Title

Effects of ascites on outcomes of colorectal surgery in congestive heart failure patients

Journal

The American Journal of Surgery, 209(6)

ISSN

0002-9610

Authors

Moghadamyeghaneh, Zhobin

Carmichael, Joseph C

Mills, Steven D

et al.

Publication Date

2015-06-01

DOI

10.1016/j.amjsurg.2014.08.021

Peer reviewed

Effects of ascites on outcomes of colorectal surgery in congestive heart failure patients

Zhobin Moghadamyeghaneh, M.D., Joseph C. Carmichael, M.D., Steven D. Mills, M.D., Alessio Pigazzi, M.D., Michael J. Stamos, M.D., F.A.C.S.*

Department of Surgery, School of Medicine, University of California, Irvine, 333 City Boulevard West, Suite 1600, Orange, CA, USA

Abstract

BACKGROUND: There are limited data regarding the effects of ascites on outcome of patients undergoing colorectal resection. We sought to identify complications related to ascites.

METHODS: The National Surgical Quality Improvement Program database was used to evaluate congestive heart failure (CHF) patients who had ascites before colorectal resection between 2005 and 2012. Multivariate regression analysis was performed to identify affected outcomes.

RESULTS: We sampled a total of 2,178 patients who suffered CHF and underwent colorectal resection, of which 195 (9%) had preoperative ascites. The mortality rate of patients who had preoperative ascites was 46.2% compared to 25.7% for patients without ascites (adjusted odd ratio [AOR], 3.38; $P < .01$). Complications affected by ascites include ($P < .05$) ventilator dependency (AOR, 2.40), acute renal failure (AOR, 2.18), and wound disruption (AOR, 2.44; $P < .05$). There was no increase in superficial
surgical site infection rate in patients with ascites (AOR, 1.01; $P = .9$).

CONCLUSIONS: The presence of ascites in CHF patients is associated with increased mortality in patients undergoing colorectal surgery. There is no correlation between ascites and surgical site infection but wound disruption increases in the presence of ascites.

Preoperative ascites as an important factor associated with high morbidity and mortality has been observed and reported previously.[1–3] In colorectal surgery, the presence of ascites is associated with a greater than 3-fold increase in mortality. Overall, mortality and morbidity of patients with ascites has been reported as high as 41% and 87%, respectively.[4–7] It is important to recognize patients with ascites and the possible complications associated with ascites before surgery in an effort to reduce the morbidity and mortality of these patients.

Respiratory acidosis, intra-abdominal infections, abdominal compartment syndrome, incisional hernia, wound dehiscence, and wound infection have been reported to be increased in patients with ascites.[1–3,6,7] Accumulation of ascites after abdominal operations despite complete drainage of ascites during surgery is typically unavoidable; therefore, preoperative medical control of ascites is usually advised.[8] Aggressive preoperative control of ascites is associated with decreased risks of respiratory

complications as well as wound dehiscence.[9] Also, use of retention sutures to prevent evisceration and dehiscence has been recommended.[9]

Most previous studies regarding the risk of preoperative ascites are limited to cirrhotic patients with a small size of the index population and not specific for colorectal surgery patients.[6–8] A large nationwide study analyzing the complications of colorectal resectional surgery in the presence of ascites in congestive heart failure (CHF) patients undergoing colorectal surgery is lacking. Therefore, we aim to report on the incidence, complications, and outcomes of patients with ascites and CHF undergoing colorectal surgery.

Methods

This study was performed using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database10 from January 1, 2005 to December 31, 2012. ACS NSQIP is a nationally validated, risk-adjusted, outcomes-based program to measure and improve the quality of surgical care in the United States.[10] ACS NSQIP provides preoperative to 30-day postoperative surgical outcomes based on clinical data. We looked at patients who underwent colorectal resections with comorbidity of CHF (in 30 days before surgery) using the appropriate procedural and diagnosis codes as specified by the International Classification of Diseases, 9th Revision, Clinical Modifications then we sampled patients who had preoperative ascites. Patients who had colorectal procedures were defined based on the following Current Procedural Terminology codes: 44140 to 44160, 44204 to 44212, 45110, and 45,395. Patients who underwent colorectal surgery without colon or rectal resection, patients with disseminated cancer, and patients younger than 18 years were excluded from this study. Patients' diagnoses were defined based on the following International Classification of Diseases, 9th Revision codes: malignant neoplasm of colon and rectum (153.0 to 153.9, 154.0, 154.1, 230.3, and 230.4), benign neoplasm of colon and rectum (211.3, 211.4), diverticulosis or diverticulitis (562.10 to 562.13), acute or chronic vascular insufficiency of intestine (557.0, 557.1, and 557.9), perforation of intestine (569.83), intestinal obstruction without mention of hernia or malignancy (560.0 to 560.9), intestinal infection due to Clostridium difficile (008.45), peritonitis and retroperitoneal infections (with or without sepsis) (567.0 to 567.9, 038.1 to .38.9), fistula of intestine (569.81), abscess of intestine (569.5), Crohn disease (555.1, 555.2), and ulcerative colitis (556.0 to 556.9).

