Evaluation of factors related to Clavien Dindo 3 and above complications in patients undergoing gastrectomy due to gastric cancer

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AIM: *In our study, we aimed to evaluate the complications after total gastrectomy by Clavien-Dindo classification and to determine the related risk factors.*
METHODS: *Patients who underwent total gastrectomy due to gastric cancer between 2015-2019 were included in the study. Patients were divided into two groups according to postoperative complication classification Clavien Dindo, those with 3 or higher were Group 1 and the others were Group 2. Demographic and clinical features, laboratory parameters, tumor characteristics, postoperative results and mean survival were compared in the groups. Risk factors for Clavien Dindo 3 and above were analyzed by univariate analysis and multivariate logistic regression analysis.*
RESULTS: *A total of 104 patients participated in our study. Group1 consisted of 25 and Group2 consisted of 79 patients. Male sex was high in both groups (52% vs67.1%, p:0.130). BMI (26 vs 23, p:0.023), albumin (3.24 vs 3.51, p:0,040), postoperative mortality (%28vs% 2.5, p:0.001), postoperative duration of hospitalization (17.60vs9.25 days, p:0.000) were different between the groups, but total survival (month) was not statistically significantly different (19.60vs18.53, p:0.377). In multivariate analysis, tumor Stage 3C (OR =0.177,95% CI = (0.067-0.468), p:0.000), operation duration ≥240 min (OR =2.105,95% CI = (1.080-4.100, p:0.029) and application of neoadjuvant treatment (HR =3.026,95%CI =(1.682-5.446), p:0.000) were indepent risk factors*
DISCUSSION: *In conclusion, obesity, hypoalbuminemia, anemia, tumor stage, duration of operation, and taking neoadjuvant therapy were closely related to postoperative complications. Although the development of postoperative complication increased the length of hospitalization and postoperative mortality, it did not decrease survival in the long term.*

KEY WORDS: Gastric cancer, Postoperative complication, Total gastrectomy

Introduction

Gastric cancer (GC) is still the fourth most common malignancy worldwide, and it is also the second most common cause of cancer-related death. The incidence and mortality of stomach cancer has been decreasing in recent years [1]. Despite improvements in chemotherapy, radiotherapy and endoscopic therapy, D2 lymphadenectomy and gastrectomy are still considered the first treatment option for advanced gastric cancer worldwide [2,3]. Significant advances in gastric cancer-related surgery and anesthesia techniques, postoperative care, and interventional radiology have manifested a marked reduction in perioperative mortality for gastric cancer, but the surgical morbidity rate still ranges from 10.5% to 40.1% [4-9]. The most common postoperative complications are infectious complications such as anastomosis leakage, intraabdominal abscess and pneumonia. Undoubtedly, postoperative complications are associated with increased length of

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hospital stay, economic cost, and hospital mortality. In addition, it has been suggested that postoperative complications increase disease recurrence and worsen patients' long-term survival [10,11].

Clavien et al developed a new approach in 1992 to rate the severity and incidence of postoperative complications based on the treatment of complications [12]. Dindo et al revised this rating system in 2004 and enabled its development [13]. This rating system started to be used more widely after it was revised and developed and was named as Clavien - Dindo (C - D) classification. With this classification, an objective, simple, reliable, reproducible, flexible and applicable five-grade classification system has been obtained to evaluate postoperative complications [12-14].

Data on predictive factors for postoperative morbidity in the literature are heterogeneous. Variables such as patient's age, comorbid diseases, body mass index, serum albumin level, tumor stage and location, surgical technique, lymph node dissection, additional organ resections are defined as potential factors for high postoperative complications [4,5,14,15].

In this study, we aimed to evaluate the factors associated with Clavien-Dindo 3 and above complications in patients who underwent total gastrectomy in our clinic and to present our results in the light of the literature.

