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ORIGINAL SCIENTIFIC REPORT

Postoperative Peritonitis After Digestive Tract Surgery: Surgical Management and Risk Factors for Morbidity and Mortality, a Cohort of 191 Patients

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Abstract

Background Postoperative peritonitis (POP) following gastrointestinal surgery is associated with significant morbidity and mortality, with no clear management option proposed. The aim of this study was to report our surgical management of POP and identify pre- and perioperative risk factors for morbidity and mortality.

Methods All patients with POP undergoing relaparotomy in our department between January 2004 and December 2013 were included. Pre- and perioperative data were analyzed to identify predictors of morbidity and mortality.

Results A total of 191 patients required relaparotomy for POP, of which 16.8% required >1 reinterventions. The commonest cause of POP was anastomotic leakage (66.5%) followed by perforation (20.9%). POP was mostly treated by anastomotic takedown (51.8%), suture with derivative stoma (11.5%), enteral resection and stoma (12%), drainage of the leak (8.9%), stoma on perforation (8.4%), duodenal intubation (7.3%) or intubation of the leak (3.1%). The overall mortality rate was 14%, of which 40% died within the first 48 h. Major complications (Dindo–Clavien > 2) were seen in 47% of the cohort. Stoma formation occurred in 81.6% of patients following relaparotomy. Independent risk factors for mortality were: ASA > 2 (OR = 2.75, 95% CI = 1.07–7.62, $p = 0.037$), multiorgan failure (MOF) (OR = 5.22, 95% CI = 2.11–13.5, $p = 0.0037$), perioperative transfusion (OR = 2.7, 95% CI = 1.05–7.47, $p = 0.04$) and upper GI origin (OR = 3.55, 95% CI = 1.32–9.56, $p = 0.013$). Independent risk factors for morbidity were: MOF (OR = 2.74, 95% CI = 1.26–6.19, $p = 0.013$), upper GI origin (OR = 3.74, 95% CI = 1.59–9.44, $p = 0.0034$) and delayed extubation (OR = 0.27, 95% CI = 0.14–0.55, $p = 0.0027$).

Conclusion Mortality following POP remains a significant issue; however, it is decreasing due to effective and aggressive surgical intervention. Predictors of poor outcomes will help tailor management options.

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Introduction

Postoperative peritonitis (POP) is the most feared complication after gastrointestinal surgery, with incidence ranging from 0.7 to 3.5% [1, 2]. While POP remains the commonest cause of death in gastrointestinal surgery, mortality rates have decreased from 60 to 20% over the past few decades [1, 3, 4].

The causes of POP are multifactorial; however, they are commonly associated with anastomotic leaks and perforations [5, 6]. Anastomotic leaks are accompanied with increased morbidity, mortality, length of stay and hospital costs [7]. Multiple studies have identified risk factors associated with anastomotic leaks; however, few have reported on the surgical management of POP [1, 8]. Yeast or enterococcus infections, unsuitable antibiotic therapy and surgical reintervention for sepsis control are associated risk factors for mortality in the postoperative setting [3, 5, 9, 10]. Furthermore, limited studies assessing perioperative mortality risk factors have identified age, hyper/hypothermia and mechanical ventilation as significant factors [3, 5, 9, 10]. Current evidence is lacking on the prognosis of patients following POP. Stratification of patients according to severity is needed to guide appropriate management and prognosis of patients.

The aim of this study was to report the surgical approach of POP and to identify pre- or perioperative risk factors associated with severe morbidity and mortality.

Patients and methods

Patients

A retrospective review of all patients undergoing relaparotomy for POP following gastrointestinal surgery was performed from January 2004 to December 2013. POP after bariatric, hepatic or pancreatic surgery was excluded to obtain a homogenous population.

Patient characteristics, including past medical history and American Society of Anesthesiology (ASA) Score, details of initial surgery and clinical presentation at time of relaparotomy, were retrospectively collected from the patient's charts. APACHE II Score was calculated based of the data prior to relaparotomy.

