Risk assessment in emergency laparotomy for outcome prediction in patients presenting to the emergency department

Original Article

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ABSTRACT

Background: Despite a larger percentage of high-risk patients presenting for emergency surgery, the perioperative mortality has decreased significantly over the last half-century. By identifying high-risk patients in the preoperative phase and planning their perioperative management, morbidity and mortality can be reduced. This risk increases if the surgery is performed as an emergency. The main aim of this study is to evaluate risk factors that may be associated with higher postoperative mortality in patients undergoing emergency laparotomy, which can help in better management to decrease postoperative mortality.

Patients and Methods: Patients who presented to Kasr Alainy Hospital of Cairo University, Emergency Department who underwent emergency laparotomy were evaluated for risk factors, which include age, sex, type of surgery, the time interval between onset of symptoms and surgical intervention, presence of peritonitis preoperatively, and previous laparotomy. Postoperatively, patients were followed up for occurrence of 10 days postoperative mortality, hospital readmission within 2 weeks after hospital discharge, and length of postoperative hospital stay.

Results: The mean age of patients of emergency laparotomy was 42 years while the male : female ratio was 1.14 : 1. Indication of surgery showed a statistically significant difference in mortality with the highest incidence in patients with intestinal ischemia. The longest hospital stay was found in patients with blunt abdominal trauma.

Conclusion: The type of surgery, according to the pathology of the target organ, can affect the 10 days postoperative mortality, which is highest in patients with intestinal ischemia.

Key Words: Emergency laparotomy, hospital readmission, peritonitis, postoperative hospital stay, postoperative mortality.

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INTRODUCTION

Emergency laparotomy is a common and costly emergency general surgery procedure. It is performed for multiple indications and is associated with significant periprocedural morbidity. Overall mortality is 15% but varies substantially depending on the indication, patient-specific factors, and health system factors[1,2]. Emergency laparotomies form a broad group of time-sensitive surgeries done on variable patient populations. Broadly, they can be divided into trauma and nontrauma laparotomies. Most common nontrauma surgeries include laparotomies done for intestinal perforation and obstruction, while trauma laparotomies are done for hemorrhage control as well as control of peritoneal spillage after bowel injury. The average mortality rate after emergency laparotomies range from 10 to 18% in different studies, which is much higher than elective surgeries. There is significant global inequity among different countries in terms of access to standard emergency surgical facilities, with lower-income countries sharing the highest burden of surgical mortalities. General surgical procedures account for a large proportion of the care provided in hospitals in many countries[3,4].

In comparison with emergency surgery, patients undergoing elective surgical procedures have a much lower mortality and morbidity rate. Elective surgery constitutes most of the general surgical procedures[5]. Acute abdominal surgery can be stratified by risk (high and low risk), where high-risk procedures require a significant amount of hospital resources and are associated with high mortality and morbidity[6]. Emergency laparotomy – which is a high-risk procedure – is a cornerstone of emergency surgery and is often performed when the clinically impaired patient requires urgent surgery for an acute abdominal condition. Although the underlying pathology varies, patients undergoing emergency laparotomy can be seen as a subgroup in the field with high mortality, especially among the elderly with comorbidity[7].

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Study objectives

Patients were followed up during the postoperative period. The primary objective of this study is to evaluate risk factors that may be associated with higher postoperative mortality in patients undergoing emergency laparotomy, which can help in better management to decrease postoperative mortality by investigating the number of patients with postoperative mortality within 10 days postoperatively. The secondary objectives were to find out the rate of hospital readmission within 2 weeks from discharge and the length of postoperative hospital stay in days and the relation of this to the investigated risk factors.

PATIENTS AND METHODS:

We conducted an observational cohort study that included patients who presented to the Emergency Department, Kasr Alainy Hospital of Cairo University with an emergency condition that indicated surgical exploration laparotomy.

Inclusion criteria

Patients who were admitted to the Emergency Department (above 13 years old and below this age were considered pediatric patients) were indicated for surgical exploration via a midline incision.

