



Research Article

Volume 7 Issue 2 - September 2017
DOI: 10.19080/CTOIJ.2017.07.555707

Canc Therapy & Oncol Int J

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Comparison of Short and Long Term Outcomes for Open vs. Laparoscopic Assisted Abdominoperineal Resection for Rectal Cancer



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Submission: September 20, 2017; Published: September 25, 2017

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Abstract

Purpose: The present study compared the perioperative/postoperative and oncological outcomes of open abdominoperineal resections (APRs) to laparoscopic assisted APRs for rectal cancer.

Material and Methods: Between January 2001 and December 2014, 110 patients who underwent APRs for low rectal cancers (Open APRs; group I: 81 vs. Laparoscopic APRs; group II: 29) were retrieved from a prospective database.

Results: With a median follow up of 59.7 months. Mean operation times for groups I and II were 265.4min and 283.8min ($p = 0.987$). The mean blood losses were 666.9ml and 375.8ml ($p < 0.05$). Mean lengths of hospital stay were 27.7 days and 19.1 days ($p = 0.054$). Mean times to a soft diet were 7.22 days and 5.21 days ($p < 0.05$). Morbidity was not significantly different between the two groups. The 5-year overall survival rates for group I and group II were 66.3% and 78.0%, respectively ($p = 0.754$). The 5-year disease free survival rate was also comparable, being 64.8% (group I) vs. 67.3% (group II) ($p = 0.791$). The local recurrence rates were 9.9% vs. 3.4% ($p = 0.278$).

Conclusion: Based on the present data, laparoscopic assisted APRs have the benefits of less blood loss, time to diet, length of hospital stay, and lower wound infection rate compared to open APRs. Laparoscopic assisted APR has the benefits of short term outcomes and is feasible for rectal cancer surgery.

Keywords: Rectal cancer; Abdominoperineal resection; Open surgery; Laparoscopic surgery

Abbreviations: APRs: Abdomino Perineal Resections; CRT: Chemo Radiotherapy; TNM: Tumor Node Metastasis; AJCC: American Joint Committee on Cancer

Introduction

The abdominoperineal resection (APR) has been regarded as the gold standard for the surgical treatment of lower-lying rectal cancer (also for cases of sphincter or puborectal muscle invasion) [1]. APRs require the total mesorectal excision of the rectum and anal sphincters, resulting in the formation of a permanent colostomy. Laparoscopic surgery for colorectal cancer is being performed increasingly worldwide. In recent years, the results of a few large randomized trials were published; these results confirmed that perioperative outcomes were better after laparoscopic surgery of colon cancer compared to open surgery, but the morbidity and survival rates were not significantly different [2,3]. However, the role of minimally invasive (laparoscopic or robotic) surgery for rectal cancer is still debated, and oncologic safety is still controversial-although a few large randomized multicentric trials reported that laparoscopic surgery for rectal cancer does not increase the

morbidity rate and oncologic outcomes were not significantly different compared to open surgery [4-6].

APR is performed in the case of a distal margin that cannot be free, when the anal sphincters are infiltrated or when the sphincter functioning is impaired, even if the low anterior resection method is technically possible. There are a few studies that compare the short-term clinicopathologic outcomes and long-term oncologic outcomes between the laparoscopic and conventional open APR for lower-lying rectal cancer. The present study compared the perioperative/postoperative clinical and oncologic outcomes of open vs. laparoscopic assisted APR for low-lying rectal cancer.

Material and Methods

Between January 2009 and December 2014, all patients undergoing open APRs and laparoscopic assisted APRs for low

rectal adenocarcinomas were identified from a prospective database. The patients with stage IV cancer were excluded from the present study. All data of the clinical and pathological features were reviewed retrospectively. Five (6.2%) patients received neoadjuvant chemo radiotherapy (CRT) before surgery in the open APR group, and 12(41.4%) patients received CRT before surgery in the laparoscopic assisted APR group. These patients received neoadjuvant long course CRT (5-fluorouracil based chemotherapy, 50.4 Gy) as they were T3 or T4 and/or node positive. All patients underwent a colonoscopy and biopsy, staging scans (CT scan chest, abdomen and pelvis/MRI pelvis), and occasionally PET scans and an endorectal ultrasound. Repeat scans were performed a minimum of four weeks after finishing CRT. Surgery was performed 6-8 weeks after the completion of the CRT.