Operative findings were recorded, and the Manheim index was calculated using the reintervention operative report [11]. Data on the origin of peritonitis, surgical management, types of drainage and wound closure were collected.

For postoperative outcomes, death, surgical and medical complications, catecholamines infusion, delayed extubation and enteral nutrition data were collected. Complications were classified according to the Clavien–Dindo classification [12]. Initial relaparotomy for POP and immediate postoperative intensive care admissions were not considered as complications.

Surgical approach

During relaparotomy, the entire peritoneal cavity and all previous suture sites were explored for evidence of a septic source. Peritoneal fluid was systematically sampled for microbiology analysis. A lavage was performed with warm saline to dilute the bacterial inoculum. Peritoneal drainage was performed based on surgeon preference and operative findings. Generalized peritonitis required multiple drains including at the site of leakage and/or the hypochondriums and Douglas pouch. Localized peritonitis was managed by local drainage of the sepsis. Passive drainage with Penrose drain was the commonest drain used.

A decision on surgical management was based on the findings at relaparotomy.

Intestinal perforation was treated according to the site: (1) For duodenal perforation, an intubation of the defect was performed with a Helisonde drain® associated with two closed suction drains and a Penrose drain placed behind and in front of the helicoidal drain as previously described [13–15]; (2) for small bowel perforation, a stoma was created at the perforation site; and (3) for colonic perforation, a stoma was performed at the perforation site if possible or a colonic resection was performed with the formation of a stoma.

Anastomotic leakage was treated by drainage or in most cases by a takedown of the anastomosis. The decision was made in accordance with the intra-operative findings and the general condition of the patient. Drain management was only performed for defects <1 cm with minimal inflammation of the peritoneum. Three drainage approaches were performed: (1) drain in contact with the defect; (2) intubation of the defect with a Helisonde drain®; and (3) drain in contact with the defect with diverting stoma formation in cases of pelvic anastomotic leaks following intra-operative colonic lavage.

In case of the takedown of an oesophagojejunal anastomosis, the esophageal stump was intubated with a Helisonde drain® to keep the esophagus in the abdomen and a stoma was made with the Roux en Y jejunum. In the case of a colorectal or coloanal anastomotic takedown, a Hartmann procedure was performed and a pelvic drain with a Mikulicz was placed as previously described [15].

Postoperative care

Following relaparotomy, patients were cared for in an ICU or ward-based setting depending on anesthesiologist and surgeon choice.

Broad-spectrum antibiotics were systematically used postoperatively and were tailored based on bacteria cultured from swabs taken at the time of relaparotomy. Empirical antifungal treatment was added in case of a Dupont's Score of 3 or more and systematically adapted to the yeast species [16].

Parenteral nutrition support was started to provide 25 kCal/kg and was switched to enteral nutrition as soon as possible. Bile or chyme reinfusion was performed when patient had a proximal jejunostomy [17].

Drain removal was dependent on output measurements. Mikulicz packing drainage and Helisonde drain® were managed according to the department practice as previously described [14]. Mikulicz packing drainage was removed mesh by mesh after POD 9. The bag itself was removed at POD 14. Helisonde drain® was used to irrigate 3L of saline solution to dilute secretions. Closed drains were removed after POD 5. After their removal, the Helisonde drain® was removed by turning it two counterclockwise turns each day and was eventually replaced with a 12-F silicone drain.

Statistical analysis

Morbidity and mortality risk factors were evaluated by including 15 and 20 variables in the univariate analysis, respectively: sex, age, American Society of Anesthesiologists (ASA), malnutrition, neoplasia, origin of the peritonitis [upper or lower gastrointestinal tract (GI)], transferred patient, multiorgan failure (MOF) at relaparotomy, presence of shock at relaparotomy, peritonitis >24 h, transfusion during relaparotomy, Mannheim Score, APACHE II Score, immediate postoperative extubation, delayed enteral nutrition, plus for mortality: renal failure, respiratory failure, presence of one or more septic source, generalized or local peritonitis and delay of relaparotomy. Univariate analysis was performed using Chi-square, Fisher's exact test or a Student's t test when appropriate. The Mannheim Peritonitis Index and the APACHE II Score were not included in the multivariate analysis, as we preferred to evaluate relevant variables of each scoring systems. Multivariate analysis was performed using a multivariate regression. All variables with a p value <0.2 were included. A p value <0.05 was considered to be statistically significant. Statistical analysis was carried out using the SPSS 21.0 software (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, version 21.0. Armonk, NY: IBM Corp.).

