Cirrhosis
(Cirrhosis of the Liver)

What is cirrhosis?

Cirrhosis is a complication of many liver diseases that is characterized by abnormal structure and function of the liver. The diseases that lead to cirrhosis do so because they injure and kill liver cells and the inflammation and repair that is associated with the dying liver cells causes scar tissue to form. The liver cells that do not die multiply in an attempt to replace the cells that have died. This results in clusters of newly-formed liver cells (regenerative nodules) within the scar tissue. There are many causes of cirrhosis; they include chemicals (such as alcohol, fat, and certain medications), viruses, toxic metals (such as iron and copper that accumulate in the liver as a result of genetic diseases), and autoimmune liver disease in which the body's immune system attacks the liver.

Why does cirrhosis cause problems?

The liver is an important organ in the body. It performs many critical functions, two of which are producing substances required by the body, for example, clotting proteins that are necessary in order for blood to clot, and removing toxic substances that can be harmful to the body, for example, drugs. The liver also has an important role in regulating the supply to the body of glucose (sugar) and lipids (fat) that the body uses as fuel. In order to perform these critical functions, the liver cells must be working normally, and they must have an intimate relationship with the blood since the substances that are added or removed by the liver are transported to and from the liver by the blood.

The relationship of the liver to the blood is unique. Unlike most organs in the body, only a small amount of blood is supplied to the liver by arteries. Most of the liver's supply of blood comes from the intestinal veins as the blood returns to the heart. The main vein that returns blood from the intestines is called the portal vein. As the
portal vein passes through the liver, it breaks up into increasingly smaller and smaller veins. The tiniest veins (called sinusoids because of their unique structure) are in close contact with the liver cells. In fact, the liver cells line up along the length of the sinusoids. This close relationship between the liver cells and blood from the portal vein allows the liver cells to remove and add substances to the blood. Once the blood has passed through the sinusoids, it is collected in increasingly larger and larger veins that ultimately form a single vein, the hepatic vein that returns the blood to the heart.

In cirrhosis, the relationship between blood and liver cells is destroyed. Even though the liver cells that survive or are newly-formed may be able to produce and remove substances from the blood, they do not have the normal, intimate relationship with the blood, and this interferes with the liver cells' ability to add or remove substances from the blood. In addition, the scarring within the cirrhotic liver obstructs the flow of blood through the liver and to the liver cells. As a result of the obstruction to the flow of blood through the liver, blood “backs-up” in the portal vein, and the pressure in the portal vein increases, a condition called portal hypertension. Because of the obstruction to flow and high pressures in the portal vein, blood in the portal vein seeks other veins in which to return to the heart, veins with lower pressures that bypass the liver. Unfortunately, the liver is unable to add or remove substances from blood that bypasses it. It is a combination of reduced numbers of liver cells, loss of the normal contact between blood passing through the liver and the liver cells, and blood bypassing the liver that leads to many of the manifestations of cirrhosis.

A second reason for the problems caused by cirrhosis is the disturbed relationship between the liver cells and the channels through which bile flows. Bile is a fluid produced by liver cells that has two important functions: to aid in digestion and to remove and eliminate toxic substances from the body. The bile that is produced by liver cells is secreted into very tiny channels that run between the liver cells that line the sinusoids, called canaliculi. The canaliculi empty
into small ducts which then join together to form larger and larger ducts. Ultimately, all of the ducts combine into one duct that enters the small intestine. In this way, bile gets to the intestine where it can help with the digestion of food. At the same time, toxic substances contained in the bile enter the intestine and then are eliminated in the stool. In cirrhosis, the canaliculi are abnormal and the relationship between liver cells and canaliculi is destroyed, just like the relationship between the liver cells and blood in the sinusoids. As a result, the liver is not able to eliminate toxic substances normally, and they can accumulate in the body. To a minor extent, digestion in the intestine also is reduced.

