



Comparison of Open and Laparoscopic Gastrectomy in Elderly Patients

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Abstract

Purpose The purpose of this study was to estimate surgical outcomes of elderly patients older than 80 years who received laparoscopic or open gastrectomy for gastric cancer and to identify risk factors for postoperative complications.

Methods Two hundred forty-two elderly patients older than 80 years underwent gastric cancer surgery between January 2010 and December 2016 in three tertiary hospitals. They were divided into two groups: laparoscopic gastrectomy ($N = 59$) and open gastrectomy ($N = 183$). The surgical outcomes and risk factors for postoperative complication were evaluated.

Results Among the elderly patients, 24.4% showed an ASA score of 3 or 4, and 20.7% showed a Charlson comorbidity index (CCI) score of 2 or more. 46.3% of patients had hypertension and 15.3% had diabetes. The laparoscopic gastrectomy group showed similar operation time, less intraoperative blood loss, and faster postoperative gastrointestinal recovery compared to the open gastrectomy group. The incidence of postoperative complications was 30.1% in the open group and 22.0% in the laparoscopic group ($P = 0.249$). One patient died for pulmonary complication in the open gastrectomy group. In multivariate analysis, older age, male, higher CCI score, and open approach were found to be correlated with increased risk for postoperative complications.

Conclusions Although elderly patients over 80 years had a high incidence of comorbidity, gastric cancer surgery can be safely performed. The laparoscopic approach might be feasible for open surgery in improving quality of life in these patients, given a faster postoperative intestinal recovery period, with similar risk for postoperative complications.

Keywords Gastric cancer · Elderly patients · Octagenarian · Gastrectomy · Laparoscopy

Introduction

The incidence of gastric cancer in the elderly population has gradually increased over time, due to extended life spans and a larger aging population. The elderly population often has underlying conditions, such as cardiovascular, cerebrovascular, kidney, or pulmonary diseases, or organs with reduced function.

Therefore, the rate of mortality or complications after gastrectomy is higher in elderly patients compared to non-elderly patients,^{1,2} and surgeons tend to avoid performing aggressive or major surgeries on these patients. Considering the mean global life expectancy for both sexes was 71.5 years in 2013 (mean 73.8 years for females and 69.1 years for males)³ and Korean life expectancy was 82.4 years in 2014,⁴ clinician reluctance to perform invasive procedures, including major surgeries, for elderly patients over 80 years old is understandable.

However, a better understanding of the physiology of elderly patients and the development of perioperative supportive care and advanced anesthetic technique have allowed elderly patients and their caregivers to select surgery more confidently. Therefore, the use of surgery in elderly patients is currently increasing and this trend is apparent in gastric cancer surgery. Moreover, a previous study reported that surgical treatment was associated with a better prognosis than supportive care in gastric cancer patients ≥ 80 years old.⁵

Laparoscopic gastrectomy has rapidly spread in the world as a minimally invasive treatment for gastric cancer since the

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first report by Kitano et al. in 1994.⁶ Recently, several studies have reported that this procedure reduces postoperative complications compared to open gastrectomy and specifically reduces respiratory complications.^{7–9} Laparoscopic gastrectomy with less invasiveness, less pain, and an earlier recovery could be a feasible procedure for elderly patients at high risk for postoperative morbidity. However, the safety and feasibility of laparoscopic gastrectomy have not been clearly determined in elderly patients.¹⁰

The purpose of this study was to evaluate surgical outcomes of elderly patients over 80 years old, to compare the postoperative outcomes of patients who underwent laparoscopic or open gastrectomy, and to identify risk factors for development of postoperative complications after gastric cancer surgery.

Materials and Methods

Study Cohort

A total of 242 elderly patients over 80 years old underwent curative gastrectomy for gastric cancer between January 2010 and December 2016 in three hospitals. Patients with remnant cancer or another type of cancer were excluded. All patients were treated according to the Japanese classification of gastric carcinoma (JCGC) as defined by the Japanese Gastric Cancer Association.¹¹ The medical records were retrospectively reviewed using data from the three hospitals. All information was obtained with the appropriate institutional review board waivers, and the data were collected without revealing any personal information (Samsung Medical Center IRB No. 2017-02-122, Yonsei University College of Medicine IRB No. 4-2017-0439, and BOHUN 2017-04-003).

