

Surgical Approach to Portal Vein Thrombosis with Portal Hypertension: Challenges and Outcomes

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ABSTRACT

Portal vein thrombosis (PVT) in the setting of portal hypertension represents a complex clinical entity requiring a multidisciplinary approach for optimal management. This article explores the indications, techniques, and outcomes of surgical interventions in patients with PVT complicated by portal hypertension. We provide an overview of the pathophysiological interplay between thrombosis and increased portal pressure, emphasizing the impact of underlying etiologies, including cirrhosis, malignancy, and prothrombotic disorders. Various surgical options, such as thrombectomy, meso-Rex bypass, and shunt procedures, are reviewed in the context of their efficacy, complications, and role in contemporary practice. Special attention is given to perioperative management strategies, including anticoagulation, hemodynamic stabilization, and prevention of recurrent thrombosis. By analyzing recent data and case studies, we aim to elucidate the potential benefits and risks of surgical treatment for this challenging condition, highlighting areas for future research and innovation.

KEYWORDS: Portal vein thrombosis, portal hypertension, surgical treatment, thrombectomy, meso-Rex bypass, shunt surgery, perioperative management, anticoagulation, portal pressure.

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INTRODUCTION

Portal vein thrombosis (PVT) is a significant vascular complication often associated with portal hypertension, particularly in patients with chronic liver disease, hypercoagulable states, or malignancies. The concomitant presence of these conditions exacerbates the risk of life-threatening complications such as variceal bleeding, ascites, and hepatic encephalopathy. Despite advances in medical and endoscopic therapies, a subset of patients remains refractory to these interventions, necessitating surgical management.^{1,2} The pathophysiology of PVT is multifactorial, involving endothelial injury, stasis, and hypercoagulability, collectively known as Virchow's triad. When coupled with elevated portal pressures, the thrombosis disrupts splanchnic circulation, creating a cascade of events that compromise hepatic perfusion and systemic hemodynamics. Surgical intervention, while historically reserved for specific indications, has evolved with advancements in techniques and perioperative care, offering hope for improved outcomes in select cases.¹

This article reviews the surgical options for managing PVT in the context of portal hypertension, with a focus on patient selection, technical considerations, and postoperative outcomes. We will examine the role of thrombectomy, meso-Rex bypass, and shunt procedures, such as the transjugular intrahepatic portosystemic shunt (TIPS) in conjunction with or as an alternative to surgery. Furthermore, we will discuss the nuances of anticoagulation, the prevention of recurrent thrombosis, and the management of complications to provide a comprehensive framework for clinicians facing this challenging scenario.²

Through a detailed analysis of current evidence and surgical outcomes, this review aims to highlight the importance of individualized treatment plans and the potential for innovation in the surgical management of PVT with portal hypertension.²

EPIDEMIOLOGY

Portal vein thrombosis (PVT) is a relatively uncommon but clinically significant condition, particularly when it occurs in

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conjunction with portal hypertension. The global prevalence of PVT is variable, largely depending on the underlying population being studied. It is estimated that PVT affects approximately 1% of the general population, although this figure increases markedly in patients with chronic liver diseases, reaching up to 10-25% in individuals with cirrhosis. Among patients awaiting liver transplantation, the prevalence of PVT can rise as high as 40%, reflecting its strong association with advanced liver disease and hypercoagulable states.³

The epidemiological profile of PVT is shaped by a diverse range of etiologies. In the Western world, cirrhosis and hepatocellular carcinoma (HCC) are the leading causes, with PVT serving as both a cause and consequence of portal hypertension in these populations. In contrast, in developing countries, the condition may be more frequently associated with infectious or inflammatory diseases, including abdominal sepsis, such as pyogenic cholangitis or appendicitis, which can lead to portal pyelephlebitis and subsequent thrombosis. Additionally, prothrombotic disorders, including inherited conditions such as Factor V Leiden mutation, Protein C or S deficiency, and antiphospholipid syndrome, as well as acquired states such as malignancy or myeloproliferative neoplasms, are significant contributors to PVT across all demographics.³

