



# Non-Hepatic Abdominal Surgery in Patients with Cirrhotic Liver Disease

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## Abstract

Cirrhotic liver disease is an important cause of peri-operative morbidity and mortality in general surgical patients. Early recognition and optimization of liver dysfunction is imperative before any elective surgery. Patients with MELD <12 or classified as Child A have a higher morbidity and mortality than matched controls without liver dysfunction, but are generally safe for elective procedures with appropriate patient education. Patients with MELD >20 or classified as Child C should undergo transplantation before any elective procedure given mortality exceeds 40%. Laparoscopic procedures are feasible and safe in cirrhotic patients.

**Keywords** Abdominal surgery · Chronic liver disease · Cirrhosis · Appropriate surgical decision making · Postoperative care

## Introduction

Chronic liver disease and cirrhosis not only serve as major causes of morbidity and mortality but are also associated with

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### Learning Objectives

1. Describe the physiologic changes of cirrhosis and their impact on peri-operative management
2. Describe the tools for assessing the severity of liver disease and their use for predicting postoperative complications in cirrhotic patients
3. Identify cirrhotic patients who can safely undergo general surgical procedures and those that have a prohibitively high risk
4. Review procedure-specific data to use during the operative decision-making

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increased surgical risk and poor outcomes after surgery. Elective surgery should be preceded by thorough patient evaluation and medical optimization via an interdisciplinary approach. Detailed conversations about surgical morbidity and mortality must occur between patient and surgeon to allow for appropriate surgical decision-making. Postoperative care must focus on patient recovery and close observation for liver decompensation. In the emergent setting, surgery on the cirrhotic patient carries a high mortality rate indicating a need for careful yet aggressive resuscitation and monitoring.

## Symptoms and Pathophysiology

Cirrhosis is the end result of liver damage from varying etiologies; alcoholism, chronic hepatitis C infection and non-alcoholic fatty liver disease (NAFLD) are the most common causes in Western countries.<sup>1</sup> There are many other causes of cirrhosis including autoimmune hepatitis, primary biliary cirrhosis, primary sclerosing cholangitis, hemochromatosis, Wilson's disease, and idiopathic cases. The common disease pathway involves injury to and necrosis of hepatocytes leading to fibrosis of liver parenchyma resulting in loss of liver function. The exact mechanisms at the cellular level are not entirely understood leading to continued studies with an aim to clarify pathogenesis and improve therapeutic options.<sup>1</sup> The liver is a vital organ playing a role in protein synthesis, metabolism of drugs and nutrients, detoxification, and portal venous blood filtering. Any hepatic dysfunction can lead to alterations in these processes. Pathophysiologically, cirrhosis results in a hyperdynamic state including increased cardiac

output and decreased systemic vascular resistance.<sup>2</sup> Baseline portal blood flow is reduced due to portal hypertension, and diminished autoregulation can also result in decreased hepatic arterial blood flow. It has also been suggested that arteriovenous shunting and decreased splanchnic blood flow change overall systemic circulation in the setting of cirrhosis. Splanchnic vasodilation causes effective hypovolemia, driving sodium and water retention mediated by the renin-angiotensin system.<sup>3</sup> Activation of the renin-angiotensin system causes renal vasoconstriction, making patients susceptible to kidney injury.<sup>3</sup> Due to these physiologic alterations, the cirrhotic liver is far more vulnerable to hypotension or hypoxemia which can both occur in the operative setting.<sup>4</sup>

### Diagnosis and Classification

A patient with cirrhosis can present on a spectrum from undiagnosed to fulminant liver failure, dependent on the severity of the underlying disease. Clinically, a patient will fall into one of two phases: compensated or decompensated. Compensated cirrhosis is difficult to recognize whereas decompensated cirrhosis will manifest a wide spectrum of clinical findings as well as laboratory findings. These include ascites, encephalopathy, esophageal varices, gastrointestinal bleeding, thrombocytopenia, and hypoalbuminemia.<sup>5</sup> The gold standard for diagnosis of cirrhosis remains liver biopsy; however, non-invasive modalities including ultrasound (US), contrast-enhanced US, Doppler US, and elastography have become more useful in establishing a diagnosis of liver fibrosis.<sup>5</sup>