Patient Characteristics and Clinical Data

Collected sociodemographic characteristics were age, sex, body mass index (BMI), smoking history, and alcohol drinking history. Clinicopathologic characteristics included American Society of Anesthesiologists (ASA) score, Charlson comorbidity index (CCI),¹² comorbidity, history of previous abdominal surgery or endoscopic submucosal dissection (ESD), and tumor classification at diagnosis. Tumor stage at diagnosis was determined in accordance with the 7th edition of the Union International Centre Cancer/American Joint Committee on Cancer classification system.¹³

Reviewed surgical factors were extent of resection, extent of lymph node dissection, presence of combined resection, mean operative time, intraoperative blood loss, length of hospital stay after surgery, and times to first flatus passage and diet initiation, as well as postoperative complications. Postoperative complications were classified

according to the criteria proposed by Clavien and Dindo.¹⁴ Hospital mortality was defined as death during hospitalization or postoperative death from any cause within 30 days.

We compared these variables according to operation type, the laparoscopic approach versus the open method, and analyzed risk factors for postoperative complications in elderly patients.

Selection of Open or Laparoscopic Gastrectomy

Because this study is a retrospective study, the selection of surgical method was decided by individual patients and their surgeons' preference. Laparoscopic gastrectomy was initially performed in cases of early gastric cancer (EGC), which was defined as the tumor involving mucosal or submucosal layer with little lymph node metastasis, and was later extended to treat advanced gastric cancer (AGC), which was defined as the tumor involving more than proper muscle layer, as the accumulation of surgical experiences and the advancement of surgical techniques. In this patients, open gastrectomy was performed more frequently in patients with AGC than in those with EGC.

Perioperative Management

Each patient received standardized pre- and postoperative management according to the routine manual. All patients wore anti-embolic stockings as the prophylaxis for deep vein thrombosis from before surgery until active ambulation after surgery. All patients received intravenous patient-controlled analgesia (PCA) using fentanyl after surgery, and additional analgesic drugs were administered depending on the requirements of the individual patient for the management of postoperative pain. Oral feeding was initiated after the passage of flatus and diet was progressed step by step from water, to a liquid, to soft diet, as tolerated by the patient. Patients were discharged once they were free of complications.

Statistical Methods and Analyses

The data were statistically compared using an independent *t* test for continuous variables and the chi-squared test or Fisher's exact test for categorical data analysis, as appropriate. Patients who were performed total gastrectomy were excluded in the multivariate analysis for recurrence. A *P* value less than 0.05 was considered significant. Statistical analysis was performed using SPSS version 23.0 (IBM Corp., Armonk, NY, USA).

Results

Patient and Tumor Characteristics

Among 242 elderly patients, there were 183 patients in the open gastrectomy group; their clinical characteristics are summarized in Table 1. The mean ages of patients were 82.2 ± 2.4 and 83.1 ± 3.3 years in the open and laparoscopic groups, respectively. The male-to-female ratio, BMI, ASA score, CCI, smoking history, and drinking history were all similar between the two groups. In all patients, 24.4% showed an ASA score 3 or 4, and 20.7% showed a CCI score of 2 or more. The incidence of ASA score of 1 was 12.6% in the open group and 6.8% in the laparoscopic group, with most patients showing an ASA score of 2 or 3. In all patients, 46.3% had hypertension and 15.3% had diabetes. The percentages of patients with a history of previous ESD ($P = 0.006$) and of early gastric cancer ($P < 0.001$) were significantly higher in the laparoscopic group, possibly because laparoscopic gastrectomy was usually performed in cases of less advanced cancer.

Effect of Approach Method on Surgical Outcomes

Table 2 shows surgical data from the two groups. Patients in the laparoscopic group had a higher frequency of subtotal gastrectomy and a lower frequency of D2 lymph node dissection compared to those in the open group. The mean operation time was similar in both groups. The laparoscopic group showed less intraoperative blood loss ($P < 0.001$) and shorter hospital stay ($P = 0.002$) compared to the open group. In addition, in patients without postoperative complications, the laparoscopic group showed earlier first flatus passage and diet initiation ($P < 0.001$) compared to the open group.

