

Survival rates and associated risk factors in colorectal cancer treatment

Tasas de supervivencia y factores de riesgo asociados en el tratamiento del cáncer colorrectal

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Abstract

Objective: This study retrospectively investigates the risk factors affecting survival rates in patients with colorectal cancer.

Methods: A total of 232 patients who underwent surgery between 2011 and 2016 were included in the analysis. The average age of the patients was 63.7 years, and the majority were male. Among these patients, 84.5% underwent elective surgeries, while 13.8% had liver metastases. **Results:** The findings revealed that survival is significantly influenced by the type of surgery, tumor differentiation, the presence of liver metastases, carbohydrate antigen 19-9 (CA 19-9) levels, T and N stages, and the lymph node ratio. Patients who had poorly differentiated tumors, or exhibited elevated CA 19-9 levels demonstrated a higher risk of mortality. In addition, liver metastases were strongly associated with significantly lower survival rates. **Conclusions:** The study emphasized that survival rates decreased as the tumor stage progressed and patients who underwent elective surgery performed better. These findings emphasize the critical importance of early diagnosis and treatment planning. Identifying these risk factors is crucial for the development of personalised treatment strategies and further research with larger cohorts is essential to deepen and validate these associations.

Keywords: Colorectal cancer. Survive. Risk factors.

Resumen

Objetivo: Analizar en un estudio retrospectivo los factores de riesgo que influyen en la supervivencia de pacientes con cáncer colorrectal. **Métodos:** Se incluyeron 232 pacientes operados entre 2011 y 2016, con una edad media de 63.7 años, predominantemente varones. El 84.5% se sometieron a cirugías electivas, mientras que el 13.8% presentaban metástasis hepáticas. **Resultados:** La supervivencia se vio significativamente afectada por el tipo de cirugía, la diferenciación tumoral, la presencia de metástasis hepáticas, los niveles de CA 19-9, los estadios T y N, y la proporción de ganglios linfáticos. Los pacientes con tumores poco diferenciados, metástasis hepáticas o niveles elevados de CA 19-9 mostraron mayor riesgo de mortalidad. **Conclusiones:** A medida que avanza el estadio tumoral, las tasas de supervivencia disminuyen, y los pacientes que se someten a cirugía electiva tienen mejores resultados. Estos hallazgos destacan la importancia del diagnóstico precoz y de la planificación del tratamiento, siendo fundamentales para desarrollar estrategias personalizadas. Se requieren más estudios con cohortes más amplias para confirmar estas asociaciones.

Palabras clave: Cáncer colorrectal. Supervivencia. Factores de riesgo.

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Introduction

Colorectal cancer ranks among the most common malignancies globally and is a leading contributor to cancer-related deaths.¹ The lifetime risk for an individual to develop colorectal cancer is estimated at approximately 4%, underscoring the importance of advancing research and therapeutic interventions in this field. Survival rates in colorectal cancer are highly contingent on early diagnosis and the treatment approaches employed.² Furthermore, various studies exploring the impact of different risk factors on survival outcomes have produced diverse findings.³ The objective of this study is to identify the key risk factors that influence survival in patients with colorectal cancer and to provide clinical recommendations on how these factors can be effectively integrated into current practice.

Methods

A retrospective cohort study was conducted on 232 patients who underwent colorectal cancer surgery at Haydarpaşa Numune Training and Research Hospital, General Surgery Clinic, between January 2011 and January 2016. Diagnostic pre-operative colonoscopy was performed for all patients, except in emergency cases. In addition, all patients were assessed with computed tomography (CT), and supplementary imaging modalities such as abdominal ultrasonography, magnetic resonance imaging, and positron emission tomography-CT were employed as required. Pre-operative levels of carcinoembryonic antigen (CEA) and carbohydrate antigen 19-9 (CA 19-9) were measured. Emergency surgeries were performed on patients presenting with mechanical bowel obstruction, while elective surgeries were conducted after appropriate pre-operative preparation. Patients with tumors located in the mid or distal rectum received neoadjuvant chemoradiotherapy 28 days before surgery. Post-operative oncologic treatment planning was carried out in collaboration with the oncology department, tailored to each patient's disease stage. Perioperative morbidity was documented for all patients.

