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## Original article

# What are the risk factors for readmission in patients with an ileostomy?

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### ABSTRACT

**Purpose:** the aim of this study was to identify the risk factors for readmission among patients submitted to colorectal surgery.

**Methods:** a single-center colorectal quality-assessment database was queried for patients undergoing colorectal procedures with ileostomy during 2009. The sample was divided into readmitted vs. non-readmitted. Readmission was defined as admission within the first 30 days after the index procedure. Groups were compared by pre, intra and postoperative characteristics. A multivariate analysis was performed to identify the risk factors for readmission.

**Results:** the query returned 496 patients, [267 (54%) males, median age 48 years (IQR: 34-60)]. Eighty-three (17%) were readmitted; 296 patients (60%), were operated due to inflammatory bowel disease, 89 (18%) for cancer, 16 (3%) for diverticular disease and 95 (19%) for other diagnosis. The three most common procedures were total proctocolectomy with ileal pouch-anal anastomosis (IPAA) in 103 patients (21%), total colectomy with end ileostomy in 117 (24%) and small bowel resections (including enterocutaneous fistula takedown and J-pouch excision) in 149 (30%). The following variables were significantly more common in readmitted patients: current smoking (24% vs. 14%,  $p = 0.02$ ), postoperative DVT/PE (10% vs. 4%,  $p = 0.04$ ), wound infection (20% vs. 10%  $p = 0.01$ ), sepsis (22% vs. 8%  $p < 0.001$ ) and organ or space surgical site infection (OrgSSI) (35% vs. 5%,  $p < 0.001$ ). Postoperative OrgSSI was the only independent factor associated with readmission in a multivariate analysis ( $p < 0.001$ ). **Conclusion:** colorectal surgeons should be alert for OrgSSI when facing an ileostomy patient readmitted after a colorectal procedure.

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## Quais são os fatores de risco para readmissão em pacientes com ileostomia?

### R E S U M O

#### Palavras-chave:

Ileostomia

Readmissão

**Objetivo:** o objetivo deste estudo foi identificar os fatores de risco para readmissão em pacientes submetidos à cirurgia colorretal.

**Métodos:** um banco de dados de avaliação da qualidade colorretal em um único centro foi consultado para pacientes submetidos à procedimentos colorretais com ileostomia em 2009. A amostra foi dividida em readmitidos versus não readmitidos. A readmissão foi definida como a admissão dentro dos primeiros 30 dias após o procedimento índice. Os grupos foram comparados em relação à características pré, intra e pós-operatórias. A análise multivariada foi realizada para identificar os fatores de risco para readmissão.

**Resultados:** a consulta identificou 496 pacientes, [267 (54%) do sexo masculino, idade média de 48 anos (VIQ: 34 -60)]. Oitenta e três (17%) foram readmitidos; 296 pacientes (60%) foram operados por doença inflamatória intestinal, 89 (18%) por câncer, 16 (3%) por doença diverticular e 95 (19%) devido a outro diagnóstico. Os três procedimentos mais comuns foram proctocolectomia total com anastomose anal e bolsa ileal (IPAA) em 103 pacientes (21%), colectomia total com ileostomia final em 117 (24%) e ressecções do intestino delgado (incluindo a remoção de fístula enterocutânea e excisão da bolsa em J) em 149 (30%). As seguintes variáveis foram significativamente mais comuns em pacientes readmitidos: tabagismo atual (24 % vs. 14%,  $p = 0,02$ ), TVP/EP pós-operatório (10% vs. 4 %,  $p = 0,04$ ), infecção da ferida cirúrgica (20 % vs. 10%  $p = 0,01$ ), sepse (22% vs. 8%,  $p < 0,001$ ) e infecção de órgão/espaço do sítio cirúrgico (IOSC) (35 % vs. 5%,  $p < 0,001$ ). A infecção do IOSC pós-operatório foi o único fator independente associado com a readmissão na análise multivariada ( $p < 0,001$ ). **Conclusão:** os cirurgiões colorretais devem estar alertas para IOSC diante de um paciente com ileostomia readmitido após um procedimento colorretal.