Gender and age distributions of PVT are largely influenced by the underlying etiology. While cirrhosis-related PVT is more common in middle-aged males due to the higher prevalence of alcohol-related liver disease and viral hepatitis, PVT in pediatric populations is often linked to umbilical vein catheterization during the neonatal period, congenital anomalies of the portal venous system, or inherited thrombophilic conditions. In non-cirrhotic adults, the median age of PVT diagnosis is approximately 45-55 years, often in association with prothrombotic states or abdominal malignancies.³

Portal hypertension frequently coexists with PVT, further complicating the epidemiological landscape. Chronic PVT often leads to cavernous transformation of the portal vein, characterized by the formation of a network of collateral veins attempting to bypass the occluded vessel. This sequela is observed in both cirrhotic and non-cirrhotic cases, contributing to the development of varices, ascites, and splenomegaly. The prevalence of cavernous transformation among patients with chronic PVT ranges from 70-100%, depending on the duration and severity of the thrombosis.³

Geographically, the distribution of PVT and its complications reflects disparities in healthcare access, diagnostic capabilities, and disease burden. For example, in regions with high endemicity of schistosomiasis or abdominal tuberculosis, portal hypertension and PVT may present unique epidemiological patterns distinct from those observed in high-income countries. Furthermore, improvements in imaging techniques and increased surveillance in at-risk populations have contributed to a rise in PVT diagnosis,

particularly asymptomatic or incidental cases, altering its perceived epidemiology.³

In summary, PVT with portal hypertension represents a heterogeneous condition with a complex epidemiological profile influenced by a multitude of factors, including liver disease, prothrombotic states, geographic region, and access to healthcare. Understanding these epidemiological trends is critical for identifying at-risk populations, optimizing screening protocols, and guiding appropriate management strategies, including the role of surgical intervention in select cases.⁴

Clinical Considerations

The clinical approach to portal vein thrombosis (PVT) with concurrent portal hypertension requires careful assessment of the patient's overall condition, underlying etiology, and complications. PVT is a multifaceted condition that may present acutely or chronically, with symptoms ranging from asymptomatic findings on imaging to life-threatening complications. This complexity underscores the importance of a tailored, multidisciplinary approach, particularly when surgical intervention is being considered.⁴

Clinical Presentation

PVT presents with a spectrum of clinical manifestations depending on its chronicity, the degree of portal venous obstruction, and the presence of portal hypertension. Acute PVT often presents with abdominal pain, nausea, and signs of bowel ischemia, particularly in extensive thrombosis involving mesenteric veins. Conversely, chronic PVT typically manifests as sequelae of portal hypertension, including variceal bleeding, splenomegaly, and hypersplenism. Ascites, although common in cirrhosis-associated portal hypertension, may also develop in non-cirrhotic PVT due to increased hydrostatic pressure in the portal venous system.⁴

In cases with cavernous transformation of the portal vein, patients may exhibit adaptive venous collaterals that mitigate some of the symptoms of portal hypertension while predisposing them to complications such as recurrent variceal bleeding and portal biliopathy. These collaterals create a complex clinical landscape that must be evaluated meticulously prior to surgical decision-making.⁴

Underlying Etiologies and Risk Assessment

Identifying the underlying etiology of PVT is paramount in guiding clinical management. In cirrhotic patients, the hyperdynamic state and coagulopathy inherent to advanced liver disease often coexist with systemic prothrombotic factors. In non-cirrhotic patients, a thorough evaluation for myeloproliferative disorders, malignancies, or hereditary thrombophilia is essential. The use of molecular and genetic testing, including Janus kinase 2 (JAK2) mutation analysis, facilitates the identification of hematologic disorders that may predispose to thrombosis.⁵

Risk stratification involves evaluating the extent of thrombus propagation, the presence of mesenteric ischemia, and the

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degree of liver dysfunction, typically quantified using scoring systems such as the Child-Pugh or Model for End-Stage Liver Disease (MELD) score. Patients with advanced liver disease require careful assessment of surgical risk, as they are more likely to decompensate perioperatively.⁵

