

Anesthesia for Liver Transplantation

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KEYWORDS

- Liver transplantation • Anesthesia • Liver • Cirrhosis • End stage liver disease
- Coagulopathy

KEY POINTS

- Each program appoints a director of liver transplant anesthesia, who must meet the requirements of the American Society of Anesthesiologists and the United Network for Organ Sharing.
- Liver cirrhosis may cause major dysfunction in all organ systems.
- Cirrhotic cardiomyopathy may be masked by the typical high cardiac output and low peripheral vascular resistance often found in liver failure.
- Portopulmonary hypertension and hepatopulmonary syndrome often found with liver cirrhosis are at opposite ends of a vascular endothelial dysfunction pathway.
- The proper management of the coagulopathy of a failing liver requires an understanding of clot formation in “real time” and routine laboratory coagulation tests.

LIVER: BASIC ANATOMY AND PHYSIOLOGY

The liver is the largest internal organ in the body, receiving 25% to 30% of the cardiac output. It has a dual blood supply. The hepatic artery provides 25% and the portal vein provides 75% of the blood supply. Each vessel provides 50% of oxygen delivery. In liver transplantation (LT), adequate flow through the hepatic artery is essential for the viability of a new liver graft.¹ Terminal branches of both the arterioles and venules drain into sinusoids, where Kupffer cells filter and degrade particulate matter such as endotoxins from the blood. Venous drainage is through hepatic veins into the inferior vena cava. Bile canaliculi, between hepatocytes, form into bile ducts that drain into the intestine.

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The liver plays a major role in the metabolic pathway of carbohydrates, fats, and proteins. Glucose is stored as glycogen and is converted by the liver to lactate, with the generation of energy. Protein is metabolized to ammonia and urea, which is then excreted in the urine. The liver also produces nearly all the plasma proteins, except immunoglobulins. Notably, the liver produces albumin, which serves as the most abundant plasma protein, the body's primary transport protein and major determinant of oncotic pressure. Another important liver function is drug metabolism, especially via the cytochrome p450 isoenzymes. The liver is also involved in hormone, vitamin, and mineral metabolism.

LIVER DISEASE: PATHOPHYSIOLOGY

A thorough understanding of the pathophysiology of liver disease is required to care for the liver transplant patient. The etiologies of the liver disease that most frequently need transplantation are listed in [Box 1](#).

In the United States, hepatitis C virus is currently the number one indication for LT, with hepatic malignancy second. Given the new effective antiviral therapies for hepatitis C virus and the increasing obesity epidemic, nonalcoholic fatty liver disease is likely to become the most common cause of liver disease in the United States in the future.

Liver Cirrhosis

The term liver cirrhosis was coined by Rene Laennec in the 1840s. Hepatocellular death can occur via necrosis or apoptosis, most often owing to ischemia, viruses, and drug and alcohol toxicity. Cirrhosis refers to the damaging effects of inflammation, hepatocellular injury, and the resulting fibrosis and regeneration of the liver, all of which result in loss of normal liver function. Increased resistance to blood flow through the liver leads to portal hypertension and the development of varices. The failing liver is no longer able to clear the toxins that pass through it. Extensive endothelial dysfunction adversely affects all major organs.

Two commonly used scoring systems assess the severity of liver dysfunction. The Child-Turcotte-Pugh (CTP) classification has been used to assess surgical risk in

Box 1

Common liver diseases that present at selection committee for possible transplantation

Viral Hepatitis
Alcoholic (Laennec's) cirrhosis
Nonalcoholic steatohepatitis or nonalcoholic fatty liver disease
Hepatocellular cancer
Primary sclerosing cholangitis
Primary biliary cirrhosis
Autoimmune hepatitis
Cryptogenic cirrhosis
Drug induced (acetaminophen, amiodarone)
Acute liver failure
Genetic: amyloidosis, Wilson's disease

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