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Insight view of Laparoscopic Gastrectomy for Early Gastric Cancer Treatment

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ABSTRACT

Gastric cancer is the third most common cancer worldwide. Early gastric cancer (EGC) is an invasive gastric adenocarcinoma that invades no more deeply than the submucosa with or without lymph node metastasis irrespective of the tumor size. Gastric cancer may manifest in a variety of histologic, anatomic, and genetic patterns, which influences the surgical approach and requires a customized and multimodality treatment plan for each patient. Gastrectomy remains the treatment of choice for patients with early gastric cancer that are not suitable for endoscopic treatment or in the case of non-curative endoscopic resections. Over the last decade, laparoscopic gastrectomy has gradually gained popularity as a surgical option for distal early gastric cancer. Although an open surgical approach should be applied for any case with concerns of respectability 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. The aim of the current article to review the different surgical options for the treatment of EGC. As the indications are continued to expand to treat more advanced tumors and with the supporting data from the additional prospective studies to clearly define the ontologically appropriate application of laparoscopic gastrectomy.

Keywords: Early Gastric Cancer; open surgical approach; Laparoscopic Gastrectomy

Introduction

Gastric cancer (GC) ranks fifth for incidence and third for mortality among cancers worldwide. With over one million new cases and 782,685 deaths in 2018, GC accounts for 5.7% of all cancer incidence and 8.2% of total cancer mortality. Considering that death occurs in about 75% of new cases, it can be inferred that the case fatality rate is high **(1)**.

Gastric cancer can be divided into two broad clinicopathologic categories. The clinical concept of early gastric cancer was established in 1962 by the Japanese society of Gastroenterological Endosopy. Early GC, also known as surface or superficial GC, is defined

as carcinoma confined to the mucosa or submucosa, irrespective of lymph node status, and corresponds to pT1 of GC staging system **(2)**.

The term "early" is not linked to tumor size or shape or duration of the disease but is used to define GC at a possibly curable stage. Patients with early GC who undergo surgery have an average 5-year survival rate of 80–95% **(2)**.

Follow-up studies of Western patients diagnosed with high-grade dysplasia showed that 60–80% of high-grade dysplasia progressed to carcinoma within a very short mean follow-up time of 6 months. In other words, high-grade dysplasia was already carcinoma **(3)**.

The symptoms of gastric cancer are generally nonspecific and contribute to its frequently advanced stage at the time of diagnosis. Symptoms include epigastric pain, early satiety, and weight loss. These symptoms are frequently mistaken for more common benign causes of dyspepsia including PUD and gastritis. The pain associated with gastric cancer tends to be constant and non-radiating and is generally not relieved by eating. More advanced lesions may manifest with either obstruction or dysphagia depending on the location of the tumor. Some degree of GI bleeding is common, with 40% of patients having some form of anemia and 15% having frank hematemesis **(4).**

A complete history and physical examination should be performed, with special attention to any evidence of advanced disease, including metastatic nodal disease; supraclavicular (Virchow) or periumbilical (Sister Mary Joseph node); and evidence of intra-abdominal metastases such as hepatomegaly, jaundice, or ascites. Drop metastases to the ovaries (Krukenberg tumor) may be detectable on pelvic examination, and peritoneal metastases can be felt as a firm shelf (Blumer shelf) on rectal examination. Complete blood count, chemistry panel including liver function tests, and coagulation studies should be carried out **(4).**

The standard for the diagnosis of gastric cancer is endoscopic biopsy. Generally, the mass or abnormal mucosa is targeted for biopsy, although in the case of a malignant gastric ulcer, at least six to eight biopsies of the heaped-up edges of the ulcer and base should be performed **(Fig. 1)**. However, a recent study suggested that three to four biopsy samples are usually sufficient to diagnose advanced gastric cancer in gastric ulcers with 95% sensitivity **(5)**. The histological report must therefore provide information about a possible *Helicobacter pylori* infection, gastritis staging, the histotype and the GC grading in the case of adenocarcinoma **(6).**

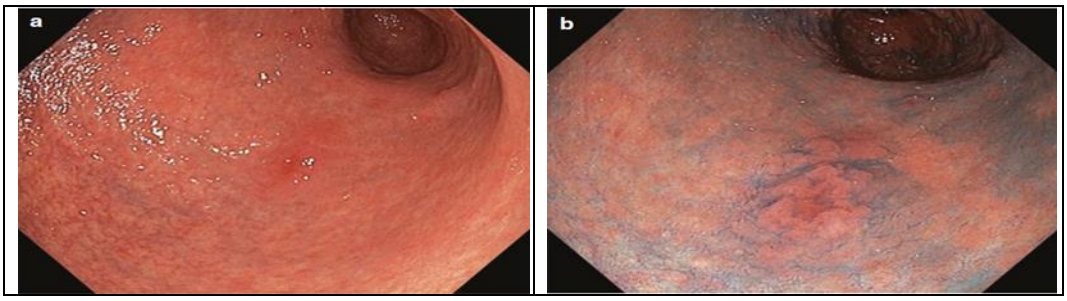

Fig. (1): High-grade dysplasia: (**a**) white light imaging; (**b**) chromoendoscopy **(6).**

