Deep organ space infection after emergency bowel resection and anastomosis: The anatomic site does not matter

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BACKGROUND: Deep organ space infection (DOSI) is a serious complication after emergency bowel resection and anastomosis. The aim of this study was to identify the incidence and risk factors for the development of DOSI.

METHODS: National Surgical Quality Improvement Program database study including patients who underwent large bowel or small bowel resection and primary anastomosis. The incidence, outcomes, and risk factors for DOSI were evaluated using univariate and multivariate analyses.

RESULTS: A total of 87,562 patients underwent small bowel, large bowel, or rectal resection and anastomosis. Of these, 14,942 (17.1%) underwent emergency operations and formed the study population. The overall mortality rate in emergency operations was 12.5%, and the rate of DOSI was 5.6%. A total of 18.0% required ventilatory support in more than 48 hours, and 16.0% required reoperation. Predictors of DOSI included age, steroid use, sepsis or septic shock on admission, severe wound contamination, and advanced American Society of Anesthesiologists classification. The anatomic location of resection and anastomosis was not significantly associated with DOSI.

CONCLUSION: Patients undergoing emergency bowel resection and anastomosis have a high mortality, risk of DOSI, and systemic complications. Independent predictors of DOSI include wound and American Society of Anesthesiologists classification, sepsis or septic shock on admission, and steroid use. The anatomic location of resection and anastomosis was not significantly associated with DOSI. (*J Trauma Acute Care Surg*. 2015;79: 805–811. Copyright © 2015 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Epidemiologic/prognostic study, level III.

KEY WORDS: Deep organ space infection; emergency general surgery; anastamosis.

Intestinal pathology is one of the most common causes of acute surgical admission, accounting for more than one third of the total surgical admissions from the emergency department.[1,2] These pathologies span a wide range of disease processes including diverticulitis, appendicitis, malignancies, small or large bowel obstruction, inflammatory bowel disease, and proctologic disease, many of which ultimately require surgical intervention. Complications related to intestinal resection and anastomoses generate significant morbidity including superficial wound and deep space infections and anastamotic dehiscence.[3–7]

Most studies describing the contributing conditions and risk factors for the development of surgical infections are based on data from elective or semielective operations. Increasing body mass index (BMI), long-term preoperative glycemic control, smoking, and location of colonic operation have been identified as risk factors for postoperative surgical infections.[4,6,8] Patients who present with emergency surgical needs, however, likely represent a distinct patient population. They are often sicker, have peritonal contamination, have less well-compensated comorbid conditions, and have less opportunity for preoperative optimization.

In the current analysis, we used the American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP) database to provide a large patient sample size to investigate risk factors for and distribution of infectious complications after emergency bowel anastomoses. Although surgical site infections (SSIs) have potential to cause significant morbidity, we chose to focus on intra-abdominal or deep infections, described as "deep organ space infections" or DOSI, because these infections after bowel anastomoses are more commonly associated with anastamotic dehiscence or intra-abdominal catastrophe that result in a significant deviation of the clinical plan. This study was designed to characterize the risk factors for developing DOSI after emergency bowel anastamosis and to better understand the factors that influence outcomes in this population.

PATIENTS AND METHODS

We conducted a retrospective review of the ACS NSQIP database from 2005 to 2010. The ACS NSQIP is a validated, deidentified surgical database the collects preoperative demographics and potential risk factors, intra-operative variables, and postoperative data regarding 30-day outcomes. Approval was obtained from the Los Angeles County Hospital + University of Southern California Institutional Revision Board. Patients were selected using current procedural terminology (CPT) codes for large bowel, small bowel, and rectal anastamoses (Table 1). Patients with ostomy creation were eliminated from the analysis. Patients who underwent emergency operations were extracted. Pediatric patients (age < 16 years) were excluded from the analysis. Patients that underwent proctectomy for congenital megacolon or repair of rectal prolapse (codes 45120, 45125, and 45130) were excluded because of the differing underlying pathology associated with these operations. Patients who developed DOSI, defined by NSQIP as an infection within 30 days after operation, related to the operation, and involving anatomy that was manipulated during the operation excluding the incision, were identified.

