Portal hypertension in adults

AUTHORS: Wissam Bleibel, MD, Sanjiv Chopra, MD, MACP, Michael P Curry, MD
SECTION EDITOR: Bruce A Runyon, MD, FAASLD
DEPUTY EDITOR: Kristen M Robson, MD, MBA, FACG

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: **Sep 2023.**
This topic last updated: **Sep 06, 2022.**

INTRODUCTION

Portal hypertension often develops in the setting of cirrhosis, schistosomiasis, or extrahepatic portal vein thrombosis. It is the result of resistance to portal blood flow and may lead to complications such as variceal bleeding and ascites.

This topic will review the development, clinical manifestations, and diagnosis of portal hypertension in adults. The causes of portal hypertension and the treatment of its complications are discussed in detail elsewhere:

- (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis".)
- (See "Noncirrhotic portal hypertension".)
- (See "Cirrhosis in adults: Overview of complications, general management, and prognosis", section on 'Preventing complications'.)
- (See "Primary prevention of bleeding from esophageal varices in patients with cirrhosis" and "Methods to achieve hemostasis in patients with acute variceal hemorrhage" and "Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis".)
- (See "Portal hypertensive gastropathy".)
- (See "Ascites in adults with cirrhosis: Initial therapy" and "Ascites in adults with cirrhosis: Diuretic-resistant ascites".)
- (See "Spontaneous bacterial peritonitis in adults: Treatment and prophylaxis".)
- (See "Hepatic hydrothorax", section on 'Management'.)

- (See "Hepatopulmonary syndrome in adults: Natural history, treatment, and outcomes", section on 'Treatment and prognosis'.)
- (See "Portopulmonary hypertension", section on 'Treatment'.)

PATHOPHYSIOLOGY

Portal hypertension develops when there is resistance to portal blood flow and is aggravated by increased portal collateral blood flow [1]. The resistance most often occurs within the liver (as is the case in cirrhosis), but it can also be prehepatic (eg, portal vein thrombosis) or posthepatic (eg, Budd-Chiari syndrome). (See "Noncirrhotic portal hypertension", section on 'Etiology'.)

There are two components to the increased resistance, structural changes and dynamic changes [1]. Structural changes occur when there is distortion of the liver microcirculation by fibrosis, nodules, angiogenesis, and vascular occlusion. Dynamic changes occur when there is contraction of activated hepatic stellate cells and myofibroblasts that surround hepatic sinusoids and are in the fibrous septa and vascular smooth muscle cells of the hepatic vasculature. The dynamic changes are thought to be due to increased production of vasoconstrictors (eg, endothelins, angiotensin-II, norepinephrine, thromboxane A2) and reduced release of endothelial vasodilators (eg, nitric oxide).

As portal hypertension worsens, splanchnic blood flow is increased because of local release of vascular endothelial growth factor, nitric oxide, and other splanchnic vasodilators that cause splanchnic arteriolar vasodilation and angiogenesis. In addition to worsening the portal hypertension, these changes also lead to systemic hypotension, vascular underfilling, stimulation of endogenous vasoactive systems, plasma volume expansion, and increased cardiac output, factors that are important in the development of ascites. (See "Pathogenesis of ascites in patients with cirrhosis", section on 'Portal hypertension'.)

ETIOLOGY

The two most common causes of portal hypertension worldwide are cirrhosis and hepatic schistosomiasis [2]. In Western countries, portal hypertension is typically the result of cirrhosis, with noncirrhotic portal hypertension accounting for less than 10 percent of cases. In other parts of the world, noncirrhotic portal hypertension due to causes such as schistosomiasis and portal vein thrombosis are the leading causes of portal hypertension (table 1 and table 2). (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis" and "Noncirrhotic portal hypertension", section on 'Etiology'.)

Among asymptomatic patients with cirrhosis, 80 to 90 percent will have an elevated portal pressure gradient (the difference in pressure between the portal vein and inferior vena cava, normally ≤5 mmHg), 40 percent of whom will have esophageal varices [2]. Among those who do not have varices, varices develop at a rate of approximately 6 percent per year.

