

Original Article

Laparoscopic Surgery and Incidence of Adhesion Ileus in Patients with Right-sided Colon Cancer

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Key Words

Right-sided colon cancer;
Open right hemicolectomy;
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Adhesion;
Ileus

Purpose. Adhesions are an inevitable consequence of abdominal or pelvic surgery that may cause additional complications and increase hospital costs. A number of human and animal studies have shown that laparoscopic surgery is associated with a lower incidence of adhesion formation than open surgery. In this retrospective study, we compared the incidence of adhesion ileus between patients who underwent right hemicolectomy using laparoscopy and those who received open surgery.

Materials and Methods. We retrospectively reviewed the medical and surgical records of all patients who underwent elective hemicolectomy for right-sided colon cancer between January 2005 and December 2011. Adhesion ileus was suspected in patients who presented to our emergency department or outpatient department with complaints of constipation for more than 48 hours together with intermittent, painful cramping, vomiting, or abdominal distension without flatus. For these patients, computed tomography (CT) imaging showed the presence of dilated bowel loops with a transitional zone over the adhesion site.

Results. There were 281 patient who underwent elective right-sided hemicolectomy using open surgery (n = 164) or laparoscopy (n = 117) at our institution. The mean follow-up time was 66 months (median: 53 months, range, 24-96 months). Both the groups were comparable in terms of their age, gender, and American Society of Anesthesiologists (ASA) classification. There were no significant differences in the rates of re-admission for adhesion ileus (5.5% vs 3.4%, $p = 0.416$) or surgery for adhesion (2.4% vs 0%, $p = 0.089$) between the open and laparoscopic groups.

Conclusions. In our 281-patient cohort, our results revealed that there was no significant difference in the incidence of post-surgical adhesion ileus between patients who underwent laparoscopic-assisted surgery and patients who received open surgery for right-sided colon cancer.

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Adhesions are an inevitable consequence of abdominal or pelvic surgery, with a prevalence reaching 97% in patients undergoing abdominal sur-

gery.^{1,2} The complications of post-operative adhesion include bowel obstruction, chronic abdominal pain, and female infertility.³ Adhesion is also associated

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with increased hospital costs. Wilson et al. reported that in the UK, the cumulative cost of adhesion-related readmissions over 10 years was estimated to be £569 million.⁴ Although randomized trials have shown that the survival of patients who underwent colorectal cancer employing laparoscopic techniques was equivalent to that of patients who are treated using traditional open surgery,⁵⁻⁷ it is still unclear whether either techniques results in improved functional outcomes. A number of human and animal studies have shown that laparoscopic surgery is associated with a lower incidence of adhesion formation than open surgery;⁸⁻¹⁰ however, the majority of these studies were single-center, non-randomized, and largely heterogeneous studies. In this retrospective study, we compared the incidence of adhesion ileus between patients who underwent right hemicolectomy using laparoscopy and those who had open surgery.

Patients and Methods

We retrospectively reviewed the medical and surgical records of all patients who underwent elective hemicolectomy for right-sided colon cancer during the period from January 2005 to December 2011 at Changhwa Christian Hospital, a 1676-bed medical center in central Taiwan. The patient exclusion criteria included a history of abdominal surgery before or after right hemicolectomy, use of anti-adhesion barrier, and evidence of other intra-abdominal tumors. In addition, patients with stage IV disease were excluded in order to avoid the possible effects of carcinomatosis.

Adhesion ileus was suspected in patients who presented to our emergency department or outpatient department with complaints of constipation for more than 48 hours concurrent with intermittent painful cramping, vomiting, or abdominal distension without flatus. These patients also presented with distended abdomens and high-pitched, hyperactive bowel sounds. In patients suspected of having adhesion, we regularly perform computed tomography (CT) imaging to rule out other mechanical causes such as hernia, volvulus, or cancer progression. A characteristic CT finding of adhesion ileus is the presence of dilated bowel loops with

a transitional zone over the adhesion site. Paralytic ileus caused by spinal injury, diabetic coma, or uremia should also be excluded. Patients were treated using either open surgery or laparoscopic-assisted right hemicolectomy at the discretion of the surgeon. During the laparoscopic procedure, colon mobilization, mesentery dissection, and vessel ligation were performed intra-corporeally, while bowel resection and anastomosis were performed extra-corporeally.

Statistical Analysis

Data were recorded in a computer database. Surgical risk factors associated with postoperative adhesion ileus included operative time, estimated blood loss, length of postoperative hospital stay, admission for adhesion ileus, and surgery for adhesion ileus. We used the chi-square test or Fisher's exact test for comparisons of categorical data and the independent *t*-test to determine differences in the means of continuous variables. A *p*-value of less than 0.05 was regarded as statistically significant. All statistical analyses were performed with the statistical package SPSS for Windows (Version 16.0, SPSS Inc; Chicago, IL, USA).