TABLE 1. CPT Codes Used for Data Abstraction

CPT Code	Code Description
44120	Enterectomy, resection of small intestine; single resection and anastomosis
44125	Enterectomy, resection of small intestine; single resection and anastomosis with enterostomy
44140	Colectomy, partial; with anastomosis
44145	Colectomy, partial; with coloproctostomy (low pelvic anastomosis)
44160	Colectomy, partial, with removal of terminal ileum with ileocolostomy
44204	Laparoscopy, surgical; colectomy, partial, with anastomosis
44205	Laparoscopy, surgical; colectomy, partial, with removal of terminal ileum with ileocolostomy
44207	Laparoscopy, surgical; colectomy, partial, with anastomosis, with coloproctostomy (low pelvic anastomosis)
45113	Laparoscopy, surgical; mobilization (take-down) of splenic flexure performed in conjunction with partial colectomy
45114	Proctectomy, partial, with anastomosis; abdominal and transacral approach
45116	Proctectomy, partial, with anastomosis; transacral approach only

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Demographics, comorbidities, and preoperative conditions as diabetes mellitus, history of alcohol or smoking ("current smoker within 1 year" and alcohol intake as more than two drinks per day in 2 weeks before admission), congestive heart failure, hypertension requiring medications, renal failure, steroid therapy, weight loss, chemotherapy or radiotherapy, and overall morbidity burden as classified by American Society of Anesthesiologists (ASA) score. Systemic inflammatory response syndrome (SIRS), sepsis, and septic shock on admission were also included (http://site.acsnsqip.org/wp-content/uploads/2012/03/2011-User-Guide_Final.pdf). Operative factors included open or laparoscopic operation, type of anastamosis performed, and wound classification (clean, clean/contaminated, contaminated and dirty/infected).

Many of the postoperative complications reported in the ACS NSQIP database were evaluated: superficial and deep infection, wound disruption, deep venous thrombosis/pulmonary embolism, urinary tract infection, progressive renal insufficiency, acute renal failure, ventilator for more than 48 hours, sepsis, shock, return to the operating room, hospital length of stay (LOS), and mortality.

Statistical Analysis

Normality of distribution of continuous variables was assessed using histograms, skewness, and the Shapiro-Wilk test.

Patient characteristics, operative variables, and outcome as well as variables of patients undergoing non-emergency and emergency surgery and patients with or without DOSI were compared in univariable analysis. Categorical variables were analyzed using Fisher's exact or Pearson's χ^2 test. Continuous variables were compared using the Mann-Whitney U-test. $p < 0.05$ was considered statistically significant.

The effect of the anatomic location of resection and anastomosis on DOSI was further analyzed in the emergency cohort using backward stepwise likelihood ratio logistic regression analysis. Clinically important predictor variables were correlated with DOSI using Pearson's and Spearman's correlation and entered in the regression model if the p value was less than 0.05. The degree of multicolinearity between predictor variables was assessed using the variance inflation factor (VIF) and Pearson's correlation. A VIF less than 5 and a Pearson's correlation coefficient less than 0.5 were assumed to exclude significant colinearity. Results were reported as odds ratio (OR) and 95% confidence interval (CI). The regression model performance was assessed using Hosmer-Lemeshow statistics and the area under the receiver operating characteristic curve (AUROC) of the predicted probability of DOSI and mortality.

Statistical analyses were performed using IBM SPSS Statistics for Mac, version 20.0 (IBM Corp., Armonk, NY).

