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Laparoscopic Surgery for Gastric Cancer

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1. Introduction

Even though an overall incidence of the gastric cancer has been declined it remains as the second leading cause of cancer-related deaths world widely with the highest incidence in Korea and Japan. [1]

Over the past decade, however, the overall survival rate of patients with gastric cancer has been increased. This increased survival resulted from not only the early detection with an intensive surveillance in accordance of the development of an endoscopy but also the aggressive surgery approaches including an extensive lymph node dissection; combined with a resection of adjacent organs, if indicated. Additionally the improved perioperative management on the patients has improved the survival. [2]

Since the first case of a laparoscopy-assisted gastrectomy was reported by Kitano et al. in 1994, [3] the number of patients underwent laparoscopic gastrectomy for early gastric cancer (EGC) has been increased rapidly especially in Korea and Japan, where there is a high incidence of EGC. According to survey by the Korean Gastric Cancer Association in 2009, the number of gastric cancer operations performed laparoscopically has surprisingly increased (Fig. 1).

The technical innovations in laparoscopic instrument and the advances in the surgical techniques have allowed for a widespread acceptance of a laparoscopic surgery in gastric cancer management. The Advantages of the laparoscopic gastrectomy over the conventional open surgery include a reduced postoperative pain, an enhanced recovery, a shorter hospital stay, and a better cosmesis. [4,5] Although there is a high level of an evidence to support short-term efficacy of a laparoscopic gastrectomy for EGC, still the long term results accounts on the patients' survival are still infrequent. The technical feasibility of the laparoscopic radical lymphadenectomy must need to be proven in the long-term, and the oncologic concerns involved in laparoscopic gastrectomy such as the oncological effects of a pneumoperitoneum, must still be resolved. A prospective multi-center randomized clinical trial has started to assess the short- and long-term outcomes of laparoscopic gastrectomy for early stage gastric cancer (KLASS trial, Korean Laparoscopic Gastro-intestinal Surgery Study Group) on March 2005.

This review will summarize the current status for laparoscopic surgery for gastric cancer, ongoing controversies on the clinical trial, and the future perspectives of the minimally invasive treatment.

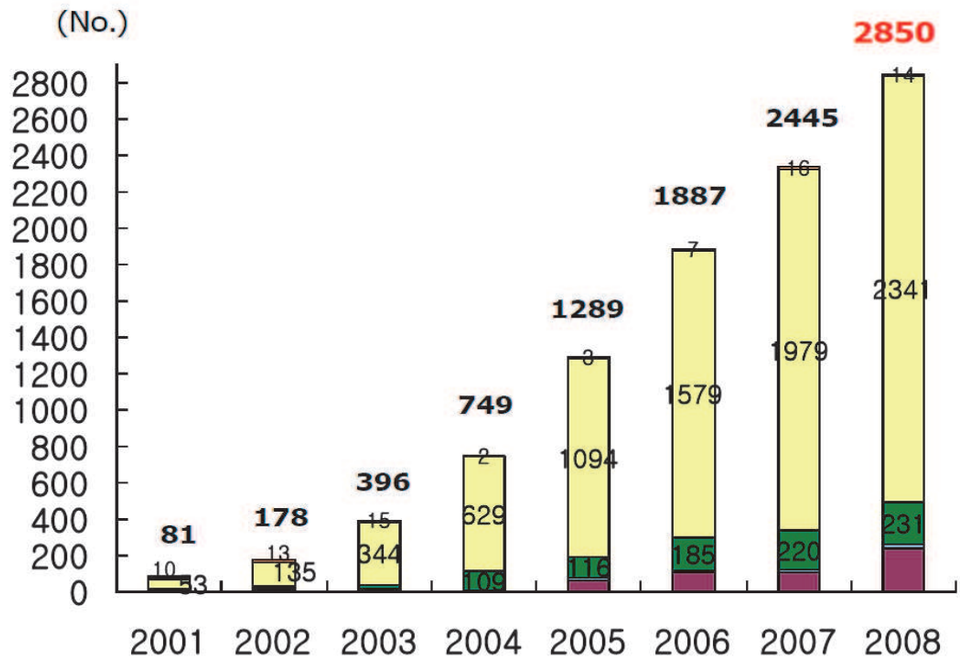
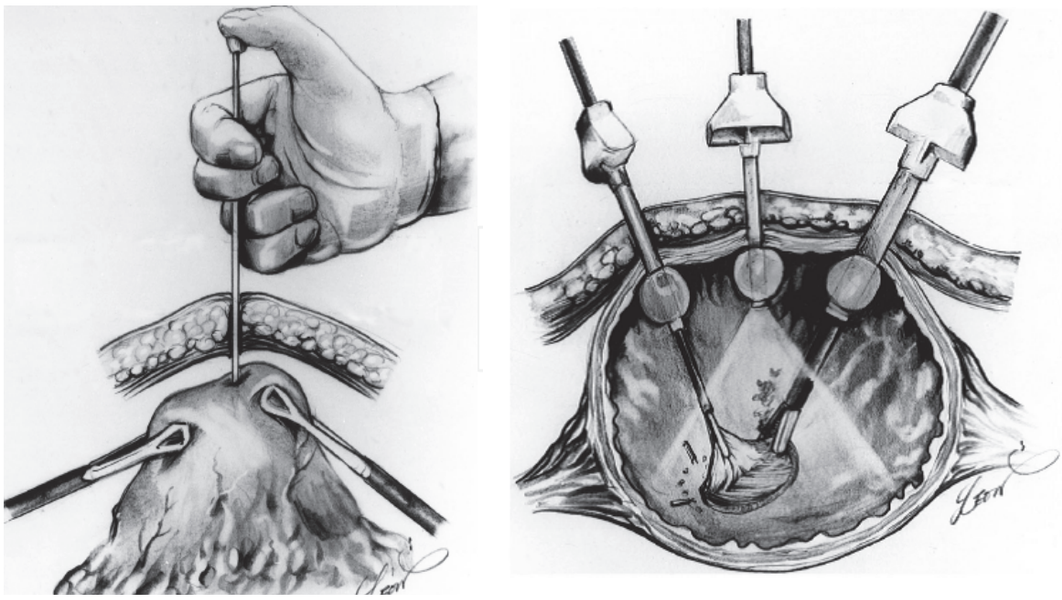


