의학석사 학위논문

Early Postoperative Small Bowel Obstruction is an Independent Risk Factor for Subsequent Adhesive Small Bowel Obstruction in Patients Undergoing Colectomy

대장절제술을 받은 환자에서 유착성 소장폐쇄에 영향을 미치는 술후 조기 소장폐쇄의 위험도 분석

2012년 12월

서울대학교 대학원

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December 2012

Seoul National University Graduate School

Department of Clinical Medical Sciences

Soo Young Lee

Early Postoperative Small Bowel Obstruction is an Independent Risk Factor for Subsequent Adhesive Small Bowel Obstruction in Patients Undergoing Colectomy

지도 교수 허 승 철

이 논문을 의학석사 학위논문으로 제출함
2012년 10월

서울대학교 대학원
임상의과학과
이 수 영

이수영의 의학석사 학위논문을 인준함
2013년 01월

위 원 장 _____ (인)
부위원장 _____ (인)
위 원 _____ (인)

학위논문 원문제공 서비스에 대한 동의서

본인의 학위논문에 대하여 서울대학교가 아래와 같이 학위논문 제공하는 것에 동의합니다.

1. 동의사항

① 본인의 논문을 보존이나 인터넷 등을 통한 온라인 서비스 목적으로 복제할 경우 저작물의 내용을 변경하지 않는 범위 내에서의 복제를 허용합니다.

② 본인의 논문을 디지털화하여 인터넷 등 정보통신망을 통한 논문의 일부 또는 전부의 복제.배포 및 전송 시 무료로 제공하는 것에 동의합니다.

2. 개인(저작자)의 의무

본 논문의 저작권을 타인에게 양도하거나 또는 출판을 허락하는 등 동의 내용을 변경하고자 할 때는 소속대학(원)에 공개의 유보 또는 해지를 즉시 통보하겠습니다.

3. 서울대학교의 의무

① 서울대학교는 본 논문을 외부에 제공할 경우 저작권 보호장치(DRM)를 사용하여야 합니다.

② 서울대학교는 본 논문에 대한 공개의 유보나 해지 신청 시 즉시 처리해야 합니다.

논문제목 : Early Postoperative Small Bowel Obstruction is an Independent Risk Factor for Subsequent Adhesive Small Bowel Obstruction in Patients Undergoing Colectomy

학위구분 : **석사 □ · 박사 □**

학 과 : 임상의과학과

학 번 : 2011-22005

연 락 처 :

저 작 자 : 이 수 영 (인)

제 출 일 : 2012 년 10 월 25 일

서울대학교총장 귀하

Abstract

Introduction: This study was carried out to investigate whether postoperative ileus (POI) or early postoperative small bowel obstruction (EPSBO) affects the development of adhesive small bowel obstruction (SBO) in patients who underwent colectomy.

Methods: A total of 1002 patients who consecutively underwent open colectomy by a single surgeon were prospectively enrolled. POI was defined as the absence of bowel function for more than 5 days or as the delay of the oral intake beyond postoperative 7 days. EPSBO was defined as clinical and radiologic findings of SBO between postoperative 7 to 30 days after resuming oral intake. Median follow up period was 51 months.

Results: Eighty five patients (8.5%) developed POI and 42 patients (4.2%) developed EPSBO, with seven of them experiencing both POI and EPSBO. During the follow-up period, seventy patients (7.0%) developed adhesive SBO, eleven (15.7%) of whom needed laparotomy. Likelihood of adhesive SBO in patients with EPSBO was 21.4% and without EPSBO was 6.4% ($p=0.0001$). But that in patients with POI was 10.6% and without POI was 6.7% ($p>0.05$). The cumulative risk of adhesive SBO was 8.3% at 5 years while that in patients with and without EPSBO was 26.5% and 7.5% each ($p<0.001$). Multivariate analysis showed IPAA (HR=3.988, $p=0.028$), colostomy (HR=2.254, $p=0.024$) and EPSBO (HR=4.077, $p=0.001$) as independent risk factors for adhesive SBO.

Conclusions: Development of adhesive SBO after coletomy is more frequent in patients with EPSBO as well as IPAA and colostomy but POI does not increase the risk of adhesive SBO.

Keywords: Adhesion, small bowel obstruction, ileus

Student Number: 2011-22005

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Introduction

Regardless of the type of surgery, patients who underwent laparotomy have a 90% risk of developing intraperitoneal adhesions.[1] Although majority of the patients remain asymptomatic, up to 20% of them have a risk of re-admission related to adhesions.[2,3] Because adhesive small bowel obstruction (SBO) impact not only on healthcare cost but also on quality of life, identifying those who are at high risk of adhesive SBO is important. Schnuriger et al.[4] reviewed papers and suggested that open colectomy, open gynecologic surgery and ileal pouch-anal anastomosis (IPAA) were risk factors for adhesive SBO after abdominal surgery (figure 1). Although operation related factors such as operation types, preoperative peritonitis or long operation time are major concerns of adhesive SBO, postoperative ileus (POI) and early postoperative small bowel obstruction (EPSBO) are also important issues because they are significant causes of extended hospitalization due to impaired bowel function following surgery.

We hypothesized that delayed bowel movement recovery or small bowel obstruction at early postoperative period might affect subsequent adhesive SBO. Therefore, we performed this study to identify whether POI or EPSBO would be a risk factor of subsequent adhesive SBO.

