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ORIGINAL ARTICLE

Clinicopathological and Prognostic Factors in Node-Negative Gastric Cancer Patients Who Underwent Curative Resection

Muhammet KOCABAŞ,[1] Mustafa CAN,[2] Nuriye ÖZDEMİR,[3] Selma KARAAHMETOĞLU[4]

[1]Deparment of Endocrinology and Metabolism, Tokat State Hospital, Tokat-*Türkiye*
[2]Deparment of Endocrinology and Metabolism, Muş State Hospital, Muş-*Türkiye*
[3]Deparment of Medical Oncology, Gazi University Faculty of Medicine, Ankara-*Türkiye*
[4]Deparment of Internal Medicine, Ankara City Hospital, Ankara-*Türkiye*

OBJECTIVE

In our study, we aimed to determine the clinicopathological and prognostic factors and their effects on overall survival (OS) and disease-free survival (DFS) in patients who underwent curative resection for gastric cancer and did not have lymph node metastasis.

METHODS

A total of 138 patients followed for lymph node-negative gastric cancer between 2001 and 2016 were included in the study. The effects of clinicopathological and prognostic factors such as age, sex, tumor localization, tumor differentiation, tumor TNM stage, type of surgery, lymphovascular invasion, perineural invasion, presence of *Helicobacter pylori*, tumor size, histopathologic subtype of the tumor, complete blood count, tumor markers, and adjuvant treatments on OS and DFS were analyzed.

RESULTS

In the current study, Eastern Cooperative Oncology Group (ECOG) performance score before adjuvant treatment (hazard ratio [HR]=2.320; p<0.001), largest tumor diameter (HR=1.198; p=0.029), post-operative carbohydrate antigen 19-9 (CA19-9) level (HR=1.104; p=0.047), and post-operative carcinoembryonic antigen (CEA) level (HR=1.183; p=0.043) were found to be independent predictors of recurrence rate. In addition, ECOG score before adjuvant treatment (HR=2.585; p<0.001), post-operative CEA level (HR=1.128; p=0.005), and post-operative CA 19-9 level (HR=1.080; p=0.006) were independent predictors of mortality risk in OS analysis.

CONCLUSION

Some clinicopathological and prognostic factors, such as ECOG score, largest tumor diameter, post-operative CA 19-9 level and post-operative CEA level, could assist us to predict recurrence and mortality in node-negative gastric cancer patients who underwent curative resection. More comprehensive studies are required to be carried out in this context.

Keywords: Carbohydrate antigen 19-9; carcinoembryonic antigen; Eastern Cooperative Oncology Group; Gastric cancer; node-negative gastric cancer.

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Dr. Mustafa CAN
Muş Devlet Hastanesi,
Endokrinoloji ve Metabolizma Kliniği,
Muş-Türkiye
E-mail: can1120can@gmail.com

INTRODUCTION

According to the World Health Organization (WHO) data, there were an estimated 1,089,103 new cases of gastric cancer worldwide in 2020. Gastric cancer was the sixth in the incidence ranking, accounting for 5.6% of all cancer cases. There were an estimated 768,793 deaths (7.7% of all cancer-related deaths) due to gastric cancer in 2020.[1] There are significant differences in the incidence of the disease due to dietary habits, ethnic differences, geographical conditions, socio-economic conditions, lifestyle, prevalence of *Helicobacter pylori*, and most importantly, improved outcomes due to early diagnosis of the disease.[2–4] In Asian countries such as Japan and Korea, treatment results have improved, primarily due to early diagnosis of the disease. However, in western countries, 80% of gastric cancer patients are diagnosed in advanced stages and the prognosis of these patients is generally poor.[5]

It is known that the only curative treatment of gastric cancer is complete resection of the tumor and involved lymph nodes.[6,7] More than half of radically resected gastric cancer cases recur locally and/or with distant metastases. Therefore, median survival is rarely more than 12 months and 5-year survival in patients with metastatic gastric cancer is <10%.[8] Today, the diagnosis of recurrence remains difficult, and the standard treatment is not fully established. If the clinicopathological factors that play a role in recurrence are known, treatment modalities which can prevent or delay the development of recurrence can be developed.

