The role of laparoscopy in emergency colorectal surgery

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ABSTRACT

الأهداف: لتقييم نتائج طريقة التنظير البطني مقارنة بالطريقة المفتوحه في جراحة القولون والمستقيم الطارئة.

المنهجية: اشتملت هذه الدراسة الأترابية بأثر رجعي على جميع المرضى الذين تزيد أعمارهم عن 15 عامًا وخضعوا لعملية جراحية طارئة في القولون والمستقيم خلال الفترة من 2016–2021م في مدينة الملك عبد العزيز الطبية، الرياض، المملكة العربية السعودية. قسمنا المرضى على أساس الطريقة الجراحيه إلى مجموعات بالمنظار ومجموعات مفتوحة.

النتائج: اشتملت الدراسة على 241 مريضا (182 استئصالا مفتوحا، 59 طريقة بالمنظار). كانت مدة الإقامة في وحدة العناية المركزة أقصر في المنظار عنها في المجموعة المفتوحة (1±3 أيام مقابل 7±16 يومًا). بعد الانحدار اللوجستي متعدد المتغيرات، كان لدى المرضى الذين خضعوا لعملية استئصال بالمنظار نسبة خطر أقل 70% للإصابة بعدوى في الموقع الجراحي من أولئك الذين خضعوا لعملية جراحية مفتوحة (نسبة الأرجحية المعدلة = 0.33، فاصل الثقة 95%: [0.06–1.67])، وهو فرق لم يكن مهمًا (p=0.18). أخيرًا، كان لدى المرضى الذين خضعوا لعملية جراحية مفتوحة نسبة عالية من الوفيات لمدة 30 يومًا (n=26؛ 14.3%)، مقارنة بأولئك الذين خضعوا لعملية استئصال بالمنظار (p=0.023، 3.4%؛ n=2).

الخلاصة: منظار البطن في جراحة القولون والمستقيم الطارئة آمن وممكن، وله نتائج أفضل. يعد تخصص جراحة القولون والمستقيم مؤشراً مستقلاً على احتمال زيادة الخضوع لمنظار البطن في جراحة القولون والمستقيم الطارئة.

Objectives: To assess the outcomes of the laparoscopic approach compared to those of the open approach in emergency colorectal surgery.

Methods: This retrospective cohort study included all patients aged >15 years who underwent emergency colorectal surgery from 2016-2021 at King Abdulaziz Medical City, Riyadh, Saudi Arabia. Patients were divided based on the surgical approach into laparoscopic and open groups.

Results: A total of 241 patients (182 open resections, 59 laparoscopic approaches) were included in this study. The length of stay in the intensive care unit was shorter in the laparoscopic than in the open group (1±3 days vs. 7±16 days). After multivariable logistic regression, patients undergoing laparoscopic resection had a 70% lower risk of surgical site infection than those undergoing open surgery (adjusted odds ratio=0.33, 95% confidence interval: [0.06-1.67]), a difference that was not significant (p=0.18). Lastly, patients who underwent open surgery had a high proportion of 30-day mortality (n=26; 14.3%), compared to those who underwent laparoscopic resection (n=2; 3.4%, p=0.023).

Conclusion: Laparoscopy in emergency colorectal surgery is safe and feasible, with a trend toward better outcomes. Colorectal surgery specialization is an independent predictor of an increased likelihood of undergoing laparoscopy in emergency colorectal surgery.

Keywords: laparoscopic, emergency, colorectal, surgery

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Colorectal cancer (CRC) is the third most commonly diagnosed malignancy worldwide, with a rising incidence. In 2020, more than 1.9 million new cases of CRC were diagnosed.[1] A recent study demonstrated that 33% of patients with CRC required emergent surgical intervention.[2]

There has been a continuous increase in the use of the laparoscopic approach for elective colorectal surgeries, with evidence of better surgical and patient-reported outcomes, including fewer complications, earlier return of gastrointestinal (GI) function, less postoperative pain, and shorter length of hospital stay (LOS) compared with those after open surgery.[3-6]

Introduction of the laparoscopic approach has revolutionized the field of minimally invasive surgery, and it has been widely adopted in many specialties. However, despite its widespread use in elective surgery, it is unclear whether this technique can be used in emergency colorectal settings.[7,8] Most global studies on this topic have been context-specific with the range of presenting pathology, with the strongest evidence for procedures such as appendicitis, cholecystitis, diverticular disease, and malignancies.[9-14]

However, few studies have addressed the safety and feasibility of laparoscopic colorectal surgery in emergency settings; therefore, this study aimed to assess the outcomes of laparoscopic colon surgery in terms of mortality and morbidity compared with those of open surgery in emergency settings.

