Chapter 7
Surgery in Patients with Hepatic Cirrhosis: Management of Portal Hypertension

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Introduction

Portal hypertension (PH) is one of the most serious complications of hepatic cirrhosis and portomesenteric venous thrombosis [1]. The need for any major surgical procedure in these complex patients carries a relatively high morbidity and mortality. Of the major risk factors are marginal hepatic reserve, large gastrointestinal varices, and massive portomesenteric venous collaterals. Accordingly, thorough preoperative evaluation, personalized management strategy, and collaborative postoperative care are essential to achieve successful outcomes.

The primary focus of this chapter is to comprehensively address the pharmacologic, radiologic, and surgical management of PH in patients undergoing major abdominal, thoracic, and other complex surgical procedures. The proposed preemptive and active management strategies are discussed in the milieu of the pathophysiology of the portal hypertension and the coexisted pathology that is in need for surgical and other therapeutic interventions.

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Pathophysiology

The term PH was first introduced in1902 describing large portosystemic abdominal collateral vessels in the setting of cirrhosis [2]. In 1937, the first time proposed concept of measuring the portal pressure was technically feasible through an intra-abdominal approach [3, 4]. In 1953, the percutaneous intrasplenic methodology was introduced as an alternative technique followed by direct and percutaneous intrahepatic portal pressure measurement [5]. With the recent evolution of the minimally invasive radiologic techniques, portal pressure measurements can be safely obtained to establish accurate diagnosis and guide appropriate therapy (Fig. 7.1).

In patients with hepatic cirrhosis, the diagnosis of PH is established when the hepatic venous pressure gradient (HVPG), calculated by the difference between the portal and the hepatic venous pressure, exceeds 5 mmHg. The clinical syndrome and its various complications commonly occur when the HVPG exceeds 10 mmHg [6]. In patients with presinusoidal PH particularly those with splenic and diffuse portomesenteric venous thrombosis, the HVPG is usually within a normal range. Computed Tomography (CT) and standard semi-quantitative selective visceral angiography are the gold standard for the accurate diagnosis and proper management of these complex patients (Fig. 7.2).

The clinical syndrome of PH includes gastroesophageal varices, ascites, spontaneous bacterial peritonitis, gastropathy, colopathy, hepatic hydrothorax, hepatorenal syndrome, hepatopulmonary syndrome, pulmonary hypertension, and cirrhotic cardiomyopathy [7–9]. The presence of one or more of these morbid events commonly influences the decision making process and overall results of any required major abdominal, thoracic and other surgical interventions. Of major consideration, is the interplay between the landscape of the PH complication and the required surgical procedure.

The development of gastrointestinal varices is one of the most serious consequences of PH. This life threatening complication occurs in 35–80% of cirrhotic patients [8, 10–12]. The risk of variceal bleeding ranges from 25% to 40% with a recurrence rate of 70% [8]. With the initial attack, mortality ranges from 30% to 50% with a high cumulative attrition rate. With major surgical interventions, the inevitable hemodynamic changes in the systemic and portal circulation with altered hepatic homeostasis could potentially provoke bleeding from silent or overt gut varies. As a result, a preemptive management strategy is desired to reduce risk of primary and recurrent variceal hemorrhage.

In addition to substantial gut varices, patients with splenic and diffuse portomesenteric venous thrombosis often develop respective segmental and extensive abdominal collaterals. These extra-anatomic vascular channels add great technical difficulties to any major abdominal surgery particularly in patients with complex pathology (Fig. 7.3). This ominous problem is commonly associated with increased risk of intraoperative bleeding due to innate thin vessel wall with turbulent flow pattern and high intravascular pressure. Other potential surgical complications include postoperative bleeding and anastomotic leaks due to mesenteric venous congestion with impaired tissue healing and altered gut homeostasis.

The development of complex life threatening abdominal and cardiothoracic disorders is not uncommon in patients with liver cirrhosis and PH. Defined hepatic lesions, pancreatic tumors, gastrointestinal neoplasms, colorectal malignancies, and other complex gut disorders are common coexisted diagnoses. In some of these patients, concomitant thrombosis of the portomesenteric venous system does occur due the proximity, aggressiveness, and thrombogenicity of the disease process. Cardiac revascularization, valve replacement, lung resection, and organ transplantation are the commonly required cardiothoracic procedures

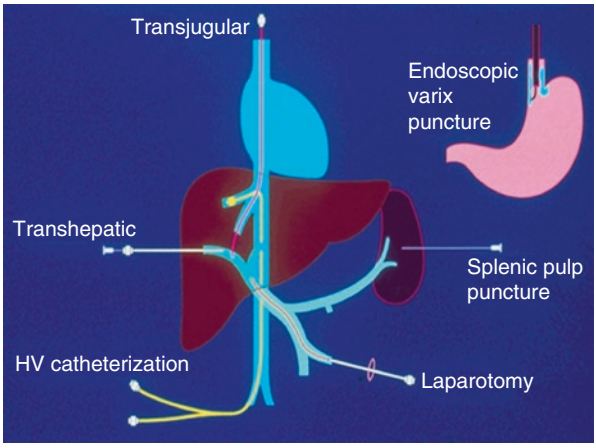

Fig. 7.1 The different routes to measure the portal pressure. Catheterization of one of the hepatic veins via the transjugular approach to measure the free and wedged hepatic venous pressure is the most commonly utilized methodology to calculate the portal pressure

