LESS

Original Article

Laparosc Endosc Surg Sci 2023;30(2):57-65
DOI: 10.14744/less.2023.60024

Evaluation of surgical margins of laparoscopic gastric cancer surgery: Single-center results

Kutay Sağlam, Cengiz Ceylan, Hüseyin Kocaaslan, Mehmet Kulus, Ömer Güngörür, Fatih Karayol, Yavuz Selim Angın, Fatih Akdamar, Cemalettin Aydın

Department of Gastrointestinal Surgery, Inonu University, Malatya, Türkiye

ABSTRACT

Introduction: Surgical margin positivity incidence is reported between 5 snd 20% in gastric cancer surgery. Although some studies showed that presence of positive surgical margins affects overall survival negatively, others reported no effect. The aim of this study is to investigate the relationship between surgical margin and the survival of patients who underwent laparoscopic gastrectomy in our clinic.

Materials and Methods: Between 2015 and 2022 years, patients who underwent laparoscopic gastrectomy because of gastric cancer were included in this study. Surgical resection margin (diameter) width, microscopic evaluation of the surgical margin, pathological tumor stage, resected lymph nodes numbers and involvement, and overall survival were analyzed.

Results: After patients with benign disorders and inadequate lymph nodes resection were excluded from the study, 136 patients were included the study. Median surgical margin length width? was 2.3 (0.1–10) cm, and 13 (9.6%) patients had positive surgical margin after pathological evaluation. Median survival was 51.00±18.56 months in patients with positive surgical margins and 46.00±2.99 months in patients with negative surgical margins (p=0.977). The 1, 3, and 5-year survival rates of patients with negative versus positive surgical margins (78.9% vs. 69.2%, p=0.426), (46.3% vs. 46.2%, p=0.990), and (17.1% vs. 30.8%, p=0.225), respectively. Surgical margin was positive in 3 (7.7%) patients with proximal tumors, and in 10 (10.3%) patients with distal located tumors.

Conclusion: While most studies emphasized surgical margin positivity in proximal tumors, the rate of distal surgical margin positivity was found to be higher in this study. In conclusion, no correlation was found between surgical margin positivity and overall survival.

Keywords: Distal, Gastric cancer, Minimally invasive, Proximal, Resection

Introduction

According to Globocan 2020 data, stomach cancer is the fifth cancer most common cancer in the world and the fourth most common reason for cancer-related death.[1] The most important goal in gastric cancer surgery is R0 resection, meaning without microscopic tumors on the resection margins, and with adequate lymphadenectomy. On the other hand, positive surgical margin or R1 resection means inadequate surgery. Surgical margin positivity incidence has changed from between 5 and 20% due to

Received: 12.06.2023 **Revision:** 12.06.2023 **Accepted:** 14.06.2023
Correspondence: Cemalettin Aydın, M.D., Inönü Üniversitesi Tıp Fakültesi, Gastrointestinal Cerrahi Bilim Dalı, Malatya, Türkiye
e-mail: aydincemalettin@gmail.com

location, stage of the tumor, or surgical technique.[2] Some studies showed that the presence of a positive surgical margin affected overall survival negatively.[3] However, others did not find an association between surgical margin positivity and a decrease in overall survival.[4]

The aims of this study were firstly to evaluate the positivity rate of surgical margins in gastric cancer patients who underwent laparoscopic gastrectomy in our clinic. The second aim was to investigate the relationship between surgical margins and patient survival and the factors affecting it.

Materials and Methods

Between 2015 and 2022 years, patients who underwent laparoscopic gastrectomy because of gastric cancer were included in this study. Patients who had inadequate lymph node resection numbers (<15 lymph nodes) for evaluation of tumor involvement were excluded from the study. Patient demographic data, concomitant disease, tumor location, neoadjuvant chemotherapy status, surgery type, complications, length of stay, surgical resection margin diameter and microscopic evaluation, pathological tumor stage, resected lymph nodes numbers, and overall survivals were all analyzed. The study was approved by the ethics comity of Inonu University (Approval No: 2023/703).

