



Hernia repair in patients with chronic liver disease - A 15-year single-center experience

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ABSTRACT

Background: Elective hernia repairs in chronic liver disease (CLD) patients are often avoided due to the fear of hepatic decompensation and mortality, leaving the patient susceptible to an emergent presentation.

Methods: CLD patients undergoing ventral or inguinal hernia repair in emergent and non-emergent settings at our institution (2001–2015) were analyzed. Predictors of 30-day morbidity and mortality (M&M) were determined using univariate analysis and multivariate logistic regression.

Results: A total of 186 non-emergent repairs identified acceptable rates of M&M (27%) and 90-day mortality (3.7%, 0/21 for MELD \geq 15). Meanwhile, 67 emergent repairs had higher rates of M&M (60%) and 90-day mortality (10%; 25% for MELD \geq 15). M&M was associated with elevated MELD scores in emergent cases (14 ± 6 vs 11 ± 4 ; $p = 0.01$) and intraoperative drain placement in non-emergent cases (OR1.31, $p < 0.01$).

Conclusion: In patients with advanced CLD, non-emergent hernia repairs carry acceptable rates of M&M, while emergent repairs have increased M&M rates associated with higher MELD scores.

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Introduction

Abdominal wall hernias have been estimated to occur in 20%–40% of patients with chronic liver disease (CLD) due to increased intra-abdominal pressure from ascites and malnutrition from altered liver function.^{1–3} The morbidity and mortality (M&M) associated with CLD is potentiated by the presence of a hernia, creating a challenging cohort for surgeons in both the emergent and elective setting. Despite the prevalence of abdominal wall hernias in this population, a paucity of data exists by which to risk stratify these patients. Previous prospective and retrospective studies in this population are limited in their number of patients or inclusion of incisional hernias, while large national database reviews often lack key operative details.^{4–8} Surgeons are frequently

met with the dilemma of whether to repair the hernia electively, or proceed with a ‘watch and wait’ approach with repair at the time of symptom progression.^{1,3,9,10} Elective repair is often deferred due to the fear of perioperative complications, hepatic decompensation, and death. Conversely, delayed repair can leave the patient susceptible to an emergent presentation. Since few hernias are actually repaired prior to symptom progression or liver transplantation, the morbidity of hernia repair in patients with CLD is not well understood. Therefore, the purpose of our study is to detail the 30-day complications and 90-day mortality associated with hernia repair in patients with CLD at a single institution in both the elective and emergent setting. We hypothesized that patient and operative variables could help risk stratify patients’ risk of M&M and aid in surgical planning.

Methods

Retrospective chart review was performed on all patients with a diagnosis of CLD – including end-stage liver disease (ESLD) or

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Table 1
Emergent hernia repairs.