The severity of liver disease can further be assessed via scoring systems including the Child-Turcotte-Pugh (CTP) and the model for end-stage liver disease (MELD) scores (Table 1). The CTP score emerged in 1964 to serve as a risk predictive model for liver disease patients undergoing portosystemic surgery but has now evolved into a mechanism for assessing surgical risk beyond hepatic procedures.<sup>6</sup> The five score parameters include serum

albumin, serum bilirubin, international normalized ratio (INR), ascites, and encephalopathy, each of which is graded numerically from 1 to 3 points with a higher score signifying more advanced disease.

The MELD score was initially introduced to predict mortality after transjugular intrahepatic portosystemic shunt (TIPS) procedure and then used to stratify patients awaiting liver transplantation. More recently, it has been justified as a means of predicting perioperative mortality in cirrhotic patients.<sup>7</sup> The MELD score is comprised of three variables including INR, total serum bilirubin, and serum creatinine levels.

### Pre-operative Assessment and Risk Stratification

The cirrhotic patient is a complex entity with variable degrees of disease that can be difficult for the surgeon to manage. Ideally, a physician with liver disease specialization should pre-operatively assess the patient. After routine labs are checked including a basic metabolic panel to assess sodium and creatinine, platelet count, hepatic function panel, coagulation studies, and nutrition parameters, both MELD and CTP scores should be calculated.

Peri-operative morbidity and mortality may be more accurately assessed using the MELD calculation as opposed to CTP, as it is based on objective data only.<sup>2</sup> However, it has also been suggested that both CTP and MELD scores complement each other offering a more accurate evaluation of liver dysfunction and level of decompensation.<sup>8</sup> Causey et al. proposed the use of CTP for predicting 30-day mortality, MELD for predicting 3-month mortality, and MELD-Na for predicting 90-day mortality.<sup>9</sup>

Douard et al. suggested that Child A patients are acceptable candidates for elective procedures, Child B should undergo pre-operative optimization to convert to Child A, and Child C are poor operative candidates with operative mortality exceeding 40%.<sup>10</sup> Northup et al. in a retrospective study

**Table 1** Instructions to calculate the CTP and MELD scores for patients with liver disease

Child-Turcotte-Pugh (CTP) score: sum of the assigned point values for each of the clinical parameters listed below

Clinical parameter	1 point	2 points	3 points
Total bilirubin (mg/dL)	<2	2–3	>3
Serum albumin (g/dL)	>3.5	2.8–3.5	<2.8
INR	<1.7		>2.3
Ascites	None	Mild	Moderate to severe
Hepatic encephalopathy	None	Grade I or II (suppressed with medication)	Grade III or IV (refractory)

Model for end-stage liver disease (MELD) score:  $3.78 \times \ln[\text{serum bilirubin (mg/dL)}] + 11.2 \times \ln[\text{INR}] + 9.57 \times \ln[\text{serum creatinine (mg/dL)}] + 6.43$

INR international normalized ratio

determined a 1% increase in mortality for each 1-point increase in MELD up to 20 and a 2% increase in mortality to for each 1-point increase above a score of 20.<sup>7</sup> Teh et al. found patients with MELD score >20 should have elective procedures postponed until after transplantation; scores from 12 to 19 should have transplantation considered; MELD < 11 have lower postoperative mortality which may be acceptable to patients when deciding to have elective surgical procedures.<sup>11</sup>

While the initial utility of the CTP and MELD scores was for patients undergoing medical management, additional studies since that time have outlined the risk of elective abdominal surgeries based on pre-operative score (Table 2).<sup>12,13</sup> Additionally, the CTP also corresponds to increased morbidity with postoperative complications including bleeding, infection, renal dysfunction, increased ascites, worsening encephalopathy, and liver failure.<sup>4</sup>

Physical exam and evaluation for the sequelae of liver disease including ascites and encephalopathy should be performed. If patients have renal dysfunction, ascites, or evidence of encephalopathy, they should be optimized via medical therapy prior to intervention.<sup>4</sup> Patients should be carefully questioned about alcohol use and be asked to abstain prior to elective surgery.