In the previous studies, T-stage was reported to be a significant independent predictor of tumor recurrence and metastases in patients with node-negative gastric cancer. However, there is no consensus on the prognostic significance of other clinicopathological factors such as age, tumor size, number of lymph nodes taken, and lymphovascular invasion.[9]

The purpose of this study was to determine the clinicopathological and prognostic factors and their effects on overall survival (OS) and disease-free survival (DFS) in patients who underwent curative resection for gastric cancer and did not have lymph node metastasis.

MATERIALS AND METHODS

This study was performed in the Department of Medical Oncology of Ankara Numune Training and Research Hospital. A total of 138 patients followed-up for node-negative gastric cancer between 2001 and 2016 were included in the study. The Local Ethics Committee approved the study with the approval dated 27.04.2016 and numbered 2016-1139. All subjects were informed about our study in detail and signed an informed consent form before enrollment.

Inclusion criteria were determined as: (i) To have undergone curative surgery and (ii) to have followed up for node-negative gastric cancer. The exclusion criteria were defined as presence of one of the following conditions: (i) Lymph node metastasis, (ii) distant metastasis, and (iii) neoadjuvant chemotherapy.

Data such as age, sex, tumor localization, tumor differentiation, tumor TNM stage, type of surgery, lymphovascular invasion, perineural invasion, presence of *H. pylori*, tumor size, histopathologic subtype of the tumor, complete blood count, tumor markers, and adjuvant treatments were recorded. Post-operative performance status of the patients according to Eastern Cooperative Oncology Group (ECOG) performance scale was recorded. Patients included in the study were followed every 3 months for the first 2 years, every 6 months for the next 2 years and then annually. Ultrasonography, abdominal computed tomography (CT), esophagogastroscopy, and measurement of serum tumor marker levels were performed to determine post-operative recurrence.

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows 20 (IBM SPSS Inc., Chicago, IL) program. Kolmogorov–Smirnov test was used to determine whether the data were normally distributed or not. Continuous variables were given as mean±standard deviation if the distribution was normal, and as median (minimum-maximum) if the distribution was not normal. In the comparison of independent group differences, the significance test of the difference between the two means (Independent samples t-test) was used when the parametric test assumptions are provided; The Mann–Whitney U-test was used to compare the independent group differences when the parametric test assumptions were not provided. Chi-square and Fisher's exact Chi-square test were used to compare categorical data. DFS was determined as the time from operation to recurrence. In the patients who died before the recurrence assessment, the date of death was accepted as the date of recurrence. The final date of the disease assessment was taken into account for the patients who had no recurrence until the end of the study. OS was calculated as the time from diagnosis to death. In the patients who

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were still alive at the end of the study, the last date on which the patient was evaluated was taken into consideration. Multivariable stepwise Cox regression analysis was used to determine the independent risk factors for recurrence and mortality. Cutoff value of numerical independent predictors was evaluated with receiver operating characteristic curve analysis Youden index method and Kaplan–Meier analysis were used to show the effect on recurrence and mortality according to cutoff value. A probability p<0.05 was defined as statistically significant.

RESULTS

The study population consisted of 138 patients (39.1% female and 60.9% male) and the mean age at diagnosis was 61.6±12.0 years. The median follow-up period was 130 months (min: 1 month, max: 175 months). During the follow-up, 29% of the patients died. When the pathological stages were examined, most of the patients (39.9%) were in stage T3, 28.3% were in stage T2, 23.2% were in stage T1, and 8.7% were in stage T4. Surgical treatment and pathological data of the patients are shown in Table 1.

Of the 138 patients included in the study, 66 (47.8%) received adjuvant chemotherapy. When it comes to the details of adjuvant treatment, 25 (18.1%) of the patients received 5- Fluorouracil (5-FU) +Folinic acid, 11 (8.0%) patients received Cisplatin+Folinic acid+5- FU, and 30 (21.7%) patients received the MAYO regimen (5-FU+leukovorin). Five (3.6%) of the patients received adjuvant radiotherapy. A total of 49 (35.5%) patients received adjuvant chemoradiotherapy, of which 8 (5.8%) received radiotherapy+Bolus 5-FU, and 41 (29.7%) received radiotherapy+5-FU.