CLINICAL MANIFESTATIONS

Portal hypertension is often asymptomatic until complications develop. The clinical manifestations of portal hypertension include splenomegaly, abdominal wall collateral vessels, and thrombocytopenia. Many of the other clinical manifestations seen in patients with portal hypertension are related to the underlying cause of the portal hypertension (eg, spider angiomata and gynecomastia in a patient with cirrhosis) or the complications of portal hypertension. (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis", section on 'Clinical manifestations' and "Noncirrhotic portal hypertension".)

Complications of portal hypertension include:

- Variceal hemorrhage
- Portal hypertensive gastropathy
- Ascites
- Spontaneous bacterial peritonitis
- Hepatorenal syndrome
- Hepatic hydrothorax
- Hepatopulmonary syndrome
- Portopulmonary hypertension
- Cirrhotic cardiomyopathy
- Portal cholangiopathy

The clinical manifestations associated with these complications include:

- Variceal hemorrhage – Patients with variceal hemorrhage typically present with hematemesis and/or melena. If the bleeding is severe, there may be signs of hemodynamic instability. (See "Approach to acute upper gastrointestinal bleeding in adults", section on 'Bleeding manifestations'.)

- Portal hypertensive gastropathy – Portal hypertensive gastropathy (congestive gastropathy), while extremely common in patients with portal hypertension, is an uncommon cause of significant bleeding in these patients. When portal hypertensive gastropathy is the sole cause of bleeding, there is diffuse mucosal oozing with no other

lesions such as varices to account for the gastrointestinal bleeding and anemia. The mucosa is friable, and bleeding presumably occurs when the ectatic vessels rupture. The severity of gastropathy is related to the level of portal pressure, the level of hepatic vascular resistance, and the degree of reduction in hepatic blood flow (See "Portal hypertensive gastropathy".)

- Ascites – Ascites is the accumulation of fluid within the peritoneal cavity. Patients with ascites typically report progressive abdominal distension that may be painless or associated with abdominal discomfort. Patients may also complain of weight gain, shortness of breath, early satiety, and dyspnea resulting from fluid accumulation and increased abdominal pressure. Physical examination findings include abdominal distension, dullness to percussion, and a fluid wave. (See "Evaluation of adults with ascites", section on 'Clinical manifestations'.)

- Spontaneous bacterial peritonitis – Clinical manifestations of spontaneous bacterial peritonitis include fever, abdominal pain, abdominal tenderness, altered mental status, and acute kidney injury. Some patients are asymptomatic and present with only mild laboratory abnormalities. The new onset of renal failure should prompt an investigation for spontaneous bacterial peritonitis. (See "Spontaneous bacterial peritonitis in adults: Clinical manifestations".)

- Hepatorenal syndrome – Hepatorenal syndrome refers to the development of renal impairment in the setting of cirrhosis. Arterial vasodilatation in the splanchnic circulation, which is triggered by portal hypertension, appears to play a central role in the hemodynamic changes and the decline in renal function in hepatorenal syndrome. Hepatorenal syndrome is characterized by a generally benign urine sediment, a very low rate of sodium excretion, and a progressive rise in the plasma creatinine concentration. (See "Hepatorenal syndrome".)

- Hepatic hydrothorax – Hepatic hydrothorax is defined as the presence of a pleural effusion in a patient with cirrhosis and no evidence of underlying cardiopulmonary disease. It results from the movement of ascitic fluid into the pleural space through defects in the diaphragm and is usually right-sided. The negative intrathoracic pressure generated during inspiration favors the passage of fluid from the peritoneal to the pleural space. Thus, many patients have only mild or no clinically detectable ascites. Patients usually present with shortness of breath, cough, hypoxemia, and/or chest discomfort. (See "Hepatic hydrothorax".)

- Hepatopulmonary syndrome – Hepatopulmonary syndrome is defined by the presence of liver disease, an increased alveolar-arterial gradient while breathing room air, and evidence for intrapulmonary vascular abnormalities. The clinical features of hepatopulmonary syndrome are the consequences of both hepatic and pulmonary dysfunction. More than 80 percent of patients present with symptoms of liver disease; the remainder experience dyspnea as their initial symptom. Hypoxia is a common finding. (See "Hepatopulmonary syndrome in adults: Prevalence, causes, clinical manifestations, and diagnosis", section on 'Clinical manifestations'.)

- Portopulmonary hypertension – As the name implies, portal hypertension-associated pulmonary hypertension (portopulmonary hypertension) refers to the presence of pulmonary hypertension in patients with portal hypertension. Patients with portopulmonary hypertension may present with fatigue, dyspnea, peripheral edema, chest pain, or syncope. (See "Portopulmonary hypertension", section on 'Suspecting PAH'.)

