Assessment of quality of oncologic colorectal resection in emergency colorectal cancer surgeries

Abdrabou N. Mashhour[a], Amr Elshayeb[a], Asmaa S. ElGendy[a], Ahmed S. Khalifa[a], Heba A. Ibrahim[b], Mohamed M. Raslan[a]

Departments of [a]General and Colorectal Surgery, [b]Pathology, Faculty of Medicine, Cairo University, Cairo, Egypt

Correspondence to Mohamed M. Raslan, MD, Department of General and Colorectal Surgery, Faculty of Medicine, Cairo University, Cairo 11451, Egypt.
E-mail: raslan@kasralainy.edu.eg

Received: 16 February 2023
Revised: 10 March 2023
Accepted: 19 March 2023
Published: 9 June 2023

The Egyptian Journal of Surgery 2023, 42:286–293

Introduction
Complicated colonic cancers present at a more advanced stage and are associated with high postoperative morbidity and mortality. This study aims at analyzing the quality of colorectal resection in emergency colorectal surgeries and its outcome, which is affected by multiple factors and can be classified as surgeon, pathologist, disease, or patient related.

Patients and methods
This is a prospective cross-sectional study that included 36 patients who underwent emergency resection for colorectal cancer presented to the Emergency Department at Kasr Al Ainy Teaching Hospital, Cairo University, Egypt. Patients were assessed by American Society of Anesthesiology score preoperatively and were followed up for 1 month postoperatively for morbidity and mortality. Age, sex, presentation, site of malignancy, type of operation, any intraoperative/postoperative complications, operative time (skin to skin), time of the operation, level and subspecialty of the operator, histopathology of the resected segment including margins, lymph nodes (LNs), and type of cancer were all assessed during the study.

Results
In the current study, the outcome of the surgery performed in the emergency setting showed that 38.9% of the patients in the study underwent a proper oncological resection regarding retrieval of LNs.

Conclusion
The morbidity and mortality were high; however, it was possible to respect the principles of oncologic resection, regarding the extent of resection, surgical margins, and LN dissection, but less than shown in the literature. This may be attributed to further complications of the disease and the clinical condition of most of the patients.

Keywords:
colorectal cancer, emergency colorectal surgeries, lymph nodes, resection

Egyptian J Surgery 42:286–293

1110-1121

Introduction

Colorectal cancer has a good prognosis when diagnosed in the initial stages. Intestinal obstruction is the most common clinical presentation in patients with colorectal cancer admitted to the emergency room, followed by colonic perforation [1].

Patients with complicated colonic cancers present to clinics or Emergency Department at a more advanced stage with a lower resectability rate and higher postoperative morbidity and mortality rates when compared with uncomplicated ones. Resection of complicated colorectal cancer aiming for cure in medically fit candidates could be done with comparable morbidity and mortality to the elective resection at the same stage. Survival outcome is also comparable if oncologic resection was done by a subspecialized surgeon [2].

The prognosis of patients with colorectal cancer after tumor resection is defined by the presence of neoplastic cells in lymph nodes (LNs). The sampled LN number and its histopathologic analysis play a significant role for proper staging and work as independent prognostic markers for postoperative adjuvant therapy. Furthermore, it denotes the quality of surgery and extent of oncologic resection. There are several factors that can affect node retrieval and can be classified as surgeon, pathologist, disease, or patient related. Both patient and type of disease-related variables are non-modifiable factors and raise the question about the minimum number of examined

LNs that should be retrieved, and if the number must be individually assigned [3].

Current guidelines stress on the retrieval and evaluation of at least 12 LNs in the pathologic surgically excised specimen for colorectal cancer [4]. The effect of high-volume surgeons on the postoperative outcomes has been studied and was well noticed, making it significantly better. During emergency settings, emergency colorectal surgeries are accomplished by general surgeons, which may be a major part of their practice. The influence of subspecialized training on outcomes after emergent colon surgery, however, is not well described [5].

The aim of this study was to provide statistical data for a period of 6 months, focusing on assessment of the quality and adequacy of colorectal resection in emergency colorectal cancer surgeries in the Emergency Department of a high-volume tertiary referral hospital, Kasr Al Ainy Teaching hospitals, Cairo University. The assessment was guided by the histopathological assessment of involvement of circumferential margins (CRM), longitudinal margins (LRM), and the retrieved LN number. This is done to improve the outcome regarding decreasing the morbidity and mortality rates and increasing the survival rates in an unselected patient population. The analysis of this data will lead to discussion of further modifications that may be suggested to the current guidelines followed in the Emergency Department of Kasr Al Ainy teaching hospitals, Cairo University.