All patients received full bowel preparation and a single shot of prophylactic antibiotics. All patients underwent total mesorectal excision. Adjuvant chemotherapy was performed with 5-fluorouracil and a leucovorin-based regimen (six cycles of monthly bolus intravenous 5-fluorouracil [400-425 mg/m²/day], days 1-5, and leucovorin [20 mg/m²/day], days 1-5). The reasons for no postoperative adjuvant chemotherapy were high age, refusal, and side effects of the adjuvant chemotherapy. Patients received close follow ups and are recorded on a database until death or May 2016. Disease-free survival was defined as being from the date of surgery to the date of the detection of recurrence, the last follow-up, or death. Patients in the two groups undergoing open APRs and laparoscopic assisted APRs were compared with respect to demographics and oncologic outcomes. The present study is retrospective chart review study.

Operation Techniques (Laparoscopic Assisted APR)

The surgical procedure was divided into the abdomen phase and the perineum phase. All surgeries in the laparoscopic APR group were performed with laparoscopic assisted surgery at the abdomen phase. The 12mm camera port insertion was created by the open technique 2cm above the umbilicus and pneumoperitoneum. Three 5mm working ports were inserted at the right and left midclavicular line at the level of the umbilicus and at the left midclavicular line at the level of the anterior superior iliac spine. The 12mm working port was inserted at the right midclavicular line at the level of the anterior superior iliac spine. All surgeries were performed on the basis of the principles of a total mesorectal excision with pelvic autonomic nerve preservation. At the root of the inferior mesenteric artery, high ligation with principal lymph node re-trieval was performed. The rectum was mobilized by sharp dissection, and the visceral pelvic fascia enveloping the mesorectum was separated from the parietal fascia overlying the pelvic cavity under laparoscopic vision. The total mesorectal excision was finished when it approached the levator muscle in the abdomen phase.

The proximal colon was transected at the level of the pelvic floor, and the end colostomy was performed at the left lower

abdomen (5mm working port site). The wound was then closed at the abdomen. For the perineum phase, the anus was closed by suturing, and perineal dissection of the anal sphincter was performed between the anal verge and ischial tuberosity to the level where the ab-dominal procedure was terminated. While keeping the perineal body intact, the levator ani muscles were sufficiently excised to create a negative circumference resection margin.

Statistical Analysis

All statistical analyses were performed using SAS Version 9.1.3 (SAS Institute Inc., Cary, NC) and SPSS software, Version 24.0 (SPSS, Chicago, IL). Categorical variables were analyzed using the χ^2 or Fisher's exact test, and continuous variables were analyzed using the Student's test/Mann-Whitney U rank test. Cumulative-incidence methods were used to estimate the rate of cancer recurrence. Overall survival and disease-free survival were analyzed using the Kaplan-Meier method, and a comparison was performed using the log-rank test. P values less than 0.05 were considered statistically significant. The differences in overall and disease-free survival were assessed using the log-rank test.

Results

Patient's characteristics

Table 1: Patient characteristics (n=110).

	Open APR (n=81) (%)	Open APR (n=81) (%)	p value
Age(mean±SD,(range)) (year)	62.9±11.7(36-90)	61.0±12.1 (33-81)	0.486
Sex, n (%)			0.327
Male	53(65.4%)	16(55.2%)	
Female	28(34.6%)	13(44.8%)	
Weight(mean±SD,(range)) (kg)	59.9±9.4 (43.3-94.3)	58.6±10.6 (39.6-73.2)	0.217
Height(mean±SD,(range)) (cm)	160.5±8.5 (139.6-185.5)	160.2±10.4 (141.1-179.0)	0.081
BMI(mean±SD,(range)) (Kg/m ²)	23.3±3.2(17.9-31.8)	22.7±2.6(16.7-26.8)	0.200
ASA score, n (%)			0.390
1	53(65.4%)	20(68.9%)	
2	23(28.4%)	9(31.1%)	
3	5(6.2%)	0(0.0%)	
Previous operation history	3(3.7%)	1(3.4%)	0.950
Initial CEA	17.5±62.7 (0.5-68.1)	15.7±31.4 (0.0-138.1)	0.953
Preoperative CCRTx	5(6.2%)	12(41.4%)	Ns
Postoperative CCRTx	4(4.9%)	4(13.8%)	
Adjuvant chemotherapy	50(61.7%)	6(20.7%)	