RESULTS

Population

A total of 87,562 patients who met inclusion criteria were identified to have had small bowel, large bowel, or rectal anastomoses as defined by CPT code (Table 1). Of these, 14,942 underwent emergency operation defining our study population (Table 2). Hypertension, smoking, and diabetes were common comorbidities (n = 8,233, 55.1%; n = 3,143, 21.0%; n = 2,396,

TABLE 2. Demographic, Preoperative and Intraoperative Variables, and Outcome Measures in Patients Undergoing Emergency and Nonemergency Intestinal Anastamoses

	Emergency (n = 14,942)	Nonemergency (n = 72,620)	p*
Male sex	6,655 (44.6)	33,983 (46.9)	<0.001
BMI, kg/m^2**	25.8 (8.3)	27.2 (7.8)	<0.001†
Diabetes	2,396 (16.0)	10,404 (14.3)	<0.001
Smoke	3,143 (21.0)	13.098 (18.0)	<0.001
>2 drinks of alcohol	566 (3.8)	2,476 (3.4)	0.011
Congestive heart failure	523 (3.5)	710 (1.0)	<0.001
Hypertension	8,233 (55.1)	37,110 (51.1)	<0.001
Renal failure	604 (4.0)	221 (0.3)	<0.001
Steroid therapy	1,100 (7.4)	3,449 (4.7)	<0.001
Weight loss	850 (5.7)	3,729(5.1)	0.003
Chemotherapy	411 (2.8)	954 (1.3)	<0.001
Radiotherapy	128 (0.9)	1,115 (1.5)	<0.001
SIRS/sepsis	5,816 (38.9)	3,656 (5.0)	<0.001
Septic shock	1,511 (10.1)	246 (0.3)	<0.001
ASA score			
1	544 (3.8)	2,378 (3.3)	<0.001
2	3,723 (25.7)	35,665 (49.2)	
3	6,417 (44.3)	31,068 (42.8)	
4	3,806 (26.3)	3,396 (4.7)	
Approach			
Open	14,105 (94.4)	44,061 (60.7)	<0.001
Laparoscopy	837 (5.6)	28,559 (39.3)	<0.001
Anastomosis			
LB-LB	4,432 (29.7)	33,632 (46.3)	<0.001
SB-LB	2,575 (17.2)	14,540 (20.0)	
SB-SB	7,445 (49.8)	9,431 (13.0)	
S/LB-R	490 (3.3)	15,017 (20.7)	
Wound classification			
2	6,578 (44.0)	60,391 (83.2)	<0.001
3	3,314 (22.2)	7,851 (10.8)	
4	5,050 (33.8)	4,378 (6.0)	
Superficial infection	1,399 (9.4)	6,036 (8.3)	<0.001
Deep infection	382 (2.6)	1,059 (1.5)	<0.001
Wound disruption	465 (3.1)	1,048 (1.4)	<0.001
DOSI	835 (5.6)	2,606 (3.6)	<0.001
Deep venous thrombosis	462 (3.1)	904 (1.2)	<0.001
Pulmonary embolism	175 (1.2)	468 (0.6)	<0.001
Urinary tract infection	658 (4.4)	2,440 (3.4)	<0.001
Progressive renal insufficiency	206 (1.4)	497 (0.7)	<0.001
Acute renal failure	431 (2.9)	456 (0.6)	<0.001
Ventilator > 48 h	2,693 (18.0)	1,926 (2.7)	<0.001
Sepsis	1,141 (7.6)	3,158 (4.3)	<0.001
Septic shock	1,323 (8.9)	1,499 (2.1)	<0.001
Return to operating room	2,392 (16.0)	4,148 (5.7)	<0.001
Hospital LOS, d**	9 (11)	6 (5)	<0.001†
Mortality	1,873 (12.5)	1,378 (1.9)	<0.001

