

Short-term outcomes of open versus laparoscopic surgery in elderly patients with colorectal cancer

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Abstract

Background Along with an aging society, the number of elderly patients with colorectal cancer treated with a surgical modality has gradually increased. Our purpose is to verify the safety and effectiveness of laparoscopic surgery for the treatment of colorectal cancer in elderly patients.

Methods We compared the short-term outcomes of open versus laparoscopic surgery in patients aged 80 years or older with colorectal cancer between 2007 and 2014.

Results Of 150 elderly colorectal patients, 62 patients received laparoscopic surgery, and 88 patients, open surgery. In the laparoscopic surgery group, two patients were converted to open surgery due to extensive adhesion. The amount of blood loss was smaller in patients treated with laparoscopic surgery than those with open surgery (44.0 ± 86.5 vs. 329.9 ± 482.1 ml, $P < 0.01$). In the laparoscopic surgery group, days until oral intake (5.3 ± 1.9 vs. 7.0 ± 3.0 days, $P < 0.01$) and hospital stay (17.2 ± 6.8 vs. 22.0 ± 14.0 days, $P < 0.01$) were shorter. Morbidity (30.6 vs. 42.0 %) and mortality (1.6 vs. 1.1 %) in laparoscopic and open surgery groups were similar.

Conclusion Laparoscopic surgery in elderly patients with colorectal cancer was a safe and less invasive alternative to open surgery, with less blood loss and shorter hospital stay.

Keywords Laparoscopic surgery · Open surgery · Colorectal cancer · Elderly patients

Colorectal cancer is the one of the most common malignancies worldwide, and in recent years, the incidence rates in Japanese males have exceeded the peak of incidence observed in the USA, Canada and New Zealand [1]. Of all cancer deaths in Japan, the age-adjusted mortality rate of colorectal cancer is ranked third in men and second in women [1]. Similar to other malignancies, colorectal cancer occurs more frequently in elderly patients, and also in Japan, an increased incidence of colorectal cancer is observed with increasing the age [2, 3]. Along with an aging society, the number of elderly patients who received surgical treatment for colorectal cancer has gradually increased. Unfortunately, most elderly patients have other comorbidities such as cardiovascular or pulmonary disease and reduced functional reserve, which increase the operative risk and the risk of postoperative morbidity and mortality.

It was more than 20 years since the first experiences of laparoscopic colectomy have been reported by Jacobs in 1991 [4]. Several large-scale randomized controlled trials that compared laparoscopic surgery and open surgery for colon/rectal cancer have confirmed that laparoscopic surgery was associated with less postoperative pain, rapid recovery of intestinal function, shorter hospital stay and similar long-term oncologic outcomes such as overall survivals and disease-free survivals compared with open surgery [5–15]. But operating times were significantly longer in the laparoscopic surgery group than in the open surgery group. As for the number of harvested lymph nodes, postoperative morbidity and mortality, there were no statistical differences between the two groups. So, recently laparoscopic surgery for colorectal cancer has become common and widely accepted as a therapeutic option.

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This minimally invasive type of surgery might also be an effective treatment method for elderly patients. However, the median/mean age of the patients included in these large-scale randomized trials was from 58 to 71 years old [5, 7, 9, 11, 12, 14]. So the safety and effectiveness of laparoscopic surgery is not clear in octogenarians with colorectal cancer who might have other comorbidities such as cardiovascular or pulmonary disease.

The purpose of this study was to verify the safety and effectiveness of laparoscopic surgery for the treatment of colorectal cancer in patients older than 80 years.

Methods

Patients and methods

From 2007 to 2014, 150 consecutive colorectal cancer patients aged 80 years or older who were intended to receive curatively resected surgery in our hospital were studied retrospectively. Patients with recurrent colorectal cancers, patients who received palliative surgery from the beginning and patients with synchronous metastases (Stage 4) were excluded. The short-term outcomes (i.e., morbidity, mortality and postoperative hospital stay) of open versus laparoscopic surgery and the clinicopathological and operative data were studied. Robotic surgery was considered as a laparoscopic technique and included in laparoscopic surgery. Conversion of laparoscopic surgery to open surgery was defined as an abdominal incision different from that planned at the start of the operation. The results of pathological examination were classified according to the TNM classification of the International Union Against Cancer (UICC) [16]. The resumption of oral intake was decided by the operating surgeon according to patient's general condition and laboratory data. Patients were discharged when they had sufficient oral intake, no complications or well-controlled complications and no excessive anxiety about leaving the hospital. Short-term morbidity and mortality were defined as 30-day or in-hospital morbidity and mortality. The study was conducted with the approval of the ethics committee of our hospital, and we obtained informed consent from all patients before surgery.