Endoscopic ultrasound (EUS) performed prior to any treatment is important in the initial clinical staging of gastric cancer and can improve the diagnostic accuracy of stage T, particularly in discriminating T1a from T1b or T2 **(Fig. 2)**. It may be useful for evaluating the presence of abnormal or enlarged lymph nodes susceptible to cancer (N assessment), while not so necessary in

advanced forms (T3–T4 tumors) and to detect signs of spread, such as lesions in surrounding organs or the presence of ascites **(6).**

Computed tomography (CT) can easily assess for the presence of abdominal ascites, hepatic lesions, or adnexal metastasis. It is also useful in assessing for local invasion of the tumor into other organs or major vessels and aids in operative planning. The presence of major vascular or organ involvement may change operative management **(7).** One drawback of CT scan is the fact that it does not allow for the assessment of metastasis that are smaller than 5 mm. There could be peritoneal or liver disease under this size which would not be picked up on CT scan and would contraindicate surgical resection. In addition, 20–30 % of patients may have intraperitoneal disease upon surgical exploration that was not found on CT scan **(7).**

18Fluoro-deoxy-2-glucose (FDG) is the most widely used positron emission tomography (PET) radiotracer in cancer imaging. FDG, a radiotracer analogue of glucose, is injected into the body, and imaging acquisition with positron emission tomography-computed tomography (PET/CT) will reveal FDG distribution that reflects glucose usage in the body. **(7).** PET may be an effective modality for monitoring response to these therapies, sparing unresponsive patients further toxic treatment **(Fig. 4)**. Additionally, in a study of patients with locally advanced tumors (T3/4) or N-positive on EUS, PET/CT was able to detect occult metastases that were missed on regular CT in 10% of patients **(8).**

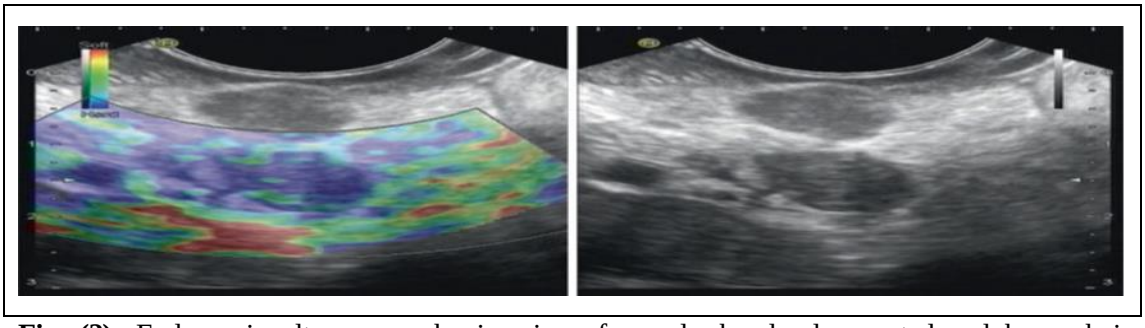

Fig. (2): Endoscopic ultrasonography imaging of round, sharply demarcated and hypoechoic malignant lymph nodes, also evaluated by elastography **(6).**

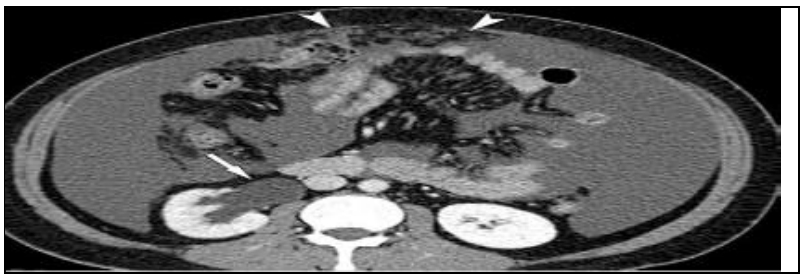

Fig. (3): Peritoneal metastasis in a 40-year-old woman with stomach cancer. **(7).**