*Fisher's exact test unless indicated otherwise.
**Values are medians (interquartile ranges).
†Mann-Whitney U-test.
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16.0%, respectively), and more than 70% of patients had ASA classification of 3 or 4. SIRS or sepsis were common on admission, present in 5,816 patients (38.9%). The majority of patients underwent open operations (n = 14,105, 94.4%), with small bowel–to–small bowel anastomosis (SB-SB) being the most common (n = 7,445; 49.8%), followed by large bowel–to–large bowel (LB-LB, n = 4,432; 29.7%), small bowel–to–large bowel (SB-LB, n = 2,575; 17.2%), and small or large bowel–to–rectum (S/LB-R, n = 490; 3.3%). In these emergent cases, more than 50% of the wounds were classified as contaminated (Class 3, n = 3,314, 22.2%) or dirty/infected (Class 4, n = 5,050, 33.8%).

DOSI was identified in 5.6% of patients undergoing emergency bowel anastomosis and in 3.6% of patients undergoing elective bowel anastomoses ($p < 0.001$). Overall, patients undergoing emergency operation were sick with a median hospital LOS of 9 days, 18.0% required assisted ventilation for greater than 48 hours, 16.0% underwent repeat operation, and there was a 12.5% mortality rate.

Comorbidities and incidence of preoperative sepsis and shock were significantly higher in patients undergoing emergency operation (Table 2). Emergency surgery patients were more likely to have an open operation, and wound classification was more likely to be contaminated or infected. As expected from the preoperative differences, postoperative complications including infectious, organ failure, repeat operation, hospital LOS, and mortality were all significantly higher in patients after emergency operation.

Deep Organ Space Infection

On univariate analysis of patients undergoing emergency operations (Table 3), patients who developed DOSI were more likely to have presented with SIRS/sepsis or septic shock (44.1% vs. 38.6%, $p = 0.002$ and 15.1% vs. 9.8%, $p < 0.001$, respectively). Several preexisting conditions including history of steroid use or weight loss were significantly more common in patients who developed DOSI, and the overall ASA classification was higher in this population. Interestingly, there was no statistical difference in the distribution of anastamotic type in those who developed DOSI. Absolute rates of DOSI were highest after SB-SB (5.8%), followed by LB-LB (5.6%), S/LB-R (5.5%), and SB-LB (5.1%) anastamosis. There were significantly more patients who developed DOSI after dirty/infected Class 4 wounds. Postoperative complications were more common in those who developed DOSI including a higher rate of sepsis and shock (32.9% vs. 6.1%, $p < 0.001$ and 26.5% vs. 7.8%, $p < 0.001$, respectively), higher incidence of deep venous thrombosis and pulmonary embolism (6.0% vs. 2.9% and 2.2% vs. 1.1%, $p < 0.001$, respectively), and more frequent return to the operating room (50.9% vs. 13.9%, $p < 0.001$). Despite these differences, mortality in the patients who had documented DOSI was not higher. As DOSI is a diagnosis made later in the hospital course, any mortality before the diagnosis would be classified in the "no DOSI" group. In the study population, many of the DOSIs were recognized at greater than 10 days after operation, while much of the mortality occurred in the first 10 days. This outcome is likely biased by the early mortality rates in the sicker, high-risk patients who may have expired before the diagnosis of DOSI; however, these data are not sufficient to assess cause or contributors to mortality.

TABLE 3. Demographic, Preoperative and Intraoperative Variables, and Outcome Measures in Patients With Emergency Operations Who Did and Did Not Develop DOSI