**What are the common causes of cirrhosis?**

**Alcohol** is a very common cause of cirrhosis, particularly in the Western world. The development of cirrhosis depends upon the amount and regularity of alcohol intake. Chronic, high levels of alcohol consumption injure liver cells. Thirty percent of individuals who drink daily at least eight to sixteen ounces of hard liquor or the equivalent for fifteen or more years will develop cirrhosis. Alcohol causes a range of liver diseases; from simple and uncomplicated fatty liver (steatosis), to the more serious fatty liver with inflammation (steatohepatitis or alcoholic hepatitis), to cirrhosis.

**Nonalcoholic fatty liver disease (NAFLD)** refers to a wide spectrum of liver diseases that, like alcoholic liver disease, ranges from simple steatosis, to nonalcoholic steatohepatitis (NASH), to cirrhosis. All stages of NAFLD have in common the accumulation of fat in liver cells. The term nonalcoholic is used because NAFLD occurs in individuals who do not consume excessive amounts of alcohol, yet, in many respects, the microscopic picture of NAFLD is similar to what can be seen in liver disease that is due to excessive alcohol. NAFLD is associated with a condition called insulin resistance, which, in turn, is associated with the metabolic syndrome and diabetes.
mellitus type 2. Obesity is the most important cause of insulin resistance, metabolic syndrome, and type 2 diabetes.

Cryptogenic cirrhosis (cirrhosis due to unidentified causes) is a common reason for liver transplantation. It is termed cryptogenic cirrhosis because for many years doctors have been unable to explain why a proportion of patients developed cirrhosis. Doctors now believe that cryptogenic cirrhosis is due to NASH (nonalcoholic steatohepatitis) caused by long standing obesity, type 2 diabetes, and insulin resistance. The fat in the liver of patients with NASH is believed to disappear with the onset of cirrhosis, and this has made it difficult for doctors to make the connection between NASH and cryptogenic cirrhosis for a long time. One important clue that NASH leads to cryptogenic cirrhosis is the finding of a high occurrence of NASH in the new livers of patients undergoing liver transplant for cryptogenic cirrhosis. Finally, a study from France suggests that patients with NASH have a similar risk of developing cirrhosis as patients with long standing infection with hepatitis C virus. (See discussion that follows.) However, the progression to cirrhosis from NASH is thought to be slow and the diagnosis of cirrhosis typically is made in patients in their sixties.

Chronic viral hepatitis is a condition where hepatitis B or hepatitis C virus infects the liver for years. Most patients with viral hepatitis will not develop chronic hepatitis and cirrhosis. For example, the majority of patients infected with hepatitis A recover completely within weeks, without developing chronic infection. In contrast, some patients infected with hepatitis B virus and most patients infected with hepatitis C virus develop chronic hepatitis, which, in turn, causes progressive liver damage and leads to cirrhosis, and, sometimes, liver cancers.

Inherited (genetic) disorders result in the accumulation of toxic substances in the liver which lead to tissue damage and
cirrhosis. Examples include the abnormal accumulation of iron (hemochromatosis) or copper (Wilson's disease). In hemochromatosis, patients inherit a tendency to absorb an excessive amount of iron from food. Over time, iron accumulation in different organs throughout the body causes cirrhosis, arthritis, heart muscle damage leading to heart failure, and testicular dysfunction causing loss of sexual drive. Treatment is aimed at preventing damage to organs by removing iron from the body through bloodletting (removing blood). In Wilson disease, there is an inherited abnormality in one of the proteins that controls copper in the body. Over time, copper accumulates in the liver, eyes, and brain. Cirrhosis, tremor, psychiatric disturbances and other neurological difficulties occur if the condition is not treated early. Treatment is with oral medication that increases the amount of copper that is eliminated from the body in the urine.

