Original Article

Predictors of Morbidity and Mortality after Surgery for Small Intestinal Perforation

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ABSTRACT

Background: A frequent surgical emergency with significant morbidity and death is small intestinal perforation. It has been shown that a variety of factors affect how well surgical patients fare.

Objectives: To determine straightforward and understandable prognostic indicators related to patients and surgery that are linked to postoperative morbidity and death in patients having surgery to repair an intestinal perforation.

Patients and Methods: This was a prospective study included 50 cases of small intestinal perforation who were subjected to history taking, clinical examination and both laboratory and radiological investigations. All cases were prepared for surgery and surgical intervention was performed. After discharge, patients were followed through clinical and radiological assessment. Operative and postoperative data were recorded.

Results: Age, leukocytosis, hyperglycemia, hypoalbuminemia, arterial blood gases abnormalities (ABG), history of (multiple diseases, diabetes mellitus (DM), hypertension (HTN), cardiac disease, hepatic disease), an ASA score ≥3, shock on presentation, delay between symptoms onset and operation, prolonged operative time, ICU admission, blood transfusion and perforation cause were significant predictive factors for post-operative mortality. Same factors (except hepatic disease history) along with specimen pathology and jejunal perforation were significant predictors for post-operative morbidity.

Conclusions: Among patients underwent surgery for intestinal perforation age, leukocytosis, hypoalbuminemia, RBS, ABG abnormalities, history of (multiple diseases, DM, HTN, cardiac disease), ASA score, shock on presentation, time interval between symptoms and admission, operative time, jejunal perforation, perforation cause, perioperative blood transfusion, ICU admission and pathology results were significant predictors for post-operative morbidities. Fore mortality, the same predictors apply with addition to hepatic disease and exclusion of pathology result and jejunal perforation.

Key Words: Postoperative morbidity, Postoperative mortality, Small Intestinal Perforation.

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INTRODUCTION

Small intestinal perforation, defined as loss of continuity of the bowel wall, is a potentially devastating complication that can arise from a variety of disease processes. Common causes of perforation include trauma, instrumentation, inflammation, infection, malignancy, ischemia, and obstruction[1]. Small intestinal perforation is a common surgical emergency associated with considerable mortality, ranging from 30 to 50%[2].

Contained or controlled perforations can be managed conservatively with interventional radiology-guided drainage of fluid collections. However, the failure of conservative management with persistence of symptoms and/or development of sepsis, necessitate surgical intervention[3,4].

Historically, laparotomy has been the standard intervention for acute abdomen; recently, however, laparoscopic exploration has emerged as a viable option to identify and treat the source of perforation[5,6]. Resection or repair of the perforated site, with or without diversion, is usually undertaken. Risks and benefits of surgery, particularly amongst elderly patients and those with medical comorbidities, should be thoroughly discussed before offering surgical intervention[7].

PATENTS AND METHODS

Study design

Over the course of two years, from July 2022 to July 2024, this prospective study was carried out at the

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Emergency Hospital, Mansoura University Hospitals, and Mansoura City, Egypt. All patients with small intestinal perforation, such as traumatic small intestinal perforation, IBD-related perforated terminal ileum, perforated ulcers, etc., of any age or gender who consented to participate were included in the current study. The research did not include patients with duodenal ulcers that had been perforated.

All cases were subjected to history taking, which included personal history including name, age, gender, occupation, residence, and special habits; current complaints, including abdominal pain, vomiting, constipation, and distension; analysis of each complaint regarding onset, course, duration, exacerbating factors, relieving factors, and associations; review of other GI symptoms; current medical problems, including diabetes, hypertension, ischemic heart disease, etc.; current medications and their indications; family history of similar conditions; and previous surgical history. In addition, clinical examination and general examination were also conducted, which included the assessment of vital signs, general appearance and body build, anthropometric measurement, head and neck examination, and systemic examination, which included cardiovascular, respiratory, abdominal, and neurological examinations. Local abdominal examination included inspection (abdominal distension, visible peristalsis, previous abdominal scars, hernia orifices, and abdominal movements with respiration), and palpation (tenderness, rebound tenderness, rigidity, organomegaly, and palpable masses). Percussion for the detection of dullness associated with free fluid and auscultation (absent intestinal sounds detect ileus due to the presence of free fluid).

