

Laparoscopic techniques and strategies for gastrointestinal GISTs

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Abstract: The laparoscopic approach is widely accepted surgical treatment for gastrointestinal submucosal tumors (SMTs). In this chapter, we will introduce laparoscopic techniques and strategy for gastrointestinal SMTs, in accordance with those for gastrointestinal stromal tumors (GISTs). The indication for a laparoscopic approach has been related to tumor size. The upper limit of tumor size has increased, according to recent trends, and there is no established guideline for a lower limit. All patients undergoing laparoscopic surgery receive preoperative examinations including gastrofiberscopy, upper gastrointestinal radiography, computed tomography (CT), and endoscopic ultrasonography (EUS). Gastric tumors <20 mm in diameter measured by EUS or CT are preoperatively localized by gastrofiberscopic clipping of the mucosa covering the SMT. While maintaining the principle of local resection with a negative resection margin, different surgical techniques are required depending on the location and configuration of the tumor. A single dose of a second-generation cephalosporin is administered to patients as a prophylactic antibiotic before or immediately after operation. If a patient undergoes wedge resection, a semi-bland diet will be provided within 48–72 hours. However, in cases of proximal or distal gastrectomy, the diet will be restricted for several days. A “no-touch” technique, by which the risk of tumor dissemination can be minimized, includes grasping the surrounding tissues, holding the threads sutured at the normal serosa around the tumor, and using a laparoscopic stapler or bag during laparoscopic resection.

Keywords: Laparoscopic; submucosal tumor (SMT); gastrointestinal stromal tumor (GIST)

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Introduction

Laparoscopic surgery has been widely accepted in all surgical fields, since laparoscopic cholecystectomy was introduced in the late 1980s (1). Surgical treatment for gastrointestinal submucosal tumor (SMT) has not been excluded from this trend. Laparoscopic wedge resection has been a widely accepted procedure for SMTs of stomach (2). Additionally, laparoscopic surgery has been feasibly performed for SMTs of small bowel, even though this procedure is rarely applied due to the low prevalence (3).

However, as we perform laparoscopic surgery for an SMT of gastrointestinal tract, the possibility of gastrointestinal stromal tumor (GIST) should be considered at all times. GISTs sometimes show malignant behavior and account for a considerable portion of gastrointestinal SMTs. Therefore, surgeons should focus on certain principles when laparoscopic surgery is used for SMTs presenting with features of GISTs, even though GISTs are mostly confirmed by postoperative pathologic examination. In this chapter, we will introduce laparoscopic techniques and strategy for gastrointestinal SMTs, in accordance with those for GISTs.

Patient selection and work up

Patient selection

The indication for laparoscopic approach has been related to tumor size. In case of gastric SMTs, the limitation of tumor size for laparoscopic surgery has traditionally been considered “diameter not more than 2 cm,” but it has become larger based on the recent evidences. In 2006, Otani *et al.* (4) reported that laparoscopic surgery had been feasibly performed for SMTs up to 5 cm in diameter. Moreover, some researchers also reported their experiences of laparoscopic surgery for larger SMTs (>5 cm, but <10 cm) (5,6). This limit regarding tumor size is expected to be higher in the near future. With respect to this issue, the current guidelines do not state an absolute indication regarding tumor size (7,8). In addition, there is no lower limit on tumor size. Actually, in our institute, the indications for laparoscopic surgery include the relatively small SMT (<10 mm in diameter and definitely visible by endoscopy), regardless of symptoms (9).

Meanwhile, with regard to SMTs at small bowels, a size limit for laparoscopic approach has not been established. Unlike the stomach, as these organs are mainly composed of tubular structures, laparoscopic manipulation can be easily performed (10). For example, even if we encounter a large jejunal or ileal tumor, this condition may be controlled by manipulating the nearby segments. However, duodenal SMTs require some considerations regarding tumor size, since the 2nd portion of duodenum correlates with the surrounding structures (i.e., biliary or pancreatic duct).

Work up of the selected patient

All patients undergo preoperative examinations to clarify the clinical diagnosis. Preoperative data include the tumor size, location, growth pattern, and the presence of metastasis is determined through the combined evaluation using gastrofiberscopy, upper gastrointestinal radiography, endoscopic ultrasonography (EUS), and computed tomography (CT). Endoscopic biopsy or EUS is performed only when clinically indicated.

