Approach to Emergent Neurotrauma-related Neurosurgical Procedures in Patients with Hepatic Disease

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Abstract

Liver diseases constitute a group of pathologies of extraordinary importance, because of the large number of patients who suffer from these as well as the consequences that they can have on these individuals if they undergo any surgical procedure. Therefore, these patients have greater risk of suffering unfavorable outcomes than a healthy person undergoing emergency neurosurgical procedures (ENP) for neurotrauma. For this reason, there is a need to classify these patients according to their surgical risk based on risk factors secondary to the concurrent hepatic derangements. Among the possible tools that allow us to stage patients with liver disease are the Child–Turcotte–Pugh (CTP) and model for end-stage liver disease (MELD) scales, which have proven utility in effectively predicting the outcomes, including morbidity and mortality in hepatic disease patients who are undergoing surgery. They also help to predict the risk of complications such as intracranial hemorrhage secondary to coagulopathy due to hepatic derangement.

Keywords
► hepatopathies
► liver disease
► neurosurgery

Introduction

The global incidence of chronic liver diseases (CLDs) is on a steady rise. The pathology of CLDs is widespread, including viral hepatitis, alcoholic liver disease, and nonalcoholic hepatic steatosis. Advances in the treatment of liver pathologies has led to an increase in the survival of patients with CLDs and progression to advanced cirrhosis and even hepatocellular carcinoma.[1] This creates a greater challenge for doctors, since the treatment of the presenting pathology is complicated by underlying liver diseases.[2-6] This is true even for neurological disorders, especially neurotrauma cases that require emergency surgery. Hence, it becomes crucial to stratify the surgical risk in patients with liver diseases at the time of undergoing brain surgeries as well as the identification of preoperatively modifiable risk factors. This is essential to address and optimize the patients to reduce perioperative complications and improve postoperative results. This article attempts to present an updated review on the current understanding and approach for treating CLD patients presenting with neurotrauma.

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Overview

The adverse association between CLDs and surgery is clearly pronounced in literature, and liver cirrhosis has even been extensively described as a risk factor associated with increased morbidity and mortality.[7-9] The morbidity rate in patients with liver cirrhosis has been reported in literature to be 52.1% with mortality rate of 24.3%.[10,11] Studies established that the greater the severity of the liver disease, the greater the risk of mortality and the poorer prognosis with neurosurgeries.[10,12] Severe liver disease itself complicates surgical procedures to a greater extent by various mechanisms including protein synthesis dysfunction which, in turn, leads to hypoproteinemia, difficulty in wound healing, and physical recovery from the procedure.[13] Further, cirrhosis leads to portal hypertension that increases collateral circulations and hematological alterations of liver diseases such as deficiencies of coagulation factors, vitamin K and thrombocytopenia due to splenic sequestration that increase the risk of surgical bleeding.[14,15]

Preoperative Risk Factors in Patients with Liver Disease

It has been described that the presence of underlying liver disease is associated with poor postoperative results. CLD in itself encompasses many important complications, such as hepatic encephalopathy and coagulopathies,[16] which lead to significant impact on any type of surgery. Neurosurgical patients are especially vulnerable to adverse outcomes due to risk of intracranial hemorrhage.[17] This makes it fundamentally important for surgeons to know which preoperative risk factors could lead to poor outcomes in patients with liver disease at the time of neurological surgery.[11] A study performed in 2018 with a large cohort of patients described that patients undergoing neurosurgical interventions with liver disease have a higher risk of mortality and an increase in hospital stay of more than 10 days compared with those without liver disorders.[18] For this reason, surgeons must be cautious when considering a patient with liver disease as a candidate for neurosurgery. As a major preoperative risk factor, CLD deranges the coagulation system and thus not only leads to spontaneous intracranial hemorrhage requiring surgical treatment[19] but also increases the risk of rebleeding, reoperations, and transfusion of blood products.[20]

Another risk factor that impacts postoperative outcomes is the nutritional status of patients with liver disease, since they have low levels of albumin preoperatively, which negatively impacts the healing of cranial wounds and increases chances of infections with lethal complications.[21,22]

Several independent risk factors with liver disease which increase the risk of devastating consequences in patients undergoing brain surgery include heart failure, kidney disease, stroke, and viral hepatitis as a cause of cirrhosis.[23] For this reason, the identification and prompt correction of modifiable risk factors in patients with liver disease who require neurosurgical surgery become important to reduce the incidence of complications and improve postoperative outcomes.

