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BRIEF ARTICLE

Minilaparotomy to rectal cancer has higher overall survival rate and earlier short-term recovery

Xiao-Dong Wang, Ming-Jun Huang, Chuan-Hua Yang, Ka Li, Li Li

Xiao-Dong Wang, Ming-Jun Huang, Chuan-Hua Yang, Ka Li, Li Li, Gastrointestinal Surgery Center, West China Hospital in Sichuan University, Chengdu 610041, Sichuan Province, China

Author contributions: Wang XD and Li L designed the study; Wang XD, Yang CH and Li L performed the clinic works in the study (operations and peri-operative management); Wang XD, Huang MJ and Li K collected information and research data; Wang XD and Huang MJ analyzed the data and wrote the manuscript.

Correspondence to: Dr. Li Li, Gastrointestinal Surgery Center, West China Hospital in Sichuan University, Chengdu 610041, Sichuan Province, China. drlili116@126.com
Telephone: +86-28-85422481 Fax: +86-28-85422481
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Abstract

AIM: To report our experience using mini-laparotomy for the resection of rectal cancer using the total mesorectal excision (TME) technique.

METHODS: Consecutive patients with rectal cancer who underwent anal-colorectal surgery at the authors' hospital between March 2001 and June 2009 were included. In total, 1415 patients were included in the study. The cases were divided into two surgical procedure groups (traditional open laparotomy or mini-laparotomy). The mini-laparotomy group was defined as having an incision length ≤ 12 cm. Every patient underwent the TME technique with a standard operation performed by the same clinical team. The multimodal preoperative evaluation system and postoperative fast track were used. To assess the short-term outcomes, data on the postoperative complications and recovery functions of these cases were collected and analysed. The study included a plan for patient follow-up, to obtain the long-term outcomes related to 5-year survival and local recurrence.

RESULTS: The mini-laparotomy group had 410 patients, and 1015 cases underwent traditional laparotomy. There were no differences in baseline characteristics between the two surgical procedure groups. The overall 5-year survival rate was not different between the mini-laparotomy and traditional laparotomy groups (80.6% *vs* 79.4%, $P = 0.333$), nor was the 5-year local recurrence (1.4% *vs* 1.5%, $P = 0.544$). However, 1-year mortality was decreased in the mini-laparotomy group compared with the traditional laparotomy group (0% *vs* 4.2%, $P < 0.0001$). Overall 1-year survival rates were 100% for Stage Ⅰ, 98.4% for Stage Ⅱ, 97.1% for Stage Ⅲ, and 86.6% for Stage Ⅳ. Local recurrence did not differ between the surgical groups at 1 or 5 years. Local recurrence at 1 year was 0.5% (2 cases) for mini-laparotomy and 0.5% (5 cases) for traditional laparotomy ($P = 0.670$). Local recurrence at 5 years was 1.5% (6 cases) for mini-laparotomy and 1.4% (14 cases) for traditional laparotomy ($P = 0.544$). Days to first ambulation (3.2 ± 0.8 d *vs* 3.9 ± 2.3 d, $P = 0.000$) and passing of gas (3.5 ± 1.1 d *vs* 4.3 ± 1.8 d, $P = 0.000$), length of hospital stay (6.4 ± 1.5 d *vs* 9.7 ± 2.2 d, $P = 0.000$), anastomotic leakage (0.5% *vs* 4.8%, $P = 0.000$), and intestinal obstruction (2.2% *vs* 7.3%, $P = 0.000$) were decreased in the mini-laparotomy group compared with the traditional laparotomy group. The results for other postoperative recovery function indicators, such as days to oral feeding and defecation, were similar, as were the results for immediate postoperative complications, including the physiologic and operative severity score for the enumeration of mortality and morbidity score.

CONCLUSION: Mini-laparotomy, as conducted in a single-centre series with experienced TME surgeons, is a safe and effective new approach for minimally invasive rectal cancer surgery. Further evaluation is required to evaluate the use of this approach in a larger patient sample and by other surgical teams.