Fig. 1. Annual number of laparoscopic procedures performed for gastric adenocarcinoma in Korea. Orange bar, wedge resection; yellow bar, distal gastrectomy; green bar, total gastrectomy; sky blue bar, gastrojejunostomy; purple bar, other procedures

2. History and the current status of laparoscopic surgery for gastric cancer

The history of laparoscopic gastric surgery dates from 1992, when Peter Goh of Singapore performed the first entirely laparoscopic Billroth II distal gastrectomy on a patient affected with chronic gastric ulcer. [6] The first laparoscopic wedge resection for gastric cancer was carried out by Ohgami et al. [7] They used a T-fastener and performed an intragastric mucosal resection for a patient with EGC in 1992. (Fig. 2) And Ohashi et al. attempted the intragastric mucosal resection (IGMR) for EGC of the stomach located at the posterior wall for the first time [8]. The aim of both procedures was to minimize the extent of gastric resection for the treatment of a malignant disease with a low risk of lymph node metastasis, therefore to reduce the accompanying physiologic side effects by the standard gastrectomy.

In June 1993, J.S. Azagra performed their first laparoscopic gastrectomy for gastric cancer. [9] Kitano et al. had reported the first laparoscopy-assisted distal gastrectomy (LADG) with D1+α lymph node dissection for EGC in 1994. Since then, various types of laparoscopic gastric surgery have been successfully performed using laparoscopy. Recent advances in techniques for performing the lymph node dissection and the development of new instrumentations, such as stapling devices and ultrasonic devices, have made it possible to perform almost all the procedures in gastrectomy with lymphadenectomy laparoscopically which comparable to the open conventional surgery. Function-preserving surgery, such as pylorus preserving surgery, proximal gastrectomy, and segmental gastrectomy has been also successfully performed by laparoscopy.



Source : World J Surg 1999;23:187-193. [7]

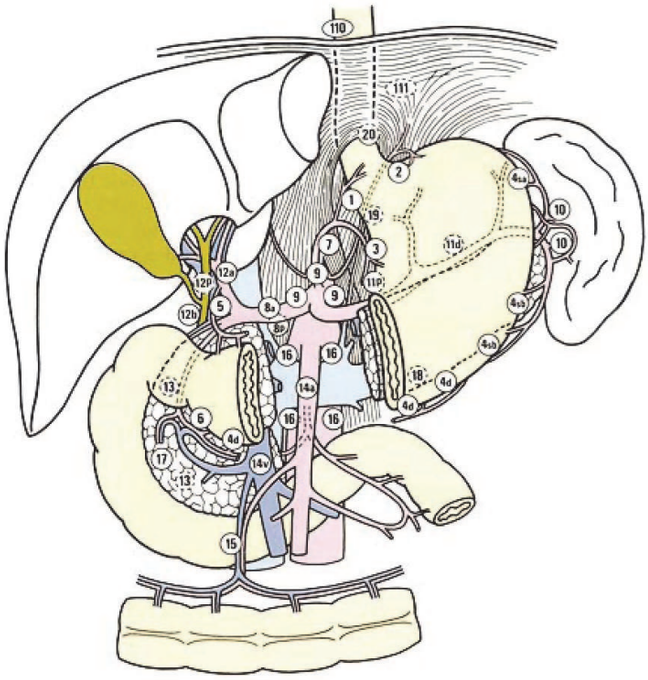
Fig. 2. Lesion lifting technique with T-fastener originally reported by Ohgami et al. in 1992.