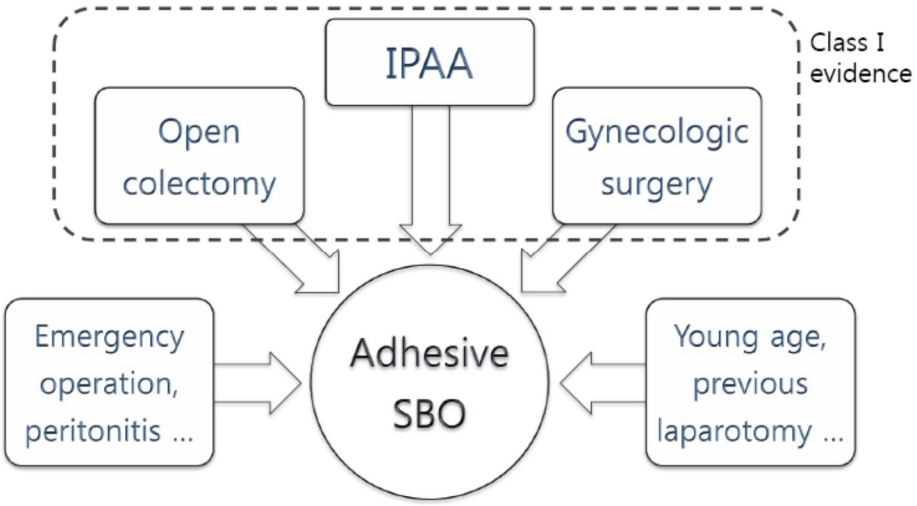

Figure 1. Known risk factors for adhesive SBO.

Materials and methods

1. Patients

Because colorectal surgery has proved to be the most important type of surgery that causes intra-abdominal adhesions[5] and because open colectomy has proved to be a risk factor of adhesive SBO[4], this study was carried out targeting patients of open colectomy. Therefore, we selected patients among the prospectively collected cohort of consecutive 1148 patients who underwent open colectomy by a single surgeon from 2005 to 2007 at Seoul National University Hospital. The exclusion criteria were as follows: 1) Patients with postoperative diagnosis of pseudomyxoma peritonei, peritoneal carcinomatosis, seeding ileus or colonic metastasis from other primary cancer 2) patients operated due to adhesive small bowel obstruction or radiation enteritis 3) patients with a history of previous colectomy 4) patients who died during admission 5) patients transferred to other hospital before oral intake 6) patients with follow-up period of less than 1 month. 7) patients of delayed oral intake due to prolonged tracheal intubation or anastomotic leakage. As such, a total of 1002 patients were enrolled in this study (figure 2). The median follow up period was 51 months (range 1-82).

Adhesive SBO was defined as SBO which developed after postoperative 30 days due to intraperitoneal adhesion and which required admission. So, cases of SBO which were finally proved to be obstructed by malignant seeding nodules were excluded. POI was defined as the absence of bowel function for more than 5 days[6,7] based on a time of bowel recovery.[8] Delay of the oral intake for seven or more days postoperatively due to abdominal distension, nausea and vomiting was also classified as POI. EPSBO was defined as SBO diagnosed by clinical symptoms and signs as well as radiologic findings between postoperative 7 to 30 days after resuming oral intake.[9] When symptoms such as abdominal distension or nausea arise in early postoperative period, it is very difficult to distinguish between POI and EPSBO. Because majority of patients recovered without definite diagnosis, the actual cause of obstructive symptom was uncertain. Therefore, we defined postoperative 7th day as a cut-off dividing POI

and EPSBO.[10]

Clinicopathological factors were collected and analyzed (table 3-5) as well, in order to eliminate the possibilities of confounders between POI or EPSBO and adhesive SBO. Operation history included major laparotomy except appendectomy or cesarean section. Obstruction and perforation was defined on the basis of preoperative colonoscopy and radiological findings as well as operative findings. Chronic steroid use was defined as the use of steroid medication on a daily basis for at least 30 days at the time of admission. Operation types were classified as right (ileocecectomy, right hemicolectomy, transverse colectomy), left (left hemicolectomy, anterior resection, Miles' operation, Hartmann's operation) or both (subtotal colectomy, total colectomy). Preoperative albumin level was the latest value before the operation. Postoperative laboratory findings were the value on the second postoperative day. Postoperative opioid use was calculated in morphine equivalents according to a conversion rates proposed by Nissen et al.[10] (table 1) and divided by the patient's body weight.

