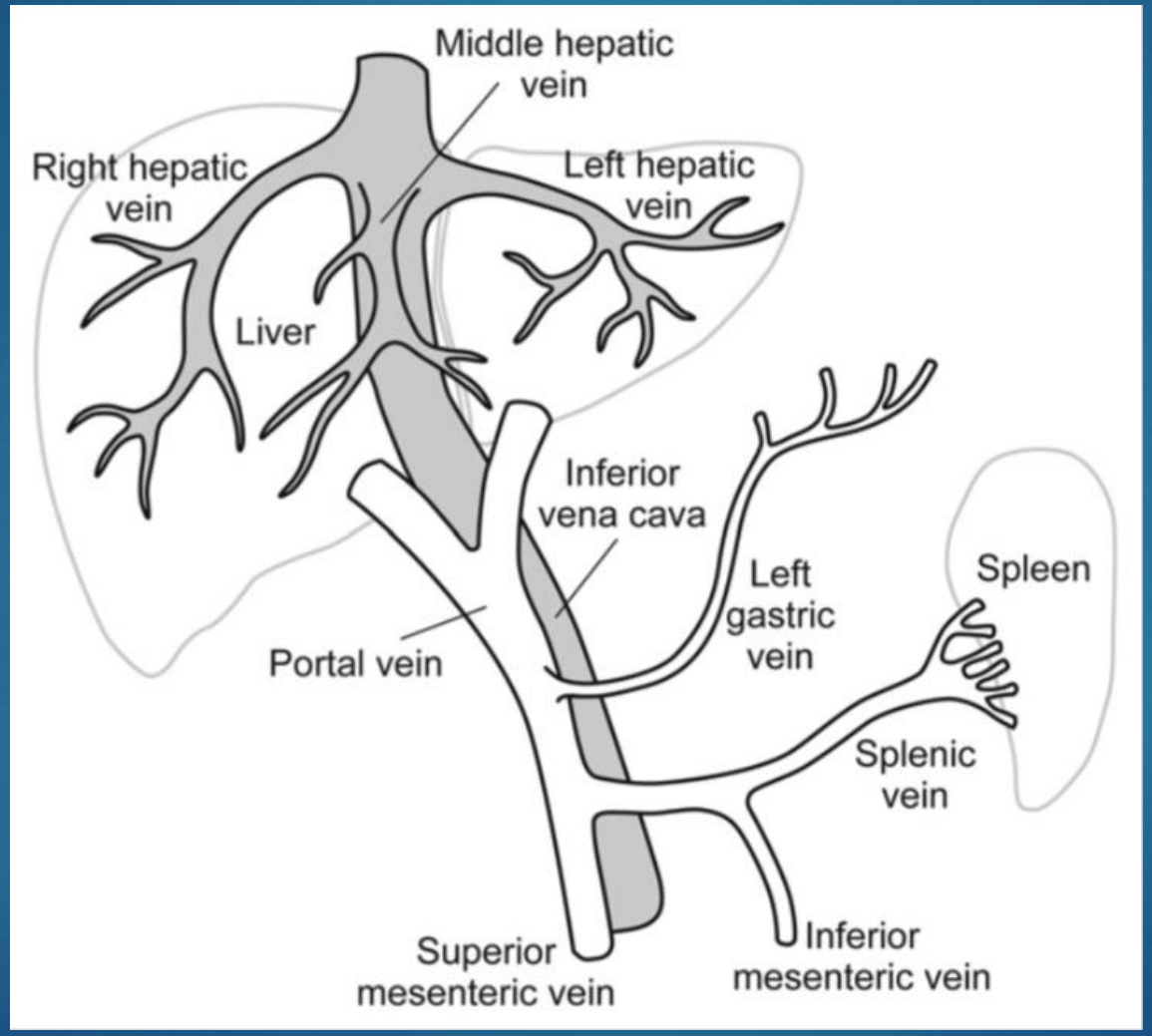


Image From *Parikh S, Shah R, Kapoor P. Portal Vein Thrombosis. Am J Med 2010; 123: 111-119.*

Beth Israel Deaconess Medical Center
Sergio Alfaro, HMS III
Gillian Lieberman, MD

