

Early Postoperative Small Bowel Obstruction after Colorectal Surgery: Incidence and Exploratory Analysis of Potential Risk Factors

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ABSTRACT

Background: Early postoperative small bowel obstruction (EPSBO) is a common complication following colorectal surgery, which can significantly impact patient outcomes. This study aimed to investigate the incidence of EPSBO and identify potential risk factors among patients who underwent colorectal surgery.

Methods: A descriptive study was conducted on a cohort of 100 patients who underwent colorectal surgery at a tertiary center at SKIMS, Srinagar, Jammu & Kashmir, India. Descriptive, bivariate, and predictive screening analyses were performed to examine patient characteristics, assess association between different relevant variables and EPSBO, and identify significant predictors, respectively.

Results: Our study included a total of 100 patients, with a mean age of 50.39 years. Postsurgery, 11% of the individuals in the cohort developed EPSBO. Early postoperative small bowel obstruction developed around 4.30 days after surgery, and radiographic data revealed dilated gut loops in 72.70% of EPSBO cases. Bivariate analysis revealed significant association between EPSBO and variables such as previously operated, medical comorbidities, smoking status, anemia, neoadjuvant chemoradiotherapy (NACRT), bowel preparation, operative procedure, surgery duration, and type of anastomosis ($p < 0.05$). History of previous bowel habits, previously operated, perioperative bowel preparation, and blood transfusion were identified as the most influential predictors of EPSBO in the predictive screening study.

Conclusion: This study provides insights into the incidence of EPSBO and its potential risk factors for postcolorectal surgery among patients. The findings emphasize the need to take the patient's history of past bowel habits and other factors into account when determining the risk of EPSBO. Future studies should go deeper into these correlations and consider treatments to reduce the occurrence of EPSBO in this patient population.

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INTRODUCTION

Colorectal surgery is a commonly performed procedure to treat a variety of benign and malignant conditions including colorectal cancer, diverticular disease, and inflammatory bowel disease. While advances in surgical procedures and perioperative care have improved results dramatically, postoperative complications remain a concern. Postoperative small bowel obstruction (SBO) is one such problem. Postoperative bowel obstruction, whether mechanical or functional, is a common and serious complication that not only can result in longer hospital stays, additional surgical interventions, and increased medical costs, but can also increase mortality and morbidity in patients undergoing abdominal surgery.^{1,2} With an incidence of more than 9%,³ SBO can be classified into Early SBO and Late SBO depending on the date of onset of SBO from the day of surgery. Early SBO occurs within the first 30 days following surgery (EPSBO), whereas late SBO occurs after the initial 30-day postoperative window.

The prevalence of EPSBO following colorectal surgery is a complex phenomenon with multiple potential contributing factors. Identifying the prevalence and risk factors for EPSBO is critical for improving patient outcomes, establishing preventive interventions, and adjusting postoperative treatment. Previous research has attempted to address this issue, but the evidence is sparse, and the risk variables discovered vary across groups and surgical methods.

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This descriptive observational study which was carried out at the Department of General Surgery, Colorectal Division, SKIMS, Srinagar, Jammu & Kashmir, India from July 2019 to July 2020 encompassing a diverse cohort of patients who underwent elective or emergency colorectal surgery. We intended to look at the incidence of EPSBO and identify relevant risk factors, particularly at our tertiary center. Our primary goals were to estimate the incidence of EPSBO during the first 30 days after surgery and to investigate the association between various demographic, clinical, and surgical characteristics and the occurrence of EPSBO.

METHODS

An extensive review of medical records was performed to identify patients who had EPSBO after colorectal surgery during the research period. Within the first 30 postoperative days, EPSBO was defined as clinical signs and radiographic evidence of small intestinal obstruction. The current investigation was conducted on 100 patients over a 1-year period.

Inclusion Criteria

- Benign colorectal diseases requiring abdominal surgeries.
- Malignant colorectal cancer patients.
- Emergency colorectal surgeries.
- Age above 18 years.

