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ARAŞTIRMA / RESEARCH

CRP/albumin ratio as an age-dependent prognostic factor in patients with COVID-19 pneumonia

COVID-19 pnömonili hastalarda yaşa bağımlı bir prognostik faktör olarak CRP/albümin oranı

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Abstract

Purpose: The aim of our study was to determine whether C-reactive protein/albumin is an age-related marker in Covid-19 pneumonia.
Materials and Methods: We performed a retrospective research on 296 patients (166 male/130 female) with Covid-19 pneumonia. The participants were divided into two groups as <65 and ≥65 years of age. The need of intensive care unit, pulse steroid requirement and mortality rates were all compared using the The C-reactive protein/albumin ratio.
Results: The C-reactive protein/albumin was found to be high in patients over the age of 65 as well as those under the age of 65 who were admitted to the intensive care unit and was found to be significant in demonstrating mortality in patients aged 65 and over. According to univariate analysis, the C-reactive protein/albumin ratio was statistically significant for the risk of intensive care admission in both patients under 65 and over 65 years of age (OR:1.515 and OR:1.357, respectively). According to multivariate analysis, the CRP/albumin ratio was statistically significant for the risk of intensive care admission, only in patients over the age of 65 (OR:1.209).
Conclusion: The increased C-reactive protein/albumin levels are thought to be useful in predicting the severity of Covid-19, hospitalisation time, and mortality rates. This variable can be calculated and used to predict the clinical course of Covid-19 pneumonia without regard to age.
Keywords:. C-reactive protein, albumin, Covid-19, pneumonia

Öz

Amaç: Çalışmamızın amacı, Covid-19 pnömonisinde C-reaktif protein/albüminin yaşa bağlı bir belirteç olup olmadığını belirlemekti.
Gereç ve Yöntem: Covid-19 pnömonisi olan 296 (166 erkek/ 130 kadın) hasta üzerinde retrospektif bir araştırma yaptık. Katılımcılar <65 ve ≥65 yaş olmak üzere iki gruba ayrıldı. Yoğun bakım yatışı, pulse steroid ihtiyacı ve ölüm oranları C-Reaktif protein/albümin oranı kullanılarak karşılaştırıldı.
Bulgular: CRP/albümin oranı; yoğun bakım ünitesi ve kliniğe alınan 65 yaş üstü ve 65 yaş altı hastalarda istatistiksel olarak yüksekti ve 65 yaş ve üzeri hastalarda mortaliteyi göstermede anlamlı bulundu. Tek değişkenli regresyon analizine göre C-reaktif protein/albümin oranı hem 65 yaş altı hem de 65 yaş üstü hastalarda yoğun bakıma yatış riski için istatistiksel olarak anlamlı idi (sırasıyla OR:1.515 ve OR:1,357). Çok değişkenli analize göre ise CRP/albümin oranı 65 yaş üstü hastalarda istatistiksel olarak anlamlı bulundu (OR: 1.209).
Sonuç: Artmış CRP/albümin oranının Covid-19 ciddiyeti, hastanede kalış süresi ve ölüm oranlarını tahmin etmede faydalı olduğu düşünülmektedir. Bu değişken kolay hesaplanabilir ve yaştan bağımsız olarak Covid-19 hastalarının klinik seyrini tahmin etmek için kullanılabilir.

Anahtar kelimeler: CRP, Albumin, Covid-19, pnömoni

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INTRODUCTION

Coronavirus disease 2019 (Covid-19), which began in December 2019 in the Wuhan region of China, has grown to the size of a pandemic, affecting the entire world. Its clinical spectrum is broad, ranging from asymptomatic disease to severe pneumonia[1,2]. The clinical course of patients with Covid-19, and the progression to severe disease, are difficult to predict. Various laboratory parameters have been analyzed to assess the clinical course of Covid-19[3].

Lymphocyte count and percentage, D-dimer, Ferritin, and C-reactive protein (CRP) elevation, and the prevalence of pneumonia in thorax computed tomography are used as disease severity criterion[3]. CRP is a nonspecific acute phase protein that is induced in the liver and serves as a sensitive biomarker of inflammation, infection, and tissue damage. It increases rapidly and significantly in acute inflammatory conditions[4-6].