Complete blood count, CRP, liver and renal function tests, serum electrolytes, arterial blood gases, random blood sugar, and international normalized ratio were among the laboratory tests. Diagnostic peritoneal aspiration of free fluid, pelvic-abdominal ultrasonography, pelvic-abdominal computerized tomography (CT) with intravenous and oral contrast, and abdominal *X*-Rays (erect and supine positions) were among the radiological tests.

Ethical consideration

All subjects provided signed informed permission following a thorough discussion of the specifics and risks associated with each operation. The institutional review board (IRB) and local ethics committee of Mansoura University's medical faculty gave their approval to the study.

Anesthetic consultation

Before surgery, the anaesthetic team evaluated each patient, and cases were categorized using the American Society of Anaesthesiologists' (ASA) categorization system.

Preoperative preparation:

Resuscitation and evaluation were closely related. Acutely sick patients' systemic disorders were taken into consideration when correcting the intravascular fluid deficit. Using a wide-bore IV cannula, warmed crystalloids (normal saline or lactated Ringer solution) were administered. Physical indicators (blood pressure, pulse rate), urine output, lactate levels, CVP, etc., were used to guide fluid treatment. Vasopressors were prescribed to patients who did not respond to proper hydration management. Insertion of a nasogastric tube avoided aspiration in elderly individuals and patients with disturbed mental status. To assess urine production, Foley's catheterization was required. Considering the patient's renal function, parenteral analgesics and antibiotics were administered in a sufficient dosage. The patient and their family should be informed about the potential for many staged procedures, temporary stomas, postoperative intensive care unit treatment, and anticipated surgical problems before giving their written consent for surgery.

Operative details included suction of free fluid if present, examination of the intestine, detection of the perforation Figures (1-4), and dealing with it either by primary repair, resection anastomosis, or diversion (except patients with irreducible hernia underwent laparotomy). Patients with irreducible hernia were operated on from the incision of hernia and managed either from the same incision or needed laparotomy.

Figure 1: Perforation at the constriction ring of irreducible hernia.

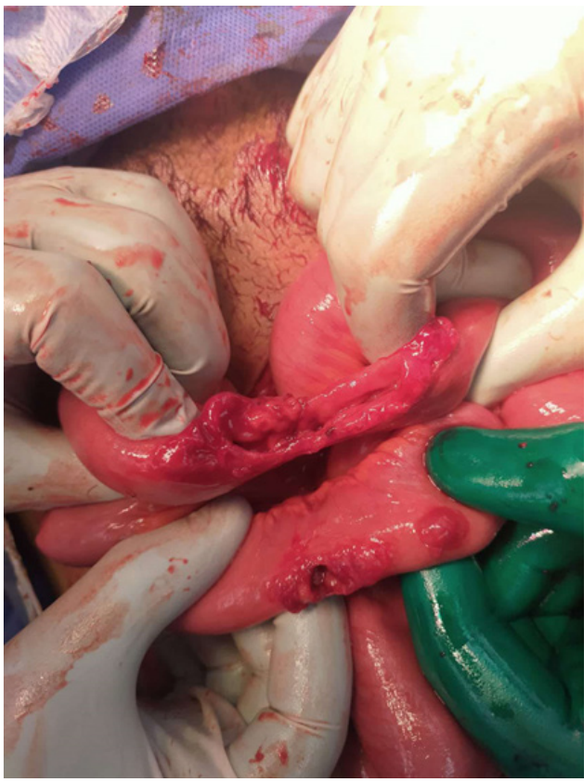

Figure 2: perforations caused by gun shoot.

