



## Prolonged postoperative ileus after elective colorectal cancer surgery

### Prolongirani postoperativni ileus posle elektivne kolorektalne hirurgije zbog karcinoma

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#### Abstract

**Background/Aim.** Postoperative ileus is a frequent and frustrating occurrence for both, patients and surgeons after abdominal surgery. Besides clinical importance of postoperative ileus, its economic aspect is also important. The aim of this prospective study was to analyze development of prolonged postoperative ileus after elective colorectal surgery for cancer and its impact on early postoperative outcome. **Methods.** This prospective study included all eligible patients, 18 years or older, scheduled for open colorectal resection for cancer from June, 2015 to February, 2016. Patients with metastatic disease, prior hemioirradiation or any resection other than curative were excluded. The study duration was up to 30 days postoperatively. Primary outcome measure was development of prolonged postoperative ileus according to strict definition. The impact of prolonged postoperative ileus on other outcome measures such as postoperative complications, surgical site infections, anastomotic leakage, reoperations, mortality and length of hospital stay were of great interest, too. **Results.** This prospective study included 103 patients, 64 (37.9%) men and 39 (62.1%) women, mean age 66 years. Prolonged postoperative ileus developed in 12 (11.3%) patients.

One third of the patients had some type of surgical site infection, while 47.6% had complications. Ten (9.7%) patients required reoperation. Comparing the group of patients with prolonged postoperative ileus with those without, there were no statistically significant differences in rates of surgical site infection and anastomotic leakage. There was statistically significant difference in terms of complications ( $\chi^2 = 34.966$ ;  $p < 0.001$ ), complications grade III ( $\chi^2 = 23.43$ ;  $p < 0.001$ ) and reoperations ( $\chi^2 = 15.724$ ;  $p < 0.001$ ). Patients who developed prolonged postoperative ileus had statistically significant longer postoperative hospital stay ( $Z = 2.291$ ,  $p = 0.022$ ) and longer total length of hospital stay ( $Z = 2.377$ ,  $p = 0.015$ ). According to regression analyzes prolonged postoperative ileus represents a risk factor for reoperations [odds ratio (OR) = 12.286;  $p = 0.001$ ]. **Conclusion.** Prolonged postoperative ileus, although not life-threatening complication affects recovery, increases length of hospital stay and contributes to poor surgical outcome.

**Key words:**  
colorectal neoplasms; postoperative complications; ileus; digestive system surgical procedures; elective surgical procedures; risk factors.

#### Apstrakt

**Uvod/Cilj.** Postoperativni ileus je česta i frustrirajuća pojava i za bolesnike i za hirurge posle abdominalnih hirurških intervencija. Osim kliničkog, važan je i ekonomski aspekt postoperativnog ileusa. Cilj rada bila je analiza pojave postoperativnog ileusa posle elektivnih kolorektalnih operacija zbog karcinoma i njegov uticaj na rani postoperativni ishod. **Metode.** Studijom su bili obuhvaćeni bolesnici životnog doba od 18 i više godina, lečeni od juna 2015. do februara 2016. godine, kod kojih je bila planirana kolorektalna resekcija zbog karcinoma. Isključujući kriterijumi bili su metastatska bolest, pre-

thodna hemio- i zračna terapija i nekurativna resekcija. Studija je trajala do 30 dana posle operacije. Pojava prolongiranog postoperativnog ileusa, utvrđenog prema strogoj definiciji, postavljena je kao krajnji cilj, a ispiti van je i njegov uticaj na druge parametre ishoda lečenja kao što su: postoperativne komplikacije, infekcija na mestu operativnog rada, dehiscencija anastomoze, reoperacije, mortalitet i trajanje hospitalizacije. **Rezultati.** Prospektivnom studijom obuhvaćena su 103 bolesnika, 64 (37,9%) muškarca i 39 (62,1%) žena, prosečne starosti 66 godina. Prolongirani postoperativni ileus se javio kod 12 (11,3%) bolesnika. Trećina bolesnika imala je neki tip infekcije na mestu operativnog rada, dok je stopa