Patients and methods

This prospective cross-sectional analytic study was conducted on patients admitted in the Emergency Department presenting with a colorectal cancer emergency over a 6-month period. Ethical committee approval was obtained (CODE MS 396-2020). The study included patients undergoing colorectal cancer emergency resection in the Emergency Department of Kasr Al Ainy teaching hospitals, Cairo University between November 2020 and May 2021. This method was chosen to detect and analyze the perioperative factors affecting the outcome of surgery.

The patient presentation could be in the form colonic obstruction, perforation, or bleeding. The study included all patients who presented with either hemodynamic stability or instability. The patients who had irresectable rectal cancer or received neoadjuvant therapy were excluded from the study.

Diagnosis was made clinically and by imaging. Erect abdominal radiograph was done to diagnose obstruction or perforation, and abdominal computed tomography (CT) with intravenous (i.v.) (+/−oral) contrast also was done for better assessment of abdominal pathology. All patients were subjected to the routine preoperative preparations in the form of 'Drip and Suck': insertion of Ryle NGT, patient was kept NPO, and i.v. fluids were given through two wide-bore cannulas. Patients' American Society of Anesthesiology (ASA) score was calculated preoperatively. All patients signed a preoperative informed consent including the possibility of intestinal stoma.

The operative procedure decision performed depended on the intraoperative finding, being the most important. Other factors that influenced the decision included tumor location, peritoneal soiling, assessment of resectability, vital stability of the patient, age, comorbidities, intraoperative adhesions, tissue edema, and friability. Right or extended right hemicolectomy was done for resectable right-sided tumors with or without anastomosis. For resectable left-sided tumor, resection with diversion was performed. Total colectomy was done in fit patients presented with impending perforation of the dilated cecum or suspicious multiple synchronous colonic tumors.

Surgical specimens were examined regarding proper oncologic resection, including adequate proximal, distal, and circumferential resection margins and adequate lymphadenectomy (number of LN harvests at least 12 LNs). Moreover, tumor characteristics were compared regarding tumor size, grade, and stage; lymphatic or venous invasion; nodal stage; and TNM stage. The following data were collected: age, sex, BMI, comorbidities, ASA score, presentation, site of malignancy, type of operation, any intraoperative/postoperative complications, operative length (skin to skin), time of the operation, surgical experience of the operator, histopathology of the resected segment including margins, number of LNs retrieved, type of cancer, and TNM classification.

All patients were followed up for 1 month postoperatively for morbidity and mortality after discharge in the emergency outpatient clinic.

Statistical analysis

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences, Armonk, NY: IBM Corp.), version 22.

Data were summarized using mean, SD, median, minimum, and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were done using the nonparametric Kruskal–Wallis and Mann–Whitney tests. *P* values less than 0.05 were considered statistically significant.

Results

During the period of the study, 36 patients were included in the final analysis. Patient characteristics, operation details, pathological details, and postoperative outcomes are summarized in Table 1. Most of the patients (91.7%) presented with intestinal obstruction, 75% underwent colonic diversion with colostomy, and only 25% were operated on without colonic diversion. Most of cases were operated by a resident surgeon assisted by an assistant lecturer (61.1%), followed by an assistant lecturer (25%), and 13.1% were done by a lecturer. Operative complications were uncommon, representing 5.6%, in the form of intestinal injury in one case and superior mesenteric vein injury in another (Tables 2–4).

Regarding histopathology assessment of surgical specimens, 100% of cases had free distal and proximal margins (free LRM). On the contrary, 100% had infiltration of the pericolic fat (positive CRM), which means that all cases were R1 resection. There were no early stages in our cohort, and all cases were T3 (91.7%) and T4 (8.3%), with four (11.1%) cases having metastasis already in stage IV. Among our patients, 52.8% were node negative, whereas 47.2% were node positive. Adequate LN dissection (≥12 LN) was achieved in 38.9% of cases and not accomplished in 61.1% of cases (all when D1 resection was attempted). The mean number of LNs was 13.3±9.8, with minimum retrieved number of four LNs and maximum of 44 LNs. The split bar chart in Fig. 1 shows the nodal status in correlation to adequate LNs retrieval. Factors affecting adequate LN dissection are mentioned in Table 5, showing that the BMI is one significant factor with a weak correlation coefficient −0.25 and *P* value of 0.023. The operation timing did not affect the adequacy of LNs retrieval as shown in Fig. 2.