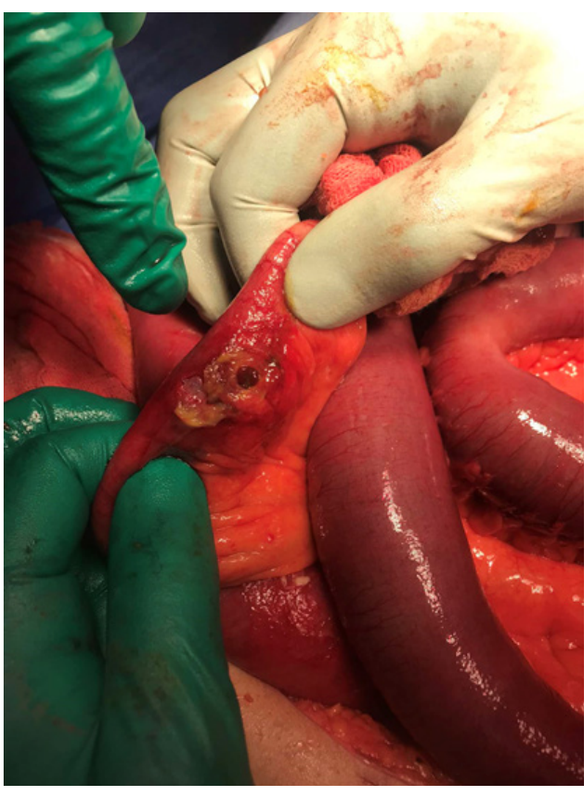

Figure 3: Perforation caused by a stab.

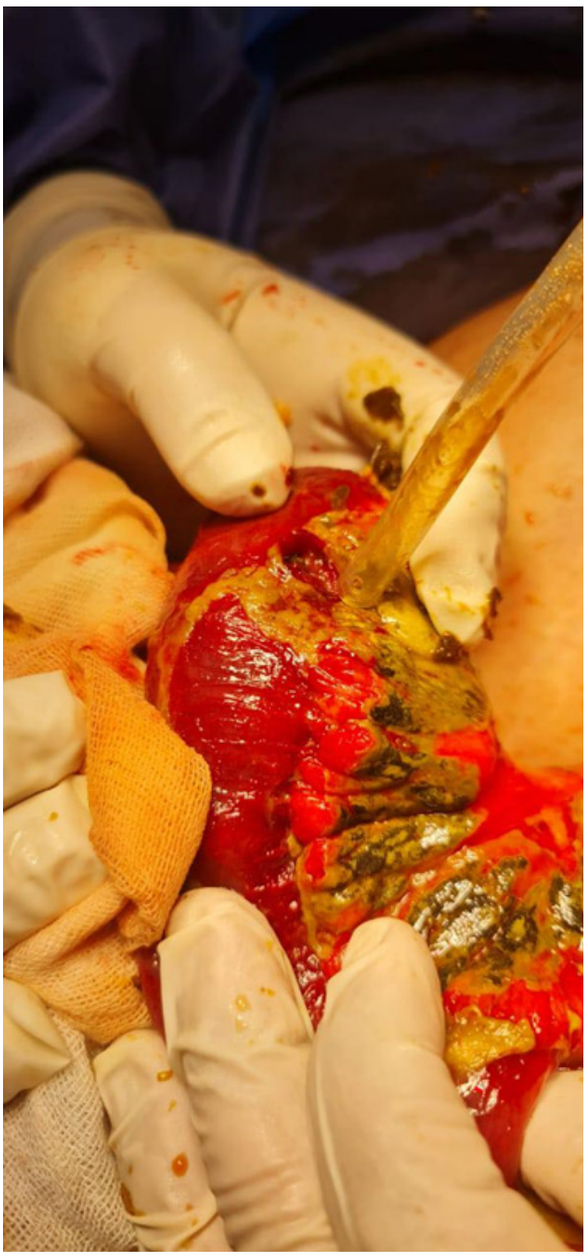

Figure 4: A pathological perforation.