Exclusion Criteria

- Perineal colorectal procedures.
- Redo colorectal procedures.

Initially, we planned to use multivariate analysis to identify independent risk factors for EPSBO. However, during the initial analysis stage, we stumbled into issues such as multicollinearity and convergence challenges, which prevented us from moving further with multivariate analysis. As a result, our investigation was limited to bivariate analysis, which focused on the relationships between individual variables and the frequency of EPSBO.

All of the admitted patients who underwent colorectal surgeries in the Colorectal Division of Department of General & Minimal Invasive Surgery SKIMS, and patients satisfying all the inclusion criteria were selected for the final analysis. Patients who reported clinical features such as abdominal distention, fever, abdominal pain, vomiting, or inability to pass flatus, during the first 30 days were found to be sent for blood work which was further correlated with radiological investigations such as X-ray/computed tomography (CT) and ultrasonography (USG) to rule out any obstruction. Records about the demographic characteristics of patients such as age, sex, residence, and body mass index (BMI) were collected. Patient history which included previously operated, relevant drug history, medical comorbidities, smoking, and previous bowel habits was collected. In the investigations section, we collected data about the hemoglobin (Hb) level of patients and data about NACRT. From the intraoperative period section, we collected data about blood transfusion, method of surgery, type of surgery, duration of surgery, blood loss during surgery, and method of anastomosis. From the postoperative period section, we collected data about the day of obstruction, postoperative complaints presented, CT/X-ray findings, paralytic ileus, and use of stoma catheter.

Bivariate analysis was carried out to investigate the association between several independent variables and the occurrence of early postoperative small bowel obstruction (EPSBO). The normality of data distributions was evaluated, and nonnormally distributed data and normally distributed data were then compared using Mann-Whitney *U* tests and Student's *t*-tests, respectively. Chi-square tests or Fisher's exact tests, as appropriate, were utilized to evaluate the proportional differences between EPSBO and non-EPSBO patients for categorical variables.

In addition to the bivariate analysis, a predictor screening analysis was conducted to identify potential risk factors for EPSBO. This predictive screening step was included to gain knowledge about variables that might later be utilized in multivariate analysis and predictive modeling.

Table 1: General characteristics of patients undergoing colorectal surgery

Variable	Value
Age (years), (mean \pm SD)	50.39 \pm 12.02
Gender (male:female)	76:24
Residence (urban:rural)	60:40
BMI (kg/m ²) (median, IQR)	24.64 (28.33–21.75)
Hb (median, IQR)	11.90 (13.50–9.83)
Previously operated, <i>n</i> (%)	14 (14)
Drug history	0 (0)
Medical comorbidities, <i>n</i> (%)	19 (19)
Dietary lifestyle, vegetarian:nonvegetarian	2:98
Smoker, <i>n</i> (%)	12 (12)
Alcoholic, <i>n</i> (%)	1 (1)
History of previous bowel habits, <i>n</i> (%)	60 (60)
Bowel preparation, <i>n</i> (%)	64 (64)
NACRT, <i>n</i> (%)	11 (11)
Blood transfusion given, <i>n</i> (%)	15 (15)

All statistical analyses were performed using a Statistical Package for the Social Sciences (SPSS), version 26.0, software package, and JMP 17 at a significance level of $p < 0.05$, indicating statistical significance.

RESULTS

Patient Demographics

A total of 100 patients who underwent colorectal surgery at our tertiary center between 20 July 2019 and 19 July 2020 were included in the study. The average age of the patients was 50.39 years, with a standard deviation (SD) of 12.02. Among the participants, 76% were male and 24% were female. From the medical records it was found that 60% lived in urban areas, while 40% resided in rural areas. The median BMI was 24.64 kg/m², with an interquartile (IQR) range of 28.33–21.75. The median Hg level was 11.90 gm/dL, with an IQR range of 13.50–9.83 (Table 1).

