Predictors of mortality in patients undergoing emergency abdominal surgery: a prospective study

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Background
Emergency surgery, compared with planned surgery, is strongly associated with increased risks of adverse postoperative outcomes owing to the short time available for diagnostic procedures, patient optimization, and surgical intervention in patients presenting with physiological derangement.
Patients and methods
A prospective cohort study was performed that included 118 patients. They were divided into two groups according to the outcome: group M and group S. A number of predictors were stratified into preoperative, intraoperative, and postoperative predictors and correlated with mortality.
Results
The most frequently encountered intraoperative finding was viscus perforation (27.1%), followed by appendicitis (25.4%). There was a mortality incidence of 31.35%. Septic shock was the most common cause of death (64.7%). Mortality was strongly correlated with a number of predictors, including age, BMI, diabetes, hypertension and liver disease, systolic blood pressure on presentation and after patient optimization, respiratory rate, Glassgo coma scale (GCS), urine output, acid–base derangement, presence of multiorgan dysfunction especially renal and cardiovascular, and coronavirus disease infection. Intraoperative and postoperative predictors included severe hypotension after induction, urine output, contamination, bleeding and need for blood transfusion, need for ICU admission, need for hemodynamic support/mechanical ventilation, need for dialysis, contractility less than 40%, postoperative lactate levels, and development of complications. Duration of symptoms, history of surgery within 30 days, length of trial of conservative management if indicated, operative time, and presence of malignancy were not shown to be significant predictors.
Conclusion
Executing the study has assisted in highlighting care processes that need improvement and that could be focused upon. Furthermore, it proved to be a reliable tool to be used for auditing purposes that allows risk adjusted measurement of the quality of care hence providing standardization of medical care.

Keywords:
acute abdomen, emergency abdominal surgery, intra-abdominal sepsis, mortality, peritonitis, risk adjustment, scoring system, sepsis

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Background and rationale

Owing to the limited time available for diagnosis and evaluation in patients presenting with physiological derangement, emergency surgery is substantially related with higher chances of negative postoperative outcomes compared with scheduled surgery [1].

A critical and impartial indicator of success is mortality. Measures of outcome must incorporate techniques to account for variations in characteristics including patient presentation, general fitness of the local population, and the type of operation performed to give meaningful comparative audit between various groups [2].

The projected lifespan and quality of life of patients of all age groups can be significantly increased by identifying current problems present in the emergency surgery situation. It enhances results, lessens problems, and guarantees prompt, safe, and efficient care. It helps in identifying care processes that might use improvement, such as interdisciplinary decision-making, resource allocation for critical care, and patient communication. Additionally, it may be used as a tool for auditing

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and evaluating the level of care in an effort to offer uniform management of surgical emergencies [3].

Patients and methods

Patients who presented to the emergency unit of Kasr Al-Ainy University hospitals with acute abdomen were evaluated as follows:

(1) Immediate assessment and the necessary resuscitative measures, according to the CCrISP protocol, which delineates the following principles:
   (a) Immediate management in the form of airway, breathing, circulation assessment and treatment, dysfunction of the central nervous system and treatment, and exposure of the patient to sufficient full assessment and treatment.
   (b) Full patient assessment through history and systemic examination.
   (c) Adjuncts to the immediate assessment in the form of insertion of a urinary catheter to monitor the urine output and placement of a nasogastric tube, in case of intestinal obstruction, to provide bowel decompression.
(2) Laboratory investigations in the form of hemoglobin, total leukocytic count (TLC), platelets count, prothrombin concentration (PC), international normalized ratio (INR), creatinine, urea, alanine tranferase (ALT), aspartat tranferase (AST), and lactate.
(3) Radiological studies in the form of pelvi-abdominal ultrasound, erect chest radiograph, erect abdominal radiograph, and contrast or noncontrast enhanced abdominal and pelvis computed tomography, according to the proposed provisional diagnosis.
(4) A diagnosis was made whether a patient requires emergency surgery or a conservative management. Patients in whom a decision to operate were included in the study. Patients who were admitted under observation and received conservative management were excluded. Patients in whom a decision to operate was later made due to failed conservative management were included. Appropriate consent regarding the procedures was obtained from the patients.
(5) In case of mortality, event description and management were noted.

Primary outcome

Occurrence of mortality within 30 days of admission was the primary outcome.

Secondary outcomes

To define the predictors of mortality, parameters classified into preoperative, intraoperative, and postoperative factors were assessed between the groups of the study: group M (mortality) and group S (survival).

Preoperative parameters

They included the following:

(1) Age.
(2) BMI.
(3) Comorbidities.
(4) Duration of symptoms and history of surgical procedures within 30 days of presentation.
(5) Heart rate, systolic blood pressure, respiratory rate, and Glassgo coma scale (GCS).
(6) TLC, hemoglobin, creatinine, urea, ALT, PC, INR, lactate, Na, and K.
(7) Acid–base balance.
(8) Presence of organ dysfunction.
(9) Postoptimization heart rate and systolic blood pressure.
(10) Urine output.
(11) Temporal classification of surgery.
(12) Coronavirus disease (COVID) status.