**Primary biliary cirrhosis (PBC)** is a liver disease caused by an abnormality of the immune system that is found predominantly in women. The abnormal immunity in PBC causes chronic inflammation and destruction of the small bile ducts within the liver. The bile ducts are passages within the liver through which bile travels to the intestine. Bile is a fluid produced by the liver that contains substances required for digestion and absorption of fat in the intestine, as well as other compounds that are waste products, such as the pigment bilirubin. (Bilirubin is produced by the breakdown of hemoglobin from old red blood cells.) Along with the gallbladder, the bile ducts make up the biliary tract. In PBC, the destruction of the small bile ducts blocks the normal flow of bile into the intestine. As the inflammation continues to destroy more of the bile ducts, it also spreads to destroy nearby liver cells. As the destruction of the hepatocytes proceeds, scar tissue (fibrosis) forms and spreads throughout the areas of destruction. The combined effects of progressive inflammation, scarring, and the toxic
effects of accumulating waste products culminates in cirrhosis. For more, please read the Primary Biliary Cirrhosis article.

**Primary sclerosing cholangitis (PSC)** is an uncommon disease found frequently in patients with ulcerative colitis (see Ulcerative Colitis article). In PSC, the large bile ducts outside of the liver become inflamed, narrowed, and obstructed. Obstruction to the flow of bile leads to infections of the bile ducts and jaundice and eventually causes cirrhosis. In some patients, injury to the bile ducts (usually as a result of surgery) also can cause obstruction and cirrhosis of the liver.

**Autoimmune hepatitis** is a liver disease caused by an abnormality of the immune system that is found more commonly in women. The abnormal immune activity in autoimmune hepatitis causes progressive inflammation and destruction of liver cells (hepatocytes), leading ultimately to cirrhosis.

Infants can be born without bile ducts (biliary atresia) and ultimately develop cirrhosis. Other infants are born lacking vital enzymes for controlling sugars that leads to the accumulation of sugars and cirrhosis. On rare occasions, the absence of a specific enzyme can cause cirrhosis and scarring of the lung (alpha 1 antitrypsin deficiency).

**Less common causes of cirrhosis include unusual reactions to some drugs and prolonged exposure to toxins, as well as chronic heart failure (cardiac cirrhosis).** In certain parts of the world (particularly Northern Africa), infection of the liver with a parasite (schistosomiasis) is the most common cause of liver disease and cirrhosis.

**What is new and in the future for cirrhosis?**

Progress in the management and prevention of cirrhosis continues. Research is ongoing to determine the mechanism of scar formation
in the liver and how this process of scarring can be interrupted or even reversed. Newer and better treatments for viral liver disease are being developed to prevent the progression to cirrhosis. Prevention of viral hepatitis by vaccination, which is available for hepatitis B, is being developed for hepatitis C. Treatments for the complications of cirrhosis are being developed or revised and tested continually. Finally, research is being directed at identifying new proteins in the blood that can detect liver cancer early or predict which patients will develop liver cancer.

**Cirrhosis at a Glance**

Cirrhosis is a complication of liver disease which involves loss of liver cells and irreversible scarring of the liver. Alcohol and viral hepatitis B and C are common causes of cirrhosis, although there are many other causes. Cirrhosis can cause weakness, loss of appetite, easy bruising, yellowing of the skin (jaundice), itching, and fatigue. Diagnosis of cirrhosis can be suggested by the history, physical examination and blood tests, and can be confirmed by liver biopsy. Complications of cirrhosis include edema and ascites, spontaneous bacterial peritonitis, bleeding from varices, hepatic encephalopathy, hepatorenal syndrome, hepatopulmonary syndrome, hypersplenism, and liver cancer. Treatment of cirrhosis is designed to prevent further damage to the liver, treat complications of cirrhosis, and preventing or detecting liver cancer early. Transplantation of the liver is becoming an important option for treating patients with advanced cirrhosis.

**How is cirrhosis diagnosed and evaluated?**

The single best test for diagnosing cirrhosis is biopsy of the liver. Liver biopsies, however, carry a small risk for serious complications,
and, therefore, biopsy often is reserved for those patients in whom the diagnosis of the type of liver disease or the presence of cirrhosis is not clear. The possibility of cirrhosis may be suggested by the history, physical examination, or routine testing. If cirrhosis is present, other tests can be used to determine the severity of the cirrhosis and the presence of complications. Tests also may be used to diagnose the underlying disease that is causing the cirrhosis. The following are some examples of how doctors discover, diagnose and evaluate cirrhosis:

In taking a patient's history, the physician may uncover a history of excessive and prolonged intake of alcohol, a history of intravenous drug abuse, or a history of hepatitis. These pieces of information suggest the possibility of liver disease and cirrhosis.

