Yonago Acta medica 2000;43:73–80

Clinicopathological Aspects of Gastric Carcinoma in the Remnant Stomach

Masahide Ikeguchi, Shin-ichi Oka and Michio Maeta*

*First Department of Surgery and *Department of Fundamental Nursing, Faculty of Medicine, Tottori University, Yonago 683-0826, Japan*

The clinicopathological differences between remnant gastric carcinoma (RGC) after partial gastrectomy for benign disease (RGC-BD) and RGC after partial gastrectomy for gastric carcinoma (RGC-GC) were evaluated. The incidences of developing gastric carcinomas in patients more than 10 years after partial gastrectomy for benign disease or for gastric carcinoma were compared with those of developing gastric carcinomas in patients with colorectal carcinoma who were determined to have no malignant disease in the stomach preoperatively. Next, we analyzed the clinicopathological differences among RGC-BD, RGC-GC and primary gastric carcinoma (PGC) in the upper third of the stomach. RGC-BD was detected in 8 of 1,187 (0.7%) patients and RGC-GC was detected in 19 of 764 (2.5%) patients. Among the controls, 7 of 226 (3.1%) patients developed gastric carcinoma. The estimated risk of developing of RGC-BD and RGC-GC were 0.12 and 0.798. No difference was found among 18 patients with RGC-BD, 16 patients with RGC-GC and 229 patients with PGC in terms of patient age, histologic type, tumor size and distribution of tumor stage. The 5-year survival rate for patients with PGC (55%) was not different from that for patients with RGC-BD (43%) or that for patients with RGC-GC (65%). However, the interval between initial operation and detection of RGCs was longer in RGC-BD than in RGC-GC (P = 0.004), and RGCs were more frequently detected at the site of anastomosis in patients with RGC-BD (50%) than in patients with RGC-GC (19%, P = 0.057). The incidence of developing RGCs after partial gastrectomy for benign and malignant diseases was low. The histologic type of tumors and tumor stages of RGC-GC were not different from those of RGC-BD; however, RGC-GC developed within a short time and most lesions were at sites remote from the anastomosis. These findings indicate that carcinogenesis of RGC-GC appears to be different from that of RGC-BD.

Key words: partial gastrectomy for benign disease; partial gastrectomy for gastric carcinoma; primary gastric carcinoma in the upper third of the stomach; prognosis; remnant gastric carcinoma

Carcinomas developing in the remnant stomach after partial gastrectomy for benign gastroduodenal disease, such as gastric ulcer or duodenal ulcer, have been intensively investigated in Western countries (Kivilaakso et al., 1977; Northfield and Hall, 1990). However, little data exists on the group of patients who undergo a partial gastric resection for gastric carcinoma, later developing the second primary lesion in the gastric remnant. As a result of the increasing number of patients who have undergone gastrectomy for early gastric cancer in Japan, the incidence of developing second primary gastric cancer in the remnant stomach has increased (Furukawa et al., 1993; Isozaki et al., 1998). However, the clinicopathological difference between the 2 types of gastric carcinomas which developed in the remnant stomach (after

Abbreviations: B-I, Billroth I; B-II, Billroth II; PGC, primary gastric carcinoma; RGC, remnant gastric carcinoma; RGC-BD, RGC after partial gastrectomy for benign disease; RGC-GC, RGC after partial gastrectomy for gastric carcinoma

partial gastrectomy for benign disease and after partial gastrectomy for gastric carcinoma) has not been well discussed.

In this study, we designed 2 studies to determine the difference between these 2 types of gastric carcinomas in the remnant stomach (remnant gastric carcinoma, RGC). First, we followed patients who had undergone distal partial gastrectomy for benign disease or for gastric carcinoma at our hospital, and compared the incidences of developing gastric carcinomas in the remnant stomachs. Next, we analyzed the clinicopathological differences between the 2 types of RGCs gastrectomized in our hospital. Also, we compared the clinicopathological data of patients with RGC with that of patients with primary gastric carcinoma (PGC) which developed in the upper third of the stomach.