One of the most important pre-operative components is managing the expectations of patients and their families. This involves detailed conversations about surgical risk including 30- and 90-day mortality as well as complications including worsening liver function and prolonged hospital courses. Both surgical and non-surgical options in the elective setting should be discussed to allow patients every opportunity to make a well-informed decision about their care.<sup>14</sup> The decision to proceed with an elective operation in a patient with cirrhosis is not transparent. The patient's overall clinical status, degree of liver dysfunction, need for surgery, and proposed surgical intervention all need to be carefully evaluated. Contraindications for elective or semi-elective procedures include acute liver failure, fulminant liver failure, acute viral hepatitis, acute alcoholic hepatitis, and ASA class V.<sup>2</sup> Im

et al. proposed a preoperative liver assessment (POLA) checklist to serve as a guideline for assessing surgical risk which includes characterization of liver disease, identification of comorbid conditions, history of prior and current hepatic decompensation, evaluation of liver function, coagulopathy, calculation of MELD/CTP, and review of medications.<sup>2</sup>

If the decision to pursue surgery in the elective setting is made, preoperative evaluation by anesthesia is essential. The anesthetist needs to be aware of the severity of the liver disease to guide volume resuscitation and preoperative antibiotic administration as well as which anesthetic agents are not hepatotoxic. Volume expanders may be utilized to avoid worsening of ascites and peripheral edema. In the setting of ascites, gram-negative coverage with a third-generation cephalosporin should be chosen to reduce the risk of bacterial peritonitis.<sup>14</sup>

## Treatment and Outcomes

### Critical Care in Cirrhotic Patients

Anesthesia can lead to acute hepatic decompensation in cirrhotic patients, and knowledge of the physiologic alterations previously discussed is crucial for intraoperative management. In addition, hepatic dysfunction leads to an alteration in metabolism and pharmacology of commonly used anesthetic and analgesic agents. Several commonly used peri-operative medications require dose reduction: propofol, dexmedetomidine, ketamine, midazolam, and morphine.<sup>15</sup>

Patients with liver disease can present intravascularly volume deplete, though they have total body volume overload. These patients may benefit from volume expanders and blood products (guided by thromboelastography (TEG)) to prevent worsening ascites, peripheral edema, and congestive heart failure.<sup>16</sup> Antibiotic prophylaxis should be given to every patient with liver disease undergoing a gastrointestinal procedure.

A consensus statement published in 2016 recommends crystalloid solutions for initial resuscitation in volume-depleted patients (10–20 mL/kg), although balanced salt solutions (such as IsoLyte®) may be more beneficial to normal saline in patients with relative hyperchloremia (normal serum chloride with hyponatremia).<sup>3</sup>

Albumin is superior to crystalloids in three scenarios: spontaneous bacterial peritonitis (SBP), large-volume paracentesis, or type 1 hepatorenal syndrome. Fluid management in cirrhotic patients requires careful monitoring of volume status using invasive catheters as well as trends in serum lactate (though may have delayed clearance). For persistent hypotension, norepinephrine, vasopressin, or a trial of hydrocortisone 200–300 mg/day divided are indicated.<sup>3</sup>

Management of coagulopathy includes maintaining platelet counts above  $50 \times 10^9/L$ , hemoglobin above 7 mg/

**Table 2** Using the CTP and MELD scores to predict 30-day mortality after elective surgery (all types of procedures) in patients with liver disease

Score	Mortality (%)
Child-Turcotte-Pugh (CTP) score <sup>12,13</sup>	
Class A (5–6 points)	10
Class B (7–9 points)	30
Class C (10–15 points)	76–82
Model for end-stage liver disease (MELD) score <sup>11</sup>	
Less than 8	5.7
Greater than 20	Over 50

dL, and fibrinogen greater than 1.5 g/L during active bleeding or the perioperative period. In the setting of bleeding in decompensated cirrhosis,  $\epsilon$ -aminocaproic acid is an effective and safe use for hyperfibrinolysis (though controlled trials are lacking).<sup>3</sup>

