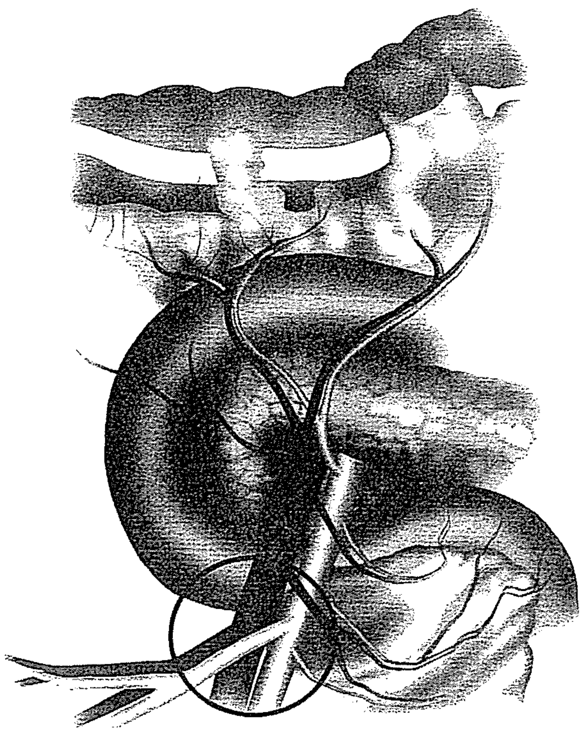

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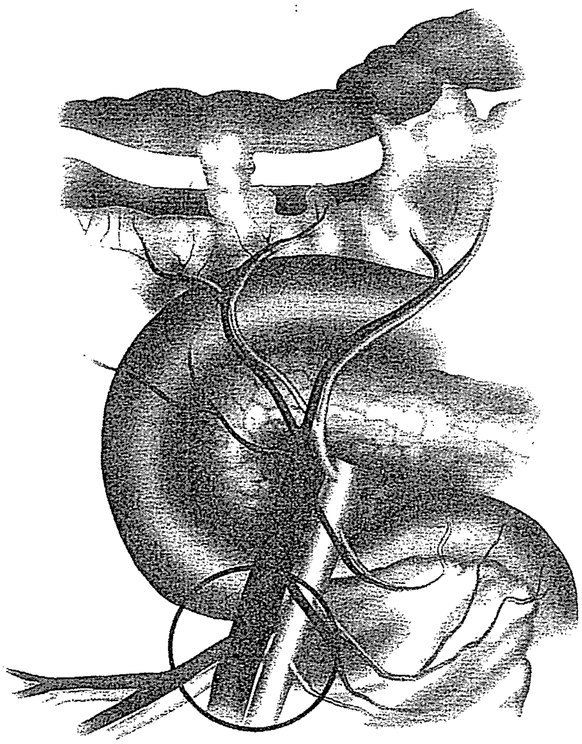


B

Figure 8.3.9. Anatomic variations of the origin of the ileocolic vessels. **A** The ileocolic artery runs in front of the superior mesenteric vein. **B** The ileocolic artery runs behind the superior mesenteric vein.

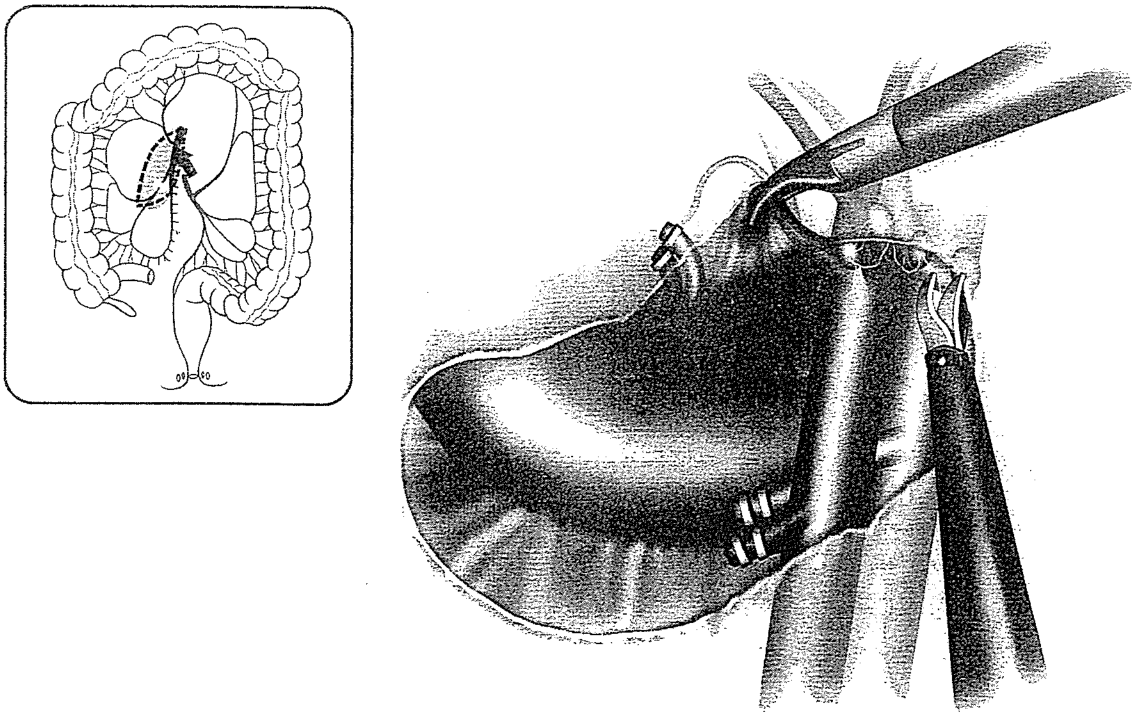


Figure 8.3.10. Dissection of the ventral side of the superior mesenteric vein permits a complete dissection of the root of the middle colic artery and vein.

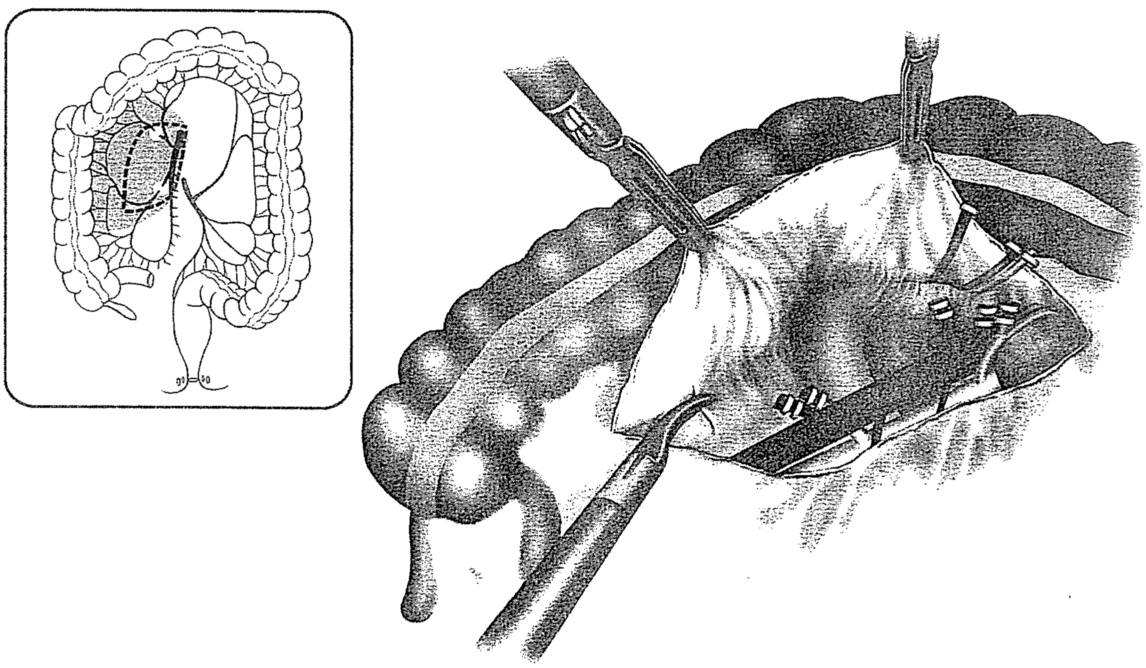


Figure 8.3.11. Accessory middle colic or right colic veins are clipped and divided. These are common.

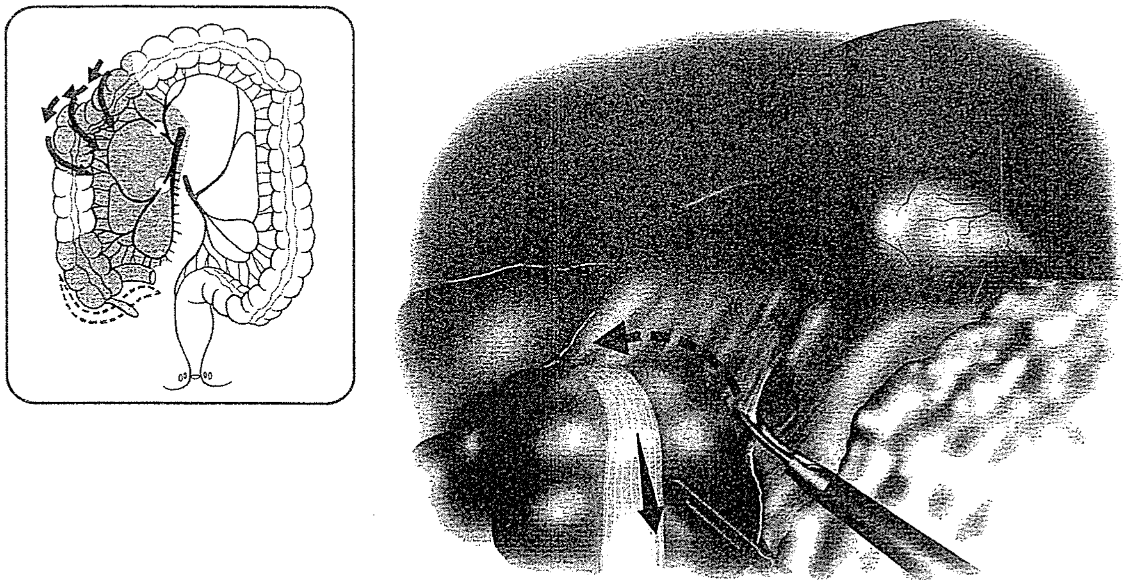


Figure 8.3.15. With earlier steps accomplished, the hepatocolic ligament is easily divided, freeing up the proximal transverse and hepatic flexure of the right colon.

the anastomosis are accomplished extracorporeally by functional end to end anastomotic method using conventional staplers or by a hand-sewn method (Figure 8.3.17). The anastomotic site is returned to the peritoneal cavity. Wounds and peritoneal cavity are copiously irrigated. All wounds are closed and operation is completed (Figure 8.3.18).

