Colorectal emergencies: are there any modifiable factors affecting outcome?

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Background
Colorectal emergencies are common and associated with significant mortality. Emergency presentation *per se* is an independent risk factor for postoperative morbidity and mortality. The aim of this study is to define modifiable factors to account for the high morbidity and mortality in colorectal emergencies.
Patients and methods
A total of 137 colorectal emergencies presenting to Kasr Alainy Emergency Department were managed according to the general condition of the patient, site and severity of pathology, bowel wall edema, and friability as well as the experience of the surgical team. Morbidity and 30-day mortality were analyzed using univariate followed by multivariate analysis to determine modifiable factors to improve outcome. Studied factors were patient factors (demographic and comorbidities), site of pathology, presence or absence of malignancy, hemodynamic instability, local pathology, and the treatment adopted.
Results
Mean age was 45.6 years. Of 48.2% females and 51.8% males, 52.6% presented with colorectal cancer-related emergencies, 7.3% with colorectal trauma, and the remaining 40.1% with nononcological pathology (40.1%). Postoperative morbidity and mortality occurred in 18.2 and 20.4%, respectively. Hemodynamic instability after initial resuscitation harbored the highest risk for mortality in the multivariate module (R=6.6), followed by malignancy (R=3.9), type of operative management (R=1.7), and comorbidity (R=1.4).
Conclusion
Comorbidity and colorectal malignancy are independent nonmodifiable factors increasing perioperative mortality warranting vigilance. Hemodynamic instability after initial resuscitation is the single most important modifiable factor emphasizing the importance of maximized joint efforts in preoperative optimization of these patients using damage control resuscitation principles. Operative time is an important modifiable factor dictating the shortest appropriate surgical option.

Keywords:
colorectal emergencies, modifiable factors, mortality

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Introduction

Colorectal emergencies are very common; they might be related to colorectal oncological or nononcological emergencies encompassing a myriad of presentation.

Multiple studies of colorectal emergency surgeries estimated the overall mortality between 15 and 50% depending on the underlying pathology, timing of presentation (early or late), and associated comorbidities (metabolic, cardiovascular, infectious, respiratory, or obesity-related comorbidities). These factors substantially increase the incidence of mortality. Moreover, emergency presentation is regarded as an independent risk factor for postoperative mortality and morbidity [1–7].

Reviewing available literature reveals a confusingly wide range of different inclusion and exclusion criteria adopted by the various research authorities. Although some studies involved colorectal surgery in general (oncology related or not as well as emergency presentation or elective), other research groups studied oncological emergencies versus elective surgical oncologic interventions.

The aim of this study is to define one or more modifiable factors to account for the high morbidity and mortality in colorectal emergency surgery.

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Patients and methods

This is a retrospective audit observing 137 consecutive patients presenting to the authors in Kasr Alainy teaching hospital with emergency presentations (obstruction, perforation, inflammatory phlegmon, or bleeding) involving the colorectum. These patients were managed according to the protocols adopted in this teaching hospital. Unstable patients were resuscitated first according to ATLS or CCrisp guidelines [8]. Selection of the surgical treatment modality was decided upon the general condition of the patient, site and severity of pathology, bowel wall edema, and friability as well as the experience of the surgical team. Observed morbidity and 30-day mortality were recorded for the final assessment.

Univariate statistical analysis was performed to determine factors affecting morbidity and 30-day perioperative mortality. This was followed by multivariate analysis for morbidity in the studied patients. The significance level was set at *P* value less than or equal to 0.05. Statistical analysis was performed with IBM SPSS Statistics, version 23 for Windows (IBM Corp., Armonk, NY, USA).

The aim was to find a modifiable factor to improve outcome in colorectal emergencies. The studied factors were either (a) patient factors, such as demographics as well as associated comorbidities, (b) site of pathology in the colorectum, (c) pathologic state of the organ before the emergency occurred (an emergency in a previously healthy organ or a similar emergency in an organ harboring a neoplasm), (d) degree of the presenting derangement either systemically (hemodynamic instability after initial resuscitation) or locally (obstruction, perforation, or phlegmon), and (e) the treatment adopted in these cases.