Recurrence occurred in 31.2% of the patients and the median DFS was 128 months (min: 3 months and max: 175 months). The effects of possible risk factors on DFS are shown in Table 2. Accordingly, ECOG level before adjuvant treatment (hazard ratio [HR]=2.320; p<0.001), the largest tumor diameter (HR=1.198; p=0.029), carbohydrate antigen 19-9 (CA19-9) level (HR=1.104; p=0.047), and post-operative carcinoembryonic antigen (CEA) level (HR=1.183; p=0.043) were the independent predictors of the risk of recurrence. A 1 ng/mL increase in the post-operative CEA level increased the risk of recurrence by 1.183-fold and a 1 U/mL increase in post-operative CA 19-9 level was found to increase the risk of recurrence by 1.104 fold (Table 2). The largest tumor diameter above 3.5 cm predicted the risk of recurrence with 86.7% sensitivity and 45.1% specificity (area under curve [AUC]±standard error [SE]=0.674±0.054; p=0.001) (Fig. 1). The largest tumor diameter above 3.5 cm was found to have a risk of recurrence of 3.667 times more than the largest tumor diameter of 3.5 cm and below (HR=3.667; Median DFS: ≤3.5 cm=107 months vs. >3.5 cm=91 months; log rank p=0.009) (Fig. 2). Post-operative CEA level above 1.7 ng/mL predicted recurrence risk with 72.7% sensitivity and 58.7% specificity (AUC±SE=0.840±0.058; p<0.001) (Fig. 3). Post-operative CEA levels above 1.7 ng/mL were found to have a risk of recurrence of 2.865 times more than post-operative CEA levels of 1.7 ng/mL or less (HR=2.865; Median DFS: ≤1.7 ng/mL = 111 months vs. >1.7 ng/mL =90 months; Log Rank p=0.023) (Fig. 4).

Table 1 Surgical treatment and pathological data

Variables	All population, n=138	
	n	%
Tumor localization		
Cardia	20	14.5
Fondus/corpus	58	42.0
Antrum/pylorus	60	43.5
Lymph node dissection type		
D1 dissection	14	10.1
D2 dissection	124	89.9
Type of surgery		
Total	67	48.6
Subtotal	71	51.4
Number of retrieved lymph nodes	16 (3-66)	
Pathological grade		
Unknown	32	23.2
Low	28	20.3
Middle	45	32.6
High	33	23.9
Pathological subtype		
Adenocarcinoma	120	87.0
Signet-ring cell	12	8.7
Histopathologic subtype	6	4.3
Unknown	90	65.2
Diffuse type	14	10.1
Intestinal type	34	24.6
Lymphovascular invasion (+)	36	26.1
Perineural invasion (+)	36	26.1
Helicobacter pylori (+)	6	4.3
Largest tumor diameter‡, cm	4.5 (0.3–12)	
Middle tumor diameter‡, cm	4 (0.4–10)	
Short tumor diameter‡, cm	1.2 (0.3–5)	

‡: Numerical variables not showing normal distribution were shown as median (min-max)

Table 2 Independent predictors of recurrence (DFS)

