

## PORTAL HYPERTENSION: MODERN DIAGNOSIS AND TREATMENT

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**Abstract:** Portal hypertension is a common and serious complication of chronic liver disease, particularly cirrhosis. It is defined by an increase in the pressure within the portal venous system and is responsible for significant morbidity and mortality due to complications such as variceal bleeding, ascites, and hepatic encephalopathy. With advancements in diagnostic imaging and therapeutic interventions, the management of portal hypertension has significantly improved in recent years. This article explores the pathophysiology, current diagnostic modalities, and state-of-the-art treatment options for portal hypertension, highlighting recent innovations and clinical strategies.

**Key words:** portal hypertension, treatment, diagnosis, blood vessels.

**Introduction:** Portal hypertension (PH) is characterized by elevated blood pressure in the portal vein, typically resulting from resistance to blood flow through the liver. This condition most frequently arises due to cirrhosis, in which normal liver tissue is replaced with fibrotic tissue that disrupts normal vascular architecture. Clinically significant portal hypertension is defined as a hepatic venous pressure gradient (HVPG) of 10 mmHg or more. It is a key driver of life-threatening complications in liver disease, and timely intervention is essential for patient survival.

**Pathophysiology of Portal Hypertension:** Portal hypertension develops due to a combination of increased vascular resistance within the liver and increased splanchnic blood flow. In cirrhosis, the architecture of the liver is distorted by fibrosis and regenerative nodules, which increase intrahepatic vascular resistance. At the same time, vasodilators such as nitric oxide lead to dilation of splanchnic arteries, increasing blood flow into the portal system and compounding the hypertension.

Collateral blood vessels may form to divert blood from the high-pressure portal system to the systemic circulation. These vessels are often fragile and located in areas such as the esophagus and stomach, where they form varices that are prone to rupture and bleeding.

Portal hypertension is a condition defined by an abnormal elevation of blood pressure within the portal venous system, typically when the hepatic venous pressure gradient (HVPG) exceeds 5 mmHg. Clinically significant portal hypertension (CSPH) is defined at  $\geq 10$ –12 mmHg and is commonly seen in chronic liver diseases, particularly cirrhosis.

Understanding the pathophysiology involves identifying the site of increased resistance, the mechanisms involved, and systemic changes that result from sustained portal pressure elevation. **Portal Venous System Overview:** The portal venous system drains blood from the gastrointestinal tract, spleen, pancreas, and gallbladder into the liver. The portal vein is formed by the confluence of the superior mesenteric vein and the splenic vein. Normally, the portal pressure ranges between 5–10 mmHg. When this pressure increases beyond normal, portal hypertension develops.

These factors make blood flow through the liver more difficult, raising pressure upstream in the portal vein.

#### Increased Portal Blood Inflow

- Due to splanchnic arterial vasodilation in response to portal hypertension and liver dysfunction.
- Mediated by nitric oxide (NO), carbon monoxide, glucagon, and vascular endothelial growth factor (VEGF).
- This vasodilation causes hyperdynamic circulation — high cardiac output, low systemic vascular resistance.

Increased blood volume delivered to the portal vein exacerbates the already elevated pressure. Clinical Manifestations: The clinical manifestations of portal hypertension depend on its severity and underlying cause. Common features include:

- Splenomegaly: Enlargement of the spleen due to congestion.
- Ascites: Accumulation of fluid in the peritoneal cavity.
- Esophageal and gastric varices: Fragile veins prone to bleeding.
- Caput medusae: Dilated periumbilical veins visible on the abdominal wall.
- Hepatic encephalopathy: Cognitive dysfunction due to the accumulation of toxins not cleared by the liver.
- Thrombocytopenia and anemia: Resulting from splenic sequestration and blood loss.

#### Non-Invasive Diagnostics

Ultrasound with Doppler is typically the first-line diagnostic tool. It allows for visualization of portal vein flow, measurement of portal vein diameter, and detection of thrombosis. Transient elastography (FibroScan) is widely used to assess liver stiffness, indirectly reflecting portal pressure.

CT and MRI provide more detailed imaging of the liver and vasculature. They are particularly useful in identifying collateral vessels and evaluating the presence of hepatocellular carcinoma. Endoscopic Evaluation: Esophagogastroduodenoscopy (EGD) remains the gold standard for the detection of varices. It allows direct visualization and classification of varices, enabling appropriate prophylactic or therapeutic interventions. Invasive Measurement: Hepatic venous pressure gradient (HVPG) measurement is the most accurate method for diagnosing portal hypertension. It involves catheterization of the hepatic vein and provides quantitative data on the severity of the condition. An HVPG  $\geq 10$  mmHg is associated with the development of complications such as varices.

Treatment Strategies: Medical Management: The first line of treatment often involves non-selective beta-blockers (NSBBs) such as propranolol, nadolol, or carvedilol. These medications reduce cardiac output and splanchnic vasodilation, thereby decreasing portal pressure. Diuretics, particularly spironolactone and furosemide, are used to manage ascites. Albumin infusions are indicated in patients undergoing large-volume paracentesis or experiencing hepatorenal syndrome. For acute variceal bleeding, vasoactive agents such as octreotide or terlipressin are administered to reduce splanchnic blood flow. Endoscopic

**Interventions:**Endoscopic variceal ligation (EVL) is the preferred method for controlling active esophageal variceal bleeding and preventing recurrence. It is more effective and safer than sclerotherapy, which is now used mainly when ligation is not possible. **Interventional Radiology:**In patients with recurrent variceal bleeding or refractory ascites, a transjugular intrahepatic portosystemic shunt (TIPS) is often indicated. This procedure involves placing a stent between the portal and hepatic veins, creating a low-resistance pathway for blood flow and reducing portal pressure.

Though effective, TIPS is associated with an increased risk of hepatic encephalopathy and requires careful patient selection. **Surgical Approaches:** Surgical shunts are rarely performed today due to the invasiveness and potential complications. However, they may be considered in patients who are not candidates for TIPS and have preserved liver function. **Liver Transplantation:**Liver transplantation remains the definitive treatment for patients with end-stage liver disease and portal hypertension. It not only cures the underlying liver pathology but also reverses portal hypertension and its complications.

**Emerging Therapies and Research:** Recent research has explored the use of statins for reducing intrahepatic resistance and improving endothelial function. Additionally, antifibrotic agents are being developed to target liver fibrosis directly. The role of the gut-liver axis is increasingly recognized, and interventions aimed at modifying the intestinal microbiome, such as rifaximin and probiotics, show promise in reducing systemic inflammation and hepatic encephalopathy. Advanced biomarkers, imaging techniques, and AI-assisted diagnostics are also improving the ability to detect portal hypertension and predict complications before they arise.

**Prognosis and Monitoring:** Patients with portal hypertension require lifelong monitoring, even when asymptomatic. Regular surveillance for varices (via endoscopy), hepatocellular carcinoma (via imaging and alpha-fetoprotein levels), and evaluation of liver function are essential for managing the condition and improving outcomes.

**Conclusion:** Portal hypertension is a complex and progressive condition primarily resulting from chronic liver diseases like cirrhosis. With modern diagnostic tools and therapeutic strategies, including pharmacological agents, endoscopic techniques, and radiological interventions, the management of portal hypertension has greatly evolved. Liver transplantation remains the ultimate cure, but early diagnosis and multidisciplinary care can significantly prolong survival and enhance quality of life. Ongoing research into novel therapies holds promise for even better outcomes in the future.

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