Materials and Methods

Study design

In order to analyze the incidence of developing gastric carcinoma in the remnant stomach, we studied 2,880 patients (2,045 males, 835 females; mean age, 53.9 years; age ranges, 15–88 years) who underwent distal partial gastrectomy between 1960 and 1985 in our hospital. Billroth I (B-I) reconstruction was performed in 1,717 patients and Billroth II (B-II) reconstruction was performed in 1,163 patients. Distal partial gastrectomy was performed for benign disease in 1,383 patients (1,072 males, 311 females; mean age, 49.6 years; age range, 15–86 years). Benign gastroduodenal diseases in 1,383 patients included gastric ulcer (839), duodenal ulcer (273), polyp (150), gastritis (99) and benign submucosal tumor (22). Distal partial gastrectomy was performed for gastric carcinoma in 1,497 patients (973 males, 524 females; mean age, 58 years; age range, 21–88 years). Tumor stages for these patients included Stages IA (498), IB (222), II (249), IIIA (204), IIIB (155) and IV (169). These 2,880 patients were followed till the end of 1999. The mean follow-up period was 210 months (range: 0–480 months). The mean follow-up period of the 1,383 patients who underwent partial gastrectomy for benign diseases was 282 months (range: 0–480 months) and that of the 1,497 patients who underwent partial gastrectomy for gastric carcinoma was 144 months (range: 0–469 months). The follow-up records of patients were obtained from our hospital and from affiliated hospitals. For the controls, we investigated the incidence of occurrence of gastric carcinoma in 516 patients (297 males, 219 females; mean age, 60 years; age range, 22–91 years) with colorectal carcinoma who underwent colorectal resection between 1960 and 1985 in our hospital. These 516 patients were confirmed to have no gastric carcinomas in the stomach prior to colorectal operation by the upper barium gastrointestinal series or by the endoscopic studies. They were followed up at our hospital till the end of 1999. The mean follow-up period of these 516 patients was 121 months (range: 0–473 months).

Between 1960 and 1993, 23 patients with RGC after partial gastrectomy for benign disease (RGC-BD) and 37 patients with RGC after partial gastrectomy for gastric carcinomas (RGC-GC) were treated in our hospital. In the 23 patients with RGC-BD, the first gastrectomies for 6 patients were performed in our hospital and those for the remaining 17 patients were done in other hospitals. In the 37 patients with RGC-GC, the first gastrectomies for 18 patients were performed in our hospital and those for the remaining 19 patients were done in other hospitals. In order to analyze the clinicopathological differences between RGC-BD and RGC-GC, we excluded 26 patients (RGC-BD: 5 patients and RGC-GC: 21 patients) whose interval period between the initial gastrectomy and the detection of carcinoma in the remnant stomach was less than 10 years from our study; we could not negate the possibility that some cancer could have already developed in the upper third of the stomach at the time of distal partial gastrectomy for benign disease or for malignant disease, and was overlooked at the time of the initial operation, nor could we negate the possibility of cancer recurrence in the remnant stomach after distal partial gastrectomy for gastric carcinoma. Kidokoro et al. (1985) reported

that the recurrence of gastric carcinoma usually occurred within 10 years regardless of the initial stage of disease. To eliminate these possibilities, an interval of more than 10 years is required between the initial partial gastrectomy and the detection of carcinoma in the remnant stomach (Takeda et al., 1992). Thus, RGCs (RGC-BD: 18 patients and RGC-GC: 16 patients) found after more than 10 years from initial gastrectomy are likely to represent true new neoplasms. As a control group for RGC, 299 patients with PGC located in the upper third of the stomach who underwent gastrectomy between 1960 and 1993 were investigated.

Clinicopathological and statistical analysis

Clinicopathological factors were determined in accordance with criteria from the Japanese Research Society for Gastric Cancer (1999). Histological classifications of tumors followed the criteria established by Laurén (1965). The chi-square test and Fisher's exact probability test were used to compare the distribution of individual variables among the groups. Differences in the numerical data (patient age and tumor size) among the groups were evaluated by the Mann-Whitney *U* test or by the Kruskal-Wallis test. The survival distributions were estimated using the method of Kaplan and Meier. Corrected survival rates were used; that is, only deaths caused by gastric carcinoma were regarded as outcome events, and all other deaths were considered censored events. Differences between survival distributions were tested for statistical significance by log rank analysis. All statistical analyses were performed using the StatView-5.0 software package for Macintosh (Abacus Concepts Inc., Berkeley, CA). *P* values less than 0.05 were considered to be statistically significant.

