ORIGINAL ARTICLE

Laparoscopic vs Open Colorectal Surgeries in Urgent Surgical Situations

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Abstract

Background: Using minimally invasive surgeries (MISs) in non-elective and urgent cases was assessed by many previous studies and found to be nearly similar to and even better than open surgeries. There was no sufficient data regarding long-term, follow-up, tumor recurrence, or survival data of studied patients in those studies.

Aim of our study is to compare performing MIS and open colectomy in patients undergoing urgent (nonemergency, non-elective) colectomies, regarding primary outcomes of 30-day morbidity and mortality, secondary short-term outcomes, long-term and follow-up findings of included patients.

Patients and methods: A total of 200 patients were included, and we divided them into two groups according to the performed surgical approach: The first group included 100 patients who underwent MISs and the second group underwent open surgery and included 100 patients. We evaluated the primary patients' outcome which was 30-day postoperative morbidity and mortality. Secondary evaluated patients' outcomes included; ICU admissions, surgical reintervention, wound infection or dehiscence, postoperative ileus, postoperative leakage at an anastomotic site, and occurrence of intra-abdominal infections. Long-term evaluated patients' outcomes included the occurrence of incisional hernias and oncological outcomes as overall survival rates and recurrence rates.

Results: Regarding demographic and baseline data, patients who underwent open surgery were older (65 years vs 58 years, $p < 0.001$). More females underwent open surgery (54% vs 50%, $p = 0.002$). Overweight and obese patients were more likely to have MIS colectomy ($p < 0.001$). There is a statistically significant relation between approach and all histopathological types (24.2% within the laparoscopic approach vs 11.6% within the open approach had mucoid carcinoma), *N* stage (82.8% within the laparoscopic approach vs 43.8% within open the approach had N stage 0), American Joint Committee on Cancer (AJCC) stage (63.8% within laparoscopic approach vs 20.8% within open approach had AJCC stage II) Open colectomy were liable to be diagnosed with acute diverticulitis and volvulus ($p < 0.001$). Operative time is longer in MIS patients in comparison to open colectomy patients the median time to complete an MIS colectomy was 21 minutes longer ($p < 0.001$). Postoperative mortality is less in MIS patients than the open surgery patients. On univariable analysis, 30-day postoperative mortality following MIS colectomy was lower than that after open surgery ($p < 0.05$).

Conclusions: Using MIS in urgent colectomy is associated with less postoperative, morbidity, mortality, short-term complications, and long-term complications than open colectomy.

Keywords: Advanced laparoscopic surgery, Laparoscopic, Open, Minimally invasive surgeries, Open surgery, Urgent colectomy.

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Introduction

Minimally invasive surgeries (MISs) have become the preferred surgical approach for performing elective resections of the colon and rectum.[1] Minimally invasive surgeries have many clear benefits as less postoperative pain and ileus, short hospital length of stay (LOS), and better quality of life in addition to similar oncologic outcomes.[2] These advantages made MISs the approaches of choice by most surgeons for performing nearly 50% of elective colorectal resections.[3]

Using MISs in non-elective and urgent cases was assessed by many previous studies and found by most of them to be nearly similar to and even better than open surgeries.[4,5] Minimally invasive surgeries in urgent cases was found to be associated with; reduced costs, short LOS, and less postoperative morbidity and mortality than open colectomy.[6]

These former studies include both urgent and emergency colorectal resections and using MISs was reported in 5–30% of all cases.[7,8]

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There was no sufficient data regarding long-term, follow-up, tumor recurrence, or survival data of studied patients in those studies.

Aim of our study is to compare performing MIS and open colectomy in patients undergoing urgent (nonemergency, non-elective) colectomies, regarding primary outcomes of 30-day morbidity and mortality, secondary short-term outcomes, long-term and follow-up findings of included patients.

Patients and Methods

This is a retrospective randomized study that was approved by the Institutional Review Board of the Faculty of Medicine, Zagazig University. We included all colectomies performed between January 1, 2016, and December, 2021.

After the application of inclusion criteria of selecting patients with non-elective colectomy and excluding all cases with elective planned colectomy and cases with incomplete data, 200 patients were included, and we divided them into two groups according to the performed surgical approach: The first group included 100 patients who underwent MISs and the second group underwent open surgery and included 100 patients.

