Surgery in Liver Diseases: Perioperative Evaluation & Management

Ulfa Kholili, Denada Aisyah Syalini***

*Division of Gastroentero-hepatology, Department of Internal Medicine
University of Airlangga/ Dr. Soetomo Hospital, Surabaya
**Department of Internal Medicine, Faculty of Medicine
University of Airlangga Dr. Soetomo Hospital, Surabaya

Corresponding author:
Ulfa Kholili. Division of Gastroentero-hepatology, Department of Internal Medicine, Airlangga University/ Dr. Soetomo Hospital. Jl. Mayjend Prof Dr Moestopo 6-8 Surabaya Indonesia. Phone: +62-31-5501614; Facsimile: +62-31-5023865. E-mail: ulfakholili1975@gmail.com

ABSTRACT

Many patients with liver disease would have to undergo surgery. Surgery and anesthesia in patients with liver disease are associated with extremely high perioperative complications and mortality. Identification of the type of liver disease, stratification of risk factors, and management of preoperative, intraoperative, and postoperative complications are essential to reduce the morbidity and mortality. Surgical risk is increased in patients with liver cirrhosis. Child turchote pugh (CTP) and the model for end stage liver disease (MELD) are two scoring systems which are often used nowadays to stratify risk factors in patients with liver cirrhosis who will undergo surgery. Elective surgery is well tolerated in cirrhosis patients with CTP class A and permissible in patient with CTP class B with preoperative preparation, except for extensive liver resection surgery and cardiac surgery. Elective surgery is contraindicated in patients with CTP class C, acute viral hepatitis, alcoholic hepatitis, fulminant liver failure, and liver disease with severe extrahepatic complication such as hypoxemia, cardiomyopathy, and acute renal failure. Intensive monitoring in the postoperative period and early intervention of complications are also essential to reduce the morbidity and mortality.

Keywords: *surgery, liver disease, perioperative*

ABSTRAK

Pasien-pasien dengan penyakit hati banyak yang menjalani pembedahan. Tindakan pembedahan dan prosedur anestesi pada pasien-pasien penyakit hati berhubungan dengan tingginya komplikasi dan kematian perioperatif. Untuk itu, diperlukan identifikasi jenis penyakit hati, stratifikasi faktor risiko, dan penatalaksanaan komplikasi preoperatif, intraoperatif, dan postoperative untuk mengurangi morbiditas maupun mortalitas. Risiko pembedahan akan meningkat pada pasien sirosis hati. Child turchote pugh (CTP) dan model for end stage liver disease (MELD) merupakan sistem skoring yang saat ini digunakan untuk menilai faktor risiko pada pasien sirosis yang menjalani pembedahan. Operasi elektif dapat dilakukan pada pasien dengan CTP kelas A dapat dilakukan dengan persiapan optimal pada pasien dengan CTP kelas B kecuali pada operasi reseksi hati dan operasi jantung. Operasi elektif dikontraindikasikan pada pasien CTP kelas C, hepatitis virus akut, alkoholik hepatitis, gagal hati fulminan, dan penyakit hati dengan komplikasi ekstrahepatik berat seperti hipoksemia, kardiomiopati, dan gagal hati akut. Monitoring ketat pada kondisi postoperatif serta intervensi awal terhadap komplikasi sangat penting untuk menurunkan morbiditas dan mortalitas.

Kata kunci: *operasi, penyakit hati, perioperatif*

INTRODUCTION

Liver has an important role in homeostasis of many physiological systems in our body. Liver performs many processes such as food and drugs metabolism, plasma protein synthesis, coagulation factors synthesis, detoxification as well as excretion of many endogenous and exogenous substances. It also plays important role in immune reaction to injury, sepsis, and inflammation.[1] Liver disease comprises a large spectrum of hepatic dysfunction. It includes asymptomatic transaminitis, cirrhosis, and end-stage liver disease. Liver disease can contribute to an increased risk of perioperative morbidity and mortality.[2]