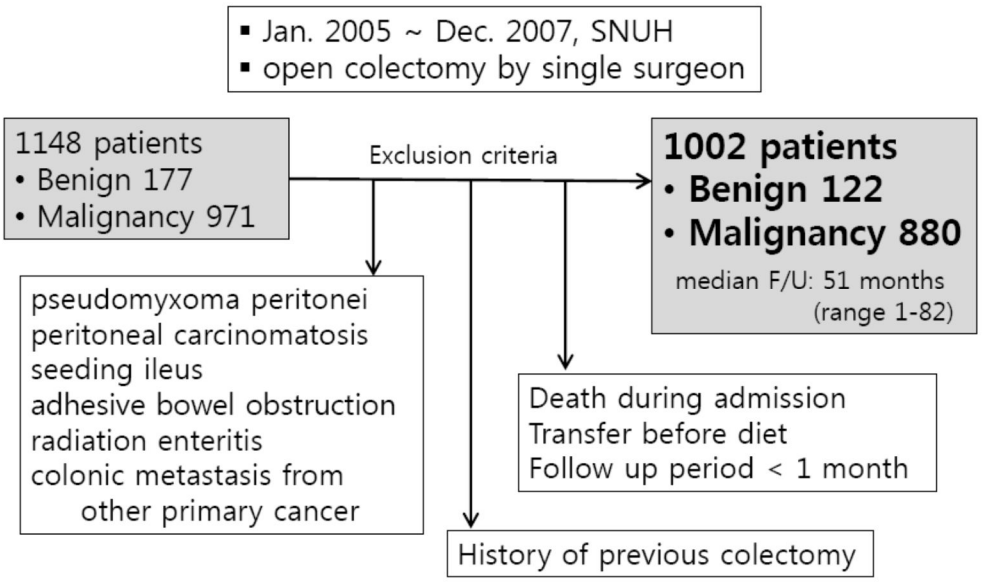

Figure 2. Diagram showing the selection of patients.

Table 1. Opioid conversion table

Drug	Equivalent dose (mg) compared to morphine 10mg IV	Dose×conversion factor
Tramadol (oral)	150	×0.067
Pethidine (IV)	75	×0.133
Nalbuphine (IV)	10	×1
Fentanyl (IV)	0.1	×100
Morphine (IV)	10	×1
Morphine (oral)	3.3	×3

2. Operation

All colectomies were performed by one experienced colorectal surgeon by open method. Anastomosis was made by either hand-sewing method or double-stapling technique for rectal anastomosis. One or two Jackson-Pratt drain was inserted during operation and removed within 5 days after surgery if anastomotic leakage was not definite. Regular postoperative care was as follows; Regardless of the recovery of bowel function, oral intake was started within postoperative 3 days unless obstructive symptoms such as vomiting occurred. An opioid-based intravenous patient-controlled analgesia was used for pain control. The patients were discharged within 7 days if there was no complication requiring admission.

3. Statistical analysis

Clinical and laboratory factors were assessed for the likelihood of POI and EPSBO by using simple logistic regression model. Variables with $p<0.05$ were considered statistically significant and used for multivariate logistic analysis. With regard to EPSBO, p value less than 0.1 was used for the entry criterion for multivariate analysis. For adhesive SBO simple and multiple Cox regression models were used. Kaplan-Meier survival analysis was also used. SPSS ver. 19.0 was used for statistical analyses.

Results

1. Patient characteristics

This study consisted of 1002 patients (median age 61 years, 598 male), 87.8% of whom underwent colectomy because of malignancy. Of the carcinoma of colon, stage III was the most common in 40.8%. Other malignancies such as malignant lymphoma or malignant melanoma comprised about 1.7% of all patients. The median operation time was 95 minutes (range 35-500). The most common operations performed were anterior resection (53.8%) and right hemicolectomy (23.6%). Patient characteristics were summarized in table 2.

Table 2. Patient characteristics

Characteristics	Values
Age (years), median (range)	61 (19-91)
Sex, no (%)	
Male	598 (59.7%)
Female	404 (40.3%)
Disease entity, no (%)	
Benign	122 (12.2%)
Malignancy	880 (87.8%)
Adenocarcinoma of colon/rectum	863 (86.1%)
TNM stage, no (%, of adenocarcinoma)	
0	12 (1.4%)
I	137 (15.9%)
II	270 (31.3%)
III	352 (40.8%)
IV	92 (10.7%)
Other malignancy	17 (1.7%)
Operation time (min), median (range)	95 (35-500)
Operation type, no (%)	
Ileocecectomy	32 (3.2%)
Right hemicolectomy	236 (23.6%)
Transverse colectomy	14 (1.4%)
Left hemicolectomy	30 (3.0%)
Anterior resection	539 (53.8%)
Miles' operation	34 (3.4%)
Hartmann's operation	47 (4.7%)
Subtotal/total colectomy	70 (7.0%)
Total proctocolectomy with ileal pouch anal anastomosis	28 (2.8%)

2. The occurrence of POI, EPSBO and adhesive SBO

Eighty five patients experienced POI (8.5%) and 42 patients had EPSBO (4.2%). Of them, seven patients developed both POI and EPSBO. On the long term follow up, adhesive SBO occurred in 70 patients (7.0%). Patients who had suffered from POI or EPSBO developed into adhesive SBO (10.6% and 21.4%, respectively) more than the others did (6.2%). However, while the adhesive SBO in patients with POI (10.6%) was not significantly higher than that in patients without POI (6.7%, 61/917, $p>0.05$), the difference in rates of adhesive SBO in patients with EPSBO (21.4%) and without EPSBO (6.4%, 61/960) was significant ($p=0.0001$, χ^2 test). Eleven out of 70 patients (15.7%) who had adhesive SBO required operation (figure 3). Three of the 9 patients with EPSBO (33.3%) needed operation while eight of the 61 patients without EPSBO (13.1%) underwent operation ($p=0.136$). The overall cumulative risk of adhesive SBO was 4.1% at 1year, 6.9% at 3 years and 8.3% at 5 years (figure 4).