- Cirrhotic cardiomyopathy – Cirrhotic cardiomyopathy is defined by chronic cardiac dysfunction in the setting of cirrhosis. It is characterized by decreased contractile responsiveness to stress or altered diastolic relaxation with electrophysiologic abnormalities. It is thought to be related to both portal hypertension and cirrhosis. (See "Definition and classification of the cardiomyopathies", section on 'Cirrhotic cardiomyopathy'.)

- Portal cholangiopathy – Portal cholangiopathy (also referred to as portal biliopathy) is common in patients with chronic portal vein thrombosis and is due to compression of the large bile ducts by the venous collaterals that form in patients with chronic portal vein thrombosis. Portal cholangiopathy is associated with biliary obstruction and can result in recurrent ascending cholangitis and jaundice. (See "Chronic portal vein thrombosis in adults: Clinical manifestations, diagnosis, and management" and "Epidemiology and pathogenesis of portal vein thrombosis in adults", section on 'Portal cholangiopathy'.)

DIAGNOSIS

A diagnosis of portal hypertension can be made if a patient with a known risk factor for portal hypertension (eg, cirrhosis) has clinical manifestations of portal hypertension. In such cases, additional testing is not needed to confirm the diagnosis. However, if the diagnosis is in doubt, the hepatic venous pressure gradient (HVPG) can be determined to help confirm the diagnosis. The HVPG may also aid in the management of patients receiving nonselective beta blockers as

part of their treatment. (See "Primary prevention of bleeding from esophageal varices in patients with cirrhosis", section on 'Portal hemodynamics'.)

In patients with portal hypertension who do not have a previously identified risk factor, additional testing is required to determine the cause. (See 'Evaluation for an underlying cause' below.)

Hepatic venous pressure gradient — The HVPG is measured to approximate the gradient in pressure between the portal vein and the inferior vena cava (IVC). It can quantify the degree of portal hypertension due to sinusoidal resistance to blood flow (the most common cause of portal hypertension) (table 3). A normal HVPG is between 1 and 5 mmHg [3,4]. Portal hypertension is present if the HVPG is ≥6 mmHg. Portal hypertension typically becomes clinically significant when the HVPG is ≥10 mmHg, at which point varices may develop. Once the HVPG is ≥12 mmHg, patients are at risk for variceal bleeding and the development of ascites.

The portal pressure gradient can also be determined by direct measurement of the pressure in the portal vein and IVC. However, direct measurement of pressure in the portal is more invasive and is associated with a risk of intraperitoneal bleeding, so it is rarely used. (See 'Contraindications and limitations' below.)

Prognostic implications of HVPG thresholds — The risk of developing complications of portal hypertension and mortality rates increase as HVPG values increase [5]. Various HVPG thresholds have been noted to have prognostic significance among patients with cirrhosis [2]:

- In patients with compensated cirrhosis:
  - HVPG 10 mmHg: Development of gastroesophageal varices, development of hepatocellular carcinoma, decompensation after surgery for hepatocellular carcinoma
  - HVPG 12 mmHg: Variceal bleeding
  - HVPG 16 mmHg: First clinical decompensation in patients with varices, mortality
- In patients with decompensated cirrhosis:
  - HVPG 16 mmHg: Variceal rebleeding, mortality
  - HVPG 20 mmHg (in patients with active variceal hemorrhage): Failure to control active variceal hemorrhage, low one-year survival
  - HVPG 22 mmHg: Mortality in patient with alcoholic cirrhosis and acute alcoholic hepatitis

- HVPG 30 mmHg: Spontaneous bacterial peritonitis

Technique — The HVPG is calculated by subtracting the free hepatic venous pressure (FHVP, which reflects intra-abdominal pressure) from the wedged hepatic venous pressure (WHVP, which reflects portal venous pressure) [2,3]. These values are obtained by hepatic vein catheterization. The FHVP is determined by direct measurement of pressure in the hepatic vein. The WHVP is typically obtained by balloon occlusion of the hepatic vein, though it can also be estimated by wedging the catheter in the end tributaries of a hepatic vein. The balloon occlusion technique estimates the pressure from a larger portion of the liver than is obtained if the catheter is wedged in an end tributary.