komplikacija iznosila 47,6%. Ukupno 10 (9,7%) bolesnika je reoperisano. Upoređivanjem grupe sa i bez prolongiranog postoperativnog ileusa nisu uočene statistički značajne razlike u stopama hirurških infekcija i dehiscentija anastomoze. Utvrđena je statistički značajna razlika u pogledu komplikacija ( $\eta^2 = 34.966$ ;  $p < 0.001$ ), komplikacija III stepena ( $\eta^2 = 23.43$ ;  $p < 0.001$ ) i reoperacija ( $\eta^2 = 15.724$ ;  $p < 0.001$ ). Bolesnici koji su razvili prolongirani postoperativni ileus imali su statistički značajno duži period hospitalizacije posle operacije ( $Z = 2.291$ ,  $p = 0.022$ ) kao i duže ukupno trajanje hospitalizacije ( $Z = 2.377$ ,  $p = 0.015$ ). Prema regresionom

modelu prolongirani postoperativni ileus predstavlja faktor rizika za reoperaciju ( $OR = 12.286$ ;  $p = 0,001$ ). **Zaključak.** Mada ne predstavlja komplikaciju koja neposredno ugrožava život, prolongirani postoperativni ileus utiče na oporavak, produžava vreme bolničkog lečenja i doprinosi lošem ishodu hirurškog lečenja.

**Ključne reči:**  
kolorektalne neoplazme; postoperativne komplikacije; ileus; hirurgija digestivnog sistema, procedure; hirurgija, elektivna, procedure; faktori rizika.

## Introduction

Postoperative ileus was first mentioned by Cannon and Murphy in 1906. It was described as transient postoperative gastrointestinal dysmotility. For a long time considered as inevitable postoperative event, nowadays it brought itself into attention due to the effect on postoperative recovery<sup>1</sup>. If it extends longer than usually expected, it may cause other serious adverse events. Postoperative ileus is multifactorial in origin. Etiology includes neurogenic, inflammatory, hormonal and pharmacologic influences. Neurogenic component is related to pain, while surgical manipulation causes inflammatory response. Hormonal influence on ileus is primarily mediated via corticotropin-releasing hormone as a response to trauma. Opiate based medications are often mentioned factor involving in pathophysiology of postoperative ileus for its inhibitory effect through stimulation of  $\mu$ -opioid receptors in the bowel<sup>2,3</sup>. Various terms can be found in literature addressing the same problem, from postoperative paralytic ileus, prolonged ileus, and pathologic ileus<sup>4</sup>. To make reporting and research on the subject more comprehensive, there is a need for clearer definition of the factors that constitute prolonged postoperative ileus (PPOI) with increased awareness and recognition of its impact<sup>5</sup>. More than several parameters were identified as risk factors for development of PPOI such as: advanced age, male gender, blood loss, duration of surgery, previous operation, emergency surgery, opiate use and procedures requiring stoma. Risk factors vary between different studies<sup>6</sup>. Symptoms of postoperative ileus include nausea and vomiting, abdominal distension, lack of bowel sounds, passage of flatus and defecation<sup>4</sup>. Intolerance of oral intake due to nausea and vomiting aggravate catabolism which further compromises recovery<sup>7</sup>. Although not life-threatening PPOI affects recovery, increases hospital length of stay and healthcare resource utilization and costs<sup>2</sup>.

The rate of PPOI after abdominal operations is reported to be from 4% to as far as 75%<sup>8</sup>. The cause for such difference in reported rates is believed to be in variations in its definition<sup>9</sup>. Highest rates of PPOI are reported after operations in urology such are radical cystectomies, from 10%–40%, where it accounts for 50%–70% of all complications<sup>10,11</sup>. PPOI is frequent complication in gynecology, especially following debulking surgery with the incidence from 7.6%–30%<sup>12</sup>. According to the latest meta-analysis incidence of PPOI after colorectal resections is around 10%<sup>13</sup>.

