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Systematic Review / Meta-analysis

Perioperative management of patients with liver disease for non-hepatic surgery: A systematic review

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ABSTRACT

Background: Liver disease is a multisystem condition that is classified as acute or chronic depending on the length of time. Cirrhosis patients are expected to undergo surgery in the last two years of their lives, according to estimates. In patients with elevated liver enzyme levels, anesthesia and surgery may deteriorate liver function. Preoperative identification, optimization and anesthetic management are essential for optimum outcomes in patients with liver disease undergoing surgery.

Methods: The literatures are searched using medical search engines like Google scholar, PubMed, Cochrane library and HINARI to get access for current and update evidence on perioperative optimization of patients with liver disease. The key words for literature search were (liver disease OR liver failure) AND (liver disease OR perioperative management) AND (non-hepatic surgery OR anesthesia). After searching using these search engines then collected by filtering based on the level of significance to this guideline with proper appraisal and evaluation of study quality with different level of evidences.

Conclusions: and recommendations: Patients with liver disease presenting with non-hepatic surgery might have postoperative complications that can lead to death. Efforts should be expended to favorably alter a patient's preoperative Child's class before undertaking an elective operation.

1. Introduction

The liver is the body's main internal organ. It is situated below the diaphragm in the right upper quadrant of the abdominal cavity and weighs approximately 1.4 kg in women and 1.6 kg in men. It performs a variety of important functions, including bile production, plasma protein synthesis (e.g., clotting factors), drug metabolism, and vitamin, mineral, and glucose storage. Liver disease is a multisystem condition that is classified as acute or chronic depending on the length of time between the onset of symptoms and the triggering event. Acute liver failure is characterized as the emergence of symptoms of serious liver injury with encephalopathy and diminished synthetic function in a patient who has no prior liver disease and has been sick for less than 26 weeks [1,2].

The frequency and prevalence of chronic liver disease are unknown, but best estimates suggest that they are much higher. Geographic location, race, and socioeconomic status all play a role in the cause and burden of liver disease. Cirrhosis, viral hepatitis, and hepatocellular carcinoma are estimated to cause 2 million deaths worldwide per year, with the vast majority of these deaths due to complications of cirrhosis, viral hepatitis, and hepatocellular carcinoma [2].

Chronic liver disease is becoming more common in the United States and around the world as a result of hepatitis C (HCV), hepatitis B (HBV), alcohol, and non-alcoholic fatty liver disease (NAFLD). Cirrhosis patients are expected to undergo surgery in the last two years of their lives, according to estimates. In a large proportion of patients with well-compensated or occult cirrhosis, general anesthesia and surgery can cause complications, which can result in significant morbidity and mortality [3].

Most surgical procedures result in small elevations in serum liver biochemical test levels, whether performed under general, spinal, or epidural anesthesia. In patients without underlying liver disease, minor

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postoperative increases in serum aminotransferase, alkaline phosphatase, or bilirubin levels are not clinically important. Surgery, on the other hand, can hasten hepatic decompensation in patients with underlying liver disease, especially those with compromised hepatic synthetic function. The intensity of the operation is related to the operational risk [4].

In patients with elevated liver enzyme levels, anesthesia and surgery may deteriorate liver function; thus, choosing anesthetics with less hepatotoxicity may be critical in these patients. Preoperative evaluation is critical for elective procedures to ensure a proper risk benefit calculation for elective surgery and to direct optimization. The emphasis of postoperative treatment should be on patient rehabilitation and close monitoring for liver decompensation. Non-hepatic surgery is more common in general and occurs often in the course of acute care surgery [5–8].'

1.1. Pathophysiology of liver disease

Inflammation, fibrosis, and eventually cirrhosis are all symptoms of chronic hepatocyte damage. Cirrhosis is caused by the gradual fibrotic replacement of hepatocytes, resulting in hepatic architecture distortion and increased resistance to portal venous flow. The most common disease pathway includes hepatocyte damage and necrosis, which leads to fibrosis of the liver parenchyma and loss of liver function. The liver is an important organ that helps with protein synthesis, drug and nutrient metabolism, detoxification, and portal venous blood filtering. Changes in these processes may occur as a result of any hepatic dysfunction [5,7].

Cirrhosis of the liver is caused by various mechanisms of liver damage that result in necrosis, inflammation, and fibrogenesis. It is characterized histologically by diffuse nodular regeneration surrounded by thick, fibrotic septa, followed by parenchymal extinction and collapse of liver structures, resulting in pronounced hepatic vascular architecture distortion. As a result of this distortion, portal blood flow resistance increases, resulting in portal hypertension and hepatic synthetic dysfunction. As a result of the portal hypertension and hepatic synthetic dysfunction, each organ system becomes dysfunctional [9].

These patients have improved cardiac production, systemic vasodilation with reduced systemic vascular resistance, diastolic dysfunction, and an inadequate reaction to surgical stress due to impaired liver functions [10].