Variables	DFS	Univariable		Multivariable	
		HR (%95 CI)	p	HR (%95 CI)	p
Gender					
Female	114.7	Ref		–	–
Male	100.9	1.049 (0.560–1.964)	0.881	–	–
Age at diagnosis	–	1.034 (1.006–1.062)	0.015*		
Cigarette					
Smokers	120	Ref			
Non–smokers	128	0.929 (0.508–1.698)	0.811		
Tumor localization					
Cardia	62	Ref			
Fundus/corpus	100	0.604 (0.263–1.388)	0.235		
Antrum/pylorus	128	0.472 (0.200–1.111)	0.086		
Lymph node dissection type					
D1 dissection	92	Ref			
D2 dissection	110	0.707 (0.277–1.804)	0.468		
Type of surgery					
Total	94	Ref			
Subtotal	128	0.501 (0.269–0.930)	0.029*		
T stage					
1–2	128	Ref			
3–4	98	2.169 (1.157–4.066)	0.016*		
Pathological subtype					
Adenocarcinoma	128	Ref			
Signet–ring cell	114	1.067 (0.379–2.998)	0.903		
Other	109	2.097 (0.643–6.838)	0.219		
Pre–adjuvant ECOG		2.420 (1.573–3.724)	<0.001*	2.320 (1.506–3.575)	<0.001*
Number of retrieved lymph nodes		0.988 (0.965–1.012)	0.32	–	
Post-operative tumor diameter		1.164 (1.025–1.322)	0.011*	1.198 (1.019–1.169)	
Lymphovascular invasion					
No	113	Ref		–	–
Yes	80	2.382 (0.983–5.771)	0.054	–	–
Perineural invasion					
No	97	Ref	–	–	
Yes	81	1.615 (0.642–4.062)	0.308	–	–
Post-operative laboratory results					
Hemoglobin	–	1.037 (0.816–1.317)	0.767	–	–
Protein	–	0.765 (0.496–1.181)	0.227	–	–
Albumin	–	0.583 (0.333–1.018)	0.058	–	–
Neutrophils	–	1.000 (0.995–1.005)	0.069	–	–
Lymphocytes	–	0.995 (0.980–1.010)	0.619	–	–
Platelets	–	1.001 (0.994–1.008)	0.192	–	–
CA 125	–	1.004 (0.991–1.017)	0.531	–	–
AFP	–	0.674 (0.359–1.268)	0.221	–	–
CEA	–	1.130 (1.066–1.198)	<0.001*	1.183 (1.102–1.269)	0.043*
CA 19–9	–	1.070 (1.040–1.100)	<0.001*	1.104 (1.100–1.108)	0.047*

Multivariable regression model: –2Log Likelihood=147,82; p<0.001; *: p<0.05 shows statistical significance. DFS: Disease-free survival time (months); HR: Hazard ratio; CI: Confidence interval; ECOG: Eastern Cooperative Oncology Group; CA: Carbohydrate antigen; AFP: Alpha-fetoprotein; CEA: Carcinoembryonic antigen

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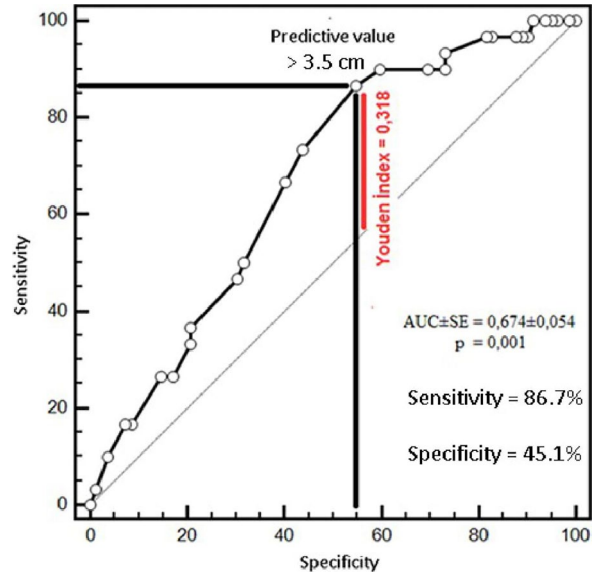

Fig. 1. The predictive value of the largest tumor diameter in predicting the risk of recurrence.

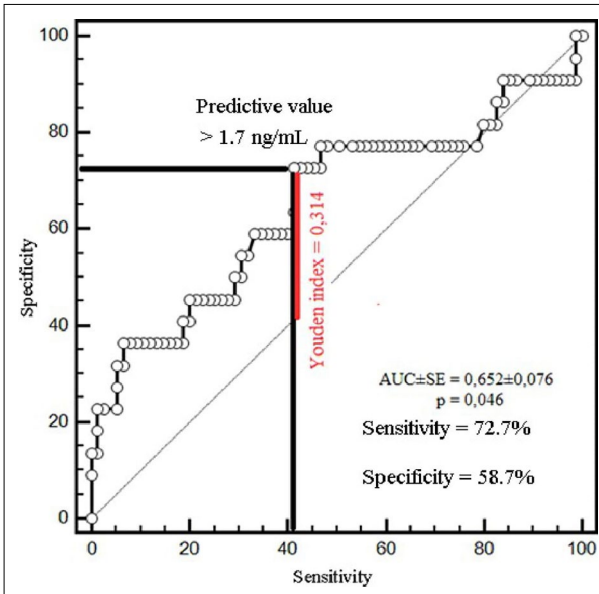

Fig. 3. The predictive value of the post-operative carcinoembryonic antigen level in predicting the risk of recurrence.

