

Laparoscopic Partial Gastrectomy for Early Gastric Cancers using Plastic T-fasteners for Lifting Gastric Wall

Toshio MIURA, Hiroyuki KUSANO, Tohru YASUTAKE, Akio KAWAGUCHI, Masaaki EGUCHI, Masashi MURAOKA, Iwao HISAMATSU, Eiki J. NISHIZAWA, Hiroyuki YAMAGUCHI, Tohru NAKAGOE and Hiroyoshi AYABE

First Department of Surgery, Nagasaki University School of Medicine, 1-7-1 Sakamoto, Nagasaki 852, Japan

Between September 1992 and July 1996, 2 patients with type I early gastric cancer, 3 with type IIa, and 14 with type IIc, totaling 19 patients underwent laparoscopic partial gastrectomy (gastric wedge resections in 17 and Billroth II distal gastric resection in 2). There were 12 men and 7 women. Mean age was 65.4 years ranging from 44 to 86. Gastric lesions were located on the anterior wall in 7, posterior wall in 8 and lesser curvature in 4. In 15 of 19 patients, we performed laparoscopic surgery by a lesion lifting method using plastic T-fasteners. Average operative time was 164.8 ± 49.6 min (range 85-252) in all, 153.7 ± 46.7 min for the lesion lifting method, and 227 ± 33 min for distal gastrectomy. Average blood loss was 44.1 ± 57.3 ml, 30.9 ± 43.7 ml, and 97 ± 61 ml, respectively. Mean hospital stay after surgery was 13.6 ± 6.8 (6-30) days. There was no mortality and no postoperative complications. The average size of tumors in type I, IIa and IIc was 30 mm, 17.3 mm and 20 mm, respectively. In histologic examination, 16 cases were differentiated carcinoma and the remaining 3 cases were signet cell carcinoma. One of 4 cases diagnosed as SM cancer preoperatively was m (mucosal) cancer, two were sm (submucosal), and one was mp (muscularis propria) cancer histologically, but no one was involved in regional lymph nodes. These results indicate that laparoscopic partial gastrectomy will play an increasing role in the treatment of early gastric cancer without lymph node involvement as well as benign gastric tumors.

Introduction

The basic principle in the surgical treatment of benign tumors of the stomach is local excision with a margin of surrounding gastric wall, but gastric cancers are usually treated by gastrectomy combined with lymph node dissection. Partial gastrectomy is performed only for early gastric cancers without lymph node involvement diagnosed by preoperative ultrasound examination. In recent years, mucosal gastric resection has been widely performed by endoscopists for polypoid and depressed cancers of the gastric mucosa¹⁾. However, the popularity of laparoscopic cholecystectomy has led to the adaptation of videoscopic techniques to many surgical procedures. For early gastric cancer, we performed laparoscopic partial gastrectomy by

lifting the gastric wall using a small button tied to a nylon suture. During initial trials, we felt that it was necessary to accurately lift the target gastric lesions with clear definition of the tissue to be resected. We devised a plastic T-fastener using the principles developed by Brown et al²⁾, and have performed partial gastrectomy, linear gastrectomy and partial colectomy under videoscopy. In this study, we report surgical procedures on 15 patients who underwent laparoscopic partial gastrectomy using these T-fasteners, review the prognosis and evaluate surgical treatment options.

Patients and Methods

From September 1992 to July 1996, 30 patients with early gastric cancer and submucosal tumor underwent laparoscopic surgery (Table 1). Of these, 19 patients with early gastric cancer underwent laparoscopic partial gastrectomy. Two of them underwent distal Billroth II gastrectomy (Table 2). There were 12 men and 7 women with a median age of 65.4 (range 44-86) years. Gastric lesions were located on the anterior wall in 7 (5 in the antrum, 2 in the body), on the posterior wall in 8 (3 in the antrum, 4 in the body and 1 in the cardia) and on the lesser curvature in 4 (2 body and 2 cardia). Preoperatively, 15 of 19 lesions were diagnosed as M-early gastric cancers and 4 as SM-cancer. Macroscopically, they were type I in 2, type IIa in 3, and type IIc in 14 cases. Preoperative diagnosis of invasion in depth and lymph nodal involvement were based on endoscopic findings combined with ultrasound examination (Table 3, Fig. 1). Five were found to have local recurrence after endoscopic mucosal resection.

Table 1. Procedures of cases performed laparoscopic gastric resection

	early cancer	submucosal tumor	
		malignant	benign
Wedge resection (28)	17	1	10
Distal B-II resection (2)	2	0	2
Total cases (30)	19	1	10

(1992.9-1996.7)

Table 2. 19 Cases underwent laparoscopic partial gastrectomy with early gastric cancers