Exclusion criteria

Patients who were managed conservatively without surgical intervention, pediatric group of patients (patients who are 13 years old or less), and patients who underwent emergency laparotomy via incisions other than midline such as subcostal, lanz, or paramedian incision.

Methodology assessment of risk factors: we assessed risk factors that may be associated with poor surgical outcomes and poor survival. We assessed the following:

(1) Age of patients in years.

(2) Sex: male or female.

(3) The time interval between onsets of symptoms till abdominal incision is measured in hours.

(4) Presence of peritonitis which is diagnosed by clinical examination of the abdomen (guarding, rigidity, and tenderness, laboratory: increased total leukocytic count (4.5–11×109/l) and confirmed by imaging: air under diaphragm on erect abdominal radiograph in cases of perforated viscus or by evidence of intraabdominal free fluid collection by pelvi-abdominal ultrasound or computed tomography (CT) of the abdomen and pelvis.

(5) Presence of previous midline laparotomy by history taking and presence of midline scar during abdominal examination.

(6) The type of surgery, according to the pathology of the target organ, was divided into intestinal obstruction, perforated viscus, abdominal abscess, intestinal ischemia, and abdominal trauma.

Preoperative preparation

Patients with acute abdomen were evaluated and resuscitated by bolus of intravenous fluids and broad-spectrum antibiotics if indicated. With proper care to avoid delay for unnecessary imaging in case of vital instability or signs of peritonitis. Routine laboratories were done, including complete blood count, liver and kidney function tests, coagulation profile, and serum electrolytes, including sodium and potassium. The ECG was done for patients above 40 years old or with cardiac history.

Informed consent

All included patients signed a written informed consent for surgical intervention after being informed about expected benefits and potential risks.

Operative procedure

Patients were operated under general anesthesia in a supine position via midline incision with special consideration for examination of the whole abdominal quadrants. Repair of the pathology when identified as an omental patch for perforated peptic ulcer, resection of gangrenous bowel, evacuation of any collection and control of bleeding in cases of trauma, proper lavage and drains, then closure of the abdominal wall.

Postoperative care

Patients were well assessed, and critical patients were admitted to the ICU. Special attention is needed during postoperative follow-up to ensure adequate hydration, proper antibiotic coverage, pain control, thromboembolic prophylaxis, and psychological support. Patients were discharged after achieving vital stability, pain control, open bowel, and tolerating a regular diet for frequent follow-up visits in the outpatient clinic.

Ethical considerations

The thesis protocol and consent were submitted to the local ethical committee of the Faculty of Medicine, Cairo University. All study procedures followed the ethical code of The Declaration of Helsinki. All study-related information was stored securely at the study site. All participant information was stored in locked file cabinets in areas with limited access.

Sample size

Using Clin calc sample size calculator for analytic study; with 0.05 alpha error and power of the study 0.80. According to the literature, preoperative predictors of risk emergency surgeries mortality were found in 17.5% of all emergency surgeries. The predictors were age (the mean age of the survivors was 36.52±13.32 years as compared to 56.2±9.85 years), duration of symptoms (mean duration of the symptoms was 3.42±1.85 days); all the nonsurvivors had symptoms for more than 3 days (6.4±1.55 days) and the delay in instituting surgical intervention (nonsurvivors=80%) were operated upon more than 24 h after admission (1.8±1.2 days), whereas 86.95% of the survivors were operated upon the same day (0.13±0.33 days) minimum sample size calculated to evaluate preoperative risk assessment in emergency laparotomy patients will be 100 patients. Ten percent increase to cover follow-up to have a total sample size of 110 emergency laparotomy patients.

Sampling technique

A convenient sample of patients admitted to the Emergency Department of Kasr Alainy Hospital with the inclusion and exclusion criteria during the data collection period were assigned to the study. Patients were followed up for 10 days postoperative period.

Statistical analysis

Data were coded and entered using the Statistical analysis was done using IBM SPSS statistics for windows, Version 28.0. Armonk, NY: IBM Corp. Data was 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 made using the nonparametric Kruskal–Wallis and Mann–Whitney tests (Chan, 2003a). For comparing categorical data, χ^2 test was performed. The exact test was used instead when the expected frequency was less than 5 (Chan, 2003b). Correlations between quantitative variables were done using the Spearman correlation coefficient (Chan, 2003c). *P values* less than 0.05 were considered statistically significant.

