

# Laparoscopy-assisted Gastrectomy for Early Gastric Cancer in Young and Elderly Patients

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## Abstract

Open gastric surgery in elderly patients is associated with higher morbidity and mortality rates than those reported among younger individuals. Therefore, minimally invasive surgery may have a larger impact on the elderly compared to the younger age group. The objective of this study was to evaluate the experience of laparoscopy-assisted distal gastrectomy (LADG) in patients with early gastric cancer and compare the results in patients 70 years of age and older to those in patients younger than 70 years of age. From January 1998 to October 2004, a total of 103 patients underwent LADG. Of these patients, 30 who were older than 70 years were compared with 73 who were younger. Preoperative co-morbidity, operative results, postoperative outcomes, and survival were analyzed. Furthermore, as a standard control of this study, we reviewed 54 distal gastrectomy cases with open surgery (open distal gastrectomy; ODG) in the same term with the same background factors, categorized into elder ( $n = 16$ ) and younger ( $n = 38$ ). The mean age of the elderly patients was 75 years in the LADG group. A significantly higher proportion of elderly patients had concurrent diseases in both groups. Blood loss was significantly less in the elderly than in younger patients undergoing LADG, and it was less in the LADG group than in the ODG group. The overall 5-year survival rates in the LADG group were not significantly different between elderly and younger patients. Laparoscopy-assisted distal gastrectomy is a safe and effective treatment for early gastric cancer in the elderly. Therefore, chronological age alone should not be considered a contraindication in selecting patients for LADG.

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Census estimates project that 25% of the Japanese population will be over the age of 70 by the year 2014. The life expectancy of the elderly continues to increase.<sup>1</sup> The functional reserve of various organs is often compromised with age, making it difficult to select surgical procedures and assess patients' tolerance to surgical stress. A previous study showed that age is an independent factor affecting mortality and morbidity.<sup>2–4</sup> Therefore, minimally invasive surgery may have a larger impact on the elderly than on the younger population in

terms of fewer cardiorespiratory complications, shorter hospital stays, and a more rapid return to physical activities. Gastric cancer is one of the most common malignancies and the leading cause of cancer death in Japan.<sup>5,6</sup> Laparoscopic gastrectomy is considered less invasive than open gastrectomy, resulting in a more rapid recovery and a shorter hospital stay.<sup>7–9</sup> For elderly patients, who are often less able to withstand the trauma and stress of open abdominal surgery, the advantages of a laparoscopic approach may be particularly important. However, the safety of advanced laparoscopy with prolonged carbon dioxide pneumoperitoneum has not been established in an elderly population.

We reviewed our experience with laparoscopy-assisted distal gastrectomy in patients with early gastric cancer and compared the results in patients 70 years of age and older to those younger than 70 years of age.

## PATIENTS AND METHODS

A total of 103 patients with early gastric cancer underwent laparoscopy-assisted distal gastrectomy at Gunma University hospital between June 1998 and October 2004. Thirty patients (29.1%) were 70 years of age or older. The clinicopathological features of this elderly group were reviewed using hospital records and compared with those of 73 younger patients, defined as those younger than 69 years of age. Furthermore, as a standard control in this study, we reviewed 54 distal gastrectomy cases with open surgery (open distal gastrectomy; ODG) in the same term with the same background factors, categorized into elder ( $n = 16$ ) and younger ( $n = 38$ ). Informed consent was obtained from each patient. Of the 46 elderly patients with early gastric cancer, 30 chose LADG for their treatment.

The evaluation of the preoperative stages of gastric cancer was based on examination, including gastrointestinal endoscopy, endoscopic ultrasonography, and an upper GI series. The diagnostic accuracy of preoperative endoscopic ultrasonography for early gastric cancer is 70.5% in our institution. In both groups of patients, all tumors were adenocarcinomas invading the mucosa or submucosa of the stomach. The indications for LADG included the following: depth of tumor invasion limited to the mucosa or submucosa, absence of lymph node metastases in preoperative examinations, and a tumor of any histological type. Furthermore, LADG was indicated when the tumor was located in the middle or lower part of the stomach.