Key words: Rectal neoplasm; Mini-laparotomy; Survival; Total mesorectal excision

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INTRODUCTION

Laparoscopic surgery has become popular throughout the world[1-3]. This surgical method enhances early postoperative recovery with less pain, less analgesic use, an earlier return of gastrointestinal function, and fewer wound and pulmonary complications. Total mesorectal excision (TME) is acknowledged worldwide as the preferred technique for surgical resection of rectal cancer[4-6]. Multiple studies have reported marked reductions in local recurrence with the TME technique, including single-centre, multiple-centre, and population studies[7,8]. The laparoscopic approach to TME resection of rectal cancer is currently being evaluated in multicentre randomised trials[9-12].

A less-recognised surgical technique aimed at improving postoperative recovery is mini-laparotomy. With this technique, surgical dissection is performed under direct vision, as in open surgery; laparoscopic equipment and training is not required. Early experience with mini-laparotomy has been reported from a few medical centres in case series of colon and rectal resection[13-15]. Mini-laparotomy has been developed as a techniques based on the advanced recognition of more information about pelvic anatomy and the dissection of subtle perirectal structures in laparotomy[16,17].

In view of these circumstances, our surgical centre has performed mini-laparotomies for rectal cancer for approximately 8 years. The aim of this study is to report our experience using mini-laparotomy for the resection of rectal cancer using the TME technique. Furthermore, we aim to compare the oncologic findings and the postoperative recovery indexes of mini-laparotomy and traditional laparotomy, thus providing more evidence to help surgeons select an operating procedure.

MATERIALS AND METHODS

Included cases

This study is registered as an International Clinical Trial (ChiCTR-TRC-09000618) to compare TME resection of rectal cancer using traditional open laparotomy *vs* mini-laparotomy. This is a retrospective analysis of consecutive patients with rectal cancer observed at the Anal-colorectal Surgery Ward in West China Hospital of Sichuan University between March 2001 and June 2009. The inclusion criteria were as follows: (1) diagnosis of rectal cancer; (2) no previous history of lower abdominal operations or pelvic operations; (3) possibility of curative resection; and (4) intestinal continuity was restored by anastomosis. The exclusion criteria were (1) curative resection was not achieved; (2) resections without anastomosis (APR and Hartmann); and (3) actively exciting the study. All of the enrolled patients provided informed consent, which included information about (1) the different kinds of treatment available for their cancer; (2) the benefit of different operation procedures; and (3) their doctor's recommendation. Ultimately, the choice of surgical technique was left to the patient. The database from the anal-colorectal surgery of West China Hospital in Sichuan University provided the research data[18]. If any data required for the study were missing, the patient was excluded. Most of the patients who were excluded for this reason were missing data related to pathology and surgical baselines; 5-year survival and local recurrence; and the first time of aerofluxus, defecation, ambulation, oral feeding during the recovery phase. Ultimately, 1415 patients were included in the study.

A multimodal preoperative evaluation system was used to assess the preoperative clinical cancer stage[19]. Clinical Stages Ⅲ and Ⅳ patients were treated with neoadjuvant and adjuvant chemotherapy consisting of FOLFOX-4 (Oxaliplatin 85 mg/m^2 ivgtt 2 h, 1 d; LV 200 mg/m^2 ivgtt 2 h, 1-2 d; 5-Fu 400 mg/m^2 *iv*, 1-2 d). Perioperative radiation is not used at our centre.

Surgery was performed by traditional open laparotomy as the standard procedure. Mini-laparotomy was performed on an ad-hoc basis, with increasing frequency in the latter years of this study. No patient within the mini-laparotomy group was converted to a traditional laparotomy.

Short-term perioperative data were obtained in all cases. Long-term follow-up data were available from 7 to 103 mo. The follow-up methods used included telephone follow-up, outpatient department follow-up and follow-up letters. Follow-up data were obtained in 96.3% of cases (1362/1415).

Operation and clinical management procedures

TME and pelvic autonomic nerve preservation were performed in all cases in accordance with the Colorectal Surgery Guideline of West China Hospital of Sichuan University[20]. The surgery and perioperative management were performed by the same clinical team for both the traditional open laparotomy and mini-laparotomy groups.

