

# Proximal Subtotal Gastrectomy for the Treatment of Carcinoma of the Upper Third of the Stomach: Its Indications Based on Lymph Node Metastasis and Perigastric Lymphatic Flow

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**Abstract:** To clarify the indications for a proximal subtotal gastrectomy in the treatment of carcinoma in the upper third of the stomach based on lymph node metastases, 1055 patients in whom either a D<sub>2</sub> or greater lymph node removal was performed were reviewed. In the patients in which the lesion was confined to the upper stomach and did not invade beyond the muscularis propria of the stomach wall, no metastases to either the lymph nodes above and below the pylorus or the lymph nodes along the greater curvature were observed. A lymphatic flow study revealed a minimal flow to these nodes from the upper stomach in patients without lymph node metastasis, but in cases with lymph node metastases the lymphatic flow changed. The indications for a proximal subtotal gastrectomy for a carcinoma of upper third of the stomach therefore must fulfill the following two conditions: (1) The deepest layer of cancerous invasion does not extend beyond the muscularis propria of the stomach wall, and (2) No macroscopic evidence of lymph node metastasis can be detected during surgery.

**Key Words:** proximal subtotal gastrectomy, gastric cancer, lymph node metastasis, perigastric lymphatic flow

## Introduction

The principles of surgical treatment of carcinoma of the stomach to obtain a cure are: (1) to perform a sufficiently extensive gastric resection to obtain a tumor-free margin and (2) to remove the lymph nodes which are likely to be involved by metastasis. Expanding the area of resection and widening the range of lymph node removal needlessly are not always recommended in view of the postoperative quality of life. Without compromising the strategy for

cure, organs should always be preserved as much as possible.

With respect to carcinoma of the upper third of the stomach, some recommend a total gastrectomy<sup>1–3</sup> while others claim that there is no difference between a total and proximal gastrectomy in terms of the surgical outcome.<sup>4–6</sup>

If cancer-free margins can be obtained by a proximal gastrectomy, the difference in radicality between a total gastrectomy and a proximal subtotal gastrectomy thus depends on whether or not the lymph nodes above and below the pylorus and the lymph nodes along the greater curvature are removed. The aim of the present study was to clarify the indications of a proximal subtotal gastrectomy for the treatment of carcinoma of the upper stomach based on lymph node metastases and the perigastric lymphatic flow.

## Patients and Methods

### *Lymph Node Metastases*

Of the 1,630 patients who underwent surgery for gastric cancer between August 1978 and December 1991, 1,055 patients in whom either a D<sub>2</sub> or greater lymph node removal was performed were reviewed to clarify the relationship of the incidence of lymph node metastasis with the location of the cancer and the depth of invasion in the gastric wall. In 105 patients whose primary lesion was confined to the upper third of the stomach and did not extend to the middle stomach (including the cases in which the esophagus was involved), the lymph node stations that were involved by metastasis were investigated. The metastatic rate of each lymph node station was calculated as follows: The metastatic rate = number of patients with metastasis/number of patients with lymph node dissection.

### *Perigastric Lymphatic Flow After Endoscopic Injection of $^{99m}\text{Tc}$ -Rhenium Colloid*

The lymphatic flow from the upper part of the stomach to the perigastric lymph nodes was examined in five patients with upper gastric cancer who underwent radical resection including an extended lymph node dissection. Twenty-four hours before the operation, 1 ml of  $^{99m}\text{Tc}$ -Rhenium colloid ( $^{99m}\text{Tc}$ -RC), which had 3–5 mCi of radioactivity, was injected into the gastric wall around the malignant lesion. Immediately after the operation, the radioactivity in each lymph node was determined by a scintillation counter to quantitatively evaluate the lymphatic flow.<sup>7</sup>

### *Long-Term Results*

In 71 out of 105 patients with carcinoma confined to the upper third of the stomach, the long-term results of the 31 patients following a proximal subtotal gastrectomy and the 40 patients following a total gastrectomy were compared. The patients with an absolute noncurative resection ( $n = 15$ ), the patients with a subtotal distal gastrectomy ( $n = 6$ ), and the patients that died of other causes ( $n = 13$ ) were excluded from this analysis. The operative mortality rate of the patients with a radical resection was 8.3% (3/36) for a proximal subtotal gastrectomy and 10.4% (5/48) for a total gastrectomy.