TABLE I - *Clavien-Dindo Classification of surgical complications*

Grade	Definition
Grade I	Any deviation from the normal course without the need for pharmacological treatment or surgical, endoscopic and radiologic interventions. Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics, electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included
Grade III	Requiring surgical, endoscopic or radiological intervention
IIIA	Intervention not under general anesthesia
IIIB	Intervention under general anesthesia
Grade IV	Life-threatening complication (including CNS complications)* requiring IC/ICU management
IVA	Single organ dysfunction (including dialysis)
IVB	Multiorgan dysfunction
Grade V	Death of a patient

*Brain hemorrhage, ischemic stroke, subarachnoid bleeding, but excluding transient ischemic attacks; CNS: central nervous system; IC: intermediate care; ICU: intensive care unit.

Material and Method

160 patients who underwent total gastrectomy for gastric adenocarcinoma in our clinic between January 2015 and January 2019 participated in the study. A prospective database was created by examining patient files and hospital information system records, pathology reports, anesthesia follow-up forms and nurse observation forms. Patients were analyzed retrospectively using this database. Patients under 18 years of age, who underwent palliative surgery, subtotal gastrectomy, with Stage 4 disease, and patients without pathological diagnosis of adenocarcinoma were excluded from the study. The remaining 104 patients were included in the study. We have not received an ethics comitee because study is designed retrospectively

Patients were divided into two groups according to postoperative complication classification Clavien Dindo (Table I) [13], those with 3 or higher were Group 1 and the others were Group 2. Patients' age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, accompanying additional disease status, neoadjuvant treatment status, preoperative albumin value (gr / dl), hemoglobin (gr / dl) level, blood count, surgical approach (conventional, laparoscopic), operation duration (min), average blood loss (ml), mean onset of oral intake (days), presence of postoperative mortality, postoperative hospitalization duration (days), 30-day unplanned readmission to the hospital, histological grade of the tumor, number of lymph nodes collected, number of metastatic lymph nodes, tumor diameter, pathological stage, and survival were compared in the groups. In the preoperative evaluation, all patients underwent upper gastrointestinal endoscopy, diagnosed as adenocarcinoma by biopsy, and complete blood count and biochemical examination was performed. Thorax-abdominal-pelvis computed tomography (CT) was performed for postoperative staging, positron emission tomography (PET-CT) and endosonography were performed in patients when deemed necessary. Tumor-node-metastasis (TNM) 2010-2016 system was used for tumor staging. In accordance with the National Comprehensive Cancer Network (NCCN) and European Society for Medical Oncology (ESMO) guidelines, all patients with clinical T2 and above, node - / +, were directed to neoadjuvant chemotherapy [2,3].

Unplanned admission to the hospital was accepted as unplanned re-admission to the hospital within the first 30 days after discharge.

Wound infection was defined as a superficial or deep incisional surgical area infection occurring in the surgical wound, according to the definition of the Centers for Disease Control (CDC) [16].

Anastomosis leak was defined as a disruption in anastomosis integrity determined by the combination of clinical, radiological and operative tools.

Perioperative mortality was defined as death within 30 days postoperatively or during hospital stay.

Operation Technique

All patients were operated by surgeons who completed the learning curve or by assistants under the supervision of these surgeons. All patients were taught and performed respiratory physiotherapy (triball spirometry) before surgery. To prevent thromboembolic complications, low molecular weight heparin (LMWH) was administered at 22:00 the night before the surgery and varicose stockings were applied the morning of the surgery. Antibiotic prophylaxis was achieved with 1 g of Cefazolin before the induction of anesthesia and all surgeries were performed under general anesthesia.

In the open (conventional) technique, midline or bilateral subcostal incision was preferred. Dissection was started by liberating the omentum from the transverse colon, then the right gastroepiploic artery-vein was found and ligated at the root. Short gastric arteries were tied close to the spleen. The small omental space was entered. Fat tissues in the right and left paracardial region were included in the specimen. The duodenum was transected from the distal of the pylorus with linear cutter closure stapler. The next dissection was continued over the porta hepatis. Hepatic bifurcation was demonstrated and a. hepatica propria was opened, the dissection was continued along the main hepatic artery and lymph nodes along the left gastric root, splenic artery, and celiac lymph nodes were also included in the specimen. The esophagogastric junction was fully liberated and the esophagus was transected. All esophagojejunostomy anastomoses were performed with circular 26-29 mm diameter staplers. Based on the choice of the surgeon, jejenojejunal anastomosis was performed with linear cutter closure stapler or hand-sewn anastomosis.