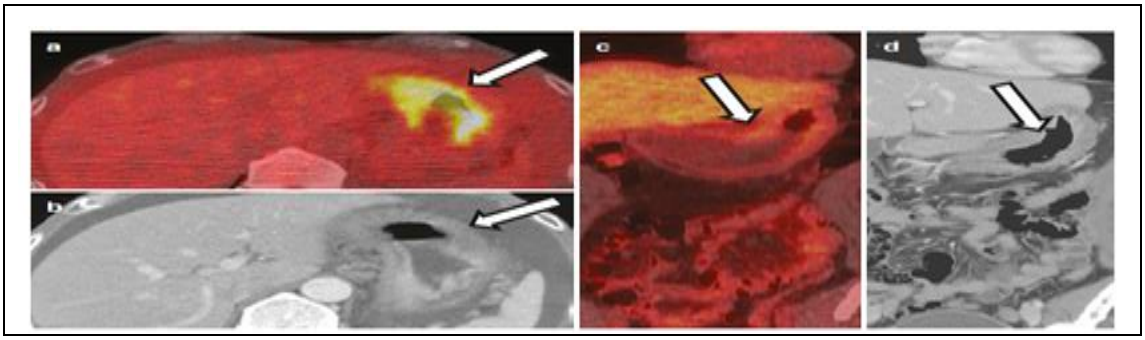

Fig. (4): Variability of FDG uptake according to histologic subtype. (**a**, **b**) PET/CT and CT images of intestinal-type gastric cancer with intense FDG uptake. (**c**, **d**) Mild FDG uptake is seen in the signet ring cell-type gastric cancer **(7).**

Staging Laparoscopy:

The first report on the use of laparoscopy to stage gastric cancer dates back to the 1980s. In this study, Popova et al. found that laparoscopy could have prevented 42.5% of 193 gastric cancer patients from having to undergo unnecessary laparotomy **(6)**. Nowadays, staging laparoscopy is a recommended step of the preoperative work-up in most of the published guidelines. Its main role is to detect the presence of peritoneal involvement for which CT scan displayed low accuracies **(6).**

The NCCN guidelines recommend that patients suspected of having subserosal (T3) or nodal involvement, be evaluated for staging laparoscopy with peritoneal cytology. This has the benefit of identifying metastatic disease in a large portion of patients without the use of laparotomy. Thus, patients who appear resectable but have occult disease are spared the morbidity of a laparotomy. In addition, the diagnosis of metastatic disease is diagnosed in a minimally invasive way, which allows patients who would benefit from chemotherapy to begin treatment without significant delay **(7).**

Laparoscopic peritoneal lavage for peritoneal cytology is a routine step in staging laparoscopy, as it allows the surgeon to identify microscopic spread in the absence of detectable dissemination **(Fig. 5)**. Currently, peritoneal cytology status is an integral part of the TNM staging system. Peritoneal lavage consists of the instillation of 250 mL of physiological saline into the abdominal cavity, which is subsequently aspirated. The lavage fluid can be analyzed by standard cytology or real-time polymerase chain reaction **(6).** In the 7th edition of the AJCC staging manual, positive peritoneal cytology is considered M1 disease, which would contraindicate surgical resection. In addition, these patients may have prolonged survival with chemotherapy, which should be offered to these patients instead of surgery **(7).**

The use of staging laparoscopy spared these patients a nontherapeutic laparotomy. In addition, when compared to patients who underwent noncurative laparotomy, there was a lower rate of in hospital mortality and shorter length of hospitalization. The findings show that a large portion of patients who appear resectable will be upstaged to metastatic disease and are not candidates for curative resection **(2).**

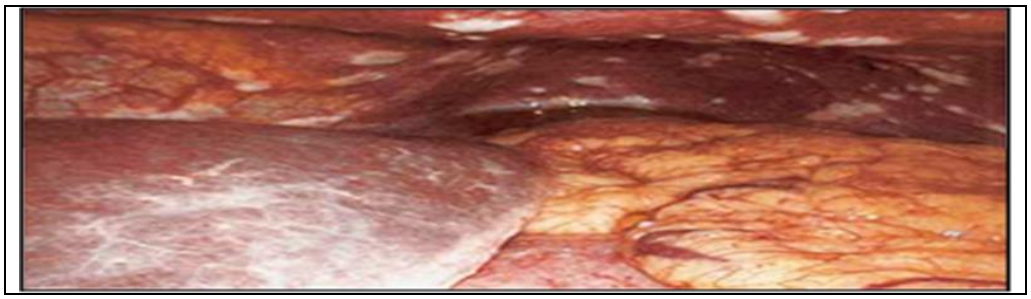

Fig. (5): Laparoscopy of Gastric cancer showing peritoneal metastasis not detected on CT abdomen **(9).**

Endoscopic Treatment

The early detection of gastric cancer is now well established all over the world. In Japan, more than 80% of cancers are diagnosed at an early stage, while in the West gastritis-like cancer lesions are still missed during routine endoscopy due to their lower incidence. In the East, most early cancers are treated by endoscopy **(1)**.