Many patients with liver disease would have to undergo surgery. It was estimated that 10% patients with liver disease will need surgery in the last two years of their life.[3] Less invasive surgical techniques have made surgery possible for patients with advanced liver diseases. Surgery and anesthesia in patients with liver disease are associated with extremely high perioperative complications and mortality.[1] Because of the loss of hepatic reserve capacity and other systemic derangements which are the result of liver dysfunction (such as hemodynamic impairments), patients with liver disease have impaired response to surgical stress. These individuals consequently have increased risk of bleeding, infection, impaired wound healing, postoperative hepatic decompensation, including hepatic coma or death. Therefore, the decision to perform surgery in these patients must be considered carefully. Increased perioperative risk also correlate with severity of liver diseases. The major causes of death are uncontrolled haemorrhage (from coagulopathy intraoperatively or variceal bleeding postoperatively), sepsis, and multiorgan failure.[4]

Identification of the type of liver disease, stratification of risk factors, and management of perioperative complications are important to reduce morbidity and mortality intraoperative and postoperative. Perioperative identification includes history taking and physical examination to detect risk factors and evidence of liver dysfunction. Risk factor stratification in patient with liver cirrhosis is calculated using child turchotte pugh (CTP) score and model for end stage liver disease (MELD) score. Intensive monitoring in the postoperative period and early intervention of complications are essential.[5] This review provides information about preoperative, intraoperative, and postoperative procedures in patient with liver disease.

EFFECT OF SURGERY & ANESTHESIA DRUGS ON THE LIVER

Alteration of Hepatic Blood Flow

Intraoperative hypotension is common in patient with liver disease. Factors which contribute to alter of the hepatic blood flow are: (1) The use of anesthesia which can reduce hepatic perfusion 30-5-% during induction procedure; (2) Hyperdinamic circulation and altered hepatic arterial buffer in cirrhotic liver; and (3) Other factors (bleeding, vasoactive drugs, continuous positive pressure ventilation, pneumoperitoneum).[1]

Isoflurane, desflurane, sevoflurane preferred in patients with liver disease because these drugs have minimal effect on liver blood flow compared to other inhalation anesthetic. Halothane and enflurane should be avoided because they can reduce blood flow and oxygen supply to the heart and halothane may also increase the risk of drug-induced hepatitis.[6]

Hipoxemia Effect

Use of anesthesia may increasethe risk of aspiration in patients with advanced liver disease that can lead to hypoxemia. Other risk factors are encephalopathy, ascites, and hepatic hydrothorax.[1]

EFFECT OF LIVER DECOMPENSATION ON ANESTHESIA DRUGS

Liver dysfunction will affect the metabolism of drugs used perioperatively through some mechanisms which are: (1) Alteration in metabolism by the cytochrome P450 enzyme; (2) Decreased concentration of plasma protein binding; and (3) Decreasedbiliary excretion. All of these three factors will lead to increaseddrug toxicity.[1]

Volatile Agents

Anesthetics inhalation metabolized by liver as much as 0.2% for isoflurane, 2-4 % for enflurane, and 20 % for halothane. Because of isoflurane metabolism in the liver is minimal, the drug has used as the first choice of inhalation anesthetics.[6] Halothane is not recommended because the liver metabolism is high. This is due to the immune sensitization by proteins that are the result of oxidative halothane metabolism by cytochrome P450 2E1 in people who are predisposed genetically.[7]

Intravenous Agents

Propofol has become the first choice of intravenous anesthetic drug in patients with liver disease because propofol has the shortest half life, even in patients with decompensated cirrhosis and in several study propofol increased hepatic blood flow.[7]

Non-depolarizing Muscle Relaxan

The increased volume of distribution of nondepolarizing muscle relaxant drugs in patients with liver disease, so that it was required a larger dose to achieve the effects of neuromuscular blockade. Atracurium and cisatracurium are the first line drugs in patients with liver disease because they are eliminated not through the kidneys and liver. For operation with long duration such as liver transplantation, doxacurium more recommended because their metabolism are through the kidneys.[8]

Sedative, Narcotics & Intravenous Induction

The use of sedatives and narcotics groups in patients with compensated liver disease are generally well tolerated but should be monitored carefully in patient with hepatic disfunction because these drugs may cause prolonged suppression of the central nervous system and precipitate hepatic encephalopathy. Levels of these drugs in the blood, which undergone first pass metabolism in the liver, will increased because of decreased blood flow to the liver in patients with liver dysfunction. Elimination of benzodiazepine class drugs which do not undergo glucoronidation such as midazolam, diazepam and chlordiazepoxide are prolonged in liver disease, so that their half life are extended. Lorazepam, oxazepam and temazepam, which undergone glucoronidation, do not affected by the presence of liver dysfunction. Overall, the use of narcotics and benzodiazepines should be avoided in patients with liver disfunction. When necessary, an opioid remifentanil is the first choice and oxazepam is recommended as a sedative because their metabolisms are not affected by hepatic dysfunction.[1] Many types of anesthetic management (general anesthesia, regional anesthesia, or monitored anesthesia care) did not affect mortality, which reported in one of the largest reported series (733 patients).[9]

