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Opinion

The imperative for an updated cirrhosis surgical risk score

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ABSTRACT

The burden of cirrhosis is increasing, as is the need for surgeries in patients with cirrhosis. These patients have increased surgical risk relative to non-cirrhotic patients. Unfortunately, currently available cirrhosis surgical risk prediction tools are non-specific, poorly calibrated, limited in scope, and/or outdated. The Mayo score is the only dedicated tool to provide discrete post-operative mortality predictions for patients with cirrhosis, however it has several limitations. First, its single-center nature does not reflect institution-specific practices that may impact surgical risk. Second, it pre-dates major surgical changes that have changed the landscape of patient selection and surgical risk. Third, it has been shown to overestimate risk in external validation. Finally, and perhaps most importantly, the score does not account for differences in risk based on surgery type. The clinical consequences of inaccurate prediction and risk overestimation are significant, as patients with otherwise acceptable risk may be denied elective surgical procedures, thereby increasing their future need for higher-risk emergent procedures. Confident evaluation of the risks and benefits of surgery in this growing population requires an updated, generalizable, and accurate cirrhosis surgical risk calculator that incorporates the type of surgery under consideration.

Cirrhosis results in significant morbidity, mortality, and healthcare costs [1], and inadequate surgical risk stratification is an increasingly salient contributor to this burden. Non-alcoholic steatohepatitis, alcohol use disorder, and an aging hepatitis C population [1–4] have led to a growing population of patients with cirrhosis or advanced fibrosis, many of whom develop surgical indications over time. Furthermore, cirrhosis confers an increased surgical risk relative to the general population [5], likely related to poor wound healing, impaired hepatorenal medication clearance [6], and increased predilection toward bleeding, among other factors. Given this risk, a multidisciplinary pre-operative evaluation is critical to improve patient surgery selection and optimize outcomes. This assessment may be shared by gastroenterologists, hepatologists [6], surgeons [7], and anesthesiologists [8]. However, currently-available risk stratification tools are non-specific, poorly calibrated, based on single-center cohorts, and/or outdated. An accurate risk score must be specific to patients with cirrhosis and the modern surgical procedures they may undergo.

Although pre-operative risk stratification is a cornerstone of surgical management, existing clinical tools do not capture cirrhosis physiology appropriately. For example, the widely used American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) surgical risk calculator does not include cirrhosis as an input, nor does it address the spectrum of decompensated disease. The only ACS NSQIP cirrhosis-related variable is ascites within 30 days of surgery [9], and the score accuracy has not been assessed broadly in patients with cirrhosis [10]. While the American Society of Anesthesiologists (ASA) physical status classification system has been associated with surgical risk in cirrhosis [11], it does not provide discrete post-operative mortality predictions, and again is not specific to cirrhosis surgical risk.

The model for end-stage liver disease (MELD) and Child-Turcotte-Pugh (CTP) scores are perhaps the most commonly applied risk scores in the field of chronic liver disease. With respect to surgical risk prognostication, however, the literature is divided as to the utility of the MELD and the CTP scores. MELD has been linearly associated with increased 30-day postoperative mortality [12], and several studies demonstrated its superiority over CTP in predicting surgical risk [13,14]. In contrast, several studies support the superiority of CTP scoring in predicting surgical mortality [8,15,16], however more recent literature has noted an overall weaker association between CTP class and postoperative mortality among a realistic cohort where few CTP Class C patients underwent surgery [17]. In the context of elective surgeries, a comparison between

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MELD and CTP scores showed no association with postoperative death or decompensation for either score [18]. Ultimately, the roles of MELD and CTP in surgical risk assessment are limited, especially as neither was designed to be a comprehensive cirrhosis surgical risk prediction tool. Furthermore, CTP suffers from subjectivity in assessment of ascites and hepatic encephalopathy, as well as a narrow score range which limits its ability for granular prediction.

To date, the Mayo risk score is the only tool designed to specifically estimate cirrhosis surgical risk, providing discrete post-operative mortality predictions at 7 days, 30 days, 90 days, 1 year, and 5 years [12]. This score was developed from a single-center cohort of major cardiovascular, orthopedic, and abdominal surgeries from 1980 to 2004. While the score marks an improvement over other options, it has several important limitations. First, given its single-center nature, the score may not reflect institution-specific practices that impact surgical risk. Second, major advances in the surgical field, including an increased adoption of endovascular and minimally invasive techniques, have changed the landscape of patient selection and associated surgical risk. Third, the score is inadequately calibrated. The sole external validation study for the Mayo score demonstrated good discrimination but significant overestimation of risk. Indeed, the actual 1-year post-operative mortality in this study was significantly lower than that predicted by the Mayo score (8.9% versus 22.6%, $p < 0.01$) [11]. Finally, and perhaps most importantly, the score does not account for procedure-specific risks. A recent study of the National Inpatient Sample database demonstrated that surgery type significantly impacts post-operative risk in patients with cirrhosis [19]. For example, major abdominal surgery had a ten-fold increased in-hospital mortality risk compared to major orthopedic surgery (odds ratio 8.27, 95% confidence interval 5.96–11.49). This highlights the primacy of surgery type in estimating post-operative risk.

The clinical consequences of inaccurate prediction and overestimation of surgical risk are significant. Patients with cirrhosis who might actually have acceptable surgical risk are likely being denied elective surgery. This compounds a risk-aversion phenomenon where elective procedures are deferred until a surgical indication becomes emergent. This is important, as both single-procedure [20,21] and multi-procedure [18] studies of patients with cirrhosis demonstrate uniformly higher mortality with emergent versus elective surgery. A common example of this scenario in patients with cirrhosis is the abdominal hernia, which often presents in the setting of ascites and elective operative management is rarely pursued. Instead, surgical intervention is typically reserved for a complication such as incarceration, a high-mortality scenario. A more accurate and better-calibrated risk prediction tool would therefore be expected to promote lower-risk elective surgeries and limit higher-mortality surgeries, thereby reducing post-operative mortality overall.

As suggested above, a clinically useful novel cirrhosis surgical risk score must overcome the limitations of the currently available prediction tools. To date, surgical risk stratification in cirrhosis has come from case reports and small series of isolated, disparate procedures such as infrarenal aortic aneurysms [22], subdural hematomas [23], head and neck flaps [24], and others [25–28]. Only a dataset that includes a diverse set of surgeries, sourced from a large, multi-center cohort will enable the development of an accurate surgical risk score that incorporates surgical procedure type. Furthermore, these data must post-date the Mayo score in order to reflect modern surgical advances that have occurred in the ensuing 15 years. This includes endovascular techniques [29,30] that have revolutionized cardiothoracic surgery, which historically carried the highest mortality rates in patients with cirrhosis [31]. Derivation and validation of an updated, generalizable, and accurate cirrhosis surgical risk calculator will enable physicians and surgeons to confidently weigh the risks and benefits of surgery in this growing population, with the ultimate goal of minimizing both short- and long-term morbidity and mortality. Until that point, even the best efforts of providers may result in misguided management.

Abbreviations

ACS NSQIP	American College of Surgeons National Surgical Quality Improvement Program
ASA	American Society of Anesthesiologists
CTP	Child–Turcotte–Pugh
MELD	model for end-stage liver disease

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Conflicts of interest

The authors have no conflicts of interest to disclose.

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