

Original Article

Comparison of Surgical Outcomes between Laparoscopic and Open Abdominoperineal Resection for Stage II/III Rectal Cancer: A Retrospective Study

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Purpose. This study aimed to review and compare the clinical outcomes of laparoscopic and open abdominoperineal resection for post-operative pathological stage II/III rectal cancer.

Methods. This retrospective study was conducted in Taiwan Adventist Hospital. We included 72 patients with stage II/III rectal cancer who underwent laparoscopic or open APR between January 2005 and January 2015. The patients were divided into laparoscopic (Lap-APR; n = 36) group and open (Open-APR; n = 36) APR groups. The patient and operative data were reviewed. Wilcoxon rank-sum test was used to compare the continuous variables, while Fisher's exact test was used to compare categorical variables.

Results. No significant difference was observed in patient demographics and tumor characteristics between the Lap-APR and Open-APR groups, except body mass index ($p < 0.001$). Additionally, no significant difference was observed in the mean number of harvested nodes between the two groups. However, the mean operative time was significantly higher in the Lap-APR group than in the Open-APR group ($p = 0.02$), while the mean blood loss was significantly lower in the Lap-APR group than in the Open-APR group ($p < 0.0001$). Moreover, the duration of postoperative hospital stay was significantly lower in the Lap-APR group than in the Open-APR group ($p < 0.0001$). This study also shows no significant difference in the tumor recurrence rate between the two groups.

Conclusions. Lap-APR may be a technically safe and feasible approach that shows better, lower blood loss, and shorter hospital stay compared to Open-APR.

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Key Words

Abdominoperineal resection;
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Abdominoperineal resection (APR), also known as Miles operation, was introduced in the late nineteenth century as the standard surgical treatment for low rectal cancer.¹ Surgical resection plays a central role in curative treatment of rectal cancer.² Tumors involving the levator ani muscle or the external anal sphincter and tumors for which a negative distal margin may not be guaranteed using sphincter-preserving surgeries are clear indications for APR.³

Laparoscopy has been used in colorectal surgery for more than 20 years. A meta-analysis of short-term results from multiple non-randomized and randomized trials found that laparoscopic resection of rectal cancer was feasible, effective, and safe with reduced risks of postoperative morbidity and mortality.^{5,6}

Laparoscopic surgery had a longer operative time compared to conventional open surgery.¹⁰ In the present study, we also found that the operative time was significantly longer in the Lap-APR group compared to the Open-APR group. Most studies have reported that the duration of hospital stay after rectal cancer surgery was shorter with laparoscopic surgery compared to conventional open surgery.^{11,12}

Tumors of the distal rectum and/or anal canal are manipulated and extracted through the perineal wound. Therefore, except the trocar and colostomy sites, no additional abdominal incision is required that there may be some difference are worthy to discuss between laparoscopic APR and open APR such as post operative wound pain, post operative hospital stay, rate of incisional hernia.

We aimed to compare clinical outcomes between laparoscopic APR and open APR in patients with stage II/III rectal cancer.

Materials and Methods

Patients

In this retrospective study, the data of 72 patients who were diagnosed with stage II/III rectal cancer at our hospital were collected between January 2005 and January 2015. Patients with large tumors, a history of extensive adhesion or ulcerative colitis, multiple can-

cers or distant metastasis, risk factors (such as multiple (≥ 3) previous operations in the abdomen or pelvis), elderly patients at risk of intolerance to pneumoperitoneum, patients showing advanced tumor characteristics with potential involvement of adjacent structures, and patients undergoing open surgical operations, who would have been unlikely to qualify for laparoscopy, were excluded.

All patients underwent preoperative colonoscopy, barium study, and radiographic study. Diagnosis of adenocarcinoma, mucinous adenocarcinoma, or signet ring carcinoma of the rectum (≤ 10 cm from the anal verge) was confirmed pathologically. Emergency APR was not performed during this period.

All enrolled patients were fit to undergo either laparoscopic (Lap-APR group) or open (Open-APR group) APR under general anesthesia. The study protocol was reviewed and approved by the Institutional Review Board of our hospital and was conducted in compliance with the Declaration of Helsinki. The patients provided written informed consent prior to surgery, and prior to analysis, patient information was anonymized and de-identified.