RESULTS

Patients' characteristics

A total of 191 patients underwent relaparotomy for POP during the study interval. Patient and surgical indication are summarized in Tables 1 and 2, respectively. Thirty-six patients (18.8%) had upper GI surgery, while 155 (81.2%) had lower GI surgery. Ninety-two patients had a history of previous abdominal surgery including 67 procedures with gastrointestinal resections or peritonitis. A further eight patients had a previous postoperative peritonitis.

Table 1 Characteristics of 191 patients at initial procedure before peritonitis

Characteristic	Total (%) n = 191
Age at operation[a]	61 (18–84)
Male	97 (50.8)
ASA Score > 3	85 (44.5)
BMI kg/m[2a]	23 (4–41)
Denutrition	74 (38.7)
Preoperative chemotherapy	18 (9.4)
Preoperative radiotherapy	13 (6.8)
Previous abdominal surgery	92 (48.2)
Perioperative transfusion	17 (8.9)

ASA American Society of Anesthesiologists, *BMI* body mass index, *FAP* familial adenomatous polyposis

[a]Mean ± standard deviation (range)

Table 2 Indication for initial surgery

Characteristic	Total (%) n = 191
Neoplasia	94 (49.2)
Antrum	8 (4.2)
Fundus	8 (4.2)
Cardia	7 (3.7)
Lower esophagus	4 (2.1)
Right colon	17 (8.9)
Left colon and upper rectum	24 (12.7)
Rectum	14 (7.3)
PAF	4 (2.1)
Carcinosis	4 (2.1)
Pelvic resurgence	1 (0.5)
Gynecologic/urologic neoplasia	2 (1)
Inflammatory bowel disease	23 (12)
Emergency surgery	41 (21.5)
Appendicectomy	4 (2.1)
Small bowel obstruction	8 (4.2)
Neoplasic obstruction	10 (5.2)
Perforated diverticulitis	3 (1.6)
Crohn disease	6 (3.1)
Other	10 (5.2)

FAP familial adenomatous polyposis

Forty-one patients (21%) initially had emergency surgery, nine for peritonitis, including three perforated diverticulitis, four perforated Crohn disease, one perforated small bowel obstruction and one perforation during the endoscopic procedure. Twenty-three had an anastomosis performed during the emergency procedure including three patients with peritonitis, one Crohn's disease (ileocolic anastomosis), one perforated diverticulitis (colorectal anastomosis with derivative stoma) and the endoscopic perforation (colocolic anastomosis).

The majority of patients (*n* = 154; 80.6%) had had an anastomosis performed during the initial procedure.

Clinical presentation

Table 3 shows the clinical presentation at diagnosis of POP. Most frequent signs were abdominal pain (82%), tachycardia (61%) and fever (49%).

A CT scan was performed in 65% of patients. The remaining patients had either generalized peritonitis, abnormal leakage through a drain or abdominal scar with signs of sepsis or multiorgan failure that could not delay intervention.

Transferred patients

Among the 191 patients, 63 (33%) were transferred from another hospital to our center for POP management. The mean delay to transfer was 16 days (0–57) after initial surgery. Most patients were transferred for a leak through the scar or drain associated with septic signs, septic shock (*n* = 25; 38.7%) or multiorgan failure (*n* = 13; 20.6%). The majority of patients had undergone at least one relaparotomy prior to transfer (*n* = 37. 58.6%).