Overall survival was defined as the time from surgery to death from the disease. Early mortality, defined as death within the 1st month post-surgery, was excluded from the survival analysis. Overall, survival was analyzed according to the American Joint Committee on

Cancer (AJCC) TNM staging system. Risk factors for survival included age, sex, tumor location (colon or rectum), metastatic lymph node ratio, lymph node involvement, depth of wall invasion based on AJCC TNM classification, lymphovascular and perineural invasion, tumor differentiation, CEA and CA 19-9 levels, presence of liver metastasis, and the urgency of the operation. Liver metastasis was determined through both pre-operative and intraoperative findings. Tumor location was similarly assessed through pre-operative and intraoperative evaluations. AJCC TNM staging was based on histopathological data and liver metastasis presence. Data for this study were gathered through retrospective analysis of prospectively collected patient records, with current patient status confirmed through telephone interviews.

Descriptive statistics (mean, standard deviation, median, frequency, proportion, minimum, and maximum) were employed to characterize the data. Comparisons between two groups for non-normally distributed parameters were performed using the Mann-Whitney U-test. Pearson's Chi-square (χ^2) test, Fisher-Freeman-Halton test, Fisher's exact test, and Yates' corrected χ^2 test were utilized for categorical data analysis. Stepwise logistic regression analysis was conducted to assess the impact of various risk factors on mortality. Survival analysis was carried out using the Kaplan-Meier method, and the log-rank test was applied to evaluate differences in survival between groups. Statistical significance was defined at levels of $p < 0.01$ and $p < 0.05$.

Results

In this study, 232 patients diagnosed with colorectal cancer and who underwent surgical treatment between 2011 and 2016 were retrospectively analyzed. The mean age of the patients was 63.74 ± 11.95 years, with 59.5% ($n = 138$) being male and 40.5% ($n = 94$) female. Regarding surgical intervention, 84.5% ($n = 196$) of the patients underwent elective surgery, while 15.5% ($n = 36$) underwent emergency surgery. Survival analyses were performed using the Kaplan-Meier method, and statistical differences between groups were evaluated using the Log Rank test.

Pre-operative liver metastasis was observed in 13.8% ($n = 32$) of the cases. The pre-operative adjuvant therapy status was assessed. It was detected that 75.4% ($n = 175$) of the patients did not receive any, 16.4% ($n = 38$) received both radiotherapy (RT) and chemotherapy (CT), 6.5% ($n = 15$) received only

short-course RT, and 1.7% (n = 4) received only chemotherapy (CT). Elevated CEA levels (≥ 5 ng/mL) were detected in 36.6% (n = 78) of the cases, while 63.4% (n = 135) had normal CEA levels (< 5 ng/mL). Regarding CA 19-9 measurements, 83.6% (n = 179) were found to have levels below 37 U/mL, while 16.4% (n = 35) had levels above 37 U/mL (Table 1).

When examining the types of operations were assessed, it was detected that 84.5% (n = 196) of the cases underwent elective surgery, 15.5% (n = 36) underwent emergency surgery. Regarding tumor localization, 50.4% (n = 117) of the tumors originated in the colon, and 49.6% (n = 115) originated in the rectum. The types of surgery were performed, 86.6% (n = 201) underwent open surgery, and 13.4% (n = 31) underwent laparoscopic surgery. Regarding the presence of liver metastasis, single focus of metastasis was detected in 4.7% (n = 11), 2-5 focused of metastasis were detected in 3.9% (n = 9), multiple metastasis were detected in 4.7% (n = 11, and 86.6% (n = 201) had no metastasis (Table 2).

Tumor differentiation was assessed among the cases. Moderate differentiation was detected in 90.9% (n = 211), and 9.1% (n = 21) had poor differentiation. Lymphovascular invasion was observed in 40.9% (n = 95) of the cases, perineural invasion was found in 27.2% (n = 63). Regarding tumor invasion depth, 10.3% (n = 24) of the cases were classified as T1, 9.5% (n = 22) as T2, 69% (n = 160) as T3, and 11.2% (n = 26) as T4. Examination of lymph node involvement revealed that 56% (n = 130) were N0, 28% (n = 65) were N1, and 15.9% (n = 37) were N2. Distant metastasis (M) analysis revealed that 84.9% (n = 197) were M0, 12.5% (n = 29) were M1a, and 2.6% (n = 6) were M1b (Table 3).

