original article

Surgical outcomes and prognostic factors associated with emergency left colonic surgery

Dauda Bawa,[a] Yasser Mohammad Khalifa,[a] Saleem Khan,[a] Waddah Norah,[b] Nibras Noman[c]

From the [a]Department of Surgery, King Abdullah Hospital Bisha, Rlyadh, Saudi Arabia; [b]Department of Surgery, Haql General Hospital, Haql, Tabuk, Saudi Arabia; [c]Department of Surgery, University of Liverpool, Merseyside, United Kingdom

Correspondence: Dr. Dauda Bawa · Department of Surgery, King Abdullah Hospital Bisha, Riyadh 67714, Saudi Arabia · bawos211@yahoo.com · ORCID: https://orcid.org/0000-0003-0293-4782

Citation: Bawa D, Khalifa MK, Khan S, Norah W, Noman N. Surgical outcomes and prognostic factors associated with emergency left colonic surgery. Ann Saudi Med 2023; 43(2): 97-104. DOI: 10.5144/0256-4947.2023.97

Received: November 20, 2022

Accepted: February 2, 2023

Published: April 6, 2023

Funding: None.

BACKGROUND: Mortality from emergency left-sided colorectal surgery can be substantial due to acuteness of the presentation and the urgent need to operate in the setting of a limited preparation in a morbid patient.

OBJECTIVES: Determine the 30-day postoperative outcomes and identify risk factors for complications and mortality following emergency colorectal operations.

DESIGN: Retrospective

SETTINGS: Three tertiary hospitals in three countries.

PATIENTS AND METHODS: Factors that were studied included age, sex, ASA score, type and extent of the operation, and presence/absence of malignancy. Unadjusted 30-day patient outcomes examined were complications and mortality. Differences in proportions were assessed using the Pearson chi-square test while logistic regression analyses were carried out to evaluate the correlation between risk factors and outcomes.

MAIN OUTCOME MEASURES: 30-day postoperative morbidity and mortality

SAMPLE SIZE: 104 patients.

RESULTS: Among 104 patients, 70 (67.3%) were men, and 34 (32.7%) were women. The mean (SD) age was 57.2 (17.1) years. The most common indication for emergency colonic surgery was malignant obstruction in 33 (31.7%) patients. The postoperative complication rate was 24% (25/104), and the mortality rate was 12.5% (13/104) within 30 days of the operation. The ASA status (P=.02), presence of malignancy (P=.02), and the presence of complications (P=.004) were significantly related to mortality in the multivariable logistic regression analysis.

CONCLUSIONS: The 30-day mortality of emergency colorectal operations is greatly influenced by the presence of malignancy in the colon and physiological status at the time of the procedure.

LIMITATIONS: The retrospective design and small sample size.

CONFLICT OF INTEREST: None.

Emergency colorectal surgery is commonly encountered by general surgeons in acute care settings. The indications are wide-ranging, from trauma and inflammation to ischemia and cancer. Common indications for distal colonic emergency surgical intervention in sub-Saharan and North Africa include malignant obstruction, sigmoid volvulus, and iatrogenic and non-iatrogenic trauma. In Saudi Arabia and other Gulf countries, diverticular disease and cancer are also seen frequently, mainly due to population growth, Westernization of diets, longer lifespans, changing risk factors, and diagnosis and identification of cancer because of screening and registration.[1-3] The increased frequency of diagnostic and therapeutic endoscopy has been accompanied by increased perforations, and with it, the prevalence of complications.[4]

Most emergency surgeries on the colon are for mechanical large bowel obstruction (LBO). Over three-quarters of colonic obstruction occurs at the descending and sigmoid colon where the caliber of the lumen is reduced significantly, and the fecal material is somewhat solid.[5,6] This also happens to be where diverticular disease and malignancy are most prevalent. The most common causes of LBO in the United States are colorectal adenocarcinoma, colonic diverticula, and volvulus, occurring with an estimated prevalence of 50%, 20%, and 10% respectively.[7] Acute LBO frequently presents with sepsis, dehydration, and hemodynamic instability. Complications associated with colonic perforation from diverticulitis and trauma are related to bacterial or fecal peritonitis which is life-threatening. Moreover, colorectal cancer, ischemic colitis, inflammatory bowel disease, and specific infections can cause colonic perforation.

Patients who present with LBO or perforation may be advanced in age, often with comorbidities, malnutrition, dehydration, and they may be anemic. The acute nature of the presentation, and the urgent need to relieve obstruction or control sepsis, necessarily means that limited or no preparation is done prior to surgery in many cases. Abbreviated resuscitation periods in which thorough review and medical management of comorbidities along with a comprehensive risk assessment are foregone in favor of emergency surgical intervention. This poses a challenge to surgical management, including approach and technique, and may lead to an increase in postoperative morbidity and mortality.