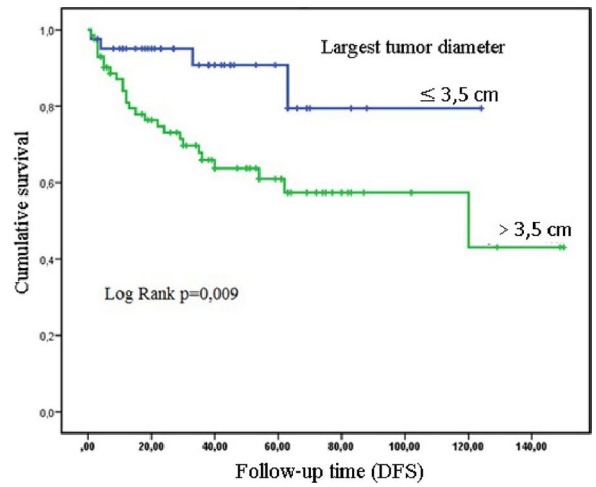

Fig. 2. Recurrence risk according to the determined largest tumor diameter cutoff value (DFS: months).

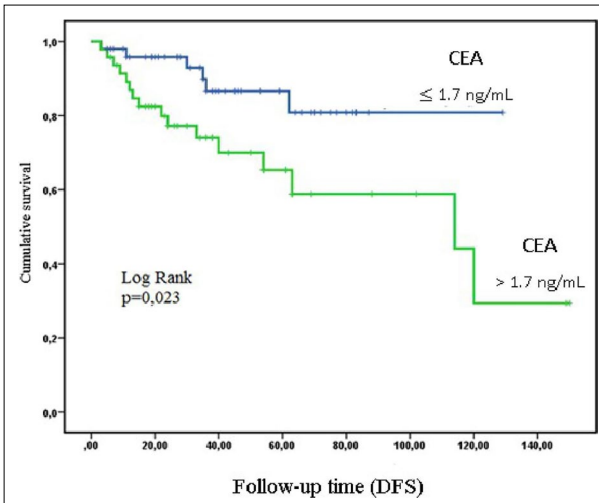

Fig. 4. Recurrence risk according to the determined post-operative carcinoembryonic antigen cutoff value (DFS: months).

The effects of possible risk factors on OS are shown in Table 3. ECOG level before adjuvant treatment (HR=2.585; p<0.001), post-operative CEA level (HR=1.128; p=0.005), and post-operative CA 19-9 level (HR=1.080; p=0.006) were independent predictors of mortality.

A 1 ng/mL increase in the post-operative CEA level increased the mortality risk by 1.128-fold and a 1 U/mL increase in post-operative CA 19-9 level was found to increase the mortality risk by 1.080 fold. Post-operative CEA level above 1.58 ng/mL predicted mortality risk with sensitivity of 84.2% and specificity of 53.8% (AUC±SE=0.711±0.074; p=0.004) (Fig. 5). Post-operative CEA level above 1.58 ng/mL was found to have a mortality risk of 4.936 times higher than post-operative CEA levels of 1.58 ng/mL or less (HR=4.936; Median OS: ≤1.58 ng/mL=117 months vs. > 1.58 ng/mL = 94 months; Log Rank p=0.005) (Fig. 6).