Minimally invasive surgery patients included: Totally laparoscopic surgery, laparoscopic surgery with open assistance, and laparoscopic surgery with unplanned conversion to open surgery.

The group of patients who underwent open surgeries included all patients with planned urgent open colectomies.

We compared between both groups of patients as regards; baseline demographic data and comorbidities.

We evaluated the primary patients' outcome which was 30-day postoperative morbidity and mortality. Secondary evaluated patients' outcomes included; ICU admissions, surgical reintervention, hospital LOS, wound infection or dehiscence, postoperative ileus, postoperative leakage at anastomotic site, occurrence of intra-abdominal infections, and pulmonary or cardiac complications.

Long-term evaluated patients' outcomes included the occurrence of incisional hernias and oncological outcomes as overall survival rates and recurrence rates.

Statistical Analysis

We analyzed data using SAS/STAT software (version 90.4), SAS Institute Inc., Cary, North Carolina, USA. We compared baseline data using the × 2 test for all categorical variables, and we used *t*-test for continuous variables. We compared operative time using the Wilcoxon Rank-Sum test.

We compared postoperative outcomes using the × 2 test and logistic regression, then using multivariable logistic regression analysis. We considered a *p*-value of < 0.05 a statistically significant value.

Results

This study included 200 patients with an age range from 30 to 68 years with a mean age of 50.51 years and a mean BMI of 22.54 kg/m^2. Males represented 33% of them. Patients of 135 underwent histopathological examination; of them, 51.1% had conventional adenocarcinoma, 21.5% had benign lesions. Among 106 patients with confirmed malignancy by HPE; 29.2, 28.3, and 23.6% had T stage 4, 3, and 1, respectively. concerning N stage; 65.1% had stage 0, 16% had N stage 3 with no patient with distant metastasis. About 50, 29.2, and 20.8% had grades II, III, and I, respectively.

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On investigating the cause of resection, 53, 14.5, and 10% underwent resection for malignancy, benign neoplasm, and ischemia respectively. About 37, 25, and 23% underwent right hemicolectomy, sigmoid resection, and anterior resection respectively.

Of patients, 56.5% underwent an open approach while the remaining 45.5% had a laparoscopic approach.

Among the MIS group of patients (20%) underwent unplanned conversion to open.

Regarding demographic and baseline data, patients who underwent open surgery were older (65 years vs 58 years, $p < 0.001$). More females underwent open surgery (54 vs 50%, $p = 0.002$).

Overweight and obese patients were more likely to have MIS colectomy ($p < 0.001$).

American Society of Anethesiologists (ASA) I and II patients were more likely to have MIS in comparison with ASA III patients ($p < 0.001$). Patients with comorbid conditions were more likely to have open surgery ($p < 0.001$).

Minimally invasive surgery patients were more likely to have completed mechanical and antibiotic bowel preparation ($p < 0.001$).

Generally, the commonest surgery indications were obstructing or perforating colorectal cancer and acute diverticulitis.

There is statistically significant relation between approach and all of sex (79.3% within laparoscopic approach vs 57.5% within open approach were females), reason for resection (66.7% within laparoscopic approach vs 42.5% within open approach underwent resection for malignancy), ASA classification (20.7% within laparoscopic approach vs 58.4% within open approach had ASA I), and type of primary operation (2.3% within laparoscopic approach vs 12.4% within open approach underwent anterior resection).

There is a statistically non-significant relation between the approach and either age, BMI, or resection site (Table 1).

There is a statistically significant relation between approach and all histopathological types (24.2% within the laparoscopic approach vs 11.6% within the open approach had mucoid carcinoma), N stage (82.8% within the laparoscopic approach vs 43.8% within the open approach had N stage 0), American Joint Committee on Cancer (AJCC) stage (63.8% within laparoscopic approach vs 20.8% within open approach had AJCC stage II).

There is statistically non-significant relation between approach and either T stage, M stage, or grade.

Minimally invasive surgery colectomy patients were liable to be diagnosed with obstructing or perforating colorectal cancer, chronic diverticulitis with stricture, ulcerative colitis, or bleeding colorectal polyps.