1.2. Justification

The incidence of liver disease continues to increase across the world and it is associated with increased perioperative morbidity and mortality. Surgery is often needed in patients with concurrent liver disease and the number of surgical procedures performed including major operations is also increasing. Anesthesia and surgery may deteriorate liver function in a patient with liver disease. Preoperative identification, optimization and anesthetic management are essential for optimum outcomes in patients with liver disease undergoing surgery. So in our set up there is no local evidence-based protocol to manage these patients.

This evidence-based guideline/protocol focused on preoperative evaluation, preoperative optimization and risk stratification of patients undergoing non-hepatic surgical procedures. This document also showed that intraoperative anesthetic management and postoperative care of these patients.

2. Methods

The literatures are searched using medical search engines (data bases) like Google scholar, PubMed, Cochrane library and HINARI to get access for current and update evidence on perioperative optimization of patients with liver disease. The key words for literature search were (liver disease OR liver failure) AND (liver disease OR perioperative management) AND (non-hepatic surgery OR anesthesia).

After searching using these search engines then collected by filtering based on the level of significance to this guideline with proper appraisal and evaluation of study quality with different level of evidences and only English language. The strength of evidence and grade of recommendation was based on WHO 2011 level of evidence (Table 1). **This review was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement** [11] (Fig. 1).

3. Discussion

An evidence based guideline done in India recommends that decompensating symptoms such as jaundice, coagulopathy, ascites, renal dysfunction, electrolyte disturbances, and encephalopathy should be assessed in all patients with clinically suspected liver disease [12]**1a.**

Preoperative assessment and treatment of patients with chronic liver disease begin with a detailed preoperative history and physical examination and it is important to assess for the presence and severity of liver disease. Aside from recognizing the risk factors for liver disease (blood transfusions, tattoos, illegal drug usage, sexual promiscuity, family history of liver disease, alcoholism, travel history, and a review of prescription or over-the-counter medications), it's also necessary to evoke any prior history of decompensation, such as ascites, edema, or hepatic encephalopathy, variceal bleeding, or anesthesia related complications [3]**1a.**

A full blood count, coagulation profile, liver function tests, serum electrolytes, and creatinine should be included in a minimum range of blood tests. Cirrhotic patients often experience coagulopathy, electrolyte disruptions, and renal dysfunction, all of which have clear perioperative consequences [2]**1a.**

An evidence-based guideline done in Turkey showed that malnourished patients with liver disorders are known to have a greater risk of having negative clinical effects and incurring higher healthcare costs. Nutrition screening, which includes SGA and anthropometric measurements, is an effective first phase in detecting malnutrition early and initiates the entire nutrition care process. It is therefore important for appropriate nutrition policies and protocols to be implemented so that all patients with chronic liver diseases are monitored closely from a nutritional standpoint [13]**1a.**

Individualized dietary support and fluid therapy plans can be used for perioperative therapy in patients with liver diseases, taking into account the patient's needs, disease process features, liver function, and gastrointestinal tract tolerance [14]**2a.**

Scores such as the Child-Turcotte-Pugh (CTP) and the model for end-stage liver disease (MELD) can be used to determine the severity of liver disease. The MELD estimate, as opposed to CTP, which provide a more accurate assessment of peri-operative morbidity and mortality since it is based solely on objective data. However, it has been proposed that CTP and MELD scores work together to provide a more precise measure of liver dysfunction and decompensation [5]**1a.**

An evidence-based guideline done in France according to a risk assessment for non-hepatic surgery, converting a Child C patient to a

Table 1
Level of evidences and recommendations.

Level	Type of evidence	Recommendation
1a	Cochrane systemic reviews, Meta analyses, systematic reviews of RCTs, evidence-based guidelines	Strongly recommended/ directly applicable
1b	Randomized clinical trials/RCTs	Highly recommended/ directly applicable
2a	Systematic reviews of case control or cohort studies.	Extrapolated evidence from other studies
3a	Non-analytic studies, e.g., Case reports, case series	Extrapolated evidence from other studies

Source: Good clinical practice, GCP, WHO, 2011.