Complication Types and Risk Factors for Postoperative Complication Development

The postoperative 30 days or in-hospital complication rate and type are shown in Table 3. The overall rate of complication was 30.1% (55/183 patients) in the open group and 22.0% (13/59 patients) in the laparoscopic group ($P = 0.249$). The most common complication in the open group was wound complications of grade I (14 patients, 7.7%), followed by pulmonary complication of grade II (12 patients, 6.6%). In the laparoscopic group, there was one patient with grade IIIa or higher complications, classified as life-threatening or requiring surgical intervention. Only one patient with laparoscopic gastrectomy had an anastomotic leak, and he recovered with conservative management including adequate drainage. The patient was discharged on postoperative day 22. Five patients in the open group were admitted to the intensive care unit (ICU) for pulmonary complications (three patients for pneumonia and two patients for atelectasis with desaturation); one

patient was discharged on postoperative day 22, while the others had an average hospital stay. One patient died for pulmonary complication in the open gastrectomy group on postoperative 19th day. Except this patient, there was no additional postoperative mortality for postoperative 90 days. The mortality rate was 0.5% in the open gastrectomy group and there was no mortality in the laparoscopic group.

Table 4 presents risk factors for postoperative complication development in elderly patients with gastrectomy, as assessed by a multivariate analysis. Advanced age ($P = 0.009$), male gender ($P = 0.032$), higher CCI score ($P = 0.049$), and open approach ($P = 0.042$) were independent risk factors for postoperative complications in patients aged 80 or over. ASA score ($P = 0.666$), an open surgical approach ($P = 0.200$), tumor status (EGC vs. AGC, $P = 0.530$), and combined resection were not significantly correlated with postoperative complications.

Discussion

Although elderly patients have been considered as a population that might not be able to tolerate major surgery and to have increased risk for morbidity and mortality, a longer life span and a larger aging population make surgery in elderly patients inevitable. In gastric cancer, the incidence of old age is increasing, but postoperative risks have not been well-evaluated. In addition, although the clinical advantages of laparoscopic versus open surgery have been evaluated in non-elderly patients,^{15,16} the safety and feasibility of laparoscopic gastrectomy have not been well-demonstrated in elderly patients. Therefore, this study was designed to evaluate the surgical outcomes of elderly patients 80 years or older after gastric cancer surgery, to compare the clinical outcomes of the laparoscopic and open approaches, and to investigate risk factors for postoperative morbidities.

This study revealed that elderly patients older than 80 years had more comorbidities including cardiovascular disease (hypertension, coronary disease, or stroke) and diabetes than the general population.^{17,18} In this study, 46.3% of patients had hypertension and 15.3% had diabetes, while the general population of Korean adults over 30 years has shown a prevalence of approximately 30.0% for hypertension¹⁷ and 11.0% for diabetes.¹⁸ In addition, elderly patients over 80 years in this study showed higher CCI or ASA scores, with regard to physical status, as in other studies of patients undergoing gastrectomy.^{19,20}

The present study showed that laparoscopic gastrectomy had less intraoperative blood loss and a faster postoperative gastrointestinal recovery compared to open gastrectomy in elderly patients over 80 years old. Considering that elderly patients with laparoscopic gastrectomy more frequently underwent subtotal gastrectomy ($P = 0.003$) and had less D2