Results

During the study period, 281 patients underwent elective right-sided hemicolectomy via open surgery (*n* = 164) or laparoscopy (*n* = 117) at our institution.

The mean patient follow-up time was 66 months (median: 53 months, range, 24-96 months). Both the groups were comparable in terms of age, gender, and American Society of Anesthesiologists (ASA) classification (Table 1). Body mass index (BMI) (22.56 vs 24.34 kg/m², *p* < 0.001) and tumor size (6.34 vs 4.16 cm, *p* < 0.001) were significantly different and the percentage of patients with less advanced-stage disease was significantly higher in the laparoscopic group than in the open surgery group, respectively. In addition, although the operative time was longer for patients who underwent laparoscopic surgery (150.8 vs 218.6 min, *p* < 0.001), these patients had less blood

loss (117.4 vs 65.6 ml, $p = 0.011$) and fewer days of hospitalization (13.8 vs 9.1 days, $p = 0.041$) than patients who underwent open surgery (Table 2). There were no significant differences in the rates of re-admission for adhesion ileus (5.5% vs. 3.4%, $p = 0.416$) or surgery for adhesion (2.4% vs. 0%, $p = 0.089$) between the open and laparoscopic groups.

Discussion

Adhesions are a product of inflammatory reactions. The process is initiated by peritoneal trauma, which induces the production of various pro-inflammatory mediators. These substances, which include histamine and cytokines, increase vascular permeability and promote fibrin-rich exudate formation. The process of fibrinolysis occurs simultaneously. How-

ever, inadequate or impaired fibrinolysis can result in a permanent adhesion. In addition, proliferating fibroblasts invade this area of remodeling and deposit extracellular matrix material such as collagen that contributes to adhesion formation.^{11,12}

Previous investigations have found that laparoscopic surgery for cholecystectomy,¹⁰ ovarian cystectomy,¹³ or fundoplication¹⁴ induces fewer adhesions than open surgery, because it requires only a small peritoneum incision, does not involve retraction of the abdominal wall, and requires less small bowel manipulation.¹⁵ However, few studies have evaluated whether laparoscopic colorectal surgery results in a lower incidence of adhesions than open surgery. E. M. Burns et al. retrospectively reviewed the records for 187,148 patients who received colorectal surgery between 2002 and 2008.¹⁶ The study found that at a median follow-up time of 31.8 months, patients who underwent lap-

Table 1. The characteristics of patients undergoing elective right hemicolectomy for stage I-III colon cancer between 2005 and 2011

	Open (n = 164)	Laparoscopic-assisted (n = 117)	p value	Total (N = 281)
	Mean ± SD	Mean ± SD		Mean ± SD
Age, median (range) (yr)	67.0 ± 12.6	67.6 ± 11.4	0.723	67.3 ± 12.1
BMI, median (range, kg/m ²)	22.6 ± 3.5	24.3 ± 3.4	< 0.001	23.3 ± 3.6
Tumor size (cm) L	6.3 ± 2.5	4.2 ± 2.1	< 0.001	5.4 ± 2.6
Gender			0.161	
Male	91 (55.5%)	55 (47.0%)		146 (52.0%)
Female	73 (44.5%)	62 (53.0%)		135 (48.0%)
ASA classification			0.120	
I	2 (1.2%)	6 (5.1%)		8 (2.8%)
II	66 (40.2%)	50 (42.7%)		116 (41.3%)
III	88 (53.7%)	59 (50.4%)		147 (52.3%)
IV	8 (4.9%)	2 (1.7%)		10 (3.6%)
Cancer stage			< 0.001	
I	13 (7.9%)	29 (24.8%)		42 (14.9%)
II	89 (54.3%)	52 (44.4%)		141 (50.2%)
III	62 (37.8%)	36 (30.8%)		98 (34.9%)

Table 2. Right hemicolectomy and adhesion ileus surgical endpoints

	Open (n = 164)	Laparoscopic-assisted (n = 117)	p value	Total (N = 281)
	Mean ± SD	Mean ± SD		Mean ± SD
Operative time (min)	150.8 ± 55.1	218.7 ± 58.6	< 0.001	179.1 ± 65.7
Estimated blood loss (mL)	117.4 ± 199.0	65.6 ± 106.8	0.011	95.9 ± 168.6
Length of post operation stay (days)	13.8 ± 23.7	9.1 ± 8.3	0.041	11.9 ± 19.0
Admission for adhesion ileus	9 (5.5%)	4 (3.4%)	0.416	13 (4.6%)
Surgery for adhesion ileus	4 (2.4%)	0 (0%)	0.089	4 (1.4%)

aroscopic surgery had a significantly lower risk of developing clinically relevant postoperative adhesions than patients who underwent conventional surgery. In their study, however, there were various indications for the use of one type of surgery. For example, some of the patients in the right hemicolectomy group had cancer, while others had diverticulitis or ischemic bowel disease. Thus, the patient's underlying disease may have affected the study outcome. Other reports are also limited by a mixture of many types of colorectal surgery and operative indications.^{9,17,18}