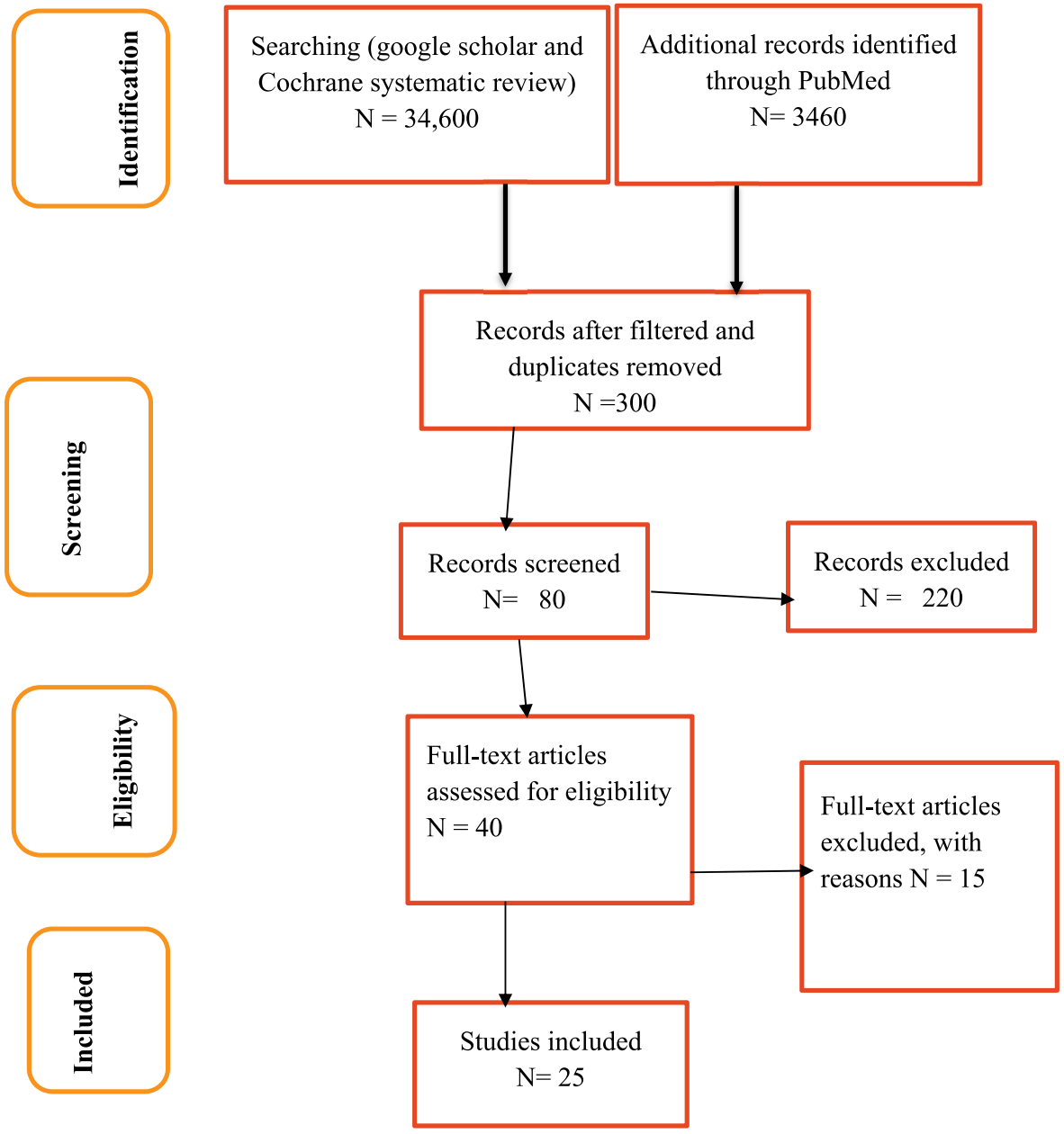

Fig. 1. PRISMA- 2020 flow diagram for selection of studies.

Child B patient prior to surgery can improve post-surgery survival so that coagulopathy and thrombocytopenia should be treated with vitamin K replacement, fresh-frozen plasma (FFP), and likely cryoprecipitate transfusions to get the prothrombin time down to within 3 s of normal and to achieve a goal of platelet counts >50 000/mm3 [15] **1a.**

Even in patients with CTP class B, emergency surgery has a 4 to 5 times higher mortality rate, and such operations, like cardiac surgeries with cardiopulmonary bypass, should be avoided.

If necessary, emergency operations should be delayed, and semi-elective surgery should be planned with meticulous medical management. Getting older, as well as the presence and severity of comorbidities may provide additional clue in assessing the perioperative morbidity and mortality [10]**2a.**

Anesthetic agents are chosen based on factors like protein binding, distribution, and drug metabolism. Propofol is favored over benzodiazepines for sedation procedures because it has a quicker onset of sedation and recovery time in cirrhotic patients. Because of its rapid redistribution, propofol is the preferred induction agent for general anesthesia due to its rapid redistribution; however, it can induce vasodilation, which can reduce liver perfusion [16]**1b.**

An evidence based guideline done in India recommends that anesthetics can reduce hepatic blood flow by 30–50%; therefore: isoflurane, desflurane, sevoflurane, and propofol are recommended for patients with liver disease because they cause less disruption in hepatic arterial blood flow than other inhaled anesthetics [12]**1a.**

An evidence-based guideline done in India recommends that Halothane, 20% of which is metabolized by the liver, is no longer widely used and should be avoided by people who have liver disease. Enflurane, on the other hand, is just 4% metabolized by the liver. Isoflurane, desflurane, and sevoflurane have very little hepatic metabolism (0.2%), making them the best anesthetic options for patients with liver disease, along with nitrous oxide [12]**1a.**

In general, propofol is favored as a narcotic over benzodiazepines. Sufentanil and remifentanil are the opioids of choice for liver insufficiency. Since the muscle relaxants vecuronium and rocuronium are only

metabolized by the liver, they should be avoided. In patients with liver disease, atracurium and cisatracurium are favored because they are not metabolized by the liver [12]**1a.**