Statistical analysis

For categorical variables, data were presented as frequencies and percentage, and Fisher's exact probability test or Chi-square test was applied to evaluate the significance of differences in proportions. Continuous variables were shown as mean \pm standard deviation (SD) and were

estimated using Mann–Whitney *U* test or a *t* test. Associations were considered significant when $P < 0.05$.

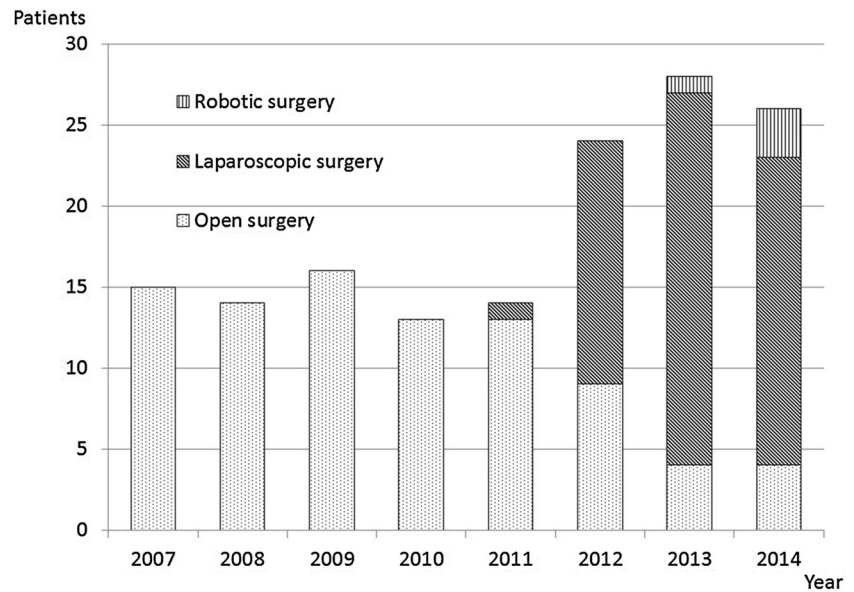
Results

In our institute, until 2011, the laparoscopic surgery was limited to patients with colon cancer preoperatively diagnosed as early stage, but the application of the laparoscopic surgery gradually increased after 2012, and presently, laparoscopic surgery is indicated in almost all feasible patients. Furthermore, from 2012 the robotic surgery was introduced into patients with rectal cancer when they chose this procedure. It was similar in elderly patients, to whom the robotic surgery was also indicated (Fig. 1). In 2014, four elderly patients received open surgery because of resection of adjacent organ (spleen) in one case, pulmonary comorbidity in one and two emergent surgeries.

Of 150 elderly colorectal patients, 62 patients received laparoscopic surgery (including four patients who received robotic surgery) and the remaining 88 patients received open surgery. Mean age of the patients was 83.3 years, and there were 66 men and 84 women. Characteristics of patients in open and laparoscopic surgery groups are given in Table 1. There were no statistical differences between the two groups. More than two-thirds of patients had some kind of comorbidities, and pulmonary comorbidity was the most common in the elderly patients. About a quarter of patients had history of other malignancies.

Operative data are given in Table 2. There was no statistical difference between two groups related to the type of operation. No intraoperative complications occurred in either group. Conversion to open surgery was required in two cases (3.2 %) of laparoscopic surgery, because of extensive adhesion. All emergency surgeries were performed by open surgery. Operative times were slightly longer in the laparoscopic surgery group than those in the open surgery group, but there was no statistical difference between the two groups. The amount of blood loss was smaller in patients treated with laparoscopic surgery group than those receiving open surgery group (44.0 ± 86.5 vs. 329.9 ± 482.1 ml, $P < 0.01$, respectively), and the number of patients requiring blood transfusion during surgery was also smaller in the laparoscopic surgery group (two patients vs. 18 patients, $P < 0.05$).