The indications of EMR/ ESD depend on the tumor diameter and depth of tumor invasion and tumor grade as was reported in diagnostic mucosal biopsy. The Paris Endoscopic Classification was developed for the systematic evaluation of superficial lesions in the GI tract with importance in clinical application as it enables estimation of the depth of the invasion **(2)**.

Superficial neoplasms are defined as those extending through the mucosa and submucosa of the digestive tract, are usually asymptomatic, and often represent incidental findings on endoscopy. These lesions can be polypoid or non-polypoid **(Fig. 6)**. Polypoid lesions are those that protrude into the lumen of the digestive tube (Paris 0-I) and can be pedunculated (0-Ip), sessile (0-Is), or semi-pedunculated (0-Isp). Non-polypoid lesions include flat lesions (0-II) and ulcerative lesions (0-III). Flat lesions, depending on the level of surrounding mucosa, can be elevated (0-IIa), at mucosal level (0-IIb), or depressed (0-IIc). The prefix "0" in the classification indicates a superficial lesion **(2,10)**.

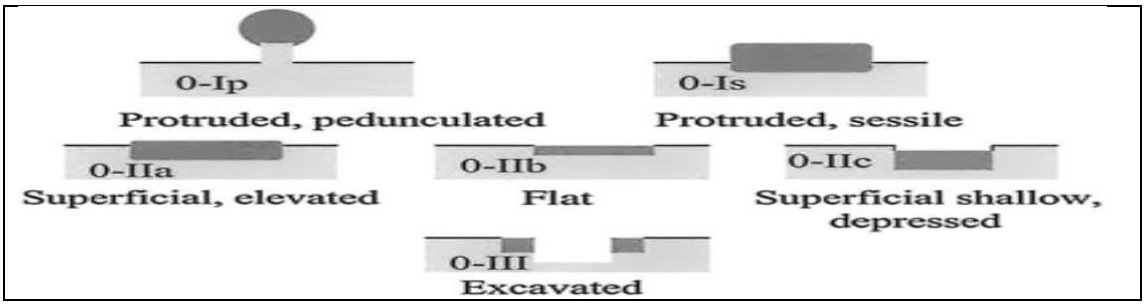

Fig. (6): Schematic representation of the major variants of type-0 neoplastic digestive lesions: polypoid (Ip and Is), nonpolypoid (IIa, IIb, and IIc), nonpolypoid and excavated (III) (10).

EMR technique has two major limitations: resection size is limited by the diameter of the snare, and the margins of the cut are unpredictable, because of slipping of the snare on the target lesion when it is fastened tightly for the resection. Incomplete resections were evident after EMR procedures **(6)**. ESD which can allow en bloc resection regardless of the tumor size is now standard option **(Fig. 7)**. When the tumor does not meet several pathological factors, the resection is finally valued as "non-curative" resection, and then recommended to undergo surgery **(3)**.

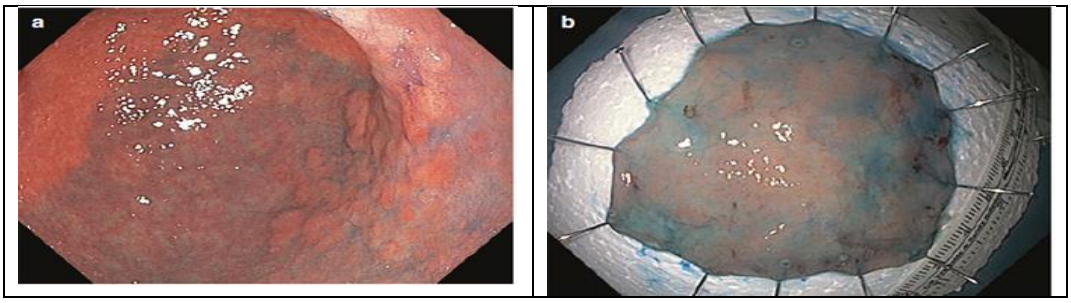

Fig. (7): (a) T1a differentiated-type adenocarcinoma without ulcerative findings. (b) Endoscopic specimen (6).

Recently, a scoring system called as "eCura system" for decision making in patients with non-curative ESD has been established using large-scale retrospective study. This scoring system predicted cancer-specific survival in patients who did not meet the curative criteria. ESD without additional treatment may be an acceptable option for patients at low risk, especially elderly patients **(3)**.