PREOPERATIVE SCREENING

Perioperative patient screening should include careful history taking and physical examination to identify risk factors for liver disease. History taking includes: (1) Symptoms of chronic liver disease (pruritus, fatigue, bleeding, yellowish skin, oedema, mental alteration); (2) History of prior blood transfusion, jaundice or liver disease, and family history of liver disease; (3) History of metabolic diseases such as diabetes mellitus, hypertension, hyperlipidemia, obesity; (4) History of autoimmune disease such as systemic lupus erithematosus, autoimmune thyroid disease; and (5) Social history, which includesdrug abuse, sexual promiscuity, tattoo, excessive alcohol use, use of hepatotoxic medicine and herbal.[10]

Physical Examination

Cirrhosis may be suspected due to abnormal finding in physical examination. The picture on below describes physical signs in liver disease.[10]

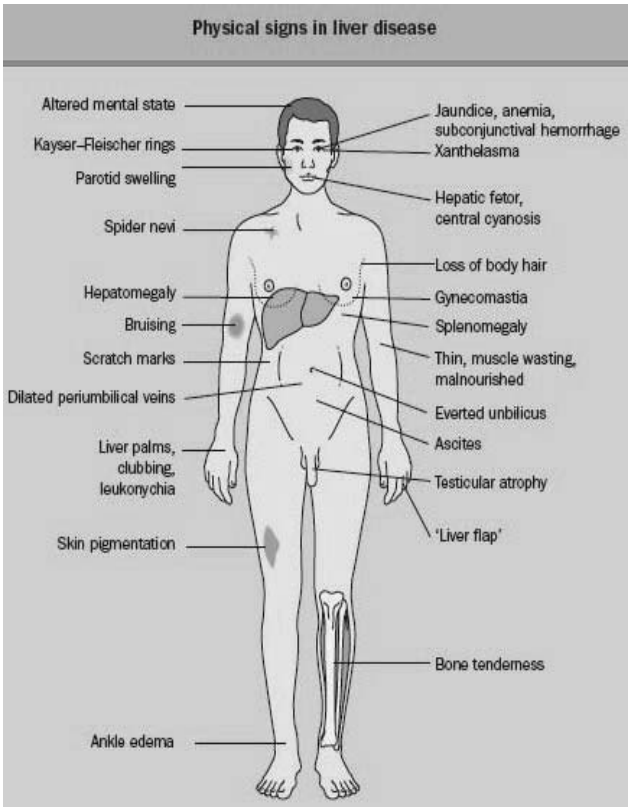

Figure 1. Physical signs in liver disease[10, 11]

Laboratory & Radiology Testing

Preoperative liver biochemical testing for screening in healthy and asymptomatic patient is debatable.[8] Some studies did not recommend biochemical testing because it was not cost effective and has low positive predictive value.[12] Other studies report an incidence of 6-34% undiagnosed cirrhosis in asymptomatic patients with abnormal liver function test results.[2] Though not performed as part of routine preoperative screening,

routine laboratory testing as a part of general medical examination for some patients with subclinical liver disease, may reveal abnormalities in liver biochemical test.[12]

Laboratory tests which should be evaluated if there is a clinical suspicion of liver disease are include: (1) Complete blood count; (2) Blood glucose; (3) Electrolyte and creatinin serum; (4) Coagulation factor; (5) Liver biochemical test (alanine transaminase, aspartate transaminase, albumin serum, bilirubin serum, alkali phosphatase) (elective surgery should be deferred if there is elevation in AST and ALT serum greater than three times the upper limit of normal value or with any elevation in total bilirubin concentration); (6) Serology of viral hepatitis, autoimmune hepatitis, and metabolic disease; (7) Examination of ascites, which is needed to exclude infection. Radiology tests include: (1) Abdominal ultrasonography; (2) Magnetic resonance cholangio-pancreatography (MRCP) or endoscopic-retrograde cholangio-pancreatography (ERCP) which may be considered when biliary obstruction is suspected.[2]

