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Analysis of Risk Factors for the Development of Incisional and Parastomal Hernias in Patients after Colorectal Surgery

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Purpose: The purpose of this study was to evaluate the overall rate and risk factors for the development of an incisional hernia and a parastomal hernia after colorectal surgery.

Methods: The study cohort consisted of 795 consecutive patients who underwent open colorectal surgery between 2005 and 2007 by a single surgeon. A retrospective analysis of prospectively collected data was performed.

Results: The overall incidence of incisional hernias was 2% (14/690). This study revealed that the cumulative incidences of incisional hernia were 1% at 12 months and 3% after 36 months. Eighty-six percent of all incisional hernias developed within 3 years after a colectomy. The overall rate of parastomal hernias in patients with a stoma was 6.7% (7/105). The incidence of parastomal hernias was significantly higher in the colostomy group than in the ileostomy group (11.9% vs. 0%; P = 0.007). Obesity, abdominal aortic aneurysm, American Society of Anesthesiologists score, serum albumin level, emergency surgery and postoperative ileus did not influence the incidence of incisional or parastomal hernias. However, the multivariate analysis revealed that female gender and wound infection were significant risk factors for the development of incisional hernias female: P = 0.009, wound infection: P = 0.041). There were no significant factors related to the development of parastomal hernias.

Conclusion: Our results indicate that most incisional hernias develop within 3 years after a colectomy. Female gender and wound infection were risk factors for the development of an incisional hernia after colorectal surgery. In contrast, no significant factors were found to be associated with the development of a parastomal hernia.

Keywords: *Ventral hernia; Surgical stomas; Ileostomies; Colostomies*

INTRODUCTION

Incisional hernias are known to account for 2 to 20% of ventral hernias after abdominal surgeries [1-4]. Moreover, according to a study on hernias, the incidence of incarceration is 6 to 15% in patients with incisional hernias [5, 6]. When an incarcerated small bowel is not immediately treated, strangulation may occur in 2% of patients with hernias [5]. This may lead to serious complications such as intestinal perforation and panperitonitis. Thus, active surgical treatment is critical for patients with hernias.

Unlike general operations on abdominal organs, organ resection and stoma (colostomy and ileostomy) construction are concurrently performed in most cases during colorectal operations. Therefore, incisional hernias, as well as parastomal hernias, may also be associated with ventral hernias. Although, the incidence of parastomal hernias increases over time, such hernias mostly occur within two years after stoma construction [7, 8]. Parastomal hernias have a postoperative incidence rate of up to 5 to 30%, higher than that of ordinary incisional hernias [9].

Although incisional and parastomal hernias are postoperative side effects inducing serious complications, few studies have been performed domestically on the incidence and the risk factors of those hernias during long-term follow-up periods after colorectal surgery. Thus, this study aimed to identify the incidence and the risk factors of abdominal hernias after colorectal surgery in Korea.

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METHODS

This study was a retrospective study with prospective data collection on patients who underwent colorectal surgery at Seoul National University Hospital from January 2005 to December 2007 in order to analyze patients with at least a five-year follow-up postoperatively. To prevent surgeon bias, we included only patients who received colorectal surgery via abdominal section from one experienced surgeon. Patients with a past surgical history were excluded from the study population, and subjects were only followed until the point of performing another surgery other than stoma take-down. The follow-up period lasted until June 2012, and all operations and the closure of the abdominal wound were conducted with the same procedure. The incision site was closed with a method of continuous running suture using 1-0 Vicryl (polyglycolic acid), and the muscle fascia was closed with the same suturing method using 1-0 polydioxanone (PDS). The closure was strengthened with a simple interrupted suture using 1-0 Vicryl acid (polyglycolic acid).

The study investigated the occurrence of hernias in patients who underwent stoma construction by classifying subjects according to sex, age, and follow-up period, as well as the dependences of the occurrence of abdominal hernias on the cancer diagnosis, the colorectal incision sites, and the presence and types of stoma. The study examined the following risk factors with respect to hernias: patient-related risk factors were age, sex, body mass index, abdominal aortic aneurysm, preoperative serum hemoglobin level, preoperative serum albumin level, American Society of Anesthesiologists (ASA) score, and the causes of surgery. Surgical risk factors were the degree of emergency, preoperative bowel obstruction, preoperative bowel perforation, operation time, estimated blood loss, the presence of postoperative stoma, postoperative infections, postoperative ileus (within 30 days postoperatively), and admission days. The hernia was examined by categorizing it as an incisional and a parastomal hernia. The study included cases where hernias were detected on physical examination and postoperative radiological examination during the follow-up period. The ASA scores of only 770 patients were recorded for data collection, and intraoperative bleeding volumes were recorded only in 613 patients.