Pre-operative preparation

Before operation, tumors <2 cm in diameter measured on CT or EUS are localized by gastrofiberscopic clipping of the mucosa covering the SMT. With respect to small gastric SMTs, the general information regarding tumor

characteristics (e.g., location and shape of tumor) are intuitively provided by CT gastrography, in which virtual gastroscopy and surface-shaded volume rendering techniques are included (9).

After general anesthesia is induced, the patient is placed in the supine position, with his or her legs abducted. At first, a scope port is established on the umbilical area, and pneumoperitoneum is made by carbon dioxide infused through the scope port, with an insufflation pressure of 12 mmHg. Then, a flexible or 30-degree rigid scope is inserted through this port. After we performed diagnostic laparoscopy, two ports are additionally established on the upper abdomen to allow identification of the tumor location and to apply a laparoscopic linear cutter. The operator surgeon is usually positioned on the right side of the patient, with the scopist positioned between the patient's legs, managing the scope. An assistant surgeon can be additionally positioned on the left side of patient.

Procedure

In general, the principle of surgical treatment for GISTs is local resection with a negative resection margin (2). Laparoscopic surgery is no exception to this general principle. In addition, according to the location and configuration (i.e., exophytic versus endophytic) of tumor, the different surgical techniques are requested.

Anterior wall of stomach

Exogastric approach is predominantly applied for exophytic tumors at the gastric anterior wall (2). In this condition, we can isolate the tumor by manipulating the surrounding normal tissue with laparoscopic instruments (11). Then, to acquire the oncologic safety margin, laparoscopic linear stapler should be applied to the normal tissue of stomach (*Figure 1*). If the gastric wall is excessively resected, this procedure can result in deformity or stenosis of the gastric lumen (2). Thus, laparoscopic linear stapler should be applied perpendicularly to the longitudinal axis of the stomach (11).

Recently, eversion method, another technique to prevent stenosis, has been introduced (12). When a large endophytic SMT is located at the gastric anterior wall, it is difficult to trace the tumor in the serosal surface. In this situation, eversion method involves a gastrotomy, through which the tumor can be everted out of the stomach. Then, laparoscopic linear stapler is applied to the stalk of the everted tumor. Simultaneously, the gastrotomy can be closed with the linear

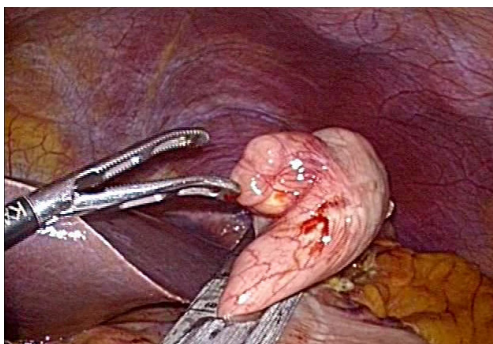


Figure 1 Exogastric approach for the tumor at anterior gastric wall.

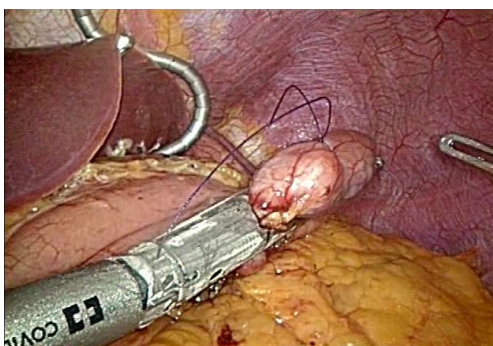


Figure 2 Exogastric approach for the tumor at posterior gastric wall.

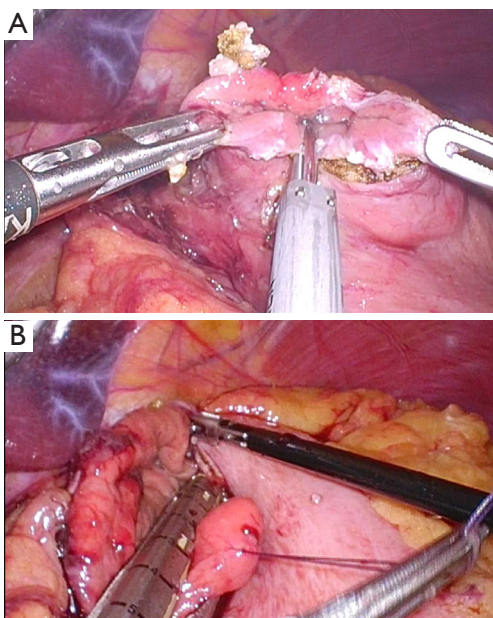


Figure 3 Transgastric resection for the tumor at posterior gastric wall. (A) Gastrostomy on anterior gastric wall; (B) resection of tumor with laparoscopic linear stapler.

