

# Current technical aspects of oncological hepatic surgery

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**BACKGROUND:** With the recent advances in oncological hepatic surgery, major liver resections became more widely utilized procedures. The era of modern hepatic surgery witnessed improvements in patients care in preoperative, intraoperative and postoperative aspects. This significantly improved surgical outcomes regarding morbidity and mortality. This review article focuses on the recent advances in oncological hepatic surgery.

**DATA SOURCES:** This review includes only data from peer-reviewed articles and journals. PubMed database was utilized as the primary source of the supporting literature to this review article on the latest advances in oncological hepatic surgery. Comprehensive and high sensitivity search strategies were performed to search related studies exhaustively up till June 2016. We critically and independently assessed over 50 recent publications written on this topic according to the selection criteria and quality assessment standard. We paid particular attention to the studies published in high impact journals that address the use of the surgical techniques mentioned in the articles in well-known institutions.

**RESULTS:** Among all utilized approaches aiming at the preoperative assessment of the liver function, Child-Turcotte-Pugh classification remains the most reliable tool correlating with survival outcome. Although the primary radiological tools including ultrasonography, computed tomography and magnetic resonance imaging remain on top of the menu of tests utilized in assessment of focal hepatic lesions, intraoperative ultrasonography projects to be a powerful additional tool in terms of sensitivity and specificity compared to the other conventional techniques in assessment of the liver in

the operative setting, a procedure that can change the surgical strategy in 27.2% of the cases and consequently improve the oncological surgical outcome. In addition to the conventional surgical techniques of liver resection and portal vein embolization, associating liver partition and portal vein ligation for staged hepatectomy “ALPPS” projects to be an alternative option in patients with marginally resectable tumors with an inadequate size of future liver remnant with an accepted surgical oncological outcome.

**CONCLUSIONS:** Considering the clinicopathological nature of hepatic lesions, the comprehensive assessment and proper choice of the liver resection technique in highly selected patients is associated with improved surgical oncological outcome. Patients with underlying marginal future liver remnant volumes can now safely benefit from a wider range of surgical intervention, a breakthrough that significantly improved morbidity and mortality in this group of patients.

(*Hepatobiliary Pancreat Dis Int* 2017;16:147-154)

**KEY WORDS:** liver surgery;  
liver neoplasms;  
technical aspects;  
oncosurgery;  
liver metastasis

## Introduction

Liver resection has long presented challenges for surgeons due to the liver's complex anatomy, unique vasculature and need for preservation of adequate functional reserve after resection. With the advances in surgical techniques utilized in liver surgery in recent years, hepatic resection is being undertaken more often, in a wider range of disease states, and with improved outcomes. Improvements in preoperative assessment, operative technique, and postoperative care have allowed for more aggressive resections to be offered to patients with equivalent, or perhaps better, outcomes. This article reviews recent literature regarding preoperative hepatic assessment, optimization of operative conditions, and a detailed discussion on the most current techniques used for hepatic resections.

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doi: 10.1016/S1499-3872(16)60147-9  
Published online November 4, 2016.

## Preoperative functional assessment of the liver

Both qualitative and quantitative evaluation of the liver preoperatively is of pivotal importance when planning a hepatic resection. Determination of the future liver remnant (FLR) can be done using indocyanine green (ICG) clearance rate, the lidocaine-MEGX test, or volumetrically using axial imaging. Regardless of the method chosen, it is essential to assure that an adequate volume of functional hepatic parenchyma will remain after resection.<sup>[1,2]</sup> Although volumetric measurements perform well for the majority of patients, it is important to note that patients with liver function compromised by underlying disease may have inadequate functional reserve despite preservation of an otherwise “adequate” volume. For patients with borderline FLRs (e.g. 20% of the original volume of a normal liver or 40% of the original volume of a cirrhotic liver), preoperative portal vein embolization (PVE, see below) can be considered in an effort to induce hypertrophy of the FLR up to 12% of the total hepatic volume.<sup>[3]</sup>

Regarding predicting rates of morbidity and mortality of hepatic resection preoperatively, the Child-Turcotte-Pugh (CTP) classification has remained the most studied classifications in the literature that was found to correlate well with survival outcome after liver surgery. Estimates for one- and two-year survival can be made on a basis of the CTP class: 95% and 90% for class A, 80% and 70% for class B, and 45% and 38% for class C, respectively.<sup>[4]</sup>

## Preoperative PVE

The use of preoperative PVE has significantly changed the approach to major hepatectomy and has made extended resections safer for patients.<sup>[5]</sup> Percutaneous PVE is minimally invasive procedure that can be easily performed in the radiology suite with local anesthesia or under conscious sedation.<sup>[6]</sup> PVE is most useful for patients with underlying marginal FLR volumes (i.e., FLR <20% in patients with a normal liver, FLR <30% for patients with non-alcoholic steatohepatitis, and FLR <40% in patients with cirrhosis). So it facilitates hepatectomy with much less risk of postoperative liver failure and consequently lower rates of postoperative morbidity and mortality.<sup>[7-10]</sup> Success rates of PVE vary widely according to the underlying liver condition. While liver cirrhosis was found to have an adverse effect on PVE outcome, cholestasis and chemotherapy were not associated with worse observed outcome compared to normal liver condition.<sup>[11]</sup> While PVE can induce up to 12% hypertrophy of the total hepatic volume, it takes a mean interval of 31 days between PVE and surgery to allow for adequate FLR.<sup>[3,12]</sup>

## Preoperative assessment of the liver

Ultrasonography (US) remains the easiest, fastest and the most non-invasive modality for liver imaging. With jaundice being a typical presentation of hepatic disease, US can determine whether this is obstructive versus non-obstructive jaundice and evaluate other possible accompanying conditions namely evidence of fibrosis or cirrhosis and the presence or absence of mass lesions.

Computed tomography (CT) is the standard examination for most hepatic mass lesions due to its ability to provide excellent visualization of the hepatic parenchyma and vasculature as well as to identify extrahepatic diseases. Tri-phasic thin slice CT scan of the liver is a useful dedicated technique to utilize for patients with known or suspected hepatic lesions.

Magnetic resonance imaging (MRI) plays a significant role in the assessment of hepatic lesions and can help in distinguishing the malignant lesions in the liver from the benign ones. The use of hepatobiliary-specific contrast agents and the acquisition of delayed imaging helps the abdominal radiology to make a well-informed assessment of the nature of hepatic lesions, even as small as 10 mm in size.<sup>[13]</sup>

## Choosing abdominal approach

Hepatic resections can be approached in either a traditional open fashion or via a laparoscopic approach. The choice of technique depends on the surgeon's experience, the nature, and location of the hepatic lesions and the patient's underlying medical condition. For the open approach, the most preferred one among surgeons is a right subcostal incision which enables easy and safe access to the liver. A right subcostal incision may be extended either in the midline towards the xiphoid process or to the left side. A hybrid approach with laparoscopic hepatic mobilization followed by open surgery through a more limited incision has also been described.

## Intraoperative ultrasonography (IOUS)

IOUS is an important tool to utilize both before and during hepatic resection. The use of IOUS early in the case helps to identify any previously undetected lesions, to map the transection plane, and to determine the relevant vasculature in relation with the hepatic surface. Ferrero et al described IOUS sensitivity/specificity of 92%/97.8% compared to 63.6%/91%, 68.8%/92.3%, and 53.6%/95.8% for CT, MRI, and fluorodeoxyglucose positron emission tomography respectively.<sup>[14]</sup> Also, in the same study surgical strategy was changed in 27.2% of the

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