Preoperative factors that were analyzed include patient characteristics (age, sex, and race), and 12 comorbidity conditions, which include diabetes mellitus with oral agents or insulin, weight loss (.10% in last 6 months), history of severe chronic obstructive pulmonary disease, current smoker within 1 year, ascites, alcohol abuse (.2 drinks per day in 2 weeks before admission), hypertension requiring medication. Preoperative laboratory values that were analyzed include hyponatremia (serum sodium level ,130 mmol/L), hypernatremia (serum sodium level .145 mmol/L), hypoalbuminemia (serum albumin level ,3.5 g/dL), anemia (hematocrit ,30%), and prerenal azotemia (serum blood urea nitrogen or creatinine ratio .20). Other factors analyzed include postsurgical complications (superficial surgical site infection [SSI], deep incisional SSI, organ space SSI, wound disruption, pneumonia, unplanned intubation, ventilator dependency

.48 hours, cardiac arrest requiring cardiopulmonary resuscitation [CPR], urinary tract infection, myocardial infarction, acute renal failure [ARF], and hospitalization .40 days), pathologic conditions (colorectal cancer, diverticulosis or diverticulitis, ulcerative colitis, and benign colorectal tumor), surgical procedure (total colectomy, abdominoperineal resection of the rectum, and partial colectomy), and surgical techniques (laparoscopic vs open). The overall rate of preoperative ascites and the rate of postoperative complications by procedure type and diagnosis were examined. Risk-adjusted analysis was performed to identify independent predictors of postoperative complications after colorectal operation. Male gender, age below 70 years, Caucasian race, and benign colorectal tumor were used as reference data points for comparison in line with the literature.[11]

Statistical analysis

Statistical analysis was performed with SPSS software, version 19 (SPSS Inc., Chicago, IL). Logistic regression analysis was used to estimate the association between preoperative ascites and each outcome, including inhospital mortality and all the considered postoperative complications. P values less than .05 were considered statistically significant. For each outcome, the adjusted odds ratio (AOR) with a 95% confidence interval was calculated and reported to estimate the relative risk associated with ascites. Adjustments were made for hypertension, smoke, diabetes mellitus, chronic obstructive pulmonary disease, weight loss, alcohol abuse, ascites, dialysis, surgical technique (laparoscopic vs open), admission type (emergent vs nonemergent), age, and race. Patients with missing data points were excluded from final analysis.

Results

A total of 2,178 patients with preoperative comorbidity of CHF who underwent colorectal resection from 2005 to 2012 were identified. The mean age of patients was 74 years, with a standard deviation of 12 years, and 68% of the patients were older than 70 years; most patients were Caucasian (82.7%) and male (50.4%). Most common comorbidities (excluding CHF and ascites) included hypertension (82.2%), and diabetes (35%). Demographic data of Patients

Among the CHF patients who underwent colorectal resection, 195 patients (9%) had preoperative ascites. For patients with ascites, the mean length of stay in the hospital was 27 days with a standard deviation of 23 days, whereas for patients without ascites, it was 21 days with a standard deviation of 17 days. The adjusted mean difference in hospitalization was significant (confidence interval [CI], 1.83 to 9.30; P = .004).

