

# Non-malignant left colon emergency surgery: evaluation of factors affecting clinical outcomes and complications

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## ABSTRACT

**BACKGROUND:** Emergency colorectal resections hold a significant position in general surgical practice, and pathologies of the left colon are relatively common. This study was conducted to assess the outcomes of isolated left colon surgeries with benign etiologies, drawing on clinicopathological and biochemical data.

**METHODS:** We carried out a retrospective review and statistical analysis of demographic, clinical, and laboratory data of patients who underwent left colon surgery at the general surgery clinic of a tertiary care hospital, excluding those with malignancy-related emergencies, from January 2017 to January 2022.

**RESULTS:** The average age of the 48 patients in the study was  $56.9 \pm 16.4$  years. Complicated acute diverticulitis was the most frequent indication for emergency surgery ( $n=19$ , 39.6%). The Hartmann procedure was the surgical technique most often employed ( $n=30$ , 62.5%). The rates of postoperative morbidity and mortality within 30 days were 27.1% and 8.3%, respectively. Increased postoperative morbidity was linked to advanced age (mean  $65.4 \pm 15.8$  vs.  $53.8 \pm 15.7$ ,  $p=0.028$ ), the preoperative administration of vasopressors, lower platelet counts, hypoalbuminemia ( $<3$  mg/dl), and azotemia (blood urea nitrogen  $>20$  mg/dl). There was no statistically significant correlation between comorbidities, American Society of Anesthesiologists (ASA) scores, surgical methods, or other clinical data and postoperative outcomes.

**CONCLUSION:** For emergency colorectal surgery pertaining to left colon pathologies, it is critical to conduct a comprehensive evaluation in the perioperative period, especially for elderly and hypotensive patients with renal function abnormalities and for those requiring vasopressors.

**Keywords:** Colon resection; emergency general surgery; mortality; surgical complications.

## INTRODUCTION

Emergency left colon surgery is commonly performed for both colorectal malignancies and benign conditions such as diverticular disease, colonic volvulus, inflammatory bowel disease, and blunt and penetrating trauma. Although methods like Hartmann's procedure, colon resection and anastomosis, and primary repair are utilized in surgical treatments, debates continue over the ideal surgical approach. The adaptability of the laparoscopic method, now broadly recognized in elec-

tive surgeries, to emergency contexts is well-documented, with reported advantages in postoperative mortality, morbidity, and hospitalization duration.<sup>[1]</sup> It is also acknowledged that emergency laparoscopic colorectal surgery is typically undertaken by seasoned colorectal surgeons in high-volume centers.<sup>[2]</sup>

Many studies have reported that emergency colorectal surgery carries a significant risk of mortality and morbidity due to factors such as inadequate bowel preparation, contamination, and bacterial proliferation.<sup>[3,4]</sup> This risk correlates with vari-

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ous elements, including the patient's clinical status, comorbidities, and the underlying cause of the disease. Moreover, emergency situations like obstruction, perforation, bleeding, etc., associated with colorectal malignancy are included in numerous studies as risk factors. Nonetheless, this study focuses on examining postoperative outcomes and identifying clinicopathologic and biochemical factors that may contribute to morbidity and mortality in emergency left colon surgeries conducted for non-malignant reasons.

## MATERIALS AND METHODS

This retrospective study was conducted at a tertiary-care university hospital and adhered to the Declaration of Helsinki as revised in 2013. Approval was obtained from the Gülhane Hospital Clinical Research Ethics Committee (Date: 07.06.2023, Decision No: 2023/128).

The study comprised 48 patients aged 18 years and older who underwent emergency left colon surgery for conditions such as intestinal obstruction, diverticulitis, sigmoid volvulus, blunt and penetrating trauma (excluding other solid and luminal organ injuries), iatrogenic left colon perforations, and other acute abdominal causes within the general surgery clinic of a tertiary care hospital from January 2017 to January 2022. Cases involving colorectal malignancy emergencies, elective surgeries, and patients with incomplete follow-up data were omitted.