Coagulopathy is a contraindication to epidural anesthesia due to the risk of epidural hematoma, but the benefits of regional anesthesia outweigh the risks in carefully selected patients. The use of epidurals in abdominal surgery has been associated with better pain control, faster return of bowel function, and reduced hospital length of stay.<sup>17</sup> Patients with liver disease with normal coagulation factors, platelet count, and pre-procedure TEG are good candidates for epidural anesthesia. Catheter removal should be evaluated with the same coagulopathy work-up and can be removed safely after normalization of parameters. In a recent study, the risk of epidural hematoma after removal in the setting of coagulopathy was 0.3%, compared to 0.01–0.03% in baseline population.<sup>18</sup>

Many of the strategies for management of the postoperative cirrhotic patient mirror those pre-operatively: avoid medications metabolized by the liver, monitor intravascular volume, avoid metabolic disturbances, and use lactulose for hepatic encephalopathy and opioid-induced constipation. If the patient will remain nil per os (NPO), early parenteral nutrition should be used. Lower postoperative morbidity was observed in cirrhotic patients after hepatectomy with the use of parenteral nutrition instead of intravenous fluids with electrolytes.<sup>19</sup>

## General Surgical Principles

Ideally, surgical intervention should be delayed until the patient is stabilized and optimized. Outcomes of emergent interventions are inferior to elective cases in liver disease.<sup>11,20–23</sup> Additionally, mortality rates for cirrhotics are higher than matched controls across several procedures (Table 3). However, in the appropriately selected patient, common abdominal procedures can be performed safely.

For all cirrhotic patients undergoing any surgical procedure, the overall postoperative morbidity and 30-day mortality

are 30.1 and 11.6%, respectively.<sup>28</sup> When analyzing only laparoscopic procedures, the morbidity and mortality decreased to 16 and 0.6%.<sup>29</sup> A nationwide database study revealed that cirrhotic patients had a higher length of stay (LOS), mortality rate, and hospital cost compared to non-cirrhotic controls across all operations studied. Furthermore, the presence of portal hypertension conferred even higher LOS, mortality rate, and cost when compared to cirrhotics.<sup>22</sup>

In a retrospective analysis of cirrhotic patients who underwent major surgery (cardiac, gastrointestinal, or orthopedic) by Teh et al., the only significant predictors of postoperative mortality in multivariate analysis were MELD, ASA class, and age.<sup>11</sup> Of these, MELD was the most significant with an almost linear increase in 30- and 90-day mortality with increasing MELD (for example, MELD of 8 carries a 5.7% 30-day mortality compared to MELD 20 with > 50% mortality).<sup>11</sup> The authors used the data to publish an online calculator that uses MELD to predict postoperative mortality risk over time (from 1 week to 5 years) for major surgical procedures (available at <http://www.mayoclinic.org/meld/mayomodel9.html>).<sup>11</sup> In other studies, the overall risk of postoperative mortality in cirrhotic patients is increased in emergent procedures, gastrointestinal tract surgery, albumin < 3.0 mg/dL, transaminase levels more than three times upper limit of normal, ascites, portal hypertension, and intraoperative transfusion.<sup>10,21</sup> A multivariate analysis at a single institution found intraoperative transfusion (OR 16.8), albumin < 3 (OR 15.0), and ASA > 3 (OR 10.5) to be associated with adverse outcomes in their cirrhotic population.<sup>30</sup>

## Emergent Abdominal Laparotomy

In a retrospective study of a level 1 trauma registry, the overall in-hospital mortality after trauma for cirrhotic patients is twice that of non-cirrhotic controls (12 vs 6%, OR 5.65). Cirrhotic patients were more likely to develop acute respiratory distress syndrome (ARDS), coagulopathy, and sepsis than the control group. When analyzing only those cirrhotics who underwent emergent exploratory laparotomy, the mortality rate increased to 40% (compared to 15% in controls, OR 4.35).<sup>31</sup> Similar mortality was reported in another matched retrospective study: 45% mortality in cirrhotics compared to 24% in matched controls (HR 7.6). The mortality rate for minor trauma in cirrhotic patients (defined as Injury Severity Score < 16) was 29% compared to 56% after major trauma (ISS 16–25).<sup>32</sup>