Table 1 Demographics of CHF patients who have undergone colon and rectal surgery in the United States, NSQIP 2005 to 2011

Patient characteristics	Patients with CHF without ascites (1,983), n (%)	Patients with CHF and ascites (195), n (%)	*P* value	Odd ratio (95% CI)
Age, years				
Mean	74	70	—	—
Median	76	72	—	—
≥70	1,369 (69)	88 (45.1)	<.01	.59 (.43 to .79)
Sex				
Female	991 (50.02)	88 (45.12)	.19	.82 (.61 to 1.10)
Admission				
Emergent	897 (45.2)	138 (70.8)	<.01	2.93 (2.12 to 4.04)
Race				
White	1,509 (82.4)	159 (85.9)	.08	1.38 (.95 to 2.02)
Black or African American	258 (14.1)	23 (12.4)	.62	.89 (.56 to 1.40)
Asian or Pacific Islander	4 (.2)	1 (.5)	.38	2.55 (.28 to 22.9)
Others	61 (3.3)	2 (1.1)	.10	.32 (.07 to 1.34)
Comorbidity				
Hypertension	1,638 (82.6)	152 (77.9)	.10	.74 (.52 to 1.06)
Chronic obstructive pulmonary disease	614 (31)	53 (27.2)	.27	.83 (.59 to 1.15)
Smoking	345 (17.4)	39 (20)	.36	1.18 (.82 to 1.71)
Chronic renal disease on dialysis	227 (11.4)	36 (18.5)	<.01	1.75 (1.18 to 2.58)
Diabetes mellitus	702 (35.4)	61 (31.3)	.25	.83 (.60 to 1.14)
Preoperative Pneumonia	169 (11.4)	44 (27)	<.01	2.86 (1.95 to 4.18)
Alcohol abuse	53 (3.6)	8 (4.1)	.39	1.38 (.64 to 2.96)
Weight loss	137 (7)	21 (10.8)	.051	1.61 (.99 to 2.62)
Pathology				
Colorectal cancer	608 (38.8)	26 (16.9)	<.01	.34 (.22 to .53)
Diverticulosis or diverticulitis	211 (13.5)	19 (12.3)	.69	.90 (.55 to 1.48)
Vascular insufficiency of intestine	202 (12.9)	26 (16.9)	.17	1.35 (.87 to 2.10)
Intestinal obstruction*	146 (9.3)	11 (7.1)	.37	.75 (.40 to 1.41)
Perforation of intestine	144 (9.2)	29 (18.8)	<.01	2.23 (1.45 to 3.42)
Peritonitis and retroperitoneal infections	84 (5.3)	15 (9.7)	.02	1.88 (1.06 to 3.33)
Benign colorectal tumor	72 (4.6)	3 (1.9)	.12	.41 (.12 to 1.32)
Clostridium difficile intestinal infection	47 (3)	16 (10.4)	<.01	3.68 (2.04 to 6.62)
Ulcerative colitis	21 (1.3)	4 (2.6)	.21	1.95 (.66 to 5.75)
Abscess or fistula of intestine	18 (1.1)	5 (3.2)	.03	2.87 (1.05 to 7.82)
Angiodysplasia of intestine	9 (.6)	0	.34	.99 (.99 to 1)
Crohn disease	5 (.3)	0	.48	.99 (.99 to 1)

CHF = congestive heart failure; CI = confidence interval; NSQIP = National Surgical Quality Improvement Program.
*Excluded malignancy.

The risk-adjusted analysis for postsurgical complications associated with ascites is reported in Table 2. The adjusted risk of morbidity in patients with ascites was estimated to be more than 1.5 times that of patients without ascites (AOR, 1.65; CI, 1.03 to 2.65; P =.037). Postsurgical complications having a relationship with ascites included ventilator dependency (AOR, 2.40), ARF (AOR, 2.18), prolonged hospitalization (AOR: 2.14), and wound disruption (AOR, 2.44). Although organ space SSI was higher in patients with ascites (7.2% vs 4.5%), ascites was not an independent risk factor of organ space SSI (AOR, .88; P =.8). There was no increase in superficial SSI rate in patients with ascites (AOR, 1.01; P = .9; Table 2).