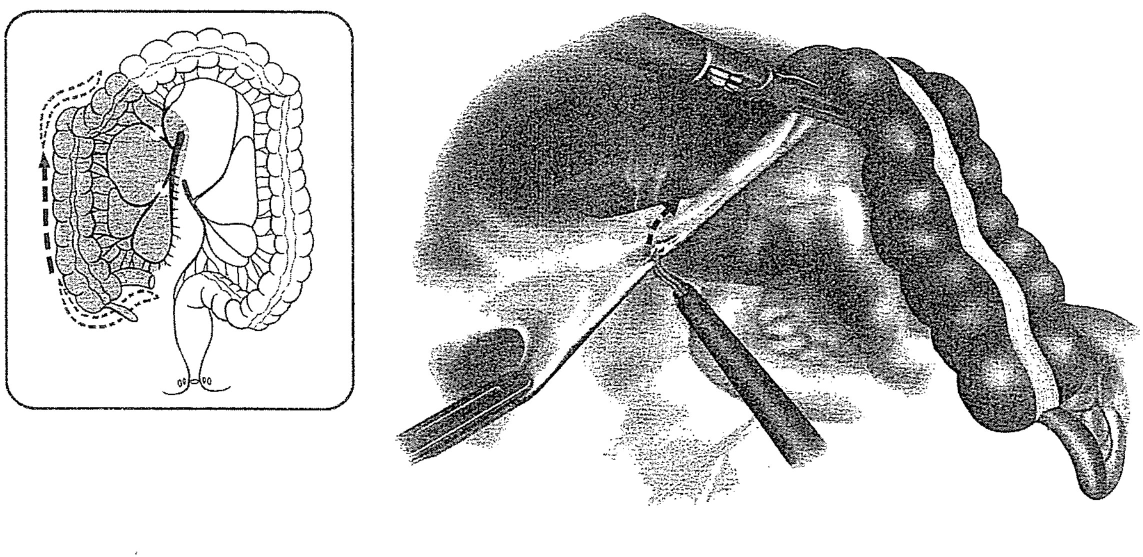
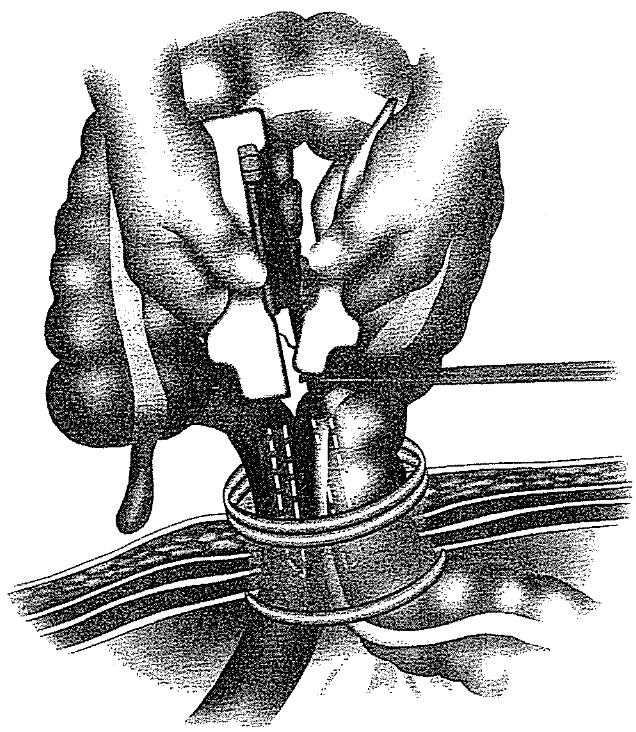


Figure 8.3.16. Finally, the tumor-bearing segment of the right colon, with its lateral attachments, are freed up, completing the right colon mobilization.



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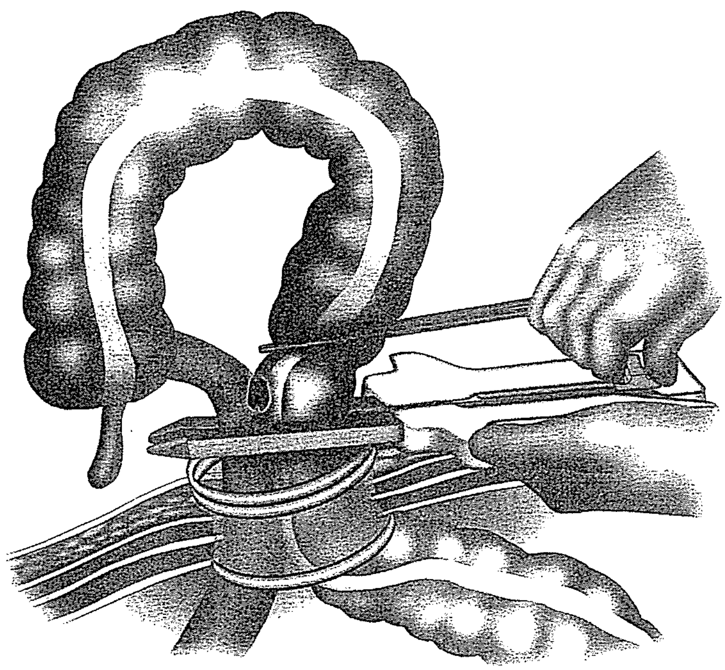
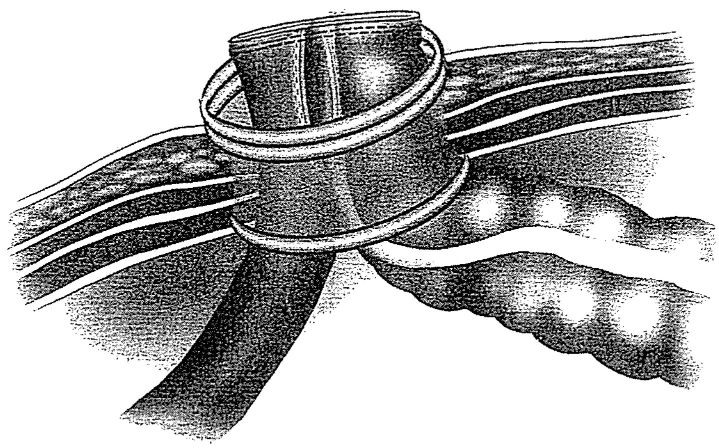


B

Figure 8.3.17. After drawing out the right colon using a wound protector, an anastomosis is accomplished extracorporeally. **A** A functional end-to-end anastomosis is created with a linear-cutter stapler. Note that the colon is occluded using a large Kocher clamp. **B** The anastomosis is completed with a right-angled firing of the linear-cutter stapler, completely sealing off the bowel. **C** The completed anastomosis before returning it to the abdomen.



C

Figure 8.3.17. *Continued*

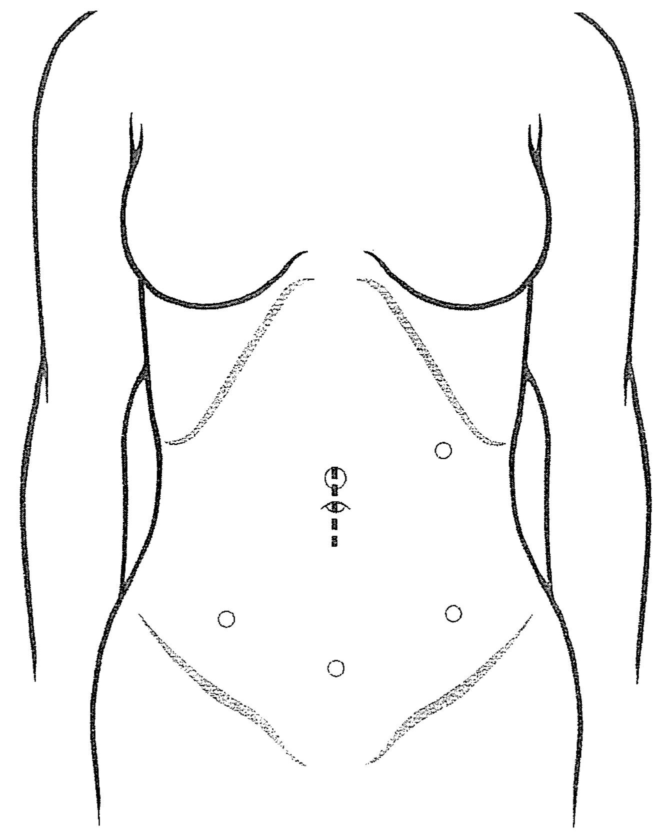


Figure 8.3.18. Appearance of the abdomen after the completion of the operation, showing the incision used to extract the specimen and perform the anastomosis (dotted line).