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## Introduction

Construction of an ileostomy is a common procedure in colorectal surgery. A diverting (defunctioning) loop ileostomy may be used in patients for whom the integrity of a bowel anastomosis is a critical concern. In this setting, the aim is to decrease the morbidity and perhaps the incidence of anastomotic leak.<sup>1</sup> A diverting loop ileostomy may also be used to help control and alleviate persistent perineal sepsis,<sup>2</sup> obstructive tumors,<sup>3</sup> refractory pelvic floor disorders,<sup>4</sup> and other conditions in which definitive surgery is either unneeded or unwise. The creation of an end ileostomy (EI) is required in patients with dysfunctional or unsalvageable anal sphincters and in cases in which an anastomosis is unsafe, such as those with refractory *Clostridium difficile* colitis.<sup>5</sup> While the creation of an ileostomy is often of great benefit in these scenarios, it may also open the door to other types of morbidity including pouching difficulty, hernia, prolapse, dehydration, and acute renal failure.<sup>6</sup>

Although a previous study from our unit found no link between the presence of an ostomy and the incidence of readmission after colorectal surgery, we have recently observed an increased rate of readmissions in patients who underwent colorectal surgery that resulted in an ileostomy.<sup>7</sup> With the awareness that hospital readmissions are now under in-

creased scrutiny, we intend to identify and rank the factors associated with readmission in patients undergoing colorectal procedures with an ileostomy formation.<sup>8</sup>

## Material and methods

A single center, departmental, IRB-approved database was queried for the period of January to December 2009. Every patient who underwent small bowel, colon, or rectal surgery that required hospitalization was included. Patients who underwent anorectal surgery procedures, under 18 years of age, and those without 30-day follow-up were excluded. Data was collected on a staggered daily schedule that resulted in 80% patient registered. The readmission rate for all patients in the database was determined and then a focused query was performed on patients who underwent major colorectal procedures that included either end ileostomy (EI) or diverting loop ileostomy (DLI) formation. The data collected included patient demographics, diagnoses, preoperative variables, smoking status, American Society of Anesthesiologists physical status classification (ASA class), steroid use for the past 30 days, chemotherapy and/or radiotherapy for malignancy within 90 days from surgery date, preoperative blood laboratory

values (creatinine, albumin, white blood cell count and hematocrit), surgical variables (surgical technique, duration of surgery, estimate blood loss (EBL), anastomosis type), postoperative morbidity, readmission and mortality. During the evaluation period, a trained research nurse assessed each patient at the time of hospital discharge and at 45 days after the discharge date. The assessment was performed via review of the electronic medical records for both hospitalization and outpatient visits and also by direct communication with the patient to ensure that readmission to other hospitals was noted. The research nurse in charge of data collection followed strict definitions for each of the study outcomes, which, in most cases, were the same as the ACS NSQIP definitions.<sup>9</sup>

The study population was divided into two groups according to the readmission status (Readmitted vs. Non-Readmitted). Readmission was defined as admission to any hospital within 30 days after the date of the index surgery. Groups were compared with respect to the preoperative, intraoperative and postoperative variables. For the readmitted group, the following additional data was recorded: reason for readmission, readmission diagnostic imaging results, treatments required during readmission, and readmission length of stay (LOS).

**Statistical analysis**

Categorical variables were summarized as absolute numbers and percentages. Continuous variables were expressed as medians and interquartile ranges (IQR) and compared with the Wilcoxon rank sum test.

In order to better evaluate the factors associated with patient readmission, a univariate analysis was performed using as independent factors the perioperative variables that had a p-Value ≤ 0.10 in the comparison of study groups.

Variables that were associated with readmission in the univariate analysis were selected for a multivariate analysis.

**Results**

In the one-year study period, 1,583 patients were registered in the database of which 188 (12%) were readmitted; 496 patients underwent major colorectal procedures that included an ileostomy creation and out of these, 83 (17%) required hospital readmission, including 75 (15%) who were readmitted to our hospital.

**Preoperative variables**

The preoperative patient characteristics and demographics are described in Table 1. The proportion of patients that were current smokers was significantly higher in the readmitted group (24% vs. 14%, p = 0.02). All other preoperative variables were not significantly different between groups.

**Table 1 - Patient characteristics.**

Pre-operative Variables	Readmitted n = 83 (17%)	Non-Readmitted n = 413 (83%)	p-value
Gender (n%)			
Male	47 (57)	220 (53)	0.63
Female	36 (43)	193 (47)	
Age (years)	48.3 (37-62)	48.5 (33-60)	0.56
ASA (n%)			
I / II	52 (63)	244 (59)	0.62
III / IV	31 (37)	169 (41)	
BMI (kg/m <sup>2</sup> )	26 (22-30)	25 (22-29)	0.2
Smoker (%)			
Current	20 (24)	58 (14)	0.02
Quit/Never	63 (76)	355 (86)	
Diagnosis (%)			
IBD	48 (58)	248 (60)	0.89
Cancer	17 (21)	72 (17)	
Diverticulitis	2 (2)	14 (4)	
Other	16 (19)	79 (19)	
Steroids <sup>a</sup> n = 296 (n%)	19 (40)	105 (42)	0.75
Infliximab <sup>a</sup> n = 296 (n%)	6 (12)	40 (16)	0.66
Preoperative Chemotherapy <sup>b</sup> (n%) n = 89	2 (12)	16 (22)	0.5
Pelvic Radiation <sup>b</sup> n = 89 (n%)	3 (18)	14 (19)	1.0
Creatinine (mg/dL)	0.82 (0.7-0.9)	0.84 (0.7-1.0)	0.51
Albumin (g/dL)	3.9 (3.2-4.3)	3.9 (3.3-4.4)	0.81
WBC (billion cells/L)	8.2 (6.6-11.1)	7.6 (5.7-10.6)	0.08
HTC (%)	38.9 (35.2-41.9)	38.8 (34.2-42.4)	0.79