Intraoperative Details and Incidence of Early Postoperative Small Bowel Obstruction

Out of the total cohort of 100 patients, we found that the open and laparoscopic (LAP) method was used in 25 and 75% of cases, respectively. Elective vs emergency among 75% vs 25% of cases, Distribution of surgery time was less than 1 hour for 74% of cases and greater than 1 hour among 26% of cases. Less than 300-mL of blood loss during the study was recorded in the majority of cases (93%). Most of the cases were stapler stitched (87%) (Table 2). About 11% developed EPSBO following colorectal surgery. The average time of onset for EPSBO was approximately 4.30 days postoperatively. Radiographic findings in EPSBO patients reflected dilated gut loops in 72.70% of cases, the absence of gas in the distal gut in 9.10%, and multiple air-fluid levels in 18.20% (Table 3).

Association with Early Postoperative Small Bowel Obstruction

We observed from the bivariate analysis that several variables were significantly associated with EPSBO. These variables included age, BMI, anemia, history of previous bowel habits, previous surgeries,

Table 2: Intraoperative details of patients undergoing colorectal surgery

Variable	n (%)
Operative method	
Open	25 (25)
Laparoscopic	75 (75)
Type of surgery, n (%)	
Elective	75 (75)
Emergency	25 (25)
Duration of surgery	
<1 hour	74 (74)
1–2 hours	19 (19)
2–4 hours	7 (7)
Blood loss during surgery	
<300 mL	93 (93)
≥300 mL	7 (7)
Method of anastomosis	
Hand stitched	13 (13)
Stapler	87 (87)

Table 3: Postoperative details of patients undergoing colorectal surgery

Variable	n (%)
Postoperative complaints (vomiting/nausea/pain/abdominal distention) presented, n (%)	11 (11)
Medical ileus, n (%)	13 (13)
Stoma catheter used, n (%)	3 (3)
EPSBO, n (%)	11 (11)
Day of obstruction, (mean ± SD)	4.30 ± 0.90
X-ray findings of EPSBO cases	
Dilated gut loops, n (%)	8 (72.70)
Absent gas in distil gut, n (%)	1 (9.10)
Multiple air fluid levels, n (%)	2 (18.20)

Table 4: Frequency of EPSBO by risk factors

Variable	EPSBO n (%)	No EPSBO n (%)	p-value
Age (years), (mean ± SD)	51.64 ± 7.5	50.24 ± 12.5	0.72
Gender (male)	10 (90.90)	66 (74.15)	0.22
BMI (kg/m ²), median (IQR)	32.70 (35.90–30.70)	23.60 (26.93–21.5)	0.001
Anemia	10 (90.90)	41 (46.06)	0.005
Previously operated	10 (90.90)	4 (4.50)	<0.0001
Medical comorbidities	10 (90.90)	11 (12.36)	<0.0001
Smoker	10 (90.90)	7 (7.90)	<0.0001
History of previous bowel habits	11 (100)	4 (4.50)	<0.0001
NACRT	11 (100)	4 (4.50)	<0.0001
Bowel preparation	7 (63.63)	9 (10.11)	<0.0001
Blood transfusion given	10 (90.90)	5 (5.62)	<0.0001
Operative method			
Open	11 (100)	20 (22.47)	<0.0001
Laparoscopic	0 (0)	69 (77.53)	
Elective surgery	11 (100)	82 (92.13)	0.337
Surgery time (>1 hour)	11 (100)	15 (16.85)	<0.0001
Blood loss during surgery, (≥300 mL)	2 (18.20)	5 (5.62)	0.125
Method of anastomosis, (hand stitched)	7 (63.63)	6 (6.74)	<0.0001

(Contd...)

medical comorbidities, smoking status, bowel preparation, operative method, surgery duration, blood loss during surgery, and method of anastomosis ($p < 0.05$) (Table 4).