Patients who are known to have chronic viral hepatitis B or C have a higher probability of having cirrhosis.

Some patients with cirrhosis have enlarged livers and/or spleens. A doctor can often feel (palpate) the lower edge of an enlarged liver below the right rib cage and feel the tip of the enlarged spleen below the left rib cage. A cirrhotic liver also feels firmer and more irregular than a normal liver.

Some patients with cirrhosis, particularly alcoholic cirrhosis, have small red spider-like markings (telangiectasias) on the skin, particularly on the chest, that are made up of enlarged, radiating blood vessels. These spider telangiectasias also can be seen in individuals without liver disease, however.

Jaundice (yellowness of the skin and of the whites of the eyes due to elevated bilirubin in the blood) is common among patients with cirrhosis, but jaundice can occur in patients with liver diseases without cirrhosis and other conditions such as hemolysis (excessive break down of red blood cells).
Swelling of the abdomen (ascites) and/or the lower extremities (edema) due to retention of fluid is common among patients with cirrhosis though other diseases can cause them commonly, e.g., congestive heart failure.

Patients with abnormal copper deposits in their eyes or certain types of neurologic disease may have Wilson's disease, a genetic disease in which there is abnormal handling and accumulation of copper throughout the body, including the liver, that can lead to cirrhosis.

Esophageal varices may be found unexpectedly during upper endoscopy (EGD), and they strongly suggesting cirrhosis.

Computerized tomography (CT or CAT) or magnetic resonance imaging (MRI) scans and ultrasound examinations of the abdomen done for reasons other than evaluating the possibility of liver disease may unexpectedly detect enlarged livers, abnormally nodular livers, enlarged spleens, and fluid in the abdomen that suggest cirrhosis.

Advanced cirrhosis leads to a reduced level of albumin in the blood and reduced blood clotting factors due to the loss of the liver's ability to produce these proteins. Thus, reduced levels of albumin in the blood or abnormal bleeding suggest cirrhosis.

Abnormal elevation of liver enzymes in the blood (such as ALT and AST) that are obtained routinely as part of yearly health examinations suggests inflammation or injury to the liver from many causes as well as cirrhosis.

Patients with elevated levels of iron in their blood may have hemochromatosis, a genetic disease of the liver in which iron is handled abnormally and which leads to cirrhosis.

Auto-antibodies (antinuclear antibody, anti-smooth muscle antibody and anti-mitochondrial antibody) sometimes are
detected in the blood and may be a clue to the presence of autoimmune hepatitis or primary biliary cirrhosis, both of which can lead to cirrhosis.

Liver cancer (hepatocellular carcinoma) may be detected by CT and MRI scans or ultrasound of the abdomen. Liver cancer most commonly develops in individuals with underlying cirrhosis.

If there is an accumulation of fluid in the abdomen, a sample of the fluid can be removed using a long needle. The fluid then can be examined and tested. The results of testing may suggest the presence of cirrhosis as the cause of the fluid.

How is cirrhosis treated?

Treatment of cirrhosis includes 1) preventing further damage to the liver, 2) treating the complications of cirrhosis, 3) preventing liver cancer or detecting it early, and 4) liver transplantation.

Preventing further damage to the liver

Consume a balanced diet and one multivitamin daily. Patients with PBC with impaired absorption of fat soluble vitamins may need additional vitamins D and K.

Avoid drugs (including alcohol) that cause liver damage. All patients with cirrhosis should avoid alcohol. Most patients with alcohol induced cirrhosis experience an improvement in liver function with abstinence from alcohol. Even patients with chronic hepatitis B and C can substantially reduce liver damage and slow the progression towards cirrhosis with abstinence from alcohol.
Avoid nonsteroidal anti-inflammatory drugs (NSAIDs, e.g., ibuprofen). Patients with cirrhosis can experience worsening of liver and kidney function with NSAIDs.

