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Is Mean Platelet Volume a Useful Predictor of Hospital Mortality in Covid-19 Patients?

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Abstract

Background: Elevated Mean Platelet Volume (MPV) can indicate the activation of platelets and the coagulation cascade, which has been suggested as a predictor of mortality in some diseases. The aim of this study was to investigate the role of MPV in predicting hospital mortality in patients with Covid-19.

Methods: This was a cross-sectional single-center retrospective study. The data of all patients with a PCR-confirmed diagnosis of Covid-19 hospitalized within a 3-month period were analyzed. The patients' files were reviewed, and the data were recorded into a checklist, including demographic characteristics, underlying diseases, and laboratory test results. Hospital mortality was designated as the main outcome of the study.

Results: A total of 201 Covid-19 patients, confirmed by PCR, were included in this study. In-hospital mortality was observed in 28 patients (13.9%). The results of univariate regression analysis revealed that the triage level, history of chronic pulmonary disease, age, oxygen saturation, lymphocyte count, BUN, Cr, and CRP were significantly related to in-hospital mortality. However, MPV showed no significant relationship with in-hospital mortality.

Conclusion: Low triage level, advanced age and hypoxia predicted a higher risk of in-hospital mortality in Covid-19 patients. The role of MPV as a predictor of patient outcome in Covid-19 remains inconclusive, necessitating further studies with larger sample sizes.

Keywords: Covid-19, In-hospital mortality, Mean platelet volume, Patient outcome

Introduction

Since late 2019, the Covid-19 pandemic ravaged the world. Multiple mutations in SARS-Cov2 conferred this virus with ever-changing transmissibility and pathogenicity features. Covid-19 manifests as a respiratory disease characterized by the involvement of the upper and lower airways, followed by multiorgan dysfunction. If the disease progresses and remains untreated, death may be inevitable. Several factors have been suggested to predict mortality in Covid-19 patients, among which laboratory parameters have a special place (1-4). Establishing early prognostic criteria for Covid-19 patients using prediction models at the time of hospital admission can help relieve pressure from the healthcare system by allowing evidence-based risk prediction and decision-making when triaging patients and allowing healthcare workers to provide the most appropriate care to patients, which can improve their outcomes (5,6).

Platelets play a major role in arterial and venous thrombosis. Also, platelet-virus interactions can activate the coagulation cascade during viral infections. The Mean Platelet Volume (MPV) provides an inexpensive, simple, and readily available hematological parameter, which is routinely reported in Cell Blood Count (CBC). This parameter is an indicator of platelets' function and size, and its variations can reflect either the presence of systemic inflammation (7) or the activation of platelets and the coagulation pathway (8). Thrombocytosis has been suggested to predict thromboembolic events (9,10). One of the serious complications of Covid-19 can be the over-activation of the coagulation cascade and the development of thromboembolism. In this regard, MPV may provide a helpful parameter to predict the outcome of Covid-19 patients early.

Accordingly, the aim of this study was to investigate the role of MPV in predicting in-hospital mortality in Covid-19 patients.

Materials and Methods

This was a cross-sectional single-center retrospective study on patients with Covid-19 confirmed by PCR admitted to the Afzalipur Hospital of Kerman, the referral center for internal diseases in southeast of Iran, during a 3-month period from the beginning of April to the beginning of June 2022. The data were gathered by reviewing patients' files and recorded into a checklist. Patients whose files were incomplete and those with negative PCR test results, regardless of the presence or absence of lung parenchyma involvement in high-resolution CT scan, were excluded from the study. The variables of the study consisted of demographic characteristics, underlying diseases, and laboratory test results. In-hospital mortality was the main outcome of the study.

Statistical analysis

Statistical analysis of the data was conducted in SPSS 20 (IBM Corp. Armonk, New York, USA) software. Categorical variables were expressed using frequencies (percentages), and quantitative variables were presented as mean±SD. The relationship between in-hospital mortality and other variables was investigated using univariate logistic regression, and Odd Ratio (OR) and 95% Confidence Interval (CI) were calculated to determine the strength of this relationship. $p<0.05$ was considered statistically significant.

Results

Overall, 201 patients with Covid-19, confirmed by a positive PCR test result, were included in this study. In-hospital mortality was observed in 28 patients (13.9%). The patients' characteristics have been described in table 1.

The relationship between in-hospital mortality and qualitative and quantitative variables was assessed using univariate regression analysis (Tables 2 and 3). In-hospital mortality was significantly associated with the level of triage, history of chronic pulmonary disease, age, oxygen saturation, lymphocyte count, and serum levels of Blood Urea Nitrogen (BUN), Creatinine (Cr), and C-Reactive Protein (CRP). However, MPV was not significantly associated with in-hospital mortality. The assessment of the relationship between MPV and in-hospital mortality at the cut-off of 10.1 showed no significant difference in the rate of in-hospital mortality between the patients who had MPV above or below this threshold ($p=0.62$) (11).

