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The Importance of C-Reactive Protein for Preoperative Evaluation, Inoperability and Survival in Patients with Peritoneal Metastasis

Periton Metastazı olan Hastalarda Preoperatif Değerlendirme, İnoperabilite ve Sağkalım İçin C-Reaktif Proteinin Önemi

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ABSTRACT

Objective: C-reactive protein (CRP) is an inflammatory marker that has predictive value for survival in many types of cancer. The aim of this study is to examine the preoperative CRP level as a predictive biomarker for surgery due to peritoneal carcinomatosis whether the disease is resectable or not.

Method: A total of 126 patients who underwent laparotomy for cytoreductive surgery and HIPEC between 2014- 2019 were included in this study.

Results: In the comparative analysis, for operated and unresectable patients, CRP values measured in the same week preoperatively were found to be statistically significant markers for operability. The CRP values were found 4.3 and 18 g/L, respectively. This difference was found to be statistically significant ($p = 0.03$) In the subsequent subgroup analysis, in patient group with PCI ≥9, the CRP value was found to be significantly higher than the PCI <9 group ($p = 0.006$).

Conclusion: We suggest that CRP can give us an idea as a simple and cheap biomarker in these group of patients. We suggest that CRP can give us an idea as a simple and cheap biomarker in these group of patients. It should be kept in mind that if the preoperative CRP value is high in patients who are planned to have CRS + HIPEC, patient could be unresectable. In patients undergoing cytoreductive surgery and HIPEC, high CRP levels were found to be associated with higher PCI and lower survival.

Keywords: : C-reactive protein, biomarker, peritoneal carcinomatosis, cytoreductive surgery, intraperitoneal hyperthermic chemotherapy

ÖZ

Giriş: C-reaktif protein (CRP), birçok kanser türünde sağkalım için prediktif değere sahip inflamatuar bir belirteçtir. Bu çalışmanın amacı, hastalığın rezektabl olup olmadığına peritoneal karsinomatozise bağlı cerrahide prediktif biyo-belirteç olarak preoperatif CRP düzeyini incelemektir.

Yöntem: 2014- 2019 yılları arasında sitoredüktif cerrahi ve HİPEK için laparotomi yapılan 126 hasta çalışmaya dahil edildi.

Bulgular: Karşılaştırmalı analizde ameliyatlı ve rezeke edilemeyen hastalarda ameliyat öncesi aynı hafta ölçülen CRP değerlerinin ameliyat için istatistiksel olarak anlamlı belirteçler olduğu görüldü. CRP değerleri sırasıyla 4.3 ve 18 g / L bulundu. Bu fark istatistiksel olarak anlamlı bulundu ($p = 0.03$). Sonraki alt grup analizinde PCI ≥9 olan hasta grubunda CRP değeri PCI <9 grubuna göre anlamlı olarak yüksek bulundu ($p = 0.006$).

Sonuç: CRP'nin bu hasta grubunda basit ve ucuz bir biyobelirteç olarak bize fikir verebileceğini öne sürüyoruz. CRP'nin bu hasta grubunda basit ve ucuz bir biyobelirteç olarak bize fikir verebileceğini öne sürüyoruz. KRS + HİPEK planlanan hastalarda preoperatif CRP değeri yüksek ise hastanın rezeke edilemeyebileceği unutulmamalıdır. Sitoredüktif cerrahi ve HİPEK geçiren hastalarda, yüksek CRP düzeylerinin daha yüksek PCI ve daha düşük sağkalım ile ilişkili olduğu bulunmuştur.