Patient characteristics, tumor characteristics, and operative outcomes were compared between the Lap-APR and Open-APR groups. The data were obtained from medical charts, operation records, and pathology reports. Pathological findings were based on the 6th edition of TNM classification. Routine follow-up was performed for all enrolled patients 2 weeks after surgery, 3 monthly for the first year, 6 monthly for the second year, and yearly thereafter. The median follow-up period was 48 months (range, 12-110 months). Adjuvant chemoradiation was administered according to the National Comprehensive Cancer Network guidelines to treat rectal cancer based on TNM staging.

Surgical technique

Same surgical team with experience of more than 100 laparoscopic and open colorectal cancer procedures annually performed all operations in this study. Each patient underwent mechanical bowel preparation and received a course of antibiotics before surgery. For laparoscopic APR, the patient was placed in

a modified lithotomy position; then, a pneumoperitoneum was created via an open technique using a Hasson trocar inserted above the umbilicus, and four working trocars were inserted under direct vision. We placed a 12-mm camera port at the umbilicus, two 5-mm ports bilateral to the rectus muscle sheath, and a 12-mm port 3 cm medial to the anterior superior iliac spine on the right side.

Medial to lateral approaches were used to mobilize the sigmoid colon and rectum from the pelvic floor. The inferior mesenteric artery was clipped and divided at 1 cm from its origin; thus, preserving the hypogastric nerve. Therefore, a complete take down of the splenic flexure was not required in most cases. After the rectum with the mesorectum had been mobilized completely according to the total mesorectal excision principle, the sigmoid colon was transected with a linear stapler. The specimen was removed through the perineal wound. A terminal colostomy was fashioned at the left lower trocar site using the sigmoid colon.

Data collection

Data, including patients' age at the time of APR, sex, body mass index, time of surgery, estimated blood loss, operative complications, time to bowel function return, and duration of hospital stay, were assessed. Postoperative ileus was defined as bowel function cessation lasting longer than 5 days after surgery.

The discharge criteria for the Lap-APR and Open-APR groups were identical and included tolerance of three meals without nausea or vomiting, passage of flatus and stool, and adequate pain control with oral analgesia.

Statistical analysis

Patient characteristics are summarized using total number, percentages, and mean \pm standard deviation. A Student's t-test or chi-square test was used to compare each factor. SPSS statistical software version 22 for Windows (IBM Corp., Armonk, NY, USA) was used to perform all statistical analyses. A *p*-value of < 0.05 was considered significant.

Results

Patient demographics and clinical characteristics

This study included 72 patients who were diagnosed with anorectal cancer. Of these patients, 36 patients underwent laparoscopic APR and 36 patients underwent open APR. Table 1 presents the patient's characteristics. Among the patients, the median age was 63.9 ± 8.0 years in the Lap-APR group and 62.4 ± 7.1 years in the Open-APR group. Of the 36 patients in the Lap-APR group, 18 were men and the other 18 were women; where as the 36 patients in the Open-APR group, 21 were men and 15 were women. There were no significant differences in age, sex, previous surgery, and preoperative CRT incidence between the two groups. In the Lap-APR group, conversion to open surgery was not required. There was a significant difference in body mass index between the Lap-APR and Open-APR group (28.1 ± 2.7 and 25.7 ± 3.3 kg/m², respectively; $p < 0.001$).

Table 2 presents the tumor characteristics. No significant difference was observed in histologic tumor

Table 1. Patients' characteristics

	Lap-APR ^a group (n = 36)	Open-APR group (n = 36)	<i>p</i> -value
Age (years)	63.9 \pm 8.0	62.4 \pm 7.1	0.395
Sex (male)	18 (50)	21 (58.3)	0.478
Previous surgery in the abdomen or pelvis (1 \leq n < 3)	20 (55.6)	18 (50)	0.637
Preoperative CRT ^b	26 (72.2)	19 (52.8)	0.88
BMI ^c (kg/m ²)	28.1 \pm 2.7	25.7 \pm 3.3	< 0.001

Data are presented as mean \pm standard deviation or number (percentage).

