

Post-gastrectomy spleen enlargement and esophageal varices: Distal vs total gastrectomy

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Received: January 28, 2010 Revised: March 5, 2010
Accepted: March 12, 2010

Published online: June 14, 2010

CONCLUSION: Endoscopy should be performed to detect EVs when the platelet count-to-spleen diameter ratio is < 2600.

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Key words: Spleen enlargement; Esophageal varices; Platelet count; Distal gastrectomy; Total gastrectomy

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Oida T, Mimatsu K, Kano H, Kawasaki A, Kuboi Y, Fukino N, Amano S. Post-gastrectomy spleen enlargement and esophageal varices: Distal vs total gastrectomy. *World J Gastroenterol* 2010; 16(22): 2801-2805 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v16/i22/2801.htm> DOI: <http://dx.doi.org/10.3748/wjg.v16.i22.2801>

Abstract

AIM: To study the relationship between platelet count-to-spleen diameter ratio and post-gastrectomy esophageal varices (EVs) development in patients without liver cirrhosis or hepatitis.

METHODS: We retrospectively studied 92 patients who underwent gastrectomy. They were divided into 2 groups on the basis of the surgical treatment: the distal gastrectomy (DG) group and total gastrectomy (TG) group. The incidence of EVs was determined and postoperative platelet counts, spleen diameters, and platelet count-to-spleen diameter ratios were compared between the 2 groups.

RESULTS: EVs were not detected during the first 6 mo after surgery in either group; however, at 12 mo after surgery, EVs were detected in 2 patients (3%) in the DG group and in 1 patient (3.6%) in the TG group; their mean platelet count-to-spleen diameter ratio was 2628 ± 409 , and 2604 ± 360 , respectively.

INTRODUCTION

Esophageal varices (EVs) are one of the major life-threatening complications of liver cirrhosis^[1], and its prevalence is approximately 40% at the time of diagnosis, and 60% in those with decompensated disease^[2,3]. When EVs rupture, the mortality rate ranges from 17% to 57%^[4-7]. Therefore, screening of all patients diagnosed with liver cirrhosis for the presence of EVs is recommended^[8,9]. Giannini *et al*^[10] performed a study to identify parameters that could aid noninvasive prediction of EVs, and reported that the platelet count-to-spleen diameter ratio was the best noninvasive predictor of EVs. However, spleen enlargement is frequently observed during follow-up of noncirrhotic patients who have

undergone gastrectomy, and, in addition, some of these patients developed EVs. Thus, we studied the relationship between the platelet count-to-spleen diameter ratio and the development of EVs, and compared distal and total gastrectomy (TG) with regard to these variables in patients without liver cirrhosis or hepatitis.

MATERIALS AND METHODS

Patients

We retrospectively studied 92 patients (66 men and 26 women; age range, 30-80 years; mean age, 68 ± 10 years) who underwent gastrectomy between May 2002 and April 2006 at the Department of Surgery, Social Insurance Yokohama Central Hospital, Yokohama, Japan. The following patients were excluded from our study: those who had undergone abdominal operation in the past, those with hepatitis, and those in whom disease recurrence was observed. Preoperative upper gastrointestinal endoscopy was performed in all the patients, further, EVs were not confirmed in any of the patients. These patients were divided into the following 2 groups on the basis of the surgical treatment they received: patients who underwent distal gastrectomy (DG), and patients who underwent TG. The maximum bipolar diameter of the spleen was measured by ultrasound scanning. The platelet count, spleen diameter, and platelet count-to-spleen diameter ratio were measured after surgery, and their relationship with the occurrence of EVs was studied.

Endoscopic classification of esophageal varices

On the basis of the endoscopic findings, the EVs were classified into 3 grades: grade 1, varices could be compressed with the endoscope; grade 2, varices could not be compressed with the endoscope; and grade 3, varices were confluent around the esophagus^[11].

Statistical analysis

Univariate analysis was performed using the Student *t* test for continuous variables and Fisher's exact test and the χ^2 test for categorical variables. A *P*-value of less than 0.05 was considered to be significant.