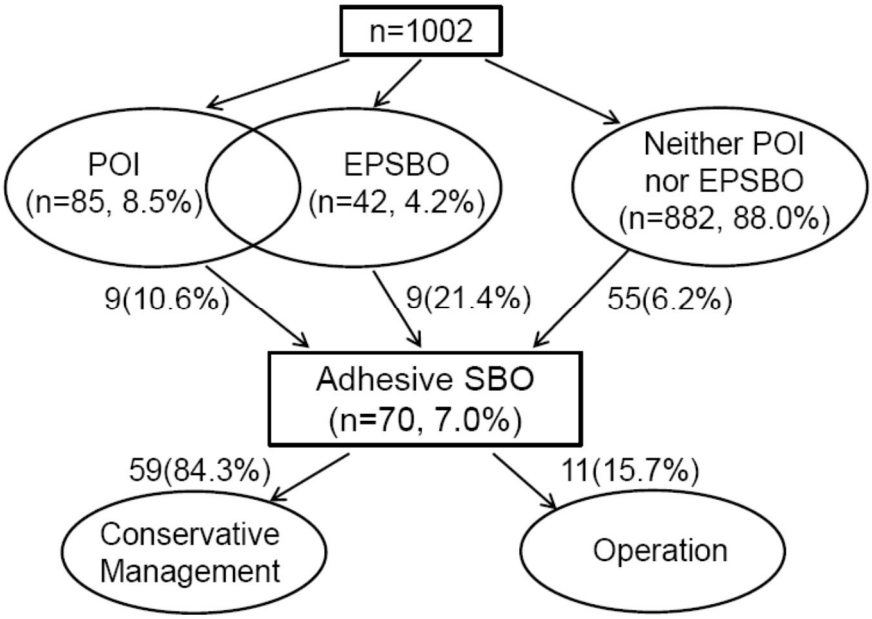

Figure 3. Diagram showing the development of POI, EPSBO and adhesive SBO.

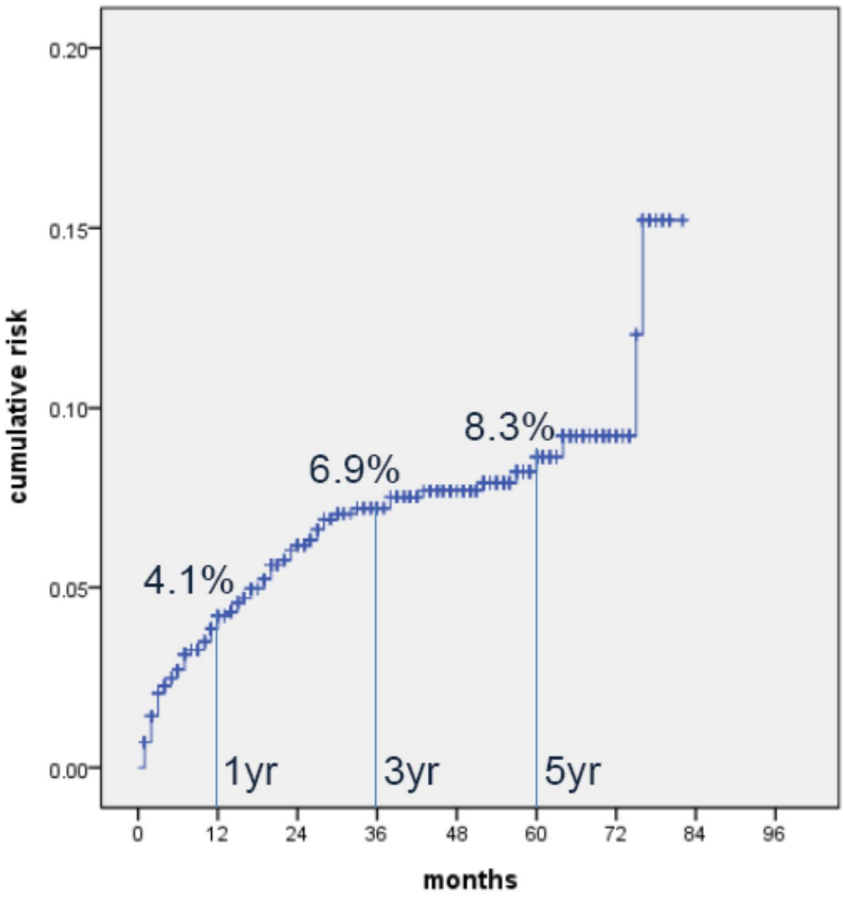

Figure 4. Cumulative risk of adhesive SBO. 4.1% at 1 year, 6.9% at 3 years and 8.3% at 5 years.

3. Risk factors for postoperative ileus (POI)

Preoperative bowel perforation, total or subtotal colectomy, IPAA operation, long operation time (>120min), large amount of blood loss (>100mL), stoma formation and low preoperative serum albumin are the risk factors of POI (table 3). But on a multivariate analysis, total or subtotal colectomy and ileostomy formation were independent risk factors for POI. On the contrary, IPAA operation is a protective factor for POI (HR 0.116, p=0.007)

