

Retrospective Study

Clinical comparison of laparoscopy vs open surgery in a radical operation for rectal cancer: A retrospective case-control study

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Abstract

AIM: To assess the diverse immediate and long-term clinical outcomes, a retrospective comparison between laparoscopic and conventional operation was performed.

METHODS: A total number of 916 clinical cases, from January 2006 to December 2013 in our hospital, were analyzed which covered 492 patients underwent the laparoscopy in radical resection (LRR) and 424 cases in open radical resection (ORR). A retrospective analysis was proceeded by comparing the general information, surgery performance, pathologic data, postoperative recovery and complications as well as long-term survival to investigate the diversity of immediate and long-term clinical outcomes of laparoscopic radical operation.

RESULTS: There were no statistically significance differences between gender, age, height, weight, body mass index (BMI), tumor loci, tumor node metastasis stages, cell differentiation degree or American Society of Anesthesiologists scores of the patients ($P > 0.05$). In contrast to the ORR group, the LRR group experienced less operating time ($P < 0.001$), a lower blood loss ($P < 0.001$), and had a 2.44% probability of conversion to open surgery. Postoperative bowel function recovered more quickly, analgesic usage and the average hospital stay ($P < 0.001$) were reduced after LRR. Lymph node dissection during LRR appeared to be slightly more than in ORR ($P = 0.338$). There were no obvious differences in the lengths and margins ($P = 0.182$). And the occurrence rate in the two groups was similar ($P = 0.081$). Overall survival rate of ORR and LRR for 1, 3 and 5 years were 94.0% and 93.6% ($P = 0.534$), 78.1% and 80.9% ($P = 0.284$) and 75.2% and 77.0% ($P = 0.416$), respectively.

CONCLUSION: Laparoscopy as a radical operation for rectal cancer was safe, produced better immediate outcomes. Long-term survival of laparoscopy revealed that it was similar to the open operation.

Key words: Laparoscopic; Open surgery; Short-term outcomes; Long-term outcomes; Rectal cancer

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Core tip: This is a retrospective case-control study between laparoscopic surgery and open surgery in rectal cancer. There are 916 clinical cases, collecting from January 2006 to December 2013 in our hospital, which covered 492 cases in laparoscopic group and 424 cases in open group. We compared the general information, surgery performance, pathologic data, postoperative recovery and complication as well as the long-term survival of the patients. And then we concluded that laparoscopy can produce better immediate outcomes in rectal cancers. And the long-term survival of laparoscopy was similar to the open operation.

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INTRODUCTION

It has been estimated that about 1.4 million new cases of colorectal cancer are diagnosed worldwide and nearly 0.7 million colorectal cancer-related deaths occur, of which about 33% are due to rectal cancer^[1]. Owing to the restriction of surgery and medicine the

prognoses of rectal cancer patients are critically poor, with up to 40% locoregional recurrence and less than a 50% 5-year survival rate before the 1980s^[2]. With improvement of surgery and treatment with neoadjuvant chemoradiotherapy, radiotherapy and immune therapy, the recurrence rates have been reduced with survival rates now greater than 70%^[3].

It is more than 20 years since laparoscopy was applied to the treatment of malignant colorectal cancer by Jacobs and others^[4]. With improved techniques and updated surgical instruments, laparoscopy is more widely used to treat rectal cancer. Its principal advantages are its clear view and reduced wounding, less interference to the immune system, quick post-operative recovery and a lower overall operating expense^[5-7]. Yet many controversies remain whether laparoscopy, although minimally invasive, is inferior to conventional open surgery for the long-term treatment of this serious cancer. For example, it has been suggested that laparoscopy may stimulate tumor invasion and metastasis. Most large scale randomized controlled trials (RCT) worldwide have conducted research [conventional vs laparoscopic-assisted surgery in colorectal cancer (CLASICC), colorectal cancer laparoscopic or open resection (COLOR), etc.] on colon rather than rectal cancer. In 2013, National Comprehensive Cancer Network tended to recommend laparoscopy for rectal cancer patients with clinical research trials encouraged to compare laparoscopic and conventional operations.