Table 2 Risk-adjusted analysis of outcomes associated with ascites in congestive heart failure patients who have undergone colon and rectal surgery

Complication	Patients without ascites (1983), n (%)	Patients with ascites (195), n (%)	*P* value	Adjusted odds ratio	95% confidence interval
No complication	Reference	Reference	—	—	—
Mortality	509 (25.7)	90 (46.2)	<.01	3.38	2.12 to 5.41
Overall morbidity	978 (49.3)	125 (64.1)	.03	1.65	1.03 to 2.65
Cardiopulmonary complications*	719 (36.3)	109 (55.9)	<.01	2.04	1.28 to 3.26
Nonmedically-related complications†	574 (28.9)	61 (31.3)	.92	.97	.59 to 1.59
Wound disruption	70 (3.5)	9 (4.6)	.049	2.44	1.005 to 5.93
Ventilator dependency	584 (29.5)	97 (49.7)	<.01	2.40	1.50 to 3.84
Acute renal failure	111 (5.6)	29 (14.9)	.02	2.18	1.08 to 4.39
Hospitalization >40 days	212 (10.8)	43 (22.3)	.01	2.14	1.19 to 3.82
Myocardial infarction	46 (2.3)	5 (2.6)	.31	1.77	.58 to 5.36
Urinary tract infection	128 (6.5)	14 (7.2)	.83	1.09	.47 to 2.49
Septic shock	255 (12.9)	35 (17.9)	.82	1.07	.56 to 2.03
Superficial SSI	124 (6.3)	8 (4.1)	.98	1.01	.38 to 2.64
Organ space SSI	89 (4.5)	14 (7.2)	.82	.88	.29 to 2.64
Unplanned intubation	269 (13.6)	28 (14.4)	.65	.85	.43 to 1.68
Cardiac arrest	119 (6)	9 (4.6)	.36	.61	.21 to 1.76
Deep incisional SSI	40 (2)	2 (1)	.61	.59	.7 to 4.59

SSI = surgical site infection.
*Ventilator dependency, myocardial infarction, cardiac arrest, and unplanned intubation.
†Wound disruption, urinary tract infection, septic shock, superficial SSI, organ space SSI, and deep incisional SSI.

Among the CHF patients who underwent colorectal resection, 1,035 (47.5%) were admitted emergently. The unadjusted mortality rate in emergently or nonemergently admitted patients was 39.7% and 16.4%, respectively, whereas the adjusted risk of mortality in emergently admitted patients was estimated to be 2 times greater than in patients without (AOR, 2.74; CI, 2.04 to 3.69; P < .01). Risk-adjusted analysis of complications associated with emergent admission compared with nonemergent admission in CHF patients has been reported in

Table 3.

Table 3 Risk-adjusted analysis of outcomes associated with emergent admission compared to nonemergent admission in congestive heart failure patients who have undergone colon and rectal surgery

Complication	Nonemergent admission (1,143), n (%)	Emergent admission (1,035), n (%)	*P* value	Adjusted odds ratio	95% confidence interval
No complication	Reference	Reference	—	—	—
Mortality	188 (16.4)	411 (39.7)	<.01	2.74	2.04 to 3.69
Overall morbidity	416 (36.4)	687 (66.4)	<.01	2.95	2.26 to 3.85
Cardiopulmonary complications*	245 (21.4)	583 (56.3)	<.01	3.56	2.69 to 4.70
Nonmedically related complications†	285 (24.9)	350 (33.8)	.01	1.44	1.08 to 1.91
Ventilator dependency	172 (15)	509 (49.2)	<.01	3.89	2.89 to 5.24
Acute renal failure	42 (3.7)	98 (9.5)	<.01	2.90	1.61 to 5.24
Septic shock	92 (8)	198 (19.1)	<.01	2.36	1.56 to 3.56
Cardiac arrest	39 (3.4)	89 (8.6)	.01	1.98	1.12 to 3.49
Unplanned intubation	129 (11.3)	168 (16.2)	<.01	1.79	1.22 to 2.61
Myocardial infarction	19 (1.7)	32 (3.1)	.06	2.12	.94 to 4.78
Wound disruption	29 (2.5)	50 (4.8)	.17	1.61	.81 to 3.21
Hospitalization > 40 days	90 (7.9)	165 (16.1)	.08	1.44	.94 to 2.21
Urinary tract infection	68 (5.9)	74 (7.1)	.79	.93	.58 to 1.51
Organ space SSI	52 (4.5)	51 (4.9)	.59	.83	.43 to 1.61
Superficial SSI	86 (7.5)	46 (4.4)	.13	.65	.37 to 1.14

SSI = surgical site infection.
*Ventilator dependency, myocardial infarction, cardiac arrest, and unplanned intubation.
†Wound disruption, urinary tract infection, septic shock, superficial SSI, organ space SSI, and deep incisional SSI.

