

Risk factors for post-colectomy adhesive small bowel obstruction

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Objective. The purpose of this study was to assess the risk factors for adhesive small bowel obstruction (SBO) following colectomy for colorectal cancer. **Patients and methods.** In this retrospective study we analyzed 284 patients who underwent surgery for colorectal cancer at the Department of Surgery University Clinical Center Tuzla in the period from 1st January 2009 until 31st December 2014. All patients underwent open colectomy. The length of follow up was from 6 months to 6 years (median follow up 3 years and 6 months). The study included all patients who underwent surgery due to colon cancer. The study excluded patients with postoperative small bowel obstruction after colon cancer surgery with different comorbidities. **Results.** In the analyzed sample of 284 patients, a small bowel obstruction occurred in 13.7% patients after surgery for colon cancer. The highest correlation of risk factors and the occurrence of postoperative small bowel obstruction after colectomy for colorectal cancer in multivariate regression analysis was found to be for Tumor-Node-Metastasis ≥ 3 (or =3.680), and postoperative complications (or =30.683). **Conclusions.** Postoperative SBO have many causes, but in this study the highest risk factors were the Tumor-Node-Metastasis ≥ 3 , and postoperative complications.

Introduction

Postoperative abdominal adhesions are associated with significant morbidity and mortality, placing a substantial burden on healthcare systems worldwide. It is estimated that in 93%-100% of patients undergoing transabdominal surgery, the operation results in postoperative adhesions. These widespread adhesions differ from patient to patient, depending on the type of surgery and possible postoperative complications (1). Small bowel obstruction (SBO) is caused mainly by postoperative adhesions (more than 75% of all cases) (2-6), and is a common postoperative morbidity of col-

ectomy for colorectal cancer (7). It leads to markedly lower patient quality of life, longer hospital stays and increased hospitalization costs (8). Postoperative SBO is one of the major concerns in surgery, and the appearance of early postoperative SBO symptoms is a serious issue because it affects the long-term prognosis of patients with colorectal cancer. Patients with clinical deterioration or with a CT scan evoking strangulated SBO need urgent surgery (9-10).

Patients undergoing surgical management for SBO had a reduced risk of recurrence requiring hospitalization, as well as SBO symptoms, as compared to those

with conservative treatment (11). Acute SBO is still considered by many a relative contraindication for laparoscopy. However, laparoscopy is a feasible and effective treatment for acute SBO with acceptable morbidity but laparotomy remains the standard approach (12).

This study was designed to evaluate the risk factors for postoperative SBO after colectomy for colorectal cancer from our database, which contains 284 colectomy cases over 5 years.

Patients and methods

From January 1st 2009 to December 31st 2014 (6 years) at the Department of Surgery, University Clinical Centre, Tuzla, 284 patients underwent surgery for colorectal cancer (213 males, and 71 females). This retrospective study included all patients who underwent surgery for colorectal cancer. The study excluded patients under 40 years, patients with inflammatory bowel disease, abdominal abscess and associated abdominal cancer. The factors studied regarding adhesive postoperative SBO were as follows: age, gender, American Society of Anesthesiologists (ASA) score, operation time, elapsed time from the latest operation, the presence of foreign material and intra-abdominal drain, tumor size and location, operative procedures, Tumor-Node Metastasis stage, the urgency of the surgery, application of radiation and/or chemotherapy, and postoperative surgical and medical complications.

Data collected through a pre-established questionnaire were included. Patients were divided in two groups. The SBO group (39 patients), were the patients who underwent surgery one or more times due to postoperative SMO. The non SMO group (245 patients) were patients who underwent surgery due to colorectal cancer without clinical signs of postoperative SMO. All patients underwent open colectomy surgery. The

duration of follow up ranged from 6 months to 6 years (median follow up: 3 years and 6 months). We treated patients with subocclusion interference conservatively, and we treated patients surgically who had clear clinical and radiological signs of intestinal obstruction. This is usually performed by adhesiolysis, but in two cases we had to perform resection of the small intestine due to intestinal obstruction. Adhesions as the cause of postoperative small bowel obstruction were detected by clinical and radiological examinations and intraoperatively.

Statistical analysis

Statistical analysis was done using the biomedical application software MedCalc 12.3 statistical software. Categorical variables were analyzed by the χ^2 -test, the χ^2 -test contingency, and by comparing proportions and the odds ratio (OR) for each variable, with 95% confidence intervals (CI). Non-parametric correlation by Spearman was used to test the significant relationships between the variables. Utilizing univariate and multivariate logistic regression analysis, the level of impact of certain variables on the presence of a postoperative small bowel obstruction caused by adhesion was tested. The difference between samples was considered significant if $p < 0.05$.