Table 3 Independent predictors of mortality risk (OS)

Variables	DFS	Univariable		Multivariable	
		HR (%95 CI)	p	HR (%95 CI)	p
Gender					
Female	120	Ref		–	–
Male	102	1.186 (0.614–2.292)	0.612	–	–
Age at diagnosis	–	1.037 (1.009–1.067)	0.011*		
Cigarette					
Smokers	104	Ref		–	–
Non–smokers	112	0.858 (0.458–1.609)	0.634	–	–
Tumor localization					
Cardia	64	Ref		–	–
Fundus/corpus	112	0.564 (0.243–1.307)	0.181	–	–
Antrum/pylorus	125	0.402 (0.167–0.967)	0.042*	–	–
Lymph node dissection type					
D1 dissection	91	Ref		–	–
D2 dissection	116	0.633 (0.247–1.625)	0.342	–	–
Type of surgery					
Total	98	Ref		–	–
Subtotal	117	0.456 (0.238–0.875)	0.018*	–	–
T stage					
1–2	112	Ref		–	–
3–4	105	1.866 (0.983–3.543)	0.056	–	–
Pathological subtype					
Adenocarcinoma	116	Ref		–	–
Signet–ring cell	94	1.375 (0.329–5.747)	0.663	–	–
Other	91	1.121 (0.398–3.161)	0.829	–	–
Pre–adjuvant ECOG		2.567 (1.640–4.016)	<0.001*	2.585 (1.566–4.266)	<0.001*
Number of retrieved lymph nodes		0.977 (0.951–1.003)	0.085	–	–
Post-operative tumor diameter		1.124 (0.982–1.286)	0.090	–	–
Lymphovascular invasion					
No	117	Ref		–	–
Yes	82	2.592 (1.016–6.614)	0.046*	–	–
Perineural invasion					
No	97	Ref		–	–
Yes	84	1.432 (0.561–3.651)	0.452	–	–
Post-operative laboratory results					
Hemoglobin	–	0.983 (0.762–1.267)	0.893	–	–
Protein	–	0.618 (0.393–0.973)	0.038*	–	–
Albumin	–	1.132 (0.822–1.558)	0.448	–	–
Neutrophils	–	1.005 (0.998–1.013)	0.109	–	–
Lymphocytes	–	1.010 (0.993–1.027)	0.729	–	–
Platelets	–	0.998 (0.990–1.006)	0.096	–	–
CA 125	–	1.001 (0.985–1.018)	0.876	–	–
AFP	–	1.150 (1.083–1.220)	<0.001*	1.128 (1.038–1.226)	0.005*
CEA	–	1.090 (1.050–1.130)	<0.001*	1.080 (1.020–1.140)	0.006*
CA 19–9	–	0.983 (0.762–1.267)	0.893	–	–

Multivariable regression model: −2Log Likelihood=110,60; p<0.001; *: p<0.05 shows statistical significance. OS: Overall survival (months); DFS: Disease-free survival time; HR: Hazard ratio; CI: Confidence interval; ECOG: Eastern Cooperative Oncology Group; CA: Carbohydrate antigen; AFP: Alpha-fetoprotein; CEA: Carcinoembryonic antigen

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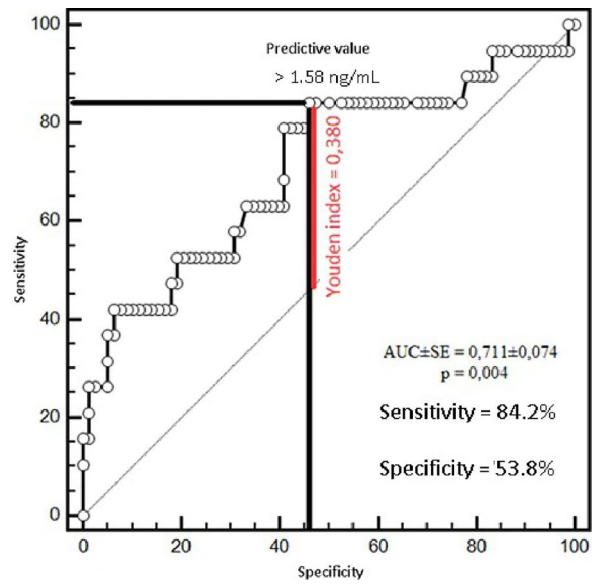

Fig. 5. Predictive value of post-operative carcinoembryonic antigen level in predicting mortality risk.

