Portal Vein Thrombosis

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Agenda

- Introduce index patient
- Discuss portal vein thrombosis (PVT)
  - Etiology
  - Menu of radiologic tests
  - Complications
- Review hepatic anatomy and vasculature
- Companion Cases
- Review various treatment options
Let's meet our patient ...
Ms. S: Initial presentation

- Ms. S is a 61 year old woman with ulcerative colitis and primary biliary cirrhosis (PBC) who was transferred from an outside hospital with worsening abdominal pain, bloody diarrhea and ascites.
  - Her ulcerative colitis had become steroid-unresponsive during the weeks prior to admission.
  - She has had PBC for ten years and her illness has been complicated by ascites and hepatic encephalopathy.

A review of her outside hospital CT showed a possible portal vein thrombus.
Portal Vein Thrombus: Overview

- Rare event but can have serious clinical consequences

Types
- Acute or chronic
- Bland or malignant

Presentation
- Often subtle or asymptomatic
  - Symptoms are often those of primary illness
    - GI bleeding, abdominal pain, varices, ascites and splenomegaly
- In symptomatic patients, variceal bleeding is the most common presentation

Complications
- Portal hypertension from increased pressure to portal vein obstruction
- Thrombus can spread to splanchnic veins and potentially cause mesenteric ischemia, which is a surgical emergency

*High clinical suspicion and effective interpretation of radiologic findings are key to making the diagnosis of portal vein thrombus*
Etiology of Portal Vein Thrombus

- **Cirrhosis**
  - 25% of patients with PVT have cirrhosis
    - 1% of patients with cirrhosis develop PVT
    - Likelihood of developing thrombus is associated with severity of disease
  - Stasis of flow in portal system predisposes to clot formation
  - Deficiency of protein C, protein S and antithrombin III lead to a hypercoagulable state

- **Malignancy**
  - Hepatocellular carcinoma (HCC), pancreatic cancer
  - Development of thrombus is a poor prognostic factor in HCC

- **Hypercoagulable states**
  - Factor V Leiden, Prothrombin gene mutation, Protein C deficiency, Protein S deficiency, Antithrombin III deficiency
  - Myeloproliferative disease

- **Infection**
  - Rare cause of PVT
  - Intra-abdominal infection such as diverticulitis and appendicitis can cause a pylephlebitis of portal vein
  - In the pediatric population, omphalitis (infection of umbilical stump) can spread to portal vein

- **Post surgical**
  - Post splenectomy
  - Post transplant, secondary to surgical manipulation of portal system

**Often multifactorial**

**Etiology unknown in up to 1/3 of cases**
Portal vein thrombosis is a *radiologic* diagnosis.

Let’s take a look at the various options for imaging ...
# PVT: Menu of Radiologic Tests

<table>
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<tr>
<th>Test</th>
<th>Indications &amp; Findings</th>
<th>Advantages</th>
<th>Disadvantages</th>
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| Ultrasound      | - Echogenic thrombus  
                 - No blood flow on Doppler                                                | - Non invasive      | - Operator dependent  
                 - Acute thrombi could be hypoechoic or anechoic  
                 - Difficult to assess splenic vein and other branches due to background liver echogenicity |
| Contrast CT     | - Non-enhancing filling defect within lumen  
                 - Rim enhancement  
                 - Variations with phase                                                  | - Readily available | - Contraindicated in patients with contrast allergy, renal insufficiency    |
| MRI             | - Can see increased signal intensity on T2                                  | - Non invasive      | Expense  
                 - No contrast                                                             | Claustrophobia  
                 - Ascites may cause artifact                                                |
| Angiography     | - Often pre-operative or during TIPS  
                 - Filling defect                                                          | - Gold standard     | Invasive  
                 - Shows extent, location and severity of thrombus                          | Contrast         |
| MRA / CTA       | - Filling defect                                                           | - Good visualization of collaterals                                      | Invasive  
                 - Contrast                                                               |
Anatomy Review

Portal venogram showing main, left and right portal veins

© Elsevier Drake et al: Gray’s Anatomy for Students - www.studentconsult.com
Ms. S: Patent Left Portal Vein and Left Portal Vein thrombosis on CT