Table 1. The interval (in years) between primary operation and detection of RGC in 36 patients

Year after gastric resection	Number of patients with RGC-BD	RGC-GC
< 4	0	5
5 – 9	0	4
10 – 14	4	11
15 – 19	4	5
20 ≤	0	3
Total	8	28

RGC, remnant gastric carcinoma; RGC-BD, RGC detected after distal partial gastrectomy for benign gastroduodenal disease; RGC-GC, RGC detected after distal partial gastrectomy for gastric carcinoma.

Results

The incidence of developing gastric carcinoma in the remnant stomach

In the 2,880 patients who underwent distal partial gastrectomy between 1960 and 1985, 36 patients (RGC-BD: 8 patients and RGC-GC: 28 patients) developed gastric carcinoma in their remnant stomach by the end of 1999. The intervals between initial partial gastrectomy and detection of RGC for these 36 patients are shown in Table 1. The mean interval between initial operation and the detection of RGC of the 8 patients with RGC-BD was 178 months (125–228 months) and that of the 28 patients with RGC-GC was 142 months (22–271 months). Of the 2,880 patients, 1,951 patients (1,187 patients for benign diseases and 764 patients for gastric carcinomas) survived more than 10 years after partial gastrectomy. Newly developed gastric carcinomas in the remnant stomach more than 10 years after initial operation were detected in 8 of 1,187 (0.7%) patients for benign diseases and in 19 of 764 (2.5%) patients for gastric carcinomas. Among the 516 colorectal carcinoma patients (control patients), 226 patients were followed up more than 10 years after surgery and 7 patients (3.1%) were found to have gastric carcinoma. The details of the incidence of developing RGCs after partial gastrectomy are shown in Table 2. In our case-control study, estimated risks (odds ratios) of the development of RGCs after partial gastrectomy for benign diseases and for gastric carcinomas were low (0.212 and 0.798, Table 2).

Table 2. The incidence of developing gastric carcinoma in the remnant stomach more than 10 years after partial gastrectomy

Initial operation for	Total number of patients	Number of patients† (%)	Odds ratio [95% confidence limit]
Benign gastroduodenal disease			
Total	1187	8 (0.8)*	0.212 [0.083–0.539]
Operative procedure			
Billroth I	902	7 (0.8)****	
Billroth II	285	1 (0.4)*****	
Gastric carcinoma			
Total	764	19 (2.5)**	0.798 [0.332–1.919]
Operative procedure			
Billroth I	469	12 (2.6)******	
Billroth II	295	7 (2.4)*******	
Control group	226	7 (3.1)***	1.00

† Patients with newly developed gastric carcinoma in the remnant stomach.
Control group: patients with colorectal carcinoma who were followed up for more than 10 years after colorectal operation.
Statistically significant differences were observed between * and ** ($P = 0.001$) and between * and *** ($P = 0.001$).
No significant differences were detected between ** and *** ($P = 0.614$), between **** and ***** ($P = 0.444$) or between ****** and ******* ($P = 0.873$).

Clinicopathological differences between RGCs and PGC in the upper third of the stomach