Morbidity rate was 75%. Early postoperative complications varied between wound infection with the highest incidence (30.6%), followed by septic shock (16.7%), burst abdomen (13.9%), leakage (8.3%), and refashioning of stoma in 5.6%. The mortality rate was 16.7% in this study (five cases because of septic shock and the last one because of pulmonary embolism), as shown in Table 4.

Early postoperative complications (Table 6) were significantly associated with ASA score, as the incidence of postoperative complications in ASA score 3–4 was 100%, with *P* value 0.01.

Table 1 Patient data included in the study

Patient characteristics	Mean±SD	Percentage
Age	55.9±13.4	
BMI	34.9±4.4	
	n (%)	
Sex		
Female	16 (44.4)	
Male	20 (55.6)	
Comorbidities		
None	24 (66.7)	
DM	7 (19.5)	
HCV	1 (2.8)	
HTN	3 (8.3)	
Leprosy	1 (2.8)	
ASA score		
ASA II	12 (33.3)	
ASA III	14 (38.9)	
ASA IV	6 (16.7)	
ASA V	4 (11.1)	
Presentation		
Obstruction	33 (91.7)	
Perforation	3 (8.3)	

ASA, American Society of Anesthesiology; DM, diabetes mellitus; HCV, hepatitis C virus; HTN, hypertension.

Table 2 Operation details

	n (%)
Procedure	
Extended right hemicolectomy	2 (5.6)
Low ant resection	2 (5.6)
Left hemicolectomy	8 (22.2)
Right hemicolectomy	10 (27.8)
Sigmoidectomy	13 (36.1)
Subtotal colectomy	1 (2.8)
Diversion	
No	9 (25.0)
Yes	27 (75.0)
Surgeon	
Lecturer	5 (13.9)
Assistant lecturer	9 (25)
Resident assisted by assistant lecturer	22 (61.1)
Operative duration (h)	3.3±0.8
Operative complications	
No complications	34 (94.4)
Intestinal injury	1 (2.8)
SMV injury	1 (2.8)

Table 3 Marginal assessment of the surgical specimens

	n (%)
Proximal margins	
Free	36 (100.0)
Distal margins	
Free	36 (100.0)
Circumferential margins	
Infiltrating pericolic fat	36 (100.0)
Plane of resection	
D1	22 (61.1)
D2	7 (19.4)
D3 (CME)	7 (19.4)
Adequate LN dissection	
No	22 (61.1)
Yes	14 (38.9)
R status	
R0	0
R1	36 (100)
R2	0
Histopathology	
Adenocarcinoma grade II	31 (86.1)
Adenocarcinoma grades II–III	1 (2.8)
Adenocarcinoma grade III	1 (2.8)
Mucinous carcinoma	3 (8.3)
T stage	
T3	33 (91.7)
T4a	3 (8.3)
N stage	
N0	19 (52.8)
N1	7 (19.4)
N1a	4 (11.1)
N1c	1 (2.8)
N2	1 (2.8)
N2a	2 (5.6)
N2b	2 (5.6)
M stage	
M1	4 (11.1)
Mx	32 (88.9)
Staging	
Stage I	0
Stage II	18 (50.0)
Stage III	14 (38.9)
Stage IV	4 (11.1)

LN, lymph node.

Table 4 Postoperative outcome

	n (%)
Early postoperative complications	
No complications	9 (25.0)
Burst abdomen	5 (13.9)
Leakage	3 (8.3)
Refashioning of stoma	2 (5.6)
Septic shock	6 (16.7)
Wound infection	11 (30.6)
Mortality	
Lived	30 (83.3)
Died	6 (16.7)

The mortality rate (Table 7) was the highest among patients who were presented with intestinal perforation (33.3%) with *P* value 0.015 when compared to patients who were presented with intestinal obstruction only. Higher ASA score was associated with increased mortality rate as all patients with ASA score 5 were expired in this cohort ($P<0.0001$). Moreover, the surgeon was significantly associated with postoperative mortality as the highest mortality rate was reported in lecturer level (50%), followed by residents assisted by assistant lecturer (33.3%) with *P* value of 0.02.