To the best of our knowledge, only one other study has investigated the impact of laparoscopic colorectal surgery on the incidence of adhesion ileus using a uniform operative indication and procedure. Ng et al. studied 156 patients who received laparoscopic-assisted (n = 76) or open anterior resection for upper rectal cancer (n = 77) and found that the laparoscopic approach resulted in a significantly lower incidence of adhesion-related bowel obstruction and requirement for reoperation.¹⁹ In contrast, our investigation did not indicate that laparoscopy is superior to open surgery with respect to postoperative adhesion formation. Differences in the operative field between the two studies may at least in part explain these contradictory findings. To perform surgery for rectal cancer, pelvic dissection is required before mesorectal excision can be accomplished. After the operation, however, the small intestine tends to lie in the dissected pelvic cavity, where the post-operative tissue discharge containing various types of inflammatory cytokines tends to accumulate and can result in adhesion formation in this area. Other reasons might explain the lack of difference in adhesion between laparoscopic and open surgery in our study. First, although the laparoscopic approach results in a smaller abdominal incision, the amount of the serosal plane that needs to be dissected is the same with both techniques. Second, some experimental studies have demonstrated that CO₂ insufflation and increased intra-abdominal pressure are associated with peritoneal ischemia, decreased fibrinolysis, and increased adhesion formation.^{20,21} Third, pneumoperitoneum can potentially injure the whole peritoneal surface, resulting in adhesion formation in remote areas.²² Fourth, although no patients in the laparoscopy group required

surgical intervention for adhesion ileus, there was still no statistical difference from the open surgery group, which had a very low incidence but nonetheless some instances of adhesions requiring additional surgery. More cases should be observed and followed in the future to confirm this trend.

Adhesion ileus is a clinical diagnosis and there are no uniform diagnostic criteria for the disease. The incidence of adhesion formation is unknown because it is ethically unjustified to ask patients to receive diagnostic laparoscopy at the same time interval. Some patients may live uneventfully with extensive post-operative adhesion, while others may suffer bowel obstruction due to a single adhesion band. In addition, it is unknown how long it takes for an adhesion to develop postoperatively. Therefore, a prospective study with long-term follow-up is needed to further evaluate whether laparoscopic or open surgery for right-sided colon cancer is associated with an increased risk for adhesion ileus.

Conclusions

This study found no significant difference in the incidence of adhesion ileus between patients who underwent laparoscopic-assisted surgery and patients who received open surgery for right-sided colon cancer.

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原 著

腹腔鏡手術對右側大腸癌病人術後 沾黏性腸阻塞發生率的影響

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目的 在腹部或骨盆手術後，沾黏反應是無可避免的，腸沾黏可能會造成許多併發症，若發生併發症，隨之而來的就是高額的醫療費用。有些關於人類或動物的研究發現腹腔鏡手術造成沾黏的發生率低於傳統開腹手術。在這篇回溯性研究中，我們比較腹腔鏡右側結腸切除與傳統開腹之間沾黏性腸阻塞的發生率。

方法 本研究採回溯性分析，回顧於西元 2005 年一月至西元 2011 年十二月之間，於本院因右側大腸癌而接受右半結腸切除術的病人的手術紀錄及病歷。收錄患者主要於急診時主訴腹痛、嘔吐、或腹脹無排氣排便超過 48 小時，並且於電腦斷層掃描發現擴張的腸道及阻塞點位於沾黏的區域。

結果 共收錄 281 位患者，其中傳統開腹手術 164 位，腹腔鏡手術 117 位，平均追蹤時間為 66 個月（範圍，24~96 個月）。兩組間年齡、性別、麻醉分級類似。因沾黏性腸阻塞而住院 (5.5% vs 3.4%, $p = 0.416$) 或再手術 (2.4% vs 0%, $p = 0.089$) 的發生率，並無統計學上顯著差異。

結論 右側結腸癌病人接受傳統開腹手術或腹腔鏡手術，於本院術後沾黏性腸阻塞的發生率，兩者並無顯著差異。

關鍵詞 右側結腸癌、右半結腸切除術、腹腔鏡右半結腸切除術、沾黏、腸阻塞。