In addition, increased levels of D-dimer and CRP are also thought to be prognostic biomarkers that help predict prognosis. An increase in inflammatory markers, especially CRP, has been reported in patients requiring invasive mechanical ventilation[7]. CRP elevation is known to have a short-term prognostic significance in elderly patients. It is thought that immune system functions deteriorate with age. Furthermore, in advanced age; inflammation increases and there is a continuous production of inflammatory mediators and cytokinesas[8].

Albumin is an important serum protein and its significant role in systemic inflammation has been proven. In addition to being a negative acute phase reactant, low serum albumin level; reflects poor nutritional status and has been shown to be an independent predictor of morbidity in some patients[3]. The unique hypoalbuminemia in Covid-19 is probably caused by a cytokine storm's hepatotoxicity. Low serum albumin is known to be related to mortality and a bad prognosis in Covid-19[9].

CRP to albumin ratio (CAR), which is the ratio of these two laboratory parameters to one another, and is used to assess the patient's inflammation and nutritional status and it is known to be a prognostic factor in cases of malignancy and severe disease[7]. In recent studies, it has been emphasized that CAR may be a promising prognostic biomarker for risk stratification and clinical management of patients with severe Covid-19 and can be an early predictor of disease progression[10].

We hypothesized that elevated CAR is associated with mortality and severity of the disease in elderly patients with Covid-19 pneumonia and it may be age-independent prognostic factor of the disease. Because of that; we aimed to determine whether CAR is an age-dependent prognostic factor in patients followed up with Covid-19 pneumonia.

MATERIALS AND METHODS

Study population

We performed a single center (Ankara Ataturk Sanatorium Training and Education Hospital), retrospective research. Initially, 385 patients who admited to outpatient clinic with Covid-19 pneumonia confirmed by RT-PCR positivity between June 2020 and December 2020 were included in the study. 65 of them were excluded because they did not have thorax CT examination and 24 of them were excluded because of missing data. As a result, the study included 296 patients who fully met the criteria. The participants in the study were divided into two groups as <65 and ≥65 years of age. The need of intensive care unit, pulse steroid requirement and mortality rates were all compared using the CRP/albumin ratio.

Data collection

The clinical characteristics and thelaboratory data of the patients on the first day of hospitalization (complete blood count, C-reactive protein, albumin, D-dimer), thorax computed tomography (CT) images and treatment regimens were obtained retrospectively from the hospital's data automation system (Akgun Web) and written medical records. CT examinations were performed to patients on the admission day and performed with two multi-detector CT scanners (Emotion 6, Siemens, Germany and Alexion 16, Toshiba Medical Systems, Japan). CT images were independently reviewed by two experienced radiologists.

Albumin levels were measured by spectrophotometric method (Beckman coulter AU580, USA) and CRP was measured by an immunoturbidimetric method in autoanalyzer Beckman Coulter AU580, USA). D-dimer was

measured by latex agglutination method in Diagon CoagXL (Sysmex CS 2500, JAPAN) device. Total blood count parameters were measured using the Empedance method onMindray BC-6800 auto hematology analyzer. CAR, which was created with the data obtained from laboratory parameters, were calculated mathematically.

Favipravir, low molecular weight heparin, 40 mg methylprednisolone and nonspecific antibiotic treatment were administered to the patients in accordance with the Covid-19 diagnosis and treatment guideline of the Ministry of Health of the Republic of Turkey. Administering 250 mg of methylprednisolone for 3 days to patients whose clinical condition worsened during the treatment period was called pulse steroid requirement.

Data of the study were collected with the same researchers (TSO, ESA, OE, DY, BAO). The patients' informed consent was obtained. It was approved by the Ethics Committee of the University of Health Sciences, Ataturk Sanatorium Training and Research Hospital (Date: 2022, Decision No: 2012-KAEK-15/2527).

