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Featured Article

Fix it while you can … Mortality after umbilical hernia repair in cirrhotic patients

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ABSTRACT

Background: We hypothesize that patients with compensated cirrhosis undergoing elective UHR have an improved mortality compared to those undergoing emergent UHR.
Method: The NIS was queried for patients undergoing UHR by CPT code, and ICD-10 codes were used to define separate patient categories of non-cirrhosis (NC), compensated cirrhosis (CC) and decompensated cirrhosis (DC).
Results: A total of 32,526 patients underwent UHR, 97% no cirrhosis, 1.1% compensated cirrhosis, 1.7% decompensated cirrhosis. On logistic regression, cirrhosis was found to be independently associated with mortality (OR 2.841, CI 2.14–3.77). On subset analysis of only cirrhosis patients, elective repair was found to be protective from mortality (OR 0.361, CI 0.15–0.87, $p = 0.02$).
Conclusions: In this retrospective review, cirrhosis as well as emergent UHR in cirrhotic patients were independently associated with mortality. More specifically, electively (rather than emergently) repairing an umbilical hernia in cirrhotic patients was independently associated with a 64% reduction in mortality.

Introduction

Umbilical hernia is a common condition, reflected by its prevalence of 2% in the general adult population, and over 175,000 umbilical hernia repairs (UHR) are performed annually in the United States.[1,2] Cirrhosis complicated by ascites is associated with 20% risk of developing an umbilical hernia, and with over 630,000 people living with cirrhosis in the United States alone, many are subject to both conditions.[3] Umbilical hernias in cirrhotic patients tend to enlarge over time, causing discomfort and difficulty in performing daily activities and ultimately reducing the quality of life. Furthermore, complications of untreated umbilical hernias can be serious, including skin ulceration and subsequent rupture of the hernia sac, which can lead to leakage, bacterial peritonitis, incarceration, and evisceration.

Historically, high morbidity and mortality rates precluded cirrhotic patients from undergoing UHR and favored nonoperative management. In small volume studies, more than 40% of patients that were managed nonoperatively ultimately required emergent surgical intervention and 40% of those had significant complications, including surgical site infection, intra-abdominal abscess, and secondary bacterial peritonitis.[3–6] Selection of the appropriate patient for elective UHR with regards to their cirrhosis progression remains controversial. Child-Turcotte-Pugh (CTP) and Model for End-stage Liver Disease (MELD) scores have both become general risk calculators for morbidity and mortality in patients with cirrhosis. Multiple studies have shown an association between higher CTP and MELD scores and poor outcomes in the setting of UHR, though there is no consensus regarding which scoring system is the better predictor.[7–10] With the decompensation of cirrhosis, the liver loses synthetic function which is represented by higher MELD scores, and patients are more likely to develop ascites, coagulopathy, bleeding varices and encephalopathy represented by higher CTP scores. Some studies suggest elective umbilical hernia repair in patients with ascites,[11,12] while others assert that elective umbilical herniorrhaphy should be reserved for patients with relatively well-preserved liver function.[4,11–16]

More recent studies have shown improved outcomes in the elective setting, though the majority are small cohort studies. With this study we present a comparison of outcomes of elective vs emergent umbilical hernia repair in non-cirrhotic patients versus compensated and decompensated patients with cirrhosis. We hypothesize that elective UHR will confer a lower mortality than emergent UHR in cirrhotic patients, and that mortality after elective

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UHR in cirrhotic patients will have a comparable mortality to non-cirrhotic patients undergoing elective UHR.

Materials and methods

The National Inpatient Sample (NIS), a publicly available all-payer inpatient care database, was used to identify a cohort of patients between January 1, 2016 and December 31, 2018. The NIS represents a stratified random sample of 20% of all hospital discharges in the United States. This database contains demographic, encounter, outcome and resource utilization data. We identified eligible patients using diagnosis and procedure codes specified in the *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM), and categorized them as non-cirrhotic (NC), as compensated cirrhotic (CC) and decompensated cirrhotic (DC) groups. Decompensated cirrhosis was defined as those carrying an additional diagnosis of ascites and/or encephalopathy. Variables analyzed included patient demographics, hospital teaching status, discharge disposition and admission status. Surgical outcomes of interest were mortality, length of stay (LOS), and total charges.