Among the CHF patients who underwent colorectal resection, 339 patients (15.6%) underwent laparoscopic surgery. The unadjusted mortality rate in patients with open and laparoscopic colorectal procedures was 30.7% and 10.3%, respectively, whereas the adjusted risk of mortality in patients with open colorectal procedures was estimated to be more than 3.5 times that of patients without (AOR, 3.64; CI, 2.14 to 6.19; P <.01). Also, laparoscopic surgery was associated with fewer postoperative complications (Table 4).

Table 4 Risk-adjusted analysis of outcomes associated with open surgery compared to laparoscopic surgery in congestive heart failure patients who have undergone colon and rectal surgery

Complication	Laparoscopic surgery (339), n (%)	Open surgery (1839), n (%)	*P* value	Adjusted odds ratio	95% confidence interval
No complication	Reference	Reference	—	—	—
Mortality	35 (10.3)	564 (30.7)	<.01	3.64	2.14 to 6.19
Overall morbidity	93 (27.4)	1,010 (54.9)	<.01	2.46	1.71 to 3.55
Cardiopulmonary complications*	48 (14.2)	780 (42.4)	<.01	3.29	2.11 to 5.11
Nonmedically related complications†	67 (19.8)	568 (30.9)	.13	1.35	.91 to 2
Ventilator dependency	32 (9.4)	649 (35.3)	<.01	4.60	2.66 to 7.92
Cardiac arrest	6 (1.8)	122 (6.6)	.07	2.59	.91 to 7.31
Acute renal failure	9 (2.7)	131 (7.1)	.10	2.18	.85 to 5.59
Unplanned intubation	27 (8)	270 (14.7)	.052	1.76	.99 to 3.11
Septic shock	23 (6.8)	267 (14.5)	.08	1.74	.93 to 3.26
Hospitalization >40 days	17 (5)	238 (13)	.17	1.60	.80 to 3.21
Myocardial infarction	6 (1.8)	45 (2.4)	.63	1.30	.43 to 3.86
Urinary tract infection	16 (4.7)	126 (6.9)	.53	1.23	.63 to 2.40
Wound disruption	7 (2.1)	72 (3.9)	.88	1.07	.40 to 2.83
Organ space SSI	9 (2.7)	94 (5.1)	.83	.91	.39 to 2.12
Superficial SSI	23 (6.8)	109 (5.9)	.41	.76	.40 to 1.45

SSI = surgical site infection.
*Ventilator dependency, myocardial infarction, cardiac arrest, and unplanned intubation.
†Wound disruption, urinary tract infection, septic shock, superficial SSI, organ space SSI, and deep incisional SSI.

The most common preoperative abnormal laboratory value of CHF patients who underwent colorectal resection was hypoalbuminemia (67.4%) followed by prerenal azotemia (42.6%). Univariate analysis of the data shows that patients with ascites had higher hypoalbuminemia (odds ratio [OR], 3.27), hypernatremia (OR, 2.28), and prerenal azotemia (OR, 1.37). Preoperative abnormal laboratory values of patients are reported in Table 5.

Table 5 Univariate analysis of preoperative laboratory values associated with ascites in congestive heart failure patients who have undergone colon and rectal surgery

Preoperative laboratory values	Patients without ascites, n (%)	Patients with ascites, n (%)	*P* value	Odds ratio	95% confidence interval
Hypoalbuminemia*	1,299 (65.5)	168 (86.2)	<.01	3.27	2.16 to 4.97
Hypernatremia†	74 (3.8)	16 (8.2)	<.01	2.28	1.30 to 4.01
Prerenal azotemia‡	831 (41.9)	97 (49.7)	.03	1.37	1.02 to 1.84
Hematocrit less than 30%	464 (25)	55 (30.9)	.08	1.34	.95 to 1.87
Hyponatremia§	75 (3.8)	9 (4.6)	.57	1.22	.60 to 2.47

*Serum albumin level less than 3.5 g/dL.
†Serum sodium level higher than 145 mmol/L.
‡Serum blood urea nitrogen/creatinine ratio > 20.
§Serum sodium level less than 130 mmol/L.