No.	Name	Age	Sex	Location	Circle	Macro. type	Preop-diag.	Postop-diag.	Histol. find.	INF	ly & v	Size (mm)	Procedure	Blood loss (ml)	Ope. time (min)	Analges. per os	Hosp-stay (d)	
1	F. A.	77	♀	body	ant	I	SM	sm	tub ₁	β	ly ₀ v ₀	15×13	L. lifting (T-f)**	7	95	0	4	6
2	W. T.	86	♀	antrum	post	I	SM	sm	tub ₁	α	ly ₁ v ₁	45×15	L. lifting (T-f)	0	160	1	3	12
3	M. K.	63	♀	body	post	IIa	M	m	tub ₁	α	ly ₀ v ₀	30×20	L. lifting (T-f)	0	191	0	5	19
4	T. I.	60	♂	antrum	ant	IIa*	M	m	tub ₁	α	ly ₀ v ₀	14×10	L. lifting (T-f)	120	190	4	6	11
5	M. Y.	79	♂	antrum	ant	IIa	M	m	tub ₁	β	ly ₀ v ₀	08×06	L. lifting (T-f)	0	90	0	5	9
6	T. M.	81	♀	antrum	ant	IIc	SM	mp	tub ₁	β	ly ₀ v ₀	28×22	L. lifting (b.)	0	220	1	4	8
7	S. N.	76	♂	body	less	IIc	M	m	sig	β	ly ₀ v ₀	15×05	lapa-assist	180	154	1	6	16
8	H. D.	75	♂	antrum	post	IIc	M	m	tub ₁	α	ly ₀ v ₀	35×20	L. lifting (T-f)	53	168	4	6	17
9	K. K.	69	♂	antrum	ant	IIc	M	m	tub ₁	α	ly ₀ v ₀	29×23	L. lifting (T-f)	36	161	3	5	12
10	H. H.	64	♂	cardia	less	IIc*	M	m	tub ₁	β	ly ₀ v ₀	09×05	L. lifting (T-f)	6	140	2	4	8
11	S. H.	56	♂	cardia	less	IIc*	M	m	tub ₁	α	ly ₀ v ₀	10×10	T-f assist	132	175	3	5	12
12	T. H.	62	♂	antrum	ant	IIc	M	m	tub ₁	α	ly ₀ v ₀	14×03	T-f assist	50	168	3	4	7
13	R. N.	63	♂	body	less	IIc	M	m	tub ₁	α	ly ₀ v ₀	10×04	lapa-ass (BII)***	54	203	2	5	28
14	M. Y.	44	♂	antrum	post	IIc*	SM	m	sig	α	ly ₀ v ₀	30×18	lapa-ass (BII)	140	250	5	6	13
15	T. S.	59	♀	body	post	IIc	M	m	tub ₁	β	ly ₀ v ₀	25×15	L. lifting (d.T-f)	0	90	5	3	8
16	S. K.	57	♂	cardia	post	IIc*	M	m	tub ₁	α	ly ₀ v ₀	15×15	L. lifting (d.T-f)	10	180	4	4	15
17	S. A.	60	♀	body	post	IIc	M	m	tub ₁	α	ly ₀ v ₀	10×03	L. lifting (d.T-f)	0	120	2	3	7
18	K. N.	67	♂	body	post	IIc	M	m	tub ₁	γ	ly ₀ v ₀	35×30	L. lifting (d.T-f)	0	120	6	9	30
19	S. K.	45	♀	body	ant	IIc	M	m	sig	γ	ly ₀ v ₀	15×12	L. lifting (T-f)	0	85	4	2	20

*cases after endoscopic mucosal resection

**L. lifting : lesion lifting technique

***lapa-ass(BII): laparoscopic assisted Billroth II gastrectomy

T-f.: plastic T-fastener

d. T-f.: Lesion lifting technique using plastic double T-fastener

(according to the general rule for gastric carcinoma from the Japanese Research Society for Gastric Cancer)

(1992.9-1996.7)

Table 3. Patients and materials

Number of case : 19 patients
 Sex : Male 12, Female 7
 Median age : 64.5 (range 44-86) yr
 Preoperative diagnosis :
 Macroscopic type
 type I 2
 type IIa 3
 type IIc 14
 Depth of cancer invasion
 m 15, sm 4
 Location of lesions :
 anterior wall 7 (antrum 5, body 2)
 posterior wall 8 (antrum 3, body, 4, cardia 1)
 lesser curve 4 (body 2, cardia 2)

Indications for laparoscopic and laparoscopic-assisted gastric surgery :

As the early gastric carcinomas less than 1 cm in diameter were usually resected by endoscopic mucosal resection (EMR), we relegated the carcinomas measuring less than 35 mm in diameter to laparoscopic surgery. Macroscopically, elevated (IIa) and protruded (I) types measuring less than 35 mm, depressed (IIc) types of measuring less than 25 mm without ulceration or ulcer scar and differentiated ally were selected for laparoscopic partial resection alone (Table 4). Depressed type cancers showing histologic findings of undifferentiated ally underwent laparoscopic-assisted distal partial gastrectomy with Billroth II anastomosis extracorporeally without radical lymph node dissection in patients with these criteria, under laparotomy.

Table 4. Indication of laparoscopic partial gastric resection for early gastric cancer

- Early gastric cancer without lymph node involvement
- 1) carcinomas showing type IIa or type I with tumor diameter of less than 35 mm
 - 2) type IIc carcinomas with tumor diameter of less than 25 mm, with histologic type of differentiated, without ulcer or ulcer scar
 - 3) others
 - a) incomplete EMR or recurrent cases after EMR
 - b) elderly patients (older than 80 yr)
 - c) high risk cases (chronic renal failure etc.)

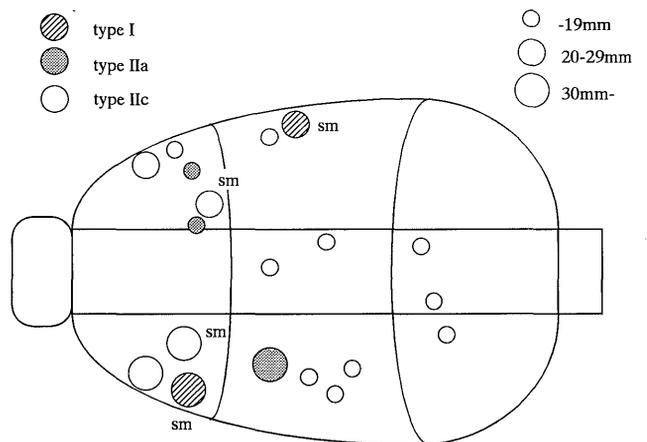


Fig. 1. Location, type, size and depth of invasion of 19 early gastric cancers undergoing laparoscopic partial gastrectomy

Anesthesia and trocar placement :

Under general anesthesia with the patient supine, pneumoperitoneum was established and maintained at or below 10 mmHg. Two patients underwent an abdominal wall-elevating method. A 10-mm trocar was inserted below the umbilicus and a 0° or 30° laparoscope was introduced. Under direct vision, the remaining trocars were inserted through the abdominal wall. A 10-mm trocar was positioned on the right mammary line. A 12-mm trocar was introduced 5-6 cm to the left of the umbilicus. The last 5-mm trocar was placed 2 finger-breadths below the left costal margin (Fig. 2). The surgeon used the right and left paramedian trocars in a two-handed technique. An Endo GIA stapler was introduced through the 12-mm trocar. Under laparoscopic and gastroscopic guidance, a skin marker was placed over the stomach lesion to identify the cutaneous site for introduction of a 3-mm trocar. Usually, this trocar was placed 2 to 3 finger-breadths below the xyphoid just to the left of the midline and was used to introduce a slotted needle.