In the laparoscopic technique, the patients were placed in the supine position and their arms were tied at their side. The attending surgeon was located to the right of the patient and the resident to the left of the patient.

5 ports (5-12mm) were used. Pneumoperitoneum was created by entering under the navel with the Veress needle and a 10-mm camera port was placed 3-4 cm lateral from the left supra-umbilical midline in the closed technique. Other ports, under direct vision, were placed as follows; a 15 mm working port (for staplers) from the right supra-umbilical region, another 5 mm working port at the right mid-clavicular region, in parallel, a second 5 mm assistant port on the left side. Another port, preferably 5 mm, was entered for the liver retractor from the right flank region. D2 lymph node dissection in both groups was performed to include no: 1-6 and no: 7,8a, 9,10,11p, 11d, 12a lymph node stations for total gastrectomy, as specified in the Japanese gastric cancer guidelines. Ultrasonic dissector (Johnson & Johnson medical, New Brunswick, NJ, USA) was used for dissection in the laparoscopic technique. Duodenum transection, stomach resection, jejenum resection and anastomoses were all performed intracorporeally with an endo-linear stapler (Johnson & Johnson ECHELON FLEX medical, New Brunswick, NJ, USA). Omentectomy was performed on every patient independent of stage. Esophagojejunal anastomosis was performed as a hand-sewn anastomosis using endo-luminal stapler (OrVil ™, Covidien Japan, Tokyo, Japan) or laparoscopically with double sutures. All openings formed in the intestinal mesos were closed with 3/0 non-absorbable sutures.

Statistical Evaluation

SPSS 23.0 (IBM Corp., Armonk, N.Y., USA) package program was used for statistical analysis of the data. Categorical measurements were summarized as numbers and percentages, and continuous measurements were summarized as mean, deviation, and minimum-maximum. Pearson's Chi-squared test was used to compare categorical variables. In comparing the continuous measurements between the groups, the distributions were checked and independent student t-test analysis was applied to the binary variables. Cox regression was used for multivariate evaluations. Kaplan-Meier analysis and Log Rank tests were used in survival analyzes. Statistical significance level was taken as 0.05 in all tests.

Results

A total of 104 patients participated in our study. Group 1 consisted of 25 and Group 2 consisted of 79 patients. The average age was similar between the groups (61% vs 58%, p:0.412). Male sex was dominant (52% vs 67.1%, p: 0.130). The number of patients with an ASA score of 3 was higher in Group 1 than Group 2 (%24 vs %11.4, p:0.022). BMI was higher in Group 1 (26 vs 23, p: 0.023). Comorbid diseases were similar (p: 0.225). The number of patients receiving neoadjuvant CT was similar (24% vs 29%, p: 0.412). The demographic characteristics of the patients are summarized in Table II.

The white blood cell count (WBC) (p: 0.283), neutrophil count (p: 0.126), lymphocyte count (p: 0.421), platelet count (p: 0.908) measured in the preoperative period were similar. Hemoglobin level was lower in Group 1 (10.55 vs 11.78, p:0.023). Albumin level was lower in Group 1 (3.24 vs 3.51, p :0.040). Laboratory parameters are summarized in Table III.