Patient characteristics were analyzed comparing the open APR group (group I) and laparoscopic assisted APR group (group II) (Table 1). Eighty-one patients were in group I, while 29 patients belonged to group II. Mean age, sex ratio, height, weight, BMI, ASA scores, previous operation history, and initial CEA were not significantly different between the groups. Five patients (6.2%) who received neoadjuvant CRT were in group I, and 12 patients (41.4%) who received neoadjuvant CRT were in group II. Four patients (4.9%) who received postoperative CRT were in group I, and four patients (13.8%) who received postoperative CRT were in group II. Adjuvant chemotherapy was performed on 50 patients (61.7%) in group I and six patients (20.7%) in group II. All of group I had surgery performed on them in the lithotomy position. Perineal dissection was performed on 16 patients (55.2%) in a prone position, and perineal dissection was performed on 13 patients (44.8%) in a lithotomy position in group II (Table 1).

Pathologic Results

Table 2: Postoperative pathologic outcomes.

	Open APR (n=81) (%)	Laparoscopic APR (n=29) (%)	p value
pTNM stage, no. (%) CR			0.056
I	1(1.2%)	2(6.9%)	
IIa	35(43.2%)	4(13.8%)	
IIb	2(2.5%)	1(3.5%)	
IIIa	2(2.5%)	0(0.0%)	
IIIb	26(32.1%)	12(41.4%)	
IIIc	7(8.6%)	3(10.3%)	
pT stage, no. (%) CR			0.082
1	1(1.2%)	2(6.9%)	
2	9(11.1%)	5(17.2%)	
3	64(79.0%)	16(55.2%)	
4	6(7.4%)	4(13.8%)	
pN stage, no. (%)			0.318
0	46(56.8%)	14(48.3%)	
1a	11(13.6%)	9(31.0%)	
1b	11(13.6%)	2(6.9%)	
1c	1(1.2%)	0(0.0%)	
2a	5(6.2%)	1(3.5%)	
2b	7(8.6%)	3(10.3%)	
Grade of differentiation, no. (%)			0.139
Well	13(16.0%)	4(13.8%)	
Moderate	53(65.4%)	22(75.9%)	
Poor	9(11.1%)	2(6.9%)	
Mucinous Signet ring cell	0(0.0%) 0(0.0%)	0(0.0%) 1(3.4%)	

Harvested no. of lymph nodes, (mean± SD, range), (No)	15.3±10.1 (0-33)	21.5±13.3 (0-47)	0.315
Lymphovascular Invasion			0.625
-	54 (66.7%)	21 (72.4%)	
+	27 (33.3%)	8 (27.6%)	
PRM, (mean± SD, range), (cm)	21.7±8.7(4.5-30.0)	17.3±7.8(7.0-30.3)	0.716
DRM, (mean± SD, range), (cm)	4.4±1.9 (0.5-8.5)	2.9±1.3 (0.2-5.0)	0.052
Mass size	4.7±2.3 (1.5-8.5)	4.5±2.4 (0.7-9.8)	0.772
CRM 1 mm < 1 mm ≥	6(7.4%) 75(92.6%)	0(0.0%) 29(100.0%)	0.168

The tumor-node-metastasis (TNM) stage, pT stage, pN stage, and pM stage, according to the 7th American Joint Committee on Cancer (AJCC) and histologic grade of differentiation, were not significantly different between both groups. The mean number of harvested lymph nodes was 15.3±10.1 in group I and 21.5±13.3 in group II (p = 0.315). The mean proximal resection margins in group I and group II were 21.7±8.7cm and 17.3±7.8cm, respectively (p = 0.716). The mean distal resection margins were 4.4±1.9cm and 2.9±1.3cm, respectively (p = 0.052). The mean specimen mass sizes were 4.7±2.3cm in group I and 4.5±2.4cm in group II (p = 0.772). The lymphovascular invasion rates were 33.3% in group I and 27.6% in group II, and they were not significantly different (p = 0.716). The circumferential resection margin positive rate was 7.4% in group I and 0% in group II (p = 0.168) (Table 2).

