Short-term outcomes between laparoscopy-assisted and open colorectomy for colorectal cancer in elderly patients: A case-matched control study

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Abstract. With the increase in life expectancy, surgical intervention for colorectal cancer (CRC) is more frequently performed in elderly patients. This retrospective study was designed to compare short-term outcomes between laparoscopy-assisted colorectomy (LC) and open colorectomy (OC) in elderly patients with CRC. A total of 89 CRC patients aged ≥75 years undergoing LC were matched with 89 counterparts undergoing OC. The matching criteria included general information and preoperative status. The operative data and short-term postoperative outcomes were compared. Following analysis, patients in the LC and OC groups were comparable for the matching criteria. Compared with the OC group, the operative time was longer (P=0.046), but the estimated blood loss (P<0.001) and intraoperative transfusion (P=0.042) were less in the LC group. As regards short-term postoperative outcomes, the duration of postoperative hospital stay was shorter (P=0.001) and the incidence of wound complications was lower (P=0.044) with LC. The overall complication, other complications, reoperation and mortality rates were comparable between the two groups. In conclusion, considering the operative variables and short-term outcomes, LC is a safe procedure and appears to be superior to OC for elderly patients with CRC.

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Introduction

Due to the significant advances in life quality and health care, life expectancy continues to increase worldwide, with a consequent increase in the elderly population. The incidence of colorectal diseases necessitating surgical intervention, particularly colorectal cancer (CRC), usually increases with advancing age. In fact, approximately one half of patients with CRC are aged >70 years and CRC is the second leading cause of cancer-related mortality in this age group (1,2). Aging *per se*, regardless of other factors, is not a prognostic factor in gastrointestinal surgery (3). However, advanced age is usually accompanied by underlying comorbidities, such as cardiovascular and pulmonary diseases, which may significantly affect the outcomes of surgical treatment for CRC. Thus, surgery for elderly CRC patients is a major medical care issue.

Surgeons usually select colorectomy for CRC treatment in resectable cases, which may be performed as open colorectomy (OC) or laparoscopy-assisted colorectomy (LC). The laparoscopic procedure, compared with laparotomy, is considered to be a safe and feasible procedure, associated with a milder immunological and inflammatory response (4). Furthermore, LC is reportedly associated with decreased morbidity and mortality, faster recovery and shorter hospital stay (5,6). However, LC usually requires longer operative time and results in specific physiological changes affecting the cardiovascular and pulmonary systems (7). Due to these concerns and underlying comorbidities in elderly patients, surgeons face a dilemma when considering LC for CRC.

The availability of recent reports comparing LC and OC for elderly patients is limited (8-12), with data on CRC being even more scarse (12). To the best of our knowledge, no data contraposing LC and OC in the Chinese population are available. Therefore, we conducted this study to compare the short-term outcomes of LC and OC for elderly CRC patients.

Patients and methods

Patient selection. Patients aged ≥75 years undergoing elective LC for CRC between 2007 and 2013 at the Sixth Affiliated

Table I. Demographics and clinical characteristics of the patients.

Variables	LC group (n=89)	OC group (n=89)	P-value
Age (years)	78.6±3.1	79.0±3.8	0.375
Gender ratio, F/M	35/54	40/49	0.448
BMI (kg/m^2)	22.5±3.6	21.7±3.4	0.143
Hemoglobin (g/l)	113.3±24.9	111.8±20.9	0.409
Comorbidities	50 (56.2)	48 (53.9)	0.763
Previous abdominal surgery	11 (12.4)	11 (12.4)	1.000
ASA score, I/II/III/IV	1/36/46/2	0/32/52/4	0.528
Tumor location, colon/rectum	51/38	52/37	0.879
TNM stage, 1/2/3/4	13/33/33/10	12/34/30/12	0.848

LC, laparoscopy-assisted colorectomy; OC, open colorectomy; F, female; M, male; BMI, body mass index; ASA, American Society of Anesthesiology. Values are expressed as mean ± standard deviation, or as number (percentage).

Hospital of Sun Yat-sen University and the First Affiliated Hospital of Guangzhou Medical University (Guangzhou, China), were included in this retrospective study and then matched with the same number of patients who underwent OC for CRC during the same period. Thus, all the eligible patients were divided into two groups, namely the LC and the OC groups. Data on the preoperative status, surgical variables and short-term postoperative outcomes were obtained by careful chart review.

The exclusion criteria for the two groups were uniform and included emergency cases, patients who had received neoadjuvant therapy and cases without resection of the colon or rectum. Of note, conversion of LC to OC was excluded in our study.

This study was approved by the Institutional Review Boards of the two participating hospitals.