Results

In the analyzed sample of 284 patients, small bowel obstruction after surgery for colorectal cancer was found in 39 patients. The majority of patients in the SBO group (56.4%), were over 60 years of age, and in the non SMO group the majority of patients were 40-60 years of age. There were similar percentages of male and female patients in both study groups. An ASA score of \geq III was most common in patients in the SMO group, that is in 74.3%. The number of previous surgi-

Table 1 Preoperative characteristics of patients with colectomy for colorectal cancer

Characteristic	Groups		p
	SMO n (%)	non SMO n (%)	
Age (year)			
40-60	17 (43)	208 (84)	<0.0001
>60	22 (56)	34 (13)	
Gender			
Male	30 (76)	183 (74)	>0.05
Female	9 (19)	62 (25)	
ASA score			
II	10 (25)	143 (58)	<0.0001
III	20 (51)	93 (38)	
IV	9 (23)	9 (3)	
No. of previous procedures			
1	32 (82)	215 (87)	0.0017
2	5 (12)	30 (12)	
3-5	2 (5)	0 (0.0)	

SBO=Small bowel obstruction.

cal procedures was about the same for both groups of patients (Table 1).

A median laparotomy was the only access in both groups of patients. Operation time exceeded three hours in 69.2% patients in the SMO group, and in 69% patients in the non SMO group the operation time was less than 3 hours. Intra-abdominal drains and foreign material were present in all patients in both groups. The most common surgical procedure in both groups was Miles' operation, followed by anterior rectal resection, Hartmann's procedure and left hemicolectomy. TNM stage 3 colorectal tumors were found in 76.5% in the SMO group, and in 53.9% in the non SMO group. TNM stage 2 was significantly more represented in patients in the non SMO group (37.1%), in relation to the SMO group (12.8%) (Table 2).

On the basis of the analysis of the preoperative and intraoperative risk factors for postoperative small bowel obstruction

after colectomy due to colorectal cancer, it was determined that the following parameters significantly increased the likelihood of postoperative small bowel obstruction caused by adhesions: postoperative complications (OR: 38.3), TNM ≥ 3 (OR: 7.94), operating time (OR: 5.0), and age group 40-60 (OR: 0.126). Male gender, ASA score ≥ 3 , emergency surgery, the application of radiation and/or chemotherapy and tumor location did not significantly increase the likelihood of the occurrence of postoperative obstruction of the small bowel in patients after colectomy for colorectal cancer (Table 3).

By multivariate regression analysis of preoperative and intraoperative risk factors for postoperative small bowel obstruction after colectomy for colorectal cancer, we found that TNM ≥ 3 (OR-30.68) and postoperative complications (OR-3.68) are the best predictive risk factors for postoperative small bowel obstruction (Table 4).

Table 2 Intraoperative risk factors for small bowel obstruction after colectomy for colorectal cancer

Characteristic	Groups		p
	SMO n (%)	non SMO n (%)	
Operating time (min)			
<180	12 (30.8)	169 (69.0)	<0.0001
>180	27 (69.2)	76 (31.0)	
The presence of foreign material	39 (100)	245 (100)	NS
The presence of an intra-abdominal drain	39 (100)	245 (100)	NS
Tumor location			
Colon	2 (5.1)	49 (20.0)	0.0926
Rectum	37 (94.9)	196 (80.0)	
Tumor size (cm)			
>5	19 (48.7)	115 (47.0)	0.9728
<5	20 (51.3)	130 (53.0)	
Operative procedure			
Miles' operation	15 (38.5)	99 (40.4)	0.1845
Anterior rectal resection	13 (33.3)	108 (44.0)	
Hartmann's procedure	9 (23.1)	27 (11.0)	
Left hemicolectomy	2 (5.1)	11 (4.6)	
Tumor-Node Metastasis stage			
II	5 (12.8)	132 (37.1)	<0.0001
III	30 (76.5)	91 (53.9)	
IV	4 (10.3)	22 (9.0)	

SBO=Small bowel obstruction.

Table 3 The probability ratio of preoperative and intraoperative risk factors for postoperative small bowel obstruction after colectomy for colorectal cancer in univariate analysis

Risk factor	Groups		OR	95% CI	p
	SMO n	non SMO n			
The age group 40-60 (years)	17	208	0.126	0.060-0.262	<0.0001
Male sex	30	183	1.129	0.508-2.510	>0.05
ASA score ≥ 3	29	102	1.222	0.548-2.727	>0.05
Number of previous surgeries ≥ 2	11	30	2.815	1.271-6.236	>0.05
The urgency of the surgery	2	15	0.828	0.182-3.77	>0.05
Operating time >3 h	27	76	5.000	2.406-10.402	<0.0001
Tumor location					
Colon	13	49	0.500	0.239-1.043	>0.05
Rectum	26	196			
Tumor-Node Metastasis ≥ 3	34	113	7.943	3.005-20.992	<0.0001
Application of radiation and/or chemotherapy	36	58	2.134	0.625-7.293	>0.05
Postoperative complications	26	12	38.833	16.057-93.914	<0.0001

SBO=Small bowel obstruction.