Statistical analysis

Statistical analysis was performed with IBM SPSS Statistics 22.0. In the evaluation of data, frequencies and percentages were given for qualitative data. For quantitative data, descriptive statistical methods were applied to obtain an arithmetic mean and standard deviation for those with normal distribution and a median (interquartile range: 75th percentile-25th percentile) for those without standard deviation. Kolmogorov-Smirnov tests were used to identify normally distributed data. The chi-square test or Fisher's exact test was used to compare qualitative data between groups. In comparisons between two independent groups, student sample t tests were used for data with normal distribution and the Mann-whitney U test was used for data with non-normal distribution. Ancova analysis was used to compare the CAR by adjusting the age variable between the two-category variables (The relationship between CAR and mortality, intensive care unit and pulse steroid requirement). Univariate and multivariate logistic regression analyses were applied to determine the prognostic factors for intensive care hospitalization, pulse steroid requirement and mortality in all groups. It was evaluated degrees of relation between variables with spearman correlation analysis. All statistical calculations were evaluated at 95% confidence intervals and at a significance level of $p<0.05$.

G*Power software version 3.1.9.2 was used to calculate sample size (Institute of Experimental Psychology, Heinrich Heine University, Dusseldorf, Germany). Because there was no other study to which we could refer, a pilot study of 20 subjects under the age of 65 and 20 subjects over the age of 65, was conducted to calculate the sample size. Based on the CAR results of the pilot study participants, with a bilateral (two-tailed) type I error of 0.05 and a power of 95 percent ($1-\beta = 0.95$) and an effect size (d) factor of 0.558, the number of cases required was determined to be at least 85.

RESULTS

A total of 296 patients were included in the study. The patients were male in 56 percent (n:166). The patients were divided into two groups: those under the age of 65 and those over the age of 65. While the average age of 197 patients under the age of 65 was 50; the mean age of 99 patients over the age of 65 was 73. In Table 1, demographic characteristics were compared according to age groups. The rates of concomitant chronic obstructive pulmonary disease (COPD), hypertension, diabetes mellitus (DM) and coronary artery disease (CAD) were found to be statistically significantly higher in patients over 65 years of age compared to patients under 65 years of age. There was no statistically significant difference between the groups in terms of other variables.

Desaturation, admission to intensive care unit and clinic, hospitalization time, the usage of steroid, need for pulse steroids, mortality, pulmonary parenchyma involvement greater than 50% and the presence of consolidation were found to be statistically significantly higher in patients aged 65 and over compared to patients under 65 years of age. There was no statistically significant difference between the groups in terms of ground glass involvement in chest tomographies. When the laboratory parameters at the time of diagnosis were evaluated, the lymphocyte percent and albumin values were found to be statistically significantly lower in patients aged 65 and over compared to patients under 65 years of age. Neutrophil percent, neutrophil/lymphocyte, CRP, CRP/albumin, ferritin, D-dimer, and the number of involved lobes were all found to be statistically significantly higher in patients aged 65 and older (Table 2).

Table 1. The study group's sociodemographic characteristics and comorbidities by age groups

		Age Groups				p
		<65 (n:197)		≥65 (n:99)		
Age		50	(17)	73	(10)	<0.001
Gender	Male	109	(55.3%)	57	(57.6%)	0.713
	Female	88	(44.7%)	42	(42.4%)	
COPD		12	(6.1%)	22	(22.2%)	<0.001
Asthma		17	(8.6%)	13	(13.1%)	0.226
Hypertension		49	(24.9%)	59	(59.6%)	<0.001
Diabetes Mellitus		41	(20.8%)	33	(33.3%)	0.019
Malignancy		13	(6.6%)	9	(9.1%)	0.441
Hypothyroidism		6	(3.0%)	3	(3.0%)	0.999
Rheumatological Disease						0.104
Gout		-		1	(1.0%)	
Rheumatoid arthritis		4	(2.0%)	4	(4.0%)	
Cardiac diseases						<0.001
Atrial Fibrillation		3	(1.5%)	3	(3.0%)	
CHF		3	(1.5%)	4	(4.0%)	
CAD		10	(5.1%)	25	(25.3%)	
CAD, CHF		-		2	(2.0%)	

COPD: Chronic ostructive pulmonary disease, CAD: Coronary Arter Disease, CHF: Congestive Heart Failure; Mann whitney u test, Pearson's chi-square test or fisher exact test; Statistically significant p-values were in bold

Table 2. The comparison of desaturation, radiological and laboratory findings, hospitalization in clinic and intensive care unit, treatment, and mortality based on the study group's age groups.