Apart from clinical importance of postoperative ileus, its economic aspect is often mentioned. Retrospective analysis of more than 17,000 primary procedures has shown that patients with PPOI have statistically significant higher costs of treatment in comparison to patients without this complication (\$25,089 vs. \$16,907)<sup>8</sup>. Increased costs are not only related to longer hospital length of stay but also to additional measures taken for diagnostics and management of this complication<sup>14</sup>.

The aim of this prospective study was to analyze development of PPOI and its impact on early outcomes after elective colorectal resections for cancer.

## Methods

This prospective study included all eligible patients aged 18 years or older scheduled for open colorectal resection for cancer in the period from June, 2015 to February, 2016. The study was approved by the local ethics committee and before the inclusion patients signed informed consent. Patients with metastatic disease, prior chemoradiotherapy or any resection other than curative were excluded from the study. The seventh edition of the Union for International Cancer Control (UICC) classification from 2009 was used for staging colorectal adenocarcinoma. All patients were operated by the same group of surgeons using the same protocol of preoperative and postoperative care. All patients had mechanical bowel preparation. In cases of placement of nasogastric catheter for decompression, the same was removed at the conclusion of the operation. Liquid diet was prescribed to all patients on postoperative day one, followed by solid food as tolerated. None of the patients received opiate based analgesia postoperatively, nor there were epidurals used. The study duration was up to 30 days after the surgery. Primary outcome measure was development of PPOI according to definition proposed by Vather et al.<sup>9</sup>, as two or more of the following occurring on or after day 4 postoperatively without prior resolution of postoperative ileus: nausea/vomiting, inability to tolerate an oral diet over the preceding 24 h period, the absence of flatus over the preceding 24 h period, abdominal distension and/or radiological evidence of bowel distension without mechanical obstruction.

The impact of PPOI on other outcome measures such as postoperative complications, surgical site infection (SSI), anastomotic leakage, reoperations, mortality and length of hos-

pital stay were also of great interest. Postoperative complications were graded according to Clavien-Dindo classification<sup>15</sup>. Anastomotic leakage was defined as purulent or fecal discharge from a drain, pelvic abscess on computed tomography (CT) scans or peritonitis evidenced at laparotomy. Analyzed variables were stratified according to the presence or absence of PPOI and presented as percent frequency. Normally distributed data are presented as mean  $\pm$  standard deviation (SD) and in the case when the normality was not assessed as median  $\pm$  interquartile range. Student's *t*-test was used to assess statistical significance of parametric continuous data and Mann-Whitney *U* test for nonparametric continuous variables. The comparison of frequency distributions was performed by  $\chi^2$  or Fisher's exact test. The relative risk was evaluated by logistic regression analysis and the results presented as odds ratio (OR) with 95% confidence interval and *p*-value. Results were considered statistically significant at *p* value < 0.05. Statistical analysis was performed using SPSS for Windows (Version 20; SPSS, Chicago, IL).

## Results

Prospective analysis included 103 patients with colorectal cancer, 64 (37.9%) men and 39 (62.1%) women, mean age  $66 \pm 10.1$  years (range 29–85), without statistically significant difference in age between genders (*p* = 0.542). Baseline characteristics of the patients with colorectal cancer are shown in Table 1.

One quarter of the patients had either low rectal resection with protective ileostomy or right hemicolectomy, 25 (24.3%) and 27 (26.2%) patients, respectively. Superior rectal resection was done in 17 (16.5%) patients, followed by left hemicolectomy in 14 (13.6%), and low rectal resection in 8 (7.8%) patients. In others abdomino-perineal resection, Hartmann' procedure or total colectomy was performed.