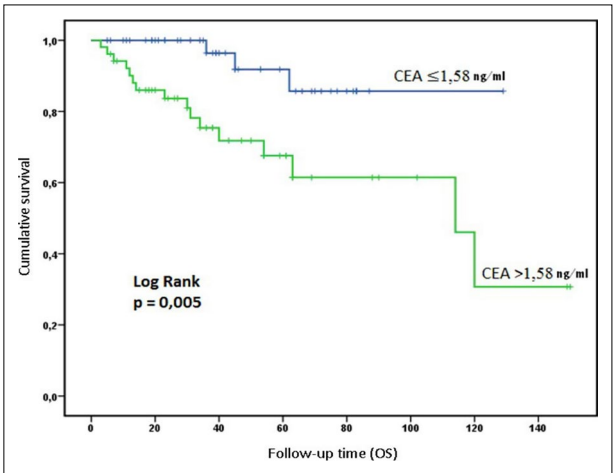

Fig. 6. Mortality risk according to the determined post-operative carcinoembryonic antigen cutoff value (OS: months).

DISCUSSION

In gastric cancer, which has a high risk of mortality, a satisfactory decrease in the mortality rate has not yet been achieved, and studies on the factors affecting survival and the development of effective treatments are still current issues.[10,11] Patients with node- negative gastric cancer have better OS rates compared to those with lymph node metastases, but it is a known fact that some patients with node-negative gastric cancer are at an increased risk of recurrence.[12] Therefore, many studies have been conducted to determine the prognostic factors associated with OS and DFS in patients with node-negative gastric cancer. In curatively resected gastric cancer cases, the most important prognostic factors are the gastric wall invasion depth and lymph node metastasis status.[13–15] Although the relationship between the gastric wall invasion depth and OS has been sufficiently clarified, the role of many important prognostic factors such as tumor size, tumor markers, presence of lymphovascular invasion, tumor localization, and ECOG performance status of the patient is still unclear.[16,17]

Zhao et al.[18] in their study with 646 patients with lymph node negative advanced stage gastric cancer showed that lymphovascular invasion, advanced T stage (T3-T4), and an inadequate number of retrieved lymph nodes were independent predictive factors of tumor recurrence in node-negative advanced gastric cancer. Older age, localization in the upper third of the stomach, lymphovascular invasion and the depth of tumor invasion (T4 stage) were independently associated with long-term survival. With regard to node-negative patients with ≥15 retrieved lymph nodes and advanced T stage (T3-T4) were independent risk factors for both tumor recurrence and long-term survival. Pacelli et al.[19] have compared distal gastric cancer with proximal gastric cancer in 707 patients and the prognosis of proximal gastric cancer was found to be worse due to advanced tumor stage and higher postoperative mortality. In our study, tumor localization was not found to be an independent predictor, but univariable overall OS analysis showed better prognosis of gastric cancer with distal (antrum- pylor) localization.

Kim et al.[20] compared node-negative and node-positive gastric cancer in 2848 gastric cancer patients and tumor size, serosa invasion and recurrence were found as independent predictors of OS. In a study of 277 patients with node-negative gastric cancer, Saito et al.[21] reported that tumor diameter was a prognostic predictor, and patients with a tumor diameter >7 cm had worse survival than those with a tumor diameter <7 cm. In our study, tumor diameter was not found to be associated with OS, but was found to be an independent predictor of recurrence. In addition, we found the cutoff value of tumor diameter, which is an independent predictor for recurrence, as 3.5 cm. The sensitivity of this cutoff value was 86.7%, the specificity was 45.1%, and it was found to be insufficient in terms of diagnostic evaluation. Kaplan–Meier analysis showed that patients with a tumor diameter >3.5 cm had a risk of recurrence of 3.667 times more than patients with a

tumor diameter of 3.5 cm or less. However, this predictive value was not effective in terms of mortality.