A large body of research exists, which involved a comparison between laparoscopic and open radical resection for rectal cancer^[8]. The research included resection margin length of both sides, mesentery length and the number of lymph nodes retrieved, which suggested the same effectiveness of radical laparoscopy to an open operation^[9,10]. However, laparoscopic surgery also has the advantage of less trauma, less pain postoperatively and a reduced hospital stay for patients. In previous years, laparoscopy took longer than open section surgery but now laparoscopy can be completed in about the same time as open section, mainly due to the accumulation of practical surgical experience using this technique; one additional benefit is the reduced occurrence of complications^[11]. Research on the long-term curative effect has revealed closely similar 1-, 3- and 5-year survival rates of laparoscopic rectal cancer surgery compared to open resection^[6,12-14]. Earlier research found a high incidence of postoperative implantation metastasis and peritoneal implantation metastasis after laparoscopic radical surgery for rectal cancer^[15]. But recent research has reported a similar implantation metastasis incidence for laparoscopic and open section^[16]. It was assumed that earlier outcomes could have been related to the neglect of tumor-free principles during the operations.

RCT research includes that of Milson, Schwandner,

CLASICC^[9,10,17] and others, who reached the conclusion of the similar long-term benefits of laparoscopic and open resection for rectal cancer. Leung also concluded that there were similar long-term effects of laparoscopic and conventional surgery for recto sigmoid colon cancer^[16]. The RCT research focused on laparoscopic and open section for rectal tumors, which was conducted by Gong, Park and the COLOR II stage experiments are still in progress^[13,18,19]. From the perspective of evidence-based medicine, a RCT outcome based on large number of cases should prove the long-term efficacy or otherwise of a laparoscopic radical operation for rectal cancer.

MATERIALS AND METHODS

Patients

Between January 2006 and December 2013, 492 patients in group LRR and 424 patients in group ORR in the Shanghai First People's Hospital Affiliated Shanghai Jiao Tong University were enrolled in our study. Open surgeries (OP) and laparoscopic-assisted surgeries (LAP) were performed by the same surgical teams, respectively. Two groups of patients underwent preoperative colonoscopy and had biopsy-proven adenocarcinoma. The trial received approval from the Shanghai First Peoples' Hospital Affiliated Shanghai Jiao Tong University research ethics committee and prior written informed consent was obtained from all patients.

Patients diagnosed with rectal cancer without other serious diseases were included in the study. Patients with distant metastasis of the tumor or associated malignant tumor; intestinal obstruction; recurrence of the tumor or other digestive system malignancy; those who had a palliative operation for the tumor which could not be resected or had widespread metastasis in the abdominal cavity, were excluded from the study.

Preoperative preparation and operation procedures

Both groups had preoperative fiber colonoscopy and biopsy for pathology confirmation of a clear diagnosis of rectal cancer. Preoperative staging was evaluated by enhanced CT or MRI scanning of the abdomen and pelvis, as well as chest X-ray films, ultrasonography or other assisted auxiliary examination. Both teams employed preoperative intestinal preparations: twice oral gentamicin 80000 U/d, 3 times 0.4 g oral metronidazole for 3 d, and 1 d fluid food before surgery. Polyethylene glycol-electrolyte powder was given to prepare the bowel.

Both groups were operated on by a fixed team of experienced physicians. Under the tumor-free technique principle, the operation should be performed based on colorectal cancer radical excision and rectal tumor patients should be operated according to TME principles. The preoperative preparation of the laparoscopy group closely mimicked the open

resection group. Patients were placed in the bladder lithotomy position, with tracheal intubation anesthesia and a pneumoperitoneum established under a maintained pressure of 10-14 mmHg. The 5-trocar technique was adopted by using an ultrasound knife to incise the sigmoid right-sided mesentery and clear the peritoneum to free up presacral space to the right side of the rectum. A medical grasper was used to retract the superior rectum vessels and was directed upwards in a retrograde direction to facilitate separation of the left-sided Toldt anadesma, reveal the ureter and bare the root of the upper mesentery artery. A part of the upper mesentery artery and the inferior mesenteric aorta in the horizontal position was separated using a titanium clamp. Downward pressure was used to separate the presacral space and remove the peritoneum from the right side of the rectum. The sigmoid was isolated and the peritoneum removed to the left side of the rectum and also the anterior sacral fascia to protect the hypogastric nerve and plexus. Next, the antetheca denonvillier fascia was separated as well as the right and left ligament down to the pelvic floor, and a further incision made 3-5 cm below the umbilicus in the center. Through this incision, gradually the rectal tumor was removed in the same way as during an open operation. Subsequently, an intestinal anastomosis was completed or an enterostomy, and the pelvic region rinsed with copious quantities of distilled water to decrease the growth of cancer cells. A regular drainage tube was indwelled close to the anastomotic area and was routed to the lower abdomen or ischiorectal fossa. Open section mainly used a high frequency electric knife and the operative principle and methods were identical to LRR operated group.