A retrospective cohort study done in Korea recommended that in patients with preoperatively elevated liver transaminase levels who underwent non-hepatic surgeries, the improvement in ALT level was significantly lower after total intravenous anesthetics (TIV) than after inhalational (INHA); this indicates that in these patients, TIVA might be a better option than INHA. Despite this, the majority of patients in both groups had relatively stable livers following surgery, with lower AST and ALT levels than before. These results could support the use of both TIVA and INHA anesthesia in patients with elevated liver enzyme levels [8]**2a.**

When compared to halothane, newer agents including sevoflurane and desflurane undergo less hepatic metabolism and are thus safer in cirrhotic patients. The majority of available analgesics are metabolized in the liver and removed via the kidneys, which can be troublesome for patients with chronic liver disease (CLD). While most patients tolerate acetaminophen well, the dosage should be decreased in those with decompensated hepatitis [16]**1b.** Because of their adverse effects, such as gastrointestinal bleeding and renal damage, non-steroidal anti-inflammatory drugs are not recommended. Long-acting opioids like morphine should be avoided, but titrated doses of fentanyl or sufentanil are well tolerated in cirrhotic patients [16]**1b.** See sample literatures reviewed for perioperative management of patients with liver disease (Table 2).

3.1. Areas of controversies

Opiates should be avoided or used sparingly at low and infrequent doses because of the possibility of precipitating hepatic encephalopathy, according to an evidence-based recommendation published in London in 2010 on pain control for cirrhotic patients [17]**1a.**

On the contrary opioids are successfully used in patients with liver disorders, according to a 2014 evidence-based recommendation published in Iran, and Fentanyl is the opioid of choice for these patients. The oxygen content of the liver and liver blood flow is not impaired when the standard drug dosage is used [18]**1a.** A systematic review done in Iran 2016 on opioid drugs in patients with liver disease, Anesthetists face a constant challenge in managing pain in patients with liver disease due to drug side effects, especially opioids. Since opioids may induce sedation, constipation, and sudden encephalopathy, they should be used with caution. Because of these drugs' clearance is reduced in patients with hepatic insufficiency, the initial dose must be reduced, the intervals between doses should be increased, and certain patients must be monitored on a regular basis [19]**2a.**

Finally, in liver disease, decreased doses of opioids with increased intervals prevent drug accumulation. Long-acting opioids, such as morphine and mepiridine, should be avoided, but shorter-acting opioids, like fentanyl is well tolerated when used in lower doses and titrated to effect [2]**1a**.

Nephrotoxic drugs and non-steroidal anti-inflammatory drugs should be avoided, and caution should be practiced [3]**1a** while anesthesia for severe liver failure guideline in Toronto 2019 concluded that even though acetaminophen is generally well tolerated, it should be used with caution in patients with advanced cirrhosis, especially those who are malnourished. Because of the risk of gastrointestinal bleeding and kidney failure, nonsteroidal anti-inflammatories should be used with caution [2]**1a.**

Benzodiazepines should be avoided in general, according to an evidence-based recommendation published in the United States in 2017. When midazolam and propofol were compared in cirrhotic patients, propofol was consistently found to be safer due to its faster removal [3] **1a** on the other hand according to a systematic analysis published in the

Table 2
Summary of literatures reviewed for perioperative management of patients with liver disease.

Authors/year	Title	Design	Outcome	Recommendation
Spring et al., 2020.	*Anesthesia for the Patient with Severe Liver Failure, Anesthesiology Clinics*	Evidence based guideline	Acetaminophen is usually well tolerated, but caution should be used in patients with advanced cirrhosis	Strongly recommended
Muilenburg et al., 2009.	Surgery in the Patient with Liver Disease	Evidence based guideline	Careful attention should be paid to the assessment of intravascular volume	Strongly recommended
Bleszynski et al., 2018.	Acute care and emergency general surgery in patients with chronic liver disease:	Evidence based guideline	Chronic liver disease in the surgical patient directly affects perioperative care	Strongly recommended
Hickman et al., 2019.	Non-Hepatic Abdominal Surgery in Patients with Cirrhotic Liver Disease'	Evidence based guideline	patient with Child A or MELD <12 are generally safe for elective procedures	Strongly recommended
Newman et al., 2020.	Perioperative Evaluation and Management of Patients With Cirrhosis	Systematic review	(CTP class A or MELD <10) and few comorbidities generally tolerate surgery well.	Recommended
Abbas N et al., 2017.	Perioperative Care of Patients With Liver Cirrhosis	Evidence based guideline	Nephrotoxic and hepatotoxic medications need to be avoided.	Strongly recommended
Rai R et al., 2012.	Surgery in a Patient with Liver Disease	Evidence based guideline	pre-operative assessment, optimization, and appropriate peri-operative care can substantially reduce risks	Strongly recommended
Bhangui et al., 2012.	Assessment of risk for non-hepatic surgery in cirrhotic patients	Systematic review	Child score and MELD score are common methods	Recommended
Oh SK et al.,*2020.*	Comparison of the postoperative liver function between total intravenous anesthesia and inhalation anesthesia in patients with preoperatively elevated liver transaminase levels	A retrospective cohort study	TIVA may be safer for patients with preoperatively elevated liver transaminase levels.	Optional
Chandok and Watt, 2010.	Pain management in the cirrhotic patient	Evidence based guideline	Several factors have to be taken into consideration prior to starting any pain regimen in patients with cirrhosis.	Strongly recommended
Soleimanpour et al., 2015.	Intravenous hypnotic regimens in patients with liver disease	Systematic review	some hypnotic drugs used during anesthesia could be safely used in patients with impaired liver function	Recommended
Senzolo et al., 2009.	Should we give thromboprophylaxis to patients with liver cirrhosis and coagulopathy	Evidence based guideline	thromboprophylaxis should be recommended in patients with liver cirrhosis at least when exposed to high-risk conditions for thrombotic complications	Strongly recommended
Saner and Bezinover, 2019.	Assessmentand management of coagulopathy in critically-ill patients with liver failure	Evidence based guideline	Thrombosis prophylaxis has to be considered in susceptible populations.	Strongly recommended
Pandey, 2012.	Perioperative risk factors in patients with liver disease undergoing non-hepatic surgery	Evidence based guideline	The actions of neuromuscular blocking agents may be prolonged in patients with liver disease	Strongly recommended

