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Laparoscopic Intra-Gastric Resection of Gastric Sub-Mucosal Tumors under Oral Endoscopic Guidance

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Abstract

Introduction: A laparoscopic approach is often selected for resection of gastric submucosal tumor (GST), and several variations of this procedure have been reported. The approach selected greatly depends on the characteristics of the tumor, including its size or location, and also the experience and skill of the surgeon. Here we report our experience with intragastric resection of GSTs under oral endoscopic guidance.

Methods: We performed laparoscopic intragastric resection of GSTs in 13 patients. The criteria for this approach were a tumor less than 5 cm in diameter and 8 cm^2 in cross-section, and a tumor location on the posterior gastric wall in the upper and middle stomach or near the esophagogastric junction. Under general anesthesia, two or three ports were directly inserted into the stomach. Partial resection of the stomach including the tumor and an adequate margin in all directions was performed using a linear stapler. The resected specimen was retrieved orally using a plastic bag.

Results: Laparoscopic intragastric resection of GST was successful in all patients. The mean maximum tumor diameter was 27 mm. The mean operation time was 176 min, and intraoperative blood loss was minimal. One patient required a gastrostomy and enlargement of one of the port sites in order to remove the tumor. There was no intra- or postoperative complications. The mean postoperative hospital stay was 7.5 days. The diagnosis after pathological examination of the tumor was gastrointestinal stromal tumor in 8 patients, leiomyoma in 4 and a cyst in one in one. There were no recurrences during a mean follow-up period of 121.7 months.

Conclusion: A laparoscopic intragastric approach is well suited for patients who have a GST located in the upper and middle part of the stomach. It is anticipated that an oral endoscope will be used increasingly during laparoscopic procedures in the future.

Keywords: Laparoscopic treatment; Intragastric resection; Gastric submucosal tumor; Minimally invasive surgery; Stomach

Introduction

A laparoscopic approach is often selected for resection of gastric submucosal tumor (GST) because it yields outcomes similar to those of an open procedure. Curative surgical resection for GST means the confirmation of an adequate surgical margin around the tumor without lymphadenectomy. This can be achieved by a laparoscopic approach with minimal invasiveness. Several types of laparoscopic resection of GST have been reported, including exogastric, intragastric, transgastric, combined laparo-endoscopic methods, and proximal or distal gastrectomy. The selection of these methods greatly depends on the characteristics of the tumor including its size or location, and the experience and skill of the surgeon. We have previously described a technique for exogastric and intragastric resection of GST, and intragastric resection has been applied for tumors located on the posterior gastric wall or near the esophagogastric junction (EGJ) with intragastric growth [1-4]. After our experience with intragastric resection of GST, we adopted it for tumors located in the middle of the stomach. The use of an oral endoscope is necessary in order to perform safe intragastric resection of GST. Here we report our experience with intragastric resection of GST under oral endoscopic guidance.

Materials and Methods

During the past 20 years, we have performed laparoscopic resection of GST for 38 tumors in 34 patients (16 men and 18 women) with a mean age of 55.9 years (range, 34-83 years). An intragastric approach was used in 13 patents with 18 tumors (36.2%). These comprised 5 men and 8 women, with a mean age of 60.6 years (range, 34-83 years). The tumor was located on the posterior wall of the upper stomach in 6 patients, the posterior wall of the middle stomach in 5 patients, the lesser curvature of the upper stomach in 4 patients, the lesser curvature of the middle stomach in 2 patients and the greater curvature of the upper stomach in one patient. The mean distance from the oral side of the tumor to EGJ was 2.8 cm (range, 1.0-3.0 cm) for the tumors located in the upper stomach, and 6.0 cm (range, 5.0-7.0 cm) for the tumors located in the middle stomach (Table 1).

No.	Age	Gender	Location	Distance from the EGJ(cm)
1	61	M	Upper/Posterior	1
2	66	F	Upper/Posterior	1
3	64	M	Upper/Greater curvature	3
4	75	F	Upper/Posterior	3
5	70	F	Upper/Lesser curvature	3
6	71	M	Upper/Lesser curvature	2.5
7	52	F	Upper/Lesser curvature	3
8	69	F	Upper/Posterior	3
9	40	F	Upper/Posterior	3
			Upper/Lesser curvature	3
10	34	F	Middle/Posterior	6
11	61	M	Upper/Posterior	2.5
12	70	F	Middle/Lesser curvature	5
			Middle/Posterior	6
13	55	M	Middle/Lesser curvature	7

EGJ: Esophagogastric Junction

Table 1: Clinical data of intragastric resection.