	Non DOSI (n = 14,107)	DOSI (n = 835)	p*
Male sex	6,236 (44.3)	419 (50.3)	<0.001
BMI, kg/m^2**	25.8 (8.3)	26.4 (9.7)	0.014†
Diabetes	2,269 (16.1)	127 (15.1)	0.526
Smoke	2,911 (20.6)	232 (27.8)	<0.001
>2 drinks of alcohol	523 (3.7)	43 (5.1)	0.036
Congestive heart failure	501 (3.6)	22 (2.6)	0.179
Hypertension	7,788 (55.2)	445 (53.3)	0.283
Renal failure	565 (4.0)	39 (4.7)	0.323
Steroid therapy	1,000 (7.1)	100 (12.0)	<0.001
Weight loss	779 (5.5)	71 (8.5)	<0.001
Chemotherapy	379 (2.7)	32 (3.8)	0.058
Radiotherapy	119 (0.8)	9 (1.1)	0.438
SIRS/sepsis	5,448 (38.6)	368 (44.1)	0.002
Septic shock	1,385 (9.8)	126 (15.1)	<0.001
ASA classification			
1	525 (3.8)	19 (2.4)	<0.001
2	3,565 (26.1)	158 (19.6)	
3	6,028 (44.0)	389 (48.3)	
4	3,567 (26.1)	239 (29.7)	
Approach			0.010
Open surgery	13,300 (94.3)	805 (96.4)	
Laparoscopy	807 (5.7)	30 (3.6)	
Anastomosis			
LB-LB	4,186 (29.7)	246 (29.5)	0.620
SB-LB	2,444 (17.3)	131 (15.7)	
SB-SB	7.014 (49.7)	431 (51.6)	
S/LB-R	463 (3.3)	27 (3.2)	
Wound classification			
2	6,314 (44.8)	264 (31.6)	<0.001
3	3,141 (22.3)	173 (20.7)	
4	4,652 (33.0)	398 (47.7)	
Superficial infection	1,318 (9.3)	81 (9.7)	0.719
Deep infection	353 (2.5)	29 (3.5)	0.085
Wound disruption	364 (2.6)	101 (12.1)	<0.001
Deep venous thrombosis	412 (2.9)	50 (6.0)	<0.001
Pulmonary embolism	157 (1.1)	18 (2.2)	<0.001
Urinary tract infection	589 (4.2)	69 (8.3)	<0.001
Progressive renal insufficiency	179 (1.3)	27 (3.2)	<0.001
Acute renal failure	388 (2.8)	43 (5.1)	<0.001
Ventilator > 48 h	2,368 (16.8)	325 (38.9)	<0.001
Sepsis	866 (6.1)	275 (32.9)	<0.001
Septic shock	1,102 (7.8)	221 (26.5)	<0.001
Return to operating room	1,967 (13.9)	425 (50.9)	<0.001
Hospital LOS, d**	9 (10)	23 (25)	<0.001†
Death	1,785 (12.7)	88 (10.5)	<0.001

*Fisher's exact test unless indicated otherwise.
**Values are medians (interquartile ranges).
†Mann-Whitney U-test.
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Multivariate Analysis

Multivariate analysis was performed to identify independent risk factors for developing DOSI after emergency

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operation (Table 4). Steroid use, sepsis, or septic shock on admission were predictors of DOSI (OR, 1.540, $p = 0.001$; OR, 1.336, $p = 0.006$; OR, 1.521, $p = 0.001$). The presence of diabetes, however, was not a predictor of DOSI. Although diabetes was not an independent predictor, overall morbidity burden was shown to affect DOSI rates with an approximately two times higher incidence of DOSI in patients ASA 3 and 4 (table 4). In addition, degree of wound contamination at the time of surgery was noted to be an independent predictor of developing DOSI, with increased rate of DOSI in patients with Class 4 wound cases (OR, 1.593; $p < 0.001$). On stepwise regression, the type or location of anastamosis was excluded as a predictor of developing DOSI.

No significant multicolinearity was detected between the predictor variables of the regression models. The VIF was smaller than 2.0 and the Pearson's correlation coefficient was smaller than 0.5 for all variables included in the regression analysis. The performance of the regression model is shown in Table 4.

DISCUSSION

DOSI remains an important complication after emergency bowel anastomoses, occurring after 5.6% of operations. Patients who develop DOSI have a significantly higher rate of postoperative complications, sepsis, and need for repeat operation. Several risk factors for developing DOSI were identified including steroid use, sepsis or septic shock on admission, contaminated wounds, and advanced ASA classification. After emergency operation, the location of bowel anastomosis was not a predictor of DOSI.