Table 3. Risk factors for postoperative ileus

Variable		No. of patients	Univariate analysis		Multivariate analysis	
			HR (95% CI)	p-value	HR (95% CI)	p-value
Age (yr)	>70	22/194 (11.3%)	1.511 (0.904-2.523)	0.115		
	≤70	63/807 (7.8%)				
Sex	M	59/598 (9.9%)	1.591 (0.985-2.571)	0.058		
	F	26/404 (6.4%)				
BMI (kg/m^2)	≤25	67/753 (8.9%)	1.310 (0.754-2.277)	0.339		
	>25	17/245 (6.9%)				
ASA	3,4	7/88 (8.0%)	1.007 (0.448-2.264)	0.987		
	1,2	69/873 (7.9%)				
Operation history	Yes	10/133 (7.5%)	0.861 (0.443-1.710)	0.669		
	No	75/869 (8.6%)				
Obstruction	Yes	21/172 (12.2%)	1.665 (0.987-2.808)	0.056		
	No	64/830 (7.7%)				
Perforation	Yes	9/52 (17.3%)	2.407 (1.130-5.125)	0.023	1.060 (0.376-2.986)	0.912
	No	76/950 (8.0%)				
Chronic steroid use	Yes	4/25 (16.0%)	2.107 (0.706-6.287)	0.181		
	No	81/977 (8.3%)				
Disease entity	Benign	13/122 (10.7%)	1.338 (0.717-2.497)	0.360		
	Malignancy	72/880 (8.2%)				
Operation type	Both	21/70 (30.0%)	6.286 (3.123-12.651)	<0.001	4.166 (1.619-10.722)	0.003
	Left	46/650 (7.1%)	1.117 (0.636-1.963)	0.700	0.865 (0.433-1.726)	0.680
	Right	18/282 (6.4%)				
IPAA	Yes	6/28 (21.4%)	3.090 (1.217-7.843)	0.018	0.116 (0.024-0.556)	0.007
	No	79/974 (8.1%)				
Operation time (min)	>120	42/307 (13.7%)	2.403 (1.535-3.763)	<0.001	1.612 (0.891-2.917)	0.115
	≤120	43/695 (6.2%)				
EBL (mL)	>100	44/371 (11.9%)	2.241 (1.325-3.789)	0.003	1.431 (0.791-2.589)	0.235
	≤100	23/406 (5.7%)				
Stoma	Ileostomy	16/66 (24.2%)	4.463 (2.392-8.328)	<0.001	2.906 (1.218-6.936)	0.016
	Colostomy	12/83 (14.5%)	2.357 (1.208-4.598)	0.012	1.933 (0.831-4.496)	0.126
	None	57/852 (6.7%)				
Preoperative albumin (g/dL)	≤3.5	31/245 (12.7%)	1.886 (1.182-3.010)	0.008	1.467 (0.822-2.617)	0.194
	>3.5	54/757 (7.1%)				
Postoperative albumin (g/dL)	≤3.5	74/847 (8.7%)	1.245 (0.645-2.403)	0.515		
	>3.5	11/154 (7.1%)				
Postoperative Ca (mg/dL)	≤8.0	41/397 (10.3%)	1.455 (0.932-2.273)	0.099		
	>8.0	44/600 (7.3%)				
Postoperative K (mmol/L)	≤3.5	16/192 (8.3%)	0.972 (0.551-1.716)	0.923		
	>3.5	69/807 (8.6%)				
Postoperative opioid use (mg/kg)	>3	54/625 (8.6%)	1.056 (0.665-1.674)	0.818		
	≤3	31/377 (8.2%)				

HR: hazard ratio, CI: confidence interval, BMI: body mass index, ASA: American Society of Anesthesiologists score, EBL: estimated blood loss

4. Risk factors for early postoperative small bowel obstruction (EPSBO)

Regarding EPSBO, previous operation history was the only statistically significant factor which is associated with the occurrence of EPSBO (table 4). Long operation time (>120min) and the presence of colostomy were not significant but had tendency to be related with EPSBO. On multivariate analysis, only previous operation history was a significant risk factor for the occurrence of EPSBO (hazard ratio 2.142, p 0.043).

Table 4. Risk factors for early postoperative small bowel obstruction

Variable		No. of patients	Univariate analysis		Multivariate analysis	
			HR (95% CI)	p-value	HR (95% CI)	p-value
Age (yr)	≤70	37/807 (4.6%)	1.816 (0.704-4.684)	0.217		
	>70	5/194 (2.6%)				
Sex	M	25/598 (4.2%)	0.993 (0.529-1.864)	0.983		
	F	17/404 (4.2%)				
BMI (kg/m^2)	≤25	32/753 (4.2%)	1.043 (0.505-2.154)	0.909		
	>25	10/245 (4.1%)				
ASA	3,4	4/88 (4.5%)	1.046 (0.365-3.003)	0.933		
	1,2	38/873 (4.4%)				
Operation history	Yes	10/133 (7.5%)	2.127 (1.020-4.434)	0.044	2.142 (1.023-4.489)	0.043
	No	32/869 (3.7%)				
Obstruction	Yes	9/172 (5.2%)	1.334 (0.626-2.840)	0.456		
	No	33/830 (4.0%)				
Perforation	Yes	3/52 (5.8%)	1.430 (0.427-4.791)	0.562		
	No	39/950 (4.1%)				
Chronic steroid use	Yes	0/25 (0.0%)	0.000	0.998		
	No	42/977 (4.3%)				
Disease entity	Benign	8/122 (6.6%)	1.746 (0.789-3.865)	0.169		
	Malignancy	34/880 (3.9%)				
Operation type	Both	2/70 (2.9%)	0.563 (0.125-2.537)	0.455		
	Left	26/650 (4.0%)	0.798 (0.410-1.551)	0.505		
	Right	14/282 (5.0%)				
IPAA	Yes	0/28 (0.0%)	0.000	0.998		
	No	42/974 (4.3%)				
Operation time	>120	18/307 (5.9%)	1.741 (0.931-3.258)	0.083	1.750 (0.896-3.418)	0.102
(min)	≤120	24/695 (3.5%)				
EBL (mL)	>100	14/371 (3.8%)	0.799 (0.395-1.617)	0.532		
	≤100	19/406 (4.7%)				
Stoma	Ileostomy	1/66 (1.5%)	0.370 (0.050-2.747)	0.331	0.288 (0.038-2.198)	0.230
	Colostomy	7/83 (8.4%)	2.216 (0.950-5.168)	0.066	1.779 (0.725-4.365)	0.208
	None	34/852 (4.0%)				
Preoperative	≤3.5	11/245 (4.5%)	1.101 (0.545-2.225)	0.789		
albumin (g/dL)	>3.5	31/757 (4.1%)				
Postoperative	≤3.5	33/847 (3.9%)	0.653 (0.306-1.394)	0.271		
albumin (g/dL)	>3.5	9/154 (5.8%)				
Postoperative	≤8.0	18/397 (4.5%)	1.140 (0.610-2.129)	0.681		
Ca (mg/dL)	>8.0	24/600 (4.0%)				
Postoperative	≤3.5	6/192 (3.1%)	1.447 (0.601-3.486)	0.410		
K (mmol/L)	>3.5	36/807 (4.5%)				
Postoperative opioid	>3	31/625 (5.0%)	1.736 (0.862-3.497)	0.122		
use (mg/kg)	≤3	11/377 (2.9%)				