Statistical Analysis

The analyses were performed using SPSS v23. Compliance of numerical data with normal distribution was checked by Kolmogorov–Smirnov test. Continuous numerical variables were analyzed with the Mann–Whitney U test. The median, minimum, and maximum values of these variables were presented. Chi-square analysis was performed for categorical variables. Frequency and percentage values of these variables were presented. Univariate logistic regression analysis was performed for each variable by taking the variables with statistically significant P values in similar variables. The effect of surgical margin positivity on overall survival was analyzed using the Kaplan–Meier method and log-rank test. P<0.05 was considered statistically significant.

Results

Between 2015 and 2018 years, 260 patients underwent laparoscopic gastrectomy for gastric pathologies. After benign disorders and inadequate lymph nodes, harvested patients were excluded from the study, 136 patients were included in the study. Eighty-seven (64%) patients were male and median age was 62 years (range 26–91). Other demographic dates are listed in Table 1. Ninety-seven

Table 1. Demographical variables of patients

	Median (min-max)	Count (%)
Age, years	62 (26–91)	
Gender		
Male		87 (64.0)
Female		49 (36.0)
BMI, kg/m^2	25.06 (15.8–45)	
ASA		
1		16 (11.8)
2		88 (64.7)
3		31 (22.8)
4		1 (0.7)
HT		
Absence		99 (72.8)
Presence		37 (27.2)
DM		
Absence		119 (87.5)
Presence		17 (12.5)
COPD		
Absence		127 (93.4)
Presence		9 (6.6)
CAD		
Absence		126 (92.6)
Presence		10 (7.4)
CEA	1.94 (0.1–363.2)	
CA 19-9	8.56 (0.1–2157)	
Neoadjuvant Chemotherapy		
Absence		121 (89.0)
Presence		15 (11.0)
Perioperative bleeding, ml	100 (0–900)	
Operative Time	300 (120–720)	
Location		
Upper		39 (28.7)
Distal		97 (71.3)
Complication		
Absence		105 (77.2)
Presence		31 (22.8)

BMI: Body mass index; HT: Hypertension; DM: Diabetes mellitus; COPD: Chronic obstructive pulmonary disease; CAD: Coronary artery disease; ASA: American society of anesthesiologists.

(71.3%) patients had tumors originating from the distal stomach. Median tumor diameter was 5.5 cm (0.1–19), median surgical margin length was 2.3 (0.1–10) cm. Median harvested lymph nodes and metastatic lymph nodes numbers were 30 (15–85) and 5 (0–44), respectively. Twenty-nine (21.3%) patients had early-stage tumor and 33 (24.3%) patients had no lymph node metastasis. The results of the pathologies of the specimens are shown in Table 2. Thirteen (9.6%) patients had a positive surgical margin after pathological evaluation. The characteristics of patients with positive and negative surgical margins are summarized in Table 3. There were no differences in the T stages and lymphatic metastases of patients with and without positive surgical margins. There was no significant difference in the number of lymph nodes removed and the metastatic rates of these lymph nodes in patients with positive and negative surgical margins. Median survival was 51.00±18.56 months in patients with positive surgical margins and 46.00±2.99 months in patients with negative surgical margins, p=0.977 (Table 4). The 1, 3, and 5-year survival rates of patients with negative versus positive surgical margins were (78.9% vs. 69.2%, p=0.426), (46.3% vs. 46.2%, p=0.990), and (17.1% vs. 30.8%, p=0.225), respectively (Table 4 and Fig. 1).

When we classified according to tumor localization, preoperative CEA and CA 19-9 levels of patients with distal localization were significantly lower than patients with proximal tumors, respectively (p=0.018, p=0.012). The duration of operation and the amount of intraoperative bleeding in distal localized tumors were less than for proximal localized tumors (p<0.001). Patients with proximal tumors received more neoadjuvant chemotherapy (p=0.004). When we compared proximally and distally located tumors as being of early or advanced stages, no differences were found in the tumor T stages. Surgical margin was positive in 3 (7.7%) patients with proximal tumors, and in 10 (10.3%) patients with distal tumors. Detailed characteristics of the patients according to distal and proximal location are summarized in Table 5.