Companion Patient 1 Malignant Thrombus and Cavernoma on CT

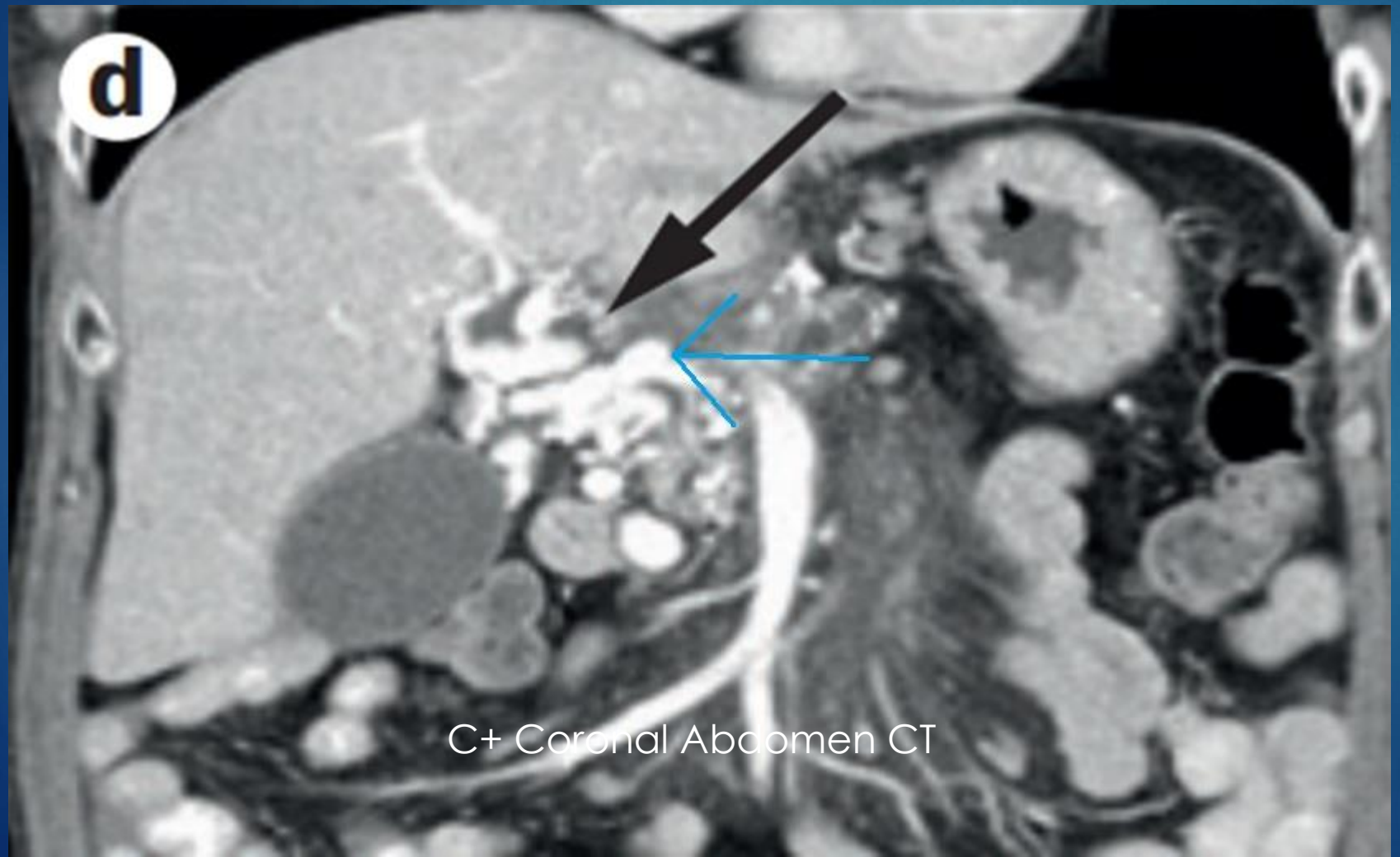


Image From *Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315*

Sergio Alfaro, HMS III
Gillian Lieberman, MD

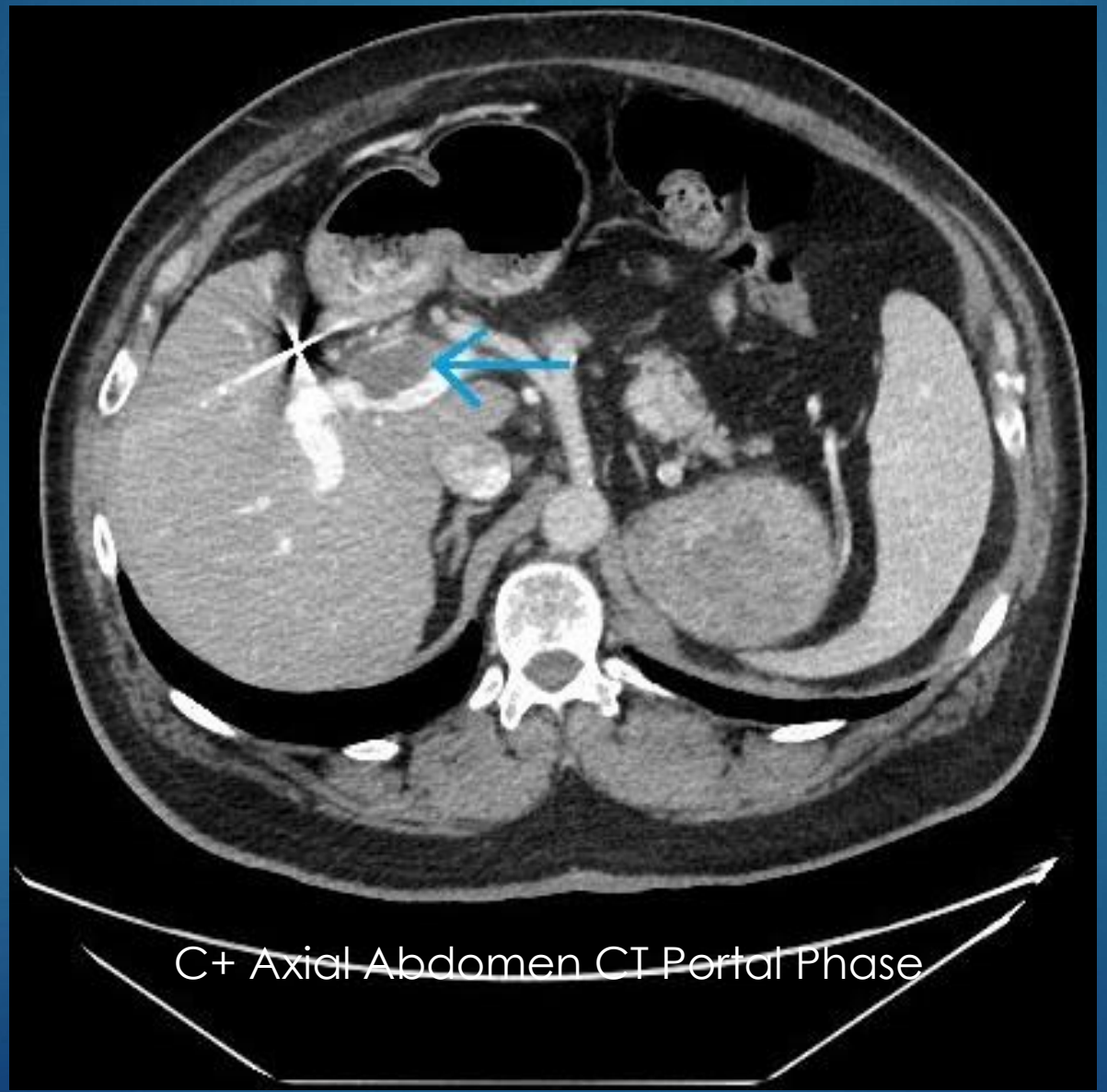
Classification of PVT

- Grade I: Thrombosis <50% of portal vein
- Grade II: >50% or complete thrombosis portal vein, may extend into superior mesenteric vein (SMV)
- Grade III: Complete thrombosis of portal vein and proximal SMV; patent distal SMV
- Grade IV: Complete thrombosis of portal vein and SMV (proximal and distal)

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Beth Israel Deaconess Medical Center
Sergio Alfaro, HMS III
Gillian Lieberman, MD

Index Patient's PVT on CT



C+ Axial Abdomen CT Portal Phase

Image From PACS BIDMC

Incidence of PVT

- General population ≈ 1%
- 60% of noncirrhotic and nonmalignant PVT associated with congenital or acquired thrombophilic disorders
- Patient with cirrhosis = 10-25%
  - Highest rate for those with decompensated cirrhosis

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Risk factors for PVT

1) Cirrhosis

2) Hepatocellular carcinoma

3) Abdominal septic foci

4) Acute pancreatitis

5) Hematological malignancies

6) Congenital or acquired prothombotic disorders

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Clinical Presentation of PVT

- Acute PVT in patients without underlying liver disease can be

1) Asymptomatic

OR

2) Paucisymptomatic

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

IMAGING

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Indications for Imaging a Probable PVT

1) Abdominal pain

2) Variceal bleeding

3) Cirrhosis

4) HCC

- Index patient had all of them except for #2

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

First Imaging Technique for PVT

- Ultrasonography (US)
  - Accuracy of 88-98%
  - In most studies sensitivity and specificity are 80-100%
  - Once visualized other imaging techniques not required to confirm diagnosis

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Appearance of PVT on US

- Benign thrombosis appears as an **isoechoic** or **hypoechoic** mass filling vessel

1) Partial/Mural Thrombosis

2) Complete Thrombosis

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Beth Israel Deaconess Medical Center
Sergio Alfaro, HMS III
Gillian Lieberman, MD