Data on age, gender, body mass index (BMI), comorbidity, American Society of Anesthesiologists (ASA) score, the interval from symptom onset to surgery, reason for surgery, intraoperative exploratory findings, surgical technique, duration of operation, blood/blood product transfusion, use of vasopressor agents, length of hospital stay, intensive care unit admission, and laboratory results were extracted from patient files. Postoperative mortality (within 30 days) and morbidity were assessed, and clinicopathological factors potentially linked to these outcomes were statistically scrutinized.

### Statistical Analysis

Data analyses were performed using IBM SPSS Statistics version 25.0 software (IBM Corp., Armonk, NY, USA). Categorical data were presented as numbers and percentages, normally distributed continuous variables as means and standard deviations, and non-normally distributed variables as medians with minimum-maximum values. The normality of distribution for continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests prior to further analyses. Following the distribution tests, normally distributed continuous variables were examined using Student's t-test, while non-normally distributed variables were evaluated using the Mann-Whitney U test. Categorical variables were compared utilizing Fisher's Exact test and the Chi-square test. In the statistical analysis, comparisons yielding a p-value less than 0.05 were deemed to indicate statistical significance.

**Table 1.** Descriptive, clinical, and laboratory characteristics of patients

Characteristics	Number (percentage)
Age*	56.9±16.4
Gender	
Female	20 (41.7)
Male	28 (58.3)
BMI (kg/m2)*	26.1±2.9
Comorbidity	18 (37.5)
HT	14 (29.2)
Cardiovascular	7 (14.6)
DM	6 (12.5)
COPD	2 (4.2)
ASA score	
II	27 (56.3)
III	19 (39.6)
IV	2 (4.2)
Symptom-surgical duration	
< 6 hours	10 (20.8)
6-24 hours	6 (12.5)
24-72 hours	20 (41.7)
> 72 hours	12 (25.0)
Diagnosis (indication for emergency surgery)	
Acute diverticulitis	19 (39.6)
Sigmoid volvulus	15 (31.3)
Iatrogenic colon injury	7 (14.6)
Traumatic injury (GSI/Penetrating Trauma)	4 (8.3)
Other	3 (6.3)
Laboratory	
WBC*	14.3±3.8
Neutrophil*	11.8±3.7
Platelet*	250±84
Hemoglobin*	12.9±1.9
Albumin*	3.1±0.3
CRP**	114 (8-531)
BUN**	16 (7-42)
Hypoalbuminemia (<3mg/dl)	17 (35.4)
Azotemia (BUN >20 mg/dl)	13 (27.1)

\*Mean ± Standard Deviation, \*\* Median (minimum-maximum). BMI: body mass index, HT: hypertension, DM: diabetes mellitus, COPD: chronic obstructive pulmonary disease, ASA: American Society of Anesthesiologists, GSI: gunshot injury, WBC: white blood cell count, CRP: C-Reactive protein, BUN: Blood Urea Nitrogen

## RESULTS

The average age of the patients was  $56.9 \pm 16.4$  years, with a range of 23 to 89 years. A total of 64.6% of the patients were over the age of 65. The male-to-female ratio was 1.4:1. Around one-third of the patients (37.5%) had comorbid conditions. Regarding the time from symptom onset to surgery, 20.8% were operated on within less than 6 hours, while surgery was performed after more than 72 hours in 25% of the cases. Acute diverticulitis was the most frequent emergency surgery indication, representing 39.6% of the cases. Laboratory evaluations showed hypoalbuminemia in 35.4% and azotemia in 27.1% of the patients (refer to Table 1).

