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Review

ANTERIOR ABDOMINAL WALL HERNIAS AND THEIR SURGICAL TREATMENT IN CIRRHOTIC PATIENTS – LITERATURE REVIEW

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ABSTRACT

The population of patients with chronic liver disease and liver cirrhosis shows increased perioperative morbidity and mortality rates compared to the general population. The severely compromised liver function in combination with the surgical treatment and the specific pathophysiological features of cirrhotic patients contribute to these results.

Anterior abdominal wall hernias are a surgical treatment challenge in that population due to their increased incidence, recurrency rates and risk of complications requiring emergency surgery. The presence of ascites determines their occurrence, being a prerequisite for the development of multiple complications in the perioperative period, some of which are potentially life-threatening. All this requires a thorough analysis of the pathophysiological abnormalities in patients with liver cirrhosis, as well as optimization of their condition before performing surgical intervention in order to reduce morbidity and mortality rates in this population.

Key words: abdominal wall, hernia, liver cirrhosis, surgical outcomes

Chronic liver disease has a negative effect on surgical outcomes. Postoperative mortality in cirrhotic patients is 16.6-50.4% for non-hepatic abdominal surgery procedures in terms of elective or emergency surgery. Postoperative complications range in severity from wound infections and prolonged hospital stay to the need for liver transplantation or patient's death within one month after surgery. In many studies, the 30-day mortality exceeds 15%, with 40% of surgical interventions performed as emergency surgery procedures (1, 2). According to other studies, mortality rates in cirrhotic patients undergoing surgery range from 8.3% to 25% compared with 1.1% in noncirrhotic patients. Mortality is determined by the severity of liver disease and the type of surgery, which requires precise risk stratification for surgical treatment (3).

In cirrhotic patients there are symptomatic hernias of the anterior abdominal wall in relation to the presence of ascites and general organomegaly. Ascites control plays a crucial role for successful hernioplasty in cirrhotic patients (4). Ascites is a pathological accumulation of fluid in the peritoneal cavity, developing in 5-10% of patients with compensated liver cirrhosis. The formation of ascites is due to the activation of the mechanisms for water and salt retention - the renin - angiotensin - aldosterone system (RAAS) and the sympathetic nervous system. This leads to the development of a positive water balance in the body and transudation of fluids into the extracellular space. The presence of ascites leads to an increased risk of developing potentially life-threatening complications such as spontaneous bacterial peritonitis, restrictive respiratory failure, hernias of the anterior abdominal wall. Ascites is a poor prognostic factor for the 5-year survival of patients which ranges from 80% in compensated cirrhosis to 30% in patients with decompensated cirrhosis and ascites. In 80% of patients, the presence of ascites is due to liver disease, and in the remaining cases, the causes may be the presence of solid neoplasm, heart failure, tuberculosis. The severity of ascites is graded from 1-3 depending on the amount of free fluid in the abdominal cavity **(Table 1).**

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Table 1. *Ascites classification*

Grade 1 /mild/	Clinically undetectable, detected on ultrasound
Grade 2 /moderate/	Visible abdominal wall distension
Grade 3 /severe/	Significant abdominal wall tension
Uncomplicated	Uninfected, without hepatorenal syndrome
Refractory	Cannot be evacuated, rapid recruitment after paracentesis, unsatisfactory prevention with diuretic therapy
Diuretic resistant	Does not respond to intensive diuretic therapy
Unresponsive to diuretics	Significant side effects of diuretic therapy

A common complication of ascites in patients with cirrhosis is the development of recurrent ascites, which accumulates at least three times a year despite conservative treatment measures such as diuretics and a low-salt diet. A potentially life-threatening complication is the development of spontaneous bacterial peritonitis (SBP) which, in case of clinical suspicion, requires diagnostic paracentesis to be performed to determine the neutrophil count (>250 cells indicate spontaneous bacterial peritonitis), total protein level (values <1.5g/dL are a risk factor for the development of spontaneous bacterial peritonitis), albumin level and microbiological examination of the ascitic fluid (5–7).