When examining only blunt trauma, a MELD score greater than 16 was associated with a significantly higher mortality rate compared to patients with lower MELD scores (85.7 vs 6.2%).<sup>33</sup>

**Table 3** Risk of operative mortality in cirrhotic patients for common abdominal procedures, compared to non-cirrhotic patients<sup>24–27</sup>

Surgical procedure	Mortality in cirrhotic patients (%)	Mortality in non-cirrhotic patients (%)
Open cholecystectomy	2–8.3	0.9
Laparoscopic cholecystectomy	0.6–1.3	0.13
Colorectal procedures	14–29	5
Umbilical hernia repair	0.6–3.8	0.1–0.5

## Vascular Surgery

In a retrospective study of elective infrarenal aortic aneurysm repairs in 24 cirrhotic patients, 30-day mortality and major postoperative complications were equivalent to the matched controls. However, a 2-year actuarial survival was 77.4% in cirrhotics compared to 97.8% ( $p = 0.03$ ); MELD greater than or equal to 10 was associated with higher mortality rates.<sup>34</sup> A database review found that cirrhotic patients had a 5.8-fold higher mortality rate than matched controls, and patient with portal hypertension had a 7.8-fold higher mortality rate.<sup>22</sup>

## Biliary Surgery

Cholecystectomy is the most frequently performed surgical procedure for patients with cirrhosis.<sup>22</sup> Laparoscopic cholecystectomy is preferred to open cholecystectomy in cirrhotic patients, as studies have shown lower mortality, fewer complications, shorter operative time, and shorter length of stay (Table 4).<sup>24,25,35,41,42</sup> However, cirrhotic patients undergoing laparoscopic cholecystectomy have higher rates of conversion to an open procedure, bleeding complications, acute cholecystitis, and surgical morbidity compared to non-cirrhotic controls.<sup>24</sup> For patients with prohibitively high surgical risk (i.e., Child C), cholecystostomy tube with antibiotics is an alternative to medical management.

Interestingly, surgical outcomes are also variable with the etiology of cirrhosis. Thulstrup et al. found that patient with alcoholic cirrhosis had an 11-fold increased risk for mortality following open cholecystectomy compared to either non-alcoholic cirrhosis or non-cirrhotic controls.<sup>26</sup>

Two studies examined the use of Harmonic scalpel without clips and conventional technique with clips in laparoscopic cholecystectomy—the first randomized Child classes A and B patients to Harmonic scalpel ( $n = 20$ ) and conventional

electrocautery dissection with clips on the duct ( $n = 20$ ). The authors found shorter operative time, less blood loss, less frequent gallbladder perforation with the harmonic scalpel, and lower postoperative complication rate.<sup>43</sup> A second study found similar results, as well as decreased postoperative pain.<sup>44</sup>

Patients with cirrhosis had a 3.4-fold higher risk of mortality after cholecystectomy compared to the general population (Table 3). Patients with cirrhosis and portal hypertension had a 12.3-fold higher risk after cholecystectomy.<sup>22</sup>

## Foregut Surgery

Obesity is associated with hepatic steatosis, and recent studies have shown bariatric surgery can reduce the histologic and biochemical manifestations of non-alcoholic fatty liver disease.<sup>45</sup> A matched study of Child A patients with NASH to non-cirrhotic controls who underwent sleeve gastrectomy found equivalent postoperative complication rates on 7.7%.<sup>46</sup>

In cirrhotic patients with gastric cancer, laparoscopic gastrectomy has been shown to be safe in CTP A patients; in a retrospective review of 41 patients, 54% had postoperative complications but no mortalities were observed.<sup>47,48</sup>