Abdominal CT 1 month prior to admission

Abdominal CT on admission

Patent left portal vein

Left portal vein occlusion

* ascites
Portal Vein Thrombus: CT Findings

- Non enhancing filling defect within lumen
- Rim enhancement
  - Flow through dilated vasa vasorum
  - Increased flow around periphery of clot
- Can see phase dependent changes
  - Enhancement during arterial phase as hepatic artery compensates for decreased blood flow from portal system
  - Decreased attenuation during portal venous phase
- Occasionally can see calcifications in chronic thrombus
- Can see arterial phase enhancement if malignant thrombus
Ultrasound of Portal System

- Can detect presence, direction and characteristics of portal venous blood flow
  - *hepatopetal* = flow toward liver
    - Normal direction of portal venous flow
  - *hepatofugal* = flow away from liver

- Normal portal venous flow is continuous hepatopetal with minimal respiratory variation

- Hepatofugal flow in the portal system develops when pressure in portal system is greater than pressure in collateral vessels

- Thrombus in portal vein would show absence of flow and an echogenic thrombus
Ms. S: Patent Portal Vein on US

- Transverse color doppler ultrasound of main portal vein
- Flow depicts patent main portal vein

- Transverse color doppler ultrasound of left portal vein
- Flow depicts patent left portal vein
- Possible small echogenic thrombus in left portal vein
Ms. S: Clinical Course

- **Ulcerative Colitis**
  - Treated with an infusion of Remicade, a TNF-\(\alpha\) inhibitor
  - Received 2 units packed red blood cells

- **Primary biliary cirrhosis**
  - Developed hepatic encephalopathy
    - Treated with lactulose and rifaximin
  - Therapeutic paracentesis

- **Tested positive for HIT antibodies**
  - Lower extremity ultrasound showed no DVTs

- **Acute PVT**
  - Review of outside hospital CT showed left portal vein thrombus
  - Doppler ultrasound revealed patent left portal vein, though non-occlusive thrombus could not be ruled out
  - Anticoagulation contraindicated given GI bleeding
  - Scheduled for follow up CT in 2 weeks

Represented within 2 weeks for acute decompensation of end stage liver disease
Ms. S underwent ultrasound and CT scans which showed progression of her portal vein thrombus.
Ms. S: Portal Vein Thrombus on Ultrasound

No flow in main portal vein
Echogenic thrombus

Next Step?
Ms. S: Main Portal Vein Thrombus on CT

- Non enhancing filling defect in main PV
- Multiple collateral vessels
- ascites
Ms. S: Left and Right Portal Vein Thrombi on CT

- Left portal vein occlusion
- Right portal vein occlusion

Contrast enhanced abdominal CT, axial images, portal venous phase
Ms. S: Superior Mesenteric Vein Thrombus on CT

Filling defect in superior mesenteric vein (SMV)
Ms. S: Main Portal Vein and SMV Thrombus on CT

- Thrombus in main portal vein
- Thrombus in SMV
- Ascites
- Multiple collateral vessels

Contrast enhanced abdominal CT, portal venous phase, maximum intensity projection, coronal reconstruction
Ms. S: Interim Clinical Course

- Acute liver failure
  - MELD 28, up from 13 during last admission
  - Total bilirubin 16.4, up from 2.6 during last admission
- She developed a leukocytosis which was concerning for possible spontaneous bacterial peritonitis
- Hypotensive and tachycardic
  - Placement of central line
- She became hypoxic to 88% on RA
  - Chest x-ray to evaluate hypoxia
Ms. S: Pneumothorax and Pleural Effusion on Chest X-RAY

- Right pleural effusion
- Left pneumothorax
- Collapsed left lung
- Central line → possible cause of pneumothorax

- Chest tube with re-expanded left lung
Ms. S: Clinical Progression

- Significant clinical decompensation, most likely due to occlusive portal vein thrombus
  - Anticoagulation contraindicated given GI bleed
  - The transplant team was consulted
    - She was not a candidate for transplant because of her ulcerative colitis and possible sepsis

- She developed disseminated intravascular coagulation and methicillin-resistant staph aureus bacteremia

- She was ultimately made comfort measures only and passed away soon after
Ms. S’s case demonstrated an acute, bland thrombus in the setting of cirrhosis.