### *Postoperative Physical Status*

In the patients alive to date without any evidence of recurrent cancer who were followed up in our institute more than 2 years after operation, the physical status after a proximal subtotal and a total gastrectomy were compared, including weight, red cell counts, hemoglobin, serum total protein, albumin, cholesterol and iron. The proximal subtotal gastrectomy group consisted of 17 patients (14 men and 3 women, average age 53.8 years), while the total gastrectomy group consisted of 13 patients (12 men and 1 woman, average age 58.7 years). In the proximal subtotal gastrectomy group, a combined resection of the spleen was performed in two patients while a combined resection of the pancreas tail and spleen was performed in one patient. In addition, the intestinal continuities were reconstructed by the double-tract method in 14 patients and a jejunal interposition in 3 patients. In the total gastrectomy group, a combined resection of the spleen was performed in 3 patients, a combined resection of the pancreas tail and spleen was performed in 4 patients, while the intestinal continuities were reconstructed by the double-tract method in 12 patients and a jejunal interposition in 1 patient.

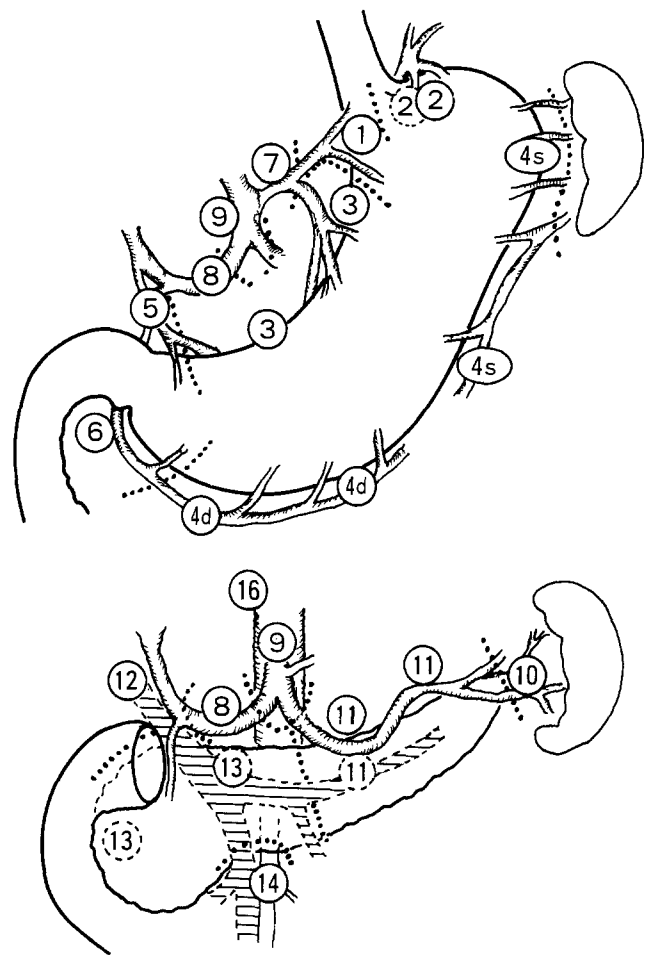
The numbering of the upper abdominal lymph node stations according to the General Rules for the Gastric

Cancer Study in Japan<sup>8</sup> is shown in Fig. 1. The statistical differences were evaluated by the chi-squared test (a comparison of the incidence of lymph node metastases), the Wilcoxon test (a comparison of the two items) and the generalized Wilcoxon test (the cumulative survival rate calculated by Kaplan-Meier method).