Anahtar Kelimeler: C-reaktif protein, biyo-belirteç, peritoneal karsinomatoz, sitoredüktif cerrahi, hipertermik intraperitoneal kemoterapi

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INTRODUCTION

Until recently, peritoneal carcinomatosis (PC) was considered as terminal stage disease for many cancer types, and palliative treatments and chemotherapy regimens were the only options. In the treatment of peritoneal carcinomatosis, even with the most appropriate chemotherapy protocols, the median survival was known to be between 7-15 months (1,2). Today, the perception of peritoneal carcinomatosis has changed and it has started to be accepted as a locoregional disease limited to the abdomen, and this perception has gained importance especially in the treatment of colorectal, ovarian and stomach cancers, pseudomyxoma peritonei and mesothelioma (3). With advances in the surgical treatment of peritoneal cancers in the last three decades, positive results have been obtained with cytoreductive surgery (CRS) with intraperitoneal hyperthermic chemotherapy (HIPEC), and publications emerged showing that the mean survival time is longer than standard chemotherapy regimens (4,5). Cytoreductive surgery and hyperthermic intraperitoneal chemotherapy which defined by Sugarbaker et al. and used in the treatment of peritoneal cancers, is consisted of multiple organ resections and peritonectomy procedures (6). The most important factors for long survival in this procedure are peritoneal cancer index (PCI) and complete cytoreduction (7,8). Even today, it is not easy to prepare patients with such peritoneal metastasis for the operation. In the management of peritoneal surface malignancies, preoperative evaluation, determination of the extent of the disease and accurate patient selection are very important (9,10).

C-reactive protein (CRP) is an inflammatory marker that has predictive value for survival in many types of cancer (11-13). Although its importance has been shown mostly for solid tumors (renal cell carcinoma, pancreas, hepatocellular, lung, ovary cancer) in the literature, its importance is also significant for gastrointestinal tumors (8,12-15). CRP has been shown in some studies as an important marker of gastrointestinal system cancers, especially for stage IV gastric and colorectal cancers (16,17). It is also used by medical oncologists to evaluate response to tumor and to detect recurrence (16).

In this study, we retrospectively examined patients who underwent laparotomy with a diagnosis of peritoneal carcinomatosis that were considered operable in preoperative evaluations. The aim of this study is to examine the effects of the pre-operative CRP level in patients scheduled for surgery due to peritoneal carcinomatosis, whether the disease is resectable or not, and in patients who can be resected, in terms of PCI and survival. We investigated whether the CRP level is a predictive marker that can be used in preoperative staging or not.

MATERIAL AND METHOD

Patients who underwent laparotomy for cytoreductive surgery and HIPEC due to gastrointestinal malignancies, peritoneal metastases of ovarian cancer and malignant mesothelioma between 2014 and 2019 were included in the study. All patients included in the study were those who were discussed and decided to be operated in oncology councils including radiologists, medical oncologists, and gastrointestinal surgeons. Data of all patients scheduled for cytoreductive surgery were prospectively collected. The demographic characteristics of these patients and all information about previous primary tumor resections and pathologies, were recorded. Preoperative evaluations were performed according to patient, by abdominal and thorax computed tomography (CT), PET-CT or magnetic resonance (MRI) and upper/lower endoscopic examinations performed for gastrointestinal malignancies. Solid organ metastases, especially the peritoneal cancer index (PCI), and their resectability were evaluated with these imaging methods. Carcinoembryonic antigen (CEA), CRP values and other hematological and biochemical parameters of the patients preoperatively checked and recorded in the same week of surgery and analyzed retrospectively. Patients who were considered operative in the preoperative evaluation underwent laparotomy and all patients diagnosed with malignancy by frozen examination were included in the study.

Inclusion and Exclusion Criteria

Primary pathologies of the patients included in the study were stomach, colorectal, small intestine and ovary carcinomas, and malignant mesothelioma. Patients with primary or recurrent peritoneal metastases were included in the study. Patients with extraabdominal metastasis, paraaortic lymph node metastasis, pleural malignant effusion, and multiple small bowel obstructions and patients with high PCI on CT were considered inappropriate for CRS + HIPEC and considered as unresectable patients. Patients with more than 3 liver metastases and patients with major hepatectomies were also not included in the study. Patients with ECOG performance status ≤3, patienrs with PCI<20 for colorectal cancers and PCI<13 for gastric cancer and no signs of biliary obstruction were included in the study. Except for patients requiring total cystectomy, patients with ureter involvement were considered operable and were included in the study.