Near half of the patients, 49 (47.6%), had some grade of complication, of whom 38 developed complications grade I or II (Table 2). According to grading, these patients experienced complications which did not required any surgical, radiological or endoscopic intervention, was not consisting of organ dysfunction, was not life threatening and did not required ICU treatment. Recorded complications grade I or II were: SSI, postoperative diarrhea, PPOI and postoperative bleeding requiring transfusions. Most common postoperative complication was SSI developed in 37 (26.2%) patients. The rate of anastomotic leakage was 5.4%. PPOI occurred in 12 (11.3%) patients. Association of certain demographic variables such as age and gender, American Society of Anesthesiologists (ASA) grade, duration of surgery, type of anastomosis and presence of stoma, with PPOI is shown in Table 3. None of the analyzed parameters reached statistical significance in regression analysis as a risk factor for development of PPOI. Ten patients (9.7%) required reoperation in the early postoperative period (Table 2). Indications for reoperation were as follows: PPOI in 3 (30%) of patients, small bowel obstruction in 2 (20%) of patients, anastomotic leakage in 4 (40%) of patients and ischemic perforation in one (10%) patient.

**Table 1**  
**Clinical and pathological characteristics of patients with colorectal cancers in analyzed cases (according to the UICC classification, 7th edition, 2009)**

Characteristics of colorectal cancers	Patients
	n (%)
Tumor site	
right colon	27 (26.2)
left colon	25 (24.3)
rectum	50 (48.5)
synchronous	1 (1.0)
Stage (TNM classification)	
I	20 (19.4)
IIA	35 (34.0)
IIB	3 (2.9)
IIC	3 (2.9)
IIIA	7 (6.8)
IIIB	25 (24.3)
IIIC	10 (9.7)
T (Tumor)	
1	9 (8.7)
2	17 (16.5)
3	69 (67.0)
4	2 (1.9)
4a	3 (2.9)
4b	3 (2.9)
N (Nodus)	
0	58 (56.3)
1a	12 (11.7)
1b	9 (8.7)
1c	4 (3.9)
2a	11 (10.7)
2b	9 (8.7)

**UICC – Union for International Cancer Control;**

**TNM – tumor, nodus, metastasis.**

Total average length of hospital stay was  $12.60 \pm 6.65$  days (range 7–49). Mean duration of treatment in intensive care unit was  $1.62 \pm 1.43$  days. Patients spent in hospital an average of  $9.39 \pm 6.07$  (4–46) days after the operation.

Comparing the group of the patients with PPOI with those without there was no statistically significant difference in SSI and anastomotic leakage. However, there was a statistically significant difference in terms of complications ( $\chi^2 = 34.966$ ; *p* < 0.001). Complications grade III (requiring surgical, endoscopic or radiologic intervention) were seen more often in the patients with PPOI ( $\chi^2 = 23.43$ ; *p* < 0.001). Also, reoperations were more often done in the patients with PPOI ( $\chi^2 = 15.724$ ; *p* < 0.001) (Table 2). The patients who developed PPOI had statistically significant longer postoperative hospital stay (*Z* = 2.291; *p* = 0.022), which substantially contributed to statistically significant longer total length of hospital stay (*Z* = 2.377; *p* = 0.015). The length of the treatment in the intensive care unit did not differ between groups (*Z* = 1.662; *p* = 0.096) (Table 4).

Logistic regression analysis was used to evaluate PPOI as a risk factor for complications, reoperations and mortality. According to analysis PPOI is not a risk factor for the development of other complications (OR = 1.197; *p* = 0.773), nor for anastomotic leakage in particular (OR = 2.167; *p* = 0.509) (Table 5). Multinomial logistic regression confirmed

that PPOI had no influence on occurrence of any type of SSI (Table 5). Our results showed that a patient who had PPOI had 12 times more chances to undergo reoperation (OR = 12.286;  $p = 0.001$ ), while PPOI poses no risk of mortality (OR = 0.291;  $p = 0.170$ ) (Table 5).

