Indonesian Journal of Medical Laboratory Science and Technology

Open Access p-ISSN 2684-6748 | e-ISSN 2656-9825 IJMLST

The Correlation Results of Examination of Hemoglobin and The Erythrocyte Index in Patients With Suspected Covid-19 in The Hospital of Kendari City

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Received: Mei 17, 2021
Revised: Januari 10, 2022
Accepted: Maret 8, 2022
Published: April 28, 2022

DOI: 10.33086/ijmlst.v4i1.2105

Abstract

Coronavirus disease 2019 has become a global problem causing hundreds of thousands of deaths worldwide. Haemoglobin is more susceptible to COVID-19 virus attacks. Haemoglobin functions as a carrier of oxygen to organs in the body. When the concentration of haemoglobin in the blood circulation is low, the transport of oxygen to several organs in the body can be disrupted. SARS-CoV-2 interacts with haemoglobin in red blood cells. This interaction causes the virus to break the haemoglobin chain and cause hemolysis. The erythrocyte index which consists of mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) values are used to indicate the occurrence of anemia in COVID-19 patients. This research method used descriptive analytic with a cross sectional study design. The population of this study was suspected COVID-19 patients with a sample of 27 people. Sampling was carried out using purposive sampling. This study aims to determine the relationship between haemoglobin examination results and erythrocyte index in suspected COVID-19 patients.The instrument in this study used secondary data which included the results of examination of haemoglobin values and erythrocyte index. The results of the test using a parametric statistical approach with the correlation analysis method showed that there was a correlation between the results of the haemoglobin and MCV test (P-value 0.057 > 0.05), while the haemoglobin and MCH test had no correlation (P-value 0.777 > 0.05), and there is no correlation between haemoglobin and MCHC examination (P-value 0.372 > 0.05).

Keywords

Anemia, Erythrocyte Indeks, Haemoglobin.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) has become a global problem causing hundreds of thousands of deaths worldwide since December 2019. The main challenge in handling this new outbreak is the limited data regarding variations in clinical and epidemiological findings (1). In December 2019, in Wuhan, Hubei Province, China, 44 cases of pneumonia were reported due to infection with a new type of coronavirus that had not been identified. The virus was later known as SARS-CoV-2 because it has 82% similarity in its genome sequence to severe acute respiratory syndrome-corona virus (SARS-CoV) which became an outbreak of the disease in Guangzhou, China in 2003. The disease caused by infection of SARS-CoV-2 is then referred to as coronavirus disease 2019 (COVID-19). Since March 11, 2020, World Health Organization (WHO) has designated COVID-19 as a global pandemic (1,2).

According to WHO, data as of March 30, 2020, there were 693,224 cases and 33,106 deaths worldwide. Europe and North America have become the epicenter of the COVID-19 pandemic, with cases and deaths surpassing China. The United States ranks first with the most COVID-19 cases with the addition of 19,332 new cases on March 30, 2020, followed by Spain with 6,549 new cases. Italy has the highest mortality rate in the world at 11.3% (3).

The first COVID-19 was reported in Indonesia on March 2, 2020 (4). By April 9, 2020 the pandemic had spread to all provinces in Indonesia after Gorontalo confirmed its first case, with Jakarta, West Java, and East Java being the worst-affected provinces. So far, Indonesia has recorded 496 deaths, more than any other Southeast Asian country. The fatality rate is also one of the highest in the world. The researchers suggest the main reason for this high number might be a lack of testing, hence many cases went undetected (5).

In Southeast Sulawesi, 332 COVID-19 cases were confirmed as positive cases, with 113 patients undergoing treatment, 214 declared cured and 5 people died. While 535 cases were asymptomatic (OTG), 15 cases were patients under surveillance (PDP), and 39 were declared as People Under Monitoring (ODP). Meanwhile, in Kendari City the number of positive cases was 66 cases, with 57 cases of patients were declared cured, and 3 cases of patients dead (6).