Tumor sizes in the cases ranged from 0 to 15 cm, with an average of 4.93 ± 2.65 cm. The staging of the cases was assessed, it was detected that 13.8% (n = 32) were stage 1, 34.9% (n = 81) were stage 2, 36.2% (n = 84) were stage 3, and 15.1% (n = 35) were stage 4. Analysis of the metastatic lymph node ratio revealed that 30.6% (n = 71) had a ratio between 0 and 0.24, 10.3% (n = 24) had a ratio of ≥ 0.25 . The survival time of the cases ranged from 1 to 60 months, with an average of 25.06 ± 15.77 months. Investigation of mortality status revealed that 86% (n = 191) of the cases were survived, 14% (n = 31) had died (Table 4).

Statistically significant difference in mortality rates based on age groups was not detected ($p = 0.102$; $p > 0.05$). However, a statistically significant relationship

Table 1. General characteristics of the cases

Characteristics	n (%)
Age	
Min-Max (Median)	20-94 (65)
Mean $\pm$ SD	63.74 $\pm$ 11.95
< 65	84 (36.2)
≥ 65	148 (63.8)
Gender	
Female	94 (40.5)
Male	138 (59.5)
Liver metastasis on application	
No	200 (86.2)
Yes	32 (13.8)
Adjuvant treatment before operation	
No	175 (75.4)
RTx-KTx	38 (16.4)
RTx	15 (6.5)
KTx	4 (1.7)
CEA (ng/mL)	
Normal	135 (63.4)
High	78 (36.6)
Min-Max (Median)	0.5-3425 (3.4)
Mean $\pm$ SD	41.85 $\pm$ 262.24
CA 19-9 (U/mL)	
< 37	179 (83.6)
> 37	35 (16.4)
Min-Max (Median)	0.8-23376 (8.7)
Mean $\pm$ SD	167.18 $\pm$ 1615.58
Hospitalization period (day)	
Min-Max (Median)	2-33 (7)
Mean $\pm$ SD	9.10 $\pm$ 5.05

CEA: carcinoembryonic antigen; CA 19-9: carbohydrate antigen 19-9; SD: standard deviation.

was detected between mortality rates and CA 19-9 (U/mL) measurements ($p = 0.011$; $p < 0.05$). It was observed that patients with CA 19-9 levels above 37 had a 3.5-fold higher risk of mortality. The odds ratio (OR) for CA 19-9 was 3.519 (95% confidence interval [CI]: 1.452-8.524).

A statistically significant relationship was detected between mortality rates and the type of surgery performed ($p = 0.014$; $p < 0.05$). Patients who underwent emergency surgery had a 3.2-times higher risk of mortality. The OR for the type of surgery was 3.162 (95% CI: 1.335-7.491). A statistically significant relationship was also detected between mortality rates and the presence of liver metastasis ($p = 0.001$; $p < 0.01$). Patients with liver metastasis had a 5.3-fold higher risk of mortality (OR 5.286 [95% CI: 2.189-12.762]).

A statistically significant relationship was detected between mortality rates and tumor differentiation ($p = 0.008$; $p < 0.01$). Patients diagnosed by poorly

Table 2. General characteristics of the cases

Characteristics	n	%
Operation typea		
Elective	196	84.5
Emergency (mechanical intestinal obstruction)	36	15.5
Tumor localization		
Colon	117	50.4
Rectum	115	49.6
Operation mode		
Open surgery	201	86.6
Laparoscopic	31	13.4
Presence of liver metastasis		
Non	201	86.6
Metastasis in 1 focus	11	4.7
2-5 metastases	9	3.9
Multiple metastasis	11	4.7
Perioperative complications		
Non	216	93.1
Splenic injury	2	0.9
Colonic injury	1	0.4
Tumor perforation	2	0.9
Presacral vein bleeding	3	1.3
Internal iliac artery injury	1	0.4
Small intestine injury	2	0.9
Ureteral injury	1	0.4
Urethra injury	2	0.9
Vaginal injury	2	0.9

Table 3. Histopathologic features of the cases

Characteristics	n	%
Tumour differentiation		
Moderate	211	90.9
Poor	21	9.1
Lymphovascular invasion		
No	137	59.1
Yes	95	40.9
Perineural invasion		
No	169	72.8
Yes	63	27.2
Tumour invasion depth (pT)		
T1	24	10.3
T2	22	9.5
T3	160	69.0
T4	26	11.2
Lymph node involvement (pN)		
N0	130	56.0
N1	65	28.0
N2	37	15.9
Distant metastasis (M)		
M0	197	84.9
M1a	29	12.5
M1b	6	2.6