RESULTS

Table 1 shows the patient characteristics and preoperative variables. No differences were observed between the 2 groups with respect to mean age, sex ratio, and preoperative clinical data. The gastric cancers were staged according to the Japanese Classification of Gastric Carcinoma^[12], and their stages were found to be similar.

Table 2 shows the variables 3 mo after the operation. The mean platelet count, mean spleen diameter, and mean platelet count-to-spleen diameter ratio were $25.8 \times 10^4 \pm 4.2 \times 10^4/\mu\text{L}$, 93.9 ± 7.6 mm, and 2769 ± 453 , respectively, in the DG group, and $25.1 \times 10^4 \pm 3.9 \times 10^4/\mu\text{L}$, 96.8 ± 9.5 mm, and 2593 ± 328 , respectively, in the TG group. No differences were observed between the 2 groups, and no EVs developed in either group.

Table 1 Characteristics of patients *n* (%), (mean \pm SD)

	DG group (<i>n</i> = 64)	TG group (<i>n</i> = 28)	<i>P</i> -value
Age (yr)	68.3 \pm 10.1	69.3 \pm 6.7	0.6522
Sex ratio (male:female)	46:18	20:8	0.9651
Stage			
I A	15 (23.4)	5 (17.9)	0.5504
I B	13 (20.3)	7 (25)	0.6160
II	16 (25.0)	7 (25)	1.00
III A	17 (26.6)	7 (25)	0.8752
III B	3 (4.7)	2 (7.1)	0.6382
Initial disease			
Hypertension	10 (15.6)	3 (10.7)	0.7474
Diabetes mellitus	9 (14.1)	3 (10.7)	0.7502
Atrial fibrillation	2 (3.1)	1 (3.6)	1.00
Apoplexy	2 (3.1)	0 (0)	0.5184
Parkinson disease	1 (1.6)	0 (0)	0.3043
Old pulmonary tuberculosis	4 (6.3)	1 (3.6)	1.00
Preoperative platelet count ($\times 10^4/\mu\text{L}$)	24.8 \pm 4.1	24.5 \pm 3.4	0.7386
Preoperative spleen diameter (mm)	90.8 \pm 8.5	91.9 \pm 10.4	0.5908
Preoperative Platelet count/spleen diameter ratio	2744 \pm 473	2674 \pm 369	0.4921

DG: Distal gastrectomy; TG: Total gastrectomy.

Table 2 Clinical data 3 mo postoperatively *n* (%), (mean \pm SD)

	DG group (<i>n</i> = 64)	TG group (<i>n</i> = 28)	<i>P</i> -value
Platelet count ($\times 10^4/\mu\text{L}$)	25.8 \pm 4.2	25.1 \pm 3.9	0.4580
Spleen diameter (mm)	93.9 \pm 7.6	96.8 \pm 9.5	0.1251
Platelet count/spleen diameter ratio	2769 \pm 453	2593 \pm 328	0.0674
Esophageal varices			
Grade 1	0 (0)	0 (0)	1.00
Grade 2	0 (0)	0 (0)	1.00
Grade 3	0 (0)	0 (0)	1.00
Total occurrence rate	0 (0)	0 (0)	1.00

Grade 1: The varices could be depressed by the endoscope; Grade 2: The varices could not be depressed by the endoscope; Grade 3: The varices were confluent around the esophagus.

Table 3 shows the variables 6 mo after the operation. The mean platelet count, mean spleen diameter, and mean platelet count-to-spleen diameter ratio were $26.7 \times 10^4 \pm 4.3 \times 10^4/\mu\text{L}$, 95.6 ± 7.6 mm, and 2853 ± 458 , respectively, in the DG group, and $26.5 \times 10^4 \pm 3.9 \times 10^4/\mu\text{L}$, 100.6 ± 9.4 mm, and 2632 ± 373 , respectively, in the TG group. There was no significant difference between the 2 groups with respect to the platelet count; however, the mean spleen diameter in the TG group was significantly greater than that in the DG group ($P < 0.0078$), and the mean platelet count-to-spleen diameter ratio in the TG group was significantly lower than that in the DG group ($P < 0.0274$). No EVs developed in the patients in either group.