Laparoscopy-assisted distal gastrectomy with Billroth I reconstruction was performed by two skilled surgeons (E.M. and T.A.) according to a standard technique, as described elsewhere.<sup>7,10</sup> Laparoscopy-assisted distal gastrectomy was performed according to the following procedures. The patients in both groups underwent surgery under general and epidural anesthesia. Laparoscopic surgery was done with the patient in the supine position under CO<sub>2</sub> pneumoperitoneum and 10 cm H<sub>2</sub>O. Four surgical ports were made into the upper abdomen; one of them, at the subumbilicus, was for a laparoscope. The greater omentum was first divided and dissected with ultrasonically activated coagulating shears (LCS, Ethicon, Cincinnati, OH). The right and the left gastroepiploic

arteries were then identified and divided at their roots after double clipping for the dissection of the lymph node along the greater curvature. The lesser omentum was opened, and the right gastric artery was divided. The left gastric artery was then exposed and divided after double clipping at the root while the lymph nodes were dissected.

A transverse incision was made with a 5-cm length at the epigastrium. The duodenum was divided distal to the pyloric ring under direct vision after the surgeon grasped a miniature purse-string suture device (Takasago Medical, Tokyo, Japan). After exteriorization of the distal stomach extra-abdominally through the transverse incision, an 80-mm (linear stapler GIA USSC, Norwalk, CT) was applied at the greater curvature of the stomach, and the resected stomach was removed, together with the lymph nodes. A Billroth I anastomosis was then performed with a circular stapler (Premium plus CEEA, 31 mm, USSC, Norwalk, CT) through the same incision. After the anastomosis was completed, an open lymphadenectomy of the common hepatic and celiac axis was performed through the transverse epigastric incision.

With the LADG method, the perigastric lymph nodes were removed, together with the gastric, gastroepiploic, common hepatic, and celiac arteries (D1 + #7, 8a, 9, number of lymph nodes).<sup>11</sup> Open distal gastrectomy (ODG) was performed in the usual manner through an upper midline laparotomy incision from the xiphoid process to the umbilicus. After surgery, the epidural tube was used for pain control, and this was maintained until the patients no longer complained of abdominal pain. All resected stomachs were opened immediately after surgery, and dissected lymph nodes were divided according to the guidelines of the Japanese Gastric Cancer Association.<sup>11</sup> On formalin-fixed specimens, the size, location, and gross type were measured and determined.

The age and sex of the patients were documented, and the following features were obtained from medical charts: histological type, depth of wall invasion, tumor size, presence of lymph node metastasis, and co-morbidity. Surgical details included the operative time, estimated blood loss, postoperative hospital stay, intraoperative complications, and early and long-term outcome variables. Postoperative complications included ileus, wound infection, anastomotic leakage, anastomotic stenosis, pneumonia, and bleeding. Patients were followed postoperatively for a minimum of 6 months in the outpatient clinic.

## Statistical Analysis

All values are presented as mean  $\pm$  SE. Statistical analyses were performed by the Mann-Whitney *U*-test,

**Table 1.**  
Demographic characteristics of patients undergoing distal gastrectomy

	Laparoscopy		Open gastrectomy		<i>P</i> <sup>1a</sup>	<i>P</i> <sup>2b</sup>	<i>P</i> <sup>3c</sup>
	Elder <i>n</i> = 30	Younger <i>n</i> = 73	Elder <i>n</i> = 16	Younger <i>n</i> = 38			
Age	75.2 ± 0.5	56.6 ± 1.0	74.3 ± 0.7	54.7 ± 1.6	<0.05	0.39	<0.05
Male/female	20/10	49/24	14/2	24/14	0.96	0.12	0.06
Histological type					<0.05	0.31	<0.05
Differentiated	25	44	15	18			
Undifferentiated	5	29	1	20			
Depth of wall invasion					0.50	0.41	0.89
Mucosa	15	40	6	10			
Submucosa	15	32	15	23			
Tumor size	2.9 ± 0.4	2.6 ± 0.1	3.5 ± 0.5	3.5 ± 0.2	0.33	0.39	0.93
Lymph node metastasis							
Present/absent	1/29	5/68	2/14	5/33	0.48	0.23	0.94

<sup>a</sup>LADG (≥ 70 years) versus LADG (< 70 years).

<sup>b</sup>LADG (≥ 70 years) versus ODG (≥ 70 years).

<sup>c</sup>ODG (≥ 70 years) versus ODG (< 70 years).

the chi-squared test, or the unpaired Student's *t*-test, as appropriate. *P* values less than 0.05 were considered to be significant. Survival data for 103 patients were analyzed by means of the Kaplan-Meier method, and the log-rank test was used for the assessment of the differences between prognostic factors. In all cases, survival was calculated from the date of operation to the date of the most recent follow-up examination or to the date of death. Statistical analysis was carried out with the Stat View J-4.5 software program (Abacus Concepts, Berkeley, CA).