Matching standards. Patients in the OC group were selected to match those in the LC group according to general information and preoperative status. The matching criteria included age, gender, body mass index (BMI), preoperative hemoglobin level, comorbid diseases, previous abdominal surgery, American Society of Anesthesiology (ASA) score and diagnosis. The comorbid diseases included cardiovascular, respiratory and renal diseases, hypertension and diabetes, which may affect the choice of procedure. Other comorbidities, such as benign prostatic hyperplasia and cataract, were not considered to be significant. Among the aforementioned variables, BMI and preoperative hemoglobin level were used to assess the nutritional status, while comorbidity factors were evaluated by comorbid disease, previous abdominal surgery and, particularly, ASA score. These matching standards were, to some extent, applied to avoid unnecessary bias and confounding, as this study mainly focused on the comparison of the two surgical procedures.

Comparison of LC and OC. Our attention was focused on the surgical and postoperative evaluation. The surgical variables included type of procedure performed (LC or OC), operative time, estimated blood loss, intraoperative transfusion, location of resection and type of anastomosis configuration, if required. Short-term postoperative outcomes, such as intensive care unit (ICU) stay, duration of postoperative hospital stay, short-term complications, reoperation due to complications and mortality within 3 months postoperatively, were included.

Statistical analysis. Data were analyzed using the Statistical Package for Social Science software, version 16.0 (SPSS Inc., Chicago, IL, USA). For all variables, descriptive statistics were conducted, including means and standard deviations or medians and ranges for continuous factors, and frequencies for categorical factors. Student's t-tests or Wilcoxon rank-sum tests were used to compare continuous factors, whereas Chi-square or Fisher's exact probability tests were used for categorical variables. The differences were considered statistically significant when the two-sided P-values were <0.05.

Results

General information. In total, 178 patients were included in this study; 89 patients underwent LC for CRC (55 from the Sixth Affiliated Hospital of Sun Yat-sen University and 34 from the First Affiliated Hospital of Guangzhou Medical University). A further 89 patients were assigned to the OC group according to the matching criteria. The oldest patient was aged 90 years at the time of the operation. The mean age was 78.6 years in the LC group and 79.0 years in the OC group (P=0.375), while the gender ratio was similar between the two groups (P=0.448). The preoperative nutritional status was comparable between the two groups, with an average BIM of 22.5 and 21.7 kg/m^2 (P=0.143), and an average hemoglobin concentration of 113.3 and 111.8 g/l (P=0.409) in the LC and OC groups, respectively. As regards preoperative comorbidity factors, 56.2 and 53.9% patients had comorbid diseases in the LC and OC groups, respectively (P=0.763), while 12.4% of the patients in both groups had undergone previous abdominal surgery (P=1.000). More than one half of the patients in the LC and OC groups (53.9 and 62.9%, respectively) had and ASA score of 3 or 4. Overall, the LC and OC groups were comparable for the matching criteria. The demographics

Table II. Surgical variables.

Variables	LC group	OC group	P-value
Operative time (min)	236.3±87.5	212.0±65.1	0.046[a]
Estimated blood loss (ml)	100.0 (10-2,200)	200.0 (30-3,000)	<0.001[a]
Intraoperative transfusion	16 (18.0)	29 (32.6)	0.042[a]
Location of resection			0.293
Right colectomy	17 (19.1)	24 (27.0)	
Left colectomy	7 (7.9)	11 (12.4)	
Sigmoid resection	25 (28.1)	17 (19.1)	
Rectal resection	40 (44.9)	37 (41.6)	
Use of anastomosis configuration			0.103
No	3 (3.6)	8 (11.9)	
Yes[a]	80 (96.4)	59 (88.1)	0.139
Anastomosis ring	9 (11.3)	12 (20.3)	
Staple	71 (88.7)	47 (79.7)	

[a]Hand-sewn anastomoses were not taken into consideration. LC, laparoscopy-assisted colorectomy; OC, open colorectomy. Values are expressed as mean ± standard deviation, median (range), or as number (percentage). [a]Results with statistical significance.

Table III. Postoperative evaluation.

Variables	LC group	OC group	P-value
ICU stay	27 (30.3)	31 (34.8%)	0.522
Postoperative hospital stay duration (days)	13.0 (6-82)	16.0 (8-196)	0.001[a]
Complications			
Overall	29 (32.6)	37 (43.8)	0.214
Wound	3 (3.4)	10 (11.2)	0.044[a]
Abdominal infection	2 (2.2)	6 (6.7)	0.278
Intestinal obstruction	7 (7.9)	10 (11.2)	0.444
Anastomotic fistula	3 (3.4)	3 (3.4)	1.000
Hernia	1 (1.1)	2 (2.2)	1.000
Cardiovascular	2 (2.2)	3 (3.4)	1.000
Respiratory	7 (7.9)	13 (14.6)	0.154
Urinary infection	3 (3.4)	3 (3.4)	1.000
Renal failure	2 (2.2)	3 (3.4)	1.000
Stoma	2 (2.2)	2 (2.2)	1.000
Reoperation for complications	4 (4.5)	10 (11.2)	0.095
Mortality within 3 months	2 (2.2)	5 (5.6)	0.441

LC, laparoscopy-assisted colorectomy; OC, open colorectomy; ICU, intensive care unit. Values are expressed as mean ± standard deviation, median (range), or as number (percentage). [a]Results with statistical significance.

and clinical characteristics of the enrolled patients, with the P-values for matching are summarized in Table I.