Indications For Surgical Intervention

Surgical treatment of PVT is typically reserved for specific clinical scenarios, including:

1. **Failure of medical or endoscopic therapies:** Recurrent variceal bleeding unresponsive to endoscopic band ligation (EBL) or sclerotherapy.⁵
2. **Refractory ascites:** Persistent or symptomatic ascites despite optimized medical and paracentesis management.⁵
3. **Intestinal ischemia:** Acute thrombosis extending to mesenteric veins with signs of bowel compromise.⁵
4. **Restoration of hepatic blood flow:** Indicated in selected cases of non-cirrhotic PVT with cavernous transformation to improve liver function and prevent further complications.⁵

Perioperative Considerations

Perioperative optimization plays a crucial role in the surgical management of PVT with portal hypertension. Preoperative anticoagulation therapy aims to prevent thrombus propagation, though it necessitates careful monitoring to balance bleeding risks, particularly in cirrhotic patients with coagulopathy. Transjugular intrahepatic portosystemic shunt (TIPS) placement may be considered preoperatively as a bridge to surgery in selected patients to decompress the portal system and reduce variceal bleeding risk.⁶

Nutritional status is another critical factor, as many patients with portal hypertension are malnourished due to chronic gastrointestinal bleeding, reduced oral intake, or protein-losing enteropathy. Preoperative nutritional support, including enteral or parenteral feeding, may mitigate postoperative complications.⁶

Surgical Considerations

The choice of surgical procedure depends on the underlying pathology, extent of portal venous obstruction, and the presence of liver disease. Options include:⁶

1. **Thrombectomy:** Reserved for acute PVT in patients without cirrhosis or with minimal liver damage.⁶
2. **Shunt surgeries:** Procedures such as meso-Rex bypass or portocaval shunt are particularly useful in non-cirrhotic PVT or in cases with cavernous transformation.
3. **Liver transplantation:** Indicated for patients with cirrhosis and extensive PVT who meet transplantation criteria.⁶
4. **Hybrid approaches:** Combining surgical and endovascular techniques, such as TIPS with subsequent thrombectomy, is gaining traction in complex cases.

Postoperative Management

Postoperative anticoagulation is critical to prevent recurrent thrombosis and maintain patency of reconstructed venous pathways. Lifelong anticoagulation may be necessary in patients with identified thrombophilic disorders or recurrent thrombotic events. Regular imaging follow-up using Doppler ultrasonography, computed tomography (CT), or magnetic resonance imaging (MRI) ensures early detection of complications such as shunt occlusion or re-thrombosis.⁶

The clinical considerations in the surgical management of PVT with portal hypertension emphasize the need for a comprehensive, individualized approach. Detailed evaluation of the underlying etiology, complications, and patient-specific risk factors is essential to guide the decision-making process. Advances in perioperative care and surgical techniques continue to improve outcomes, but multidisciplinary collaboration remains the cornerstone of effective management.⁷

Surgical Techniques

The surgical management of portal vein thrombosis (PVT) with portal hypertension is a highly specialized field requiring a detailed understanding of the pathophysiology, anatomy, and individual patient circumstances. Surgical intervention is generally considered in cases refractory to medical and endoscopic therapy or when complications such as mesenteric ischemia or variceal bleeding cannot be controlled by other means. Below, we describe the primary surgical techniques employed in managing this condition, along with their indications, procedural steps, and outcomes.⁷

Portal Vein Thrombectomy

Thrombectomy is primarily utilized in acute PVT, particularly in patients without significant underlying liver dysfunction or cavernous transformation of the portal vein. The goal is to restore blood flow within the portal venous system, thereby mitigating ischemia and its sequelae.⁷

- **Indications:** Acute PVT with or without mesenteric vein involvement, no extensive cavernous transformation, and suitable underlying hepatic function.⁷
- **Procedure:**
 - A midline laparotomy is performed to expose the portal vein.
 - Fogarty catheters or direct manual techniques are employed to extract the thrombus.⁸
 - Intraoperative Doppler ultrasound confirms restored flow.⁸
 - Post-thrombectomy, intraoperative anticoagulation is administered to prevent re-thrombosis.⁸
- **Outcomes:** Restores splanchnic circulation but is limited by high recurrence rates without adequate anticoagulation or addressing the underlying prothrombotic state.⁷