Introducer needle and T-fasteners :

A specially designed 25 cm, 13-gauge introducer needle with a beveled tip and a 5-mm longitudinal side slot was fashioned. The plastic bar of the T-fastener (7-8 mm long, 4-5F in diameter) was made by cutting a Fogarty arterial embolectomy catheter (Edwards Laboratories, Inc. Calif., U.S.A.). Then, it was tied with a nylon suture (4 or 5-0)

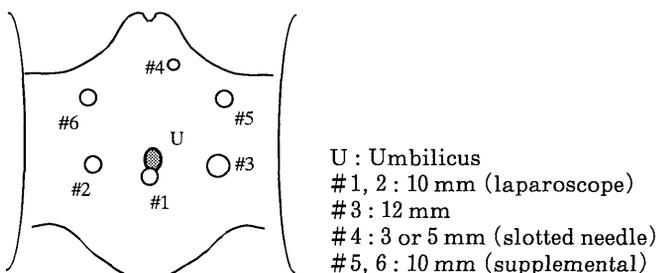


Fig. 2. Surgiport trocar placement for laparoscopic partial gastrectomy

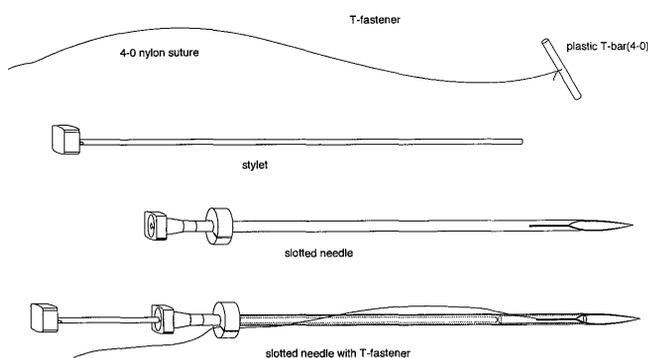


Fig. 3. T-fastener and slotted needle

and carried in the needle so that the bar was positioned within the lumen at the tip of the needle. The suture protruded from the slot with the tail alongside the needle. The proximal end of the nylon suture was held in the slit of the rubber ring attached to the root of the needle (Fig. 3). Introducer needle applying the double T-fastener used for lifting the posterior lesions of the stomach was 13-gauge without a slit at the tip of the needle. The double T-fastener was made by tying the plastic bar on the both sides of a 4-0 nylon suture (Fig. 4).

T-fastener placement and surgical procedure :

a) Lesion-lifting technique using T-fasteners

Under direct vision, both laparoscopically and gastroscopically, a slotted needle loaded with a T-fastener was introduced with a single sharp thrust through the 3-mm (or 5 mm) trocar into the gastric lumen just outside of the lesion (Fig. 5-(1)). A stylet was advanced into the needle lumen (Fig. 5-(2)), and the plastic bar was pushed out of the slot into the gastric lumen. The needle and the stylet were then withdrawn, leaving the T-fasteners inside the lumen (Fig. 5-(3)). In the same manner, the remaining three T-fasteners were placed in a diamond configuration in the appropriate positions surrounding the lesion (Fig. 5-(4)).

After all the T-fasteners had been placed with appropriate tension on the nylon sutures, the initial application of the 30 mm Endo-GIA stapler to the retracted gastric wall was then accomplished (Fig. 6-(1)). It was applied to the gastric wall 0.5-1.0 cm apart from the line connected to each nylon suture. The gastric wall was then excised in a similar manner with serial application of the stapler (Fig. 6-(2,3)). In cases involving a lesion on the posterior wall near the greater curvature, the greater curvature was mobilized and the gastrocolic ligament was divided with a clip applicator, and T-fasteners were placed.

b) Lesion-lifting technique using double T-fasteners

The anterior gastric wall was retracted and fixed to the abdominal wall using two T-fasteners (Fig. 7). The greater omentum was opened using endoclips, and the posterior gastric wall was exposed. A 13-gauge introducer