Table (1): new concept of Japanese guidelines:

Endoscopic curability A (eCuraA),	When "absolute indication" is confirmed in the specimen together with clear margins and no lymphovascular invasion.
Endoscopic curability B (eCuraB),	In cases of "expanded indication" together with clear margins and no lymphovascular invasion.
Endoscopic curability C (eCuraC):	All the other cases in which gastrectomy, in patients fit for surgery, is indicated.

Curative resection is defined when the lateral and vertical margins of the specimens are free of cancer and no lymphatic invasion or vascular involvement are detected. Noncurative resection includes those which do not meet the curative criteria or T1b cancers or when poorly cohesive/ signet ring cell or undifferentiated carcinoma is found (6).

While reporting an EMR/ESD specimen, pathologists should follow a synoptic reporting system including the following parameters: 1. Number and size of the specimen. 2. Histological type and layers of the wall present. 3. Grade of dysplasia (low- or high-grade) and tumor differentiation. 4. Vascular and perineural involvement. 5. Status of the resected margin, which has been inked, should be evaluated. 6. Depth of invasion. 7. Ancillary investigations to do: immunohistochemistry, special stains, and molecular studies as indicated **(7)**.

All patients with curative resection who met the traditional criteria were followed up by annual upper gastrointestinal endoscopy in order to detect local recurrence and/or metachronous gastric cancers **(12)**. The 5-year survival rate was 92% in patients with traditional criteria group and 93% in the expanded criteria group. There was no significant difference in overall survival between both groups **(7)**.

Surgical treatment

Gastrectomy with lymph node dissection had been the gold standard for treatment of EGC in Japan **(11)**. Outcomes of surgical resection for early stage of gastric cancer are quite good, with a greater than 90% 5-year overall survival, even without adjuvant chemotherapy or radiotherapy **(13)**.

The fundamental goal of cancer surgery is complete surgical resection of tumor, en bloc lymph node dissection, and careful hemostasis. If this goal is not achieved, cancer cells can be disseminated through broken lymphatics and vessels. The extent of gastric resection should be decided upon based on the location of tumor in the stomach and the safety resection margin so that microscopic tumors are not left in remaining stomach. The "no-touch" technique should be used during the entire procedure. The no-touch technique entails wrapping the primary tumor **(8)**.

Unnecessary manipulation and dissection should be avoided as mitogenic factors for wound healing could be produced in response to the surgery; these could stimulate the proliferation of undetected micrometastatic tumors that remained after surgery **(9)**.

- **Indicators of unresectability:**

The only widely accepted criteria of unresectability for gastric cancer are the presence of distant metastases, invasion of a major vascular structure, such as the aorta, or disease encasement or occlusion of the hepatic artery or celiac axis/proximal splenic artery. Distal splenic artery involvement is not an indicator of unresectability; the vessel can be resected en bloc with a left upper quadrant exenteration: stomach, spleen, and distal pancreas **(15)**.

The lymphatics around the stomach are rich, and the presence of locoregional lymph node metastases that are located geographically distant from the tumor (eg, celiac nodes with a primary

tumor on the greater curvature of the stomach) should not necessarily be considered an indicator of unresectability **(15)**.

In cases of advanced gastric cancer with direct infiltration of the spleen or pancreas, splenectomy or splenopancreatectomy are formally indicated in order to achieve a curative R0 resection . Total gastrectomy with splenectomy should be recommended for tumors that are located along the greater curvature or when a macroscopic involvement of stations 4sa or 10 is present." Spleen should be preserved in total gastrectomy for advanced gastric cancer of the upper stomach provided the tumor does not involve the greater curvature **(6)**.

- **Reconstruction after Gastrectomy:**

Common options for reconstruction after subtotal gastrectomy include a gastroduodenostomy (Billroth I); and antecolic or retrocolic gastrojejunostomy (Billroth II); or an antecolic or retrocolic Roux en y gastrojejunostomy. Other options also include intestinal interposition. A Roux-en- Y reconstruction has the advantage of being simple to construct with a greater likelihood for a tension-free anastomosis than a Billroth I, as well as avoiding the difficult problem of bile reflux associated with a Billroth II reconstruction, particularly if the length of the Roux limb is 40 cm or greater **(16)**.

Hofmiester method; the principle of this method is closure of about one half of the gastric outlet adjacent to the lesser curve and performing a gastrojujenal anastomosis at the side of the greater curvature with approximation of the jejunum to the entire end of the gastric remnant. The anastmosis may be performed antecolic or retrocolic (to the left side of the middle colic artery). This operation decreases the incidence of sudden over distention of the jejunum after eating, and also the incidence of biliary gastritis is less with this method of reconstruction **(17)**.