Liver biopsy is a gold standard to diagnose and determine severity of liver disease. Patients are at acceptable risk of surgery if they are noted to have mild-to-moderate histological damage (Stage 0, I, and II fibrosis based on Knodell histology activity index criteria) and patients with evidence of bridging fibrosis or cirrhosis (Stage III and IV fibrosis) may require a more cautious approach before surgery.[10] If the patient has comorbidities, further testing will be necessary.[12]

Nature of The Underlying Liver Disease

Acute Hepatitis

Patient with acute hepatitis who undergone surgery have an increased of operative risk with mortality rate 10-13%.[12] These increased risks are probably occur as a result of the acute hepatocellular injury and associated hepatic dysfunction. Acute hepatitis should be considered a contraindication to elective surgery and surgical intervention should be postponed until signs of active inflammation (patient's clinical, biochemical & histologic parameters) have subsided.[2] In live saving operation, patient with acute hepatitis should be monitored closely perioperative.[6]

Alcoholic Hepatitis

Alcoholic hepatitis is a contraindication to elective surgery and will increase the perioperative mortality rate greatly after urgent and emergency surgery with mortality rate up to 58%. Patients who consume alcohol in a long time will have increased tolerance to the majority of anesthetic drugs. Reexamination of liver function for elective surgery preparation should be performed after more than 12 weeks of alcohol abstinence. This was done in order to prevent alcohol withdrawal as well as an increase in the toxicity of acetaminophen and halothan.[8]

Acute Hepatic Failure

Patients with conditions of acute liver failure (defined as the development of jaundice, coagulopathy, and hepatic encephalopathy) are contraindicated to any type of surgery other than liver transplantation.[7]

Obstructive Jaundice

The mortality rate increased by 8-28 % in patients with obstructive jaundice who undergone surgery. Factors that increase mortality risk include early hematocrite < 30 %, total bilirubin > 11mg /dL, and malignancy. If this three risk factors occur, the mortality rate will increase to 60 % but if none of them occur, the mortality rate is < 5 %. Other risk factors are creatinine serum > 1.4 mg /dL, albumin serum < 3 g/dL, age > 65 years, transaminase serum > 90 IU/L and BUN > 19 mg/dL.[3]

Chronic Hepatitis

Surgical risk in patients with chronic hepatitis depends on the presence of liver inflammation and degree of liver disease. Chronic hepatitis patients with mild and moderate liver inflammation without signs of hepatic decompensation is not associated with an increase surgical risk. However, chronic hepatitis patients with severe liver inflammation (multilobular necrosis or bridging on liver biopsy) and accompanied by hepatic decompensation (impaired liver synthesis, excretion, portal hypertension) will have increased surgical risk.[7]

Liver Cirrhosis

Cirrhosis is a state of decreased systemic vascular resistance, and blood flow to the liver often reduced, especially in the presence of portal hypertension. Those who have cirrhosis should undergo further testing to identify the presence of clinically significant portal hypertension, because this increases risk for hypoxemic tissue injury. Indicators of significant portal

Table 1. Child-Turcotte-Pugh score16

Component	Score[a]		
	1 point	2 points	3 points
Total bilirubin concentration (μmol/L)[b]	< 34	34-50	> 50
Serum albumin concentration (g/L)	> 35	28-35	< 28
International normalized ratio	< 1.7	1.7-2.2	> 2.2
Ascites	None	Controlled with medication	Treatment-refractory
Encephalopathy	None	Grade I-II (or controlled with medication)	Grade III-IV (or treatment-refractory)

[a]Add up the points for each component, and use the total score to calculate the Child-Turcotte-Pugh class: Class A = 5-6 points, Class B = 7-9 points and Class C = 10-15 points. bFor patients with chronic cholestatic diseases, assign 1 point for a bilirubin concentration of up to 68 μmol/L, 2 points for a bilirubin concentration of 68-170 μmol/L, and 3 points for a bilirubin concentration > 170 μmol/L

hypertension include thrombocytopenia, splenomegaly, varices, ascites, and hepatic venous pressure gradient greater than 10. [13]