We performed a univariate analysis comparing NC, CC, and DC group baseline characteristics and outcomes as well as emergent and non-emergent hospital admissions using a chi-squared test with Yates correction for categorical variables and unpaired Student's t-test or Wilcoxon rank-sum test for continuous data. A multivariate logistic analysis was performed to identify risk factors for mortality. Subgroup analysis was performed to evaluate the effect of cirrhosis and emergent UHR. All analyses were performed using the SPSS software. P values < 0.05 were considered significant.

This study was approved by the University of Texas at Austin Institutional Review Board.

Results

There were 32,526 patients that underwent umbilical hernia repairs reported to the NIS over the 3-year period of 2016–2018. Patient demographics are displayed in Table 1. Of these, 31,627 were classified as no cirrhosis (97%). Of the 899 (3%) with cirrhosis, 342 (38%) had compensated cirrhosis and 557 (62%) had decompensated cirrhosis. Overall there were more males in the cirrhosis group than no cirrhosis (68% vs 45% respectively, $p < 0.0001$). The average patient age was 56 years, and 67% were white non-Hispanic, with no significant difference between cirrhosis patients and those without in either category ($p = 0.64$, $p = 0.57$).

Average length of stay in the elective setting for NC and CC was 6 days with no significant difference between them ($p = 0.42$). DC average LOS was 14 days, significantly longer than both NC and DC ($p = 0.0001$ and $p < 0.0001$). With an average LOS of 12, 12 and 16 days for NC, CC and DC respectively in the emergent setting. The longer LOS in the DC group was significant compared to NC and CC ($p = 0.002$, $p = 0.03$).

Elective UHR average charges were significantly higher in the DC group at $213,000 compared to NC $79,000 and CC $90,000 ($p < 0.0001$). Although the average charge for emergent repair in NC ($153,000) was higher than in the elective setting, it was still much lower than either CC $225,000 or DC $259,000 ($p = 0.0009$, $p < 0.0001$).

In the elective setting, mortality for NC, CC and DC were 0.6%, 2% and 5% respectively. The only statistically significant difference found was between NC and DC ($p < 0.0001$), as there was no difference between NC and CC ($p = 0.16$). As expected, mortality was higher for all groups in the emergent setting with 3% for NC, 7% for CC, and 8% DC. Compared to the lower mortality in the NC group, the higher mortality rate for CC and DC was statistically significant ($p = 0.001$ and $p < 0.0001$).

A logistic regression analysis was performed with the primary outcome of mortality measured against patient demographics, teaching hospital status, elective umbilical hernia repair and cirrhosis status. The presence of cirrhosis was found to be independently associated with mortality in all patients (Table 2). On subset analysis including only patients with cirrhosis, elective repair was independently protective with a 64% reduction in mortality risk (Table 3).

Discussion

Following elective UHR, patients with compensated cirrhosis were found to have similar outcomes to those without cirrhosis. In the emergent setting all patients with cirrhosis had similar outcomes regardless of level of hepatic decompensation, with significantly worse outcomes after UHR compared to a cohort without cirrhosis. Both emergent UHR and a diagnosis of cirrhosis are independently associated with an increased mortality risk, however the risk among patients with cirrhosis is greatly attenuated when UHR is performed in an elective setting.

When comparing overall outcomes of cirrhosis patients versus controls, the average length of stay is between 2 and 5 days in the current literature.[12,13,20] Emergent repair, especially in the setting of cirrhosis, is associated with a much longer LOS of 12–13 days compared to 3–5 days for elective repair.[4,21] The results presented here align with these published outcomes.

Current studies are generally limited in scope to small cohorts, and as such do not report charge data. Our database review reveals a significant increase in charges when comparing emergent UHR in decompensated cirrhosis to elective repair in non-cirrhotic and compensated cirrhotic patients. This is likely attributable to the increased rate of postoperative complications and medical comorbidities associated with declining hepatic function. Worsening MELD and CTP scores have been independently associated with increased postoperative morbidity, as has poorly controlled ascites.[9,21] Emergent UHR in any level of cirrhosis is also associated with higher complication rates of 17–26%, both of which likely contribute to the higher overall charges seen in this population.[13,20]

Table 1
Demographics.

