Editorial

Hepatectomy: more complex operations and improved perioperative outcomes

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Over the past several decades liver resection has become more prevalent. There are progressive improvements in survival for a variety of malignancies and liver metastases are no longer a contraindication for resection in all cancers. What has also evolved is patient safety. Anesthetic techniques, patient selection and the ability to address complications in a timely manner has mitigated the perioperative mortality that was previously associated with liver resection.

For primary tumors of the liver such as hepatocellular carcinoma (HCC), the quality of the parenchyma itself, the absence of distant disease, limited donors for transplantation and better screening have led to more liver resections. More predictive tools have evolved in patient selection to avoid for example operating on patients with significant cirrhosis, thrombocytopenia and additional cardiopulmonary disease. Additionally, there are risk calculators that estimate morbidity and mortality and allow for optimizing patient selection (1).

In the context of liver metastases, there is more abundant data on disease biology. For example, in colorectal cancer, disease biology is assessed via the number of liver tumors, response to chemotherapy, the preoperative carcinoembryonic antigen (CEA) level, number of lymph nodes positive on the primary, the size of the largest tumor, the presence of extrahepatic disease and mutation status (KRAS, BRAF and MSI) and the number of preoperative cycles of chemotherapy (2,3). This knowledge facilitates patient selection and optimizes outcomes.

Both before and in the operating room there are also technical and liver specific factors that can be used to help judgment for resection or not. These can include the size of the future liver remnant, the quality of the liver and the maintenance of low central venous pressure during parenchymal transection (4).

These factors that are disease and patient specific, together provide individualized decisions for offering safe hepatic resection to patients.

A recent study by Cloyd and colleagues examined the utility of the comprehensive complication index (CCI) in the context of hepatectomy outcomes with increasing complexity over time at a large volume center (5). This group reviewed 3,707 hepatectomies performed at the same center from 1998 to 2015. They divided the time period in thirds (1998–2003, 2004–2009, and 2010–2015) and evaluated volume, patient and tumor characteristics, surgical complexity and perioperative outcomes. They were able to demonstrated that over the 3 intervals in time, the volume nearly doubled (794 to 1,511). Additionally, the technical complexity of surgery increased with the rates of major hepatectomy going from 20% to nearly 30% in this time span. The rates of major hepatectomy increased even in the context of more parenchymal sparing efforts during this time, demonstrating that more complex patients were being taken to the operating room over time. The rates of portal vein embolization went from 5% to 9% and the rate of preoperative chemotherapy went from 70% to 89%. In terms of perioperative data, the median blood loss decreased from 300 to 200 mL per case and the transfusion rates decreased from 19% to only 5%.

In this study surgical complications were described as any deviation from the normal postoperative course

within 90 days after surgery and graded according to the Clavien-Dindo classification and scored using the CCI. The CCI was used as it has been shown to be a more sensitive assessment of postoperative complications than other measures. A CCI of 26.2 was used as a threshold for complication severity as it corresponds to 1 postoperative complication of Calvien-Dindo grade IIIa severity.

Notably, 40% of hepatectomies were associated with at least 1 complication. Only 4% demonstrated postoperative hepatic insufficiency as determined by a bilirubin greater than 7. A total of 697 hepatectomies (19%) were associated with CCI ≥26.2 and 75% of these experienced greater than one complication. Additionally, the rate of mortality overall was 2%. The trend over the time period was from 3.1% down to 1.3%.

Several aspects of this study need attention. First, the author's institution is uniquely poised to report on this subject as they are only one of a very few elite centers that can report this volume of liver resections in the United States. Therefore, the findings are certainly powered to report modern day outcomes in an optimized setting of high-volume expertise. Second, the authors demonstrate the landscape of liver surgery today. Specifically, the increase in number of hepatectomies performed over time and the associated decrease in length of stay, estimated blood loss, and mortality. At the level of national data, looking at procedure specific trends in surgical outcomes in the United States between 2008 and 2015, Liu *et al.* found that hepatectomy demonstrated the greatest improvement across outcomes (6). Specifically, there were improved outcomes as they pertain to mortality, renal failure, surgical site infection, unplanned intubation and urinary tract infection. Although, Liu and colleagues looked at a multitude of surgeries, hepatectomy had the greatest magnitude of improvement nationally. The added benefit of the current study by Cloyd is that the granular data of these improvements in outcomes can be assessed.

As it pertains to the type of operations, over time more patients are being assessed for an adequate functional liver remnant and it was during this time period that the standards were established from data developed at this institution for what is deemed an adequate FLR. The functional liver remnant was established in the 1990's and perhaps earlier but was quantified then (7). The association between outcomes and liver remnant volume was quantified and more earnestly taken into consideration when making decisions for resection. Now there are more objective guidelines that help clinical decision making and these have largely evolved from the same group. Specifically, the FLR is not only important but the kinetic growth rate is also important in predicting liver specific complications (8). The concept and study of portal vein embolization was also matured during this time period as a functional reserve assessment of the liver as it pertains to its inherent ability to grow. Also, during this time period more patients underwent repeat resections and two stage hepatectomies. These are all a reflection to more aggressive yet safe approaches to optimizing outcomes. This study is limited as it does not highlight oncologic long-term outcomes, though this was not the goal. There are a multitude of studies demonstrated prolonged survival in patients that undergo hepatectomy when there is good biology (9,10).

This speaks to patient selection. The authors highlight their rigorous preoperative assessment of patients to optimize their physiology and their biology prior to surgical intervention. Characteristics of tumor biology in colorectal cancer as noted above include the disease-free interval in metachronous disease, the CEA, the nodal involvement in the primary and the number and size of liver tumors all as important factors in surgical decision making (2).

The authors also highlight the limitation of this data set not vastly including a large number of patients with HCC as those patients are often seen in the context of cirrhosis. HCC is often managed and evaluated at centers with a robust transplant program and therefore the numbers of those patients is limited in this data set. There are unique issues as they pertain to HCC, namely the degree of cirrhosis and the eligibility for transplantation and also liver directed therapy that all contribute to surgical decision making in these patients.

The overall conclusion of this article and perhaps liver surgery today is that more and more patients are candidates for resection and that both preoperative decisions making and intraoperative techniques have made this safer and perhaps accessible for more patients.

Acknowledgments

None.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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