

The effects of C-reactive protein/albumin ratio and hematologic parameters on predicting the prognosis for emergency surgical patients in intensive care

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ABSTRACT

BACKGROUND: Diagnosis and treatment of emergency surgical pathologies should be addressed within hours, and the prognosis of the patient may deteriorate further in cases of delay. Easy and effective markers are needed in this regard. Our aim in this study is to evaluate the CRP/albumin ratio and the usability of hematological parameters in predicting prognosis in emergency surgical patients in intensive care.

METHODS: This study was performed by retrospectively scanning the files of the patients who were followed up in the intensive care unit. Patients hospitalized after emergency surgery were taken as 'emergency group' and patients hospitalized after elective major surgery were taken as 'control group'. In addition to the demographic characteristics of the patients, the length of hospitalization in the intensive care unit, whether there was a need for mechanical ventilation, platelet/lymphocyte (P/L), neutrophil/lymphocyte (N/L), C-reactive protein (CRP)/albumin values were recorded and the values of both groups were compared statistically.

RESULTS: In this study, 341 patients were included, of which 111 were emergency (32.6%) (Group 1), 230 were elective (67.4%) (Group 2) cases. When the emergency and elective cases were compared, the average CRP/albumin value was 49.05 in Group 1 and 32.8 in Group 2 ($p=0.001$). N/L values were 11.9 in Group 1 and 9.87 in Group 2 ($p=0.04$). When looking at another hematological parameter, P/L, it was found 272.62 in Group 1 and 229.17 in Group 2 ($p=0.03$). Hospitalization days were 13.61 days in Group 1, while 12.43 days in Group 2. When CRP/albumin >40 , its sensitivity was determined as 80.49% and its selectivity as 67.22% ($p<0.001$).

CONCLUSION: The CRP/albumin ratio can be used as an effective marker in determining the urgency of surgical cases and predicting mortality.

Keywords: CRP/albumin; emergency; intensive care unit; mortality.

INTRODUCTION

While surgical diseases increase the global health burden, patients and physicians come across some of these diseases as threatening emergencies for organs and life.^[1] It is reported that surgical emergencies constitute an important part of all surgical interventions.^[2] The acute abdominal picture as the primary surgical emergency constitutes approximately 5–10% of the patients coming to the emergency department and is a common disease window that extends from relatively mild

causes such as appendicitis, cholecystitis to life-threatening causes, such as ileus, mesenteric ischemia, and perforation.^[3,4] In some cases, it is necessary to decide within hours for diagnosis and treatment, and in late cases, the prognosis of the patient may deteriorate.

Some of the emergency surgical cases must be followed up in the intensive care unit in the postoperative period. For this, in addition to the type of emergency surgical pathology, many factors, such as age, additional disease, and periopera-

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tive complications, are involved in decision making.^[5] Many factors may play a role in the prognosis of these patients after they are taken to intensive care.

C-reactive protein/albumin (CRP/albumin) is an inflammatory marker and has been reported to have a decisive effect on prognosis and diagnosis in many studies.^[6] In addition, neutrophil/lymphocyte (N/L) and platelet/lymphocyte (P/L) are hematological parameters that have been studied in the literature for predicting the prognosis.^[7-9] Our aim in this study is to evaluate the prognosis of emergency surgery patients in intensive care, using CRP/albumin and hematological parameters.

MATERIALS AND METHODS

This study was conducted by retrospectively scanning the files of patients who were followed up in the ARS-3 intensive care unit in Aydın State Hospital between January 2018 and January 2020 in the postoperative period. Patients hospitalized after emergency surgery were taken as 'emergency group – Group 1' and patients hospitalized after elective major surgery were taken as 'control group – Group 2'. Permission was obtained from Aydın Adnan Menderes University Local Ethics Committee for this study. Patients under 18 years of age, patients who remained less than 24 hours in intensive care, patients who did not undergo surgery, patients who were followed up in intensive care for non-surgical reasons, and patients showing a mortal course in less than 24 hours were not included in this study.

In addition to the demographic data of the patients, the length of hospitalization in the intensive care unit, whether there was a need for mechanical ventilation, P/L, N/L, CRP/albumin values were recorded and the values of both groups were compared statistically.