Postoperative care

Full mobilization of the patient was encouraged from the 1st post-operative day. Analgesia was maintained via intravenous nalbuphine 10mg which can be repeated every 6 hours. Then intravenous paracetamol, later on oral analgesics were administrated. IV fluids (2000ml of ringer lactate and 1000ml glucose 10%) were given daily. Then, Oral fluids were started after 3days. It was started earlier at 1st or 2nd post-operative day in patients who underwent diversion once the stoma has become functioning. CBC was ordered for all patients daily for the first four days unless the patient had more complications.

Serum electrolytes were ordered every day till the patient started oral intake. Frequent monitoring of vital signs along with abdominal examination was done in all patients. Any abnormalities were recorded. If leakage was suspected, abdominal US or triphasic CT were ordered. If postoperative course was uneventful, patients were discharged and drains were removed on the 3rd to 5th postoperative day after fulfilling the following criteria (tolerance of sufficient liquids such that intravenous fluids are no longer required, fever less than 37.5 for the 24 hours prior to discharge, adequate pain control with oral medications). Any post-operative complication was noted, recorded and managed. Complication were: surgical site infection (managed conservatively) burst abdomen (closed in the OR), fistula (managed by re-exploration and diversion) and chest infection (managed by pomologists and ICU doctors)

Follow up

After discharge, regular follow up visits were scheduled according to the pathology of the disease. 30 days follow up was the end point of the study. During these visits, the patients were clinically assessed. Radiological assessment was ordered when required. Any complication was recorded and managed.

Data collection

Demographic data along with medical history, ASA score, random blood sugar level, albumin level, arterial blood gases levels, operative data (operation time, operative finding, procedure done), perioperative blood transfusion, postoperative complications, ICU admission and specimen pathology if present was collected for further analysis.

RESULTS

The age and sex of each subject under study are described in this table. With a minimum age of 5 years and a maximum age of 84 years, the mean age of all the patients under study was 40.9±22.5 years. Regarding sex, the patients under study were 19 girls (38%) and 31 men (62%) (Table 1).

Table 1: Description of age and sex in all studied patients:

		Studied patients (*N*= 50)	
Sex	Male	31	62%
	Female	19	38%
Age (years)	Mean±SD	40.9±22.5	
	Min–Max	5–84	

According to this table, the following variables could be used as significant predictors of mortality in the patients under study: age, leukocytosis, albumin level, RBS, ABG, history of multiple diseases, medical history, history of diabetes mellitus, history of hypertension, history of heart disease, history of hepatic disease, ASA score, shock at presentation, time between symptoms and operation, operative time, cause of perforation, ICU admission, presence of complications and blood transfusion (Table 2).

This table shows that age, leukocytosis, albumin level, RBS, ABG, history of multiple diseases, medical history, history of DM, history of HTN, history of cardiac disease, ASA, shock on presentation, time interval between symptoms and admission, operative time, jeujnal perforation, cause of perforation, blood transfusion, ICU admission and pathology results could be used as significant predictive factors for post-operative morbidities in the studied patients (Table 3).

Table 2: Multivariate logistic regression analysis for factors predictive of death outcome in the studied patients:

	B	SE	*p*-value	Odds	95% CI	
Age	0.123	0.041	<0.001	1.13	1.043	1.225
Leukocytosis	20.469	11147	0.019	775427917	0.000	0.000
Albumin	20.797	8987	0.001	1076983174	0.000	0.000
RBS	1.507	0.699	0.025	4.51	1.147	17.749
ABG	1.928	0.841	0.013	6.87	1.322	35.766
History of multiple diseases	3.283	0.893	<0.001	26.7	4.6	153.6
Medical History	3.568	1.112	<0.001	35.44	4.009	313
History of DM	1.674	0.729	0.016	5.33	1.278	22.254
History of HTN	2.010	0.735	0.003	7.47	1.767	31.556
History of cardiac dis	1.764	0.858	0.03	5.83	1.084	31.377
History of hepatic disease	2.918	1.184	0.002	18.50	1.817	188
ASA	2.484	0.716	<0.001	11.99	2.949	48.734