		Age Groups		p
		<65 (n:197)	≥65 (n:99)	
Desaturation		55 (27.9%)	64 (64.6%)	<0.001
ICU admission		24 (12.2%)	32 (32.3%)	<0.001
Duration of hospitalization (day)		8 (8)	11 (9)	0.010
Hospitalization in clinic		99 (50.3%)	84 (84.8%)	<0.001
Need of steroid		82 (41.6%)	76 (76.8%)	<0.001
Need of pulse steroid		15 (7.6%)	20 (20.2%)	0.002
Mortality		2 (1%)	16 (16.2%)	<0.001
Lung parenchyma involvement	Less	163 (82.7%)	62 (62.6%)	<0.001
	More	34 (17.3%)	37 (37.4%)	
Ground glass		169 (85.8%)	92 (92.9%)	0.073
Consolidation		77 (39.1%)	68 (68.7%)	<0.001
Lymphocyte %		23.57 ± 11.04	16.91 ± 9.79	<0.001
Neutrophil/Lymphocyte		2,9 (3.43)	4.7 (7.97)	<0.001
Neutrophil %		67.6 (18.6)	74.7 (21)	<0.001
CRP		24.4 (79.4)	84 (139)	<0.001
Albumin		39.1 (7)	33.8 (6.6)	<0.001
CRP/albumin		0,6 (2.29)	2.7 (4.31)	<0.001
Ferritin		162 (307.4)	263 (412.3)	0.001
D-Dimer		0,54 (0.65)	1 (1.47)	<0.001
Number of lobes		4 (3.5)	5 (2)	0.001

ICU: intensive care unit, CRP: C-reactive protein. Student t test, mann whitney U test, Pearson's chi-square test or fisher exact test. Statistically significant p-values were in bold

A statistically significant positive correlation was found between CAR and the length of clinic hospitalization in both patients under and over the age of 65 ($p<0.05$), (Figure 1).

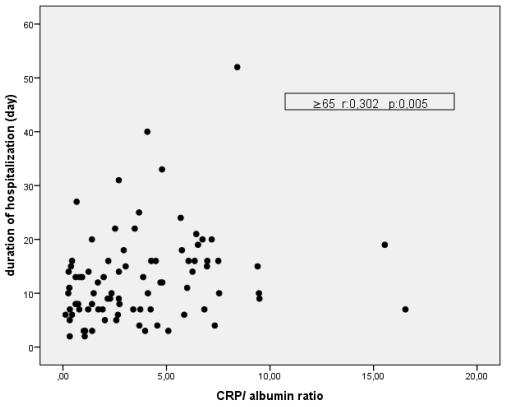

Figure 1. The relationship between CRP/ albumin and the length of clinic stay in patients over the age of 65.

According to table 3; CAR was found to be high in patients over the age of 65 as well as those under the age of 65 who were admitted to the intensive care unit and clinic. The CAR was found to be significant in demonstrating mortality in patients aged 65 and over.Regardless of age, CAR was found to be significant in determining the hospitalization in a clinic or intensive care unit and the need of pulse steroid. When the effect of age is eliminated; according to the applied Ancova analysis, the CAR was statistically significantly higher in patients with mortality, intensive care unit hospitalization and those who needed pulse steroids, compared to those who did not (Table 3-4).