Intraoperative parameters

They included the following:

(1) Operative time.
(2) Severe hypotension after induction and need for hemodynamic support.
(3) Presence of intra-abdominal contamination.
(4) Urine output.
(5) Presence of malignancy.
(6) Bleeding and need for transfusion of blood/blood products.

Postoperative parameters

They included the following:

(1) Need for ICU admission.
(2) Need for hemodynamic support/mechanical ventilation.
(3) Lactate.
(4) Contractility.
(5) Need for dialysis.
(6) Occurrence of complications.

Hypotension was defined as a systolic blood pressure less than 100 mmHg.

Extreme hypotension was defined as systolic blood pressure less than 90 mmHg.

Tachypnea was defined as more than 25 breaths per minute.

Emergent surgery was defined as surgery within 2 h.

Urgent surgery was defined as surgery within 24 h.

Expedited surgery was defined as surgery within 48 h.

Approval was obtained through the Research Committee of the Faculty of Medicine at Cairo University.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS), version 26 was used to code the data and create statistical computations (IBM Corp., Armonk, New York, USA). Quantitative data were statistically represented using the mean, SD, median, minimum, and maximum. Categorical data were statistically described using frequency (count) and relative frequency (%). The nonparametric Kruskal–Wallis and Mann–Whitney tests were used to compare quantitative variables. An analysis using the χ^2 test was done to compare categorical data. When the anticipated frequency is less than 5, an exact test was used instead. The Spearman correlation coefficient was used to determine correlations between quantitative variables. Statistics were considered significant at P values less than 0.05.

Results

In this study, 120 patients with acute abdominal pain who visited the emergency department of Kasr Al-Ainy Hospital between December 2020 and May 2021 were included. Considering the lack of intraoperative results, two patients were eliminated.

According to the outcome after surgical intervention, patients were stratified into the following groups:

(1) Group M (mortality): 37 (31.4%) patients.
(2) Group S (survival): 81 (68.6%) patients.

The most frequently encountered intraoperative finding was viscus perforation (27.1%), followed by appendicitis (25.4%) (Table 1). There was a mortality incidence of 31.4%. Septic shock was the most common cause of death (64.7%). Mortality was strongly correlated with a number of predictors including age, BMI, diabetes, hypertension and liver disease, systolic blood pressure on presentation and after patient optimization, respiratory rate, GCS, urine

Table 1 Intraoperative findings

	Mortality		Total
	Yes	No	
Findings (intraoperative)			
Adhesive IO			
Count	0	5	5
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	6.1	4.2
% of total	0.0	4.2	4.2
Appendicitis			
Count	4	26	30
% within findings (intraoperative)	13.3	86.7	100.0
% within mortality	10.8	32.1	25.4
% of total	3.4	22.0	25.4
Colonic perforation (traumatic/pathological)			
Count	2	1	3
% within findings (intraoperative)	66.7	100.0	100.0
% within mortality	5.4	1.2	2.4
% of total	1.6	0.8	2.4
Colonic/rectal mass			
Count	4	5	9
% within findings (intraoperative)	44.4	55.6	100.0
% within mortality	5.2	6.1	7.5
% of total	3.3	1.4	7.5
Diverticulitis			
Count	1	1	2
% within findings (intraoperative)	50.0	50.0	100.0
% within mortality	2.7	1.2	1.6
% of total	0.8	0.8	1.6
Gangrene/strangulation			
Count	0	2	2
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	2.4	1.6
% of total	0.0	1.6	1.6
GB empyema			
Count	0	2	2
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	2.5	1.7
% of total	0.0	1.7	1.7
Leakage			
Count	6	1	7
% within findings (intraoperative)	85.7	14.3	100.0
% within mortality	16.2	1.2	5.9
% of total	5.1	0.8	5.9
Liver abscess			
Count	0	1	1
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	1.2	0.8
% of total	0.0	0.8	0.8
MVO			
Count	3	3	6
% within findings (intraoperative)	50.0	50.0	100.0
% within mortality	8.1	3.7	5.1
% of total	2.5	2.5	5.1
Complicated stoma			
Count	0	3	3
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	3.6	2.4
% of total	0.0	2.4	2.4

(*Continued*)

Table 1 (*Continued*)