United States in 2019 longer half-lives and higher levels of unbound (i.e. free) medication, cause increased sedative impact and duration of circulating benzodiazepines, which may precipitate encephalopathy. Shorter-acting agents like midazolam are preferred at lower doses and with close monitoring [6]**1a**.

According to a systematic study done in Italy patients with cirrhosis and liver disease cannot be considered auto-ant coagulated, since there is clear evidence of thrombotic events, including an appreciable frequency of DVT and PE comparable to other chronic diseases, despite irregular standard coagulation tests. As a result, thromboprophylaxis should be prescribed in patients with liver cirrhosis that are at high risk for thrombotic complications, at the very least. In this category of patients, LWMHs seem to be reasonably safe; however, if there are significant risk factors for bleeding, graduated compression stockings or intermittent pneumatic compression should be considered [20]**2a.**

On the other hand, an evidence-based guideline published in the United States in 2019 on the assessment and treatment of coagulopathy in critically ill patients with liver failure found that patients with liver failure are at high risk for both bleeding and clotting complications at any level of LT. Increased mortality and morbidity are linked to these complications. There is currently no approved procedure for thrombosis prevention [21]**1a**.

3.2. Preoperative evaluation and risk assessment

According to an evidence-based guideline on anesthesia for serious liver failure, preoperative assessment of patients with liver disease should include history, examination, and focused investigation and the history should show the cause and extent of liver failure, as well as any complications, medications used, and the existence of other medical comorbidities such as coronary artery disease and diabetes [2]**1a**. A comprehensive history with a focus on the risk factors for liver disease, such as personal history of blood transfusion, intravenous drug usage, tattoos, high-risk sexual activity, alcoholism, family history of liver disease, travel history, analysis of prescription and over-the-counter medication use, and symptoms suggestive of liver decompensation was recommended in another guideline on perioperative treatment of patients with liver disease [10]**1a.** Any past history of decompensation, such as ascites, edema, or hepatic encephalopathy, variceal bleeding, or anesthesia-related complications, should be elicited [3]**1a.**

Medical suspicion of liver disease should occur in any patient with palmar erythema, swollen parotid glands, spider naevi, edema feet, gynecomastia, and testicular atrophy in men or breast atrophy in women, according to a recommendation focused on surgery for a patient with liver disease [12]**1a.** Evidence of decompensated illness, such as hepatic encephalopathy and ascites, can be identified throughout an examination. Hepatic encephalopathy would most likely cause a delay in waking up from anesthesia, as well as an increased susceptibility to anesthetic medications including benzodiazepines and delirium [2]**1a.** Physical examination should be performed with focus on the clinical signs of chronic liver disease and features of portal hypertension [10]**1a.**

A full blood count, coagulation profile, liver function tests, serum electrolytes, and creatinine should be included in a minimum set of blood investigations for acute liver failure, according to a guideline. Baseline blood tests, ECG, CxR, ECHO, and cardiopulmonary exercise monitoring are also part of a physician-led preoperative evaluation [2, 16]**1a.**

Only patients with well-compensated chronic liver disease should seek elective surgery. For patients who need emergency surgery, immediate patient optimization is needed, which should include attention to intravascular volume status, coagulation function, neurological assessment, and infection screening [22]**1a.**

3.3. Risk stratification

The Child-Pugh (Table 3) classification and the model for end-stage liver disease (MELD) score are valuable methods for predicting perioperative morbidity and mortality in patients. Child A patients are acceptable candidates for elective procedures with special intraoperative care. Child B should undergo pre-operative optimization to convert to Child A, and Child C or with a MELD score greater than 20, are at a high risk for anesthesia, and should be postponed to elective surgeries.