Perioperative/Postoperative Outcomes According to Position

The mean operation time was 265.4±58.2 min in group I and 283.8±56.6 min in group II (p = 0.987). The mean blood loss was 666.9±355.1ml in group I and 375.8±222.7ml in group II (p = 0.047). The mean length of hospital stay was 27.7±10.4days in group I and 19.1±6.4 days in group II (p = 0.054). The mean time to sips of water was 4.80±1.7days in group I and 1.59±0.8 days in group II (p = 0.043). The mean time to a liquid diet was 6.06±1.7 days in group I and 4.10±0.9days in group II (p = 0.032). The mean time to a soft diet was 7.42±2.1days in group I and 5.21±0.9days in group II (p = 0.026). The perioperative/postoperative complication rate was not significantly different between the two groups (p = 0.777).

Urinary dysfunction was present in seven patients (8.7%) in group I and in two patients (6.8%) in group II (p = 0.769). Voiding difficulty was observed in five patients (6.2%) in group I and in one patient (3.4%) in group II. Frequency of voiding was in one patient (3.4%) in group II. Voiding incontinence was observed in two patients (2.5%) in group I. Impotence was in one patient

(3.4%) in group II (p = 0.093). Ileus was observed in four patients (4.9%) in group I (p = 0.293). Wound infection were observed in seven patients (8.6%) in group I (p = 0.102). An intra-abdominal abscess, peri-anal abscess, and gastrointestinal bleeding were in one patient (1.2%) in group I (p = 0.548). Sepsis was in two patients (2.5%) in group I (p = 0.393) (Table 3).

Table 3: Peri-postoperative outcomes at open versus laparoscopic APR.

	Open APR (n=81) (%)	Laparoscopic APR (n=29) (%)	P value
Operation time (min)	265.4±58.2 (235-450)	283.8±56.6 (190-400)	0.987
Blood loss (ml)	666.9±355.1 (100-1500)	375.8±222.7 (100-1000)	0.047
Length of hospital stay (day)	27.7±10.4(10-71)	19.1±6.4(11-31)	0.054
Time to sips of water (day)	4.80±1.7	1.59±0.8	0.043
Time to liquid diet (day)	6.06±1.7	4.10±0.9	0.032
Time to soft diet (day)	7.42±2.1	5.21±0.9	0.026
Total Morbidity (n; %)	23(28.4%)	3(10.3%)	0.777
Urinary dysfunction			0.769
Voiding difficulty	5(6.2%)	1(3.4%)	
Frequency			
Voiding incontinence	0(0.0%)	1(3.4%)	0.093
Importance	2(2.5%)	0(0.0%)	
Ileus	0(0.0%)	1(3.4%)	0.293
Wound infection	4(4.9%)	0(0.0%)	0.102
Intraabdominal abscess	7(8.6%)	0(0.0%)	0.548
Perianal abscess	1(1.2%)	0(0.0%)	0.548
Gastrointestinal bleeding	1(1.2%)	0(0.0%)	0.393
Sepsis	2(2.5%)	0(0.0%)	

Oncologic Outcomes

The mean follow-up period was 59.7 months. The five-year overall survival rates for group I and group II were 66.3% and 78.0%, respectively (p = 0.754). The five-year disease-free survival rate was also comparable, with 64.8% (group I) vs. 67.3% (group II) (p = 0.791) (Figure 1). Systemic recurrence was 25.9% in group I and 20.7% in group II (p = 0.659). The organs of systemic recurrence were the lungs, liver, para-aortic node, spine, and inguinal lymph node. The recurrence of the lung was observed in 10 patients (12.3%) in group I and in four patients (13.7%) in group II. The recurrence of the liver was observed in six patients (7.4%) in group I. The recurrence of the para-aortic node was observed in two patients (2.5%) in group I and in one patient (3.4%) in group II. The systemic recurrence of the spine was observed in one patient (1.2%) in group I and in one patient (3.4%) in group II. The systemic recurrence of the inguinal node was observed in one patient (1.2%) in group I and in one patient (3.4%) in group II. The local recurrence rate was 9.9% (group I) vs. 3.4% (group II) (p = 0.278). The sites of local recurrence were the pelvic side wall, the perineum, and the rectal fossa (Table 4).

Table 4: Recurrence pattern of open versus laparoscopic APR.

