Original Article

Factors Associated with Incisional Hernia Recurrence after Colorectal Surgery

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Key Words
Colorectal surgery;
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Purpose. An incisional hernia is a significant complication of colorectal surgery. Recurrence after incisional hernia repair also negatively affects the patient's quality of life. The current study aimed to identify the factors that influence the outcomes of incisional hernia repair after colorectal surgery.
Methods. We retrospectively surveyed patients who had undergone incisional hernia repair after colorectal surgery at our institution between 2016 and 2018. Patient demographics, surgical data, and outcomes, including recurrence and complications were analyzed. Logistic and Cox regression analyses were performed to identify the factors related to the recurrence incisional hernia.
Results. We included 33 patients. Mean follow-up time was 32.21 months, and incisional hernia recurrence rate was 18.2% (6/33). Hernia site was a significant factor related to recurrence. Lateral incisional hernia was a risk factor for incisional hernia recurrence (hazard ratio = 9.869, $p = 0.039$).
Conclusions. A lateral incisional hernia was a risk factor for recurrence in patients who had undergone incisional hernia repair after colorectal surgery. This finding implied that the surgeon should meticulously oversee both the intraoperative and postoperative care of patients who have undergone lateral incisional hernia repair after colorectal surgery.
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An incisional hernia is a significant complication after abdominal surgery; it often results in an adverse impact on the patient's quality of life.[1] The incidence of incisional hernia ranges between 2-20% in relevant studies on long-term follow-up.[2-4] Therefore, incisional hernia repair has become one of the most commonly performed procedures in the general surgery field.[5] Roughly 100,000 repairs are performed annually in the United States.[6] In Taiwan, there are an estimated 2,500-3,000 incisional and ventral hernia repairs per year.[7]

An incisional hernia after colorectal surgery is an important issue. A population-based registry study conducted in Sweden revealed that the cumulative incidence of incisional hernia after an open colorectal surgery was 5.3%.[8] However, a prospective study conducted in Singapore also showed that the incidence of incisional hernia was 13.0% during a three-year follow-up period. In contrast, Seo et al. reported a 1.5% of incidence rate during a three-year follow-up period,[9] which showed a significantly better result compared to other studies.

Recurrence and postoperative complications play an important role in assessing the outcomes of incisional hernia repair. Overall, the recurrence rate after incisional hernia repair can reach 13% at three years

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of follow-up to 32% at 10 years of follow-up.[2] A nationwide cohort study in Denmark, which included 3,242 patients with five years of follow-up, indicated an overall complication rate of 4.9% (major complications, including bowel obstruction, perforation, and bleeding, accounted for 1.4%).[10]

This study aimed to identify the factors that influence the complication and recurrence rates of incisional hernia repair after colorectal surgery in a university-based tertiary referral center.

Materials and Methods

We retrospectively reviewed patients who had undergone incisional hernia repair after colorectal surgery at our institute between January 1, 2016 and December 31, 2018. Patients aged < 20 years who underwent incisional, emergent incisional, parastomal, primary ventral, or umbilical hernia repair were excluded from the study. Charts of the patients were reviewed continuously until February 28, 2023. Additionally, we retrospectively collected data on colorectal surgeries performed during the same period, including the surgery types and methods.

Demographic data collected included sex, age, height, weight, body mass index (BMI), presence of diabetes, hypertension, liver cirrhosis, smoking status, use of steroids, and recent chemotherapy.

Any surgery that resulted in incisional hernia was marked as an index surgery. Details of the index surgery, including surgery type, approach method, and the time from index surgery to incisional hernia repair, were recorded.

The characteristics of the incisional hernia, including the width and length of the hernia recorded on the chart, were collected. Hernia location was recorded according to the European Hernia Society (EHS) classification.[11]

Outcomes, including follow-up time, postoperative complications (within 30 days after operation), short-term complications (30 days to one year after operation), long-term complication (one year after surgery), and recurrence, were also recorded. Complications included surgical site infection, peri-surgical site abscess formation, fistula formation, seroma, hematoma, poor wound healing, and bowel obstruction or adhesion, resulted in surgical intervention. Assessment of recurrence had two sources: records on the charts or imaging study. The imaging study was reviewed retrospectively to detect recurrent incisional hernias.