Variable	M&M Event N = 40 (60%)	No M&M Event N = 27 (40%)	p-value
Age, years (Mean, SD)	55 ± 11	57 ± 11	0.59
Female Gender (N, %)	14 (35%)	11 (41%)	0.83
Race (N, %)			
Caucasian	25 (63%)	24 (89%)	0.06
AA	8 (20%)	3 (11%)	
Hispanic	2 (5%)	0	
Asian	0	0	
Other	5 (12%)	0	
BMI, kg/m ² (Mean, SD)	29.1 ± 8.7	26.6 ± 6.5	0.19
CCI (Median, SD)	5 ± 1	4 ± 2	0.07
Age-Adjusted CCI (Mean, SD)	6.3 ± 1.8	5.7 ± 1.9	0.18
Cause of CLD (N, %)			
Viral Hepatitis	13 (33%)	9 (33%)	>0.99
Alcohol	22 (55%)	16 (59%)	0.93
NASH	8 (20%)	5 (19%)	>0.99
Cholestatic Liver Disease	1 (2.5%)	0	>0.99
Metabolic Disease	0	0	
Cancer	0	0	
Unknown	3 (7.5%)	0	0.27
Other	1 (2.5%)	1 (4%)	>0.99
Interventions for CLD Prior to Abdominal Wall Hernia Repair (N, %)			
Hepatology Consult	28 (70%)	23 (85%)	>0.26
Spironolactone	26 (65%)	21 (78%)	0.40
Furosemide	20 (50%)	17 (63%)	0.43
Propranolol	9 (23%)	5 (19%)	0.93
TIPS	14 (35%)	10 (37%)	>0.99
Peritoneovenous Shunt	1 (3%)	2 (7%)	0.56
Paracentesis	22 (55%)	12 (44%)	0.55
Variceal Banding	17 (43%)	10 (37%)	0.85
Lactulose	21 (53%)	10 (37%)	0.32
Interferon Therapy	0	1 (3.7%)	0.40
Other	2 (5%)	0	0.65
Na ⁺ , mmol/L (Mean, SD)	135 ± 6.4	135 ± 5.3	0.96
Creatinine, mg/dL (Mean, SD)	1.5 ± 1.9	1.3 ± 0.7	0.42
Bilirubin, mg/dL (Mean, SD)	2.9 ± 2.6	1.3 ± 0.9	0.009
Albumin, g/dL (Mean, SD)	3.0 ± 0.6	3.1 ± 0.7	0.79
Platelet Count, k/uL (Mean, SD)	110 ± 70	147 ± 81	0.06
INR (Mean, SD)	1.33 ± 0.25	1.19 ± 0.17	0.009
PTT, sec (Mean, SD)	33 ± 7	30 ± 5	0.10
Ascites (N, %)			
None	0	3 (11%)	0.10
Mild	17 (42%)	8 (30%)	
Severe	23 (58%)	16 (59%)	
Hepatic Encephalopathy (N, %)			
None	12 (30%)	9 (33%)	
Minimal	28 (70%)	16 (59%)	
Advanced	0	2 (7%)	0.24
Child-Pugh-Turcott Class			
A	0	2 (7%)	
B	26 (65%)	19 (70%)	
C	14 (35%)	6 (22%)	0.13
MELD Score (Median, SD)	14 ± 6	11 ± 4	0.011
Cirrhosis (N, %)	40 (100%)	25 (93%)	0.51
HCC (N, %)	2 (5%)	2 (7%)	>0.99
Operative Characteristics			
Skin Breakdown over Hernia (N, %)	11 (28%)	7 (26%)	>0.99
Leakage of Ascites (N, %)	9 (23%)	5 (19%)	0.77
Incarcerated Hernia (N, %)	33 (83%)	20 (74%)	0.60
CDC Wound Class (N, %)			
1	20 (50%)	16 (59%)	0.76
2	15 (38%)	10 (37%)	
3	4 (10%)	1 (4%)	
4	1 (2%)	0	
Hernia Type (N, %)			
Primary Epigastric	1 (3%)	2 (7%)	0.50
Incisional Hernia	2 (5%)	3 (11%)	
Umbilical Hernia	32 (80%)	20 (74%)	
Unilateral Inguinal Hernia	4 (10%)	3 (11%)	
Bilateral Inguinal Hernias	0	3 (11%)	
Femoral Hernia	2 (5%)	0	
Surgical Approach (N, %)			
Open	39 (97%)	26 (96%)	0.65

Table 1 (continued)

Variable	M&M Event N = 40 (60%)	No M&M Event N = 27 (40%)	p-value
Laparoscopic	1 (3%)	0	
Laparoscopic to Open	0	1 (4%)	
Mesh Utilization (N, %)	7 (18%)	5 (19%)	>0.99
Mesh Location (N, %)			
Onlay	1 (3%)	2 (7%)	0.85
Inlay	1 (3%)	0	
Sublay	4 (10%)	2 (7%)	
Intraperitoneal	1 (3%)	1 (4%)	
Mesh Type (N, %)			
Synthetic	5 (19%)	5 (19%)	0.47
Biosynthetic	0	0	
Biologic	2 (7%)	0	
Fascial Closure (N, %)	39 (98%)	27 (100%)	>0.99
Drain Placement (N, %)	15 (38%)	5 (19%)	0.16
Hernia Width, cm (Mean, SD)	5.7 ± 8.0 (N = 14)	2.4 ± 1.3 (N = 11)	0.18