Perioperative surveillance, postoperative management and follow-up evaluation

Common data included gender, age, height, weight, body mass index (BMI), tumor location, tumor node metastasis (TNM) staging, cell differentiation grade, American Society of Anesthesiologists (ASA) scores and so on. The operative index included the time to complete the operation, blood loss, sample lengths, average retrieved lymph node numbers and the conversation rates. The postoperative pain score on day 1 was adopted as the basis of a numerical rating scale. The degree of pain was assessed by a number from 0 to 10 in which 0 was pain-free and 10 was the highest pain intensity experienced by patients. Individual patients specified their degree of pain: 0-4 was mild pain; 5-6 medium pain, and 7-10 severe pain. Postoperative data was recorded which included comprised peristalsis recovery time, exsufflation time, time until off-bed, time until the first liquid and semi-liquid intake, duration of hospital stay and the overall hospitalization duration.

FOLFOX plan, XELOX plan and the Capecitabine

Table 1 Clinical comparison of radical operation data for rectal cancer

	LRR (n = 492)	ORR (n = 424)	P value
Gender			
Male	301	243	0.235
Female	191	181	
Age (yr, mean ± SD)	64.5 ± 11.9	63.3 ± 12.3	0.290
BMI (kg/m ²)	23.274 ± 3.463	23.438 ± 3.533	0.999
Preoperative comorbid diseases	52.8% (260/492)	58.7% (249/424)	0.074
Hypertension	60	57	
Coronary heart disease	37	34	
Arrhythmia	21	20	
COPD	10	13	
Pulmonary infection	3	5	
Asthma	2	3	
Diabetes	42	70	
Hepatic cirrhosis	4	3	
Cerebral infarction	20	6	
Renal failure	17	7	
Autoimmune	5	0	
Others	39	31	
ASA score			0.498
I	109	108	
II	321	264	
III	62	52	
Previous abdominal surgery	75 (15.2%)	65 (15.3%)	0.971

LRR: Laparoscopy in radical resection; ORR: Open radical resection; BMI: Body mass index; COPD: Chronic obstructive pulmonary disease; ASA: American Society of Anesthesiologists.

plan were regularly deployed in postoperative chemotherapy for 6 mo, apart from cancer stage 0 and I. The postoperative follow-up commonly involved a clinical visit or telephone follow-up. As of 28th February 2014, the shortest follow-up duration was 2 mo, the longest 109 mo and the average 55 mo, with a 95.1% follow up success rate.

Statistical analysis

SPSS Statistics for Windows, Version 17.0 (SPSS, Inc., Chicago, IL, United States) was used for analyses. A *t*-test was used to analyze normally distributed data and a Mann-Whitney *U*-test for other types of distributions. A χ^2 test was used to analyze count data. $P < 0.05$ was considered to be statistically significant. The survival curves for two group were used Kaplan-Meier method, and the log-rank test was applied to analyze the differences between the results.

RESULTS

Clinical data of patients

Of the 916-recorded cases, 492 cases were LRR. There were 301 males and 191 females, aged 64.5 ± 11.9, BMI index 23.274 ± 3.463, I stage 93 cases, II stage 218 cases and III stage 181 cases in TNM staging, with one-score for 109 cases, two-scores for 321 cases and three-scores for 62 cases in ASA assessments. In 424 cases in the ORR group, there were 243 males and 181 females, aged 63.3 ± 12.3, BMI index 23.438 ±

Table 2 Surgery index

	LRR (n = 492)	ORR (n = 424)	P value
Surgery duration (min)	143.89 ± 50.865	164.86 ± 67.993	< 0.001
Surgery bleeding (mL)	111.54 ± 97.148	154.03 ± 154.545	< 0.001
Maximum incision (cm)	4.14 ± 0.738	13.8 ± 2.603	< 0.001
Conversions to open	12 (2.4%)		
Tumor diameter (cm)	4.338 ± 1.6387	4.325 ± 1.8274	0.914
Sample length(cm)	18.050 ± 5.1748	17.553 ± 5.7995	0.182
Proximal margin (cm)	10.487 ± 4.2906	10.673 ± 5.2175	0.567
Distal margin (cm)	3.214 ± 1.8727	2.873 ± 2.4913	0.022
Lymph nodes retrieved (unit)	11.09 ± 6.503	10.68 ± 6.321	0.338

LRR: Laparoscopy in radical resection; ORR: Open radical resection.

3.533, I stage 83 cases, II stage 211 and III stage 130 cases in TNM staging, with one-score 108 cases, two-score 264 and three-score 52 cases in ASA scores. The cases of previous abdominal surgery in ORR and LRR group were 75 and 65. There was comparability between the two groups in terms of age, gender, tumor staging, ASA scores and so on ($P > 0.05$; see Table 1).