Surgical Procedure and Histopathological Examination

The SRC procedure was performed as described by Sugarbaker (18). All patients underwent laparotomy with a median incision between xiphoid process and symphysis pubis. First, after removing all adhesions, the abdomen was explored for liver and peritoneal metastases. PCI was calculated and recorded. Biopsy obtained from all patients and frozen examination was performed. PCI was calculated as described by Sugarbaker by dividing the abdomen into 9 regions and 4 separate sections in the small intestine. Lesion size (LS) recorded as LS0 for no visible implants, LS1 for implants under 0,5 cm, LS2 between 0,5 cm and 5 cm, and LS3 over 5 cm. PCI was scored between 0 and 39 according to the distribution of the tumor and the size of the tumor (19). If necessary, palliative surgical procedures were performed for unresectable patients. Operation time and number of organ resections of operable patients were recorded. Primary tumor and related lymph node dissection was performed in operable patients. After cytoreduction was completed, four catheters were placed in the abdomen and the abdomen was closed. Hyperthermic intraperitoneal chemotherapy regimens; Cisplatin (90 mg/m^2) or Oxaliplatin (300-460 mg/m$^{2)}$ was performed at 42^{o}C for approximately one hour. Histopathological staging of all patients was re-evaluated in order to provide standardization in retrospective cases according to AJCC 8th edition (2017) (20). The mean survival times of all patients and operable patients were evaluated separately. Unresectable patients were discharged after laparotomy or palliative surgery and referred to medical oncologist. All follow-up records of the patients after the surgery were checked from the digital data system and the death data obtained from the death information system.

Statistical Analysis

The data were transferred to IBM SPSS Statistics program v. 21 IBM Corp: Armonk, NY, USA) for analysis. We used SPSS software, version 17 (SPSS Inc., Chicago, IL, USA) in this study for statistical analysis. Descriptive data were given as mean or median (range). Categorical variables were described using frequency distributions. Independent sample t-test was used to show differences in the means of continuous variables and the Chi-square test was used in cases with categorical variables. A p-value < 0.05 was considered significant. Survival was calculated using the Kaplan–Meier method and compared between groups using the log-rank test. Length of survival was calculated as the period from the date of initial operation to the date of death or last follow-up.

RESULTS

A total of 126 patients who were considered operable for peritoneal carcinomatosis were scheduled for CRS + HIPEC and operated. Consecutively collected data of these patients were analyzed retrospectively. While 74 (58.7%) of these patients were operated, 52 (41.3%) were evaluated as unresectable with the findings of laparotomy and the operation was terminated or palliative procedures were performed. The mean age of the patients included in the study was 56.27. The rate of patients with ECOG scores of 0-2 were 92.1%. Sixty (47.6%) of the patients were female and 66 (52.4%) were male. The postoperative hospitalization period of the patients ranged from 3-109 days and the median length of stay was 14 days. When the primary pathology was examined, the operation was performed mostly due to colorectal and stomach cancers. Afterwards, the most common tumor operated were ovarian cancers, pseudomyxoma peritonei (PMP), malignant mesothelioma and

small bowel cancers, respectively. Fifty-four (42.9%) of these were primary malignancies and 72 (57.1%) were recurrent malignancies. The mean CEA and CRP values of all patients preoperatively measured in the same week of surgery were found to be 2.5 ng/ml and 7 g/L, respectively. Patients with a PCI value of more than 20 in colon and ovarian malignancies and peritoneal metastases due to malignant mesothelioma and over 13 in peritoneal metastases due to gastric carcinoma were considered unresectable. The median peritoneal cancer index of the patients who could underwent CRS + HIPEC was 8.86 ± 6.71. Of the 3 patients with PCI = 0, two were patients with positive peritoneal cytology and one had been operated in an external center for perforated appendix mucocele and had completion HIPEC in our clinic. The mean white blood cell (WBC) and neutrophil percentages of all patients were 6.68 x10^9 /L and 61.2 x10^9 /L, respectively. (Table-1)