N = Number; SD = Standard Deviation; CLD = Chronic Liver Disease; AA = African American; BMI = Body Mass Index; NASH = Nonalcoholic Steatohepatitis; TIPS = Transjugular Intrahepatic Portosystemic Shunt; Na+ = Sodium; INR = International Normalized Ratio; PTT = Partial Thromboplastin Time; MELD = Model for End-Stage Liver Disease; HCC = Hepatocellular Carcinoma.

cirrhosis – who underwent inguinal hernia repair (IHR) or ventral hernia repair (VHR) – including primary or incisional defects – from January 2001 through December 2015 at the Cleveland Clinic. Patients who were assigned their diagnosis of liver disease after their hernia repair were excluded, as well as those with incomplete data to calculate a Model for End-Stage Liver Disease (MELD) Score. Those patients who were repaired during or following liver transplantation were also removed from analysis. There were no additional exclusions based on technique or their emergent/non-emergent presentation.

Patient demographic information, cause of CLD, associated diagnoses (i.e. ascites, encephalopathy, cirrhosis, hepatocellular carcinoma), management interventions for CLD prior to hernia repair, and the severity of CLD were collected for each patient. The severity of CLD was defined using the Charlson Comorbidity Index (CCI), age-adjusted CCI, Child-Turcotte-Pugh Score, laboratory values, and MELD Score.^{11–18} These scores were calculated at the time of preoperative patient evaluation prior to abdominal wall hernia repair in order to most accurately reflect the extent of liver disease at the time of their operation. Operative variables included the presence of skin breakdown, leakage of ascites, emergent nature, acute incarceration, Centers for Disease Control (CDC) wound class, hernia type (i.e. primary, incisional, inguinal, etc), surgical approach, mesh type and utilization, mesh position, fascial closure, hernia width and drain placement.

The primary outcome of interest was a composite of any 30-day postoperative morbidity and/or mortality (M&M). Thirty-day morbidity outcomes included the incidence of surgical site infection (SSI) as defined based on the Centers for Disease Control and Prevention (CDC) definitions, wound dehiscence, bacterial peritonitis, decompensated liver failure as documented by a hepatologist, postoperative admission to the Intensive Care Unit, 30-day unplanned hospital readmission, 30-day unplanned reoperation, and 30-day mortality.^{19,20} Additional 90-day mortality was recorded as well.

Statistical analysis

Data were described using mean/median and standard deviation for continuous variables and counts and percentages for categorical variables. Ultimately we aimed to highlight variables associated with 30-day postoperative M&M to risk-stratify patients in the emergent setting and help guide surgical decision-making in the elective setting. As such, patients who presented emergently were analyzed separately from non-emergent cases. Preoperative

patient variables, liver disease characteristics, and operative variables known at the time of preoperative evaluation were then compared between those patients who experienced a 30-day M&M event and those patients that did not using chi-square analysis and Fisher's exact test for categorical variables and two sample t-tests for continuous variables.²⁰ For non-emergent cases, multivariate logistic regression was used to identify the variables that had an independent association with the composite 30-day M&M outcome while controlling for relevant covariates. A backward-elimination approach was used in which predictors with $p > 0.10$ were dropped at each step to allow for a final model. Finally, 30-day M&M rates as well as all 90-day mortality were stratified by MELD score in emergent and non-emergent scenarios.

Results

A total of 468 patients were extracted from the medical record with a diagnosis of CLD that underwent IHR or VHR from January 2001 through December 2015 at the Cleveland Clinic. Excluded patients included the 187 hernias fixed during or after liver transplantation, 18 with incomplete MELD data, and 11 who were assigned their diagnosis of liver disease after their hernia repair. The remaining 253 cases comprised 186 (74%) non-emergent and 67 (26%) emergent repairs. These hernia repairs consisted of 63% isolated ventral/incisional defects, 28% isolated inguinal hernias, and 9% concomitant scenarios. Ninety-one (36%) patients experienced a total of 159 M&M events.