Operation times (235 vs 226 min, p: 0.533), mean blood loss (303 vs 336 ml, p: 0.116), mean time to oral intake (5.79 vs 4.69 days, p: 0.095) were similar in the groups. Postoperative mortality was higher in Group 1 (28% vs. 2.5%, p: 0.001). In Group 1, the laparoscopic surgical approach was higher (28% vs 11.4%, p: 0.051). Postoperative hospitalization was higher in Group 1 (17 vs 9, p: 0.000). 60% of patients in Group 1 had an unplanned readmission to the hospital within 30 days

TABLE II - *Characteristics of patients*

		Group 1 (n: 25)	Group 2 (n: 79)	p
Age (min-max)		61.16±16.75 (14-89)	58.31±14.46 (20-86)	0.412
Sex	Male	13 (52.0)	53 (67.1)	0.130
	Female	12 (48.0)	26 (32.9)	
ASA score	1	8 (32.0)	50 (63.3)	0.022
	2	11(44.0)	20 (25.3)	
	3	6 (24.0)	9 (11.4)	
BMI (min-max)		26.01±4.87 (17-40.3)	23.93±3.59 (16-36)	0.023
Accompanying Disease	DM	0 (0.0)	5 (6.3)	0.225
	HT	6 (24.0)	7 (8.9)	
	CAD	1 (4.0)	3 (3.8)	
	More than one accompanying disease	4 (16.0)	10 (12.7)	
	None	14 (56.0)	54 (68.4)	
Neoadjuvant CT	No	19 (76.0)	56 (70.9)	0.412
	Yes	6 (24.0)	23 (29.1)	

BMI: Body mass index; ASA: American Society of Anesthesiologists; DM: Diabetes mellitus; HT: Hypertansion; CT-Chemotherapy

TABLE III - *Laboratory parameters*

	Group 1 (n: 25) Mean ± sd (min-max)	Group 2 (n: 79) Mean ± sd (min-max)	p
WBC mm^3	8.47±4.28 (3.56-19.8)	7.61±3.18 (3.09-18.0)	0.283
Neutrophil mm^3	6.03±4.02 (2.71-17.6)	4.59±2.67 (0.54-14.8)	0.126
Lymphocyte mm^3	1.67±0.87 (0.39-4.03)	1.83±0.86 (0.5-5.43)	0.421
Platelet mm^3	269.0±106.02 (56-465)	266.35±97.24 (75-591)	0.908
Hemoglobin gr/dl	10.55±2.43 (6.2-14.3)	11.78±2.29 (7.6-16.5)	0.023
Albumin gr/dl	3.24±0.76 (1.60-4.40)	3.51±0.51 (1.80-4.76)	0.040

WBC: White Blood Cell.

after discharge, and no patients in Group 2 admitted again (p:0.000). Intraoperative and postoperative outcomes are shown in Table IV.

Tumor localization was most common in the antrum in both groups (36% vs 36.7%, p: 0.090). Tumor diameter (7.09 vs 5.43 cm, p: 0.089), dissected (30 vs 31, p: 0.757) and metastatic (8.60 vs 7.44, p: 0.631) lymph node numbers were similar in the groups. Tumor stage was most commonly stage 2b (40%) in Group 1, and stage 3c (32.9%) in Group 2, but distributions were similar in the groups (p: 0.275). In both groups, poorly differentiated tumors were observed most frequently (40% vs 40.5%, p: 0.977). Tumor characteristics are shown in Table V.

The mean survival was similar in the groups (19.60 vs 18.53 months, p: 0.377), it is shown in Table VI and Fig. 1.

In the multivariate analysis, the tumor being localized in the corpus (OR (95% CI) 2.142 (1.120-4.095) p: 0.021), poorly differentiated (p: 0.002) and well diffe-

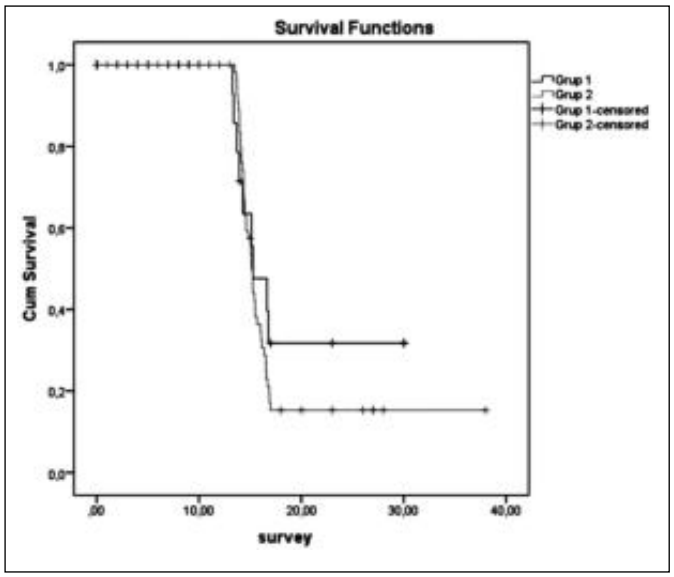

Fig. 1: Total survival duration according to groups.