Severity of The Liver Disease Associate with Surgical Risk

Asymptomatic Patients

Asymptomatic patients with significantly abnormal liver function should have their elective surgery postponed and their liver disease investigated. Their perioperative risk should be reassessed after their liver dysfunction is characterized.[14]

Symptomatic Liver Disease

Elective surgery is contraindicated in patients with acute viral hepatitis, alcoholic hepatitis, fulminant liver failure, severe coagulopathy, and liver disease with severe extrahepatic complication such as hypoxemia, cardiomyopathy, and acute renal failure. When these contraindications are absent, patient with liver disease could undergone through preoperative evaluation, and treatment of the liver disease should be optimized before elective surgery.[8]

Surgical risk is increased in patients with liver cirrhosis. The magnitude of surgical risk is correlated with the degree of hepatic decompensation. Child turchote pugh (CTP) and the model for end stage liver disease (MELD) are two scoring systems which are often used nowadays to assess the severity of liver disease and the stratification of risk factors in patients with liver cirrhosis who will undergone surgery.[4,5] CTP consists of five parameters which three of them are objective (serum bilirubin, serum albumin, and prothrombin time) and the other two are subjective (the presence of ascites and encephalopathy). CTP score is range between 5-15, and classified into CTP class A with score of 5-6, score 7-9 for CTP class B and score 10-15 for CTP class C.[15]

Two multicenter retrospective study reported consistent results, in which mortality ratein cirrhotic patients who undergone surgery with CTP class A was 10 %, 30% in CTP class B % and 76-82 % in CTP class C. The general consensus is that elective surgery is well tolerated in patients cirrhosis with CTP class A, permissible with preoperative preparation in patient with CTP class B except those who undergoing extensive liver resection surgery and cardiac surgery. While the elective surgery in chirrotic patient with CTP class C is contraindicated, and nonoperative selection is recommended.[15]

CTP score has several limitations in terms of clinical parameters that are subjective as well as the determination of cut-off grades used in biochemical parameters. The last few years, MELD score (Model for End Stage Liver Disease) has used as a prognostic factor for operative mortality in patients with liver cirrhosis.[3] MELD score consist of three biochemical variables: creatinine serum, total bilirubin serum and INR (International Normalized Ratio).[2]

A retrospective study conducted by Teh, et al. in 772 patients with liver cirrhosis who undergone intraabdominal, orthopedic, and cardiovascular surgery

MELD = 3.78 x $\log_e$ serum bilirubin (mg/dL) + 11.20 x $\log_e$ INR + 9.57 x $\log_e$ serum creatinine (mg/dL) + 6.43 (constant for liver disease etiology)

Notes:

If the patient has been dialyzed twice within the last 7 days, then the value for serum creatinine used should be 4.0

Any value less than one is given a value of 1 (i.e. if bilirubin is 0.8, a value of 1.0 is used) to prevent the occurrence of scores below 0 (the natural logarithm of 1 is 0, and any value below 1 would yield a negative result)

Figure 2. Model for end stage liver disease (MELD) score[2]

proved that the MELD score is significant to predict 30-day, 90-day and long-term postoperative mortality rate. At 30 days postoperative, patients with MELD score less than or equal to 7 had a mortality rate of 5,7%, patients with MELD score 8-11 had mortality rate of 10.3%, and patients with MELD score 12-15

had mortality rate of 25.4%. Mortality rate increased linearly with the increase in MELD score.[17]Use of CTP score and MELD score are not mutually exclusive and can complement each other,however MELD score is probably the most precise single predictor for perioperative mortality risk.[8]

ESTIMATING THE RISK FACTOR

Risk factor stratification in patient with liver disease is influenced by: (1) Severity of liver disease; (2) Comorbid condition; and (3) Timing & type of surgery.[8] The greatest morbidity and mortality risks are found in emergency surgery, intra- abdominal surgery and cardiac surgery.[3]

Henje & Patel have proposed an algorithm for the preoperative assessment of patients with liver disease based on severity of liver disease.

Timing of Surgery

Emergency Surgery

The results of several studies concluded that patients with cirrhosis who undergone emergency surgery particularly abdominal surgery or surgery due to trauma have a higher mortality rate than patients with normal liver function and have correlation with increasing CTP score. The mortality rate in cirrhosis patient with CTP class A who underwent emergency surgery was 22 %, 38% in CTP B, and 100% in CTP C.[12]

Elective Surgery

Elective surgery is contraindicated in several clinical scenarios listed in table 2.