Primary endpoint was to clarify the current situation of incisional hernia after colorectal surgery at our institution, including outcomes, such as complications and recurrence rates. Secondary endpoint was to identify factors related to these outcomes to provide future advice for incisional hernia repair.

Qualitative variables were presented as numbers (percentages), and quantitative variables were presented as means ± standard deviations. Categorical variables were analyzed using the chi-squared test or Fisher's exact test. Continuous variables were analyzed using the Student's t-test. For variables with significant results, multivariate analysis was completed using Logistic and Cox regression analyses to specify the factors related to incisional hernia recurrence. Statistical significance was set at $p < 0.05$. Analyses were performed using SPSS Statistics® version 25 (IBM® Corporation, Armonk, NY, USA).

Results

Between January 1, 2016 and December 31, 2018, 33 patients were enrolled in this study, and their demographic data are shown in Table 1. Among the patients, six had recurrences (recurrence group: 6/33, 18.2%), while the remaining 27 had no recurrence (non-recurrence group: 27/33, 81.8%). During the study period, 1,905 colorectal procedures were performed at our institution, including 1,159 laparoscopic, 442 open, and 304 ostomy creation procedures. Considering the surgery type, there were 627 right-sided hemicolectomies, 163 left-sided hemicolectomies, and 811 anterior resections (including low anterior resections). The estimated overall incisional hernia prevalence was 1.7%.

The mean age at the time of incisional hernia repair was 64.24 ± 13.56 years. Mean BMI was 25.26 ±

4.16 kg/m^2. Additionally, 12.1% (4/33) of the patients met the criteria of obesity (BMI ≥ 30 kg/m^2). While considering the criteria for obesity in Taiwan (BMI ≥ 27 kg/m^2), 11 (33.3%) patients met the criteria. In terms of their comorbidities, 21.2% (7/33) of the patients had diabetes mellitus and 45.5% (15/33) had hypertension. The prevalence of liver cirrhosis was 3.0% (1/33). The percentage of patients with smoking habits within one year before the hernia repair was 9.1% (3/33). Four (12.1%) of the patients were taking steroids during the hernia repair period. Eight (24.2%) patients received chemotherapy within eight weeks of hernia repair.

The index surgery varied according to the surgery type. Hence, 24.2% of the patients received right hemicolectomy (8/33), 54.5% received left hemicolectomy (18/33), and 21.2% received ostomy closure (7/33) (Table 2). Approximately half of the patients (16/33, 48.5%) underwent laparoscopic surgery. The mean time from the index surgery to hernia repair was 19.34 months.

Hernia location was retrospectively evaluated and

Table 1. Demographic data of the included incisional hernia repair patients (n, %)

	Total (n = 33)	Recurrence		*p* value
		Yes (n = 6) (18.2%)	No (n = 27) (81.8%)	
Sex				0.656
Male	16 (48.5)	2 (33.3)	14 (51.9)	
Female	17 (51.5)	4 (66.7)	13 (48.1)	
Age (years)	64.24 ± 13.56	66.83 ± 10.94	63.67 ± 14.19	0.613
Height (cm)	159.78 ± 7.86	158.53 ± 8.36	160.06 ± 7.88	0.694
Weight (kg)	64.45 ± 11.57	68.58 ± 12.74	63.54 ± 11.34	0.401
BMI (kg/m^2)	25.26 ± 4.16	27.19 ± 3.67	24.83 ± 4.21	0.215
Obesity[a]	4 (12.1)	1 (16.7)	3 (11.1)	0.571
Obesity (Taiwan criteria)[b]	11 (33.3)	3 (50.0)	8 (29.6)	0.375
Comorbidity				
Diabetes mellitus	7 (21.2)	0 (0)	7 (25.9)	1.000
Hypertension	15 (45.5)	2 (33.3)	13 (48.1)	0.665
Liver Cirrhosis	1 (3.0)	1 (16.7)	0 (0)	0.182
Smoking habits	3 (9.1)	0 (0)	3 (11.1)	1.000
Steroid	4 (12.1)	0 (0)	4 (14.8)	1.000
Chemotherapy[c]	8 (24.2)	1 (16.7)	7 (25.9)	0.296

BMI, body mass index.

