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Does Intraperitoneal Drainage Improve Outcomes After Umbilical Hernia Repair in Patients with Ascites? A Propensity-Matched Cohort Study

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A B S T R A C T

Background: Intraperitoneal drainage during Umbilical Hernia Repair (UHR) in cirrhotic patients is often used to control postoperative ascites, typically via drain placement or aspiration. Despite potential complications, many surgeons continue this practice. This study aimed to compare postoperative outcomes in patients who underwent UHR with or without drainage.

Methods: The TriNetX database (Clinical trial database) was used to retrospectively analyze U.S. patients aged ≥18 years with ascites who underwent UHR, either with drainage (Cohort 1) or without (Cohort 2). Drainage was defined as the placement of any intraperitoneal drain or aspiration. Outcomes included hernia recurrence requiring repair, prolonged hospitalization, ascites leak, postoperative complications and Surgical Site Infection (SSI). Propensity score matching was performed using age, MELD lab values, BMI and comorbidities.

Results: Cohort 1 contained 539 patients and Cohort 2 contained 17,148 patients. 536 patients per cohort were identified after matching. Patients who underwent drainage had no statistically significant difference in hernia recurrence rate (OR 1.67, 95% CI [0.95, 3.29]), length of hospital stay (OR 1.05, 95% CI [0.56, 1.96]), ascites leak (OR 1.12, 95% CI [0.70, 1.77]) or SSI (OR 1.04, 95% CI [0.70, 2.09]). 42.9% of Cohort 1 versus 36.9% of Cohort 2 had postoperative complications (OR 1.28, 95% CI [1.004, 1.64]).

Conclusion: Matched patients with ascites who underwent intraperitoneal drainage procedures following UHR had no improvement in hernia recurrence, ascites leak, surgical site infections and length of hospital stay and had a statistically significant increase in postoperative complications, indicating a lack of benefit to routine intraperitoneal drainage for UHR.

Keywords: Umbilical hernia, Ascites, Cirrhosis, Drainage, Surgical outcomes, Intraperitoneal drain, Postoperative complications

Abbreviations: UHR: Umbilical Hernia Repair; SSI: Surgical Site Infection; BMI: Body Mass Index; PD: Peritoneal Dialysis; HCOs; Health Care Organizations; MELD: Model for End-Stage Liver Disease; COPD: Chronic Obstructive Pulmonary Disease

1. Introduction

Umbilical Hernias (UH) are a common complication in cirrhotic patients with ascites. The hernia can enlarge quickly if not repaired and lead to significant complications such as bowel strangulation or peritonitis, resulting in severe morbidity[1].

Control of ascites is recommended in the management of umbilical hernias to reduce recurrence and morbidity rates[2]. Medical conservative treatment with diuretics is generally attempted first. If medical management fails, options for invasive control of ascites include paracentesis, Peritoneal Dialysis (PD) catheter placement or shunting. These procedures are not without risks, including infection, bleeding, need for fluid correction causing electrolyte imbalance, prolonged length of stay and higher hospital costs[3-5]. Despite these risks, many surgeons continue to use drains, including closed-suction surgical drains and subsequently must manage these postoperative complications. Furthermore, the duration of drainage is unclear and there have not been any large randomized controlled trials to demonstrate their effectiveness.

The objective of our study was to evaluate patients who underwent UHR with or without intraperitoneal drainage and to compare the differences in hernia recurrence requiring reoperation, length of hospital stay, ascites leak, Surgical Site Infection (SSI) and postoperative complications.

2. Materials and Methods

2.1. Data Source

The data used in this study were collected on October 13th, 2024, from the TriNetX U.S. Collaborative Network. The TriNetX platform provides access to electronic medical records from over 110 million patients in 66 Health Care Organizations (HCOs). The information that is available covers demographics, diagnoses (based on ICD-10-CM codes for the International Classification of Diseases, Tenth Revision, Clinical Modification), procedures (coded using ICD-10-PCS or CPT), medications (coded using the Veterans Affairs National Formulary) and laboratory tests (coded using Logical Observation Identifiers Names and Numbers or LOINC). The HCOs include data for patients with or without insurance from hospitals, primary care clinics or specialists.

2.2. Patient Consent Statement

TriNetX complies with the Health Insurance Portability and Accountability Act to protect the privacy and security of healthcare data. Data is deidentified and directly retrieved from electronic health record systems of participating organizations in a systematic and standardized format.