Recently, these laparoscopic gastrectomies have been increased remarkably in Japan and Korea. A national Japanese survey showed that more than 4500 patients with gastric cancer underwent laparoscopic gastrectomy in 2007. [10] Although LADG was first reported as a minimally invasive surgery for EGC, some aggressive surgeons successfully performed extended (D2) lymph node dissection on patient so that LADG can be used to treat AGC. [11,12] There are surgeons who are now trying to expand the indications of laparoscopy-assisted gastrectomy to the treatment options for an advanced gastric cancer. In 1999, Uyama et al. [13] reported the result of LADG with D2 lymph node dissection for advanced cancer. With the exception of early reports, the retrieved number of lymph nodes in laparoscopic surgery for advanced gastric cancer has been reported as equivalent to that in open surgery. Korean surgeons could acquire advanced-laparoscopic skills for gastrectomy by maintaining the exchange fellowship program and the clinical researches with the expert in Japan. Considering that the majority of gastric cancer patients in Korea are managed by a limited number of experts at high-volume centers, it was easy for the Korean surgeons to catch up with high level of the proficiency. The wide acceptance and the development of laparoscopic surgery for malignant gastric disease in the West have been increased slowly. Laparoscopy-assisted distal, subtotal, or total gastrectomy for early and advanced gastric cancer is now emerging in the West with progressive acceptance among various groups, although this upward trend has been slowed by the difference in natural history of gastric adenocarcinoma in the East compared with the West. [14]

3. Optimal extent of lymph node dissection for gastric cancer

The extent of lymph node dissection for gastric cancer has consistently been a subject of debate world widely. Three types of laparoscopic lymph node dissection are performed (Table 1): perigastric lymph node dissection (D1 + α), additional lymph node dissection

along the common hepatic artery (D1 + β), and extended lymph node dissection covered for non-regional lymph nodes. (D2). [15]



Source: Japanese Gastric Cancer Association. Japanese Classification of Gastric Carcinoma; 2nd English Edition. [15]

Fig. 3. Perigastric regional lymph node stations.

D2 dissection has been a standard procedure in Japan and Korea although it was not based on the clinical trial. Two European randomized trials comparing D2 with D1 dissection was failed to show a survival benefit of D2 dissection, which was resulted in high rate of a postoperative mortality. [16, 17] However, the survival benefit in these trials seems to be biased on the technical factors and the patients' selection factors which was resulted in the high rate of postoperative complications and high operative mortality rates. A report from the retrospective analyses series have shown superior stage-by-stage survival rates when compared with data from other countries in which D2 dissection is not a standard procedure. Extended lymph node dissection remains a standard of care in the Far East and also in Western specialized units where it can be conducted safely. [18]

D0 : No dissection or incomplete dissection of the Group 1 nodes
D1 : Dissection of all the Group 1 nodes
D2 : Dissection of all the Group 1 and Group 2 nodes
D3 : Dissection of all the Group 1, Group 2 and Group 3 nodes

Table 1. Definition of lymph node dissection(D)

With the advances of laparoscopic technique in gastric cancer surgery, the standard surgical procedure for EGC has been discussed. Initially, laparoscopic gastrectomy was indicated only for EGC patients with a low risk of lymph node metastasis. The Japanese Gastric

Cancer Association proposed clinical guidelines for the treatment of gastric cancer in 2001. Based on those recommendations, laparoscopic gastrectomy (LG) is recommended for gastric cancer patients with a preoperative stage Ia (cT1N0M0) diagnosis. Although a number of institutes adhere to the guideline, laparoscopic gastrectomy has also been referred to as a pre-established technique that is still under clinical investigation due to the uncertain quality of lymph node dissection and the lack of proof based on long term follow-up data. [15]

Yasuda et al. [19] recommended D1 + α lymph node dissection for submucosal cancer measured 1–4 cm in diameter based on pathologic report. Hyung et al. [20] proposed D2 lymph node dissection for a differentiated submucosal cancer more than 2.5 cm in diameter and for undifferentiated submucosal cancer more than 1.5cm. The Japanese Gastric Cancer Association (JGCA) guidelines have set the optimal lymph node dissection level for EGC. Based on a large nationwide registry data, JGCA defined modified gastrectomies A and B (MG-A, MG-B) for treatment of EGC. MG-A is indicated for clinically mucosal cancer or small (< 1.5cm) differentiated-type submucosal cancer. And MG-A proposed dissecting the perigastric nodes and those along the left gastric artery are resected (D1 + No. 7). MG-B is indicated for the submucosal cancers and small (< 2 cm) EGC with clinical N1 disease. In this procedure, the nodes along the hepatic artery (No. 8a) and celiac artery (No. 9) should be resected in addition to those of MG-A. In other EGCs (N1 and > 2 cm, or N2), D2 standard gastrectomy is recommended. In total gastrectomy for proximal EGC, the spleen may be preserved because the lymph nodes metastases in the splenic hilar nodes are extremely rare in EGC.