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Preoperative evaluations

All patients were investigated preoperatively by means of an upper gastrointestinal radiological series as well as by endoscopy to assess the distance between the EGJ and the proximal side of the tumor. Endoscopic ultrasound was also performed to evaluate the size and location of the tumor within the stomach wall layers. Computed tomography with contrast medium was added to clarify whether there was any liver metastasis, dissemination, ascites or lymphadenopathy, as well as the relationship between the tumor and the whole stomach.

Indication

The initial criteria were a tumor diameter greater than 2 cm or an endoscopically evident tendency for the tumor to grow in size during follow-up, and a tumor location on the posterior wall of the upper stomach or near the EGJ. Subsequently, the criteria were extended to include a tumor location on the posterior wall of the middle stomach and a tumor less than 5 cm in size or 8 cm2 in cross-section [4].

Surgical technique

Under general anesthesia, the patient was placed supine, and a 12-mm port was initially introduced on the umbilicus using an open laparotomy technique. Carbon dioxide (CO2) insufflation was used to establish a pneumoperitoneum in the operative field, and the intra-abdominal pressure was maintained at 10 mmHg. The stomach was inflated by airflow via an oral endoscope. When an intragastric approach was used, the abdominal wall and the anterior wall of the stomach were fixed using a double-straight needle device (Ideal Lifting: Olympus Medical Systems Co., Tokyo, Japan). After this procedure, two or three ports (one 12-mm and one or two 5-mm ports) were inserted into the stomach via the left or right upper quadrant of the abdominal wall, depending on the tumor location, under the oral endoscopic guidance. Good visualization of the intragastric operative field was obtained using CO2 insufflation. Partial resection of the stomach including the tumor and an adequate margin in all directions was performed using a linear stapler so as not to cause any deformity of the stomach and EGJ. The linear stapler was first fired on the normal gastric wall near the distal side of the tumor. The direction of the cut line was modified so that it remained clear of the EGJ. The resected specimen was retrieved orally using a plastic bag. If the tumor could not be removed orally, a gastrostomy was created by enlarging one of the port sites. The resected specimen was investigated immediately to ensure free pathologically margins. The two or three port holes in the stomach were closed with an extracorporeal suture or intracorporeally using an Endo GIA or hand-sawing. After repair of the port holes, the stomach was re-inflated to confirm hemostasis. The laparoscope was used to check for leakage from the closed sites, and the gastroscope was used to exclude stenosis at the EGJ.

Postoperative evaluation

For postoperative evaluation of the patency of the EGJ and the shape of the residual stomach, all patients underwent an upper gastrointestinal radiological series on postoperative day 1 as well as gastroscopy every 6 months thereafter.

Results

In all 13 cases, laparoscopic intragastric resection of the GST was successful. The surgical data are shown in table 2. The mean maximum diameter of the tumor was 27 mm (range, 10-65 mm). The mean operation time was 176 min (range, 109-217 min), and the intraoperative blood loss was minimal. One patient needed a gastrostomy and enlargement of one of the port sites in order to remove the tumor. There was no intra- or postoperative complications. Oral intake was re-commenced between the first and third postoperative day in all cases. The mean postoperative hospital stay was 7.5 days (range, 4-12 days). The diagnosis after pathological examination of the tumor was gastrointestinal stromal tumor in 8 patients, leiomyoma in 4 and a cyst in one in one. There was no evidence of EGJ stenosis at the 6-monthly follow-up examinations, although there was mild deformity of the stomach in cases where the resected tumor had been more than 5 cm in diameter. There were no recurrences during a mean follow-up period of 121.7 months (range, 1-192 months).