Eradicate hepatitis B and hepatitis C virus by using anti-viral medications. Not all patients with cirrhosis due to chronic viral hepatitis are candidates for drug treatment. Some patients may experience serious deterioration in liver function and/or intolerable side effects during treatment. Thus, decisions to treat viral hepatitis have to be individualized, after consulting with doctors experienced in treating liver diseases (hepatologists).

Remove blood from patients with hemochromatosis to reduce the levels of iron and prevent further damage to the liver. In Wilson's disease, medications can be used to increase the excretion of copper in the urine to reduce the levels of copper in the body and prevent further damage to the liver.

Suppress the immune system with drugs such as prednisone and azathioprine (Imuran) to decrease inflammation of the liver in autoimmune hepatitis.

Treat patients with PBC with a bile acid preparation, ursodeoxycholic acid (UDCA), also called ursodiol (Actigall). Results of an analysis that combined the results from several clinical trials showed that UDCA increased survival among PBC patients during 4 years of therapy. The development of portal hypertension also was reduced by the UDCA. It is important to note that despite producing clear benefits, UDCA treatment primarily retards progression and does not cure PBC. Other medications such as colchicine and methotrexate also may have benefit in subsets of patients with PBC.

Immunize patients with cirrhosis against infection with hepatitis A and B to prevent a serious deterioration in liver
function. There are currently no vaccines available for immunizing against hepatitis C.

**Treating the complications of cirrhosis**

**Edema** and **ascites.** Retention of salt and water can lead to swelling of the ankles and legs (edema) or abdomen (ascites) in patients with cirrhosis. Doctors often advise patients with cirrhosis to restrict dietary salt (sodium) and fluid to decrease edema and ascites. The amount of salt in the diet usually is restricted to 2 grams per day and fluid to 1.2 liters per day. In most patients with cirrhosis, however, salt and fluid restriction is not enough, and diuretics have to be added.

Diuretics are medications that work in the kidneys to promote the elimination of salt and water into the urine. A combination of the diuretics spironolactone (Aldactone) and furosemide can reduce or eliminate the edema and ascites in most patients. During treatment with diuretics, it is important to monitor the function of the kidneys by measuring blood levels of blood urea nitrogen (BUN) and creatinine to determine if too much diuretic is being used. Too much diuretic can lead to kidney dysfunction that is reflected in elevations of the BUN and creatinine levels in the blood.

Sometimes, when the diuretics do not work (in which case the ascites is said to be refractory), a long needle or catheter is used to draw out the ascitic fluid directly from the abdomen, a procedure called abdominal paracentesis. It is common to withdraw large amounts (liters) of fluid from the abdomen when the ascites is causing painful abdominal distension and/or difficulty breathing because it limits the movements of the diaphragms.

Another treatment for refractory ascites is a procedure called transjugular intravenous portosystemic shunting (TIPS see below).

**Bleeding from varices.** If large varices develop in the esophagus or upper stomach, patients with cirrhosis are at risk for serious bleeding
due to rupture of these varices. Once the varices have bled, they tend to bleed again and the probability that a patient will die from each bleeding episode is high (30%-35%). Therefore, treatment is necessary to prevent the first (initial) bleeding episode as well as rebleeding. Treatments include medications and procedures to decrease the pressure in the portal vein and procedures to destroy the varices.

**Propranolol (Inderal)**, a beta blocker, is effective in lowering pressure in the portal vein and is used to prevent initial bleeding and rebleeding from varices in patients with cirrhosis. Another class of oral medications that lowers portal pressure is the nitrates, for example, isosorbide dinitrate (Isordil). Nitrates often are added to propranolol if propranolol alone does not adequately lower portal pressure or prevent bleeding.

