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Effect of prolongation of operative time on the outcome of patients with gastric carcinoma

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Abstract. The aim of the present study was to analyze the effect of the prolongation of operative time (OT) on the prognosis of patients with gastric carcinoma. In total, 330 patients with gastric carcinoma were enrolled. Correlation of OT with clinicopathological features including the prognosis of the patients were analyzed. Although tumors of patients for whom the OT was longer proved to be at a significantly more advanced stage of disease and univariate analysis demonstrated that the prognosis of these patients was significantly unfavorable, tumor stage was the only factor independently associated with worse prognosis for the patients based on multivariate analysis. Duration of OT was not an independent prognostic indicator. However, OT is dependent on the surgical procedure to treat tumor progression of gastric carcinoma.

Introduction

Although surgical treatment for gastric carcinoma requires standard surgical techniques, the operative period in surgical treatment for gastric carcinoma depends, not only on the experience of the surgeons, but also on tumor-related factors and the physical condition of the patients including whether or not they have co-morbidities.

Although the continuous progress in early detection of tumors and advancement in peri-operative management have undoubtedly contributed to an improvement in the survival of patients with gastric carcinoma (1), the number of investigations regarding the effect of the operative time (OT) on the post-operative outcome of patients with gastric carcinoma is limited.

It may be speculated that the OT taken for the surgical treatment of gastric carcinoma is greatly influenced by the degree of tumor advancement.

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Key words: operative time, gastric carcinoma, prognosis

The aim of the present study was to analyze the effect of the OT for surgical treatment on the postoperative outcome of the patients with gastric carcinoma.

Patients and methods

Patients. In total, 330 patients with gastric carcinoma were enrolled. These patients had been treated by distal or total gastrectomy through laparotomy and lymph node dissection in our institution between 1998 and 2010. These 231 males and 99 females had a median age of 68 years (range, 27-89).

The study was approved by the ethics committee of the Fukuoka Higashi Medical Center. Consent was obtained from either the patient or the patient's family.

Division of operative time. The OT ranged from 88 to 438 min with a mean of 210 min. Patients whose OT was longer and shorter than this mean length were classified into groups L (n=138) and S (n=192), respectively.

Follow-up. Patients were followed-up until they succumbed to the disease and only patients who died of gastric carcinoma were included in the tumor-related deaths. The period from the surgery to the date of death was regarded as the survival time. For patients who died of other non-tumor disease, the period from the surgery to the last date when the patient was known to be alive during the study was regarded as the survival time.

Pathological investigation and TNM tumor stage. The pathological factors were determined according to the Japanese Classification of Gastric Carcinoma outlined by the Japanese Gastric Cancer Association (2). TNM tumor stages were determined by the TNM classification of malignant tumors prescribed by the International Union Against Cancer (3).

Statistical analysis. Statistical analysis was conducted using StatView (SAS Institute Inc, Cary, NC, USA). The Chi-square test was used to compare the difference of proportion values. The Mann-Whitney test was used to compare the mean age of patients. Survival curves were generated using the Kaplan-Meier method and the Mantel-Cox test was used to compare the survival curves. $P<0.05$ was considered to indicate a statistically significant result.

Table I. Correlation of OT with clinicopathological variables of patients and tumors.

Variables	Group L (n=138)	Group S (n=192)	P-value
Gender			
Male	102 (73.9)	129 (67.2)	0.189
Female	36 (26.1)	63 (32.8)	
Age	67.2±9.4	68.2±11.7	0.448
Location of tumors			
Upper	38 (27.5)	24 (12.5)	0.003
Middle	67 (48.6)	114 (59.4)	
Lower	33 (23.9)	54 (28.1)	
Gross type[a]			
0	47 (34.1)	97 (50.5)	0.009
1, 2	35 (25.4)	41 (21.4)	
3, 4	56 (40.5)	54 (28.1)	
Histology[b]			
Well	24 (17.4)	52 (27.1)	0.114
Moderately	37 (26.8)	48 (25.0)	
Undifferentiated	77 (55.8)	92 (47.9)	
Depth of tumors			
T1	44 (31.9)	98 (51.0)	0.035
T2	12 (8.7)	25 (13.0)	
T3	51 (37.0)	58 (30.2)	
T4	31 (22.4)	11 (5.8)	
Lymph node metastasis			
No	60 (43.5)	119 (62.0)	0.0009
Yes	78 (56.5)	73 (38.0)	
N1	20	28	
N2	20	23	
N3	38	22	
Lymphatic invasion			
No	46 (33.3)	104 (54.2)	0.0002
Yes	92 (66.7)	88 (45.8)	
Venous invasion			
No	88 (63.8)	153 (79.7)	0.001
Yes	50 (36.2)	39 (20.3)	
Tumor stage			
I	49 (35.5)	106 (55.2)	<0.0001
II	29 (21.0)	47 (24.5)	
III	49 (35.5)	37 (19.3)	
IV	11 (8.0)	2 (1.0)	

OT, operation time. [a]Type 0, superficial tumor; type 1, polypoid; type 2, ulcerating circumscribed; type 3, ulcerating infiltrative; type 4, diffusely infiltrative. [b]Well, well-differentiated adenocarcinoma; moderate, moderately differentiated adenocarcinoma; undifferentiated, poorly differentiated adenocarcinoma, signet ring cell carcinoma or mucinous carcinoma. Values in parentheses are the percentages.