Companion Patient 2 Benign Thrombus US

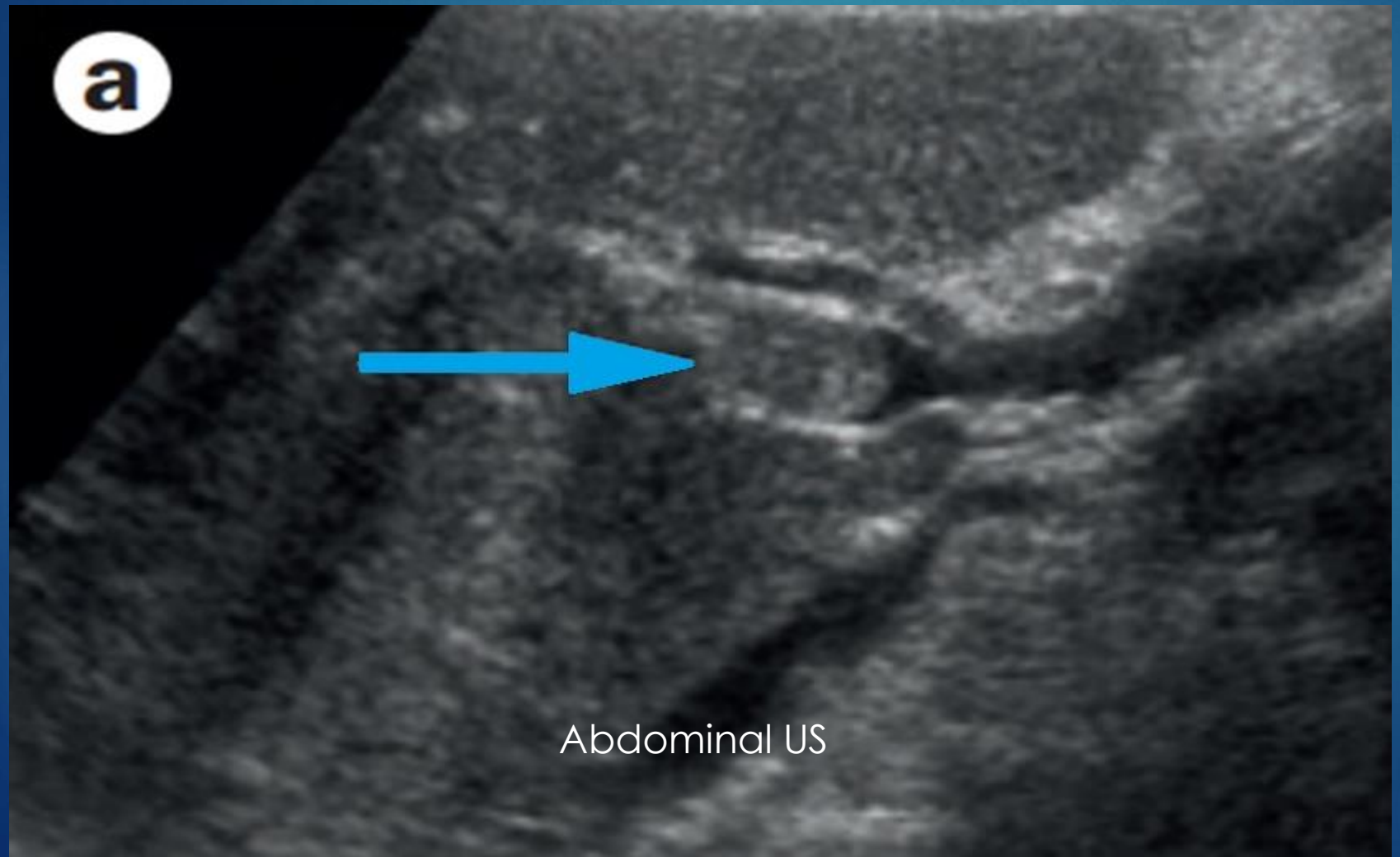


Image From *Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315*

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Signs of Malignant PVT on US

- Malignant PVT is characterized by any one of these:

1) Enlargement of portal vein due to thrombus

2) Disruption of the vessel's walls

3) Intra-thrombus arterial neovascularization

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Characterization of Thrombus with US

1) Color Doppler Ultrasonography (CDUS)

OR

2) Spectral Doppler (Pulsed Wave Ultrasonography, PWUS)