HR: hazard ratio, CI: confidence interval, BMI: body mass index, ASA: American Society of Anesthesiologists score, EBL: estimated blood loss

5. Risk factors for adhesive small bowel obstruction (adhesive SBO)

When the same risk factors including POI and EPSBO were analyzed for the adhesive SBO, IPAA, the colostomy formation and EPSBO were associated with the occurrence of adhesive SBO (table 5). Multivariate analysis shows that all of these three factors were independent risk factors (IPAA; hazard ratio 3.988, p 0.028, colostomy; hazard ratio 2.254, p 0.024, EPSBO; hazard ratio 4.077, p 0.001) for the development of adhesive SBO. And three out of the seven (42.9%) patients who suffered both POI and EPSBO developed into adhesive SBO, which was significantly more frequent than in the others (HR=10.388, p=0.002). Cumulative risk of adhesive SBO in patients with and without EPSBO was 26.5% and 7.5% each ($p<0.001$) at 5 years (figure 5).

Table 5. Risk factors for adhesive small bowel obstruction

Variable		No. of patients	Univariate analysis		Multivariate analysis	
			HR (95% CI)	p-value	HR (95% CI)	p-value
Age (yr)	≤70	60/807 (7.4%)	1.478 (0.742-2.942)	0.266		
	>70	10/194 (5.2%)				
Sex	M	37/598 (6.2%)	0.741 (0.455-1.207)	0.229		
	F	33/404 (8.2%)				
BMI (kg/m^2)	≤25	56/753 (7.4%)	1.326 (0.724-2.426)	0.360		
	>25	14/245 (5.7%)				
ASA	3,4	4/88 (4.5%)	0.612 (0.217-1.724)	0.353		
	1,2	63/873 (7.2%)				
Operation history	Yes	11/133 (8.3%)	1.238 (0.633-2.422)	0.533		
	No	59/869 (6.8%)				
Obstruction	Yes	15/172 (8.7%)	1.346 (0.742-2.444)	0.328		
	No	55/830 (6.6%)				
Perforation	Yes	3/52 (5.8%)	0.807 (0.245-2.657)	0.724		
	No	67/950 (7.1%)				
Chronic steroid use	Yes	2/25 (8.0%)	1.162 (0.268-5.034)	0.841		
	No	68/977 (7.0%)				
Disease entity	Benign	11/122 (9.0%)	1.379 (0.703-2.704)	0.350		
	Malignancy	59/880 (6.7%)				
Operation type	Both	8/70 (11.4%)	2.011 (0.830-4.872)	0.122		
	Left	45/650 (6.9%)	1.159 (0.652-2.063)	0.615		
	Right	17/282 (6.0%)				
IPAA	Yes	6/28 (21.4%)	3.878 (1.518-9.903)	0.005	3.988 (1.158-13.736)	0.028
	No	64/974 (6.8%)				
Operation time	>120	27/307 (8.8%)	1.462 (0.886-2.414)	0.137		
(min)	≤120	43/695 (6.2%)				
EBL (mL)	>100	25/371 (6.7%)	0.906 (0.522-1.570)	0.724		
	≤100	30/406 (7.4%)				
Stoma	Ileostomy	8/66 (12.1%)	2.166 (0.982-4.781)	0.056	1.267 (0.439-3.656)	0.661
	Colostomy	11/83 (13.3%)	2.400 (1.198-4.807)	0.014	2.254 (1.110-4.557)	0.024
	None	51/852 (6.0%)				
Preoperative	≤3.5	17/245 (6.9%)	0.990 (0.562-1.745)	0.973		
albumin (g/dL)	>3.5	53/757 (7.0%)				
Postoperative	≤3.5	59/847 (7.0%)	0.973 (0.499-1.898)	0.937		
albumin (g/dL)	>3.5	11/154 (7.1%)				
Postoperative	≤8.0	30/397 (7.6%)	1.144 (0.700-1.871)	0.591		
Ca (mg/dL)	>8.0	40/600 (6.7%)				
Postoperative	≤3.5	18/192 (9.4%)	1.533 (0.874-2.690)	0.136		
K (mmol/L)	>3.5	51/807 (6.3%)				
Postoperative opioid	>3	44/625 (7.0%)	1.022 (0.618-1.690)	0.931		
use (mg/kg)	≤3	26/377 (6.9%)				
POI	Yes	9/85 (10.6%)	1.662 (0.794-3.476)	0.177		
	No	61/917 (6.7%)				