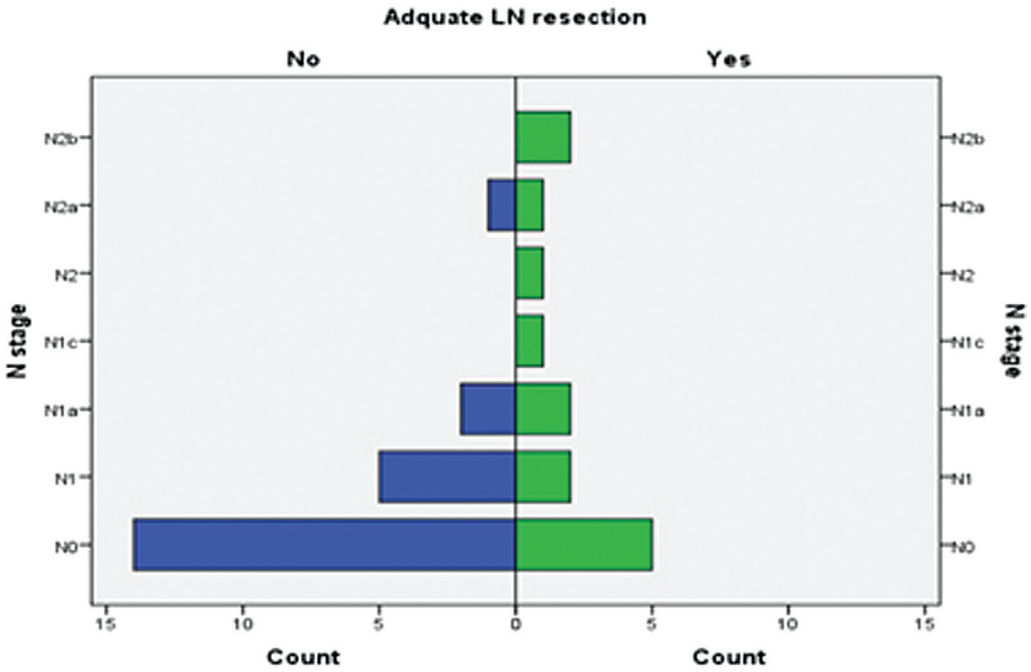
Discussion

It is well known that complicated colorectal cancer cases present at a more advanced stage with a lower resectability rate and higher postoperative morbidity and mortality rates. It is difficult to compare the outcomes between complicated and noncomplicated cases because the outcomes are dependent upon not only the patient's disease and its presentation but also the site of the lesion, the patient's age, coexistent medical problems, and the type of surgery performed. Controlling of this complex 'case mix' is usually impossible and so general conclusions may be made in relation to one series which may not be applicable to another [3].

The outcomes, safety, and feasibility of emergency curative complicated colorectal cancer resection are still issues that need further studies [2]. The main emergency clinical presentation in our study was intestinal obstruction (91.7%) followed by perforation (8.3%) similar to studies conducted by Wong and colleagues, Elmessiry and Mohamed, in 2008 and 2020, respectively. Sigmoid colon was the most common level of obstruction with 36.1% of patients undergoing sigmoidectomy, which is similar to the study of Enciu *et al.* [6], which showed that most of the tumors were located on the left colon [2,7].

In our study, regarding the outcome of the surgery performed in the emergency setting, 75% of the patients in the study had postoperative morbidity, including wound infection (30.6%), septic shock in 16.7%, burst abdomen in 13.9%, and leakage in 3%, which required re-exploration. Although the mortality rate in our study (16.7%) is high, the majority of the included patients had an ASA score of 2–3 (72.1%), and 27.8% with an ASA score of 4–5. Studies done by McArdle and Hole, Costa and colleagues, and Elmessiry and Mohamed showed a mortality rate of 8.1, 15, and 11.1%, respectively, whereas the studies by

Figure 1



Split bar chart showing nodal status in correlation to adequate lymph node dissection.

Table 5 Factors affecting adequate lymph node dissection

Factors affecting adequate LN dissection	Adequate LN resection		*P* value
	No [*n* (%)]	Yes [*n* (%)]	
BMI (mean±SD)	36.4±2.8	32.6±5.5	0.023
ASA			
II	8 (36.4)	4 (28.6)	
III	7 (31.8)	7 (50.0)	0.73
IV	4 (18.2)	2 (14.3)	
V	3 (13.6)	1 (7.1)	
Procedure			
Extended right hemicolectomy	1 (4.5)	1 (7.1)	
Low ant resection	2 (9.1)	0	
Left hemicolectomy	5 (22.7)	3 (21.4)	0.70
Right hemicolectomy	6 (27.3)	4 (28.6)	
Sigmoidectomy	8 (36.4)	5 (35.7)	
Subtotal colectomy	0	1 (7.1)	
Operator			
Assistant lecturer	7 (31.8)	2 (14.3)	
Lecturer	3 (13.6)	2 (14.3)	0.48
Resident	12 (54.5)	10 (71.4)	
Plane of resection			
D1	22 (100)	0	
D2	0	7 (50)	0.001
D3	0	7 (50)	
Time of surgery			
a.m.	12 (54.5)	7 (50)	0.87
p.m.	10 (45.5)	7 (50)	

ASA, American Society of Anesthesiology; LN, lymph node.