Pathological characteristics are given in Table 3. Surgery of transverse colon cancer was more common in the open surgery group, but the difference did not reach statistical significance. Histology, pT stage, pN stage and number of harvested lymph nodes were not statistically different between the two groups. One patient with rectal cancer achieved pathological complete response (CR) after

Fig. 1 Change in the operation in elderly patients**Table 1** Patient characteristics

	Open surgery (<i>n</i> = 88)	Laparoscopic surgery (<i>n</i> = 62)	<i>P</i> value
Gender			Ns
Male	36	30	
Female	52	32	
Age			Ns
Mean (range)	83.4 (80–93)	83.1 (80–91)	
Comorbidities			
Overall (%)	61 (69.3)	42 (67.7)	Ns
Cardiovascular	16	15	
Pulmonary	27	22	
Liver	6	6	
Renal	12	7	
Cerebrovascular	14	11	
Diabetes mellitus	17	16	
History of other malignancies			
Yes (%)	20 (22.7)	14 (22.5)	

Ns not significant

preoperative chemoradiotherapy in the laparoscopic surgery group. Tumor size was smaller in patients treated with the laparoscopic group than those with the open surgery group (38.4 vs. 47.2 mm, $P < 0.05$, respectively). A complete R0 resection was achieved in all patients. The number of overall resections of the adjacent structures was not significant difference between the two groups, but the most difficult cases, which needed the resection of organs such as uterus, vagina or spleen, were performed by open surgery.

Postoperative events are given in Table 4. Days until oral intake was significantly shorter in the laparoscopic

group than those in the open surgery group (5.3 ± 1.9 vs. 7.0 ± 3.0 days, $P < 0.01$, respectively), and the laparoscopic surgery group was associated with shorter hospital stay (17.2 ± 6.8 vs. 22.0 ± 14.0 days, $P < 0.01$, respectively). Morbidity rate (30.6 vs. 42.0 %, respectively) and mortality rate (1.6 vs. 1.1 %, respectively) in laparoscopic and open surgery groups were similar. One patient in the laparoscopic surgery group and one patient in the open surgery group died in the postoperative period due to pneumonia. The laparoscopic surgery group showed a significantly lower incidence of wound infection (1.6 vs. 10.2 %, $P < 0.05$).

Table 2 Operative data

	Open surgery (<i>n</i> = 88)	Laparoscopic surgery (<i>n</i> = 62)	<i>P</i> value
Types of operation			Ns
Right colectomy	31	16	
Transverse colon resection	7	1	
Left colectomy	4	3	
Sigmoid resection	21	24	
Anterior resection	15	14	
Intersphincter resection	0	1	
Abdominoperitoneal resection	3	2	
Hartmann's operation	7	1	
Diverting stoma	4	4	Ns
Conversion (%)	2 (3.2)		
Emergency surgery	4	0	Ns
Operative time (min)			Ns
Mean ± SD	210.2 ± 85.2	239.0 ± 94.5	
Range	93–511	86–646	
Blood loss			<i>P</i> < 0.01
Mean ± SD	329.9 ± 482.1	44.0 ± 86.5	
Range	2–2800	2–570	
Blood transfusion			<i>P</i> < 0.05
Yes	18	2	

Ns not significant

Discussion

Previously, some studies have reported the safety and feasibility of laparoscopic surgery in elderly patients, but these reports included septuagenarian or only colon cancer or only rectal cancer or not included T4b colorectal cancer [2, 3, 17–21]. So this time all patients analyzed were older than 80 years of age, were diagnosed with colorectal cancer and were intended to receive curative resection. We observed a significantly shorter hospital stay, faster recovery of bowel function and less blood loss in the group receiving laparoscopic surgery, which is similar to the previous reports comparing laparoscopic with open surgery for colorectal cancer in elderly patients [2, 17, 20, 21], and the large-scale randomized controlled trials comparing laparoscopic with open surgery for colon/rectal cancer [5, 8, 9, 11, 12, 14]. The duration of operating time, intraoperative complications, postoperative complications and R0 resections in our study were comparable between laparoscopic surgery and open surgery groups. Radicality of resection, as assessed by the number of harvested lymph nodes and the rate of negative resected proximal and distal margins of the specimen, did not differ between the groups. In our study, 62 elderly patients received laparoscopic surgery and conversion to open surgery was required in two cases (3.2 %) of laparoscopic surgery due to extensive adhesion. The conversion rate in our study was comparable

to COREAN trial [13] and other studies including elderly patients [2, 3, 17, 19], but was lower than those in some large-scale randomized trials [5, 8, 9, 11, 14]. The conversion rate may be reduced with increasing the experience of the surgical team. However, in some cases, conversion to open surgery is required, and we need to decide appropriately the conversion to open surgery for the safe therapy of elderly patients with colorectal cancer.