- These can confirm absence of flow

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

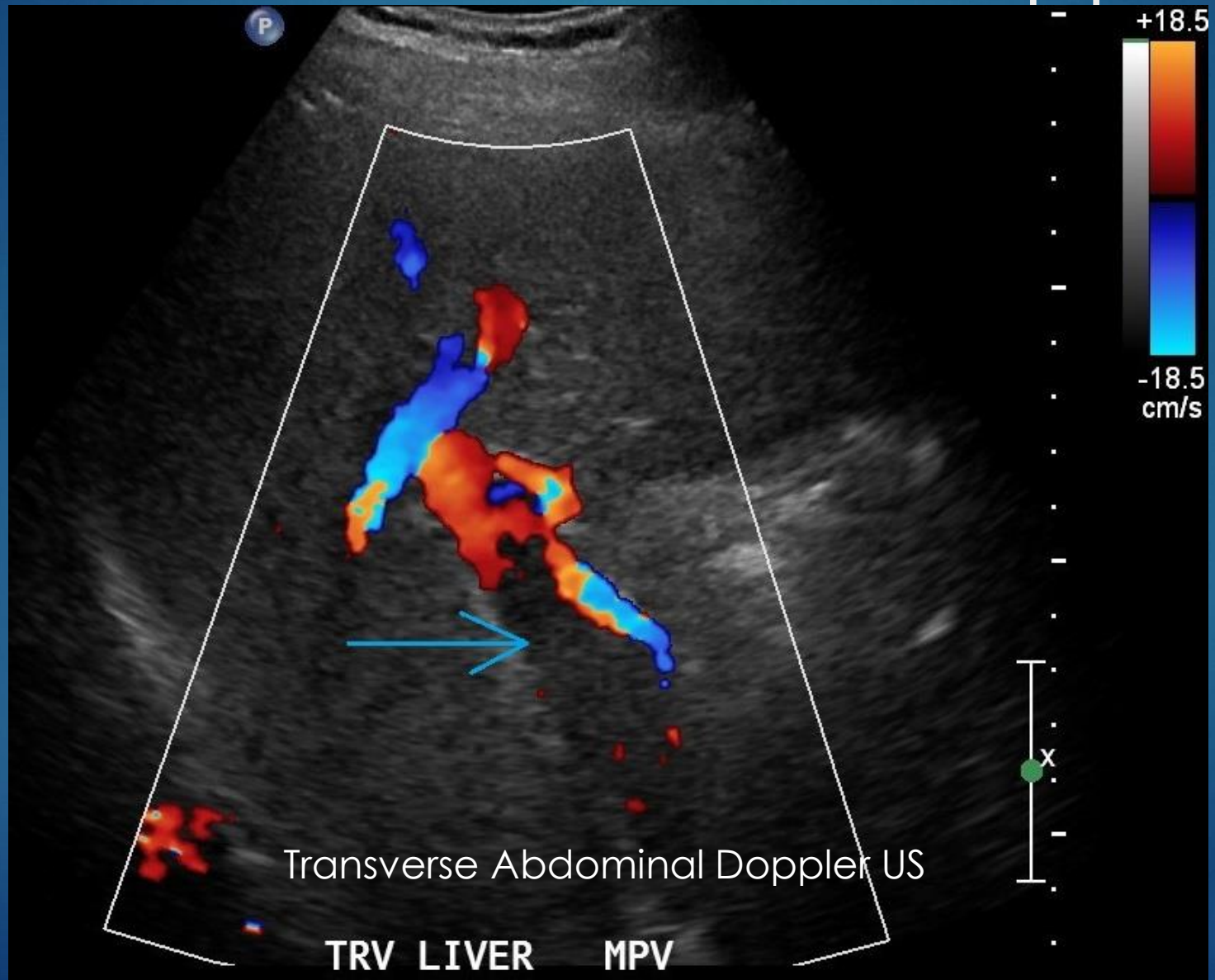
Color Doppler Ultrasonography

- Useful for assessment of portal cavernoma
- Cannot reliably exclude PVT in low portal vein blood flow velocity
  - Instead use Contrast-enhanced Ultrasonography (CEUS)
    - Great for assessing presence or absence of flow

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Beth Israel Deaconess Medical Center
Sergio Alfaro, HMS III
Gillian Lieberman, MD

Index Patient PVT Color Doppler US



Transverse Abdominal Doppler US

Image From PACS BIDMC

Drawbacks of US

- Reduced visualization in patients with abundant bowel gas or fat
- Reduced accuracy for the detection of thrombi in the splenic vein and SMV
- Cannot assess for bowel ischemia
- Only as good as the one using it so should be done by experienced professionals

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

If US Not Usable or Suspecting Ischemia

- Move on to either:

1) Contrast-Enhanced CT (CECT)

OR

2) Contrast-Enhanced MRI (CEMRI)

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Compare and Contrast CECT and CEMRI

- CECT and CEMRI similar accuracy for PVT diagnosis
  - Make choice based on resources and radiologist's experience
- CECT is faster than CEMRI
  - With fewer artifacts due to movement
  - Enable a quick, complete evaluation of whole abdomen
- CECT technique of choice for severe abdominal symptoms or signs

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Drawbacks of CECT

1) Ionizing radiation

2) Risks of allergic reaction to contrast

3) Risk of nephrotoxicity due to iodine-based contrast

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Contraindication for CEMRI

- Patients with renal failure
  - Risk of nephrogenic systemic fibrosis due to gadolinium-based contrast agents

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Contrast Imaging has Four Distinct Phases

1) Precontrast (0 sec)

2) Arterial (20-25 sec)

3) Portal (60-70s recommend 80s)

4) Late (3 minutes)

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Contrast Imaging Phase Discussion

- Best phase to diagnose PVT: Portal
- Worst phase to diagnose PVT: Late arterial
- Possible false-positive with low portal venous flow
  - Delayed arrival of contrast = appearance of filling defect

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

ASSOCIATED DISEASES

Actively Search for Septic Foci

- Act as local factor increases risk of nonmalignant PVT
  - CT and MRI more accurate than US for assessing presence of:
    1) Diverticulitis
    2) Abdominal abscesses
  - CT method of choice in patients with fever OR symptoms suggestive of infection

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Cirrhosis versus Noncirrhosis PVT

- US best method to discover if liver is cirrhotic
  - Single most accurate sign is **liver surface nodularity**
  - Best seen with high-frequency probes

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Beth Israel Deaconess Medical Center
Sergio Alfaro, HMS III
Gillian Lieberman, MD