A life table was used in the analysis of the cumulative survival rate. A t-test was used for univariate analysis and continuous variables, and a chi-square test was used for categorical variables. Multivariate analyses were conducted using a cox-regression analysis on variables with $P \leq 0.1$ in the univariate analysis. All statistical analyses were performed using the SPSS ver. 16.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

A total of 965 patients received surgery by one surgeon between January 2005 and December 2007. Among those, a total of 795 patients were included as the study population: 690 patients who did not undergo a colostomy take-down and 105 patients with stoma take-down. Subjects were 522 males and 273 females, with a mean age of 61 years old (range, 19 to 91; standard deviation [SD], ±12) and an average follow-up period of 39 months (range, 0 to 80; SD, ±23). Among all subjects, incisional hernias occurred in 17 patients: 14 patients without colostomy take-down and 3 patients who received a colostomy take-down. Moreover, 7 patients presented with a parastomal hernia. The distribution of incisional and parastomal hernias for the various types of surgeries is presented in Table 1. Sixteen patients with abdominal hernias underwent surgery. In addition, eight patients with conservative treatment had been followed up after a hernia was detected only on a computed tomography (CT) scan instead of a physical examination.

The incidence of incisional hernias was 2% (14/690) in cases without stoma construction. In contrast, the incidence of parastomal hernias was 6.7% (7/105) in cases with stoma construction. Surgery was performed for a parastomal hernia after an average period of 3.5 months for 4 out of the 7 patients who developed a parastomal hernia. On the other hand, surgery was not conducted on three patients because the hernia was detected only on a CT scan without any symptoms. Patients who underwent a colostomy take-down were classified into ileostomy and colostomy groups. In the ileostomy group, a total of 46 subjects did not develop a parastomal hernia. Among those, 32 patients received ileostomy closure after an average period of 8.5 ± 3.9 months. In addition, 14 patients received permanent ileostomy with an average follow-up period of 19.5 ± 17.7 months. Among the total of 59 patients in the colostomy group, 7 (11.9%) developed a parastomal hernia. A colostomy closure was performed on three of those 59 patients, with an average follow-up period of 8.6 ± 4.4 months. Fifty-six patients received a permanent colostomy and were followed for an average period of over 25.5 ± 21.4 months. All parastomal hernias occurred in cases involving a permanent colostomy. The incidence of parastomal hernias was significantly higher in the colostomy group than in the ileostomy group ($P = 0.007$) (Table 2).

Of the 14 patients without stoma construction who developed incisional hernias, 7.1% (8/14) developed those hernias during the first postoperative year, 78.6% (11/14) during the second post-

Table 1. Incidence of ventral hernias according to diagnosis and site of operation

Operation site	No hernia	Incisional hernia	Parastomal hernia	Total
Right colon	201 (98.0)	4 (2.0)	0 (0)	205
Left colon	33 (94.3)	2 (5.7)	0 (0)	35
Rectum	502 (96.5)	11 (2.1)	7 (1.4)	520
Others[a]	35 (100)	0 (0)	0 (0)	35

Values are presented as number (%).
[a]Total proctocolectomy, total colectomy, subtotal colectomy and debulking surgery with colon resection.

operative year, and 85.7% (12/14) during the third postoperative year. However, incisional hernias did not develop after four years. The cumulative incidences were 1%, 2%, and 3% during the first, second, and third years, respectively, and the cumulative incidence of 3% remained unchanged from the fourth year. Furthermore, of the 7 patients with stoma construction who developed parastomal hernias, 28.6% (2/7) developed those hernias during the first postoperative year, 57.1% (4/7) during the second postoperative year, and 71.4% (5/7) during the third postoperative year. Only one patient developed a parastomal hernia after 5 years. The cumulative incidences were 2%, 7%, and 9% during the first, second, and third year, respectively, and the incidence rate for parastomal hernias was shown to be relatively higher compared to that for incisional hernias. However, the cumulative incidence of parastomal hernias remained unchanged at 9% after the fourth year postoperatively.

