



Technical note

Laparoscopic D2 lymph node dissection for advanced gastric cancer located in the middle or lower third portion of the stomach

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Abstract

The standard lymph node dissection for advanced gastric cancer is a D2 dissection, performed in accordance with the new Japanese classification of gastric carcinoma (13th edition). Although laparoscopic D2 dissections according to the General rules for gastric cancer study (12th edition) have been reported, no studies have reported laparoscopic D2 dissections according to the revised classification for advanced gastric cancers located in the middle or lower portions of the stomach. The lack of such studies is due to the perceived technical difficulty of the procedure. However, we successfully performed this novel procedure in five patients with advanced gastric cancer located in the middle or lower portions of the stomach. In fact, this surgical procedure is technically feasible and safe.

Key words Laparoscopic surgery · D2 dissection · Advanced gastric cancer

Introduction

Recently, laparoscopic surgery has become widely used for the treatment of early gastric cancer [1–6]. Despite its increasing prevalence, this modality remains rarely used for treating advanced gastric cancers [7–9].

Since the 13th edition of the *Japanese classification of gastric carcinoma (JCGC)* was published in June 1999, the standard lymph node dissection for advanced carcinomas has been a “D2 dissection” [10,11]. In order to utilize laparoscopic surgery in the treatment of advanced gastric cancers, the laparoscopic D2 dissection according to the new *JCGC* (13th edition) is necessary. It should be noted that laparoscopic D2

dissections have been performed for advanced gastric cancers, but only when the cancer has been limited to the upper portion of the stomach [9]. Such laparoscopic procedures have not been reported for middle and lower stomach lesions, because of the technical difficulty involved in dissecting the lymph nodes along the hepatic artery and superior mesenteric vein.

Herein, we describe the technical aspects and initial results for laparoscopic D2 dissection, according to the new *JCGC*, for advanced gastric cancer located in the middle or lower portion of the stomach.

Definition of regional lymph nodes

The lymph node stations and groups were defined according to the 13th edition of the *JCGC* [10]. In patients with advanced gastric cancers located in the middle or lower portions of the stomach, we removed the following lymph nodes: the right paracardial lymph nodes (LN), LN no.1; the LN along the lesser curvature, LN no.3; the LN along the left gastroepiploic vessels, LN no.4sb; the LN along the right gastroepiploic vessels, LN no.4d; the suprapyloric lymph nodes, LN no.5; and the infrapyloric lymph nodes, LN no.6; the LN along the left gastric artery, LN no.7, the LN along the common hepatic artery (anterosuperior group), LN no.8a; the LN around the celiac artery, LN no.9; the LN along the proximal splenic artery, LN no.11p; the LN in the hepatoduodenal ligament (along the hepatic artery), LN no.12a; and the LN along the superior mesenteric vein, LN no.14v.

Selection of patients

Among patients with advanced gastric cancer, the indications for laparoscopic surgery followed in our study were: (a) tumor location in the middle or lower

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third of the stomach; (b) depth of tumor invasion confined to the subserosal layer (cT2); and (c) no evidence of lymph node metastasis, or metastasis confined to group 1 nodes (less than cN1). Neither tumor size nor histologic types were considered in the selection criteria. Patients with medical conditions that precluded general anesthesia were not enrolled in this study. The specific clinical features in our five patients (according to the new *JCGC*) [10] are shown in Table 1.

Operating room setup

The patient, under general anesthesia, was placed in the supine position with the legs apart. A 20° head-up tilt was applied in order to prevent the transverse colon or small intestine from visually compromising the operative field. The primary surgeon stood on the patient's right, with the first assistant on the patient's left, and the camera operator between the patient's legs. Two video monitors were placed over the patient's shoulders.

Surgical technique

After pneumoperitoneum was established, using the open technique, five ports (12mm in diameter) were placed. A flexible electrolaparoscope (Fujinon, Tokyo, Japan) was introduced through the infraumbilical port.

The operation began with an examination of the peritoneal cytology, using peritoneal lavage.

Lymph node dissection and gastric resection

The gastrocolic ligament, including LN station no.4sb, was divided proximally about 4 cm from the left epiploic arcade toward the lower pole of the spleen, using ultrasonic shears (Laparoscopic Coagulating Shears [LCS]; Ethicon, Cincinnati, OH, USA). The roots of the left gastroepiploic vessels were exposed, using an ultrasonic aspirator (Ultrasonic Surgical Unit [USU];

Olympus Optical, Tokyo, Japan), and divided with double clips. The LN station no.4sb lymph nodes were divided from the greater curvature using the LCS.