Companion Patient 3 Nodular Liver Surface US

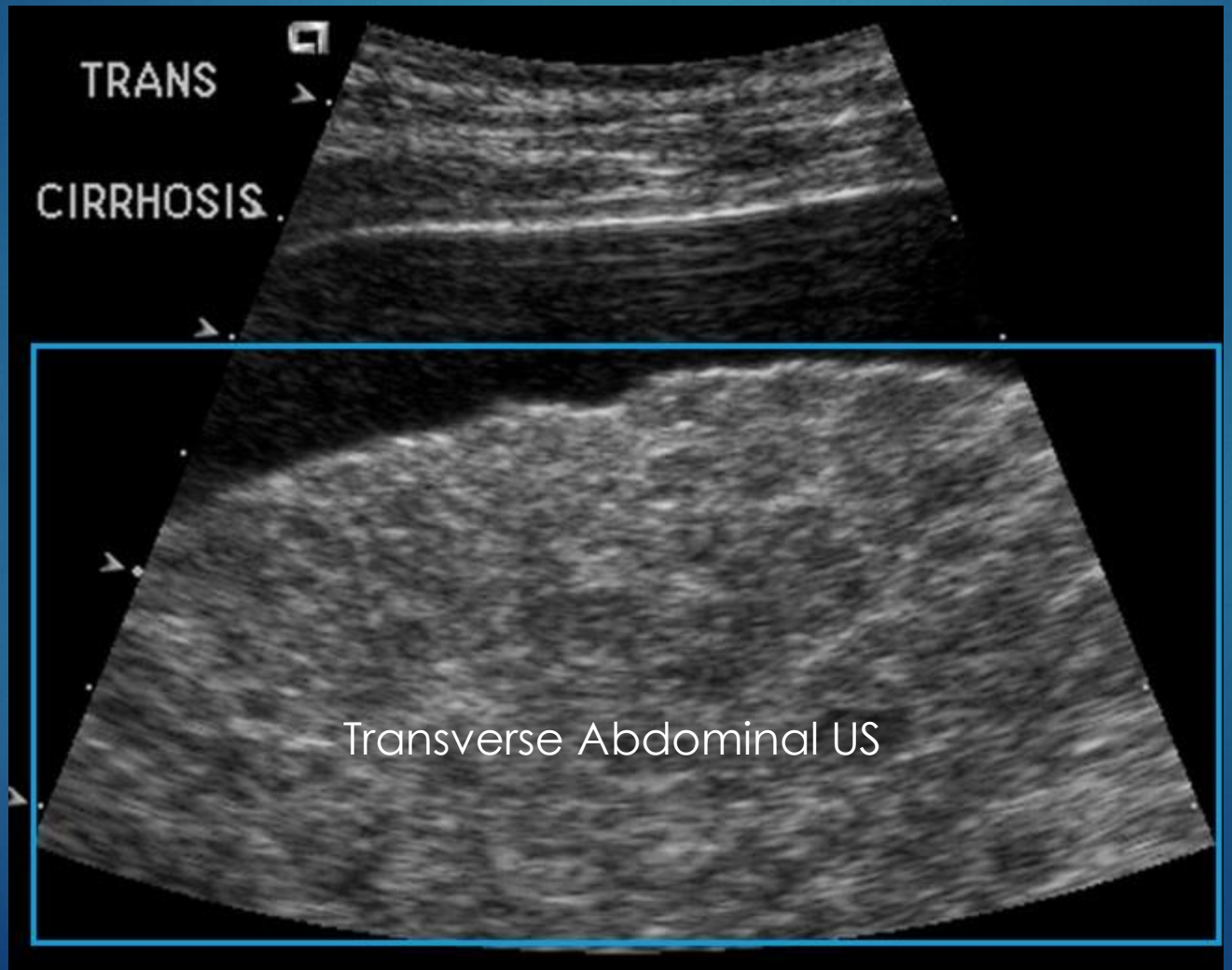


Image From *Journal of Ultrasound* *http://www.jultrasoundmed.org/content/21/9/1023/F7.expansion*

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Signs Not Specific for Cirrhosis

1) Atrophy of right liver lobe and lateral segment of left liver lobe

2) Hypertrophy of caudate lobe and fourth liver segment

   - Both of these seen in 91% of patients with non-cirrhotic cavernomatosis

3) Curling of hepatic veins

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Cirrhosis and Idiopathic Portal Hypertension

- Long-lasting PVT in patients with idiopathic portal hypertension
  - Indistinguishable via imaging

- Gold standard for those whom cannot be classified:

  Liver Biopsy

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

US and Nodules

- US alone is NOT accurate enough characterize nodules in cirrhosis
- CT or MRI used for comprehensive abdominal assessment in new diagnosis of PVT

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

MALAGNANCIES

Intrahepatic and Extrahepatic Malignancies

- US screening method of choice to ID malignant nodules in Cirrhosis
- Screen for presence of direct invasion of portal vein
  - Caused by malignancies such as pancreatic carcinoma or HCC

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Benign VS Malignant Thrombosis in HCC

- Malignant invasion of portal vein occurs in 12-30% of patients with HCC
- Nonmalignant PVT can be caused by concurrent cirrhosis
- Existence of malignant PVT contraindicates:
  1) Locoregional therapies
  2) Liver transplantation
- Accurate extensive imaging work-up needed in patients with both HCC and cirrhosis

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Differentiate Between Benign from Malignant PVT on US

- US and Doppler
  - Bland Thrombus
    1) Non continguous with primary tumor
    2) Normal lumen diameter
    3) No intraluminal vascularity
  - Malignant Thrombus
    1) Continuity of tumor with adjacent vein
    2) Abnormal arterial vascularity
    3) Irregular and expanded venous lumen

Rohatgi S, Howard SA, Tirumani SH, Ramaiya N, Krajewski KM. Multimodality Imaging of Tumour Thrombus. CARJ. 2015; 66: 121-129

Differentiate Between Benign from Malignant PVT on CECT

- CECT
  - Bland Thrombus
    1) Appear homogenous
    2) No contrast enhancement
  - Malignant Thrombus
    1) Contiguity with tumor mass
    2) Adherent to vessel wall
    3) Variable degrees of enhancement similar to primary mass
       a) Hyper enhancement arterial phase
       b) Wash-out late phase