4. Procedure of laparoscopy assisted distal gastrectomy

Under a pneumoperitoneum at a pressure of 12 mmHg, the greater omentum is divided proximally about 4 to 5 cm from the gastroepiploic arcade toward the lower pole of the spleen using laparoscopic ultrasonic shears (Harmonic Scalpel; Ethicon Endo-Surgery, Cincinnati,OH, USA). For the patients with gastric cancer located in the middle third of the stomach, the roots of left gastroepiploic vessels are exposed and divided with double clipping at their origin from the splenic artery. For the patients with gastric cancer located in the lower third of the stomach, the superior mesenteric vein is exposed with an aid of ultrasonic shears and hooks, and fatty tissue with small lymph nodes (No. 14v) is cleared (Fig. 4). The right gastroepiploic vein is divided at the level of the pancreas border, and the right gastroepiploic artery is then divided at its roots by double clipping after No. 4sb lymph nodes are divided away from the greater curvature. After the right gastric artery have been exposed and divided at its origin by double clipping, the duodenum is transected 1 cm distal to the pylorus via an endoscopic stapler (Endocutter 45 staple; Ethicon, Endo-Surgery, Cincinnati,OH, USA). The lymph nodes with fatty tissue along the hepatic artery (No. 12a), the anterosuperior aspect of common hepatic artery (No. 8a), the celiac axis (No. 9), and the proximal splenic artery (No. 11p) are dissected along each artery using an ultrasonic dissector and a hook-type monopolar bovie. The left gastric vein is divided, and the root of the left gastric artery was exposed and divided with double clipping, thereby allowing dissection of the left gastric artery lymph nodes (No. 7). The perigastric lymph nodes are dissected along the upper lesser curvature up to the esophagogastric junction. The mobilized stomach is then pulled out through this minilaparotomy. After removing the specimens, Billroth I gastroduodenostomy using a circular stapler (Proximate CDH 25;

Ethicon Endo-Surgery, Cincinnati, OH, USA) or Billroth II gastrojejunostomy by hand sewing are performed. [21]

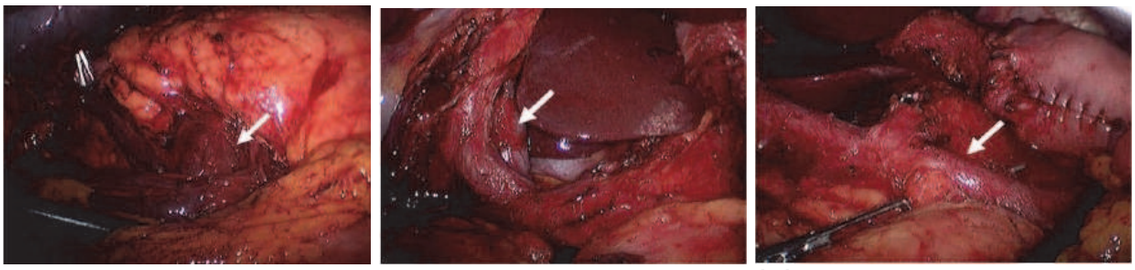


Fig. 4. Intraoperative view after completion of the laparoscopic lymph node dissection White arrow indicates the superior mesenteric vein (a), the portal vein (b), and the splenic artery (c).

