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The relationship between mean platelet volume and CURB-65 in predicting hospitalization and 28-day mortality in COVID-19 pneumonia patients admitted to the emergency department

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ABSTRACT

Aims: This study aimed to investigate the combined prognostic value of mean platelet volume (MPV) and CURB-65 scoring in predicting hospital admission status and 28-day mortality among COVID-19 pneumonia patients admitted to the emergency department.

Methods: A prospective observational study was conducted on patients diagnosed with COVID-19 pneumonia in the Adult Emergency Medicine Clinic of Ankara Bilkent City Hospital. Inclusion criteria included polymerase chain reaction (PCR) positivity and characteristic findings on thoracic computed tomography (CT). Clinical, laboratory, and radiological data were collected, and statistical analyses were performed using SPSS 22.0. ROC curve analysis evaluated the prognostic performance of MPV and CURB-65.

Results: Among 500 patients included in the study (55.8% male, mean age: 64±14 years), 49 (9.8%) patients died within 28 days. Higher CURB-65 scores and MPV levels were significantly associated with increased 28-day mortality ($p<0.001$ and $p=0.019$, respectively). Comorbidities such as coronary artery disease, hypertension, cancer, heart failure, and stroke history were also significant predictors of mortality ($p<0.05$). Patients with CURB-65 scores ≥3 and elevated MPV values had a markedly increased mortality risk. Moreover, thoracic CT findings such as diffuse infiltration and consolidation correlated significantly with poor outcomes ($p=0.017$ and $p=0.001$, respectively).

Conclusion: The combined use of CURB-65 and MPV offers a valuable tool for predicting 28-day mortality in COVID-19 pneumonia patients. These findings suggest the need for further studies to validate the utility of this combined approach in clinical practice.

Keywords: COVID-19, CURB-65, mean platelet volume, mortality prediction, emergency department

INTRODUCTION

In December 2019, the process that started with an increase in pneumonia cases of unknown cause in Wuhan, China, moved to a different dimension with the identification of a new coronavirus strain in January 2020. The disease caused by this virus, called severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), was declared a pandemic by the World Health Organization (WHO) in March 2020. COVID-19 has a wide spectrum of clinical manifestations, ranging from mild upper respiratory tract infection to acute respiratory distress syndrome (ARDS) and death.[1]

COVID-19 pneumonia has a special place among viral pneumonias and a significant proportion of patients are hospitalized due to respiratory failure. Comorbid conditions such as advanced age, hypertension (HT), diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), cardiovascular diseases and malignancies increase the mortality risk of the disease. Accurately predicting the intensive care needs and mortality risk of COVID-19 patients is critical to ensure the effective use of limited health resources.[2-5]

The CURB-65 score is a widely used clinical scoring system to assess mortality and prognosis in pneumonia patients. Mean platelet volume (MPV) is a hematologic parameter evaluated as an indicator of inflammation and thrombotic processes.

In this study, we investigated the predictive power of the combined use of MPV and CURB-65 score on hospitalization and 28-day mortality in COVID-19 pneumonia patients admitted to the emergency department. With this study, it is planned to reduce the length of time patients stay in the emergency department, determine which patients need intensive care, and thus reduce the emergency department workload.

METHODS

The study was initiated with the approval of the Ankara Bilkent City Hospital Clinical Researches Ethics Committee (Date: 11.11.2020, Decision No: 1283). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study is planned as a retrospective, cross-sectional diagnostic accuracy study. This study was conducted with a prospective observational design in patients admitted to Ankara Bilkent City Hospital Adult Emergency Medicine Clinic and diagnosed with COVID-19 pneumonia. Inclusion criteria included the presence of COVID-19 pneumonia findings on thoracic computed tomography (CT) and confirmation of infection by polymerase chain reaction (PCR) testing.

In addition to clinical, laboratory and radiologic findings, CURB-65 score and the use of MPV were evaluated in relation to the place of hospitalization and 28-day mortality.