Table 3
Child—Turcotte–Pugh (CTP) classification.

A. Classification			
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	1.7–2.3	>2.3
Ascites	None	Mild	Moderate to severe
Hepatic encephalopathy	None	Grade I or II	Grade III or IV

B. Interpretation		
Points	Class	Mortality
5–6	A	10%
7–10	B	30%
10–15	C	76–82%

3.4. Intraoperative anesthetic management

A systematic review on perioperative evaluation and management of patient with cirrhosis concluded that the overall intraoperative objectives are to preserve hepatic blood flow and oxygen supply while minimizing exposure to hepatotoxic drugs to prevent more liver harm(6) **1a.**

According to the Intravenous Hypnotic Regimens (IHR) in patients with liver disease guideline, opioids are successfully used in patients with liver diseases, and fentanyl is the medication of choice for these patients when used at an average dose, liver oxygen content and liver blood flow are not impaired [18]**1a.**

Analgesics are often metabolized in the liver and removed by the kidneys. To avoid drug accumulation in patients with liver disease, lower opioid doses with longer periods should be used. Long-acting opioids like morphine and mepiridine should be avoided, but shorter-acting opioids like live fentanyl are well tolerated when given in small doses and titrated to effect [2]**1a.** Avoid mepiridine in patients with liver disease because it reduces clearance and increases the risk of seizures. Morphine has been shown to have reduced clearance and improved oral bioavailability in patients with liver disease, and it should be avoided to prevent accumulation and increased risk of adverse reactions. If morphine is needed, the intervals between doses should be increased [23]**1a.**

For patients with liver failure, a few opioids are favored. At lower doses and longer dosing times, tramadol should be used with caution. Fentanyl is the safest drug because it does not have a toxic metabolite and it does not normally need dosage changes [23]**1a.**

Perioperative risk factors in patient with liver disease undergoing non-hepatic surgery guideline in India concluded that Inhalational agents isoflurane, desflurane and sevoflurane undergo hepatic metabolism, extent of which is 0.2% for isoflurane, 2%–4% for enflurane, and 20% for halothane presumably, this leads to a lesser incidence of drug-induced hepatitis. Therefore, isoflurane has become the inhalation agent of choice in patients with liver disease. Remembering that halothane can cause lethal hepatitis in patients who undergo general anesthesia, so; this drug should be avoided [24,25]**1a.**

Rocuronium and vecuronium, amino steroid neuromuscular agents, are metabolized in part by the liver, and their term of action can be extended in liver failure. Peripheral nerve stimulators should be used to titrate these drugs to impact. Atracurium and *cis*-atracurium, two benzylisoquinolinium neuromuscular agents, are unaffected by liver

disease. Succinylcholine is metabolized by plasma cholinesterase, a liver enzyme; despite the fact that succinylcholine has a long time of action, it is not clinically important [2]**1a.**

In cases of advanced liver cirrhosis, the dose of intravenous anesthetic agent thiopental should be decreased and propofol is the preferred intravenous anesthetic agent [10]**1a.**

Normal monitoring of arterial blood gases, lactate, glucose, electrolytes, and coagulation status is recommended for all patients (as recommended by the AAGBI), but intrusive monitoring of both arterial and central venous pressure are recommended for major surgery and regular monitoring of arterial blood gases, lactate, glucose, electrolytes, and coagulation status are also recommended for major surgery. It's also a good idea to keep track of patients core body temperature, neuromuscular block, and urine production [22]**1a.**

4. Postoperative anesthetic management

An evidence based guideline on surgery in patients with liver disease concluded that urine output must be monitored carefully as intraoperative fluid shift can lead to poor renal perfusion which if not detected early and treated aggressively can lead to acute renal failure. In these patients, it is important to monitor the CVP, pulse, BP, and oxygen saturation continuously [12]**1a.**

An evidence-based guideline on non-hepatic abdominal surgery in patients with cirrhotic liver disease suggested that many of the postoperative cirrhotic patient's treatment techniques are similar to those used before surgery: avoid liver-metabolized drugs, control intravascular volume, avoid metabolic disturbances, and use lactulose for hepatic encephalopathy (HE) and opioid-induced constipation. If the patient will remain null per os (NPO), parenteral feeding should be started as soon as possible [5]**1a.**

Opioid-induced constipation should be avoided with the use of laxatives, and these patients should be closely monitored for symptoms of sedation and encephalopathy. In patients who are intolerant to opiates due to advanced disease and a high risk of HE, regional analgesia in the form of local infiltration or transverse abdominis plane block is a choice. Only after coagulopathy has been corrected with INR 100 000/mm3, epidural analgesia can be considered [10]**1a.**

According to a Spanish guideline on the outcome of abdominal surgery in patients with cirrhosis, postoperative management should preferably be done in the ICU, at least for the first 24 h, particularly in CTP B and C. It's crucial to monitor for potential complications, which vary depending on the severity of the LC and the type of operation [26]**1a.**