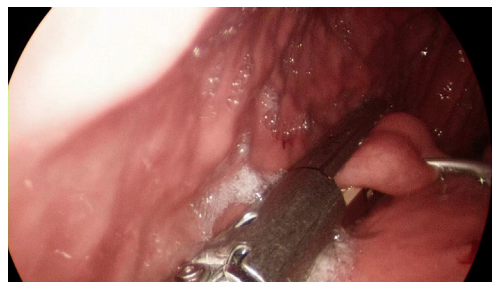


Figure 4 Intra-gastric resection of the tumor at posterior gastric wall. Courtesy of Sang-II Lee, Department of Surgery, Chungnam National University School of Medicine.

cutter. At this time, the gastrostomy should be made near the point at which the tumor is expected to locate. In addition, as for exogastric approach, the direction of laparoscopic stapler should also be perpendicularly arranged to the longitudinal axis of the stomach.

Posterior wall of stomach

If SMTs are located at the gastric posterior wall, the appropriate approach is adopted according to whether the tumor is exophytic or endophytic. If it is possible to mobilize and rotate the stomach, the exogastric approach can be applied for an exophytic lesion (*Figure 2*) (13). However, an endophytic lesion mostly requires the more complex approaches, since the tumor localization is not easy during laparoscopic surgery. In general, either transgastric or intra-gastric approach can be applied.

As shown in *Figure 3*, transgastric approach is to resect the tumor through an anterior gastrotomy (14). This gastrotomy can be closed by either hand-sewing or stapling (The direction of stapling line should be arranged perpendicularly to the longitudinal axis of the stomach).

The intra-gastric approach is to resect the tumor with laparoscope and instruments inserted into the gastric lumen (*Figure 4*) (15). In order to prevent the retraction of trocar, balloon trocar is recommended for use in this method (16). Recently, several surgeons reported single-incision intra-gastric approach (15). In this procedure, the stomach is brought out and incised through a single umbilical incision, which is kept open with a wound retractor. Then, the tumor is manipulated and resected via a commercial 4-holes single port inserted through the gastrotomy.



Figure 5 Laparoscopic techniques and strategies for gastrointestinal GISTs (19).

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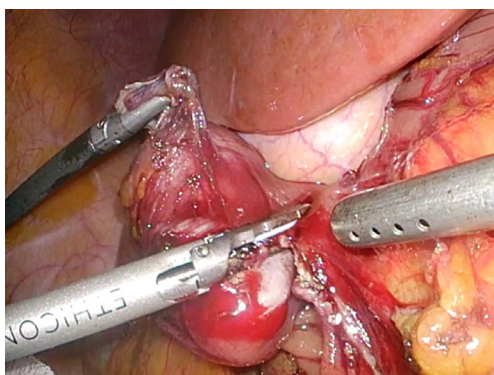


Figure 6 Wedge resection of the tumor at the 2nd portion of duodenum.

Lesser curvature/prepyloric antrum of stomach

When SMTs are located at the lesser curvature or prepyloric antrum, laparoscopic wedge resection is challenging procedures (2). As these areas characterized by the low distensibility, postoperative stenosis of the gastric lumen may occur. In addition, there is a risk of vagus nerve injury, which can induce delayed gastric emptying or functional gastric outlet obstruction (2,11). With these reasons, many surgeons prefer full-thickness resection of the tumor without laparoscopic stapler (2). In this method, gastric wall should be closed by hand sewing. Distal gastrectomy can be considered unless stenosis or deformity can be avoided.