Inclusion Criteria

- Presenting to the emergency department with COVID-19 symptoms
- To be 18 years of age or older
- Having a viral pneumonia image with CT
- Positive PCR test for COVID-19

Exclusion Criteria

- Patients under 18 years of age
- Patients presenting to the emergency department in cardiac arrest

Statistical Analysis

The data obtained were analyzed with SPSS 22.0 software. Categorical data were evaluated with Chi-square test, while Independent sample t-test or Mann-Whitney U test were used for continuous variables. ROC curve analysis was performed to determine the prognostic value of CURB-65 and MPV and statistical significance level was accepted as $p<0.05$.

RESULTS

The findings obtained to evaluate the effect of MPV and CURB-65 score on predicting 28-day mortality and hospitalization in patients admitted to the emergency department, diagnosed with COVID-19 infection, PCR test positive and lung involvement on thorax CT were presented in tables in line with statistical analyses.

As shown in Table 1, 279 (55.8%) of the patients were male and 221 (44.2%) were female in our study in which a total of 500 patients were evaluated. Of the 500 patients, 49 (9.8%) died within 28 days and 451 (90.2%) did not die within 28 days. According to the results of our study, 7.7% of female and 11.5% of male patients died. There was no statistically significant difference between the mortality groups in terms of gender distribution ($p=0.158$).

Table 1. Relationship between gender and mortality*

		Total		28 days mortality				p value
				No		Yes		
		n	Collumns, %	n	Line, %	n	Line, %	
Total		500	100.0%	451	90.2%	49	9.8%	
Gender	Male	279	55.8%	247	88.5%	32	11.5%	0.158
	Female	221	44.2%	204	92.3%	17	7.7%	

*Chi-square test

In our study, the age factor was statistically significant in terms of 28-day mortality ($p<0.01$) and is shown in Table 2. The mean age of the patients included in our study was 64±14 years. In patients who did not die within 28 days, the mean age was 63±14 years, and in the group of patients who died within 28 days, the mean age was 75±10 years, and the difference was statistically significant ($p<0.001$).

As shown in Table 3, the comorbidities of the patients and their effect on 28-day mortality were also analyzed in our study. As a result of the statistical analyses, the presence of CAD, HT, cancer/immunosuppression, CHF and LVO were found to be significant in terms of 28-day mortality ($p<0.05$). In our study, 103 (20.6%) patients had CAD and 20 (19.4%) of these patients died within 28 days. HT was diagnosed in 249 (49.8%) patients and 32 (12.9%) of these patients died within 28 days. 54 (10.8%) of 500 patients had a history of cancer/immunosuppression and 11 (20.4%) of these patients had a mortal course of Covid-19 within 28 days. Thirty (6%) patients were diagnosed with CHF and 7 (23.3%) of these patients died within 28 days. Of the 500 patients included in the study, 21 (4.2%) had a history of LVO and 8 (38.1%) of these 21 patients died within 28 days.

Table 4 shows the relationship between the hematologic findings of the patients included in the study and mortality. Among the hematologic findings, RBC, HGB, RDW, NLR and MPV were statistically significant in terms of 28-day mortality ($p<0.05$)

The relation of complete blood count parameters with the place of hospitalization is shown in Table 5. Among these parameters, RBC, HGB, PLT, RDW, MPV and NLR were statistically different between the groups in the ward-intensive care unit follow-up ($p<0.05$).