Studies comparing the total gastrectomy and subtotal gastrectomy in the treatment of gastric cancer have shown that life expectancy is the same but the morbidity and mortality rates are higher in total gastrectomy.[22] Bozzetti et al.[23] have compared 315 patients who were underwent subtotal gastrectomy with 303 patients who were underwent total gastrectomy in terms of survival and there was no difference between total gastrectomy and surgical margin negative subtotal gastrectomy. According to the study conducted by Hartgrink et al.[24] with a total of 1078 patients, total gastrectomy is recommended only if the tumor localization requires total gastrectomy. In the study of Deng et al.[25] with 112 node-negative gastric cancer patients, the operation type was found to be an independent predictor of OS, and subtotal gastrectomy was associated with longer post-operative survival. In our study, subtotal gastrectomy showed longer DFS and OS compared to total gastrectomy, and it was determined by univariable analysis that it may be a possible prognostic predictor, although it is not an independent predictor.

In a study of 774 patients with gastric cancer, Harrison et al.[26] found that D2 lymph node dissection affected survival in patients with node-negative gastric cancer. In the study of Bilici et al.[27] 113 node-negative gastric cancer patients were included in the study and the prognostic significance of D1 and D2 dissection could not be determined. In our study, longer DFS and OS were observed in D2 dissection than D1 dissection but it was not found as a prognostic factor. In fact, this may be explained by inadequate lymph node dissection in patients who underwent D1 lymph node dissection.

Sura et al.[28] reported that 20 or more lymph node dissections were associated with better survival in a study of 17,851 gastric cancer patients. In the study performed by Liu et al.,[29] 147 patients with stage 3 gastric cancer, the cutoff value for the number of dissected lymph nodes was found to be 15. The mean number of dissected lymph nodes was 15.88 in the study of Sura et al., and 18.3 in the study of Liu et al.[28,29]

Gu et al.[30] found that lymph node count was positively correlated with OS and was an independent predictor of OS in patients with node-negative gastric cancer. In a study of 2373 patients with stage III gastric cancer, Liu et al.[31] investigated the prognostic impact of negative lymph node counts and reported that patients with negative lymph node count >14 had better 5-year OS than those with negative lymph node count ≤14. In another study, Zhang et al.[32] suggested that lymph node count should be >31 for an accurate prognostic assessment in patients with node-negative Stage III gastric cancer. In our study, the median number of dissected lymph nodes was 16. The fact that the number of dissected lymph nodes in our study was not related to survival and recurrence may be due to the fact that we did not undergo a stage-based examination as in other studies.

Baba et al.[33] in their study with 123 patients with stage 4 gastric cancer, found a poor prognosis in patients with an ECOG score of 2 or higher compared to those with ECOG scores 0 and 1. In our study, the increase in ECOG score was found to be an independent predictor of both recurrence and mortality risk.

There are reports in the literature that CEA and CA 19-9 may have prognostic significance in gastric cancer. Marrelli et al.[34] showed that CA 19-9 level positively correlated with stage in 153 gastric cancer patients. Kwon et al.[35] showed that normalization of Ca 19-9 levels after curative gastric resection in gastric cancer was associated with curative surgical treatment. In a study of 36 patients with gastric cancer, Mihmanlı et al.[36] showed that patients with normal CEA levels had better survival than those with high CEA levels. In their study, Sun et al.[37] aimed to identify factors associated with early and late recurrence in patients with node-negative gastric cancer, and they found that high CA19-9 level was an independent predictor of late recurrence (>24 months). In our study, post-operative CEA and CA 19-9 levels were found to be independent prognostic factors in terms of both recurrence and mortality.

In a study conducted by Jeong et al.[38] with 1874 gastric cancer patients, 967 of whom were lyph node negative, CEA level was associated with survival and the cut-off value for CEA was determined as 5 ng/mL. In our study, it was found that having a CEA level above 1.7 ng/mL was associated with a higher risk of relapse and a value above 1.58 ng/mL was associated with a higher risk of mortality.

Our study has some limitations such as retrospective design and small sample size.

CONCLUSION

ECOG score, CEA, and CA 19-9 levels were found to be predictors of both recurrence and mortality risk in gastric cancer patients who underwent curative surgery and had no lymph node metastasis. Tumor diameter was determined as an independent predictor for recurrence only. These parameters may have a role in making a more accurate treatment timing decision and prognosis evaluation. Prospective studies with larger sample sizes are needed on this subject.

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