Endoscopic Surgery in the Field of Gastroenterology: Stomach and duodenum

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Naoki HIKI,[*1] Tetsu FUKUNAGA,[*2] Takeshi SANO,[*3] Toshiharu YAMAGUCHI[*4]

Abstract

In Japan, laparoscopic gastrectomy for gastric cancer has been performed more frequently in recent years. However, laparoscopic gastrectomy is not a standard procedure because of its technical complexity, which can cause large variations in surgical outcomes among different facilities. Many facilities are likely to begin with laparoscopy-assisted distal gastrectomy (LADG), and aim at stepping up to laparoscopic total gastrectomy or group-2 lymph node dissection. However, most important is the standardization of techniques, particularly among operator assistants. Therefore, it is important to proceed to the next step only after competence in performing LADG has been achieved, avoiding overly hasty progression. This paper provides an outline of the current status, indications, and limitations of indications of laparoscopic gastrectomy, and discusses the future prospects of the procedure based on these issues.

Key words Laparoscopy, Gastric cancer, Extended indications, Reduction surgery

Introduction

Laparoscopic gastrectomy for early gastric cancer has rapidly become more common. Medical facilities that use this technique are gradually increasing, and it would not be an exaggeration to say that laparoscopic gastrectomy is approaching the status of a standard treatment for early gastric cancer. However, at present, not all cases of gastric cancer are amenable to laparoscopic surgery. The actual situation is that most cases of laparoscopic surgery requiring total gastrectomy or extended (D2) lymph node dissection are dealt with only in medical facilities that have a great deal of experience in laparoscopic gastrectomy.

To safely implement and extend the indications of laparoscopic gastrectomy, it is essential to understand the advantages and disadvantages of laparoscopic surgery. Standardization of the procedure is useful for making good use of its advantages. This paper provides an outline of the current status, advantages, and disadvantages of laparoscopic gastrectomy, and describes the current limitation of its indications and the future prospects of the procedure.

Current Status of Laparoscopic Gastrectomy

Laparoscopic surgery for the treatment of gastrointestinal cancers began with laparoscopic cholecystectomy. Since Kitano et al. tried laparoscopy-assisted distal gastrectomy (LADG) for the first time in 1991,[1] the indications for LADG have been extended rapidly. A questionnaire survey carried out by the Japan Society for Endoscopic Surgery (JSES) revealed that endoscopic surgery was performed in a total of 2,631 cases/year in 2005, corroborating the beginning of a rapid increase in the use of this technique.

*1 Chief of Gastroenterlogical Surgery, Cancer Institute Hospital, Tokyo, Japan (naoki.hiki@jfcr.or.jp).
*2 Chief of Gastroenterlogical Surgery, Cancer Institute Hospital, Tokyo, Japan.
*3 Chief of Digestive Tract, Cancer Institute Hospital, Tokyo, Japan.
*4 Vice-Director of Cancer Institute Hospital.
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Table 1 Treatment for early gastric cancer

	N0	N1	N2
T1(M)	IA EMR (en bloc excision) [differentiated, 2.0 cm or less, UL(−) in concaved cases] Reduction surgery A (cases other than the above)	IB Reduction surgery B (2.0 cm or less) Standard surgery (D2) (2.1 cm or more)	II Standard surgery (D2)
T1 (SM)	IA Reduction surgery A (differentiated, 1.5 cm or less) Reduction surgery B (cases other than the above)	IB Reduction surgery (2.0 cm or less) Standard surgery (D2) (2.1 cm or more)	II Standard surgery (D2)

[Cited and partly modified from Japanese Gastric Cancer Association ed. Gastric Cancer Treatment Guidelines (for Doctors) 2nd ed. revised 2004 Apr. Tokyo: Kanehara & Co., Ltd.; 2004.]

However, the indications of endoscopic surgery have been extended more for cases of colon cancer than for those of gastric cancer, showing a dramatic increase from the first case in 2000 to 5,259 cases/year in 2005.[2] Thus, endoscopic surgery has been utilized more in the treatment of colon cancer than in gastric cancer. At present, LADG has not been fully generalized or standardized because of discrepancies in the skill and precision of lymph node dissection among different facilities, and thus further spread of the standardized procedures is desirable.

Indications of LADG

LADG has been positioned as a form of reduction surgery in the Japanese Gastric Cancer Association's *Gastric Cancer Treatment Guidelines*, revised in April, 2004, and its indications in clinical practice are restricted to early gastric cancer cases (**Table 1**).[3] According to a questionnaire survey carried out by the JSES,[2] only 20% of medical facilities where laparoscopic gastrectomy was feasible were using the LADG technique for standard gastrectomy with D2 dissection.