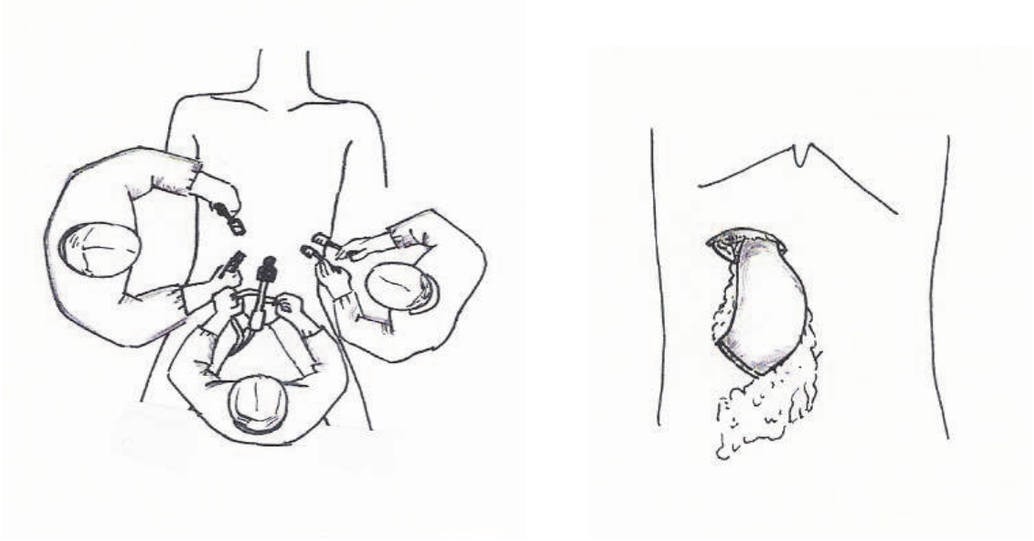


Fig. 5. Laparoscopy assisted distal gastrectomy. The position of patients and operating team are different between theinstitutions. The author prefer to use semi-lithotomy position and operator stands at patient's right side.(left) After full mobilization of stomach and resection of duodenum, half to two thirds of stomach is resected and gastroduodenal anastomosis is followed.(right)

5. Function preserving laparoscopic surgery

To improve the quality of life after gastrectomy, various types of the function-preserving surgery were designed to perform in the laparoscopic era. The proximal gastrectomy, the pylorus preserving gastrectomy, or the vagus nerve preserved gastrectomy is the good examples for the function-preserving gastrectomies. Laparoscopic proximal gastrectomy has performed for EGC located in the proximal third of the stomach. [22] Pylorus-preserving gastrectomy (PPG) was originally indicated as a treatment option for gastric ulcers, but is now applied for patients with EGC located in the distal two-thirds of the stomach. The distal 2/3 of the stomach is resected but approximately 2 cm from a pyloric cuff should be

preserved in this procedure. The hepatic and pyloric branches of the vagus nerve are also should be preserved. All the regional lymph nodes, except the suprapyloric nodes (No. 5) can be dissected as in the standard D2 operation. PPG is currently indicated for EGC, located at the mid third of the stomach, which the nodal metastasis to No. 5 is extremely uncommon. The incidence of postgastrectomy dumping syndrome and the risk of the stone formation in a gall bladder (GB) appears to be decreased, and the tendency of the body weight recovery is acceptable compared to that of Billroth I reconstruction. [23] Following the establishment of laparoscopy-assisted PPG (LAPPG), this procedure has been used in many institutions. [24]

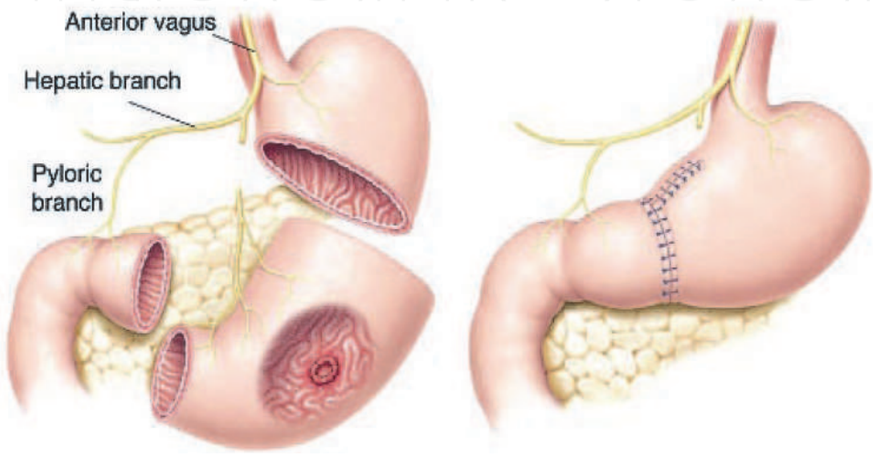


Fig. 6. Pylorus preserving gastrectomy. The pyloric cuff, 2-3 cm from the pyloric ring, is preserved together with the hepatic and pyloric branch of the anterior vagal trunk. Source: Scand J Surg. 2006; 95(4):249-255. [25]

6. Short-term outcomes after laparoscopic gastrectomy

Analysis of data from various retrospective case series almost invariably revealed show that laparoscopic gastrectomy can now be performed safely with less amount of the blood loss, although it usually requires a little bit longer operating time. (Table 2)