Statistical Analysis

SPSS 20 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.) statistical package program was used to evaluate the data. Mean±standard deviation, percentage and frequency values variables were used. In addition, homogeneity of variances, one of the prerequisites of parametric tests, was checked with the "Levene" test. Normality assumption was evaluated with the "Shapiro-Wilk" test. When the differences between the two groups are required to be evaluated, "Student's t-test" was used when the prerequisites for the parametric test were met, whereas "Mann-Whitney U test" was used when they were not met.

The performance of a parameter can be defined by the diagnostic adequacy of the test or its ability to accurately separate cases into subgroups (e.g., healthy/patient). The cut-off scores of CRP/albumin, MPV, N/L and P/L ratios were evaluated by ROC analysis. AUC Value, Sensitivity, Selectivity values were calculated. Statistical significance level was accepted as $p < 0.05$.

RESULTS

In this study, 341 patients were included, and 111 of them were emergency (32.6%) (Group 1), 230 were elective (67.4%) (Group 2) cases. Emergency cases were included, 46 of them were acute appendicitis (41.4%), 33 were ileus (29.7%), 19 were perforation (17.1%), 9 were trauma (8.1%) and four were mesenteric ischemia (3.7%). Elective cases were included, 58 of them were obesity surgery (25.2%), 100 were malignancy surgery (43.4%) and 72 were other surgeries (e.g., open cholecystectomy, open abdominal surgery, laparotomy) (31.4%). Ninety-five of the patients were male (57.2%), 146 were female (42.8%) and the age average was 63.84. While 36 patients (11.3%) needed mechanical ventilation in the postoperative period, 282 (88.7%) did not. In the postoperative intensive care unit, 88% (300 patients) of the patients who needed follow-up were discharged from the hospital, while 41 (12%) were exitus (Table 1). While the mortality rate was

Table 1. General distribution of the patients

	n	%
Gender		
Female	146	42.8
Male	195	57.2
Emergency/elective		
Emergency	111	32.6
Elective	230	67.4
Mechanical ventilator		
No	282	88.7
Yes	36	11.3
Exit		
Exitus	41	12.0
Healthy	300	88.0

Table 2. Evaluation of blood values in emergency and elective cases

	Emergency (n=111)	Elective (n=230)	p
Age	66.14±19.54	62.73±14.35	0.100
CRP	129.5±80.85	91.03±72.23	0.001
Albumin	2.87±0.67	3.17±0.66	0.001
CRP/albumin	49.05±36.19	32.8±30.14	0.001
N/L	11.9±9.25	9.87±7.21	0.040
P/L	272.62±181.53	229.17±130.05	0.030
Hospitalization (day)	13.61±12.21	12.43±7.83	0.350
Mortality	30	11	0.001

CRP: C-reactive protein; N/L: Neutrophil/lymphocyte; P/L: Platelet/lymphocyte.

27% in emergency cases, it was 4.8% in elective cases and statistical significance was determined (p=0.001).

When the emergency and elective cases were compared, the average CRP/albumin value was 49.05 in Group 1 and 32.8 in Group 2 (p=0.001). N/L values were 11.9 in Group 1 and 9.87 in Group 2 (p=0.04). When looking at another hematological parameter, P/L, its value was 272.62 in Group 1 and 229.17 in Group 2 (p=0.03). While the average number of hospitalization days was 13.61 days in Group 1, it was found 12.43 days in Group 2 (p=0.35) (Table 2).

Table 3. Correlation between CRP/albumin hospitalization and intensive care hospitalization

Emergency/elective		CRP/albumin	Hospitalization
Emergency			
Hospitalization	r	.183	
	p	.054	
	n	111	
Intensive care hospitalization day	r	.194*	.767**
	p	.041	.000
	n	111	111
Elective			
Hospitalization	r	.412**	
	p	.000	
	n	230	
Intensive care hospitalization day	r	.362**	.519**
	p	.000	.000
	n	230	230

p: Statistical significance (p<0.05 is statistically significant). r: Correlation coefficient (varies between +1 and -1). CRP: C-reactive protein.

When the CRP/albumin ratio was compared with the duration of intensive care and hospitalization, it was observed that there was a positive correlation between the parameters, and as the CRP/albumin ratio increased, the duration of intensive care and hospitalization significantly increased (Table 3). Similarly, cases with high CRP/albumin ratio needed mechanical ventilator support more (p=0.001).