Table 1 Clinical characteristics of patients

	Open gastrectomy (<i>n</i> = 183)	Laparoscopic gastrectomy (<i>n</i> = 59)	<i>P</i> value
Age (years, mean ± SD)	82.2 ± 2.4	83.1 ± 3.3	0.056
Sex			
Male	122 (66.7)	36 (61.0)	0.436
Female	61 (33.3)	23 (39.0)	
BMI (kg/m ² , mean ± SD)	21.9 ± 3.1	22.6 ± 3.1	0.114
Charlson comorbidity index (<i>n</i>)			
0	76 (41.5)	20 (33.9)	0.372
1	71 (38.8)	25 (42.4)	
2	26 (14.2)	12 (20.3)	
3	8 (4.4)	1 (1.7)	
4	1 (0.5)	0 (0)	
5	1 (0.5)	0 (0)	
6	0 (0)	1 (1.7)	
ASA score			
1	23 (12.6)	4 (6.8)	0.400
2	113 (61.7)	43 (72.9)	
3	46 (25.1)	12 (20.3)	
4	1 (0.5)	0 (0)	
Comorbidities			
Hypertension	85 (46.4)	27 (45.8)	
Diabetes	25 (13.7)	12 (20.3)	
Pulmonary (COPD, asthma)	13 (7.1)	3 (5.1)	
Cardiology (arrhythmia, angina, valve)	18 (9.8)	4 (6.8)	
Cerebral infarct	11 (6.0)	4 (6.8)	
Pulmonary tuberculosis	4 (2.2)	1 (1.7)	
Liver disease (cirrhosis, hepatitis)	4 (2.2)	1 (1.7)	
Kidney disease	4 (2.2)	1 (1.7)	
Thyroid disease	2 (1.1)	0 (0)	
Previous abdominal surgery	34 (18.6)	15 (25.4)	0.267
Previous ESD	10 (5.5)	11 (18.6)	0.006
Smoking	49 (26.8)	10 (16.9)	0.455
Drinking	48 (26.2)	12 (20.3)	1.000
Tumor classification			< 0.001
EGC	59 (32.2)	38 (64.4)	
AGC	124 (67.8)	21 (35.6)	
T stage			< 0.001
T1	59 (32.2)	38 (64.4)	
T2	29 (15.8)	10 (16.9)	
T3	44 (24)	5 (8.5)	
T4	51 (27.9)	6 (10.2)	
N stage			0.002
N0	90 (49.2)	45 (76.3)	
N1	25 (13.7)	7 (11.9)	
N2	29 (15.8)	3 (5.1)	
N3	39 (21.3)	4 (6.8)	

BMI body mass index, ASA American Society of Anesthesiologists, COPD chronic obstructive pulmonary disease, ESD endoscopic submucosal dissection, EGC early gastric cancer, AGC advanced gastric cancer

A *p*-value less than 0.05 was italicized.

Table 2 Comparison of operative and postoperative outcomes between open and laparoscopic gastrectomy groups

	Open gastrectomy (n = 183)	Laparoscopic gastrectomy (n = 59)	P value
Resection extent			
Subtotal	143 (78.1)	56 (94.9)	<i>0.003</i>
Total	40 (21.9)	3 (5.1)	
Extent of lymph node dissection			
D1+	16 (8.7)	29 (49.2)	< <i>0.001</i>
D2	167 (91.3)	30 (50.8)	
Combined resection			
Gallbladder	14	4	
Spleen	6	0	0.122
Appendix	3	0	
Others*	6	0	
Operation time (min)	169.4 ± 52.2	172.1 ± 61.4	0.770
Intraoperative blood loss (ml)	175.2 ± 148.1	100.4 ± 76.7	< <i>0.001</i>
Hospital stay after surgery (days) [†]	8.4 ± 0.9	7.8 ± 1.8	<i>0.002</i>
First flatus passage (days) [†]	4.2 ± 0.8	3.7 ± 0.9	< <i>0.001</i>
Diet initiated (days) [†]	4.2 ± 0.7	3.6 ± 0.9	< <i>0.001</i>

*Included combined resections of the liver, pancreas, colon, etc.

[†] These were compared for patients without postoperative complications

A p-value less than 0.05 was italicized

lymph node dissection ($P < 0.001$) than open gastrectomy, the less blood loss and faster recovery associated with

laparoscopic surgery were expected. Elderly patients undergoing surgery often have concerns about the relatively longer

Table 3 Postoperative complications

	Open gastrectomy (n = 183)	Laparoscopic gastrectomy (n = 59)	P value
Total complications	55 (30.1)	13 (22.0)	0.249
Clavien-Dindo			0.880
Grade I			
Wound	14	1	
Ileus	4	1	
Delayed emptying	2	3	
Urinary	2	0	
Grade II			
Pulmonary	12	3	
Cardiovascular	5	1	
Wound	3	0	
Urinary	3	1	
Anastomotic	0	1	
Cachexia	2	0	
Delirium	0	1	
Grade IIIa			
Complicated fluid collection	1	0 (0)	
Cardiovascular	1		
Grade IV			
Pulmonary	5 (2.7)	1 (0)	
Grade V			
Pulmonary	1 (0.5)	0 (0)	

Table 4 Risk factors associated with postoperative complication development

	Odds ratio	95% CI	<i>P</i> value
Age	1.166	1.038–1.310	<i>0.009</i>
Sex			
Male			
Female	0.434	0.203–0.929	<i>0.032</i>
BMI	0.974	0.869–1.092	<i>0.652</i>
Charlson comorbidity index	1.398	1.001–1.955	<i>0.049</i>
Operation type			
Open			
Laparoscopy	0.401	0.166–0.966	<i>0.042</i>
Tumor status			
EGC			
AGC	1.280	0.624–2.626	<i>0.501</i>
Combined resection			
No			
Yes	1.125	0.406–3.112	<i>0.821</i>