The literature is flooded with studies on various risk factors that have been reported as significant risk indicators for postoperative mortality from emergency colorectal surgeries. Some factors are modifiable while some are not. Examples of unmodifiable risk factors include comorbidity and age. However, there is insufficient evidence to reliably link many potentially modifiable risk factors in emergency left colonic and rectal surgery to postoperative morbidity and mortality. In general, the mortality rate following colorectal surgery ranges from 1 to 16.4%[8-11] and morbidity rates as high as 35% have also been reported.[8,9,12]

Outcomes are closely related to the adequacy of resuscitation and the quality of surgery. The extent and type of surgery are usually determined by the colorectal lesion and disease severity, which also depend on the availability of resources, expertise, and preferences of the surgeon.[13] To positively impact surgical outcomes, surgeons must have mastered many technically difficult colon surgeries in both emergency and elective settings. The standard surgical treatment approach is continually debated and evolving.[13] The authors sought to determine surgical outcomes and risk factors for complications and mortality among patients who underwent emergency surgery to treat colorectal diseases at centers in Saudi Arabia, Egypt and Nigeria.

PATIENTS AND METHODS

We collected data from patient records in the surgical units at King Abdullah Hospital (Saudi Arabia), Zagazig University Hospital (Egypt) and Dalhatu Araf Specialist Hospital (Nigeria). Before the analyses each database was reviewed, and all data inputs were double-checked by a single consultant surgeon to guarantee accuracy. Emergency cases were those who presented with acute symptoms and were admitted to the hospital without planned investigations or treatments, and emergency operations were those surgeries without the usual detailed preliminary planning. Patients who had iatrogenic left colonic perforation during colonoscopy were classified as having presented with a left colonic emergency. Among the surgical indications were cancer, diverticular disease, ischemic colitis, inflammatory bowel disease, iatrogenic injury, trauma, sigmoid volvulus following failed detorsion, and stercoral peritonitis. Factors that were studied included age, sex, American Society of Anesthesiology (ASA) score, type of operation, presence of postoperative complications, the extent of operation or staging of operation, and disease origin (presence/absence of malignancy). Prior to surgery, patients were evaluated using clinical examinations, blood tests, abdominal ultrasound, computed tomography with contrast enema as necessary, and abdominal and chest radiography. The respective Ethical Research Committees gave

their approval to each participating surgeon and the study was carried out in accordance with the Helsinki declaration.

Inclusion criteria were emergency cases involving male and female patients undergoing emergency operations, with ASA scores of I to IV, with the anatomical location from the distal transverse colon to the rectum. Exclusion criteria were patients with ASA score V, stage IV colonic cancer, and incomplete data or data acquisition errors. Colonic injuries with other significant visceral injuries were excluded.

The lesion's location dictated the procedure that was carried out. If a complex lesion was located at or close to the splenic flexure, a left hemicolectomy or extended right colectomy with ileocolic anastomosis was performed. When lesions distal to the splenic flexure were present, an anterior rectal resection or left hemicolectomy was carried out. Resection and primary anastomosis with intraoperative colonic lavage for the therapy of left colonic emergencies were the first options for surgery. According to the surgeon's evaluation, several high-risk patients had protective ileostomies done (e.g., steroid-dependent treatment, and fecal peritonitis in fit patients). In high-risk patients (septic shock, fecal peritonitis), alternative techniques like terminal ileostomy, Hartmann procedure, bowel bypass, or colostomy were used. There were no laparoscopic procedures and no stenting carried out in this series.

Unadjusted 30-day patient outcomes examined were complications, treatment, and mortality. In every patient with diversion, the colostomy/ileostomy was closed after a minimum of 8 weeks following the first surgery. Postoperative mortality was defined as any death that took place within the first 30 postoperative or hospital days, regardless of the amount of time that passed between the initial procedure and the death.

The statistical analyses were carried out using IBM SPSS version 28.0. (Armonk, New York, United States: IBM Corp). The Pearson chi-square test was used to assess differences in proportions. A *P* value of .05 or lower was taken to denote statistical significance in a two-sided test. The Fisher exact test was used when sample sizes were small. Multivariable logistic regression was used to examine the relationship between possible prognostic variables and 30-day complications and mortality. To identify independent risk factors, the variables linked to early complications and mortality with a *P* value <.1were analyzed in the logistic regression models.We emphasize that modeling survival in this cohort was exploratory and not meant to inform clinical practice.