Given the surgical subgroups, the CRP/albumin ratio was in the highest perforation group with 66.7±38.58 in emergency cases, with the highest rate with 38.13±33.35 in malignancy in elective cases. In emergency cases, N/L and P/L ratios reached the highest values in the mesenteric ischemia subgroup. In elective cases, no significant difference was found between surgical subgroups in terms of N/L and P/L ratio. (Table 4).

As a result of the ROC analysis evaluation, the parameter that can give a statistically significant cut-off value for mortality was found only as CRP/albumin. When CRP/albumin>40, its sensitivity was determined as 80.49% and its selectivity as 67.22% (p<0.001) (Fig. 1). No significant cut-off value was found in evaluating the mortality of N/L and P/L values (Figs. 2, 3).

DISCUSSION

Surgical emergencies are an important patient burden all over the world and it is very important for mortality and morbidity to predict the diagnosis and prognosis quickly and to decide on the treatment.^[2] Acute appendicitis is one of the most common surgical emergencies, and nonspecific markers, such as CRP, white blood cell, bilirubin, liver function tests, and TNF α, have been studied in the literature to date.^[10,11] In addition, it has been evaluated in many surgical pathologies, such as acute appendicitis, in inflammatory markers, such as P/L, CRP/albumin, N/L, which have become popular

Table 4. Comparison of laboratory values of surgical sub groups

Group	C-reactive protein/albumin	Neutrophil/lymphocyte	Platelet/lymphocyte
Emergency			
Acute appendicitis (n=46)	46.7±39.17 ^a	9.85±7.77 ^a	214.85±135.5 ^a
Ileus (n=33)	47.1±31.98 ^a	10.21±5.87 ^a	294.59±222.92 ^b
Perforation (n=19)	66.7±38.58 ^b	17.35±14.5 ^b	301.85±144.83 ^b
Trauma (n=9)	35.56±25.57 ^c	9.99±4.76 ^a	279.77±172.53 ^b
Mesenteric ischemia (n=4)	42.6±20.21 ^a	21.5±7.13 ^b	579.8±140.93 ^c
Elective			
Obesity surgery (n=58)	25.91±25.43 ^c	21.5±7.13 ^b	196.89±102.8 ^a
Malignancy surgery (n=100)	38.13±33.35 ^c	7.76±4.68 ^a	230.26±138.85 ^a
Other surgeries (n=72)	30.75±28 ^c	10.36±6.86 ^a	254.81±13.45 ^a
p	0.001	0.001	0.001

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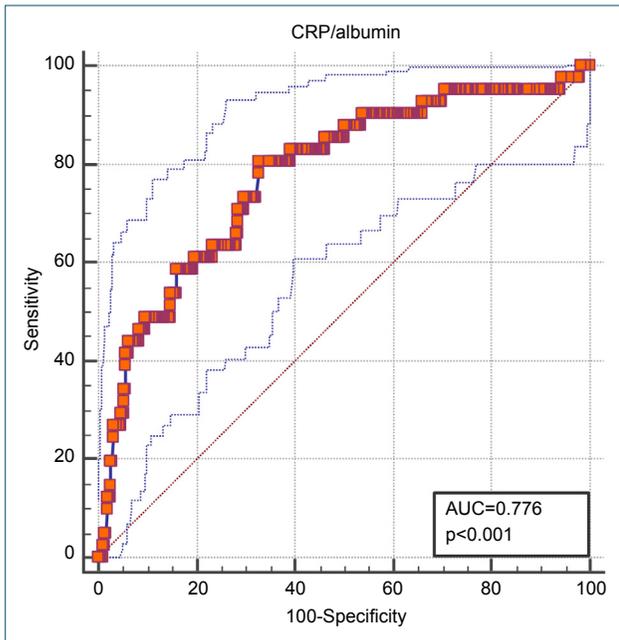


Figure 1. Sensitivity and specificity increased of C-reactive protein (CRP)/albumin values to mortality.