BMI body mass index, *COPD* chronic obstructive pulmonary disease, *EGC* early gastric cancer, *AGC* advanced gastric cancer

A *p*-value less than 0.05 was italicized

operation time required for laparoscopic surgery compared to open surgery. However, laparoscopic gastrectomy showed a similar mean operation time to open gastrectomy in this study. Li et al. also demonstrated that the mean operative time of laparoscopic gastrectomy was similar to that of open gastrectomy for elderly gastric cancer patients.¹⁰ Since the first laparoscopic partial gastrectomy for gastric cancer was introduced in 1994,⁶ most medical centers have staff with sufficient experience and advanced skill for laparoscopic gastrectomy, and surgical time has ceased to be an obstacle in a spread of laparoscopic surgery.

No significant differences were observed in the incidence of postoperative complications between the two groups. Postoperative complications occurred in 13 (22.0%) patients in the laparoscopic group and 55 (30.1%) in the open group (*P* = 0.249). Previous studies of postoperative complications in elderly patients after laparoscopic gastrectomy for gastric cancer have reported incidences ranging from 11.5 to 16.8%.^{10,21–23} A previous study reported an overall postoperative complication rate of 14.8% after laparoscopic surgery and 29.6% after open surgery in an elderly population.¹⁰ The most common type of complication after open gastrectomy, which has a longer incision length compared to laparoscopic gastrectomy, was wound complications (17 patients, 14 with grade I and 3 with grade II, 9.3%).

Some elderly patients present with a poor compensatory ability due to a weakened immune system, which can be exacerbated by nutritional insufficiency. Elderly patients are generally less tolerant to the pneumoperitoneum that forms an essential part of

laparoscopic surgery. However, in our data, pulmonary complications developed in 18 (9.8%) patients (12 with grade II and 6 with grade IV or V) in the open gastrectomy group, and 4 (6.8%) patient (3 with grade II and one with grade IV) in the laparoscopic gastrectomy group. This suggests that the existence of pneumoperitoneum did not make a significant difference in the prevalence of pulmonary complications between the laparoscopic and open surgery groups, and various factors including postoperative pain, combined disease, and baseline pulmonary function have an influence on pulmonary complication.

We found that older age, male gender, a CCI score of 2, and open gastrectomy were significantly associated with increased risk for postoperative complications in elderly patients who underwent gastrectomy. Advanced age has been well-documented as among the highest risk factors for postoperative complications after gastrectomy.^{24–26} In addition, the CCI is widely used for objective quantification of comorbidities. In recent years, several studies have reported that CCI score is associated with postoperative complications in patients who undergo gastrectomy.^{20,27} CCI score therefore might be more clinically useful as a prognostic factor for postoperative complications after gastrectomy than age, which cannot describe the general performance of patients, in the elderly population.

This study might have a selection bias: laparoscopic gastrectomy was performed more often for patients with early gastric cancer, and open gastrectomy for advanced gastric cancer. Moreover, certain surgical outcomes such as surgical extent and operative difficulty can be different by tumor status, which can also affect postoperative recovery. This could be the reason that the laparoscopic group showed a higher frequency of subtotal gastrectomy cases, less intraoperative blood loss, and similar prevalence of postoperative complications in the present study. With a more thorough investigation of laparoscopic surgery as a treatment for patients with advanced gastric cancer, the feasibility of laparoscopic gastrectomy in elderly patients would be established.

In conclusion, although elderly patients over 80 had a high incidence of comorbidity, gastric cancer surgery can be safely performed. The laparoscopic approach, associated here with a similar risk of postoperative complication development and a faster postoperative intestinal recovery compared with the open approach, might be feasible for open surgery to improve quality of life in elderly patients.

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Final approval of the version to be published: all authors.

Compliance with Ethical Standards

All information was obtained with the appropriate institutional review board waivers, and the data were collected without revealing any personal information (Samsung Medical Center IRB No. 2017-02-122, Yonsei University College of Medicine IRB No. 4-2017-0439, and BOHUN 2017-04-003).

Conflict of Interest The authors declare that they have no conflicts of interest.

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