ASA, American Society of Anesthesiology classification; BMI, body mass index; IBD, inflammatory bowel disease; WBC, white blood cells; HTC, hematocrit.

<sup>a</sup> Analysis done only with IBD patients.

<sup>b</sup> Analysis done only with cancer patients.

**Intraoperative and postoperative variables**

The three most common procedures performed were major operations involving small bowel resections (including enterocutaneous fistula takedown and J-pouch excision) in 149 patients (30%), total abdominal colectomy with end ileostomy in 117 (24%), and total proctocolectomy with ileal pouch-anal anastomosis (IPAA) in 103 (21%) patients (Table 2).

Table 3 summarizes the intraoperative and postoperative variables. The proportion of patients diagnosed with deep venous thrombosis/pulmonary embolism (DVP/PE), wound infection, organ space surgical site infection

**Table 2 - Surgical procedures.**

Surgical Procedure n(%)	Readmitted n = 83 (17%)	Non-Readmitted n = 413 (83%)	p-value
Small bowel resection	27 (35)	122 (30)	0.60
Total abdominal colectomy / end ileostomy	16 (19)	101 (24)	0.33
Total proctocolectomy/IPAA	16 (19)	87 (21)	0.77
Low anterior resection	10 (11)	35 (8)	0.40
Segmental colectomy	7 (8)	43 (10)	0.69
Total proctocolectomy/ End ileostomy	7 (8)	23 (6)	0.45
Other	0 (0)	2 (1)	1

**Table 3 - Intraoperative and postoperative information.**

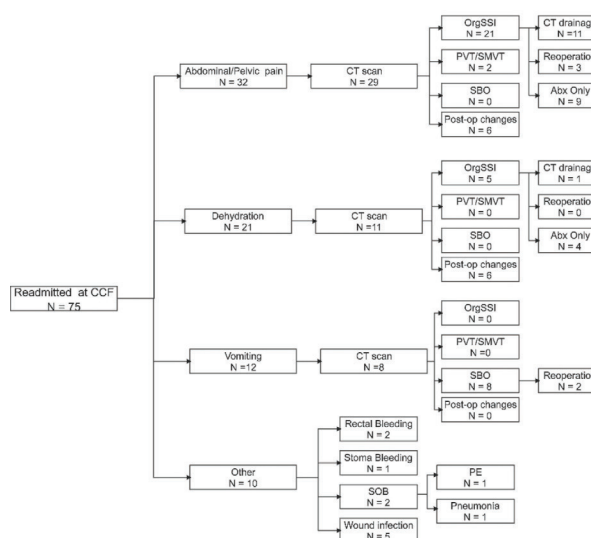
Intraoperative and post-operative variables	Readmitted n = 83 (17)	Non-Readmitted n = 413 (83)	p-value
Operative technique n (%)			1.0
Laparoscopic	20 (24)	102 (25)	
Open	63 (76)	311 (75)	
Operative time (min.)	167 (119-265)	172 (120-240)	0.96
EBL (mL)	300 (150-500)	250 (150-500)	0.96
Wound class n (%)			0.45
2	33 (73)	193 (82)	
3	4 (9)	15 (6)	
4	8 (18)	29 (12)	
Anastomosis n (%)			0.37
Hand sewn	10 (24)	33 (17)	
Stapled	32 (76)	160 (83)	
Intraoperative abscess n (%)	18 (22)	70 (17)	0.18
Stoma type n (%)			0.54
End	41 (49)	220 (53)	
Diverting	42 (51)	193 (47)	
Post operative complications n (%)			
Ileus	21 (25)	73 (18)	0.07
DVT/PE	8 (10)	17 (4)	0.04
Organ SSI	29 (35)	19 (5)	< 0.001
Sepsis	18 (22)	33 (8)	< 0.001
Wound infection	17 (20)	41 (10)	0.01
UTI	1 (1)	14 (3)	0.93
Mortality n(%)	0 (0)	14 (3)	0.14

EBL, estimate blood loss; DVT/PE, deep venous thrombosis, pulmonary embolism; Organ SSI, organ space surgical site infection; UTI, urinary tract infection.