^a Laparoscopic abdominoperineal resection; ^b Chemoradiation therapy; ^c Body mass index.

type, depth of tumor invasion (T), nodal involvement (N), and stage between the Lap-APR and Open-APR group. Additionally, no significant difference was observed in the mean number of harvested nodes between the two groups.

Operative results

Table 3 presents the operative outcomes. A positive margin was defined as the presence of tumor cells at or within 1 mm from the margin.⁴ In the present study, negative circumferential, distal, and proximal

margins were confirmed microscopically in all cases. The resections were considered curative (R0 resection) in all patients.

The mean operative time was significantly longer in the Lap-APR group than in the Open-APR group (197 ± 41 vs. 177 ± 29 min, $p = 0.02$). However, the mean blood loss was significantly lower in the Lap-APR group than in the Open-APR group (149 ± 100 vs. 277 ± 130 mL, $p < 0.0001$). There was no significant difference in the postoperative complication rate between the two groups. Additionally, there was no significant difference in the time to the first passage of

Table 2. Tumor characteristics

	Lap-APR ^a group (n = 36)	Open-APR group (n = 36)	p-value
Tumor			
T (T3/T4A)	29 (80.6)/7 (19.4)	30 (83.3)/6 (16.7)	0.759
N			0.760
0	9 (25)	9 (25)	
1A	5 (13.9)	5 (13.9)	
1B	7 (19.4)	8 (22.2)	
2A	12 (33.3)	8 (22.2)	
2B	3 (8.3)	6 (16.7)	
Stage			0.491
2A	9 (25)	9 (25)	
3B	17 (47.2)	21 (58.3)	
3C	10 (27.8)	6 (16.6)	
Histology			0.453
Adeno	31 (86.1)	33 (91.7)	
Adeno-mucin	5 (13.9)	3 (8.3)	
Tumor size (cm)	4.0 ± 1.3	4.0 ± 0.9	0.830
Harvested lymph nodes	18.9 ± 4.0	17.5 ± 4.1	0.144

Data are presented as mean ± standard deviation or number (percentage).

^a Abdominoperineal resection.

Table 3. Operative outcomes

	Lap-APR ^a group (n = 36)	Open-APR group (n = 36)	p-value
Complication	12 (33.3)	14 (38.8)	0.158
Prostate injury	4 (11.1)	0 (0)	
Postoperative ileus	1 (2.7)	2 (2.7)	
Ureter injury	0 (0)	3 (8.3)	
Urinary retention	2 (5.6)	2 (5.6)	
Urinary tract infection	2 (5.6)	2 (5.6)	
Abdominal wound infection	0 (0)	2 (5.6)	
Perineal wound infection	3 (8.3)	3 (8.3)	
Parastomal hernia	1 (2.7)	1 (2.7)	
Operative time (minutes)	197 ± 41	177 ± 29	0.02
Estimated blood loss (mL)	149 ± 100	277 ± 130	< 0.0001
Time to passage of flatus (days)	2.8 ± 0.7	2.8 ± 0.8	0.76
Time to oral intake (days)	3.6 ± 1.3	3.6 ± 1.1	1
Postoperative hospital stay (days)	13.5 ± 3.7	17.2 ± 3.5	< 0.0001

Data are presented as mean ± standard deviation or number (percentage).

^a Abdominoperineal resection.

flatus and time to oral intake between the two groups. The duration of postoperative hospital stay was significantly shorter in the Lap-APR group than in the Open-APR group (13.5 ± 3.7 vs. 17.2 ± 3.5 days, $p < 0.0001$). On the contrary, there was no significant difference in the number of local recurrences between the two groups. In regard to distant recurrence, one case of lung metastasis was noted in the Lap-APR group and one case of liver metastasis was noted in the Open-APR group. The local recurrence rate between the two groups was no significant statistically difference (Table 4).