[a] Obesity was defined as BMI ≥ 30 kg/m^2. [b] Obesity in Taiwan was defined as BMI ≥ 27 kg/m^2.

[c] Received hernia repair within eight weeks after chemotherapy.

Table 2. Characteristics of index surgery[a] (n, %)

	Total (n = 33)	Recurrence		*p* value
		Yes (n = 6)	No (n = 27)	
Surgery type				0.325
Right side hemicolectomy	8 (24.2)	2 (33.3)	6 (22.2)	
Left side hemicolectomy	3 (9.1)	1 (16.7)	2 (7.4)	
Anterior resection or low anterior resection	15 (45.5)	3 (50.0)	12 (44.4)	
Ostomy closure	7 (21.2)	0 (0)	7 (25.8)	
Surgical method				0.491
Open	17 (51.5)	2 (33.3)	15 (55.6)	
Laparoscopy	16 (48.5)	4 (66.7)	12 (44.4)	
Time since index surgery to hernia repair (month) (n)	19.34 ± 19.73 (32)	29.00 ± 38.86 (6)	17.12 ± 12.37 (26)	

[a] Defined as surgery that resulted in incisional hernia.

documented using the classification of EHS (Table 3). Hence, 63.6% of the patients (21/33) developed middle class hernia, and 51.5% (17/33) belonged to class M3 (umbilical type). Additionally, 36.4% of the patients (12/33) developed a lateral class hernia, most of which were class L2 (24.2%, 8/33). Hernia location significantly determined the recurrence rate. The recurrence rate of the lateral class hernias was 83.3%, and that of the middle class was 16.7% ($p = 0.016$). Hernia size was not routinely recorded in our institution, with only approximately two-third of the patients being documented, and lead to apparent bias. The mean hernia length was 5.21 ± 3.69 cm and width was 5.23 ± 2.98 cm. The hernia length and width were smaller in the recurrence group (3.00 ± 0 vs. 5.63 ± 3.90 cm, $p = 0.017$).

The mean follow-up time was 32.21 ± 15.88 months, which is slightly more than two and half years (Table 4). Approximately 66% of the patients underwent incisional hernia repair with a mesh. The post-

Table 3. Characteristics of incisional hernia

	Total (n = 33)	Recurrence		*p* value
		Yes (n = 6)	No (n = 27)	
Hernia location[a] (n, %)				**0.016**[c]
Middle	21 (63.6)	1 (16.7)	20 (74.1)	
M1	0 (0)	0 (0)	0 (0)	
M2	1 (3.0)	0 (0)	1 (3.7)	
M3	17 (51.5)	1 (16.7)	16 (59.3)	
M4	3 (9.1)	0 (0)	3 (11.1)	
M5	0 (0)	0 (0)	0 (0)	
Lateral	12 (36.4)	5 (83.3)	7 (25.9)	
L1	0 (0)	0 (0)	0 (0)	
L2	8 (24.2)	2 (33.3)	6 (22.2)	
L3	4 (12.1)	3 (50.0)	1 (3.7)	
Hernia size recorded[b]				
Hernia length (cm) (n)	5.21 ± 3.69 (19)	3.00 ± 0 (3)	5.63 ± 3.90 (16)	**0.017**
Hernia width (cm) (n)	5.23 ± 2.98 (22)	3.00 ± 0 (3)	5.58 ± 3.06 (19)	**0.002**

[a] Classified according to the European Hernia Society incisional hernia classification. [b] According to the record on operating note. [c] Lateral vs. Middle.