In our study, patients with transverse colon cancer often received open surgery, because transverse colon cancer was excluded from the previous large-scale randomized trials, and also the variation of the vascular distribution and the anatomical complexity due to the proximity of important structures, such as pancreas, duodenum and spleen. But some reports demonstrated the safety and feasibility of laparoscopic surgery for transverse colon cancer with better short-term outcomes and equivalent oncologic outcomes compared with open surgery [22–24]. So, now we indicate laparoscopic surgery for the treatment of transverse colon cancer, and further investigation will be necessary to confirm the safety and feasibility of this kind of treatment in octogenarians.

Shukla et al. [25] in a retrospective study reported on the feasibility of laparoscopic resection in the majority of T4 colon cancers with comparable short- and long-term clinical and oncologic outcomes, but also documented that surgeon bias and local extent of the tumor on

Table 3 Pathological characteristics

	Open surgery (<i>n</i> = 88)	Laparoscopic surgery (<i>n</i> = 62)	<i>P</i> value
Tumor location			Ns
Cecum	7	4	
Ascending colon	16	12	
Transverse colon	18	2	
Descending colon	1	2	
Sigmoid colon	34	29	
Rectum	12	13	
Histology			Ns
Well/moderately differentiated	82	60	
Others	6	2	
Tumor size (mm)			<i>P</i> < 0.05
Mean ± SD	47.2 ± 22.7	38.4 ± 20.0	
Range	12–120	11–110	
pT stage		Ns	
T1	20	14	
T2	15	10	
T3	49	24	
T4a	13	9	
T4b	4	4	
TX	0	1	
pN stage			Ns
N0	53	42	
N1	29	16	
N2	6	4	
Number of harvested lymph nodes			Ns
Mean ± SD	18.8 ± 10.6	17.5 ± 9.8	
Range	0–53	1–39	
Proximal margin, distal margin			Ns
Negative	88	62	
Positive	0	0	
R stage			Ns
R0	88	62	
R1/2	0	0	
Invasion of adjacent structure			Ns
Overall	8	5	
Omentum	1		
Ovary	1		
Uterus	1		
Vagina	2		
Abdominal wall		2	
Bowel	2	3	
Spleen	1		

Ns not significant

preoperative imaging most likely played important roles in the selection for a laparoscopic or an open approach. In this report, there was a tendency for a slightly higher rate of adjacent structures resection in the open surgery group than that in the laparoscopic surgery group. In our study

of elderly patients, there was no significant difference in the number of cases requiring resection of adjacent structures between the two groups, and a complete R0 resection was achieved in all patients. But the difficult cases which needed the resection of the adjacent organs,

Table 4 Postoperative recovery, morbidity and mortality

	Open surgery (<i>n</i> = 88)	Laparoscopic surgery (<i>n</i> = 62)	<i>P</i> value
Days until oral intake (days)			<i>P</i> < 0.01
Mean ± SD	7.0 ± 3.0	5.3 ± 1.9	
Range	3–21	2–10	
Postoperative hospital stay (days)			<i>P</i> < 0.01
Mean ± SD	22 ± 14.0	17.2 ± 6.8	
Range	12–111	7–40	
Morbidity			
Overall (%)	37 (42.0)	19 (30.6)	Ns
Wound infection (%)	9 (10.2)	1 (1.6)	<i>P</i> < 0.05
Intraabdominal abscess	2	5	Ns
Anastomotic leakage	0	1	Ns
Infection via catheter	3	0	Ns
Urinary tract infection	3	1	Ns
Pneumonia	2	2	Ns
Enterocolitis	1	0	Ns
Cholecystitis	1	0	Ns
Delirium	3	4	Ns
Bowel obstruction	9	2	Ns
Bleeding	1	0	Ns
Anastomotic stenosis	1	0	Ns
Cerebral infarction	1	1	Ns
Angina	1	0	Ns
Liver dysfunction	0	1	Ns
Urinary retention	0	1	Ns
Disuse syndrome	1	0	Ns
Mortality (%)	1 (1.1)	1 (1.6)	Ns