Table 4. Histopathological, liver resection, and survival characteristics of the cases

Characteristics	n (%)
Tumor size (cm)	
Min-Max (Medyan)	0-15 (4.5)
Ort ± SD	4.93 ± 2.65
Grade	
Grade 1	32 (13.8)
Grade 2	81 (34.9)
Grade 3	84 (36.2)
Grade 4	35 (15.1)
Number of lymph nodes removed	
Min-Max (Medyan)	3-98 (20.5)
Mean ± SD	24.44 ± 13.47
Number of lymph nodes removed (21)	
Min-Max (Median)	0-28 (0)
Mean ± SD	1.75 ± 3.75
Metastatic lymph node rate (%)	
No	137 (59.1)
0-0.24	71 (30.6)
≥ 0.25	24 (10.3)
Additional procedure (hepatectomy)	
No	227 (97.8)
Right hepatectomy	2 (0.9)
Left lateral segmentectomy	2 (0.9)
Left hepatectomy	1 (0.4)
Liver segment resection	
No	217 (93.5)
Yes	15 (6.5)
Survival status	
Early mortality	10 (4.3)
Excitus by tumor	31 (13.4)
Alive	191 (82.3)
Life expectancy (months)	
Min-Max (Medyan)	1-60 (23)
Mean ± SD	25.06 ± 15.77

SD: standard deviation.

differentiated tumors had a 4.3-fold higher risk of mortality. The OR regarding tumor differentiation was 4.351 (95% CI: 1.561-12.125).

Statistically significant difference was not observed in mortality rates based on CEA (ng/mL) measurements ($p = 0.384$; $p > 0.05$). Similarly, statistically significant difference was not observed in mortality rates according to tumor localization ($p = 0.659$; $p > 0.05$), post-operative complications ($p = 0.545$; $p > 0.05$), or tumor size ($p = 0.584$; $p > 0.05$) (Table 5). Patients who has T4 stage tumor had higher mortality rates compared by in other stages was observed noteworthy.

Table 5. Results of the univariate analysis of patient, tumor, and perioperative risk factors affecting overall survival (n = 222)

Risk factors	Mortality		p
	Alive	Ex	
Age (years)			
< 65	76 (91.6)	7 (8.4)	ª0.102
≥ 65	115 (82.7)	24 (17.3)	
Gender			
Female	77 (85.6)	13 (14.4)	ª1.000
Male	114 (86.4)	18 (13.6)	
CEA (ng/mL)			
< 5	113 (88.3)	15 (11.7)	ª0.384
≥ 5	63 (82.9)	13 (17.1)	
CA 19-9 (U/mL)			
< 37	152 (89.4)	18 (10.6)	ª0.011*
≥ 37	24 (70.6)	10 (29.4)	
Operation type			
Elektif	166 (88.8)	21 (11.2)	ª0.014*
Urgent	25 (71.4)	10 (28.6)	
Tumor localization			
Colon	98 (87.5)	14 (12.5)	ª0.659
Rectum	93 (84.5)	17 (15.5)	
Liver metastasis			
No	173 (89.6)	20 (10.4)	ª0.001**
Yes	18 (62.1)	11 (37.9)	
Tumor size (cm)			
Min-Max (Median)	0-15 (4.5)	0-13 (5)	ª0.584
Mean ± SD	4.79 ± 2.60	5.07 ± 2.67	
Tumor differentiation			
Moderate	179 (88.2)	24 (11.8)	ª0.008**
Poor	12 (63.2)	7 (36.8)	
Post-operative complications			
No	137 (87.3)	20 (12.7)	ª0.545
Yes	54 (83.1)	11 (16.9)	

ªYates' continuity correction test.

ªFisher exact test;

ªMann-Whitney U-Test.

*p < 0.05.

**p < 0.01.

CA 19-9: carbohydrate antigen 19-9; SD: standard deviation.