Table 4 shows the variables 12 mo after the operation. The mean platelet count, mean spleen diameter, and mean platelet count-to-spleen diameter ratio were $26.8 \times 10^4 \pm 3.9 \times 10^4/\mu\text{L}$, 102.4 ± 8.7 mm, and 2628 ± 409 , respectively, in the DG group, and $27.5 \times 10^4 \pm 3.7 \times 10^4/\mu\text{L}$, 105.9 ± 9.0 mm, and 2604 ± 360 , respectively,

Table 3 Clinical data 6 mo postoperatively *n* (%), (mean \pm SD)

	DG group (<i>n</i> = 64)	TG group (<i>n</i> = 28)	<i>P</i> -value
Platelet count ($\times 10^3/\mu\text{L}$)	26.7 \pm 4.3	26.5 \pm 3.9	0.8016
Spleen diameter (mm)	95.6 \pm 7.6	100.6 \pm 9.4	0.0078
Platelet count/spleen diameter ratio	2853 \pm 458	2632 \pm 373	0.0274
Esophageal varices			
Grade 1	0 (0)	0 (0)	1.00
Grade 2	0 (0)	0 (0)	1.00
Grade 3	0 (0)	0 (0)	1.00
Total occurrence rate	0 (0)	0 (0)	1.00

Table 4 Clinical data 12 mo postoperatively *n* (%), (mean \pm SD)

	DG group (<i>n</i> = 64)	TG group (<i>n</i> = 28)	<i>P</i> -value
Platelet count ($\times 10^3/\mu\text{L}$)	26.8 \pm 3.9	27.5 \pm 3.7	0.4358
Spleen diameter (mm)	102.4 \pm 8.7	105.9 \pm 9.0	0.0843
Platelet count/spleen diameter ratio	2628 \pm 409	2604 \pm 360	0.7887
Esophageal varices			
Grade 1	2 (3)	1 (3.6)	1.00
Grade 2	0 (0)	0 (0)	1.00
Grade 3	0 (0)	0 (0)	1.00
Total occurrence rate	2 (3)	1 (3.6)	1.00

Table 5 Clinical data 24 mo postoperatively *n* (%), (mean \pm SD)

	DG group (<i>n</i> = 64)	TG group (<i>n</i> = 28)	<i>P</i> -value
Platelet count ($\times 10^3/\mu\text{L}$)	26.4 \pm 3.7	25.8 \pm 4.0	0.4533
Spleen diameter (mm)	104.4 \pm 9.8	109.9 \pm 10.1	0.0164
Platelet count/spleen diameter ratio	2546 \pm 380	2357 \pm 365	0.00287
Esophageal varices			
Grade 1	2 (3)	2 (7.1)	0.5825
Grade 2	0 (0)	1 (3.6)	0.3043
Grade 3	0 (0)	0 (0)	1.00
Total occurrence rate	2 (3)	3 (10.7)	0.1629

Table 6 Clinical data 36 mo postoperatively *n* (%), (mean \pm SD)

	DG group (<i>n</i> = 64)	TG group (<i>n</i> = 28)	<i>P</i> -value
Platelet count ($\times 10^3/\mu\text{L}$)	26.3 \pm 3.8	25.5 \pm 4.3	0.3904
Spleen diameter (mm)	105.6 \pm 9.8	110.6 \pm 9.6	0.0147
Platelet count/spleen diameter ratio	2515 \pm 386	2317 \pm 381	0.0256
Esophageal varices			
Grade 1	3 (4.7)	3 (10.7)	0.3638
Grade 2	1 (1.6)	1 (3.6)	0.5184
Grade 3	0 (0)	0 (0)	1.00
Total occurrence rate	4 (6.3)	4 (14.3)	0.2082

ly, in the TG group. No differences were observed between the 2 groups. However, 2 patients (3%) in the DG group and 1 patient (3.6%) in the TG group had grade 1 EVs. There was no significant difference between the 2 groups with respect to the occurrence of EVs.