First, the 67 emergent repaired were analyzed. Univariate analysis of patient demographic information, preoperative laboratory values, liver disease characteristics and operative variables comparing the 40 (60%) patients who had an M&M event to the 27 (40%) that did not are summarized in Table 1. There were no statistically significant differences between the two groups with respect to their demographics, liver disease characteristics (including treatments and interventions), or operative variables. Only an elevated INR (1.33 ± 0.25 vs. 1.19 ± 0.17 ; $p = 0.009$), total bilirubin (2.9 ± 2.6 vs. 1.3 ± 0.9 ; 0.009), and MELD Score (14 ± 6 vs. 11 ± 4 ; $p = 0.011$) were associated with 30-day postoperative M&M. Given the paucity of univariate associations and relatively small cohort of emergent cases, multivariate analysis was deferred for this group.

Next, an identical analysis was done for the 186 non-emergent repairs, of which 51 (27%) had an M&M event. Findings are summarized in Table 2. Variables associated with M&M after univariate analysis included an elevated CCI (4 ± 2 vs 4 ± 2 ; $p = 0.03$), rate of

Table 2
Non-emergent hernia repairs.

Variable	M&M Event N = 51 (27%)	No M&M Event N = 135 (73%)	p-value
Age, years (Mean, SD)	54 ± 11	54 ± 10	>0.99
Female Gender (N, %)	13 (25%)	33 (24%)	>0.99
Race (N, %)			
Caucasian	43 (84%)	109 (81%)	
AA	5 (10%)	12 (9%)	
Hispanic	1 (2%)	5 (4%)	
Asian	0	0	
Other	2 (4%)	9 (7%)	0.92
BMI, kg/m ² (Mean, SD)	28.5 ± 5.6	27.6 ± 5.9	0.37
CCI (Median, SD)	4 ± 2	4 ± 2	0.03
Age-Adjusted CCI (Mean, SD)	5.7 ± 2.4	5.1 ± 1.9	0.11
Cause of CLD (N, %)			
Viral Hepatitis	14 (27%)	44 (33%)	0.62
Alcohol	32 (63%)	65 (48%)	0.11
NASH	4 (8%)	20 (15%)	0.31
Cholestatic Liver Disease	3 (6%)	13 (10%)	0.56
Metabolic Disease	0	7 (0.8%)	0.19
Cancer	0	1 (3.3%)	>0.99
Unknown	3 (6%)	4 (3%)	0.39
Other	0	4 (3%)	0.58
Interventions for CLD Prior to Abdominal Wall Hernia Repair (N, %)			
Hepatology Consult	42 (82%)	112 (83%)	>0.99
Spironolactone	30 (59%)	64 (47%)	0.22
Furosemide	27 (53%)	56 (41%)	0.22
Propranolol	11 (22%)	32 (24%)	0.91
TIPS	17 (33%)	19 (14%)	0.006
Peritoneovenous Shunt	2 (4%)	3 (2%)	0.62
Paracentesis	19 (37%)	28 (21%)	0.03
Variceal Banding	16 (31%)	37 (27%)	0.72
Lactulose	19 (37%)	29 (21%)	0.045
Interferon Therapy	0	11 (8%)	0.04
Other	4 (10%)	13 (10%)	>0.99
Na ⁺ , mmol/L (Mean, SD)	135 ± 14	136 ± 12	0.47
Creatinine, mg/dL (Mean, SD)	1.0 ± 0.8	1.0 ± 0.5	0.54
Bilirubin, mg/dL (Mean, SD)	2.1 ± 3.6	1.7 ± 3.1	0.54
Albumin, g/dL (Mean, SD)	3.4 ± 0.7	3.7 ± 0.7	0.003
Platelet Count, k/uL (Mean, SD)	117 ± 68	127 ± 81	0.37
INR (Mean, SD)	1.23 ± 0.24	1.15 ± 0.19	0.04
PTT, sec (Mean, SD)	31 ± 7	31 ± 7	0.84
Ascites (N, %)			
None	16 (31%)	58 (43%)	0.26
Mild	23 (45%)	56 (41%)	
Severe	12 (24%)	21 (16%)	
Hepatic Encephalopathy (N, %)			
None	29 (57%)	97 (72%)	
Minimal	22 (43%)	37 (27%)	
Advanced	0	1 (1%)	0.07
Child-Pugh-Turcott Class			
A	5 (10%)	10 (7%)	
B	38 (75%)	112 (83%)	
C	8 (15%)	13 (10%)	0.35
MELD Score (Median, SD)	10 ± 5	9 ± 4	0.04
Cirrhosis (N, %)	3 (6%)	8 (6%)	>0.99
HCC (N, %)	4 (8%)	6 (4%)	0.47
Operative Characteristics			
Skin Breakdown over Hernia (N, %)	1 (2%)	5 (4%)	>0.99
Leakage of Ascites (N, %)	2 (2%)	1 (1%)	0.18
Incarcerated Hernia (N, %)	7 (14%)	12 (9%)	0.48
CDC Wound Class (N, %)			
1	41 (80%)	123 (91%)	0.03
2	8 (16%)	9 (7%)	
3	2 (4%)	0	
4	0	1 (2%)	
Hernia Type (N, %)			
Primary Epigastric	1 (4.2%)	3 (2%)	0.20
Incisional Hernia	15 (22.2%)	22 (16%)	
Umbilical Hernia	21 (73.6%)	64 (47%)	
Unilateral Inguinal Hernia	18 (6.9%)	54 (40%)	
Bilateral Inguinal Hernias	1	11 (8%)	
Femoral Hernia	0	3 (2%)	
Surgical Approach (N, %)			
Open	46 (90%)	119 (88%)	0.38