(OrgSSI) and/or sepsis increased significantly in the readmitted group. Moreover, for 21 (72%) out of 29 patients in the readmission group with an OrgSSI, diagnosis was made at the time of readmission.

#### Reasons for readmission

Among the 75 patients who were readmitted at the Cleveland Clinic, the most common complaint or diagnosis was abdominal pain in 32 (43%), dehydration in 21 (28%) patients and nausea/vomiting in 12 (16%). Forty-nine patients underwent CT imaging of the abdomen and pelvis. Of these, the most common pathologic finding were OrgSSI (26 patients [33%]) and small bowel obstruction (SBO) (8 patients [16%]) (Fig. 1).



**Fig. 1 - Common pathologic finding. CCF, Cleveland Clinic Foundation; PVT, portal vein thrombosis; SMVT, superior mesenteric vein thrombosis; SBO, small bowel obstruction, PE, pulmonary embolism; Abx, antibiotic.**

**Univariate and multivariate analysis**

In order to more accurately assess the factors associated with readmission, univariate and multivariate analyses were performed using the readmission as dependent variable and perioperative data as independent variables.

In the univariate analysis current smoking status, venous thromboembolism (DVT/PE), OrgSSI, sepsis, and wound infection were significantly associated with the occurrence of readmission (Table 4). However, in the multivariate analysis this association persisted only for OrgSSI (Table 5).

**Diverting stoma vs. end stoma (Table 6)**

To examine more thoroughly the implications of stoma type in patient readmission we further divided the patients readmitted at the Cleveland Clinic into two groups: diverting stoma vs. end stoma. When patients with a diverting loop ileostomy were compared to those with an end ileostomy, no significant differences were observed neither in readmission chief complaints nor in diagnose. However there was a trend for an increased rate of OrgSSI in the diverting stoma group.

**Table 4 - Univariate analysis.**

Independent variables n (%)	Readmitted n = 83 (17%)	Non-readmitted n = 413 (83%)	Odds ratio	95% Confidence interval	p-value
Sepsis	18 (22)	33 (8)	3.18	1.66-5.94	< 0.001
Organ SSI	29 (35)	19 (5)	11.13	5.89-21.5	< 0.001
Wound infection	17 (20)	41 (10)	2.33	1.22-4.28	0.01
Smoking	20 (24)	58 (14)	1.94	1.07-3.4	0.02
DVT/PE	8 (10)	17 (4)	2.48	0.98-5.80	0.05
30-days prior surgeries	3 (4)	3 (0.7)	5.12	0.93-28.12	0.06
Ileus	21 (25)	73 (18)	1.57	0.88-2.71	0.11
WBC	8.2 (6.6-11.1)	7.6 (5.7-10.6)	0.99	0.95-1.03	0.82

DVT/PE, deep venous thrombosis, pulmonary embolism; Organ SSI, organ space surgical site infection; WBC, white blood cells.

**Table 5 - Multivariate analysis.**

Independent variables n(%)	Odds ratio	95% Confidence interval	p-value
Organ SSI	13.27	5.73-33.76	< 0.001
Smoking	1.77	0.91-3.31	0.08
Wound infection	1.68	0.78-3.49	0.17
Sepsis	1.75	0.7-4.83	0.23
DVT/PE	1.24	0.4-3.53	0.69

DVT/PE, deep venous thrombosis, pulmonary embolism; Organ SSI, organ space surgical site infection.

**Table 6 - Diverting vs. end stoma: causes for readmission at the Cleveland Clinic.**

Readmission variables n (%)	Diverting stoma	95% Confidence interval	p-value
<b>Chief complain<sup>a</sup></b>			
Abdominal pain	17 (47)	15 (39)	0.49
Dehydration	12 (33)	9 (23)	0.44
Vomiting	4 (11)	7 (18)	0.52
Other	3 (8)	8 (21)	0.19
<b>Diagnosis<sup>b</sup></b>			
DVT	1(3)	2 (3)	0.60
Ileus	2 (6)	1 (3)	0.61
OrgSSI	17 (47)	10 (26)	0.06
SBO	4 (11)	8 (21)	0.35
Wound infection	5 (13)	1 (3)	0.10

Organ SSI, organ space surgical site infection; SBO, small bowel obstruction.