Results

The age of the studied patients ranged from 6 to 89 years, with mean age of 45.6±17.49 years. Overall, 48.2% of the patients were females, and males were 51.8%. Seventy-two (52.6%) patients presented owing to colorectal cancer-related emergencies, 10 (7.3%) patients presented owing to either blunt or penetrating trauma, and the remaining 55 (40.1%) patients presented with a nononcological colorectal pathology.

A total of 52 (38%) patients had associated comorbidities. Forty-one (29.9%) patients presented with hemodynamic instability. Twenty-five (18.2%) patients had postoperative morbidity, and 28 (20.4%) patients died within 30 days postoperatively. No statistically significant relation was found between the factors enrolled and the observed morbidity.

Univariate analysis to determine factors affecting mortality showed that group type (oncological and nononcological groups), age, comorbidities, hemodynamic instability on presentation, specific etiology, site of pathology (right side, left side, rectum, or the whole colon), and type of management (diversion, repair without diversion, resection with diversion, resection, and anastomosis with or without diversion) showed statistically significant *P* value regarding mortality (Table 1).

All these variables were further entered for multivariate analysis to exclude confounders. The results showed that oncology etiology *per se*, hemodynamic stability on presentation, and type of operative management were significant independent variables predicting mortality.

Regarding the effect of patient-related factors on 30-day perioperative mortality, age (with a cut-off value 55 years) and predating comorbidity showed a statistically significant effect on 30-day mortality (univariate $P=0.012$ for age and $P=0.001$ for comorbidity). These variables were further entered for multivariate analysis to exclude confounders. Age was not found to be an independent risk factor for mortality ($P=0.468$). Yet, co-morbidity persisted as a statistically significant independent factor on multivariate analysis.

Hemodynamic instability at presentation was associated with the most added risk in the multivariate module ($R=6.6$), followed by group type whether oncological or not ($R=3.9$). The next variable that added to mortality was type of operative management ($R=1.7$). The least variable was comorbidity ($R=1.4$).

Analyzing the operative choice in relation to mortality, we found that mortality was associated more frequently with relatively prolonged surgical intervention. Two out of four patients who did resection with primary anastomosis without diversion died (50%). Overall, 40% of patients who had resection with primary anastomosis and proximal diversion died. The least surgical option that resulted in mortality was primary repair without diversion (8.8%). Percentages of mortality among different surgical option subgroups are presented in Fig. 1.

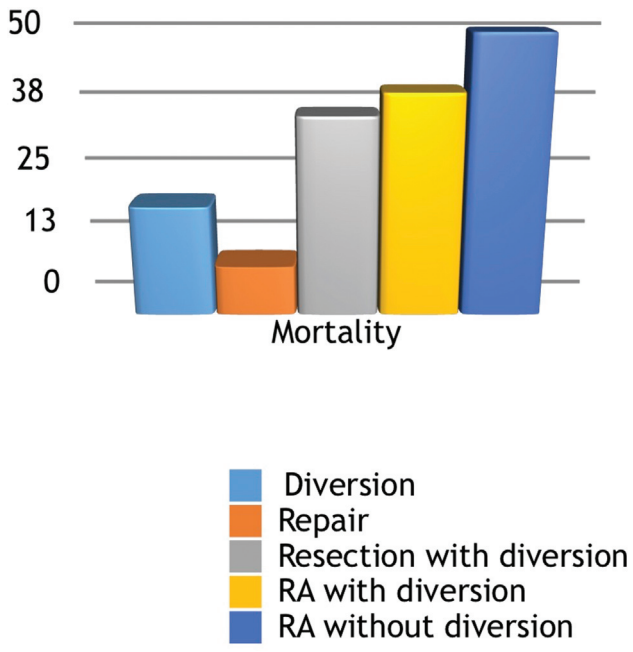
A significant correlation was found between type of comorbidity and the cause of death whether