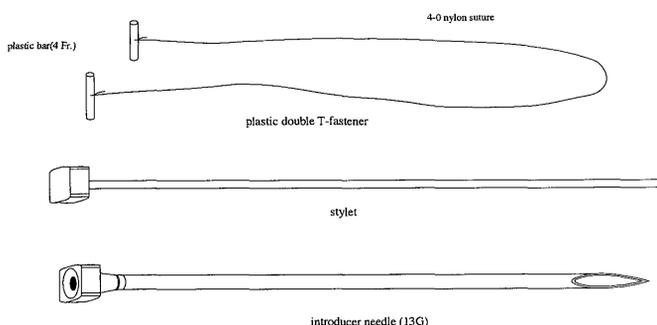
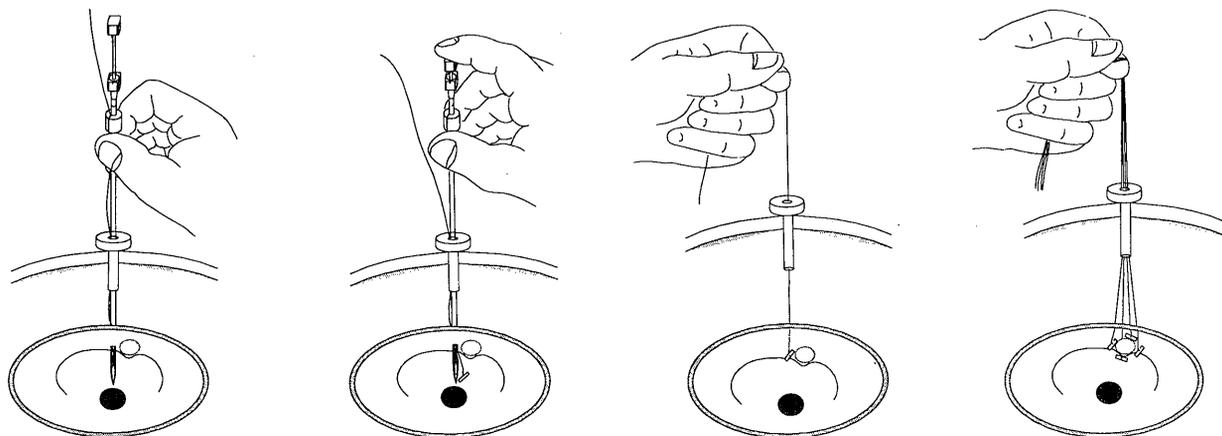
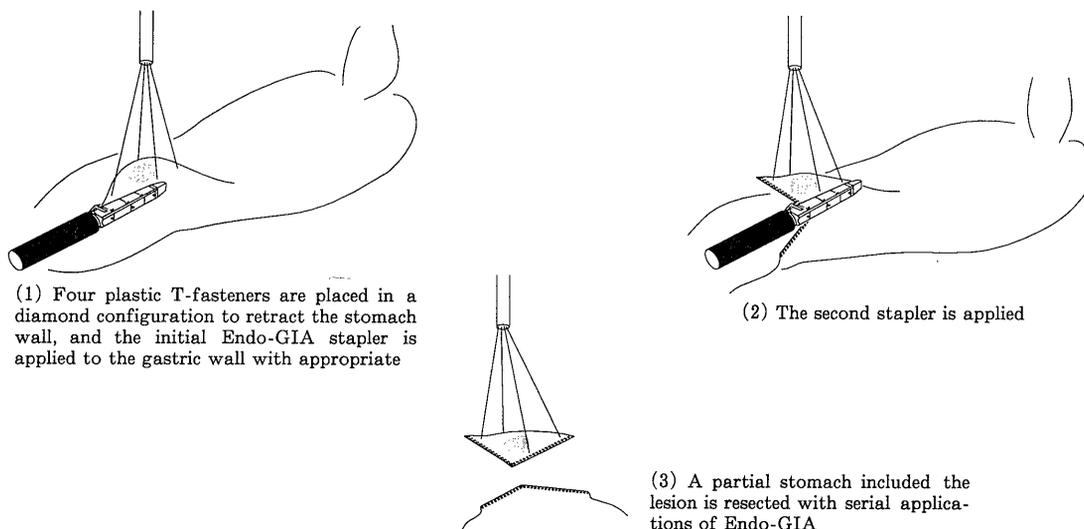


Fig. 4. Introducer needle and plastic double T-fastener



- (1) The plastic bar with an attached nylon suture is introduced via a slotted needle through the 5 mm trocar and the stomach wall
- (2) The plastic T-bar is dislodged inside the stomach lumen by the stylet
- (3) The stomach wall is retracted to the abdominal wall by pulling on the nylon suture
- (4) The stomach wall including the lesion is retracted by pulling on the four nylon sutures

Fig. 5. The technique of placing the plastic T-fastener for lifting the stomach wall

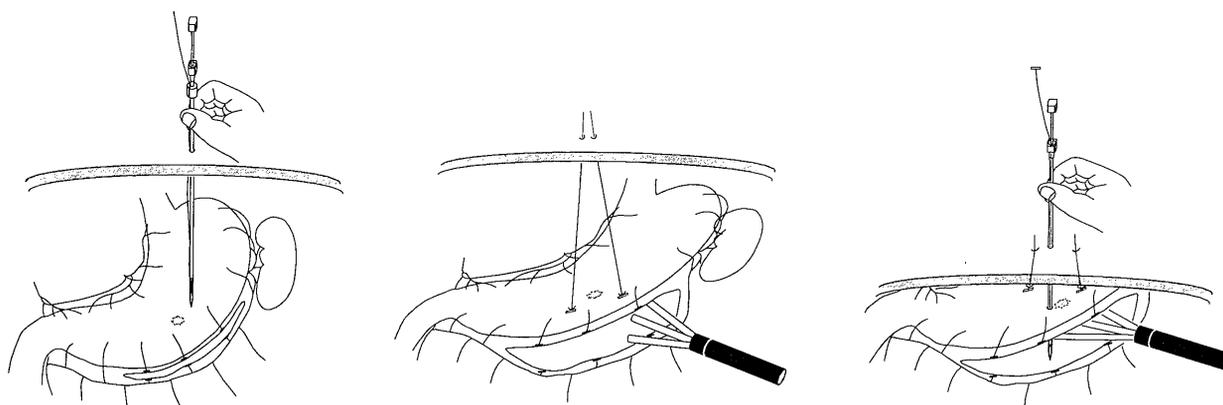


- (1) Four plastic T-fasteners are placed in a diamond configuration to retract the stomach wall, and the initial Endo-GIA stapler is applied to the gastric wall with appropriate

- (2) The second stapler is applied

- (3) A partial stomach including the lesion is resected with serial applications of Endo-GIA

Fig. 6. Technique of laparoscopic partial resection of the stomach with Endo-GIA

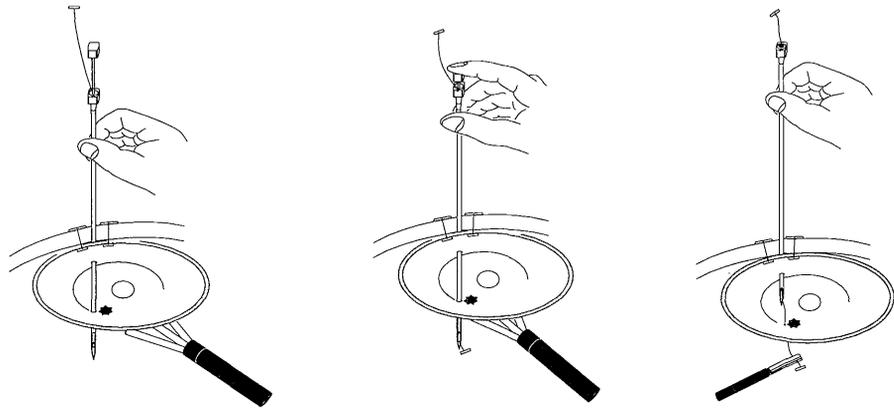


- (1) Greater omentum was opened using endoclips, and slotted needle with T-f was inserted into the gastric lumen