After division of the gastrocolic ligament, including LN station no.4d, distally toward the pylorus, attention was directed toward the inferior edge of the head of the pancreas. In focusing upon this region, the middle colic vein, superior mesenteric vein, gastrocolic trunk, and right gastroepiploic vein were exposed, and LN station no.14v was dissected, using the LCS and USU (Fig. 1). The roots of the right gastroepiploic vessels were divided with double clips, and the LN station no.6 lymph nodes were dissected from the duodenum, using the LCS.

The duodenum was transected 1 cm distal to the pylorus, using an endoscopic stapling device with precedence to the division of the right gastric vessels. The bifurcations of the gastroduodenal, the common hepatic, and the proper hepatic arteries were exposed. Following this exposure, these arteries were taped with vessel tapes (Fig. 2A). Next, the proper hepatic artery was skeletonized, using the LCS. This procedure allowed us to dissect LN station no.12a, and to identify the root of the right gastric artery (Fig. 2B), which was subsequently divided by clipping.

After the dissection of LN stations nos.12a and 5, the tape, which encircled the common hepatic artery, was retracted caudally. Following retraction, the common hepatic artery was skeletonized and LN station no.8a was dissected, using the LCS (Fig. 3A). Next, the root of the splenic artery was isolated and taped with vessel tape. The proximal splenic artery was skeletonized along the upper border of the pancreas, and LN station no.11p was dissected, using the LCS (Fig. 3B).

The left gastric vein was divided, and the root of the left gastric artery was exposed and divided with double clips, allowing the dissection of the LN station no.7 lymph nodes. Further dissection of the LN station no.9 lymph nodes was added proximally.

The LN station no.1 lymph nodes were dissected along with skeletonization of the upper-third of the lesser curvature. The stomach was transected, using endoscopic stapling devices, and an en-bloc resection of

Table 1. Clinical features

Case no.	Age (years)/ Sex	Tumor location	Macroscopic type ^a	Clinical findings ^a
1	58/Male	M	2	cT2,cN0,cH0,cP0,cM0
2	69/Male	M	3	cT2,cN1,cH0,cP0,cM0
3	71/Male	LM	2	cT2,cN0,cH0,cP0,cM0
4	70/Male	L	2	cT2,cN0,cH0,cP0,cM0
5	51/Male	L	2	cT2,cN0,cH0,cP0,cM0

M, middle portion of stomach; LM, lower middle portion of stomach; L, lower portion of stomach

^a According to *Japanese classification of gastric carcinoma (JCGC)* [10]

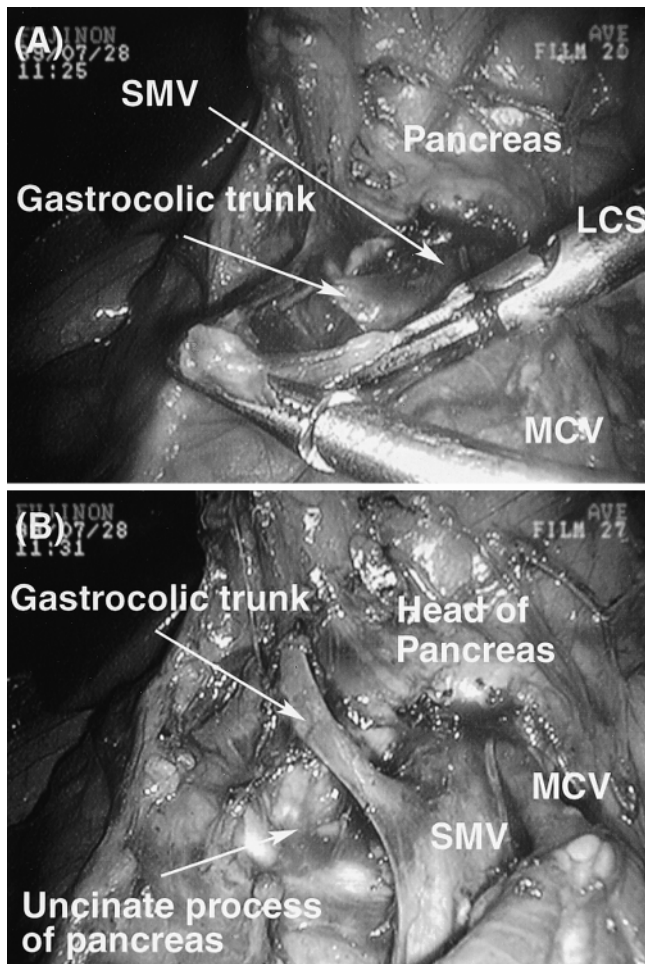


Fig. 1A,B. Dissection of lymph node (LN) station no.14v. **A** The middle colic vein (MCV), superior mesenteric vein (SMV), and gastrocolic trunk were exposed, and LN station no.14v was dissected using Laparoscopic Coagulating Shears (LCS; Ethicon). **B** Complete dissection of LN station no.14v

the stomach and D2 lymph nodes was completed. The complete lymph node dissection is shown in Fig. 4.