Coronavirus is a positive single-strain RNA virus, encapsulated and unsegmented. Coronavirus belongs to the order Nidovirales of the Coronaviridae family. The structure of the coronavirus forms a cube-like structure with the S protein located on the surface of the virus. S protein or spike protein is one of the main viral antigen proteins and is the main structure for gene writing. This S protein plays a role in the attachment and

entry of the virus into host cells (interaction of protein S with its receptors on the host cell). Coronavirus is sensitive to heat and can be effectively inactivated by disinfectants containing chlorine, lipid solvents at 56^{o}C for 30 minutes, ether, alcohol, peroxyacetic acid, non-ionic detergents, formalin, oxidizing agents, and chloroform (7).

Haemoglobin is more susceptible to COVID-19 virus attacks. In patients with COVID-19 cases, most of them come with complaints of shortness of breath, causing less and less haemoglobin that can carry oxygen and carbon dioxide to be spread throughout the body, so that it can interfere with the respiratory tract. The attack of the COVID-19 virus can damage many organs and cause inflammation that occurs in the human lungs.

MATERIALS AND METHODS

This research method used descriptive-analytic with a cross-sectional study design that was carried out from June 2020 to July 2020. The population of this study was suspected COVID-19 patients at the Kendari City General Hospital with a sample of 27 people, and sampling was carried out using purposive sampling with sample criteria.

Inclusion Criteria

Patients with suspected COVID-19 with symptoms (fever and at least one sign/symptom of respiratory illness, such as cough, shortness of breath); history of travel or living in a community area of COVID-19; Age 16 - 53 years; gender male or female; and patients with haemoglobin and erythrocyte index examinations.

Exclusion Criteria

Patients with suspected COVID-19 who do not perform haemoglobin and erythrocyte index examinations (8).

To address the research objectives, this research used secondary sources, which included the results of the examination of haemoglobin values and erythrocyte index. The erythrocyte index consists of the value of Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentrate (MCHC). Haemoglobin values and erythrocyte index were obtained from the results of routine blood examinations at the laboratory of suspected COVID-19 patients

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Statistical Analysis

In this research, all data analyses were performed by using SPSS for Windows Version 20.0 (SPSS Inc., Chicago) and Microsoft Excel. Data consist of the haemoglobin and erythrocyte index examinations. These data were tested for correlation, including to determine the relationship between haemoglobin, erythrocyte index, and suspected COVID-19 patients.

RESULTS

This research was conducted at the Kendari City General Hospital with a total of 27 patients. The patients were suspected COVID-19 patients who came to the hospital with COVID-19 symptoms. Table 1-7 shows classification of patients with suspected COVID-19 based on haemoglobin examination results.

The type of data used in this study is quantitative data (medical records of COVID-19 patients at the Kendari City General Hospital) in the form of haemoglobin and erythrocyte index examination results {Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC)}. These data were evaluated by using a parametric statistical, since data does follow normal distribution.

Table 1. Classification of patients with suspected COVID-19 Based on Haemoglobin examination results

Results of Haemoglobin (g/dl)	Frequency (n)	(%)
Normal	26	96.29
Low	1	3.70
Amount	27	100

Table 1 shows laboratory result of patient enrolled in this study. Based on Table 1, patients with suspected COVID-19 with normal haemoglobin examination results were 26 patients (96.29%), while patients with low examination results were 1 patient (3.70%).

Table 2. Classification of patients with suspected COVID-19 based on MCV results

Result of MCV (fL)	Frequency (n)	(%)
Normal	25	92.6
Low	2	7.40
Amount	27	100

Based on Table 2, the results of the examination of MCV values with normal values were 25 people (92.6%) while patients with low examination results were 2 patients (7.40%).

Table 3. Classification of patients with suspected COVID-19 based on MCH results

Result of MCH (pg)	Frequency (n)	(%)
Normal	10	37.4
Low	17	62.7
Amount	27	100

Based on Table 3, the results of the examination of MCH values with normal examination results were 10 patients (37.4%), while patients with low examination results were 17 patients (62.7%).

Table 4. Classification of patients with suspected COVID-19 based on MCHC

Result of MCHC (g/dl)	Frequency (n)	(%)
Normal	10	37.4
Low	17	62.7
Amount	27	100

Based on Table 4, the results of the examination of MCHC values with normal examination results were 10 patients (37.4%), while patients with low examination results were 17 patients (62.7%).