## RESULTS

### Patient Characteristics

The mean age was significantly different (*P* < 0.05) in the LADG group: 75.2 ± 0.5 years and 56.6 ± 1.0 years (Table 1). The rate of differentiated types of tumor was significantly higher in the elderly group. The rates of submucosal invasions of the tumor and lymph node metastasis were not significantly different between the groups. The LADG and ODG groups were well matched in terms of clinicopathological factors (Table 1).

### Concurrent Disease

Of the 30 elderly patients in the LADG group, 13 (43.3%) had chronic diseases, such as cardiovascular disease (7/30, 23.3%), diabetes mellitus (10%), or respi-

ratory disease (10%) (Table 2). The most frequent concurrent disease of the elderly patients in both groups was cardiovascular disease. A further assessment revealed that patients in the elderly group had significantly more chronic diseases than those in the younger group.

### Operative and Perioperative Results

The conversion rate to open gastrectomy from laparoscopic gastrectomy was 0% in both the elderly and younger groups. Operative and perioperative results are shown in Table 3. Blood loss was significantly less in the elderly patients than in the younger patients undergoing LADG and less in the LADG group than in the ODG group. The operative time was not prolonged in the elderly group. Overall, three surgical complications were encountered. Two younger patients in the LADG group had intraoperative complications; one had a duodenal injury, and the other had a pancreatic injury. One younger patient in the ODG group had an intraoperative complication of major blood loss from a splenic injury. There was no difference in the intraoperative surgical complication rate in either group. The length of the postoperative hospital stay was significantly less after LADG than ODG in the elderly patients. There were no operative or in-hospital deaths or perioperative complications with pneumoperitoneum in any of the groups.

### Postoperative Complications

Table 4 shows the postoperative course. The postoperative complication rate was similar in the two groups

**Table 2.**  
Concurrent diseases

	Laparoscopy		Open gastrectomy		<i>P1<sup>a</sup></i>	<i>P2<sup>b</sup></i>	<i>P3<sup>c</sup></i>
	Elder <i>n</i> = 30	Younger <i>n</i> = 73	Elder <i>n</i> = 16	Younger <i>n</i> = 38			
None	17	70	12	36	< 0.05	0.30	< 0.05
Co-morbidity	13 (43%)	4 (5.4%)	4 (25%)	2 (5%)			
Cardiovascular disease	7	1	2	1			
Diabetes mellitus	3	1	1	0			
Respiratory disease	3	0	0	0			
Liver disease	0	2	1	1			

<sup>a</sup>LADG (≥ 70 years) versus LADG (< 70 years).

<sup>b</sup>LADG (≥ 70 years) versus ODG (≥ 70 years).

<sup>c</sup>ODG (≥ 70 years) versus ODG (< 70 years).

**Table 3.**  
Operative and perioperative results

	Laparoscopy		Open gastrectomy		<i>P1<sup>a</sup></i>	<i>P2<sup>b</sup></i>	<i>P3<sup>c</sup></i>
	Elder <i>n</i> = 30	Younger <i>n</i> = 73	Elder <i>n</i> = 16	Younger <i>n</i> = 38			
Operation time, minutes	198.1 ± 7.3	215.0 ± 6.1	183.2 ± 6.5	208.0 ± 7.0	0.11	0.18	0.07
Blood loss, g	170.3 ± 18.5	248.6 ± 23.5	416.9 ± 36.3	443.6 ± 35.5	< 0.05	< 0.05	0.66
Intraoperative complications, number	0 (0%)	2 (2.7%)	0 (0%)	1 (2.6%)	0.35	0.98	0.88
Hospital stay, days	19.2 ± 1.9	16.5 ± 0.7	28.4 ± 3.5	24.0 ± 2.1	0.11	< 0.05	0.26

<sup>a</sup>LADG (≥ 70 years) versus LADG (< 70 years).

<sup>b</sup>LADG (≥ 70 years) versus ODG (≥ 70 years).

<sup>c</sup>ODG (≥ 70 years) versus ODG (< 70 years).

**Table 4.**  
Postoperative and follow-up complications

	Laparoscopy		Open gastrectomy		<i>P1<sup>a</sup></i>	<i>P2<sup>b</sup></i>	<i>P3<sup>c</sup></i>
	Elder <i>n</i> = 30	Younger <i>n</i> = 73	Elder <i>n</i> = 16	Younger <i>n</i> = 38			
Complication (–)	26	63	12	33	0.86	0.16	0.17
Complication (+)	4 (13.3%)	10 (13.6%)	4 (25%)	(13.1%)			
Ileus	0	1	1	3			
Wound infection	1	1	2	0			
Leakage	0	2	1	2			
Stenosis	2	4	0	0			
Pneumonia	1	1	0	0			
Bleeding	0	1	0	0			

<sup>a</sup>LADG (≥ 70 years) versus LADG (< 70 years).