## **Results**

### *Relationship Between the Incidence of Lymph Node Metastases and the Main Tumor Area or the Depth of Invasion*

The deeper the invasion the higher the rate of lymph node metastasis for all gastric cancers, but some dif-



**Fig. 1.** The sites and borders of lymph node stations. 1, right cardia; 2, left cardia; 3, along the lesser curvature; 4, along the greater curvature; 4d, along the right gastroepiploic artery; 4s, along the left gastroepiploic artery; 5, suprapyloric; 6, infrapyloric; 7, along the left gastric artery; 8, around the common hepatic artery; 9, around the celiac artery; 10, at the splenic hilus; 11, along the splenic artery; 12, in the hepatoduodenal ligament; 13, behind the pancreas head; 14, at the root of the mesentery; 16, paraaortic

ferences were detected in relation to the main tumor site. In cancer of the upper third of the stomach, the incidence of metastasis was low in cancer involving only the mucosa (m-cancer) and in cancer involving the submucosa (sm-cancer), and even in cancer which involved the muscularis propria (mp-cancer). However, in cancer involving the subserosa (ss-cancer) there was a significant increase in the incidence of metastasis ( $p = 0.08$ ). In contrast, in cancer of the distal third of the stomach the incidence tended to be high even in m- and sm-cancer (so-called early cancer), and when invasion reached the muscularis propria level, the metastasis rate then rapidly rose further. In mp-cancers, the incidence of metastasis in cancer of the upper third of the stomach was significantly lower than in cancer of the distal third of the stomach (Fig. 2).

The metastatic patterns of tumors confined to the upper third of the stomach were analyzed (Table 1). In m-, sm-, or mp-cancer there were no metastases to the No. 5 suprapyloric lymph nodes, the No. 6 infrapyloric lymph nodes, or to the No. 4d lymph

nodes along the greater curvature (along the right gastroepiploic artery). In ss-cancer there was metastasis to the No. 5 lymph nodes, while in cancer which involved the serosa (se-cancer) and cancer which invaded the neighboring organs (si-cancer), metastasis was found at the No. 4d, 5, and 6 lymph nodes, although in patients with a curative resection no metastasis was found at the No. 4d and 6 nodes.

In six patients with metastasis at the No. 4d, 5, and 6 lymph nodes, the primary lesions were judged to be positive for serosal invasion, and macroscopical evaluations of lymph node metastases were judged to be positive in five patients and negative in one patient.

No relationship was observed between the histological type of cancer and the extent of lymph node metastasis.

*Perigastric Lymphatic Flow After Endoscopic Injection of <sup>99m</sup>Tc-RC*

Table 2 shows the radioactivity of the perigastric lymph nodes. In cases 1, 2, and 3 with no lymph node metastasis, the No. 4d, 5 and 6 lymph nodes demonstrated minimal activity which indicated minimal lymphatic flow to these lymph nodes from the upper part of the stomach. In case 4, the metastases of the No. 2 and 3 lymph nodes were found macroscopically during the operation, while the No. 4s and 4d lymph nodes revealed positive metastasis histologically. In case 5, large nodular metastases of the No. 3, 7, and 9 lymph nodes were detected macroscopically. The No. 5 lymph node revealed high radioactivity with histological metastasis.

*Long-Term Results in Cases of a Proximal Subtotal and Total Gastrectomy*

Dividing the patients into two groups according to whether or not the deepest layer of invasion extended

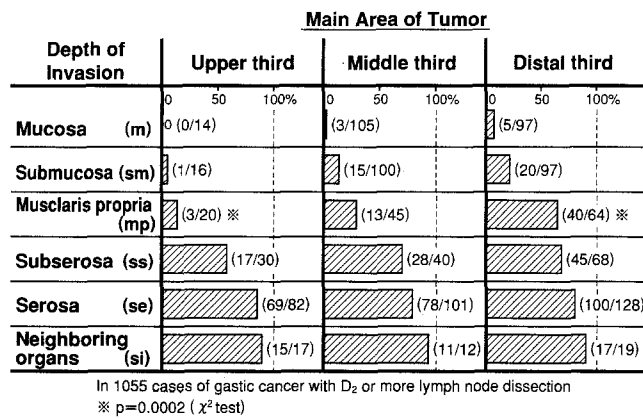


Fig. 2. The incidence of lymph node metastasis according to tumor location and the depth of invasion