Any drug that is nephrotoxic should be avoided. Starting oral feeding as soon as possible is recommended to help avoid SBP. Following surgery, the patient's liver, renal, and coagulation profiles, as well as blood sugar levels, should be closely monitored in order to diagnose early liver or renal failure. Any decline in liver or renal function could indicate sepsis, and broad-spectrum antibiotics should be given to these patients with a low threshold. Since the liver metabolizes the bulk of opioids, their dosage should be decreased [12]**1a.**

5. Conclusions and recommendations

Patients with liver disease presenting with non-hepatic surgery might have postoperative complications that can lead to death. There are predictors of outcome in these patient population like preoperative Child's class. So that efforts should be expended to favorably alter a patient's preoperative Child's class before undertaking an elective operation. In these patients anesthesia and surgery may deteriorate liver function; thus, choosing anesthetics with less hepatotoxicity could be helpful for good outcome (Figs. 2–4).

Limitations

This review did not address management strategies for emergency

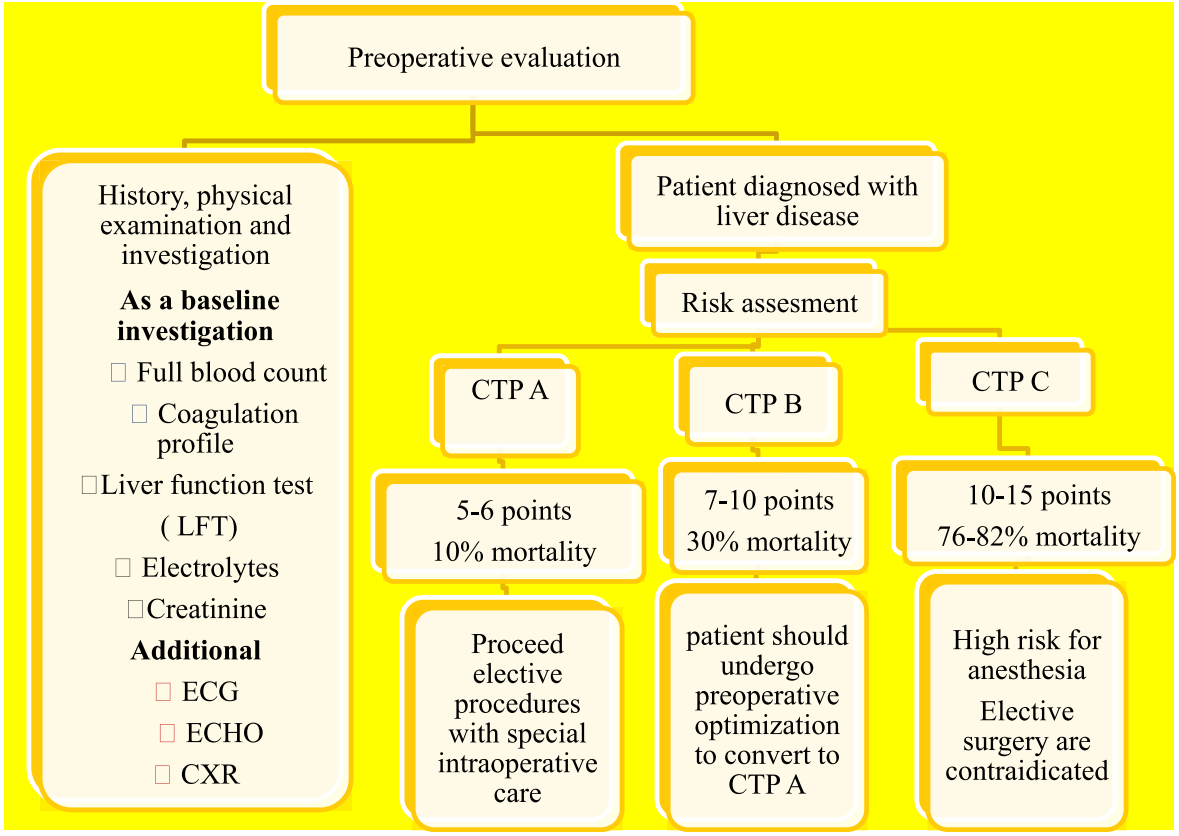

Fig. 2. Preoperative evaluation and preparation.