After giving the patient intravenous sedation (eg, midazolam), a balloon-tipped catheter is introduced through the right jugular vein, often under ultrasound guidance [2]. The catheter is advanced through the right atrium into the IVC and then into the right hepatic vein using fluoroscopic guidance. Alternatively, the femoral or antecubital veins can be used to for venous access.

To obtain the FHVP, the catheter is maintained in the hepatic vein 2 to 4 cm from its takeoff from the IVC. Typically, the difference in pressure between the IVC (measured at the hepatic vein ostium) and hepatic vein is ≤1 mmHg [3]. A difference >1 mmHg suggests incorrect placement of the catheter (too deep into the hepatic vein). Pressure in the right atrium cannot be used to approximate the FHVP.

To obtain the WHVP, the hepatic vein is occluded by inflating the balloon at the tip of the catheter. A small amount of contrast dye (5 mL) is injected to confirm that the hepatic vein is occluded. If it is occluded, there should be no reflux of the dye above the balloon, and it should not washout via communications with other hepatic veins. Veno-venous communications may lead to washout of the contrast. These communications are rare in cirrhosis, though they are commonly seen in idiopathic portal hypertension [6,7]. The pressure should not be recorded until a stable value is obtained, which often takes 45 to 60 seconds [3].

Once the FHVP and WHVP are determined, the HVPG is calculated by subtracting the FHVP from the WHVP.

Contraindications and limitations — A limitation of the HVPG is that the WHVP is a measure of pressure within the hepatic sinusoids. As a result, pre-sinusoidal causes of portal hypertension may be associated with a normal FHVP, WHVP, and HVPG (table 3) [2]. In addition, the HVPG may be normal with post-sinusoidal causes of portal hypertension that increase pressure both in the hepatic vein and in the sinusoids. However, in this situation, both the FHVP and the WHVP will be abnormal. If pre-sinusoidal portal hypertension is suspected

and the HVPG is normal, direct measurement of the pressure in the portal vein and IVC can be obtained to determine the portal perfusion gradient. Direct measurement is performed using transhepatic or transvenous catheterization of the portal vein.

A relative contraindication to HVPG measurement is an allergy to iodinated contrast [2]. This can be overcome by using carbon dioxide in place of contrast when confirming balloon occlusion. In patients with a history of cardiac arrhythmias, care should be taken when moving the catheter in the right atrium. Finally, patients with thrombocytopenia or an elevated international normalized ratio may require platelets or fresh frozen plasma, respectively, prior to performing an HVPG measurement. (See "Cirrhosis in adults: Overview of complications, general management, and prognosis", section on 'Thrombocytopenia or elevated INR'.)

Complications — Complications with HVPG measurement are uncommon and typically are related to local injury at the venous access site [2]. Arrhythmias, which are usually transient, may be seen as the catheter is moved within the right atrium.

Associated procedures — Other procedures that can be performed at the same time as HVPG measurement include transjugular liver biopsy, measurement of hepatic blood flow and indocyanine green clearance, and wedged hepatic retrograde portography using carbon dioxide. (See "Transjugular liver biopsy", section on 'Technique' and "Tests of the liver's capacity to transport organic anions and metabolize drugs", section on 'Indocyanine green'.)

Noninvasive tests — Less invasive methods for diagnosing portal hypertension have been evaluated and include ultrasonography and transient elastography. However, neither test has replaced HVPG measurement for confirming the diagnosis.

Ultrasonography — Findings on transabdominal ultrasound with Doppler imaging may support a diagnosis of portal hypertension, but lack sensitivity [8]. Findings that may be seen in patients with portal hypertension include [2]:

- Ascites
- Splenomegaly
- Nodular liver
- Portal flow mean velocity <12 cm/second
- Inversion of flow in the portal vein,
- Portosystemic collaterals (patent-paraumbilical vein, splenorenal collaterals, dilated left and short gastric veins)
- Portal vein diameter >13 mm
- Decreased or no respiratory variation in splenic and superior mesenteric vein diameter
- Portal/splenic/superior mesenteric vein thrombosis

Transient elastography — Transient elastography using ultrasound is a noninvasive method for detecting hepatic fibrosis. Studies are also looking at it as an option for noninvasively diagnosing portal hypertension (image 1) [9]. (See "Noninvasive assessment of hepatic fibrosis: Ultrasound-based elastography", section on 'Transient elastography'.)