Only six RCTs that compared LADG to ODG have been published (Table 3). Kitano et al. [26] had reported no difference in the morbidity and mortality rates between 14 LADG and 14 ODG for EGC. An RCT by Huscher et al., [27] compared the clinical outcomes of LADG with those of ODG for EGC and AGC showed that the morbidity and mortality rates were almost the same between the two procedures. These results suggest that LADG is technically feasible in patients with gastric cancer. Korean Surgeons performed a multi-institutional, prospective, randomized trial for LADG to assess the short- and long-term outcomes of laparoscopy assisted distal gastrectomy (LADG) for EGC in Korea (Korea Laparoscopic Gastrointestinal Surgery Study Group, KLASS trial). A total of 342 patients were randomized (LADG, 179 patients; ODG, 161 patients). [28] There were no significant intraoperative complications or incidence of open conversion in the LADG group. Early complications occurred in 20 patients (11.6%) in the LADG group and 27 patients (15.08%) in the ODG group, and the late complications occurred in three patients each, (1.74% and 1.67%) among the two groups; there were no statistically significant differences in terms of

complications rates between these two groups. Re-operations were performed in 3 patients in the LADG group; (1) omentectomy was performed because of intra-abdominal bleeding, (2) segmental resection of an afferent loop was performed, and (3)primary repair of an leakage at the anastomotic site was done to control peritonitis. In the ODG group, three patients underwent reoperation because of the anastomotic leakage, the postoperative adhesive ileus, and the wound dehiscence. Mortality occurred in two patients in the LADG group; one patient who died of liver function failure due to the chronic hepatitis B, in combination with multiple organ failure. And the other one who had liver cirrhosis (Child B) and chronic renal failure die of a sudden exacerbation of chronic liver disease and resulted in acute liver failure. Even with the aid of the intensive care, these patients have died in 30 and 31 days postoperatively. The morbidities and mortalities were not statistically different between the two groups ($P > 0.49$).

Study (year)	Country	*n*		Level of L/N dissection	Indication
		LADG	ODG		
Adachi (2000)	Japan	49	53	D1+ α	T1a or T1b
Shimizu (2000)	Japan	21	31	D1+ α	T1a
Yano (2001)	Japan	24	35	D1+ α	T1a or superficial T1b
Migoh (2003)	Japan	10	17	D1+ α	T1a or T1b
Miura (2004)	Japan	89	342	D1,D2	T1a or T1b
Noshiro (2005)	Japan	37	31	D2	T1 or T2N0
Tanimura (2005)	Japan	235	200	D2	T1 or T2aN0
Mochiki (2005)	Japan	89	60	D1+β	T1N0
Naka (2005)	Japan	20	22	D1+ β	T1N0
Kim (2005)	Korea	16	16	D2	T1a or T1b
Kim (2005)	Korea	71	76	D1+ α, β, D2	T1aN0
Cho (2006)	Korea	38	35	D1+ β, D2	T1N0-1, T2N0
Ikenaga (2006)	Japan	47	33	D1+ β	T1a
Lee (2006)	Korea	136	120	D1+ β	T1a
Shin (2007)	Korea	80	97	D1+ β	T1a or T1b
Song (2007)	Korea	44	31	D2	T1a or T1b

Table 2. Retrospective studies for comparing open versus laparoscopic gastrectomy

Kodera et al. [29] performed meta-analyses of the following parameters based on randomized trials only, of which there are currently 6 comparing laparoscopy-assisted distal gastrectomy with open distal gastrectomy; the estimated blood loss, the operating time, the number of lymph nodes retrieved, the morbidity and mortality. Quality of the randomized trials would have to be considered as rather mixed, as the KLASS trial is the only multicenter trial with a large sample size. Most notably, the estimated blood loss was reduced at the cost of longer operating time. Surgical complications seemed to be considerably less common with the laparoscopic approach by the meta-analysis, although

Authors	Year	Country	Number of patients	
			LADG	ODG
Kitano	2002	Japan	14	14
Lee	2005	Korea	24	23
Hayashi	2005	Japan	14	14
Huscher	2005	Italy	30	29
Kim YW	2008	Korea	82	82
Kim HH	2010	Korea	179	161

Table 3. Characteristics of the 6 randomized clinical trials

statistical significance had been lacking in the individual studies. A surprisingly high morbidity for open surgery in a trial by Lee and colleagues [30] was thought to be caused by the inclusion of pulmonary complications. The reason that it was so unusually frequent is unknown, but might be attributed to inadequate criteria for reporting such events, it could have occurred by chances, or the limited number of cohort size of the individual trials. In-hospital mortality was acceptable ranges and minimized in all of the studies, as has been shown in other retrospective case series of both laparoscopic and open surgery in the Far East. On the other hand, the quality of lymphadenectomy in terms of the number of the retrieved lymph nodes highly favored open surgery. This result conflicts with earlier findings by some single-institutional retrospective studies, but a meta-analysis of randomized trials only should be regarded as less biased. Whether the difference in retrieval translates into difference in long-term survival remains unknown.

7. Long-term outcomes after laparoscopic gastrectomy

There was a report of an odd recurrence among patients operated on during the 1990s that casts doubt about the oncologic feasibility of laparoscopic surgery for gastric cancer when the surgical technique is im-mature. [31] However, long-term outcomes of the same case series as a whole were excellent. Lee et al. [32] reported the long term oncologic outcomes from laparoscopic gastrectomy 601 cases. At a median follow-up time of 35.9 months (range 3 to 113 months), cancer recurrence occurred in 15 patients and metachronous gastric remnant cancer was detected in 6 patients. The 5-year overall and disease-free survival rates were 94.2% and 89.9%, respectively, for stage IA tumors, 87.4% and 82.7% for stage IB, 80.8% and 70.7% for stage IIA, and 69.6% and 63.1% for stage IIB.