Table 5. Risk factors for adhesive small bowel obstruction (continued)

Variable		No. of patients	Univariate analysis		Multivariate analysis	
			HR (95% CI)	p-value	HR (95% CI)	p-value
EPSBO	Yes	9/42 (21.4%)	4.019 (1.840-8.780)	<0.001	4.077 (1.841-9.031)	0.001
	No	61/960 (6.4%)				

HR: hazard ratio, CI: confidence interval, BMI: body mass index, ASA: American Society of Anesthesiologists score, EBL: estimated blood loss, POI: postoperative ileus, EPSBO: early postoperative small bowel obstruction

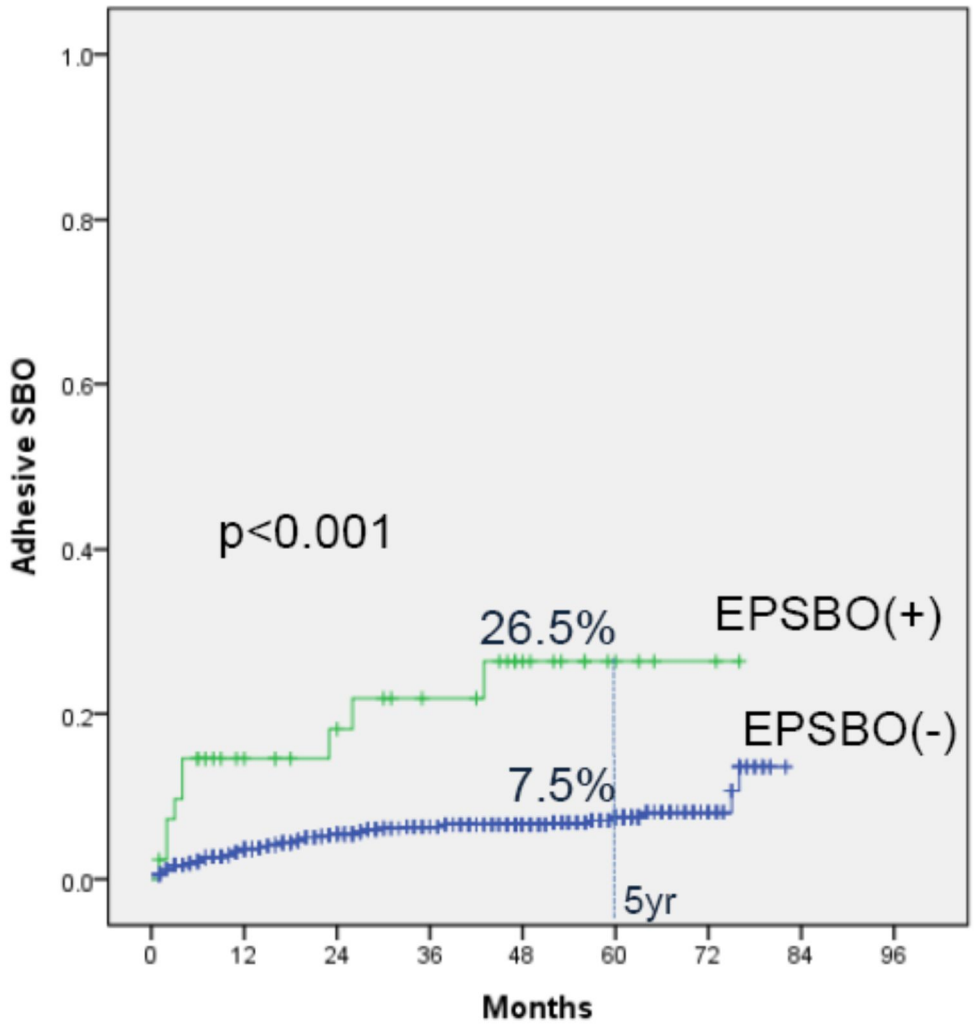

Figure 5. Development of adhesive SBO according to the occurrence of EPSBO. The patient group who suffered EPSBO showed much higher incidence of adhesive SBO.

Discussion

1. Postoperative ileus (POI)

POI is different from mechanical bowel obstruction arising from configurational disarrangement of bowels and is considered as prolonged inhibition of coordinated bowel activity.[11] It may be caused by several pathways such as enteric nervous systems, inflammatory response, neuropeptide and hormonal factors and so on.[12] Total or subtotal colectomy and ileostomy formation were the independent risk factor for POI whereas IPAA was a protective factor in this study. The subtotal or total colectomy and ileostomy formation after colectomy can be indicators of extensive small bowel manipulation among the factors we considered here. Snoek et al insisted by a recent mouse model study[13] that manipulation of small bowel triggered an intestinal barrier disturbance and mast cell dependent inflammatory response to the muscle of intestine which was a cause of POI. More extensive operation inevitably relates to more bowel manipulation that leads to POI, which was reflected in our data. Meanwhile, more proximal location of ileostomy after IPAA operation is thought to be the reason of protective effect of POI in IPAA. Short course from the stomach to ileostomy probably contribute to less POI.