In the comparative analysis, for operated (CRS + HIPEC) and unresectable patients, CEA and CRP values measured in the same week preoperatively were found to be statistically significant markers for operability. Considering the CRP values between the CRS + HIPEC group and the group that could not be operated, the CRP values of the groups that could and could not be operated were 4.3 and 18 g/L, respectively. This difference was found to be statistically significant (p = 0.03) (reference normal level is 0-5 gr/L).

In the subsequent subgroup analysis, the patient group to whom CRS + HIPEC was performed was also evaluated within itself. The mean PCI of this group was found to be 8.86 ± 6.71. Therefore, two groups were formed as PCI≥9 and PCI <9. In the patient group with PCI ≥9, the CRP value was found to be significantly higher than the group with less than nine (p = 0.006).

When CRP was compared between the operated and non-operated groups, the cut-off value for CRP was found to be 7.92 (The reference range for C-reactive protein is 0-5mg/dl) (sensitivity: 73.3%, specificity: 73.5%, positive predictive value (PV): 57,69% and negative predictive value (NPV): 77.02%) (Figure-1). In our study, we detected that the rate of inoperability increased in patients with a CRP value above this value.

Table 1: Characteristics of all Patients Undergoing Laparotomy for Cytoreductive Surgery and HIPEC

Variables		Number of patients	
		n	%
Gender	Female	60	47.6
	Male	66	52.4
Age (Mean± SD)		56.27 ± 12.9	
ECOG score	0	12	9.5
	1	60	47.6
	2	44	34.9
	3	10	7.9
Primary Tumor	Gastric	45	35.7
	Small bowel	4	3.2
	Colon	43	34.1
	Overy	14	11.1
	PMP	13	10.3
	M.Mesotelioma	7	5.6
Tumor	Primary	54	42.9
	Recurrence	72	57.1
CEA (ng/ml)	Normal value	0 - 2.5	
	Median	2.5	
	Range	0.4- 309	
	Mean±SD	11.7 ± 27.1	
CA19-9 (U/ml)	Normal value	<30.9	
	Median	15.2	
	Range	0.6- 2000	
CRP (gr/L)	Normal value	0 - 5	
	Median	7	
	Range	0.3- 158	
Albumin (gr/L)	Normal value	3.2-4.8	
	Median	4.12 ± 0.51	
Wbc (x10^9/L)	Normal value	3.6-10.5	
	Median	6.68 ± 2.55	
Neutrophil percentage (x10^9/L)	Normal value	1.5-7.7	
	Median	61.2 ± 11	
Patients Undergoing Cytoreduction		74	58.7
Inoperable Patients		52	41.3
Length of stay (Day)	Median	14	
	Range	3-109	
Survival	Alive	68	54.0
	Ex	58	46.0
Total		126	

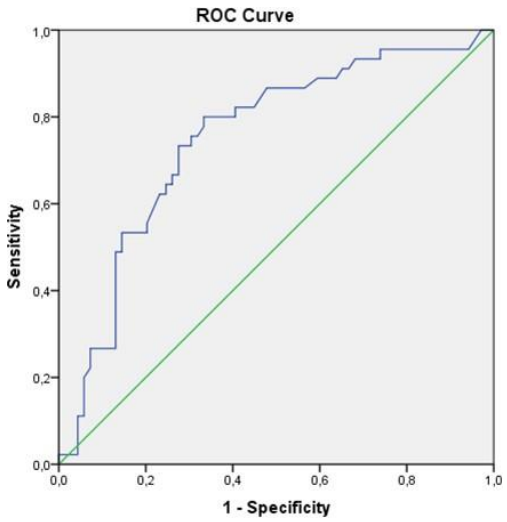


Figure 1 : Roc curve analysis of the sensitivity of the CRP cut-off value.