Open colectomy was liable to be diagnosed with acute diverticulitis and volvulus ($p < 0.001$). Operative time is longer in MIS patients in comparison to open colectomy patients the median time to complete an MIS colectomy was 21 minutes longer ($p < 0.001$).

Postoperative mortality is less in MIS patients than in open surgery patients.

Table 1: Relation between approach and baseline data among studied patients

	Laparoscopic	*Open*	
	N = 87 (%)	*N = 113 (%)*	*p*
Sex			
Male	18 (20.7%)	48 (42.5%)	0.001**
Female	69 (79.3%)	65 (57.5%)	
Reason for resection			
Malignancy	58 (66.7%)	48 (42.5%)	<0.001**
Benign neoplasm	8 (9.2%)	21 (18.6%)	
Diverticular disease	5 (5.7%)	11 (9.7%)	
Obstruction	0 (0%)	7 (6.2%)	
Ischemia	7 (8%)	13 (11.5%)	
Colo proctitis	7 (8%)	7 (6.2%)	
Perforation	2 (2.3%)	6 (5.3%)	
Resection site			
Cecum	20 (23%)	26 (23%)	0.193
Ascending colon	16 (18.4%)	11 (9.7%)	
Transverse colon	10 (11.5%)	6 (5.3%)	
Descending colon	18 (20.7%)	28 (24.8%)	
Sigmoid colon	14 (16.1%)	23 (20.4%)	
Rectum	9 (10.3%)	19 (16.8%)	
ASA classification			
0	69 (79.3%)	47 (41.6%)	<0.001**
I	18 (20.7%)	66 (58.4%)	
Type of primary operation			0.041*
Right hemicolectomy	36 (41.4%)	37 (32.7%)	
Left hemicolectomy	18 (20.7%)	28 (24.8%)	
Transverse colon resection	10 (11.5%)	6 (5.3%)	
Sigmoid resection	21 (24.1%)	28 (24.8%)	
Anterior resection	2 (2.3%)	14 (12.4%)	
	Mean ± SD	*Mean ± SD*	*p*
Age (year)	49.49 ± 8.42	51.29 ± 8.95	0.15
BMI (kg/m^2)	22.63 ± 1.33	22.47 ± 1.32	0.406

χ^2, Chi-square test; *t*, independent sample *t* test; MC, Monte Carlo test; *$p < 0.05$ is statistically significant; **$p \leq 0.001$ is statistically highly significant

On univariable analysis, 30-day postoperative mortality following MIS colectomy was lower than that after open surgery ($p < 0.05$).

Prolonged duration of staying in hospital (>30 days), postoperative bleeding, shock, sepsis, postoperative ileus, reoperation, dehiscence or infection of the wounds, anastomotic leakage, deep venous thrombosis (DVT), urinary tract infection (UTI), surgical site infections (SSI), pulmonary embolism (PE), and hospital readmission were lower for the MIS patients.

Minimally invasive surgery patients had a shorter duration of hospital stay ($p < 0.001$).

Regarding long-term incidence of incisional hernias is less in the MIS group of patients (Table 2).

Table 2: Relation between approach and histopathological data of studied patients

	Laparoscopic	*Open*	
	N = 87 (%)	*N = 113 (%)*	*p*
Histological type			
Conventional adenocarcinoma	39 (59.1%)	30 (43.5%)	0.004*
Mucoid carcinoma	16 (24.2%)	8 (11.6%)	
Squamous cell carcinoma	3 (4.5%)	10 (14.5%)	
Benign	8 (12.1%)	21 (30.4%)	
T stage			
1	11 (19%)	14 (29.2%)	0.378
2	24 (41.4%)	6 (12.5%)	
3	9 (15.5%)	11 (22.9%)	
4	14 (24.1%)	17 (35.4%)	
N stage			
0	48 (82.8%)	21 (43.8%)	<0.001**
1	5 (8.6%)	3 (6.3%)	
2	3 (5.2%)	9 (18.8%)	
3	2 (3.4%)	15 (31.3%)	
M stage (0)	58 (100%)	48 (100%)	
AJCC stage	*N* = 58	*N* = 48	
I	11 (19%)	11 (22.9%)	0.024*
II	37 (63.8%)	10 (20.8%)	
III	10 (17.2%)	27 (56.3%)	
Grade	*N* = 58	*N* = 48	
I	11 (19%)	11 (22.9%)	0.073
II	38 (65.5%)	15 (31.3%)	
III	9 (15.5%)	22 (45.8%)	

χ^2, Chi-square test; MC, Monte Carlo test; *$p < 0.05$ is statistically significant; **$p \leq 0.001$ is statistically highly significant

There is a statistically significant relation between approach and short-term complications. The open approach significantly increases the risk of short-term complications by 2.2 folds.