Table 2 (continued)

Variable	M&M Event N = 51 (27%)	No M&M Event N = 135 (73%)	p-value
Laparoscopic	3 (6%)	14 (10%)	0.51
Laparoscopic to Open	2 (2%)	2 (2%)	
Mesh Utilization (N, %)	28 (55%)	82 (61%)	0.94
Mesh Location (N, %)			
Onlay	11 (39%)	36 (46%)	
Inlay	1 (4%)	2 (3%)	
Sublay	13 (46%)	31 (40%)	
Intraperitoneal	3 (11%)	9 (12%)	
Mesh Type (N, %)			0.22
Synthetic	26 (93%)	78 (97%)	
Biosynthetic	0	2 (2%)	
Biologic	2 (7%)	1 (1%)	>0.99
Fascial Closure (N, %)	47 (92%)	123 (91%)	
Drain Placement (N, %)	15 (29%)	11 (8%)	<0.001
Hernia Width, cm (Mean, SD)	5.7 ± 5.3 (N = 11)	3.6 ± 3.4 (N = 51)	0.10

preoperative TIPS (33% vs 14%; $p=0.006$), preoperative paracentesis (37% vs 21%; $p=0.03$), use of lactulose (37% vs 21%; $p=0.045$), lower rates of interferon therapy (0% vs 8%; $p=0.04$), decreased albumin (3.4 ± 0.7 vs 3.7 ± 0.7 ; $p=0.003$); an elevated INR (1.23 ± 0.24 vs 1.13 ± 0.19 ; $p=0.04$), higher MELD score (10 ± 5 vs 9 ± 4 ; $p=0.04$), presence of contamination ($p=0.03$), or intraoperative drain usage (29% vs 8%; $p=0.001$). Multivariate analysis of non-emergent repairs found that only intraoperative drain placement continued to carry an association with postoperative M&M (OR 1.31; CI 1.09–1.57; $p < 0.01$) – **Table 3**.

Comparing emergent to non-emergent repairs, emergent repairs carried statistically higher rates of postoperative ICU admission (27% vs 5%; $p < 0.0001$), bacterial peritonitis (10% vs 3%; $p=0.02$), unplanned re-operation (9% vs 1%; $p=0.005$), unplanned re-admission (27% vs 14%, $p=0.02$), and all 30-day M&M (60% vs 27%). While not statistically significant, emergent repairs had higher 90-day mortality (10% vs 3.7%; $p=0.06$) – summarized in **Table 4**.