rentiated (HR (95% CI) 3.520 (1.712-7236), p : 0.001), BMI ≥ 25 and <30 (HR (95% CI) 1.823 (1.022-3.250) p: 0.042), tumor stage 1A (p: 0.014), 2B (p: 0.009), 3B (p: 0.032), 3C (p: 0,000), operation time> 240 min (HR (95% CI) 2.105 (1.080-4.100) p: 0.029), and the patient receiving neoadjuvant CT (HR (95% CI) 3.026 (1.682-5.446) p: 0.000), were independent risk factors for the development of Clavien-Dindo 3 and above complications. Univariate and multivariate logistic regression analysis of factors associated with severe complications are shown in Table VII.

Discussion

Total gastrectomy is the preferred procedure for the curative resection of gastric carcinoma, despite its association with significant postoperative complications. However, the lack of consensus on how to identify and rate negative postoperative events has largely prevented the evaluation of surgical procedures. The "major and minor complications", the erroneous and often confusing term, is now disappearing from the surgical field and is replaced by a simple and easily understandable Clavien - Dindo classification [16].

Most studies evaluating the factors related to morbidity after total gastrectomy evaluated total postoperative morbidity [5,6,10,11]. A limited number of studies in the literature are related to the severity of complications [7,13,18,19]. Using a severity rating to evaluate postoperative complications provides several advantages. The Clavien-Dindo classification is easy to apply and widely accepted. Clavien-Dindo 3 and above complications are more important for us, as they can have clinical significance and potentially life-threatening consequences. Since level I and II complications are generally not fully documented, they are used in the definition of total morbidity [18].

ASA physical condition classification is one of the most widely used standard scores of preoperative evaluations for surgical patients, and high ASA scores are associated

TABLE IV - *Intraoperative and Postoperative outcomes*

		Group 1 (n: 25)	Group 2 (n: 79)	p
Operation duration (min)		235.40±65.89 (170-480)	226.89±56.96 (160-500)	0.533
Average blood loss (ml)		303.80±126.46 (50-500)	336.45±93.04 (50-450)	0.166
Average return to oral intake (day)		5.79±5.12 (2-28)	4.69±1.53 (1-10)	0.095
Postoperative mortality	Yes	7 (28.0)	2 (2.5)	0.001
	No	18 (72.0)	77 (97.5)	
Operation type	Conventional	18 (72.0)	70 (88.6)	0.051
	Laparoscopic	7 (28.0)	9 (11.4)	
Postoperative duration of hospitalization (day)		17.60±12.59 (2-46)	9.25±4.81 (5-40)	0.000
30-day hospital readmission	None	10 (40.0)	79 (100.0)	0.000
	Ileus	2 (8.0)	0 (0.0)	
	Oral intake disorder	1 (4.0)	0 (0.0)	
	Pneumonia	1 (4.0)	0 (0.0)	
	Wound site infection	11 (44.0)	0 (0.0)	