Table 1. Rates (%) of lymph node metastasis in cancers confined to the upper third of the stomach, in 105 cases of gastric cancer with a D<sub>2</sub> or greater lymph node dissection

Depth of invasion	Lymph node station number															
	1	2	3	4s	4d <sup>a</sup>	5 <sup>a</sup>	6 <sup>a</sup>	7	8	9	10	11	12	13	14	16
m or sm <i>n</i> = 22 ( <i>n</i> = 22)	0	0	4.5 (4.5)	0	0	0	0	0	0	0	0	0	0	0	0	0
mp <i>n</i> = 16 ( <i>n</i> = 16)	0	0	12.5 (12.5)	0	0	0	0	0	0	6.3 (6.3)	0	6.3 (6.3)	0	0	0	0
ss <i>n</i> = 23 ( <i>n</i> = 20)	26.1 (25.0)	8.7 (10.0)	39.1 (35.0)	13.1 (10.0)	0	5.0 (5.8)	0	17.4 (15.0)	4.3 (0)	4.3 (5.0)	8.7 (5.0)	4.3 (5.0)	4.5 (0)	0	0	18.2 (0)
se or si <i>n</i> = 44 ( <i>n</i> = 32)	45.5 (43.8)	31.8 (34.8)	54.5 (53.1)	15.9 (18.8)	4.8 (0)	10.0 (6.9)	2.6 (0)	27.3 (18.8)	9.1 (3.1)	6.8 (3.1)	11.4 (15.6)	16.2 (21.8)	4.8 (0)	0	0	23.8 (0)

Parenttheses, in cases with a radical resection

<sup>a</sup>These lymph nodes may be left undissected in proximal subtotal gastrectomy

**Table 2.** The radioactivity (cpm/mg) of the lymph nodes after the injection of  $^{99m}\text{Tc}$ -Rhenium colloid into the gastric wall of the upper part of the stomach

Lymph node station	Case 1 (pos. wall)	Case 2 (pos. wall)	Case 3 (less. cur.)	Case 4 (pos. wall)	Case 5 (less. cur.)
1	11	7,479	7,736	617	840 <sup>a</sup>
2	647	627	—	1 <sup>a</sup>	—
3	46,586	1,717	1,193	4 <sup>a</sup>	504 <sup>a</sup>
4s	418	5,017	6,676	3 <sup>a</sup>	—
4d	6	5	66	13 <sup>a</sup>	1
5	3	10	2	1	202 <sup>a</sup>
6	3	8	75	29	11
7	13,990	759	1,070	1,202	4 <sup>a</sup>
8	5,337	7	8	5	29
9	8,575	2,351	773	191	5 <sup>a</sup>
10	932	8,696	2,192	773	1
11	366	1,799	131	2,301	1
12	6	50	3	24	1
13	1	—	1	—	—
14	4	—	—	9	—
16	574	3	55	73	23

Parentheses, site of injection; pos. wall. posterior wall; less. cur., lesser curvature

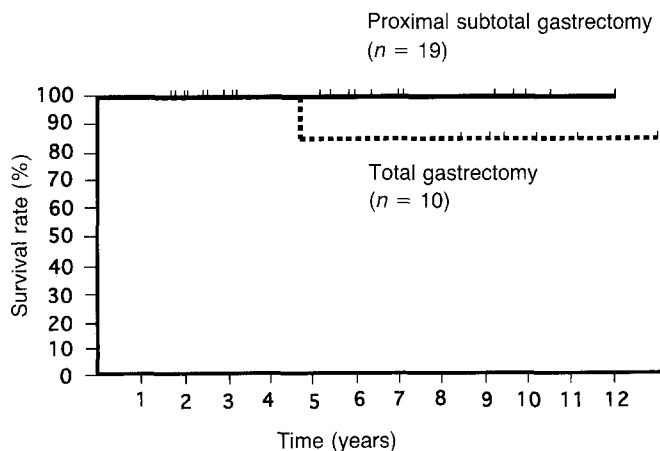
<sup>a</sup> Positive lymph node metastasis

beyond the muscularis propria, the long-term results after either a proximal subtotal and total gastrectomy were compared. However, no statistically significant difference was observed between the two groups (Figs. 3 and 4). In patients in which the deepest layer of invasion did not extend beyond the muscularis propria, only one patient in the total gastrectomy group died of liver recurrence. When the deepest layer of invasion extended beyond the muscularis propria, three patients died of peritoneal recurrence, one of local recurrence, one of lung recurrence, and one of unknown causes