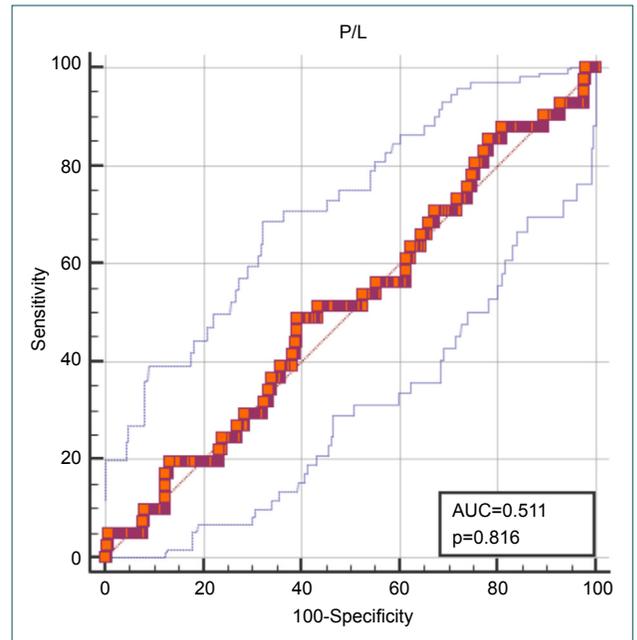


Figure 3. Sensitivity and specificity of increased platelet/lymphocyte (P/L) values to mortality

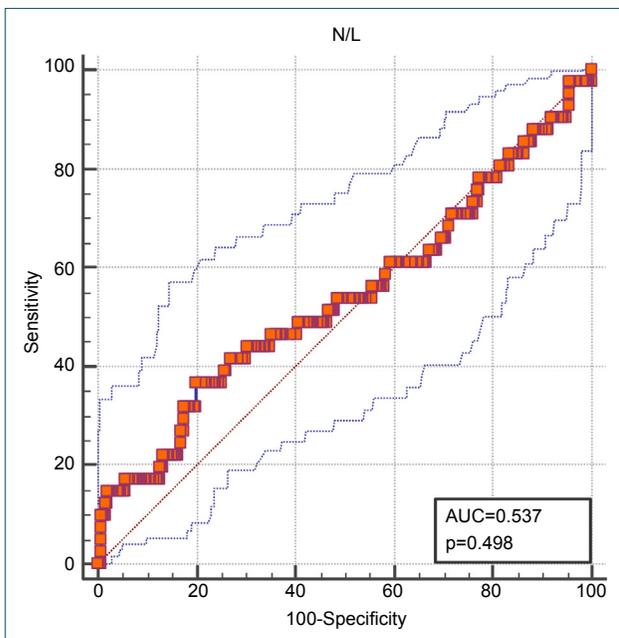


Figure 2. Sensitivity and specificity of increased neutrophil/lymphocyte (N/L) values to mortality

recently.^[12,13] These are not only limited to acute appendicitis but have been recommended markers both in the diagnosis stage and in predicting prognosis in many emergency surgical cases.^[6,14,15] In our study, we used these studies in the literature to investigate the prognosis of the cases.

Platelet/lymphocyte ratio is accepted as a guiding marker from diagnosis to prognosis in many diseases from malignancies to the cerebrovascular events.^[16,17] Çelik et al.^[18] reported that in their study on 334 patients with pediatric acute appendi-

citis, the complication rate was significantly higher with the increase in P/L value. Again, Yılmaz et al.^[9] found that patients with high P/L values had higher mortality rates in their study on 34 mesenteric ischemia patients. In our study, the fact that P/L values are higher in emergency cases than elective cases is an indication that it can be a marker in terms of diagnosing patients and deciding on surgery.

Neutrophil/lymphocyte ratio has taken its place in the literature as a cheap and time-saving marker in inflammatory diseases.^[19] In their study on 372 acute appendicitis patients, Ahmed et al.^[20] have reported that N/L values are an important, useful and easy marker in determining the severity and urgency of the disease. In another study, it has been stated that N/L value might be a useful determinant in patients with intestinal obstruction, which is an important reason for applying to the emergency room.^[21] In our study, the N/L value was higher in emergency cases compared to elective cases and served as an inflammatory marker in accordance with the literature. However, when we evaluated all our cases, a statistically significant cut-off value could not be determined to evaluate the prognosis in N/L value. We think that it can be used in emergency-elective separation, although it could not find cut-off value since it can be very high in some cases and very low in some others.