The serum/ascites albumin gradient (SAAG) identifies with 97% accuracy the presence of portal hypertension, and if the gradient value is >1.1g/dL (>11g/L) the patient is considered to have portal hypertension due to cirrhosis, alcoholic hepatitis, congestive heart failure, massive liver metastases, constrictive pericarditis, Budd-Chiari syndrome. At gradient values <1.1g/dL (<11g/L) the patient does not have portal hypertension and the ascites is due to peritoneal carcinomatosis, peritoneal tuberculosis, pancreatitis, serositis, nephrotic syndrome. The most commonly used methods to relieve the symptoms of ascites and reduce the risk for developing complications related to its presence are divided into conservative and invasive measures. Conservative measures include a low-salt diet and diuretic therapy with loop and potassium-sparing diuretics. Invasive decompression methods are included in the therapeutic approach in case of unsatisfactory or absent effect of conservative methods and include high-volume paracentesis and peritoneovenous shunting procedures. Diuretic therapy of ascites can be guided by SAAG, which is a determinant of the diuretic response - with SAAG> 1.1g / dL (benign ascites in cirrhosis, liver metastases, etc.) a good diuretic response is observed, unlike patients with values < 1.1g / dL (peritoneal carcinomatosis, malignant ascites), in whom there is no response to diuretic therapy. Paracentesis relieves symptoms of ascites in 90% of patients, with no consensus on the duration of fluid drainage (varies between 30-90 min and 19-24 h). The amount of evacuated ascitic fluid could reach up to 5 l without significant risk of affecting plasma volume and renal function of the cirrhotic patient. Endoscopic ultrasound-guided paracentesis can be performed to specifically search for malignant ascites and tumour formations of the upper gastrointestinal tract, pancreas and biliary tree. Possible complications of paracentesis include secondary peritonitis, pulmonary thromboembolism, severe post-procedural hypotension. Peritoneovenous shunts drain ascitic fluid to the superior caval vein. There are two types of shunting procedures - Le Veen shunt and Denver shunt, which drain the fluid through a one-way valve that opens at a pressure of 3 cmH2O in the Le Veen shunting procedure and at 1 cmH2O in Denver shunting procedure. In this way, more effective treatment of refractory malignant ascites is provided, compared to conventional paracentesis. Contraindications include hemorrhagic ascites, high protein content >4.5g/dL, portal hypertension, coagulopathy, advanced heart or kidney failure (8).

According to the Northup et al., a single high-volume paracentesis does not lead to good postoperative control of ascites and requires preoperative diuretic therapy. In well-selected patients, preventive placement of a transjugular intrahepatic portosystemic shunt (TIPS) is recommended before surgical treatment to reduce the portal pressure and the ascetic fluid accumulation. Abdominal drain placement is recommended to relieve pressure on the performed hernioplasty. Urgent surgical treatment of incarcerated hernia has higher morbidity and mortality rates unlike those in elective surgical treatment which is recommended to avoid further complications. The recommendations for conservative control

of ascites associated with liver cirrhosis include preoperative high-volume paracentesis with intravenous infusion of 6-8 g of albumin for each liter of ascites drained as well as antibiotic prophylaxis with third-generation cephalosporins /1 g/day/ in patients with a history of spontaneous bacterial peritonitis or low total protein concentration in the ascites. Limitation of intravenous infusions and transfusion of biological products is recommended in order to avoid an increase in extracellular volume, ascites, and portal pressure (4).

According to Bhangui et al., the increased incidence of anterior abdominal wall hernias in patients with liver cirrhosis is due to the significant abdominal wall distension from ascites in combination with loss of muscle mass from malnutrition, which is a common feature in cirrhotic patients. The authors indicate a 16% incidence of herniation in cirrhotics, increasing to 24% in the presence of concomitant ascites. There is a 4-fold higher incidence of umbilical hernias in ascites. According to the French Surgical Association, in patients with cirrhosis, a 5% mortality rate is observed in umbilical hernioplasty - 11% in emergency and 2% in elective surgery procedures. In patients classified as Child – Pugh – Turcotte (CPT) class A and B, 8% recurrence and 5.7% mortality rates are found in inguinal hernias (9).

Multiple retrospective studies recommend a wait-and-see approach in cirrhotic patients with existing anterior abdominal wall hernias, due to significantly increased morbidity and mortality rates, compared to those in non-cirrhotics. Surgical treatment is recommended only as an emergency procedure in case of life-threatening complications. However, the risk of conservative treatment of a complicated hernia is many times greater than that of surgical treatment, which necessitates a revision of the surgical approach in this group of patients. The indications for surgical treatment remain controversial.