Regarding the results of univariate logistic regression, variables with p-values below 0.2 were selected to

Table 1. Baseline characteristics

Variables	N(%)
Gender	
Male	113 (56.2)
Female	88 (43.8)
Past medical history	
Hypertension	51 (25.4)
Diabetes mellitus	35 (17.4)
Chronic lung disease	20 (10)
Chronic kidney disease	10 (5)
Age, Mean±SD	50.61±29.44
O_2 saturation (%),Mean±SD	87.44±9.71
Platelet count, Mean±SD	221.64±112.51
Lymphocyte, Mean±SD	20.34±16.28
MPV [1], Mean±SD	9.85±0.98
BUN, Mean±SD	23.47±19.80
Cr, Mean±SD	1.15±1.15
Bilirubin Indirect, Mean±SD	0.7±2.54
Bilirubin Direct, Mean±SD	0.53±1.27
AST [2], Mean±SD	62.68±141.23
ALT [3], Mean±SD	51.74±139.40
Blood sugar, Mean±SD	148.39±87.23
ESR [4], Mean±SD	58.36±92.70
CRP [5], Mean±SD	51.86±62.93
Hospital mortality	28 (13.9)

1. Mean platelet volume,2. Aspartate transaminase, 3. Alanine transaminase, 4. Erythrocyte sedimentation rate, 5. C-reactive protein.

enter into a multiple logistic regression model based on the backward method. All variables that were significant at the 5% level were selected to remain in the model (Table 4).

Discussion

Our study demonstrated that the level of triage, advanced age and hypoxia was significantly associated with in-hospital mortality in Covid-19 patients. However, no significant relationship was observed between in-hospital mortality and MPV in these patients.

Patient prioritization based on the triage level is of particular importance in Covid-19 patients. Accurate assessment of patients at the time of admission to the hospital can help early identification of high-risk patients (12). Considering that the risk of in-hospital mortality at the time of admission is higher in Covid-19 patients than in non-Covid patients, it is crucial for doctors to pay special attention to the appropriate triage of Covid-19 patients (13). Our study showed that Covid-19 patients with a lower triage level had a higher in-hospital mortality rate, highlighting the need for the accurate triage of these patients.

Our results indicated that advanced age, and hypoxia increased the rate of in-hospital mortality in Covid-19 patients. Henkens *et al* also noted that an advanced age, the presence of pulmonary disease, and hypoxia

Table 2. Associations qualitative variables with predicting hospital mortality using univariate analysis

Variables	Mortality (N%)		Odds ratio (95% CI)	p-value
	Yes	No		
Triage level				
1	10 (35.70)	14 (8.10)	6.3 (2.4-16.26)	<0.001
2	18 (64.30)	159 (91.90)	Reference	
Gender				
Male	17 (60.70)	96 (55.50)	1.24 (2.802-0.548)	0.606
Female	11 (39.30)	77 (44.50)		
Past medical history				
Hypertension	11 (39.28)	40 (60.72)	2.15 (4.967-0.932)	0.073
Diabetes mellitus	5 (17.90)	30 (82.1)	1.03 (2.944-0.365)	0.947
Chronic lung disease	6 (30)	14 (70)	3.09 (8.897-1.087)	0.036
Chronic kidney disease	2 (16.66)	10 (83.34)	1.58 (7.888-0.319)	0.573

Table 3. Associations of quantitative variables with predicting hospital mortality using univariate analysis

Variables	Mortality (Mean±SD)		Odds ratio (95% CI)	p-value
	Yes	No		
Age	70.03±24.38	47.46±29.03	0.30 (0.485-0.187)	<0.001
O_2 saturation	78.01±15.54	88.97±7.40	0.91 (0.949-0.874)	<0.001
Platelet	221.85±116.75	221.60±112.16	1.00 (1.004-0.996)	0.991
Lymphocyte	13.28±12.78	21.55±16.54	0.95 (0.991-0.913)	0.016
MPV	9.88±0.88	9.85±1.01	0.77 (2.167-0.275)	0.624
BUN	35.07±19.19	21.56±19.30	1.02 (1.044-1.008)	0.005
Cr	1.72±1.17	1.06±1.12	1.42 (1.898-1.072)	0.015
Bilirubin ID	0.46±0.29	0.75±2.79	0.71 (2.495-0.205)	0.599
Bilirubin D	0.49±0.46	0.54±1.39	0.96 (1.410-0.662)	0.859
AST	64.84±54.38	62.28±151.84	1.00 (1.003-0.997)	0.932
ALT	37.26±24.12	54.35±151.06	0.99 (1.004-0.993)	0.593
Blood sugar	155.57±92.28	147.03±86.51	1.00 (1.005-0.997)	0.635
ESR	59.91±34.34	58.06±100.31	1.00 (1.005- 0.996)	0.929
CRP	96.86±82.73	44.03±55.57	1.01 (1.016-1.004)	0.001

Table 4. Associations of variables with predicting hospital mortality using multiivariate analysis