Table 3 Clinical presentation at relaparotomy

Characteristic	Total (%) *n* = 191
Abdominal pain	156 (82)
Tachycardia	117 (61)
Peritoneal irritation sign	105 (55)
Fever	93 (49)
Abnormal drainage	35 (18)
Postoperative ileus	21 (6)
Evisceration	12 (6)
MOF	48 (25.1)
Septic shock	65 (16.5)
Renal failure	45 (23.6)
Respiratory failure	41 (21.5)
Sepsis	176 (92)
APACHE II Score[a]	10 (1–39)
White blood cell count	
>10,000	114 (59.7)
4000–10,000	62 (32.5)
<4000	15 (7.9)
CRP[a]	213 (14–652)
CT scan sign	124 (64.9)
Pneumoperitoneum	47 (37.9)
Intra-abdominal fluid	74 (59.7)
Abscess	52 (41.9)
Anastomotic leakage on opacification	32 (25.8)

MOF multiple organ failure, *CRP* C-reactive protein

[a]Median ± standard deviation

Relaparotomy

Details of all relaparotomies are given in Table 4. Relaparotomies occurred after a mean delay of 9 (1–195) days following first procedure. The majority of patients (*n* = 153; 80.1%) had only one cause of peritonitis.

In the case of anastomotic leaks (*n* = 127), the main management was takedown of the anastomosis (99/127; 78%) with the formation of a stoma. Intubation of the leak was only performed in the case of upper GI defects (6/127; 4.7%), whereas suture closure of the defect with protective stoma formation was performed for coloanal or low colorectal anastomosis (18/127; 14.2%). Three patients (1.6%) had simple drainage close to the leakage, and only one patient had a redo anastomosis.

Duodenal defects were mostly treated by intubation of the defects (14/16; 87.5%). Only two patients had a simple drainage. Thirty-eight patients had a gastrointestinal perforation. All colonic and enteral perforations were used in the formation of a stoma. Eventually, 156 patients (81.7%) had one or more stomas after relaparotomy.

Postoperative course

Postoperative course and complications are summarized in Table 5. Overall mortality was 14.1% (*n* = 27). The majority of deaths occurred between POD 0–10 (*n* = 16; 59%) including 11 deaths (41%) in the first 48 h from MOF due to POP (*n* = 10) and one for a myocardial infarction. Three deaths (11%) occurred between POD 10 and 20 with nine deaths (33%) after POD 20.

Immediate extubation following relaparotomy was performed in 82 patients (42.9%). Eighty-nine patients (46.6%) had severe postoperative complications Clavien–Dindo ≥ 3. Only three patients had a scheduled second-look operation. A total of 39 patients had a non-surgical procedure including 19 (10%) radiological drainages.

Risk factors analysis

Morbidity and mortality risk factors are summarized in Tables 6 and 7. Four risk factors were independently associated with mortality on multivariate analysis: ASA Score ≥3 (OR = 2.75; IC95 [1.07–7.62]; *p* = 0.037), upper GI origin (OR = 3.55; IC95 [1.32–9.56]; *p* = 0.013), MOF at relaparotomy (OR = 5.22; IC95 [2.11–13.55]; *p* = 0.0037) and perioperative transfusion (OR = 2.70; IC95 [1.05–7.47]; *p* = 0.040).

Table 4 Perioperative findings during relaparotomy and surgical management

Characteristic	Total (%) $n = 191$
Median delay before reintervention[a]	9 (1–195)
Perioperative transfusion	85 (44.5)
Mannheim Score[b]	26 (4–43)
Generalized peritonitis	88 (46.1)
Peritonitis cause	
Anastomotic leakage	127 (66.5)
Duodenal fistula	16 (8.4)
Perforation	40 (20.9)
Enteral necrosis	11 (5.8)
Colonic necrosis	12 (6.3)
Secondary leakage of stump left in the abdomen	6 (3.1)
Biliary fistula	2 (1)
No etiology found	5 (2.6)
Abscess	10 (5.2)
Evisceration	14 (7.3)
Surgical Management	
Anastomosis takedown	99 (51.8)
Intubation of the leakage	6 (3.1)
Duodenal intubation	14 (7.3)
Drainage of the leakage	17 (8.9)
Suture with derivation stoma	22 (11.5)
Redo anastomosis	1 (0.5)
Stoma on perforation	16 (8.4)
Enteral resection + stoma	23 (12)
Colonic resection	10 (5.2)
Stoma	156 (81.7)
Jejunostomy	20 (10.5)
Feeding jejunostomy	34 (17.8)
Osophagostomy	1 (0.5)
Ileocolostomy	31 (16.2)
Ileostomy	87 (45.6)
Colostomy	51 (26.7)
Hartmann's procedure	33 (17.3)
1 stoma	122 (63.9)
2 stoma	27 (14.1)
3 stoma	5 (2.6)