Special Considerations

The identification of a small tumor in the colon may be difficult even in conventional open surgery. In laparoscopic surgery, where there is no tactile sensation, pre- or intraoperative marking of the tumor is frequently needed. Various kinds of marking methods, e.g., dye injection and mucosal clip placement by preoperative colonoscopy, have been reported for the tumor localization.[5] Several reports demonstrated the usefulness of tattooing the colonic wall adjacent to the tumor with India ink in four quadrants using preoperative colonoscopy.[6,7] However, effective injection in all four points of the bowel is sometimes difficult to achieve. In some cases, we failed to achieve serosal staining visible at laparoscopy, which forced us to use intraoperative colonoscopy. This complicated the laparoscopic colon resection because of the distended bowel related to air insufflation during colonoscopy.

Preoperatively, we prefer to inject India ink into the anterior wall (antimesenteric side) of the bowel as follows: 1) A patient is placed in the supine position. 2) The tumor is irrigated with proper amount of water through the colonoscopic instrumental channel. 3) Because the water is collected in the posterior side of the bowel, the anterior wall is easily confirmed and India ink is injected precisely, which leads to optimal visualization of the lesion during laparoscopy.

In laparoscopic surgery, hemostasis is sometimes much more difficult and much more time-consuming than in open surgery. Therefore, very careful attention should be given, especially during the dissection of major vessels. In addition to skillful dissection and understanding of vascular anatomy, integrated three-dimensional computed tomography imaging is very helpful to simulate and navigate the individual patient's vascular anatomy, and to expeditiously accomplish laparoscopic dissection without blood loss.[8,9] Also, bipolar scissors and forceps are very safe and effective tools compared with monopolar electrocautery, so we prefer this to minimize the risk of inadvertent injury of vessels and/or bowels. As previously mentioned, a particular concern for bleeding in extracting right colon from the small incision is the injury of accessory right colic vein. Therefore, it should be divided before extracting right colon to avoid its injury at Henle's trunk.

Conclusions

Right-sided colon cancer can be adequately treated by proper laparoscopic procedures adherent to the oncologic principles. Port-site metastasis after laparoscopic colon cancer surgery is unlikely to be a major risk factor when the procedure is performed according to oncologic principles. We believe laparoscopic right colectomy for cancer performed by expert surgeons is accepted as less invasive surgery without sacrificing the survival benefit compared with conventional open right colectomy.

Editors' Comments

They have very well described a laparoscopic-assisted approach for the oncologic right colon resection, which is very similar to our method.

Indications: We agree with the authors regarding their indications.

Patient positioning: If available, a full-length gel pad on the operating table instead of a bean bag is more comfortable and the gel pad firmly anchors even the heaviest of patients without the risk of the above.

Instruments: We do not use the bipolar scissors, but instead substitute the bipolar LigaSure™ device (LigaSure Atlas™ or LigaSure V™).

Cannula positioning: We generally agree with their positioning.

Technique: We use a similar technique to what is described here and believe this description is excellent. We certainly believe that the laparoscopic oncologic approach described herein will accomplish an excellent cancer operation.

When intraoperative colonoscopy is indicated for precise localization of pathologies at surgery, we prefer CO_2-insufflating colonoscopy over standard colonoscopy. CO_2 is absorbed from colonic lining more rapidly than air, thus can attenuate persistent bowel distention.[10] The CO_2 feeder for colonoscopy is now commercially available (ECR, Olympus, Tokyo, Japan).

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Original articles

Surg Endosc (2006) 20: 1348–1352
DOI: 10.1007/s00464-004-8247-9

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SURGICAL ENDOSCOPY and Other Interventional Techniques

A multicenter study on laparoscopic surgery for colorectal cancer in Japan

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Received: 1 March 2005/Accepted: 28 March 2005/Online publication: 24 July 2006

Abstract
Background: Laparoscopic colectomy for malignant disease technically is feasible but not widely accepted because there are no large-series studies or data on long-term outcomes. A retrospective, multicenter study investigating a large series of patients was conducted in Japan to evaluate preliminary long-term results of laparoscopic surgery for colorectal cancer.
Methods: The study group comprised 2,036 patients who underwent laparoscopic colorectal resection April 1993 to August 2002 in 12 participating surgical units (Japanese Laparoscopic Surgery Study Group).
Results: Of the 1,495 patients with colon cancer, 781 (59%) had International Union Against Cancer (UICC) stage I, 248 (19%) had stage II, and 284 (22%) had stage III disease. Cancer recurred for 61 (4.1%) of 1,367 curatively treated patients (median follow-up period, 32 months; range, 6–125 months). The 5-year survival rate was 96.7% for stage I, 94.8% for stage II, and 79.6% for stage III disease. Of the 541 patients with rectal cancer, 220 (56%) had stage I, 62 had (16%) stage II, and 108 (28%) had stage III disease. Cancer recurred for 30 (5.6%) of 476 curatively treated patients (median follow-up period, 25 months; range 6–102 months). The 5-year survival rate was 95.2% for stage I, 85.2% for stage II, and 80.8% for stage III disease.
Conclusions: The findings indicate that laparoscopic surgery for colorectal cancer yields an oncological outcome as good as that reported for conventional open surgery in the Japanese Registry for all disease stages.

Key words: Laparoscopic surgery — Colorectal cancer — Multicenter study — Outcome — Survival rate

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Rapid advances in instruments and techniques have promoted widespread use of laparoscopic surgery as a treatment for colorectal disease. Multiple clinical studies confirm the usefulness of laparoscopic colectomy [5, 14], and investigators report faster recovery, less pain, shorter hospital stay, and a quicker return to normal activities with laparoscopic than with conventinal open colectomy [3, 4, 9, 10]. Thus, it is generally accepted that laparoscopic colectomy is less invasive and more beneficial than open colectomy.

However, laparoscopic surgery for the treatment of malignancies remains controversial because of concerns about the adequacy of lymphadenectomy, the extent of resection, early findings of port-site metastases, and the lack of data on long-term results. Several randomized controlled trials comparing laparoscopic and conventional open surgery were conducted in Western countries in the late 1990s. In a recent study of patients with stage III tumors, Lacy et al. [12] reported superior long-term surgical results in terms of cancer-related survival with laparoscopic colectomy than with conventional open colectomy. However, the long-term oncologic results of laparoscopic surgery for colorectal cancer remain unclear [7, 13, 19].

In Japan, laparoscopic surgery for colorectal cancer was introduced in 1992. To date, individual institutions have reported decreased invasiveness, improved quality of life for patients, and satisfactory short-term oncologic results [1, 6, 11, 16, 20], but there have been no large-scale studies in Japan.

Thus we designed a retrospective study to analyze the data obtained from 12 surgical units participating in the Japanese Laparoscopic Surgery Study Group, supported in part by a Grant-in-Aid for Cancer Research from the Japanese Ministry of Health, Labour, and Welfare. We report the perioperative results and preliminary long-term outcomes for large number of patients who underwent laparoscopic surgery for colorectal cancer in Japan.

Materials and methods

The study group consisted entirely of patients who underwent laparoscopic resection for colorectal cancer in the 12 participating institutions during the period April 1993 to August 2001. Each surgeon in the participating institutions had experienced at least 30 laparoscopic surgeries for colorectal cancer as an operator. All the participating surgeons were personally responsible for obtaining the written informed consent of their patients. Clinical data including patient age, sex, surgical procedures, body mass index (BMI), conversion to open surgery, previous laparotomy, postoperative complications, and postoperative oncologic outcome, and histopathologic data including histologic type, depth of tumor invasion, lymph node metastasis, and TNM stage International Union Against Cancer (UICC) were obtained for each patient.

All the patients underwent standard mechanical cathartic bowel preparation with polyethylene-glycol (+) electrolyte solution the day before surgery. Laparoscopic colonic resection consisted of the following procedures: mobilization of the colon under carbon dioxide pneumoperitoneum, division of the mesentery and ligation of the main vessels inside the peritoneal cavity or via a minilaparotomy resection of the tumor-bearing portion of the colon via a minilaparotomy approximately 5 cm long, anastomosis for a right or transverse colectomy extraabdominally via the minilaparotomy, or anastomosis for a sigmoid colectomy or low anterior resection inside the peritoneal cavity with a circular stapler introduced transanally, and observation and irrigation of the peritoneal cavity under a reestablished pneumoperitoneum. Conversion from laparoscopically assisted surgery to open surgery was allowed at the surgeon's discretion for the patient's safety and because of technical difficulties, the presence of associated conditions, or findings of advanced disease or inadequate oncologic margins.

All patients were monitored postoperatively by means of physical examinations; blood tests; serum carcinoembryonic antigen testing at least every 3 months for the first year, every 6 months for the next 2 years, and yearly for 5 years; liver ultrasonography; abdominal and pelvic computed tomography scanning, chest x-ray; and colonoscopy at least yearly.

Differences in categorical variables among postoperative complications, tumor recurrences, and other clinicopathologic data were analyzed by chi-square test, and differences in continuous variables were analyzed by the Student's t-test. Survival rates were calculated using the Kaplan–Meier method

Results

During the study period, 2,036 patients (1145 men, 891 women) underwent laparoscopic cancer. colorectal resection 1,495 for colon cancer and 541 for rectal cancer. The laparoscopic surgical procedures for colon and rectal cancer are shown in Table 1. Sigmoid colectomy was the most common laparoscopic procedure for colon cancer patients, and anterior resection was the most common for rectal cancer patients. The clinicopathologic characteristics of patients with colon and rectal cancer are shown in Table 2. The rate of conversion to open surgery was 4.8% of patients with colon cancer and 4.4% of patients with rectal cancer. The reasons and frequencies of conversion are given in Table 3.