RESULTS

In the period spanning 1 January 2013 through 31 December 2016, 116 patients underwent emergency surgery for colorectal diseases across the three centers involved in the study. Inclusion criteria were satisfied for 104 who had undergone emergency surgery for colonic perforation (**Table 1**). There were 70 (67.3%) men and 34 (32.7%) women with a mean age of 57.2 (17.1) years. The most common indication for emergency colonic surgery was malignant obstruction in 33 (31.7%), followed by sigmoid diverticulitis with perforation or abscess in 17 (16.3%) patients. Twenty-seven (26.0%) patients required diversions and/or repairs without resection and 77 (74.0%) required resections, with or without diversion (**Table 2**). On further analysis, colectomy with diversion was performed in 35 (33%) of the patients; resection and primary anastomosis in 30 (28.6%), and resection and primary anastomosis with covering colostomy or ileostomy in 12 (11.4%). Hartmann's operation was performed in 10 (9.5%) of the patients; defunctioning colostomy, or ileostomy in 9 (8.6%), and bowel decompression and primary repair in 8 (7.6%).There were 25 (24%) postoperative complications within 30 days of the operation and a mortality rate of 12.5% (13/104). The commonest complication was an anastomotic leak in 5 (11.9%) and the least common complication was pneumonia in 1 (1%) patient.

There were no significant correlations between age, sex, malignancy, and the type of emergency operation or 30-day complications by univariate and multivariate analysis (**Tables 3 and 4**). Among the risk factors for mortality were ASA score above Grade II (*P*=.02), the presence of malignancy (*P*=.02), and the presence of complications with substantially increased odds ratios for risk of death (*P*=.004). Age above 65 years was associated with a mortality rate of 21.9% compared to age below 65, which was associated with a mortality rate of 8.3% (*P*=.06).

DISCUSSION

The rate of early complications was 24%, and the mortality rate was 12.5 % in our study. Ingrahram et al compared the outcomes of 31 848 patients who underwent elective and emergency colorectal surgery in 142 hospitals and discovered that the elective cases had a morbidity rate of 23.9% and a mortality rate of 1.9%, while the emergency cases had a morbidity and mortality rates of 48% and 15.3%, respectively.[14]

Univariate analysis demonstrated that 30-day postoperative complications were independent of age, sex, malignancy, and the type of emergency

Table 1. Patient demographic and clinical characteristics (n=104).

Characteristics	
Age	
≤65	72 (69.2)
>65	32 (30.8)
Race	
Black African	30 (28.9)
Arab	69 (66.3)
Other Asian	5 (4.8)
ASA Grade Score	
I	21 (20.2)
II	33 (31.7)
III	36 (34.6)
IV	14 (13.5)
Indications for operation	
Diverticular perforation/abscess	17 (16.3)
Malignant colonic obstruction	33 (31.7)
Iatrogenic perforation	10 (9.6)
Sigmoid volvulus	15 (14.4)
Non-iatrogenic colonic trauma	15 (14.4)
Diverticular stricture	6 (5.8)
Ischemic colitis	3 (2.9)
Malignant colonic perforation	5 (4.8)
Emergency surgical procedures	
Hartmann's procedure	10 (9. 5)
Resection and primary anastomosis	30 (28.6)
Colectomy, primary anastomosis, and colostomy/ileostomy	12 (11.4)
Colectomy and stoma	35 (33.3)
Defunctioning colostomy/ileostomy	9 (8 .6)
Primary repair and bowel decompression	8 (7.6)
Complications	
Anastomotic leak	5 (11.9)[a]
Prolonged ileus	3 (2.9)
Abdominal wound dehiscence	2 (1.9)
Venous thromboembolism	2 (1.9)
Intra-abdominal abscess	3 (2.9)
Intestinal obstruction	4 (3.8)
Hemorrhage	1 (1.0)
Wound sepsis	4 (3.8)
Pneumonia	1 (1.0)

Data are n (%). ASA: American Society of Anesthesiology. [a]From a total of 42 resections and primary anastomoses.

operation. However, the presence of complications was a significant determinant of mortality in our study (*P*=.002). The most common indication for emergency colonic surgery in our study was malignancy (obstruction in 33 and perforation in 5 patients). The frequency of malignancy as a reason for emergency colonic surgery varies between 7% and 40%, but a value of around 30% is presented in most papers in the literature.[15] This is not surprising since an estimated 20% of colorectal cancer cases are present as emergencies. Despite screening programs, there is no question that the rising age-standardized rates, incident case counts, and deaths from colorectal cancer in Africa, the Gulf, and other regions of the world have led to a trend in large cities for a rise in the frequency of emergent presentation from colorectal disorders.[16-18] Emergency presentation is an independent poor prognostic indicator for significant morbidity and mortality rates and decreased overall survival.[19-21]