Comparison of LRR and ORR operations

The operation time of LRR was shorter than ORR (143.89 ± 50.865 min vs 164.86 ± 67.993 min), with a difference that reached statistical significance ($P < 0.001$). ORR produced more blood loss than LRR (111.54 ± 97.148 mL vs 154.03 ± 154.545 mL) and the difference was statistically significant ($P < 0.001$). Proximal and distal margins for both samples were negative. The sample length obtained from LRR and ORR were not significantly different ($P = 0.182$) but the distal margin of LRR was longer compared to ORR (3.214 ± 1.8727 cm vs 2.873 ± 2.4913 cm) the difference being statistically significant ($P = 0.022$). The average retrieved lymph node numbers during LRR appeared to be slightly above ORR but it was not statistically different ($P = 0.338$). In LRR there were 12 cases of conversion (2.4% conversion rate) to open resection comprising 1 case of surgical bleeding, 6 cases of tight adhesion between the tumor and surrounding tissues and 5 cases of serious abdominal and pelvic adhesion. Table 2 summarizes these operative results.

Pathology findings

After postoperative pathology, 88 cases were well-differentiated, 285 cases moderately-differentiated, 86 cases poorly-differentiation and 33 cases of mucinous cancer in LRR, while 92 cases were well-differentiated, 237 moderately-differentiated, 72 cases poorly-differentiated and 23 cases of mucinous cancer in ORR. The differences were not statistically significantly different ($P = 0.476$). For TNM staging, LRR contained 93 cases of I stage, 218 cases of II stage and 181 cases of III stage while ORR were 83 cases of I stage, 211 cases of II stage and 130 cases

Table 3 Pathology findings

	LRR	ORR	χ^2	P value
Differentiation			2.495	0.476
Well-differentiated	88	92		
Moderate-differentiation	285	237		
Poorly-differentiated	86	72		
Mucinous cancer	33	23		
pT			7.468	0.058
T1	33	29		
T2	164	108		
T3	207	193		
T4	88	94		
pN			6.865	0.076
N0	252	233		
N1	147	96		
N2	75	73		
Nx	18	22		
Lymph node metastasis				0.259
Yes	240	191		
No	252	233		
TNM stage				0.134
I	93	83		
II	218	211		
III	181	130		

pT: Pathology Tumor; pN: Pathology Node; pM: Pathology metastasis; TNM: Tumor node metastasis.

of III stage cancer, but the apparent differences were not statistically significant ($P = 0.134$). Table 3 shows the results in detail.

Perioperative complications

There were 95 cases of perioperative complications (19.3% incidence rate) for LRR which included: 3 cases of ureter injury, 2 cases of massive hemorrhage, 7 cases of postoperative bleeding, 3 cases of anastomotic hemorrhage, 24 cases of anastomotic leakage, 7 cases of incisional infection, 8 cases of ileus, 1 case of pelvic abscess, 8 cases of pulmonary infection, 2 cases of acute cardiac failure, 1 case of deep vein thrombosis, and 1 case of lymphatic fistula. For ORR, with (a 24.1% occurrence rate) there were 102 cases of perioperative complications in the ORR group, which were: 1 case of ureter injury, 15 cases of anastomotic leakage, 27 cases of incisional infection, 1 case of postoperative pelvic abscess, 9 cases of inflammatory ileus, 10 cases of acute cardiac failure and 2 cases of sudden death. The incidence rate of perioperative complications in the LRR and ORR groups were not significantly different ($P = 0.081$). Table 4 shows the results in detail.

Postoperative recovery

The duration of LRR was distinctly shorter than ORR in terms of peristalsis recovery ($P < 0.001$), off-bed time ($P = 0.017$), gastrointestinal decompression ($P < 0.001$), retention catheterization ($P < 0.001$), oral food time ($P < 0.001$), abdominal drainage ($P = 0.008$), hospital stay ($P < 0.001$) and various other aspects. The difference in duration for the two groups

was statistically different. Table 5 shows the detailed results.

Postoperative analgesics and pain scores

LRR was significantly less than ORR in terms of the requirement for postoperative analgesic administration ($P < 0.001$). The difference in the NRS postoperative pain score between the 2 groups was statistically significant showing that the degree of postoperative pain for LRR was evidently less than that after ORR (Table 6).

Economic cost

The overall hospitalization cost for LRR and ORR was little different because although the operation costs of LRR were more than ORR, the cost of medication for LRR was lower than ORR. Thus, overall there was no statistically significant difference between the costs of the operation as detailed in Table 7.