Ns not significant

such as uterus, vagina or spleen, received open surgery. Even in 2014, open surgery was performed in elderly patients with T4b colon cancer that invaded into spleen. But now, laparoscopic surgery is also performed in some cases who require the resection of the adjacent organs, such as vagina or bladder wall. As shown in the previous report [25], laparoscopic surgery may be considered as an alternative approach for T4 colon cancer even in octogenarians, but the appropriate selection of patients with T4 colon cancer is necessary to perform laparoscopic surgery safely, and when needed, the conversion to open surgery must be considered.

In our study, morbidity rate in laparoscopic and open surgery groups was similar (30.6 vs. 42.0 %, respectively), and there was no statistical difference between the two groups. While some previous studies also documented there was no statistical difference in morbidity between laparoscopic and open surgery groups [18, 20, 21], others documented lower morbidities in laparoscopic surgery groups compared with open surgery group [2, 17, 19]. But there were no reports showing higher morbidities in

laparoscopic surgery groups compared with open surgery group, laparoscopic surgery seemed to be safe in elderly patients with colorectal cancer. In our study, the wound infection rate was lower in the laparoscopic surgery group than that in the open surgery group (*P* < 0.05), similar to the previous report [17].

Inoue et al. [3] reported that selection criteria for laparoscopic surgery in elderly as well as non-elderly patients with colorectal cancer should include pulmonary comorbidities because patients with pulmonary comorbidities who received laparoscopic surgery exhibited similarly high rates of postoperative complications compared with patients with pulmonary comorbidities who received open surgery (41.2 vs. 46.7 %, respectively, *P* = 0.7547). In our study, one of four cases of elderly patients received open surgery because of pulmonary comorbidity in 2014. And one patient in the laparoscopic surgery group and one in the open surgery group died in the postoperative period due to pneumonia. So, further study is needed about the indication of laparoscopic surgery in colorectal cancer patients with pulmonary comorbidities.

Odermatt et al. reported the feasibility and safety of emergency resection of the perforated or obstructed colon cancer by laparoscopy compared with open surgery using a propensity score-matched design. In this study, the overall 3-year survival rate and the 3-year recurrence-free survival rate were not significantly different between the laparoscopic group and the open group, and the laparoscopic group showed a significantly shorter length of hospital stay but had a trend toward a lower R0 resection rate and a higher wound infection [26]. In our study of elderly patients, all emergency colorectal cancer resections were performed by open surgery. Although we consider laparoscopic surgery unfeasible under emergency, due to the bowel dilatation and the contaminated ascites, which may affect clear visualization, affecting safe performance of the procedure, in the future we need a further investigation to evaluate the feasibility and efficacy of emergency laparoscopic surgery, initially to be confirmed in younger selected patients and then to be expanded to the elderly selected patients with colorectal cancer.

The present study had some limitations. First, this study was not a large-scale multicenter randomized trial, but retrospective study conducted at a single institute. Second, the operative method was different depending on the period. Until 2011, the open surgery was common, but presently the laparoscopic surgery is indicated in almost all patients. The third limitation is that because of the short-term follow-up of laparoscopic group the present study was an analysis of the short-term results, so the long-term results remain unknown. Oncological long-term outcomes are most important to clarify the true feasibility of laparoscopic surgery in elderly patients with colorectal cancer. Further study is needed to confirm the long-term outcomes.

In conclusion, laparoscopic surgery in elderly patients with colorectal cancer was a safe and less invasive alternative to open surgery, with less blood loss and shorter hospital stay.

Compliance with ethical standards

Disclosures Takeshi Nishikawa, Dr. Soichiro Ishihara, Dr. Keisuke Hata, Dr. Koji Muroto, Dr. Koji Yasuda, Dr. Kensuke Otani, Dr. Toshiaki Tanaka, Dr. Tomomichi Kiyomatsu, Dr. Kazushige Kawai, Dr. Hiroaki Nozawa, Dr. Hironori Yamaguchi and Prof. Toshiaki Watanabe declare no conflicts of interest or financial ties to disclose.

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