- (2) Lifting and fixing the anterior gastric wall by two T-fasteners, and exposed the posterior wall using an Endo-fork

- (3) An introducer needle with double T-fastener was inserted into the gastric wall

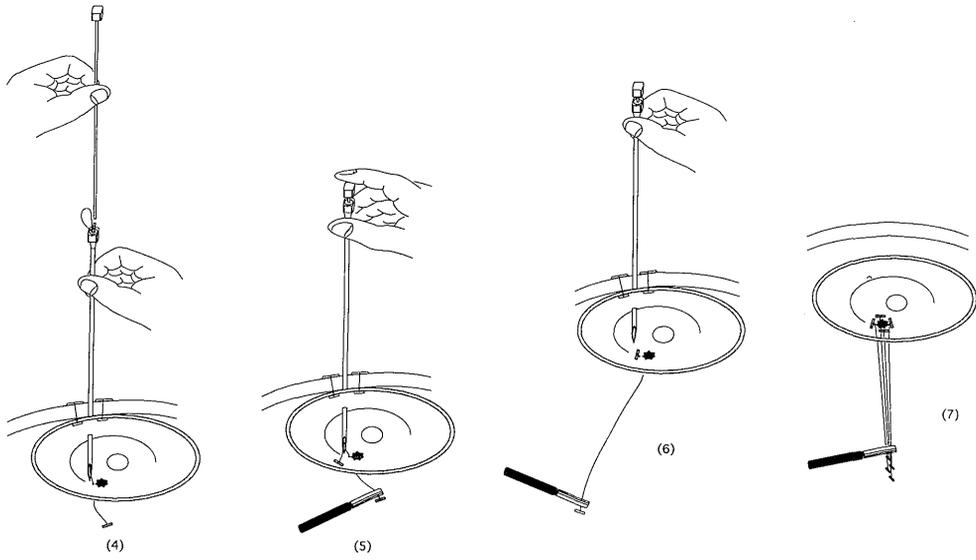
Fig. 7. Lesion-lifting technique for the posterior lesion of the stomach (1)



(1) Introducer needle loaded with an end of a double T-fastener was introduced through the abdominal wall and the anterior gastric wall against the lesion located on the posterior wall, and the needle was inserted through the posterior gastric wall just outside the lesion

(2) One of the bar was pushed out in the abdominal cavity

(3) Bar was pulled out by a grasper, and the needle was then withdrawn into the gastric lumen, leaving the plastic bar under the stomach

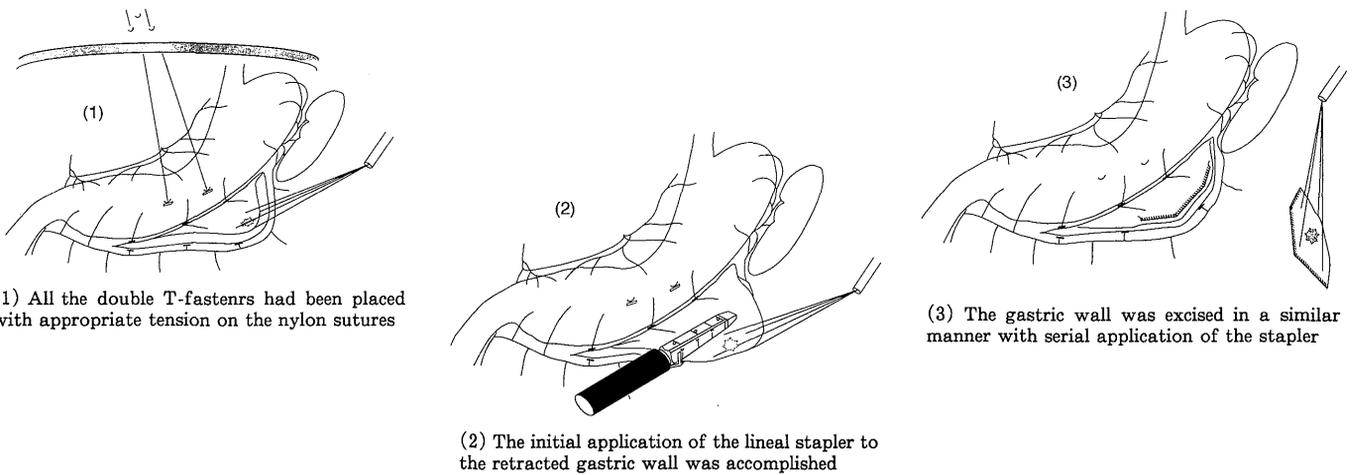


(4) (5) The other side plastic bar of a double T-fastener was put into the introducer needle, and advanced into the gastric lumen pushed by a stylet

(6) The plastic bar was placed by pulling nylon suture with plastic bar out of the stomach by Endo-grasper

(7) In the same manner, the remaining 3 bars were placed in a diamond configuration in the appropriate position surrounding the lesion

Fig. 8. Lesion-lifting technique for the posterior lesion of the stomach (2)



(1) All the double T-fasteners had been placed with appropriate tension on the nylon sutures

(2) The initial application of the lineal stapler to the retracted gastric wall was accomplished

(3) The gastric wall was excised in a similar manner with serial application of the stapler

Fig. 9. Lesion-lifting technique for the posterior lesion of the stomach (3)

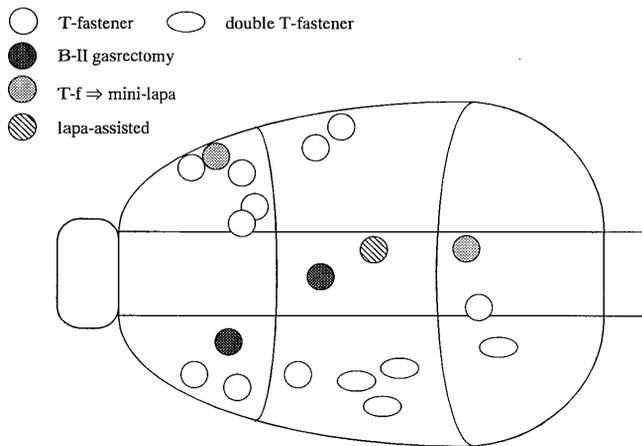


Fig. 10. Surgical procedures of 19 early gastric cancers undergoing laparoscopic gastrectomy

needle loaded with an end of a double T-fastener was introduced through the trocar into the abdominal cavity, and further into the gastric lumen through the anterior gastric wall against the lesion located on the posterior wall (Fig. 8-(1)).