Table 2. Incidence of parastomal hernias in the stoma formation group

	Ileostomy	Colostomy	P-value
Parastomal hernia			0.007
Yes	0 (0)	7 (11.9)	
No	46 (100)	52 (88.1)	

Table 3. Characteristics of the stoma group according to the development of an incisional hernia

Characteristic	No incisional hernia (n = 676)	Incisional hernia (n = 14)	P-value
Age (yr)	60.9 ± 11.8	65.6 ± 7.9	0.142
Gender			0.005
Male	446 (66.0)	4 (28.6)	
Female	230 (34.0)	10 (71.4)	
Obesity	23.0 ± 3.0	24.1 ± 3.8	0.215
AAA	4 (0.6)	0 (0)	0.921
ASA score			0.136
≤2	596 (88.2)	11 (78.6)	
>2	60 (11.8)	3 (21.4)	
Cancer	649 (96.0)	14 (100)	0.569
Emergency	8 (1.2)	0 (0)	0.848
Bowel obstruction	126 (18.6)	2 (14.3)	0.503
Bowel perforation	7 (1.0)	1 (7.1)	0.152
Preoperative anemia[a]	299 (44.2)	7 (50.0)	0.436
Preoperative hypoalbuminemia[b]	149 (22.0)	3 (21.4)	0.626
Operation site			0.367
Right colon	198 (29.3)	4 (28.6)	
Left colon	33 (4.9)	2 (14.3)	
Rectum	419 (62.0)	8 (57.1)	
Other[c]	26 (3.8)	0 (0)	
Operation time (min)	106.8 ± 58.1	143.9 ± 105.5	0.212
Estimated blood loss (mL)	212.1 ± 366.2	308.8 ± 304.6	0.459
Wound infection	43 (6.4)	3 (21.4)	0.060
Ileus	98 (14.5)	2 (14.3)	0.668
Hospital stay (day)	8.1 ± 5.0	13.2 ± 15.0	0.222

Values are presented as mean ± standard deviation or number (%).
AAA, abdominal aortic aneurysm; ASA score, American Society of Anesthesiologists score.
[a]Male, serum hemoglobin ≤ 13; and female, serum hemoglobin ≤ 12. [b]Serum albumin ≤ 3.0. [c]Total proctocolectomy, total colectomy, subtotal colectomy and debulking surgery with colon resection.

According to univariate analysis, the risk factors for an incisional hernia after colorectal surgery were related to the gender of subjects and showed a statistically significant tendency toward surgical wound infection (P = 0.06) (Table 3). There were no factors related to the development of parastomal hernia in the group performed with stoma take-down (Table 4). The risk factors for a high incidence of incisional hernias were identified to be sex (P = 0.009;

Table 4. Characteristics of the stoma group according to the development of a parastomal hernia

Characteristic	No parastomal hernia (n = 98)	Parastomal hernia (n = 7)	P-value
Age (yr)	60.5 ± 13.6	65.4 ± 12.1	0.351
Gender			0.866
Male	67 (68.4)	5 (71.4)	
Female	31 (31.6)	2 (28.6)	
Obesity	23 ± 3.1	24.9 ± 2.8	0.121
AAA	3 (3.1)	0 (0)	0.639
ASA score			0.847
≤2	82 (83.7)	6 (85.7)	
>2	11 (16.3)	1 (14.3)	
Cancer	89 (90.8)	7 (100)	0.402
Emergency	11 (11.2)	0 (0)	0.349
Bowel obstruction	26 (26.5)	0 (0)	0.116
Bowel perforation	13 (13.3)	1 (14.3)	0.939
Preoperative anemia[a]	12.4 ± 2.1	12.9 ± 91.6	0.548
Preoperative hypoalbuminemia[b]	3.7 ± 0.6	3.7 ± 0.4	0.996
Operation time (min)	153 ± 50.0	173 ± 73.0	0.333
Estimated blood loss (mL)	263 ± 212.0	342 ± 237.0	0.387
Wound infection	14 (14.3)	9	0.283
Ileus	32 (32.7)	0	0.070
Hospital stay (day)	11 ± 7.8	10.7 ± 4.4	0.935

Values are presented as mean ± standard deviation or number (%).
AAA, abdominal aortic aneurysm; ASA score, American Society of Anesthesiologists score.
[a]Male, serum hemoglobin ≤ 13; and female, serum hemoglobin ≤ 12. [b]Serum albumin ≤ 3.0.

Table 5. Multivariate analysis of the risk factors for the development of an incisional hernia after colorectal surgery: Cox regression analysis

	Incisional hernia	
	P-value	Odds ratio (95% confidence interval)
Gender	0.009	4.686 (1.5-15)
Wound infection	0.041	3.789 (1.1-13.6)

odds ratio, 4.686; 95% confidence interval [CI], 1.5 to 15) and postoperative incisional infection (P = 0.041; Exp (B), 3.789; 95% CI, 1.1 to 13.6) according to the multivariate analysis conducted on variable found to have a significant probability of 0.1 in the univariate analysis (Table 5).

