Editorial

Measuring success in hepatectomy

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Advancements in liver resection

Historically, operating on the liver has been a precarious endeavor due to its vascularity and complex anatomy. The high mortality rate associated with liver surgery in its early stages rendered it risky. In 1886, the first partial hepatectomy was attempted by Antonio Lius, but resulted in fatal postoperative hemorrhage (1). In 1887, Dr. Langenbuch performed the first successful liver resection, although reoperation was required due to hemorrhage (1). The earliest estimates of morbidity and mortality for hepatectomy were bleak. In 1963, Dr. Brunschwig reported a 29% mortality rate for right and left lobe resections (2). It was not until the 1970s–1980s that advancements in technology and immunosuppressants allowed for acceptable outcomes (3). With improvements in surgical tools, antibiotics, and general anesthesia, recent data for liver resection yield a postoperative morbidity of 19.6–37% and 90-day mortality of 3–5.4% (4-7).

Open, laparoscopic, and robotic hepatectomy

Morbidity rates continue to improve as we move away from open surgery in favor of minimally invasive approaches. This holds true in hepatectomy. Gavriilidis *et al.* conducted a meta-analysis of 79 studies comparing robotic, laparoscopic, and open hepatectomy (8). Both robotic and laparoscopic cohorts had lower estimated blood loss (EBL), shorter length of stay (LOS), and less Clavien-Dindo III–IV grade morbidity compared to the open cohort. The robotic cohort had longer "operative time" and "duration of clamping" compared to both laparoscopic and open cohorts. Five-year overall survival was better in the robotic and laparoscopic cohorts compared to the open cohort. Differences in 1, 3, and 5-year disease free survival as well as overall survival at 1 and 3 years were nonsignificant.

Results vary in comparisons between robotic and laparoscopic hepatectomy. However, a more recent study analyzing posterosuperior liver resection showed that robotic resection had shorter operative time (160 *vs.* 208 min, P=0.001), shorter Pringle maneuver duration (40 *vs.* 51 min, P=0.047), lower EBL (92 *vs.* 150 mL, P=0.005), and shorter postoperative hospital stay (5.4 *vs.* 7.5 days, P=0.048) (9). In propensity score matched analysis, robotic resection had reduced operative time (P=0.036) and lower EBL (P=0.024) than laparoscopic resection. Although the differences between robotic and laparoscopic surgery generally have been unclear, outcomes may become more apparent over time as familiarity, training, and technology in robotic systems improve.

Surgical outcome indicators

Mortality rates for liver resection in hepatocellular

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carcinoma (HCC) have fallen so much so that a more informative measure is needed to compare procedural outcomes within and across institutions for improvement in care delivery. Existing measures that have been used for this purpose include the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP), Agency for Healthcare Research and Quality Patient Safety Indicator (AHRQ-PSI), Clavien-Dindo Classification system (CDC), Comprehensive Complication Index (CCI), and Textbook Outcome (TO). Among these, the ACS-NSQIP has been the most successful (10). However, the ACS-NSQIP uses single outcome measures that are reported individually and does not adapt to unique outcomes of interest for complex procedures. Rather, an outcome indicator that reports a composite score and captures relevant outcomes for a procedure would have improved risk-adjusted mortality prediction and would better represent overall performance in comparisons (11,12).

Textbook outcomes

While the ACS-NSQIP reports each outcome separately, TO can be reported as either individual outcomes or a composite percentage of outcome variables met. The outcome variables can be defined depending on the procedure or subspeciality, and usually include intra-operative and post-operative goals. There is abundant evidence to suggest that TO is useful for inter-procedural, inter-cohort, and inter-hospital comparisons (13-17). TO can help reduce healthcare costs as it identifies complications just as the ACS-NSQIP does, which in turn decreases LOS and postoperative readmissions (13,18). TO predicts survival as it correlates with 5-year overall survival and recurrence free survival in HCC (19). The U.S. News & World Report ranking was not found to be linearly correlated with TO, suggesting that patients should rely on an institution's TO rather than rank (20). TO is also said to reduce clinician pressure to meet performance metrics at the expense of quality of care (21). Merath *et al.* highlighted the granularity of TO, which is especially important for creating distinction where low procedure-related mortality rates cannot (22). Accordingly, TO has become increasingly popular as researchers work toward codifying outcome variables by procedure.

TO for hepatectomy

D'Silva *et al.* provided a broad review of TO in laparoscopic liver resection as well as across multiple surgery types (23). Their review calls for further consideration of the parameters used in TO. The authors summarized support for TO, highlighting their previous efforts in illustrating that overall survival and 5-year recurrence-free survival correlate with TO. Their data also suggest that TO is expected to vary depending on the indication for a given procedure. A discussion on ways to make comparisons more equitable would have increased the impact of their work. Whether this will involve establishing specific averages for each indication or assigning a difficulty score, D'Silva *et al.* helped to establish the groundwork for this discussion.

Although laparoscopic resection is associated with better morbidity, discussion of open liver resection would increase generalizability. Open hepatectomy is still widely practiced and sometimes preferred depending on the presenting case. Validating TO for both open and laparoscopic resection would be a testament to its robustness. Additionally, they briefly mentioned four factors that resulted in failure to achieve TO but did not follow it up with a meaningful interpretation.

Their discussion on TO for colorectal, gastrectomy, esophageal, bariatric, sarcoma, vascular, pediatric, and lung surgery makes a step toward establishing a standardized definition for TO outcome variables (23,24). However, the current goal is to establish parameters that best suit each procedure or field. The customizability of TO is one of its main selling points.

Recently, an international consensus survey among 44 surgeons assessed 26 outcome variables using a modified Delphi method (25). In doing so, Görgec *et al.* aimed to establish an international definition for a composite "Textbook Outcome in Liver Surgery (TOLS)". TOLS consists of 7 variables: intraoperative incidents, 90-day major complications, 90-day readmission, bile leakage, liver failure, in-hospital and 90-day mortality, and margins of resection. Notably, prolonged LOS was added in a separate definition called "TOLS+". An online calculator was made with these parameters which is available via https://www.evidencio.com/models/show/2794. Given these recent advancements, the future looks bright for TO and will likely involve efforts replicating the work of D'Silva *et al.* as well as Görgec *et al.* to vet outcome variables for various TO use cases.

Summary

As morbidity and mortality continue to decrease, we require standardized and representative measures to compare surgical outcomes. Although the ACS-NSQIP is well-established, TO is emerging as a promising quality tool.

The work of D'Silva *et al.* along with many others has contributed and continues to contribute to defining TO for various procedures and surgical subspecialties. Their narrative review helps establish novel applications of textbook outcomes, which will inform patients, clinicians, policymakers, and national rankings for the foreseeable future.

We anticipate future research will continue the discussion on optimizing TO across fields with consideration for patient priorities and variable procedural difficulty. We hope their work will enable continued improvement at the surgeon-level and innovation at the global scale.

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