The Hartmann procedure was the surgical method used in the majority of cases (62.5%). Other surgical interventions included resection and anastomosis (14.6%), primary repair (16.7%, with 3 open and 5 laparoscopic), laparoscopic lavage (4.2%), and primary repair with diverting colostomy (2.1%). Three-quarters of the patients required intensive care unit admission. Postoperative complications were observed in 27.1% of patients, with surgical site infections being the most common (10.4%). Mortality was recorded in 4 patients (8.3%) within 30 days after surgery (see Table 2).

Among those who died within 30 days postoperatively, diagnoses included acute diverticulitis (n=2) and sigmoid volvulus (n=2). The Hartmann procedure was performed in 3 of these patients, and resection and anastomosis in one. Causes of mortality were fecal peritonitis and septicemia (documented in Table 3).

Demographic, clinical, and laboratory characteristics potentially associated with postoperative complications were examined. Patients with postoperative complications were found to have a higher average age ( $p=0.028$ ) and elevated blood urea nitrogen levels ( $p<0.001$ ), as well as increased frequencies of hypoalbuminemia ( $p=0.006$ ) and azotemia ( $p<0.001$ ), and a reduced platelet count ( $p=0.009$ ) (as shown in Table 4).

**Table 2.** Surgical technique and prognosis-related characteristics of patients

Characteristics	Number (Percentage)
Emergency surgical technique	
Hartmann procedure	30 (62.5)
Resection+anastomosis	7 (14.6)
Primary repair	8 (16.7)
Laparoscopic lavage	2 (4.2)
Primary repair+diverting colostomy	1 (2.1)
Surgical duration (minutes)*	120 (60-210)
Exploratory findings	
Diffuse purulent/fecal peritonitis	20 (41.7)
Perforation	15 (31.3)
Ischemia and necrosis	13 (27.1)
Blood/blood product usage	7 (14.6)
Use of vasopressor agents	9 (18.8)
Duration of hospitalization (days)*	8 (2-42)
ICU hospitalization	36 (75.0)
Postoperative complications	13 (27.1)
Surgical site infection	5 (10.4)
Postoperative ileus	2 (4.2)
Stoma-associated ischemia and necrosis	2 (4.2)
Stoma-associated mucocutaneous separation	2 (4.2)
Anastomotic leakage	1 (2.1)
Wound dehiscence/evisceration	1 (2.1)
Clavien-Dindo classification	
Class I	6 (12.5)
Class II	1 (2.1)
Class IIIa	1 (2.1)
Class IIIb	5 (10.4)
Mortality (within 30 days)	4 (8.3)

\* Median (min-max). ICU: Intensive care unit.

**Table 3.** Characteristics of patients with mortality

Number of Patient	Age	Gender	American Society of Anesthesiologists Score	Comorbidity	Diagnosis	Complication	Hypoalbuminemia	Azotemia	Emergency surgical technique	Blood/blood product transfusion	Surgical duration (minutes)	Vasopressor agent usage	Hospitalization (days)	Intensive Care Unit administration
1	61	Male	III	-	Acute diverticulitis	-	-	-	Hartmann procedure	-	100	+	2	+
2	82	Male	III	+	Sigmoid volvulus	-	+	+	Hartmann procedure	+	150	+	6	+
3	74	Female	III	+	Sigmoid volvulus	+	+	+	Hartmann procedure	-	180	+	22	+
4	80	Male	III	-	Acute diverticulitis	+	+	+	Resection + anastomosis	-	120	+	14	+