Among the factors that may affect the CRP value; there was no statistically significant difference when we are looking at age, gender, WBC value, ostomy status and patient performance status. (p = 0.68, p= 0.32, p = 0.09 p = 0.39, p = 0.24, respectively).

In multivariate analysis of these two groups (operated (CRS + HIPEC) and unresectable patients group); age,gender and CRP value were found statistically significant (Table-3)(p=0.03, p=0.043, p=0.046).

The median survival of the resectable patients was 22.4 (range 1-73) months and the unresectable patients were 7.7 (range 1-28) months. When the survival analysis between the group in which CRS + HIPEC was performed and the group that could not performed, it was observed that mean survival time is significantly higher in the CRS + HIPEC group (p <0.001) (Table-2).

Table 2 : Comparison of Operable and Inoperable Patients

Variables		CRS+HİPEC		Inoperabl		p value
		n	%	n	%	
		74	58.7	74	58.7	
Age (mean±SD)		54.28 ± 11.8		59.11 ± 14.0		0.55
Gender	Female	41	55.4	19	36.5	0.03
	Male	33	44.6	33	63.5	
CEA		2 (0.6-187)		2.5 (0.4-309)		<0.01
CRP (mean±SD)		4.3 (0.30- 117)		18 (0.4-158)		0.03
WBC (mean±SD)		6.56 ± 2.52		6.88 ± 2.63		0.67
Neutrophil percentage (mean±SD)		59.9 ± 9.09		63.36 ± 13.47		0.58
Albumin (mean±SD)		4.23 ± 0.4		3.94 ± 0.56		0.45
Overall survival	Alive	59	79.7	9	17.3	<0.001
	Ex	15	20.3	43	82.7	

WBC: White blood cell. CRP: C- Reaktif Protein. PCI score: Peritoneal Cancer Index.

Table 3: Multivariate Analysis of Operable and Inoperable Group of Patients						
Variables		**CRS+HİPEC**		**Inoperabl**		**p value**
		n	**%**	**n**	**%**	
		74	58.7	52	41.3	
Age (mean±SD)		54.28 ± 11.8		59.11 ± 14.0		0.03
Gender	**Female**	41	55.4	19	36.5	0.043
	Male	33	44.6	33	63.5	
CEA		2 (0.6-187)		2.5 (0.4-309)		0.20
CRP (mean±SD)		4.3 (0.30- 117)		18 (0.4-158)		0.046
WBC (mean±SD)		6.56 ± 2.52		6.88 ± 2.63		0.55
Neutrophil percentage (mean±SD)		59.9 ± 9.09		63.36 ± 13.47		0.41
WBC: White blood cell, CRP: C- Reaktif Protein, PCI score: Peritoneal Cancer Index.						

DISCUSSION

In our study, we investigated the importance of CRP in terms of operability and survival in patients scheduled for cytoreductive surgery and HIPEC due to peritonitis carcinomatosis. Although 41.3% of the patients with peritoneal metastasis that we operated with the CRS + HIPEC plan were evaluated as preoperatively operable, we found that they were unresectable when laparotomy was performed. Preoperative same week CRP levels were significantly higher in unresectable patients. When we evaluate at the patients who were operable, we found that the PCI values were higher and the survival was lower in patients with high CRP values. According to these results, we suggest that CRP is a predictive biomarker for operability and also it can predict high PCI and low survival in operable group of patients scheduled for cytoreductive surgery.