Comments

Preoperative ascites in CHF patients who undergo colorectal resection is associated with a poor prognosis and a significant mortality rate, as well as an observed increase in length of stay. The in-hospital mortality rate of CHF patients undergoing a colorectal operation is very high (27.5%). For those with CHF and ascites, there is a significantly greater mortality rate of 42.6% (AOR, 3.38; P <.01). The higher rate of mortality in CHF patients with ascites can be best explained by the fact that 70% of such patients were admitted emergently. Emergency admission increases the mortality of patients by more than 2 times (AOR, 2.74; P <.01). Ascites was also associated with significantly increased morbidity and mean length of hospitalization, which is in line with the literature.[5]

This study reinforces the serious nature of ascites. Ascites is a well-known risk factor of postoperative mortality of patients with liver disease, which has been previously identified in the literature.[7,8] In liver disease, uncontrolled ascites is an important part of the Child-Turcotte-Pugh classification that makes surgeons avoid elective operations when the Current Procedural Terminology scores are high.7,8 This study, with an observed 42.6% mortality rate in CHF patients with ascites, reinforces the strong associations between ascites and postoperative complications. Avoiding elective operations in CHF patients with ascites and attempting to correct the ascites before surgery seem reasonable. However, further studies are indicated to see if aggressive treatment of ascites in CHF patients will decrease complications.

Over the 9-year study period, the mortality rate of patients with ascites was higher than patients without ascites (Fig. 1).We also identified a steady decrease in mortality and morbidity of patients with or without ascites after 2010, which may be related to better perioperative care (Fig. 1).

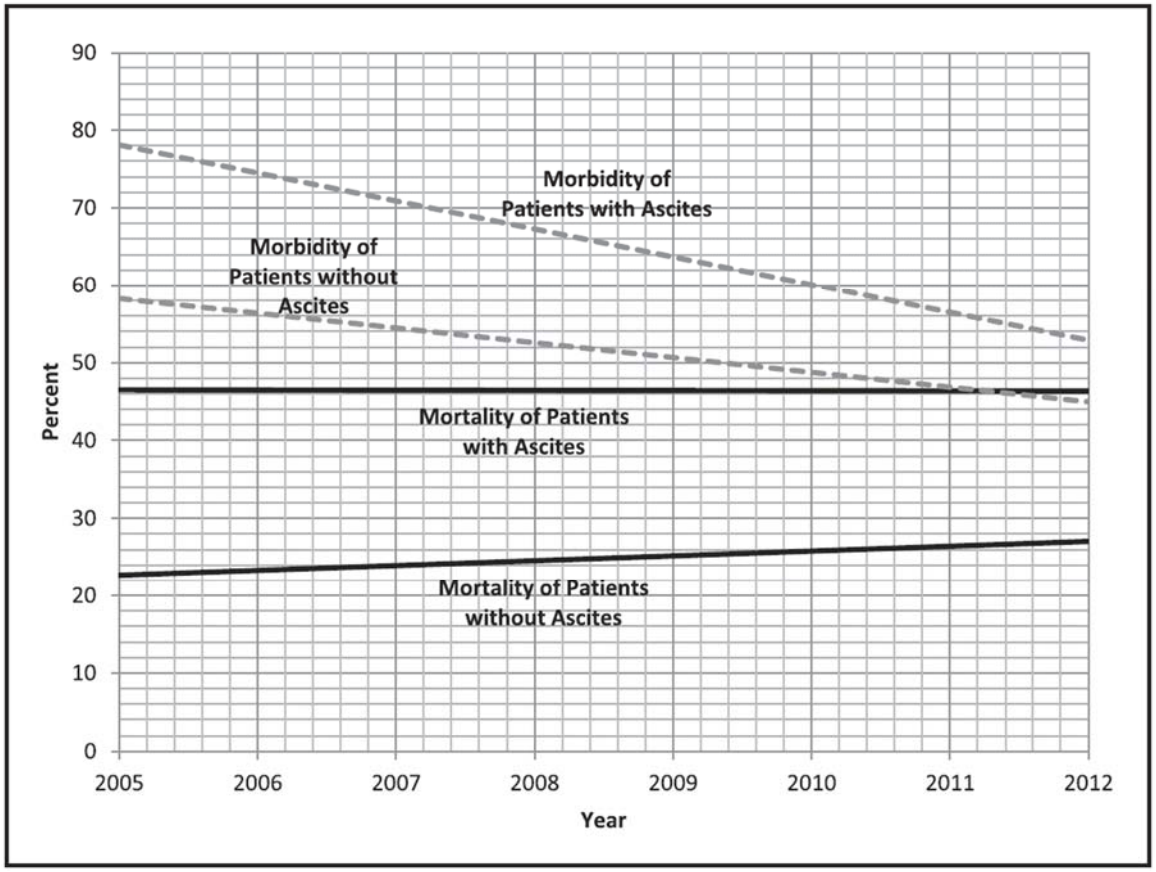

Figure 1 Mortality and morbidity in congestive heart failure patients who underwent colorectal resections.