**Octreotide (Sandostatin)** also decreases portal vein pressure and has been used to treat variceal bleeding.

**During upper endoscopy (EGD)**, either sclerotherapy or band ligation can be performed to obliterate varices and stop active bleeding and prevent rebleeding. Sclerotherapy involves infusing small doses of sclerosing solutions into the varices. The sclerosing solutions cause inflammation and then scarring of the varices, obliterating them in the process. Band ligation involves applying rubber bands around the varices to obliterate them. (Band ligation of the varices is analogous to rubber banding of hemorrhoids.) Complications of sclerotherapy include esophageal ulcers, bleeding from the esophageal ulcers, esophageal perforation, esophageal stricture (narrowing due to scarring that can cause dysphagia), mediastinitis (inflammation in the chest that can cause chest pain), pericarditis (inflammation around the heart that can cause chest pain), and peritonitis (infection in the abdominal cavity). Studies have shown that band ligation may be slightly more effective with fewer complications than sclerotherapy.
Transjugular intrahepatic portosystemic shunt (TIPS) is a non-surgical procedure to decrease the pressure in the portal vein. TIPS is performed by a radiologist who inserts a stent (tube) through a neck vein, down the inferior vena cava and into the hepatic vein within the liver. The stent then is placed so that one end is in the high pressure portal vein and the other end is in the low pressure hepatic vein. This tube shunts blood around the liver and by so doing lowers the pressure in the portal vein and varices and prevents bleeding from the varices. TIPS is particularly useful in patients who fail to respond to beta blockers, variceal sclerotherapy, or banding. (TIPS also is useful in treating patients with ascites that do not respond to salt and fluid restriction and diuretics.) TIPS can be used in patients with cirrhosis to prevent variceal bleeding while the patients are waiting for liver transplantation. The most common side effect of TIPS is hepatic encephalopathy. Another major problem with TIPS is the development of narrowing and occlusion of the stent, causing recurrence of portal hypertension and variceal bleeding and ascites. The estimated frequency of stent occlusion ranges from 30%-50% in 12 months. Fortunately, there are methods to open occluded stents. Other complications of TIPS include bleeding due to inadvertent puncture of the liver capsule or a bile duct, infection, heart failure, and liver failure.

A surgical operation to create a shunt (passage) from the high-pressure portal vein to veins with lower pressure can lower blood flow and pressure in the portal vein and prevent varices from bleeding. One such surgical procedure is called distal splenorenal shunt (DSRS). It is appropriate to consider such a surgical shunt for patients with portal hypertension who have early cirrhosis. (The risk of major shunt surgery in these patients is less than in patients with advanced cirrhosis.) During DSRS, the surgeon detaches the splenic vein from the portal vein, and attaches it to the renal vein. Blood then is shunted from the spleen around the liver, lowering the pressure in the
portal vein and varices and preventing bleeding from the varices.

**Hepatic encephalopathy** Patients with an abnormal sleep cycle, impaired thinking, odd behavior, or other signs of hepatic encephalopathy usually should be treated with a low protein diet and oral lactulose. Dietary protein is restricted because it is a source of the toxic compounds that cause hepatic encephalopathy. Lactulose, which is a liquid, traps the toxic compounds in the colon. Consequently, they cannot be absorbed into the blood stream and cause encephalopathy. To be sure that adequate lactulose is present in the colon at all times, the patient should adjust the dose to produce 2-3 semi formed bowel movements a day. (Lactulose is a laxative, and the adequacy of treatment can be judged by loosening or increasing frequency of stools.) If symptoms of encephalopathy persist, oral antibiotics such as neomycin or metronidazole (Flagyl) can be added to the treatment regimen. Antibiotics work by blocking the production of the toxic compounds by the bacteria in the colon.

**Hypersplenism** The filtration of blood by an enlarged spleen usually results in only mild reductions of red blood cells (anemia), white blood cells (leukopenia) and platelets (thrombocytopenia) that do not require treatment. Severe anemia, however, may require blood transfusions or treatment with erythropoietin or epoetin alfa (Epogen, Procrit), hormones that stimulate the production of red blood cells. If the numbers of white blood cells are severely reduced, another hormone called granulocyte-colony stimulating factor is available to increase the numbers of white blood cells. An example of one such factor is filgrastim (Neupogen).

