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TANAFFOS

Relationship of Mean Platelet Volume (MPV) and Mean Corpuscular Volume (MCV) with the Outcome of Patients with Acute Exacerbation of COPD

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Background: Mean platelet volume (MPV) reflects the platelet production rate and stimulation, while mean corpuscular volume (MCV) represents the average size of red blood cells. Considering the possibility of the relationship between red cell index changes and different severities of chronic obstructive pulmonary disease (COPD) as well as the uncertainty of the available results in this regard, the present study aimed at evaluating the relationship between MPV and MCV in the outcome of patients with acute exacerbation of COPD (AECOPD).

Materials and Methods: In this cross-sectional analytical study, 150 patients with AECOPD that referred to the emergency department (ED) were included in the study. The severity of the disease was recorded using the GOLD classification, and the MPV and the MCV were evaluated based on the reference range of kits in the laboratory. Then, the data were analyzed using SPSS software.

Results: The mean MPV and MCV were 9.7±8.3 and 85.9±11.5, respectively, and had no significant difference in different severities of COPD(P>0.05). Moreover, although MCV in survivals with a mean of 88.81±6.47 was higher than that of non-survivals with a mean of 85.77±11.73, and MPV in the non-survivals with a mean of 8.53±9.74 was higher than that of survivals with the mean of 8.86±0.92, this difference was not statistically significant (P>0.05).

Conclusion: Overall, the results of this study showed that the mean MPV and MCV did not have any significant relationship with AECOPD and patient outcome.

Keywords: Mean Platelet Volume (MPV); Mean Corpuscular Volume (MCV); Chronic Obstructive Pulmonary Disease (COPD); Mortality

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is recognized by airflow limitation (1). Despite its consideration as a preventable disease, it remains a global public health issue and a leading cause of mortality. According to Global Initiative for Chronic Obstructive Lung Disease (GOLD) and the World Health Organization (WHO), the mentioned disease was the third leading cause of mortality in the world by 2020, accounting for 7% of all deaths (2, 3). Since systemic inflammation has been recognized as a risk factor for atherosclerosis, cardiovascular events, anorexia, cachexia, and osteoporosis which are more common in patients with COPD, systemic inflammation has been focused on in COPD. Therefore, various studies have examined systemic inflammation markers such as C-reactive protein (CRP) and leukocyte count in these patients (4, 5).

Pertinent studies have revealed high levels of white blood cell count (WBC), absolute and relative neutrophil counts, mean platelet volume (MPV), and mean corpuscular volume (MCV) in COPD patients (6-8). MPV has been studied as an inflammatory indicator in many diseases and has been found to increase in cardiovascular diseases, peripheral vascular disease, and cerebrovascular disease (9). The relationship between MPV and COPD is controversial. A number of studies have shown that patients with stable COPD had a higher MPV than controls, while some other studies have reported no significant relationship in this respect (10, 11). Malek et al.'s study revealed no significant difference in MPV between case and control groups as well as between COPD stages (12).

Another study revealed that patients with acute exacerbation of COPD (AECOPD) had lower MPV than controls. Moreover, the MPV level in patients with stable COPD was lower than that of controls (9).

Clinical experiences confirmed by several studies show that hypoxemia is associated with macrocytosis in COPD (13-16). The results of Tsantes et al.'s study indicated that the MCV level increased in hypoxemic COPD patients (13). Moreover, another study reported an increase in MCV levels with disease exacerbation in COPD patients (17).

Systemic inflammation has been recognized as a risk factor for atherosclerosis, cardiovascular events, anorexia, cachexia, and osteoporosis which are more common in patients with COPD. Some inflammatory markers include MPV, MCV, and complete blood count (CBC).

Therefore, as systemic inflammation is noteworthy in COPD, contradictory findings have been reported in previous studies, and the mentioned issue is of great significance in the prevention of unwanted complications, the present study aimed at investigating the relationship of MPV and MCV with the outcome of patients with AECOPD.