TABLE V - *Tumor characteristics*

		Group 1 (n: 25)	Group 2 (n: 79)	p
Tumor localization	Antrum	9 (36.0)	29 (36.7)	0.090
	Cardia	4 (16.0)	8 (10.1)	
	Corpus	8 (32.0)	24 (30.4)	
	Small curvature	0 (0.0)	13 (16.5)	
	Linitis Plastica	4 (16.0)	3 (3.8)	
	EGJ	0 (0.0)	2 (2.5)	
Tumor diameter (cm)		7.09±4.80 (1.4-20)	5.43±4.01 (0-20)	0.089
Number of total lymph nodes dissected (mean) (min-max)		30.32±14.80 (4-62)	31.31±13.77 (3-63)	0.757
Number of positive lymph nodes (mean) (min-max)		8.60±11.80 (0-47)	7.44±10.0 (0-38)	0.631
pSTAGE	1A	4 (16.0)	10 (12.7)	0.275
	1B	1 (4.0)	6 (7.6)	
	2A	0 (0.0)	5 (6.3)	
	2B	10 (40.0)	15 (19.0)	
	3A	1 (4.0)	10 (12.7)	
	3B	1 (4.0)	7 (8.9)	
	3C	8 (32.0)	26 (32.9)	
Pathological grade	Poorly differentiated	10 (40.0)	32 (40.5)	0.977
	Undifferentiated	5 (20.0)	13 (16.5)	
	Well differentiated	5 (20.0)	18 (22.8)	
	Mildly differentiated	5 (20.0)	16 (20.3)	

EGJ: Esophagogastric junction.

Table VI - *Survival duration based on groups*

Group	Average Mean±sd (min-max)	Median Mean±sd (min-max)	p
Group 1	19.60±1.99 (15.69-23.50)	15.27±1.31 (12.69-17.86)	0.377
Group 2	18.53±1.14 (16.28-20.78)	15.12±0.13 (14.85-15.38)	

with postoperative complications [20]. In their study, Zhou, J evaluated the factors associated with complications after gastrectomy, an ASA score of 3 or more (odds ratio 6.147; 95% CI, 1.728–21.868; p = 0.005) was a risk factor for complications [21]. In our series, the percentage of patients with ASA 2 and 3 scores was higher in the group that developed complications, and supported the literature.

Obesity is associated with serious complications that can develop after surgery. It has been proven as a risk factor for postoperative complications in patients undergoing gastrectomy [22]. In the study of Bickenbach KA et al investigating the effect of obesity on postoperative morbidity, A BMI of ≥25 was associated with increased postoperative complications (47.9 vs. 35.8%, p <0.001) [20]. In our study, BMI was higher in the group with complications (26 vs 23, p: 0.023). Also, in our multivariate analysis, BMI> 25 and <30 was an independent risk factor.

Serum albumin is known as a negative acute phase protein, systemic factors such as inflammation and stress can affect the serum albumin level. Therefore, low serum albumin level represents a continuous systemic inflammatory response along with malnutrition [23]. In the Zhou, J et al study, malnutrition was a risk factor for complications after gastrectomy (OR, 95%CI, 1.763 (1.371–2.266) p<0.05) [8]. In our series, albumin level was lower in the group with complications (3.24 vs 3.51, p: 0.040). Hypoalbunemia alone was not a risk factor for the development of complications. In the same study, Zhou, J et al. found that a level of hemoglobin below 11 (OR, 95% CI, 1.763 - 1.556 (1.250–1.937) p <0.05) was associated with complications [8]. The hemoglobin gr / dl ratio was lower in the group with complications in our series (10.55 vs 11.78, p: 0.023).

Problems during neoadjuvant therapy may delay curative surgery and toxicity associated with chemotherapy may increase surgical complications [24]. In the CRITICS study, inability to complete neoadjuvant therapy was an

TABLE VII - *Univariate and Multivariate Logistic Regression Analysis of Factors Associated with Severe Complications*