Esophago-gastric junction (EGJ)

Laparoscopic surgery for SMTs at EGJ is also technically demanding procedure. If the lesion shows a malignant

potential, invasive approach is sometimes required (2). In other words, radical surgery is rather safer than wedge resection, because the attempt to get an adequate resection margin can result in stenosis of EGJ. With this reason, in several institutes, total gastrectomy has been performed for EGJ tumors. Even if laparoscopic proximal gastrectomy was introduced in 1990s (17), most surgeons have avoided this procedure on account of late complications, such as reflux esophagitis or stricture, regarding esophago-gastrostomy (2). Double tract reconstruction is one of the potential solutions for this issue. Recently, Ahn *et al.* (18) reported that less reflux and stricture are showed after laparoscopic proximal gastrectomy with double tract reconstruction.

Nevertheless, for most SMTs including GISTs, proximal gastrectomy is also excessive procedure. Intra-gastric or transgastric approach is a useful option for benign or even some malignant lesions (*Figure 5*). In addition, for certain benign lesion, laparoscopic enucleation can be a good solution to prevent stenosis of EGJ (20).

Small bowel

Meanwhile, SMTs of small bowel is resected extracorporeally or intracorporeally based on the surgeon's preference. When wedge resection is tried for a duodenal tumor (*Figure 6*), it is important not to involve the papillary region. In addition, gastrojejunostomy is often necessary, as duodenum is also risk of postoperative stenosis. In case of jejunal or ileal SMT, extracorporeal resection is easily performed through an umbilical port wound even though the tumor is large (3,11). However, it is important to avoid the iatrogenic spillage of tumor cells during the whole time of laparoscopic surgery. In addition, when the tumor invaded to the adjacent organ, conversion to open surgery should be considered.

Completion of laparoscopic surgery

After resection of tumor, the specimen is placed in a vinyl bag, which is delivered through the umbilical port wound that is slightly enlarged to accommodate the tumor. After hemostasis is achieved and integrity of the staple line is confirmed, the abdominal cavity is irrigated and the port wounds are closed.

Post-operative management

If the patient undergoes wedge resection, a semi-bland diet

will be provided within 48–72 hours. However, in cases involving proximal or distal gastrectomy, the diet will be restricted for several days.

Whether adjuvant chemotherapy is administered should be determined according to the postoperative pathologic report, in which the final diagnosis is also revealed. The final pathologic report includes the immunohistochemical staining profile, tumor size, tumor mitotic index, and resection margin status. The lesions in which the postoperative immunohistochemical staining is positive for CD117 (KIT) are diagnosed as GISTs, and mutation analysis for the c-KIT mutation is also performed (9). GISTs are divided into four groups according to the Risk Assessment Classification proposed by Fletcher *et al.* (21). Mitotic figures for all specimens are counted in 50 randomly selected high-power fields by the experienced pathologist.

Tips, tricks and pitfalls

As some GISTs carry malignant potential, we should always consider the possibility of intraperitoneal dissemination caused by manipulation of the tumor during laparoscopic approach (11). In most SMTs with benign features (i.e., lipomas leiomyomas, schwannomas, and granular cell tumors), laparoscopic approach cause little concern regarding peritoneal dissemination because those tumors seldom recur (22,23). However, since some SMTs are diagnosed as GISTs, there is a risk of high grade malignancy. Although most GISTs show an acceptable prognosis after laparoscopic surgery (24), such a favorable outcome cannot be expected in the patient who undergoing tumor rupture.

With regard to this issue, many surgeons take ‘tumor size’ into consideration, with an assumption that large tumors may require more manipulation than small, increasing the opportunity for dissemination. With this reason, laparoscopic surgery has been generally recommended for relatively small GISTs (i.e., diameter ≤ 2 cm) based on the GIST Consensus Conference in 2004 (25). However, the tumor size is not the only factor to decide the applicability of laparoscopic procedure. Regardless of size, open surgery may be necessary in highly vascular or fragile tumors, due to increased risk of tumor bleeding or rupture. Therefore, during laparoscopic surgery for SMT, it is desirable to handle the tumor without grasping it directly. This principle has been widely accepted, and we currently have several tips for manipulating the tumor without touching it. A “no-touch” technique, described in 2002, includes grasping

the surrounding tissues, holding the threads sutured at the normal serosa around the tumor, and using a laparoscopic stapler or vinyl bag (26). By applying these techniques in laparoscopic surgery, we can minimize the risk of tumor cell dissemination.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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