Table 5 shows the variables 24 mo after the operation. The mean platelet count, mean spleen diameter, and mean platelet count-to-spleen diameter ratio were $26.4 \times 10^4 \pm 3.7 \times 10^4/\mu\text{L}$, 104.4 ± 9.8 mm, and 2546 ± 380 , respectively, in the DG group, and the corresponding values were $25.8 \times 10^4 \pm 4.0 \times 10^4/\mu\text{L}$, 109.9 ± 10.1 mm, and 2357 ± 365 , respectively, in the TG group. No differences were observed between the 2 groups with respect to the platelet count; however, the mean spleen diameter in the TG group was significantly greater than that in the DG group ($P < 0.0164$), and the mean platelet count-to-spleen diameter ratio in the TG group was significantly lower than that in the DG group ($P < 0.00287$). Two patients (3%) in the DG group and 2 patients (7.1%) in the TG group had grade-1 EVs, and 1 patient (3.6%) in the TG group had grade 2 EVs; however, there was no significant difference between the 2 groups with respect to the occurrence of EVs.

Table 6 shows the variables 36 mo after the operation. The mean platelet count, mean spleen diameter, and mean platelet count-to-spleen diameter ratio were $26.3 \times 10^4 \pm 3.8 \times 10^4/\mu\text{L}$, 105.6 ± 9.8 mm, and 2515 ± 386 , respectively, in the DG group, and $25.5 \times 10^4 \pm 4.3 \times 10^4/\mu\text{L}$, 110.6 ± 9.6 mm, and 2317 ± 381 , respectively, in the TG group. No differences were observed between the

2 groups with respect to the platelet count; however, the mean spleen diameter in the TG group was significantly greater than that in the DG group ($P < 0.0147$), and the mean platelet count-to-spleen diameter ratio in the TG group was significantly lower than that in the DG group ($P < 0.0256$). However, 3 patients (4.7%) in the DG group and 3 patients (10.7%) in the TG group had grade 1 EVs, and 1 patient (1.6%) in the DG group and 1 patient (3.6%) in the TG group had grade 2 EVs. There was no significant difference between the 2 groups with respect to the occurrence of EVs.

DISCUSSION

Bleeding from ruptured EVs is the leading cause of death among patients with liver cirrhosis^[1], and the mortality rate from this complication varies between 17% and 57%^[4-7]. Thus, cirrhotic patients should be screened for the presence of EVs. Some authors suggested that repeated endoscopy at intervals of 2-3 years should be performed in patients without varices, and that it should be performed at intervals of 2 years in patients with small varices in order to evaluate the development or progression of EVs^[13,14]. However, in order to develop less invasive and cost-effective screening procedures for EVs, several studies have attempted to validate parameters that could be used for noninvasive screening^[15-21], and have found that platelet count and spleen diameter showed a good correlation with the presence of EVs. In addition, Giannini *et al*^[10] and Baig *et al*^[22] reported that

the platelet count-to-spleen diameter ratio has the highest accuracy for noninvasive prediction of EVs in cirrhotic patients. However, spleen enlargement is frequently observed after patients have undergone gastrectomy. Thus, we studied the relationship between the platelet count-to-spleen diameter ratio and the presence of EVs after gastrectomy, and compared distal and TG with regard to these parameters in patients without liver cirrhosis or hepatitis. In addition, in order to avoid surgical influence, patients who had undergone abdominal operation in the past were excluded from this study. All our patients were healthy and did not exhibit any recurrence during their follow-up. In patients who did not have liver cirrhosis or hepatitis, the occurrence rate of EVs was thought to be low; however, splenic arterial flow was thought to increase after but not before the surgery. In general, blood flow in the celiac artery (CA) is diverted into 3 arteries: the common hepatic artery (CHA), left gastric artery (LGA), and splenic artery (SA). During gastrectomy (distal and total), the LGA and left gastric vein are ligated and cut, and blood flow from the CA is diverted into 2 arteries - the CHA and SA. Thus, blood flow in the CHA and SA increases after surgery. Moreover, during lymph node dissection around the celiac axis, collateral veins from the splenic vein are ligated and cut; thus, in our patients, blood outflow from the spleen was thought to decrease after the surgery as compared to that before the surgery. Also, in the TG group, short gastric veins were ligated and cut, and blood outflow from the spleen was thought to be lower than that in the GD group patients. This may be one of the main reasons why spleen enlargement was greater in the TG group than in the DG group.