RESULTS:

Demographic features

A total of 128 patients were included in our final analysis with a mean age of 42.17±16.80 years ranging from 14 to 86 years. Eighty-three (64.8%) patients were males, and 45 (35.2%) were females.

Interval between onset of symptoms and surgical intervention

The mean time interval between the onset of symptoms and surgical intervention was 34.3±75.4 h with SD 75.39.

Patients' presentation

Twenty-seven (21.1%) patients had previous laparotomy; 64 (50%) patients had peritonitis.

Among the included patients, 29 (22.7%) were admitted for perforated viscus, 11 (8.6%) patients with penetrating abdominal trauma, 49 (38.3%) with intestinal obstruction, 18 (14.2%) with intestinal ischemia, eight (6.3%) blunt abdominal trauma, and 13 (10.2%) abdominal abscesses.

Study outcomes

The mortality rate was 23.4%, eight (6.3%) patients were readmitted after 2 weeks from hospital discharge, and the mean postoperative hospital stay was 5.8±5.4 days.

Relation between risk factors and study outcomes

Age

Table 1 shows the relationship between age and outcomes, and age showed no statistically significant difference in terms of incidence of mortality with *P values* of 0.059. Also, age has no significant impact on hospital readmission after 2 weeks from hospital discharge, with a *P value* of 0.85. Age was negatively correlated with length of hospital stay with a *P value* of 0.017.

Sex

Table 2 shows the relation between the sex of the patients and the outcomes discussed. Sex showed no significant difference in the incidence of 10-daypostoperative mortality with a *P value* of 0.28. Also, sex was not significantly associated with the need for hospital readmission after 2 weeks from hospital discharge with *P values* more than 0.05. Sex were not significantly associated with differences in length of postoperative hospital stay with *P values* more than 0.05.

Table 1: The relation between age and different outcomes

	Mortality within 10 days postoperatively				
	Yes		No		
	Mean	SD	Mean	SD	*P* value
Age (years)	47.97	21.10	40.40	14.93	0.059
	Hospital readmission within 2 weeks from hospital discharge				
	Yes		No		
	Mean	SD	Mean	SD	*P* value
Age (years)	42.63	12.01	42.14	17.11	0.852
				Postoperative hospital stays	
Age (years)		Correlation coefficient		–0.211	
		P value		0.017	
		N		128	

Table 2: Relation between sex and outcomes

	Mortality within 10 days postoperatively					
	Yes		No			
	Count	%	Count	%		*P* value
Sex						
Male	17	20.5	66	79.5		0.284
Female	13	28.9	32	71.1		
	Hospital readmission within 2 weeks from hospital discharge					
	Yes	No				
	Count	%	Count	%		*P* value
Sex						
Male	6	7.2	77	92.8		0.712
	Postoperative hospital stay					
	Mean	SD	Median	Minimum	Maximum	*P* value
Sex						
Male	6.20	5.77	5.00	1.00	34.00	0.225

Time interval between onset of symptom and surgical intervention

The time interval between the onset of symptoms to surgical intervention showed no statistically significant difference in terms of incidence of mortality with a *P value* of 0.638. Also, this had no significant impact on readmission after 2 weeks from hospital discharge with a *P value* of 0.13. Lastly, the time interval between the onset of symptoms and surgical intervention in hours was not significantly associated with the difference in length of postoperative hospital stay with a *P value* more than 0.05. This is shown in (Table 3).