Table 2. Contraindication for Elective Procedures in Patients with Liver DIsease[8]

Contraindication for Elective Procedures in Patients with Liver Disease
Acute liver failure
Acute renal failure
Acute viral Hepatitis
Alcoholic Hepatitis
Cardiomyopathy
Hypoxemia
Severe coagulopathy (despite treatment)

Patient for whom there are no absolute contraindications should undergo individualized risk stratification based on the cause of their underlying liver disease, severity of liver disease, and type of surgical procedure.[13]

Type of Surgery Associated with Operative Risk

Intraabdominal Surgery

Intraabdominal surgery increases morbidity and mortality in patients with liver cirrhosis. Intraabdominal surgery causesgreater reduction in blood flow and the result is larger liver ischemia. Futhermore, intraabdominal surgery increases intraoperative bleeding complications due to portal hypertension, especially in patients with a history of previous intraabdominal surgery and the presence of coagulopathy. The mortality rate in patients with liver cirrhosis who undergone laparotomy varies between 20-54%, where emergency surgery has worsenthe prognosis and the mortality ratereached 50%. MELD score over 14 and serum hemoglobin levels < 10 mg/dL are the best predictors of increased mortality rate in intraabdominal surgery.[6]

Biliary tract surgery is often performed in patients with liver cirrhosis. MELD score $\leq$ 8 is the cut

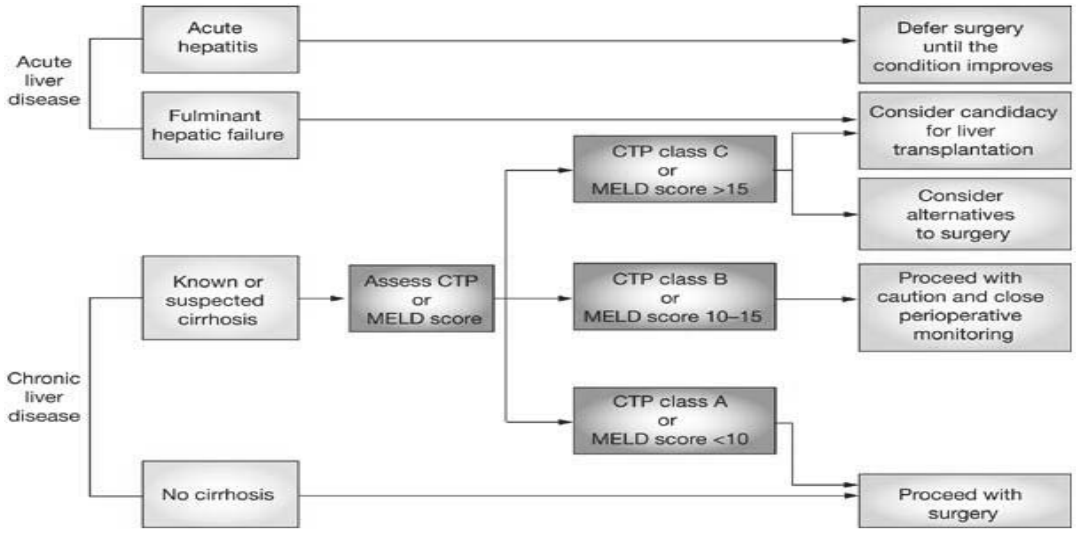

Figure 3: Algorithm for the preoperative assessment of patients with liver disease[2]

off to undergone laparoscopic cholecystectomy in patients with liver cirrhosis. In general, laparoscopic cholecystectomy can be performed in patients with CTP class A and in patients with CTP class B without portal hypertension. In patients with CTP class C, non-operative management are preferred. If non-operative management fails,then percutaneouscholecystostomyshould be considered.[6]

Cardiac Surgery

The risk factors of hepatic decompensation after cardiac surgery are total bypass time, the use of pulsatile flow bypass as opposed non-pulsatile bypass and perioperative vasopressor use. Cardiopulmonary bypass may aggravate the coagulopathy in liver disease by inducing thrombopathy, fibrinolysis, and hypocalcemia.[8]Patient with liver cirrhosis who undergone cardiopulmonary bypass surgery showed low mortality rate in CTP A (0 % and 3 %), which greatly increased in CTP B (42 % and 50 %) and CTP C (100 %). More than 75 % of patients with liver cirrhosis with CTP B and C suffered acute liver failure. CTP score > 7 and MELD score > 13 are predictors of increased mortality in patients with liver cirrhosis who undergone cardiac surgery.[7]