A statistically significant relationship was observed between mortality rates and N stages ($p=0.041$; $p<0.05$). Patients with N2 lymph node involvement had higher mortality rates compared to those with N0 involvement. A statistically significant association was also observed between mortality rates and the percentage of metastatic lymph nodes ($p=0.024$; $p<0.05$). Specifically, patients who have a metastatic lymph node percentage > 0.25 had higher mortality rates than those with a percentage below 0.25. Statistically significant relationships were not observed between mortality rates and lymphovascular invasion ($p=0.135$) or perineural invasion ($p=0.625$) ($p>0.05$). In

Table 6. Results of univariate analysis of histopathological and lymph-node-related risk factors affecting overall survival (n = 222)

Risk factors	Mortality		p
	Alive	Ex	
Lymphovascular invasion			
No	117 (89.3)	14 (10.7)	ª0.135
Yes	74 (81.3)	17 (18.7)	
Perineural invasion			
No	141 (87)	21 (13)	ª0.625
Yes	50 (83.3)	10 (16.7)	
Tumor invasion depth (pT)			
T1	23 (95.8)	1 (4.2)	ª0.043*
T2	20 (90.9)	2 (9.1)	
T3	131 (86.8)	20 (13.2)	
T4	17 (68)	8 (32)	
Lymph node involvement (pN)			
N0	114 (90.5)	12 (9.5)	ª0.041*
N1	51 (83.6)	10 (16.4)	
N2	26 (74.3)	9 (25.7)	
Number of lymph nodes removed			
< 21	92 (84.4)	17 (15.6)	ª0.620
≥ 21	99 (87.6)	14 (12.4)	
Metastatic lymph node rate (%)			
No	119 (88.8)	15 (11.2)	ª0.024*
0-0.24	58 (86.6)	9 (13.4)	
≥ 0.25	14 (66.7)	7 (33.3)	

ªYates' continuity correction test.

ªFisher-Freeman-Halton test.

ªPearson's chi-squared test.

*p < 0.05.

addition, statistically significant difference was not observed in mortality rates based on the number of lymph nodes involved ($p=0.620$; $p>0.05$) (Table 6).

In the Stage 2 group, 74 out of 78 patients (94.9%) survived, four patients died. The mean survival time was observed 55.43 ± 2.12 months. The last death occurred in the 40th month, and the 5-year cumulative survival rate was 83.1%, with a standard error of 8.2%.

In the Stage 3 group, 68 out of 79 patients (86.1%) survived, 11 patients died. The mean survival time was 49.36 ± 1.75 months. The last death occurred in the 50th month, and the 5-year cumulative survival rate was 65.5%, with a standard error of 10%.

In the Stage 4 group, 17 out of 33 patients (51.5%) survived, 16 patients died. The mean survival time was 34.67 ± 4.26 months. The last death occurred in the 41st month, and the 5-year cumulative survival rate was 36.5%, with a standard error of 10.6%.

When evaluating survival rates among the groups using the Log Rank test, a statistically significant difference in 5-year survival rates was observed ($p=0.001$; $p<0.01$). It is significantly noteworthy that

the survival rate in the Stage 4 group is lower than that of the other three stages, with survival rates inversely proportional to stage progression.

Factors that were significant or near significant in univariate analysis concerning mortality were included in the logistic regression analysis. Accordingly, logistic regression analysis was performed to investigate the effects of age (> 60), CEA (≥ 5 ng/mL), CA 19-9 (≥ 37 U/mL), type of surgery (emergency), presence of liver metastasis, tumor differentiation, lymphovascular invasion, tumor wall depth (T), and lymph node involvement (N).

In the Backward Conditional Logistic Regression analysis for mortality, the model was found to be significant, with a very good explanatory power (86%). The OR for the presence of liver metastasis ($p = 0.001$) was 4.790 (95% CI: 1.850-12.400), and for poor tumor differentiation ($p = 0.026$), it was 4.008 (95% CI: 1.180-13.616). Both factors had a statistically significant impact on mortality ($p < 0.05$).

The OR for emergency surgery was 2.699 (95% CI: 0.921-7.909), and although this was near statistical significance, it did not reach the threshold ($p = 0.070$; $p > 0.05$).

Among 187 patients who underwent elective surgery, 166 patients (88.8%) survived, and 21 deaths were observed. The mean survival time was 52.45 ± 1.47 months. The last death occurred in the 50th month, and the 5-year cumulative survival rate was 71.4%, with a standard error of 6.5%.

Among 35 patients who underwent emergency surgery, 25 patients (71.4%) survived, and 10 deaths were observed. The mean survival time was 44.77 ± 3.91 months. The last death occurred in the 35th month, and the 5-year cumulative survival rate was 60.0%, with a standard error of 10.4%.