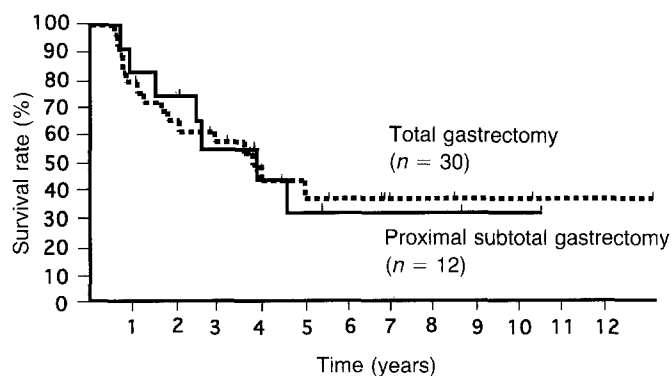
following a proximal subtotal gastrectomy. Following a total gastrectomy, six patients died of peritoneal recurrence, three of liver recurrence, two of lymph node recurrence, one of local recurrence, one of brain recurrence, and four of unknown causes.

#### *Physical Status After a Proximal Subtotal and Total Gastrectomy*

When we compared the physical status of the patients at 2 years after a proximal subtotal and total gastrectomy, the postoperative/preoperative body weight ratio was significantly higher in the former group than in the latter, although the patients' backgrounds of the



**Fig. 3.** The cumulative survival rates (Kaplan-Meier method) after either a proximal subtotal or total gastrectomy for cancer confined to the upper third of the stomach (in patients in which the deepest layer of invasion did not extend beyond the muscularis propria). No significant difference was found



**Fig. 4.** The cumulative survival rates (Kaplan-Meier method) after either a proximal subtotal or total gastrectomy for cancer confined to the upper third of the stomach (in patients in which the deepest layer of invasion extended beyond the muscularis propria). No significant difference was observed

two groups were not similar. All other factors were similar in both groups (Table 3).

## Discussion

The resection rates and curative resection rates for cancer of the gastric cardia are low, and this entity has been treated as a cancer for which it is difficult to obtain a cure. Although an elective total gastrectomy has been thought to be better for a cure, McNeer et al.<sup>9</sup> did not find an improvement in the long-term results. An extended total gastrectomy permits an en bloc removal of the lymph node groups, but this hardly constitutes sufficient theoretical grounds to require total gastrectomy for tumors of the upper stomach. The choice of whether to perform a total gastrectomy or a proximal resection should thus be decided on the basis of whether or not there are metastases in the perigastric lymph nodes. Papachristou and Fortner<sup>10</sup> proved that surgical treatment for adenocarcinoma of the cardia was curative only in cases of stage I and II disease, where an extended total gastrectomy resulted in a significantly higher survival rate than a proximal subtotal gastrectomy. However, in their study, the location of the sites of lymph node metastasis were not precisely described.

As a result of improvements in diagnostic technology in recent years, the number of early cancer cases has increased, and more conservative surgery is now being discussed. A proximal subtotal gastrectomy is a type of limited surgery. To ensure that there is no decrease in the radical cure, careful studies of the indications for its use are required.

In cases of shallow invasion, the rate of lymph node metastasis in carcinoma of the upper stomach was lower than that of cancer of the distal stomach. The findings of Boku et al.<sup>11</sup> were similar to ours, although Sowa et al.<sup>12</sup> found no difference in the rate of lymph node metastasis of early cancer.