Clinicopathological findings of 18 patients with RGC-BD, 16 patients with RGC-GC and 299 patients with PGC are shown in Table 3. No statistically significant differences were observed among the 3 groups (as assessed in terms of patient age, histologic type, tumor size and distribution of histologic stage). Remnant gastrectomy was performed for 28 patients (RGC-BD: 15 and RGC-GC: 13). Because of distant metastases or the degree of advancement of gastric carcinomas, gastrectomy could not be performed in 6 patients with RGC (RGC-BD: 3 and RGC-GC: 3). The resectability rate of RGC-BD was 83% and that of RGC-GC was 81%. Partial remnant gastrectomy was performed for 2 patients and total remnant gastrectomy was done for the remaining 26 patients with RGC. In the 299 patients with PGC, total gastrectomy was performed for 173, and proximal gastrectomy for the remaining 126 patients. One patient with RGC-BD and 18 patients with PGC died from postoperative complications (total gastrectomy: 12 and proximal gastrectomy: 6). The postoperative mortality rates of the 3 groups were not significantly different (Table 3). Among patients who underwent resection of the stomach, 8 patients with RGC-BD, 4 patients with RGC-GC and 107 patients with PGC had died from gastric carcinoma by the end of 1999. The 5-year survival rate for the 299 patients with PGC was 55%, while that for the 15 patients with RGC-BD was 43%, and that for the 13 patients with RGC-GC was 65%, as estimated by the Kaplan-Meier method. No statistically significant difference was found among the 3 survival curves by the log rank test ($P = 0.548$, Fig. 1).

Pathological differences between RGC-BD and RGC-GC

The initial operative procedure and histologic type of tumor of patients with RGC-BD were not different from those of patients with RGC-GC. However, the interval between the initial operation and detection of RGCs was longer in RGC-BD than in RGC-GC ($P = 0.004$). According to our classification of the location of RGCs (Ikeguchi et al., 1994), RGCs were more

Table 3. Clinicopathological differences among RGC-BD, RGC-GC and PGC

	RGC-BD [18]	RGC-GC [16]	PGC [299]	*P*
Age (mean, year)	63.7	64.3	59.4	0.098
Gender				
Male/female	16/2	8/8	204/95	0.05
Histologic type				
Diffuse type/intestinal type	8/10	9/7	172/127	0.557
Tumor size (mean, cm)	6.2	6.1	7.1	0.374
Stage				
IA	3	6	59	
IB	2	2	26	
II	3	1	54	0.569
IIIA	1	2	60	
IIIB	4	1	36	
IV	5	4	64	
Operative mortality (%)	1/15 (6.7)	0/13 (0)	18/299 (7.9)	0.655

[ ], number of patients.
PGC, primary gastric carcinoma located in the upper third of the stomach; RGC, remnant gastric carcinoma; RGC-BD, RGC after partial gastrectomy for benign disease; RGC-GC, RGC after partial gastrectomy for gastric carcinoma.

frequently detected at the site of anastomosis in patients with RGC-BD (50%) than in patients with RGC-GC (19%, $P = 0.057$, Table 4). Moreover, 10 of 12 tumors (83%) located at the anastomotic site were the diffuse type while, in contrast, only 7 of 22 tumors (32%) located at other sites were the diffuse type. The difference was significant ($P = 0.004$). However, no significant correlations were detected between initial operative procedures (B-I or B-II) and the location of RGCs ($P = 0.799$) or between initial operative procedures and the histologic types of tumors ($P = 0.492$). The interval between the initial operation and detection of RGCs of 12 tumors located at the anastomotic site (mean: 232 months) was longer than that of 22 tumors located at other sites (mean: 205 months, $P = 0.027$). Based on these results,

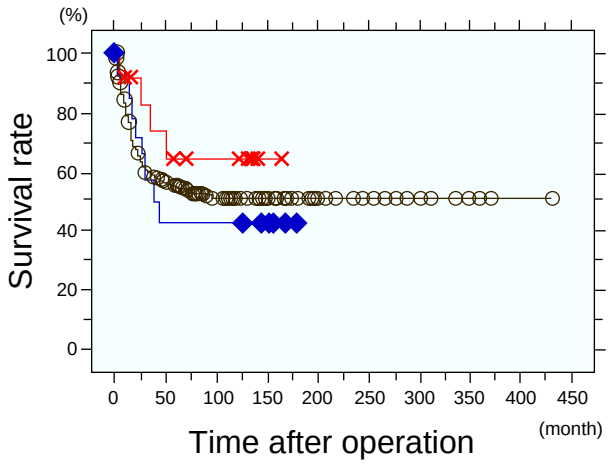

Fig. 1. Survival curve for 299 patients with PGC (○—○), for 15 patients with RGC-BD (◆—◆) and for 13 patients with RGC-GC (×—×) are shown. No statistically significant difference was found among the 3 survival curves by the log rank test ($P = 0.548$).