Giannini *et al*^[10] reported that the prevalence-adjusted positive and negative predictive values for a platelet count-to-spleen diameter ratio of 909 were 96% and 100%, respectively, and Baig *et al*^[22] reported that the prevalence-adjusted positive and negative predictive values for a platelet count-to-spleen diameter ratio of 1014 were 9.4% and 95.1%, respectively. In our study, grade 1 EVs were detected in 2 patients (3%) in the DG group, and in 1 patient (3.6%) in the TG group at 12 mo after surgery, and the mean platelet count-to-spleen diameter ratio of the patients was found to be 2628 ± 409 in the DG group, and 2604 ± 360 in the TG group. At 24 mo after surgery, grade 2 EVs were detected in 1 patient (3.6%) in the TG group, and the mean platelet count-to-spleen diameter ratio of these patients was found to be 2357 ± 365 . In the DG group, grade 2 EVs were detected 36 mo after the surgery, and the mean platelet count-to-spleen diameter ratio of the patients was found to be 2515 ± 386 . In our study, EVs developed in 4 patients each in the DG group (6.3%) and the TG group (14.3%) after the surgery; however, no patient exhibited grade 3 EVs. In addition, none of our patients had liver cirrhosis or hepatitis; this contributed to the higher platelet count-to-spleen diameter ratio than that reported by Giannini *et al*^[10] and Baig *et al*^[22]. To the best of our knowledge, studies on the relationship between the platelet count-to-spleen diameter ratio and the presence of EVs have not

been conducted in patients who underwent gastrectomy. Thus, on the basis of the results of our study, we suggest that the occurrence rate of EVs may increase after 6 mo post DG and when the platelet count-to-spleen diameter ratio is less than 2600. Thus, in the case of patients who have undergone gastrectomy for gastric cancer, the development of EVs after surgery is a strong possibility.

In conclusion, spleen enlargement after gastrectomy is greater in the case of TG than DG, and the platelet count-to-spleen diameter ratio is a useful parameter for the non-invasive prediction of EVs after gastrectomy. In addition, we think that the occurrence rate of EVs increases after 6 mo post gastrectomy, and therefore, when the platelet count-to-spleen diameter ratio is less than 2600, endoscopy should be performed to determine the presence of EVs.

COMMENTS

Background

Esophageal varices (EVs) are one of the major life-threatening complications of liver cirrhosis, and its prevalence rate is approximately 40% at the time of diagnosis, and 60% in those with decompensated disease. Therefore, screening of all patients diagnosed with liver cirrhosis for the presence of EVs is recommended.

Research frontiers

Spleen enlargement is frequently observed during follow-up of noncirrhotic patients who have undergone gastrectomy. The authors studied the relationship between the platelet count-to-spleen diameter ratio and the development of EVs, and compared distal and total gastrectomy (TG) with regard to these variables in patients without liver cirrhosis or hepatitis.

Innovations and breakthroughs

The authors retrospectively studied 92 patients who underwent gastrectomy. They were divided into 2 groups on the basis of the surgical treatment: the distal gastrectomy (DG) group and TG group. The incidence of esophageal varices was determined and postoperative platelet counts, spleen diameters, and platelet count-to-spleen diameter ratios were compared between the 2 groups.

Applications

Spleen enlargement after gastrectomy is greater in the case of TG than DG, and the platelet count-to-spleen diameter ratio is a useful parameter for the noninvasive prediction of EVs after gastrectomy.

Peer review

It is an interesting manuscript, though the background did not identify the real reason why the authors were embarking on their endeavor. The results were well presented and the discussion would be improved. It is a nice experiment.

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S- Editor Wang JL L- Editor Cant MR E- Editor Lin YP