Table 2

Postoperative complications in patients operated due to colorectal cancer					
Complications	Overall	No PPOI	PPOI	$\chi^2$	$p$
	n (%)	n (%)	n (%)		
SSI					
none	76 (73.8)	69 (75.8)	7 (58.3)		
superficial incisional	13 (12.6)	11 (12.1)	2 (16.7)		
deep incisional	5 (4.9)	4 (4.4)	1 (8.3)		
organ/ space infection	9 (8.7)	7 (7.7)	2 (16.7)	1.932	0.587
Other then PPOI					
no	64 (62.1)	57 (62.6)	7 (58.3)		
yes	39 (37.9)	34 (37.4)	5 (41.7)	0.083	0.773
PPOI					
no	91 (88.7)				
yes	12 (11.3)				
Graded according to Clavien and Dindo					
no	54 (52.4)	54 (59.3)	0 (0.0)		
I	21 (20.4)	16 (17.6)	5 (41.7)		
II	17 (16.5)	15 (16.5)	2 (16.7)		
III	3 (2.9)	0 (0.0)	3 (25.0)		
IV	1 (1.0)	1 (1.1)	0 (0.0)		
V	7 (6.8)	5 (5.5)	2 (16.7)	34.966	< 0.001
Anastomotic leakage					
no	87 (94.6)	78 (95.1)	9 (90.0)		
yes	5 (5.4)	4 (4.9)	1 (10.0)	0.455	0.500
Reoperation					
no	93 (90.3)	86 (94.5)	7 (58.3)		
yes	10 (9.7)	5 (5.5)	5 (41.7)	15.724	< 0.001

PPOI – prolonged postoperative ileus; SSI – surgical site infection.

Table 3

Association between prolonged postoperative ileus (PPOI) and demographic and operative variables				
Parameters	Values	OR	95%CI	$p$
Age (years), mean $\pm$ SD	66.00 $\pm$ 10.06	0.999	0.941–1.061	0.973
Male gender, n (%)	64 (37.9)	0.361	0.170–1.907	0.361
ASA grade, n (%)				
I*	14 (13.6)			
II	57 (55.3)	0.840	0.155–4.566	0.840
III	30 (29.1)	0.667	0.098–4.520	0.678
IV	2 (1.9)	0.588	0.036–6.658	0.999
Duration of surgery (min), mean $\pm$ SD	124.90 $\pm$ 39.72	1.013	1.000–1.027	0.051
Anastomosis, n (%)				
ileo-colic*	26 (28.6)			
colo-colonic	14 (15.4)	0.323	0.034–3.083	0.326
colo-rectal	50 (54.9)	0.365	0.089–1.500	0.162
ileo-rectal	1 (1.1)	0.000	0.000	1.000
Stoma	33 (32)	2.370	0.701–8.010	0.156

\*referent value. ASA – American Society of Anesthesiologists; SD – standard deviation; OR – odds ratio.

Table 4

Hospitalization variables in observed groups				
Parameters	Length of stay (days), mean $\pm$ SD		$Z^*$	$p$
	no PPOI	PPOI		
Total	12.39 $\pm$ 6.91	14.17 $\pm$ 3.99	2.377	0.017
Preoperative stay	3.11 $\pm$ 2.34	2.75 $\pm$ 1.35	0.105	0.916
Intensive care	1.55 $\pm$ 1.41	2.17 $\pm$ 1.52	1.662	0.096
Postoperative length of stay	9.24 $\pm$ 6.24	10.58 $\pm$ 4.60	2.291	0.022

PPOI – prolonged postoperative ileus.

**Table 5**  
**Prolonged postoperative ileus (PPOI) as a risk factor for other complications**

Complications	OR	95%CI	<i>p</i>
All	1.197	0.352–4.071	0.773
Anastomotic leakage	2.167	0.218–21.554	0.509
Reoperation	12.286	2.855–52.873	0.001
Mortality	0.291	0.050–1.699	0.170
SSI			
superficial incisional	0.558	0.102–3.040	0.500
deep incisional	0.406	0.040–4.151	0.447
organ/space infection	0.355	0.062–2.050	0.247

SSI – surgical site infection; OR – odds ratio.