	No Cirrhosis N = 31627 97.2%	Compensated N = 342 1.1%	Decompensated N = 557 1.7%	P Value (overall)
Age	57 ± 18	59 ± 13	56 ± 13	0.07
Female	17434 (55)	131 (38)	161 (29)	**< 0.0001**
White	21508 (68)	223 (65)	365 (66)	0.26

Continuous variables as mean ± standard deviation; Discrete variables as number (percentage). **Bold** indicates statistically significant difference.

Table 2
Logistic regression for mortality.

	OR	CI	P value
Age	1.03	1.02–1.03	**< 0.0001**
Female	0.75	0.63–0.89	**0.0007**
White	0.91	0.76–1.08	0.28
Elective repair	0.199	0.16–0.25	**< 0.0001**
Cirrhosis	2.84	2.14–3.77	**< 0.0001**
Teaching Hospital	1.16	0.96–1.39	0.11

Includes all patients undergoing umbilical hernia repair. OR = odds ratio, CI = 95% confidence interval. **Bold** indicates statistically significant difference.

Table 3
Logistic Regression for Mortality: Cirrhosis subset analysis.

	OR	CI	P value
Age	1.01	0.99–1.03	0.53
Female	0.77	0.42–1.39	0.38
White	0.78	0.46–1.36	0.39
Elective	**0.36**	**0.15–0.97**	**0.02**
Decompensated Cirrhosis	1.35	0.75–2.45	0.32
Teaching Hospital	1.07	0.57–2.01	0.84

Includes only patients with either compensated or decompensated cirrhosis undergoing umbilical hernia repair. OR = odds ratio, CI = 95% confidence interval. **Bold** indicates statistically significant difference.

Mortality rates follow the trend of increasing LOS and morbidity in emergent repair and decompensated cirrhosis. Rates as low as 1.4% have been reported for elective UHR in tertiary centers with hepatobiliary transplant surgeons.[12] Other centers have reported rates from 2.5% to 5.5% overall, though generally these studies do not differentiate between emergent or elective cases.[4,13,22] When comparing emergent to elective UHR in those with cirrhosis, there is an increase in mortality rate from 0-0.6% to 3.8–6.5%.[4,11,13] By separating the degree of liver dysfunction into compensated and decompensated cirrhosis, this study found that patients with compensated cirrhosis behaved similarly to patients without cirrhosis in the elective setting. Additionally, any degree of cirrhosis was found to have increased mortality compared to controls in emergent UHR. We believe this supports the concept that umbilical hernias should be repaired electively in patients with compensated cirrhosis, as defined by the lack of or adequate pre-operative control of ascites as mentioned in the literature.[15,23–25] Interestingly, hospital teaching status was not independently associated with mortality in patients with cirrhosis.

As a retrospective review of a national inpatient database, this data excludes surgical interventions performed in an outpatient, day surgery or ambulatory setting. As such, reported outcomes are limited to in-hospital mortality and morbidity which could underrepresent a true 30-day mortality rate. As an administrative database, there could be coding errors or omissions which would result in incorrect patient categorization, although multiple studies have been used to publish reliable results using this database.[17–19] The database does not contain lab values or physical exam characteristics to allow for scoring by MELD and CTP, though we believe the diagnosis of ascites and/or encephalopathy to be adequate surrogate markers of severely inhibited liver function to allow for appropriate categorization. Despite these limitations, this study represents the largest cohort of patients with cirrhosis investigated and provides insight into selecting appropriate operative candidates for elective umbilical hernia repair.

Conclusion

In this retrospective database review of inpatients, emergent UHR and cirrhosis were independently associated with mortality. Additionally, we found a 64% risk reduction in mortality following elective UHR in compensated cirrhosis with secondary outcomes comparable to patients without cirrhosis. We believe that the historical reluctance towards elective UHR in cirrhosis may not be warranted, as progression of both cirrhosis and hernia symptoms necessitating emergent repair increases risk of mortality. We therefore recommend a proactive approach for elective repair in patients with compensated cirrhosis.

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