Of the 1,495 patients with colon cancer, 188 (12.6%) had postoperative complications (Table 4). Complications occurred more frequently after transverse colectomy than after other surgical procedures ($p < 0.05$). The presence of complications was not associated with any other factor, such as tumor stage or patient age, sex, history of laparotomy, or body mass index (BMI). Curative surgery was performed for 1,411 patients (94.4%), but not for 84 patients (5.6%) because of liver metastasis ($n = 46$), lung metastasis ($n = 13$), peritoneal dissemination ($n = 20$), or metastases ($n = 5$).

Cancer recurred in 61 (4.3%) of the 1411 curatively treated patients during a median follow-up period of 32 months (range, 6–125 months) (Table 5). Recurrence was not associated with any surgical procedure or conversion to open colectomy. The 5-year survival rate was 96.6% for the patients with stage I, 94.8% for those with stage II, and 79.6% for those with stage III disease (Fig. 1). The 5-year survival rates were not associated

Table 1. Laparoscopic procedures for colorectal cancer

	Patients n (%)
Colon cancer	1495 (100)
Ileocecal resection	188 (13)
Right colectomy	409 (27)
Transverse colectomy	206 (14)
Left colectomy	132 (9)
Sigmoid colectomy	560 (37)
Rectal cancer	541 (100)
Anterior resection	500 (92)
Abdomino perineal resection	41 (8)

Table 2. Clinicopathologic characteristics of patients with colorectal cancer

	Patients n (%)	
	Colon cancer ($n = 1495$)	Rectal cancer ($n = 541$)
Previous laparotomy		
Absence	1061 (71)	400 (74)
Presence	434 (29)	141 (26)
BMI		
<26	1051 (77)	406 (75)
26 to 32	314 (21)	124 (23)
>32	30 (2)	11 (2)
Histologic type		
Well	1017 (68)	292 (54)
Moderate	403 (27)	211 (39)
Poor	15 (1)	6 (1)
Others	60 (4)	32 (6)
Depth of invasion		
T1	493 (33)	147 (27)
T2	239 (16)	124 (23)
T3	449 (30)	146 (27)
T4	314 (21)	124 (23)
Lymph node metastasis		
Absence	1151 (77)	384 (71)
Presence	344 (23)	157 (29)
Curability		
Curable	1405 (94)	487 (90)
Noncurable	90 (6)	54 (10)
Tumor staging[a]		
Stage I	837 (56)	287 (53)
Stage II	269 (18)	87 (16)
Stage III	299 (20)	149 (26)
Stage IV	90 (6)	27 (5)

BMI, body mass index

[a] International Union Against Cancer (UICC-TNM) staging

The records of the Multi-Institutional Registry of Large Bowel Cancer in Japan indicate that the 5-year survival rates for those undergoing curative open surgery were 93.4% (stage I), 84.5% (stage II), and 74.0% (stage III) for colon cancer, and 93.9% (stage I), 79.8% (stage II), and 64.7% (stage III) for rectal cancer (UICC stages) [15]. The 5-year survival rates of patients undergoing laparoscopic surgery in our study are as good as those for patients undergoing conventional open surgery for disease at each stage of the UICC stages. In fact, the 5-year survival rate for our stage II colon cancer patients undergoing laparoscopic surgery was superior to that reported for patients undergoing conventional open surgery (94.8% vs 84.5%). Furthermore, the 5-year survival rate for our stage III rectal cancer patients undergoing laparoscopic surgery was superior to that reported for patients undergoing conventional open surgery (80.8% vs 64.7%). Lacy et al. [12] reported recently that the cancer-related survival rate after laparoscopic surgery was significantly higher than that after conventional open surgery for patients with stage III tumors. The superiority of laparoscopic over open colectomy may involve the relation between immunologic status and surgical stress. Our study investigated a large series of patients undergoing laparoscopic surgery, but it was an uncontrolled study. To evaluate the oncologic outcome of laparoscopic surgery, long-term results of prospective randomized controlled trials are needed.

Among the curatively treated patients in our study, 4.1% of the patients with colon cancer and 5.6% of those with rectal cancer had recurrence. The rates and types of recurrence were similar to those reported for conventional open surgery. There were many reports of patients with port-site metastases and abdominal incisional recurrence [2]. In recently reported laparoscopic series, the frequency of port-site metastasis has been very low, ranging from 0% to 1.3% [17]. It was considered that port-site metastases were related to the unskillful laparoscopic technique in early periods. Experimental studies investigating murine models showed that carbon dioxide pneumoperitoneum, as comparsed with laparotomy, reduced lung metastases and peritoneal dissemination and enhanced liver metastases [8, 18]. Conclusions about the influence of carbon dioxide pneumoperitoneum on tumor development cannot be drawn from these studies because the data on ecological outcome are inadequate.

In this study, postoperative complications were observed in 12.6% of patients with colon cancer and 14.1% of patients with rectal cancer, and the frequency of complications was consistent with that in previous studies [3, 9, 12]. No specific laparoscopic complications were detected. An examination of the relation between the occurrence of complications and surgical procedures showed that postoperative complications occurred more frequently for patients undergoing transverse colectomy than in patients undergoing any other procedure. The technical difficulties in ligating the roots of middle colic vessels in laparoscopic surgery may account for this finding.

In our series, about three-fourths of all the patients underwent laparoscopic right colectomy, sigmoid colectomy, or anterior resection. Histopathologic examination showed that Tl, T2, T3, and T4 disease each accounted for one-fourth of the total patients, and that stage I disease was present in more than half of our patients. Curative surgery was performed for 94.4% of all patients with colon cancer and 93.9% of those with rectal cancer. These findings suggest that laparoscopic surgery for colorectal cancer has been accepted as a radical treatment for potentially curable patients in Japan.

We conclude from our findings that laparoscopic surgery is safe treatment for colorectal cancer, with an oncologic outcome as good as that of conventional open surgery. The results of our nonrandomized retrospective clinical analysis must be confirmed by large-scale prospective randomized trials.

Acknowledgement. This work was supported in part by a Grant-in-Aid for Cancer Research from the Japanese Ministry of Health, Labour, and Welfare (No. 13-17). The following centers and surgeons participated in the multicenter study initiated by the Japanese Laparoscopic Surgery Study Group (JLSSG): Seigo Kitano, Norio Shiraishi, Masafumi Inomata, Oita University Faculty of Medicine (Oita); Masaki Kitajima, Kasuhiro Yasuda, Hirotoshi Hasegawa, Keio University School of Medicine (Tokyo); Fumio Konishi, Yutaka Kawamura, Omiya Medical Center Jichi Medical School (Omiya); Masahiko Watanabe, Kitasato University (Sagamitara); Susumu Satomi, Tohoku University Faculty of Medicine (Sendai); Nobuyoshi Shimizu, Okayama University Faculty of Medicine (Okayama); Masaki Fukunaga, Urayasu Hospital Juntendo University School of Medicine (Tokyo); Yoshinobu Sumiyama, Yoshihisa Saida, Ohashi Hospital Toho University School of Medicine (Tokyo); Shinei Kudo, Junichi Tanaka, Northern Yokohama Hospital Showa University (Yokohama); Nobuhiko Tanigawa, Junji Okuda, Osaka Medical University (Osaka), Tatsuro Yamakawa, Nobuyoshi Miyajima, Mizonoguchi Hospital Teikyo University (Tokyo), Hideo Yamada, Sakura National Hospital (Chiba), and Masao Nakata, Shikoku Cancer Center (Matsuyama).

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Table 3. Reasons for conversion to open surgery[a]

	Patients *n* (%)	
	Colon cancer	Rectal cancer
Advanced disease	34 (47)	11 (46)
Intraoperative complications	22 (31)	7 (29)
Bleeding	15 (21)	4 (16)
Injury to other organs	7 (10)	3 (13)
Adhesion	4 (6)	3 (13)
No visualization of critical structures	4 (6)	2 (8)
Complicating disease	2 (3)	0
Others	6 (8)	1 (4)
Total	72 (100)	24 (100)

[a] There were 1,495 patients with colon cancer and 541 patients with rectal cancer

Table 4. Postoperative complications[a]

	Patients *n* (%)	
Postoperative complications	Colon cancer	Rectal cancer
Bowel obstruction	31 (19)	13 (20)
Anastomotic leakage	22 (14)	22 (33)
Postoperative bleeding	5 (3)	1 (1)
Wound infection	97 (60)	29 (43)
Pneumonia	4 (2)	0
Intraabdominal abscess	3 (2)	2 (3)
Total	162 (100)	67 (100)

[a] There were 1,495 patients with colon cancer and 541 patients with rectal cancer

Table 5. Tumor recurrence[a]

	Patients *n* (%)	
	Colon cancer	Rectal cancer
Tumor recurrence	61 (100)	30 (100)
Location of recurrence		
Liver	35 (65)	14 (48)
Lung	6 (11)	2 (7)
Peritoneum	7 (13)	6 (21)
Locoregional	2 (4)	4 (14)
Lymph node	4 (7)	3 (10)
Portsite	0	0

[a] There were 1,411 patients with colon cancer and 508 patients with rectal cancer

with any surgical procedure, presence of complications, or conversion to open colectomy.

Of the 541 patients with rectal cancer, 76 (14.1%) experienced had postoperative complications (Table 4). The complications were not associated with any of the factors studied, including surgical procedure, tumor stage, sex, age, history of laparotomy, or BMI.