No approved medication is available yet to increase the number of platelets. As a necessary precaution, patients with low platelets should not use aspirin or other nonsteroidal antiinflammatory drugs (NSAIDS) since these drugs can hinder the function of platelets. If a low number of platelets are associated with significant bleeding, transfusions of platelets usually should be given. Surgical removal of
the spleen (called splenectomy) should be avoided, if possible, because of the risk of excessive bleeding during the operation and the risk of anesthesia in advanced liver disease.

**Spontaneous bacterial peritonitis (SBP)** Patients suspected of having spontaneous bacterial peritonitis usually will undergo paracentesis. Fluid that is removed is examined for white blood cells and cultured for bacteria. Culturing involves inoculating a sample of the ascites into a bottle of nutrient-rich fluid that encourages the growth of bacteria, thus facilitating the identification of even small numbers of bacteria. Blood and urine samples often are obtained as well for culturing because many patients with spontaneous bacterial peritonitis also will have infection in their blood and urine. In fact, many doctors believe that infection may have begun in the blood and the urine and spread to the ascitic fluid to cause spontaneous bacterial peritonitis. Most patients with spontaneous bacterial peritonitis are hospitalized and treated with intravenous antibiotics such as ampicillin, gentamycin, and one of the newer generation cephalosporins. Patients usually treated with antibiotics include:

- Patients with blood, urine, and/or ascites fluid cultures that contain bacteria.
- Patients without bacteria in their blood, urine, and ascitic fluid but who have elevated numbers of white blood cells (neutrophils) in the ascitic fluid (>250 neutrophils/cc).
- Elevated neutrophil numbers in ascitic fluid often means that there is bacterial infection. Doctors believe that the lack of bacteria with culturing in some patients with increased neutrophils is due either to a very small number of bacteria or ineffective culturing techniques.

Spontaneous bacterial peritonitis is a serious infection. It often occurs in patients with advanced cirrhosis whose immune systems are weak, but with modern antibiotics and early detection and treatment, the prognosis of recovering from an episode of spontaneous bacterial peritonitis is good.
In some patients oral antibiotics (such as Cipro or Septra) can be prescribed to prevent spontaneous bacterial peritonitis. Not all patients with cirrhosis and ascites should be treated with antibiotics to prevent spontaneous bacterial peritonitis, but some patients are at high risk for developing spontaneous bacterial peritonitis and warrant preventive treatment:

- Patients with cirrhosis who are hospitalized for bleeding varices have a high risk of developing spontaneous bacterial peritonitis and should be started on antibiotics early during the hospitalization to prevent spontaneous bacterial peritonitis.
- Patients with recurring episodes of spontaneous bacterial peritonitis.
- Patients with low protein levels in the ascitic fluid (Ascitic fluid with low levels of protein is more likely to become infected.)

**Prevention and early detection of liver cancer**

Several types of liver disease that cause cirrhosis are associated with a particularly high incidence of liver cancer, for example, hepatitis B and C, and it would be useful to screen for liver cancer since early surgical treatment or transplantation of the liver can cure the patient of cancer. The difficulty is that the methods available for screening are only partially effective, identifying at best only 50% of patients at a curable stage of their cancer. Despite the partial effectiveness of screening, most patients with cirrhosis, particularly hepatitis B and C, are screened yearly or every six months with ultrasound examination of the liver and measurements of cancer-produced proteins in the blood, e.g. alpha fetoprotein.

**Liver transplantation**

Cirrhosis is irreversible. Many patients' liver function will gradually worsen despite treatment and complications of cirrhosis will increase and become difficult to treat. Therefore, when cirrhosis is far advanced, liver transplantation often is the only option for treatment. Recent advances in surgical transplantation and medications to
prevent infection and rejection of the transplanted liver have greatly improved survival after transplantation. On average, more than 80% of patients who receive transplants are alive after five years. Not everyone with cirrhosis is a candidate for transplantation. Furthermore, there is a shortage of livers to transplant, and there usually is a long (months to years) wait before a liver for transplanting becomes available. Therefore, measures to retard the progression of liver disease and treat and prevent complications of cirrhosis are vitally important.