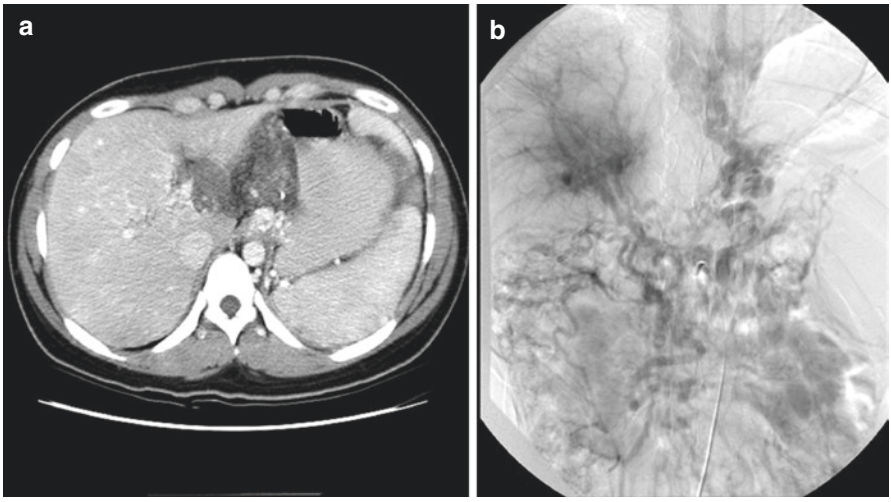

Fig. 7.2 Radiologic imaging of the abdomen and portomesenteric venous system; (**a**) computed tomography (CT) with no radiologic features of hepatic cirrhosis and preserved liver volume. The observed portal vein thrombosis dictated the need for visceral angiography. (**b**) The venous phase of selective superior mesenteric arteriography demonstrating diffuse portomesenteric venous thrombosis with development of extensive abdominal collaterals. Note the presence of large gastroesophageal variceal collaterals with some hepatopedal flow

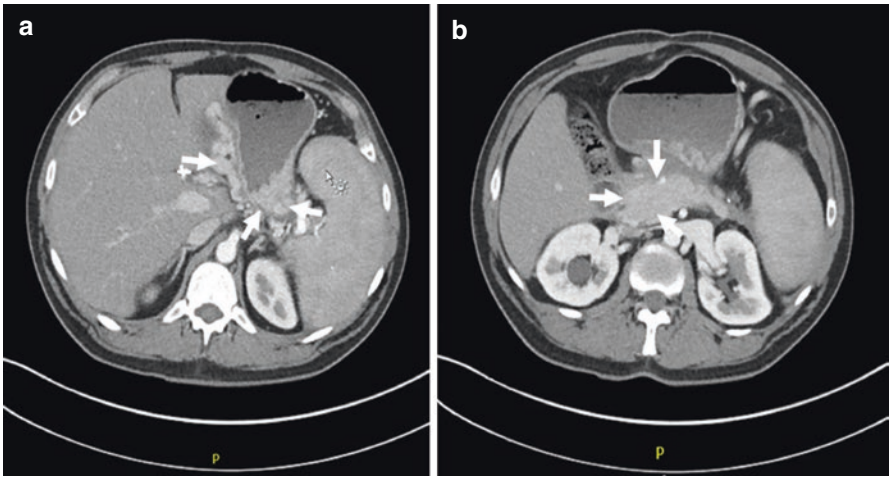

Fig. 7.3 Abdominal computed tomography (CT) of a patient with recurrent life threatening Pancreatitis, splenic vein thrombosis, and brittle diabetes. (**a**) Massive gastric variceal and pancreatic collaterals (*arrows*). (**b**) Large pancreatic tumor with failed attempts of surgical resection at a local hospital. The patient underwent successful near total pancreatectomy combined with splenectomy and complete gastric devascularization

Management Strategy

In patients with active gastroesophageal variceal hemorrhages and intra-abdominal bleeding, aggressive resuscitation along with simultaneous diagnostic and therapeutic measures must be promptly initiated. Emergent endoscopy and abdominal visceral angiography are the most reliable tools to identify and control variceal bleeding [8, 12, 13]. For those with intra-abdominal hemorrhage due to ruptured portosystemic collaterals or earlier surgical intervention, emergent surgical exploration is mandatory along with other treatment modalities.

The strategy of elective management is guided by the status of hepatic reserve and severity of portal hypertension. Adequate hepatic reserve is roughly measured by clinical and biochemical evidence of preserved hepatic functions with radiologically acceptable liver volume. The etiology and stage of liver damage is accurately defined by histopathologic examination of percutaneous or transjugular needle liver biopsy.

The level of PH is commonly assessed by the radiologic measurement of the HVPG. The coexistence of gut varices is better diagnosed by pan-endoscopic examination of the digestive tract. Upper endoscopy and colonoscopy are valuable in the respective detection of foregut and hindgut varices. For midgut and ectopic varices, push enteroscopy and capsule endoscopy have been the most useful investigative tools. Nonetheless, selective visceral angiographies better assess patency of the splanchnic arterial and portal venous circulation with detection of any associated vascular anomalies.

With suspected splenic and portomesenteric venous thrombosis, dedicated superior mesenteric, splenic, and inferior mesenteric angiographies are strongly recommended. The serial images of the venous phase characterize the collateral pattern, identify direction of flow, and semiquantitate the residual portal and preferential collateral flow (Fig. 7.2b). These valuable information are crucial for the proper management of patients who are in need for major abdominal surgical intervention.

Proper preoperative planning, fine surgical techniques, and collaborative postoperative care at highly specialized medical center are essential for successful outcome. Preemptive nonoperative PH treatment is recommended in high risk patients particularly those who are in need for extra-abdominal surgery. In contrast, simultaneous portal hypertensive and disease specific surgery is a good alternative for patients with abdominal pathology. With preoperative diagnosis of marginal hepatic reserve and postoperative development of liver failure, simultaneous or sequential organ transplantation should be promptly entertained.

Therapeutic Modalities

The different modalities that are currently available for the treatment of gut varices and portomesenteric abdominal venous collaterals are categorized and described herein.

Pharmacologic Treatment

The therapeutic efficacy of the currently available pharmacological agents is due to reduction of both portal blood flow and intrahepatic vascular resistance. They are more commonly used as an adjunct therapy. The indications, efficacy, and side effects of each agent are described herein.

Vasopressin

Vasopressin is a potent splanchnic vasoconstrictor that is used for the management of acute life threatening variceal hemorrhage. It reduces HVPG and variceal pressure by 23% and 14%, respectively [14]. However, the potent systemic vasoconstrictive action of the drug is associated with numerous side effects that limit its use for very selected high risk patients and those who failed other therapeutic modalities. To improve the safety profile, the addition of nitroglycerin has been shown to mitigate many of its systemic side effects [15].

Terlipressin is a triglycyl lysine derivative of vasopressin. It produces less systemic vasoconstriction with reduced side effects. In addition, it has a longer half-life. Compared to placebo, Terlipressin has shown to better control active variceal

bleeding and improved survival [16]. The drug has yet to be approved for clinical use in the United States but it is commonly utilized elsewhere worldwide [17]. Both Vasopressin and Terlipressin are valuable therapeutic options for patients with persistent active variceal bleeding particularly those with hemodynamic instability following any abdominal or thoracic surgery and not suitable candidates for any other portal hypertensive therapeutic interventions.

Somatostatin

Somatostatin (SST) is a naturally occurring 14-amino acid peptide that causes splanchnic vasoconstriction and decreases portal blood flow. Despite its short half-life, SST is equally effective in controlling variceal hemorrhage compared to other pharmacologic agents and other treatment modalities such as balloon tamponade and endoscopic sclerotherapy [18, 19]. Despite its proven therapeutic efficacy, SST is not currently available in the United States.

Octreotide is a synthetic SST analogue that is routinely used in the United States as an adjunct therapy for the management of active variceal bleeding. The therapy is initiated from the outset and administered as continuous infusion because of its short half-life. The major therapeutic advantage of a short course of maintenance octreotide therapy is reduction in the risk of variceal rebleeding but without improvement in survival [20]. Despite the lack of current published data, it is our recommendation to use octreotide as a perioperative preemptive therapy for patients with endoscopic evidence of significant gut varices particularly in those with history of variceal bleeding.

Beta Blocker

Nonselective beta blockers (NSBBs) are used extensively for primary and secondary prophylaxis of PH variceal bleeding. By producing unopposed alpha adrenergic vasoconstriction, it decreases portal pressure. It is most effective when the risk of bleeding is high by preventing the first attack and reducing the rate of recurrence. However, the role of NSBBs in preventing first time variceal bleeding among those at a low risk of variceal bleeding has yet to be determined. A meta-analysis of six randomized controlled trials showed that the incidences of large varices development, first upper-gastrointestinal bleeding, and death were similar between NSBB and placebo groups [21].

The most commonly used NSBBs in PHT patients are propranolol, carvedilol, and nadolol. Compared to propranolol, nadolol offers a longer half-life, once daily-use, and better tolerance by patients [10]. A recent meta-analysis showed that the carvedilol is more effective in decreasing HVPG than propranolol, and it may be as effective as endoscopic band ligation (EBL) in preventing variceal bleeding [22]. It is our recommendation to use NSBBs in all patients undergoing major abdominal surgery with coexisted gut varices.

Nitrates

Nitrates have been used in combination with vasopressin in the setting of acute variceal hemorrhage (AVH). These drugs cause systemic hypotension, thereby decreasing vasopressin-associated vasoconstriction and portal pressure [10]. Nitrates can also be used with NSBB to prevent variceal rebleeding with greater HVPG reduction [23]. The most commonly used nitrate in PH patients is isosorbide mononitrate since it is long-acting with minimal first-pass metabolic clearance [10].

Other Therapeutic Agents

Statins
Simavastatin is used to decrease intrahepatic vascular resistance through nitrous oxide upregulation. In a double blinded placebo-controlled trial, simvastatin was associated with an 8% reduction of HVPG [24]. Another recent study proved the additive effect of simvastatin when used as adjunctive treatment in patients receiving standard therapy. It showed no effect on the rebleeding rate but improved survival [25].

Antibiotics
Prophylactic antimicrobial therapy is commonly used in patients with acute variceal hemorrhage. The aim is to guard against bacterial translocation, bacterial infection, and aspiration pneumonia. Such a therapeutic strategy reduces the overall infectious morbidity and improves survival. Of the most commonly used drugs are quinolone and ceftriaxone [10].

Endoscopic Therapy

The revisiting of endoscopic interventions with the introduction of advanced technology has revolutionized the management of gut varices in the majority of cirrhotics and selected patients with portomesenteric venous thrombosis [26, 27]. Over the last few decades, the efficacy of different endoscopic therapeutic modalities has been extensively studied and comprehensively published in the medical and surgical literature [13]. All of the currently published prospective and retrospective studies proved the superiority of endoscopic interventions particularly in patients with active variceal bleeding [13, 28]. The therapeutic efficacy of prophylactic and elective treatment in conjunction with other medical, radiologic, and surgical modalities has also been fully documented in the literature [29].

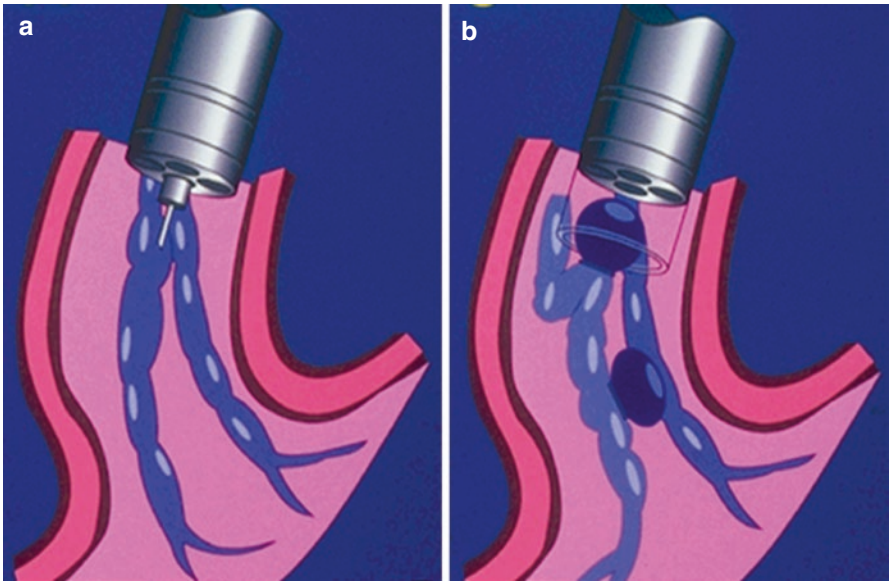

Fig. 7.4 Endoscopic ablation of the esophageal varices with sclerotherapy (**a**) and band ligation (**b**)

Endoscopic band ligation (EBL) and sclerotherapy, when technically feasible, are lifesaving procedures for patients with active esophageal variceal bleeding along with comprehensive medical and pharmacologic therapy (Fig. 7.4). Both modalities are also effective as prophylactic and elective treatment with temporary and permanent obliteration of the esophageal varices. In selective cases, NSBBs is commonly used as an alternative or adjunct therapy.

When technically feasible, both sclerotherapy and EBL have a high therapeutic index with control of active bleeding in nearly 95% of patients with esophageal varices. However, both techniques are associated with a relatively high rebleeding rate of 50% [29]. Although commonly performed, the long-lasting prophylactic role of each procedure has yet to be fully documented.

Endoscopic therapy has certain technical limitations and significant side effects. With massive upper-gastrointestinal hemorrhage, poor visualization with the inability to identify and obliterate the bleeding varices is frequently witnessed [13, 29, 30]. One of the other major constraints is the inability to perform sclerotherapy or EBL in patients with gastric and enteric varices. The main side effects of endoscopic obliteration of the esophageal varices are induced hemorrhage, chest pain, dysphagia, odynophagia, ulceration of the mucosa, and esophageal perforation [29, 31]. However, recent data suggest that sclerotherapy guided with endoscopic ultrasound (EUS) increases the procedure's safety and efficacy [31].

Preemptive and elective EBL along with NSBBs are valuable therapeutic options for patients with large esophageal varices who are in need of major surgical intervention. For those with gastric, enteric, and ectopic varices, individualized radiologic and surgical treatments are alternative options as described later.

Radiologic Interventions

Recent advances in the field of diagnostic and therapeutic intervention radiology added a new dimension to the effective management of patients with PH and gut varices. The procedures are mainly indicated for patients who failed or are not suitable candidates for endoscopic treatment. Of the commonly utilized procedures are intrahepatic portosystemic shunts, variceal obliteration, and collateral as well as splenic artery embolization.

The intrahepatic portosystemic shunt is the most commonly utilized radiologic procedure [32]. Along with the embolization techniques, these minimally invasive procedures are valuable therapeutic options for the emergent, elective, and prophylactic treatment of large gut varices and massive abdominal collaterals. The technical feasibility of the radiologic procedure is influenced by the altered vascular anatomy of the liver, site of gut varices, pattern of abdominal collaterals, and complexity of the associated abdominal pathology.

Intrahepatic Shunts

The therapeutic goal of the radiologic shunts is to reduce the portosystemic gradient to 6–12 mm Hg. The transjugular intrahepatic portosystemic shunt (TIPS) is the most commonly performed procedure and is created within the liver between the portal and hepatic vein (Fig. 7.5). Direct intrahepatic portocaval shunt (DIPS) is another endovascular portocaval shunt that is technically more complex than TIPS. DIPS is specifically indicated for patients with thrombosed hepatic veins and other anatomical abnormalities that preclude the successful performance of the TIPS [33].

The major indications of radiologic shunts are active and recurrent variceal hemorrhage particularly in patients who failed pharmacological and endoscopic treatment. TIPS and DIPS are also indicated for patients with refractory ascites and hepatic hydrothorax as well as those with hepatorenal, Budd-Chiari, and hepatopul-

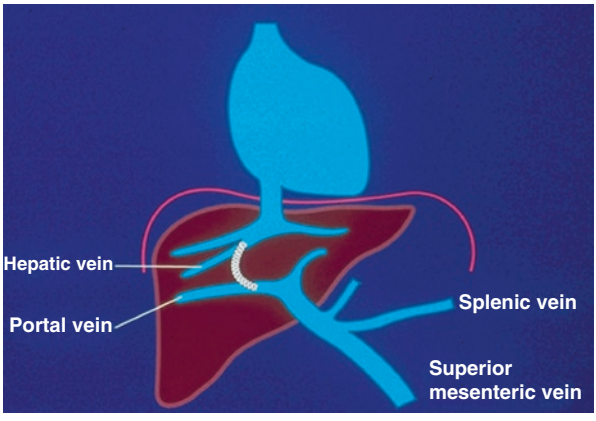

Fig. 7.5 Transjugular intrahepatic portosystemic shunt (TIPS) between the portal and hepatic venous system. The radiologically created total shunt effectively decompresses the portal system by bypassing the high intrahepatic vascular resistance associated with cirrhosis

monary syndromes. Both procedures are most effective in patients with recurrent variceal hemorrhage and refractory ascites [6]. Nonetheless, these minimally invasive radiologic shunts are commonly used as a bridge to liver transplantation. The preemptive therapeutic role of radiologic shunts in patients with large gastrointestinal varices and significant abdominal collaterals has yet to be defined.

With a mortality rate mainly determined by calculated MELD (Model for End-Stage Liver Disease) score, intra-abdominal hemorrhage is the most serious procedural complication with an incidence ranging from 0.6% to 4.2% [34]. With diversion of portal flow, hepatic encephalopathy is common with an incidence ranging from 33% to 55% [35]. Stent dysfunction is another important complication with a primary patency rate of 50% at 1 year. However, some improvement has been achieved with the introduction of coated stents with a 1-year primary patency rate up to 88% [36]. Along with aggressive medical treatment of hepatic encephalopathy, diligent follow-up with serial Doppler ultrasound is strongly recommended for early detection and prompt treatment of shunt stenosis [6, 37].

Variceal Obliteration and Collateral Embolization

The radiologic balloon-occluded retrograde transvenous obliteration (BRTO) procedure has been recently introduced for elective treatment of gastric varices. It is commonly utilized in Asia with a recurrent bleeding rate less than 5% [38, 39]. Moreover, BRTO can be performed in patients with poor hepatic reserve. Long-term complications include gastropathy and bleeding esophageal varices. A recent meta-analysis comparing TIPS and BRTO in patients with gastric varices showed no difference in incidences of technical failure and procedure-related complications. However, BRTO was associated with a lower rate of postoperative rebleeding and hepatic encephalopathy [40].

Percutaneous transhepatic embolization (PTE) has been shown to be effective in controlling acute portosystemic variceal bleeding [11]. However, the procedure is associated with a high risk of early rebleeding with an incidence of 37–65%. Accordingly, PTE is currently limited to patients who failed or are not suitable candidates to radiologic shunts particularly those with marginal hepatic reserve [41]. PTE is also indicated for patients with massive abdominal collaterals that are located in the vicinity of complex abdominal pathology with the intent of surgical resection.

Splenic artery embolization has been predominantly used in conjunction with other therapeutic modalities including radiologic shunts and endoscopic ablation. Complete or partial occlusion of the splenic arterial flow significantly reduces the portal and collateral venous flow. Infarction of 50–70% of the splenic cell mass is often required to achieve long term benefits particularly in patients with severe hypersplenism. Significant side effects include splenic abscess, bacterial peritonitis, and hepatic failure in patients with marginal reserve [42]. In addition, the gradual development of splenic arterial collaterals commonly erodes its long-term therapeutic benefits. Nonetheless, the procedure is highly recommended in patients with extensive gastric varices due to isolated splenic and diffuse portomesenteric venous thrombosis.

Portal Hypertensive Surgery

Until the 1970s revisit of endoscopic sclerotherapy and the 1980s introduction of clinical liver transplantation, portal hypertensive surgery was the only available therapeutic modality for patients with cirrhosis and bleeding varices [43, 44]. Despite the 1960s and 1970s popularity of total shunts, the observed prohibitive risk of incapacitating hepatic encephalopathy triggered relentless efforts to introduce other surgical procedures with the aim to selectively decompress or ablate the gastroesophageal varices. Of these, are the selective shunt and the gastroesophageal devascularization procedures. By the mid-1980s, the results of liver transplantation had significantly improved and the organ replacement operation had become the standard of care for patients with end-stage liver disease including those with active and recurrent variceal hemorrhage. Meanwhile, the minimally invasive intrahepatic radiologic shunts were introduced with encouraging results [32]. As a result, portal hypertensive surgery has become less popular and only used after failure of the aforementioned therapeutic modalities. It is our current practice to use surgery as an elective treatment for patients with preserved hepatic functions and as a preemptive therapy for those receiving lifelong anticoagulation with significant gut varices.

Interesting data has recently emerged from a large meta-analysis comparing surgical and radiologic shunts [45]. The reviewers reported a higher rate of shunt stenosis (66%) and variceal rebleeding (28%) with TIPS compared to surgical shunts with a respective rate of 10% and 5%. The incidence of hepatic encephalopathy was also higher after TIPS (54%) compared to surgical shunts (32%). With similar overall mortality, the 5-year survival rate was better after shunt surgery [45]. Accordingly, more utilization of surgical shunts after failure of endoscopic therapy should be seriously considered particularly in low-operative-risk patients with adequate hepatic reserve [46].

Total Shunts

The prototype of portosystemic shunts was first described by Eck in 1877 with the aim to totally decompress the splanchnic circulation and lower the portal pressure [47]. It involves dissection of the hepatic hilum with diversion of the portal blood flow to the systemic circulation. It is created by connecting the portal vein or one of its major branches to the inferior vena cava or one of its tributaries. The commonly utilized modalities were the end to side, side to side, and H-graft portocaval shunts. Despite its high therapeutic indices, a prohibitive risk of severe acute and chronic encephalopathy with the ultimate precipitation of hepatic failure is observed in most patients with patent shunt [48]. These sinister morbidities are due to the total diversion of the portal blood flow away from the hepatocytes.

In the 1980s, Sarfeh introduced the concept of partial portosystemic shunt by using an 8-mm polytetrafluoroethylene graft anastomosed between the portal vein and inferior vena cava (Fig. 7.6). The 8-mm H-graft portocaval shunt maintains

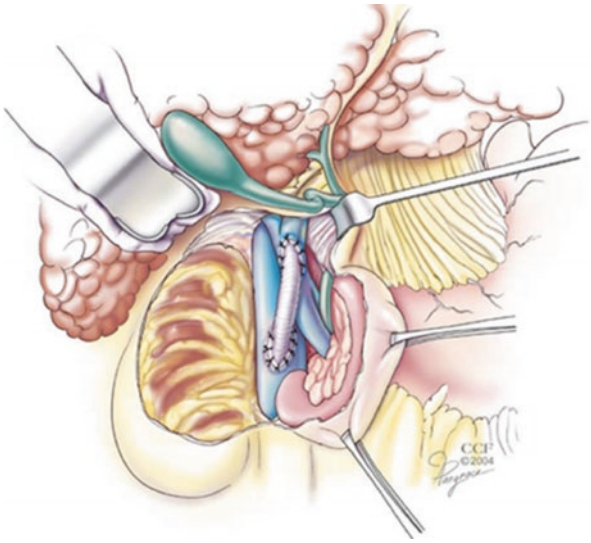

Fig. 7.6 Partial portosystemic shunt with an 8-mm synthetic vascular graft anastomosed between the portal vein and inferior vena cava (Sarfeh shunt). The procedure reduces the portal pressure to a level that decompresses the gut varices with partial preservation of the portal flow (From Henderson [67] with permission)

some portal flow to the liver and overcomes the high risk of hepatic encephalopathy commonly seen with the conventional total shunts. This new shunt modality provided excellent control of bleeding with a relatively low risk of encephalopathy and acceptable rate of long-term survival [49, 50]

Selective Shunts

In the mid-1970s, the late Dean Warren introduced distal splenorenal shunt (DSRS) with the aim to selectively decompress the gastroesophageal varices with preservation of the portal flow (Fig. 7.7a). Despite its proven therapeutic efficacy, the procedure did not gain wide popularity due to the required high surgical skills [51, 52]. In addition, most of the published data demonstrated gradual loss of the proposed shunt selectively with the development of gastric, colosplenic, and pancreatic collaterals (Fig. 7.7b). Accordingly, a technical modification was introduced with the addition of complete splenopancreatic disconnection (Fig. 7.7c). With the increased utilization of the radiologic shunt among Child A/B patients, DSRS has been rarely utilized in recent years despite its relatively lower rates of encephalopathy and the minimal need for reintervention [53].

The seemingly superselective coronocaval shunt was introduced by Inokuchi to provide direct decompression of the gastroesophageal varices into the systemic circulation with better long-term shunt selectivity [54]. When technically feasible, the left gastric vein is dissected and anastomosed to the inferior vein cava. The operation did not gain much popularity because of the technical difficulties and the wide anatomic variations of the left gastric venous system among variceal bleeders [55].

Compared to total surgical shunts, selective shunts do not significantly influence the outcome of future liver transplantation [56]. Technical difficulties have been observed at

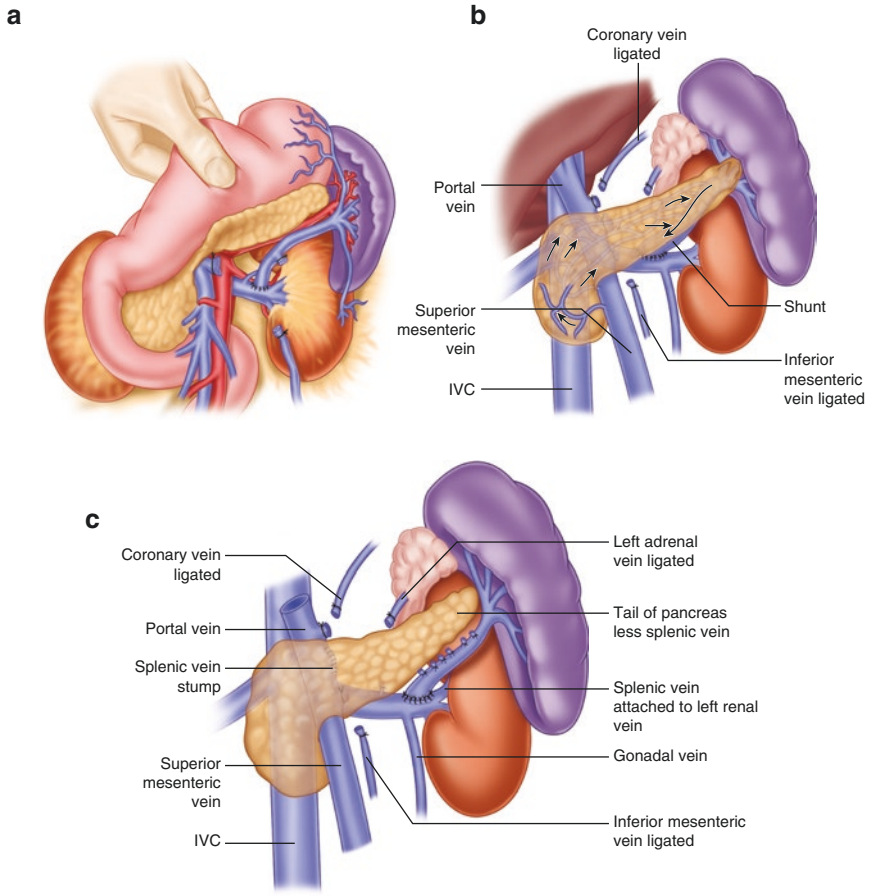

Fig. 7.7 Distal splenorenal shunt (DSRS) with (**a**) selective decompression of the gastroesophageal varices, (**b**) development of postoperative portosystemic collaterals including pancreatic siphon, (**c**) the modified technique of splenopancreatic disconnection (**a**, From Henderson [67] with permission, **b** & **c**, from Warren [68] with permission)

a higher rate after total shunts particularly in patients with shunt and portal vein thrombosis. With selective shunts, the hepatic hilum remains intact with less risk of surgical bleeding and other technical complications [57, 58]. With patent DSRS, the shunt is commonly ligated soon before or immediately after reperfusion of the transplanted liver.

Nonconventional Shunts

The management of diffuse portomesenteric venous thrombosis is a true challenge particularly in patients with hepatic cirrhosis and complex abdominal pathology. In most instances, both radiologic and endoscopic interventions are not technically feasible because of occlusion of the portal system with diffuse

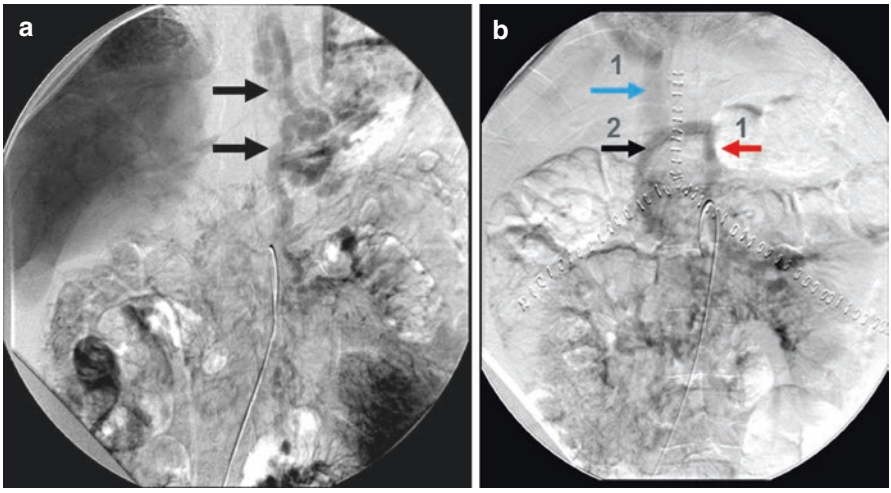

Fig. 7.8 (**a**) Large gastoresophageal variceal collaterals (*black arrows*) in a patient with diffuse portomesenteric venous thrombosis and preserved hepatic functions. (**b**) Nonconventional portosystemic shunt between a left gastric collateral and inferior vena cave using an 8-mm Gortex graft. Note the impressive decompression of the variceal collaterals (*1*) via the patent Gortex graft (*2*) with visualization of the inferior vena cava

gastric and enteric varices. With preserved hepatic functions, creation of a nonconventional portosystemic shunt should always be considered particularly in patients with sizeable variceal collaterals (Fig. 7.8). The procedure is also indicated as a preemptive therapy for patients requiring lifelong anticoagulation because of the forbidden risk of uncontrollable variceal gut hemorrhage. With the development of hepatic failure, modified liver or composite visceral transplantation is properly indicated without significant increase in morbidity and mortality.

Gastroesophageal Devascularization

The gastroesophageal devascularization procedure along with splenectomy was first introduced by Hassab in Egypt [59, 60], and later by Sugiura in Japan [61]. The less extensive Hassab procedure includes gastric devascularization with ligation of the left gastric vascular pedicle, in the absence of an aberrant left replaced hepatic artery, along with splenectomy or splenic artery ligation (Fig. 7.9). The more extensive Sugiura operation involves esophageal transection with complete devascularization of the lower esophagus and stomach utilizing a thoracoabdominal approach. Because of its technical complexity, the procedure did not gain much popularity in the western hemisphere.

With preserved hepatic functions, gastric devascularization can be used for patients who are not shunt candidates and those with isolated splenic or diffuse

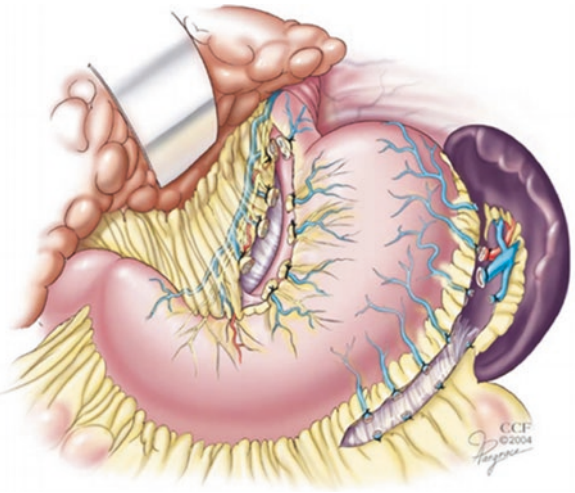

Fig. 7.9 Gastroesophageal devascularization with splenectomy**.** Note ligation and transection of the gastroepiploic vascular arcades close to the gastric wall with complete disconnection of the short gastric vessels. Splenectomy should be avoided in the hypercoagulable patients particularly those with myeloproliferative disorders (From Henderson [67] with permission)

portomesenteric venous thrombosis. Compared to shunt surgery, the ablative procedure is associated with a lower incidence of encephalopathy but with higher rates of rebleeding and persistent ascites. Nonetheless, both surgical procedures have similar operative mortality and long-term survival [62]. With the need for major surgical intervention, gastric devascularization can be done as a first stage operation or simultaneously with the nonportal hypertensive abdominal surgery. The procedure does not preclude or significantly affect the outcome of future transplantation.