A vertical incision was used for all cases. The traditional laparotomy incision extended from the pubis to above the umbilicus with a length of 13 to 18 cm, as in Figure 1. The mini-laparotomy incision extended from

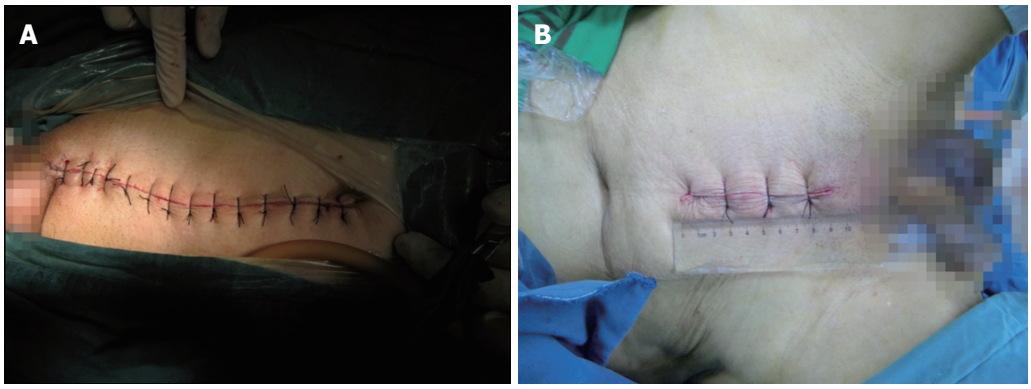

Figure 1 Mini-laparotomy (A) and traditional laparotomy (B).

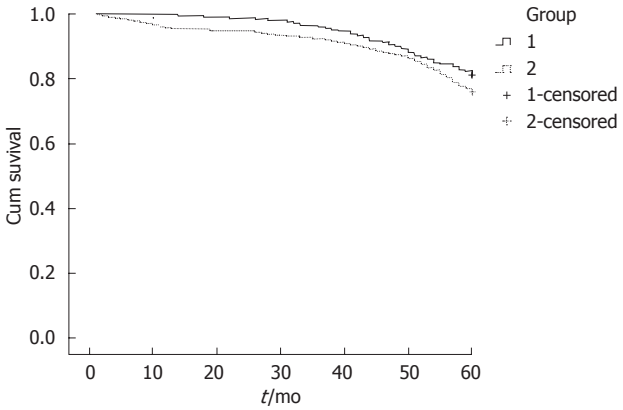

Figure 2 Survival rates of the mini-laparotomy (1) and traditional laparotomy groups (2).

the pubis for a length of 12 cm or less. For the traditional laparotomy, a fixed self-retaining retractor was used on the incision, and a moveable curved retractor was used for dynamic exposure during dissection. In mini-laparotomy, two curved retractors were used in dynamic exposure during dissection without a fixed abdominal wound retractor. Dissection was performed using electrocautery and an ultrasonic knife in both open laparotomy and mini-laparotomy. In both mini-laparotomy and traditional laparotomy, the splenic flexure was not mobilised. The superior rectal artery was ligated just below the bifurcation of the inferior mesenteric artery with clearing of the superior rectal artery lymph nodes.

A post-operative fast-track protocol was used[21,22] with early ambulation. Discharge criteria included eating a normal diet, normal ambulation, no fever, and no post-operative complications.

Definition of outcome

The primary outcome variables are 5-year survival and local recurrence. Local recurrence was classified as intro-/peri-anastomotic and pelvic recurrence. Secondary outcomes are immediate postoperative complications, including physiologic and operative severity score for the enumeration of mortality and morbidity (POSSUM) score[23], and recovery functions (the time of the first aerofluxus, defecation, ambulation, and oral feeding during the recovery phase). In addition, the patients' postoperative complications were recorded as important information about secondary outcomes, which included gastric retention, incision infection, pulmonary infection, anastomosis leakage, and intestinal obstruction.

Statistical analysis

The mini-laparotomy and traditional laparotomy data were compared and analysed with *t* tests, and the count data used the χ^2 test or Fisher's exact probability test. Local recurrence and overall survival were assessed using Kaplan-Meier survival curve analysis. The data are expressed as means ± SD. The significance level was 0.05. Statistical tests were performed using SPSS 15.0.