The identification and prevention of superficial SSI have been the topic of significant policy and reform during the past decade. The developments of superficial SSI and DOSI, however, are separate entities, with different implications on outcome and with likely different risk factors. For example, in a 2013 NSQIP analysis,[4] BMI was a much stronger predictor of SSI, whereas steroid use and radiation were more likely to predict DOSI. While significant focus has been placed on the prevention of superficial infections, few studies distinguish between these and the deeper organ space infections. In the current analysis of emergency operations, DOSI rates were influenced by steroid use, sepsis or septic shock, ASA classification, and level of wound contamination at the time of operation. Identification of risk factors specific to deep infections will be integral as further root-cause analyses are performed to improve surgery-specific patient outcomes.

TABLE 4. Risk Factors for DOSI in Patients Undergoing Emergency Surgery

	OR	95% CI (Lower/Upper)	p
Age	0.987	0.982–0.992	<0.001
ASA score			
ASA 1 (reference group)			<0.001
ASA 2	1.230	0.74–2.045	0.424
ASA 3	2.023	1.223–3.348	0.006
ASA 4	1.848	1.095–3.122	0.022
Wound class			
Wound Class 2 (reference group)			<0.001
Wound Class 3	1.164	0.94–1.440	0.164
Wound Class 4	1.593	1.324–1.916	<0.001
Smoker	1.160	0.974–1.382	0.096
Steroid use	1.540	1.216–1.950	<0.001
Operative time	1.003	1.002–1.004	<0.001
Sepsis at admission	1.336	1.085–1.645	0.006
Septic shock at admission	1.521	1.176–1.967	0.001

Backward stepwise logistic regression analysis.
Regression model performance: AUROC = 0.660 (95% CI, 0.641–0.679; $p < 0.001$), Hosmer-Lemeshow test: $\chi^2 = 14.900$, $df = 8$, $p = 0.061$.

Traditionally, colonic anastamosis are considered the most tenuous, while small bowel anastamoses are thought to be the most forgiving. In the present analysis, location of bowel anastamosis after emergency operation was not an independent risk factor for developing DOSI. However, a potential selection bias exists as patients selected for ostomy creation at the time of index operation are not included in the analysis. Conventional surgical management would suggest that patients with colonic injury, significant contamination, comorbidities, or instability would be more likely to receive an end or diverting ostomy and thus be excluded from the present analysis. These data, however, show that the lowest absolute rates of DOSI occurred after SB-LB and S/LB-R anastamoses. On univariate and multivariate analyses, the anastamotic location was not a predictor of DOSI, while the traditional factors thought to contribute to DOSI such as ASA score and steroid use achieved significance. Further prospective evaluation of the influence of anastamotic location on outcome after emergency surgery is warranted.

Although anastamotic dehiscence was not specifically investigated in this analysis, the majority of the current literature describing postoperative infectious complications after emergency bowel anastomosis stems from the analysis of anastamotic breakdown. The literature describing risk factors for anastamotic dehiscence, similar to other infectious complications, is largely based on elective cases, with very few series investigating the complications after emergency operation. After elective operation, male sex, steroid use, malnutrition, obesity, ASA, intra-abdominal contamination, operation length, postoperative blood transfusion and crystalloid resuscitation, and location of anastamosis are some of the many risk factors that have been associated with anastamotic dehiscence and postoperative infection.[6,7,9–15] Although emergency operations were not specified, in a study of 707 patients with colonic anastamoses, leukocytosis and sepsis were found to be independent risk factors for anastamotic dehiscence,[11] suggesting that the factors contributing to an emergency operation may influence anastamotic integrity. In addition, anastamotic dehiscence is associated with an increased hospital and intensive care unit LOS, cost, and mortality.[3,13,14]