Predictor Screening Analysis

A predictor screening analysis was performed to chalk out the most contributing variables responsible for the development of EPSBO. From the analysis, it was discovered that the history of previous bowel habits emerged as the strongest predictor, followed by the history of previous abdominal surgeries, perioperative bowel preparation, and blood transfusion. Other variables, such as smoking status, surgery duration, BMI, medical comorbidities, NACRT, method of anastomosis, and operative method, also showed some predictive value but to a lesser extent (Table 5).

Overall, these results suggest that EPSBO is a significant complication post colorectal surgery, showing 11% of patients being affected by it in our study. Several factors, including patients' history of previous bowel habits, previous surgeries, and perioperative bowel preparation, appear to influence the risk of developing EPSBO. These findings highlight the impertinence of considering these variables while assessing the risk of EPSBO in patients undergoing colorectal surgery.

DISCUSSION

The purpose of the current study was to determine the incidence of EPSBO following colorectal surgery and to identify possible risk factors for this event. Our research offers insightful information about the incidence and potential risk factors for EPSBO in this particular patient population. Our study's observation of an 11% incidence of EPSBO highlights the clinical importance of this complication for individuals having colorectal surgery. Miller et al.,⁴ while examining the frequency of readmission and risk factors of strangulation in patients with early postoperative small obstructive bowel, recorded that 5.3% of the operated patients were readmitted with the diagnosis of intestinal obstruction. Shin and Hong⁵ in their

Table 4: (Contd...)

Variable	EPSBO n (%)	No EPSBO n (%)	p-value
Stoma catheter			
Inserted	3 (27.27)	0 (0)	<0.0001
Not inserted	8 (72.73)	89 (100)	

Table 5: Predictor screening to find the most influential potential risk factors

Predictor	Contribution	Portion	Rank
History of previous bowel habits	14.4012	0.3798	1
Previously operated	7.5450	0.1990	2
Perioperative bowel preparation	5.5904	0.1474	3
Blood transfusion	3.4660	0.0914	4
Smoker	2.3234	0.0613	5
Duration of surgery	1.8535	0.0489	6
BMI	1.3344	0.0352	7
Medical comorbidity	0.6456	0.0170	8
NACRT	0.4306	0.0114	9
Method anastomosis	0.1575	0.0042	10
Method of surgery	0.1155	0.0030	11
Anemia	0.0304	0.0008	12
Stoma catheter used	0.0217	0.0006	13

study recorded an 8.1% incidence of early postoperative intestinal obstruction.

The most commonly affected age group in our study was 40–49 years (45.5% cases), with mean age of patients being 51.64 ± 7.5. Similar observation was reported in the study conducted by Adhikari S et al.,⁶ with the most commonly affected age group being 41–50 years. Among the affected patients most of these were males (90.90%, 10:1), this male predominance was observed in other studies as well.^{7–10} We further in our study observed that the average time for the emergence of EPSBO was approximately 4.30 days postoperatively.

Several variables have significant relationships with EPSBO, according to the bivariate analysis of the data. This included BMI, anemia, NACRT, previous surgical history, medical comorbidities, smoking status, intestinal preparation, blood transfusion, surgical technique, length of surgery, and anastomosis method.

In our study, patients with EPSBO had BMI (kg/m²), median (IQR) values of 32.70 (35.90–30.70) vs 23.60 (26.93–21.5), showing that the majority of the affected individuals belonged to the obese class. Studies by Morimoto et al.¹¹ also produced similar findings. A comparable study reported that low hemoglobin level had no significant association with EPSBO ($p = 0.117$), in contrast to our study's finding that adjuvant chemotherapy/radiotherapy and low hemoglobin level have a significant association with EPSBO ($p = 0.005$). In a similar vein, we discovered that patients with a history of constipation were significantly more likely to develop EPSBO. Constipated bowel history was reported by every patient with EPSBO. For this component to be validated for EPSBO, additional research, particularly those concentrating on prior bowel habits, needs to be conducted. When looking at the patient's medical history, a significant association between having undergone abdominal surgery in the past and EPSBO was found ($p < 0.0001$). This outcome is consistent with research by Zheng et al.,¹² which discovered a significant association between EPSBO and a history of prior abdominal surgery.