	Mortality Yes	Mortality No	Total
Necrotizing fasciitis of abdominal wall			
Count	1	1	2
% within findings (intraoperative)	50.0	50.0	100.0
% within mortality	2.7	1.2	1.7
% of total	0.8	0.8	1.7
Necrotizing pancreatitis			
Count	1	1	2
% within findings (intraoperative)	50.0	50.0	100.0
% within mortality	2.7	1.2	1.7
% of total	0.8	0.8	1.7
Perforated prepyloric ulcer			
Count	12	21	33
% within findings (intraoperative)	36.40	63.6	100.0
% within mortality	32.4	25.9	27.9
% of total	10.1	17.8	27.10
Strangulated diaphragmatic hernia			
Count	0	1	1
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	1.2	0.8
% of total	0.0	0.8	0.8
Strangulated hernia			
Count	3	3	6
% within findings (intraoperative)	50.0	50.0	100.0
% within mortality	8.1	3.7	5.1
% of total	2.5	2.5	5.1
Sigmoid volvulus			
Count	0	1	1
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	1.2	0.8
% of total	0.0	0.8	0.8
Negative			
Count	0	3	3
% within findings (intraoperative)	0.0	100.0	100.0
% within mortality	0.0	3.7	2.5
% of total	0.0	2.5	2.5
Total			
Count	37	81	118
% within findings (intraoperative)	31.4	68.6	100.0
% within mortality	100.0	100.0	100.0
% of total	31.4	68.6	100.0

output, acid–base derangement, presence of multiorgan dysfunction especially renal and cardiovascular, and COVID infection. Intraoperative and postoperative predictors included severe hypotension after induction, urine output, contamination, bleeding and need for blood transfusion, need for ICU admission, need for hemodynamic support/mechanical ventilation, need for dialysis, contractility less than 40%, postoperative lactate levels, and development of complications. Duration of symptoms, history of surgery within 30 days, length of trial of conservative management if indicated, operative time, and presence of malignancy were not shown to be significant predictors.

Demographics

Patient characteristics

Age, sex, and BMI

There was a slight male predominance (57.6%) in the study. The mean age in group M and S was 55.49 and 34.07 years, respectively. Most of the patients were in the obese category (48%) in group M, whereas most of them were in the average category (41.97%) in group S. Both groups were statistically homogenous regarding sex distribution (P=0.182); however, age and BMI showed a statistically significant predisposition to mortality (P<0.001). Table 2 describes the demographic data of the patients.

Comorbidities

A total of 40 patients presented with a history of comorbidities. Diabetes was the most common comorbidity noted among the study population (n=20, 17.7%). Table 3 describes the distribution of comorbidities among the population.

Duration of symptoms and surgical history within 30 days of presentation

Table 2 Patients demographics

	Mortality Yes: Mean	SD	Median	Minimum	Maximum	Mortality No: Mean	SD	Median	Minimum	Maximum	*P* value
Age	55.49	14.30	56.00	15.00	78.00	34.07	17.12	33.00	8.00	76.00	<0.001

		Mortality Yes: Count	%	Mortality No: Count	%	*P* value
Sex	Male	18	26.5	50	73.5	0.182
	Female	19	38.0	31	62.0	
BMI	Underweight	4	23.5	13	76.5	<0.001
	Average	5	12.8	34	87.2	
	Overweight	4	18.2	18	81.8	
	Obese	18	56.3	14	43.8	
	Morbidly obese	6	75.0	2	25.0	

The mean duration of symptoms was 4 days. A history of surgical procedures within 30 days of presentation was noted in 11.8% of patients. Both factors did not show a contribution to mortality.

Vitals and GCS

Systolic blood pressure and respiratory rate showed a statistical significance across both groups, with a *P* value of less than 0.001 and 0.034, respectively. However, the heart rate was not shown to contribute to mortality. Table 4 describes the vital parameters of the population on presentation.

Mortality rate in hypotensive and extremely hypotensive patients was 69.2 and 81.8%, respectively (Table 4). Systolic blood pressure, respiratory rate, and GCS showed a significant contribution to mortality (Table 5).

A similar result was noted when correlating postoptimization vitals to mortality. Pulse and blood pressure showed a *P* value of less than 0.001 and 0.128, respectively. However, extreme hypotension after resuscitation was an independent predictor.

Acid–base status

Of all acid–base disturbances, metabolic acidosis (whether compensated or uncompensated) and uncompensated metabolic alkalosis were independent predictors of mortality ($P<0.001$).

Multiorgan dysfunction

A total of 32 (30.0%) patients presented with single/multiple organ dysfunction. Among all organ dysfunction, renal and cardiovascular were the only

Table 3 Patients' comorbidities

	Mortality				
	Yes		No		
	Count	%	Count	%	*P* value
Diabetic					
Yes	12	57.1	9	42.9	0.005
No	25	25.8	72	74.2	
HTN					
Yes	9	64.3	5	35.7	0.011
No	28	26.9	76	73.1	
Cardiac					
Yes	3	60.0	2	40.0	0.177
No	34	30.1	79	69.9	
Hepatic					
Yes	8	61.5	5	38.5	0.023
No	29	27.6	76	72.4	
Renal					
Yes	1	50.0	1	50.0	0.531
No	36	31.0	80	69.0	