Our findings suggest that the presence of malignancy is an independent risk factor for 30-day postoperative mortality (*P*=.02). The implication of this finding is in the approach to management. Management of acute left-side malignant colonic obstruction (LMCO) and perforation remains controversial.[15,22] The 2017 World Society of Emergency Surgery guidelines on colon and rectal cancer emergencies recommend that patients with malignant colorectal obstruction or perforation should be considered unstable and managed by damage control surgery. Red flag signs to consider include hypothermia (core temperature 35°C), coagulopathy, signs of sepsis, and metabolic acidosis (pH 7.2 and base deficit, 8).[15] Unlike in trauma, damage control surgery in non-trauma settings follows initial resuscitation. The aim of abbreviated surgery here is to obtain source control, deferring definitive anatomical reconstruction to a later date.

The general principles that guided the authors' choice of surgical procedure included the physiological condition of the patient, the site of disease, and the state of the colon. The complication rates among non-staged and staged operations were 26% (n=20/77) and 18.5% (n=5/27), respectively, with no significant difference between the two groups (*P*=.60). This finding is supported by Breitenstein et al,[23] who found no benefit from two-or three-stage resections versus one-stage resections in a large meta-analysis. Similarly, a Cochrane review in 2004 addressing primary or staged resections found the evidence at the time was too weak to determine the best surgical management strategy.[24]

According to the Association of Coloproctology of Great Britain and Ireland consensus guidelines in emergency colorectal surgery, for left-sided obstruction (from the distal transverse colon), in a patient with stable physiology, resection with primary anastomosis is preferable; worsening clinical condition and comorbidity dictate resection with an end colostomy.[14] This technique is not without drawbacks. Our leakage rate was 11.9% and occurred exclusively among patients that had a resection and primary anastomosis without diversion. Resection and primary anastomosis during emergency surgery carry a high clinical leakage rate of up to 18%, compared with 6% in elective surgery.[23] To reduce the rate of leakage, self-expanding metal stents (SEMS) are used by some to avoid emergency surgery. Currently, SEMS is recommended mainly for palliation and is discouraged for use as a bridge to surgery (BTS) in colon cancer obstruction. Recent studies have shown that BTS offers no advantage over emergency surgery and might even reduce overall survival and may worsen oncologic outcomes.[25-27]

Age older than 65 years was associated with a mortality rate of 21.9% compared to age younger than 65 years, which was associated with a mortality rate of 8.3%. Age older than 65 years was not statistically significantly associated with mortality in the univariate (*P*=.06) or multivariate analysis (*P*=.97). Therefore, age was not an independent risk factor for the outcome of our study. Recent studies have cast doubt on the roles of preoperative physiology and comorbidity as risk factors for increased morbidity and mortality following emergency general surgery.[28,29] Our findings are similar to findings by Pacilli et al[30] and Papamichael et al,[31] who studied outcomes of emergency colorectal surgery among elderly patients and found no correlation per se between morbidity and mortality with age. It is undeniable, nonetheless, that those elderly individuals have a higher prevalence of comorbidities, which can affect their clinical course.[32] Authors like McGlicuddy et al sought to emphasize age as a risk factor for morbidity and mortality.[33] For these studies that support increasing age as a definite risk factor for morbidity or mortality, the study population usually consists of a large proportion of patients with comorbidities. The acute illness process combined with comorbidity is a possible explanation for the poorer outcome seen with increasing age compared to elective surgery in younger patients.

Many authors have consistently reported that an American Society of Anesthesiologists (ASA) physical status classification grade above II is a significant predictor of morbidity and mortality after emergency colorectal surgery.[32,34-38] This was also significantly correlated to mortality in the present study (*P*=.01). The mortality rate among patients with an ASA grade score of III and IV was 22% compared to 3.7% among patients with an ASA score of I and II, thus emphasizing the role of physiologic status at the time of emergency operation.

There were no statistically significant differences between the surgical procedures, including the use of either diversion with delayed repair/anastomosis or resection with primary anastomosis in postoperative complications or mortality rates. We emphasize the selection of the appropriate operation for the appropriate patient, which is consistent many studies that compared primary anastomosis and diversion with delayed anastomosis in cases where resection is indicated in emergency colorectal surgery.[39,40] Zorcolo et al argued that primary resection and anastomosis can be safely performed with low morbidity and mortality in selected patients with emergency colorectal diseases even in the presence of peritonitis.[41] Another controversy concerns the management of complicated diverticulitis. Results of recent reviews have shown that primary resection and anastomosis with or without diversion

Table 2. The distribution of demographic values and outcomes by extent of the operation (resection or no resection).