## Discussion

The current prospective study was undertaken to evaluate PPOI following elective colorectal resection for cancer and its effect on other complications such as SSI, anastomotic leakage, reoperation, mortality and hospital stay. In order to eliminate factors that might influence gastrointestinal recovery all patients having the same indications for operation were included in the study and were operated using open approach, without epidurals or opiate based analgesia postoperatively, no nasogastric tubes nor use of prokinetics<sup>16</sup>. According to the results in this study, the incidence of PPOI, as defined by Vather et al.<sup>9</sup>, after open elective colorectal surgery was 11.3%. Similar rate of 12.7% was reported by Moghadamyeghaneh et al.<sup>17</sup>, although studies are hard to compare since they were different in design and definition of prolonged postoperative ileus. Retrospective study by Juarez-Parra et al.<sup>18</sup> used the same definition of PPOI but with reported incidence almost twice higher (22.3%), even though some of the patients were operated by laparoscopic approach. Some authors argue that after laparoscopic surgery faster bowel recovery is to be expected because there is less surgical trauma, reduction in release operative stress hormones, less postoperative pain with the reduction in need for analgetics. Additional factor that might have the influence is intraabdominal humidity, since laparotomy induces evaporation from the bowel surface and exposes the intestine to a nonphysiological environment. Chen et al.<sup>19</sup>, confirmed a statistically significant lower rate of postoperative vomiting after laparoscopic colectomy in comparison to open group and significant differences related to diet tolerance (2.1 vs. 3.2 days), length of ileus (3.5 vs. 5.3 days), and length of hospitalization (6.6 vs. 8.1 days). In their study, cancer was the indication for surgery in only 13% of patients<sup>19</sup>, which could have been influenced on the extent of resection, thus effecting a level of operative trauma. In a large retrospective analysis from 2015 on 32,392 elective colectomies, PPOI was reported in 14% of cases. This study also included indications other than cancer, like diverticular disease or volvulus. A higher PPOI rate was noted especially in these cases. The highest difference in rates of PPOI was also found between open and laparoscopic approach, where for every type of procedure open approach was associated with > 10% higher rates of ileus compared to laparoscopic approach<sup>20</sup>. In a prospective study in which only laparoscopic colectomies

for benign and malignant colorectal disorders were analyzed, the rate of PPOI was reported to be 10.2%<sup>21</sup>, just slightly lower than the rate reported in this study which included only open procedures. Limitation in use of opiates in this study protocol for postoperative pain management could be the reason for similar rates of PPOI. Different design of studies in terms of indications for surgery, definition of PPOI, approach, postoperative care pathway, use of opiate based analgesia, makes results difficult to interpret.

According to latest meta-analysis the rate of PPOI after colorectal surgery is around 10%, with lower incidence after laparoscopic colonic resections, but with variation in incidence depending on the definition used<sup>13</sup>. Although minimal invasive surgery is evolving parallel with enhanced recovery protocols, PPOI is still important postoperative event<sup>21</sup>.

Various risk factors for development of PPOI are identified in studies, also due to diversity in definitions of PPOI used as well due to different study designs. For example, according to retrospective analysis from Millan et al.<sup>22</sup>, male sex, COPD and ileostomy were independent factors associated with higher risk of this complication. On the other hand Kronberg et al.<sup>21</sup> showed that age, preoperative albumin level, previous abdominal surgery and chronic preoperative use of narcotics were associated with PPOI. Moghadamyeghaneh et al.<sup>17</sup> found that advanced age, duration of surgery and ileocolic anastomosis was associated with PPOI. According to our results, neither age, gender, ASA grade, duration of surgery, type of anastomosis and creation of stoma reached statistical significance in regression analysis. Identification of other potential risk factors that could be related to PPOI was beyond the scope of this paper.