Table 4. Outcomes of incisional hernia repair (n, %)

	Total (n = 33)	Recurrence		*p* value
		Yes (n = 6)	No (n = 27)	
Follow up time (month)	32.21 ± 15.88	41.00 ± 15.56	30.26 ± 15.56	0.136
Mesh	22 (66.7)	4 (66.7)	18 (66.7)	1.000
Postoperative complication[a]				1.000
Yes	2 (6.1)[b]	0 (0)	2 (7.4)	
No	31 (93.9)	6 (100)	25 (92.6)	
Short-term complication[c]				0.216
Yes	5 (15.2)[d]	2 (33.3)	3 (11.1)	
No	28 (84.8)	4 (66.7)	24 (88.9)	
Long-term complication[e]				0.094
Yes	3 (9.1)[f]	2 (33.3)	1 (3.7)	
No	27 (81.8)	4 (66.7)	23 (85.2)	
Loss of follow up	3 (9.1)	0 (0)	3 (11.1)	
Time since incisional hernia repair to recurrence (month)	13.17 ± 7.08	13.17 ± 7.08	0	

[a] Within 30 days after operation. [b] Two patients with wound infection. [c] Thirty days to one year after operation. [d] Two patients with wound infection and three with chronic pain. [e] One year after operation. [f] Three patients with chronic pain.

operative complication rate was 6.1% (2/33) with two patients with wound infection. The short-term complication rate was 15.2% (5/33), including two patients with wound infection and three with chronic pain. Three (9.1%) patients were followed-up within one year. The long-term complication rate was 9.1% (3/33), including three patients with chronic pain. The mean time from incisional hernia repair to recurrence was 13.17 ± 7.08 months.

Multivariate analysis was performed to identify the factors related to recurrence after incisional hernia repair (Table 5). The factors mentioned above, including demography, characteristics of index surgery, incisional hernia, incisional hernia repair, and outcomes, were analyzed between the recurrence and non-recurrence groups. The most significant factor was hernia location (lateral vs. middle). Odds ratio was 14.286 in the univariate analysis. The hernia size did not showed significance in the analysis.

Additionally, the Cox regression analysis of the factors associated with recurrence showed that hernia location and short-term complications were both significant factors in the univariate analysis (Table 6). Long-term complication was a risk factor in the univariate analysis, but it showed no significance in the multivariate analysis.

Discussion

We analyzed 33 patients who had undergone incisional hernia repair at our institution between January 1, 2016 and December 31, 2018. The mean follow-up period was 32.21 months. Our study revealed a cumulative recurrence rate of 18.2%, whereas the postoperative complication rate was 6.1%. The significant factor related to recurrence was hernia location, while the lateral class hernias resulted in more incisional hernia recurrence compared to the middle class.

In this study, we found a recurrent rate of 18.2% (6/33). Two-third of the patients underwent incisional hernia repair with a mesh, and the recurrence rate was not significantly different. In a nationwide cohort study with a five-year follow-up period, the overall recurrence rate was 13.2% in a mesh group and 18.3% in a non-mesh group.[10] Nevertheless, Juvany et al. reported a recurrence rate of 16% with a three-year follow-up period for patients with midline incisional hernia who received open onlay mesh repair.[2] Köckerling reviewed 47 studies and reported that approximately 20% of incisional hernias would recur.[12] These studies showed a comparable recurrence rate to our study. However, mesh placement was not a significant factor in our study. At our institution, there is no universal protocol, such as mesh placement or mesh position for incisional hernia repair, which may interfere with mesh placement.

The hernia size showed a significant difference between recurrence and non-recurrence group in our study. However, in the multivariate analysis and Cox regression, there was no such association. Otherwise, the retrospective data collection and data loss inevitably led to severe bias. Therefore, in our series, we could not make the conclusion that the hernia size was a significant risk factor. Further study will be necessary to clarify the characteristics of hernia size in the incisional hernia recurrence.

In our study, the site of the incisional hernia was

Table 5. Significant factors among the recurrence group

	Univariant analysis		
	OR	95%	*p*
Hernia location[a]	14.286	1.414-144.373	**0.024**

OR, odds ratio. [a] Lateral vs. Middle.