When evaluating survival rates among the groups using the Log Rank test, a statistically significant difference in 5-year survival rates was observed ($p = 0.018$; $p < 0.05$). The survival rate in the emergency surgery group was observed to be lower than that of the elective surgery group.

Among 203 patients who diagnosed moderately differentiated tumors, 179 patients (88.2%) survived, and 24 deaths were observed. The mean survival time was 52.30 ± 1.41 months. The last death occurred in the 50th month, and the 5-year cumulative survival rate was 71.7%, with a standard error of 6.1%.

Among 19 patients who diagnosed poorly differentiated tumors, 12 patients (63.2%) survived, and seven deaths were observed. The mean survival time was

36.72 ± 4.85 months. The last death occurred in the 31st month, and the 5-year cumulative survival rate was 40.1%, with a standard error of 15.0%.

Statistically significant difference in 5-year survival rates was observed using the Log Rank test ($p = 0.001$; $p < 0.01$). The survival rate for patients who diagnosed poorly differentiated tumors was observed to be lower than for those with moderately differentiated tumors.

Among 193 patients without liver metastasis, 173 patients (89.6%) survived, and 20 deaths were observed. The mean survival time was 52.88 ± 1.42 months. The last death occurred in the 50th month, and the 5-year cumulative survival rate was 71.3%, with a standard error of 6.6%.

Among 29 patients with liver metastasis, 18 patients (62.1%) survived, and 11 deaths were observed. The mean survival time was 38.96 ± 7.79 months. The last death occurred in the 37th month, and the 5-year cumulative survival rate was 50.2%, with a standard error of 12.0%.

Statistically significant difference in 5-year survival rates was observed using the Log Rank test among the groups ($p = 0.001$; $p < 0.01$). Patients with liver metastasis exhibited a reduced survival rate compared to those without.

Regarding tumor differentiation, the 5-year survival rate was 71.7% for patients who diagnosed moderately differentiated tumors, it was 40.1% for those with poorly differentiated tumors. This finding was also statistically significant ($p = 0.045$).

The presence of metastasis significantly impacted survival, with a 5-year survival rate of 35.4% in 97 patients who diagnosed metastatic disease, compared to 74.2% in 135 patients without metastasis. This difference was statistically significant ($p < 0.001$).

The survival was affected by findings also demonstrated that age, gender, tumor stage, and treatment modalities. Patients with advanced age and higher tumor stages had significantly lower survival rates.

These data clearly indicate that the type of surgical intervention, tumor differentiation, and the presence of metastasis play critical roles in survival outcomes in colorectal cancer patients.

Discussion

Colorectal cancer is recognized as a significant cause of morbidity and mortality worldwide and stands out as the most commonly encountered type of gastrointestinal system cancers.^{4,5} Despite being one of

the leading causes of cancer-related deaths, it is well established that colorectal cancers can be completely treated if diagnosed early.^{6,7} In recent years, advancements in diagnostic methods, the widespread implementation of screening programs, progress in surgical techniques, and innovations in RT and systemic treatment have contributed to the earlier detection of colorectal cancer and improved survival rates.^{8,9}

Surgical treatment of colorectal cancers is currently regarded as the only curative approach.¹⁰ Developments in diagnostic and therapeutic methods have significantly contributed to the improvement of survival rates.¹¹ These advancements have been made possible through the early diagnosis of tumors, the use of more precise staging systems, the accumulation of knowledge and experience in surgical treatment, and innovations in adjuvant therapy.^{12,13}

Advancements in surgical treatment, including a better understanding of lymphatic anatomy, resections performed with the preservation of fascial planes, and the progress in surgical technology, have enabled the performance of less traumatic and shorter-duration surgeries.^{14,15} These developments have not only reduced perioperative morbidity and mortality rates but also positively impacted oncological outcomes.¹⁶

Accurate pre-operative staging is critical in determining the appropriate treatment modality.^{17,18} It is well known that inappropriate treatment approaches can have adverse effects on oncological outcomes.^{19,20} In this study, the 5-year cumulative survival rate was found to be 69%. The 5-year survival rates between stages showed statistically significant differences, and these results are consistent with the literature.

Determinants of staging systems are independent risk factors. As the knowledge of tumor biology increases, these risk factors change or new ones are added. These developments also affect surgical and adjuvant treatment approaches.²¹ The 5-year cumulative and stage-specific survival rates of colorectal tumors in our clinic were found to be consistent with the literature, and risk factors affecting patients' survival were investigated.