Optimizing the condition of patients with liver cirrhosis minimizes the risk of developing postoperative complications and reduces the risk of hernia recurrence, which allows elective surgical interventions performance, which should be undertaken after assessing the liver function and general condition of the particular patient indicated for surgical treatment. In a study by Salamone et al., the authors analyzed the characteristics of cirrhotic patients undergoing hernioplasty and studied the risk factors for postoperative morbidity and mortality. The study included 117 patients with liver cirrhosis who underwent hernioplasty for a period of six years, 35% of whom underwent emergency surgery procedures. The mean preoperative Model of end-stage liver disease (MELD) score was 13, and 27 patients died within 30 days of surgery, 22 of whom underwent emergency surgery. Significantly more postoperative complications were reported in those who underwent emergency surgery, graded 3-5 according to the Clavien-Dindo classification of postoperative complications. The mortality rates in elective surgeries were 6.6% compared to emergency surgeries, which were 53.6%, which was explained by MELD score >20 points in both groups (20% in elective surgeries, 41% in emergency surgeries), high frequency of CPT C class (16% elective, 62% emergency surgeries) and American society of anesthesiologists score (ASA) >3 (90% elective, 100% emergency surgeries). When determining the indications for hernioplasty in patients with cirrhosis, it is necessary to classify the severity of liver damage according to CPT and MELD. Poor postoperative results are observed in patients with MELD 8-14 points and the worst are in MELD >20 points. Early elective hernioplasty is recommended in patients with controlled liver cirrhosis, good control of ascites to reduce the risk of postoperative complications and hernia recurrence, with refractory ascites being considered a direct cause of complicated hernia (10).

The conservative approach to umbilical hernias in cirrhotic patients leads to a higher mortality rate than that reported in elective surgery procedures. Emergency surgery is associated with a higher incidence of postoperative complications compared to elective surgery. Poor postoperative outcomes are associated with a higher CPT score, the presence of ascites, and emergency surgery for symptomatic hernia. Uncontrolled ascites and hernioplasty without mesh placement are important factors for hernia recurrence. In relation to inguinal hernias, no differences are observed between cirrhotic and non-cirrhotic patients in the development of postoperative complications and recurrence. The rate of postoperative complications is 6.3-10.9%, and the mortality rate is 0-0.8%, regardless of the CPT score and the presence of

ascites, so elective surgery is recommended for inguinal hernias in cirrhotic patients (11, 12).

Zielsdorf et al. conducted a retrospective analysis covering 17,812 patients who underwent surgery during a period of four years, of whom 7,402 were operated on for inguinal hernia, 5,014 for umbilical hernia, and 5,396 underwent colon resection. The aim of the study was to analyze MELD as a predictor of postoperative complications after inguinal hernioplasty, umbilical hernioplasty and colon resection, selected as representative general surgical interventions performed on patients with cirrhosis. Their MELD score was calculated preoperatively, and the endpoint of the study was to determine the frequency of development of the following complications - surgical wound infection, dehiscence, urinary infection, pneumonia, sepsis, reintubation, deep vein thrombosis, pulmonary embolism, renal failure, cerebral stroke, cardiac arrest, bleeding, hemotransfusion, reoperation. The mean age of the patients was 59.7 years, the mean BMI was 28.3, and in all three surgical groups there were 4% with a history of alcohol abuse. Ascites was documented in 1.8% of inguinal hernias, 1.5% of colonic resections, and 6.6% of umbilical hernias. 5.6% of patients had a history of chronic obstructive pulmonary disease, <1% had a history of chronic heart failure and previous myocardial infarction, approximately 7% had a history of cardiac surgery or coronary intervention, 2.4% had a history of stroke, and no patient in the study was on chronic dialysis. In the inguinal hernioplasty group, the mean MELD was 8.6 points, with a postoperative complication rate of 3.4%. For each point increase above the calculated mean MELD, there was a 7.8% increase in the development of postoperative complications. The presence of one or more comorbidities increased the risk of developing postoperative complications by 56%. The 30-day mortality rate was 0.2%. In the umbilical hernia group, the calculated mean MELD was 8.5 points with a postoperative complication rate of 6.4%. For each point increase above the calculated mean MELD, there was a 13.8% increase in the development of postoperative complications. The presence of one or more comorbidities more than doubled the risk of developing postoperative complications. The 30-day mortality rate was 0.5% (1).