MATERIALS AND METHODS

In the present cross-sectional study, 150 patients with AECOPD were included. A convenient and cross-sectional sampling technique was used involving patients that were referred to the emergency department (ED) of Khatam Al-Anbia and Ali Ibn Abitaleb hospitals in Zahedan in 2017.

Inclusion criteria included patients with COPD that were hospitalized due to acute exacerbation. Exclusion criteria consisted of comorbidity with any other factors that increase or decrease the inflammatory response in the body such as DVT, pulmonary embolism, other non-pulmonary infections, inflammatory bowel disease, left-sided heart failure, myocardial infarction, rheumatoid arthritis, history of chemotherapy, use of anti-inflammatory drugs, and patients' non-cooperation.

After obtaining the ethical code from the Local Ethics Committee of Zahedan University of Medical Sciences (IR.ZAUMS.REC.1396.251) and the written consent from the eligible patients, their basic and clinical information including age, sex, MPV, MCV, and severity of COPD were recorded.

It should be noted that COPD was generally diagnosed based on spirometry and the patient's previous history (20). These patients were included in the study only if they had been referred to the hospital with an exacerbation of cough, sputum, or shortness of breath. A blood sample was immediately taken for CBC. A pulmonary function test (PFT) was performed for all patients using a spirolab spirometer. A trained technician in each hospital explained the maneuvers to the patients before performing the test and recorded the necessary information in the checklist. The severity of AECOPD was assessed based on the global GOLD classification presented in the following four categories: mild (FEV1≥80%), moderate (50%≤FEV1<80%), severe (30%≤FEV1<50%), and very severe (FEV1<30%).

In addition, CBC was examined in patients with an automatic blood catheter (Sysmex kx2 in Japan). The blood test was collected in laboratory tubes containing potassium citrate. The test was performed within one hour after sampling, and the MPV and MCV values were recorded in the laboratory of Khatam Al-Anbia and Ali Ibn Abitaleb hospitals based on the range of the kits available in these laboratories. Ethylenediaminetetraacetic acid was not used in the test tube due to the possibility of increasing the platelet volume and distorting the study.

MPV and MCV values were evaluated as primary outcomes. Moreover, the length of hospitalization and outcome of the disease including death, hospitalization in the ward, hospitalization in the intensive care unit (ICU), and discharge, were evaluated as secondary outcomes.

Patient information was entered into Statistical Package for the Social Sciences (SPSS) software, version 25 (IBM Corporation, Armonk, NY). Data were presented as means ± standard deviation (SD) or frequency (percentage). The independent samples t-test was used to compare the mean MPV and MCV considering the outcome of the patient (survival or non-survival). One-way analysis of variance was used to compare the mean MPV and MCV in the category of the length of hospital stay and different severities of COPD. Furthermore, the Chi-squared test was run to compare the frequency distribution of COPD severity according to the outcome of the patients. A significance level of less than 0.05 was considered in all analyses.

RESULTS

According to the findings of the present study, 57.3% and 42.7% of 150 patients were male and female, respectively. Overall, 49.3%, 28%, 16.7%, and 6% of patients had mild, moderate, severe, and very severe COPD, respectively. The mean age of all patients with COPD was 67.52 ± 12.9 (Table 1).

Table 1. Basic and clinical characteristics of patients with COPD

Characteristics		Number (Percentage)
Age	40-60 yrs.	45(30%)
	>60 yrs.	105(70%)
Sex	Male	86(57.3%)
	Female	64(42.7%)
Smoking		48(32%)
Comorbidity	Hypertension	22(14.7%)
	Diabetes mellitus	9(6%)
Severity of COPD	Mild	74(49.3%)
	Moderate	42(28%)
	Severe	25(16.7%)
	Very severe	9(6%)
Mortality		8(5.3%)
Length of hospital stay	0-10 days	125(83.3%)
	11-20 days	22(14.7%)
	21-30 days	3(2%)

The mean MPV in the age group of 40-60 and the age group of 60 and older was 8.95±1.17 and 10.01±9.89, respectively. There was no statistically significant difference between the mean MPV and the age of patients with AECOPD (P=0.923). Moreover, no statistically significant difference was observed between the gender of patients with AECOPD and MPV, and MCV (P>0.050).