Methods. This retrospective cohort study included 241 patients who underwent emergency laparoscopic and open colorectal surgery from July 2016 to July 2021 at King Abdulaziz Medical City, Riyadh, Saudi Arabia. Patients who were less than 15 years old, underwent other major surgical procedures at the same time, or underwent elective colorectal surgery were excluded.

A chart review technique was used, using the BestCare system, to collect patient characteristics (age, gender, body mass index [BMI], urgency, surgeon specialty, diagnosis, American Society of Anesthesiologists [ASA] classification, white blood cell count [WBC], preop-sepsis, smoking, anticoagulation, steroid, and comorbidities), hospital characteristics (amount of blood loss, stoma, and type of resection), and postoperative outcomes (LOS, 30-day mortality [30D], intensive care unit-LOS [ICU-LOS], surgical site infection [SSI], readmission, reoperation, and complications) among patients who underwent laparoscopic surgery. The data were entered and coded in Microsoft Excel and then imported to Statistical Package for the Social Sciences, version 25.0 (IBM Corp., Armonk, NY, USA) software. This study was carried out according to the guidelines of the Declaration of Helsinki. It was approved by the Institutional Review Board (ethics approval number: RSS21R/020/07).

Statistical analysis. Statistical analyses were carried out using Statistical Package for the Social Sciences, version 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables are presented as proportions and continuous variables as mean ± standard deviation (SD). Pearson χ^2 test was used for categorical variables and independent t-test was used for continuous variables to investigate the differences between subjects who underwent laparoscopic and open surgery in terms of patient and hospital characteristics. Binary logistic regression (univariate and multivariate) was used to estimate the odds ratio (OR) of undergoing laparoscopic resection to adjust for patient characteristics (age, gender, BMI, urgency, surgeon specialty, diagnosis, ASA class, WBC, preop-sepsis, smoker, anticoagulation, steroid, and comorbidities) and hospital characteristics (amount of blood loss, stoma, and type of resection). Linear and binary logistic regressions were carried out to estimate the postoperative outcomes (LOS, 30D mortality, ICU-LOS, SSI, readmission, reoperation, and complications) among patients who underwent laparoscopic surgery, with adjustments for the patient and hospital characteristics. A p-value of <0.05 and 95% confidence intervals (CI) were used to report the statistical significance and precision of results.

Results. The baseline characteristic distributions presented in Table 1 include patient, surgeon, and hospital characteristics of patients who underwent open resection and laparoscopic resection. Of the 241 resections, 182 were open resections and 59 laparoscopic resections. Most patients were in the age group of 50-64 years, with 30.2% undergoing open resection and 42.5% undergoing laparoscopic resection. Most participants were male (n=104), and there was no significant difference in the gender distribution between patients who underwent open resection and those who underwent laparoscopy (p=0.092; Table 1). A total of 150 patients underwent urgent open surgery, and 41 patients underwent urgent laparoscopic resection; there was a statistical difference between the 2 groups (p=0.033).

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Table 1 - Patient's characteristics according to surgical approach (N=241).