Table 6. Cox regression of the factors related among the recurrence

	Univariate analysis			Multivariate analysis		
	HR	95%	*p*	HR	95%	*p*
Hernia location[a]	10.68	1.243-91.668	**0.031**	9.869	1.120-86.981	**0.039**
Long-term complication	6.507	1.163-36.410	**0.033**	5.708	0.886-36.795	0.067

HR, hazard ratio. [a] Lateral vs. Middle.

associated with recurrence. The lateral class of incisional hernias had a higher recurrence rate than the middle class (hazard ratio, 9.869; $p = 0.039$). However, Benlice et al. reported that a midline incision for specimen extraction would increase the incidence of incisional hernia compared to a Pfannenstiel incision and incision off the midline.[13] Many studies supported similar results.[9,14] In contrast, a large cohort conducted in Korea, which enrolled 4,276 colorectal cancer patients, showed no significant difference between midline or transverse incision in a multivariable analysis; they raised an issue that specimen extraction site will influence the risk of incisional hernia in an Asian population.[15] Morita et al. suggested that an extraction site on the left lower abdomen or transumbilical will not influence the incisional hernia rate in patients who received laparoscopic resection.[16] A retrospective match-paired study enrolled 269 patients who underwent laparoscopic sigmoidectomy; they revealed that left lower transverse incision would result in increased incisional hernia incidence compared to Pfannenstiel-Kerr incision during extraction.[17] The issue was still in debate, and owing to our study design, we could not estimate the incidence of incisional hernia between the extraction sites.

Only few studies have compared the recurrence rates of incisional hernias between lateral and midline incisions. Pereira et al. reported that midline incision was an independent risk factor when compared to non-midline incision (such as trocar umbilical, parastomal, and Pfannenstiel incisions).[18] In contrast, an international prospective cohort conducted in France included 1,075 patients, regardless of their index surgery. They reported that recurrence rate was associated with lateral incision ($p = 0.02$ at one-year follow-up and 0.002 at two-year follow-up).[19] Our study showed a similar result. Lateral incisional hernia repair is more difficult than midline incisional hernia repair, owing to the greater complexity of anatomy and a relative lack of repair skills and experience of the surgeon.[20]

In our series, the lateral class incisional hernias mostly came from the extraction site (four from extraction sites and one from port site) when compared to the middle class of incisional hernias (one case from open surgery). In terms of incisional hernia recurrence, our study showed a higher recurrence rate in the lateral class of incisional hernia after colorectal surgery than in the middle class. In other words, we might provide an alternative thought process, while facing the debate on different extraction sites.

This study had three major limitations. First, the small sample size may have compromised the results. A longer study period is required to evaluate other factors related to hernia recurrence. Second, our study could not detect the incidence rate of incisional hernia, but only the prevalence rate. Third, the protocol for incisional hernia repair was not standardized at our institution and was highly surgeon-dependent, which led to selection bias.

Conclusion

Thirty-three patients who had undergone incisional hernia repair after colorectal surgery between 2016 and 2018 at a university-based tertiary referral center were analyzed. The recurrence rate was 18.2% with an average of 32 months of follow-up. Lateral class hernias showed a higher hernia recurrence rate than middle class incisional hernias. This finding implied that the surgeon should meticulously oversee both the intraoperative and postoperative care of patients who have undergone lateral incisional hernia repair after colorectal surgery.

Declarations of Interest

None.

Financial Report

None to declare.

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原　著

影響大腸直腸癌術後切口疝氣復發之因素

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目的　探討大腸直腸癌術後切口疝氣復發之影響因素。

方法　本研究以回溯方式蒐集自 2016 至 2018 年曾因接受大腸直腸手術而接受切口疝氣修補之病人。本研究分析病人之臨床資訊、手術資料、切口疝氣復發率及併發症機率。

結果　總計 33 名病人納入本研究。平均追蹤時間為 32.21 個月，平均疝氣復發率為 18.2% (6/33)。疝氣部位顯著影響其復發率。側腹疝氣之復發率明顯較正中腹為高 (hazard ratio = 9.869, p = 0.039)。

結論　本研究發現大腸直腸手術後之切口疝氣經修補後，以側腹疝氣復發率為高。對於此類病人，手術醫師術中及術後的傷口處理應特別謹慎小心。

關鍵詞　大腸直腸手術、切口疝氣、復發。