## Colorectal Surgery

Similar to gallbladder disease, laparoscopy is a safe and effective option for colorectal resections, with lower morbidity and mortality than open operations in cirrhotic patients (Table 4).<sup>12,38,39,49</sup>

Patients with cirrhosis had a 3.7-fold higher risk of mortality after colectomy compared to the general population. Patients with cirrhosis and portal hypertension had a 14.3-fold higher risk after colectomy.<sup>22</sup> A large population-based study found that patients with compensated cirrhosis had a higher in-hospital mortality after colorectal surgery compared to non-

**Table 4** Comparison of laparoscopic versus open abdominal procedures in cirrhotic patients

Study	Design	Population	Findings
<b>Cholecystectomy</b>			
Chimielecki et al <sup>27</sup>	Retrospective cohort	Open: 1852 Lap: 13,809	Open procedures associated with higher postop infection, hemorrhage, pRBC transfusion, liver failure
Laurence et al <sup>25</sup>	Meta-analysis of 3 RCTs <sup>35–37</sup>	Open: 108 Lap: 112	Open procedures associated with increased total postop complications, infections, hepatic insufficiency, and hospital LOS
<b>Colectomy</b>			
Martinez et al <sup>38</sup>	Retrospective	Lap: 17	Morbidity 29% compared to 30–48% morbidity in open colon resections <sup>12,39</sup>
<b>Appendectomy</b>			
Tsugawa et al <sup>40</sup>	Retrospective	Open: 40 Lap: 15	Open procedures associated with increased postoperative morbidity and pain

cirrhotic controls (14% vs 5%, OR 3.91); similarly, patients with portal hypertension had an even higher mortality at 29% (OR 11.3).<sup>23</sup> A population-based study of over 39,000 patients found 30-day mortality to be 8.7% for normal patients, 13.3% for non-cirrhotic liver disease, and 24.1% for cirrhotic liver disease (RR = 1.49 and 2.59, respectively).<sup>50</sup> Ghaferi et al. found that MELD > 15 was associated with higher mortality and complications compared to patients with MELD < 15.<sup>51</sup> Dincler et al. reported increased postoperative complications in Childs B or C cirrhosis after elective laparoscopic colorectal procedures.<sup>52</sup> Meunier et al. found the only factor predicting morbidity was ascites and predicting mortality was postoperative infection on multivariate analysis.<sup>49</sup>

### Abdominal Wall Hernia Surgery

Umbilical hernias are a common finding in cirrhotic patients with ascites, occurring in up to 20% of patients.<sup>53</sup> A study by Marsman et al. showed conservative management of umbilical hernias in this population had a success rate of only 23%; 10 of 13 patients required re-admission for incarceration, and 6 of those required emergent hernia repair.<sup>54</sup> In light of this, studies have shown that elective umbilical hernia repair can be performed safely, with better outcomes than emergent repair.<sup>53,55,56</sup> Ascites confers an eightfold increase in risk for recurrence<sup>57</sup>; the risk of recurrence is also increased with suture repair (14%) compared to mesh repair (2.7%) of the defect.<sup>58</sup> A randomized study showed prosthetic mesh can be placed without an increase in postoperative infection.<sup>58</sup>

A large population-based study used logistic regression analysis to identify the risk factors for mortality in cirrhotic patients undergoing umbilical hernia repair. Postoperative mortality in this population was associated with age over 65, MELD > 15, serum albumin < 3.0 mg/dL, and sepsis at the time of presentation.<sup>59</sup>

A cohort study of more than 32,000 patients found higher rates of intensive care admissions (15.9 vs 6.0%) and mortality (2.5% versus 0.2%) for cirrhotic patients matched with non-cirrhotic controls.<sup>56</sup> However, these findings were not significant when comparing only elective cases, suggesting that elective hernia repairs are safe.