Finally, **Fig. 1** demonstrates increased rates of M&M in the emergent and non-emergent setting as a function of MELD score. Likewise, **Fig. 2** shows 90-day mortality rates in the emergent and non-emergent settings also as a function of MELD score. While some groups are small, non-emergent repairs carry low mortality rates even with high MELD scores. Conversely, mortality rates increase dramatically for patients with a high MELD score in an emergent setting.

Discussion

Our review of 186 non-emergent hernia repairs in patients with CLD identified relatively acceptable rates of postoperative 30-day M&M (27%) and 90-day mortality (3.7%). Specifically, the 21 patients with advanced liver disease (MELD ≥ 15) demonstrated no postoperative mortalities in the non-emergent setting. Multivariate

Table 3

Multivariate analysis for M&M in non-emergent repairs.

Associated on Univariate ($p < 0.05$)	Odds Ratio	Confidence Interval	p-value
TIPS	1.08	0.91–1.29	0.38
Paracentesis	1.06	0.91–1.24	0.43
Lactulose Therapy	1.05	0.90–1.22	0.57
Interferon Therapy	0.83	0.64–1.08	0.16
Drain Use	1.31	1.09–1.57	<0.01
Charlson Score	1.03	0.99–1.07	0.15
Albumin	0.92	0.83–1.02	0.12
INR	1.51	0.90–2.51	0.12
MELD	0.98	0.96–1.01	0.22
CDC II-IV	1.16	0.96–1.41	0.12

analysis only identified intraoperative drain placement as being associated with postoperative M&M in the non-emergent setting (OR 1.31, $p < 0.01$). The 67 CLD patients who underwent emergent hernia repair expectedly fared worse, with higher rates of postoperative M&M (60%) and 90-day mortality (10%). Higher MELD scores – as well as its INR and total bilirubin components – were associated with 30-day M&M following univariate analysis (14 ± 6 vs 11 ± 4 ; $p=0.011$) and increased 90-day mortality in the emergent setting – 25% for those with a MELD ≥ 15 (**Table 4**). This data supports elective hernia repair even in patients with advanced CLD, particularly to avoid the significant morbidity and mortality associated with emergent repair.

In order to corroborate the benefits of elective repair, the impact of “watchful waiting” would need to be evaluated. A retrospective review by Marsman et al. documents 34 cirrhotic patients with ascites and an umbilical hernia. Their results of watchful waiting were a 77% (10/13) incidence of acute incarceration, 46% (6/13) rate of emergent repair, and 15% (2/14) mortality. During the same time period they found a 71% (12/17) success rate of elective repair, while the others all survived wound complications and recurrence.⁹ Given these findings, the group abandoned watchful waiting and prospectively followed their next 30 elective repairs, documenting a 7% (2/30) morbidity rate, 7% recurrence rate (median 25-month follow-up), and 7% unrelated mortality rate.⁴ Still, data from the Denmark hernia registry has shown an increased mortality rate in cirrhotics hernia repairs even in the elective setting when compared to non-cirrhotics (Odds Ratio 3.7 {1.1–12.2}).⁶

Table 4

Specific M&M outcomes.

Outcome	Emergent N = 67	Non-Emergent N = 186	p-value
ICU Admission (N, %)	18 (27%)	9 (5%)	<0.0001
Superficial SSI (N, %)	8 (12%)	10 (5%)	0.09
Deep SSI (N, %)	1 (1.5%)	2 (1%)	>0.99
Organ Space SSI (N, %)	1 (1.5%)	1 (1%)	>0.99
Wound Dehiscence (N, %)	5 (7.5%)	11 (6%)	0.77
Bacterial Peritonitis (N, %)	7 (10%)	5 (3%)	0.02
Decompensated Liver Failure (N, %)	9 (13%)	15 (8%)	0.23
30-Day Unplanned Reoperation (N, %)	6 (9%)	2 (1%)	0.005
30-Day Unplanned Readmission (N, %)	18 (27%)	26 (14%)	0.02
30-Day Mortality (N, %)	0	5 (3%)	0.33
Total 30-Day M&M ^a	40 (60%)	51 (27%)	<0.0001
Total 90-Day Mortality	7 (10%)	7 (3.7%)	0.06

ICU = Intensive Care Unit; SSI = Surgical Site Infection.