Factors	Diversion +/- Repair (n=27)	Colectomy +/- Diversion (n=77)	*P* value
Age (years)	49.4 (18.8), 16-78	59.9 (15.7), 21-94	.42
Sex			
Male	21 (77.8)	49 (63.6)	**<.001**
Female	6 (22.2)	28 (36.4)	
ASA Grade Score			
Grades I-II	16 (59.3)	38 (49.4)	.37
Grades III-IV	11 (40.7)	39 (50.6)	
Race			
Black African	10 (37.0)	20 (26.0)	
Arab	15 (55.6)	54 (70.1)	**<.001**
Asian/non-Arab	2 (7.4)	3 (3.9)	
Complications			
Present	5 (18.5)	18 (23.4)	.60
Absent	22 (81.5)	59 76.6)	
Mortality rate	5 (18.5)	8 (10.4)	.27

Data are n (%) and mean (standard deviation) and range for age.

have a better outcome compared to Hartmann's procedure.[42,43] However, Hartmann's procedure has its place as a life-saving procedure in elderly patients with poor ASA scores.[44,45] In conclusion, the 30-day mortality of emergency colorectal operations is greatly influenced by the presence of malignancy in the colon and the patient's physiological status at the time of the procedure.

Table 3. Logistic regression analysis of possible prognostic factors with 30-day postoperative complications as dependent variable.

Factors	No. of patients with complications/ Total no. patients	Univariate analysis		Multivariate analysis	
		Odds ratio (CI 95%)	*P* value	Odds ratio (CI 95%)	*P* value
Sex					
Male	16/70 (22.9%)	1 (reference)	.69	1 (reference)	.9
Female	9/34 (26.5%)	0.82 (0.32-2.12)		1.76 (0.48-3.92)	
Age					
≤65	15/72 (20.8%)	1 (reference)	.25	1 (reference)	.14
>65	10/32 (31.3%)	0.58 (0.23-1.48)		1.88 (0.59-6.09)	
ASA Grade					
I – II	9/54 (16.7%)	1 (reference)	.07	1 (reference)	.08
III - IV	16/50 (32.8%)	0.42 (0.17-1.08)		2.05 (0.67-6.01)	
Preoperative colon status					
Benign	15/66(22.7%)	1 (reference)	.93	1 (reference)	.55
Malignant	8/38(21.1%)	0.951 (0.3-3.05)		0.95 (0.30-3.05)	
Type of emergency surgical operation					
Hartmann procedure	2/10 (80%)	1 (reference)	.28	0.67 (0.38-11.89)	.79
Resection and primary anastomosis	7/30 (23.3%)	0.8 (0.12-5.32)	.82	0.54 (0.05-5.56)	.61
Colectomy, primary anastomosis, with colostomy/ileostomy	6/12 (50%)	0.24 (0.03-1.8)	.17	0.23 (0.02-2.82)	.24
Colectomy and stoma +delayed repair	5/35 (14.3%)	1.48 (0.24-9.29)	.67	1.27 (0.11-15.39)	.85
Defunctioning colostomy/ ileostomy	2/9 (22.2%)	0.84 (0.08-9.24)	.88	0.60 (0.40-8.85)	.71
Primary repair and bowel decompression	1/8 (12.5%)	1.68 (0.11-26.8)	.71	1 (reference)	>.05

Model fit summary: deviance 107.751, omnibus test of coefficients, χ^2 2.148, P=.143; Cox & Snell R squared .020; Nagelkerke R squared .031.

Table 4. Logistic regression analysis of possible prognostic factors and 30-day postoperative mortality.

Factor	Number of patients/ Total no. (%) patients	Univariate analysis		Multivariate analysis	
		OR (95% CI)	*P* value	OR (95% CI)	*P* value
Age					
≤65	6/72 (8.3%)	1 (reference)	.06	1 (reference)	.97
>65	7/32 (21.9%)	0.33 (0.1-1.06)		1.04 (0.18-6.0)	
ASA Grade					
I – II	2/54 (3.7%)	1 (reference)	.01	1 (reference)	.02
III – IV	11/50 (22%)	7.33 (1.54-4.99)		16.99 (1.50-193.07)	
Complications					
Absent	5/79 (6.3%)	1 (reference)	.002	1 (reference)	.004
Present	8/25 (32%)	6.97(12.03-3.96)		32.64 (3.07-35.18)	
Extent of surgery					
No colectomy	5/27 (18.5%)	1 (reference)	.28	1 (reference)	.34
With colectomy	8/77 (10.4%)	0.51 (0.15-1.72)		2.39 (0.40-47.24)	
Preoperative status of the colon					
Benign	5/66 (7.6%)	1 (reference)	.05	1 (reference)	.02
Malignant	8/38 (21.1%)	0.31 (0.09-1.02)		15.39 (1.44-164.2)	

Model fit summary: deviance 74.925, omnibus test of coefficients: *P*=.062, Cox&Snell R square .033; Nagelkerke R square .062

REFERENCES

1. AlLehbi A, Masoodi I, AlMtawa A, Alqutub A, Alsayari K, Alomair AO. Clinical spectrum of colonic diverticulosis: a tertiary care experience in Saudi Arabia. IJMDC. 2021; 5(2): 423-427. doi:10.24911/IJMDC.51-1594026501.