Under direct vision gastroscopically, the needle was inserted through the posterior gastric wall just outside the lesion (Fig. 8-(1)). Observing the tip of the needle laparoscopically, a staylet was advanced into the needle lumen, and one of the plastic bars was pushed out in the abdominal cavity (Fig. 8-(2)). After the bar was pulled out only a few centimeters by a grasper, the needle was then withdrawn into the gastric lumen, leaving the plastic bar under the stomach (Fig. 8-(3)). The plastic bar on the other side of a double T-fastener was put into the introducer needle (Fig. 8-(4)), and advanced into the gastric lumen being pushed by a stylet (Fig. 8-(5)). The plastic bar was placed by pulling a nylon suture with plastic bar out of the stomach using an endo-grasper (Fig. 8-(6)).

Next, the second double T-fastener was put into the lumen of the introducer needle leaving in the stomach, and it was placed on the other side of the lesion after inserting the needle into that location. In the same manner, the remaining two T-fasteners were placed to result in a diamond configuration in the appropriate position surrounding the lesion (Fig. 8-(7)).

The posterior gastric wall was lifted with double T-fasteners and excised in a similar manner with serial applications of the stapler (Fig. 9).

The specimen which was pocketed in the thumb of a rubber glove or a nylon sack, used as an endo-pouch, was removed through the 12 mm trocar. The pouch was opened and the contents inspected to ensure that the resection margins were free of tumor. The lesser sack was closed by applying endoclips. Finally, the surgical field was irrigated with warm normal saline solution and inspected for bleeding. Trocars were removed and the wounds closed. A nasogastric tube was left in place until the next day.

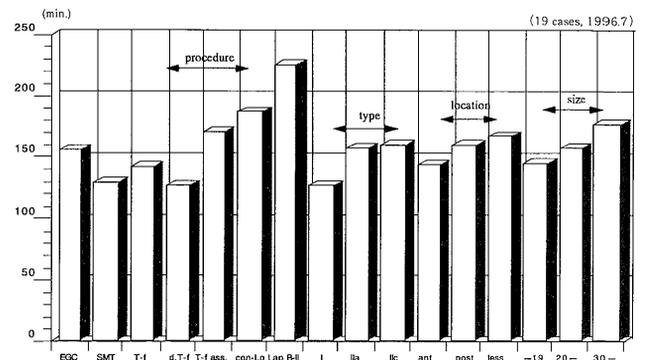


Fig. 11. Operating time by procedure, type, location and size (19 cases, 1996.7)

Results

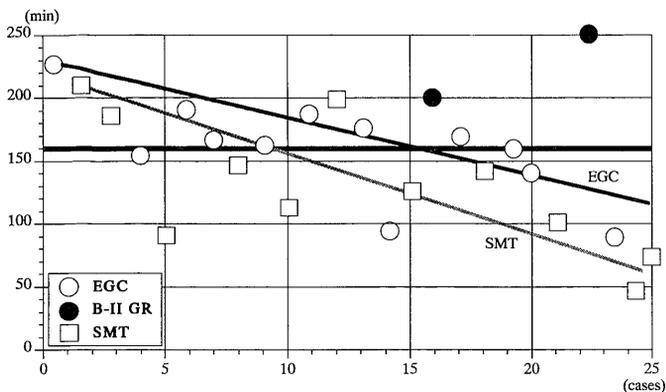
Laparoscopic surgery was performed in 19 patients. Of these, 15 underwent wedge (local) resection by the technique using plastic T-fasteners to lift the gastric wall. In one patient, the procedures were performed using a button for retraction or by holding with a Babcock grasper. One patient underwent local gastric resection by mini-laparotomy, because one lesion was located on the lesser curvature and injury of the vagus nerves could be more easily avoided by that procedure. The remaining two patients received distal partial gastrectomies with antecolic Billroth II anastomosis extracorporeally (Fig. 10, Table 2).

For various reasons, the technique using T-fasteners was converted to a mini-laparotomy in 2 patients. One patient had a type IIc cancer on the lesser curvature. It was considered that a branch of the vagus nerve would be damaged during excision if we continued with this procedure. In the other patient, the surgical field was obstructed because air passed into the small intestine.

In 15 cases of laparoscopic partial gastric resection performed using the T-fastener technique alone, the mean surgical time was 153.7 min (range 85-200). The procedure in 4 cases of posterior wall using double T-fastener was rather complicated and required 127.5 min (range 90-180) and 227 min in distal Billroth II gastrectomy (Fig. 11).

The operating time of the first 25 cases including 11 cases with submucosal tumor performed using T-fasteners is shown in Fig. 12. As our experience grew, learning curves showed a trend of decreased operating time. Operating time in early cancers was little longer than in submucosal tumors.

The mean blood loss was minimal in all patients with an average of 44.1 ml (range 0-180), 30.9 ml by the lesion-lifting method, and 97 ml in distal Billroth II gastrectomy. It was less in those patients who underwent procedures using T-fasteners, and was performed in a short operative time and was located on the anterior wall more frequently than in other patients (Fig. 13).