2.3. Design of Cohort

We used the TriNetX database to conduct a retrospective cohort study of patients aged ≥18 years who had ascites and umbilical hernias. We identified patients who underwent UHR with or without intraperitoneal drainage, whether by any drain of the abdomen or by aspiration. Because intraoperatively placed closed-suction drains lack a procedural code as well as the inherent heterogeneity of real-world practice, we categorized drainage using broader and more comprehensive codes to encompass a wide range of ascites management techniques. While we recognize that these interventions differ mechanistically, they all share the same clinical intent: to control ascites during UHR. By grouping these drainage procedures together, we can examine drainage as a collective management strategy and maximize generalizability. The codes used to build our cohorts were the following:

- **Repair of umbilical or ventral hernia:** 49560-49566, 49570-49572, 49585-49587, 49652-49657.
- **Ascites:** K70.11, K70.31, R18-R18.8.
- **Drainage of the abdomen:** 0K9L, 0K9L00Z, 0K9L30Z, 0K9K, 0K9K00Z, 0K9K30Z, 0H97, 0H97X0Z, 0H97XZX, 0H97XZZ, 0J980ZZ.
- **Insertion of tunneled intraperitoneal catheter:** 49421-49423.
- **Abdominal paracentesis, with or without imaging guidance:** 49082, 49083.

Study participants were divided into two cohorts. Cohort one included patients with ascites who underwent UHR and received intraperitoneal drainage one day before or up to one week after surgery. This perioperative window was selected to reflect the variability in real-world surgical practice and capture the full spectrum of drainage use based on surgeon preference. Cohort two included patients with ascites who underwent UHR but did not have any associated drainage procedure codes.

2.4. Outcomes

The primary endpoint was postoperative clinical outcomes. These were assessed in patients with ascites who underwent UHR with or without intraperitoneal drainage during the follow-up period, defined as 1 day after the index UHR procedure through 24 months. The outcomes evaluated included:

- **Hernia recurrence requiring reoperation:** CPT 49565-49566, CPT 49656-49657
- **Prolonged hospital course:** CPT 99356, 99357, 1013795, 1013800
- **Continued ascites leak**: ICD-10-CM N39.45, T81.3, T81.30XA, T81.31, T81.31XA, T81.32, T81.32XA, T85.63, T85.631, T85.631A
- **Postoperative complications:** ICD-10-CM T80-T88, J95.89
- **SSI, superficial and deep:** ICD-10-CM T81

2.5. Statistical Analyses

All statistical analyses were performed using the TriNetX platform. Propensity score matching was utilized to reduce the effect of confounding factors and selection bias. We adopted the TriNetX built-in platform for covariate adjustment, which uses multiple software components to ensure accuracy. We matched the two cohorts at a 1:1 ratio through the greedy nearest-neighbor algorithm. The covariates used were age, lab value components (INR, total bilirubin, creatinine, sodium) for calculating Model for End-Stage Liver Disease (MELD) score, body mass index (BMI) and comorbidities that could affect hernia recurrence, such as diabetes mellitus, tobacco use and chronic obstructive pulmonary disease (COPD). Of note, these covariates were used for matching and adjustment purposes and are not intended to characterize the overall patient population. Balance was assessed by standardized difference, with <0.1 indicating an acceptable match[6]. For outcomes of interest, we calculated odds ratios (ORs) with 95% Confidence Intervals (CIs). If the 95% CI did not include 1, this indicated statistical significance.

3. Results

3.1. Study Design

Before propensity matching, cohort one contained 539 patients from 42 HCOs in the U.S. and cohort two contained 17,148 patients from 50 HCOs. After matching, there were 536 patients in each group who had ascites, underwent UHR and were age ≥18 years at the time of hernia repair. The age at index, MELD components, BMI and comorbidities of the two cohorts before and after propensity score matching are presented in (Tables 1-3), respectively.

Table 1: Baseline characteristics of the overall study population.