Studies have reported areas under the receiver operating characteristic (AUC) curve of 0.77 to 0.99 for transient elastography predicting portal hypertension, with variable optimal liver stiffness cutoff values (13.6 to 34.9 kPa) [10-14]. It has been suggested that a value <13.6 kPa can be used to rule out portal hypertension, whereas a value ≥21.1 kPa can be used to rule it in [2]. Values between 13.6 and 21.1 kPa are considered to be indeterminant.

Evaluation for an underlying cause — If portal hypertension is diagnosed in a patient who does not have a known risk factor for portal hypertension, the evaluation should first determine whether cirrhosis is present. If cirrhosis is present, additional testing to determine the cause is indicated. (See "Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis", section on 'Diagnosis'.)

If there is no evidence of cirrhosis, the patient should be evaluated for causes of noncirrhotic portal hypertension (table 1 and table 2). (See "Noncirrhotic portal hypertension".)

DIFFERENTIAL DIAGNOSIS

In patients with signs and symptoms of portal hypertension, such as ascites or splenomegaly, it is important to consider causes of these findings other than portal hypertension. In most cases, the etiology of the findings can be differentiated from portal hypertension based on history, laboratory tests, and imaging studies. If the diagnosis is not clear, measurement of the hepatic venous pressure gradient can often confirm the presence of portal hypertension.

Examples of diagnoses that should be considered in addition to portal hypertension include:

- Hematemesis or melena: Peptic ulcer disease, Dieulafoy's lesion, Mallory-Weiss tear. (See "Causes of upper gastrointestinal bleeding in adults", section on 'Differential diagnosis'.)
- Ascites: Malignant ascites, nephrogenic ascites, tuberculosis. (See "Evaluation of adults with ascites", section on 'Etiology'.)
- Splenomegaly: Hematologic malignancy, infections, inflammation. (See "Splenomegaly and other splenic disorders in adults", section on 'Splenomegaly'.)

- Bacterial peritonitis: Secondary bacterial peritonitis (eg, from intestinal perforation). (See "Spontaneous bacterial peritonitis in adults: Diagnosis", section on 'Distinguishing spontaneous from secondary bacterial peritonitis'.)

- Hydrothorax: Malignancy, sarcoidosis, nephrotic syndrome. (See "Pleural fluid analysis in adults with a pleural effusion".)

- Hypoxemia: Heart failure, central nervous system depression, muscular weakness. (See "Measures of oxygenation and mechanisms of hypoxemia", section on 'Mechanisms of hypoxemia'.)

- Pulmonary hypertension: Idiopathic pulmonary arterial hypertension, valvular heart disease, connective tissue diseases. (See "Clinical features and diagnosis of pulmonary hypertension of unclear etiology in adults", section on 'Postdiagnostic testing and classification'.)

TREATMENT

Management in patients with portal hypertension is aimed at preventing and treating its complications. In the case of varices, this includes endoscopy to screen for varices, nonselective beta blockers and/or endoscopic variceal ligation to prevent bleeding, and treatment of active hemorrhage with endoscopic therapy or transjugular intrahepatic portosystemic shunt placement. In patients with ascites, treatment often starts with dietary sodium restriction and diuretics. (See "Primary prevention of bleeding from esophageal varices in patients with cirrhosis" and "Methods to achieve hemostasis in patients with acute variceal hemorrhage" and "Prevention of recurrent bleeding from esophageal varices in patients with cirrhosis" and "Ascites in adults with cirrhosis: Initial therapy" and "Ascites in adults with cirrhosis: Diuretic-resistant ascites".)

Patients also require treatment for the underlying cause of the portal hypertension (eg, cirrhosis, schistosomiasis). (See "Cirrhosis in adults: Overview of complications, general management, and prognosis", section on 'General management' and "Noncirrhotic portal hypertension" and "Etiology of the Budd-Chiari syndrome".)

The prevention and management of the other complications of portal hypertension are discussed in detail elsewhere:

- (See "Spontaneous bacterial peritonitis in adults: Treatment and prophylaxis".)
- (See "Portal hypertensive gastropathy".)

- (See "Hepatic hydrothorax", section on 'Management'.)
- (See "Hepatopulmonary syndrome in adults: Natural history, treatment, and outcomes", section on 'Treatment and prognosis'.)
- (See "Portopulmonary hypertension", section on 'Treatment'.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Portal hypertension and ascites".)