Table 1 Univariate and multivariate analyses of mortality

Statistical analysis	Number of cases (*N*=137)	Cases with mortality (*N*=28)	Univariate *P* value*	Multivariate *P* value*	Multivariate risk (*R*)
Age (years) (*n*)					
≤55	91	15	0.012	0.468	–
>55	46	13			
Group					
Nononcology group (*n*)	72	7	0.001	0.023	3.928
Oncology group	65	21			
Comorbidities (*n*)	52	18	0.002	0.004	1.407
Specific etiology (*n*)					
Oncology	65	21	0.028	0.241	–
Trauma	11	2			
Inflammatory	40	1			
Potentially ischemic	21	4			
Hemodynamic instability	41	19	0.000	0.001	6.514
Site of pathology [*n* (%)]					
Right colon	n=74 (54.1%)	8	0.001	0.410	–
Left colon	n=42 (30.6%)	11			
Rectum	n=15 (10.9%)	6			
Whole colon	n=6 (4.4%)	3			
Type of operative management (*n*)					
Diversion only	5	1	0.000	0.017	1.673
Primary repair without diversion	78	6			
Resection with diversion	25	9			
Resection with primary anastomosis with proximal diversion	15	6			
Resection with primary anastomosis without diversion	4	2			

*Significant at *P* value less than or equal to 0.05.

Figure 1



Bar chart presenting the percentage of mortality among different operation types.

cardiogenic shock or septic shock (*R*=0.282, *P*=0.001). Patients with comorbidity died more frequently owing to cardiogenic shock (66.67%).

Discussion

Colorectal emergencies are associated with significant morbidity and mortality [9]. In a high-flow emergency department as our university hospital, it would be very helpful to determine modifiable factors that could improve performance and hence the outcome of these emergency patients.

In our case series, we did not find that age was an independent factor affecting mortality. However, Alvarez *et al.* [10] found age to be a statistically significant independent predictor of mortality in colorectal cancer emergencies. Moreover, Kızıltan and colleagues stated that high mortality should be expected in patients older than 60 years.

On the contrary, comorbidity was a significant independent variable predicting perioperative mortality with an added risk in the multivariate module (*R*=1.4). This result is in concordance with studies involving colorectal surgery in general which revealed that prior comorbidity affected overall survival [11,12]. Studies of colorectal cancer also found that having comorbidity was associated with significantly higher mortality rate (6% mortality in ASA I–II, 20.7%

in ASA III–IV) [13]. Moreover, Askari *et al.* [1] found that having multiple comorbidities was associated with a significant increase in the perioperative mortality of colorectal cancer surgery.

There was a significant correlation between type of comorbidity and cause of postoperative death whether cardiopulmonary compromise or septic shock (R=0.282, P=0.001). These comorbid patients frequently died of cardiopulmonary compromise (nonsurgical causes). This finding keeps in going with the results of Due *et al.* [3], who had 26% of deaths in their series of patients operated upon for colorectal cancer emergencies primarily related to cardiovascular compromise rather than owing to surgical complications.

Studying the effect of site affected by the emergency event in the colorectum (reflecting different pathophysiological characteristics) using univariate analysis revealed a statistically significant increase in 30-day mortality when the left colon and rectum were involved (P=0.001). Site of colorectal affection was not found to be an independent risk factor for mortality in multivariate analysis (P=0.410). It seems that another factor is behind the apparent effect of site of affection on perioperative mortality in univariate analysis.

Controversy exists in literature reports about the effect of site of colorectal affection on mortality. Askari *et al.* [1] in a study of colorectal oncologic emergency surgery stated that the right-sided pathology was associated with a higher mortality. However, Kızıltan *et al.* [6] in their study of colorectal oncological emergencies stated that left colon cancers were associated with higher mortality. In the present study of colorectal emergencies in general, multivariate analysis proved that the site of affection of the colorectum is not an independent risk factor for mortality.