Table 4 Vitals on presentation and after optimization

	Mortality				
	Yes		No		
	Count	%	Count	%	*P* value
Pulse					
Tachycardia	23	39.0	36	61.0	0.074
Normal	14	23.7	45	76.3	
Systolic blood pressure					
Normotensive	18	20.7	69	79.3	<0.001
Hypotensive	9	69.2	4	30.8	
Hypertensive	0	0.0	6	100.0	
Extremely hypotensive	9	81.8	2	18.2	
Extremely hypertensive	1	100.0	0	0.0	
RR					
Tachypnea	26	39.4	40	60.6	0.034
Normal	11	21.2	41	78.8	
Pulse					
Tachycardia	16	41.0	23	59.0	
Normal	17	24.3	53	75.7	0.128
Extremely tachycardia	4	44.4	5	55.6	
BP					
Normotensive	22	22.7	75	77.3	
Hypotensive	7	77.8	2	22.2	<0.001
Hypertensive	3	42.9	4	57.1	
Extremely hypotensive	5	100.0	0	0.0	

Table 5 GCS

	Mortality										
	Yes					No					
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	*P* value
GCS	14.81	0.40	15.00	14.00	15.00	14.99	0.11	15.00	14.00	15.00	< 0.001

significant predictors of mortality ($P<0.001$ and 0.001, respectively) (Table 6).

Preoperative laboratory values

Table 7 describes the significant laboratory tests across both groups.

Preoperative urine output

Most of the patients in group M were oliguric (40.5%). Correlation of the urine output to mortality showed a statistical significance ($P<0.005$).

Table 6 Multiple organ dysfunction in relation to mortality

	Mortality				
	Yes		No		
	Count	%	Count	%	*P* value
MODS					
Single	12	46.2	14	53.8	
Multiple	4	66.7	2	33.3	0.014
None	21	24.4	65	75.6	
System					
Renal	6	33.3	12	66.7	
Hepatic	1	100.0	0	0.0	
Endocrinal	1	50.0	1	50.0	0.005
Cardiovascular	8	72.7	3	27.3	
None	21	24.4	65	75.6	

Coronavirus disease status

A total of 11 (9.32%) patients were found to be COVID positive, and eight (72.7%) patients died. COVID infection was noted to significantly contribute to mortality.

Duration of conservative management

The mean duration of conservative management in those who were indicated was 0.8 days among nonsurvivors. It was not statistically significant (P=0.283).

Temporal classification of surgery

Overall, 46.2% of the procedures classified as emergent were among group M. The higher the classification, the higher the mortality rate noted.

Operative time

The mean operative time was 2.6 h in group M compared with a mean of 3.26 h in group S, denoting that operative time was not a significant contributor to mortality.

Severe hypotension after induction and need for hemodynamic support

A total of 37 patients developed severe hypotension after induction. Overall, 62.1% died, whereas 37.8%

Table 7 Preoperative laboratory values

	Mortality										
	Yes					No					
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	*P* value
TLC	18.96	13.06	15.70	3.00	72.90	14.08	6.96	13.30	2.20	43.60	0.054
Hemoglobin	11.25	2.20	11.00	6.80	17.50	12.83	2.60	12.40	3.50	19.60	<0.001
PLTs	329.68	144.37	316.00	91.00	607.00	303.36	117.33	291.00	51.00	822.00	0.378
Creatinine	2.02	1.73	1.24	0.40	7.10	1.27	1.03	0.90	0.30	5.30	0.004
Urea	98.70	120.00	60.00	21.00	712.00	55.16	53.00	36.00	5.00	270.00	<0.001
ALT	72.62	151.66	34.00	11.00	921.00	36.33	53.85	23.00	5.00	460.00	0.031
AST	62.62	120.52	34.00	4.00	747.00	44.26	72.96	27.00	12.00	523.00	0.070
PC	65.22	17.60	67.00	13.00	98.00	76.64	17.68	78.00	34.00	121.00	0.002
INR	1.50	0.74	1.30	1.00	5.56	1.26	0.36	1.14	0.80	3.20	0.001
Na	132.19	6.95	132.00	117.00	149.00	134.44	6.59	135.00	109.00	154.00	0.058
K	4.23	0.79	4.20	2.20	5.90	9.57	48.20	4.18	2.70	438.00	0.961

survived. Severe hypotension after induction was a significant predictor of mortality ($P<0.001$).

Intraoperative urine output

Most of the patients in group M were oliguric (40.5%). Oliguria significantly predicted mortality, ($P<0.001$).

Contamination

Peritoneal soiling was a significant contributor to mortality ($P=0.008$). Bile and feculent soiling were the only independent predictors of mortality ($P<0.001$ and 0.001, respectively) (Table 8).

Presence of malignancy

A total of 13 (11.0%) cases had malignancy, of whom eight (61.5%) cases were survivors (group M), whereas five died. No correlation was found between malignancy and mortality ($P=0.543$).