**Table 4.** Comparison of descriptive characteristics according to the presence of postoperative complications

	Postoperative complication (+) (n=13) Number (percentage)	Postoperative complication (-) (n=35) Number (percentage)	p value
Age*	65.4±15.8	53.8±15.7	0.028 <sup>†</sup>
Gender			0.784 <sup>††</sup>
Female	5 (38.5)	15 (42.9)	
Male	8 (61.5)	20 (57.1)	
BMI (kg/m <sup>2</sup> )*	27.3±3.7	25.6±2.5	0.081 <sup>†</sup>
Comorbidity	7 (53.8)	11 (31.4)	0.190 <sup>†††</sup>
ASA grade score			0.057 <sup>††</sup>
II	6 (46.2)	21 (60.0)	
III	5 (38.5)	14 (40.0)	
IV	2 (15.4)	0	
Symptom-surgical duration			0.497 <sup>†††</sup>
< 24 hours	3 (23.1)	13 (37.1)	
> 24 hours	10 (76.9)	22 (62.9)	
Diagnosis (indication for emergency surgery)			0.562 <sup>††</sup>
Acute diverticulitis	5 (38.5)	14 (40.0)	
Sigmoid volvulus	4 (30.8)	11 (31.4)	
Iatrogenic colon injury	1 (7.7)	6 (17.1)	
Traumatic injury (GSI/Penetrating Trauma)	1 (7.7)	3 (8.6)	
Other	2 (15.4)	1 (2.9)	
Laboratory			
WBC*	14.9±4.3	14.1±3.7	0.507 <sup>†</sup>
Neutrophil*	12.6±4.1	11.5±3.6	0.376 <sup>†</sup>
Platelet*	199±60	269±84	0.009 <sup>†</sup>
Hemoglobin*	12.2±1.7	13.2±1.9	0.119 <sup>†</sup>
Albumin*	2.8±0.3	3.2±0.3	<0.001 <sup>†</sup>
CRP**	137 (45-259)	92 (8-531)	0.147 <sup>†††</sup>
BUN**	24 (16-34)	14 (7-42)	<0.001 <sup>††††</sup>
Hypoalbuminemia (<3mg/dl)	9 (69.2)	8 (22.9)	0.006 <sup>†††</sup>
Azotemia (BUN >20 mg/dl)	9 (69.2)	4 (11.4)	<0.001 <sup>†††</sup>

\*Mean ± Standard Deviation, \*\*Median (minimum-maximum). BMI: body mass index; ASA: American Society of Anesthesiologists score; GSI: gunshot injury; WBC: white blood cell count; CRP: C-Reactive protein; BUN: Blood urea nitrogen. <sup>†</sup>Student t-test; <sup>††</sup>Chi-square test; <sup>†††</sup>Fisher Exact test; <sup>††††</sup>Mann-Whitney U test.

The use of vasopressor agents was more prevalent ( $p=0.007$ ) in patients with postoperative complications, who also experienced a longer hospital stay ( $p<0.001$ ) (refer to Table 5).

## DISCUSSION

Left colon surgery holds a significant role in both elective and emergency surgical practices due to its diverse indications. Emergency colorectal resections, however, are associated with higher morbidity and mortality rates compared to elective procedures. Factors that improve outcomes in elec-

tive colorectal resection include the trend towards minimally invasive surgery, scheduled intensive care, and adherence to Enhanced Recovery After Surgery (ERAS) protocols.<sup>[5]</sup> Emergency surgeries of the left colon are often necessitated by mechanical obstruction and perforation, with perioperative management becoming complicated by factors such as dehydration, fluid-electrolyte imbalances, and sepsis. The predominance of pathologies such as obstructive colonic malignancies, diverticular disease, and volvulus in the descending and sigmoid colon is well-established in literature, and these findings have been extensively discussed.<sup>[6-8]</sup> Notably, our current

**Table 5.** Comparison of surgical technique and prognosis-related characteristics of patients according to the presence of postoperative complications