Scales to Evaluate Liver Fibrosis

AST to Platelet Ratio Index (APRI index)

The APRI index indirectly evaluates the degree of fibrosis through the index between the level of the enzyme aspartate aminotransferase and the platelet counts.[24] This has been recommended by the World Health Organization (WHO) to assess the degree of fibrosis in patients with hepatitis C due to its ease of performance and cost.[25]

A meta-analysis performed in 2009 which compiled data from 22 studies established a sensitivity of 81% and a specificity of 50% for determining liver fibrosis by the APRI index.[26] Likewise, a retrospective study performed in 2016, which included 798 patients with chronic hepatitis C, also established a sensitivity for this test at 81% with an APRI cutoff point > 2 to define patients with cirrhosis.[25] This sensitivity adds to the relationship that has been evident between the APRI score and the postsurgical outcome . This makes it useful at the time of the presurgical evaluation.[18]

$$\text{APRI} = \frac{\text{AST/AST(upper limit of normal)}}{\text{Platelet counts}} \times 100$$

< 0.5 rules out significant fibrosis
> 1.5 rules in significant fibrosis
> 2.0 cirrhosis

Child–Turcotte–Pugh (CTP) Score

This scale assesses the albumin level, bilirubin level, prothrombin time, international normalized ratio (INR), presence or absence of ascites and encephalopathy.[27] According to the score obtained, the patients is classified in category A, B or C, giving a rate estimated mortality according to subgroups. Category A patients have a mortality rate between 5% and 10%, category B patients between 10% and 40%, and category C patients have a mortality rate of 20% to 100%, and this variability is determined by the associated comorbidities.[27,28]

Chen et al[10] studied patients with liver cirrhosis who underwent brain surgery and concluded that patients with the progressive liver cirrhosis (based on the Child classification) who were undergoing brain surgery had poorer outcome. These studies allow neurosurgeons to have better guidance on decision-making when faced with a patient having concomitant liver disease. Based on the severity score, they will be able to calculate the risk of complications including mortality and determine the relevance of performing the procedure or not.[18,27]

Table 1 CTP score determining estimated mortality according to subgroups

	1	2	3
Encephalopathy	0	1–2	3–4
Ascites	0	Mild	Major
Bilirubin (mg/dl)	< 2	2–3	> 3
Albumin (g/dl)	> 3.5	2.8–3.5	< 2.8
PT prolonged (s)	1–4	5–6	> 6
INR	< 1.7	1.8–2.3	> 2.3
Child's A = 5–6 points	Child's B = 7–9 points	Child's C = 10–15 points	

Abbreviations: CTP, Child–Turcotte–Pugh; INR, international normalized ratio; PT, prothrombin time.

Model of End-Stage Liver Disease (MELD)

The score is obtained through the following biochemical tests: bilirubin, INR, and creatinine. The result is directly proportional to the risk of surgical complications, that is, the higher the score, the greater the risk (►**Table 1**). There is variability in the results of the studies performed to determine a cutoff point; however, it has been seen that values equal to or greater than 8 have a high postsurgical morbidity and mortality.[28] In search of obtaining a more accurate score on the severity of liver disease and surgical risk, from 2016, after several studies, the MELD score included the serum sodium level in its tests, as hyponatremia has been established as a negative predictor in postoperative results in patients undergoing liver transplantation.[29]