Bleeding and need for transfusion of blood/blood products

Intraoperative bleeding and need for blood transfusion were noted to correlate significantly with mortality ($P=0.006$ and $P<0.001$, respectively). However, need for transfusion of blood/blood products preoperatively did not predict this outcome ($P=0.739$) (Table 9).

Table 8 Contamination in relation to mortality

	Mortality				
	Yes		No		
	Count	%	Count	%	*P* value
Contamination/toxic fluid (intraoperative)					
Pus	3	23.1	10	76.9	
Jejunal content	1	100.0	0	0.0	
Ileal content	2	100.0	0	0.0	
Gastric	1	100.0	0	0.0	
Feculent	9	64.3	5	35.7	0.008
Exudate	0	0.0	4	100.0	
Blood	0	0.0	1	100.0	
Bile	7	24.1	22	75.9	
No	14	26.4	39	73.6	

Table 9 Bleeding and need for blood transfusion in relation to mortality

	Mortality				
	Yes		No		
	Count	%	Count	%	*P* value
Blood/plasma transfusion (preoperative)					
Yes	4	36.4	7	63.6	0.739
No	33	30.8	74	69.2	
Bleeding (intraoperative)					
<100	24	25.5	70	74.5	0.006
100–300	13	59.1	9	40.9	
300–500	0	0.0	2	100.0	
Blood/plasma transfusion (intraoperative)					
Yes	18	78.3	5	21.7	<0.001
No	19	20.0	76	80.0	

Table 10 Complications in relation to mortality

	Mortality				
	Yes		No		
	Count	%	Count	%	*P* value
Complication (postoperative)					
AF	4	100.0	0	0.0	
AKI	1	33.3	2	66.7	
ARDS+AKI	1	100.0	0	0.0	
Bleeding	0	0.0	1	100.0	
Fever	0	0.0	1	100.0	
Hypoxia	2	100.0	0	0.0	
Leakage	2	28.6	5	71.4	
Melena, pulmonary embolism	1	100.0	0	0.0	
Myocardial infarction	1	100.0	0	0.0	<0.001
Pneumonia	2	100.0	0	0.0	
Pneumothorax	0	0.0	1	100.0	
Pulmonary embolism	1	100.0	0	0.0	
Retracted stoma	2	66.7	1	33.3	
Septic shock	1	100.0	0	0.0	
SVT	1	100.0	0	0.0	
Toxic myocarditis	2	100.0	0	0.0	
Wound infection	0	0.0	14	100.0	
No	16	22.2	56	77.8	

Postoperative parameters

Need for ICU admission

A total number of 55 patients required ICU admission. Overall, 63.6% (n=35) died and 36.4% (n=20) were survivors. Need for ICU admission was noted to be a significant predictor of mortality (P<0.001).

Need for hemodynamic support and mechanical ventilation

The mean duration of need for inotropic support and mechanical ventilation in group M was 2.95 and 3.92 days, respectively. It was noted to significantly contribute to mortality (P<0.001 and 0.001, respectively).

Lactate level

Overall, 93% of patients with a normal lactate value were among the survivors (group S). The lactate value was strongly associated with mortality. The higher the lactate value, the more likely the mortality (P<0.001).

Contractility

Overall, 100% of patients with a contractility less than 40% were among the nonsurvivors. On the contrary, only 25% of patients with a contractility above 40% had an outcome of mortality compared, with 74.8% representing survivors.

Need for dialysis

Overall, 85.5% of patients requiring dialysis were among the nonsurvivors, proving the need for dialysis to be strongly correlated with mortality (P=0.004).

Complications

Development of complications was highly associated with mortality (P<0.001). Table 10 describes the postoperative complications of the studied population. AKI, leakage, and AF were independent predictors of mortality (P=0.002, 0.006, and 0.037, respectively). Overall, 100% of patients who developed cardiac and renal complications did not survive (Table 10).

Length of ICU and hospital admission

The average stay in the ICU was 5.81 days in group S and 8.14 days in group M. The average hospital stay in group M was 7.41 days, whereas it was 6.3 days in group S. Although the length of hospital stay was not a significant factor of mortality (P=0.923), the length of ICU hospitalization significantly predicted this outcome (P=0.014).

Scoring system

There are many factors affecting mortality. Furthermore, many of these predictors might coexist in the same patient. Therefore, a scoring system was proposed based on the significant predictors previously described to accurately predict mortality (Table 11).