Table 5. Correlation test for suspected COVID-19 patients based on the results of the haemoglobin and erythrocyte index examination

Correlation test	Category		Sig.
	Low	Normal	
Haemoglobin	1	26	0.057
Mean Corpuscular Volume	2	25	

*Statistically significant (p<0.05)

Based on Table 5, the results of the correlation analysis obtained a probability value of 0.057>0.05, which means that there is no relationship between the results of the haemoglobin examination and the MCV value. A p-value less than 0.05 (typically ≤ 0.05) is statistically significant

Table 6. Correlation test for suspected COVID-19 patients based on the results of the haemoglobin and erythrocyte index examination

Correlation test	Category		Sig.
	Low	Normal	
Haemoglobin	1	26	0.777
Mean Corpuscular Haemoglobin	17	10	

*Statistically significant (p<0.05)

Based on Table 6, the probability value is above 0.05 (0.777) which indicates that there is no relationship between the results of haemoglobin examination and the MCH value.

Based on Table 7, the significant value is above 0.05 (0.372), which means that there is no relationship between the results of the haemoglobin examination and the MCHC value.

Table 7. Correlation test for suspected COVID-19 patients based on the results of the haemoglobin and erythrocyte index examination

Correlation test	Category		Sig.
	Low	Normal	
Haemoglobin	1	26	0.372
Mean Corpuscular Haemoglobin Concentration	17	10	

*Statistically significant (p<0.05)

DISCUSSION

There were 26 patients with suspected COVID-19 with normal haemoglobin examination results (96.29%), while 1 patient with low test result. In this case, the results of haemoglobin examination found more normal results, this study is in line with previous research Mahrania *et al.*, (1), which found normal haemoglobin examination results in COVID-19 patients.

The results of the examination of MCV values with normal values were 25 people (92.6%) while patients with low examination results were 2 patients (7.40%). The results of this examination are following previous research conducted by Mahrania *et al.*, (1), many normal results were also found in the MCV value. A low MCV value indicates that the red blood cell volume is below normal, a

condition also known as microcytosis (small cells). Erythrocytes that are too small mean that they are only able to carry oxygen in small amounts, causing the body to become weak or tired easily (9).

The results of the examination of more MCH values obtained low examination results as many as 17 patients (62.7%). Low MCH levels are usually affected by various types of anemia, such as microcytic anemia, which occurs when red blood cells are too small to contain a certain amount of haemoglobin. The main cause is a lack of nutrients or nutrients from food, especially iron. In addition, other conditions cause low MCH, namely iron deficiency anemia, celiac disease, gastric surgery, excessive menstruation, and vitamin B deficiency (10).

The results of the examination of MCHC value found that the results of the examination were low in 17 patients (62.7%). In this case, if the MCHC value is low, it means that the haemoglobin level in each red blood cell is lower which indicates the cells are hypochromic. Where the causes of low MCHC values are usually caused by hypochromic microcytic anemia, iron deficiency, premature destruction of red blood cells, lead poisoning, cancer, and parasitic infections (11).

Based on the results of the correlation test analysis of the haemoglobin and erythrocyte index results, it was found that there was no correlation between haemoglobin and MCV, as well as haemoglobin and MCH, and there was no correlation between haemoglobin and MCHC.

These results indicate that haemoglobin levels do not affect the erythrocyte index value in suspected COVID-19 patients. Although normal haemoglobin levels are not followed by erythrocyte index values. At the beginning of the COVID-19 infection, especially in suspected patients, they showed normal hematological examinations including haemoglobin and erythrocyte index examinations. However, in COVID-19 positive patients, the virus can attack the haemoglobin in the red blood cells through a series of cellular actions, which ultimately makes the red blood cells unable to carry oxygen, resulting in a decrease in haemoglobin levels (12).

Several research literatures reported that the results of blood examinations from COVID-19 patients showed abnormal results, namely a decrease in the patient's haemoglobin and neutrophil values, while the opposite results were shown in the serum ferritin index, erythrocyte sedimentation rate, C-reactive protein, albumin, and lactate dehydrogenase in many patients, was significantly elevated (12).

A decrease in the value of haemoglobin implies that the body will accumulate a lot of harmful iron ions, which will form inflammation in the body and an increase in

C-reactive protein and albumin, causing cells to experience oxidative stress and will react, causing inflammation (13).