Evaluation of Preoperative Liver Disease

The increase in the incidence of patients with liver disease has led to expanding the study of this pathology. Various scales have been created to assess the degree of liver injury, and determine the risk, complications and postsurgical prognosis.[18] Although liver biopsy is the gold standard for diagnosing liver impairment, it is an invasive test, different clinical and laboratory parameters have been sought which more accurately approximate the severity of the disease.[24,30] These scales, in addition to being inexpensive and easy to perform, must have a high sensitivity to identify patients with cirrhosis either to rule out any surgical intervention including elective ones or, if possible, to control risk factors as evidenced by high morbidity and mortality.[27]

Complications and Postsurgical Outcome in Patient with Liver Disease

Postsurgical complications in the cirrhotic patient are related to the extent of liver injury, comorbidities, type of surgical procedure, and medical expertise. Out of these factors, the degree of dysfunction of liver disease appears to be the factor with the greatest impact on risk of mortality.[27] In the neurosurgical setting, a life-threatening complication is intracranial hemorrhage. However, it is sometimes can be overlooked due to the clinical similarities of neurologic deficits, which can be caused by hepatic encephalopathy. The evacuation of these hematomas represents 30.6% of neurosurgical procedures in patients with cirrhosis.[11,12,19]

Additionally, complications related to cirrhosis may be associated with acquired hemostatic deficiency, since coagulopathy can impair the hemostasis in these patients, with resultant increase in morbidity and mortality. Faced with incompetent hemostasis, the need for transfusion is the most anticipated complication.[10,18,19,31-33] Liao et al[34] reported greater blood loss and prolonged hospital stay in patients who underwent lumbar instrumentation and had liver cirrhosis. Similarly, another study by Goel et al, which included patients undergoing craniotomy for brain tumor, showed that liver disease is a significant predictor of surgical morbidity and mortality, with increased hospital stay due to multiple causes such as coagulopathy, hepatic encephalopathy, pulmonary failure, poor wound healing, and immunocompromise.[18] This demonstrates the importance of knowing the relationship between liver disease and risk of spontaneous intracranial hemorrhage while planning neurosurgical internventions.[17-19,34-37]

Because the complications of neurosurgical procedures in patients with liver cirrhosis are caused by alterations in coagulation, transfusion of fresh frozen plasma (FFP) has been suggested. Additionally, administration of vitamin K to correct the value of prothrombin time as well as maintaining a platelet level > 50,000 are recommended.[38-40] An uncontrollable variable that has an impact on the results of patients with liver cirrhosis is the urgency with which surgical procedures are required regardless of the type, since emergency surgery always carries a greater risk of morbidity and mortality. In these patients the risk can be two times higher than in the general population.[27] It has been suggested to improve the CTP score before surgical intervention in the cirrhotic patient to reduce the impact on morbidity and mortality. However, this optimization of liver function is not entirely practical, considering that neurosurgical interventions for bleeding intracranial is mostly an emergent management.[12]

Conclusions

Advances in medicine for the management of patients with liver disease have brought with them new challenges for surgeons, due to the increase in the requirement for surgical procedures. This raises questions about which patients should undergo surgery and which patients should not, and how to measure severity of liver disease and how to reduce postsurgical risks. Little is known about neurosurgical procedures, and there is no consensus on the most accurate scale for evaluating the severity of liver disease and thus surgical risk in neurosurgical patients. This is of vital importance in emergency settings where adequate optimization may not be a choice. The frequently used CTP and MELD scores, which determine the risk of morbidity and mortality, aid in decision-making regarding risks associated with a surgical procedure. This risk must be taken based on the calculated risk-benefit ratio and adequate patient information. It is necessary to control the possible complications of these patients, as well as the surgical risk, through the management of ascites, nutritional support, maintenance of albumin levels and, in case of bleeding, FFP transfusions and administration of vitamin K.

Conflict of Interest
None declared.

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