Table 2. Pathological outcomes of patients

	Median (min-max)	Count (%)
Tumor Size, cm	5.5 (0.1–19)	
Negative Surgical Margin Diameter (cm)	2.3 (0.1–10)	
Surgical Margin		
Positive		13 (9.6)
Negative		123 (90.4)
Tstage		
T1		29 (21.3)
T2		9 (6.6)
T3		36 (26.5)
T4a		60 (44.1)
T4b		2 (1.5)
T early/late stage		
T1		28 (20.6)
T1-2-3		108 (79.4)
Harvesting Total LAP	30 (15–85)	
Positive LAP	2.5 (0–44)	
Nstage		
N0		33 (24.3)
N1		35 (25.7)
N2		15 (11.0)
N3a		30 (22.1)
N3b		23 (16.9)
TNMstage		
1a		20 (14.7)
1b		9 (6.6)
2a		10 (7.4)
2b		20 (14.7)
3a		29 (21.3)
3b		23 (16.9)
3c		25 (18.4)
LVI		
Absence		29 (21.3)
Presence		107 (78.7)
PNI		
Absence		52 (38.2)
Presence		84 (62.8)

LVI: Lymphovascular invasion; PNI: Perineural invasion.

Discussion

In this study, the median tumor-free margin was 2.3 cm in patients who underwent laparoscopic gastrectomy. The positive surgical margin rate was 9.6%. There was no significant difference between the number of lymph nodes removed and their metastatic rates. The presence of a positive surgical margin did not have a significant effect on overall survival (p=0.97). The rate of positive surgical margins was higher in patients with distal tumors than those with proximal locations (10.3% vs. 7.7%).

The aim of optimal gastric surgery is to remove the tumor

Table 3. Analysis of continuous variables and categorical data by surgical margin

	Surgical Margin Status				p
	Negative surgical margin		Positive surgical margin		
	Median (min-max)	Count (%)	Median (min-max)	Count (%)	
Age, years	63 (29–91)		60 (34–79)		0.486*
Gender					
Male		77 (62.6)		10 (76.9)	0.306
Female		46 (37.4)		3 (23.1)	
BMI, kg/m^2	25.0 (15.8–45)		26.8 (23–35.1)		0.046*
ASA					
1		15 (12.2)		1 (7.6)	0.211
2		82 (66.7)		6 (46.2)	
3		25 (20.3)		6 (46.2)	
4		1 (0.8)		0 (0)	
HT					
Absent		88 (71.5)		11 (84.6)	0.314
Present		35 (28.5)		2 (15.4)	
DM					
Absent		108 (87.8)		11 (84.6)	0.741
Present		15 (12.2)		2 (15.4)	
COPD					
Absent		114 (92.7)		13 (100.0)	0.313
Present		9 (7.3)		0 (0)	
CAD					
Absent		114 (92.7)		12 (92.3)	0.961
Present		9 (7.3)		1 (7.7)	
CEA	1.97 (0.1–363.2)		1.8 (0.4–9.1)		0.885*
CA 19-9	8.0 (0.1–2157)		14.1 (1.2–700)		0.065*
Neoadjuvant chemotherapy					
Absent		110 (89.4)		11 (84.6)	0.598
Present		13 (10.6)		2 (15.4)	
Operation type					
lap.distal		72 (58.5)		6 (46.2)	0.446
lap.total		43 (35)		5 (38.5)	
lap.subtotal		8 (6.5)		2 (15.4)	
Operative Time, minute	300 (45–720)		360 (20–480)		0.824*
Perioperative bleeding, mL	100 (0–900)		100 (0–400)		0.934*
Complication					
Absent		93 (75.6)		11 (84.6)	0.467
Present		30 (24.4)		2 (15.4)	
Complication Type					
Absent		107 (87)		11 (84.6)	0.425
Chilous Leak		0 (0)		0 (0)	
anastomosis leak		1 (0.8)		1 (7.7	
paralytic ileus		6 (4.9)		0 (0)	
duodenal leak		2 (1.6		0 (0)	
SSI		4 (4.9)		1 (7.7	

Table 3. CONT.