<sup>b</sup>LADG (≥ 70 years) versus ODG (≥ 70 years).

<sup>c</sup>ODG (≥ 70 years) versus ODG (< 70 years).

undergoing LADG, where the most common complication was anastomotic stenosis, which required additional endoscopic dilation. The cases of leakage occurred at the gastroduodenostomy of the Billroth type I reconstruction. Drainage tubes inserted at the time of surgery functioned

well in all cases, and oral intake was resumed within a few weeks. Postoperative bleeding occurred in one patient in the younger group undergoing LADG, and the source of bleeding was identified in the anastomotic line of the gastroduodenostomy. The bleeding was stopped

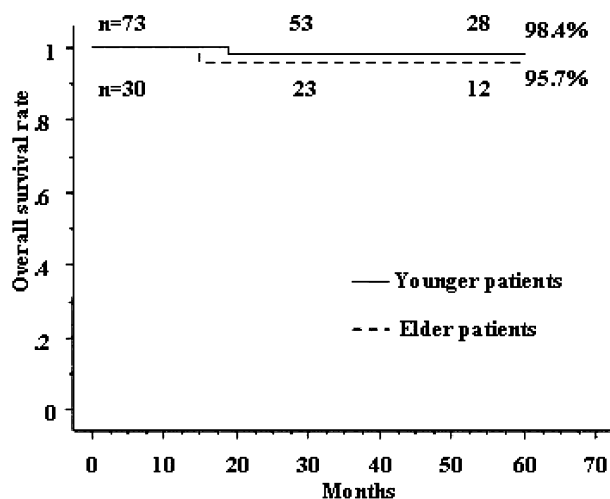
by clips with an endoscope. No notable cardiovascular complications were observed in any of the groups. There was no difference in the postoperative surgical complication rate between the LADG group and the ODG group in the elderly patients.

### Survival

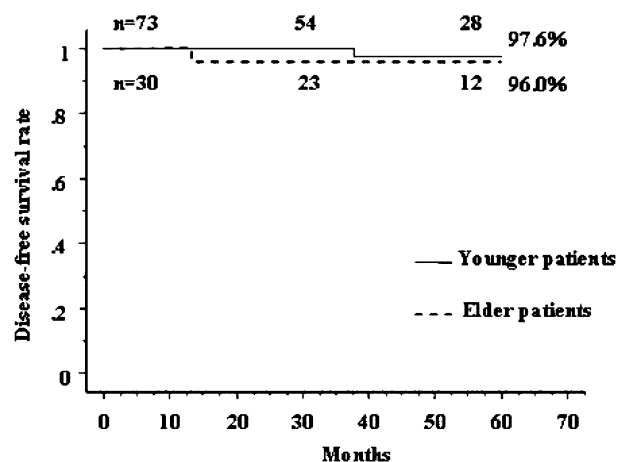
Throughout the study of 103 patients in the LADG group, two (1.9%) died during the follow-up period. The median follow-up period was 40 months. Of the deaths, one in the elderly group was lung cancer-related, and one in the younger group was due to pharyngeal cancer. All other patients survived. The cumulative 5-year survival rates of patients in the elderly group and the younger group were 95.7% and 98.4%, respectively (Fig. 1). There were no differences in the cumulative 5-year survival rates between the elderly and younger groups in the LADG group (log rank test,  $P = 0.428$ ). Two patients in the LADG groups had a recurrence of gastric cancer. One patient in the younger group had progressive recurrent disease with peritoneal seeding, and one patient in the elderly group had a recurrence of gastric cancer and rapidly progressing primary lung cancer. The latter patient died of pleural seeding of lung cancer 15 months after the gastric operation. At present, one patient in the younger group with a recurrence of gastric cancer is receiving chemotherapy. The disease-free 5-year survival rates for patients in the elderly group and the younger group are 96.0% and 97.6%, respectively (Fig. 2). There are no differences in the disease-free 5-year survival rates between the elderly and younger groups (log rank test,  $P = 0.444$ ).

### DISCUSSION

The size of the geriatric population will continue to increase dramatically in the next decade, and the number of elderly with gastric cancer is increasing, despite a plateau in the total number of patients with this cancer.<sup>12</sup> Surgical resection is the only curative modality for the treatment of gastric cancer. The increasing age of the population is accompanied by an increase in age-related diseases, as shown in Table 2. The elderly patients in our series have an increased number and severity of associated comorbidities and decreased functional reserve. Therefore, limited surgery should be considered for this patient population to reduce operative mortality. Laparoscopic gastrectomy is considered less invasive than open



**Figure 1.** Overall survival for all patients (LADG group). The 5-year survival rate was not significantly different for the younger patients and the elderly patients (log-rank test;  $P = 0.428$ ).