Discussion

Our study showed that the mean blood loss was lower in the Lap-APR group compared to the Open-APR group. Similarly, previous studies, including only patients who underwent APR, demonstrated that Lap-APR had reduced blood loss,⁸ reduced postoperative pain, shortened postoperative ileus, and earlier return of bowel function and earlier mobilization compared to Open-APR.⁹ As the perineal approach in both groups was unchanged, we believe that radical lymph node dissection and pelvic dissection in the narrow pelvic floor were achieved with proper homeostasis in the Lap-APR group through good visualization. High magnification and illumination of the surgical field by laparoscopy may allow better exposure and protection of the autonomic nerves compared to open surgery. Additionally, the minimally invasive approach with a small abdominal wound and lower blood loss may be the reason for the reduction in analgesic requirement and improvement in the rate of recovery.⁴

Laparoscopy has been used in colorectal surgery for more than 20 years. A meta-analysis of short-term results from multiple non-randomized and randomized trials found that laparoscopic resection of rectal cancer was feasible, effective, and safe with reduced risks of postoperative morbidity and mortality.^{5,6} Meta-analyses of trials, including both anterior resection and APR since the 2000s, showed that patients benefited from laparoscopic rectal surgery and had better postoperative recovery, improved abdominal

Table 4. Oncological outcomes

	Lap-APR ^a group (n = 36)	Open-APR group (n = 36)	<i>p</i> -value
Local recurrence	1 (2.8)	3 (8.3)	0.303
Distal recurrence	1 (lung) (2.8)	1 (liver) (2.8)	1

cosmesis, reduced surgical complications, and fewer abdominal wound infections and ventral hernias.⁷

However, laparoscopic surgery had a longer operative time compared to conventional open surgery.¹⁰ In the present study, we also found that the operative time was significantly longer in the Lap-APR group compared to the Open-APR group. Most studies have reported that the duration of hospital stay after rectal cancer surgery was shorter with laparoscopic surgery compared to conventional open surgery.^{11,12} We also found that the duration of postoperative hospital stay was significantly shorter in the Lap-APR group than in the Open-APR group. A short hospital stay and its economic impact are common arguments in favor of the laparoscopic approach, despite the high cost of the technique, since it is often associated with an extended operation.^{8,9,13,14} However, the duration of surgery is expected to reduce, as expertise in laparoscopic surgery improves. We found that both groups had the same duration of time to oral intake, but conventional open surgery required longer hospitalization, which may have been related to the pain associated with the large midline abdominal wound. In the Lap-APR group, the creation of a large abdominal wound was avoided, and this appeared to contribute to early recovery. A previous study showed that patients undergoing Lap-APR could be educated about their stoma and early stoma management could be achieved in the absence of a large abdominal incision.¹⁰ Additionally, stoma management was easier in patients who underwent laparoscopic APR without a large abdominal wound compared to those who underwent open APR.^{10,12}

Some surgeons believe that the quality of life of patients with a stoma is worse than that of those without a stoma. Therefore, they have indicated sphincter-preserving surgery for patients with low rectal cancer to avoid a permanent stoma. Cornish et al. reported that the quality of life of patients undergoing

APR was not worse than that of patients undergoing anterior resection and mentioned that some factors, such as continence and stool control, can influence the quality of life following anterior resection.^{10,15}

Completion of resection and lymph node harvest were considered important quality markers for colorectal tumor surgery, as they correlate with prognosis.^{16,17}

Regarding surgical quality related to the circumferential resection margin and oncological radicality reflected by the lymph node yield, the short-term results of major multicenter randomized trials CLASICC¹⁸ and COLOR,¹⁹ which compared conventional open surgery and laparoscopic rectal surgery, showed that the rate of obtaining a positive circumferential resection margin and the lymph node yield were not statistically different. A meta-analysis of randomized clinical trials also showed a comparable rate of obtaining a positive circumferential resection margin and lymph node yield between open procedure and laparoscopic procedure for the resection of rectal cancer, and the findings support the results of the present study.^{12,20,21} In our study, the mean number of harvested nodes was not significantly different between the Lap-APR and Open-APR groups, which is consistent with the findings of previous studies.

Local recurrence remains one of the main problems associated with advanced rectal cancer, even after the introduction of mesorectal excision.²² After APR, recurrence rates well beyond 15% have been reported.²³ In this study, recurrence developed in 11.1% of the patients (8.3% local recurrence) in the Open-APR group and in 5.6% of the patients (2.8% local recurrence) in the Lap-APR group, demonstrating that no statistically significant difference ($p = 0.303$) between two groups in locoregional control. However, all local and distal recurrences were stage III-related.