Table 11 *P* value, sensitivity, and specificity

	Area under curve	*P* value	95% confidence interval	
			Lower bound	Upper bound
Score	0.956	<0.001	0.922	0.990
Cutoff value			Sensitivity	Specificity
21.5			91.89%	90.12%
22.5			91.89%	91.36%
24.0			89.19%	92.59%

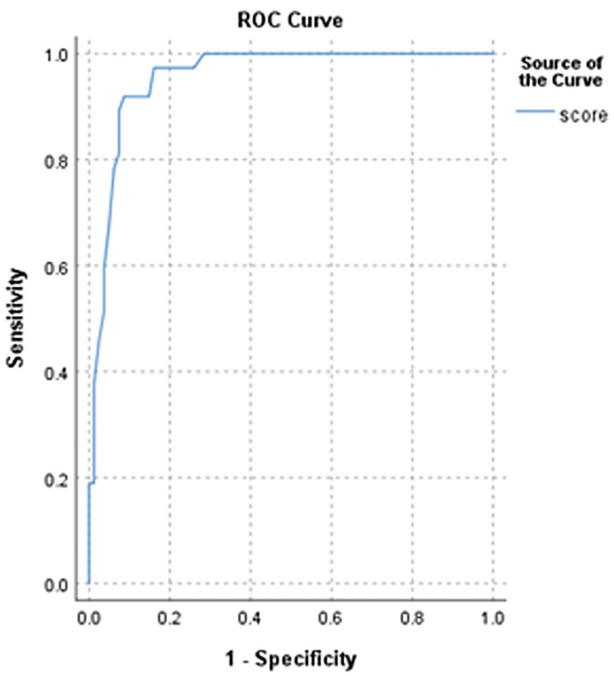
Preoperative	
Age >44	3
BMI – obese/morbidly obese	2
Diabetic/hypertensive/hepatic	2 (up to 6)
Systolic blood pressure <90 mmHg	3
Respiratory rate >25	1
Systolic blood pressure <90 mmHg after optimization	3
ABG (metabolic acidosis/uncompensated respiratory alkalosis)	3
Organ dysfunction	1
Oliguria/anuria	1
COVID positive	2
Intraoperative	
Severe hypotension after induction	2
Need for intraoperative blood transfusion	1
Oliguria/anuria	2
Postoperative	
Need for ICU admission	4
Need for mechanical ventilation	4
Need for inotropic support	4
Contractility <40%	4
Need for hemodialysis	3
High lactate value	4

A cutoff value of 23 (sensitivity – 91.89%, specificity – 91.3%) was derived from the receiver-operator characteristic (ROC) curve, above which, there is a low likelihood of mortality, and below which, there is a high likelihood of mortality (Fig. 1).

Discussion

The related mortality rate for emergency laparotomies is among the highest of all surgical procedures; it is approximately ten times higher than that of major elective gastrointestinal surgery. In the worldwide and national context, these surgeries represent a considerable illness burden. Nevertheless, emergency perioperative care routes frequently fall short of the clinical guidelines, organizational frameworks, and care

Figure 1



ROC curve. ROC, receiver-operator characteristic.

procedures that are advantageous to the majority of elective patients [4].

Several risk adjusting scoring systems exist for the assessment of surgical patients. Although some are designed to be applied on patients in the emergency setting, others were created and later executed in both elective and emergency units. However, surgical disease-specific scores are not typically used in surgical patients as they have not yet been shown to be demonstrably superior to general disease severity scores like the acute physiology and chronic health evaluation (APACHE) II or III or the sequential organ failure assessment (SOFA) [5].

In this study, 30-day mortality was strongly correlated to age, BMI, presence of history of diabetes, hypertension and liver disease, blood pressure, respiratory rate, GCS on admission, acid–base balance, blood pressure after patient optimization, presence of multiorgan dysfunction, urine output, hemoglobin, creatinine, urea, ALT, PC and INR values, COVID status, temporal classification of surgery, operative time, severe hypotension after induction, need for hemodynamic support, intraoperative urine output, presence of intra-abdominal contamination, bleeding and need for transfusion of blood/blood products, need for ICU admission, need for hemodynamic support and mechanical ventilation, postoperative lactate level, myocardial contractility, need for dialysis, development of complications, length of ICU, and hospital admission. Sex, presence of history of cardiological and renal diseases, duration of symptoms, surgical history within 30 days of presentation, pulse, platelet count, AST, K values, length of conservative management before surgical intervention, presence of malignancy, and need for transfusion of blood/blood products did not significantly affect mortality.

Mortality

The mortality incidence in our research was 31.4%. In a study by Mačiulienė *et al.* [6], the total 30-day in-hospital mortality rate was 40%. A lower incidence was reported by Nachiappan and Litake [7] in a study comprising 100 patients with viscus perforation; 16 fatalities were reported overall, equating to a mortality rate of 16%. In a research by Sartelli *et al.* [8], there were 163 (7.6%) fatalities of the 2152 patients.

Age, sex

In groups M and S, the average age was 55.49 and 34.07 years, respectively. These findings were comparable to those of the study by Mačiulienė *et al.* [6], which found that the mean age of survivors was 55 years, as opposed to 72 years for nonsurvivors (P=0.001). The risks of 30-day in-hospital mortality rose as age increased every year (odds ratio=1.08, P=0.001) [6].