This analysis demonstrates that ascites in CHF patients is a significant risk factor for postoperative complications after colorectal operations, an observation supported by the literature.4,5 Considering data on postoperative complications, we identified 4 with obvious correlation with ascites (ventilator dependency . 48 hours, ARF, prolonged hospitalization, and wound disruption). Our study confirmed the previously reported correlation between ascites and respiratory complications.[1,2]

The highest correlation between ascites and postsurgical complications exists in wound disruption. Specific consideration should be made for prevention or early recognition and immediate treatment of wound disruption associated with ascites. Patients with ascites had more than 2 times the rate of wound disruption in this study. This is related to hypoalbuminemia, which was more common in patients with ascites than other CHF patents (OR, 3.27; $P < .001$). We confirmed an earlier report of ascites as a risk factor of wound dehiscence by Riou9 in CHF patients.

Interestingly, we found that ascites is not a risk factor for wound infections in CHF patients. Although previous reports have observed ascites as a risk factor of wound infection, we did not find any correlation between ascites with superficial or deep incisional SSI in CHF patients.[2]

Controlling the ascites in CHF patients undergoing colorectal surgery may help prevent ventilator dependency. Ventilator dependency more than 48 hours, with an

overall incidence of 31.3%, is the most common postoperative complication of CHF patients in colorectal surgery. A higher incidence rate of ventilator dependency in CHF patients attributed to pulmonary alveolar edema has previously been reported.[12]

Patients with ascites have an increased risk of postoperative renal failure. Patients with ascites in our study had a 2 times higher rate of postoperative renal failure compared with patients without ascites. This might be related to the higher rate of prerenal azotemia in patients with ascites that we observed (OR, 1.37; P = .03). Further studies are indicated to see if treatment of prerenal azotemia and ascites in CHF patients will decrease the complication of renal failure in colorectal surgery. Patients with comorbidity of CHF who are emergently admitted and received colorectal resection have more than 2 times higher mortality and morbidity rates compared with nonemergently admitted patients. Also, the risk of postoperative ventilator dependency increases by more than 3 times in CHF patients who were admitted emergently. Considering that 47.5% of CHF patients in our study were admitted emergently, preventing emergency surgery in CHF patients when possible and improved perioperative care might decrease mortality and morbidity of such patients. However, there are limited data regarding this subject, and further studies are indicated to quantify effects of aggressive and advanced perioperative care in urgently admitted CHF patients.

Laparoscopic surgery appears to offer advantages compared with open procedures in CHF patients similar to healthier patients. Although most CHF patients undergo open surgery, laparoscopic procedures were used in 15.6% of colorectal procedures. Laparoscopic surgery has lower mortality and postoperative complications compared with open procedures (Table 4). We confirm the study of Kang et al,13 who reported the safety of laparoscopic surgery in high-risk patients.

Controlling ascites in CHF patients undergoing colorectal surgery may help prevent cardiopulmonary complications in colorectal surgery. Although overall nonmedically related complications are not significantly increased in patients with ascites, cardiopulmonary complications have significant association with preoperative ascites. Similarly, emergent admission (compared to nonemergent admission) and open surgical technique (compared to laparoscopic technique) have stronger associations with increased cardiopulmonary complications compared with the nonmedically related complications (Tables 1–3). Further studies are indicated to see if aggressive treatment of ascites and using a minimally invasive approach in CHF patients can decrease complications, especially cardiopulmonary complications.

Finally, this study, by excluding patients with stage 4 cancer and only including patients with comorbidity of CHF, reports the associations between a cardiogenic source of ascites and postoperative complications. Associations between other benign (liver or renal disease) or malignant sources of ascites and postoperative complications are unclear. Further studies are indicated to see if there is any difference between the sources of ascites regarding the postoperative complication rate.