	Surgical Margin Status				p
	Negative surgical margin		Positive surgical margin		
	Median (min-max)	Count (%)	Median (min-max)	Count (%)	
Post-operative hemoraji		1 (0.8)		0 (0)	
Length of stay (day)	8 (4–39)		10 (5–16)		0.083*
Tumor Size, cm	5.5 (0.1–19)		5.0 (1.7–9)		0.841*
T stage					
T1		29 (23.6)		0 (0)	0.278
T2		7 (5.7)		2 (15.4)	
T3		32 (26.0)		4 (30.8)	
T4a		53 (43.1)		7 (53.8)	
T4b		2 (1.6)		0 (0)	
Tearly/late stage					
T1		28 (22.8)		0 (0)	0.054
T2-3-4		95 (77.2)		13 (0)	
Harvesting Total LAP	30 (15–85)		32 (15–58)		0.727*
Positive LAP	2 (0–44)		3 (0–17)		0.882*
N stage					
N0		31 (25.2)		2 (15.4)	0.591
N1		31 (25.2)		4 (30.8)	
N2		12 (9.8)		3 (23.0)	
N3a		28 (22.8)		2 (15.4)	
N3b		21 (17.1)		2 (15.4)	
Tumor location					
Distal		87 (70.7)		10 (76.9)	0.639
Proximal		36 (29.3)		3 (23.1)	
TNM stage					
1a		20 (16.3)		0 (0.0)	
1b		8 (6.5)		1 (7.7)	
2a		8 (6.5)		2 (15.4)	
2b		19 (15.4)		1 (7.7)	
3a		24 (19.5)		5 (38.4)	
3b		21 (17.1)		2 (15.4)	
3c		23 (18.7)		2 (15.4)	
LVI					
Absent		27 (22.0)		2 (15.4)	0.583
Present		96 (78.0)		11 (84.6)	
PNI					
Absent		48 (39.0)		4 (30.8)	0.560
Present		75 (61.0)		9 (69.2)	

ASA: American Society of Anesthesiologists; HT: Hypertension; DM: Diabetes Mellitus; COPD: Chronic Obstructive Pulmonary Disease; CAD: Coronary Artery Disease; CEA: Carcinoembryonic antigen; CA19.9: Cancer antigen 19-9; SSI: surgical site infection; LVI: Lymphovascular Invasion; PNI: Perineural InvasionPearson Chi-square test; *Mann–Whitney U test results were considered significant at p<0.05.

with enough lymph node resection to leave a safe surgical margin. The determination of the surgical margin usually depends on the surgeon's palpation or the laparoscopy view. In proximal tumors, especially the gastroesophageal junction, surgical procedure shifts to the thorax to capture a negative surgical margin, which increases the diffi-

Table 4. Overall and 1-, 3-, and 5-year survival rates of patients with positive and negative surgical margins after laparoscopic gastrectomy

Variables	Median±SD, %	95% CI	p
Surgical margin			
Positive OS, month	51.00±18.56	40.14–51.86	0.977
Negative OS, month	46.00±2.99	14.62–87.38	
Total OS, month	47.00±3.16	40.81–53.19	
1-year SR			
Positive SM	69.2		0.426
Negative SM	78.9		
3-year SR			
Positive SM	46.2		0.990
Negative SM	46.3		
5-year SR			
Positive SM	30.8		0.225
Negative SM	17.1		

OS: Overall survival; SD: Standard deviation; CI: Confidence interval.