CT findings of the patients and their relationship with mortality are shown in Table 6. 343 (68.6%) patients had diffuse infiltration on CT and 41 (12%) of these patients died within 28 days, and the finding of diffuse infiltration on CT was statistically significant in terms of 28-day mortality ($p=0.017$). 154 (30.8%) patients had consolidation on CT and 25 (16.2%) of these patients died within 28 days, the finding of consolidation was statistically significant in terms of 28-day mortality ($p=0.001$). It was observed that 32 (6.4%) of the patients included in the study had pleural effusion and 8

Table 2. Mortality and age relationship*

	Total							28 days mortality													
								Yes							No						
	Mean	SD	Med	25	75	Min	Max	Mean	SD	Med	25	75	Min	Max	Mean	SD	Med	25	75	Min	Max	p value
Age	64	14	65	55	74	19	98	63	14	63	53	73	19	98	75	10	74	67	83	49	92	<0.001*

*Mann Whitney-U test, and *Independent samples-t test, SD: Standard deviation, Med: Median, Min: Minimum, Max: Maximum

Table 3. Mortality and comorbidity*

		Total		28 days mortality				
				No		Yes		
		n	%	n	%	n	%	p value
Total		500	100.0%	451	90.2%	49	9.8%	
Coronary artery disease	No	397	79.4%	368	92.7%	29	7.3%	<0.001
	Yes	103	20.6%	83	80.6%	20	19.4%	
Respiratory disease (asthma, chronic obstructive pulmonary disease)	No	434	86.8%	393	90.6%	41	9.4%	0.496
	Yes	66	13.2%	58	87.9%	8	12.1%	
Diabetes mellitus	No	342	68.4%	306	89.5%	36	10.5%	0.422
	Yes	158	31.6%	145	91.8%	13	8.2%	
Hypertension	No	251	50.2%	234	93.2%	17	6.8%	0.022
	Yes	249	49.8%	217	87.1%	32	12.9%	
Chronic kidney disease	No	468	93.6%	424	90.6%	44	9.4%	0.227*
	Yes	32	6.4%	27	84.4%	5	15.6%	
Cancer/immunosupressed	No	446	89.2%	408	91.5%	38	8.5%	0.006
	Yes	54	10.8%	43	79.6%	11	20.4%	
Congestive heart failure	No	470	94.0%	428	91.1%	42	8.9%	0.020*
	Yes	30	6.0%	23	76.7%	7	23.3%	
Cerebrovascular accident	No	479	95.8%	438	91.4%	41	8.6%	<0.001*
	Yes	21	4.2%	13	61.9%	8	38.1%	

*Chi-square test, and *Fisher's exact test

Table 4. Association of complete blood count with mortality*

	Living					Exitus					
	Mean	SD	Med	Min	Max	Mean	SD	Med	Min	Max	p value
WBC	6.9	3.7	6.0	.9	34.5	7.9	6.4	7.1	1.0	45.8	0.266
NEU	5.4	3.5	4.3	.5	33.0	6.4	6.4	5.2	.1	44.1	0.296
LYM	1.1	2.3	.9	.2	48.0	1.0	.5	.9	.2	2.6	1.000
LYM%	16.9	9.7	15.8	.3	55.0	17.0	12.6	16.3	1.4	76.6	0.752
RBC	4.63	.66	4.67	2.02	8.80	4.32	.79	4.38	2.28	6.35	0.002
HGB	13.2	1.9	13.4	5.1	19.5	12.2	2.4	12.3	7.6	17.5	0.003
PLT	225	101	210	7	924	216	96	218	27	415	0.719
RDW	14.2	1.6	13.8	11.3	22.2	15.2	2.0	14.8	13.1	23.1	<0.001
MPV	8.5	1.0	8.3	6.6	16.4	8.8	.9	8.6	7.6	11.6	0.019
DNI	1.4	2.7	.1	0.0	19.3	1.9	3.4	.4	0.0	17.5	0.198
NLR	6.98	7.14	4.44	0.00	54.93	14.52	14.51	9.43	2.22	70.05	<0.001

*Mann Whitney-U test, SD: Standard deviation, Med: Median, Min: Minimum, Max: Maximum, WBC: White blood count, NEU: Neutrophyl, LYM: Lymphocyte, RBC: Red blood count, HGB: Hemoglobin, PLT: Platelet, RDW: Red cell distribution width, MPV: Mean platelet volume, NLR: Neutrophyl to lymphocyte ratio

(25%) of these patients died within 28 days, and the finding of pleural effusion was statistically significant in terms of 28-day mortality (p=0.008). It was determined that 39 (7.8%) of the patients included in the study had mediastinal lymphadenopathy (LAP) on CT and 8 (20.5%) of these patients died within 28 days, and the finding of LAP on CT was statistically significant in terms of mortality (p=0.042).