Variables	Before Matching		
	Intraperitoneal Drainage Group (n = 539)	No Drainage Group (n = 17,148)	Std. diff.
Age at Index, Years			
Mean ± SD	56.9 ± 11.4	56.7 ± 13	0.0202
MELD component lab values			
INR	1.29 ± 0.339	1.31 ± 2.37	0.0102
Creatinine	2.39 ± 3.39	1.26 ± 2.42	0.3864
Total bilirubin	1.53 ± 1.9	1.02 ± 2.22	0.2481
Sodium	135 ± 4.68	138 ± 3.71	0.6029
Body Mass Index, kg/m^2			
Mean ± SD	27.5 ± 6.06	30.5 ± 6.91	0.4589
Comorbidities, n (%)			
Diabetes mellitus	189 (35.2)	6478 (38.2)	0.0622
Tobacco use	90 (16.8)	2417 (14.2)	0.0696
COPD	76 (14.2)	2411 (14.2)	0.0018

Table 2: Baseline characteristics of the propensity-matched study population. Bold font represents a standardized difference <0.1.

Variables	After Matching		
	Intraperitoneal Drainage Group (n = 536)	No Drainage Group (n = 536)	Std. diff.
Age at index, years			
Mean ± SD	56.9 ± 11.4	56.7 ± 12.3	0.0203
MELD component lab values			
INR	1.3 ± 0.339	1.26 ± 0.446	0.0926
Creatinine	2.38 ± 3.38	1.8 ± 2.38	0.2002
Total bilirubin	1.53 ± 1.9	1.36 ± 1.81	0.0945
Sodium	135 ± 4.68	137 ± 3.87	0.3929
Body mass index, kg/m^2			
Mean ± SD	27.5 ± 6.06	28.4 ± 5.91	0.1483
Comorbidities, n (%)			
Diabetes mellitus	189 (35.3%)	190 (35.4%)	0.0039
Tobacco use	90 (16.8%)	70 (13%)	0.1049
COPD	76 (14.2%)	78 (12.7%)	0.0438

Table 3: Comparison of propensity-matched patients with and without intraperitoneal drainage.

Outcomes	Patient outcome			
	Intraperitoneal Drainage Group (n = 536)	No Drainage Group (n = 536)	OR (95% CI)	Risk Difference P-value
Hernia recurrence requiring reoperation	23 (4.3%)	14 (2.6%)	1.67 (0.85, 3.29)	0.3132
Prolonged hospital course	21 (3.9%)	20 (3.7%)	1.05 (0.56, 1.96)	0.8735
Ascites leak	41 (7.7%)	37 (6.9%)	1.12 (0.70, 1.77)	0.6381
Surgical site infection	53 (9.9%)	51 (9.5%)	1.04 (0.70, 1.56)	0.8365
Postoperative complications	230 (42.9%)	198 (36.9%)	1.28 (1.004, 1.64)	**0.046**

Bold font indicates a statistically significant value. Abbreviations: 95% CI: 95% Confidence Interval; OR: Odds Ratio

3.2. Subgroup Analyses

Among patients who underwent intraperitoneal drainage after UHR, 4.3% experienced hernia recurrence requiring reoperation, compared to 2.6% of those without drainage (OR 1.67, 95% CI [0.95, 3.29]). Prolonged hospital stay occurred in 3.9% of the drainage group versus 3.7% of the non-drainage group (OR 1.05, 95% CI [0.56, 1.96]). Ascites leak was reported in 7.7% of patients with drainage and 6.9% without (OR 1.12, 95% CI [0.70, 1.77]). Surgical site infections occurred in 9.9% of the drainage group versus 9.5% of the non-drainage group (OR 1.04, 95% CI [0.70, 2.09]). The proportion of patients with other postoperative complications was significantly higher in the drainage group (42.9%) compared to those without drainage (36.9%) (OR 1.28, 95% CI [1.004, 1.64]).

4. Discussion

Umbilical Hernias (UH) are common in cirrhotic patients with ascites. The prevalence has been reported to be up to 20%, ten times higher than the non-cirrhotic population[1]which mainly consists of repeated paracentesis or transjugular intrahepatic portosystemic shunt (TIPS. Increased intra-abdominal pressure from ascites weakens the abdominal wall which, if not repaired, can result in bowel incarceration or strangulation, rupture of overlying skin and peritonitis. Ascites control before repair is frequently recommended to minimize recurrence and postoperative complications such as wound infection and dehiscence, ascites leak, decompensation of liver disease, hemorrhage and hernia recurrence[2]. When medical treatment fails, many surgeons opt for perioperative ascites drainage at the time of hernia repair.