Hepatic Resection Surgery

Patients with liver cirrhosis who undergone liver resection procedure showed increased risks of death and hepatic decompensation compared to other types of surgery. Hepatic resection will reduce compensation of remaining functional hepatocytes. One study showed the incidence of acute liver failure post liver resection is 0% for MELD score < 9, 3.6 % for MELD score 9-10, and 37.5 % for MELD score> 10.[8]

PREOPERATIVE COMPLICATION MANAGEMENT

Special considerations should be directed to the treatment of complications of chronic liver disease such as malnutrition, coagulopathy, thrombocytopenia, ascites, renal dysfunction, hepatic encephalopathy, esophageal varices, and impaired lung function.[7]This table on below showed complication of liver disease and their effect in surgery.

Table 3. Reported surgery risk in patients with liver disease [6]

Liver disease	Type of surgery	Mortality	Prognostic factors
Cirrhosis	Non laparoscopic billiary surgery	20%	Ascites, Prothrombin time, albumin
	Peptic Ulcer Surgery		Prothrombin time, systolic blood pressure, hemoglobin
		54%	Urgent surgery
	Umbilical hernioraphy		Hepatic encephalopathy, ascites, albumin, hemoglobin
	Colectomy	13%	
		24%	
			CTP score, Urgent surgery
	Abdominal Surgery for trauma		
	Emergency abdominal surgery	47%	
	Laparoscopic cholecystectomy		
	Emergency cardiac surgery	57%	CTP score
	Elective cardiac surgery		CTP Score
	Knee replacement	0.9%, 6%	
	Transurethral resection of the prostate		
	Various types	80%	
	Laparoscopic cholecystectomy	3%-46%	
	Exploratory laparotomy	0%	
	Abdominal surgery	6.7%	
Chronic hepatitis		0%	Hemoglobin, billirubin, malignancy
Hepatitis C		0%	
Acute hepatitis		100%	
Obstructive jaundice		5-60%	

Table 4. Liver disease complication and effect in surgery[12,18,19]

Liver disease complication	Effect in surgery
Malnutrition	Reduced muscle mass cause immobility, respiratory muscle dysfunction leading to prolonged mechanical ventilation, severe malnutrition cause impaired wound healing, increased risk infection
Coagulopathy	Increased bleeding risk and need of blood transfusion
Ascites	Increase the risk of abdominal wound dehiscence, abdominal wall herniation, and respiratory compromise
Renal dysfunction	Increased risk morbidity and mortality
Portosystemic encephalopathy	Post-operative immobility, lack of cooperation with nursing procedures and aspiration pneumonia
Pulmonary disorder	Hipoxemia intraoperative

Table 5. Management consideration of complication in liver disease[12,18,19]

Liver Disease Complication	Management Consideration
Malnutrition	Maintenance of an adequate calory and protein intake (1-1.5 gr/kgbb per day especially BCAA
	Enteral nutrition is first choice
	Short term intravenous lipid is not recommended for liver chirrosis
	Vitamin B1 is recommended for alcoholic hepatitis
Coagulopathy	Vitamin K supplementation (10 mg/d, three days)
	Fresh frozen plasma transfusion
	Intravenous cryoprecipitate (If Fibrinogen level <100)& Von Willebrand factor (for uncontrolled bleeding)
	Intravenous recombinant VIIa (for uncontrolled bleeding)
	Platelet transfusion (for maintenance trombocyte > 50.000/mm^3 based on type of surgery)
Ascites	Paracentesis with analysis of ascitic fluid (consider SBP)
	Dietary sodium restriction (< 2 g daily)
	Oraldiuretic therapy with spironolacton and/or furosemide (monitor electrolyte & renal function)
	Fluid restriction (if sodium serum < 120 mmol/L)
	Avoidance of excessive saline administration
	Consider TIPS in uncontrolled ascites & in rupture umbilical hernia
Renal dysfunction	Avoidance of NSAID, aminoglycoside, and intravenous contrast
	Avoidance of nephrotoxic insult
	Albumin infusion (with paracentesis volume > 5 L)
	In HRS consider combination terlipressin with albumin/midodrine with ocreotide
	Consider TIPS if other treatment failure
Portosystemic encephalopathy	Correction of reversible metabolic factors
	Avoidance of sedative and opioid narcotics, as far as possible
	Oral lactulosa, titrated to 3-4 bowel movement per day
	Administration of non-absorpable antibiotics (neomicyne, rifaximin)
	Decrease protein intake (1-1,5 gr/kgbb per day)
Pulmonary disorder	Supportive care, Oxygen supplementation
	Intravenous epoprostenol, sildenafil and bonsentan for HPS