Discussion

GSTs are frequently encountered during upper gastrointestinal endoscopy. Most of them are gastrointestinal stromal tumor (GIST), and generally show benign behavior. However, they are classified as having a low, moderate or high risk of recurrence depending on tumor size or mitotic activity. Furthermore, their prognosis is strongly correlated with the characteristics of the tumor, and not with the extent of stomach resection or lymphadenectomy [5]. Therefore, for surgical treatment of GST, local resection of the stomach is recommended with an adequate margin from the tumor, even if the small is small, and with regard to minimal surgical invasiveness, a laparoscopic approach is the preferred choice for resection. We have been selecting exogastric or intragastric approaches for local resection of the stomach depending on the location and growth condition of the tumor [4].

No.	Operation time (min)	Blood loss (ml)	Size (mm)	Diagnosis	Hospital stay (days)	Rec	Follow up (month)
1	211	minimal	20	GIST	10	-	192
2	200	minimal	17	leiomyoma	7	-	189
3	185	minimal	26	cyst	7	-	184
4	173	minimal	30	GIST	12	-	180
5	132	minimal	32	GIST	10	-	180
6	154	minimal	20	leiomyoma	7	-	167
7	135	minimal	20	GIST	10	-	161
8	150	minimal	65	GIST	7	-	140
9	190	minimal	13, 10	leiomyoma	4	-	88
10	109	minimal	30	leiomyoma	5	-	64
11	178	minimal	20	GIST	5	-	34
12	180	minimal	24	GIST	6	-	2
13	217	minimal	45	GIST	8	-	1

Rec: recurrence GIST: gastrointestinal stromal tumor

Table 2: Surgical results of intragastric resection.

Ohashi first reported a technique for intragastric resection of gastric neoplasms, in which all ports and surgical instruments were inserted directly into the gastric cavity [6]. In fact, most GSTs grow inward toward the luminal side, and form a protruding lesion. Therefore, these tumors can be resected safely using an endo-linear stapler without excessive resection of the normal gastric wall or causing major deformity of the stomach or stenosis of the EGJ. We consider that tumors larger than 5 cm in diameter or 8 cm^2 in cross-section require an additional gastrostomy for removal of the tumor from the lumen of the stomach because the tumor cannot be passed through the EGJ using an oral endoscope [4].

Use of an endo-linear stapler for local resection of the stomach is mandatory to minimize the operation time and, blood loss, and requires no suturing of the resected area. In particular, placement of a port site into the stomach is extremely important for intragastric resection of GSTs located at the middle of the stomach. If the 12-mm port is relatively close to the tumor, or if a tumor is larger than 5 cm, application of an endo-linear stapler is not easy, even if the stomach is inflated, because of the practical movable length of the stapler or the small opening of the stapler jaw. Therefore we often use a minimum-length (30 mm) linear stapler, and place the 12-mm port on the greater curvature of the lower stomach under oral endoscopic guidance.

For successful intragastric resection of GST, the use of an oral endoscope is mandatory for defining precisely the location of the tumor, for determining the port placement site in the stomach, for assisting intragastric resection, confirming hemostasis at the staple line, for retrieval of the specimen via the mouth, and for checking the presence of any air leakage from the resected area after re-inflation of the stomach. Schubert et al. [7] have also reported that intraoperative flexible endoscopy has several advantages including trans-illumination that facilitates visualization of the gastric lesion in laparoscopic view, elimination of preoperative tattooing of the lesion, and evaluation of the stapled or sutured gastric closure for any leakage after resection. However, the degree to endoscopic insufflation should be limited to avoid any multiple loops of the dilated small bowel and a consequent decrease in the working space. Therefore, we have employed insufflation of CO_2 via the inserted port site during intragastric procedures, except for initial port placement and the final check upon re-inflation of the stomach. Recently, Hiki et al. [8] have reported laparoscopic and endoscopic cooperative surgery (LECS) for resection of GIST. This method makes it possible to obtain an adequate cutting line independent of tumor location, eliminate any excessive resection of the normal gastric wall in the setting of exogastric resection, and minimize any deformity of the stomach after resection. However, its indications are limited intragastric growth-type tumors, less than 5 cm in size, those with no direct tumor exposure, and those with no ulceration, in view of the attendant risk of dissemination. It is anticipated that oral endoscopy during laparoscopic procedures will be become increasingly important in the future.