Post-operation survival

A 95.1% patient follow-up was achieved with an average duration time of 55 mo. For the total survival rate, the 1-year overall survival rate for ORR and LRR was 94.0% and 93.6% ($P = 0.534$), 3-year overall survival rate 78.1% and 80.9% ($P = 0.284$) and the 5-year overall survival rate 75.2% and 77.0% ($P = 0.416$), respectively. In stage I, the 1-year overall survival rate for ORR and LRR was 93.8% and 99.2% ($P = 0.402$), 3-year survival rate 91.6% and 90.3% ($P = 0.774$) and the 5-year survival rate 89.2% and 88.2% ($P = 0.837$), respectively. In stage II, the 1-year overall survival rate for ORR and LRR was 92.8% and 94.7% ($P = 0.489$), 3-year survival rate 79.1% and 86.2% ($P = 0.052$) and the 5-year survival rate 76.8% and 81.7% ($P = 0.140$), respectively. For Stage III, the 1 year overall survival rate for ORR and LRR was 87.8% and 91.9% ($P = 0.178$), the 3-year survival rate 69.2% and 70.7% ($P = 0.777$) and the 5-year survival rate 65.4% and 66.9% ($P = 0.787$), respectively. Refer to Table 8 and the survival curves in Figures 1A-D for the relevant data.

DISCUSSION

Due to advances in surgical techniques and medication, the outcomes of rectal cancer treatment have considerably improved^[20]. In spite of various published studies^[3,13] concerning the similar long-term outcomes of rectal cancer produced by laparoscopic surgery, the argument for choosing laparoscopy or open surgery is still heated. In the latest randomized trial for rectal cancer, it was reported that the disease-free survival (DFS) and overall survival rates for LRR and ORR group were similar^[20]. In our current trial, we studied the advantages and disadvantages of laparoscopic vs an open operation, and have retrospectively compared perioperative complications, postoperative recovery,

Table 4 Perioperative complications for the 2 groups *n* (%)

	LRR (<i>n</i> = 492)	ORR (<i>n</i> = 424)	χ^2	<i>P</i> value
Occurrence rate of perioperative complications	19.3% (95/492)	24.1% (102/424)	3.041	0.081
Intraoperative complications	10 (2)	4 (0.9)	1.795	0.180
Massive hemorrhage (> 1000 mL)	2 (0.41)	1 (0.24)		
Organ injury	3 (0.61)	2 (0.47)		
Equipment disorders	4 (0.81)	0		
Other	3 (0.61)	1 (0.24)		
Post-operative complications	85 (17.3)	98 (23.31)	4.853	0.028
Anastomotic leakage	24 (4.88)	15 (3.54)		
Wound infection	7 (1.42)	27 (6.37)		
Ileus	8 (1.63)	9 (2.12)		
Anastomotic hemorrhage	3 (0.61)	2 (0.47)		
Pelvic abscess	1 (0.20)	1 (0.24)		
Abdominal hemorrhage	7 (1.42)	4 (0.94)		
Peritonitis/septic shock	9 (1.83)	7 (1.65)		
Incisional/port herniation	4 (0.81)	10 (2.36)		
Deep vein thrombosis	1 (0.20)	0		
Lymphatic fistula	1 (0.20)	0		
Pulmonary infection	8 (1.63)	2 (0.47)		
Acute cardiac failure	2 (0.41)	10 (2.36)		
Urinary infection	4 (0.81)	4 (0.94)		
Incision split	4 (0.81)	5 (1.18)		
Sudden death	2 (0.41)	2 (0.47)		

LRR: Laparoscopy in radical resection; ORR: Open radical resection.

Table 5 Postoperative recovery

	LRR (<i>n</i> = 407)	ORR (<i>n</i> = 326)	<i>P</i> value
Peristalsis recovery (d)	1.91 ± 0.89	2.41 ± 1.13	< 0.001
Exsufflation recovery (d)	3.03 ± 1.25	3.96 ± 1.53	< 0.001
Off-bed (d)	2.80 ± 1.26	3.38 ± 1.07	< 0.017
Liquid intake (d)	3.90 ± 1.446	5.08 ± 1.763	< 0.001
Semi-liquid intake (d)	6.55 ± 1.910	7.59 ± 2.065	< 0.001
Abdominal drainage (d)	9.48 ± 7.386	11.07 ± 10.484	< 0.008
Retention catheterization (d)	5.63 ± 3.613	6.67 ± 4.043	< 0.001
Post-op hospital stay (d)	12.27 ± 3.156	18.32 ± 5.406	< 0.001
Total hospital stay (d)	21.50 ± 4.991	25.81 ± 7.868	< 0.001

LRR: Laparoscopy in radical resection; ORR: Open radical resection.