There is a statistically non-significant relation between approach and either reoperation or long-term complications. The open approach significantly increases the risk of reoperation and long-term complications by 1.8 and 1.46 folds respectively (Table 3).

There is a statistically significant relation between complications and all of sex (50% within complicated vs 26.4% of non-complicated were males), and approach (32.1% within complicated vs 47.9% within non-complicated underwent laparoscopic approach).

There is a statistically non-significant relation between approach and either age, resection site, type of operation, BMI, or ASA classification.

Regarding long-term oncological outcomes such as tumor recurrence, response to therapy, and 3-year overall survival rate and 3-year recurrence-free survival rate, there were no significant differences between performed surgical approaches (Table 4).

Discussion

In the present study, we clarified the advantages of MIS in urgent colectomy cases over open surgery and demonstrated their benefits over open colectomy regarding postoperative short-term

Table 3: Relation between approach and outcome of studied patients

	Laparoscopic	*Open*		
	N = 87 (%)	*N = 113 (%)*	*p*	*COR (95% CI)*
Reoperation	11 (12.6%)	23 (20.4%)	0.15	1.8 (0.81–3.85)
Short-term complications	16 (18.4%)	37 (32.7%)	0.023*	2.2 (1.1–4.22)*
Long-term complications	10 (11.5%)	18 (15.9%)	0.307	1.46 (0.64–3.34)

χ^2, Chi-square test; COR, crude odds ratio; CI, confidence interval; *$p < 0.05$ is statistically significant; **$p \leq 0.001$ is statistically highly significant

Table 4: Relation between complications and baseline data of studied patients

	Complicated	*Non-complicated*	
	N = 56 (%)	*N = 144 (%)*	*p*
Sex			
Male	28 (50%)	38 (26.4%)	0.001**
Female	28 (50%)	106 (73.6%)	
Reason for resection			
Malignancy	36 (64.3%)	70 (48.6%)	0.245
Benign neoplasm	5 (8.9%)	24 (16.7%)	
Diverticular disease	5 (8.9%)	11 (7.6%)	
Obstruction	0 (0%)	7 (4.9%)	
Ischemia	6 (10.7%)	14 (9.7%)	
Colo proctitis	2 (3.6%)	12 (8.3%)	
Perforation	2 (3.6%)	6 (4.2%)	
Resection site			
Cecum	16 (28.6%)	30 (20.8%)	0.385
Ascending colon	6 (10.7%)	21 (14.6%)	
Transverse colon	3 (5.4%)	13 (9%)	
Descending colon	17 (30.4%)	29 (20.1%)	
Sigmoid colon	10 (17.9%)	27 (18.8%)	
Rectum	4 (7.1%)	24 (16.7%)	
ASA classification			
0	25 (44.6%)	91 (63.2%)	<0.001**
I	31 (55.4%)	53 (36.8%)	
Type of primary operation			
Right hemicolectomy	22 (39.3%)	51 (35.4%)	0.375
Left hemicolectomy	17 (30.4%)	29 (20.1%)	
Transverse colon resection	3 (5.4%)	13 (9%)	
Sigmoid resection	10 (17.9%)	39 (27.1%)	
Anterior resection	4 (7.1%)	12 (8.3%)	
Approach			
Laparoscopic	18 (32.1%)	69 (47.9%)	0.043*
Open	38 (67.9%)	75 (52.1%)	
	Mean ± SD	*Mean ± SD*	*p*
Age (year)	51.05 ± 8.26	50.3 ± 8.95	0.585
BMI (kg/m^2)	22.51 ± 1.27	22.55 ± 1.35	0.85

χ^2, Chi-square test; MC, Monte Carlo test; *$p < 0.05$ is statistically significant; **$p \leq 0.001$ is statistically highly significant

outcomes, long-term outcome, our findings are similar to the results of Hajirawala et al.,[8] study and Warps et al.,[9] who showed that MIS is beneficial in non-elective cases of colectomy. Minimally invasive surgery in urgent colectomy was associated with lower; mortality, short hospitalization, less incidence of ileus, less wound infection or dehiscence, and less readmission rate (Tables 5 and 6).