	Open APR (n=81) (%)	Laparoscopic APR (n=29) (%)	p value
Systemic recurrence	21(25.9%)	6(20.7%)	0.659
Lung	10(12.3%)	4(13.7%)	
Liver	6(7.4%)	0(0.0%)	
Para aortic node	2(2.5%)	1(3.4%)	
Spine			
Inguinal node	1(1.2%)		
	1(1.2%)	1(3.4%)	
	1(3.4%)		
Local recurrence	8(9.9%)	1(3.4%)	0.278
Pelvic side wall	0(0.0%)	1(3.4%)	
Perineum			
Rectal fossa	3(3.7%)		
	5(6.2%)	0(0.0%)	
	0(0.0%)		
Total Number of Recurrence	29(35.8%)	8(27.6%)	

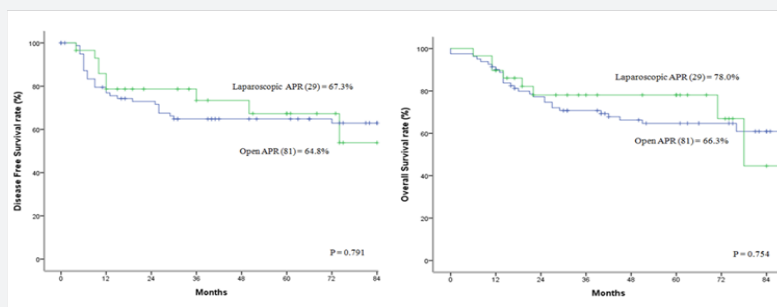


Figure 1: Comparison of 5-year disease free survival rate and 5-year overall survival rate after APR for rectal cancer.

Discussion

For patients with low-lying rectal cancer, APR is still the standard surgical option because there are patients who cannot be treated with sphincter preserving surgery, although neoadjuvant chemo radiotherapy is performed [7]. The role of minimally invasive surgery for the treatment of rectal cancer is still debated. There is controversy as to the quality of total mesorectal excision, local recurrence rate, and the survival rate after laparoscopic surgery for rectal cancer because the total mesorectal excision preserving the pelvic plexus should be performed within the narrow pelvic cavity. According to a meta-analysis of short-term results from multiple non-randomized and randomized trials, laparoscopic resection of rectal cancer has been proven to be feasible and safe, reducing risks of postoperative morbidity and mortality [8,9].

Minimally invasive approaches to surgery for colorectal cancer are thought to offer advantages compared to open surgery; the advantages regard outcomes such as length of stay, return to normal activity, and incisional pain [10-14]. Nevertheless, there are few studies of reported perioperative or postoperative outcomes and long-term oncologic outcomes of laparoscopic APR for lower-lying rectal cancer. In the present study, the perioperative outcomes of the laparoscopic APR group reported less blood loss (666.9 vs. 375.8ml, $p = 0.047$) and shorter time to diet (7.42 vs. 5.21 days, $p = 0.026$) compared to the open APR group. In addition, a shorter hospital stay (27.7 vs. 19.1 days, $p = 0.054$) was observed in the laparoscopic APR group. These results suggest that the laparoscopic assisted APR could allow a faster return of the bowel function and earlier mobilization when compared with open APR.

In addition, laparoscopic assisted APR has the benefits of a lower wound infection rate compared to open APR. An important advantage of laparoscopic APR is the fact that extensive abdominal incisions are avoided; the cosmetic effect is satisfactory, and postoperative pain is less extensive, enabling a faster return to physical activity. The COLOR II trial, phase 3 trial reported that the laparoscopic surgery group lost less blood (200 mL vs. 400 mL, $p < 0.0001$), the bowel function returned sooner (2.0 days vs. 3.0 days, $p < 0.0001$), and the hospital stay was shorter (8.0 days vs. 9.0 days, $p = 0.036$). The COLOR II trial included 200 patients (29%) who underwent laparoscopic APRs and 80 patients (23%) who underwent open APRs [15].

The COREAN trial (Comparison of Open versus laparoscopic surgery for mid and low Rectal cancer After Neoadjuvant chemo radiotherapy trial), which was an open label randomized controlled trial, reported that the laparoscopic group had less blood loss (200.0mL vs. 217.5mL, $p = 0.006$), an earlier recovery of bowel functions (time to pass first flatus, 38.5 h vs. 60.0 h, $p < 0.0001$), time to normal diet (85.0 h vs. 93.0 h; $p < 0.0001$), time to first defecation (96.5 h vs. 123 h, $p < 0.0001$), and a better physical functioning score (0.501 vs. 4.970, $p = 0.0073$) compared

to open surgery. This trial included 24 patients (14.1%) who underwent laparoscopic APRs and 19 patients (11.2%) who underwent open APRs [16].