**Figure 2.** Disease-free survival for all patients (LADG group). The disease-free 5-year survival rate was not significantly different for the younger patients and the elderly patients (log rank test;  $P = 0.444$ ).

gastrectomy, resulting in a more rapid recovery and a shorter hospital stay.<sup>7-9</sup> However, the safety of a laparoscopic approach for gastric cancer is a major concern among the elderly. In this study, the most frequent concurrent disease in the elderly group was cardiovascular disease. The increase in intra-abdominal pressure during pneumoperitoneum can lead to an increase in the systemic vascular resistance and central filling pressures, with a decrease in cardiac index, which may be detrimental in elderly patients with limited cardiac reserve.<sup>13,14</sup> The incidence of postoperative complications after LADG was 13.3% in the elderly group in our series, which is similar to other series.<sup>15,16</sup> Cardiovascular complications did not occur in either group undergoing LADG in this

study. The pressure we used was 10 mm Hg, which was similar to other series. However, the operative time of the LADG in our study was shorter than that in other series.<sup>15,17–19</sup>

In our series of LADG, the operative time in the elderly group was 198 minutes, not longer than that previously reported for conventional open gastrectomy (199 minutes).<sup>7</sup> With advances of laparoscopic instrumentation and improvements in surgeons' technique, the operative time for LADG has decreased to a time comparable with that of open gastrectomy. The two surgeons on our team who performed most of the LADG (E.M. and T.A.) are familiar with both laparoscopic digestive surgery and gastric cancer surgery.<sup>7,8,10</sup> When performed by a skilled and experienced surgeon, LADG does not take any more time than a conventional open gastrectomy. We believe that the pneumoperitoneum does not increase the cardiovascular complications in elderly patients if the operation lasts a short time. In addition, the introduction of thromboembolic prophylaxis and a systemic analysis of the risk factors and their preoperative therapy may lead to a reduction in the mortality rate among the elderly.

An earlier study of elderly patients demonstrated a short-term advantage of the laparoscopic approach.<sup>15</sup> However, the long-term survival results of minimally invasive operations for the treatment of gastric cancer in the elderly remain unclear. Furthermore, performance of radical gastric resection in elderly patients with gastric cancer is controversial. Kitamura *et al.*, in a retrospective analysis of gastric cancer surgery, found a higher mortality rate in the elderly than in younger patients.<sup>12</sup> Furthermore, Maehara *et al.*, reported that the survival rate after curative resection was lower for the elderly than for younger patients; hematogenous recurrence was higher among the elderly patients.<sup>20</sup> Some authors have suggested that this difference in prognosis is related to a delay in diagnosis in the elderly group.<sup>21</sup> Others have suggested that elderly patients are less able to overcome surgical complications.<sup>22</sup> On the other hand, there are some studies that show no increase in mortality or morbidity among elderly patients who had undergone gastric resection.<sup>23–25</sup> They concluded that gastrectomy could be carried out safely in elderly patients with long-term results comparable to those among younger patients.

In the present study, the similar cumulative survival and disease-free survival rates among individuals over 70 and under 69 years of age suggest that survival correlates with the severity of the disease rather than with age. In the elderly group, the 5-year survival rate of patients with early gastric cancer treated by LADG was 95.7%, and there have been no deaths related to gastric cancer

recurrence in any of the 30 patients. This may be attributable to the eligibility criteria that resulted in a majority of patients having confirmed stage Ia (T1N0) disease. Furthermore, the observed tendency for a better survival rate in the older patients can be explained by their lower operative mortality in this series. A number of case series of older individuals undergoing attempted laparoscopic gastrectomy demonstrated a number of short-term advantages of the laparoscopic approach. Nevertheless, the long-term survival results of laparoscopic gastrectomy for the treatment of early gastric cancer remain unclear. Further analysis in a randomized trial to establish the safety of laparoscopic surgery is needed before this procedure can be recommended as a standard treatment in an elderly population.

We concluded that LADG is a safe and effective treatment for early gastric cancer in the elderly and that chronological age alone should not be considered a contraindication in selecting patients for LADG. However, it should be noted that the GI laparoscopic procedure required longer training than that required for other laparoscopic operations, probably because it demands advanced technical skill.

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