BCAA: branched-chain amino acid; SBP: Spontaneous bacterial peritonitis; TIPS: transjugular intrahepatic portosystemic shunt; NSAID: Non-steroidal anti-inflammatory drugs; HPS: hepatopulmonary syndrome

Complications in patient with liver disease could increase the surgical morbidity and mortality risks. Management for these complications is very important to reduce surgical risk. This table on below showed management considerations for liver disease complications.

DISEASE SPECIFIC CONSIDERATION

Non-alcoholic Fatty Liver Disease

Nonalcoholic fatty liver disease (NAFLD) encompasses a spectrum from bland steatosis, to nonalcoholic steatohepatitis (NASH), to cirrhosis. Patients with NAFLD but without cirrhosis do not seem to have increased mortality following elective surgery. Even though patients with NAFLD do not have an increased risk of perioperative mortality from their liver disease, this population is at higher risk for diabetes, hypertension, hypertriglyceridemia and coronary heart disease. As a result, preoperative cardiac risk stratification is essential.[8]

Wilson's Disease

Patients using p-penicillamine should have the dose reduced before elective surgeries because it can interfere with wound healing.[13]

Autoimmune Liver Disease

Steroids are commonly used in patients with autoimmune conditions. Patients receiving steroids may require stress-dose steroids surrounding the perioperative period to prevent complications of hypotension.[13]

POSTOPERATIVE MONITORING

Postoperative monitoring in cirrhotic patients: (1) signs of liver failure such as encephalopathy, coagulation, ascites, jaundice, hypoglycemia(If these sign occur, the supportive treatment should be initiated and considered treatment in ICU. If encephalopathy occur then the factors which precipitate include gastrointestinal bleeding, anesthetic drugs, infection are considered); (2) renal function (BUN , Creatinin serum) and electrolytes; (3) liver synthetic function (PT, INR, albumin, glucose); (4) fluid loss through the third compartement, especially after intraabdominal surgery because this condition can precipitate Acute Kidney Injury; (5) use of furosemide, which should be cautiously considered because it can lead to intravascular hypovolemic; (6) limitation of intravascular fluid based on the patient's volume status, which is highly recommended to prevent exacerbation of ascites or edema; (7) prevention of hypercarbia, whichrequired to prevent splanchnic vasodilation; and (8) the choice of analgesic drugs, which should be short acting analgetics such as fentanyl, while the use of acetaminophen is restricted < 2g/day.[20]

CONCLUSION

Many patients with liver disease would have to undergo surgery. Effect of surgery and anesthesia in these

patients associated with high perioperative complications and mortality. Risk factor stratification in patient with liver disease is influenced by: (1) Severity of liver disease; (2) Comorbid condition; and (3) Timing & type of surgery. The greatest morbidity and mortality risks are found in emergency surgery, intra-abdominal surgery and cardiac surgery. CTP and MELD are two scoring systems which are often used to stratify risk factors in patients with liver cirrhosis who will undergo surgery.

General guides to reduce morbidity and mortality included: identification of liver disease type, stratification of risk factors for timing and type of surgery, well management of preoperative, intraoperative, and postoperative complications. Preoperative complication managements including malnutrition, coagulopathy, ascites, renal dysfunction, portosystemic encephalopathy and pulmonary disorders and any conditions at disease specific consideration related to liver diseases. Intraoperative complication management related with anesthesia drugs choice and their effects to the liver. Postoperative monitoring including : signs of liver failure, renal function, liver synthetic function, fluid loss, use of furosemide, limitation intravascular fluid, prevention hypercarbia and the choice of analgesic drugs.

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