	Postoperative complication (+) (n=13) Number (percentage)	Postoperative complication (-) (n=35) Number (percentage)	p value
Emergency surgical technique			0.132 <sup>†</sup>
Hartman procedure	8 (61.5)	22 (62.9)	
Resection+anastomosis	4 (30.8)	3 (8.6)	
Primary repair	0	8 (22.9)	
Laparoscopic lavage	1 (7.7)	1 (2.9)	
Primary repair+diverting colostomy	0	1 (2.9)	
Surgical duration (minutes)*	120 (90-210)	120 (60-210)	0.375 <sup>††</sup>
Exploratory findings			0.908 <sup>†</sup>
Diffuse purulent/fecal peritonitis	6 (46.2)	14 (40.0)	
Perforation	4 (30.8)	11 (31.4)	
Ischemia and necrosis	3 (23.1)	10 (28.6)	
Blood/blood product usage	3 (23.1)	4 (11.4)	0.370 <sup>†††</sup>
Use of vasopressor agents	6 (46.2)	3 (8.6)	0.007 <sup>†††</sup>
Duration of hospitalization (days)*	13 (7-42)	7 (2-12)	<0.001 <sup>††</sup>
Intensive care unit administration	12 (92.3)	24 (68.6)	0.139 <sup>†††</sup>

\*Median (minimum-maximum). <sup>†</sup>Chi-square test, <sup>††</sup>Mann-Whitney U test, <sup>†††</sup>Fisher Exact test.

study excluded left colon malignancies and instead focused on surgical outcomes for benign conditions.

A multicenter study evaluating emergency colorectal resections found postoperative morbidity and mortality rates of 48% and 15.3%, respectively.<sup>[9]</sup> In contrast, our study reported lower rates of 27.1% and 8.3%, which are within acceptable margins. Aligning with literature, the leading non-malignant cause for surgery was diverticular disease, whose rising incidence in our population may be attributed to changes in dietary habits.<sup>[10,11]</sup> The Hartmann procedure emerged as the most frequently employed surgical technique. Key considerations in selecting the surgical approach include the patients' clinical and hemodynamic statuses, intraoperative findings, and the availability of an experienced colorectal surgeon. It has been reported that resection and anastomosis may be safely performed during emergencies, even amid peritonitis.<sup>[12-14]</sup> In our study, resection and anastomosis were performed in a small subset of patients (n=7, 14.6%), with one case of mortality due to septicemia from anastomotic leakage.

Furthermore, in a randomized controlled trial comparing laparoscopic lavage to primary resection for acute perforated diverticulitis, no significant long-term difference in severe complications was found, though the laparoscopic lavage group showed a higher rate of recurrence, often necessitating subsequent sigmoid resection.<sup>[15]</sup> Within our cohort, laparoscopic lavage was conducted in two cases of acute perforated

diverticulitis, resulting in one instance of a deep surgical site infection that required percutaneous drainage postoperatively, albeit without reaching statistical significance.

Iatrogenic colonic perforation is a rare yet severe complication of colonoscopy. Early surgical intervention for source control can prevent fecal peritonitis and sepsis. Recent studies indicate that the laparoscopic approach, an increasingly preferred method, is both safe and effective.<sup>[16,17]</sup> Like many laparoscopic procedures, its benefits include reduced postoperative pain, shortened hospital stays, and a quicker resumption of normal activities. Laparoscopic primary repair was successfully executed in 71.4% (5 out of 7) of patients with iatrogenic colonic perforation, with only one patient developing a superficial surgical site infection after open primary resection and anastomosis. The relatively lower postoperative morbidity, compared to that from emergency interventions for acute diverticulitis, sigmoid volvulus, and other causes, can often be ascribed to timely diagnosis and prompt surgical response.

Our study identified statistically significant factors correlated with postoperative morbidity, including older age (mean 65.4±15.8 vs. 53.8±15.7, p=0.028), preoperative use of vasopressor agents due to hemodynamic instability, lower platelet counts, hypoalbuminemia (<3 mg/dl), and azotemia (urea >20 mg/dl). These factors-especially the vulnerability of older patients, delays in diagnosis and surgery, and existing co-

morbidities-were influential in postoperative morbidity and mortality. Consistent with our findings, a 462-patient study by Skala K. et al.<sup>[10]</sup> reported associations between high ASA scores, colonic ischemia, and stoma formation with increased postoperative morbidity. Similarly, a multicenter study of 439 patients found stoma creation, open abdomen management, and intraoperative blood transfusions linked to morbidity; additionally, preoperative vasopressor and steroid use, as well as intraoperative transfusions, were significant predictors of mortality.<sup>[11]</sup> Other research aligning with our results highlighted the significance of low serum albumin, elevated blood urea nitrogen levels, and hypotension requiring perioperative vasopressor support.<sup>[18,19]</sup> It should be noted, however, that these studies include a wider range of colorectal surgeries and patients with colonic malignancies, in contrast to the present study's focus on isolated left colon surgeries.