	B	SE	*p*-value	Odds	95% CI	
Shock on presentation	3.227	0.933	<0.001	25.20	4.047	157
Time interval between symptoms and operation	0.829	0.287	<0.001	2.29	1.305	4.023
operative time	1.941	0.684	0.001	6.97	1.823	26.626
Procedure	0.371	0.165	0.024	1.45	1.049	2.003
Cause of perforation	0.371	0.165	0.009	1.45	1.049	2.003
Perioperative blood transfusion	2.773	0.801	<0.001	16.00	3.326	76.973
Post-operative complications	21.4	7596	<0.001	1938570450	0	
ICU admission	21.5	7464	<0.001	2153966420	0.000	0.000

B: Regression coefficient; SE: Standard error; CI: Confidence interval.

Table 3: Multivariate logistic regression analysis for factors predictive of post-operative morbidities in the studied patients:

	B	SE	*p*-value	Odds	95% CI	
Age	0.068	0.019	<0.001	1.07	1.032	1.110
Leukocytosis	2.757	1.092	0.002	15.75	1.851	134
Albumin	3.792	1.101	<0.001	44.33	5.127	383
RBS	1.526	0.652	0.016	4.60	1.281	16.5
ABG	1.569	0.620	0.009	4.80	1.423	16.19
History of Multiple diseases	3.125	0.857	<0.001	22.75	4.239	122
Medical History	2.773	0.722	<0.001	16.00	3.889	65.83
History of DM	2.383	0.850	0.002	10.83	2.049	57.27
History of HTN	2.565	0.849	0.001	13.00	2.463	68.6
History of cardiac dis	2.315	1.125	0.017	10.12	1.116	91.88
ASA	1.711	0.446	<0.001	5.54	2.310	13.275
Shock on presentation	1.803	0.865	0.024	6.07	1.114	33.046
Time interval symptoms and operation	0.555	0.186	0.001	1.74	1.209	2.508
operative time	1.411	0.592	0.01	4.10	1.286	13.065
Jejunum perforation	-1.269	0.612	0.04	0.28	0.085	0.934
Mickle perforation	21.491	40193	0.25	2153966457	0.000	
Procedure	0.408	0.155	0.009	1.50	1.109	2.039
Perioperative blood transfusion	2.303	0.746	0.001	10.00	2.317	43.160
ICU admission	1.658	0.622	0.006	5.25	1.551	17.767
Cause of perforation	0.408	0.155	<0.001	1.50	1.109	2.039
Outcome	22.233	11603	<0.001	4523327574	0.000	
Pathology	0.997	0.326	0.016	2.71	1.430	5.138

B: Regression coefficient; SE: Standard error; CI: Confidence interval.

DISCUSSION

Finding straightforward and understandable patient and surgical prognostic indicators linked to postoperative morbidity and death for patients having intestinal perforation procedures was the goal of this prospective research. Fifty patients with acute abdominal pain who had been diagnosed with intestinal perforation and brought to the emergency room were included.

Among this study no intra-operative complications were reported. 40% of the patients had post-operative complications. Chest infection was the most commonly detected complication among these study patients (34.8%), followed by surgical-site infection (31.8%), then Fistula (27.3%). Burst abdomen and fistula was the least commonly detected complication 4.5%.

Wu *et al*. demonstrated that the total post-operative complication rate for patients with small-bowel perforation following emergency surgery was 74%, which is consistent with our study. The three most frequent post-operative problems were respiratory (36.5%), intra-abdominal (30.8%), and surgical-site (including fat necrosis, incision infection, incision split, and drain-site infection) (22.1%)[8].

Among this study participants (12/50, 24%) died. In agreement with the present study Mishra *et al*., studied the

mortality of patients underwent surgery for small bowel perforation. And he found that the mortality rate was 24%[9].

The current investigation found a strong statistically significant relationship between mortality and post-operative complications. Additionally, there was a strong statistically significant link between death and chest infections and surgery site infections. There is no statistically significant relationship between the result and the post-operative fistula.

The Brunner *et al*., study found that wound infection was strongly linked to death among patients who had emergency surgery for colon perforation, which is consistent with the current analysis[10].