Patients with cirrhosis and signs of portal hypertension are more likely to have comorbidities and a higher ASA class compared to the general population. Cirrhotic patients are more likely to have laboratory abnormalities – hyponatremia, hypoalbuminemia, thrombocytopenia, nitrogen retention, hyperbilirubinemia, coagulation disorders. They require more frequent emergency surgical treatment of umbilical hernias – 37.7% in cirrhotic patients and 4.9% in healthy people. Morbidity in both groups is 13.1% in cirrhotic patients and 3.9% in healthy people and mortality is 5.1% in cirrhotic patients and 0.1% in healthy people, with emergency surgical interventions increasing morbidity and mortality in cirrhotic patients to 20.8% and 7.4%, respectively, and in healthy people to 8.3% morbidity and 3.7%. Predictors of postoperative mortality in patients with cirrhosis and signs of portal hypertension are MELD >15, age >65 years, albumin <30 g/L and the presence of preoperative sepsis. In patients with MELD <15, elective surgery procedures can be performed with a mortality rate of 1.3%, in contrast to MELD >15 and a mortality rate of 11.1%. Careful assessment of the benefit-risk ratio in high-risk patients and assessment by the MELD scoring system, age, albumin levels and signs of portal hypertension is necessary, in order to achieve good postoperative results and avoid the risk of postoperative complications and hernia recurrence (13, 14).

Andraus et al. analyzed the characteristics of unselected patients with liver cirrhosis undergoing hernioplasty in their retrospective study and found that emergency surgery significantly increases morbidity and mortality rates in this population and that surgery delay increases the risk of life-threatening complications occurrence which requires emergency surgery. Elective hernioplasty has good postoperative outcome and is associated with low mortality rates, which turns it into the recommended approach in those patients. Emergency surgery is an independent risk factor for increased morbidity and mortality compared to the MELD score, CPT class and uncontrolled ascites, and preoperative treatment of ascites and renal failure is necessary for achieving good postoperative results (15).

In a study by Hickman et al., 20% of cirrhotics with ascites had umbilical hernias and the conservative treatment was successful in only 23% of them. Elective hernioplasty shows better postoperative results and is safer than emergency surgery procedures. The risk of

hernia recurrence is 8 times higher in the presence of ascites, in hernioplasty without a mesh being 14% versus 2.7% when using a mesh, which does not increase the risk of developing postoperative infection. Postoperative mortality in cirrhotics is associated with age >65 years, MELD >15 points, albumin <30 g/L, sepsis presence upon admission. Postoperative morbidity and mortality in open and laparoscopic hernioplasty in cirrhotics do not differ significantly (16).

Bleszynski et al. report that 20% of cirrhotic patients develop an umbilical hernia, requiring surgical treatment. Authors recommend elective hernioplasty with preperitoneal mesh placement as the safest method with the least postoperative complications, such as surgical site infection and ascites leakage. Intraoperative surgical considerations should include choosing an appropriate surgical access to avoid bleeding from dilated blood vessels of the anterior abdominal wall, as well as control of ascites to avoid wound complications and ascitic fluid bacterial contamination. The abdominal cavity drainage in cirrhotic patients is controversial, since prophylactic drainage of the abdominal cavity increases the risk of infection of ascites and the development of spontaneous bacterial peritonitis (SBP), and non-drainage increases the risk of leakage of ascites fluid from the surgical site and the development of wound complications and delayed healing. Prevention of the accumulation of a large volume of ascites in the postoperative period is necessary due to the risk of development of dehiscence and hernia recurrence. Ascites also predisposes formation of pulmonary atelectasis and aspiration pneumonia. High volume paracentesis and abrupt decompression lead to a higher risk of developing acute respiratory distress syndrome, electrolyte imbalance and hypovolemia. Its treatment should be carried out by salt restriction, diuretic therapy, and in extreme cases, paracentesis in refractory ascites (17).

Sabbagh et al. report anterior abdominal wall hernias occurrence in 16% of cirrhotics which reaches 24% in the presence of ascites, with umbilical hernias being 4 times more common in the presence of ascites. This requires optimization of therapy for ascites before surgical treatment of anterior abdominal wall hernias, as it is indicated as an elective hernioplasty only in patients with CPT A class. Ascites is the main risk factor for postoperative complications development such as acute renal failure, surgical site infections, liver failure, hernia recurrence in cirrhotic patients. The authors suggest performing TIPS preoperatively in patients with refractory ascites. When performing surgical treatment, closure of the peritoneum with a non-interrupted suture and synthetic mesh placement is recommended, which reduce the risks of hernia recurrence and decreases the surgical site infection risk. Postoperative mortality in patients with emergency surgery procedures reaches 11% (18).