SUMMARY AND RECOMMENDATIONS

- **Pathophysiology** – Portal hypertension develops when there is resistance to portal blood flow and is aggravated by increased portal collateral blood flow. The resistance most often occurs within the liver (as is the case in cirrhosis), but it can also be prehepatic (eg, portal vein thrombosis) or posthepatic (eg, Budd-Chiari syndrome). (See 'Pathophysiology' above.)

- **Etiology** – The two most common causes of portal hypertension worldwide are cirrhosis and hepatic schistosomiasis. In Western countries, portal hypertension is typically the result of cirrhosis. In other parts of the world, noncirrhotic portal hypertension due to causes such as schistosomiasis and portal vein thrombosis are the leading causes of portal hypertension (table 1 and table 2). (See 'Etiology' above.)

- **Clinical manifestations** – Portal hypertension is typically asymptomatic until complications develop. The clinical manifestations of portal hypertension include splenomegaly, abdominal wall collateral circulation, and thrombocytopenia. Many of the clinical manifestations seen in patients with portal hypertension are related to the underlying cause of the portal hypertension (eg, spider angiomata and gynecomastia in a patient with cirrhosis) or the complications of portal hypertension. (See 'Clinical manifestations' above.)

  The complications of portal hypertension include variceal hemorrhage, portal hypertensive gastropathy, ascites, and spontaneous bacterial peritonitis. Other complications include hepatorenal syndrome, hepatic hydrothorax, hepatopulmonary syndrome, portopulmonary hypertension, and cirrhotic cardiomyopathy.

- **Diagnosis** – A diagnosis of portal hypertension can be made if a patient with a known risk factor for portal hypertension (eg, cirrhosis) has clinical manifestations of portal hypertension. In such cases, additional testing is not needed to confirm the diagnosis. However, if the diagnosis is in doubt, the hepatic venous pressure gradient (HVPG) can be determined to help confirm the diagnosis. (See 'Diagnosis' above.)

  The HVPG is measured to approximate the gradient in pressure between the portal vein and the inferior vena cava. It can quantify the degree of portal hypertension due to sinusoidal resistance to blood flow (the most common cause of portal hypertension). A normal HVPG is between 1 and 5 mmHg. Portal hypertension is present if the HVPG is ≥6 mmHg. Portal hypertension typically becomes clinically significant when the HVPG is ≥10 mmHg, at which point varices may develop. Once the HVPG is ≥12 mmHg, patients are at risk for variceal bleeding and the development of ascites. (See 'Hepatic venous pressure gradient' above.)

- **Management** – In addition to management of the underlying cause of the portal hypertension (eg, cirrhosis, schistosomiasis), patients also need treatment to prevent and treat the complications of portal hypertension. In the case of varices, this includes endoscopy to screen for varices, nonselective beta blockers and/or endoscopic variceal ligation to prevent bleeding, and treatment of active hemorrhage with endoscopic therapy or transjugular intrahepatic portosystemic shunt placement. In patients with ascites, treatment often starts with dietary sodium restriction and diuretics. (See 'Treatment' above.)

REFERENCES

1. García-Pagán JC, Gracia-Sancho J, Bosch J. Functional aspects on the pathophysiology of portal hypertension in cirrhosis. J Hepatol 2012; 57:458.
2. Berzigotti A, Seijo S, Reverter E, Bosch J. Assessing portal hypertension in liver diseases. Expert Rev Gastroenterol Hepatol 2013; 7:141.
3. Groszmann RJ, Wongcharatrawee S. The hepatic venous pressure gradient: anything worth doing should be done right. Hepatology 2004; 39:280.
4. Pinzani M, Rosselli M, Zuckermann M. Liver cirrhosis. Best Pract Res Clin Gastroenterol 2011; 25:281.