2. Fadda MA, Peedikayil MC, Kagevi I, Kahtani KA, Ben AA, Al HI, et al. Inflammatory bowel disease in Saudi Arabia: a hospital-based clinical study of 312 patients. Ann Saudi Med. 2012; 32(3):276-82. doi: 10.5144/0256-4947.2012.276. PMID: 22588439; PMCID: PMC6081028.

3. Awedew AF, Asefa Z, Belay WB. Burden and trend of colorectal cancer in 54 countries of Africa 2010–2019: a systematic examination for Global Burden of Disease. BMC Gastroenterol. 2022; 22 (1): 204. https://doi.org/10.1186/s12876-022-02275-0.

4. Rogalski P, Daniluk J, Baniukiewicz A, Wroblewski E, Dabrowski A. Endoscopic management of gastrointestinal perforations, leaks, and fistulas. World J Gastroenterol. 2015; 21(37):10542-52. doi: 10.3748/wjg.v21.i37.10542. PMID: 26457014; PMCID: PMC4588076.

5. Frago R, Ramirez E, Millan M, Kreisler E, del Valle E, Biondo S. Current management of acute malignant large bowel obstruction: a systematic review. Am J Surg. 2014; 207(1):127-38. doi: 10.1016/j.amjsurg.2013.07.027. Epub 2013 Oct 12. PMID: 24124659.

6. Aslar AK, Ozdemir S, Mahmoudi H, Kuzu MA. Analysis of 230 cases of emergent surgery for obstructing colon cancer--lessons learned. J Gastrointest Surg. 2011;15(1):110-9. doi: 10.1007/s11605-010-1360-2. Epub 2010 Oct 26. PMID: 20976568.

7. Johnson WR, Hawkins AT. Large Bowel Obstruction. Clin Colon Rectal Surg. 2021;34(4):233-241. doi: 10.1055/s-0041-1729927. Epub 2021 Jul 20. PMID: 34305472; PMCID: PMC8292000.

8. Alves A, Panis Y, Mathieu P, Mantion G, Kwiatkowski F, Slim K. Association Française de Chirurgie. Postoperative mortality and morbidity in French patients undergoing colorectal surgery: results of a prospective multicenter study. Arch Surg. 2005;140(3):278-83, discussion 284. doi: 10.1001/archsurg.140.3.278. PMID: 15781793.

9. Longo WE, Virgo KS, Johnson FE, Oprian CA, Vernava AM, Wade TP, et al. Risk factors for morbidity and mortality after colectomy for colon cancer. Dis Colon Rectum. 2000; 43(1):83-91. doi: 10.1007/BF02237249. PMID: 10813129.

10. Tevis SE, Carchman EH, Foley EF, Harms BA, Heise CP, Kennedy GD. Postoperative ileus—more than just prolonged length of stay? J Gastrointest Surg. 2015;19(9):1684–1690. [PubMed] [Google Scholar].

11. Henneman D, van Leersum NJ, Ten Berge M, Snijders HS, Fiocco M, Wiggers T, et al. Failure-to-rescue after colorectal cancer surgery and the association with three structural hospital factors. Ann Surg Oncol. 2013;20(11):3370–3376.

12. de Silva S, Ma C, Proulx M, Crespin M, Kaplan BS, Hubbard JN, et al. Postoperative complications and mortality following colectomy for ulcerative colitis. Clin Gastroenterol Hepatol. 2011 Nov;9(11):972-80. doi: 10.1016/j.cgh.2011.07.016. Epub 2011 Jul 30. PMID: 21806954.

13. Ekinci O, Gapbarov A, Erol CI, Beyazadam D, Eren T, Alimoglu O, et al. Resection and Primary Anastomosis versus Hartmann's Operation in Emergency Surgery for Acute Mechanical Obstruction due to Left-Sided Colorectal Cancer. Indian J Surg 2021; 83: 428–434. https://doi.org/10.1007/s12262-020-02387-5.