Moreover, in cancers confined to the upper stomach, no metastasis at the No. 4d, 5, and 6 lymph node stations was found in m-, sm- and mp-cancers. Kitamura et al.<sup>13</sup> also reported results similar to ours. Maruyama et al.<sup>14</sup> reported that the metastatic rates of these lymph nodes were low even in advanced cancer. In our series, the patients with a radical resection had an extremely low rate of metastasis at these lymph nodes stations. In addition, the lymphatic flow examinations using <sup>99m</sup>Tc-RC also demonstrated minimal flow to these lymph nodes from the upper part of the stomach. However, since there is a possibility of metastasis to these lymph node stations in cancers with invasion beyond the muscularis propria layer, we implemented a policy of a total gastrectomy in such cases, although there was no significant difference in the long-term results between a proximal subtotal and a total gastrectomy. Moreover, when metastasis is macroscopically detected, it is safer to perform a total gastrectomy because of the possible changes in the lymphatic flow, as shown in case 5 in a <sup>99m</sup>Tc-RC study.

Kitamura et al.<sup>13</sup> recommended that the indications for proximal gastrectomy should be limited to m- or sm-cancers with no macroscopic metastasis and which are confined to the upper third of the stomach to ensure a safety zone. On the other hand, Kaibara et al.<sup>15</sup> reported that a proximal gastrectomy was indicated in all patients with upper gastric cancer confined to the upper third of the stomach because they found no metastasis at the No. 5 or 6 lymph nodes, and thus total gastrectomy was not thought to improve the prognosis.

Another problem is the difficulty in evaluating the depth of cancerous invasion. Recently, preoperative endoscopic ultrasonography (EUS) has been shown to be efficacious in the evaluation of the depth of invasion. The rate of a correct diagnosis improved to 90.4% in m-cancer, 69.8% in sm-cancer, 73.3% in mp-cancer, and 87.1% in ss-cancer or deeper.<sup>16</sup> However,

**Table 3.** The physical status of the patients 2 years after either a proximal subtotal or total gastrectomy

	Proximal subtotal gastrectomy (n = 17)	Total gastrectomy (n = 13)	Wilcoxon test
Before operation			
Age	53.8 ± 13.0	58.7 ± 7.7	P = 0.26
Weight (kg)	60.9 ± 9.4	59.1 ± 11.8	P = 0.62
Two years after operation			
Body weight ratio (postoperative/preoperative)	0.90 ± 0.09	0.83 ± 0.08	P = 0.028
Red cell counts (cells/ $\mu$ l)	414 ± 37 × 10 <sup>4</sup>	393 ± 60 × 10 <sup>4</sup>	P = 0.43
Hemoglobin (g/dl)	12.9 ± 1.2	12.7 ± 1.0	P = 0.48
Serum total protein (g/dl)	6.9 ± 0.6	6.8 ± 0.4	P = 0.62
Serum albumin (g/dl)	4.0 ± 0.4	3.8 ± 0.4	P = 0.24
Serum cholesterol (mg/dl)	162 ± 28	168 ± 29	P = 0.75
Serum iron ( $\mu$ g/dl)	116 ± 50	113 ± 43	P = 0.79

EUS has not yet become a routine preoperative procedure. Therefore, judgment during operation whether cancerous invasion extends beyond the mp-layer or not should be done by macroscopic findings of serosal invasion. All patients with lymph node metastasis at the No. 4d, 5, or 6 stations had macroscopic serosal invasion in our series.

With respect to the quality of life after a proximal gastrectomy, the postoperative/preoperative body weight ratio is higher in patients with a proximal gastrectomy than a total gastrectomy, although the number of patients is small and the patients' backgrounds differed between the two groups. Namely, the rate of a combined resection was higher in the total gastrectomy group than in the proximal gastrectomy group. However, when we examined the patients after a total gastrectomy, there were no significant differences in the body weight ratio according to the combined resections (data not shown). It should be emphasized that no patient suffered from reflux esophagitis after proximal gastrectomy because we reconstructed the intestinal continuity either by the double-tract method or by jejunal interposition.

In conclusion, the indications for a proximal subtotal gastrectomy in the treatment of gastric cancer confined to the upper third of the stomach must meet the following two conditions: (1) The deepest layer of invasion of the stomach wall does not extend beyond the muscularis propria (i.e. the cancer has no serosal invasion macroscopically), and (2) no macroscopic lymph node metastases should be detected during surgery.

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