Curative surgery was performed for 508 patients (93.9%), but not for 33 patients (6.1%) because of liver metastasis ($n = 13$), lung metastasis ($n = 5$), peritoneal dissemination or ($n = 4$), or and other metastases ($n = 11$). Cancer recurred in 30 (5.9%) of the 508 curatively treated patients during a median follow-up period of 25 months (range, 6–102 months) (Table 5).

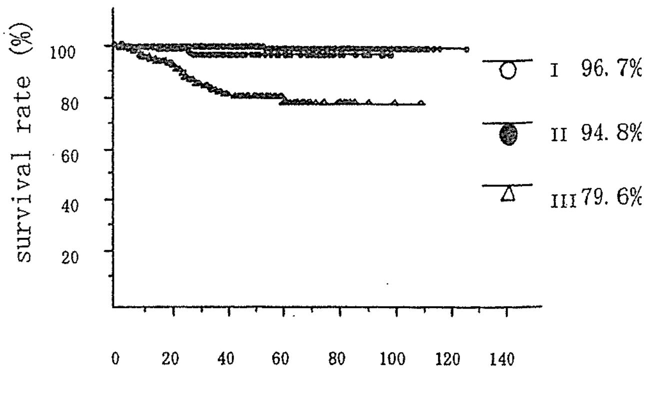

Fig. 1. The survival rate for 1,411 curatively treated patients with colon cancer is, shown. The 5-year survival rate was 96.7% for stage I, 94.8% for stage II, and 79.6% for stage III disease. International Union Against Cancer (UICC-TNM) staging was used.

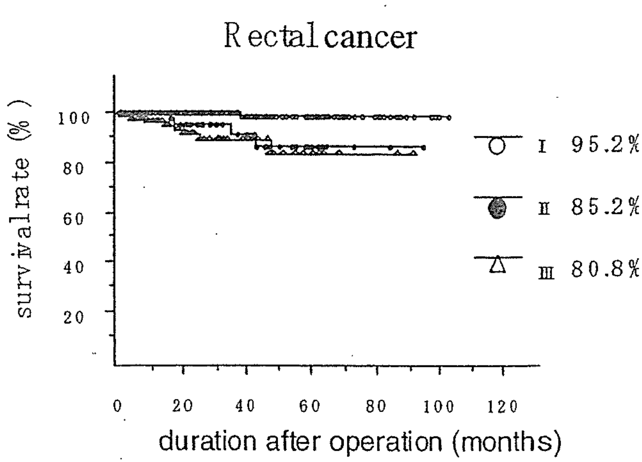

Fig. 2. The survival rate for 508 curatively treated patients with rectal cancer is shown. The 5-year survival rate was 95.2% for stage I, 85.2% for stage II, and 80.8% for stage III disease. International Union Against Cancer (UICC-TNM) staging was used.

Recurrence was not associated with any surgical procedure or conversion to open colectomy. The 5-year survival rate was 95.2% for the patients with stage I, 85.2% for those with stage II, and 80.8% for those with stage III disease (Fig. 2). The 5-year survival rates were not associated with any surgical procedure, presence of complications, or conversion to open colectomy. No port-site or abdominal wall recurrences were found in any of the 2,036 patients.

Discussion

This multicenter study reflects 10 years of experience with laparoscopic surgery for colorectal cancer in a large patient series in Japan. The short-and long-term outcomes for our patients suggest that laparoscopic surgery is a safe and effective treatment for colorectal cancer, in light of reported outcomes for conventional open surgery.

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Long-term Outcome of Laparoscopic Wedge Resection for Gastric Submucosal Tumor Compared With Open Wedge Resection

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Abstract: Little is known about the outcomes of laparoscopic wedge resection (LWR) in comparison with conventional open wedge resection (OWR) for gastric submucosal tumor. Outcomes of 21 patients who underwent LWR (n = 14) or OWR (n = 7) for gastric submucosal tumor between 1993 and 2004 were investigated. We compared the short-term and long-term operative results between the 2 groups. LWR showed several advantages over OWR for gastric submucosal tumor: less blood loss, lower fever on day 1, lower analgesic usage rate, earlier first postoperative flatus and oral intake, lower leukocyte count on days 1 and 7, and lower C-reactive protein level on days 1 and 3. All patients, except 2 with histologically diagnosed high-risk gastrointestinal stromal tumor, survived during the mean follow-up period of 60 months. LWR is feasible for the management of patients with gastric submucosal tumor.

Key Words: gastrointestinal stromal tumor, gastric GIST, gastric submucosal tumor, local resection, laparoscopy

(*Surg Laparosc Endosc Percutan Tech* 2006;16:82–85)

Gastric submucosal tumor including gastrointestinal stromal tumor (GIST) is a rare, nonepithelial, mesenchymal neoplasm of the gastrointestinal tract, and surgery remains the standard treatment.[1] Because of the low frequency of lymph node involvement, lymphadenectomy is not usually required.[2] Local resection enables one to completely resect the tumor.[3] Therefore, wedge resection of the stomach for gastric submucosal tumor is accepted worldwide.

Laparoscopic gastrectomy is becoming popular in Japan for the treatment of gastric cancer, because it improves the patient's postoperative quality of life.[4] Several reports[5–7] have indicated that laparoscopy-assisted distal gastrectomy is more useful than open gastrectomy for gastric cancer because of decreased postoperative pain, shorter hospital stay, and better quality of life after surgery. However, there are few reports of the short-term operative results of laparoscopic wedge resection (LWR) in comparison with open wedge resection (OWR) for the treatment of gastric submucosal tumor.[8–10] Also, little is known about the long-term operative results of LWR of gastric submucosal tumor.

We compared the outcomes of patients who underwent LWR with those who underwent OWR of the stomach, to evaluate the usefulness of LWR for gastric submucosal tumor.

PATIENTS AND METHODS

The study subjects were 21 patients with gastric submucosal tumor that was treated surgically in the Department of Surgery I, Oita University Faculty of Medicine and Surgery Division, Arita Gastrointestinal Hospital, between 1993 and 2004. The age and sex of patients, surgical procedures, tumor characteristics, and operative outcomes were obtained from medical charts. The 21 patients comprised 2 groups: an LWR group (n = 14) and an OWR group (n = 7). Use of LWR or OWR was selected on the basis of a preoperative assessment of the size, location, and progression of the tumor by endoscopy, barium radiology, abdominal echography and computed tomography, and endoscopic ultrasonography. A tumor diameter of 20 to 50 mm or a tumor less than 20 mm in diameter with rapid growth because of malignant potential indicated the need for LWR (Fig. 1). OWR was used for tumors larger than 50 mm in diameter, because laparotomy was required for the tumor removal without tumor rupture and subsequent peritoneal seeding. In the LWR group, the entire surgical procedure was performed laparoscopically. Hasson trocar was inserted at the subumbilical portion with the open technique, and 3 additional trocars were inserted in the upper abdomen after carbon dioxide pneumoperitoneum was established. When the tumor was located on the posterior wall of the stomach, it was exposed after division and dissection of the greater or lesser omentum with laparoscopic coagulating shears. Wedge resection of the gastric wall was performed with a multifire endoscopic

Received for publication September 14, 2005; accepted February 11, 2006.
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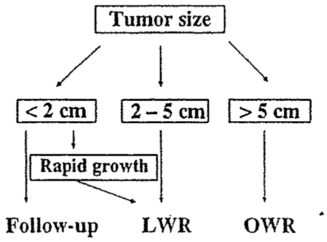

FIGURE 1. Strategy for the treatment of gastric submucosal tumor in our institution.

TABLE 2. Operative Findings in 2 Treatment Groups

	LWR* (n = 14)	OWR* (n = 7)	P
Operation time (min)	118 ± 55	165 ± 108	0.351†
Blood loss (g)			
< 20	13	3	< 0.05‡
> 20	1	4	
Intraoperative complications	0	0	

*Values are mean ± standard deviation.
†By Mann-Whitney *U* test.
‡By Fisher exact test.

stapler under laparoscopic techniques, assisted by intraoperative gastroscopy. The resected specimen was removed in a plastic bag through the umbilical wound. In the OWR group, laparotomy was performed via upper midline incision, and wedge resection of the stomach was performed as described above.

Pathologic findings including tumor diameter, microscopic margin status of the surgical specimen, mitotic count as the number of mitoses per 50 high-power fields, and immunohistochemical staining for c-kit, CD34, SMA, and S-100 were examined. Histologic resectability was determined according to the International Union Against Cancer TNM classification system[11]: R0 (no residual tumor; wide margins), R1 (microscopic residual tumor; tumor at the resection line), or R2 (macroscopic residual tumor; partial resection).

Differences between groups were analyzed by Mann-Whitney *U* test, Fisher exact test, or *t* test. A *P* value of < 0.05 was considered statistically significant.

RESULTS

The groups were similar in patient age and sex ratio (Table 1). The mean tumor diameter was less in the LWR group than in the OWR group ($P < 0.01$). All but 2 tumors were located in the upper and middle third of the stomach, and there were no differences in longitudinal and cross-sectional tumor location between the groups.

There was no difference in operation time between the 2 groups (Table 2). Blood loss was less in the LWR group than in the OWR group. No intraoperative or postoperative complications occurred in either group.

Clinical courses are summarized in Table 3. Body temperature on day 1 was lower in the LWR group than in the OWR group (37.4 vs. 38.0°C). Analgesics were given less frequently in the LWR group than in the OWR group (2.9 vs. 5.3 times). The first flatus was detected earlier in the LWR group than in the OWR group (2.1 vs. 3.5 d), and the time to oral intake was shorter in the LWR group than in the OWR group (2.9 vs. 5.2 d). The postoperative course after LWR was better than that after OWR.

As shown in Table 4, significant differences were observed between the 2 groups in the leukocyte count on days 1 and 7, proportion of granulocytes on day 1, proportion of lymphocytes on days 1 and 3, C-reactive protein level on days 1 and 3, and albumin level on day 3. The inflammatory response was lower in the LWR group than in the OWR group, and nutrition was less impaired in the LWR group than in the OWR group.