Let’s move on to see features of portal vein thrombus caused by a tumor in two companion patients.
Companion Patient #1: Portal Vein Tumor Thrombus on CT

- 71 year old male with a history of hepatitis B who presents with two days of epigastric pain, frequent bowel movements and fecal incontinence

Large hypoattenuating mass in right lobe of liver extending into portal vein
Tumor Thrombus: Radiologic Features

- Often see dilation of portal vein
  - Diameter > 23mm*
- Intrathrombus neovascularity
  - Arterial enhancement on CT
  - Pulsatile flow on doppler US
- “Thread and streak sign”
  - multiple enhancing intraluminal smaller vessels that can be seen at arterial phase imaging
- Contiguity to tumor
  - Often with direct invasion

* Tublin et al., “Benign and malignant portal vein thrombosis.”
Companion Patient #1: Inferior Vena Cava and Right Atrial Thrombi on CT

Right atrial tumor thrombus
Companion Patient #2: PVT and Cavernous Transformation on CT

- 52 year old male with a three year history of renal cell carcinoma with liver metastases and known left portal vein thrombus

Contrast enhanced abdominal CT, portal venous phase, maximum intensity projection, coronal reconstruction

Left portal vein thrombus

Multiple hypoattenuating lesions consistent with metastatic disease

Multiple serpiginous periportal collateral vessels = CAVERNOUS TRANSFORMATION
Cavernous Transformation

- Formation of multiple venous collaterals when portal system is obstructed
  - Necessary to drain tributaries of portal vein and maintain adequate hepatic perfusion
  - Can be porto-porto (bypassing obstruction) or porto-systemic

- Good imaging of collaterals is important for surgical planning

- Imaging techniques
  - CT, US, MRI, CTA, MRA
  - Appearance: spongelike, serpiginous, corkscrew, netlike
Collateral Circulation

- Reversal of flow into low pressure collateral veins due to portal hypertension
- Major porto-systemic collaterals
  - Left gastric vein, short gastric veins, esophageal veins
    - Anastomose with azygous system
    - Esophageal varices
- Para-umbilical and abdominal wall veins
  - Caput medusa
- Splenorenal shunts
- Rectal varices
- Bleeding from varices causes significant morbidity
Companion Patient #3: Porto-Porto Collaterals on CT and MRA

- Cavernous transformation on contrast enhanced CT scan, portal venous phase
- Cavernous transformation on MRI angiography
Companion Patient #4: Cirrhosis on CT scan

- 57 year old male with a history of alcoholic cirrhosis, portal hypertension, gastroesophageal varices and chronic portal vein thrombosis
- Presented for possible transjugular intrahepatic porto-systemic shunt (TIPS) procedure to alleviate portal hypertension

![Shrunken, cirrhotic liver](image)
The patient had a percutaneous venogram to visualize the portal system during his TIPS attempt.
Companion Patient #4: Portal Vein Thrombus on Percutaneous Venogram

- Blocked main portal vein
- Large splenic collateral to left and right portal veins effectively replacing main portal vein
Treatment Modalities for PVT

- Treatment dependent on nature of clot
  - Acute, recent or chronic
- Treat for varices with sclerotherapy or banding
- Direct thrombolysis with tPA or streptokinase in acute clot
- Long-term anticoagulation
  - At least three months, longer if underlying hypercoagulable state
- Mechanical thrombectomy
- TIPS
  - Controversial
    - Contraindicated if complete occlusion or significant cavernous transformation
  - Can reduce risk of variceal bleeding
  - Often in conjunction with mechanical thrombectomy or direct thrombolysis
  - Indications: failed sclerotherapy, ascites, pre-operative
  - Risk of embolism
Summary

- Portal vein thrombus is rare in the general population but not rare in the cirrhotic population
- Often asymptomatic
  - Consider workup in a patient with variceal bleed, new ascites or sudden decompensation in a patient with cirrhosis
- Ultrasound and CT are first line for diagnosis
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References