The mean MPV in newly admitted patients (between 0-10 days) was 9.8 ± 9.08, which decreased slightly over time such that it reached 8.70 ± 0.10 in patients admitted between 20-30 days. However, it should be noted that there was no statistically significant difference between AECOPD patients' MPV and their length of hospital stay (P> 0.05). In addition, the means MCV over the hospital stay of 0-10 and 20-30 days were 94.3±7.24 and 86±10.1, respectively, which were not statistically significant (P> 0.05) (Table 2).

Table 2. Determination and comparison of the mean MPV and MCV considering length of hospital stay

Length of hospital stay	MPV		MCV	
	Mean ± SD	P value	Mean ± SD	P value
0-10 days	9.8±9.08		94.3±7.24	
11-20 days	9.02±1.01	0.530	86±10.13	0.20
21-30 days	8.70±0.10		84.40±17.85	
Total	9.70±8.30		85.9±11.52	

According to the results, the highest and lowest MPV was observed in patients with moderate and mild COPD with the mean of 11.49 ± 15.60 and 8.91 ± 1.07, respectively; however, there was no statistically significant difference between MPV and the severity of COPD in patients with AECOPD (P = 0.58). Moreover, the highest and lowest MCV values were observed in patients with very severe and moderate COPD with the means of 89.60 ± 5.90 and 82.91 ± 7.75, respectively; however, the difference was not statistically significant (P = 0.089) (Table 3).

Regarding the frequency distribution of patients' mortality status considering MPV and MCV, the mean MPV was slightly higher in the non-survival (9.74 ± 8.53) while the mean MCV was slightly lower in the mentioned patients (85.77 ± 11.73). However, there was no statistically

significant difference between the mortality rate and MPV (P = 0.61) and MCV (P = 0.31) (Table 4).

Table 3. Determination and comparison of the mean MPV and MCV considering various severity of COPD

Severity of COPD	MPV		MCV	
	Mean ± SD	P value	Mean ± SD	P value
Mild	8.91±1.07	0.58	86.18±7.65	0.089
Moderate	11.49±15.60		82.91±7.75	
Severe	9.08±0.66		88.98±8.10	
Very severe	9.52±1.02		89.60±5.90	
Total	9.70±8.30		85.93±11.52	

Table 4. Determination and comparison of the mean MPV and MCV considering patient outcome (dead or alive)

Outcome	MPV		MCV	
	Mean ± SD	P value	Mean ± SD	P value
Non-survival	9.74±8.53	0.61	85.77±11.73	0.31
Survival	8.86±0.92		88.81±6.47	
Total	9.70±8.30		85.93±11.52	

It was figured out that most of the patients admitted to the ward (64 patients) had mild COPD while most of the non-survival (6 patients) had severe COPD. There was a significant difference between patient outcome and severity of COPD based on GOLD classification (P<0.001) (Table 5).

DISCUSSION

According to the findings of the present study, the mortality rate increased with AECOPD. However, no statistically significant relationship was observed between the severity of the disease and MPV and MCV. Moreover, although the mean of MPV and MCV in women was slightly higher than that of men, the observed difference was not statistically significant.

In contrast to the findings of this study, the results of Kontoninas et al.'s study indicated that the mean MCV in men was significantly higher than that of women. In addition, the mentioned study reported an inverse relationship between MCV and AECOPD severity (17). In this regard, it can be stated that women's different living conditions including climate, lifestyle, and occupations in Sistan and Baluchestan province can be considered as some factors affecting the discrepancy between the results of the mentioned and current studies.

Furthermore, the mean MPV and MCV in this study decreased with the increasing of the hospital stay. Moreover, the mean MPV and MCV decreased and increased slightly with increasing of the severity of the disease, respectively. In this respect, Wang et al.'s study showed that MPV was inversely and significantly associated with CRP and the severity of the disease. Although this relationship was not significant in our study, the results of both studies indicated an inverse relationship between MPV and the severity of the disease. In fact, the mean MPV can be stated to increase when patients recover following AECOPD (9).