EGC: early cancer, SMT: submucosal tumor, B-II GR: distal Billroth II gastrectomy
Fig. 12. Learning Curve : 25 Laparoscopic partial gastrectomy

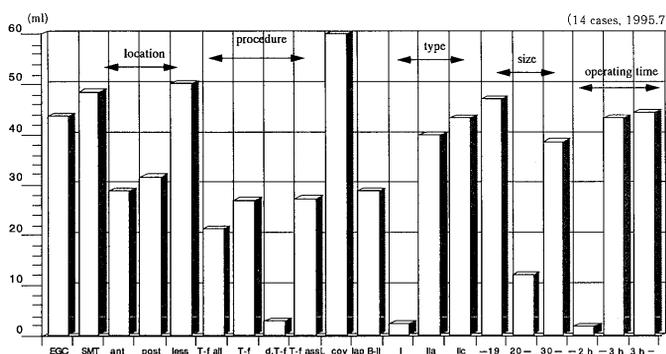


Fig. 13. Blood loss by location, procedure, type, size and operating time

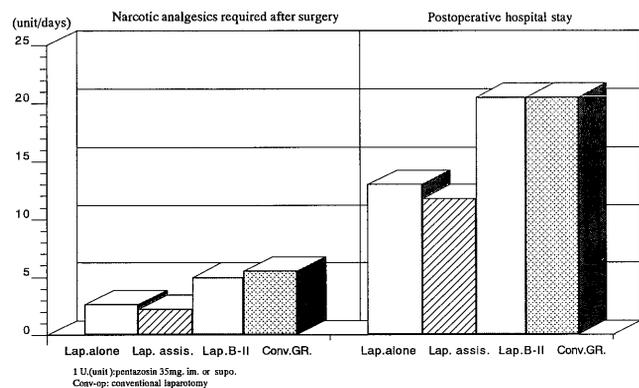


Fig. 14. Narcotic analgesics required after surgery and postoperative hospital stay

There were no deaths or major intraoperative complications. The mean hospital stay after surgery was 13.6 (6-30) days. Data on surgical time, loss of blood, analgesic doses and postoperative hospital stay among T-fastener-assisted, conventional laparoscopic and open gastrectomies are shown in Fig. 14. In the T-fastener technique, there was less blood loss, shorter postoperative hospital stay and lower doses of analgesics required than in other laparoscopic procedures or conventional open gastrectomies. Macroscopically, 19 cases of early gastric cancer involved type I, polypoid in 2; type IIa, protruded in 3 and type IIc, depressed in 14.

Table 5. Macroscopic cancer type, size in diameter, depth of cancer invasion and histologic findings of early gastric cancer underwent laparoscopic surgery

type	size (mm)	Depth of invasion			Histologic findings	
		m	sm	mp	well differentiated	signet cell
I (2)	30.0(15-45)	0	2	0	2	0
IIa(3)	17.3(8-30)	3	0	0	3	0
IIc(14)	20.0(9-35)	13	0	1	11	3

depth of histologic cancer invasion :
 m : mucosal layer, sm : submucosal layer, mp : proper muscle layer

Table 6. Relationship between preoperative diagnosis and postoperative histologic depth of invasion of early cancer underwent laparoscopic surgery

Preoperative diagnosis	Histological depth of invasion
M (15)	15 → 16 m
SM (4)	SM ₁ → 1 (type IIc)
	SM ₂ → 2 (type I)
MP	1 (type IIc) → 1 mp

depth of cancer invasion :
 M : mucosal layer, SM : submucosal layer, MP : proper muscle layer
 m : mucosal layer, sm : submucosal layer
 SM₁ : slightly invaded in the submucosal layer, SM₂ : massively invaded
 sm : slightly invaded histologically

The average size of the early gastric cancers was 20.9 mm (range 8-45 mm), and that in type I, IIa and IIc was 30 mm, 17.3 mm and 20.0 mm, respectively (Table 5). The depth of cancerous infiltration in 16 cases was limited to the mucosal layer, but cancers invaded the submucosal layer in 2 and proper muscle layer in 1. One out of 4 cases diagnosed as SM cancer preoperatively was m cancer, two were sm, and one was mp cancer histologically (Table 6).

The results of pathologic examination showed differentiated carcinoma in 16, and signet cell carcinoma in the remaining 3.

Radiography of the upper GI tract 3-5 days after surgery demonstrated normal gastric emptying without perforation or stenosis in all patients. The patients resumed oral intake on the 3rd to 5th day after the surgery and were discharged between 6 and 30 days (average 13.6 days) after the surgery. Follow-up ranged from 4 to 47 months (average 688±360 days). All patients were asymptomatic, and there was neither dumping syndrome nor diarrhea. Endoscopy performed in all patients 3 weeks and every 6 months after surgery demonstrated complete healing, and there was no sign of local recurrence of malignancy.

Discussion

Functional preservation surgery for the treatment of benign and malignant gastric lesions is desirable for both the surgeon and the attending physician. The basic surgical procedure for treatment of early gastric cancer has conventionally consisted of gastrectomy combined with lymph node dissection. The results of pathological studies regarding resected gastric specimens along with the recent advances in diagnostic techniques, such as ultrasonography and endoscopy, have led to increased use of endoscopic mucosal resection for treating gastric cancers without lymph node involvement in the clinical setting. However, endoscopic resection is difficult with large tumors and those cancers located in regions inaccessible by the endoscope. Moreover, frequent follow up examinations are required after treatment by endoscopic resection.

The success of laparoscopic cholecystectomy has led to the use of a similar technique to treat gastric lesions. In 1992, Ohgami et al.³⁾ reported a laparoscopic localized gastrectomy technique for the treatment of early gastric cancer in which a metal bar was used to lift the full thickness of the gastric wall including the tumor. They named their technique the "lesion-lifting technique." We have treated a patient with type IIc early gastric cancer by laparoscopic partial gastrectomy. The gastric wall which included the tumor was lifted by a small button tied with nylon sutures. Although resection of the tumor was attempted, insertion of the atraumatic needle proved to be technically difficult. We have learned from this experience that it is extremely important to identify the target gastric lesions accurately, and then, to lift them fully before resection. We have used plastic T-fasteners and slotted needle (13G) according to the technique reported by Brown²⁾ and developed by Duh and Way^{4,5)} for performing laparoscopic jejunostomy, colostomy, and gastrostomy. T-fasteners were placed in a diamond configuration surrounding a lesion to retract the gastric wall. A part of the stomach was resected using Endo-GIA. The outcome was satisfactory in 11 of 13 patients who underwent the laparoscopic procedure. The operation was converted into a mini-laparotomy in 2 patients because of technical difficulties or because the location of the tumor made laparoscopic resection impossible.