Table 3: Relation between time interval and different outcomes

	Mortality within 10 days postoperatively				
	Yes		No		
	Mean	SD	Mean	SD	*P* value
Time interval between onset of symptoms and surgical intervention in hours	58.33	136.59	26.92	40.38	0.638

	Hospital readmission within 2 weeks from hospital discharge				
	Yes		No		
	Mean	SD	Mean	SD	*P* value
Time interval between onset of symptoms and surgical intervention in hours	22.25	12.63	35.08	77.76	0.133
				Postoperative hospital stays	
Time interval between onset of symptoms and surgical intervention in hours		Correlation coefficient		0.062	
		P value		0.490	
		N		128	

Previous laparotomy

As shown in (Table 4), the previous laparotomy showed no significant difference in the incidence of 10 days postoperative mortality with a *P value* of 0.39. Also, previous laparotomy was not significantly associated with the need for hospital readmission after 2 weeks from hospital discharge with *P values* more than 0.05. Finally, previous laparotomy was not significantly associated with the difference in length of postoperative hospital stay with *P values* more than 0.05.

Table 4: Effect of previous laparotomy on the study outcomes

	Mortality within 10 days postoperatively					
	Yes		No			
	Count	%	Count	%		*P* value
Previous laparotomy						
Yes	8	29.6	19	70.4		0.393
No	22	21.8	79	78.2		
	Hospital readmission within 2 weeks from hospital discharge					
	Yes		No			
	Count	%	Count	%		*P* value
Previous laparotomy						
Yes	3	11.1	24	88.9		0.364
	Postoperative hospital stays					
	Mean	SD	Median	Minimum	Maximum	*P* value
Previous laparotomy						
Yes	5.70	4.34	5.00	1.00	18.00	0.613

Type of surgery

Indication of surgery showed a significant difference in the incidence of death with a *P value* of 0.007 as patients with intestinal ischemia showed the highest rate of mortality followed by intestinal obstruction, then perforated viscus, and to a lesser extent, blunt abdominal trauma, abdominal abscess, and penetrating trauma (Table 5).

Indication for surgery was not significantly associated with the need for hospital readmission after 2 weeks from hospital discharge with *P values* more than 0.05 (Table 6).

Indication for surgical intervention showed that the mean of postoperative stay was significantly higher in abdominal traumas and intestinal ischemia compared to perforated viscus and intestinal obstruction with a *P value* of 0.036 (Table 7).

Table 5: Relation between type of surgery and mortality within 10 days postoperatively

	Mortality within 10 days postoperatively				
	Yes		No		
	Count	%	Count	%	*P* value
Surgery					
Perforated viscus	8	27.6	21	72.4	
Penetrating abdominal trauma	0	0.0	11	100.0	
Intestinal obstruction	9	18.4	40	81.6	
Intestinal ischemia	10	55.6	8	44.4	0.007
Blunt abdominal trauma	2	25.0	6	75.0	
Abdominal abscess	1	7.7	12	92.3	

Table 6: Relation between type of surgery and hospital readmission within 2 weeks from hospital discharge

	Hospital readmission within 2 weeks from hospital discharge				
	Yes		No		
	Count	%	Count	%	*P* value
Surgery					
Perforated viscus	2	6.9	27	93.1	
Penetrating abdominal trauma	2	18.2	9	81.8	
Intestinal obstruction	2	4.1	47	95.9	0.373
Intestinal ischemia	1	5.6	17	94.4	
Blunt abdominal trauma	1	12.5	7	87.5	
Abdominal abscess	0	0.0	13	100.0	

Table 7: Relation between type of surgery and postoperative hospital stay

	Postoperative hospital stays					
	Mean	SD	Median	Minimum	Maximum	*P* value
Surgery						
Perforated viscus	4.28	3.65	4.00	1.00	19.00	
Penetrating abdominal trauma	7.73	5.82	7.00	2.00	19.00	
Intestinal obstruction	4.80	3.49	4.00	1.00	17.00	
Intestinal ischemia	8.33	8.46	5.50	1.00	34.00	0.036
Blunt abdominal trauma	9.62	6.63	8.00	2.00	23.00	
Abdominal abscess	5.69	6.33	3.00	1.00	19.00	

Presence of peritonitis

Table 8 shows the relation between the presence of peritonitis and the study outcomes, which showed no significant difference in the incidence of 10 days postoperative mortality with a *P value* of 0.67. Also, it was not significantly associated with the need for hospital readmission after 2 weeks from hospital discharge with *P values* more than 0.05. Lastly, the presence of peritonitis was not significantly associated with the difference in the length of postoperative hospital stay with *P values* more than 0.05.