In contrast, Lee *et al*., reported that on comparing between survivor and non-survivor groups who underwent colonic perforation surgery it was found that there was insignificant difference as regard surgical site infection[11].

This study demonstrated that among the patients under investigation, age might be a major predictor of death. This is consistent with a research by Lee *et al*. that found that patients who had colonic perforation surgery had significantly different ages (66±15.5 years vs. 73.4±13.2 years) between survivors and non-survivors[11].

High RBS, ABG abnormalities, medical history, history of multiple diseases, history of diabetes mellitus, history of hypertension, history of heart disease, history of hepatic disease, ASA grade ≥3, shock at presentation, time between symptoms and operation, duration of operation, cause of perforation, and blood transfusion were found to be significant predictors of mortality in the patients under study[12].

Mishra *et al*., study showed concordant results that among patients who had surgery for Small bowel perforation, mortality is higher in patients with age >50yrs. Also, duration of delay from appearance of 1st symptom to surgery had a significant correlation with mortality[9].

On univariate analysis of predictors of worse outcome among patients who underwent operative intervention for peritonitis from small bowel perforation included in study, American Society of Anesthesiologists score ≥3 was related to worse outcome[12].

Among this study, patients with Intra-abdominal purulent free fluid and Intra-abdominal purulent free fluid grade were insignificant predictors of mortality. In contrast with this study, Kang *et al*. reported that among patients who had surgery for gastrointestinal (GI) perforation, presence of clear or contaminated ascites was a significant predictor of mortality[13].

According to this study finding, high statistically significant correlation between peri-operative blood transfusion and mortality was found; in patients without blood transfusion, 32 patients (91.4%) were survived and 3 patients (8.6%) were died. While in patients with blood transfusion, 6 patients (40%) were survived and 9 patients (60%) were died.

In contrast with this study Brunner *et al*., reported that in adult patients treated surgically for colonic perforation, the need for an intraoperative blood transfusion was an independent risk factors for mortality[10].

In the current study patients with post-operative complications high statistically significant increased age (55.6±18 years) when compared with patients without post-operative complications (29.3±18.8 years), however, no statistically significant correlation was found between sex and post-operative complications.

As regards the correlation between postoperative morbidities and medical history in the current study, it was found that there were high statistically significant correlation of post-operative complications with history of multiple diseases and medical history. Also, there were significant correlations of post-operative complications with history of DM, hypertension and cardiac diseases. However, there were insignificant correlations with Hepatic disease, Ischemic stroke, Sub-dural hemorrhage, Crohn's disease and HCC.

This can be supported by Jakobson *et al*. study that the long-term survival of patients undergoing major abdominal surgery for malignancy is influenced by many factors including the preoperative comorbidity[15].

There is a strong statistically significant relationship between the causes of perforation and post-operative problems; among patients who had an iatrogenic perforation, seven patients (53.8%) suffered post-operative issues, whereas six patients (46.2%) had none. In contrast, 3 patients (27.3%) who suffered a perforation from an irreducible hernia experienced no post-operative problems, whereas 8 patients (72.7%) experienced issues. Seven patients (87.5%) experienced post-operative problems, whereas one patient (12.5%) experienced none at all in patients with spontaneous perforation. Lastly, all 18 patients (100%) who underwent traumatic perforation experienced no problems following surgery.

A statistically significant relationship between leukocytosis and lower blood albumin levels and post-operative problems. Similar to this study, Ylimartimo *et al*., examined 674 adults undergoing midline emergency laparotomy and found a statistically significant difference in leukocytosis and decreased serum albumin between patients with and without operation-related complications[14].

Sung *et al*., study agreed with the current study that in gastrointestinal perforation patients underwent surgery, laboratory analyses postoperatively showed the patients with complications had lower WBC count (9,528/mL) compared to those without complications (12,679/mL). Also, there was significant difference considering serum albumin[17].