Pathologic findings and recurrence are shown in Table 5. The most common histologic type of tumor was GIST (17 patients, 81%). Other histologic types were schwannoma (3 patients, 14%) and leiomyoma (1 patient, 5%). Microscopic examination showed that all tumors were completely resected (R0). The mitotic count was

TABLE 1. Patient and Tumor Characteristics in 2 Treatment Groups

	LWR* (n = 14)	OWR* (n = 7)	P
Patient			
Age (y)	61 ± 14	67 ± 8	0.332†
Sex ratio (M:F)	6:8	4:3	0.659‡
Tumor			
Size (mm)	2.9 ± 1.0	8.5 ± 7.6	< 0.05†
Location (longitudinal) U/M/L	5/9/0	3/2/2	0.074‡
Location (cross-sectional) A/P/G/L	5/3/2/4	1/4/1/1	0.401‡

*Values are mean ± standard deviation.
†By Mann-Whitney *U* test.
‡By Fisher exact test.
A/P/G/L indicates anterior wall/posterior wall/greater curvature side/lesser curvature side; U/M/L, upper/middle/lower.

TABLE 3. Postoperative Course in 2 Treatment Groups

	OWR* (n = 14)	LWR* (n = 7)	P†
Body temperature (°C)			
Day 1	37.4 ± 0.4	38.0 ± 0.5	< 0.05
Day 3	37.0 ± 0.4	37.2 ± 0.6	0.282
Day 7	36.4 ± 0.4	36.7 ± 0.3	0.120
No. days to body temperature > 37°C	2.9 ± 1.4	3.0 ± 1.1	0.912
No. times analgesics given	2.9 ± 1.5	5.3 ± 3.4	< 0.05
No. days to first walking	1.4 ± 0.6	2.2 ± 1.0	0.060
No. days to first flatus	2.1 ± 0.8	3.5 ± 0.8	< 0.05
No. days to liquid diet	2.9 ± 0.9	5.2 ± 1.6	< 0.05
Postoperative hospital stay (d)	11.0 ± 4.2	18.7 ± 9.9	0.091
Postoperative complications	0	0	

*Values are mean ± standard deviation.
†By *t* test.
Day indicates postoperative day.

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TABLE 4. Blood Analyses in 2 Treatment Groups

	LWR*(n = 14)	OWR*(n = 7)	P
Leukocytes ($\times 10^9$/L)			
Day 1	7.1 ± 1.4	11.5 ± 3.4	< 0.05
Day 3	5.9 ± 1.6	6.4 ± 1.1	0.525
Day 7	4.5 ± 1.2	6.1 ± 0.8	< 0.05
Proportion of granulocytes (%)			
Day 1	72.1 ± 6.1	84.6 ± 2.3	< 0.05
Day 3	65.4 ± 6.0	70.0 ± 2.6	0.239
Day 7	60.2 ± 13.5	66.3 ± 5.3	0.485
C-reactive protein (mg/dL)			
Day 1	2.6 ± 1.8	8.2 ± 6.1	< 0.05
Day 3	5.0 ± 4.2	12.1 ± 7.1	< 0.05
Day 7	2.5 ± 3.4	3.7 ± 2.7	0.583
Albumin (g/dL)			
Day 1	3.8 ± 0.3	3.4 ± 0.4	0.134
Day 3	4.0 ± 0.3	3.2 ± 0.1	< 0.05
Day 7	4.0 ± 0.4	3.6 ± 0.3	0.167
Proportion of lymphocytes (%)			
Day 1	18.4 ± 5.3	8.7 ± 0.1	< 0.05
Day 3	21.0 ± 2.6	14.6 ± 2.0	< 0.05
Day 7	26.4 ± 9.5	17.3 ± 2.9	0.160

*Values are mean ± standard deviation; *t* test.
†Mann-Whitney *U* test.
Day indicates postoperative day.

more than 10 mitoses per 50 high-power fields in 2 patients with GIST; these 2 developed metachronous liver metastasis. One of these patients was in the LWR group; the GIST was 4.5 cm in diameter, and the patient died of liver metastasis 32 months after LWR. The other patient was in the OWR group; the GIST was 25 cm in diameter, and the patient died of liver metastasis 9 months after OWR. No lymph node metastasis was found in either of these patients at the time liver metastasis was found. With the exception of these 2 patients and 1 patient in whom local recurrence of leiomyoma developed after LWR with an inadequate tumor-free margin (2 mm), patients remain disease free (mean follow-up period, 60 mo; range, 3 to 130 mo).

TABLE 5. Pathologic Findings and Recurrence in 2 Treatment Groups

	LWR* (n = 14)	OWR* (n = 7)
Pathologic findings histology		
GIST	11	6
Leiomyoma	1	0
Schwannoma	2	1
Mitotic count (/50 HPF)		
≦5	13	6
6 to 10	0	0
> 10	1	1
Margin		
R0/R1/R2	14/0/0	7/0/0
Recurrence		
Local	1	0
Liver	1	1
Lymph node	0	0
Peritoneum	0	0
Follow-up (mo)	60.2 (5–119)	61.3 (3–130)

*Values are mean (range).
HPF indicates high-power field.

DISCUSSION

This study showed that LWR is safe and useful for small submucosal tumor of the stomach because, in comparison with OWR, it causes less pain, is less invasive, impairs nutrition less, and allows for earlier recovery of bowel function. When LWR with an adequate tumor-free margin was performed for gastric submucosal tumor in our series, there was no local recurrence. Thus, we showed better short-term and long-term outcomes in patients who underwent LWR rather than OWR for gastric submucosal tumor.

The surgical indication and selection of surgical procedures for GIST is controversial.[12–14] In the present study, GIST measuring 2 to 5 cm indicated the need for LWR. In Japan, LWR for small GIST (2 to 5 cm) has come to be popular and feasible surgical outcomes of LWR have been reported.[10,15] Most of the tumors smaller than 2 cm are considered to be very low risk[16] and the tumors are usually followed-up carefully in Japan.[17] Only when the small GIST is assessed to have malignant potential by biopsy or rapidly increases in size, suggesting a malignant tumor, is the small GIST treated.[15] Recently, the European consensus meeting recognized a careful follow-up for small (2 cm) intramural tumors as a choice of treatment.[14] On the other hand, OWR is usually used for GIST larger than 5 cm in Japan and in western countries. Most tumors have malignant potential and laparotomy is required for tumor removal without tumor rupture and subsequent peritoneal seeding.[12]

There have been several reports of successful treatment of gastric submucosal tumors by LWR[15,18–20] and that LWR is superior to OWR because its short-term outcome is better.[8–10] Cheng et al[8] showed the advantages of LWR to be a lower analgesic usage rate, earlier postoperative oral intake, and shorter hospital stay. Matthews et al[9] also reported a shorter hospital stay after LWR for gastric submucosal tumor. Shimizu et al[10] indicated better short-term outcomes, including earlier ambulation after surgery, earlier first flatus and oral food intake, lower leukocyte count on day 1, shorter period of high fever, and shorter period of postoperative hospitalization after LWR than after OWR. Our short-term results supported these published results.

In our series, patients in the LWR and OWR groups were discharged 11 and 19 days after operation, respectively. Postoperative hospital stay in Japan is known to be longer than that in western countries. Hospitalization in Japan is not as expensive as in western countries because of special medical insurance. Therefore, most patients in Japan want sufficient rest after surgery, and are permitted to spend a long time in the hospital. In our knowledge of English literature, postoperative

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hospital stay after LWR was much longer in Japan than that in western countries.[8–10]

Complete local resection is widely accepted for the treatment of gastric submucosal tumor including GIST. In several studies, patients who underwent complete resection of GIST had better overall survival than those who underwent incomplete resection.[1,21] The optimum margin from the cut-line to the tumor edge has not been defined for wedge resection; however, wedge resection of the stomach with an adequate tumor-free margin should be performed. In this study, all patients underwent wedge resection of the stomach with microscopically negative margins. However, one patient with leiomyoma in the LWR group suffered local recurrence because of an inadequate tumor-free margin (2 mm). Thus, resection with an adequate tumor-free margin is important in LWR for gastric submucosal tumor.

About 10% to 30% of GISTs are reported to be malignant.[22,23] In cases of GIST, the mitotic rate and tumor size are thought to be prognostic factors.[23] Fletcher et al[16] proposed a scheme for assessing the risk (low, intermediate, or high) of aggressive behavior in GIST. In our study, 2 patients with high-risk GIST, according to the Fletcher et al[16] classification, died of liver metastasis. Our data support the clinical usefulness of Fletcher et al[16] risk categories. However, even when histologic features indicate a low risk, GIST can behave as a malignant tumor with delayed recurrence.[22] Therefore, Fletcher et al[16] advocated that all patients with GIST be carefully and regularly followed up for an indefinite period. To prevent the recurrence of high-risk tumors, imatinib is being evaluated for adjuvant therapy after complete resection of primary GIST.[1] In the future, adjuvant therapy with imatinib for high-risk tumors may be considered.[13,14]

In conclusion, LWR has several advantages over OWR for gastric submucosal tumor, including less pain, less invasiveness, less impaired nutrition, and earlier recovery of bowel function, with no decrease in operative curability. We believe that LWR with an adequate tumor-free margin is feasible for the management of patients with gastric submucosal tumor. Further investigations and a randomized trial to establish whether LWR is as safe and useful as OWR are needed before this procedure can be recommended as a standard treatment.