5. Leung JC, Loong TC, Pang J, et al. Invasive and non-invasive assessment of portal hypertension. Hepatol Int 2018; 12:44.
6. Okuda K, Kono K, Ohnishi K, et al. Clinical study of eighty-six cases of idiopathic portal hypertension and comparison with cirrhosis with splenomegaly. Gastroenterology 1984; 86:600.
7. Seijo S, Reverter E, Miquel R, et al. Role of hepatic vein catheterisation and transient elastography in the diagnosis of idiopathic portal hypertension. Dig Liver Dis 2012; 44:855.
8. Berzigotti A, Piscaglia F, EFSUMB Education and Professional Standards Committee. Ultrasound in portal hypertension--part 2--and EFSUMB recommendations for the performance and reporting of ultrasound examinations in portal hypertension. Ultraschall Med 2012; 33:8.
9. Vuille-Lessard É, Rodrigues SG, Berzigotti A. Noninvasive Detection of Clinically Significant Portal Hypertension in Compensated Advanced Chronic Liver Disease. Clin Liver Dis 2021; 25:253.
10. Vizzutti F, Arena U, Romanelli RG, et al. Liver stiffness measurement predicts severe portal hypertension in patients with HCV-related cirrhosis. Hepatology 2007; 45:1290.
11. Lemoine M, Katsahian S, Ziol M, et al. Liver stiffness measurement as a predictive tool of clinically significant portal hypertension in patients with compensated hepatitis C virus or alcohol-related cirrhosis. Aliment Pharmacol Ther 2008; 28:1102.
12. Bureau C, Metivier S, Peron JM, et al. Transient elastography accurately predicts presence of significant portal hypertension in patients with chronic liver disease. Aliment Pharmacol Ther 2008; 27:1261.
13. Sánchez-Conde M, Miralles P, Bellón JM, et al. Use of transient elastography (FibroScan®) for the noninvasive assessment of portal hypertension in HIV/HCV-coinfected patients. J Viral Hepat 2011; 18:685.
14. Llop E, Berzigotti A, Reig M, et al. Assessment of portal hypertension by transient elastography in patients with compensated cirrhosis and potentially resectable liver tumors. J Hepatol 2012; 56:103.

Topic 90896 Version 18.0

GRAPHICS

Classification of noncirrhotic portal hypertension

Prehepatic
Portal vein thrombosis
Splenic vein thrombosis
Splanchnic arteriovenous fistula
Splenomegaly (eg, from lymphoma, Gaucher's disease*)
Intrahepatic
Presinusoidal
Schistosomiasis*
Idiopathic noncirrhotic portal hypertension (including nodular regenerative hyperplasia)
Primary biliary cholangitis
Sarcoidosis*
Congenital hepatic fibrosis
Primary sclerosing cholangitis
Hepatic arteriopetal fistula
Adult polycystic liver disease
Arteriovenous fistulas
Autoimmune cholangiopathy
Vinyl chloride toxicity*
Neoplastic occlusion of the intrahepatic portal vein
Mineral oil granuloma*
Sinusoidal
Arsenic poisoning
Vinyl chloride toxicity*
Drugs (eg, amiodarone, methotrexate)
Alcoholic liver disease*
Nonalcoholic fatty liver disease
Gaucher's disease*
Zellweger syndrome

Viral hepatitis
Chronic Q fever
Schistosomiasis*
Amyloid or light-chain deposition in the space of Disse
Acute hepatic injury
Mastocytosis
Agnogenic myeloid metaplasia
Acute fatty liver of pregnancy
Postsinusoidal
Sinusoidal obstruction syndrome (venoocclusive disease)
Budd-Chiari syndrome*
Alcoholic liver disease*
Chronic radiation injury
Vitamin A toxicity
Epithelioid hemangioendothelioma
Angiosarcoma
Sarcoidosis*
Mycobacterium avium or *M. intracellulare* infection
Mineral oil granuloma*
Posthepatic
IVC obstruction (eg, Budd-Chiari syndrome*)
Cardiac disease (constrictive pericarditis, restrictive cardiomyopathy)

IVC: inferior vena cava.

* May cause noncirrhotic portal hypertension via several mechanisms.

Schouten JN, Garcia-Pagan JC, Valla DC, Janssen HL. Idiopathic noncirrhotic portal hypertension. Hepatology 2011; 54:1071.