In Table 7, the relationship between CURB-65 score and mortality was analyzed. The grouping of the patients included in the study according to the CURB-65 score was 465 (93%) patients in the mild-moderate risk group and 35 (7%) patients in the high-risk group. While 27 (5.8%) of the patients in the mild-moderate risk group died within 28 days, 22 (62.9%) of the patients in the high-risk group died within 28 days and

Table 5. Association of complete blood count with place of hospitalization*

	Follow-up type														
	Service							Intensive care unit							p value
	Mean	SD	Med	25	75	Min	Max	Mean	SD	Med	25	75	Min	Max	
WBC	6.9	3.8	5.9	4.5	8.2	1.2	34.5	7.2	4.8	6.2	4.7	8.1	.9	45.8	0.722
NEU	5.4	3.5	4.3	3.1	6.9	.6	33.0	5.7	4.7	4.6	3.1	6.9	.1	44.1	0.775
LYM	1.1	2.5	.9	.6	1.3	.2	48.0	1.0	.5	.9	.7	1.2	.2	3.4	0.958
LYM%	16.8	9.8	15.8	9.2	22.1	.3	55.0	17.0	10.5	16.2	9.4	22.4	1.4	76.6	0.871
RBC	4.64	0.61	4.67	4.33	5.01	2.02	7.22	4.51	0.82	4.59	4.02	4.92	2.28	8.80	0.035
HGB	13.2	1.8	13.4	12.2	14.4	5.9	17.5	12.8	2.4	12.9	11.3	14.5	5.1	19.5	0.048
PLT	219	98	205	157	261	7	924	239	104	232	160	299	26	664	0.025
RDW	14.0	1.5	13.7	13.0	14.6	11.3	21.5	14.8	1.9	14.5	13.5	15.7	11.3	23.1	<0.001
MPV	8.5	1.0	8.3	7.8	8.9	6.6	16.4	8.7	0.9	8.6	8.1	9.1	6.9	11.6	<0.001
DNI	1.3	2.8	.1	.0	1.5	.0	19.3	1.6	2.8	.4	.0	2.1	.0	17.9	0.141
NLR	5.81	5.52	4.01	2.62	6.59	.00	45.29	12.53	11.94	8.84	4.56	15.13	.87	70.05	<0.001

*Mann Whitney-U test, SD: Standard deviation, Med: Median, Min: Minimum, Max: Maximum, WBC: White blood count, NEU: Neutrophyl, LYM: Lymphocyte, RBC: Red blood count, HGB: Hemoglobin, PLT: Platelet, RDW: Red cell distribution width, MPV: Mean platelet volume, NLR: Neutrophyl to lymphocyte ratio

Table 6. Association of CT findings with mortality

		28 days mortality				p value
		No		Yes		
		n	%	n	%	
CT- ground glass	No	12	92.3%	1	7.7%	1.000*
	Yes	439	90.1%	48	9.9%	
Diffuse infiltration	No	149	94.9%	8	5.1%	0.017
	Yes	302	88.0%	41	12.0%	
Consolidation	No	322	93.1%	24	6.9%	0.001
	Yes	129	83.8%	25	16.2%	
Pleural effusion	No	427	91.2%	41	8.8%	0.008*
	Yes	24	75.0%	8	25.0%	
Crazy-paving	No	396	90.8%	40	9.2%	0.219
	Yes	55	85.9%	9	14.1%	
LAP	No	420	91.1%	41	8.9%	0.042*
	Yes	31	79.5%	8	20.5%	
Pericardial effusion	No	448	90.3%	48	9.7%	0.339*
	Yes	3	75.0%	1	25.0%	
Air bronchogram	No	433	90.8%	44	9.2%	0.064*
	Yes	18	78.3%	5	21.7%	

Chi-square test, *Fisher's exact test, CT: Computed tomography, LAP: Lymphadenopathy

the CURB-65 score was statistically significant in predicting 28-day mortality (p<0.001).