Variables	Open resection	Laparoscopic	*P*-values
Age			
18-49	51 (28.1)	11 (18.6)	0.279
50-64	55 (30.2)	25 (42.5)	
65-74	35 (19.2)	12 (20.3)	
>75	41 (22.5)	11 (18.6)	
Gender			
Male	104 (57.1)	41 (69.5)	0.092
Female	78 (42.9)	18 (30.5)	
Body mass index			
18.5-24.9	67 (37.4)	26 (44.1)	0.761
25.0-29.9	56 (31.3)	15 (25.4)	
30.0-34.9	37 (20.7)	11 (18.6)	
≥35	19 (10.6)	7 (11.9)	
Diagnosis			
Malignance	99 (54.4)	39 (66.1)	0.114
Non-malignance	83 (45.6)	20 (33.9)	
ASA class			
ASA class 1 (0, 1, and 2)	64 (35.4)	20 (33.9)	0.838
ASA class 2 (3, 4, and 5)	117 (64.6)	39 (66.1)	
Anticoagulation			
Yes	37 (20.4)	18 (30.5)	0.110
No	144 (79.6)	41 (69.5)	
Procedure			
Right hemicolectomy	50 (27.4)	12 (20.3)	0.010
Left hemicolectomy	56 (30.5)	13 (25.5)	
Subtotal and total proctocolectomy	13 (7.0)	3 (5.0)	
Hartmann-procedure	28 (14.5)	5 (7.0)	
Stoma formation	33 (19.1)	25 (41.0)	
Others	2 (1.5)	1 (1.2)	
Steroid			
Yes	8 (4.4)	4 (6.8)	0.470
No	173 (95.6)	55 (93.2)	
Non-colorectal surgeon			
Yes	101 (55.5)	43 (72.9)	0.018
No	81 (44.5)	16 (27.1)	
Type of resection			
Total	8 (4.4)	5 (8.5)	0.000
Segmental	141 (77.5)	29 (49.2)	
Stoma	33 (18.1)	25 (42.4)	
Urgency			
<48 hours	150 (82.4)	41 (69.5)	0.033
>48 hours	32 (17.6)	18 (30.5)	
WBC, mean±SD	11.75±7.18	10.11±9.13	0.439
Pre-op sepsis			
Yes	58 (31.9)	5 (9.4)	0.001
No	124 (68.1)	48 (90.6)	
Smoker			
Yes	23 (12.6)	7 (13.0)	0.950
No	159 (87.4)	47 (87.0)	

Values are presented as a number and precentage (%). ASA: American Society of Anesthesiologists, WBC: white blood cell, BL: Burkitt's lymphoma, SD: standard deviation

In terms of perioperative outcomes, there was a significant difference between the 2 groups of 63 patients who presented with a preoperative sepsis outcome in the open resection (31.9%) and laparoscopic resection (9.4%) groups. Regarding the type of procedure, stoma formation was more common in patients who underwent laparoscopy (41%), while the left hemicolectomy procedure was more common in patients who underwent open surgery (30%; p=0.010). Pulmonary comorbidities were more common in the open surgery group (p=0.045), while cardiac comorbidities were more common in the laparoscopic surgery group (p=0.028).

Table 1 - Patient's characteristics according to surgical approach (N=241). (Continuation)

Variables	Open resection	Laparoscopic	*P*-values
Co-morbid			
Pulmonary			
Yes	40 (22.0)	6 (10.2)	0.045
No	142 (78.0)	53 (89.8)	
Cardiac			
Yes	100 (54.9)	42 (71.2)	0.028
No	82 (45.1)	17 (28.8)	
Endocrine			
Yes	94 (51.6)	26 (44.1)	0.312
No	88 (48.4)	33 (55.9)	
Hepatic			
Yes	14 (7.7)	5 (8.5)	0.846
No	168 (92.3)	54 (91.5)	
Renal			
Yes	32 (17.6)	10 (16.9)	0.911
No	150 (82.4)	49 (83.1)	
Hematology			
Yes	19 (10.4)	11 (18.6)	0.097
No	163 (89.6)	48 (81.4)	
Neurology			
Yes	26 (14.3)	10 (16.9)	0.618
No	156 (85.7)	49 (83.1)	
No co-morbid			
Yes	18 (9.9)	2 (3.4)	0.116
No	164 (90.1)	57 (96.6)	
Other co-morbid			
Yes	15 (8.2)	1 (1.7)	0.079
No	167 (91.8)	58 (98.3)	
Amount BL, mean±SD	182.9±283.4	75.59±124.9	0.003
Stoma			
Yes	143 (78.6)	38 (64.4)	0.029
No	39 (21.4)	21 (35.6)	

Values are presented as a number and precentage (%). ASA: American Society of Anesthesiologists, WBC: white blood cell, BL: Burkitt's lymphoma, SD: standard deviation

Mean blood loss was significantly different between the 2 groups (p=0.003). However, there was no significant difference in the mean WBC between the 2 groups (p=0.439; Table 1).