An analysis of the American College of Surgeons National Surgical Quality Improvement Program examined patients with liver disease undergoing open or laparoscopic inguinal hernia repair; results revealed similar LOS, morbidity, and mortality (0.27% versus 0.12%, respectively) between groups.<sup>60</sup>

### Summary

Early-stage liver disease (MELD < 12 or CTP A) is associated with a higher morbidity and mortality than matched controls

but does not require alterations in management apart from patient counseling. While there are data for many specific elective procedures, general guidelines are as follows: patient with Child A or MELD < 12 are generally safe for elective procedures, Child B or MELD 12–19 should have aggressive optimization and referral for liver transplant, and Child C or MELD > 20 have a prohibitively high surgical risk (mortality > 40%) and should undergo transplantation before any elective procedures.<sup>10,11</sup>

Portal hypertension is associated with increased surgical risk across all types of procedures; if possible, hypertension should be corrected with medical management prior to surgery. Likewise, emergent surgery has been shown to have worse outcomes for all procedures; patients should be medically optimized for elective surgery whenever feasible. A summary of recommendations for specific procedures is presented below:

*Emergent abdominal laparotomy:* Mortality in cirrhotics increases with MELD > 16 or ISS > 16. Consider non-operative or minimally invasive alternatives, if available.

*Elective AAA repair:* Mortality appears to increase with MELD scores > 10.

*Biliary surgery:* Laparoscopic approaches are preferable to open, though cirrhotics have a higher rate of conversion than normal controls. The highest mortality rates are seen in Child C, though mortalities have been reported after laparoscopic cholecystectomy for Child A and B patients.

*Foregut surgery:* Both bariatric procedures and gastrectomy have been successfully performed in Child A patients.

*Colorectal surgery:* While cirrhotics have a higher mortality for both laparoscopic and open procedures compared to matched controls, the risk is acceptable in patients with MELD < 15.

*Abdominal hernia repair:* Non-operative management has poor success rates in this population, and elective procedures can be safely performed in MELD < 15.

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## CME Questions

1. A 65 yo male presents to your outpatient clinic to discuss a symptomatic right inguinal hernia. While taking his history, he reports that he has been told he has liver disease because he used to drink heavily. On physical exam, he does have a large right inguinal hernia that is easily reducible but also has a fluid wave on abdominal exam. Prior to proceeding with an elective inguinal hernia repair, you should:
  - A. Do nothing more. He is safe for an elective operation.
  - B. Check an ETOH level to ensure he is not actively still drinking but schedule his operation.
  - C. Tell him he will never be a candidate for a hernia repair due to his cirrhosis
  - D. Refer him to a hepatologist for evaluation and medical optimization given he has ascites which is a manifestation of his liver disease
2. A 45 yo female with a known history of cirrhosis presents to your office with complaints consistent with symptomatic cholelithiasis. She is interested in gallbladder removal. She has no evidence of decompensation and has had a recent EGD without varices. She sees a hepatologist regularly but has not discussed her desire for cholecystectomy with him. What is a true statement about preoperative assessment and surgical planning?
  - A. Do nothing more. He is safe for an elective operation.
  - B. Check an ETOH level to ensure he is not actively still drinking but schedule his operation.
  - C. Tell him he will never be a candidate for a hernia repair due to his cirrhosis
  - D. Refer him to a hepatologist for evaluation and medical optimization given he has ascites which is a manifestation of his liver disease