Laparoscopic partial gastrectomy is the first choice for the treatment of early gastric cancers without lymph node involvement.

On the results of pathologic examination of resected stomach and dissected lymph nodes of 238 cases with m-early gastric cancer in our institute, it was found that lymph node involvement in the m-early cancers in which the depth of cancerous invasions was limited to the proper mucosal layer was about 2.9%. Beside, no metastasis was found in cases in which no scar was present and the histologic type was differentiated.

The technique is particularly suited for those lesions located at sites that are difficult for endoscopic mucosal resection and large tumors (tumor size greater than 2 cm). Tumors which may be resected by laparoscopic partial gastrectomy are, in principle, differentiated mucosal cancers without ulcer formation. However, tumors not exceeding 35 mm in size (protruded cancer, type I or type IIa with tumor diameter of less than 35 mm., depressed cancer, type IIc cancers with tumor diameter of less than 25 mm), undifferentiated gastric cancers, and even cancers accompanied by ulcer or ulcer scar formation should also be considered for resection by our technique.

This technique is to be applied also to sm cancers without lymph node involvement, in cases of incomplete mucosal resection (EMR) or recurrence after EMR, and high-risk or elderly patients. If perigastric lymph node swelling is found during the laparoscopic surgery, the specimen is made into frozen sections for pathologic examination of possible metastasis. If positive, the procedure will be converted to laparoscopic-assisted distal gastrectomy or conventional laparotomy.

Laparoscopic partial gastrectomy in these cases should be performed in conjunction with removal of the perigastric lymph nodes. Subsequent treatments should be selected after pathological investigation of the resected surgical specimens. To approach posterior wall lesions, the greater curvature was mobilized and the gastrocolic ligament was divided using a clip applicator. The gastric wall was punctured perpendicular to the gastric wall by the slotted needle loaded with T-fasteners. For lesions located near the lesser curvature, the course of the vagus nerve must be carefully considered. Inadvertent division of this nerve will result in serious impairment of gastric emptying. If any difficulties arise during the procedure, the operation should be converted into a mini-laparotomy without hesitation.

With regard to the laparoscopic distal gastrectomy, Goh et al.⁶⁾ reported two patients who underwent laparoscopic Billroth II gastrectomy for benign disease. Kitano et al.⁷⁾ have described laparoscopically assisted Billroth I gastrectomy for early gastric cancer by a combination of laparoscopy and dissection under direct vision through a small incision. Watson et al.⁸⁾ reported an early gastric cancer treated by a totally laparoscopic technique. We also have performed this technique only on two cases. However, since perigastric lymph node can be resected, this technique will be applied to cases of suspected lymph node metastasis, difficult partial resection, and possible occurrence of postoperative disorders (stenosis, gastric emptying difficulty). Specifically, the targets in consideration as the followings: 1) early cancer in the lesser curvature, 2) lesion near the pyloric ring, 3) early cancer in the posterior wall where slotted needle puncture is technically difficult, 4) undifferentiated early cancer, 5) large size early cancer (depressed type < 30 mm, protruded type < 40 mm), and 6)

lymph node swelling observed laparoscopically. These issues require further studies including the resecting technique.

Our technique using plastic T-fasteners proved to be successful in the treatment of 7 patients with nonepithelial tumors. One of these patients had a metastatic tumor. The laparoscopic technique is also recommended for resection of nonepithelial tumors smaller than 5 cm.

The advantages of this device are as follows: 1) The material of the bar being plastic, the size can be selected and the length can be adjusted as desired, while maintaining the same strength as a metallic bar, 2) it does not cause a wound infection because of insertion of a slotted needle through a trocar, 3) it causes no injury to the tissue to be resected, 4) the target tissue can be resected with appropriate or sufficient surgical margin, 5) no stenosis is caused in cases of lesions located near the pyloric or cardiac region, and 6) this technique is safe for the patient and surgeon.

The only significant complication that may occur during the performance of our technique is hemorrhage. Bleeding occurring on the stapling line created by Endo-GIA may be easily arrested by clipping.

Our experience using the laparoscopic partial gastrectomy technique in 28 patients, with 18 malignant and 10 benign lesions, showed that the operation is easy to perform and does not result in any major complications.

We found that the lesions could be fully lifted for accurate resection. Our findings have shown that the laparoscopic partial gastrectomy technique is a useful, minimally invasive procedure for treatment of early gastric cancers and submucosal gastric tumors that are unresectable by endoscopic mucosal resection.

References

- 1) Sano T, Kobori O, Muto T: Lymph node metastasis from early gastric cancer: endoscopic resection of tumour. *Br J Surg* 79: 241-244, 1992.
- 2) Brown AS, Mueller PR, Ferucci JT Jr: Controlled percutaneous gastrostomy: Nylon T-fastener for fixation of the anterior gastric wall. *Radiology* 158: 543-545, 1986.
- 3) Ohgami M, Watanabe M, Kumai K, Kitajima M et al: Laparoscopic curative wedge resection for the early gastric and early colon cancer using a lesion lifting method. *SAGES* (abstract): S63, p77, 1994.
- 4) Duh QY, Way LW: Laparoscopic jejunostomy using T-fastener as retractors and anchors. *Arch Surg* 128: 105-108, 1993.
- 5) Duh QY, Way LW: Diagnostic laparoscopy and laparoscopic cecostomy for colonic pseudo-obstruction. *Dis Colon Rectum* 36: 65-70, 1993.
- 6) Goh P, Tekant Y, Isaac J, Kum CK, Nogi SS: The technique of laparoscopic Billroth II gastrectomy. *Surg Laparosc Endosc* 2: 258-260, 1992.
- 7) Kitano S, Iso Y, Moriyama M, Sugimachi K: Laparoscopy assisted Billroth I gastrectomy. *Surg Laparosc Endosc* 4: 146-148, 1994.
- 8) Watson DI, Devitt PG, Game PA: Laparoscopic Billroth II gastrectomy for early gastric cancer. *Br J Surg* 82: 661-662, 1995.