The current literature regarding emergent intestinal anastamoses focuses primarily on procedure selection and anastamotic dehiscence. In an analysis of 197 patients with colon injury caused by trauma, level of contamination and transfusion requirements were found to influence outcome; however; the decision to perform a diversion did not improve morbidity, concluding that primary anastamosis is a safe alternative in most emergency conditions.[16] Similarly, in a National Trauma Data

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Bank study of colon injuries, the authors analyzed 6,817 patients with colonic trauma treated with a combination of primary repair, diversion, and anastomosis. On multivariate analysis, diversion was not an independent predictor of morbidity or mortality.[17] In an NSQIP analysis of emergency operation for colonic diverticulitis, no difference in mortality or SSIs was noted in those treated with primary anastomosis versus Hartman procedure.[18] The subset of patients with enteric operations managed with an open abdomen, however, may be more likely to benefit from diversion.[19] In a 2011 Western Trauma Association study[20] of 204 patients with enteric injury and open abdomen, the authors report a 17% intra-abdominal abscess rate and a 7% anastamotic leak rate. Although no specific preoperative or intraoperative parameter was linked to postoperative leak, the authors did caution that patients with persistent open abdomen, greater than 5 days, or those with left-sided injuries may be more likely to develop anastamotic dehiscence. In the current analysis, patients who required repeat operation were significantly more likely to develop DOSI (50.9% vs. 13.9%, $p < 0.001$), further suggesting that this population is likely at higher risk and consideration should be taken with operative decision making.

There are several limitations in this study. Most importantly, the patient population was selected based on operation type. This introduced an inherent bias in comparing those who underwent emergent and nonemergent operations, as many surgeons would favor ostomy creation in the sickest of emergent cases, thus causing that patient to fall out of our analysis. Despite this, however, the emergency surgery population was significantly sicker on presentation when compared with the nonemergency population. Second, the use of DOSI as a surrogate marker for clinically significant intra-abdominal infectious complication is open to interpretation. Although defined as a deep, nonincisional infection involving the operative field, reporting of DOSI may be variable and may represent a spectrum of infectious complications. Finally, a significant limitation is in the mortality data with the reported mortality of those with DOSI significantly lower than those without. This finding is likely influenced by the fact that a significant percentage of reported mortality occurs in the early postoperative period. As DOSI is a diagnosis made within 30 days of operation and most commonly not made in the first few postoperative days, early mortality after emergency surgery that may be secondary to intra-abdominal sepsis will not be captured in this cohort. In the current analysis, a significant percentage of patient mortality was within 48 hours of operation with the time of DOSI diagnosis significantly later. Similarly, on the regression model, increasing age was not a predictor of DOSI, a finding most likely influenced by an increase in early mortality of older patients.

To our knowledge, this is the first analysis of the risk factors and outcomes of deep space infection after emergency surgery. DOSI, even after emergency surgery, is not common, occurring in 5.6% of patients; however, the presence of DOSI is associated with an increased rate of postoperative complications including sepsis and need for repeat operation. Risk factors for developing DOSI include steroid use, sepsis or septic shock on admission, contaminated operative wound, and ASA classification. The type of anastamosis did not contribute to the rate of DOSI. Further understanding of the risk factors for and outcomes after DOSI in emergency surgery patients can be used in the intraoperative decision-making process and in the development of quality improvement measures to minimize surgical patient infection-related morbidity.

AUTHORSHIP

S.S. and E.B. performed the literature search. D.D. and E.B. provided the study design. S.S. performed the data collection. S.S., T.H., E.B., and D.D. performed the data analysis. S.S., E.B., T.H., L.L., K.I., and D.D. performed the data interpretation. S.S., E.B., T.H., and D.D. wrote the article. E.B., L.L., T.H., K.I., and D.D. provided critical revision.

DISCLOSURE

The authors declare no conflicts of interest.

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