[a]Days ± standard deviation

[b]Median ± standard deviation

Table 5 Postoperative course after relaparotomy for postoperative peritonitis

Characteristic	Total (%) $n = 191$
Death	27 (14.1)
MOF	6
MOF on initial septic shock	14
Pneumonia	2
Mesenteric ischemia	1
Limitation of care	1
Myocardial infraction	1
Hepatocellular insufficiency	1
Candida septicemia	1
Delay before death[a]	6 (1–127)
ICU stay	154 (80.6)
Length of stay in ICU[a]	13 (1–237)
Length of intubation[a]	6 (1–67)
Length of hospitalization[a]	39 (7–408)
Use of vasopressive drugs	93 (48.7)
Duration of vasopressive drugs[a]	4 (1–24)
Delay before oral alimentation[a]	8 (1–104)
Delay before enteral alimentation[a]	7 (1–104)
Postoperative complication Clavien >2	89 (46.6)
Number of surgical intervention in our center	
1	159 (83.2)
2	27 (14.1)
≥3	5 (2.6)
Cause of second reintervention	
Tertiary peritonitis due a secondary leakage or a digestive necrosis	9
Failure of the conservative management of a leakage	5
Bleeding	4
Peritoneal cleansing	4
Mesenteric ischemia	2
Cholecystitis	1
Redo stoma	2
Pleural decortication	2
Second look	3
Non-surgical procedure	39 (20.4)

MOF multiorgan failure, *ICU* intensive care unit

[a]Days ± standard deviation

The prognostic score of mortality, ranging from 0 to 4 points (based on adding each risk factor together), was 0% (0/54), 8.3% (4/48), 16.9% (10/59), 40% (10/25) and 60% (3/5).

Three risk factors were significantly associated with morbidity on multivariate analysis: upper GI origin (OR = 3.74; IC95 [1.59–9.44]; $p = 0.0034$), MOF at relaparotomy (OR = 2.74; IC95 [1.26–6.19]; $p = 0.013$) and delayed postoperative extubation (OR = 0.27; IC95 [0.14–0.55]; $p = 0.0027$).

Table 6 Risk factors for mortality: univariate and multivariate analysis

Variable	*n*	Death (%) *n* = 27	Univariate analysis	Multivariate analysis		
			p	OR	IC95%	*p*
Age			0.11			0.55
>70 years	60	12 (20)				
<70 years	131	15 (11.5)				
Sex			0.172			0.50
Male	97	17 (17.5)				
Female	94	10 (10.6)				
ASA Score			0.0035	2.75	1.07–7.62	0.037
>2	85	19 (22.4)				
≤2	106	8 (7.6)				
Malnutrition			0.131			0.47
Yes	74	14 (7.3)				
No	117	13 (11.1)				
Neoplasia			0.097			0.52
Yes	92	17 (18.5)				
No	99	10 (10.1)				
POP origin			0.0017	3.55	1.32–9.56	0.013
Upper GI	36	11 (30.6)				
Lower GI	155	16 (10.3)				
Emergency initial surgery			0.54			NI
Yes	41	7 (17.1)				
No	150	20 (13.3)				
Transfer			0.39			NI
Yes	63	11 (17.2)				
No	128	16 (12.6)				
MOF			<0.001	5.22	2.11–13.55	0.004
Yes	49	17 (34.7)				
No	142	10 (7)				
Shock			<0.001			0.87
Yes	65	18 (27.7)				
No	126	9 (7.1)				
Renal failure			<0.001			0.43
Yes	45	14 (31.1)				
No	146	13 (8.9)				
Respiratory failure			<0.001			0.49
Yes	46	15 (32.6)				
No	145	12 (8.3)				
Peritonitis >24 h			0.137			0.77
Yes	101	18 (17.8)				
No	90	9 (10)				
Generalized peritonitis			0.37			NI
Yes	75	15 (20)				
No	116	12 (10.3)				
Source septic			0.016			0.46
>1	38	10 (26.3)				
=1	153	17 (11.1)				
Transfusion during relaparotomy			0.004	2.70	1.05–7.47	0.04
Yes	85	19 (22.4)				