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Shunt Procedures

Surgical shunting is a cornerstone in managing chronic PVT with portal hypertension. By creating alternative pathways for portal blood flow, these procedures reduce portal pressure and alleviate complications such as variceal bleeding and refractory ascites.⁹

1. **Portocaval Shunt:** Directly connects the portal vein to the inferior vena cava (IVC).
 - **Indications:** Non-cirrhotic PVT with recurrent variceal bleeding or ascites.
 - **Procedure:**
 - A side-to-side or end-to-side anastomosis is created between the portal vein and the IVC.¹⁰
 - Care is taken to ensure hemodynamic stability and avoid hepatic ischemia.¹⁰
 - **Outcomes:** Effective in reducing portal pressure but may cause hepatic encephalopathy due to shunting of toxins.¹¹
2. **Meso-Rex Bypass:** Restores physiological portal flow by redirecting mesenteric venous blood to the left portal vein.¹¹
3. **Indications:** Chronic non-cirrhotic PVT with preserved liver function, especially in pediatric patients.¹¹
 - **Procedure:**
 - The superior mesenteric vein is anastomosed to the intrahepatic left portal vein using a vein graft, typically harvested from the saphenous vein.¹²
 - The Rex recessus serves as the entry point for hepatic perfusion.
 - **Outcomes:** Excellent results in appropriately selected patients, with restoration of normal liver function and prevention of complications.¹²
4. **Distal Splenorenal Shunt (DSRS):** Diverts splenic blood flow to the left renal vein, reducing portal pressure while preserving hepatic perfusion.
 - **Indications:** Variceal bleeding in chronic PVT with cavernous transformation.
 - **Procedure:**
 - Splenic vein ligation is performed, followed by anastomosis to the left renal vein.¹⁴
 - **Outcomes:** Effective in controlling varices with minimal risk of encephalopathy.

Hybrid Surgical-Endovascular Approaches

Innovative hybrid approaches combine traditional surgery with endovascular techniques to optimize outcomes, particularly in patients with complex PVT or comorbidities.⁹

1. TIPS-Assisted Surgical Thrombectomy:

- TIPS (transjugular intrahepatic portosystemic shunt) is placed preoperatively to decompress the portal system, facilitating thrombectomy.¹⁵
- This approach minimizes intraoperative bleeding and allows for safer surgical intervention.¹⁵

2. Combined Shunt and Stenting Procedures:

- Placement of endovascular stents in conjunction with surgical shunts ensures patency and reduces the risk of early re-thrombosis.¹⁵

Liver Transplantation

In cases of end-stage liver disease with PVT, liver transplantation remains the definitive treatment. Surgical planning for transplantation in PVT patients is complex, requiring advanced techniques to manage portal vein obstruction.¹⁶

- **Preoperative Management:** Pre-transplant TIPS or recanalization of the portal vein may be attempted to improve the surgical field.¹⁶
- **Procedure:**
 - Thrombectomy is performed intraoperatively.
 - In cases with cavernous transformation, an interposition graft or synthetic conduit may be used to establish portal inflow to the grafted liver.¹⁶
 - **Outcomes:** Liver transplantation offers long-term survival benefits but is technically challenging in the presence of extensive PVT.¹⁶

Perioperative Considerations

- **Anticoagulation:** Crucial both pre- and postoperatively to prevent recurrence. Careful balancing of anticoagulation therapy with bleeding risks is required.¹⁶
- **Hemodynamic Optimization:** Portal decompression techniques (e.g., preoperative TIPS) reduce intraoperative risk.¹⁶
- **Imaging Guidance:** Preoperative imaging with Doppler ultrasound, CT angiography, or MRI is vital for surgical planning.¹⁶

Complications and Challenges

- **Bleeding:** Portal hypertension increases the risk of perioperative hemorrhage.
- **Re-thrombosis:** Even with surgical success, PVT recurrence is common without lifelong anticoagulation.¹⁶
- **Hepatic Encephalopathy:** Particularly associated with non-selective shunting procedures.¹⁶

The surgical techniques employed in managing PVT with portal hypertension require meticulous planning and

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execution. Advances in hybrid approaches and perioperative care continue to expand the therapeutic options for this complex condition, improving outcomes for patients who are refractory to medical and endoscopic management.