As shown in Table 2, multivariable logistic regression was carried out to adjust for the correlation between patient and hospital characteristics. After adjustment, patients in the age group of 18-49 years had a 24% (95% CI: [0.02-2.43]) decrease in the odds of having laparoscopic resection, which was not statistically significant (p=0.22). Furthermore, obese people had a 52% (95% CI: [0.05-5.15]) lower chance of undergoing laparoscopic surgery than overweight people, and the result was not significant (p=0.58). Patients who underwent laparoscopic resection were 4.7 (95% CI: [1.10-19.7]) times more likely to have anticoagulation therapy, and the result was statistically significant (p=0.03). Patients with pulmonary and cardiac comorbidities had a higher chance of undergoing laparoscopic resections than patients with other comorbidities, such as endocrine (20%), hepatic (80%), and renal diseases (60%). The results were not statistically significant. On the other hand, patients operated on by colorectal surgeons had an 83% (95% CI: [0.04-0.71]) increased chance of undergoing a laparoscopic resection compared to patients operated on by non-colorectal surgeons. This result was statistically significant (p=0.01; Table 2).

The mean LOS for patients undergoing laparoscopic resection was 14±18 days and for those undergoing open surgery was 23±28 days (p=0.005; Table 3). However, patients who underwent open surgery had a high proportion of 30D mortality (n=26; 14.3%), compared to those who underwent laparoscopic resection (n=2; 3.4%). The patients who had laparoscopic resection had 85% lower odds of 30D mortality than patients who had open surgery (adjusted OR=0.15, 95% CI: [0.01-1.8]), and this difference was not statistically significant (p=0.13). Further, only 7 patients with laparoscopic resection had a surgical site infection. After adjustment, patients undergoing

Table 2 - Adjusted odds ratio of undergoing laparoscopic approach in emergency settings.

Variables	Adjusted estimate	*P*-values
Age		
18-49	0.24 (0.02-2.43)	0.22
50-65	0.56 (0.03-8.83)	0.68
65-74	0.40 (0.03-4.71)	0.47
Gender		
Male	2.23 (0.52-9.48)	0.27
Female	Ref	
Body mass index		
18.5-24.9	0.34 (0.06-1.94)	0.23
25.0-29.9	0.89 (0.12-6.55)	0.91
30.0-34.9	0.52 (0.05-5.15)	0.58
≥35	Ref	
Diagnosis		
Malignance	0.67 (0.15-2.83)	0.58
Non-malignance	Ref	
ASA class		
ASA class 1 (0, 1, and 2)	0.22 (0.02-2.0)	0.18
ASA class 2 (3, 4, and 5)	Ref	
Anticoagulation		
Yes	4.67 (1.10-19.7)	0.03
No	Ref	
Steroid		
Yes	2.10 (0.17-24.8)	0.55
No	Ref	
Non-colorectal surgeon		
Yes	0.17 (0.04-0.71)	0.01
No	Ref	Ref
Type of resection		
Total	6.13 (0.30-123.1)	0.23
Segmental	5.22 (0.19- 137.2)	0.32
Stoma	Ref	
Urgency		
<48 hours	1.35 (0.14-12.3)	0.78
>48 hours	Ref	

Values are presented as an odd ratio and 95% confidence interval (CI). ASA: American Society of Anesthesiologists, WBC: white blood cell, BL: Burkitt's lymphoma

Table 2 - Adjusted odds ratio of undergoing laparoscopic approach in emergency settings. (Continuation)

Variables	Adjusted estimate	*P*-values
WBC	1.01 (0.93-1.09)	0.77
Pre-op sepsis		
Yes	2.71 (0.63-11.5)	0.17
No	Ref	
Smoker		
Yes	0.39 (0.04-3.78)	0.41
No	Ref	
Co-morbid		
Pulmonary		
Yes	1.78 (0.42-7.49)	0.43
No	Ref	
Cardiac		
Yes	1.22 (0.20-7.15)	0.82
No	Ref	
Endocrine		
Yes	0.82 (0.17-3.89)	0.81
No	Ref	
Hepatic		
Yes	0.22 (0.03-1.46)	0.12
No	Ref	
Renal		
Yes	0.44 (0.09-2.04)	0.29
No	Ref	
Hematology		
Yes	2.06 (0.35-11.9)	0.41
No	Ref	
Neurology		
Yes	6.80 (0.88-52.2)	0.065
No	Ref	
No co-morbid		
Yes	000	0.998
No	Ref	
Other co-morbid		
Yes	1.01 (0.09-10.7)	0.993
No	Ref	
Amount BL	0.99 (0.996-1.0)	0.06
Stoma		
Yes	3.62 (0.31-41.4)	0.30
No	Ref	

Values are presented as an odd ratio and 95% confidence interval (CI). ASA: American Society of Anesthesiologists, WBC: white blood cell, BL: Burkitt's lymphoma

laparoscopic resection had a 70% lower risk of surgical site infection than those undergoing open surgery (adjusted OR=0.33, 95% CI: [0.06-1.67]), a difference that was also not significant (p=0.18).