Table 6 continued

Variable	*n*	Death (%) *n* = 27	Univariate analysis *p*	Multivariate analysis OR	IC95%	*p*
No	106	8 (7.6)				
Mannheim Score			<0.001			NI
≥30	60	19 (31.2)				
<30	130	8 (6.2)				
APACHE II Score			<0.001			NI
≥15	54	17 (31.5)				
<15	117	6 (5.1)				
Delay since first procedure		12 (2–56)	0.13			NI
Immediate postoperative extubation			0.006			0.95
Yes	82	5 (6.1)				
No	109	22 (20.2)				

ASA American Society of Anesthesiologists, *POP* postoperative peritonitis, *GI* gastrointestinal, *MOF* multiorgan failure, *NI* non-included in the multivariate analysis

Discussion

The present study included a large cohort of patients between 2004 and 2013 with secondary peritonitis following gastrointestinal surgery. This study is one of the largest to report on all aspects of POP after digestive tract surgery in a homogenous patient cohort, something that is lacking in the current literature.

We excluded patients who underwent hepatic or pancreatic surgery as prognosis and surgical interventions are different compared to gastrointestinal surgery. Likewise, bariatric surgery was also excluded as there are clear management recommendations available [18, 19].

Furthermore, this study is, to our knowledge, the only study to focus on pre- and perioperative risk factors for morbidity and mortality, helping to aid decision making and prognosis for surgeons.

Morbidity and mortality associated with POP remains a significant issue; however, it has seen a significant reduction in recent years due to aggressive and effective management [1, 3, 4]. The present study found mortality and morbidity rates of 14.1 and 46.6%, respectively. Furthermore, a predicted mortality rate of 16.5% is seen in patients with a mean APACHE II Score of 13, similar to previous reports [20].

Due to the retrospective nature of the study, only severe complications were reported. We excluded the index relaparotomy and admission into ICU as severe complications in order to demonstrate the true impact surgical intervention of POP has on outcomes.

The present study identified factors of the Mannheim Score, upper GI and MOF as significant risk factors for mortality and severe morbidity. In the Mannheim Peritonitis Index, MOF was the most significant risk factor for mortality. Furthermore, ASA ≥ 3 was a risk factor for mortality and is more representative of prognosis than age of the patient.

A recent study by Launey et al. [21] found that the initial postoperative severity parameters were an independent mortality risk factor in POP. We did not include scoring systems such as APACHE II or the Mannheim Peritonitis Index in the multivariate analysis because it would have prevented other variables to emerge. This allowed us to prove that MOF and origin of the peritonitis are more relevant.

The most interesting and original finding in the present study is that perioperative transfusion is associated with increased postoperative mortality by a factor of 2.7. Transfusions have been shown to be associated with adverse postoperative morbidity such as anastomotic leaks [22] and mortality [23–25]. Worse survival outcomes have also been reported, especially in oncological resections [26]. This has been attributed to the immunosuppressive effects of blood transfusion [27, 28]. The need for blood transfusion must therefore be weighed against its possible adverse effects. However, the need for a transfusion can represent the severity of the patient condition, especially in case of severe sepsis developing disseminated intravascular coagulation (DIC) [29].