A single center, retrospective, case-matched study reported that low rectal cancer patients who underwent laparoscopic APRs demonstrated an improved postoperative recovery (time to first pass of flatus, urinary drainage, and postoperative hospital stay) as well as similar risks of complications compared to patients who underwent open APRs [17]. In the other single center study, a prospective randomized trial reported that laparoscopic APRs achieved a better postoperative recovery due to the earlier return of bowel functions ($p < 0.001$), mobilization ($p = 0.005$), and less analgesic requirement ($p = 0.007$) compared open APRs. There were no differences in morbidity and operative mortality rates between the two groups [18].

The number of harvested lymph nodes is an important indicator in evaluating the radical curative resection of colorectal cancer surgery, and the circumferential resection margin positivity has a notable significance for the evaluation of the prognosis of colorectal cancer surgery [19,20]. In the present study, the number of harvested lymph nodes was not significantly different between the two groups (open APRs: 15.3 vs. laparoscopic APRs: 21.5, $p = 0.315$). In addition, circumferential resection margin positivity was not significantly different between the two groups (open APRs: 7.4% vs. laparoscopic APRs: 0%, $p = 0.168$).

In long-term oncologic outcomes, many studies have confirmed the oncologic adequacy of laparoscopic surgery for rectal cancer [21-24]. In the present study, with a median follow up of 59.7 months, oncologic outcomes were not significantly different between the laparoscopic APRs and the open APRs. The five-year overall survival rates for laparoscopic APRs and open APRs were 66.3% and 78.0%, respectively ($p = 0.754$). The five-year disease-free survival rate was also comparable, 64.8% (laparoscopic APRs) vs. 67.3% (open APRs) ($p = 0.791$). Local recurrence rate was 9.9% vs. 3.4%, respectively ($p = 0.278$). The three-year results of the CLASICC trial revealed no difference in overall survival rates (open APRs: 57.7% vs. laparoscopic APRs: 65.2%, log-rank = 0.69; $p = 0.41$), disease-free survival rates (open APRs: 46.9% vs. laparoscopic APRs: 49.8%, log-rank = 0.22; $p = 0.64$), and local recurrence rates (open APRs: 21.1% vs. laparoscopic APRs: 15.1%; log-rank = 0.52; $p = 0.47$) in rectal adenocarcinoma patients who underwent laparoscopic APRs compared to conventional APRs [25].

The COREAN trial also revealed no difference in the three-year overall survival rates (open APRs: 90.4% vs. laparoscopic APRs: 91.7%) and disease-free survival rates (open APRs: 72.5% vs. laparoscopic APRs: 79.2%) [26]. A single center study has also shown in a prospective randomized trial on 99 cases with low rectal adenocarcinoma, that the five-year overall survival rates (75.2% vs. 76.5%, $p = 0.20$) and the disease-free survival rates

(78.1% vs. 73.6%, $p = 0.55$) were comparable in the laparoscopic assisted and open APR groups [18].

The present study has several limitations, including being a retrospective study, significant selection biases, a small sample size, and low numbers of patients who received adjuvant chemotherapy. There are several factors that affect the oncologic outcome in treatment of colon cancer. And also incidence and mortality rates are very different by age, gender, race, ethnicity, especially by countries. Nevertheless, the present study has tried to minimize such bias. All patients in the present study are South Koreans and all surgeries were performed in one hospital. The present study was a comparison between the two groups in these patients, and several factors affecting results were no significant difference between the two groups.

In conclusion, based on present data, laparoscopic assisted APRs were a safe and feasible procedure for the treatment of rectal cancer. Laparoscopic assisted APRs have the benefits of less blood loss, a shorter time to diet, a shorter length of hospital stay, and a lower wound infection rate compared to open APRs. Oncologic outcomes of open APRs and laparoscopic assisted APRs were not significantly different.

Conflict of Interest

No potential conflicts of interest relevant to the present article were reported. This work was supported by the Soonchunhyang University Research Fund.

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DOI: [10.19080/CTOIJ.2017.07.555707](https://doi.org/10.19080/CTOIJ.2017.07.555707)

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