RESULTS

Baseline characteristics

The characteristics of the 1415 included patients (410 mini-laparotomy cases and 1005 traditional laparotomy cases) are presented in Table 1. There were no significant difference in the baseline data for the two groups ($P > 0.05$). The surgical and pathological findings are presented in Table 2, and there were no significant differences between the two surgical groups ($P > 0.05$).

Overall survival and local recurrence

Overall 5-year survival did not differ between the mini-laparotomy and traditional laparotomy groups (80.6% *vs* 79.4%, $P = 0.333$; Figure 2). The 5-year survival rates for the different clinical stages were also similar. One-year mortality was decreased in the mini-laparotomy group compared to the traditional laparotomy group (0% *vs* 4.2%, $P < 0.0001$). The overall 1-year survival rates in the traditional group were 100% for Stage Ⅰ, 98.4% for Stage Ⅱ, 97.1% for Stage Ⅲ, and 86.6% for Stage Ⅳ. Local recurrence did note differ between surgical groups at 1 or 5 years. Local recurrence at 1 year was 0.5% (2 cases) for the mini-laparotomy group and 0.5% (5 cases) for the traditional laparotomy group ($P = 0.670$). Local recurrence at 5 years was 1.5% (6 cases) for the mini-laparotomy group and 1.4% (14 cases) for the traditional laparotomy group ($P = 0.544$).

Table 1 Baseline characteristics of the mini-laparotomy and traditional laparotomy groups

	Minilaparotomy (n = 410)	Traditional laparotomy (n = 1005)	P value
Gender			0.125
Male	273 (66.6)	635 (63.2)	
Female	137 (33.4)	370 (36.8)	
Age (yr)	61.2 ± 12.1	57.8 ± 12.4	0.385
BMI (kg/m^2)	21.3 ± 3.0	22.0 ± 2.9	0.331
Distance to dentate line (cm)	8.2 ± 3.2	7.2 ± 4.0	0.118

BMI: Body mass index.

Table 2 Surgical and pathological findings for the mini-laparotomy and traditional laparotomy groups

	Minilaparotomy	Traditional laparotomy	P value
TNM stage			0.838
Stage Ⅰ	47 (11.5)	119 (11.8)	
Stage Ⅱ	127 (31.0)	320 (31.8)	
Stage Ⅲ	151 (36.8)	379 (37.7)	
Stage Ⅳ	85 (20.7)	187 (18.6)	
Differentiation			0.579
Good	105 (25.6)	240 (23.9)	
Moderate	172 (42.0)	411 (40.9)	
Poor	133 (32.4)	354 (35.2)	
Histologic types			0.277
Adenocarcinoma	337	811	
Mucinous adenocacinoma	69	164	
Squamous carcinoma	4	30	
Operation types			0.640
High anterior resection	20 (4.9)	38 (3.8)	
Low anterior resection	124 (30.2)	284 (28.3)	
Ultralow anterior resection	189 (46.1)	482 (48.0)	
Colo-anal anastomosis	77 (18.8)	201 (20.0)	
Volume of bleeding (mL)	78.5 ± 30.0	80.8 ± 28.5	0.940
Operation time (min)	115.5 ± 35.8	114.6 ± 33.4	0.217
Lymph node counts	12.4	12.7	0.796
Proximal margin of distance (cm)	3.5	3.3	0.105
Distal margin of distance (cm)	7.0	6.9	0.780

TNM: Tumor-node-metastasis. Data are presented as n (%) or mean ± SD.

Short-term recovery and postoperative complications

The data regarding postoperative recovery functions (time of first aerofluxus, defecation, ambulation and oral feeding), length of hospital stay, and immediate postoperative complications, including POSSUM score, are shown in Table 3. Days to first ambulation and aerofluxus and hospital length of stay were reduced for the mini-laparotomy group compared with the traditional laparotomy group. Days to tolerating full oral diet and first defecation were similar between surgical groups. POSSUM scores predicting mortality and morbidity were not different between the surgical groups.