Univariate and multivariate logistic regression analyses were applied to determine the prognostic factors for intensive care hospitalization in both Covid-19 patients under 65 and over 65 years of age (Table 5). While 24 of 197 patients under the age of 65 years were admitted to the intensive care unit; 32 of the 99 patients over the age of 65 were admitted to the intensive care unit. According to the results of univariate logistic regression analysis, CAR was found to be a prognostic marker for the need for intensive care unit in all patients. When the CAR increases by one unit in patients under 65 years of age, the probability of intensive care unit admission increases 1.515 times (OR: 1.515). When CAR increases by one unit in patients aged 65 and over, the likelihood of being admitted to intensive care unit increases 1.357 times (OR:1.357). According to multivariate analysis, CAR was not statistically significant in patients under 65 years of age. It was found to be statistically significant in patients over the age of 65; as one unit increases, the probability of being admitted to intensive care unitrises 1.209 times (OR: 1.209).

Table 3. The relationship of CAR with mortality and hospitalization in a clinic or intensive care unit in patients under and over the age of 65

			CAR		**p**
			Median	**(IQR)**	
<65	Hospitalization in intensive care unit	No	0.45	(1.70)	<0.001
		Yes	3.80	(3.43)	
	Hospitalization in clinic	No	0.29	(0.57)	<0.001
		Yes	1.93	(3.72)	
	Mortality	No	0.60	(2.27)	0.449
		Yes	2.05	(3.03)	
≥65	Hospitalization in intensive care unit	No	1.71	(3.27)	<0.001
		Yes	5.84	(3.83)	
	Hospitalization in clinic	No	0.60	(2.98)	0.001
		Yes	2.83	(4.57)	
	Mortality	No	2.28	(3.61)	0.004
		Yes	4.94	(2.63)	

ICU:intensive care unit, CAR: C-reaktive protein/ albumin. Mann whitney U test, Statistically significant p-values were in bold

Table 4. The relationship between CAR and mortality, intensive care unit and pulse steroid requirement, adjusted for age

		CAR Mean ± SD	P value (Student t test)	P value ANCOVA Analysis (age controlled)
Mortality	+	4.50±2,36	<0.001	0.010
	-	2.08±2.59		
Intensive care unit	+	4.59±2.95	<0.001	<0.001
	-	1.67±2.22		
Pulse Steroid Requirement	+	4.10±2.68	<0.001	<0.001

Student t test, Ancova Analysis, Statistically significant p-values were in bold. CAR: CRP/albümin ratio

Table 5. Univariate and multivariate logistic regression analysis applied to ıdentify factors that are prognostic markers for intensive care unit in COVID-19 patients.

	Univariate Lojistic Regression				Multivariate Lojistic Regression			
	Wald	p	OR	95% CI.for OR	Wald	p	OR	95% CI.for OR
Age<65								
Sex. ref:female)	5.702	0.017	3.504	(1.252-9.809)	0.386	0.535	1.493	(0.535-1.493)
Asthma	0.003	0.956	0.958	(0.205-4.473)				
Hypertension	0.269	0.604	1.284	(0.499-3.309)				
Dm	6.668	0.010	3.272	(1.331-8.045)	3.026	0.082	2.800	(0.082-2.800)
Malignancy	0.133	0.716	1.339	(0.278-6.442)				
Hypothyroidsm	0.115	0.735	1.461	(0.163-13.064)				
Lymphocyte	14.241	<0.001	0.998	(0.997-0.999)	6.617	0.010	0.999	(0.010-0.999)
Neutrophil	20.894	<0.001	1.000	(1.000-1.000)	7.223	0.007	1.001	(0.007-1.003)
CRP/albumin	20.352	<0.001	1.515	(1.265-1.814)	1.189	0.276	1.141	(0.276-1.141)
Ferritin	20.082	<0.001	1.002	(1.001-1.003)	1.846	0.174	1.001	(0.174-1.001)
Ddimer	1.526	0.217	1.065	(0.964-1.176)				
Age≥65								
Sex. ref:female)	0.063	0.802	1.115	(0.474-2.623)				
Asthma	1.819	0.177	0.339	(0.071-1.632)				
Hypertension	1.627	0.202	1.784	(0.733-4.340)				
Dm	0.368	0.544	1.314	(0.544-3.176)				
Malignancy	0.452	0.501	0.571	(0.112-2.921)				
Hypothyroidsm	0.001	0.970	1.048	(0.092-12.008)				
Lymphocyte	6.868	0.009	0.999	(0.998-1.000)	1.525	0.217	0.999	(0.998-1.000)
Neutrophil	8.035	0.005	1.000	(1.000-1.000)	2.250	0.134	1.000	(1.000-1.000)
CRP/albumin	11.984	0.001	1.357	(1.142-1.613)	3.929	0.047	1.209	(1.002-1.459)
Ferritin	9.196	0.002	1.002	(1.001-1.003)	3.176	0.075	1.001	(1.000-1.002)
Ddimer	2.719	0.099	1.098	(0.983-1.227)				