Results

The relationship between OT and clinicopathological variables of the tumors. The proportion of tumors located in the upper area of the stomach was significantly higher (P=0.003) and the proportion of macroscopic type 3 or 4 was also significantly higher in Group L (P=0.009) (Table I).

A significant difference was observed between the two groups with respect to such tumor-related factors as depth of tumor (P=0.035), lymph node metastasis (P=0.0009),

Table II. Relationship between OT and clinical background of patients.

	Group L (n=138)	Group S (n=192)	P-value
Operative procedure			
Distal	69 (50.0)	152 (79.2)	<0.0001
Total	69 (50.0)	40 (20.8)	
Number of dissected nodes	27.1±11.7	24.5±9.6	0.032
Post-operative complications			
No	107 (77.5)	180 (93.8)	<0.0001
Yes	31 (22.5)	12 (6.2)	
Anastomotic leaks	14	8	
Others	17	4	

OT, operation time; distal, distal gastrectomy; total, total gastrectomy. Values in the parentheses are the percentages.

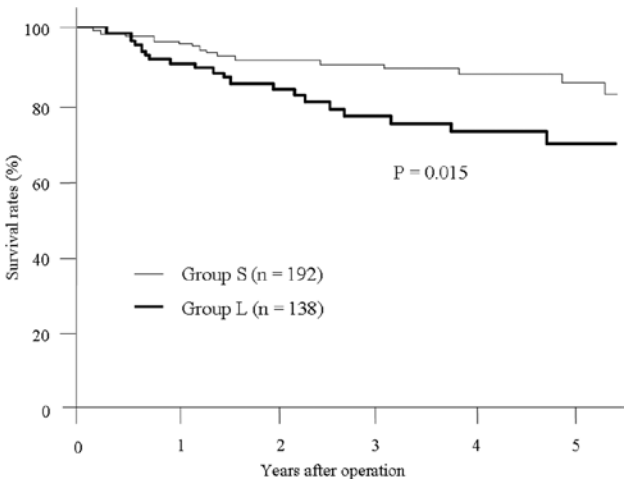

Figure. 1 Kaplan-Meier survival curves for patients. Survival of patients in group L (thick line) is significantly worse than that in group S (thin line, P=0.015).

lymphatic permeation (P=0.0002), venous invasion (P=0.001) and tumor stage (P<0.0001).

Correlation of OT with surgery-related factors and postoperative complications. The proportion of patients undergoing total gastrectomy was significantly higher in Group L (P<0.0001) (Table II). Moreover, the number of dissected lymph nodes was also significantly higher in the Group L (P=0.032). Occurrence of postoperative complications (P<0.0001) was significantly higher in the Group L.

Results of the univariate analysis revealed the 1-, 3- and 5-year survival rates of patients in group L to be 90.4, 76.3 and 69.0%, respectively. The survival rates were significantly worse that those of patients in group S (96.4, 90.4 and 85.4%, respectively, P=0.015) (Fig. 1).

Multivariate analysis demonstrated that the TNM stage of the tumor (P<0.0001) was the only factor independently associated with a worse prognosis for the patients.

Discussion

Although it is reasonable to assume that a shorter OT would result in a decrease in incidence of postoperative complications following surgery for malignant tumors including gastric carcinoma, the effect of prolongation of OT on subsequent prognosis of the patients has not been fully discussed.

A standard or permissible OT for performing standard surgical treatment for gastric carcinoma has not been definitively established; thus, the average length of the OT among the study population was selected to dichotomize the patient cohort in the present study as longer or shorter OT.

The OT may be heavily influenced by the extent of tumors including their depth, extent of nodal metastasis and invasion of surrounding tissues. In the present study, tumors of patients whose OT was longer were found to be significantly more advanced. Accordingly, the proportion of patients experiencing postoperative complications was higher in patients who had a longer OT.

The surgical procedure for a total gastrectomy is usually more time-consuming compared with that for distal gastrectomy. Gastric tumors for which total gastrectomy is required were found to be significantly more advanced compared to those that could be treated with distal gastrectomy. As such, the OT for patients who had undergone total gastrectomy was significantly longer than that for patients treated with distal gastrectomy.

Our results demonstrated that only the stage of the tumor but not the prolongation of OT was found to be a factor independently associated with prognosis of the patients with gastric carcinoma. Correlation of postoperative complications including anastomotic leakage with subsequent outcome of the patients with gastric carcinoma remains controversial (4,5). In

the present study, although incidence of postoperative complications was significantly correlated with prolongation of OT, postoperative complications were found not to be a prognostic indicator in gastric carcinoma.

In conclusion, an effort to shorten the operative period might result in a decrease in postoperative complications, which may improve the clinical outcome of patients with gastric carcinoma. Thus, in spite of the non-significance indicated by the multivariate analysis, the prolongation of OT may indirectly and eventually worsen the outcome of patients with gastric carcinoma.

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