Measurements		Univariate	Multivariate	
		P	HR (95% - CI)	p
Age group	< 65	0.125	1.00	0.623
	> 65		0.623 (0.333-1.167)	
Sex	Male	0.275	1.00	0.270
	Female		1.356 (0.789-2.330)	
Localization	Antrum	0.110	1.000	0.096
	Cardia		0.709 (0.268-1.875)	0.488
	Corpus		2.142 (1.120-4.095)	0.021*
	Small curvature		1.082 (0.481-2.434)	0.849
	Linitis Plastica		0.608 (0.082-4.525)	0.627
	EGJ		0.167 (0.072-1.216)	0.752
Grade	Poorly differentiated	0.004*	1.00	0.002*
	Undifferentiated		1.800 (0.800-4.049)	0.155
	Well differentiated		3.520 (1.712-7.236)	0.001*
	Mildly differentiated		0.957 (0.456-2.009)	0.908
BMI	< 25	0.101	1.00	0.093
	>25 and < 30		1.823 (1.022-3.250)	0.042*
	>30		1.830 (0.708-4.730)	0.212
P stage	1A	0.011*	1.00	0.014*
	1B		0.706 (0.229-2.178)	0.545
	2A		0.399 (0.127-1.250)	0.115
	2B		0.348 (0.158-0.766)	0.009*
	3A		0.712 (0.279-1.816)	0.477
	3B		0.242 (0.066-0.887)	0.032*
	3C		0.177 (0.067-0.468)	0.000*
Operation type	Open	0.553	1.00	0.543
	Laparoscopic		1.251 (0.607-2.578)	
Operation duration	<240	0.042*	1.00	0.029*
	>240		2.105 (1.080-4.100)	
Blood loss	<300	0.557	1.00	0.553
	>300		0.842 (0.478-1.485)	
ASA score	<3	0.325	1.00	0.295
	>3		1.654 (0.645-4.239)	
Hemoglobin	<10	0.259	1.00	0.269
	>10		1.402 (0.770-2.552)	
Hypoalbuminemia	<3.5	0.148	1.00	0.157
	>3.5		1.517 (0.852-2.702)	
WBC	<11	0.490	1.00	0.515
	>11		0.679 (0.211-2.180)	
Tumor diameter	< 5	0.199	1.00	0.201
	> 5		0.700 (0.405-1.209)	
Neoadjuvant CT	No	0.000*	1.000	0.000*
	Yes		3.026 (1.682-5.446)	

EGJ: Esophagogastric junction; WBC: White Blood Cell; BMI: Body mass index; ASA: American Society of Anesthesiologists, CT: Chemotherapy.

independent risk factor for the development of postoperative complications (OR %95 CI (2.09, 1.27-3.43, p:0.004)) [25]. While the rate of patients receiving neoadjuvant therapy in our series was similar in both groups, neoadjuvant therapy was an independent risk factor for the development of postoperative complications.

Although there are discussions about the relationship between minimally invasive approaches and postoperative complications in the treatment of stomach cancer, the general view is that laparoscopic surgery in gastric cancer can be performed with morbidity rates similar to the conventional approach in experienced centers [24,25]. In our

study, the laparoscopic approach was higher in the group with complications, but it was not statistically significant (28% vs 11.4%, p: 0.050). In our multivariate analysis, the type of operation was not related to complications, but the length of the operation was related to postoperative complications as expected. Especially surgeries lasting longer than 240 minutes was an independent risk factor for complications.

In the 2176 disease study of Gertsen, E. C et al, postoperative complications such as pulmonary complications, anastomosis leak, and postoperative bleeding were closely related to postoperative mortality. In the same study, especially anastomosis leakage and wound infection prolonged the length of hospital stay, and the development of intraabdominal abscess and intraoperative bowel injury was a risk factor for re-admission to the hospital [28]. Various complications have effects on worsening results after surgery, and also cause a significant increase in healthcare costs [29]. The development of complications of Clavien-Dindo 3 and above in our series increased postoperative mortality and significantly extended the length of hospital stay. The majority of patients who developed complications had to re-admit to the hospital within 30 days after discharge due to infectious reasons.

In many studies in the literature, TNM stage was defined as a marker for postoperative complications in multivariate analysis [6,17]. In the series of Zhou, J et al, stage 3-4 tumors were a risk factor for postoperative complications (OR 95% CI (2.234, 1.009–4.948, p: 0.048)). In the same study, histological type was not associated with complications [6]. Patients with advanced gastric cancer are in a poor nutritional state due to various factors. Anemia, weight loss and hypoproteinemia are common. Although nutritional support is given before surgery, surgical stress may affect the vulnerability in the occurrence of postoperative complications [21]. Tumor location affects postoperative results in many different ways in gastric surgery [6]. In our series, tumor location, grades, and stages were similar in groups. When we performed a multivariate analysis, the corpus localization, poor differentiation, stage 1a, 2b, 3b, 3c were risk factors for complications.