Proximal gastrectomy with jejunal pouch interposition (PGJP) has been advocated as an alternative operation for upper third gastric cancer proximal gastrectomy with jejunal pouch interposition for upper third gastric cancer is safe and is associated with a greater reduction in postgastrectomy symptom and better nutritional status compared with conventional total gastrectomy with Roux-en Y oesophagojejunostomy **(15)**.

- **Extent of lymph node dissection**

According to Japanese gastric cancer treatment guidelines: D1 lymphadenectomy refers to a limited dissection of only the perigastric lymph nodes (stations 1 to 7). a D1+ lymphadenectomy refers to a D1 lymphadenectomy plus stages 8a, 9, and 11p. D2 lymphadenectomy is an extended lymph node dissection, entailing removal of nodes along the hepatic, left gastric, celiac, and splenic arteries, as well as those in the splenic hilum (stations 1 to 12a). D3 dissection is a super-extended lymphadenectomy. The term has been used by some to describe a D2 lymphadenectomy plus the removal of nodes within the porta hepatis and periaortic regions (stations 1 to 16). Treatment guidelines published by the National Comprehensive Cancer Network (NCCN) recommend that gastric cancer resection include the regional lymphatics, including perigastric (D1) nodes as well as those along the left gastric artery, common hepatic artery, celiac artery, splenic hilum, and splenic artery (D2 lymph nodes), with the goal of examining 15 or more lymph nodes **(7)**. D2 lymphadenectomy is the standard of care for locally advanced gastric cancer according to most of the recent European guidelines **(18)**.

- ***Total versus partial gastrectomy:***

Total gastrectomy, which removes the entire stomach, is usually performed for lesions in the proximal (upper third) of the stomach, while partial gastrectomy (distal gastrectomy, subtotal gastrectomy) with resection of adjacent lymph nodes appears to be sufficient for lesions in the distal (lower two-thirds) of the stomach. Patients with large midgastric lesions or infiltrative disease (e.g., linitis plastica) may require total gastrectomy. In most series, quality of life after partial gastrectomy is superior to that after a total gastrectomy, at least in the short term **(19)**.

For cancers of the distal stomach, including the body and antrum, a distal gastrectomy is the appropriate operation. The proximal stomach is transected at the level of the incisura at a margin of at least 6 cm because studies have documented tumor spread as far as 5 cm laterally from the primary tumor, although some experts indicate that a 4-cm margin is adequate. Frozen section analysis should be performed before reconstruction. The distal margin is the proximal duodenum **(20)**.

Resection line involvement (RLI) in advanced gastric cancer is recognized as a significant negative prognostic factor **(6)**. RLI associated with the presence of one or more of the following features: remnant gastric cancer, esophageal invasion, tumor size >80 mm, undifferentiated tumor, macroscopic type IV, pT4 stage **(21)**.

With specific regard to proximal resection margins, the optimal length from the cranial margin of the tumor to be respected in order to avoid proximal RLI varies among the different international guidelines **(22)**. The Japanese guidelines report a 3-cm or 5-cm margin length for differentiated and undifferentiated tumors, respectively **(23)**. Of note the German guidelines were the first to recommend wider resection margins, 5 cm for intestinal and 8 cm for diffuse gastric cancer **(24)**.

The frozen section procedure is required when it is not possible to obtain a proximal resection margin as recommended by guidelines or in the presence of the risk factors for RLI reported above. Accuracy of a frozen section is high and reported to be more than 95% **(6)**.

The indication for reoperation for RLI in the case of locally advanced gastric cancer should be considered when tumor extension is limited, specifically in cases with limited nodal involvement. In cases of RLI, surgical reoperation only in patients with pN0 stage disease because only in this group did RLI affect prognosis **(25).**

In conclusion, in cases of proximal RLI after subtotal gastrectomy in patients with a subserosal tumor (pT2-3) and limited nodal involvement (pN0-1), with negative peritoneal cytology, a surgical reoperation is indicated. When the pathological stage of tumor is more advanced, a re-resection is not indicated as the long-term prognosis would likely not be affected by the RLI **(6)**.

- ***Open versus laparoscopic resection:***

Open gastrectomy remains the preferred surgical treatment for gastric cancer worldwide. In high-volume, experienced centers, however, laparoscopic gastric resection provides an alternative that offers patients a faster recovery and fewer complications while recovering a similar number of lymph nodes compared with open surgery **(26)**.