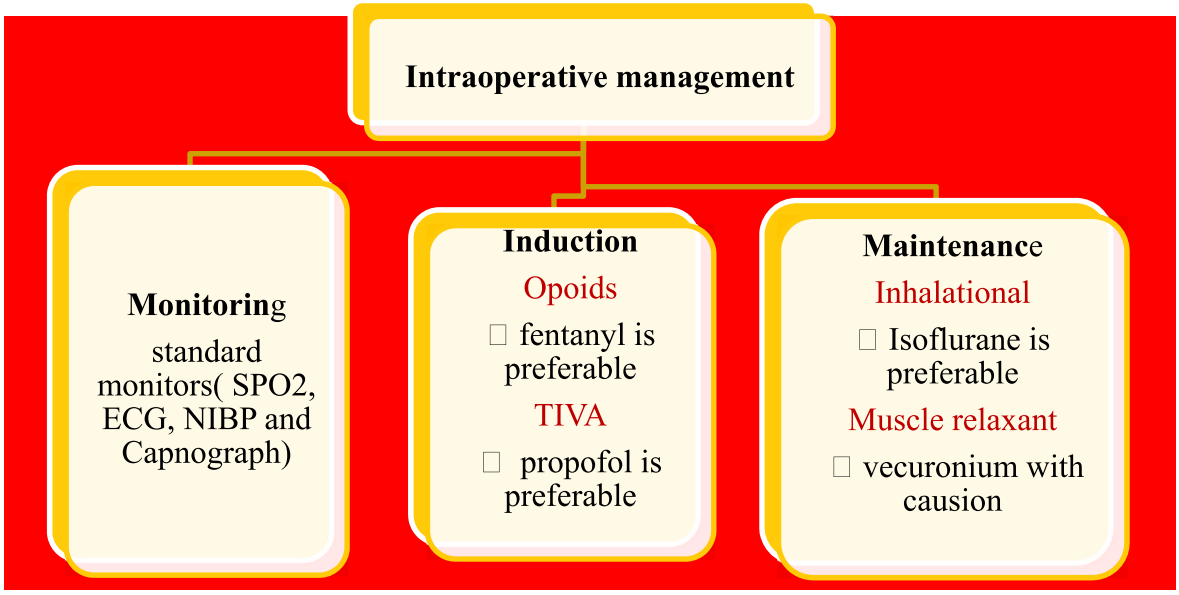

Fig. 3. Intraoperative anesthetic management.

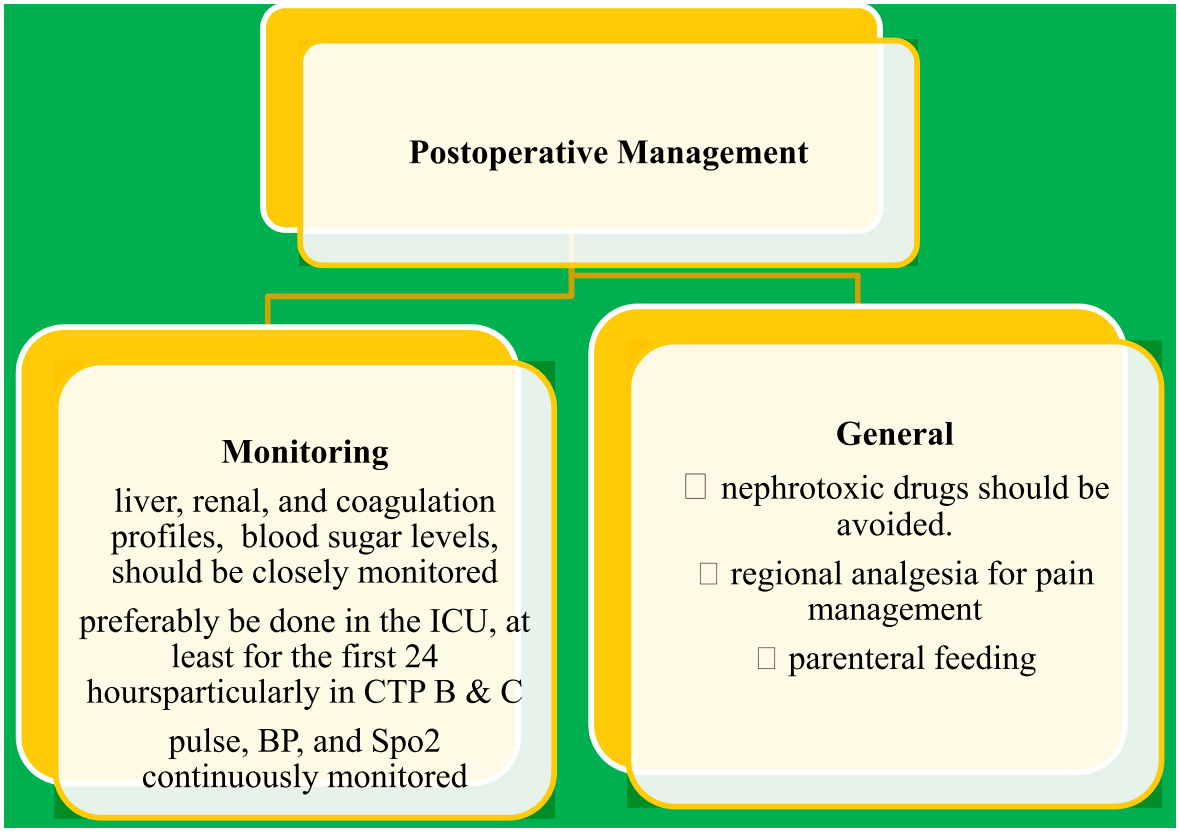

Fig. 4. Postoperative anesthetic management.

surgical patients with liver disease and hepatorenal syndrome. Researchers can further do systematic review and meta-analysis on these shortcomings.

Provenance and peer review

Not commissioned, externally peer reviewed.

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