Table 6 Postoperative analgesics and pain scores

	LRR (<i>n</i> = 492)	ORR (<i>n</i> = 424)	χ^2	<i>P</i> value
Analgesic usage			95.31	< 0.001
No	299	121		
PCIA	152	273		
Short-acting drug	41	30		
Post-op pain degree			21.43	< 0.001
Mild	263	193		
Medium	213	186		
Severe	16	45		

LRR: Laparoscopy in radical resection; ORR: Open radical resection; PCIA: Patient controlled intravenous analgesia.

economic costs, survival and so on, of rectal cancer treated in our hospital from January 2006 to December 2013.

Based on published literature^[5,7,21], we understand that the short-term outcomes of the LRR group are superior to the ORR group. In early stage laparoscopic radical rectal tumor surgery, much more time is required than for an open operation^[9]. With the improvement of medical devices, sufficient training and accumulated experience, the operating time between the two groups was shown to be similar with no statistical significance^[22]. In the present study, we found that the operating time of the LRR group was shorter than that of the ORR group, with statistical significance being achieved. It was reported in COLOR II^[18] that the blood loss volume was much less than that of open surgery proving definitively that laparoscopic surgery is capable of decreasing the

hemorrhage volume. In the present study, the volume of intraoperative bleeding in the LRR group was clearly less than that in the ORR group. This finding can probably be attributed to the fact that operators benefit from the magnified view of laparoscopy, and also improved equipment that can effectively stop bleeding. The clearance and sufficient length of the resected sample was markedly key for the success of each operation. CLASICC showed that the resected intestinal segment in laparoscopic and in open surgery were similar in length^[9], and our research verified further that the lengths of the resected sample in the LRR and ORR groups were similar, with no statistical difference being found. However, we established that the distal margin of tumor in the LRR group was longer than in the ORR group and we hypothesized that the difference between the two groups may be caused by preponderant visualization of laparoscopy in the lower

Table 7 Economic costs of the operations

	LRR (n = 492)	ORR (n = 424)	P value
Operation fee (RMB)	13628 ± 6771	10761 ± 5056	< 0.001
Medication (RMB)	15859 ± 10203	17562 ± 7006	0.06
Total hospitalization (RMB)	40889 ± 19356	42381 ± 17915	0.234

LRR: Laparoscopy in radical resection; ORR: Open radical resection.

pelvis. It was illustrated in detailed by Schwandner *et al.*^[10] that there was no difference in the lymph nodes harvested in the two groups, findings consistent with our data. The average lymph nodes retrieved from LRR and ORR were 11.09 ± 6.503 and 10.68 ± 6.321 (*P* = 0.338) in our study, which suggested a small disparity in the number of lymph nodes retrieved in LRR compared to ORR.

The NRS pain score of the ORR group was much higher than the scores of the LRR group (*P* < 0.001), and the average postoperative analgesics usage for LRR patients was much less than ORR patients (*P* < 0.001). We conclude that the postoperative pain degree of the LRR group was obviously milder than in the ORR group, findings consistent with previous reports^[6,12,23]. Additionally, the recovery time of intestinal function, off-bed time, regular food intake time, hospital stay and other aspects were evidently less than after ORR, which is in accordance with Schwandner^[10], COLOR II^[18] and other reports.

It is well documented that the leading reasons for conversion to open surgery included extensive abdominal metastasis, over-sized tumors and a confused anatomic relationship due to serious pelvic adhesion, *etc.*^[6,12,24-26]. The conversion rate was 2.44% in the current research, which is lower than the well-documented 5% of other studies. The potential cause of this discrepancy could be due to the full assessment of partial status for rectal tumor, the high admittance standard for studied cases and the elimination of advanced tumor patients from the study. In addition, a large amount of laparoscopic radical surgery for rectal cancer had been undertaken in our institute prior to this study. Thus, we had had completed the study curve and obtained extensive experience for a lower conversion rate between the two surgical techniques. Moreover, the incidence of perioperative complication rates in the LRR group was similar to that in the ORR group as previously reported^[27], findings parallel to our results, with no statistical significance between the LRR (19.3%) and ORR (24.1%) groups.