Degett and colleagues and Enciu and colleagues showed mortality rates of 19.1 and 24%, respectively. The mortality rate was the highest among patients who presented with intestinal perforation (33.3%), with *P* value of 0.015, when compared with patients who presented with intestinal obstruction only. A higher

Figure 2

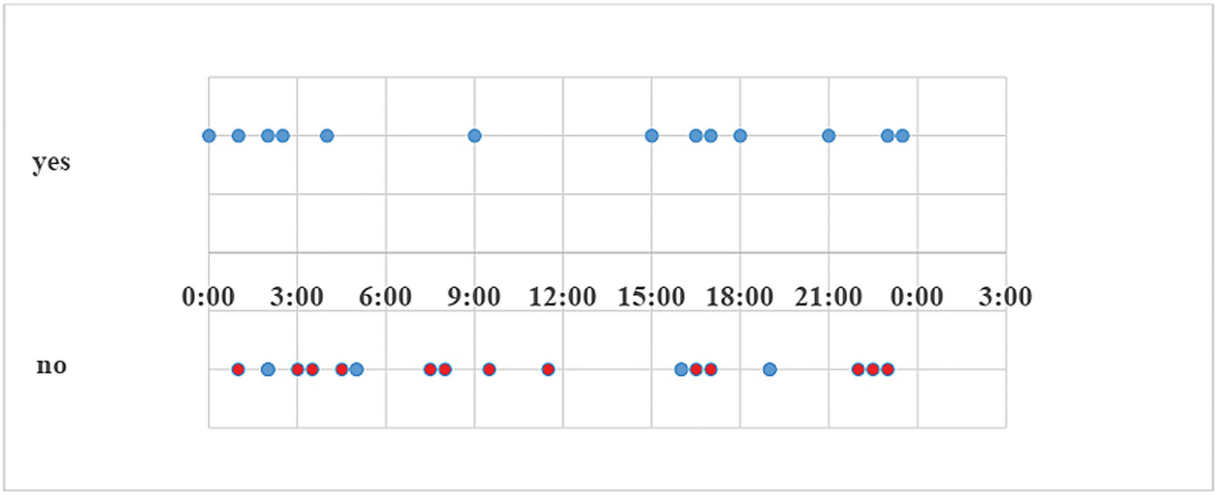


Chart showing adequacy of LN dissection in relation to time of operation. LN, lymph node.

Table 6 Factors affecting early postoperative complications

	Early postoperative complications		
	No [*n* (%)]	Yes [*n* (%)]	*P* value
Comorbidities			
None	8 (88.9)	16 (59.3)	
DM	1 (11.1)	6 (22.2)	0.56
HCV	0	1 (3.7)	
HTN	0	3 (11.1)	
Leprosy	0	1 (3.7)	
Presentation			
Obstruction	9 (100.0)	24 (88.9)	0.29
Perforation	0	3 (11.1)	
ASA			
II	7 (77.8)	5 (18.5)	
III	2 (22.2)	12 (44.4)	
IV	0	6 (22.2)	0.01
V	0	4 (14.8)	
Yes	7 (77.8)	20 (74.1)	
Level of operator			
Lecturer	1 (11.1)	4 (14.8)	
Assistant lecturer	3 (33.3)	6 (22.2)	0.79
Resident	5 (55.6)	17 (63.0)	

ASA, American Society of Anesthesiology; DM, diabetes mellitus; HCV, hepatitis C virus; HTN, hypertension.