In addition to the above-mentioned parameters, the rate of CRP/albumin, which has been used to predict the prognosis in many surgical fields ranging from acute pancreatitis to sepsis, has gained importance recently.^[6,22,23] While there are many studies in the literature on CRP for the diagnosis of acute appendicitis, which is the most common reason for referral to the emergency room, the study on CRP/albumin

is almost nonexistent. In a study of 192 acute pancreatitis patients, the CRP/albumin ratio was an important marker in determining prognosis and values above 16.28 were reported to be associated with high mortality. Yılmaz et al.^[6] found in their study on 264 patients with acute pancreatitis that CRP/albumin over 8.51 had 90% sensitivity in predicting mortality. In our study as well, when CRP/albumin was >40, its sensitivity was determined as 80.49% and its selectivity as 67.22% ($p < 0.001$). We think that the high cut-off value was because our study included all emergency surgery cases whereas other studies only included a specific emergency surgery group, and that the patients included in the study are those in need of intensive care. We link the significance of sensitivity and specificity to the use of CRP, a positive acute phase reactant, with albumin, a negative acute phase reactant.

Consequently, emergency surgical cases are the cases that constitute an important part of surgical clinics and emergency rooms today, and the ability to make decisions in these patients is very important. We think that the parameters, such as N/L, P/L and CRP/albumin that are inexpensive, which can be looked at in every healthcare institution and provide quick results, will facilitate the work of surgeons at this point. In particular, the value of CRP/albumin can be quite significant in both patients concerning urgency and mortality. We believe that the necessity and urgency of surgical interventions can be directed accordingly by finding out cut-off values for different surgical pathologies with prospective, large-scale studies on this subject.

Limitations

Hypoalbuminemia is a condition that can be encountered in malignancy surgeries. However, a limited number of cases and since subgroup scanning is not possible in elective surgical cases, it could not be taken as an exclusion criterion.

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ORJİNAL ÇALIŞMA - ÖZET

Yoğun bakımda yatan acil cerrahi hastalarda C-reaktif protein/albumin oranı ve hematolojik parametrelerin prognozu ön görmedeki etkisi

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AMAÇ: Acil cerrahi patolojilerin tanı ve tedavisinin saatler içinde yapılması gerekmekte olup, geç kalınan durumlarda hastanın prognozu daha da kötüye gidebilmektedir. Bu konuda kolay ve etkili belirteçlere ihtiyaç duyulmaktadır. Bu çalışmadaki amacımız, yoğun bakıma yatan acil cerrahi hastalarında C-reaktif protein (CRP)/albumin oranı ve hematolojik parametrelerin prognozu ön görmede kullanılabilirliğini değerlendirmektir.

GEREÇ VE YÖNTEM: Çalışma yoğun bakımda takip edilen hastaların dosyalarının geriye dönük olarak taranması ile yapıldı. Acil cerrahi sonrası yatan hastalar 'acil grubu' olarak, elektif majör cerrahi sonrası yatan hastalar 'kontrol grubu' olarak alındı. Hastaların demografik özelliklerinin yanı sıra, yoğun bakımda yatış süreleri, mekanik ventilatör ihtiyacının olup olmadığı, yoğun bakıma yatıştan önce, ameliyat öncesi kan değerlerinden platelet/lenfosit (P/L), nötrofil/lenfosit (N/L), CRP/albumin değerleri kaydedilip her iki grubun değerleri istatistiksel olarak karşılaştırıldı.

BULGULAR: Çalışmaya toplam 341 hasta alındı, bunların 111'i acil (%32.6) (Grup 1), 230'u elektif (%67.4) (Grup 2) olgu idi. Acil ve elektif olgular karşılaştırıldığında, Grup 1'de ortalama CRP/albumin değeri 49.05 saptanırken, Grup 2'de 32.8 olarak saptanmıştır (p=0.001). N/L değerleri ise Grup 1'de 11.9, Grup 2'de 9.87 bulunmuştur (p=0.04). Diğer bir hematolojik parametre olan P/L değerlerine bakıldığında ise Grup 1'de 272.62 bulunurken, Grup 2'de 229.17 olarak saptanmıştır (p=0.03). Hastanede yatış günleri Grup 1'de ortalama 13.61 gün iken, Grup 2'de 12.43 gündür. CRP/albumin >40 olduğunda duyarlılığı %80.49, seçiciliği ise %67.22 olarak belirlenmiştir (p<0.001).

TARTIŞMA: CRP/albumin oranı cerrahi olguların aciliyetini belirlemede ve mortalitesi hakkında öngöründe bulunmada etkili bir belirteç olarak kullanılabilir.

Anahtar sözcükler: Acil; CRP/albumin; mortalite; yoğun bakım ünitesi.

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