As shown in Table 8, when the association of MPV and CURB-65 with mortality was analyzed, the mean MPV value was 8.4 fl in the group with 0 CURB-65 points, 8.5 fl in the group with 1 point, 8.7 fl in the group with 2 points, 9 fl in the group with 3 points, 8.6 fl in the group with 4 points and 8.9 fl in the group with 5 points. This difference between the groups was found to be statistically significant in terms of mortality and the difference was found to be due to the 0-2nd and 0-3rd groups (p=0.001). Among the CURB-65 risk groups, the mean MPV in the high-risk group was 8.9 fl, while the mean MPV in the mild-moderate risk group was 8.5 fl, which was statistically significant in terms of mortality (p=0.003).

DISCUSSION

In our study, when the effect of gender factor on mortality was analyzed statistically, no significant difference was found (p=0.158). Although the mortality rate of men was higher than that of women, this difference was not statistically significant. Similar to our study in the literature, Liu et al.[6] conducted a study with 10.948 patients and showed that men were more susceptible to COVID-19 disease than women, but there was no significant relationship in terms of mortality.

Table 7. CURB-65 mortality association

		Total		28 days mortality				
				No		Yes		
		n	Column, %	n	Line, %	n	Line, %	p value
CURB-65	0	179	35.8%	176	98.3%	3	1.7%	<0.001*
	1	152	30.4%	150	98.7%	2	1.3%	
	2	134	26.8%	112	83.6%	22	16.4%	
	3	19	3.8%	11	57.9%	8	42.1%	
	4	9	1.8%	2	22.2%	7	77.8%	
	5	7	1.4%	0	0.0%	7	100.0%	
CURB-65 risk	Light-moderate	465	93.0%	438	94.2%	27	5.8%	<0.001*
	High	35	7.0%	13	37.1%	22	62.9%	

CURB-65: Confusion, uremia, elevated respiratory rate, hypotension, and aged 65 years or older, Chi-square test, *Fisher's exact test

Table 8. Association of CURB-65 and MPV with mortality

		MPV					p value
		Mean	SD	Median	Percentile 25	Percentile 75	
CURB-65	0	8.4	1.0	8.2	7.8	8.8	0.001*
	1	8.5	.9	8.4	7.9	9.0	
	2	8.7	1.0	8.5	8.1	9.3	
	3	9.0	.7	9.0	8.5	9.3	
	4	8.6	.9	8.9	7.8	9.5	
	5	8.9	.7	9.0	8.2	9.6	
CURB-65 risk group	Light-median risk	8.5	1.0	8.3	7.9	9.0	0.003**
	High risk	8.9	.7	9.0	8.2	9.5	

*Kruskall-Wallis test, * Subgroups were evaluated by Bonferroni analysis; the difference is due to differences between groups 0-2 and 0-3. **Mann Whitney-U test, CURB-65: Confusion, uremia, elevated respiratory rate, hypotension, and aged 65 years or older, MPV: Mean platelet volume, SD: Standard deviation

This may be explained by the fact that age and comorbid conditions are also effective on the mortality of patients along with gender.

In our study, when the mean age of patients who died within 28 days and patients who did not die were analyzed, it was observed that the mean age of patients with mortality was significantly higher and the age factor was statistically significant in terms of mortality (p<0.001). In the cohort analysis conducted by Banerjee et al.[7] in correlation with our study in the literature, it has been shown that age is one of the leading individual risk factors for COVID-19, and the risk of death increases exponentially, especially in individuals over 70 years of age, if comorbidities are also present. In addition, in the study by Williamson et al.[8] it was shown that mortality was lower in patients below the age of 50 years, whereas mortality increased exponentially in each decade above the age of 50 years.