The best contemporary evidence for the short-term advantages of laparoscopic, as compared with open, gastric surgery in prospective randomized trials includes the following: Laparoscopic gastrectomy is most commonly performed for early gastric cancers in patients who are not candidates for endoscopic resection **(27)**.

Laparoscopic distal gastrectomy has also been used to treat more advanced gastric cancers,

which require more extensive lymph node dissection **(7)**. The laparoscopic approach for early gastric cancer is widely accepted **(28)**.

Comparing open and laparoscopic subtotal gastrectomy in advanced gastric cancer have provided relevant data; the R0 resection rate was high with both the approaches, with a reduction of the complication rate in the laparoscopic group. With regards to lymph node retrieval, no differences were shown between laparoscopic and open surgery **(25)**.

Laparoscopic Distal Gastrectomy

The KLASS-01 (Korean Laparoscopic Gastrointestinal Surgery Study) multicenter trial—involving 1416 patients from 13 different Korean institutes showed a significantly lower incidence of postoperative surgical complications in the laparoscopy group compared to open surgery (13.7% vs. 18.9%, respectively). When analyzing more in detail the type of complications, the only one that showed a statistically significant difference was wound infections, with 3.6% in the laparoscopic arm and 7.0% in the open surgery group. This evidence and the lower surgical stress associated with laparoscopy are likely the main causes of the reduced length of stay of almost one day in laparoscopically treated patients (LDG 7.1 ± 3.1 vs. ODG 7.9 ± 4.1, $p < 0.001$) **(6)**.

LDG compared to ODG showed a reduced estimated blood loss but a higher intervention time. Regarding mortality and re-intervention rate, no differences were demonstrated between the two surgical approaches **(27)**.

Recently, the long-term oncological results of these two large-scale multicenter randomized controlled trials were published. The KLASS-01 trial showed that there are no significant differences in terms of overall survival (94.2% in the LDG group and 93.3% in the ODG group, $p = 0.64$) and cancer-specific survival (97.1% in the LDG arm and 97.2% in the ODG arm, $p = 0.91$) after five years of follow-up **(28)**.

Based on this strong evidence, LDG proved to be a safe alternative to open surgery for stage I distal gastric cancer when performed by experienced surgeons. LDG seems to be comparable to ODG in terms of surgical and oncological safety **(6)**.

Laparoscopic Total Gastrectomy has proven to be a complex procedure that can be particularly demanding due to the technical issue of esophagojejunal anastomosis, so concerns still exist regarding the surgical safety of the procedure **(6)**.

Robotic Surgery

Robotic gastrectomy (RG) was introduced with the aim of overcoming some disadvantages of standard minimally invasive surgery such as the lack of three dimensional and magnification views of the operating field, involuntary tremor, and straight forceps that do not allow great freedom of movement **(6)**.

Currently, robotic surgery is not reported by the international guidelines as a standard for the treatment of gastric cancer. This is due to a lack of evidence supporting robotic surgery in this setting, given that the studies available so far are mostly retrospective studies with small cohorts of patients. Meta-analyses have shown no clear advantages of robotic surgery over laparoscopic surgery in terms of both short- and long-term outcomes **(29)**.

A single-arm prospective study by Uyama et al. found a better morbidity rate (Clavien-Dindo grade ≥IIIa) in 330 patients who underwent RG compared with historical controls (laparoscopic gastrectomy) (2.45% RG vs. 6.4% laparoscopic gastrectomy, $p = 0.0018$). Notwithstanding the limits of such a comparison, RG was approved for national medical insurance

coverage in Japan after publication of this study **(29)**.

Kim et al. demonstrated how, in spite of an increase in costs and operation time, no significant improvements were observed in estimated blood loss, rates of open conversion and postoperative outcomes with the robotic compared to the laparoscopic approach **(28)**.

Laparoscopic surgery for gastric cancer

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. The first laparoscopic wedge resection for gastric cancer was carried out by Ohgami et al. who performed an intragastric mucosal resection for a patient with EGC in 1992. The aim of both procedures was to minimize the extent of gastric resection therefore to reduce the accompanying physiologic side effects by the standard gastrectomy **(30)**.

The first laparoscopic gastrectomy, with a Billroth II reconstruction, for cancer was performed by Kitano et al in 1992 and published in 1994. Subsequently, several authors have reported successful laparoscopic subtotal or total gastrectomy, demonstrating the important postoperative advantages of this procedure, that include, less postoperative pain, better cosmetic results, shorter hospital stay, and early recovery **(31)**.

Function-preserving surgery, such as pylorus preserving surgery, proximal gastrectomy, and segmental gastrectomy has been also successfully performed by laparoscopy. 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 **(32)**.