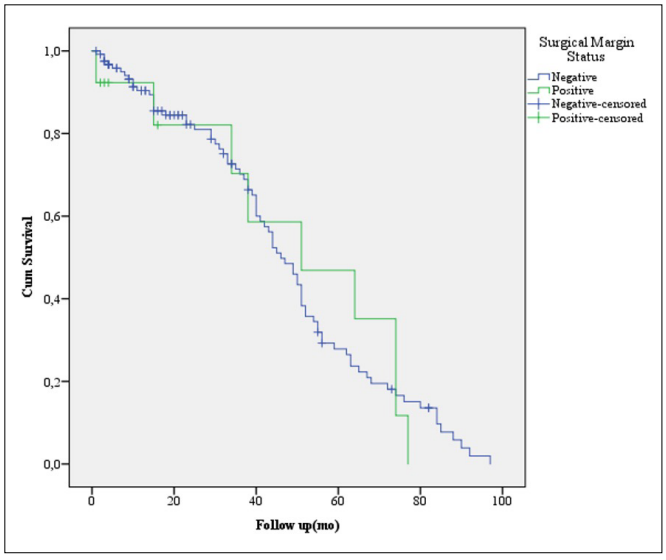

Figure 1. Kaplan–Meier survival estimates of the study population showing the overall survival rate of positive and negative surgical margins of the patients following laparoscopic gastrectomy.

culty of surgery and morbidity. According to the Japanese gastric cancer sixth edition guideline, the proximal surgical margin is recommended as 5 cm if the tumor has an aggressive and advanced pattern.[5] However, according to western studies, overall survival was determined by tumor behavior rather than surgical margin.[6,7]

Discussions on the effect of surgical margin positivity on survival and locoregional recurrences in gastric cancer continue in the literature. Keun et al. showed that positive surgical margin decreased the disease free survival and overall survival.[3] In that study, it was mentioned that locoregional recurrences were more common in patients with negative surgical margins. In another study, it was reported that recurrences were not generally within positive surgical margins, whereas peritoneal or distant recurrences were more frequent.[8,9] Zhao et al. showed that a positive resection margin was associated with tumor aggressive behavior.[9] According to that study, serosal and lymphovascular invasion were independent risk factors for positive surgical margins.[9] Lee et al. showed that surgical margin positivity had no effect on local recurrence or survival.[10] In their study, they recommend intraoperative frozen-section examination and state that no further resection is necessary when a negative margin is reached. Cho et al. reported that positivity of surgical margins affected overall survival in early-stage tumors, and that positivity of surgical margins did not contribute to overall survival in node positive tumors.[11] Because overall survival in lymph node positive group was determined by locoregionally advanced disease, not by surgical margin positivity.[11] The recent study Juez et al. reported that positive surgical margin was sign of advanced and more aggressive disease.[7]

Although studies generally draw attention to the proximal surgical margin, in our patient cohort, we had a higher

Table 5. Analysis of continuous variables and categorical dates by tumor localization

	Proximal		Distal		p
	Median (min-max)	Count (%)	Median (min-max)	Count (%)	
Age, years	64 (36–80)		61 (26–91)		0.113*
Gender					
Male		30 (76.9)		57 (58.8)	0.046
Female		9 (23.1)		40 (41.2)	
BMI, kg/m^2	24.2 (15.8–42)		25.06 (18.2–45)		0.038*
ASA					
1		2 (5.1)		14 (14.4)	0.421
2		27 (69.2)		61 (62.9)	
3		10 (25.6)		21 (21.6)	
4		0 (0)		1 (1.0)	
HT					
Absent		27 (69.2)		72 (74.2)	0.554
Present		12 (30.8)		25 (25.8)	
DM					
Absent		33 (84.6)		86 (88.7)	0.519
Present		6 (15.4)		11 (11.3)	
COPD					
Absent		37 (94.9)		90 (92.8)	0.658
Present		2 (5.1)		7 (7.2)	
CAD					
Absent		38 (97.4)		88 (90.7)	0.175
Present		1 (2.6)		9 (9.3)	
CEA	2.93 (0.1–167)		1.55 (0.1–363.2)		0.018*
CA 19-9	16.7 (0.1–293)		7.2 (0.1–2157)		0.012*
Operation type					
Distal Gastrectomy		0 (0)		78 (80.4)	<0.001
Total Gastrectomy		39 (100)		9 (9.3)	
Near Total Gastrectomy		0 (0)		10 (10.3)	
Operative Time, minute	360 (180–600)		300 (120–720)		<0.001*
Perioperative bleeding, mL	200 (120–900)		100 (0–800)		<0.001*
Complication					
Absent		28 (71.8)		76 (78.4)	0.562
Present		11 (28.2)		21 (21.6)	
Complication type					
Absent		33 (84.6)		85 (87.6)	0.431
Lymphatic Leak		0 (0)		0 (0)	
Anastomosis leak		0 (0)		2 (2.1)	
Paralytic ileus		2 (5.1)		4 (4.1)	
Duodenal stump leak		0 (0)		2 (2.1)	
SSI		4 (10.3)		3 (3.1)	
Post-operative Hemorrhage		0 (0)		1 (1.0)	