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A Multicenter Study on Oncologic Outcome of Laparoscopic Gastrectomy for Early Cancer in Japan

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Background: Laparoscopic surgery for gastric cancer is technically feasible, but it is not widely accepted because it has not been evaluated from the standpoint of oncologic outcome. We conducted a retrospective, multicenter study of a large series of patients in Japan to evaluate the short- and long-term outcomes of laparoscopic gastrectomy for early gastric cancer (EGC).

Methods: The study group comprised 1294 patients who underwent laparoscopic gastrectomy during the period April 1994 through December 2003 in 16 participating surgical units (Japanese Laparoscopic Surgery Study Group). The short- and long-term outcomes of these patients were examined.

Results: Distal gastrectomy was performed in 1185 patients (91.5%), proximal gastrectomy in 54 (4.2%), and total gastrectomy in 55 (4.3%); all were performed laparoscopically. The morbidity and mortality rates associated with these operations were 14.8% and 0%, respectively. Histologically, 1212 patients (93.7%) had stage IA disease, 75 (5.8%) had stage IB disease, and 7 (0.5%) had stage II disease (the UICC staging). Cancer recurred in only 6 (0.6%) of 1294 patients treated curatively (median follow-up, 36 months; range, 13–113 months). The 5-year disease-free survival rate was 99.8% for stage IA disease, 98.7% for stage IB disease, and 85.7% for stage II disease.

Conclusions: Although our findings may be considered preliminary, our data indicate that laparoscopic surgery for EGC yields good short- and long-term oncologic outcomes.

(*Ann Surg* 2007;245: 68–72)

In Japan, the incidence of early gastric cancer has increased to more than 50% of the overall incidence of gastric cancer because of the development of diagnostic instruments and increased use of mass and individual screenings.[1,2] For the management of patients with early gastric cancer (EGC), minimally invasive therapies, such as endoscopic and laparoscopic procedures, have been available since the 1980s.[3,4] Since the first report of laparoscopy-assisted distal gastrectomy (LADG) in 1994, LADG has been widely adopted for EGC and the number of patients undergoing LADG has been increasing in Japan.[5] Laparoscopy-assisted gastrectomy (LAG) is now performed not only as distal gastrectomy but also as proximal gastrectomy and total gastrectomy.[6–8]

Several small retrospective studies analyzing the short-term outcome of LAG showed that patients who underwent LAG had less pain, earlier recovery to active daily life, a shorter hospital stay, and better quality of life than patients who underwent conventional open surgery.[9–11] However, LAG for the treatment of malignancies remains controversial because of the lack of large-scale study data on the short-term and long-term outcomes.

To clarify the short- and long-term outcomes of LAG for EGC, we examined the clinical data obtained by 16 surgical departments that are members of the Japanese Laparoscopic Surgery Study Group.

MATERIALS AND METHODS

The study included 1294 patients with EGC who underwent LAG in one of the 16 participating departments during the period 1994 through 2003. The patients who underwent LAG in each institution for that period were all registered for the present study. All tumors were adenocarcinomas that were shown by preoperative gastric endoscopy and barium meal study to be present only in the mucosal or submucosal layer of the stomach and were not candidates for endoscopic mucosal resection. Patients with cancer in another organ or with previous upper abdominal laparotomy or with cardiac, pulmonary, or hepatic insufficiency were not included. The exclusion criteria in insufficiency of the organs were 1) operative cardiovascular risk greater than New York Heart Association II, 2) operative pulmonary risk greater than Hugh-Jones II, and 3) severe liver disease (Child classes B and C). All participating surgeons were personally responsible for obtaining the written informed consent of their patients. According to the location of the tumor, LADG, laparoscopy-assisted proximal gastrectomy (LAPG), or laparoscopy-assisted total gastrectomy (LATG) was performed.

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Supported in part by a Grant-in-Aid for Cancer Research from the Japanese Ministry of Health, Labor, and Welfare (No. 13-17).

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ISSN: 0003-4932/07/24501-0068
DOI: 10.1097/01.sla.0000225364.03133.f8

As described previously,[5,6,8] LAG consisted of the following procedures: 1) laparoscopic dissection of the lesser and greater omentum, ligation and division of the main vessels to mobilize the stomach under pneumoperitoneum, 2) laparoscopic D1+α, D1+β, or D2 lymph node dissection, based on the Guidelines of the Japan Gastric Cancer Association, and 3) resection of the distal two thirds (LADG), proximal third (LAPG), or total stomach (LATG), depending on the location of the tumor, followed by reconstruction by the Billroth-I, esophagogastrostomy, or Roux-en-Y method through a 5- to 7-cm-long minilaparotomy incision. To establish techniques of LAG as an oncologic surgery, the laparoscopic procedures for lymph node dissection in each institution had been reviewed by video examination in the group conferences.

Data obtained for each patient included the following: age, sex, body mass index, previous laparotomy, surgical procedure, operation time, conversion to open surgery, postoperative complications, postoperative oncologic outcome, histologic type of tumor, depth of tumor invasion, lymph node metastasis, and clinical stage according to the UICC staging and the WHO classification of tumors.[12,13]

All patients were monitored postoperatively by physical examination, and blood tests including a test for serum carcinoembryonic antigen at least every 3 months for the first year, every 6 months for the next 2 years, and every year for 5 years, and thereafter by abdominal ultrasonography, computed tomography, chest radiography, and gastroscopy at least once each year.

Data were compared between the three types of laparoscopic surgeries (LADG, LAPG, and LATG). Differences in categorical variables such as postoperative complications, tumor recurrences, and other clinicopathologic factors were analyzed by χ^2 test, and differences in continuous variables were analyzed by Student t test. Survival rates were calculated by the Kaplan-Meier method. A P value of <0.05 was considered significant.

RESULTS

Laparoscopic procedures consisted of 1185 (91.5%) LADGs, 54 (4.2%) LAPGs, and 55 (4.3%) LATGs, and the total patient group comprised 872 men and 422 women. The clinicopathologic characteristics of the study patients are shown in Table 1. The percentages of female patients and of mildly obese patients were greater in the LADG group than in the other groups. D1+β and D2 lymph node dissection were performed frequently in the LADG group because of the high frequency of signet-ring cells carcinoma. The operation time of LATG was longer than that of LADG or LAPG. There were no other differences between groups in patient characteristics or pathologic characteristics of tumors. According to UICC staging, there were 1212 (93.7%) stage IA tumors, 75 (5.8%) stage IB tumors, and 7 (0.5%) stage II tumors.

Intraoperative and postoperative complications occurred in 25 (1.9%) of the 1294 patients and 167 patients (12.9%), respectively (Table 2). Conversion to open surgery was required in only 14 cases (1.1%) because of intraoperative complications: bleeding in 9 cases, mechanical trouble in 3, and others in 2. Bleeding was the most frequent intraoperative complication, and it resulted mainly from the injury to the branches of the left gastric artery, short gastric vein, or spleen. Intraoperative complications occurred more frequently during LAPG than during other laparoscopic procedures ($P < 0.05$). The most frequent postoperative complications were anastomotic stenosis, anastomotic leakage, and wound infection, and there was no significant difference in the incidence of postoperative complications between laparoscopic procedures. Intraoperative and postoperative complications were not associated with any of the factors studied,

TABLE 1. Clinicopathologic Characteristics of Patients With Early Gastric Cancer

	No. of Patients			
	LADG (n = 1185)	LAPG (n = 54)	LATG (n = 55)	P
Patients				
Age (yr)	62.7 ± 11	63.7 ± 9	62.1 ± 12	NS
Male/female	786/399	41/13	45/10	<0.05*
BMI (<25/25–30/>30)	1002/176/7	40/13/1	52/2/1	<0.05*
Post-EMR (yes/no)	49/1136	2/52	0/55	NS
Previous laparotomy (presence/absence)	120/1065	5/49	6/49	NS
Operation				
Lymph node dissection (D1+α/D1+β/D2)	429/549/207	31/20/3	6/45/4	<0.05*
Operation time (min)	253.1 ± 19	229.4 ± 31	271.4 ± 26	<0.05*
Tumor				
Histologic type (tubular adenocarcinoma/signet-ring cell carcinoma/others)	933/223/29	50/3/1	46/5/4	<0.05*
Tumor depth (mucosa/submucosa)	729/456	25/29	27/28	<0.05*
Lymph node metastasis (N0/N1/N2)	1111/68/6	49/4/1	52/3/0	NS
Tumor staging† (stage IA/IB/II)	1111/68/6	49/4/1	52/3/0	NS

Data are mean ± SD or number. NS, not significant; BMI, body mass index.
*Statistical significance.
†Tumor staging is classified by UICC staging.

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TABLE 2. Intraoperative and Postoperative Complications

	No. (%) of Patients			
Complications	**LADG (n = 1185)**	**LAPG (n = 54)**	**LATG (n = 55)**	***P***
Intraoperative	20 (1.7%)	4 (7.4%)	1 (1.8%)	<0.05*
Bleeding	11	1	0	
Perforation	0	1	0	
Organ injury	5	0	0	
Machine trouble	1	2	1	
Others	3	0	0	
Postoperative	151 (12.7%)	10 (18.5%)	6 (10.9%)	NS
Bleeding	13	0	1	
Anastomotic stenosis	35	3	0	
Anastomotic leakage	25	3	0	
Intraabdominal abscess	17	0	0	
Pancreas injury	12	0	2	
Ileus	3	0	0	
Respiratory complication	9	0	0	
Wound infection	16	2	2	
Port-metastasis	0	0	0	
Others	21	2	1	

NS, not significant.
*Statistical significance.

including sex, age, body mass index, history of laparotomy and tumor stage.