Laparoscopic resection as treatment for colorectal cancer has been performed mainly in the past decade. Since the follow-up period was too short for the development of clinically relevant local tumor recurrence in some patients, a relatively low recurrence rate in the Lap-APR group may have been noted. This is important because rectal cancer recurrence generally occurs later than colon cancer recurrence.²²

Toxicity due to chemotherapeutic agents and radiation effects results in increased operative blood loss and operative time and greater risk of surgical complications, which exert a negative influence on postoperative recovery and surgical complications.^{24,25} Intensified treatment of lower rectal cancer with neoadjuvant CCRT has been found to increase the possibility of perineal wound complications.^{26,27} Concerning postoperative complications, a systematic review of eight reports comparing open and laparoscopic APR found significantly fewer early postoperative complications in the Lap-APR group compared to the Open-APR group.²⁸ In our study, no significant difference was found in the incidence of such complications.

For patients with risk factors, such as multiple previous operations (≥ 3 operations) in the abdomen or pelvis, elderly patients who may not tolerate a pneumoperitoneum, and patients with advanced tumor characteristics with potential involvement of adjacent structures, surgeons are more likely to select the open procedure than the laparoscopic procedure. The factors that define a patient's risk profile were limited in our study, and selection bias was minimized by addressing a set of important variables predicting surgical risk and prognosis. Thus, patients undergoing open operations, who would have been unlikely to qualify for laparoscopy, were excluded, and the tendency for more high-risk patients in the open group was minimized.

The present study had some limitations. First, this was a retrospective study with a relatively small sample size. Second, the study group was not randomized. The proportion of patients treated via preoperative CRT was greater in the Lap-APR group than in the Open-APR group; therefore, selection bias might have existed.

A prospective randomized trial compared open surgery and laparoscopic surgery for mid and low rectal cancer after neoCRT (the COREAN trial) and reported that the quality of oncological resection was equivalent; however, safety was significantly greater with laparoscopic surgery than with open surgery, and laparoscopic surgery had short-term advantages, including lower blood loss and earlier recovery of bowel function.²⁹ We believe that the short-term advantages

in the Lap-APR group were not associated with the bias of preoperative CRT, but were associated with the laparoscopic surgery for anorectal cancer.

In conclusion, our single-center, retrospective study showed that among patients with stage II/III low rectal cancer requiring APR, laparoscopic surgery improved the duration of hospital stay and amount of blood loss with a clear circumferential resection margin, reasonable lymph node yield, and reasonable surgical complication rate. Additionally, the incidence of APR-specific surgical complications was comparable in the Lap-APR and Open-APR groups. Thus, Lap-APR may be a technically safe and feasible approach with lower blood loss, and shorter hospital stay compared to Open-APR.

Conclusions

Not all patients are suitable for Lap-APR such as patients with large tumors, a history of extensive adhesion, multiple cancers or distant metastasis, patients showing advanced tumor characteristics with potential involvement of adjacent structures. However, lap-APR may be a technically safe and feasible approach that shows lower blood loss, and shorter hospital stay compared to Open-APR.

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原 著

比較第二期和第三期直腸癌病人接受腹腔鏡和 剖腹腹部會陰聯合切除手術結果： 一個回顧性研究

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目的 這項回顧性研究的目的是比較第二期第三期直腸癌病人接受腹腔鏡和剖腹腹部會陰聯合切除手術在臨床結果做綜合討論。

方法 這項回顧性研究，共蒐集了七十二位第二期或第三期直腸癌病人，於 2005 年一月到 2015 年一月之間三十六位病人接受腹腔鏡腹部會陰聯合切除手術，三十六位病人接受剖腹腹部會陰聯合切除手術。

結果 兩組病人族群之間除了身體質量指數之外在腫瘤特性及獲取的淋巴結等並無明顯差異，接受腹腔鏡腹部會陰聯合切除手術的族群平均手術時間較長，失血量較少，平均住院天數較短，其他結果在兩個族群之間並無明顯差異。

結論 利用腹腔鏡手術實施腹部會陰聯合切除手術相對於剖腹腹部會陰聯合切除手術在技術上可行且安全，並且帶來較少失血量以及較短的住院天數。

關鍵詞 腹部會陰聯合切除手術、腹腔鏡、直腸癌、手術時間。