The resected stomach and lymph nodes were placed in a plastic specimen bag (Endocatch II; United States Surgical, Norwalk, CT, USA).

Intraoperative histological examination

Before the reconstruction procedure, the plastic bag was retrieved through the trocar wound, and intraoperative histological examination of the group 2 lymph nodes was performed upon removal. Thus, this operation was carried out in accordance with the following strategy: (1) if there was evidence of a histological cancer invasion, the dissection of the group 3 lymph nodes was added along with conversion to open surgery; and (2) if there was no histological cancer invasion, the reconstruction was performed laparoscopically [6].

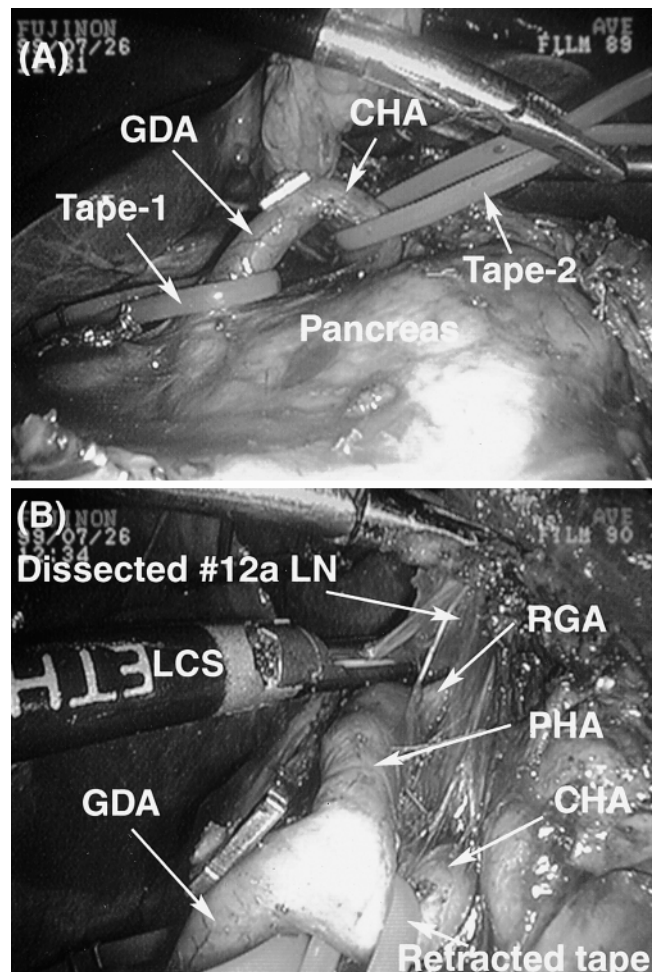


Fig. 2A,B. Dissection of LN station no.12a. **A** The gastrooduodenal artery (GDA) and common hepatic artery (CHA) were taped with vessel tapes. *Tape-1*, Rubber tape with gastrooduodenal artery; *tape-2*, rubber tape with common hepatic artery. **B** The proper hepatic artery was skeletonized, using the LCS, and the roots of the right gastric artery were identified. *PHA*, Proper hepatic artery; *RGA*, right gastric artery

Reconstruction

In the reconstruction, the intracorporeal anastomosis was performed with a Roux-en-Y gastrojejunostomy. This anastomotic procedure was carried out with a functional end-to-end anastomotic technique, using the endoscopic stapling devices. Two drains were placed through the bilateral trocar wounds and the operation was completed.

Results

We performed laparoscopic D2 dissections, according to the 13th edition of the *JCGC* [10], in five patients with advanced cancer of the middle or lower portions of