Rohatgi S, Howard SA, Tirumani SH, Ramaiya N, Krajewski KM. Multimodality Imaging of Tumour Thrombus. CARJ. 2015; 66: 121-129

Index Patient's PVT

- Thrombus showed an increase of Hounsfield unit (HU) during arterial phase
  - Due to take up of contrast in thrombus
  - Now considered a malignant PVT

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Differentiate Between Benign from Malignant PVT on CEMRI

- CEMRI
  - Bland Thrombus
    1) Low signal intensity on T2 weighted sequences
    2) No contrast enhancement
  - Malignant Thrombus
    1) Intermediate to increased signal on T2 weighted sequences
    2) Contrast enhancement in arterial phase
    3) Direct extension from tumor
    4) Vessel lumen expansion

Rohatgi S, Howard SA, Tirumani SH, Ramaiya N, Krajewski KM. Multimodality Imaging of Tumour Thrombus. CARJ. 2015; 66: 121-129

THROMBUS EXTENT AND AGE

Must Know Extent of Thrombosis!

- Important for planning effective treatment
- Description should include:
    1) Qualitative data regarding vessels involved
        a) Portal, splenic and mesenteric veins
    2) Patency of intrahepatic branches of portal vein
    3) Qualitative and quantitative data on degree of obstruction
        a) Either partially or totally occlusive

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Extent of Thrombosis and Imaging Modality

- US can accurately describe PVT in portal vein and intrahepatic branches
  - Can pick up a minimal amount of ascites
  - NOT accurate enough to exclude thrombosis extension to splenic/mesenteric vein
- Thus CECT or CEMRI is indicated to evaluate thrombosis extent
  - 1st imaging done carefully since will be used to gauge subsequent exams

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

CECT and CEMRI Better than US for Imaging Collateral Veins

- For abdominal portosystemic collaterals describe:
  1) Number
  2) Position
  3) Size

- Collaterals commonly seen arising from left and short gastric veins
  - Tend to feed spleno-renal collaterals
  - Unknown incidence and prevalence

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Ectopic Collaterals Outside Oesophago-gastric junction

- 40% more common in patients with thrombosis of portal venous system

- Ectopic collaterals include vessels in:

  1) Gall bladder wall

  2) Transparietal hepatic vessels

  3) Site of biliary-enteric and entero-cutaneous surgical anastomosis

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Presence of Collaterals Important

- Can dictate treatment
- For example patients with severe lower GI bleeding
  - Ectopic Varices might enable surgical approach
- Large collaterals might be used in selected patients with complete thrombosis
  - May attempt surgical shunting OR portal reconstruction in liver transplant

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Estimation on Age of Thrombus Needed

- Acute PVT much higher chance of recanalization during anticoagulant therapy VS chronic PVT
- Differentiation between Acute and Chronic challenging

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Signs of Chronicity Revealed with Imaging

- CT and MRI more accurate than US on finding remnant of portal vein
- Look for:
    1) Complete obliteration of vessel with no apparent remnant
    2) Presence of a cavernoma
- US can wrongly diagnose remnant portal vein when viewing large collateral vessels within a cavernoma

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Calcifications

- On US or CT (NOT MRI) may see calcifications of vessel wall or thrombus
  - Pathognomonic finding in chronic thrombosis
  - Should fully investigate for candidates of liver transplantation
    - Will add complexity to surgery
- Episodes of acute re-thrombosis may take place on top chronically affected vessel
  - May explain acute symptoms despite features of chronic thrombosis

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

PORTAL CHOLANGIOPATHY

What is Portal Cholangiopathy?

- Abnormalities of biliary system and gallbladder
  - Due to extrinsic vascular compression from peribiliary collateral vessels on bile ducts
- Transversal studies (such as MRI) have shown that >80% of patients with this disease also have portal cavernoma
- Few patients develop symptoms at follow-up
- Lab test not useful to predict risk of symptomatic disease

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Portal Cholangiopathy Imaging

- Magnetic Resonance Cholangiography (MRC) is method of choice to study biliary duct
  - Enables accurate ID in patients with PVT

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

MRC and Portal Cholangiopathy

- Appearance of portal Cholangiopathy found to be early event in PVT
  - Once abnormalities of biliary tree appear they do not progress
- Findings correlate with risk of developing clinical symptoms
  - Limited to patients showing dilatation of biliary tree (Grade 3)

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Grading Severity of Biliary Tree Abnormalities

Absent: No abnormalities

Grade 1: Minimal irregularities or angulation of the biliary tree

Grade 2: Indentations or strictures without dilation of the biliary tree

Grade 3: Strictures with dilation

intrahepatic duct ≥ 4mm

or

extrahepatic duct ≥ 7mm

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Recommendation

- MRC performed at time of diagnoses in all patients with:
  - 1) chronic PVT
    - OR
  - 2) acute PVT after 9-12 months if anticoagulant therapy fails
- This is to assess presence of portal cholangiopathy
- At 12 month follow up if no development of grade 3 portal cholangiopathy no further MRC needed
  - No progression is expected to occur