Peritoneal surface malignancies (PSM) include peritoneal metastases of gastrointestinal tract and gynecological malignancies, as well as rare primary malignancies of the peritoneum such as mesothelioma and serous papillary peritoneal carcinoma. While PSM's are historically accepted as end-stage disease and only palliative procedures could be performed, in the last two decades, many studies have shown that this disease is locoregional and that increased survival and cure can be achieved with CRS + HIPEC (21-23). In this combined treatment strategy, peritonectomy procedures and visceral organ resections are performed, and visible tumors in the abdomen and pelvis are completely removed, and HIPEC is added for microscopic tumors (24). Studies show that CRS + HIPEC treatment in peritoneal carcinomatosis provides better survival in selected patients compared to standard chemotherapy regimens (5,25,26). For colorectal cancers, Elias et al. compared patients who underwent CRS + HIPEC and those who received standard chemotherapy and found a mean survival difference of 62.7 months and 23.9 months, respectively (27) Chua et al. reported that 5 and 10-year survival rates were 73% and 68%, respectively, with cytoreductive surgery and HIPEC in patients with high index pseudomyxoma peritonei (28). Spiliotis et al. revealed that cytorective surgery and HIPEC treatment in recurrent ovarian carcinomas provided a statistically significant longer survival even for platinum resistance tumors compared to the chemotherapy group (29). The patient group in our study consisted of patients who were considered to be resectable by preoperative imaging methods and diagnosed with colon, stomach, small intestine and ovarian cancers and mesothelioma without extra-abdominal metastasis. In this treatment modality, appropriate patient

selection and preoperative evaluation, complete resection and perioperative intraperitoneal chemotherapy and postoperative care and adjuvant chemotherapy are important steps to achieve successful results (26,30). Before such a radical surgery, patients should be evaluated in all aspects and resectability should be determined correctly (31). Unnecessary laparotomies add additional morbidity and mortality to patients and delay the time to initiate chemotherapy (32). Various scoring systems are used to rate the dissemination of peritoneal metastasis, and peritoneal cancer index is the most widely used method (21). Accordingly, the abdomen is divided into 13 different regions and the index calculated with a value between 0-3 according to the tumor size is between 0-39 and gives us an idea about the extent, resectability and survival of the disease (19,33). According to consensus results used in preoperative evaluation to select the appropriate patient preoperatively; patient's performance status should be good, there should be no extra-abdominal disease, biliary obstruction, massive retroperitoneal invasion, mesenteric root involvement, pancreatic head involvement and unresectable metastasis in the liver in preoperative imaging and massive small bowel resection should not be required (34,35).

Preoperative staging CT or MRI is performed in all patients scheduled for CRS + HIPEC. PET-CT is required for non-mucinous cancers. First of all, it is necessary to determine whether the disease has extraabdominal involvement. The second purpose is whether peritoneal metastases are operable or not and their anatomical location. Meanwhile, visceral organ involvement and liver metastases are evaluated (36). Detection sensitivity of nodules smaller than 0.5 cm with CT is 11-28%. The probability of detecting nodules between 0.5-5 cm is 72%, and the detection rate for nodules larger than 5 cm is 90% (36,37). Koh et al. showed in their prospective study that preoperative CT underestimates the prevalence of peritoneal carcinomatosis (37). With the addition of laparoscopy to evaluaiton, the accuracy can be increased from 56% to 70% (32). In our patient group, surgery was performed in 74 (58.7%) of 126 patients who were considered operable in the preoperative evaluation. This made us think that operability could be evaluated better by using different parameters in preoperative evaluation. In our practice, we realize that CRP values were high in patients who were considered to be unresectable after laparotomy, and we analyzed the preoperative CRP values of all patients during the week of operation. When we compared the CRP values of patients who were considered inoperable with those who could be operated and found that value of inoperabl patients were significantly higher ($p = 0.03$). To our knowledge, our study is the first study showing that preoperative CRP can be used to demonstrate operability in patients scheduled for CRS + HIPEC for peritonitis carcinomatosis treatment.