Gastric retention and wound and pulmonary infection were not different between the surgical groups. Anastomotic leakage and intestinal obstruction were decreased in the mini-laparotomy group compared with the traditional laparotomy group. Other postoperative complications,

Table 3 Postoperative recovery of the two groups

	Minilaparotomy group	Traditional laparotomy group	P value
Recovery			
Aerofluxus (d)	3.5 ± 1.1	4.3 ± 1.8	0.000
Oral feeding (d)	4.1 ± 1.2	4.6 ± 1.2	0.628
Defecation (d)	5.0 ± 1.4	5.4 ± 1.5	0.370
Ambulation (d)	3.2 ± 0.8	3.9 ± 2.3	0.000
Hospital stay (d)	6.4 ± 1.5	9.7 ± 2.2	0.000
POSSUM scores (%)			
Predictive mortality	28.1	26.8	0.738
Predictive morbidity	5.3	5.0	0.844
Complications			
Gastric retention	8 (2.0)	18 (1.8)	0.494
Incision infection	6 (1.5)	15 (1.5)	0.592
Pulmonary infection	5 (1.2)	14 (1.4)	0.513
Anastomosis leakage	2 (0.5)	48 (4.8)	0.000
Intestinal obstruction	9 (2.2)	73 (7.3)	0.000
Other	13 (3.2)	35 (3.5)	0.456

POSSUM: Physiologic and operative severity score for the enumeration of mortality and morbidity.

Table 4 Colorectal cancer surgery study results regarding local recurrence and survival rates (%)

Another preference	Local recurrence	Survival rate
Our study	1.4	79.7
Andreoni *et al*[30]	8.2	71.0
Law *et al*[31]	9.6	66.5
Jung *et al*[7]	8.0	62.0

including urinary retention (2 cases *vs* 6 cases), urinary tract infection (0 case *vs* 2 cases), anastomotic bleeding (1 case *vs* 2 cases), intra-abdominal haemorrhage (0 case *vs* 1 case), wound dehiscence (1 case *vs* 2 cases), sexual dysfunction (1 case *vs* 3 cases), deep vein thrombosis (0 case *vs* 0 case), cardiocerebral vascular accident (0 case *vs* 0 case), psychosis (2 cases *vs* 4 cases), liver dysfunction (1 case *vs* 2 cases), and unknown fever (5 cases *vs* 13 cases) also did not differ between the two surgical groups.

DISCUSSION

The overall 5-year survival and local recurrence rates were not different between the mini-laparotomy and traditional laparotomy groups. The local recurrence and survival rates for mini-laparotomy (1.4% and 79.7%) compare favourably to those reported for traditional laparotomy, as shown in Table 4.

In our study, the results confirmed that the mini-laparotomy and traditional laparotomy groups had similar overall 5-year survival and local recurrence rates, but the minilaparotomy group experienced faster postoperative recovery and fewer complications. It may be that mini-laparotomy surgery is the safer and more effective operation for rectal cancer.

An improved understanding of pelvic anatomy has enabled the switch to a mini-laparotomy approach to rec-

tal cancer resection. Whereas others have reported on the use of mini-laparotomy mostly for colon cancer, we are among the first to report on the use of mini-laparotomy for the resection of rectal cancer[8,9,12]. There is a learning curve for the mini-laparotomy approach. However, we speculate that the learning curve is lower than that of laparoscopic proctectomy because standard instrumentation, direct vision and tactile feedback are maintained for mini-laparotomy, but not for laparoscopy. We have used mini-laparotomy for rectal resection in Chinese patients with a body mass index (BMI) of 21.3 kg/m^2 as the Chinese population is generally thinner than North American and European populations[24]; however, we also treat patients with BMIs > 27 using mini-laparotomy. Additionally, although splenic flexure mobilisation was not required for any patient in this sample, it is likely that the surgeon would be disadvantaged by the suprapubic mini-laparotomy approach if splenic flexure mobilisation was required to perform a low tension-free anastomosis. Mini-laparotomy was not associated with an increase in operative blood loss or operation time. In fact, mini-laparotomy was associated with the successful resection of all levels of rectal cancer.