In our hospital, basic indications for LADG include early gastric cancers (cT1N0, cT1N1) not amenable to endoscopic mucosal resection (EMR) or endoscopic submucosal dissection (ESD), and, currently, most cases of LADG application involve preoperative diagnosis or treatment of early gastric cancer. However, its indications are extended to cases of cT2 (MP) N0 cancers if the patient requests LADG after giving fully informed consent. In facilities where laparoscopic gastrectomy was introduced early, secure and stable surgical procedures are provided, and indications of laparoscopic gastrectomy tend to be extended. The aforementioned *Gastric Cancer Treatment Guidelines* prescribe that indications of LADG include advanced (T2N0, T2N1) cancers as the objects of clinical research. This may foster the trend toward further extension of the indications of LADG, although at a slow speed.

Diagnosis of the stages of gastric cancer: determining the indications

In Japan, the common use of upper gastrointestinal endoscopy has yielded higher rates of detection of early gastric cancer, and has led to the general concept that gastric cancer is a curable disease. It is generally known that about 70% of patients with gastric cancer get well, and the recovery rate is more than 90% for early gastric cancer. EMR/ESD and LADG are well-known treatment techniques for early gastric cancer and are minimally invasive to the body. However, since gastric cancer is a diverse disease, it is necessary for doctors who deal with gastric cancer to examine the process from diagnosis to treatment on the basis of a clear understanding of its diversity.

More specifically, it is necessary to examine whether a diagnosis of early gastric cancer is correct, because of the uncertainty of the diagnosis of gastric cancer and the difficulty of its treatment. Importantly, it is not necessarily correct that early gastric cancer carries no possibility of metastasis, and is therefore completely curable. It is possible that laparoscopic surgery under a diagnosis of

early gastric cancer infiltrating into the submucosal layer (SM) may reveal an advanced, ss or se cancer, or a preoperative diagnosis of N0 or N1 may be found to be n2 when lymph node dissection is carried out with laparoscopy.

It is difficult to diagnose the depth of invasion in cases of depressed early gastric cancer accompanied with ulcers. In such cases, the overall accuracy of diagnosis is not very high, just 50–86%, even when endoscopic ultrasound (EUS) is used.[4] Although early cancer and advanced cancer can be diagnosed correctly in 95%, the diagnosis of M cancer can be obtained in 85% of M cancers, and the percentage of SM cancers diagnosed in all SM cancers is only 50%.[5] Since lymph nodes around the stomach are likely to be swollen because of inflammatory changes such as ulcers, it may be difficult to directly diagnose lymph node involvement. Thus, we have to perform surgery in patients with a preoperative diagnosis of cT1N0 or cT1N1 cancer, bearing in mind that the preoperative diagnosis of early cancer has its limitations. The treatment plan is therefore made when the patient's consent is obtained after the uncertainty of preoperative diagnosis has been fully explained. In regard to depth of invasion, a technique of D1 + β dissection is adopted as the standard method of lymph node dissection, considering the possibility that a preoperative diagnosis of cT1 (M) may be found to be pT1 (sm), and cT1 (SM) may be found to be pT2 (mp). Lymph node dissection has so far been carried out at a high level of precision.

To examine for lymph node metastasis, a rapid diagnostic technique is used for group 2 lymph nodes as quickly as possible intraoperatively, and laparoscopic surgery is shifted to laparotomy if a diagnosis of n2 is obtained. If necessary, staging of the disease is facilitated by sampling group 3 lymph nodes.

Significance of limited surgery in cases of laparoscopic gastrectomy

The next important issue in the surgical treatment of early gastric cancer is limited surgery. Although the extent of resection often can be reduced in cases of early gastric cancer, it should be noted that reduced resection does not necessarily ensure enhanced quality of the patient's life. The patient should have a good understanding of possible symptoms attributable to limited surgery and the treatments necessary for newly occurring disorders. Therefore, the patient should be fully informed of these issues and give consent based on such information. Taking laparoscopy-assisted pylorus-preserving gastrectomy (LAPPG) as an example, the advantages and disadvantages of laparoscopic surgery will be described below.

Pylorus-preserving gastrectomy (PPG) is a surgical technique by which about 2/3 of the stomach is resected while the pyloric antrum portion about 30 mm from the pylorus ring is preserved. PPG leaves the pylorus unresected, and therefore precludes rapid inflow of orally ingested food into the duodenum and prevents postoperative dumping syndrome. PPG is aimed at improving quality of life (QOL) by these features. PPG also enables the mixing of food and gastric acid, and therefore this technique is considered to facilitate digestion and absorption, leading to the prevention of iron-deficiency anemia and weight loss.