It was reported by Shibutani et al. that high CRP levels in stage IV colorectal cancers is associated with poor prognosis, low survival, and advanced disease (38). In their meta-analysis, Shrotriya et al. showed that CRP is a poor prognostic predictor in renal cell carcinoma, gastric, esophageal, colorectal cancers and solid tumors such as lung, pancreas and hepatocellular carcinoma (39). Baba et al. published the first study in the literature to prove that CRP affects the prognosis negatively in stage IV gastric cancers and that high CRP values can be a potential marker showing the progression of the disease and low life expectancy (40). In gastric cancers, the relationship between CRP elevation has been shown in patients with serosa involvement, lymph node metastasis, or distant metastasis (40,41). In our study, the life expectancy of the patients who had statistically lower CRP values and who could undergo CRS + HIPEC was significantly higher than the patients who could not be operated ($p <0.001$). According to these results, high CRP level in patients with peritoneal metastasis can be used as a marker showing low survival.

CRP is an acute phase reactant with a half-life of 19 hours, produced in hepatocytes, and its release is regulated by interleukin 6 (IL-6) and tumor necrosis factor (TNF) (42). In chronic inflammatory diseases such as rheumatoid arthritis, CRP is used to evaluate the severity of the disease and its response to treatment (43,44). Studies have shown that the serum level of CRP increases in chronic conditions

such as malignancy, cardiovascular diseases, and metabolic syndrome (42,44). The only study we can find in the literature about patients undergoing CRS and HIPEC is the study of Marcel et al. In this article, they found the cut off value of CRP to be 35 mg/dl for peritoneal carcinomatosis due to colorectal cancer treated with chemotherapy. While survival is 22.4 months in patients with CRP <35 mg/dl, it decreases to 7.9 months in patients with CRP> 35 mg/dl (45). When we look at the subgroup analysis of 74 patients who underwent CRS + HIPEC in our series, we found the mean PCI value as 8.86 (0-30). In this group, we found that CRP values were statistically higher in patients with PCI over nine ($p = 0.006$). These results showed us that preoperative high CRP values have prognostic importance in terms of high PCI and low survival in patients who can underwent CRS + HIPEC.

It has been emphasized in several publications that the tumor markers are showing advanced stage disease, distant metastases and peritoneal carcinomatosis in preoperative evaluation, and they are indicators that can be used for postoperative survival and disease-free survival (46,47,48). All of the patients in our series consisted of advanced stage patients with positive peritoneal implants or cytology, and even when they were separated as operable and inoperable groups, preoperative serum CEA values were statistically significantly higher in advanced disease.

There are some limitations in our study. First of all, although the data of the patients were recorded prospectively, the study was designed retrospectively. Although the single-center nature of the study makes the volume of the study weak, there is no data in the literature regarding the effect of CRP on operability. In addition, the primary cancer focus of the patients we included in our study were heterogeneous, but we think that this may be ignored since the main purpose of our study is the relationship between resectability and CRP level. Finally, since the disease-free survival of patients cannot be given due to data loss in follow-up, only overall survival can be evaluated.

Conclusion

We see that preoperative staging in patients requiring cytoreductive surgery is still insufficient even with improved imaging techniques. We suggest that CRP can give us an idea as a simple and cheap biomarker in these group of patients. It should be kept in mind that if the preoperative CRP value is high in patients who are planned to have CRS + HIPEC, patient could be unresectable. In patients undergoing cytoreductive surgery and HIPEC, high CRP levels were found to be associated with higher PCI and lower survival. This study shows the prognostic value of CRP in patients scheduled for CRS and HIPEC.

Conflict of Interest: The authors declare that they have no conflict of interest.
Authors contributions: All authors contributed to the study. They read and approved the final manuscript.
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Ethics Committee Approval: Ethical approval was obtained the Local Ethics Committee (Protocol No: 2020-2896) and the Ministry of Health for this study.
Informed Consent: This is a retrospective study

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