Laparoscopic 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 **(31)**.

- ***Contraindications for Laparoscopy:***

There are few absolute contraindications to laparoscopy. The unique contraindication for patients with gastric cancer is the presence of metastatic disease, unless a staging laparoscopy or palliative procedure is planned. Uncorrected coagulopathy or inabilities to tolerate general anesthesia or laparotomy remain absolute contraindications. Relative contraindications include extensive previous surgery, previous peritonitis, severe cardiopulmonary disease and tumour size that would preclude its safe handling. Typically, the surgeon with his experience and expertise with laparoscopy helps to dictate which patient should be offered to laparoscopic approach **(30)**.

Abe and his colleagues in 2005 introduced laparoscopic lymph node dissection (LLND) after Endoscopic submucosal dissection (ESD). The combination of ESD and LLND enables the complete resection of the primary tumor and the histologic determination of lymph node status. This combination treatment is a potentially minimal invasive method, and may obviate unnecessary gastrectomy without compromising curability for EGC patients. Standard gastrectomy with extended lymph node dissection is indicated for patients if LLND reveals LN metastasis **(33)**.

There are three types of laparoscopic gastrectomies used to treat later stage gastric cancer:

totally laparoscopic procedure, laparoscopic assisted procedure and hand assisted laparoscopic procedure. Laparoscopic distal, proximal and total gastrectomy are performed according to the location of the tumour and depth of invasion, as in open surgery **(31)**.

Laparoscopy-assisted surgery has been widely performed in reconstruction in which the intestine is pulled out of the body through a small laparotomy wound. Reconstructive methods have included laparotomy, Billroth-I reconstruction, and Roux-en-Y reconstruction. Recently, great improvement in anastomosis devices and modifications in various anastomotic techniques have enabled esophagojejunostomy, anastomosis between the esophagus and remnant stomach, Billroth II and even Roux-en-Y reconstruction to be done totally laparoscopic **(34)**.

The most popular version of laparoscopic gastrectomy is laparoscopic- assisted gastrectomy (LAG), where in the lymph node dissection is completed under the laparoscope. An epigastrium auxiliary incision is then made to facilitate the excision of the specimen and the reconstruction of the digestive tract. Another version is the totally laparoscopic gastrectomy (TLG), which is characterized by an intracorporeal anastomosis without auxiliary incision and no touching of the tumor; it is considered "incisionless", with the exception of the trocar wounds. However, given the safety concerns associated with laparoscopic reconstruction of the gastrointestinal tract, many surgeons choose to continue performing LAG, while the TLG operation remains less well developed **(34)**.

It should be noted that the inclusion of the auxiliary incision in LAG makes it divergent from the minimally invasive treatment concept pursued in laparoscopic surgery. Furthermore, reconstruction through the small incision also has disadvantages, such as a potentially challenging specimen extrusion, contamination via the incision, and excessive pulling on the residual stomach. On the basis of our extensive laparoscopic experience gained from LAG, laparoscopic distal pancreatectomy, and other laparoscopic operations, laparoscopic surgeons were encouraged to develop TLG for the treatment of gastric cancer **(30)**.

The methods of gastrointestinal anastomosis after laparoscopic distal gastrectomy are the same as standard laparotomy which include the Billroth I, Billroth II, and Roux-en-Y methods. The choice between these methods depends on the patient's condition and economic situation, and on the surgeon's operating habits **(35)**.

Laparoscopic Roux-en-Y reconstruction has been the preferred method to prevent reflux gastritis and esophagitis and to decrease the probability of gastric cancer recurrence. However, the procedure is complex and time-consuming, and the extensive use of endoscopic linear staplers can result in higher costs. The Billroth I reconstruction method has the advantage of technical simplicity, involving only one anastomotic site and maintaining physiological intestinal continuity. However, gastroesophageal and duodenogastric reflux are common sequalae **(6)**.

Additionally, this technique may have limitations in its use in that it may not be feasible in obese patients or in patients with large tumors in the low- to mid-stomach. For large tumors or tumor located toward the middle section of the stomach, the recommended treatment consists of a radical resection of the distal four-fifths of the stomach with a 5-cm free margin, which makes the Billroth I anastomosis unlikely **(36)**.

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 **(34)**.

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 **(34)**.

Conclusion:

Laparoscopic distal gastrectomy is very effective, safe with some advantages over open conventional gastrectomy in the treatment of gastric cancer.

Short term oncological outcomes of laparoscopic gastrectomy are acceptable. However, there is a need to develop well-designed, adequately powered, prospective, multicenter, randomized controlled trials, investigating LG with adequate long-term follow-up.

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