Interestingly delayed extubation was also a risk factor for morbidity. Indeed, in our cohort, among the 82 patients

Table 7 Risk factors for severe morbidity: univariate and multivariate analysis

Variable	*n*	Clavien > 2 (%) *n* = 88	Univariate analysis	Multivariate analysis		
			p	OR	IC95%	*p*
Age			0.97			NI
>70 years	60	28 (33.3)				
<70 years	131	60 (45.8)				
Sex			0.024			0.11
Male	97	53 (54.6)				
Female	94	35 (37.2)				
ASA Score			0.002			0.069
>2	85	50 (58.8)				
≤2	106	38 (35.8)				
Malnutrition			0.179			0.73
Yes	74	39 (52.7)				
No	117	49 (41.9)				
Neoplasia			0.026			NI
Yes	92	39 (42.4)				
No	99	50 (50.4)				
POP origin			0.001	3.74	1.59–9.44	0.003
Upper GI	36	27 (75)				
Lower GI	155	62 (40)				
Transfer			0.19			0.98
Yes	63	34 (54)				
No	128	54 (42.2)				
MOF			<0.001	2.74	1.26–6.19	0.013
Yes	49	36 (73.5)				
No	142	52 (36.6)				
Shock			<0.001			0.42
Yes	65	45 (69.2)				
No	126	43 (34.1)				
Peritonitis >24 h			0.46			NI
Yes	101	49 (48.5)				
No	90	39 (43.3)				
Transfusion during relaparotomy			0.014			0.98
Yes	85	48 (56.5)				
No	106	40 (37.7)				
Mannheim Score			0.024			NI
≥30	60	36 (60)				
<30	130	52 (40)				
APACHE II Score			<0.001			NI
≥15	54	39 (72.2)				
<15	117	43 (36.8)				
Immediate postoperative extubation			<0.001	0.27	0.14–0.55	0.003
Yes	82	20 (24.4)				
No	109	68 (62.4)				
Delay before enteral alimentation[a]	6 (1–24)	9 (2–104)	<0.001			NI

MOF multiorgan failure, *NI* non-included in the multivariate analysis

[a]Days ± standard deviation

with immediate extubation only two patients had pneumonia (2.4%) versus 24 among the 109 patients with delayed extubation (22%). Likewise three patients from the immediate extubation group developed ARDS (3.7%) versus 10 (9.2%) in the delayed group. Mechanical ventilation is known to be a risk factor for pneumonia [30]. Early extubation and intensive chest physio are important in the postoperative setting to prevent respiratory complications after POP [31, 32].

Postoperative mortality was encountered early in the present study, with 40% of deaths occurring in the first 48 h. Controlling the initial sepsis and its subsequent consequences are the main goal in patient care [3, 10]. The current study observed a lower rate of reinterventions (16.7%) after the first relaparotomy due to aggressive surgical management and higher rate of anastomotic takedown with stoma formation. Five patients among those treated by drainage methods required a further laparotomy, of which three deaths occurred. Careful patient selection is extremely important in patients undergoing less invasive measure of sepsis control. The present study has demonstrated that patients with low colorectal anastomosis can be effectively treated with diverting stoma and drain insertion. Patients have a higher risk of definitive stoma in the case of anastomotic takedown mainly due to surgical difficulty encountered during the redo anastomosis. [33–35]. Less invasive approaches in carefully selected patients will have a significant impact on morbidity and quality-of-life issues associated with a permanent stoma [36].

Conclusion

This study found that initial presentation with MOF, upper GI origin of sepsis and ASA Score ≥ 3 are significant morbidity and mortality risk factors. Perioperative blood transfusion is also a mortality risk factor, while delayed extubation is a significant morbidity risk factor.

With aggressive management and control of the septic source of POP, morbidity and mortality rates can be decreased.

Authors' contribution TB, NC, TL, TH and CD collected data. TB, JHL, FP, PB, ET and YP interpreted the data. TN, JHL and BC analyzed the data. TB, JHL, BC and YP drafted the manuscript. NC, TL, TH, CD, FP, PB and ET revised the manuscript. All authors finally approved this manuscript. All authors are accountable for all aspects of the work.

Compliance with ethical standards

Conflict of interest The authors declare that they have no Conflict of interest.

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