The main limitations of our study are its retrospective nature and relatively small sample size. Due to the limited number of mortality cases, a comprehensive analysis and prognostic assessment were not feasible; hence, findings are primarily descriptive. Additionally, the surgical procedures were not performed by a single general surgeon.

## CONCLUSION

In conclusion, the demographic, clinical, and biochemical data identified as significant in this study have the potential to aid colorectal surgeons in predicting prognoses and implementing necessary precautions. We underscore the necessity for guidance derived from comprehensive meta-analyses and randomized controlled trials to effectively reduce postoperative mortality and morbidity.

**Ethics Committee Approval:** This study was approved by the Gülhane Training and Research Hospital Ethics Committee (Date: 07.06.2023, Decision No: 2023/128).

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## ORİJİNAL ÇALIŞMA - ÖZ

## Non-malignan acil sol kolon cerrahisi: klinik sonuçlar ve komplikasyonlar üzerine etkili faktörlerin değerlendirilmesi

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**AMAÇ:** Acil kolorektal rezeksiyonlar genel cerrahi pratiğinde önemli yer tutmakta ve sol kolon yerleşimli patolojiler azımsanmayacak ölçüde görülmektedir. Çalışmamızda, benign etiyojili izole sol kolon cerrahisi sonuçlarını klinikopatolojik ve biyokimyasal veriler üzerinden değerlendirmeyi amaçladık.

**GEREÇ VE YÖNTEM:** Üçüncü basamak bir hastane genel cerrahi kliniğinde, Ocak 2017-Ocak 2022 tarihleri arasında malignite acilleri haricinde sol kolon cerrahisi yapılan hastaların, demografik, klinik ve laboratuvar verileri retrospektif olarak taranarak istatistiksel analizi yapıldı.

**BULGULAR:** Çalışmaya dahil edilen 48 hastanın yaş ortalaması  $56.9 \pm 16.4$  yıl idi. En sık acil cerrahi endikasyonu komplike akut divertikülit idi ( $n=19$ , %39.6). En sık yapılan cerrahi teknik Hartmann prosedürüydü ( $n=30$ , %62.5). Postoperatif morbidite ve mortalite (30 gün içinde) oranımız sırasıyla %27.1 ve %8.3 idi. İleri yaş (ortalama  $65.4 \pm 15.8$ 'e karşın  $53.8 \pm 15.7$ ,  $p=0.028$ ), preoperatif vazopressör ajan kullanımı, daha düşük trombosit düzeyleri, hipoalbuminemi ( $<3$  mg/dl) ve azotemi (üre  $>20$  mg/dl) artmış postoperatif morbiditeyle ilişkiliydi. Komorbidite, American Society of Anesthesiologists (ASA) skoru, cerrahi teknik ve diğer klinik veriler ile postoperatif sonuçlar arasında istatistiksel anlamlılık bulunamadı.

**SONUÇ:** Sol kolon patolojileri nedeniyle yapılan acil kolorektal cerrahide; yaşlı, böbrek fonksiyon anormallığı olan ve vazopressör kullanımı gerektiren hipotansif hastaların perioperatif süreçte kapsamlı değerlendirilmeleri gerekmektedir.

**Anahtar sözcükler:** Acil genel cerrahi; cerrahi komplikasyonlar; kolon rezeksiyonu; mortalite.

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