Table 4. Clinicopathological differences between RGC-BD and RGC-GC

	RGC-BD [18]	RGC-GC [16]	*P*
Reconstruction of initial operation			
Billroth I/Billroth II	8/10	10/6	0.292
Histologic type			
Diffuse type/intestinal type	8/10	9/7	0.472
Interval between initial operation and detection of RGC			
(mean, month)	265	167	0.004
Location of tumor			
Anastomotic site/other site	9/9	3/13	0.057

[ ], number of patients.
RGC, remnant gastric carcinoma; RGC-BD, RGC after partial gastrectomy for benign disease; RGC-GC, RGC after partial gastrectomy for gastric carcinoma.

RGC-BD seems to develop frequently at the anastomotic site and its development seems to take longer than that of RGC-GC.

Discussion

The partial distal gastrectomy for benign gastroduodenal diseases has been considered to be a risk factor of developing RGC. However, whether gastric resection implies an increased risk for carcinoma remains a matter of dispute. Tersmette et al. (1991) calculated the estimated risk of developing RGC after distal partial gastrectomy for benign gastroduodenal diseases from reports previously published. According to their data, the estimated risk ranged from 0.2 to 4.4, and they reported that the weighted mean relative risk of RGC-BD in Japan was 0.28; significantly lower than that of RGC-BD in Europe (1.66). In our case-control study, the estimated risk (odds ratios) of developing RGC after partial gastrectomy for benign diseases was 0.212. Tersmette et al. (1991) reported that a very high incidence of primary gastric cancer in Japan statistically resulted in a decreased risk for RGC-BD. On the other hand, primary gastric cancer has been much less common in Europe, thus the risk of RGC-BD relatively increased. Interestingly, Harrison et al. (1997) reported that total caloric intake increased the risk of developing gastric carcinoma and that dietary fiber intake decreased this risk. In Italy, high intake of meat, salted fish, seasoned cheese and traditional foods were reported as risk factors in the development of gastric carcinoma (Buiatti et al., 1991; La Vecchia et al., 1995). Geographical variance and dietary differences between Japanese and European people need to be correlated with the incidence of RGC-BD.

To date, RGC-GC has not been thoroughly discussed. In investigating RGC-GC, the possibility of overlooking multiple synchronous small carcinomas in the remnant stomach or the possibility of cancer recurrence in the remnant stomach has been considered major difficulties. Overlooking small carcinomas in the remnant stomach at the time of initial partial gastrectomy has also been a problem in investigating RGC-BD. Many reports from Western countries have required that the interval between the initial operation and detection of RGC should be more than 5 years to avoid these possibilities (Luukkonen et al., 1990; Pointner et al., 1994). Kosaka et al. (1990) reported that the rate of occurrence of synchronous multiple gastric carcinomas was 5.8% by macroscopic examination, though the rate increased to 13.2% after microscopic examination of the stomach. Kodera et al. (1995) reported that in only 53% of patients with synchronous multiple gastric carcinomas, the lesions were detected before operation. Moreover, they concluded that overlooking one or more microscopic neoplastic lesions might result in the development of cancer of the gastric remnant within 10 years after initial partial gastrectomy for benign or

malignant conditions. Thus, in the study, to avoid the possibility of overlooking microscopic gastric carcinoma and to avoid the possibility of recurrence of carcinoma, we required 10 years or more for the interval between the initial partial gastrectomy and the detection of carcinoma in the remnant stomach. In the present study, the estimated risk of developing metachronous gastric carcinoma in the remnant stomach after partial gastrectomy for gastric carcinoma was 0.798.