The effect of SARS-Cov-2 other than on red blood cells, namely on white blood cells (leukocytes) (13). In COVID-19 positive patients, a decrease in the number of white blood cells, and lymphocytes and an increase in neutrophils was found. The substantial decrease in the total number of lymphocytes indicates that the coronavirus affects many immune cells and inhibits the function of the cellular immune system. An increase in the number of neutrophils and a decrease in the number of lymphocytes was found in COVID 19 patients. An increase in the number of neutrophils indicates the intensity of the inflammatory response, while a decrease in the number of lymphocytes indicates a damaged immune system (14).

SARS-CoV-2, the pathogen responsible for COVID-19, has caused morbidity and mortality at an unprecedented scale globally. Scientific and clinical evidence is evolving on the subacute and long-term effects of COVID-19, which can affect multiple organ systems. Early reports suggest residual effects of SARS-CoV-2 infection, such as fatigue, dyspnea, chest pain, cognitive disturbances, arthralgia and decline in quality of life. Cellular damage, a robust innate immune response (14).

Infants and young children are usually at high risk for admission to hospital for respiratory tract infections with viruses such as respiratory syncytial virus and influenza virus. In contrast, in children infected with COVID-19, patients have relatively mild symptoms in general compared to adults. The reason for this discrepancy is still not clearly understood, as recent reports have shown a correlation between the severity of COVID-19 and the amount of viral load (virus shedding) that infects children less than adults (15).

The following is a summary of post-acute COVID-19 by organ system:

1. Respiratory disorders

Complications that most often occur due to corona virus infection are disorders of the respiratory tract, such as respiratory failure or ARDS (Acute Respiratory Distress Syndrome) and pneumonia. This condition occurs when the lung tissue becomes inflamed and filled with fluid, thus interfering with the breathing process. When experiencing complications, patients with corona virus infection can experience a lack of oxygen. This developes and increase many COVID-19 patients requires respiratory assistance, such as installing a ventilator and giving oxygen.

2. Cardiovascular

Corona virus infection can make the heart work harder, making it dangerous for people who have a history of heart problems, such as heart disease and heart failure. Several studies have also shown that the risk

of dying from COVID-19 is much higher in people with a history of heart disease than in previously healthy people (14).

3. Kidney and liver disorders

Several case reports related to corona virus infection stated that some patients with severe symptoms may experience impaired kidney and liver function. Until now, the cause of these complications is not known. However, the body's immune reaction to the corona virus is thought to be one of the causes (14)

4. Gastrointestinal and hepatobiliary

Gastrointestinal disturbances can occur in patients with COVID-19 even after a negative nasopharyngeal swab result. COVID-19 has the potential to alter the gut microbiome, including enrichment of opportunistic organisms and depletion of beneficial commensals (14).

5. Dermatologic

Hair loss (Baldness) is the predominant symptom and has been reported in approximately 20% of COVID-19 survivors (15).

In addition to some of the complications above, patients with corona virus infection are also at risk of developing sepsis. This condition is more likely to occur in many patients with severe COVID-19 showed general signs of shock, weak and have been hospitalized for a long time (14).

A strong immune system is able to fight the corona virus well so that the symptoms of COVID-19 that appear are mild and this disease can heal by itself. On the other hand, if the immune system is unable to fight the corona virus, severe COVID-19 symptoms can appear and there is a risk of complications (14).

Bergamaschi *et al.*, (16) reported that patients who were heavily infected with COVID-19 produced low haemoglobin values. Patients with anemia will have low haemoglobin levels. In the circulation system, haemoglobin serves as a carrier for oxygen to target organs in the body. When the concentration of the haemoglobin in the circulation is low, the transport of oxygen to several organs in the body will be disrupted, therefore causing hypoxia that will eventually result in multiple organ dysfunction, especially respiratory organ dysfunction. Multiple organ dysfunction will contribute to the development of severe outcomes in COVID-19 infection. Moreover, in COVID-19 infections, the state of anemia in the patients could be worsened (17-21).

There are some limitations in our study, namely the number of samples (patient) and multiple blood samples were not taken at different time points of the disease course to see the status of RBC profiles. