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Management of patients with complications of cirrhosis

Abstract: Cirrhosis results from repeated hepatocellular injury over time, leading to portal hypertension and the development of ascites, hepatic encephalopathy, and varices. Despite improvements in medical care for patients with cirrhosis, mortality from infection, renal failure, and hepatocellular carcinoma remain high.

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Cirrhosis is the end result of many chronic liver diseases, such as viral hepatitis, alcoholic liver disease, autoimmune hepatitis, and hemochromatosis. It occurs when repeated hepatocyte damage results in the formation of fibrous tissue and the development of regenerative nodules.[1]

Cirrhosis is the 11th leading cause of death worldwide. It is the 12th leading cause of death in the United States, resulting in 27,000 deaths and 421,000 hospitalizations annually.[2-5] For individuals ages 45 to 54, cirrhosis is the 5th leading cause of death.[6]

Treatment of cirrhosis represents a significant economic burden with estimates ranging from $14 million to $2 billion, depending on the etiology of the disease.[3] This burden is expected to increase over the next 20 years, primarily related to increased cases of cirrhosis found in patients with hepatitis C and non-alcoholic steatohepatitis.[3] Without a liver transplantation, the major causes of death are progressive liver failure, hepatocellular carcinoma (HCC), gastrointestinal bleeding, sepsis, and renal failure.[6] Effective management of the sequelae of cirrhosis, however, can decrease overall costs, reduce mortality, and maintain quality of life.

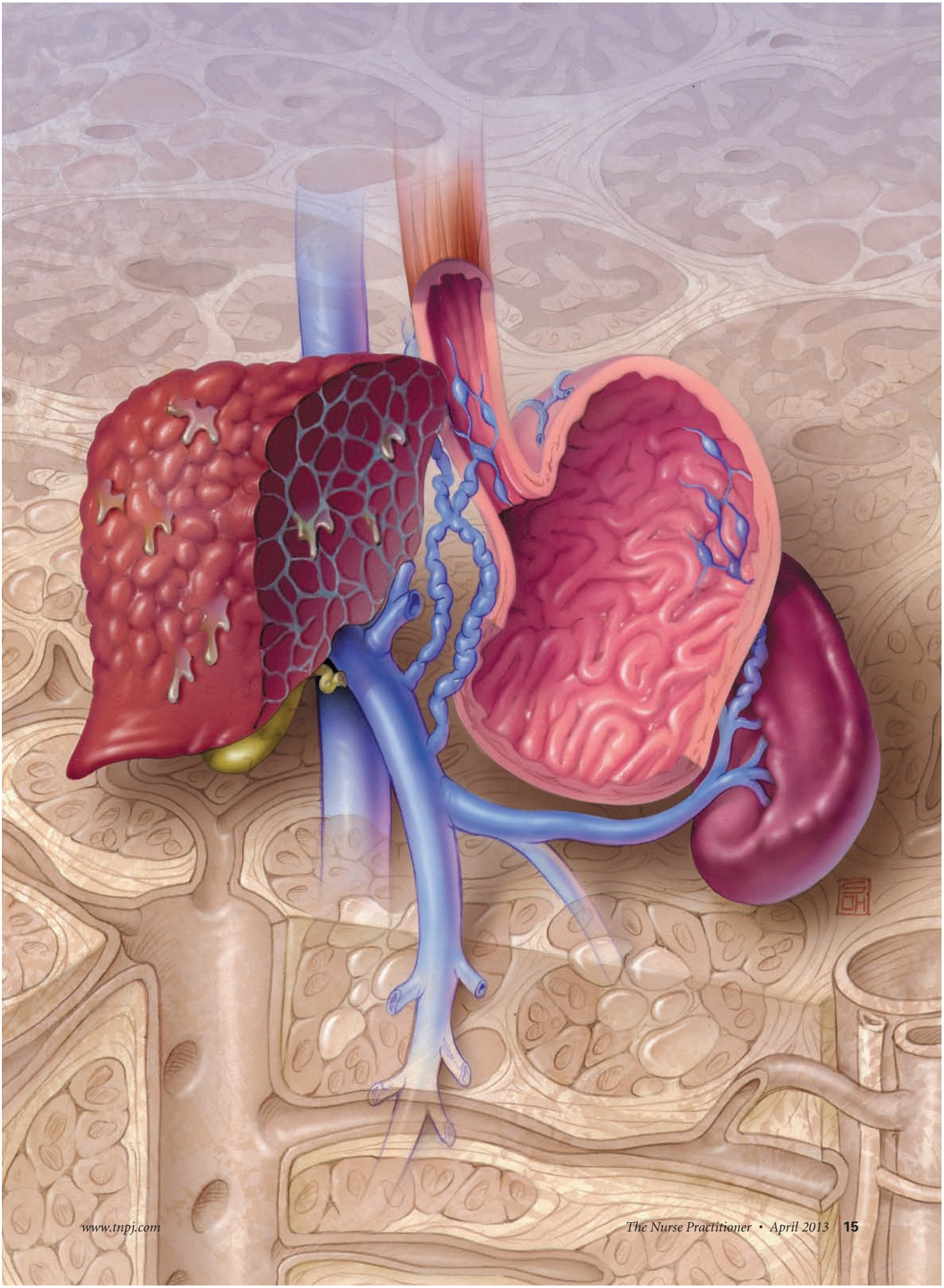
Pathology

Liver disease is progressive in response to chronic liver injury. This progression results in irreversible scarring and nodularity of the liver. This change in liver parenchyma interferes with blood flow through the liver, disrupting its biochemical function.[2,7] There is also active intrahepatic vasoconstriction accounting for 20% to 30% of total increased intrahepatic resistance. Additionally, there is an increase in portal venous inflow that results from splanchnic arteriolar vasodilatation and insufficient portal decompression through collaterals. This increase in flow exacerbates portal hypertension.[7]

End-stage liver disease results in a hyperdynamic circulation characterized by a decrease in systemic vascular resistance, a decrease in arterial BP, and an increase in cardiac output and heart rate.[8] This is likely related to splanchnic and peripheral vasodilatation, leading to a reduction in the effective arterial blood volume. This results in diminished renal blood flow and stimulation of the renin-angiotensin-aldosterone system, sympathetic nervous system, and antidiuretic hormone, leading to renal artery vasoconstriction, sodium retention, and volume expansion.[8]

Illustration by Steve Oh, M.S./Phototake ©

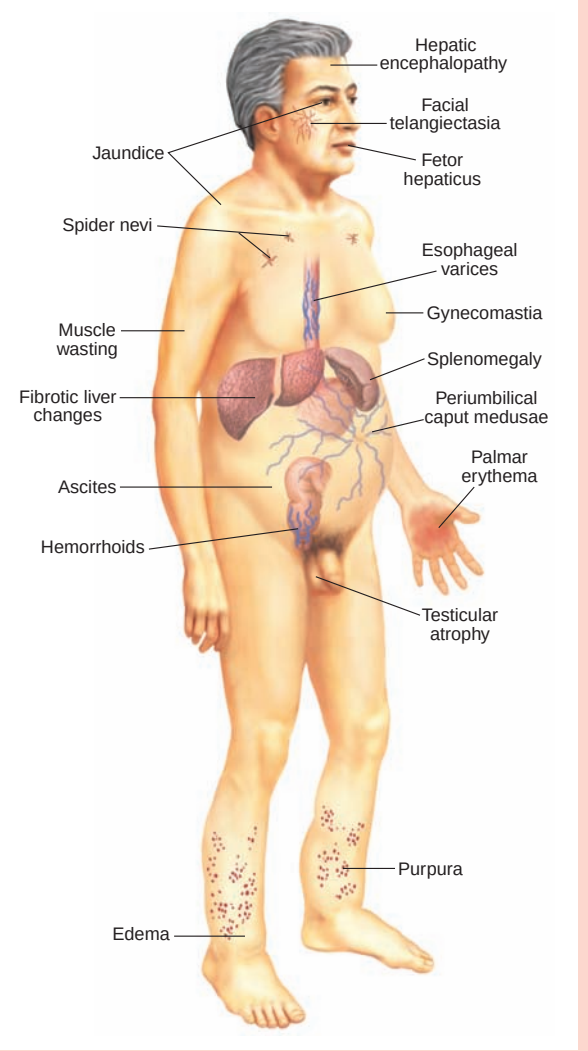
Key words: ascites, cirrhosis, esophageal varices, hepatic encephalopathy, hepatocellular carcinoma, hepatorenal syndrome



Clinical manifestations of cirrhosis are numerous and include the following: jaundice, telangiectasis, splenomegaly, ascites, palmar erythema, decreased body hair, pruritus, anorexia, malnutrition, fatigue, gynecomastia, gastrointestinal bleeding, and encephalopathy (see *Clinical manifestations of cirrhosis*). Patients with cirrhosis experience decreased life expectancy and diminished quality of life. They are also at risk for developing HCC.[1] Lab data will indicate thrombocytopenia, hypoalbuminemia, and a prolonged international normalized ratio (INR).[1,2,5]

Individuals with cirrhosis who have not developed ascites, hepatic encephalopathy, or variceal bleeding are considered more stable and identified as having compensated cirrhosis. After any of these three complications have developed, the individual is identified as having decompensated cirrhosis. The rate of change from compensated to decompensated cirrhosis remains between 5% and 10% annually.[2,6] The 5-year survival after onset of complications related to portal hypertension is less than 50%.[2,6] The median survival of patients with compensated cirrhosis is estimated to be between 7 and 10 years from the time of diagnosis. Development of complications is associated with a reduced median survival of 4 to 7 years.[7] Goals of therapy are to avoid complications and decompensation.

Clinical manifestations of cirrhosis



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Ascites

Ascites is the most common complication of cirrhosis, developing in nearly 60% of all patients with compensated cirrhosis within 10 years.[2,4-6,9] Fifteen percent of patients with ascites die within 1 year, and 44% die within 5 years.[4] Ascites is associated with a survival of less than 50% after 5 years. Prognosis worsens for those with refractory ascites, spontaneous bacterial peritonitis (SBP), and hepatorenal syndrome (HRS).[9]

Ascites results from portal hypertension, splanchnic vasodilatation, and sodium retention by the kidneys.[9] Portal hypertension causes an increased resistance to portal flow at the sinusoidal level and leads to sinusoidal portal hypertension and the backward transmission of increased pressure into splanchnic capillaries. This results in excess fluid that localizes in the peritoneal cavity.[10]

Patients with portal hypertension and cirrhosis develop local splanchnic vasodilatation, which is likely related to production of local vasodilators, such as nitric oxide.[5,9] This vasodilatation results in an increase in splanchnic capillary pressure and permeability as well as a decrease in effective arterial blood volume. This then results in an increased production of lymph fluid and compensatory activation of the renin-angiotensin-aldosterone system and sympathetic nervous system with hypersecretion of antidiuretic hormone. Aldosterone releases and sympathetic nervous system stimulation results in increased reabsorption of sodium. Antidiuretic hormone secretion results in reduced free water excretion and a dilutional hyponatremia.[5,9,10]

Approximately 1,500 mL of ascites must be present before it can be detected by physical exam. An ultrasound, however, can detect as little as 100 mL. Detection of ascites in obese patients is more difficult.[4]

Those with new onset ascites should undergo a diagnostic paracentesis to establish the cause of ascites and to rule out a bacterial infection.[2] The cause of ascites can be reliably determined by measuring the serum-ascites albumin gradient (SAAG).[9] The SAAG is calculated by subtracting the ascitic fluid albumin concentration from the serum albumin concentration. When the SAAG is less than 1.1 g/dL, the

etiology of ascites is likely to be of nonportal hypertensive origin, such as nephrotic syndrome, pancreatitis, or peritoneal carcinomatosis. When the SAAG is greater than or equal to 1.1 g/dL, the etiology of the ascites is likely related to portal hypertension or of cardiac origin.[2,9] Ideally, the albumin level will be determined from serum and ascitic fluid specimens that were obtained at the same time or at least on the same day. Routine analysis of ascitic fluid includes cell count with differential, albumin, and total protein.[4]

Treatment of ascites primarily involves sodium restriction and diuretics (see *Staging and treatment of ascites*). Initial therapy consists of dietary sodium restriction of 2 g/day and is associated with lower diuretic requirements and faster resolution of ascites.[2,9,11] Sodium restriction more stringent than 2 g/day can result in faster mobilization of fluids, but it is not recommended because it is less palatable and may worsen the malnutrition that is commonly experienced by those with cirrhosis.[4]

If sodium restriction alone is unsuccessful, diuretics should be added with a goal weight loss of 0.5 to 1 kg/day. Higher rates of fluid removal increase the risk of renal insufficiency. Spironolactone, an aldosterone antagonist, should be started at a dose of 50 to 100 mg/day, titrated up to 400 mg/day.[2,5] Serum electrolytes, blood urea nitrogen, and creatinine levels should be monitored to avoid volume depletion and electrolyte abnormalities. If spironolactone alone is not successful, furosemide may be added with a starting dose of 20 to 40 mg/day, titrated up to 80 mg twice daily, as electrolyte levels and renal function permit.[2,5]

Single-agent spironolactone can result in hyperkalemia. Therefore, a more common diuretic regimen consists of a morning dose of spironolactone 100 mg and furosemide 40 mg. The dose of both diuretics can be increased every 3 to 5 days if weight loss and natriuresis are inadequate. Amiloride may be used instead of spironolactone for patients with tender gynecomastia. It is, however, more expensive. The use of spironolactone and furosemide together can treat approximately 90% of patients with cirrhosis and ascites.[9]

Five to 10% of cirrhotic patients develop refractory ascites each year. Refractory ascites is the clinical condition that occurs when standard medical treatment with a low-sodium diet and diuretics is unable to resolve ascites. Refractory ascites can be due to diuretic resistance (ascites that cannot be mobilized due to lack of response to dietary sodium restriction and intensive diuretic use) and to diuretic intractability (ascites that cannot be mobilized or the recurrence of which cannot be prevented because of the development of diuretic-induced complications that preclude the use of an effective diuretic dosage).[10] The development of refractory ascites is an independent predictor of decreased survival.[2,9,10]

Staging and treatment of ascites[2,4,5,9,11]

Stage	Description	Treatment
1	Minimal ascites; only detectable by ultrasound	Sodium restriction
2	Moderate ascites with abdominal distension	Sodium restriction and diuretics
3	Massive ascites with marked abdominal distension	Sodium restriction, diuretics, therapeutic paracentesis, and TIPS
Refractory	Ascites that is unresponsive or inadequately responsive to diuretics or excessive adverse reactions from diuretics	Therapeutic paracentesis and TIPS

The addition of large-volume paracentesis and transjugular intrahepatic portosystemic shunt (TIPS) placement are potential treatments for refractory ascites.[9] Therapeutic paracentesis can be performed to instantaneously remove large volumes of ascitic fluid. Up to 5 L of ascitic fluid can be removed at one time without the need to treat with plasma expanders.[9] The current recommendation is to replace 8 g of albumin for every liter of ascitic fluid removed above 5 L.[4,5,9]

The most common complications of large volume paracentesis are hypovolemia, circulatory dysfunction, and renal impairment. This is referred to as paracentesis-induced circulatory dysfunction. It is important to prevent this circulatory dysfunction, as it reduces effective arterial blood volume and results in a drop in arterial BP; it also decreases renal blood flow and glomerular filtration rate. This can lead to the clinical condition known as HRS.[4]

For patients with refractory ascites requiring a large volume paracentesis more than once per month, placement of a transjugular intrahepatic portosystemic shunt (TIPS) may be considered to decrease portal pressure and improve renal sodium excretion.[5,12] TIPS placement increases portal flow, decreases portal resistance, and decreases portal pressure.[7]

TIPS placement involves the creation of an intrahepatic tract between the hepatic vein and the intrahepatic portion of the portal vein using radiologic guidance via the transjugular route. The tract is then dilated and kept patent by the deployment of an expandable stent, creating a low-resistance channel between the portal vein and the hepatic vein and bypassing the cirrhotic liver. Earlier stents allowed the growth of tissue from the surrounding liver, occluding the stent. Newer coated stents, however, minimize the

growth of that tissue and subsequent stent occlusion.[9,10,13] The goal of TIPS placement is a hepatic venous pressure gradient of less than or equal to 12 mm Hg.[12]

Not all patients are candidates for TIPS placement (see *Contraindications for TIPS placement*). Indeed, there is a 15% to 30% chance of developing or worsening hepatic encephalopathy after TIPS placement.[12,14] The risk of hepatic encephalopathy is dependent on the diameter of the shunt, the patient's age, history of hepatic encephalopathy, and active alcohol use.[14]

SBP

SBP is an infection of ascitic fluid in patients with cirrhosis. It is believed that SBP develops as a result of delayed intestinal transit and increased permeability of the intestinal wall with bacterial migration from the intestinal lumen to the mesenteric lymph nodes. Subsequently, these bacteria travel to the ascitic fluid, with the deficient immune system in patients with cirrhosis unable to mount an effective immune response.[5,9] SBP is seen in 8% to 25% of patients with cirrhosis and ascites.[2] The long-term prognosis for patients with SBP is poor, with mortalities at 2 years as high as 75%.[9]

Most patients with SBP present with fever, abdominal pain, chills, malaise, loss of appetite, nausea, vomiting, or altered mental status. However, up to 10% of patients with SBP are asymptomatic.[5,9]

SBP is identified when there is a positive ascitic fluid bacterial culture and an elevated ascitic fluid absolute polymorphonuclear neutrophil (PMN) count of 250 cells/mm^3 or greater. Up to 60% of patients with a PMN count greater than 250 cells/mm^3 have negative cultures. If the patient has an elevated cell count but a negative culture, they are labeled with "culture-negative neutrocytic ascites." Treatment should begin as soon as the elevated PMN count is identified.[9]

Cefotaxime or another third-generation cephalosporin is the treatment of choice for SBP, covering the most common isolates of *Escherichia coli*, *Klebsiella pneumoniae*, and pneumococci. Treatment most frequently requires hospitalization and the use of intravenous antibiotics. A fluoroquinolone can be substituted for cefotaxime. The substitution can occur due to allergy to cefotaxime or from provider preference.[4,6]

The International Ascites Club recommends antibiotic prophylaxis in patients with cirrhosis who have had a prior episode of SBP, as up to 70% of patients with an episode of SBP develop another episode within 1 year. Patients with prior SBP should receive long-term prophylaxis with daily norfloxacin, amoxicillin-clavulanate, or trimethoprim-sulfamethoxazole.[2,4] There remains concern that the use of a fluoroquinolone for SBP prophylaxis can lead to fluoroquinolone-resistant, Gram-positive infections.[5] Recurrence rates decrease to 20% within the first year in patients receiving SBP prophylaxis.[9]

Administration of albumin to patients with SBP reduces complications and mortality.[5] It is believed that the albumin results in increased arterial filling and a corresponding reduced arterial vasodilation. Administration of albumin reduces in-hospital mortality.[4,5]

Contraindications for TIPS placement[5,12]

- Age over 65
- Heart failure
- Grade 3-4 hepatic encephalopathy
- Uncontrolled systemic infection
- Unrelieved biliary obstruction
- Severe coagulopathy (INR greater than 5)
- Severe thrombocytopenia (platelet count less than 20,000/mm^3)
- Moderate-to-severe pulmonary hypertension
- Anatomic abnormalities, such as portal vein obstruction, large hepatic tumors, extensive polycystic liver disease, and hepatic vein obstruction

Hepatic encephalopathy

Hepatic encephalopathy is a frequent occurrence in those with cirrhosis, identified in 27% to 75% of patients. Six percent of patients with cirrhosis develop hepatic encephalopathy each year.[2,6]

The term hepatic encephalopathy covers the neurologic and psychological symptoms in patients with liver disease that cannot be explained by the presence of other pathologies. The clinical course is extremely variable and occurs in both a subclinical and overt form.[14] Clinical manifestations can occur over hours to days in patients who have previously been stable. Signs and symptoms of hepatic encephalopathy range from mild changes in cognition to significant changes in intellect, behavior, motor function, and consciousness. Changes in mental status include subtle alterations in personality, intellectual capacity, and cognitive function to more profound alterations in consciousness, which lead to deep coma with posturing.[1,2,15]

The development of hepatic encephalopathy is most often attributed to ammonia, although other factors have been identified, and there is not always a relationship between ammonia level and the degree of symptoms.[14] Common precipitating conditions include acid-base balance disturbances, electrolyte disturbances, dehydration, constipation, infections, gastrointestinal bleeding, TIPS insertion, and sedative use.[1,15] In 50% of cases, however, no obvious cause is identified.

Ammonia is produced largely in the intestine and metabolized in the liver to urea. Blood ammonia concentrations are increased in patients with cirrhosis, and hepatic clearance is impaired as a result of hepatocyte dysfunction and portosystemic shunting, with excess ammonia entering

the systemic circulation. When excess ammonia is present, astrocyte swelling occurs with a low-grade cerebral edema developing and impacting neuronal function.[15]

Grading of the degree of hepatic encephalopathy is helpful when determining the level of care required (see *Grading hepatic encephalopathy*).

Treatment of hepatic encephalopathy is aimed at reducing the ammonia load, primarily through the use of nonabsorbable disaccharides and nonabsorbable antibiotics.[15] Lactulose is a disaccharide that is not absorbed in the small intestine and passes unchanged into the large intestine where it is metabolized by colonic bacteria. The pH of the intestine is then lowered, affecting both the production and absorption of ammonia. The sugars cause a laxative effect. The usual dose of lactulose is 30 to 60 mL/dose, titrated in frequency to maintain 2 to 5 bowel movements per day.[2] Excessive use can cause diarrhea, dehydration, and kidney failure. Severe alterations in mental status can require administration of lactulose via enema.[15]

If treatment of hepatic encephalopathy is unsuccessful with lactulose, antibiotics such as neomycin or rifaximin should be added.[2] Nonabsorbable antibiotics selectively eliminate urease-producing organisms from the gastrointestinal tract, resulting in reduced ammonia production. Neomycin has been the mainstay of treatment for hepatic encephalopathy; however, small amounts of the antibiotic are absorbed and have been associated with nephrotoxicity and ototoxicity. Rifaximin is a synthetic antibiotic that has a very low rate of systemic absorption; it is as effective as neomycin with a better safety profile.[15]

Protein restriction was previously used to treat hepatic encephalopathy but only worsens the nutritional status of these patients.[2] A daily protein intake of 1.2 to 1.5 g/kg is recommended. Vegetable protein is often better tolerated than animal protein, likely related to the effects of dietary fiber on colonic function.[11,15] If required, protein restriction should be limited to patients with episodic hepatic encephalopathy who do not respond to standard treatment. Protein intake should never fall below 0.5 g/kg/day for more than 48 hours with normal protein intake being gradually restored.[11]

Malnutrition

Malnutrition is highly prevalent and associated with adverse outcomes in patients with cirrhosis. The presence of malnutrition is estimated to be as high as 80% in patients with cirrhosis and is related to the degree of liver disease.[11,16] Malnutrition is often underdiagnosed because liver disease can affect the results of many of the traditional techniques currently used to evaluate nutritional status.[11,16]

Malnutrition is often associated with vitamin and mineral deficiency. Deficiencies in water-soluble vitamins are common in alcoholic cirrhosis, while deficiencies in fat-soluble vitamins are more common in cholestatic liver disease. In more advanced stages, both fat-soluble and water-soluble vitamin deficiencies occur. Additionally, zinc, selenium, and magnesium deficiencies are common.[11] To minimize malnutrition, patients should be encouraged to eat 4 to 7 small meals per day, including a late-evening snack. Oral nutritional supplements should be added when patients are not able to maintain adequate dietary intake.

Grading hepatic encephalopathy[1,2,14,15]

Grade	Signs/symptoms
0	No abnormalities detected
1	Trivial lack of awareness; euphoria or anxiety; shortened attention span; impairment of addition/subtraction; personality change; sleep disturbance
2	Lethargy or apathy; disorientation to time; obvious personality change; inappropriate behavior; drowsiness; intermittent disorientation; short attention span
3	Somnolence to semistupor; responsive to stimuli; confusion; gross disorientation
4	Coma

Esophageal varices

Esophageal varices develop as a consequence of portal hypertension (see *Esophageal varices: Vascular changes from portal hypertension*). The elevated portal pressure results in the development of collateral circulation with portal blood diverted back into the systemic circulation. These collateral vessels are inelastic, becoming more fragile as they enlarge, and rupturing when the pressure exceeds the vessel capacity.[1] The strongest predictor for the development of varices is a hepatic venous pressure gradient greater than 10 mm Hg.[7]

The frequency of esophageal varices varies from 25% to 70% in patients with cirrhosis, with annual development at a rate of 4% to 14%.[2,6,7,12] Gastric varices are less common than esophageal varices.[7] Among those with varices, 25% to 40% hemorrhage within 2 years of diagnosis.[6] Each episode of bleeding has a 10% to 30% mortality. If untreated, over 70% of patients have recurrent bleeding within 1 year.[2]

Beta-blockers and endoscopic variceal ligation are the main treatments used for varices. Nonselective beta-blockers show clear benefits in preventing esophageal variceal bleeding. Overall, upper gastrointestinal bleeding was reduced by

40%, and it was reduced by 53% in patients with medium to large varices.[2,6] Variceal ligation success is similar to that of beta-blockers, but beta-blockers are less invasive. The combination of nonselective beta-blockers and endoscopic band ligation is more effective than either therapy alone.[2]

In patients with small varices that have not bled but have increased risk of hemorrhage, nonselective beta-blockers should be used for prevention of the first variceal hemorrhage. In patients with medium-large varices that have not bled and are not at high risk for hemorrhage, nonselective beta-blockers are preferred, and endoscopic variceal ligation should be considered in those with contraindications or intolerance to or nonadherence with beta-blockers. In patients with medium-large varices that have not bled but have a high risk of hemorrhage, nonselective beta-blockers or endoscopic variceal ligation may be recommended for prevention of the first variceal hemorrhage.[6]

Beta-blockers decrease portal venous flow, increase portal resistance, and decrease portal pressure.[7] Propranolol and nadolol are equally effective.[6] Beta-blockade dosage should be titrated to produce a 25% reduction in the patient's baseline heart rate or until the resting heart rate is 55 to 60 beats/minute.[2,6]

Treatment of acute variceal bleeding

Treatment of variceal rupture includes peripheral and central venous access with fluid resuscitation to correct hypovolemia. Management in a critical care unit is required. Blood volume resuscitation is required to maintain hemodynamic stability and a hemoglobin level of approximately 8 g/dL.[7] Vigorous resuscitation with 0.9% sodium chloride should be avoided, as this can worsen or precipitate the accumulation of ascites. Fresh frozen plasma and platelets should be considered in patients with significant coagulopathy and/or thrombocytopenia.[7]

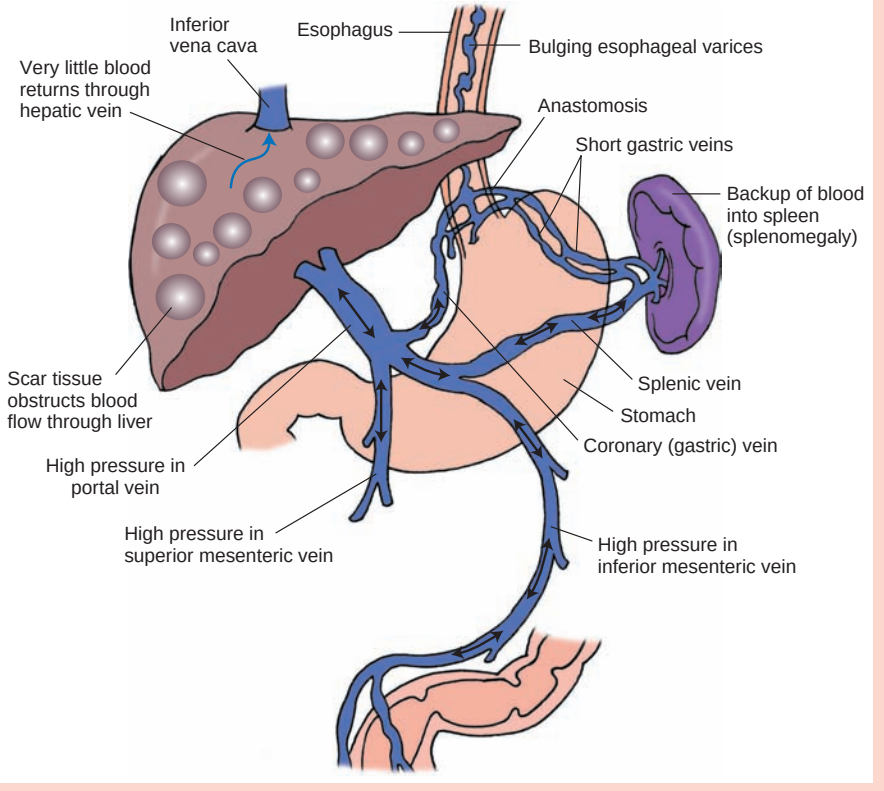
Oxygen therapy and airway protection to prevent hypoxia and aspiration are essential. Ultimately, endotracheal intubation may be required.[7] Although not FDA approved for this indication, vasoactive drug therapy using octreotide is frequently initiated and continued for at least 5 days to promote splanchnic vasoconstriction.[6,7] Endoscopic variceal band ligation is necessary once stabilization has occurred.[6] Because patients with gastrointestinal bleeding have a high incidence of SBP, patients should be given an intravenous third-generation cephalosporin or fluoroquinolone twice daily for seven days.[4,6,7]

Subsequent therapy to reduce portal hypertension includes beta-blockade therapy, repeat variceal banding, and potentially placement of a TIPS. The median rebleeding rate in untreated individuals is around 60% in 1 to 2 years with a mortality of 33%. Nonselective beta-blockers reduce rates of variceal rebleeding to slightly more than 40%. The combination of a nonselective beta-blocker plus endoscopic variceal ligation is the best option for secondary prevention of variceal hemorrhage. Referral to a liver transplant center is essential.[7]

HRS

HRS is characterized by severe renal vasoconstriction and pro-

Esophageal varices: Vascular changes from portal hypertension



Source: Morton PG, Fontaine DK. *Critical Care Nursing: A Holistic Approach.* 10th ed. Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins; 2013:947.

gressive renal failure in the absence of structural kidney abnormalities. This vasoconstriction is likely related to marked splanchnic vasodilation, resulting in activation of the renin-angiotensin-aldosterone system and the sympathetic nervous system, with increased production of local vasoconstrictors in the kidney in an attempt to maintain renal perfusion and glomerular filtration rate. The incidence of HRS is approximately 10% for hospitalized patients with cirrhosis with increasing incidences as time progresses.[9] Patients with refractory ascites are at greater risk for developing HRS.

HRS can be divided into type 1 and type 2. Type 1 HRS is the most severe form, usually developing after triggering events, such as the following: infection, large volume paracentesis without administration of albumin, gastrointestinal bleeding, administration of radiologic contrast agents, nephrotoxic antibiotic administration, and nonsteroidal anti-inflammatory drug administration; it has a poor prognosis. Acute renal failure develops rapidly, and survival is limited to 1 to 2 weeks. Patients with type 1 HRS develop a rapidly progressing reduction in renal function as defined by a doubling of the initial serum creatinine to a level greater than 2.5 mg/dL or a 50% reduction in the initial 24-hour creatinine clearance to a level less than 20 mL/minute in less than 2 weeks.[2,4]

Type 2 HRS develops more slowly with a mean survival of approximately 6 months.[9] Type 2 is a more chronic, less severe form, but is a risk factor for developing type 1 HRS.[2]

Diagnosis of HRS is based on exclusion of other causes of renal failure. Major criteria for the diagnosis of HRS in the setting of cirrhosis were updated in 2007 and include the following: cirrhosis with ascites; serum creatinine greater than 1.5 mg/dL; no improvement of serum creatinine after at least 2 days with diuretic withdrawal and volume expansion with albumin at 1 g/kg/day up to a maximum of 100 g/day; absence of any type of shock; no current or recent treatment with nephrotoxic drugs; and absence of parenchymal kidney disease.[4,9] Minor criteria that may provide support for the diagnosis include the following: urine volume less than 500 mL/day; urine sodium less than 10 mmol/L; urine osmolality greater than plasma osmolality; urine red blood cells count less than 50 per high power field; and serum sodium concentration less than 130 mmol/L.

Treatment of HRS

The treatment of HRS is challenging. Precipitating factors should be identified and treated. A diagnostic paracentesis should be performed to rule out SBP, and large volume paracentesis should be avoided. Diuretics and other potentially nephrotoxic drugs should be stopped. Administration of a fluid challenge of 1 g/kg of albumin or 1 to 1.5 L of 0.9% sodium chloride is needed to eliminate dehydration as a potential cause. However, caution should be used to avoid fluid overload.

The goal of pharmacologic treatment is to improve renal blood flow by using medications that act on the splanchnic circulation and by using plasma expansion. Although not FDA approved for this indication, the administration of vasoactive drugs such as octreotide (a somatostatin analogue) and midodrine (an alpha-1 adrenergic agonist) increases splanchnic blood flow with a subsequent increase in renal perfusion.

Renal support in the form of conventional hemodialysis or continuous venovenous hemofiltration dialysis can be used as a bridge to hepatic recovery or liver transplantation. However, when recovery is highly unlikely or transplantation is not feasible, renal support is not indicated. Patients with type 1 HRS should undergo an expedited liver transplant referral and evaluation.[4]

HCC

In the United States (2010), an estimated 24,120 cases of liver cancer occurred, and the disease caused 18,910 deaths. In fact, the incidence of HCC in the United States has doubled in the last 20 years.[2] The annual incidence of developing HCC is 1.5% in patients with compensated cirrhosis and 4% in patients with decompensated cirrhosis.[6] Survival for liver cancer remains poor, with the 1-year survival rate being only 47%. Risk factors for HCC include chronic hepatitis B, chronic hepatitis C, cirrhosis, and alcohol intake.[17]

Early detection increases survival. Surveillance for HCC allows for early detection of liver lesions when treatment will be most effective. Screening tests include ultrasonography, CT scan, or magnetic resonance imaging every 6 months for those at risk for HCC. Although not currently recommended by the American Association for the Study of Liver Diseases (AASLD), many healthcare providers incorporate serum alpha-fetoprotein (AFP) testing into the every 6-month screening despite the mixed results of studies and the differing levels at which the AFP level is deemed sensitive and specific.[18]

Moving forward

Despite significant improvements in medical care, the management of patients with cirrhosis remains challenging with less than optimal results. Although liver transplantation is the most effective treatment for end-stage liver disease and survival after transplant has consistently improved over the years, a scarcity of donor organs and growing incidence of cirrhosis requires continued improvement in ways to manage this complex group of patients.

Clinicians caring for individuals with chronic liver disease must remain vigilant for subtle changes in patient

condition. Patients and caregivers must be educated to encourage frequent follow-up, adherence to prescribed therapeutic regimens, and communication regarding adverse reactions.

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The author and planners have disclosed that they have no financial relationships related to this article.

DOI-10.1097/01.NPR.0000427610.76270.45