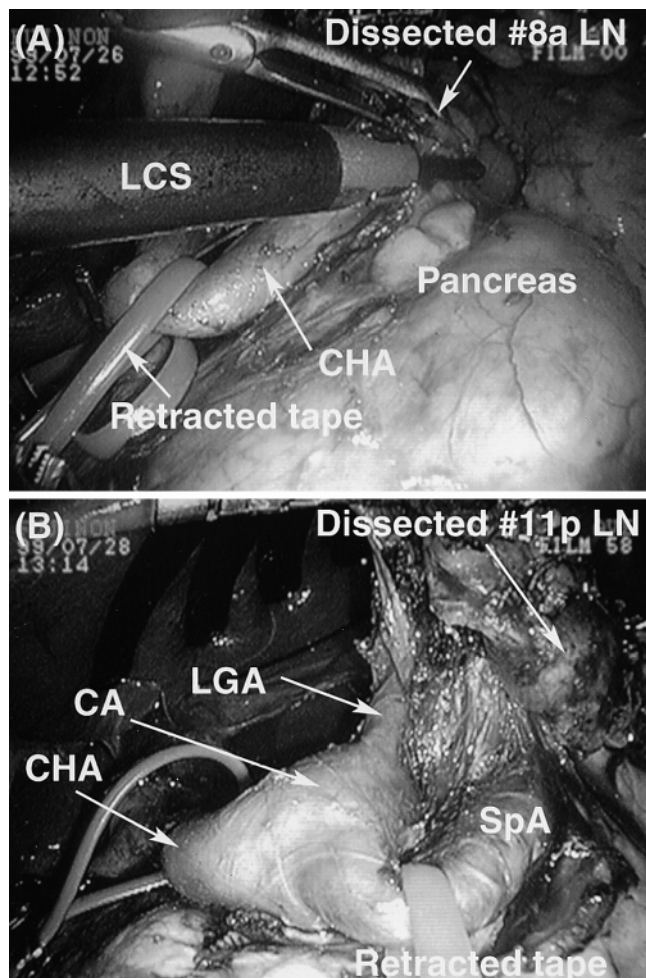


Fig. 3A,B. Dissection of LN stations no.8a and no.11p. **A** Following caudal retraction of the tape with the common hepatic artery (CHA), this artery was skeletonized, and LN station no.8a was dissected, using the LCS. **B** The root of the splenic artery was taped with vessel tape, and LN station no.11p was dissected along the upper border of the pancreas, using the LCS. CA, Celiac artery; SpA, splenic artery; LGA, left gastric artery

the stomach. In all of these patients, the procedure was completed without conversion to open surgery, because the lymph node metastasis were confined to the group 1 nodes, as determined by intraoperative histological examination. In this series, there were no mortalities, and the patients' postoperative courses were uneventful.

The average operative duration was 392 min (range, 372 to 458 min), which was significantly longer than that for the corresponding open surgery. The average blood loss was 168 g (range, 122 to 260 g), and only autologous blood transfusions were required. The average number of harvested lymph nodes per patient was 60.7 (range, 53 to 70). As determined by an unpaired *t*-test, this number was significantly different from the number of

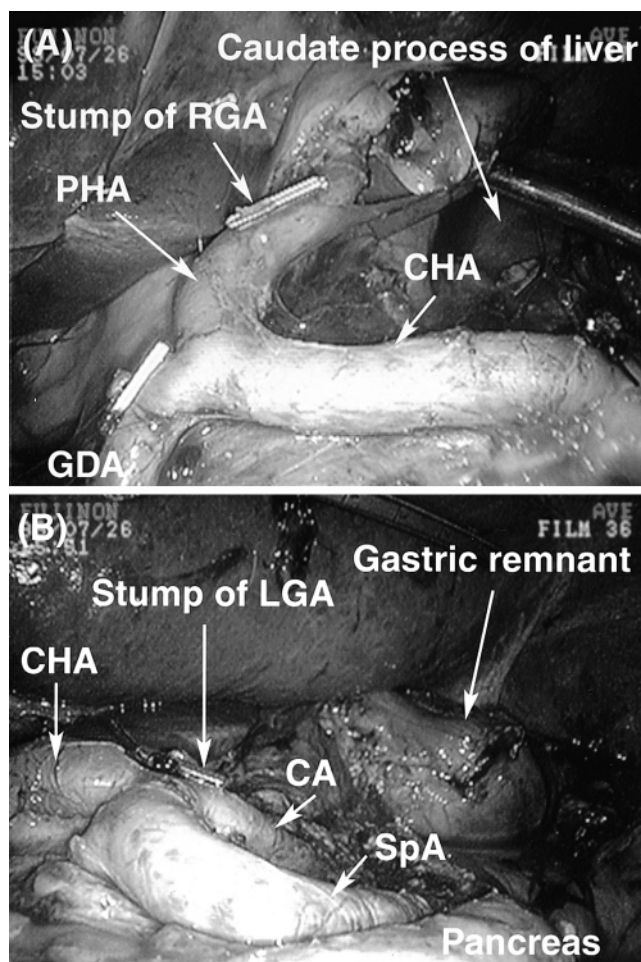


Fig. 4A,B. Complete radical lymph node dissection. GDA, Gastroduodenal artery; PHA, proper hepatic artery; RGA, right gastric artery; CHA, common hepatic artery; CA, celiac artery; SpA, splenic artery; LGA, left gastric artery