In our investigation, we discovered a substantial association between medical comorbidity and postcolorectal surgery EPSBO development, similar to this Yang et al.¹³ discovered that medical comorbidities such as chronic obstructive pulmonary disease (COPD) and hypothyroidism were independent risk factors for the development of EPIO in their pilot study of constructing Nomogram to predict the chance of occurrence. According to Sheyn et al.,¹⁴ medical comorbidities such as dyspnea and hypertension were important risk factors for EPIO. Masoomi et al.¹⁵ discovered that diabetes and hypertension were not substantially connected with the emergence of EPIO, but that peripheral vascular disease and chronic lung disease were strongly associated with a higher risk of in-hospital bowel obstruction.

In our study, there was a significant association between smoking and obstruction ($p < 0.0001$), with more than 90% of smokers developing EPSBO. Our findings concur with those of Sheyn et al.,¹⁴ but they differ from those reported by Masoomi et al.,¹⁵ In our study, we found that only 7 individuals out of 16 who underwent some sort of bowel preparation approach developed EPSBO with ($p < 0.0001$), showing a significant association between no bowel preparation and EPSBO. Yang et al.,¹³ however, in their study, found that there is no association between bowel preparation and EPSBO. This could be because our sample size is smaller.

In our study, we found that blood transfusion ($p < 0.0001$) was significantly associated with EPIO development. In our study, 90.90% of the patients who developed EPIO had received a blood transfusion. Our results are in conformity with the works of Kim et al.,¹⁶ who found that blood transfusion was one of the independent risk factors associated with EPIO development. Our results are also similar to the works of Sheyn et al.,¹⁴ who in their regression analysis found perioperative blood transfusion as one of the most significant risk factors.

Further in intraoperative assessment we found that the method of surgery in open vs LAP ($p < 0.0001$), duration of surgery in completing within 1 hour, above 1 hour ($p < 0.0001$), and method of

anastomosis in hand stitched vs stapled ($p < 0.0001$) all displayed a significant association with the development of EPIO. Similar to our results, Morimoto et al.,¹¹ and Zheng et al.¹² have reported that 65 patients operated *via* open method and with long duration of surgery were significant risk factors for the development of EPIO. Similarly, Masoomi et al.,¹⁵ reported that open colectomy cases are more likely to develop EPSBO than laparoscopic-assisted colectomy (LAC), recommending LAC as an effective surgical procedure for reducing the incidence of EPSBO after colectomy for colorectal surgery.

These results suggest that these variables may increase the risk of developing EPSBO. However, it is crucial to remember that the limitations of bivariate analysis and the absence of multivariate analysis in our study call for care when interpreting these association. Although the lack of sufficient data prevented us from performing multivariate analysis, we nonetheless carried out a predictor screening study to determine the most significant predictors of EPSBO. It showed that the history of prior surgeries, preoperative bowel preparation, blood transfusion, and the history of past bowel habits are the best markers for EPSBO. These results imply that while determining the risk of EPSBO in patients following colorectal procedures, healthcare providers should take these parameters into account. However, additional study is required to validate these results and better understand their underlying mechanisms.

CONCLUSION

Our research provides some important insights into the incidence of EPSBO and possible risk factors in individuals undergoing colorectal surgery. These results highlight the importance of conducting a thorough assessment and management of individuals who have a history of irregular bowel movements, history of prior operations, or perioperative bowel preparation. Future studies are necessary to elucidate the predictors and improve the prevention and management techniques for EPSBO in this patient population. These studies should use larger sample sizes and multivariate analysis to identify the independent risk factors.

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