Surgical variables. Laparoscopic surgery was 24 min longer compared with open laparotomy (236.3 vs. 212.0 min, respectively; P=0.046). In the LC group, the estimated blood loss was significantly lower compared to that in the OC group (100 vs. 200 ml, respectively; P<0.001), as was the number of patients requiring intraoperative transfusion (18.0 vs. 32.6%, respectively; P=0.042). The location of resection (P=0.293) and anastomosis appliance use were comparable between the two groups (96.4 vs. 88.1%, P=0.103). The surgical variables are summarized in Table II.

Postoperative evaluation. The frequency of ICU stay was comparable between the two groups. The postoperative hospital stay duration (13.0 vs. 16.0 days, P=0.001) was significantly decreased in the LC group. The overall complication rates

were 32.6% for LC and 43.8% for OC (P=0.214). However, wound complications, including wound infection and wound disruption occurred markedly more frequently in the OC group (3.4 vs. 11.2%, P=0.044). The incidence of complications other than wound complications was comparable between the LC and OC groups. A total of 14 patients (4 in the LC and 10 in the OC group, P=0.095) required reoperation due to postoperative complications. The causes for reoperation included anastomotic fistula (n=1), intestinal obstruction (n=2), hernia (n=2), stoma failure (n=2) and secondary sutures for wound infection or disruption (n=7). A total of 7 patients succumbed to postoperative multiple organ failure (2 in the LC and 5 in the OC group, P=0.441). The reoperation and mortality rates were similar between the two groups. The evaluation of postoperative outcomes is presented in Table III.

Discussion

The aim of this retrospective case-matched control study was to compare the short-term outcomes of LC and OC for elderly patients with CRC. We selected patients aged ≥75 years, as this age is considered to exceed the normal life expectancy. In fact, the life expectancy in China is ~75 years (13). The preoperative status in the two groups was balanced by matching patients according to general information and clinical characteristics.

Following analysis, LC was found to be associated with a significantly lower estimated blood loss and intraoperative transfusion rate, although the operative time was longer when compared to laparotomy. These results are similar to those reported by previous studies, as the operative time of the laparoscopic procedure was reported to be 20-30 min longer compared to laparotomy (9-12). Only in the study by Senagore *et al* was the operative time reported to be shorter with LC (14), but no further discussion was offered regarding this finding. Despite the longer operative time, less blood loss and lower transfusion rate demonstrated that LC is safe for elderly patients.

Moreover, the postoperative hospital stay was significantly shorter in the LC group compared with that in the OC group. The decreased hospital stay reflects the faster postoperative recovery of oral intake of food, bowel function and physical activity (9,10,15-18), athough such variables were not analyzed in our study.

As regards postoperative complications, we observed that wound complications, including wound infection and disruption, occurred significantly less frequently in the LC group. Stewart *et al* (19) and Frasson *et al* (8) reported similar results. This may be due to the incision in OC being longer and thus easier to develop complications.

Other complications, reoperation for complications and mortality, were not statistically significantly different between the two groups. According to the absolute numbers of occurrence, it appeared that, to some extent, LC was superior to OC. For example, the cases of abdominal infection, respiratory infection, reoperation for complications and mortality were 2 vs. 6, 7 vs. 13, 4 vs. 10 and 2 vs. 5 in the LC and OC groups, respectively. Generally, complications and mortality were comparable in previous studies as well, indicating that LC is at least as safe as OC for elderly patients.

Finally, there were certain limitations to the present study. First, the retrospective design of the study requires consideration, although it may be impractical and difficult to perform randomized controlled trials in elderly patients with CRC and, in order to avoid selection bias, patients in the two groups were matched for general information and preoperative status prior to the analysis. Future studies with larger sample sizes are required to confirm our results. Furthermore, this study only focused on short-term outcomes. For surgical intention, particularly for cancer, long-term outcomes, such as recurrence, metastasis and survival rate, should also be considered. Previously published meta-analyses (20-22) reported that long-term results, such as recurrence rate and 5-year survival rate, were similar between LC and OC, but the analyses were not specific to elderly patients. As our follow-up of the patients was insufficient to assess long-term effects, this issue should be addressed in the future.

Considering the operative variables and short-term outcomes, LC is a safe and even superior procedure to OC for elderly patients with CRC. However, further studies including more patients are required to confirm these results and assess long-term outcome.

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