The T stage is a significant risk factor that determines the patient's stage, and Stages 1 and 2 can be identified solely by the T stage.²² The literature indicates that regardless of the T stage, if there is no lymph node involvement, the disease is considered localized. It has been noted that adjuvant therapy applied in Stage 2 tumors provides a 2% survival advantage, but this advantage is not statistically

significant.²³ Therefore, adjuvant therapy is not recommended for Stage 2 colon tumors outside the rectum.²⁴ In this study, it was also found that survival significantly worsened with an increase in T stage, and the T stage itself was identified as a risk factor. This finding has been evaluated as consistent with the literature.

Although Stage 2 disease is considered localized, the 5-year survival rate with appropriate surgery is around 80%. In this scenario, the 20% of patients died due to tumor progression are exposed to factors other than those determining the stage.²⁵ According to the American Society of Clinical Oncology (ASCO) guidelines, these risk factors include pre-operative high CEA, the need for emergency surgery such as mechanical bowel obstruction or perforation, T4 tumors, inadequate lymph node dissection (< 12), and peritumoral lymphovascular invasion, and adjuvant chemotherapy is recommended for these patients. Research is ongoing to include these factors and some others in the staging system.²⁶

The National Comprehensive Cancer Network (NCCN) and ASCO guidelines consider poor tumor differentiation as an independent risk factor and identify it as a poor prognostic factor.²⁷ In this study, poor differentiation was also observed to be an independent risk factor. Therefore, poor tumor differentiation has been considered a factor that requires adjuvant chemotherapy in Stage 2 colon tumors. However, it should be noted that determining tumor differentiation poses a practical challenge for pathologists, and there may be discrepancies among observers. Efforts are ongoing to standardize this risk factor.

The prognostic significance of lymphovascular and perineural invasion has been investigated in various studies, and it is generally accepted as a poor prognostic factor.²⁸ However, in this study, lymphovascular and perineural invasion were not observed as poor prognostic factors. This result may be attributed to the limited number of patients. The NCCN guidelines propose adjuvant chemotherapy in the presence of lymphovascular and perineural invasion in Stage 2 tumors.²⁹

CEA is the most commonly used tumor marker in colorectal cancers and is elevated in 60-70% of patients.³⁰ In this study, CEA levels were found to be elevated in 36.6% of patients. CEA elevation may have a negative impact on prognosis and is considered an independent risk factor. However, in this study, no association was found between CEA elevation and prognosis. The number of patients was

insufficient for analyses performed with different threshold values.

Approximately 20% of colorectal cancers are operated on under emergency conditions, with 80% of these cases occurring due to obstruction.³¹ In this study, the prognosis of patients operated on due to obstruction was observed to be worse compared to elective surgeries. This situation can be explained by the fact that surgeries performed under emergency conditions focus on the obstruction rather than adhering to oncological principles. Therefore, mechanical obstruction is considered a factor that necessitates adjuvant therapy.

Lymph node involvement is described as an upstaging factor in the TNM classification. The presence of lymph node metastasis not only affects prognosis but also determines the postoperative treatment regimen. In this study, lymph node metastasis was found to be a factor that worsens prognosis, and a negative correlation was observed between the number of metastatic lymph nodes and survival. However, no significant relationship was observed between the number of lymph nodes and prognosis.³²

Liver metastasis is the worst prognostic metastasis of colon cancers, excluding brain metastasis, and in this study, liver metastasis was found to be the most important risk factor affecting prognosis. Among patients presenting with liver metastasis, 70-80% had disease confined to the liver, and the most effective treatment for these metastases is liver resection.³³ In this study, the 5-year survival rate in patients with liver metastasis was found to be 50.2%, which is consistent with the literature.

Conclusions

The overall survival rates and stage-specific survival rates observed in this study were found to be consistent with the literature. Obtaining accurate clinical data, properly evaluating this data, and applying treatment within a multidisciplinary framework will lead to better outcomes. Leading studies in the literature frequently involve large patient cohorts by aggregating data from multicenter registries through tumor study groups. To contribute further to the literature, forming tumor study groups and conducting studies through these groups can provide additional valuable insights.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of humans and animals. The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and adhered to the World Medical Association and the Declaration of Helsinki.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from patients, and received approval from the Ethics Committee.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

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