Technical Aspects of Orthotopic Liver Transplantation for Hepatocellular Carcinoma

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KEYWORDS

• Liver transplantation • Surgery • Hepatocellular carcinoma • Piggyback technique
• Portal vein thrombosis

KEY POINTS

- In the majority of cases, patients with cirrhosis and hepatocellular carcinoma (HCC) who undergo liver transplantation are transplanted based on their higher Model for End-Stage Liver Disease (MELD) exception score and not their physiologic MELD score; this usually results in fewer physiologic derangements during liver transplantation.
- Patients who have previously undergone locoregional therapy or liver resection for HCC can develop significant perihepatic adhesions that increase the complexity of the hepatectomy during transplant.
- Implantation strategy of the inferior vena cava (IVC) during liver transplant may need to be modified based on location of previously treated HCC.
- Patients who undergo transarterial chemoembolization for pretransplant HCC therapy may have higher rates of hepatic artery thrombosis after liver transplant; therefore, aortohepatic bypass grafting with donor iliac artery may be required for arterial in flow to the liver allograft.
- Patients with portal vein (PV) thrombosis with a bland thrombus and a patent superior mesenteric vein (SMV) can undergo successful liver transplant through either PV thrombectomy and standard end-to-end PV-PV anastomosis, or the use of SMV-PV bypass graft with donor iliac vein.

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INTRODUCTION

Hepatocellular carcinoma (HCC) remains a significant worldwide malignancy. Liver cancer, primarily HCC, is the fifth most common cancer in men, the ninth most common cancer in women, and the second leading cause of cancer death in the world.[1] In the United States, HCC ranks tenth in new estimated cancers but represents the fifth leading cause of cancer death.[2] Most cases of HCC develop in the setting of cirrhosis secondary to viral hepatitis (hepatitis B virus [HBV] and hepatitis C virus [HCV]) and alcohol overuse.[3] However, there has been a rising association between obesity, metabolic syndrome, nonalcoholic fatty liver disease (NAFLD), and HCC.[4,5] In fact, more reports have described an increased incidence of HCC in noncirrhotic patients with NAFLD or nonalcoholic steatohepatitis (NASH).[6] Due to the ongoing obesity epidemic, it is likely that the incidence of NAFLD and NASH will increase, as will the presence of HCC in these patients.

There are multiple therapies aimed at treating patients with HCC. Locoregional therapies for HCC include radiofrequency ablation,[7] microwave ablation,[8] cryotherapy,[9] transarterial embolization,[10] and radioembolization.[11] The decision to use a specific therapy is based on multiple factors, including but not limited to tumor size, biology, location, and number, as well as institutional expertise. Surgical resection of HCC can be a viable option for patients with compensated hepatic function.[12] The decision to perform resection is based upon the location of the tumor, absence of macrovascular invasion and extrahepatic disease, size of the remnant liver, severity of portal hypertension, and the lack of significant comorbidities.

Patients who are not candidates for surgical resection can be considered candidates for liver transplantation. However, careful selection of the appropriate candidate is critical for obtaining optimal outcomes after transplantation. This article discusses the selection of candidates with HCC for liver transplantation and the technical aspects of orthotopic liver transplantation for HCC.

PATIENT SELECTION

All patients with cirrhosis who are evaluated for liver transplantation undergo an extensive workup to be sure that they can tolerate the complexities of the surgical procedure. Some of these tests include, but are not limited to, noninvasive cardiac stress test, cardiac catheterization, 2-dimensional echocardiogram, and abdominal imaging to assess the hepatic vascular anatomy and the presence of tumors. When a diagnosis of HCC is made, the Milan criteria are used to determine which patients with HCC are suitable candidates for liver transplantation. The Milan criteria were established from a prospective study performed by Mazzaferro and colleagues[13] in 1996. In this report, the eligibility criteria for transplantation were the presence of a tumor 5 cm or less in diameter in patients with a single HCC, and no more than 3 tumor nodules each 3 cm or less in diameter in patients with multiple tumors. Recipients who met these criteria had overall and tumor-free 4-year survival rates of 85% and 92%, while patients with greater tumor burden had survival rates of 50% and 59%, respectively.

Because these survival rates were similar to those in liver transplant recipients without HCC, the Milan criteria became and have remained the standard tumor acceptance criteria for patients with HCC undergoing liver transplantation. However, in the past, some had felt that the Milan criteria were too restrictive, meaning that that patients with tumor burden outside Milan criteria may be suitable for liver transplantation. In 2001, Yao and colleagues[14] established the University of San Francisco (UCSF) criteria by studying patients with expanded criteria. These criteria included single