Hepatic and Composite Visceral Transplantation

Allotransplantation has revolutionized the management of patients with organ failure. Simultaneous or sequential liver transplantation has been increasingly utilized for patients with poor hepatic reserve who are in need for major surgical interventions [63, 64]. With the coexistence of portomesenteric venous thrombosis, technical modification of the transplant procedure is required including portal vein thrombectomy or cavoportal hemitransposition (Fig. 7.10a).

In patients with concomitant gut failure and complex abdominal pathology, composite visceral transplantation with combined liver-intestine (Fig. 7.10b) or multivisceral transplantation (Fig. 7.10c) is often required. The organs are transplanted en bloc along with simultaneous replacement of the splanchnic arterial and portomesenteric venous system. Of the most common indications are chronic necrotizing pancreatitis, extensive desmoid tumors, and other locally aggressive abdominal neoplasms that are not amenable for resection without organ replacement [65, 66].

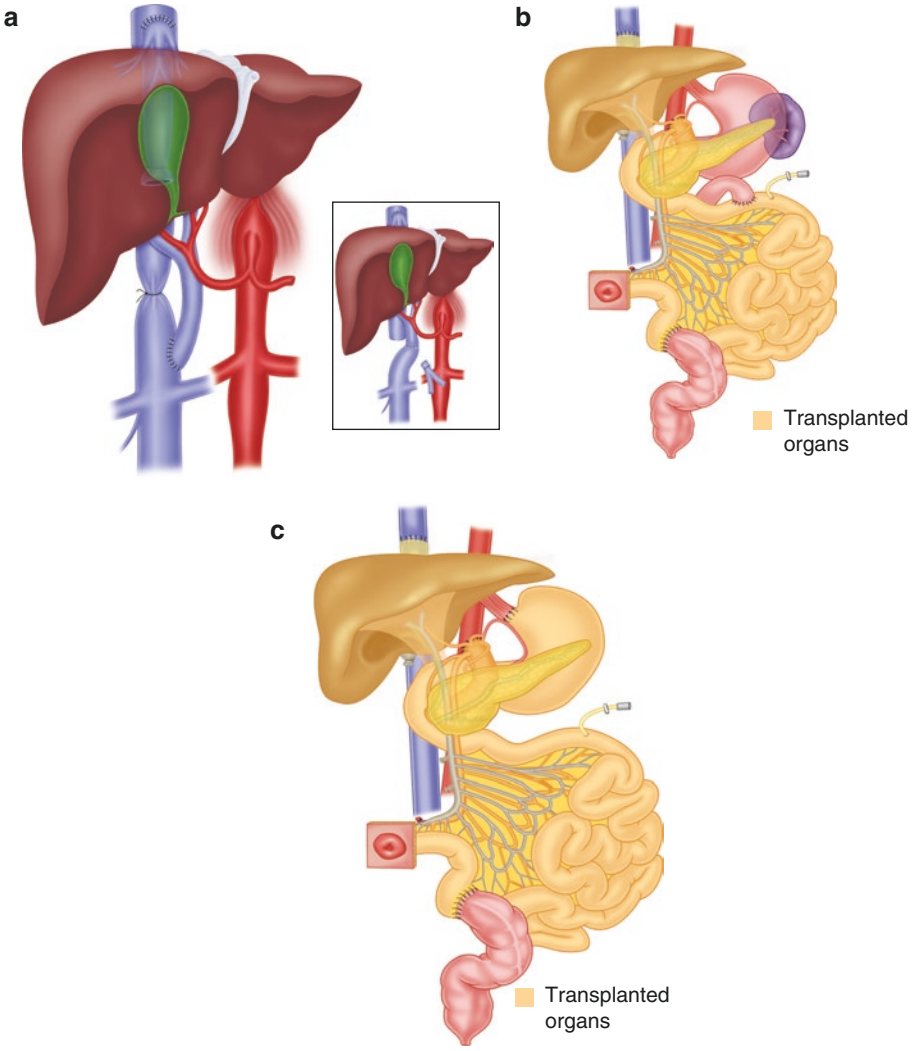

Fig. 7.10 Organ transplantation for end stage liver disease in patients with portomesenteric venous thrombosis and complex abdominal pathology. (**a**) Isolated liver transplantation with cavoportal hemitransposition. (**b**) Combined liver and intestinal transplantation en bloc with the pancreas. (**c**) Full multivisceral transplantation including the stomach, duodenum, pancreas, intestine, and liver

Summary

Thorough preoperative evaluation and comprehensive treatment strategy are crucial to the optimal management of patients with PH who are in need for major surgical intervention. The implementation of combined portal hypertensive therapy and

planned surgical tactics with adoption of fine techniques is essential to achieve successful outcome. When indicated, simultaneous or sequential therapy should be considered. It is imperative to emphasize the need for collaborative postoperative care. Organ transplantation should be considered in patients with the preoperative diagnosis of marginal hepatic reserve and postoperative development of liver failure. Nonetheless, these complex patients should always be managed at tertiary medical centers with the ultimate goal to improve the overall outcome including value of health care.

Disclosures None

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