Table 4 Multivariate regression analysis of preoperative and intraoperative risk factors for postoperative small bowel obstruction after colectomy for colorectal cancer

Risk factor	OR	95% CI	p
Number of previous surgery ≥ 2	0.915	0.214-3.907	0.9050
Operating time >3 h	1.0109	0.303-2.522	0.8029
Tumor-Node Metastasis ≥ 3	3.680	1.036-13.072	0.0439
Postoperative complications	30.683	10.183-92.455	<0.0001

Discussion

In our study, postoperative small bowel obstruction caused by adhesions after colectomy for colorectal cancer was determined in 13.7% of patients, and in similar studies, the percentage of postoperative adhesions after surgery colon tumors ranged from 5.5% (13) to 9.5% (14-17).

In our study, most patients (81.2%) with SMO after colectomy due to colorectal cancer were older than 60 years, as in Manilich's study (18). In the same study, gender was classified as a less significant risk factor for postoperative adhesions.

In our study, the proportion comparison also did not show gender as a risk factor for postoperative adhesions of the small intestine after colectomy for colorectal cancer (Table 1). The results of similar studies are very contradictory, perhaps because few studies have mentioned the role of gender in the development of complications associated with intra-abdominal adhesions.

Various factors, other than inflammatory responses, may play a role in early postoperative SBO. In our study, the highest correlation of risk factors and the occurrence of postoperative small bowel obstruction after colectomy for colorectal cancer was determined in relation to the TNM ≥ 3 (OR: 3.68), and postoperative complications (OR: 30.683) (Table 4). Those factors are considered to contribute to the increased incidence of SBO. Postoperative complications were determined as Grade II-Grade IIIb, using the Clavien-Dindo Classification of Surgi-

cal Complications. Early postoperative SBO reduces patient quality of life and also alters consecutive therapies. For instance, SBO leads to delay in introduction of chemotherapy in patients with advanced colorectal cancer. For patients with rectal cancer, which is considered to be a risk factor for postoperative SBO, attention must be paid to the choice of surgical procedure, taking operating time into account. Adhesions are the most common complication in abdominal surgery, and represent one of the greatest unsolved problems of contemporary medicine. Many surgeons are still not aware of this problem and its serious consequences (19).

Limitation of study

The limitations of this study are that it is a retrospective study, our sample does not include the group of patients treated with preventive measures for postoperative adhesions, and in our study there are no patients treated by laparoscopy-assisted colectomy. We could not measure the mean age or the corresponding dispersion measures because we did not take the exact age of the patients, we had already divided the patients into age groups.

Conclusion

Postoperative small bowel obstruction after colectomy for colorectal cancer is more likely to occur in patients with TNM ≥ 3 , and in patients who have postoperative complications.

What is already known on this subject

Small bowel obstruction is caused mainly by postoperative adhesions (more than 75% of all cases) and is a common postoperative morbidity of colectomy for colorectal cancer. It leads to markedly lower patient quality of life, longer hospital stays and increased hospitalization costs. SBO accounts for as many as 12% to 16% of surgical admissions and more than 300,000 operations annually in the United States. This represents more than 2.3 billion dollars in health care expenditures. Peritoneal trauma and inflammation always lead to the formation of acquired adhesions and they may also occur following surgery and exposure to infection or intestinal content, ischemia, irritation or foreign materials. Acute small bowel obstruction is still considered a relative contraindication for laparoscopy. Laparotomy remains the standard approach.

What this study adds

In the analyzed sample of 284 patients, small bowel obstruction after surgery for colorectal cancer was found in 39 patients. In our study, the highest correlation of risk factors and the occurrence of postoperative small bowel obstruction after colectomy for colorectal cancer was determined in relation to TNM ≥ 3 (OR-3.68), and postoperative complications (OR-30.68). TNM ≥ 3 increases the likelihood of the occurrence of SMO by 4, while postoperative complications increase the likelihood of the occurrence of SMO 31 times. We believe that the results of our study should be viewed as an overview of the current status and a good basis for future research in application of different methods to prevent postoperative adhesions and consequent obstruction of the small intestine.

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