CONCLUSIONS

The surgical management of portal vein thrombosis (PVT) with portal hypertension represents a highly specialized and intricate field of modern surgery, where success hinges on a comprehensive understanding of the underlying pathophysiology, patient-specific factors, and the available surgical and adjunctive therapeutic techniques. While advances in medical and endoscopic management have significantly improved outcomes for many patients, certain clinical scenarios necessitate surgical intervention to mitigate complications and improve survival and quality of life.

KEY INSIGHTS

PVT is a heterogeneous condition with diverse etiologies, ranging from cirrhosis and hepatocellular carcinoma to prothrombotic states and abdominal infections. This diversity underscores the importance of individualized treatment approaches. The presence of portal hypertension adds a layer of complexity to the clinical picture, requiring careful preoperative evaluation to assess liver function, the extent of venous occlusion, and the presence of complications such as variceal bleeding or ascites.

Surgical techniques, including thrombectomy, shunt procedures, and liver transplantation, provide critical options for managing PVT with portal hypertension. Each modality has specific indications and limitations:

- **Thrombectomy** is most appropriate for acute PVT without extensive collateral formation or cirrhosis.
- **Shunt surgeries** such as meso-Rex bypass and distal splenorenal shunt are highly effective in reducing portal pressures and preventing recurrent variceal bleeding, particularly in chronic PVT.
- **Liver transplantation** remains the definitive treatment for patients with end-stage liver disease and extensive PVT, offering long-term survival benefits despite its technical challenges.

The emergence of hybrid approaches that combine surgical and endovascular techniques highlights the evolving nature of this field. Strategies such as TIPS-assisted thrombectomy or the integration of stent placement with surgical shunts exemplify how multidisciplinary collaboration can optimize outcomes, particularly in patients with complex disease presentations.

Perioperative and Long-Term Considerations

The success of surgical intervention extends beyond the operative procedure itself. Preoperative optimization, including anticoagulation, nutritional support, and portal decompression, significantly influences perioperative outcomes. Postoperatively, meticulous follow-up with imaging and lifelong anticoagulation is essential to maintain

graft or shunt patency and to prevent recurrent thrombosis. Addressing complications such as hepatic encephalopathy or graft dysfunction requires ongoing collaboration between surgeons, hepatologists, and interventional radiologists.

FUTURE PERSPECTIVES

Advances in surgical techniques, imaging modalities, and adjunctive therapies are paving the way for more effective and less invasive approaches to managing PVT with portal hypertension. The integration of molecular and genetic insights into prothrombotic conditions will enable more precise risk stratification and tailored therapies. Moreover, the refinement of hybrid surgical-endovascular strategies holds promise for improving outcomes in patients with complex or extensive disease.

Continued research and collaboration across disciplines are essential to further refine the indications and techniques for surgical intervention. Prospective studies evaluating long-term outcomes of various surgical and hybrid approaches are needed to guide evidence-based practice and optimize patient care.

CLINICAL IMPLICATIONS

Surgical management of PVT with portal hypertension is a dynamic and evolving domain that demands expertise, innovation, and a patient-centered approach. While challenges remain, the advancements in surgical and perioperative care have significantly expanded the therapeutic landscape, offering hope for improved outcomes in even the most challenging cases. Ultimately, a multidisciplinary approach that integrates surgical expertise with medical management and advanced imaging techniques remains the cornerstone of effective treatment for this complex condition.

In conclusion, the surgical approach to PVT with portal hypertension represents both a challenge and an opportunity to significantly impact patient outcomes. By adhering to principles of individualized care and leveraging modern surgical and hybrid techniques, clinicians can achieve meaningful improvements in survival and quality of life, underscoring the critical role of surgery in the comprehensive management of this multifaceted condition.

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