A more extensive retrospective analysis of patients by expert laparoscopic surgeons also revealed excellent outcomes. Japanese Laparoscopic Surgery Study Group analyzed 1,185 cases of laparoscopy-assisted distal gastrectomy. [33] At a median follow-up time of 36 months, estimated 5-year disease-free survival rates were 99.8% for stage IA, 98.7% for stage IB, and 85.7% for stage II. Similarly, the excellent retrospective data suggested the non-inferiority of the laparoscopic approach to treat early-stage cancer have been reported from the KLASS group. [34] A retrospective multicenter study was performed using data from a cohort of 1,485 patients who had undergone laparoscopy-assisted gastrectomy for gastric cancer at ten institutions from 1998 to 2005. The 5-year overall survival of 1,417 patients was 95.5%, and disease-free survival was 94.1%. Fifty of 1,417 patients (3.5%) had recurrences. Incidence of recurrence was 1.6% (19/1186) in early gastric cancer and 13.4% (31/231) in advanced gastric cancer.

One Italian prospective, randomized clinical trial with a total of 59 patients was reported in 2005. [35] Twenty-nine (49.1%) patients were randomized to undergo open subtotal gastrectomy (OG), while 30 (50.9%) patients were randomized to the laparoscopic group (LG). Five-year overall and disease-free survival rates were 55.7% and 54.8% and 58.9% and 57.3% in the OG and the LG, respectively.

These encouraging data prompted several experienced investigators in Japan and Korea to extend the indication for laparoscopic approach to more advanced gastric cancers. Also, large multicenter clinical trial had been conducted and studied the long term oncologic outcomes in gastric cancer looked forward to the final results.

8. Ongoing prospective clinical trials

Randomized trials to prove the oncologic feasibility and safety of laparoscopic surgery as well as to confirm its clinical benefits are mandatory. Korean surgeons who had much larger patient cohorts were actively to launch a phase III trial. After an initial attempt, they launched the KLASS group trial (NCT00452751), a large-scale multi-institutional trial. The Japanese Gastric Cancer Treatment Guidelines discreetly selected early-stage cancer (T1N0, T1N1 or T2 (MP)-T3 (SS) N0) as tentative targets of laparoscopic surgery. The Koreans referred to these guidelines and recruited only patients with preoperative diagnosis of stage I disease in the trial. They identified comorbidity of the patients and lack of experience on the side of surgeons as risk factors for complications in their preparatory retrospective analysis, [36] and only surgeons with experience of more than 50 laparoscopic gastrectomy procedures were invited to participate in the phase III trial. The first convincing evidence of oncologic outcomes of the laparoscopic procedure will be available in the near future from Korea.

More recently, the Japan Clinical Oncology Group (JCOG) began to recruit surgeons and institutions with experience in laparoscopic gastrectomy. This was ultimately to evaluate the feasibility of a laparoscopic approach in the forthcoming clinical trials. They first conducted a phase II trial, JCOG0703, with the incidence of anastomotic leakage and pancreatic fistula as the primary end point, enrolled 176 patients, and found the incidence to be 1.7%. [37] Having confirmed the safety of the procedure in this trial, they are currently preparing for a phase III trial with long-term survival as an end point. Again, only early-stage cancers (preoperative diagnosis of T1N0, T1N1, T2 (MP) and T3 (SS) N0) will be eligible. As like mentioned previously, given the small number of events that can be expected from this population, the required sample size to show non-inferiority of the laparoscopic surgery over open surgery (<5% difference in 5-year survival) was calculated to be as much as 920, and the study group expects to complete the recruitment of patients in the following five years. Quality of life assessments using established questionnaires will also be performed among the selected institutions, where sufficient assistance from the clinical research coordinators could be provided.

9. Laparoscopic gastrectomy in the west

In Western countries, a small number of surgeons who challenged this approach did not restrict themselves to T1 stage cancer, [38] because most gastric cancers are diagnosed as locally advanced disease. A small number of studies comparing open and laparoscopic approaches have shown that survival data among those receiving laparoscopy were not

inferior to open surgery, although there were significant reductions in pain and incidence of the late postoperative complications. They have not been able to extend their experience to perform a large-scale randomized comparison between laparoscopic and open surgery as they had done with colon cancer, apparently because of the small numbers of operable disease and surgeons who are in capable of performing oncologically safe gastric cancer surgery which is done in East.