In addition, PPG is not associated with regurgitation of duodenal fluid into the remaining stomach or esophagus, and, therefore, the frequencies of postoperative gastritis in the remaining stomach and reflux esophagitis are extremely low. With the original technique,[4,5] the pyloric branch of the vagus nerve is preserved to maintain the motor function of the pylorus. Thus use of this technique in surgery for gastric cancer carries the drawback that dissection of the suprapyloric lymph nodes may become insufficient because preservation of the pyloric branch of the vagus nerve precludes proper treatment of the right gastric artery at its root. On the other hand, the pylorus has automaticity and restores its motor function in 3 months after surgery even if the pyloric branch of the vagus nerve is cut off. Therefore, based on the idea that cutting the pyloric branch of the vagus nerve is acceptable, various medical facilities adopt extended indications of PPG, such as cut the pyloric branch of the vagus nerve and dissect the suprapyloric lymph nodes.[6]

However, food stasis occurring in the early postoperative period is a problem related to this surgical technique. In many facilities, prolongation of hospital stay due to the fasting period required for the treatment of postoperative food stasis has been considered a drawback of this technique.[7–10] When metastasis to the suprapyloric lymph nodes was examined in 1,672 patients with T1 (M, SM) cancer located in area M, the metastasis rate was 0.5%, and such metastasis was always

accompanied by the involvement of lymph nodes of the lesser curvature side (No. 3).[11] We perform the rapid intraoperative cytology for No. 3 lymph nodes and suprapyloric lymph nodes (No. 5) to facilitate blood flow from the right gastric artery to the pyloric antrum and to preserve the pyloric branch of the vagus nerve. In addition, metastasis to No. 5 lymph nodes occurs at a frequency of about 50% under usual conditions, and its location is to the left of the right gastric artery. We perform aggressive dissection of lymph nodes on the left of the right gastric artery, while the right gastric artery is preserved to maintain blood flow into the pyloric antrum. We also maintain blood flow into the pyloric antrum by preserving the subpyloric artery to prevent food stasis in the stomach.

Patients are informed of the advantage of this surgery, namely, that preservation of the pyloric ring allows proper food retention in the stomach, good digestion, absence of bile gastritis due to the lack of bile regurgitation, practically elimination dumping syndrome.[12] On the other hand, patients are given the following negative information: the remaining stomach holds the ability to secrete gastric acid, possibly inducing reflux esophagitis, and food stasis occurs in an early postoperative period in about 5% of patients. Such food stasis is usually eliminated spontaneously in 3 postoperative months, and patients are instructed to eat carefully during this period. The only advantageous side of surgery with reduced resection may be anticipated, but the need to overcome the negative side of surgery should be fully explained to the patient. Otherwise, the patient may be forced to lead a dissatisfying postoperative life accompanied with a variety of life-long obstacles without prior knowledge of them.

Advantages and disadvantages of laparoscopic gastrectomy

The most prominent weakness of laparoscopic surgery characterized by its minimally invasive nature is that the patient may suffer more severe trauma than expected once a complication occurs. Therefore, when performing laparoscopic surgery, it is necessary to clearly understand its advantages and disadvantages, its possible complications, and how to treat such complications, and it is also important to explain these issues to patients.

The advantages of laparoscopic surgery include the following: 1) it provides magnified vision of small blood vessels and nerves, allowing more accurate and fewer hemorrhagic operations; 2) it requires less manipulation of the intestinal tract[13] (the period of postoperative bowel paralysis is shorter, and the long-term incidence of ileus is low);[14] and 3) it creates only a small surgical wound, enabling the patient to recover rapidly from postoperative pain. Its disadvantages include: 1) the need for technical skills that may not be available in every medical facility; 2) interference from bleeding (if bleeding occurs, it is difficult to secure the visual field, and hemostasis may be difficult); 3) it is difficult to have an overall vision; and 4) anastomosis within a narrow visual field is likely to be complicated.

Complications peculiar to laparoscopic surgery are not many. Although thrombus formation due to pneumoperitoneum was previously reported, recent studies have shown that laparoscopic surgery is associated with less frequent thrombus formation.[15] The adverse effects of insertion of a trocar port are also known. However, currently there are hardly any injuries to organs or blood vessels as a result of the improvement of trocars. If laparoscopic surgery is indicated for advanced cancers, it may be necessary to solve the problems of scattering of tumor cells by pneumoperitoneum, implantation of tumor to the trocar site, etc. When surgical complications occur after laparoscopic surgery, the patient may suspect that the use of laparoscopy is responsible. It is necessary to obtain the patient's consent after providing comprehensive information on the fact that complications of laparoscopic surgery are not different from those of usual laparotomy.