There were only 6 cancer recurrences, 1 local recurrence, 1 lymph node recurrence, 2 peritoneal disseminations, 1 liver metastasis, and 1 skin metastasis at the abdominal wall different from the port-site, during the median follow-up period of 36 months (range, 13–113 months). The cancer in all 6 recurrent cases invaded to the deeper submucosal layer. In 3 of 6 cases, lymph node metastasis (N2) was detected histologically, and the tumors were classified as stage II tumors. Recurrence was not associated with any surgical procedure, complications, or conversion to open gastrectomy. The 5-year disease-free survival rate was 99.8% for stage IA disease, 98.7% for stage IB disease, and 85.7% for stage II (Fig. 1). The 5-year disease-free survival rate was 99.4% for patients who underwent LADG, 98.7% for those who underwent LAPG, and 93.7% for those who underwent LATG (Fig. 2).

DISCUSSION

This retrospective multicenter study is the first investigation of short- and long-term outcomes of LAG for EGC in a large series of patients in Japan. Both the mortality rate and the morbidity rate associated with LAG were shown to be as low as those of conventional open gastrectomy,[14] and the 5-year survival rate of patients who underwent LAG for EGC was as good as that of patients who underwent conventional open surgery for EGC.[15,16]

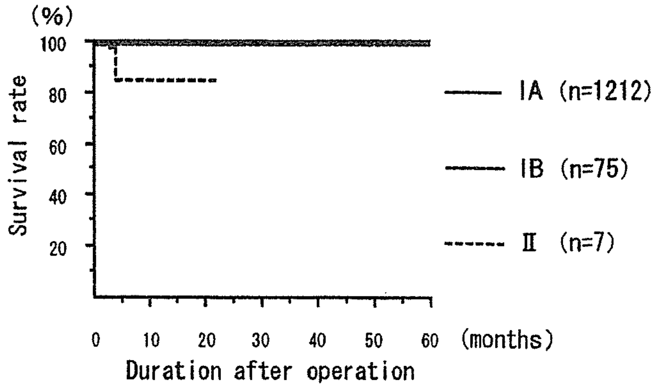

FIGURE 1. The disease-free survival rate in 1294 treated patients with early gastric cancer. The 5-year disease-free survival rate was 99.8% for stage IA, 98.7% for stage IB, and 85.7% for stage II. Tumor staging system is used with classification by the UICC staging.

Since LADG for EGC was first reported in 1994,[5] several laparoscopic procedures for EGC have been developed and have been performed by a limited number of surgeons.[6–8] Over the last decade, the number of LAGs for early cancer has rapidly increased, and the indication for LAG has extended to advanced cancer.[17] Several studies of the short-term outcome of LAG in comparison to open gastrectomy showed the several advantages of LAG, including less invasiveness, less pain, earlier recovery of bowel movement, and shorter hospital stay.[9–11] We have reported additional advantages of LADG, including less impaired respiratory function, better preservation of postoperative T_H1 cell-mediated immune function, and better postoperative quality of life.[18] Some studies, however, indicated technical difficulties and limitations in lymph node dissection performed during LAG.[19] Therefore, we performed a retrospective multicenter study to clarify the technical feasibility and oncologic outcome of LAG for EGC in Japan.

The prognosis of patients with EGC is known to be excellent, with 5-year survival rates of 90% or more.[15,16] Multivariate analysis has shown that lymph node metastasis is the only significant predictive factor for recurrence of

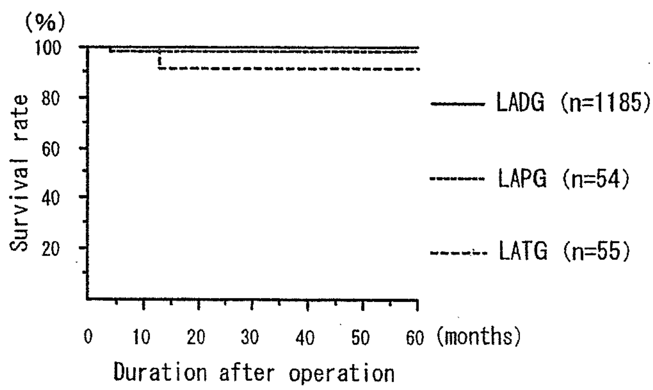

FIGURE 2. The disease-free survival rate according to operation. The 5-year disease-free survival rate was 99.4% for LADG, 98.7% for LAPG, and 93.2% for LATG.

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EGC.[20] Several recent studies showed that the extent of lymph node metastasis in patient with EGC was associated with tumor size and depth of invasion.[21] However, the extent of lymph node dissection for EGC remains controversial.[22] In the patients included in the present study, the lymph node dissection was performed laparoscopically according to the Guidelines of the Japanese Gastric Cancer Association. Several studies have evaluated laparoscopic lymph node dissection. Adachi et al, in a retrospective study of 96 patients with EGC, showed that the number of lymph nodes dissected laparoscopically was no different from that of lymph node dissected during open surgery.[9] Yano et al also conducted a retrospective study of patients with EGC and reported that the number of resected lymph nodes in D1+α lymph node dissection did not differ between LAG and open gastrectomy.[23] On the contrary, Miura et al showed less number of dissected lymph nodes along major curvature and the celiac and splenic arteries in LAG than open gastrectomy.[24] In the present retrospective study, which covered a quite long time period, the number of resected lymph nodes could not be evaluated because data of the number of resected lymph nodes in several institutions were incomplete. To establish techniques of LAG as an oncologic surgery, the laparoscopic procedures for lymph node dissection in each institution had been reviewed by video examination in the group conferences.

There are few studies on the long-term outcome of LAG for EGC. Huscher et al[25] recently showed, on the basis of the first prospective randomized trial in small series of 59 patients with EGC or advanced gastric cancer comparing the 5-year results of subtotal gastrectomy against those of with laparoscopic and open approaches, that LAG is a safe oncologic procedure; ie, the oncologic outcome matches that of conventional open surgery.[25] Our preliminary prospective randomized trial with a mean follow-up period of 21.5 months showed no difference in curability between laparoscopic and open procedures for EGC.[26] Weber et al also did not observe a difference in the 18-month survival rate between patients with gastric cancer who underwent LAG and those who underwent open gastrectomy.[27] Although the present multicenter study of a large patient series was an uncontrolled study and the follow-up period was short, the survival rate of patients with EGC who underwent LAG was shown to be good. These data suggest that LAG is feasible for EGC from the standpoint of oncologic outcome.

Several studies have investigated mortality and morbidity associated with LAG. Huscher et al reported LAG-associated mortality and morbidity rates of 3.3% and 26.7%, respectively, in a randomized trial, and these rates were the same as those of open gastrectomy.[25] Adachi et al reported, on the basis of a retrospective study comparing 49 LAGs and 53 open gastrectomies, that there was no difference in the incidence of operative complications.[9] Tanimura et al, in a retrospective study of 160 LAGs, showed that major complications such as anastomotic leakage and pancreatic injury occurred in only 6 cases (3.8%).[8] Shimizu et al reported the mortality and morbidity rates in 85 patients who underwent initial LAG were 0% and 11.8%, respectively.[28] In the present study, the mortality and morbidity rates were 0% and 14.8%, respectively, and the rate of conversion to open surgery was 1.1%. The conversion to open surgery in LAG for EGC was not associated with worse short- and long-term outcome in the present study. As laparoscopic surgeries for gastrointestinal disease have been considered as technically complex procedures with longer operation time, the significance of learning curve has been emphasized to perform them safely.[29,30] Although, in the present study, it seemed to take more 30 to 60 minutes to perform LAG than open gastrectomy, the incidence of operative complications was as low for LAG as it was for open surgery. These findings suggest that LAG with longer operation time is safe for EGC.

CONCLUSION

Our multicenter study of a large patient series showed that LAG is safe for EGC, with an oncologic outcome as good as that of conventional open surgery. Results of this retrospective nonrandomized clinical analysis should be confirmed by large-scale prospective randomized trials.

ACKNOWLEDGMENTS

The following centers and surgeons participated in the multicenter study initiated by the Japanese Laparoscopic Surgery Study Group (JLSSG): Seigo Kitano, Norio Shiraishi, Masafumi Inomata, Kazuhiro Yasuda, Oita University Faculty of Medicine (Oita); Ichiro Uyama, Masahiro Ochiai, Fujita Health University Hospital (Aichi); Kenichi Sugihara, Kazuyuki Kojima, Masayuki Enomoto, Masamichi Yasuno, Tokyo Medical and Dental University (Tokyo); Nobuhiko Tanigawa, Osaka Medical University (Osaka); Hitoshi Katai, National Cancer Center Hospital (Tokyo); Shinei Kudo, Showa University Northern Yokohama Hospital (Yokohama); Shinichi Sakuramoto, Kitasato University, School of Medicine (Kanagawa); Shuji Takiguchi, Morito Monden, Osaka University (Osaka); Shinya Tanimura, Masayuki Higashino, Yosuke Fukunaga, Osaka City General Hospital (Osaka); Yugo Nagai, Izumi Otsu Municipal Hospital (Osaka), Hirokazu Noshiro, Kyusyu University Graduate School of Medicine (Fukuoka), Ken Hayashi, Showa Inan General Hospital, Center on Endoscopic Surgery (Nagano); Hideki Hayashi, Takenori Ochiai, Graduate School of Medicine, Chiba University (Chiba); Tetsu Fukunaga, The Cancer Institute Hospital of Japanese Foundation for Cancer Research (JFCR) (Tokyo); Masaki Fukunaga, Juntendo Urayasu Hospital, Juntendo University School of Medicine (Chiba); Minoru Matsuda, Tomokazu Hoshi, Shinichi Kasai, Surugadai Nihon University Hospital (Tokyo); Tatsuo Yamakawa, Nobuo Murata, Teikyo University, Mizonokuchi Hospital (Kanagawa); Katsuhiko Yanaga, Jikei University School of Medicine (Tokyo).

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