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

LONG TERM MANAGEMENT

Proposed Follow up Management

- MRI or CT control performed 3-6 months after starting anticoagulant therapy
- CDUS evaluation characterization of PVT to see if correlates well with CT or MRI
- Report information about:
    1) Improvement
    2) Stability
    3) Progression of PVT in all vessels
- Repeated every 6 months with CDUS whenever possible
    - If cannot than use CECT or CEMRI

Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315

Algorithm for PVT

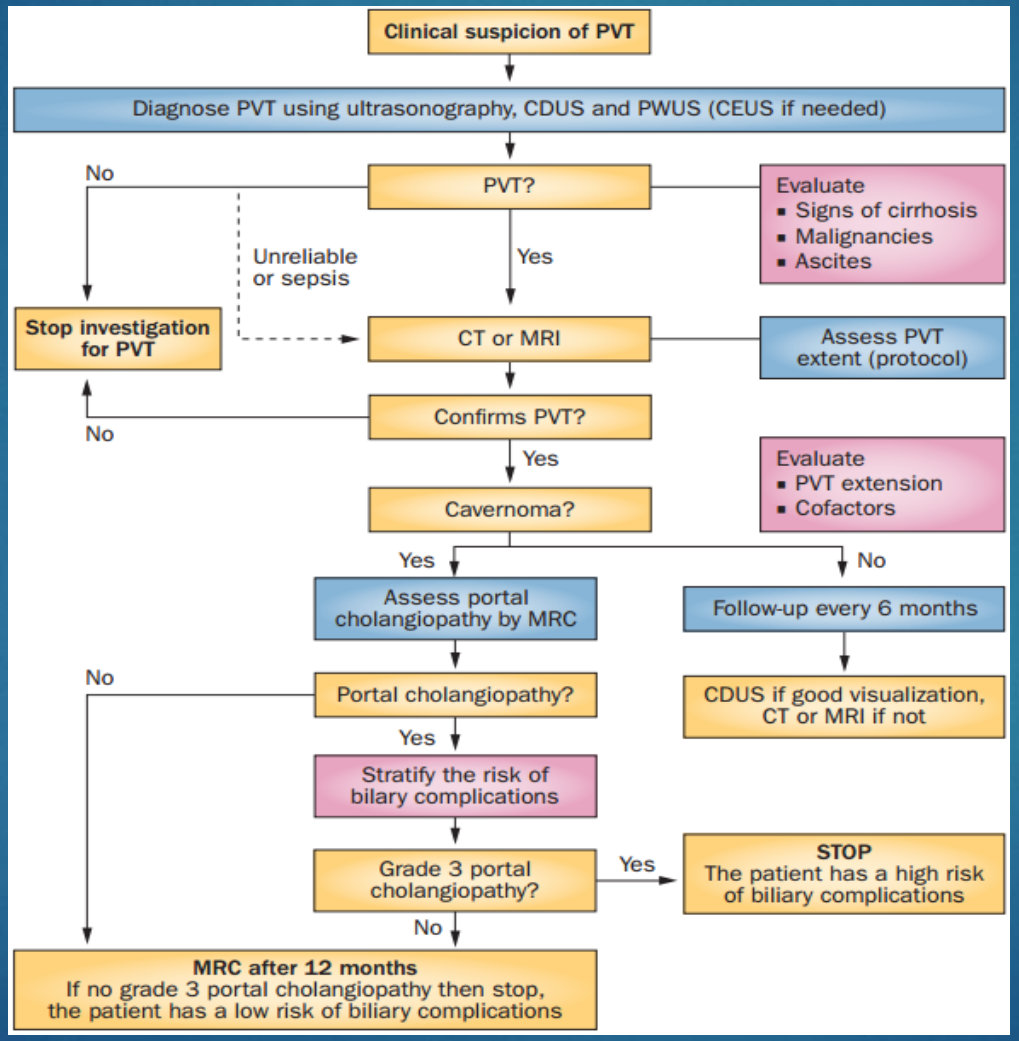


Image From *Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. Nat. Rev. Gastroenterol. Hepatol. 2014; 11: 308-315*

Sergio Alfaro, HMS III
Gillian Lieberman, MD

Summary

- PVT can present with or without symptoms
- US, CECT and CEMRI are imaging modalities of choice
- Septic Foci, Cirrhosis and Maligancies (HCC) are some diseases associated with PVT
- Thrombus extent and age are important for planning of treatment
- It is important to keep an eye on Portal Choangiopathy to prevent worsening of patients condition

Acknowledgments

- Rashmi Jayadevan, MD
- Gillian Lieberman, MD
- Joseph Singer

References

- Berzigotti A, Garcia-Criado A, Darnell A, Garcia-Pagan J-C. Imagining in clinical decision-making for portal vein thrombosis. *Nat. Rev. Gastroenterol. Hepatol.* 2014; 11: 308-315
- Journal of Ultrasound http://www.jultrasoundmed.org/content/21/9/1023/F7.expansion
- Parikh S, Shah R, Kapoor P. Portal Vein Thrombosis. *Am J Med* 2010; 123: 111-119.
- Rohatgi S, Howard SA, Tirumani SH, Ramaiya N, Krajewski KM. Multimodality Imaging of Tumour Thrombus. *CARJ*. 2015; 66: 121-129