A study by Hassan et al. included 70 patients with umbilical hernia, liver cirrhosis and ascites based on hepatitis C viral infection. Patients were staged according to CPT classification, MELD scoring system and ASA score. The aim of the study was to evaluate the effectiveness and safety of elective hernioplasty with retrorectal and preperitoneal mesh placement in selected and uncomplicated patients with cirrhosis and ascites. The patients were 32 women and 38 men with a mean age of 51.24 years /37-63 years/, mean MELD score of 18 points /12-25/, 46 of which/65.7%/ were graded as CPT B class and 24 /34.3%/ of which were graded CPT C class. The mean defect size of the hernia was 3.05 cm /1.5-6 cm/. Mean operative time 67.45 min /52-83 min/, mean hospital stay 3.8 days /2-9 days/. 2 patients /2.9%/ developed surgical site infection, treated by wound dressings and local agents application, 3 patients /4.3%/ developed seroma of the surgical site, treated by fluid collection aspiration and 1 patient /1.4%/ developed ascites fistula, treated by local application of tissue glue and wound dressings. Postoperative follow-up shows 1.4% hernia recurrence, 10% developed postoperative complications related to hernioplasty, all of whom had a mean MELD score above 25 points and CPT C class. The authors consider patients general condition optimization necessary to avoid postoperative complications and hernia recurrence. Salt intake should be restricted preoperatively in combination of Spironolactone and Furosemide administration, albumin infusion and/or paracentesis performance to control the amount of ascites fluid. In case of therapeutic resistance, invasive methods for ascites control are used, such as preoperative TIPS placement or a peritoneal dialysis catheter placement for postoperative control of ascites fluid amount. Hernioplasty with mesh placement compared to mesh-free hernioplasty in healthy individuals

shows a slightly increased risk of local complications and a reduced risk of hernia recurrence, while in patients with ascites and uncomplicated umbilical hernia, elective retrorectal preperitoneal hernioplasty with mesh placement has a lower risk of surgical site infections and hernia recurrence (19).

According to Abbas et al., in cases of umbilical and inguinal hernias in patients with liver cirrhosis, elective laparoscopic hernioplasty with mesh placement is recommended. Emergency surgical treatment is associated with a higher morbidity rates and increased mortality and should be avoided. Patients with MELD <15 points has mortality rates of 1.3%, while those with MELD>15 points has 11.1% mortality rates. In patients with MELD>15 points, age> 65 years and serum albumin levels <3g/dL and preoperative sepsis, elective hernioplasty is not recommended (20).

The study conducted by Wang et al. evaluates the efficacy and safety of laparoscopic hernioplasty in patients with liver cirrhosis and ascites. The study included 17 patients with liver cirrhosis and existing inguinal hernias who underwent laparoscopic hernia repair during a period of three years, with liver cirrhosis diagnosed by histological results or a combination of history, physical examination and imaging findings. Age, gender, etiology of cirrhosis, duration of symptoms, CPT class, ASA class, and preoperative laboratory results were also recorded and were treated with the appropriate therapy, preoperative antibiotic prophylaxis with 1 g of Cefazolin. The therapeutic measures continued in the postoperative period. The authors reported 3 cases of postoperative complications – seroma, scrotal edema, pneumonia; no recurrences were reported during the follow-up period. They reported 2 deaths in patients with liver cancer and CPT C class. Good therapeutic control of ascites shows lower hernia recurrence rates but conclusions about the superiority of laparoscopic hernioplasty over open hernioplasty in cirrhotic patients cannot be drawn due to the small size of the study and the lack of a comparative analysis with open surgery. Early elective surgery in selected patients with cirrhosis prevents the development of life-threatening complications and improves the quality of life of these patients. Further prospective studies on the efficacy of total extraperitoneal hernioplasty in patients with cirrhosis are needed (21).

In conclusion, anterior abdominal wall hernias, umbilical and inguinal hernias in particular are more common in cirrhotic patients with ascites. Multiple studies show higher morbidity rates after performing hernioplasty in that patients cohort, including surgical site infection, dehiscence, hernia recurrence, single or multiple organ failure development due to concomitant chronic diseases exacerbation. Cirrhotic patients have higher mortality rates than those in the general population increasing according to the timing of surgery, CPT class, MELD points, ASA class, age and presence of laboratory deviations. Preoperative treatment of liver cirrhosis and concomitant ascites, patients general condition optimization and elective hernioplasty are highly recommendable to achieve better surgical outcomes and to decrease morbidity and mortality rates in that population.

List of abbreviations:

RAAS – rennin – angiotensin – aldosterone
SBP – spontaneous bacterial peritonitis
SAAG – serum – ascites albumin gradient
TIPS – transjugularis intrahepatic portosystemic shunt
CPT – Child – Pugh – Turcotte classification
MELD – Model of end-stage liver disease score

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