On studying the effect of the pathological state of the organ before the emergency occurred, univariate analysis revealed that oncology-afflicted patients presenting with a surgical emergency (obstruction, perforation, significant bleeding episode, or inflammatory phlegmon) have a significantly higher 30-day mortality when compared with patients with a previously normal colorectum (P=0.001). This variable was proved to be an independent risk factor for perioperative mortality in emergency colorectal patients (P=0.023, multivariate analysis added risk R=3.9).

Multivariate analysis implies that the presence of neoplasia is an independent factor by itself apart from the other independent risk variables (hemodynamic instability and relatively prolonged intervention). Both these factors may be related to the upregulation of pathophysiologic derangement of emergencies in patients harboring neoplasia in their colorectum.

On studying the effect of the degree of systemic derangement (hemodynamic instability after initial resuscitation) or local pathology (obstruction, perforation, hemorrhage, or sepsis), univariate analysis revealed a statistically significant increase in 30-day mortality when patients were hemodynamically unstable after resuscitation (P=0.000). Furthermore, it had the highest added risk on mortality in the multivariate analysis (P=0.000, R=6.5).

Supporting evidence was found by the study by Alvarez *et al.* (2005), where they found that high Acute Physiology and Chronic Health Evaluation II score was a significant predictor of colorectal cancer emergency mortality.

In fact, hemodynamic instability is one of the two modifiable variables that serve as independent predictors of outcome. The highly statistically significant P value and the more than six-fold increased risk in patients with hemodynamic instability regarding mortality in addition to the general concordance with literature lead us to an important recommendation for our institution. Maximization of our preoperative resuscitative efforts involving experienced anesthesia and surgery consultants is absolutely mandatory. Undue expeditious initiation of definitive surgical treatment before adequate resuscitation might have adverse effects on patients' mortality as evidenced by our results. Our anesthetists and surgeons need to collaborate in the determination of 'damage control resuscitation principles' in this nontraumatic setting to optimize outcome.Studying the effect of the treatment option adopted in the patients, univariate analysis revealed a statistically significant increase in 30-day mortality in patients with relatively prolonged surgical options (P=0.000). The highest being with resection anastomosis without diversion in 50%. In multivariate analysis, surgical intervention choice was an independent factor affecting perioperative mortality (P=0.017, R=1.7).

Supporting evidence was found in studies by Kızıltan *et al.* [6] and Ansaloni *et al.* [14]. Both agreed that major prolonged resections should be avoided in the emergency setting for management of oncological

colorectal cases. Their most frequent surgical choice was resection with diversion only, which seemed to improve perioperative outcome especially in left colorectal surgery.

Again, the chosen treatment option, is the second modifiable independent predictor of outcome. Accumulating evidence suggests that in the emergency setting the simplest and above all the shortest appropriate treatment option should be chosen especially in the setting of a teaching hospital like our institution. In fact, recently there has been an extension of the damage control principles to the nontraumatic emergency surgical setting. The choice of the most abbreviated treatment option seems to be in harmony with this principle.

Conclusion

Comorbidity and presentation as pathological sequelae of colorectal oncology in the emergency setting are independent nonmodifiable factors affecting perioperative mortality in colorectal emergencies. They serve as an index for vigilance in the management of these emergencies.

The simplest shortest appropriate operative option should be adopted in colorectal emergency, as it is a modifiable independent factor affecting outcome.

The other modifiable factor is hemodynamic instability after initial resuscitation. We suggest the use of 'damage control resuscitation principles' in these patients.

We acknowledge the need for a prognostic scoring system based on these four factors to guide the treatment decision process. We recommend that the hemodynamic instability would have the highest effect (R=6.6), followed by oncology-related etiology (R=3.9). The need for resection would be the third factor included in this system (R=1.7). The least score should be assigned to whether the patient has a comorbidity or not (R=1.4).

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Conflicts of interest

There are no conflicts of interest.

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