The proportion of readmissions was slightly greater in patients who underwent laparoscopic resection (16.9% vs. 6.6%), whereas the proportion of reoperations was lower in patients who underwent laparoscopic resection (11.9% vs. 20.3%). Patients who underwent laparoscopic resection were 2.31 times more likely to have a readmission than those who underwent open surgery (adjusted OR=2.31, 95% CI: [0.52-10.23]). However, these differences were no longer significant in the multi-regression model. Concerning complications, patients who underwent laparoscopic surgery had slightly lower rates of complications (5.1% vs. 8.2%) than those who underwent open surgery (5.1% vs. 7.7%). With this adjustment, patients who had laparoscopic surgery had decreased odds of complications such as septic shock (OR=0.36, 95% CI: [0.04-2.92]), GI (OR=0.23, 95% CI: [0.004-14.6]), and genitourinary (GU) (OR=0.03, 95% CI: [0.001-1.16]) compared to patients who had open surgery. However, there was no significant association between the complications and laparoscopic resection (p=0.33, p=0.36, and p=0.49) (Table 4).

Discussion. This study aimed to assess the outcomes of laparoscopic colorectal surgery in terms of mortality and morbidity compared with those of open surgery in emergency settings.

Table 3 - Distribution of mortality and morbidity by type of intervention.

Postoperative outcomes	Open resection	Laparoscopic	*P*-values
Length of stay, mean±SD	23.52±28.8	14.15±18.1	0.005
Intensive care unit length of stay, mean±SD	7.27±16.1	1.24±3.08	0.000
30 days mortality			
Yes	26 (14.3)	2 (3.4)	0.023
No	156 (85.7)	57 (96.6)	
Surgical site infection			
Yes	37 (20.4)	7 (13.0)	0.216
No	144 (79.6)	47 (87.0)	
Readmission			
Yes	12 (6.6)	10 (16.9)	0.016
No	170 (93.4)	49 (83.1)	
Reoperation			
Yes	37 (20.3)	7 (11.9)	0.144
No	145 (79.7)	52 (88.1)	
Complications			
Septic shock			
Yes	15 (8.2)	3 (5.1)	0.423
No	167 (91.8)	56 (94.9)	
Cardiovascular			
Yes	7 (3.8)	3 (5.1)	0.678
No	175 (96.2)	56 (94.9)	
Pulmonary			
Yes	9 (4.9)	2 (3.4)	0.619
No	173 (95.1)	57 (96.6)	
GI			
Yes	14 (7.7)	3 (5.1)	0.497
No	168 (92.3)	56 (94.9)	
GU			
Yes	16 (8.8)	2 (3.4)	0.170
No	166 (91.2)	57 (96.6)	
Endocrine			
Yes	0 (0.0)	1 (1.7)	0.078
No	182 (100)	58 (98.3)	
Peritonitis			
Yes	3 (1.6)	1 (1.7)	0.981
No	179 (98.4)	58 (98.3)	
Neurology			
Yes	2 (1.1)	1 (1.7)	0.720
No	180 (98.9)	58 (98.3)	

Values are presented as a number and percentage (%). GI: gastrointestinal, GU: genitourinary, SD: standard deviation

Emergency colorectal surgery comprises a heterogeneous set of patients with different diagnoses and physical statuses. Traditional practice has always advocated for an open approach, especially in ill patients, to avoid longer operative time and pneumoperitoneum during laparoscopy, both of which might affect the hemodynamics of the patients and subsequently their postoperative outcomes.[15]