Variables	Odds ratio (95% CI)	p-value
Triage level		
1	3 (1.10-10.27)	0.040
2	Reference	
Age	1.20 (1.01-1.85)	0.003
O2 saturation	0.94(0.89-0.98)	0.006

were associated with a higher in-hospital mortality rate among Covid-19 patients (14). Borgne *et al*, in their study, underlined the role of age as a relative predictor of in-hospital mortality among Covid-19 patients, highlighting that this association was statistically significant only in the age group of 65-74 years. They also argued that the presence of underlying pulmonary diseases did not increase in-hospital mortality among Covid-19 patients (15). In line, Acar *et al* supported the role of advanced age as a risk factor and a predictor of mortality in Covid-19 patients; however, these researchers stated that underlying pulmonary diseases had a weak correlation with the risk of mortality in these patients (16). In another study, Margo *et al* asserted that the prognostic role of diseases such as diabetes, coronary artery disease, and chronic liver disease was more prominent than that of chronic pulmonary disease in patients with Covid-19 (17).

Several studies have investigated the prognostic role of laboratory tests in Covid-19 patients, the results of which; however, have been inconsistent. Regolo *et al* also underscored the prognostic roles of lymphopenia and elevated levels of CRP in Covid-19 patients (18). Similarly, Basaran *et al* pointed out that in-hospital mortality in Covid-19 patients was significantly associated with advanced age, lymphopenia, and elevated serum levels of BUN, Cr, and CRP (19). Loomba *et al* reviewed 10 studies to identify biomarkers predicting the outcome of Covid-19 patients, highlighting the prognostic role of serum Cr

and CRP levels, which was in line with our observation. In the recent study, researchers recommended using risk stratification models to better predict in-hospital mortality in Covid-19 patients (20). Küçükceran *et al* highlighted roles for advanced age, hypoxia, and elevated serum levels of BUN and Cr in predicting mortality in Covid-19 patients and stated that the BUN to albumin ratio was a more reliable predictor in this regard. However, they reported no remarkable prognostic role for underlying pulmonary diseases in these patients (21). Lino *et al* assessed the prognostic role of BUN, Cr, and CRP and reiterated that only the last two biomarkers had prognostic values in Covid-19 patients, but no such role was observed for advanced age and lymphopenia (22). In their study on Covid-19 patients, Ding *et al* affirmed prognostic roles for advanced age, lymphopenia, and elevated levels of CRP and Cr (11). Another study delineated advanced age and CRP as prognostic factors in Covid-19 patients (23). Liu *et al* noted that the prognostic role of the BUN to Cr ratio was stronger than each of them alone (24). Our findings didn´t support the prognostic role of lymphopenia and elevated serum levels of BUN, Cr, and CRP in hospitalized Covid-19 patients in the multivariate analysis.

The results of studies on the role of MPV as a predictor of mortality in Covid-19 patients have been inconsistent. A study negated a role for MPV as a predictor of mortality in Covid-19 patients (25). Also, Hammad *et al* did not find MPV as a predictor of mortality in Covid-19 patients, especially in affected females (26), and similar findings were also reported by Gowda *et al.* (27). In another study, Ozcelik *et al* compared MPV between Covid-19 patients and those infected with influenza, showing that MPV was significantly lower in Covid-19 patients (28). Taj *et al* rejected the idea that MPV had a significant relationship with the severity of Covid-19 disease (29). Likewise, Keski *et al* compared the clinical and laboratory characteristics of the survivors and victims of Covid-19 and found no role for MPV as a predictor of mortality in these patients. On the other hand, advanced age, lymphopenia, and history of hypertension were identified as independent predictors of Covid-19 mortality (30). Some studies; however, have suggested a prognostic role for MPV in predicting mortality and morbidity in Covid-19 patients (31-33). Our results did not confirm MPV as a prognostic factor and a predictor of in-hospital mortality in Covid-19 patients, which was in line with the reports of Ravindra *et al* and Güçlü *et al* (34,35). According to a study conducted by Liu *et al*, monitoring the variations of platelet parameters, such as MPV, can be of clinical importance during hospitalization, when these alterations may anticipate mortality in Covid-19 patients (36). In addition, multivariate risk stratification models can be more beneficial for identifying valuable prognostic parameters (37).

One of the limitations of this study was that it was a single-center study. Also, this was a retrospective study, and we had to exclude patients who had incomplete files. In addition, patients with a negative PCR test result, regardless of evidence of pulmonary involvement in high-resolution CT scans, were excluded from the study.

Conclusion

We here investigated the potential predictors of in-hospital mortality in Covid-19 patients. In this study, a low triage level, advanced age and hypoxia were associated with a higher in-hospital mortality rate in Covid-19 patients. Nevertheless, MPV was not significantly associated with the outcome of Covid-19 patients. Studies with larger sample sizes and multivariate risk stratification models are required to identify reliable parameters with prognostic value in Covid-19 patients.

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Ethical approval

The ethical approval for this study was obtained from the Ethics Committee of the Kerman University of Medical Sciences (IR.KMU.AH.REC.1401.048).

Conflict of Interest

The authors declare that they have no competing interests.

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