Some reports have estimated the risk of developing RGC based on the mortality rate (Luukkonen et al., 1990) or the incidence rate (Domellöf and Janunger, 1977) for gastric carcinoma in their countries (cohort studies). We conducted a hospital-based case-control study. As a control group, we selected patients with colorectal carcinoma. The possibility of selection bias in terms of the control group should be considered in any hospital-based study compared with a population-based study. Moreover, our control patients were not matched with patients who underwent partial gastrectomy in terms of age and sex. However, hospital-based individuals generally provide higher compliance and accuracy of information. We checked the control patients, who were determined to have no gastric carcinomas in their stomachs, before colorectal operation and they were followed up for a long time at our hospital. The clinical records of the control patients could be obtained every year and the incidence of developing gastric carcinoma could be accurately calculated.

What is the difference between RGC-BD and RGC-GC? Histologic distribution and stage distribution were not significantly different among the RGC-BD, RGC-GC and PGC groups. Moreover, the prognosis of patients operated on for RGC-BD was not different from that of patients operated on for RGC-GC or from that of patients with PGC. The same result was obtained by Kodera et al. (1996). Although no significant difference was found, RGCs located in the anastomotic area were frequently detected in RGC-BD, while, in contrast, RGCs located in other sites were frequently found in RGC-GC. The interval between the initial operation and detection of RGC was longer in RGC-BD than in RGC-GC. Moreover, 83% of tumors located at the anastomotic site were the diffuse type, while only 32% of tumors located at other sites were the diffuse type ($P = 0.004$). The interval between the initial operation and detection of RGCs of tumors located at the anastomotic site was longer than that of tumors located at other sites ($P = 0.027$). These findings indicate that the carcinogenesis of RGC-GC is in some regard different from that of RGC-BD.

In the previous study, we investigated the proliferative activity of normal gastric mucosa adjacent to carcinoma in 13 patients with RGC by flow cytometry (Ikeguchi et al., 1995). We reported that the percentages of the $S + G_2M$ phase of the normal mucosa in anastomotic areas from 5 patients with RGC-BD was significantly higher than those from 8 patients with RGC-GC. Assad and Eastwood (1980) reported that epithelial proliferation, assessed in biopsies morphologically, was increased significantly in the fundic mucosa of patients after antrectomy, as compared to the fundic mucosa of normal controls. These findings indicate that the increase in proliferation of cells in the mucosa of the remnant stomach is closely related to the extent of exposure of the gastric mucosa to the duodenal contents. Duodenogastric bile reflux after distal partial gastrectomy was found to induce carcinoma at the anastomotic site in animal experiments (Nishidoi et al., 1984). Dysplasia, intestinal metaplasia and atrophy of the normal mucosa have frequently been observed at the anastomotic area of the remnant stomach (Offerhaus et al., 1989). These changes in the gastric mucosa, considered to be the result of duodenogastric reflux into the remnant stomach, have been suggested to be the initial signs of developing RGC-BD. In contrast, developing RGC-GC has the characteristics of multifocal cancer; it develops relatively quickly and most lesions are located at sites remote from the anastomosis.

To realize the carcinogenesis of RGC, further investigations about the normal epithelium of the gastric remnant are necessary.