^a Patients may have experienced more than one morbidity event.

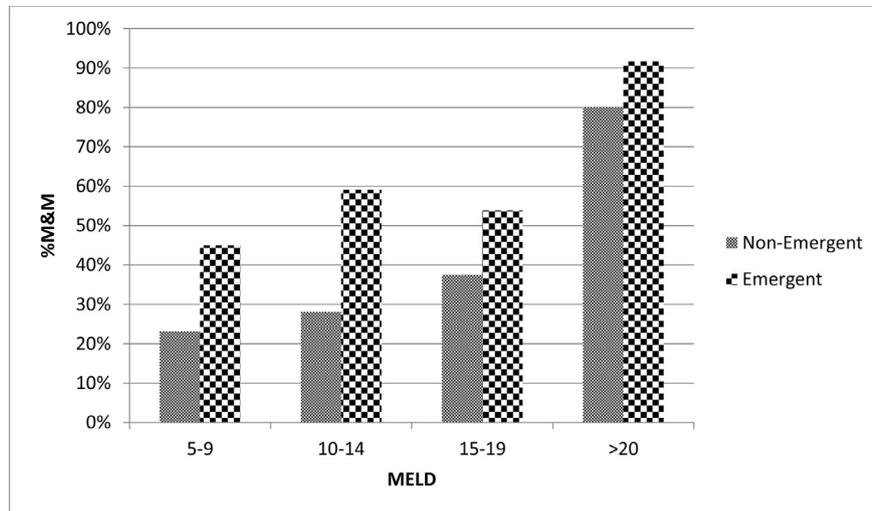


Fig. 1. M&M as a function of MELD

Conversely, data from the University HealthSystem Consortium reviewed by Carbonell et al. comparing umbilical hernia repair in 1197 cirrhotics versus >30,000 non-cirrhotics found no difference in morbidity (15.6% vs. 13.5%, $p = 0.18$) or mortality (0.6% vs. 0.1%, $p = 0.06$) in the elective setting. In the emergent setting, however, cirrhotics again faced increased morbidity (17.3% vs. 14.5%, $p = 0.04$) and mortality (3.8% vs. 0.5%, $p < 0.0001$). Together, we feel this data supports our conclusion that elective repair in order to avoid incarcerated and strangulated/contaminated scenarios appears preferable.

Other notable operative characteristics are worth discussion. First, there appears to be no association of hernia sub-type with M&M. This is important as all of the aforementioned cited studies do not include incisional hernias, which comprised 17% of our cohort. We had hypothesized that incisional and recurrent hernias may increase complexity and therefore complications, but this was ultimately unfounded. Likewise, operative technique – including open vs. laparoscopic approach, mesh utilization, mesh location, fascial closure, and hernia width (limited data), were all comparable between patients who did and did not develop complications.

Notably, the use of biologic mesh was increased in patients who developed an M&M, but its utilization correlates with an increased incidence of contaminated cases. As the meta-analysis for non-emergent repairs ultimately demonstrates, both biologic mesh and wound contamination were not associated with increased M&M. Interestingly, a randomized controlled trial with 40 patients in each arm showed that permanent mesh reinforcement (onlay) reduces recurrence (14 vs 3%, $p < 0.05$) with a minimum 6-month follow-up and no increase in complications.⁵ While our study does not find a difference in morbidity related to mesh utilization, our limited follow-up prevents any insight into the effectiveness of reducing recurrence. Another interesting finding in our analysis is that the placement of an intraperitoneal drain at the time of surgery was associated with perioperative morbidity and mortality. The practice of placing a drain in patients with ascites has commonly been advocated to “protect” the suture line, divert the ascites, and improve wound healing.²¹ Our data suggests that this practice might in fact increase complications. Nevertheless, it is important to point out that there is the likelihood for selection bias in that patients with more ascites and perhaps worse liver disease were