The comorbidities of the patients included in our study and their relationship with mortality were analyzed. In the patients included in our study, the presence of CAD, HT, cancer/immunosuppression, LVO, and CHF in the history was found to be statistically significant in terms of 28-day mortality. Many studies also support our results.

In our study, a significant difference was found between CURB-65 score and mortality (p<0.001). In the literature, in parallel with our study, Zhou et al.[9] showed that the CURB-65 score was significantly higher in patients who died. Again, in parallel with our study, Satici et al.[10] showed that CURB-65 score had 73% sensitivity and 85% specificity in predicting 30-day mortality in patients with a CURB-65 score of 2 and above. We think that the CURB-65 score is significant in terms of determining the need for intensive care and predicting mortality in patients with COVID-19 pneumonia.

When the hematologic findings of the cases were examined in our study, MPV (p=0.019), RBC (p=0.002), HGB (p=0.003), RDW (p<0.001), NLR (p<0.001) values were statistically significant in terms of 28-day mortality. In the literature, in correlation with our study, Henry et al.[11] showed that RDW was a useful predictor of morbidity and mortality in a wide range of conditions including sepsis, pneumonia and other respiratory diseases. Again, in correlation with our study, Güçlü et al.[12] showed that severe COVID-19 was associated with low HGB values and RDW was correlated with the severity of COVID-19.

In our study, it was found that the increase in MPV values was associated with mortality and MPV values were higher in intensive care unit patients. Again in the literature, in correlation with our study, Güçlü et al.[12] reported that the decrease in PLT count and increase in MPV were associated with mortality in COVID-19 patients. Similarly, in the study conducted by Ceyhan et al.[13] it was shown that MPV values increased in intensive care unit patients and were statistically significant in terms of mortality. Increased MPV values are said to be the hallmark of various thrombotic disorders including acute coronary syndrome, stroke, VTE, abdominal vein thrombosis, and even preeclampsia. Since COVID-19 infection also causes an increased rate of thrombotic processes, it is thought that increased MPV values may be a poor prognostic marker. As a result of this study, we think that MPV can be used as a marker of poor prognosis and a predictor of mortality.

In our study, when the CT findings of the patients were analyzed, it was observed that the finding of diffuse infiltration was associated with mortality. Normally, we do not expect central involvement in COVID-19 patients and if central involvement is observed in patients with COVID-19, we may think that the disease has a severe course and secondary bacterial infection may have developed if clinically and laboratory findings support this. Therefore, we think that this involvement may be associated with mortality.

In our study, the finding of consolidation on CT was found to be significant in terms of 28-day mortality (p=0.001). In the literature, in correlation with our study, Li et al.[14] reported that the finding of consolidation on CT was a finding indicating that the disease was progressing and that it would indicate a severe course of the disease.

In our study, when CURB-65 score and MPV values of the patients were analyzed together, it was observed that elevated CURB-65 and MPV were significant in terms of mortality. While CURB-65 score and MPV were found to be predictive of mortality individually, their combined use was found to be statistically significant in terms of predicting mortality. In the literature, similar to our study, Gölcük et al.[15] showed that CURB-65 score was independently predictive of mortality in community-acquired pneumonia and its correlation with MPV was more effective in predicting 28-day mortality.

CONCLUSION

There are also many studies in the literature examining MPV in COVID-19 and CURB-65 score in COVID-19, but there is no study on the use of both together. With this study, we think that the combined use of MPV and CURB-65 score can be used as a predictor of mortality in COVID-19 pneumonia, but more studies are needed in this sense.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was initiated with the approval of the Ankara Bilkent City Hospital Clinical Researches Ethics Committee (Date: 11.11.2020, Decision No: 1283).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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