Kontoninas et al.'s study revealed that MCV was directly and significantly related to the severity of COPD such that the mean MCV was much lower in patients with mild to moderate COPD as compared to AECOPD patients (17).

Table 5. Determination and comparison of the frequency distribution of COPD severity according to patient outcome

Severity of COPD	Outcome					P value
	Total	Hospitalized in the ward	Hospitalization in the ICU	Discharge from the hospital	Non-survival	
Mild	74(49.5%)	64(42.8%)	0(0%)	9(6%)	1(0.7%)	<0.001
Moderate	42(27%)	39(26%)	0(0%)	3(2%)	0(0%)	
Severe	25(16.7%)	15(10%)	3(2%)	1(0.7%)	6(3.9%)	
Very severe	9(6%)	6(3.9%)	1(0.7%)	1(0.7%)	1(0.7%)	
Total	150(100%)	124(82.7%)	4(2.7%)	14(9.3%)	8(5.3%)	

Finally, the findings of the patient outcome indicated that 5.33% of patients, 4% of whom were in AECOPD status, deceased. In fact, the highest mortality rate has been reported in patients with severe COPD. In addition, 2.66% of patients were admitted to the ICU while 9.33% of patients were discharged. However, generally, there was a significant relationship between patient outcome and severity of COPD based on GOLD classification. Moreover, MCV and MPV factors had no significant relationship with patient outcomes.

A higher healthcare utilization (18) and risk of mortality (19, 20) in COPD patients with anemia have been described in other studies. In COPD, dyspnea and poor circulatory efficiency have been found to be associated with anemia of chronic disease which has been indicated by remarkable peak work rate and lower peak oxygen uptake on cardiopulmonary exercise testing (21). The mentioned finding proposes a mechanistic association between reduced exercise capacity and lower hemoglobin and oxygen-carrying capacity (21).

The literature has indicated that distinct alterations may occur in blood cells in various lung diseases such as COPD. Erythrocytes are influenced in COPD in diverse levels such as structural alterations (22). Moreover, the novel concept is supported by recurrent themes observed in RBC biology, suggesting that erythrocytes, as signaling cells, play key roles in regulating biochemical interactions with other cells in (patho) physiology (23).

In addition, Tsantes et al.'s study indicated that the interference of extra factors between the final erythropoietic response (erythrocytosis and/or macrocytosis) and hypoxemia can also be suggested for explaining the unanticipated absence of a significant relationship between the percentages of F-cell and the levels of serum Epo, or the values of MCV and the levels of erythropoietin (Epo) (13).

The non-evaluation of the percentages of F-cell, the levels of Epo, and the erythropoietic response can be considered as the weakness of this study. However, it seems that hemoglobin (Hb) and red blood cell (RBC) as suitable criteria can be employed for examining pulmonary function by eliminating the effect of other factors. As platelet (PLT) and lymphocytes (LYM) are hardly influenced by other factors, they are regarded as benchmarks for measuring the total permeability of blood cells. The degree of compensation can be precisely reflected by the obtained red blood cell index. The body is typically in a poor state in case of respiratory failure so the abnormal general blood cell proliferation level would be reported. Therefore, it is necessary to accurately determine a variable that can reflect the changes in blood cell proliferation levels. MCV is considered to reflect the compensatory increase in RBC count and Hb level secondary to poor lung function. It can also reflect the true state of pulmonary function.

Therefore, further studies and evaluations of other effective factors such as inflammatory factors along with the mean volume of red blood cells and platelets should be performed to shed light on the issue.

CONCLUSION

According to the findings of the present study, the MPV and MCV had no statistically significant relationship with the severity of COPD, the length of hospital stay, and the mortality rate. Moreover, the severity of COPD was also found to be significantly associated with patient mortality such that most of the mortalities in the study were related to patients with severe COPD.

Conflict of interest

The authors of this study have no conflict of interest.

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