Age is a substantial predictor of mortality, according to Nachiappan and Litake [7], who included 100 patients and found that the median age of patients who survived was 40 years old and the median age of patients who died was 60 years old. However, when looking at sex as a predictor, the study had a similar outcome to ours, with nonsurvivorship rates of 13% for females (three out of 23 females) and 16.8% for males (13 out of 77 males), with just a slight male predominance (P=0.47), proving that the patients' sex has no effect on their outcome [7].

Comorbidities

Diabetes, hypertension, and liver disease were shown to significantly contribute to death in the current research (P=0.005). In a trial by Koperna and Schulz [9], individuals with diabetes mellitus had a significantly greater risk, with a 50% fatality rate (P=0.009). However, it is important to note that the majority of the patients in this research (39) had duodenal disease and then colonic pathology (14) [9]. Intriguingly, preexisting hypertension seems to be protective in a research by Anaya and Nathens [10] It is conceivable that the regular usage of beta-blockers contributes to this protective effect. Beta-blockers reduce some of the immunomodulatory effects of circulating catecholamines in this regard, which might have an effect on the risk of mortality.

Preoperative

Laboratory measures

Coagulation disorder was shown to substantially predict death in this research (*P*=0.001). According to a research by Mačiulienė *et al.* [6], coagulation impairment was noted in 34 (51%) individuals, which is consistent with this finding. The observed INR among survivors was 1.130.2 compared with 1.71.5 in nonsurvivors (*P*=0.015). Impairment of coagulation increased the risk of death (*P*=0.007) [6].

As a mortality predictor in our investigation, TLC was just slightly on the cusp of significance (*P*=0.054). Even though a lot of authors have looked at the effectiveness of TLC in identifying particular intra-abdominal illnesses, the majority of their findings have been disappointing. Leukocytosis, for instance, had a pooled sensitivity of 0.79 and a pooled specificity of 0.55 in a meta-analysis of 23 trials of individuals with clinical suspicion of acute appendicitis [5].

In surgical patients with sepsis, lactate has been widely researched as a measure of systemic hypoperfusion and is independently related to death [11]. It has not, however, undergone a thorough evaluation as a diagnostic indicator for subsequent peritonitis or as a tool for prioritizing patients for surgery. Lactate was found to be a powerful predictor of mortality in our study (*P*=0.001). The usefulness of serum lactate in patients who come with an acute abdomen and a clinical suspicion of mesenteric ischemia has been assessed in a number of small trials. According to the authors' findings in these small and carefully chosen groups, lactate level is a nonspecific indicator of systemic hypoperfusion with a sensitivity of 78–100% but a specificity of only 36–53% [12]. Serum L-lactate should be used to direct early resuscitation and as a sign of overall disease but not as a marker of intestinal ischemia, according to the recommendation by Ross *et al.* [5].

Metabolic acidosis

Although measures of metabolic acidosis, such as base deficit, have been extensively studied end points in resuscitation and are reliable predictors of injury severity and mortality in trauma, it is unclear how useful they will be in identifying patients with secondary peritonitis or directing surgical management. It has not been thoroughly examined whether metabolic acidosis may be used to diagnose subsequent peritonitis or to determine which patients require immediate surgery. Metabolic acidosis, whether compensated or uncompensated, and uncompensated metabolic alkalosis were independently associated with death in our research (*P*=0.001). In a number of modest investigations, the usefulness of metabolic acidosis in identifying individuals with strangulated obstruction or mesenteric ischemia has been evaluated, and the results indicate that metabolic acidosis is not a reliable predictor of either diagnosis [5].

Symptoms duration

The duration of symptoms before presentation did not appear to be a risk factor for death in this analysis (*P*=0.792). Similarly, Nachiappan and Litake [7] showed that patients who died experienced symptoms for 4.5 days, whereas those who lived had symptoms for a median of 2 days. Their analysis revealed no evidence that the duration of trials using conservative treatment was related to death (*P*=0.283) [7].

On the contrary, Mačiulienė *et al.* [6] reported that a longer time between the onset of peritonitis symptoms and surgery was linked to a greater death risk, with symptoms lasting around 28–17 h in survivors versus 50–34 h in nonsurvivors (*P*=0.002). Additionally, it was shown that being late to the hospital constituted a separate mortality risk factor (*P*=0.001). Long-lasting symptoms increased the likelihood of 30-day in-hospital mortality (*P*=0.02) and were predictive of poor outcomes with sensitivity of 74% and specificity of 60% [6].

Moreover, a delayed first intervention (a delay of >24 h) was linked to a higher death risk in a research done by Sartelli *et al.* [8].

Multiorgan dysfunction

The results of this investigation showed that among all organ failure, renal and cardiovascular dysfunctions were especially strong predictors of death (*P*=0.001 and 0.001, respectively). In a study by Nachiappan and Litake [7], multiorgan failure was present in 81.2% of all nonsurvivors, with a death rate of 59.1% in patients who experienced it. As a result, it has been demonstrated to significantly contribute to the patient's poor outcome (*P*=0.001) [7].