In this study high statistically significant correlation was detected between ASA and post-operative complications; as ASA grade increased the post-operative complications became more prevalent. The same was reported in Tan *et al*., study that in patients had surgery for perforated colorectal malignancy, after multivariate analysis ASA score ≥3 was an independent variables predicting worse peri-operative complications[16].

Shock at presentation and post-operative problems were statistically correlated; among patients without shock, 15 patients (36.6%) experienced post-operative difficulties, whereas 26 patients (63.4%) did not. In contrast, 7 patients (77.8%) experienced post-operative problems, whereas 2 patients (22.2%) had none at all in shock patients.

This comes agreeing with Sung *et al*., study that among patients underwent surgery for in gastrointestinal perforation circulatory shock was detected in 41.67% of the patients with post-operative complications compared to only 8.33% of those without complications[17].

A statistically significant correlation was found between post-operative complications with shock on presentation, increased Time interval between onset of symptoms and operation, increased operative time and jejunal perforation only.

This comes concordant with Mahmood *et al*., study showing that as the time interval between onset of symptoms and operation increase in patients who underwent exploratory laparotomy in emergency following spontaneous small intestinal perforation, various morbidities are increased quite significantly. Incidence of surgical-site infection in the post-operative period is increased as the time interval increases[18].

In the present study it was found a statistically significant correlation between jejunal perforation and Post-operative complications. No statistically significant correlation of post-operative complications with MD perforation, intra-abdominal purulent free fluid and intra-abdominal purulent free fluid grades.

Mahmood *et al*., reported that among patients with intestinal injuries who underwent laparotomy site of perforation didn't differ significantly between patients with and without complications[20].

Perioperative blood transfusion and post-operative problems were found to be statistically significantly correlated in this study; among patients who did not get blood transfusions, 10 patients (28.6%) suffered post-operative issues, whereas 25 patients (71.4%) did not. Twelve patients (80%) experienced post-operative problems after receiving a blood transfusion, whereas three patients (20%) experienced none at all.

This can be supported by Han *et al*., study that among 152 patients who had undergone emergent operations for colonic perforation, intra-operative transfusion was an independent risk factors for early complications[19].

There is a statistically significant relationship between post-operative ICU admission and post-operative problems; among patients who did not require ICU admission, 8 patients (27.2%) experienced post-operative issues, while 21 patients (72.4%) did not. Of the patients hospitalized to the intensive care unit, 14 patients (66.7%) had post-operative problems, whereas 7 patients (33.3%) had none at all.

In a similar vein, Ylimartimo *et al*., discovered that persons having midline emergency laparotomy were more likely to require intensive care unit hospitalizations if they had problems from the procedure than those who did not[14].

Pathology findings and post-operative problems were statistically significantly correlated; all patients (100%) with normal loops (one patient) experienced no post-operative difficulties. However, among patients with ischemic mucosa, 10 patients (71.4%) experienced post-operative problems, whereas 4 patients (28.6%) experienced none at all. Post-operative problems emerged in all patients (100%) with Crohn's disease (2 patients) and inflammatory alterations (1 patient).

This is consistent with a research by Sung *et al*. that found a significant difference between patients with and without post-operative problems in patients who had surgery for gastrointestinal perforated pathology[17].

LIMITATIONS AND RECOMMENDATIONS

It is important to consider the limitations of this study when evaluating the findings. In particular, because it was a retrospective research, selection bias may have affected it. The frequency and kinds of problems, however, were in line with other research. More research with bigger sample sizes and more varied patient cohorts is necessary to confirm the results and increase their relevance to a wider variety of people.

CONCLUSION

Among patients had surgery for intestinal perforation age, leukocytosis, hypoalbuminemia, RBS, ABG

abnormalities, history of multiple diseases, medical history, history of DM, history of HTN, history of cardiac disease, ASA score, shock on presentation, time interval between symptoms and admission, operative time, jejunal perforation, cause of perforation, perioperative blood transfusion, ICU admission and pathology results could be used as significant predictive factors for post-operative morbidities. Fore mortality, the same factors apply with the addition of hepatic disease and the exclusion of pathology result and jejunal perforation.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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