Table 5. CONT.

	Proximal		Distal		p
	Median (min-max)	Count (%)	Median (min-max)	Count (%)	
Lenght of stay (day)	8 (4–12)		8 (4–39)		0.765*
Tumor Size (cm)	6 (0.1–19)		5.3 (0.1–13)		0.226*
T stage					
T1		4 (10.3)		25 (25.8)	0.009
T2		2 (5.1		7 (7.2)	
T3		7 (17.9)		29 (29.9)	
T4a		26 (66.2)		34 (35.1)	
T4b		0 (0)		2 (2.1)	
T early/late stage					
T1		4 (10.3)		24 (24.7)	0.059
T2-3-4		35 (89.7)		73 (75.3)	
Harvesting Total LAP	33 (15–84)		29 (15–85)		0.526*
Positive LAP	6 (0–44)		2 (0–42)		0.102*
N stage					
N0		9 (23.1)		24 (24.7)	0.256
N1		8 (20.5)		27 (27.8)	
N2		3 (7.7)		12 (12.4)	
N3a		8 (20.5)		22 (22.7)	
N3b		11 (28.2)		12 (12.4)	
TNM stage					
1a		4 (10.3)		16 (16.5)	0.111
1b		1 (2.6)		8 (8.2)	
2a		3 (7.7)		7 (7.2)	
2b		2 (5.1)		18 (18.6)	
3a		11 (28.2)		18 (18.6)	
3b		7 (17.9)		16 (16.5)	
3c		11 (28.2)		14 (14.4)	
LVI					
Absent		7 (17.9)		25 (25.8)	0.458
Present		32 (82.1)		72 (74.2)	
PNI					
Absent		11 (28.2)		45 (46.4)	0.054
Present		28 (71.8)		52 (53.6)	
Neoadjuvant					
Absent		30 (76.9)		91 (93.8)	0.004
Present		9 (23.1)		6 (6.2)	
Surgical Margin					
Positive		3 (7.7)		10 (10.3)	0.639
Negative		36 (92.3)		87 (89.7)	
Surgical Margin diameter (cm)	2 (0–10)		2.3 (0–6)		0.084*

ASA: American society of anesthesiologists; HT: Hypertension; DM: Diabetes mellitus; COPD: Chronic obstructive pulmonary disease; CAD: Coronary artery disease; CEA: Carcinoembryonic antigen; CA19.9: Cancer antigen 19-9; SSI: Surgical site infection; LVI: Lymphovascular Invasion; PNI: Perineural Invasion. Pearson Chi-square test; * Mann–Whitney U test results were considered significant at P<0.05.

number of distal surgical margin positivity in tumors with an antrum location. One of the reasons for this high positivity rate may be the fact that antral tumors do not require a frozen section due to the easier surgical technique and the fear that too much descent below the pylorus may cause duodenal stump leakage. The second reason is that the tumors had an advanced stage and were located near the antropyloric junction. Kumar et al. found a high rate of positivity in the distal surgical margins in tumors located close to the pylorus and in tumors with locally advanced stage.[12]

The main limitation of the present study is that it is retrospective. Since it is a retrospective study, the data of the patients cannot be collected adequately. Second, there was a loss of data due to the delay in the control examinations of the patients during the pandemic process. The third limitation is the post-operative exclusion of patients with <15 lymph nodes. The reason for this was to eliminate the difference between the groups as the number of lymph nodes would determine the adjuvant chemotherapy treatment of the patients and this would affect evaluation of long-term survival.