Like laparoscopic colorectal resection[25], mini-laparotomy showed advantages in decreasing the postoperative length of hospital stay and was associated with shorter times to ambulation and aerofluxus[1,11]. Mini-laparotomy was associated with significantly decreased anastomotic leaking, a finding for which we have no ready explanation other than increased experience over the time of the study. The anastomotic leak rate of 0.5% compares favourably to that reported in other studies[26-28]. In addition, mini-laparotomy was associated with decreased postoperative intestinal obstruction, which may have resulted from less peritoneal manipulation and a shorter incision length. A Japanese study suggested that the mini-laparotomy approach in colorectal cancer would result in a reduced inflammatory response[29]. Furthermore, mortality at 1 year was significantly increased in the traditional laparotomy group compared with the mini-laparotomy group.

Although postoperative management was intended to be similar for mini-laparotomy and traditional laparotomy patients, as indicated by the time before achieving a full oral diet and defecation, traditional laparotomy patients were slower to ambulate. Bias in favour of the mini-laparotomy group is likely, as this procedure has gained favour in our hands with our increasing experience over the time of this study. A randomised study design is indicated to minimise this bias. The study was a single-centre series with experienced TME surgeons and a patient sample with a relatively small BMI. Because our hospital is a medical centre in southwestern China, our patients are primarily advanced cancer cases, and we have more experienced surgeons and more advanced surgical instruments than other small-to-medium sized local hospitals. Consequently, the study and results had an obvious selection bias. Further evaluation is required to evaluate the use of this approach in a larger patient sample and by other surgical teams, and our conclusions are not definitive.

In conclusion, we have shown that mini-laparotomy is a safe and effective new approach for minimally invasive rectal cancer surgery. This was a single-centre series with experienced TME surgeons and a patient sample with a relatively low BMI. Further evaluation is required to evaluate the use of this approach in a larger patient sample and by other surgical teams.

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COMMENTS

Background

Total mesorectal excision (TME) is acknowledged worldwide as the preferred technique for surgical resection of rectal cancer. The laparoscopic approach to TME resection of rectal cancer is currently being evaluated in multicentre randomised trials. A less-recognised surgical technique aimed at improving postoperative recovery is mini-laparotomy. With this technique, surgical dissection is performed under direct vision, as in open surgery; laparoscopic equipment and training is not required. Early experience with mini-laparotomy has been reported from a few medical centres in case series of colon and rectal resection. Mini-laparotomy has been developed as a techniques based on the advanced recognition of more information about pelvic anatomy and the dissection of subtle perirectal structures in laparotomy.

Research frontiers

An improved understanding of pelvic anatomy has enabled the switch to a mini-laparotomy approach to rectal cancer resection. Other studies have reported on the use of mini-laparotomy mostly for colon cancer, but for rectal cancer, it is still in blank. Like laparoscopic colorectal resection, mini-laparotomy showed advantages in decreasing the postoperative length of hospital stay and was associated with shorter times to ambulation and aerofluxus in past studies

Innovations and breakthroughs

Whereas others have reported on the use of mini-laparotomy mostly for colon cancer, the authors are among the first to report on the use of mini-laparotomy for the resection of rectal cancer. There is a learning curve for the mini-laparotomy approach. However, the authors speculate that the learning curve is lower than that of laparoscopic proctectomy because standard instrumentation, direct vision and tactile feedback are maintained for mini-laparotomy, but not for laparoscopy. Mini-laparotomy was associated with significantly decreased anastomotic leaking, a finding for which the authors have no ready explanation other than increased experience over the time of the study. The anastomotic leak rate of 0.5% compares favourably to that reported in other studies. In addition, mini-laparotomy was associated with decreased postoperative intestinal obstruction, which may have resulted from less peritoneal manipulation and a shorter incision length. Furthermore, mortality at 1 year was significantly increased in the traditional laparotomy group compared with the mini-laparotomy group.

Applications

The study results suggest that mini-laparotomy is a safe and effective new approach for minimally invasive rectal cancer surgery.

Terminology

Minilaparotomy is minimal invasive laparotomy for abdominal operations. It is different from laparoscopic operations, that minilaparotomy will have only one mini-incision, but not other holes from laparoscopic way. Minilaparotomy would be more better outcomes than traditional laparotomy.

Peer review

This is a good descriptive study conducted in a single-centre series with experienced TME surgeons, and mini-laparotomy is proved a safe and effective new approach for minimally invasive rectal cancer surgery. Minilaparotomy will be the future choice for rectal cancer care.

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