Economic efficiency is also a vital appraisal index for technology. It has been well documented that the surgical expenses for laparoscopic are well above those for open surgery due to its use of disposable surgical instruments and higher anesthesia costs, and technology equipment standards^[28,29]. However, Choi assumed that the surgical expenses only consisted of partial expenses which should have

Table 8 Postoperative survival rates

	LRR	ORR	P value
Post-op 1-yr			
I	99.2%	93.8%	0.402
II	94.7%	92.8%	0.489
III	91.9%	87.8%	0.178
Total survival rate	93.6%	94.0%	0.534
Post-op 3-yr			
I	90.3%	91.6%	0.774
II	86.2%	79.1%	0.052
III	70.7%	69.2%	0.777
Total survival rate	80.9%	78.1%	0.284
Post-op 5-yr			
I	88.2%	89.2%	0.837
II	81.7%	76.8%	0.140
III	66.9%	65.4%	0.787
Total survival rate	77.0%	75.2%	0.416

LRR: Laparoscopy in radical resection; ORR: Open radical resection.

included anesthesia, inspection, medication, medical care agents and other consumption goods^[28]. In our research, LRR surgical expenses were a slightly more costly than conventional procedures (*P* < 0.001) while the medication required for LRR was less than that of ORR, which possessed no difference of statistical importance (*P* = 0.06). In general, there was no obvious difference between LRR and ORR in terms of total hospitalization costs (*P* = 0.234). Considering a briefer hospital stay and quick recovery after LRR, the nursing labor costs will be significantly lower, which suggests that the laparoscopic approach is the most cost effective.

Concerning the survival outcomes, various studies have shown that the short-term survival and long-term survival between the LRR and ORR groups is similar. The survival outcomes of the COREAN trial revealed that the 3-year DFS rate was 72.5% in the ORR group and therefore similar to that in the LRR group (79.2%)^[30]. Based on published comparative retrospective studies, we have found that the 5-year DFS between the LRR and ORR groups was separately 82% and 79% with no statistical difference^[31]. Importantly, a randomized multicenter study revealed that the DFS rates for LRR and ORR group were 74.8% and 70.8% respectively, and that the overall survival rates for the LRR and ORR group were 86.7% and 83.6%, with no statistical difference being detected^[20]. In the present study, the follow-up duration of the 2 groups was 55 mo in total, with a 95.1% follow-up rate being achieved. We have illustrated that the 1-, 3- and 5-year survival rate between the ORR and LRR groups were not statistically significant (94.0% vs 93.6%, *P* = 0.534; 78.1% vs 80.9%, *P* = 0.284; 75.2% vs 77.0%, *P* = 0.416), findings similar to the published literature. The results here suggest that the laparoscopic radical operation is analogous to open resection and has prior immediate and long-term clinical effects. It may be related to the proficiency of laparoscopic techniques as well as the relatively protective functions of