nodes harvested (average number, 46.4) in laparoscopic distal gastrectomies for early gastric cancers ($n = 12$) reported by us previously [6]. Moreover, there was no significant difference between the laparoscopic ($n = 5$) and our conventional open D2 dissection ($n = 10$) in terms of the number of nodes harvested (average number, 60.7 and 59.2, respectively). The specific final findings and curability in our five patients (according to the new JCGC [10]) are shown in Table 2.

Discussion

Laparoscopic surgery is becoming increasingly popular as a viable option in the management of early gastric cancer [1–6]. Despite its growing appeal, laparoscopic gastrectomy for advanced disease remains very controversial [7–9]. Although laparoscopic total gastrectomies for advanced cancer lesions located in the

Table 2. Final findings and curability

Case no.	Depth of invasion ^a	Lymph node stage ^a	Stage ^a	Curability ^a
1	pT2(mp)	pN0	IB	A
2	pT3(se)	pN1	IIIA	B
3	pT2(ss)	pN1	II	A
4	pT2(mp)	pN0	IB	A
5	pT2(mp)	pN0	IB	A

^a According to JCGC [10]

upper-third portion of the stomach have been reported [7,9], laparoscopic distal gastrectomy involving a D2 dissection for advanced disease located in the middle or lower third of the stomach has never been reported. The lack of such reported surgery is due, in part, to the lymph node dissections that are required. Specifically, laparoscopic surgery aimed at treating advanced cancers located in the middle or lower third of the stomach necessitates dissections of the lymph nodes at stations no.12a and no.14v, in addition to the D2 dissection called for by the 12th edition of the *General rules for gastric cancer study* [12].

While many surgeons have suggested that laparoscopic lymph node dissection at stations no.12a and no.14v is difficult and dangerous, our experience has been decidedly different. In fact, we have found these dissections to be both feasible and technically safe.

Previously, we discussed the procedures required for laparoscopic dissections of LN stations nos.1, 3, 4d, 4sb, 5, 6, 7, 8a, 9, and 11p in patients with early-stage cancer [6]. However, the degree of dissection we advocated for early-stage disease, at LN stations nos.8a and 11p, is not oncologically adequate for advanced disease. Therefore, in this series, we performed a more comprehensive lymph node dissection that involved taping and complete skeletonization of the common hepatic and proximal splenic arteries. Although the question arises as to whether or not our laparoscopic D2 dissection is really an en-bloc dissection, the dissection is not a “pick-up dissection” and should be considered as equivalent to the dissection afforded by open surgery.

In addition to using radical lymph node dissection, the adaptation of laparoscopic surgery for treating advanced gastric cancer also requires the consideration of “port-site recurrences”. While the mechanism of this phenomenon has not been clarified, investigators have speculated that it is probably caused by some combination of the following factors: (1) tumor manipulation; (2) failure to isolate the tumor; and (3) forceful extraction of the surgical specimen [13–16]. The literature has yet to report any such recurrences after laparoscopic radical gastrectomies. We believe that a procedure in which extracorporeal gastric resection

is performed through a mini-laparotomy cannot be performed without forceful extraction of the surgical specimen. Furthermore, we assume that this forceful extraction leads to possible port-site, or mini-laparotomy wound, recurrences. Thus, gastric resections have to be performed by an intra-abdominal laparoscopic approach. Indeed, in our own 52 totally intra-abdominal laparoscopic resections for malignant disease (32 gastric cancers and 20 colorectal cancers), we have not experienced port-site recurrences. From our experience, we feel that both careful visceral manipulation and a totally intra-abdominal laparoscopic resection are essential for avoiding such recurrences, and must be incorporated into this novel procedure. Therefore, we believe that our totally intra-abdominal laparoscopic gastrectomy with D2 dissection can be indicated for cT3-stage cancer. However, at present, our indication is confined to cT2 stage, due to insufficient elucidation of the port-site recurrence mechanism and the lack of data from any randomized control studies.

Although a substantial number of cases and a randomized control study are necessary for the objective evaluation of our procedure’s benefit and curability potential, we believe that laparoscopic D2 dissection for advanced cancer of the middle or lower portions of the stomach is both technically feasible and safe, and has many advantages over open surgery. Namely, it is associated with minimal postoperative pain, quicker mobilization, shorter hospitalization, and better cosmesis.

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