Despite its frequent use, the benefit of drainage during UHR in patients with ascites remains unclear. In our study of 536 matched patients, perioperative drainage was not associated with significant improvements in hernia recurrence requiring reoperation, ascites leak, hospital stay or SSI. However, it was linked to a statistically significant increase in overall postoperative complications.

Because closed-suction drains lack a specific procedural code, we included broader codes for ascites management, including temporary Peritoneal Dialysis (PD) catheters and paracentesis. These methods were incorporated into our study as they are commonly coded for peritoneal fluid drainage and can capture the full spectrum of drainage practices commonly used in clinical settings. PD catheters, first introduced in 2005, were associated with reduced complications in small studies, though their optimal duration and risks of bacterial infections and peritonitis remain concerns[7]. Paracentesis avoids indwelling drains but can lead to hernia strangulation due to rapid fluid shifts[8]. Large-volume paracentesis (>5L of ascites), has been linked to acute kidney injury, hypotension, hepatic encephalopathy and rehospitalization[9].

A survey of 16 surgeons found that 69% would consider a concomitant procedure during UHR to control ascites, with 9 favoring a PD catheter, one for Peritoneovenous Shunt (PVS) and one for serial percutaneous drainage[10]. In addition, three controlled studies in 1984, 1985 and 1990 reported that successful control of ascites reduced hernia recurrence[11-13]. However, these studies were not randomized and two used the now-infrequently used PVS technique. Furthermore, a U.S. database analysis with the Nationwide Inpatient Sample showed that among 10,743 patients, drainage procedures increased hospital stay by 14% and expenses by 29%[3]. Fluid shifts after drainage, requiring aggressive fluid and electrolyte correction, may have contributed to these findings[4]. Additionally, drainage carries risks of bleeding, peritonitis and persistent ascites leak at the insertion site[5].

An alternative approach to consider during UHR is an extraperitoneal repair, as described by Tastaldi L, et al.[14]. This technique begins with de-epithelialization of the hernia sac back to fascia, followed by closure of the defect with autologous tissue and a secondary reinforcement with on lay mesh. This method, a modified version of the Chrevel technique[15], avoids abdominal cavity access and prevents potential enterotomies, wound infections or ascites leak, particularly in high-risk cirrhotic patients. Additionally, it can be performed under local anesthesia, eliminating the risks of deep sedation or general anesthesia. A 2010 randomized controlled trial across four Veterans Affairs medical centers, in which 73 ventral hernias were repaired laparoscopically and 73 using the open Chevrel method, demonstrated a lower recurrence rate (8.2%) for the open repair compared to the laparoscopic approach (12.5%)[16].

We acknowledge several limitations of this study due to its retrospective nature and reliance on accurate coding data across multiple institutions. Although we used propensity score matching, residual confounding factors could not be avoided entirely with this database. For example, we are unable to determine if the UH was repaired in an emergent or elective fashion, the amount of ascites present, bowel viability, the size of the hernia defect and the repair technique, all of which may have contributed to the success or failure of the repair. We are also unable to determine the severity of patient nutritional state, liver disease or initial presentation, with the consideration that patients with higher MELD scores or Child classes and ruptured umbilical hernias may be more likely to undergo drainage. Furthermore, patients may have been lost to competing healthcare organizations in the follow-up period and some postoperative complications may be undercounted. Despite these limitations, the strength of our study is derived from a large sample size and the analysis of a multicenter cohort study with a nationally validated set of outcome data and rigorous audit process. We propose that our outcomes data can be generalized and contribute to the literature regarding the lack of benefit in routine intraperitoneal drainage for ascites control during UHR, as well as improve the quality of care in cirrhotic patients.

5. Conclusion

This investigation found no statistically significant difference in hernia recurrence requiring reoperation, ascites leak, SSI and length of stay between patients who underwent perioperative intraperitoneal drainage during UHR and those who did not. However, drainage resulted in a statistically significantly higher rate of overall postoperative complications. Our literature review found that the majority of studies are small and retrospective and there is not enough robust evidence to support routine perioperative intraperitoneal drainage during UHR. The decision for drainage may depend on patient comorbidities, liver disease severity, the urgency of UHR or surgeon preference. A large-scale randomized controlled trial accounting for these factors could better evaluate the outcomes of planned versus unplanned

drainage and help identify patients who may benefit from a drain. We also recommend considering an extraperitoneal hernia repair technique to avoid access into the abdominal cavity for high-risk cirrhotic patients.

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