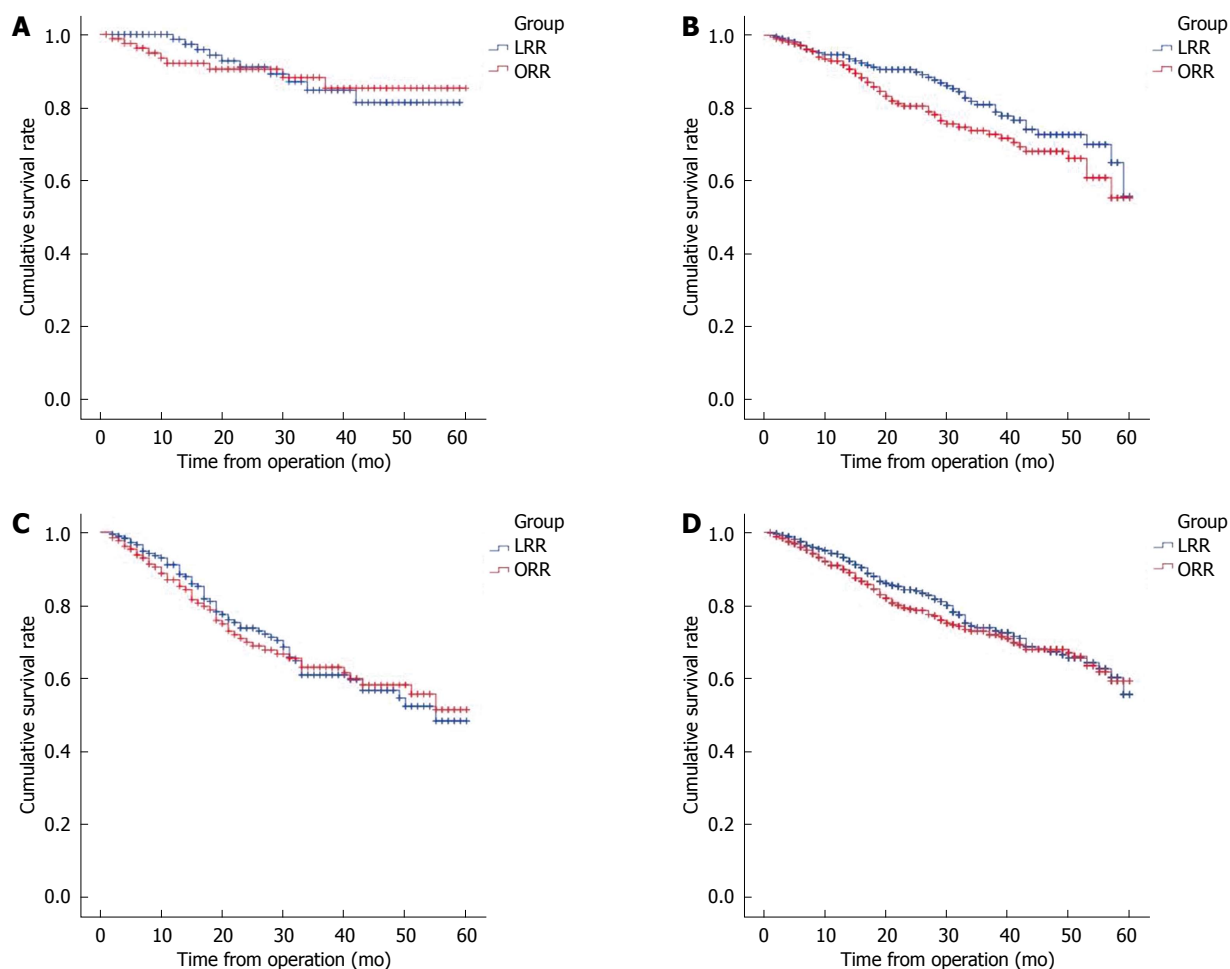


Figure 1 Different stages of postoperative survival status. A: Stage I postoperative survival status; B: Stage II postoperative survival status; C: Stage III postoperative survival status; D: Overall postoperative survival status for both groups. LRR: Laparoscopy in radical resection; ORR: Open radical resection.

laparoscopy for its less interference in cell immunity functions. Thus, the long-term survival of laparoscopic patients for rectal cancer proved equal to those given open operations.

In this original clinical research, we conclude that a laparoscopic-assisted operation has more benefits due to reduced trauma, less postoperative pain and a reduced stay in hospital, as well as faster recovery from radical rectal malignancy therapy. It is clear that the surgical scope and radical effects of tumors were similar in the laparoscopic and open resection techniques. In addition, overall hospitalization expenses, immediate perioperative complications and the long-term survival rates of patients who experienced laparoscopic surgery closely resembled the conventional operation. Thus, laparoscopic surgery may become the most effective therapy for rectal malignancy in the future.

COMMENTS

Background

As we all know, the argument for choosing laparoscopy or open surgery in rectal cancer is heated due to the inconsistent outcomes reported by different

research centers. In the latest randomized trial for rectal cancer, it was reported that the disease-free survival (DFS) and overall survival rates for laparoscopy in radical resection (LRR) and open radical resection (ORR) group were similar. In this study, they compared the short-term outcomes and long-term outcomes between the LRR group and ORR group.

Research frontiers

The outcomes between LRR group and ORR group in rectal cancer was inconsistent. Their study compared the short-term and long-term outcomes between LRR group and ORR group, and concluded the similar results reported in the latest randomized trial for rectal cancer.

Innovations and breakthroughs

It is a retrospective case-control study performed in rectal cancer with different operations, and the authors compared the short-term and long-term outcomes between the LRR group and ORR group.

Applications

The outcomes between LRR group and ORR group in rectal cancer verified that the laparoscopic surgery could have a better result than open surgery. It may affect the choice of surgery in rectal cancer.

Terminology

Conventional vs laparoscopic-assisted surgery in colorectal cancer and colorectal cancer laparoscopic or open resection: Two trials mainly compared the survival of overall survival, disease-free survival, progression-free survival between the LRR and ORR groups in colorectal cancer.

Peer-review

The authors conducted a clinical retrospective study to compare the short and long-term outcomes between laparoscopic and open surgery for rectal cancer in the Chinese population. They concluded that the laparoscopic resection as a radical operation was safe and effective, while the long-term survival of patients treated with laparoscopic surgery was similar to those with open surgery.

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