Hepatic, pulmonary, and renal dysfunctions entail the highest risk of death, which is also consistent with our findings, and mortality increases with progressively worsening organ failure [10].

The average overall fatality rate, in a study by Koperna and Schulz [9], was 18.5%. Patients without organ failure or with one organ system failing had a very good prognosis (mortality rate, 0%), whereas patients with quadruple organ failure had a mortality rate of 90% [9].

Intraoperative

Severe hypotension after induction

In our study, severe hypotension after induction was noted to happen in 62.1% of group M patients (n=23), compared with 17.3% of group S patients (n=14) (P<0.001). A total of 37 patients developed severe hypotension after induction. Overall, 62.1% had an outcome of mortality, whereas 37.8% were survivors, denoting statistical significance across both groups (P<0.001).

In a study including 197 patients, Mačiulienė *et al.* [6] indicated that severe hypotension (mean arterial pressure 65 mmHg) developed in 27 (52%) cases after induction of 52 (78%) patients who were not hypotensive before surgery. It led to hemodynamic instability in 19 (70%) instances and the intraoperative and postoperative development of septic shock (P=0.001). Between patients who were hypotensive before surgery and nonhypotensive patients, there was no difference in the incidence of perioperative septic shock (P>0.05). There were 27 nonsurvivor instances, and of these, significant postinduction hypotension had been reported in 23 (85%) cases despite their stable hemodynamic status before surgery (P=0.006). Postinduction hypotension was connected to increased in-hospital mortality (P=0.017). Less than 60% of patients who experienced a severe episode of postinduction hypotension despite fluid resuscitation survived intra-abdominal sepsis at 10 days compared with 85% of individuals who did not (P=0.001) [6].

Contamination

According to this study, peritoneal soiling significantly increased the risk of dying (P=0.008). The only independent predictors of death were bile and feculent soiling (P=0.001 and 0.001, respectively). In the research study by Nachiappan and Litake [7], there were 78 patients with generalized illness, 15 of whom passed away. Those who died had either feculent or purulent exudate, whereas all 21 patients with localized disease survived [7].

According to Sartelli *et al.* [8], small bowel perforation, severe diverticulitis, and colonic nondiverticular perforation were all significantly related with death (P=0.001) when present [8].

Postoperative

Need for ICU admission

Sartelli *et al.* [8] revealed that ICU hospitalization and postoperative septic shock were independent predictors of patient death, correlating with the findings of our study, which had a statistical significance of P value of 0.001.

Hospital stay

In the current study, group S and group M had an average ICU stay of 5.81 and 8.14 days, respectively. The average hospital stay in group M was 7.41 days, whereas it was 6.3 days in group S. Although the length of hospital stay was not a significant factor in death (P=0.923), the length of ICU hospitalization was P value of 0.014.

According to a research study by Nachiappan and Litake [7], patients who survived their hospitalization spent an average of seven days there, as opposed to 3.5 days for those who did not. This is owing to the fact that individuals who presented late and had more severe illness died sooner [7].

Scoring system

Any scoring system's efficacy depends on its capacity to correctly forecast mortality and morbidity across all group categories. The original iteration of the POSSUM scoring system failed to do this, as patients with moderate severity got exaggerated expected values for death and morbidity. The following metrics are used to assess a score's accuracy in predicting mortality: sharpness (the degree of confidence associated with a prediction), discriminatory ability (the areas under the ROC curves relating sensitivity to specificity), and reliability (agreement between predicted and observed mortality within equidistant intervals on the scale) [12].

In this study, we proposed a scoring system, based on the significant predictors, to predict mortality in patients presenting with an acute abdomen who undergo surgery. A cutoff value of 23 (sensitivity – 91.89%, specificity – 91.3%) was derived from the ROC curve, above which, there is a low likelihood of mortality, and below which, there is a high likelihood of mortality.

Results of this study were similar to the predicted mortality and morbidity values calculated by P-POSSUM [3]. However, if ease of calculation of scores is considered, their assessment was based on a logarithmic calculation that necessitated the entry of the score into a special calculator to obtain the result.

Conclusion

Executing the study has assisted in highlighting care processes that need improvement and could be focused upon. Furthermore, it proved to be a reliable tool to be used for auditing purposes that allows risk-adjusted measurement of the quality of care hence providing standardization of medical care.

This pilot study highlights the need for more research to link characteristics not previously included in other scoring systems to mortality to validate our findings. Large-scale prospective studies with precise data points on emergency abdominal surgery problems and associated protocols can be used to achieve this.

It also suggests that a local/institute-specific scoring system could be designed aiming for a more accurate assessment of the existing population served by the institute.

Ethical approval:

The study was approved by the Ethical committee of Cairo University.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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