Study limitations

This study is a retrospective review and is subject to typical biases for retrospective studies such as selection bias. Data in this study were extracted from the NSQIP database, which collects data from over 500 hospitals in the United States of

America, and there is a wide variation in hospital setting, hospital quality, surgical strategy, and surgeons' expertise, which can confound the study. In addition, NSQIP does not provide information regarding some potentially important postoperative complications that may have correlations with ascites (ie, abdominal compartment syndrome1). Patients in this study had up to 4 different nonhomogeneous primary diagnoses that can confound the study. Also, information regarding the severity of CHF in our patients was not available and this may have an effect on mortality and morbidity of the patients. In fact, ascites may be a marker of severity of CHF that could not be completely controlled for with our risk adjustment. Because patients cannot be tracked in NSQIP, we do not have information of outcomes beyond 30 days, and evaluation of long-term outcomes is not feasible Also, coding errors may exist because of the use of discharge data.14 NSQIP database does not include some procedure-specific details, such as the use of drains in surgery and prophylactic antibiotics, which may impact risk for infection.1,15 Despite these limitations, this study is the first to report on postoperative complications of ascites in CHF patients who underwent colorectal surgery.

Conclusions

The presence of ascites in CHF patients undergoing colorectal surgery is associated with a greater than 3-fold increase in mortality. Ascites is also independently associated with significant increases in overall morbidity and length of hospital stay. Postoperative complications of wound dehiscence, ARF, and ventilator dependency have independent associations with ascites. We observed no association between ascites and SSI or intra-abdominal infection. Although laparoscopic procedures only accounted for 15.6% of colorectal procedures in patients with CHF, outcomes were improved in this cohort.

References

1. Brunicardi FC, Andersen DK, Billiar TR, et al. Schwartz's Principles of Surgery. 10th ed. New York: McGraw-Hill Education; 2014.

2. Townsend CM, Sabiston DC. Sabiston Textbook of Surgery: the Biological Basis of Modern Surgical Practice. 17th:xxv, 2388 p. ill. (some col.) 2329 cm. 1 2381 CD-ROM (2384 2383/2384 in.). Philadelphia: Elsevier Saunders.

3. National Nosocomial Infections Surveillance (NNIS) System Report, Data Summary from January 1992-June 2001, issued August 2001. Am J Infect Control 2001;29:404–21.

4. Cone MM, Herzig DO, Diggs BS, et al. Effect of surgical approach on 30-day mortality and morbidity after elective colectomy: a NSQIP study. J Gastrointest Surg 2012;16:1212–7.

5. Longo WE, Virgo KS, Johnson FE, et al. Risk factors for morbidity and mortality after colectomy for colon cancer. Dis Colon Rectum 2000;43:83–91.

6. Meunier K, Mucci S, Quentin V, et al. Colorectal surgery in cirrhotic patients: assessment of operative morbidity and mortality. Dis Colon Rectum 2008;51:1225–31.

7. Mansour A, Watson W, Shayani V, et al. Abdominal operations in patients with cirrhosis: still a major surgical challenge. Surgery 1997; 122:730–5; discussion 735–736.

8. Friedman LS. Surgery in the patient with liver disease. Trans Am Clin Climatol Assoc 2010;121:192–204; discussion 205.

9. Riou JP, Cohen JR, Johnson H. Factors influencing wound dehiscence. Am J Surg 1992;163:324–30.

10. National Surgical Quality Improvement Program [home page on the Internet] Chicago, IL: American College of Surgeons; 2005. [cited 2014 Jan 17]. Available at: www.acsnsqip.org.

11. Moghadamyeghaneh Z, Mills SD, Pigazzi A, et al. Risk factors of postoperative upper gastrointestinal bleeding following colorectal resections. J Gastrointest Surg 2014;18:1327–33.

12. Ji Q, Duan Q, Wang X, et al. Risk factors for ventilator dependency following coronary artery bypass grafting. Int J Med Sci 2012;9:306–10.

13. Kang CY, Halabi WJ, Chaudhry OO, et al. A nationwide analysis of laparoscopy in high-risk colorectal surgery patients. J Gastrointest Surg 2013;17:382–91.

14. Lorence DP, Ibrahim IA. Benchmarking variation in coding accuracy across the United States. J Health Care Finance 2003;29:29–42.

15. Murray BW, Huerta S, Dineen S, et al. Surgical site infection in colorectal surgery: a review of the nonpharmacologic tools of prevention. J Am Coll Surg 2010;211:812–22.

The authors declare no conflicts of interest.
Presented as an oral presentation at the Southwestern Surgical Congress, April 16, 2014.
* Corresponding author. Tel.: 11-714-456-6262; fax: 11-714-456-6377.
E-mail address: mstamos@uci.edu