Indication range of laparoscopic gastrectomy

The indications of laparoscopic gastrectomy have been extended as the procedure has become more reliable. Formerly, the procedure was not applied to patients who had operative wounds in the abdominal region, elderly patients, or obese patients. In contrast, nowadays patients are not necessarily excluded, regardless of whether they have a history of abdominal surgery,[16] are elderly,[17] or are obese.[18] However, when the patient has a history of surgery that involved lymph node dissection or a history of at least two laparotomies, it is unclear whether laparoscopic surgery should be employed. We need to bear in mind the importance of adopting laparotomy

Table 2 Complications of laparoscopic surgery for gastric cancer in 2004 and 2005

	Distal gastrectomy	Proximal gastrectomy	Total gastrectomy
n	3,792	223	312
Bleeding	23 (0.6%)	2 (0.9%)	1 (0.3%)
Stenosis/blockage	129 (3%)	10 (5%)	4 (1%)
Suture failure	55 (2%)	13 (6%)	6 (2%)
Intraperitoneal abscess	17 (0.5%)	1 (0.5%)	1 (0.3%)
Pancreatitis/pancreatic fistula	35 (0.9%)	0	2 (0.6%)
Ileus	5 (0.1%)	0	1 (0.3%)
Respiratory complications	15 (0.4%)	1 (0.5%)	2 (0.6%)
Wound infection	40 (1%)	5 (2%)	1 (0.3%)
Shift to laparotomy	51 (1%)	5 (2%)	8 (3%)

(Cited from Japan Association for Endoscopic Surgery. Journal of Japan Society for Endoscopic Surgery. 2006;11:529–570.)

with a well-balanced view. In addition, there is a large difference between "laparoscopy can be used" and "laparoscopy should be used," and, therefore, it should be attempted to make full use of laparoscopy while taking advantage of this useful tool.

Problems involved in laparoscopic gastrectomy

According to a questionnaire survey, a total of 12,626 cases of gastric cancer were treated by laparoscopic surgery from 1991 to December 2005. In relation to the type of surgery, distal gastrectomy was most frequent, whereas D1 + α dissection was the most frequent type of dissection in 2003, whereas D1 + β dissection was most frequent in and after 2005. The number of cases with D2 dissection increased from 190 in 2003 to 278 in 2005. There was also an increase in the number of patients who underwent total gastrectomy.

Statistics of complications combined for 2004 and 2005 in relation to the type of surgery showed that none of the incidences of bleeding, intraperitoneal abscess, pancreatic fistula, ileus, respiratory complications, and wound infection were more than 2%, whereas the corresponding percentages for anastomosis-related complications such as suture failure and anastomotic stricture were 1–6%. These data indicate the difficulty of the anastomotic technique in laparoscopic surgery (**Table 2**).[2] Suture failure occurred in 2% of LADG cases, 6% of proximal gastrectomy cases, and 2% of total gastrectomy cases. In our department, laparoscopic gastrectomy has been employed in more than 500 cases, but suture failure occurred only in 2 cases of total gastrectomy, with no such cases occurring with other types of surgery. After the 2 cases of suture failure, we established a reliable anastomotic procedure by devising a better method of esophagojejunostomy through a trial-and-error process. Although the frequency of shift to laparotomy due to intraoperative accidental events is 2–3% in the national statistics, it is 0% in our department. Standardization of the procedure is extremely important to reduce complications.

Curability of laparoscopic gastrectomy

According to a report by the grant study group for cancer research from the Ministry of Health, Labor and Welfare (chief investigator: Seigo Kitano),[19] the 5-year recurrence-free survival rates after laparoscopic gastrectomy were favorable: at least 99% in cases of early gastric cancer and at least 90% in cases of advanced cancer (T2N0, T2N1). However, since the follow-up period in the above study was as short as 23 months, further data from future outcome studies are awaited.

Future Prospects of Laparoscopic Gastrectomy

The short-term and long-term results of LADG for early gastric cancer have been studied, and it

has gradually become apparent that it is a useful procedure for the treatment of such cancer. As of December 2008, a sufficiently large case series was about to be achieved in the JCOG 0703 study concerning the safety and usefulness of laparoscopy conducted by the Japan Clinical Oncology Group (JCOG), and scientific verification was underway. The most important issue is to ensure that basic LADG can be implemented safely nationwide. Namely, although LADG is the standard surgery for early gastric cancer in facilities that have an established surgical procedure, it is not yet generally regarded as the standard treatment because of its technical difficulties and the difficulty of anastomosis. Since the principle of standardization is being established, reinforcement of the education system for standardized procedures will be desirable in the future.

Future extension of indications as described in this paper is an issue in medical facilities with sufficient experience. It is needless to say that further clinical studies of high quality will be required, prior to extending the indications of laparoscopic surgery to patients with advanced gastric cancer, obese patients, those with a history of surgery, and elderly patients.

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