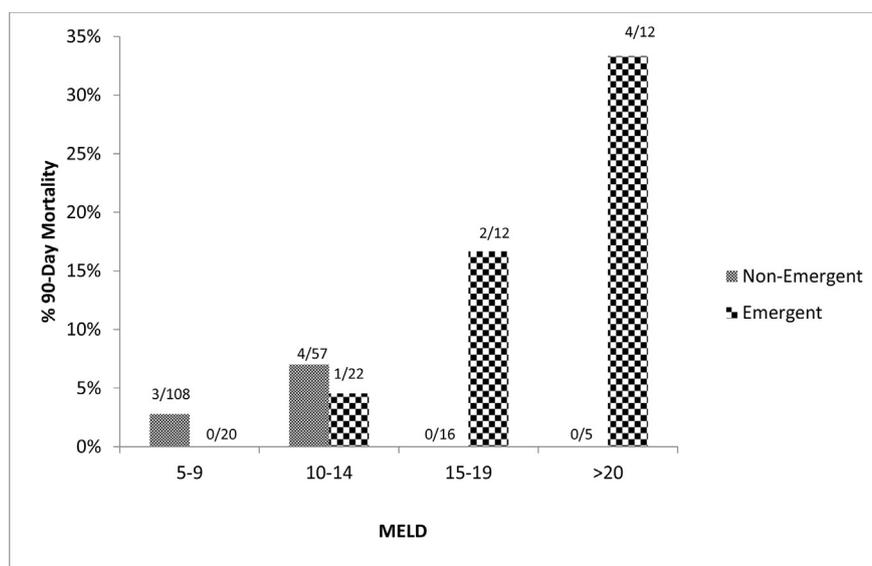


Fig. 2. 90-Day mortality as a function of MELD

more likely to have a drain placed by the surgeon. It likely would require a randomized controlled trial to adequately address this pertinent surgical decision, and given the complexity and heterogeneity of this patient population, is unlikely to ever be performed.

Next, our measurements of medical complexity, and specifically hepatic insufficiency, deserve a few comments. The Child-Pugh-Turcotte and the MELD scores have been widely used to help direct medical therapy and to predict outcomes following surgical intervention for patients with CLD. Nevertheless, both of these scores were originally developed to predict outcomes in a specific subset of patients with CLD.¹¹ The Child-Pugh-Turcotte score was originally developed to help predict the risk of emergency portosystemic shunt in the setting of bleeding esophageal varices and the MELD score was originally designed to help predict the risk of mortality following TIPS.^{11,18} Currently, both of these scores are used as a way to measure severity of liver disease and to prioritize ranking of patients on liver transplantation lists. However, it is important to note that the scores for our patients were relatively low, which was more pronounced for the MELD score than the Child-Pugh-Turcotte score. This may be explained by the fact that ascites is not a component of the MELD score. For emergent repairs, MELD score – and its components – were the only predictors of M&M as well as 90-day mortality following univariate analysis. While univariate analysis shows MELD is also associated with M&M in non-emergent cases – along with Charlson score and several other CLD-associated treatments – multivariate analysis ultimately shows that none of these is closely associated with M&M. Still stratification by MELD score (Figs. 1–2) proves to be helpful to risk-stratify patients.

Limitations of our study include the inability to determine which patients had been undergoing a “watch and wait” approach before repair and for how long, or a comparison arm of patients who never had an operation. Also, we lack long-term follow-up that is relevant for both survival and hernia recurrence. As the fear of immediate postoperative decompensation and associated morbidity was the outcome of interest, we focused on predictors of that specifically.

Conclusion

This large single-center cohort of 253 CLD patients suggests that non-emergent hernia repairs have relatively acceptable rates of M&M, even with advanced liver disease. The dramatic increase in postoperative complications and 90-day mortality in the emergent setting supports the practice of elective repair when possible.

Conflicts of interest

None directly related to this manuscript.

Source of funding

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amjsurg.2018.10.020>.

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