Conclusion

While most studies emphasized surgical margin positivity in proximal tumors, the rate of distal surgical margin positivity was found to be higher in this study. In conclusion, no correlation was found between surgical margin positivity and overall survival in gastric cancer patients who had laparoscopic resections.

Disclosures

Ethichs Committee Approval: The study was approved by the ethics comity of Inonu University (Approval No: 2023/703).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – C.A., K.S.; Design – K.S.; Supervision – C.A.; Data collection and/or processing – H.C., Y.S.A., C.C., Ö.G., F.K.; Analysis and/ or interpretation – C.C., H.K.; Literature search – F.K., F.A.; Writing – K.S.; Critical review – C.A., K.S.

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of ıncidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021;71:20949. [CrossRef]
2. Bickenbach KA, Gonen M, Strong V, Brennan MF, Coit DG. Association of positive transection margins with gastric cancer survival and local recurrence. Ann Surg Oncol 2013;20:26638.
3. Woo JW, Ryu KW, Park JY, Eom BW, Kim MJ, Yoon HM, et al. Prognostic impact of microscopic tumor involved resection margin in advanced gastric cancer patients after gastric resection. World J Surg 2014;38:43946.
4. Ohe H, Lee WY, Hong SW, Chang YG, Lee B. Prognostic value of the distance of proximal resection margin in patients who have undergone curative gastric cancer surgery. World J Surg Oncol 2014;12:296. [CrossRef]
5. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2021 (6th edition). Gastric Cancer 2023;26:125. [CrossRef]
6. Squires MH 3rd, Kooby DA, Poultsides GA, Pawlik TM, Weber SM, Schmidt CR, et al. Is it time to abandon the 5-cm margin rule during resection of distal gastric adenocarcinoma? A multi-institution study of the U.S. Gastric Cancer Collaborative. Ann Surg Oncol 2015;22:124351. [CrossRef]
7. Juez LD, Barranquero AG, Priego P, Cuadrado M, Bl L, María J. Original article. 2021;
8. Shen JG, Cheong JH, Hyung WJ, Kim J, Choi SH, Noh SH. Influence of a microscopic positive proximal margin in the treatment of gastric adenocarcinoma of the cardia. World J Gastroenterol 2006;12:38836. [CrossRef]
9. Zhao B, Lu H, Bao S, Luo R, Mei D, Xu H, et al. Impact of proximal resection margin involvement on survival outcome in patients with proximal gastric cancer. J Clin Pathol 2020;73:4705. [CrossRef]
10. Lee CM, Jee YS, Lee JH, Son SY, Ahn SH, Park DJ, et al. Length of negative resection margin does not affect local recurrence and survival in the patients with gastric cancer. World J Gastroenterol 2014;20:1051824. [CrossRef]
11. Cho BC, Jeung HC, Choi HJ, Rha SY, Hyung WJ, Cheong JH, et al. Prognostic impact of resection margin involvement after extended (D2/D3) gastrectomy for advanced gastric cancer: a 15-year experience at a single institute. J Surg Oncol 2007;95:4618.
12. Kumar S P, Kalayarasan R, Senthil G, Pottakkat B, Rajeswari M. Risk factor analysis for duodenal margin positivity following gastrectomy for resectable gastric cancer. Asia Pac J Clin Oncol. 2022 Dec 27. doi: 10.1111/ajco.13910. [Epub ahead of print]. [CrossRef]