After multivariate regression analysis, we found no differences in the postoperative outcomes between the laparoscopic and open approaches. Several studies have attempted to address the role of laparoscopy in emergency colorectal surgery with controversial results. Most of these studies have demonstrated that laparoscopy is equivalent to open surgery in emergency settings, with some demonstrating better outcomes with laparoscopy. A population-based study carried out in England showed that there was a statistical difference in the median LOS and lower 90-day mortality. However, patient characteristics were not fully adjusted for all differences.[16] Another population-based study carried out in the United States found a statistically significant reduction in LOS, mortality rate, and all complication rates in the laparoscopic group.[17] Moreover, a recent multicenter feasibility randomized clinical trial was carried out with 64 patients who showed an acceptable safety profile for laparoscopy in emergency colorectal surgery.[18]

One of the several advantages of laparoscopy in elective colorectal surgery is less blood loss than in the

Table 4 - Adjusted outcomes of laparoscopic versus open resection.

Postoperative outcomes	Adjusted estimate	*P*-values
Mean difference (B) length of stay	-4.62 (-13.4-4.23)	0.30
Mean difference (B) intensive care unit length of stay	-3.12 (-7.39-1.15)	0.15
30 days mortality	0.15 (0.01-1.8)	0.13
Surgical site infection	0.33 (0.06-1.67)	0.18
Readmission	2.31 (0.52-10.23)	0.26
Reoperation	0.37 (0.11-1.29)	0.12
Complications		
Septic shock	0.36 (0.04-2.92)	0.33
Cardiovascular	00 (0.0-1.0)	0.25
Pulmonary	0.007 (0.00-293.5)	0.36
GI	0.23 (0.004-14.6)	0.49
GU	0.03 (0.001-1.16)	0.06

Values are presented as odds ratio and 95% confidence interval (CI). GI: gastrointestinal, GU: genitourinary

open approach.[19] Our results demonstrated that, in emergency settings, the laparoscopic approach had a statistically significant lower mean blood loss than open colorectal surgery (p=0.003).

One of the controversial factors in using the laparoscopic approach in emergency settings is the physical status of the patient, which is measured using the ASA score. According to a recent study, patients with poor ASA scores had a lower chance of undergoing laparoscopy.[16] However, another study found that laparoscopy was safe in selected patients with ASA scores of <3 (patients with a score of 4 were not studied).[20] This study builds on the previous one by adding on the safety of this approach to all ASA scores, as the laparoscopic approach was used in 39 patients (66.1% in laparoscopic group); an ASA score of ≥3 was found to be safe in terms of amount of blood loss, 30D mortality, complications, LOS, ICU-LOS, superficial skin infection, and reoperation.

Although not statistically significant, almost half of our patients presenting to the emergency department were diagnosed with malignancies, with 99 patients who underwent the open approach and 39 who underwent laparoscopic surgery. Most of our patients were in the age group of 50-64 years, with 30.2% undergoing open resection and 42.5% undergoing laparoscopic resection. Moreover, among patients aged ≥65 years, 76 (41.7%) underwent the open approach and 23 (38.9%) the laparoscopic approach. This is consistent with the findings of a recent study showing that the emergency presentation of CRC is more common in elderly patients.[21]

Similar to a large study by Keller et al,[17] colorectal surgeons were the only significant variable that predicted the increased likelihood of a patient undergoing the laparoscopic approach in emergency settings. Patients operated on by colorectal surgeons had an 83% increased chance of undergoing a laparoscopic approach compared to patients operated on by non-colorectal surgeons. Another propensity score-matched study showed that 88.9% of emergency laparoscopic colorectal colectomies were carried out by colorectal surgeons.[22] This observation aligns with several studies showing that colorectal surgery specialization is an independent factor for better outcomes in patients undergoing colorectal surgery.[23]

This study showed that the laparoscopic approach in emergency settings is safe and feasible, with a trend towards better postoperative outcomes in line with growing evidence in the literature regarding the role of laparoscopy in emergency colorectal surgery.

Study limitations. Its retrospective nature, may have impacted our results. In addition, the sample size might hinder the detection of significant associations when the adjustment of variables is attempted. Therefore, to demonstrate the role of laparoscopy in emergency colorectal surgery, future studies with larger randomized clinical trials are needed.

In conclusion, the use of laparoscopy in emergency colorectal surgery is safe and feasible, with a trend toward better outcomes. Colorectal surgery specialization is an independent predictor of an increased likelihood of undergoing laparoscopy in emergency colorectal surgery.

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