

# Surgical Techniques and Imaging Complications of Liver Transplant



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## KEYWORDS

• Liver transplant • Complications • Imaging • CT • MR imaging • US

## KEY POINTS

- Liver transplant is the treatment of choice for end-stage liver disease.
- Management of transplant patients requires a multidisciplinary approach, with radiologists playing a key role in identifying complications in both symptomatic and asymptomatic patients.
- Ultrasonography remains the investigation of choice for the initial evaluation of symptomatic patients. Depending on the clinical situation, further evaluation with CT, MRI or biopsy may be performed or clinical and imaging surveillance may be continued.

Liver transplant is the treatment of choice for end-stage liver disease. Management of transplant patients requires a multidisciplinary approach, with radiologists playing a key role in identifying complications in both symptomatic and asymptomatic patients. Liver transplantation has progressed greatly since the world's first liver transplant in 1963, and liver transplant is now the treatment of choice for patients with end-stage acute or chronic liver disease.<sup>1-4</sup> As per the Organ Procurement and Transplantation Network (OPTN) data, 6455 liver transplants were performed in the United States in 2013 and 3862 transplants in 2014 (up to July 31). However, this remains inadequate, with 16,269 patients on the wait list as of October 2014.<sup>5</sup> Advances in surgical techniques, immunosuppressive therapy, and the multidisciplinary team approach have led to improved survival, with the 1-year, 5-year, and 10-year survival for deceased donor transplant being 84.3%, 68.3%, and 53.7%

as per the 2009 OPTN data.<sup>5,6</sup> The corresponding rates for live donor transplant were 86.6%, 73.1%, and 61.8% respectively.<sup>5</sup> Despite these impressive figures, liver transplant remains a complex procedure with significant morbidity and mortality. The chief causes of early mortality include surgical complications and acute rejection. The improved survival has led to the emergence of long-term complications caused by chronic immunosuppressive therapy.<sup>6</sup>

We discuss the short-term and long-term posttransplant complications and the role of diagnostic radiologists in their identification and management.

## SURGICAL TECHNIQUES FOR LIVER TRANSPLANTATION

It is important to understand the surgical techniques related to liver transplantation to proficiently assess patients in a posttransplant setting.

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## ORTHOTOPIC LIVER TRANSPLANT

The major steps of orthotopic liver transplant surgery include donor and recipient hepatectomies; inferior vena cava (IVC), portal venous arterial, and hepatic arterial anastomosis; followed by cholecystectomy and biliary anastomosis.<sup>1,7,8</sup>

The sites of vascular and biliary anastomosis are important to note for radiologists because these are the most frequent sites of future complications like stenosis. IVC anastomosis is usually the first anastomosis performed. Two techniques are popularly used. In the standard technique, the recipient's IVC is removed along with the liver and a side-to-side anastomosis of the donor IVC is performed with the superior and inferior ends of the recipient IVC. In the newer piggyback technique, the recipient IVC is not removed along with the liver, and an end-to-side anastomosis is performed between the donor's suprahepatic IVC and recipient hepatic veins at the common stump.<sup>1,9-11</sup> This technique decreases operative time and reduces the risk of hemorrhage, because no surgical dissection is required around the recipient IVC. Furthermore, it is more favorable hemodynamically for the patient because normal IVC flow is maintained during the operation, thus avoiding the need for a venovenous bypass.<sup>1,9,10</sup> The piggyback technique is preferred at our institute for caval anastomosis.

The portal venous anastomosis is an end-to-end anastomosis performed between the donor and recipient portal veins. The extrahepatic portal vein needs to be at least 4 to 5 mm in diameter for a successful anastomosis.<sup>1,3,8</sup> The hepatic arterial anastomosis is usually performed with the recipient hepatic artery as a fish-mouth anastomosis at the site of the gastroduodenal artery origin.<sup>1,3,8</sup> Variant hepatic vascular anatomy (such as replaced or accessory right or left hepatic arteries) are commonly encountered in the recipient or the donor, being present in 39% to 48% of people in previous studies.<sup>12,13</sup> Preoperative knowledge regarding the presence of an anatomic variant is essential and various surgical techniques have been described to navigate the variant vessels. Certain studies have reported the presence of variant anatomy to be associated with increased complications, although this remains controversial.<sup>14,15</sup>

The biliary anastomosis is generally performed as an end-to-end anastomosis between the donor common hepatic duct and the recipient common bile duct (CBD), thus preserving the sphincter of Oddi and minimizing the risk of

reflux. A biliary-enteric anastomosis (choledochojejunostomy) may be performed in patients with diseased CBDs (as in primary sclerosing cholangitis [PSC]) or in cases with a variant CBD that is too short.<sup>1,3,8</sup> Conventionally, a T tube is placed across the biliary anastomosis after the operation to support the anastomosis. A T tube also helps to monitor bile output and provides access for cholangiogram. However, many institutions do not follow this approach, because it leads to increased patient discomfort and a higher risk of biliary leak and late stricture.<sup>1,3,8,11,16</sup>

## LIVING DONOR LIVER TRANSPLANT

Living donor liver transplant is less common in Western countries because of potential risks to the donor (risk of death is 1.7 per 1000 in the United States) and a higher posttransplant complication rate.<sup>17</sup> However, it confers significant advantages in the form of increased donor pool and timely transplants.<sup>17</sup> Adequate assessment (usually computed tomography [CT]) of the donor liver anatomy, including split liver volumes, vascular and biliary anatomy variations, and fatty infiltration, is important.<sup>18-20</sup> Right lobar transplant is usually performed. The donor's right hepatic lobe is first removed, preserving the middle hepatic vein in the donor.<sup>18-20</sup> This step is followed by recipient hepatectomy and implantation of the donor lobe. The operation is technically much more challenging because of the short donor vessels. End-to-end hepatic venous, portal venous, and hepatic arterial anastomosis is performed, followed by biliary reconstruction with an end-to-end anastomosis or a hepaticojejunostomy.<sup>18-20</sup>

## NORMAL POSTOPERATIVE APPEARANCE OF THE LIVER

Knowledge of the expected postoperative findings after a liver transplant is essential to accurately identify complications. As is the norm with most operations, a certain amount of postoperative fluid and inflammation can be expected at the surgical bed. A small amount of ascites or fluid in the perihepatic space or along the hepatic hilum is normally seen, as is mild reactive right pleural effusion. These conditions usually resolve spontaneously within a few weeks.<sup>3,21</sup> Prominent reactive periportal and portacaval lymph nodes are also normally seen.<sup>3,21</sup>

An appearance of periportal edema (periportal hypoattenuation) may be visualized, and occurs because of lymphedema secondary to

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