Dependent Variable: ıntensive care unit, Wald: test statistics, OR: odds radio, CI: Confidence interval. Statistically significant p-values are in bold.

Table 6. Univariate and multivariate logistic regression analysis applied to ıdentify factors that are prognostic markers for pulse steroid requirement in Covid-19 patients.

	Univariate Lojistic Regression				Multivariate Lojistic Regression			
	Wald	**p**	**OR**	**95% CI.for OR**	**Wald**	**p**	**OR**	**95% CI.for OR**
Age<65								
Sex, (ref:female)	0,143	0,705	1,230	(0,420-3,598)				
Asthma	0,446	0,504	1,713	(0,353-8,313				
Hypertension	0,613	0,433	1,568	(0,509-4,835)				
Dm	0,335	0,563	1,425	(0,429-4,731)				
Malignancy	0,000	0,991	1,012	(0,122-8,359)				
Hypothyroidism	0,674	0,412	2,529	(0,27-23,163)				
Lymphocyte	5,528	**0,019**	0,999	(0,998-1,000)	2,392	0,122	0,999	(0,998-1,000)
Neutrophil	10,660	**0,001**	1,000	(1,000-1,000)	3,605	0,058	1,000	(1,000-1,000)
Crp/Albumin	10,037	**0,002**	**1,354**	(1,123-1,634)	0,516	0,472	1,099	(0,849-1,424
Ferritin	7,710	**0,005**	1,001	(1,000-1,002)	0,695	0,404	1,001	(0,999-1,002)
Ddimer	1,834	0,176	1,070	(0,970-1,179)				
Age≥65								
Sex, (ref:female)	0,060	0,806	1,133	(0,417-3,079)				
Asthma	0,213	0,644	0,687	(0,140-3,381)				
Hypertension	0,002	0,967	1,021	(0,375-2,779)				
Dm	0,031	0,860	1,098	(0,391-3,080)				
Malignancy	0,025	0,874	1,143	(0,219-5,976)				
Hypothyroidism	-	-	-	-				
Lymphocyte	0,302	0,583	1,000	(0,999-1,001)				
Neutrophil	0,120	0,729	1,000	(1,000-1,000)				
Crp/Albumin	3,200	0,074	1,143	(0,987-1,323)				
Ferritin	5,593	**0,018**	1,001	(1,000-1,002)				
Ddimer	0,752	0,386	0,908	(0,729-1,130)				

Dependent Variable: pulse steroid requirement

Univariate and multivariate logistic regression analyses were applied to determine the prognostic factors for pulse steroid requirement in both patients under and over 65 years of age (Table 6). While 15 of 197 patients under the age of 65 required pulse steroids, 20 of 99 patients over the age of 65 required them. CAR was found to be a prognostic marker for pulse steroid requirement in patients under 65 years of age, according to univariate logistic regression analysis (p=0.002). When the CAR increases by one unit in patients under 65 years of age, the probability of pulse steroid requirement increases 1.354 times (OR:1.354). According to multivariate analysis, no variable was found to be statistically significant.

DISCUSSION

The prognostic significance of CAR has been evaluated extensively in Covid-19 patients of all ages in the literature. The aim of this study was to see if CAR, a prognostic marker in Covid-19, is an age-dependent factor. Age-independent CAR was found to be significant in determining hospital admission, intensive car unit admission and the need for pulse steroid treatment.