<sup>a</sup>Percentages may not add exactly to 100% due to numbering rounding.

<sup>b</sup>Percentages may not add exactly to 100% because a single patient can have more than one complication.

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## Discussion

Hospital readmission is a relatively common situation, happening in our sample in 16% of the patients undergoing major colorectal procedures that required an ileostomy creation. The symptom that most commonly prompted patients to return to the hospital was abdominal pain followed by dehydration. Finally, among all the perioperative variables studied, the occurrence of OrgSSI was the single most important determinant for hospital admission in these patients.

The causes for readmissions in colorectal surgery have been previously evaluated.<sup>10-12</sup> However, to our knowledge this is the first report to analyze the reasons for readmissions in patients with an ileostomy. An ileostomy creation is a common procedure in colorectal surgery, usually done when a restorative procedure cannot be performed safely.<sup>1-5</sup> Although the usual purpose of an ileostomy is to decrease comorbidities, there are several potential complications associated with the stoma itself that could lead the patient to return to the hospital.<sup>6</sup> These facts lead us to understand that ileostomy patients are a singular group and, therefore, it would be important to evaluate the factors associated with hospital readmission among this group only.

Before this study, the common belief was that dehydration, due to high stoma output and complications related to the ileostomy care, would be the most common reasons for hospital readmission in this group of patients. Surprisingly, the occurrence of an OrgSSI was the single most predictive factor of hospital readmission in our study population. In fact, about 5 out of 21 patients who had dehydration as chief complaint were found to have an OrgSSI. This factor is of paramount importance as it shows that the OrgSSI diagnosis can be clouded by the presence of dehydration, which in turn can be wrongly associated to a high stoma output.

An OrgSSI is one of the most feared complications in colorectal surgery, as it is associated with increased morbidity and mortality, and so an early diagnosis is one of the key factors for its successful treatment.<sup>13</sup> Therefore, it is important to be aware of its common presence in ileostomy patients who are readmitted after surgery.

Usually, antibiotic treatment only, or in association with CT guided drainage is effective on these patients.<sup>14</sup> In fact, in our study population only 3 out of the 26 patients with an OrgSSI had to be re-operated.

Another interesting finding of this study was the readmission of one patient due to a complication related to stoma pouching. This patient had a bleeding due to stoma tearing caused by the stoma appliance. We believe that this small rate of stoma pouching complication is not only a consequence of a proper stoma creation, but because of dedicated care provided by the Cleveland Clinic enterostomal therapy nurses, well known for taking special care of these patients.<sup>15</sup> However, the fact that about 21% (16) of our patients were readmitted due to dehydration, may suggest that a better guidance regarding the use of bowel stoppers as well as diet and fluid intake is still needed.

In order to better evaluate the effect of the ileostomy type in the readmission, we further divided the readmitted at CCF group into diverting and end stoma. Interestingly, we found

that diverting stoma patients had a trend towards more sepsis and OrgSSI when compared to those with an end stoma. This finding suggests that the presence of a stoma may not decrease the incidence of anastomotic complications, and it is in agreement with a recent multicentric study from 329 Japanese hospitals that demonstrated that a diverting loop ileostomy does not relate to an overall anastomotic leakage rate, but mitigates its consequences and decreases the need for urgent abdominal reoperation in rectal cancer patients undergoing low anterior resections.<sup>16</sup>

Our study suffers from the limitations of any retrospective analysis. Although we were able to collect data regarding whether or not a patient was admitted to an outside hospital, the details of this readmission could not be retrieved. Moreover, one of the major limitations of our study is that the ileostomies were performed at the surgeon's discretion without a defined protocol. However, with few exceptions, ileostomies were routinely constructed, by the majority of the colorectal surgeons, during the procedures involved in this study. For the same reason the evaluation of the CT scan was also not clear. However, the fact that all reoperations happened among patients who underwent a CT scan makes it unlikely that an OrgSSI could have been missed.

Although this was not a randomized controlled trial, there are several strengths to the data presented here. To our knowledge, this is the first report regarding the factors associated with readmissions in ileostomy patients. Furthermore, all cases were managed in strict adherence to standard surgical principles by high-volume surgical teams limiting negative outcomes associated to technical factors.

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## Conclusion

Despite traditional belief that high stoma output and dehydration are the main factors causing readmission of ileostomy patients, an occurrence of OrgSSI was the single most important factor for hospital readmissions. Colorectal surgeons should be alert for a possible OrgSSI when facing an ileostomy patient readmitted after an abdominal colorectal procedure.

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## Conflicts of interest

The authors declare no conflicts of interest.

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