References

1 Assad RT, Eastwood GL. Epithelial proliferation in human fundic mucosa after antrectomy and vagotomy. Gastroenterology 1980;79:807–811.
2 Buiatti E, Palli D, Bianchi S, Decaril A, Amadori D, Avellini C, et al. A case-control study of gastric cancer and diet in Italy. III. Risk patterns by histologic type. Int J Cancer 1991;48:369–374.
3 Domellöf L, Janunger K-G. The risk for gastric carcinoma after partial gastrectomy. Am J Surg 1977;134:581–584.
4 Furukawa H, Iwanaga T, Hiratsuka M, Imaoka S, Ishikawa O, Kabuta T, et al. Gastric remnant cancer as a metachronous multiple lesion. Br J Surg 1993;80:54–56.
5 Harrison LE, Zhang Z-F, Karpeh MS, Sun M, Kurtz RC. The role of dietary factors in the intestinal and diffuse histologic subtypes of gastric adenocarcinoma. A case-control study in the USA. Cancer 1997;80:1021–1028.
6 Ikeguchi M, Kondou A, Shibata S, Yamashiro H, Tsujitani S, Maeta M, et al. Clinicopathologic differences between carcinoma in the gastric remnant stump after distal partial gastrectomy for benign gastroduodenal lesions and primary carcinoma in the upper third of the stomach. Cancer 1994;73:15–21.
7 Ikeguchi M, Kondou A, Oka A, Tsujitani S, Maeta M, Kaibara N. Flow cytometric analysis of the DNA content of tumor cells in cases of gastric cancer in the upper third of the stomach and in the remnant stomach. Oncology 1995;52:116–122.
8 Isozaki H, Tanaka N, Fujii K, Nomura E, Tanigawa N. Surgical treatment for advanced carcinoma of the gastric remnant. Hepato-Gastroenterology 1998;45:1896–1900.
9 Japanese Research Society for Gastric Cancer. Japanese classification of gastric carcinoma. 13th ed. Tokyo: Kanehara; 1999 (in Japanese).
10 Kidokoro T, Hayashida Y, Urabe M. Long-term surgical results of carcinoma of the gastric remnant: a statistical analysis of 613 patients from 98 institutions. World J Surg 1985;9:966–971.
11 Kivilaakso E, Hakkiluoto A, Kalima TV, Sipponen P. Relative risk of stump cancer following partial gastrectomy. Br J Surg 1977;64:336–338.
12 Kodera Y, Yamamura Y, Torii A, Uesaka K, Hirai T, Yasui K, et al. Incidence, diagnosis and significance of multiple gastric cancer. Br J Surg 1995; 82:1540–1543.
13 Kodera Y, Yamamura Y, Torii A, Uesaka K, Hirai T, Yasui K, et al. Gastric remnant carcinoma after partial gastrectomy for benign and malignant gastric lesions. J Am Coll Surg 1996;182:1–6.
14 Kosaka T, Miwa K, Yonemura Y, Urade M, Ishida T, Takegawa S, et al. A clinicopathological study on multiple gastric cancers with special reference to distal gastrectomy. Cancer 1990;65: 2602–2605.
15 Laurén R. The two histological main types of gastric carcinoma: diffuse and so-called intestinal type carcinoma. APMIS 1965;64:31–34.
16 La Vecchia C, D'Avanzo B, Negri E, Decaril A, Benchou J. Attributable risk for stomach cancer in northern Italy. Int J Cancer 1995;60:748–752.
17 Luukkonen P, Kalima T, Kivilaakso E. Decreased risk of gastric stump carcinoma after partial gastrectomy supplemented with bile diversion. Hepato-Gastroentelology 1990;37:392–394.
18 Nishidoi H, Koga S, Kaibara N. Possible role of duodenogastric reflux on the development of remnant gastric carcinoma induced by *N*-methyl-*N'*-nitro-*N*-nitrosoguanidine in rats. J Natl Cancer Inst 1984;72:1431–1435.
19 Northfield TC, Hall CN. Carcinoma of the gastric stump: risks and pathogenesis. Gut 1990;31: 1217–1219.
20 Offerhaus GJA, VD Stadt J, Huibregtse K, Tersmette AC, Tytgat GNJ. The mucosa of the gastric remnant harboring malignancy. Histologic findings in the biopsy specimens of 504 asymptomatic patients 15 to 46 years after partial gastrectomy with emphasis on nonmalignant lesions. Cancer 1989;64:698–703.
21 Pointner R, Wetscher GJ, Gadenstätter M, Bodner E, Hinder RA. Gastric remnant cancer has a better prognosis than primary gastric cancer. Arch Surg 1994;129:615–619.
22 Takeda J, Hashimoto K, Koufuji K, Tanaka K, Komada I, Kakegawa T. Remnant-stump gastric cancer following partial gastrectomy. Hepato-Gastroenterology 1992;39:27–30.
23 Tersmette AC, Giardiello FM, Offerhaus GJA, Tresmette KWF, Ohara K, Vandenbroucke JP, et al. Geographical variance in the risk of gastric stump cancer: no increased risk in Japan? Jpn J Cancer Res 1991;82:266–272.

Received April 28, 2000; accepted May 15, 2000

Corresponding author: Dr. Masahide Ikeguchi