14. Ingraham AM, Cohen ME, Bilimoria KY, Feinglass JM, Richards KE, Hall BL, et al. Comparison of Hospital Performance in Nonemergency Versus Emergency

Colorectal Operations at 142 Hospitals. J Am Coll Surg. 2010; 210 (2): 155-165 doi: 10.1016/j.jamcollsurg.2009.10.016.
15. Pisano M, Zorcolo L, Merli C, Cimbanassi S, Poiasina E, Ceresoli M, et al. 2017 WSES guidelines on colon and rectal cancer emergencies: obstruction and perforation. World J Emerg Surg 2018; 13: 36. https://doi.org/10.1186/s13017-018-0192-3.
16. Makhlouf NA, Abdel-Gawad M, Mahros AM, Lashen SA, Zaghloul M, Eliwa A, et al. Colorectal cancer in the Arab world: A systematic review. World J Gastrointest Oncol. 2021;13(11):1791-1798. doi: 10.4251/wjgo. v13.i11.1791. PMID: 34853651; PMCID: PMC8603455.
17. Irabor, D. Emergence of Colorectal Cancer in West Africa: Accepting the Inevitable. S Afric Gastroenterol Rev. 2017; 15: 11-16. 10.4103/0300-1652.234076.
18. Golder AM, McMillan DC, Horgan PG, Roxburgh CSD. Determinants of emergency presentation in patients with colorectal cancer: a systematic review and meta-analysis. Sci Rep 2022; 12: 4366 https://doi.org/10.1038/s41598-022-08447-y.
19. Miller AS, Boyce K, Box B, Clarke MD, Duff SE, Foley NM. The Association of Coloproctology of Great Britain and Ireland consensus guidelines in emergency colorectal surgery. Colorectal Dis, 2021; 23: 476-547.
20. Oh NH, Kim KJ. Outcomes and Risk Factors Affecting Mortality in Patients Who Underwent Colorectal Emergency Surgery. Ann Coloproctol. 2016;32(4):133-8. doi:10.3393/ac.2016.32.4.133. Epub 2016 Aug 3. PMID: 27626023; PMCID: PMC5019965.
21. Shin R, Lee SM, Sohn B, Lee DW, Song I, Chai YJ, et al. Predictors of Morbidity and Mortality After Surgery for Intestinal Perforation. Ann Coloproctol. 2016;32(6):221-227. doi: 10.3393/ac.2016.32.6.221. Epub 2016 Dec 31. PMID: 28119865; PMCID: PMC5256250.
22. Yamada T, Matsuda A, Takahashi G, Yoshida H. Oncological Risk of Colonic Stents Used as Bridge to Surgery for Left-Side Malignant Colonic Obstructions. Ann Surg Oncol 2022; 29: 2759–2760. https://doi.org/10.1245/s10434-021-11274-
23. Breitenstein S, Rickenbacher A, Berdajs D, Puhan M, Clavien PA, Demartines N. Systematic evaluation of surgical strategies for acute malignant left-sided colonic obstruction. Br J Surg. 2007; 94:1451–60.
24. De Salvo GL, Gava C, Pucciarelli S, Lise M. Curative surgery for obstruction from primary left colorectal carcinoma: primary or staged resection? Cochrane Database Syst Rev. 2004; CD002101. doi.org/10.1002/14651858.CD002101.pub2.
25. van Hooft JE, Bemelman WA, Oldenburg B, Marinelli AW, Lutke Holzik MF, Grubben MJ, et al. Colonic stenting versus emergency surgery for acute left-sided malignant colonic obstruction: a multicenter randomized trial. Lancet Oncol. 2011;12(4):344–52.
26. Sabbagh C, Browet F, Diouf M, Cosse C, Brehant O, Bartoli E, et al. Is stenting as "a bridge to surgery" an oncologically safe strategy for the management of acute, left-sided, malignant, colonic obstruction? A comparative study with a propensity score analysis. Ann Surg. 2013;258(1):107–15.
27. Foo CC, Poon SHT, Chiu RHY, Lam WY, Cheung LC, Law WL. Is bridge to surgery stenting a safe alternative to emergency surgery in malignant colonic obstruction: a meta-analysis of randomized control trials. Surg Endosc. 2019;33(1):293–302.
28. Mullen MG, Michaels AD, Mehaffey JH, Guidry CA, Turrentine FE, Hedrick TL, et al. Risk Associated with Complications and Mortality After Urgent Surgery vs Elective and Emergency Surgery: Implications for Defining "Quality" and Reporting Outcomes for Urgent Surgery. JAMA Surg. 2017;152(8):768-774. doi: 10.1001/jamasurg.2017.0918. PMID: 28492821; PMCID: PMC5710495.