Minimally invasive surgery was demonstrated to be better than open surgery by many previous studies.[4,5,10]

Vallance et al.,[6] showed similar results to ours that MIS was associated with a shorter duration of hospital stay and less incidence of 90-day mortality than open colectomy.

Moreover, Keller et al.,[7] demonstrated that MIS was associated with favorable short-term and long-term outcomes. Post-colectomy wound infections particularly in urgent non-elective cases are liable to occur, and it was found that MIS was associated with lower incidence than open cases.[11]

Postoperative readmissions after colectomy were associated with increased postoperative morbidity, mortality, and reduced overall survival rate.[12]

We showed similar to previous reports that patients who underwent urgent MIS colectomy were less liable to hospital re-admission this is due to a reduction in rates of most short-term postoperative complications following MIS.

Patients who underwent MIS colectomy were less likely to have hypertension, chronic obstructive pulmonary disease, renal failure, dialysis, smoking, sepsis at the time of surgery.

Table 5: Relation between complications and histopathological data of studied patients

	Complicated	*Non-complicated*	
	N = 56 (%)	*N = 144 (%)*	*p*
Histological type	*N* = 41	*N* = 94	
Conventional adenocarcinoma	25 (61%)	44 (46.8%)	0.335
Mucoid carcinoma	7 (17.1%)	17 (18.1%)	
Squamous cell carcinoma	4 (9.8%)	9 (9.6%)	
Benign	5 (12.2%)	24 (25.5%)	
T stage	*N* = 36	*N* = 70	
1	11 (30.6%)	14 (20%)	0.808
2	5 (13.9%)	25 (35.7%)	
3	11 (30.6%)	9 (12.9%)	
4	9 (24.1%)	22 (31.4%)	
N stage	*N* = 36	*N* = 70	
0	23 (63.9%)	46 (65.7%)	0.702
1	4 (11.1%)	4 (5.7%)	
2	5 (13.9%)	7 (10%)	
3	4 (11.1%)	13 (18.6%)	
M stage (0)	36 (100%)	70 (100%)	–
AJCC stage	*N* = 36	*N* = 70	
I	7 (19.4%)	15 (21.4%)	0.8
II	16 (44.4%)	31 (44.3%)	
III	13 (36.2%)	24 (34.3%)	
Grade	*N* = 36	*N* = 70	
I	7 (19.4%)	15 (21.4%)	0.989
II	18 (50%)	35 (50%)	
III	11 (30.6%)	20 (28.6%)	

χ^2, Chi-square test; MC, Monte Carlo test; *$p < 0.05$ is statistically significant; **$p \leq 0.001$ is statistically highly significant

Table 6: Binary regression analysis of factors associated with complications among studied patients

				95% CI	
	β	*p*	*AOR*	*Lower*	*Upper*
Male sex	0.924	0.006*	2.519	1.305	4.864
Open approach	0.470	0.172	1.600	0.815	3.140

*$p < 0.05$ is statistically significant; AOR, adjusted odds ratio; CI, confidence interval; Male sex and open approach independently increase risk of complications by 2.519 and 1.6 folds respectively

Patients with comorbid conditions were more liable to perform open surgery, which is in line with previous reports.[6,7]

Former studies showed that MIS in patients undergoing colectomies has less liability to short-term morbidity and mortality.[8,13]

Conclusions

We demonstrate that using MIS in urgent colectomy is associated with less postoperative, morbidity, mortality, less short-term complications, and long-term complications than open colectomy.

Points of Strength

This is a randomized cohort comparative study that included a large number of urgent colectomy patients.

Points of Weakness

This is a retrospective study that leads to the liability of bias in collected data.

Recommendations

We recommend performing a prospective and randomized study including large number of patients with urgent colectomy to prove and clarify our results.

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