Table 7 Factors related to patients' mortality

	Mortality		
	Lived [*n* (%)]	Died [*n* (%)]	*P* value
Comorbidities			
None	20 (66.7)	4 (66.7)	
DM	7 (23.3)	0	0.12
HCV	0	1 (16.7)	
HTN	2 (6.7)	1 (16.7)	
Leprosy	1 (3.3)	0	
Presentation			
Obstruction	29 (96.7)	4 (66.7)	0.015
Perforation	1 (3.3)	2 (33.3)	
ASA			
II	12 (40.0)	0	
III	13 (43.3)	1 (16.7)	<0.0001
IV	5 (16.7)	1 (16.7)	
V	0	4 (66.7)	
Level of operator			
Lecturer	2 (6.7)	3 (50.0)	
Assistant lecturer	8 (26.7)	1 (16.7)	0.02
Resident	20 (66.7)	2 (33.3)	

ASA, American Society of Anesthesiology; DM, diabetes mellitus; HCV, hepatitis C virus; HTN, hypertension.

mortality was recorded in our study with more senior staff, and this may be explained by the fact that a higher level of experience is usually required in technically demanding surgeries with expected higher rates of morbidity and mortality [2,6,8–10].

Regarding histopathological assessment, all cases were presented at an advanced stage whether T3 or T4. Moreover, 11.1% of cases presented with distant metastasis (mainly in liver) and were discovered intraoperatively. This may be explained as most of the patients with colorectal cancer presented in emergency setting with advanced disease, large tumor, and frequently distant metastasis. This may explain why oncological resections for complicated colorectal cancer are less standardized in emergency operations in comparison with elective procedures [6].

A primary objective of this study was the concern of the feasibility of the appropriate oncologic resection, which has been established in accordance with pathological

parameters, including negative surgical margins and LN dissection of at least 12 regional LNs.

Regarding proper oncologic resection, circumferential resection margins were threatened in 100% of cases. In our study, the LRM and CRM were not affected by tumor staging. Similar findings were reported by Ghazi and colleagues and Elmessiry and Mohamed in 2013 and 2020, respectively. Negative proximal and distal margins were achieved in 100% of cases, unlike Teixeira *et al.* [11], who observed 8% of positive microscopic margins in emergency cases [2,11,12].

The number of regional LNs that were dissected was greater than or equal to 12 in 38.9% of patients only, which is much less than the previous mentioned study (71%) and in the study by Enciu and colleagues, where it was 89.7%. Inadequate lymphadenectomy was more frequent in emergency compared with elective resection according to Elmessiry and Mohamed, although some other studies mentioned no significant difference in the mean number of retrieved LN between emergency and elective colorectal resection [2,6,7,9,13].

One of the patient-related factors that may affect the number of retrieved LNs is BMI. It was significantly correlated with inadequate LN dissection, with *P* value of 0.02, which may need further studies to go with or against as most of studies have shown that obesity is associated with more morbidity and mortality with no significant difference in oncological outcome [14,15].

On the contrary, surgical experience shows no statistical difference in adequacy of LN dissection. The mean number of dissected LNs was 13.3, which is accepted with the main principles of oncological resection. The total number of retrieved LNs is influenced by the plane of resection as it was inadequate in our study in all cases with D1 resection, and also, the extent of colonic resection, as it is at its maximum in total colectomy [11,14,15].

It has been suggested that emergent colon resections performed by specialized colorectal surgeons were associated with significantly lower rates of postoperative morbidity (lower rate of stoma and increases number of retrieved LNs) and mortality when compared with noncolorectal surgeons [4,16,17].

On comparison between daytime versus night time surgery, there was no significant difference in postoperative complications and outcome of surgery in our study. Fernandes *et al.* [18] observed that although 100% of surgeons reported that they are less proficient during night time, no significant difference was documented.

One of the most important drawbacks of our study is the small number of cases entitled. We recommend a larger study with more quality control, including all elective and emergency surgical resections done by expert colorectal surgeons with proper oncologic resection.

The second recommendation from our results is the concern that must be directed toward auditing the annual results of the department; this will provide a wider database that should facilitate the arrangement of statistical analysis and help reaching accurate reflection of the actual performance. However, the importance of official auditing will bring out the faults in the management process that may directly or indirectly affect the results. For example, there were specific data that were noticed in this study, such as the existence of the colorectal consultants in operating rooms, the period for which the patient had to reach the operating room after admission, or even the investigations used to reach a preoperative diagnosis before exploration. Usage of all these data and the analysis of all of them together will improve the quality of the audit, leading to a better performance in our facility.

Conclusion

After evaluation of the performance and the outcomes of the colorectal cancer emergency surgeries in Kasr Al Ainy Teaching Hospital, Cairo University, Cairo, over 6 months, it was possible to respect the principles of oncologic resection regarding the extent of resection, surgical margins, and to some extent, LN dissection, but less than shown in the literature. The morbidity and mortality were high; however, this may be attributed to further complications of the disease and the clinical condition of most of the patients.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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