We obtained successful outcomes in all of the present 13 patients who underwent resection of GSTs. Tables 3 and 4 summarize several reported series of laparoscopic intragastric resections for GSTs, with the exception of a single case report [7,9-15]. The number of cases ranged from 3 to 11, with a mean of 6.7, and the mean patient age was 71 years (range, 65-77 years). The common indications for intragastric resection of GSTs were a tumor location in the upper third of the stomach and posterior wall side, intragastric growth, and a tumor diameter of less than 5 cm. The tumors ranged in size from 27 to 38 mm, with a mean of 31 mm. The operation time ranged from 83 to 192 min, with a mean of 137 min. There were 4 complications (6.1%), including conversion to open laparotomy in 2 cases, and bleeding from the staple line and wound in one case each, respectively. The mean postoperative hospital stay ranged from 5.7 to 7.6 days, with a mean of 6.6 days. The follow-up period ranged from 1 to 99 months, and only one case of recurrence was recorded, although this period was considered inadequate for evaluation. In our present series, the operation time (176 min) was

Author	Year	Number	Gender (M:F)	Age	Location (U/M/L)	Size (mm)
Choi and Oh	2000	9	NA	NA	9/0/0	NA
Matthews et al.	2002	3	NA	NA	3/0/0	NA
Walsh et al.	2003	11	NA	NA	11/0/0	24-85
Uchikoshi et al.	2004	7	NA	NA	7/0/0	27-75
Schubert et al.	2005	7	NA	NA	NA	NA
Li et al.	2008	3	0:3	77	2/1/0	28(20-40)
Na et al.	2011	7	3:4	65	6/1/0	27(23-38)
Sahm et al.	2011	7	NA	NA	NA	38(28-48)
Current study		13	5:8	60.6	10/3/0	27(10-65)

NA: not available

Table 3: The review of the literature (basic data).

Author	Year	Operation time (min)	complication	POHS (day)	Rec	Follow up (month)
Choi and Oh [10]	2000	100-140	open conversion:1	5.9	none	up to 42
Matthews et al. [11]	2002	NA	NA	NA	NA	NA
Walsh et al. [12]	2003	186 (120-320)	none	3-8	none	16.2(1-32)
Uchikoshi et al. [13]	2004	141.4(95-200)	open conversion:1	7.6	1 in 2 year	14-99
Schubert et al. [7]	2005	83(56-130)	NA	NA	NA	NA
Li et al. [14]	2008	192(140-240)	staple line bleeding:1	7.7	none	8-57
Na et al. [9]	2011	86.3(70-105)	wound bleeding:1	5.7	none	8.5(1-23.3)
Sahm et al. [15]	2011	NA	none	6.1	NA	NA
Current study		176(132-217)	none	7.5	none	121.7(1-192)

NA: not available, POHS: postoperative hospital stay, Rec: recurrence

Table 4: The review of the literature (clinical data).

relatively long in comparison with other reports, but there were no perioperative complications. Furthermore, our mean follow-up period (121.7 months) was sufficiently long to allow evaluation of the outcome for laparoscopic intragastric resection of GSTs.

Single-incision laparoscopic surgery has made considerable progressed in recent years. We have also applied single-incision laparoscopic local resection of the stomach for GSTs showing extragastric growth. Na et al. [9] have reported single-incision laparoscopic intragastric wedge resection for GSTs. This approach does not require an intraoperative oral endoscope or pneumoperitoneum. Furthermore, there are three differences between the conventional intragastric approach and a single-incision laparoscopic approach: the latter reduces the required operation time because of the use of a single gastrostomy and extracorporeal repair, the specimen can be delivered without using an endoscope, and a better cosmetic outcome can be achieved. Therefore, this approach should be limited to selected cases involving tumors less than 5 cm in diameter without ulceration. These indications are similar to those for LECS. Single-incision laparoscopic intragastric resection is expected to become another option for curative resection of selected cases of GST.

In conclusion, laparoscopic intragastric resection can be considerably beneficial for patients with GSTs located in the upper and middle part of the stomach, and the significance of oral endoscopy during laparoscopic procedures is expected to increase.

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