Our study showed that patients with PPOI had statistically significant difference in grade of complications, especially grade III (complications requiring surgical, radiological or endoscopic intervention). Five out of 12 patients, (41.6%), with PPOI in our study, suffered from additional complications. Retrospective study on more than 32,000 colectomies also showed that patients with PPOI were more likely to suffer from another postoperative complications compared to patients without ileus (50% vs. 21%, respectively)<sup>20</sup>. In this study, almost 60% of patients with ileus suffered from additional adverse outcome. We did not find statistically significant difference between rates of SSI and anastomotic leakage amongst the patients with and without PPOI. According to some authors PPOI is significantly asso-

ciated with intra abdominal infections ( $p = 0.01$ ) and anastomotic leakage ( $p = 0.01$ )<sup>17</sup>. The reason could be the fact that in their study ileus was defined as no return of bowel function within 7 days from operation, which is important since PPOI could develop secondary to other complication, and this underlying complications must be ruled out. It is of cardinal importance to differentiate PPOI from anastomotic leakage or intraabdominal sepsis, as PPOI could represent one of their clinical features. Out of 5 patients reoperated from group with PPOI in our study, one had unrecognized anastomotic leakage. Postoperative fever in conjunction with tachycardia, hypotension, or raised inflammatory markers suggested a source of sepsis, and was to prompt investigation to exclude intra-abdominal infection<sup>23</sup>. In a retrospective study with laparoscopic colectomies no difference in rates of postoperative abdominal abscess in the patients with and without PPOI was observed (1.6% vs. 2.4%  $p = 0.53$ ). The same study reports that deep vein thrombosis (DVT) in the postoperative period was more frequently seen in patients with PPOI (7.1% vs. 1.1%;  $p = 0.026$ ) which authors found difficult to interpret, since it is hard to know what was the cause and what was the effect; it was assumed that it was related to delayed activation<sup>21</sup>.

Our results show that patient with PPOI has 12 times more chance to be reoperated in comparison to the patient without this complication (OR = 12.286;  $p = 0.001$ ), which is much higher than previously reported<sup>17,20</sup>. We presume that this was mostly due to our fear from another precipitating complications since in 3 patients operated from the group of PPOI, no underlying cause was found.

Distinguishing other postoperative complications from PPOI is of paramount importance since symptoms of PPOI are similar to, for example, postoperative small-bowel obstruction or anastomotic leakage or intraperitoneal bleeding. Many of these complications require immediate intervention since they are life-threatening conditions<sup>4</sup>.

None of the patients was readmitted for PPOI during the study period, although PPOI was often mentioned as a

reason for rehospitalization<sup>8,17,20</sup>. Our study also failed to identify PPOI as a risk factor for mortality (OR = 0.291;  $p = 0.170$ ). According to most studies<sup>16,24-26</sup>, the patients with PPOI have significantly higher mortality rate. According to a large study by Tevis et al.<sup>20</sup>, ileus alone did not increase mortality, but with every additional complication, mortality was rising dramatically to as high as 28%, like in cases with seven different complications. Increase in mortality also varied among different complications. For example ileus accompanied by SSI did not have an impact on mortality while the highest impact on mortality was seen in combination of ileus with pulmonary complications, which increased the death rate from 2% to 22%<sup>20</sup>.

Longer hospital stay of the patients with PPOI was confirmed in many studies<sup>8,17,20-25</sup> including our. In a large study from the US which included 17,876 patients with colectomy<sup>8</sup> not only that patients with PPOI had prolonged hospitalization but they were less likely to be discharged home after surgery (67.2% vs. 77.4%;  $p < 0.001$ ) and more likely to be discharged to another institution (7.7% vs. 4.9%;  $p < 0.001$ ) or to home health care (21.7% vs. 15.0%;  $p < 0.001$ ). Prolonged hospitalization in PPOI may potentiate hospital-acquired infections<sup>21</sup>.

## Conclusion

PPOI is a concern for colorectal surgeons and patients even in the era of minimally invasive surgery and after implementation of enhanced recovery protocols. PPOI in addition to economic burden has an impact on other adverse events such as other complications, reoperations, even mortality according to some authors. In every case of PPOI is important to carefully rule out possible complications. Although not life-threatening complication and by that sometimes underestimated, it affect recovery, increases hospital length of stay and contributes to poor surgical outcome.

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