Table 8: Relation between peritonitis and different study outcomes

	Mortality within 10 days postoperatively					
	Yes		No			
	Count	%	Count	%		*P* value
Presence of peritonitis						
Yes	16	25.0	48	75.0		0.676
No	14	21.9	50	78.1		
	Hospital readmission within 2 weeks from hospital discharge					
	Yes		No			
	Count	%	Count	%		*P* value
Presence of peritonitis						
Yes	7	10.9	57	89.1		0.062
No	1	1.6	63	98.4		
	Postoperative hospital stays					
	Mean	SD	Median	Minimum	Maximum	*P* value
Presence of peritonitis						
Yes	6.67	6.21	5.00	1.00	34.00	0.061
No	4.97	4.31	4.00	1.00	19.00	

DISCUSSION

Emergency laparotomies are performed in high numbers for a diverse range of pathologies and are associated with significant morbidity and mortality. Preoperative risk assessment would provide critical knowledge that may be used to modify the intraoperative plan or to mobilize greater postoperative resources based on a patient's level of risk. In the current study, we conducted a cohort study in the Emergency Department of Kasr Alainy Medical School to evaluate some risk factors that may affect the outcomes of emergency laparotomy.

A total of 128 patients were included in our final analysis: 83 (64.8%) were males, and 45 (35.2%) were females. They had a mean age of 42.17±16.80 years ranging from 14 to 86 years. These findings were like the evidence in Ahmadullah[8], that males are more commonly presented with acute abdomen to the emergency department with male : female ratio of 1.14:1. They stated that 40.8% of the included patients were aged between 24 and 40 years.

In the present study, age was negatively correlated with length of hospital stay with a *P value* of 0.017 and r=-0.211. Increased age showed no statistically significant increase in the incidence of 10 days postoperative mortality or hospital readmission within 2 weeks from hospital discharge. These results did not come in line with the results stated by Al-Temimi *et al*.[7], who stated that patients older than 90 years old have a less than 10% probability of survival. Cook and Day[9] revealed that patients with emergency laparotomy aged 70−79 years had the highest mortality rate (an almost 50% 2-year mortality rate). These results can be explained by the short follow-up period for mortality in our study (10 days).

Saunders *et al*.[2], examined the effect of sex on mortality and showed that lower mortality was in female patients. However, Haskins *et al*.[10], demonstrated an increased mortality among female patients undergoing an emergency laparotomy.

The mortality rate within 10 days postoperatively was 23.4%. Our findings also revealed that 6.3% of patients were readmitted after 2 weeks from hospital discharge while the mean postoperative hospital stay was 5.8±5.4 days while in Jansson Timan *et al*.[11], the mean length of hospital stay was 12 days with overall short-term mortality of 14.2%. Our findings were consistent with the study conducted by Purcell *et al*.[12], who conducted a cross-section study including 2509 who were admitted to a hospital with acute abdomen. Their results showed that the mortality rate was 22.2%. Costamagna *et al*.[13] have reported similar rates of mortality among patients admitted to the emergency department for emergency laparotomy. The reported mortality rate was 20% among the included cohort.

A cross-section study conducted by Tolstrup and colleagues, including 4346 patients who underwent emergency surgery. The study showed that

laparotomy was associated with a higher incidence of 30-day mortality. They demonstrated that the overall 30-day mortality was 8%. The 30-day mortality rates were 0.8% for laparoscopy groups versus 17% in laparotomy group. They stated that the mortality rate at 24 h postoperatively was 20%[14].

On the other hand, Mutharaju *et al*., reported a mortality rate of 7.2%, which agrees with Ohene-Yeboah[15], who reported a death rate of 7.4% out of most cases of hollow viscous perforation. Ahmadullah[8] reported a mortality rate of 3.6%. These rates were lower than the ones reported in our study. This can be explained by the younger age groups included in the previously mentioned studies.