DISCUSSION

The incidences of incisional hernias were reported to be 74.8% and 88.9% in the first and the second postoperative years, respectively, according to a study by Hoer et al. [10]. Moreover, the incidence of parastomal hernias increased over time, and parastomal hernias mostly occurred within two years after stoma construction [7, 8]. Similarly, hernias developed in 85.7% of the patients within the third postoperative year, as reported in previous studies [7, 8, 10]. In addition, the cumulative incidence remained unchanged from the fourth postoperative year. When subjects were followed-up over five years, incisional and parastomal hernias occurred within three years in most cases, and almost no incidence was observed from the fourth postoperative year. However, this study detected one case each of an incisional and a parastomal hernia after five years. Thus, the possibility of an incisional or a parastomal hernia occurring during a long-term follow-up period could not be completely excluded.

In this study, the incidence of parastomal hernias was examined by categorizing patients who underwent colostomy take-down into two subgroups: the ileostomy and the colostomy subgroups. Parastomal hernias did not develop in the ileostomy subgroup while 11.9% of the patients in the colostomy subgroup developed a parastomal hernia. According to a study by Carne et al. [9] in 2003, the incidences of parastomal hernias ranged between 1.8 to 28% for an ileostomy and 4 to 48% for a colostomy, exhibiting a higher rate in the group with colostomy closure. This study also found a statistically higher significance for the incidence of parastomal hernias in the colostomy subgroup. However, a temporary enterostomy was performed in 70% (32/46) of the patients who received an enterostomy. In contrast, parastomal hernias were not detected for an enterostomy because colostomy closure was conducted in 5% (3/59) of the patients.

The linea alba and the rectus sheath, which maintain the strength of the abdominal wall, are known to be healed approximately 120 days after suturing [11]. However, incisional and parastomal hernias may occur in cases of a delayed or a weakened healing process. The mechanisms and the risk factors have not been clarified. Various risk factors have been classified into three subcategories (disease, patient, and surgery). Disease-related risk factors that have been identified are obesity, ulcerative colitis (as opposed to Crohn's disease), constipation, cancer, etc. Patient-related risk factors that have been identified are age, malnutrition, and others. In addition, surgical risk factors are emergency operation (bowel obstruction and perforation), postoperative infection, etc. [12, 13]. This study examined all factors that could be collected from prospective data. Postoperative wound infection is the third most common form of infection, accounting for 14 to 16% [14] (up to 3 to 30% [15-18]) of all infections after urinary tract infection and pneumonia. Furthermore, it is also known to be one of the fundamental causes of incisional hernias [19, 20].

According to this study, the incidence of postoperative wound infection was 7.6% (60/7,795), which was relatively low compared to values in previous studies [19, 20]. In addition, although a significant increase was shown in the incidence of incisional hernias in patients with wound infections (P = 0.041), no relationship was found with the incidence of parastomal hernias. All postoperative wound infections developed at the incision site in the stoma construction group. Hence, a direct relationship between wound infection and stoma construction was unverifiable.

Some previous studies reported a relationship between sex and incisional hernia. The incidence of parastomal hernia was higher in females according to a domestic study performed by Park et al. [21], and a higher incidence of abdominal hernias was found during pregnancy according to studies of Seleverstov and Hallowell [22], and Weitzman and Drimer [23]. However, Lee et al. [24] reported that no relationship was found between sex and hernias. Although being female was identified to be a risk factor for increasing the incidence of incisional hernias, no relationship was found between sex and the incidence of parastomal hernias.

Other factors, including patient characteristics (age and obesity), patient preoperative risk factors (blood albumin level, anemia, ASA score, the presence of tumors, emergency surgery, intestinal obstruction, and bowel perforation), surgery-related risk factors (operation time and intraoperative bleeding volume), and postoperative risk factors (hernia, postoperative infections, ileus, and admission days) had no relationship with the incidence of incisional hernias. In particular, no risk factors were found to be associated with parastomal hernias.

This study had several strengths. First, subjects were comprised of pure study populations that received surgery by one surgeon. Second, the study excluded patients with a past surgical history and only included patients who underwent colorectal surgery, preventing potential selective bias, unlike other previous studies. Third, a 5-year follow-up period enabled the study to sufficiently investigate the incidences of incisional and parastomal hernias.

In conclusion, the risk factors for the development of incisional hernias after colorectal surgery were gender and postoperative incisional infection. However, the study was unable to detect factors

related to the development of a parastomal hernia after colorectal surgery.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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