2. Early postoperative small bowel obstruction (EPSBO)

EPSBO is different from adhesive SBO in many aspects. Although adhesion is the cause of the majority of EPSBO too, several other pathophysiology such as internal herniation, inflammation, intussusceptions and intramural intestinal hematoma can be causes of EPSBO.[14] Previous studies suggested clinicopathological factors such as ASA score, local remnant tumor, rectal cancer, open surgery and history of previous laparotomy could be the risk factors of EPSBO, [15-17] though there have been lack of consensus. Our result indicating that previous abdominal operation was an independent risk factor for EPSBO is not so different from the previous studies, considering the inclusion (only open surgery) and exclusion (SBO by peritoneal remnant tumor) criteria of our study.

3. Adhesive small bowel obstruction (adhesive SBO)

This study also presented that IPAA and colostomy, besides EPSBO, were independent risk factors for the development of subsequent adhesive SBO. It is in accordance with the previous statements that IPAA is one of the risk factors of adhesive SBO. Some previous studies said that diverting ileostomy was related to an increased risk of SBO in patients who underwent total proctocolectomy with IPAA.[18,19] They suggested small bowel rotation at around ileostomy site as a possible reason for this. Colostomy formation was another independent risk factor for subsequent adhesive SBO. The mechanism in which colostomy induces adhesive SBO is not clear, however it could be inferred that colonic axis towards abdominal wall is perpendicular to small bowel mesentery, which triggers adhesion as well as rotation and internal herniation.

It is universally accepted that the balance between fibrin deposition and fibrinolysis plays a key role in the development of adhesion. Surgery-induced peritoneal injury initiates inflammation with fibrinous exudates and fibrin formation.[20] Normal peritoneal healing occurs when fibrin is degraded completely. But incomplete fibrinolysis within 5 to 7 days of the peritoneal injury may induce organized fibroblasts which lead to adhesion formation.[4,21] The point is that inflammation due to operation is the initial process of the adhesion formation. EPSBO is related to peritoneal inflammation and to adhesion formation at the early postoperative period, which is presumable cause of the adhesive SBO. Although POI arises due to the inflammation of the intestine induced by bowel manipulation, it is not directly related to subsequent adhesive SBO according to our result, probably because inflammation associated with POI is within the bowel itself rather than the peritoneum. However seven patients who suffered not only POI but also EPSBO had much higher incidence of subsequent adhesive SBO than the others had. This means that inflammatory environment on both intestine and peritoneum caused by operation at early postoperative period is highly probable to develop subsequent adhesive SBO.

Meanwhile, adhesive SBO patients with history of EPSBO underwent laparotomy for the treatment of adhesive SBO more frequently than those without it although it was not statistically

significant (33.3% vs. 13.1%, p=0.136). This result may imply that operation should be considered as a preferable option in adhesive SBO following EPSBO.

4. Conclusion

In conclusion, POI is not associated with adhesive SBO, but EPSBO is an independent risk factor for subsequent adhesive SBO in patients undergoing colectomy. The patients who suffered from EPSBO should be followed more carefully whether they would develop into adhesive SBO.

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초록

서론: 본 연구는 대장절제술을 받은 환자에서 술후 장마비 (postoperative ileus), 술후 조기 소장폐쇄 (early postoperative small bowel obstruction) 및 다양한 환자, 수술 관련 요소들과 유착성 소장폐쇄 (adhesive small bowel obstruction)의 발생의 관련성에 대하여 조사하고자 하였다.

방법: 한 명의 외과의사에 의해 개복으로 대장절제술을 받은 1002명의 환자를 연구 대상으로 하였다. 술후 장마비는 수술 후 5일 이내에 장운동이 돌아오지 않거나 혹은 수술 후 7일 이내에 장폐쇄 증상으로 식이를 중단하게 된 경우로 정의하였다. 술후 조기 소장폐쇄는 소장 폐쇄의 임상적, 영상학적 소견이 수술 후 7일에서 30일 사이에 나타나는 경우로 정의하였다. 추적관찰기간의 중간값은 51개월이었다 (범위: 1~82개월).

결과: 85명(8.5%)의 환자에서 술후 장마비가 발생하였으며 42명(4.2%)의 환자에서 술후 조기 소장폐쇄가 나타났다. 추적관찰기간동안 70명(7.0%)의 환자에서 유착성 소장폐쇄가 발생하였는데 그 중 11명(15.7%)의 환자에서 개복수술을 필요로 하였다. 유착성 소장폐쇄의 누적위험도는 1년에 4.1%, 3년에 6.9%, 5년에 8.3%였다. 단변량분석 결과 유착성 소장폐쇄는 회장낭항문문합술, 대장루 및 술후 조기 소장폐쇄와 관련이 있는 것으로 나타났다 (각각 $p=0.005$, $p=0.014$ 및 $p<0.001$). 다변량분석 결과 회장낭항문문합술 (위험도=3.988, $p=0.028$), 대장루 (위험도=2.254, $p=0.024$), 술후 조기 소장폐쇄 (위험도=4.077, $p=0.001$) 각각이 유착성 소장폐쇄의 발생에 독립적인 위험인자가 되는 것으로 나타났다. 술후 장마비는 유착성 소장폐쇄와는 관련이 없었다.

결론: 술후 장마비는 유착성 소장폐쇄와 관련이 없는 반면, 술후 조기 소장폐쇄는 유착성 소장폐쇄의 발생에 독립적인 위험인자가 된다.

주요어: 유착, 소장폐쇄, 장마비

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