In their systematic examination where they investigated the long-term oncological outcomes of postoperative complications after gastrectomyLi, J et al. found worse overall survival and disease-free survival in patients who developed postoperative complications independent of histopathological stage, adjuvant therapy and surgical procedure [10]. In the study of Galata, C et al, they observed that when early postoperative deaths (30-day mortality and in-hospital mortality) related to complications were excluded, postoperative complications did not have a statistically significant effect on patient survival [30]. From these studies, we can deduce that management is as important as the development of postoperative complications. Neither general complications nor major surgical complications will be risk factors for reduced survival in patients who have successfully managed postoperative early complications. In our study, postoperative complications were associated with postoperative mortality, but did not affect long-term survival.

The main limitation of our study was the possibility of missing some complications due to its retrospective nature. Nevertheless, our results overlapped with and supported the literature.

Conclusion

In our study, variables such as ASA score, anemia, hypoalbuminemia, obesity, tumor stage, type and duration of operation, were associated with serious postoperative morbidity, which were demonstrated in many studies before. The development of postoperative morbidity extended the length of hospital stay and readmission after discharge. Although short term postoperative mortality was increased, long term survival was not affected. Understanding surgery risks, predicting postoperative risks, and identifying patients at higher risk of complications are important for both patients and surgeons in the joint decision-making process. Knowing the risk factors that can be changed especially related to postoperative complications will help us in preventing complications.

Riassunto

Nel nostro studio, abbiamo mirato a valutare le complicanze dopo la gastrectomia totale secondo la classificazione Clavien-Dindo per determinare i relativi fattori di rischio.

Sono stati inclusi nello studio pazienti sottoposti a gastrectomia totale per cancro gastrico tra il 2015-2019, divisi in due gruppi in base alla classificazione delle complicanze postoperatorie Clavien Dindo.

Quelli con 3 o più complicanze sono il Gruppo 1 e gli altri il Gruppo 2. Sono stati confrontati nei gruppi elementi demografici, caratteristiche cliniche, parametri di laboratorio, caratteristiche del tumore, risultati postoperatori e sopravvivenza media I fattori di rischio per Clavien Dindo 3 e superiori sono stati analizzati mediante analisi univariata e analisi di regressione logistica multivariata.

Sono stati utilizzati per il nostro studio un totale di 104 pazienti: il gruppo 1 era composto da 25 pazienti e il gruppo 2 da 79 pazienti, il sesso maschile era elevato in entrambi i gruppi (52% vs67,1%, p: 0,130); erano differenti tra i gruppi BMI (26 vs 23, p: 0,023), albumina (3,24 vs 3,51, p: 0,040), mortalità postoperatoria (% 28vs% 2,5, p: 0,001), durata postoperatoria del ricovero in ospedale (17.60vs9.25 giorni, p: 0.000), ma la sopravvivenza totale (in mesi) non è stata statisticamente significativamente diversa (19.60vs18.53, p: 0.377).

Nell'analisi multivariata sono risultati fattori di rischio indipendenti, lo stadio tumorale: Stage 3C (OR = 0,177,95% CI = (0,067-0,468), p: 0,000), durata dell'operazione ≥240 min (OR = 2.105,95% IC = (1.080-4.100, p: 0.029) e l'applicazione del trattamento neoadiuvante (HR = 3.026,95% IC = (1.682-5.446), p: 0.000)
In conclusione, obesità, ipoalbuminemia, anemia, stadio del tumore, durata dell'operazione e terapia neoadiuvante erano strettamente correlati a complicanze postoperatorie. Sebbene lo sviluppo di complicanze postoperatorie ha aumentato la durata della degenza e della mortalità postoperatoria, non ha ridotto la sopravvivenza a lungo termine.

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