29. Havens JM, Peetz AB, Do WS, Cooper Z, Kelly E, Askari R, et al. The excess morbidity and mortality of emergency general surgery. J Trauma Acute Care Surg. 2015;78(2):306-311.
30. Pacilli M, Fersini A, Pavone G, Cianci P, Ambrosi A, Tartaglia N. Emergency Surgery for Colon Diseases in Elderly Patients-Analysis of Complications, and Postoperative Course. Medicina (Kaunas). 2022;58(8):1062. doi: 10.3390/medicina58081062. PMID: 36013529; PMCID: PMC9415442.
31. Papamichael D, Audisio R, Horiot JC, Glimelius B, Sastre J, Mitry E, et al. Treatment of the elderly colorectal cancer patient: SIOG expert recommendations. Ann. Oncol. 2008; 20: 5–16.
32. Leong QM, Aung MO, Ho CK, Sim R. Emergency colorectal resections in Asian octogenarians: factors impacting surgical outcome. Surg Today. 2009; 39:575–579.
33. McGillicuddy EA, Schuster KM, Davis KA, Longo WE. Factors predicting morbidity and mortality in emergency colorectal procedures in elderly patients. Arch Surg. 2009; 144:1157–1162.
34. Biondo S, Parés D, Frago R, Martí-Ragué J, Kreisler E, De Oca J, et al. Large Bowel Obstruction: predictive factors for postoperative mortality. Dis Colon Rectum. 2004;47(11):1889-97. doi: 10.1007/s10350-004-0688-7. PMID: 15622582.
35. Ng HJ, Yule M, Twoon M, Binnie NR, Aly EH. Current outcomes of emergency large bowel surgery. Ann R Coll Surg Engl. 2015;97(2):151-6. doi: 10.1308/0035884 14X14055925059679. PMID: 25723694; PMCID: PMC4473394.
36. Ihedioha U, Gravante G, Lloyd G, Sangal S, Sorge R, Singh B, et al. Curative colorectal resections in patients aged 80 years and older: Clinical characteristics, morbidity, mortality and risk factors. Int J Colorectal Dis. 2013; 28:941–947.
37. Klima DA, Brintzenhoff RA, Agee N, Walters A, Heniford BT, Mostafa G. A review of factors that affect mortality following colectomy. J Surg Res. 2012; 174:192–199.
38. Bayar B, Yılmaz KB, Akıncı M, Şahin A, Kulaçoğlu H. An evaluation of treatment results of emergency versus elective surgery in colorectal cancer patients. Ulus Cerrahi Derg. 2015;32(1):11-7. doi: 10.5152/UCD.2015.2969. PMID: 26985154; PMCID: PMC4771420.
39. Jiménez FM, Costa ND. Resection and primary anastomosis without diverting ileostomy for left colon emergencies: is it a safe procedure? World J Surg. 2012; 36:1148 – 1153. doi.org/10.1007/s00268-012-1513-4.
40. Hsu TC. Comparison of one-stage resection and anastomosis of acute complete obstruction of left and right colon. Am J Surg. 2005; 189:384–387. http://dx.doi.org/10.1016/j.amjsurg.2004.06.046.
41. Capasso L, D'Ambrosio R, Sgueglia S, Carfora E, Casale LS, De Pascale V, et al. Emergency surgery for neoplastic left colon obstruction: resection and primary anastomosis (RPA) versus Hartmann resection (HR) Ann Ital Chir. 2004; 75:465–470.
42. Halim H, Askari A, Nunn R, Hollingshead J. Primary resection anastomosis versus Hartmann's procedure in Hinchey III and IV diverticulitis. World J Emerg Surg. 2019; 14:32. doi.org/10.1186/s13017-019-0251-4.
43. Lambrichts DP, Edomskis PP, van der Bogt RD, Kleinrensink GJ, Bemelman WA, Lange JF. Sigmoid resection with primary anastomosis versus Hartmann's procedure for perforated diverticulitis with purulent or fecal peritonitis: a systematic review and meta-analysis. Int J Colorectal Dis 2020; 35: 1371–1386 (https://doi.org/10.1007/s00384-020-03617-8.
44. Sanaiha Y, Hadaya J, Aguayo E, Chen F, Benharash P. Comparison of Diversion Strategies for Management of Acute Complicated Diverticulitis in a US Nationwide Cohort. JAMA Netw Open. 2021;4(11): e2130674. doi: 10.1001/jamanetworkopen.2021.30674. PMID: 34739065; PMCID: PMC8571654.
45. Assenza M, Mazzarella G, Santillo S, Bracchetti G, De Meis E, Bartolucci P, et al. Comparison Between Primary Resection Anastomosis and Hartmann Procedure for the Treatment of Hinchey III and IV Acute Diverticulitis in the Emergency Setting. Turk J Colorectal Dis 2021; 31:300-308.