In the present study, the mean time between onset of symptoms and surgical intervention was 34.3±75.4 h. Time intervals did not significantly differ in correlation to outcomes. Singh *et al*.[16], investigated the relationship between the duration of symptoms and mortality. Length of symptoms lasting more than 4 days was deemed to be a good predictor of mortality. Vester-Andersen *et al*.[17] examined the relationship between time delays to intervention with an emergency laparotomy and mortality. A range of time delays was examined, and found there was no statistically significant difference in mortality when there was a time delay to surgery. However, this was inconsistent with Purcell *et al*.[12], who conducted a cross-section study and multivariate Poisson regression showed that undergoing an operation within 1–2 days from onset of symptoms (RR 1.48, 95% confidence interval 1.16–1.87, *P=0.001*) and more than 2 days (RR 1.46, 95% confidence interval 1.17–1.82, *P=0.001*) after the presentation, were associated with an increased relative risk of mortality.

Wang *et al*.[18] have investigated the time interval between presentation and surgical intervention. Results showed that most of the delays are because of diagnostic tools, as the mean time waiting for CT abdomen for a definitive diagnosis of acute abdomen was 9.22 h, and the median time interval between CT request and CT start was 1.55 h. A cross-section study Mbah and colleagues included 136 patients with acute abdomen showed that delays between presentation and surgical interventions might cause by the patient himself as only 13 (9.6%) of the patients were operated on within 6 h. The remaining 123 patients were mainly delayed due to financial constraints. They reported that the commonest complication was wound infection in 31 (22.8%) patients 23 of them were operated on after 6 h and the mortality rate was 20.6%. All of them were operated on after 6 h of admission. These findings were consistent with the findings of the current study[19].

Our findings revealed that intestinal obstruction is the most common indication for emergency laparotomy. These results go in line with data from the first report of the National Emergency Laparotomy Audit, 2015 (UK) which stated that indications for emergency laparotomy, including intestinal obstruction 49%, perforation 24%, ischemia 9%, and abdominal abscess 7%[20]. Agboola and colleagues, detailed that patients with inflammatory lesions comprised 34.1% of all patients with acute abdomen. Perforated viscus (29.7%), obstructive lesion (27.9%), hemorrhagic lesions (2.5%), and biliary colic (1.3%), 4.5% of the patients were classified as nonspecific abdominal pain since no definitive diagnosis[21].

In our study, peritonitis was found in 50% of patients with no statistically significant effect on postoperative mortality within 10 days. However, in Barazanchi and colleagues, patients with peritonitis experienced a significant increase in crude in-hospital mortality compared with patients without peritonitis (18.2 vs. 11.8%, respectively; *P=0.002*). This may be attributed to younger age groups in our study with less comorbidities[3].

Our findings revealed that 27 (21.1%) patients had previous abdominal operations with no statistically significant effect on study outcomes. This result is consistent with Jeppesen *et al*.[22], where a history of previous abdominal surgery was not associated with an increase in 30 days postoperative mortality.

CONCLUSION

Indication for emergency laparotomy can significantly affect the 10 days postoperative mortality with the highest incidence in patients of intestinal ischemia followed by intestinal obstruction, then perforated viscus, and, to a lesser extent blunt abdominal trauma, abdominal abscess, and penetrating trauma. While the mean of postoperative hospital stay was significantly higher in abdominal traumas and intestinal ischemia compared to perforated viscus and intestinal obstruction.

RECOMMENDATIONS

Conducted a large prospective trial to compare the outcomes of acute abdomen surgeries in open and laparoscopy settings. Sensitivity analysis is used to assess the cut-off time for intervention delay in patients undergoing emergency laparotomy. Multivariate analysis to assess risk factors associated or confounding 10-day mortality and length of hospital stay in patients with acute abdomen.

LIMITATIONS

Limitations of the current study include small sample size, lack of comparison between outcomes of laparoscopy and laparotomy in the emergency settings of acute abdomen patients, and not reporting specific complications and their incidences.

CONFLICT OF INTEREST

There are no conflicts of interest.

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