The experience in laparoscopic gastrectomy for the treatment of gastric adenocarcinoma in the West has been mostly encouraged in Europe, with a small and limited series of report from the North America and South America published in recent years. In the United States, the first group to describe their experience with laparoscopic gastrectomy with curative intent for GC was Reyes et al. from Mount Sinai Medical Center, in 2001. [39] In this retrospective case-matched study with 36 patients (25 with malignant disease), they compared 18 laparoscopic surgeries with 18 open gastrectomies. Of those with GC, from the laparoscopic group, 9 patients had histologically confirmed adenocarcinoma and 3 with carcinoid tumors compared with 12 adenocarcinomas and 1 gastric lymphoma in the open group. All resected margins in the laparoscopic group were free of tumor, whereas 2 patients in the open group (stages II and III) had R1 resections, likely related to selection bias for these more advanced, open cases. There were no significant differences in extent of lymph node dissection or in intraoperative complications between the two groups. The laparoscopic approach required a significantly longer operative time (4.2 h vs. 3.0 in the open group) likely related to the learning curve of this procedure. However, there were significantly reduced amount of blood loss with fewer transfusions required, earlier return to normal bowel function, lower incidence of the postoperative ileus, and significantly reduced hospital stay in the laparoscopic versus open groups (6.3 vs. 8.6 days).

In 2006, Varela et al. [40] published the second experience with laparoscopic gastrectomy for GC in the United States, representing to date the largest American experience reported. After 15 consecutive laparoscopic gastrectomies, of which 2 were total, 4 proximal, 4 subtotal, 2 distal, and 3 laparoscopic esophagogastrectomies, no conversion to open surgery was reported, and there were no significant differences in operative time, transfusion rate, number of lymph nodes resected, median length of stay, and morbidity, although there was significantly lower blood loss among the laparoscopic group, demonstrating both the feasibility and safety of the laparoscopic approach.

10. Future perspectives

With increasing the experience and the level of the expertise of oncologic surgeons in the minimally invasive approach to gastric resection for cancer, it is becoming evident that laparoscopy, as a surgical modality for gastrectomy, provides equivalent oncologic resections with lymphadenectomy that is comparable to the open approach, with no compromise in terms of the disease recurrence or long-term survival, based on preliminary studies. In addition, based on the known benefits of the minimally invasive approach, including the reduced risks of surgery related trauma, the amount of the blood loss, pain, and earlier recovery for the patient, we are encouraged to expand our indications of laparoscopic surgery. This has been stimulated by the advances in the field of the minimally invasive surgery for benign abdominal disease, and the results from multiple Eastern studies of early-stage cancer. Although an open surgical approach should be applied for any case with concerns of resectibility of the cancer lesion, the safety margin, or

capability of operating surgeons , it appears that the minimally invasive surgical approach can be here to stay. However, until more mature long-term follow-up data on advanced gastric cancer treated by minimally invasive approaches are defined, these approaches should be limited to those patients with early- stage gastric cancer. To establish laparoscopic surgery as a standard treatment for advanced gastric cancer, multicenter RCTs comparing the short- and long-term outcomes of laparoscopic surgery versus open surgery are needed. As the indications are continued to expand to treat more advanced tumors and with the supporting data data from the additional prospective studies, we will be able to clearly define the oncologically appropriate application of laparoscopic gastrectomy for all stages of gastric adenocarcinoma.

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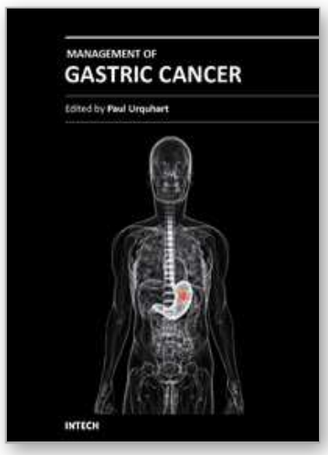

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Gastric cancer is the fifth most common cancer and the second most common cause of cancer death worldwide. More than 50% of the patients have advanced disease at diagnosis and in this case the disease has a poor outcome. The staging of gastric cancers is based on endoscopic ultrasound, computed tomography, magnetic resonance imaging, positron emission tomography, in addition to the laparoscopic staging. Many improvements in the surgical techniques have been seen in the last decade. Laparoscopic surgery is an emerging approach which offers important advantages: less blood loss, reduced postoperative pain, accelerated recovery, early return to normal bowel function and reduced hospital stay. D1 lymphadenectomy, with a goal of examining 15 or greater lymph nodes is a standard. D2 dissection is considered as a standard in several institutions especially in eastern Asia. Perioperative chemotherapy and adjuvant concurrent radiochemotherapy are recognized as standards treatments. Palliative chemotherapy is the mainstay treatment of advanced stages of the disease (metastatic and non-operable tumors). Despite these treatment advances, the prognosis of gastric cancer remains poor with a 5-year survival ranging from 10 to 15% in all stages combined.

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