Graphic 76516 Version 4.0

Disorders and medications associated with idiopathic noncirrhotic portal hypertension

Hematologic/neoplastic
Liver cancers
Sacrococcygeal teratoma
Essential thrombocytosis
Polycythemia vera
Myeloproliferative disorders
Lymphoproliferative disorders
Multiple myeloma
Spherocytosis
Sickle cell disease
Protein S deficiency
Factor V Leiden mutation
Hyperhomocysteinemia
Antiphospholipid syndrome
Immune
Primary biliary cholangitis
Polymyositis
Sjögren's syndrome
Scleroderma
CREST syndrome
Still's syndrome
Polyarteritis nodosa
Rheumatoid arthritis
Polymyalgia rheumatica
Systemic lupus erythematosus
Behçet's syndrome
Cryoglobulinemia
Idiopathic hypereosinophilic syndrome
Idiopathic thrombocytopenic purpura

Medications
Azathioprine
Thioguanine
Cyclophosphamide
Chlorambucil
Busulfan
Doxorubicin
Cytosine
Arabinoside
Bleomycin
Carmustine
Trastuzumab
Interleukin-2
Oxaliplatin
Miscellaneous
Liver transplantation
Renal transplantation
Atrial septal defect
Ventricular septal defect
Pulmonary vein anomalies
Congenital portal venous anomalies
VATER syndrome
Hereditary hemorrhagic telangiectasia
Cystinosis
Turner's syndrome

Celiac disease
Myasthenia gravis
HIV infection
Common variable immunodeficiency

CREST: calcinosis cutis, Raynaud phenomenon, esophageal dysmotility, sclerodactyly, telangiectasia; HIV: human immunodeficiency virus; VATER: Vertebral anomalies, anal atresia, TE fistula (tracheoesophageal fistula), renal defects.

Graphic 50663 Version 7.0

Hemodynamic measurements in patients with intrahepatic causes of portal hypertension

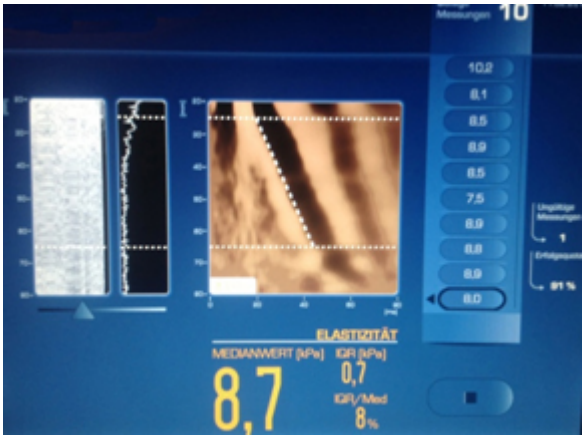
Hemodynamic measurement	Site of resistance to portal blood flow		
	Pre-sinusoidal	Sinusoidal	Post-sinusoidal
FHVP	Normal	Normal	Increased
WHVP	Normal or slightly increased	Increased	Increased
HVPG* (WHVP – FHVP)	Normal or slightly increased	Increased	Normal

FHVP: free hepatic venous pressure; HVPG: hepatic venous pressure gradient; WHVP: wedged hepatic venous pressure.

* Normally, the HVPG is ≤5 mmHg. Values between 6 and 9 mmHg are associated with "subclinical" portal hypertension, whereas values ≥10 mmHg are associated with the complications of portal hypertension (eg, varices, ascites).

Graphic 90916 Version 2.0

Transient elastography of the liver



Transient elastography showing the measurement of liver stiffness in kilopascals (kPa) along the left side of the screen. An A-mode image is displayed to assist the operator in selecting the measurement zone. On the right side, the values of 10 measurements are shown with the mean value depicted at the bottom of the screen.

Graphic 97037 Version 1.0

Contributor Disclosures

Wissam Bleibel, MD No relevant financial relationship(s) with ineligible companies to disclose. **Sanjiv Chopra, MD, MACP** No relevant financial relationship(s) with ineligible companies to disclose. **Michael P Curry, MD** Grant/Research/Clinical Trial Support: Mallinckrodt [Hepatorenal syndrome]; Sonic InCytes [Non-invasive testing for liver fibrosis]. Consultant/Advisory Boards: Albireo [Cholestasis]; Alexion [Wilson disease]; Mallinckrodt [Hepatorenal syndrome]; Sonic InCytes [Non-invasive testing for liver fibrosis]. All of the relevant financial relationships listed have been mitigated. **Bruce A Runyon, MD, FAASLD** No relevant financial relationship(s) with ineligible companies to disclose. **Kristen M Robson, MD, MBA, FACG** No relevant financial relationship(s) with ineligible companies to disclose.

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

Conflict of interest policy

→