- A. Perform a physical exam. If no ascites or evidence of encephalopathy, she should be encouraged to proceed with cholecystectomy.
- B. Perform a thorough history and physical exam, draw a full set of labs, calculate a MELD and CTP and discuss perioperative risks of morbidity and mortality
- C. Refer her back to her hepatologist to discuss non-operative management including biliary decompression with a cholecystostomy tube as she is not a candidate for surgery
- D. She should not undergo elective surgery until she is considered for liver transplantation
3. A 65 yo male in the hospital (admitted for pneumonia) who is now recovering develops complaints of an umbilical hernia. On exam, the hernia is reducible with a 2 cm fascial defect and no evidence of skin breakdown overlying the hernia. When evaluating his surgical risk, you are deciding between calculating a MELD versus a Child-Turcotte-Pugh score. Which of the following is true regarding these scoring modalities?
- A. The MELD score should only be used if the patient has a TIPS
- B. Both CTP and MELD scores are calculated based on laboratory parameters
- C. There is no data to support using either the MELD or CTP score for calculating risk of mortality
- D. The CTP score is calculated using 5 components including subjective parameters of encephalopathy and ascites in addition to serum bilirubin, serum albumin and prothrombin time
4. A 53 yo female is admitted to the hospital with abdominal pain. While getting a thorough history, she endorses a long history of IV drug use and has been told in the past that she may have “something wrong with her liver.” A hepatitis C screen performed by the ED show a positive HCV Ab. What is the best method for obtaining a diagnosis of cirrhosis?
- A. Hepatitis C virus antibody is diagnostic for cirrhosis
- B. Laboratory evaluation showing elevated liver enzymes with AST:ALT 2:1 is suggestive of cirrhosis
- C. A liver biopsy is the gold standard for diagnosis
- D. There is no single best diagnostic tool but a combination of liver function tests, coagulation studies and CT scan carries high sensitivity
5. A 56 yo male is scheduled to undergo an elective laparoscopic right hemicolectomy for T2 adenocarcinoma found on screening colonoscopy. He has a diagnosis of nonalcoholic fatty liver disease, and pre-operative MELD is 12. You observe no ascites or stigmata of liver disease on physical exam. After risk counseling and aggressive optimization, he is taken to the operating room. Which commonly used medication is safe for this patient, without the need for dose reduction or additional monitoring?
- A. Midazolam
- B. Ketamine
- C. Succinylcholine
- D. Rocuronium
6. A 41 yo female with a known history of hepatitis C cirrhosis presents to your clinic with a 6 month history of right upper abdominal pain after eating. The symptoms occur most commonly after eating fried foods. Her primary care physician has completed a laboratory and imaging work-up that revealed cholelithiasis without cholecystitis. She has missed several days of work due to the pain, and would like to have a cholecystectomy. She is seen regularly by a hepatologist, and with medical management her most recent MELD score is 8. During her pre-operative counseling, which of these statements should you tell her?
- A. Open cholecystectomy is associated with a lower postoperative mortality than the laparoscopic approach in cirrhotic patients and is the preferred operation
- B. A MELD of 8 indicates over 50% 30-day mortality after elective procedures
- C. The 30-day mortality for laparoscopic cholecystectomy for all cirrhotics approaches 8%
- D. Laparoscopic cholecystectomy is associated with lower morbidity and shorter hospital length of stay compared to open cholecystectomy in cirrhotic patients
7. A 72 yo male with a history of alcoholic cirrhosis presents to your office after a recent emergency room visit for incarcerated umbilical hernia. He reports a 10 year history of the hernia; it has always been easily reducible until last week, when it became hard and painful. He had several episodes of emesis before presenting to the hospital. It was reduced by the physician on call after pain medication. Today, he is interested in scheduling elective umbilical hernia repair to prevent another episode of incarceration. Which of these statements is most correct?
- A. Umbilical hernias are rare in cirrhotic patients, occurring in less than 5% of individuals
- B. Conservative management is preferred in these patients, as future risk of incarceration is <2%
- C. Elective repair is preferred, as patients have better outcomes than watchful waiting followed by emergent repair if complications arise
- D. Elective repair is preferred, and primary suture repair of the defect has lower recurrence rates than mesh repair
8. A 55 yo female is admitted to the surgical ICU after laparotomy with small bowel resection for a small bowel mass. She has a history of cirrhotic liver disease, and her pre-op MELD was 14. On postoperative day 3, she is still unable to be weaned from the ventilator. Laboratory work-up reveals sodium of 135, creatinine 1.2, albumin 2.9, and pre-albumin of 4.3. She is unable to start enteral nutrition, as she continues to have bilious, high output drainage from her nasogastric tube. What is the preferred type of intravenous fluids in this patient?
- A. 0.45% normal saline
- B. 5% albumin
- C. 0.9% normal saline with 40 mEq of potassium
- D. Total parenteral nutrition