Advanced age is a significant risk factor for mortality and therefore plays an important role in the clinical severity risk scoring that is recommended [11]. Covid-19 patients over the age of 65 have a significantly higher need for mechanical ventilation, intensive care admissions, and mortality rates than younger patients, according to studies [12,13]. Another study in the literature found that the rate of desaturation was higher in patients with advanced age and in patients with critical condition[13]. Desaturation,

hospitalization in a clinic and intensive care unit, hospitalization time, usage of steroid, requirement of pulse steroid, mortality, lung parenchyma involvement greater than 50%, and the presence of consolidation were found to be statistically significantly higher in patients aged 65 and over in our study, which was consistent with the literature. We believe this is due to the comorbidities that accompany patients over the age of 65.

Increased inflammatory markers at diagnosis and in elderly patients, have been linked to the disease's prognosis in Covid-19[14]. In the study of Li et al., it was stated that CRP can be used as a marker in the prognosis of Covid-19 and is useful in the early diagnosis of severe cases[15]. CRP levels rise in both Covid-19 infections and secondary bacterial infections. Furthermore, hypoalbuminemia is seen in severe Covid-19 patients as a result of malnutrition. CAR can be used to estimate the severity of Covid-19 for these reasons. It has been reported in the literature that there is a link between high CRP and low albumin levels and disease severity. CRP and albumin levels were associated with more severe disease in our study, which was consistent with the literature[16-18]. In our study, low lymphocyte and albumin levels, as well as increased CRP, CAR, and D-dimer levels, which are considered markers of severe disease, were found to be significant in patients over the age of 65. While CAR was found to be high in both patients over 65 years of age and those under 65 years of age who were hospitalized in the intensive care unit and clinic, CAR was higher in the presence of mortality in those over 65 years of age in our study.

High levels of CRP and low levels of albumin, both of which are inflammatory markers, are expected outcomes because they are aggravating factors in patients admitted to the clinic or intensive care unit[16-18]. In a study evaluating CAR in geriatric patients with Covid-19, it was discovered that CAR was associated with mortality, which is consistent with our findings[8].

Comorbidities and aggravating factors which are more common in patients over the age of 65, may be contributing to the high mortality rate in patients with high CAR. It has been reported in the literature that high CRP and low albumin levels are associated with the severity of the disease in Covid-19 and these findings are also physiological in advanced age[8,10,14,18]. This led us to believe that the CAR in advanced age may be more important in determining the severity of Covid-19. It was discovered to be statistically significantly higher than those who did not, and it was found to be a poor prognostic factor regardless of age.

There are some limitations in our study that should be considered. It was originally designed as a single-center retrospective study. Second, in patients hospitalized with Covid-19 pneumonia, laboratory values were evaluated only on the first day of hospitalization. It would have been helpful to know their value when they were first diagnosed with Covid-19 pneumonia.

As a result, it was determined that CAR was significantly higher in intensive care unit admission, pulse steroid requirement and mortality, regardless of age, and the risk of intensive care unit hospitalization was higher in patients over 65 years of age with high CAR. We believed that these patients should be monitored more closely and that the CAR level, regardless of age, could be useful in predicting the course of the disease. CAR is a parameter that can be calculated quickly and cheaply during the first admission to the hospital; thus, this variable can be calculated at admission and used to predict clinical course in patients with Covid-19 pneumonia without age discrimination.

Yazar Katkıları: Çalışma konsepti/Tasarımı: TSO, BAO, ESA, DY, OE; Veri toplama: TSO, ESA, DY, OE, BAO; Veri analizi ve yorumlama: TSO, ESA, DY, OE, BAO; Yazı taslağı: TSO, DY, ESA; İçeriğin eleştirel incelenmesi: TSO, ESA, OE, DY, BAO; Son onay ve sorumluluk: TSO, ESA, OE, DY, BAO; Teknik ve malzeme desteği: TSO, ESA, BAO; Süpervizyon: TSO, BAO, ESA; Fon sağlama (mevcut ise): yok.
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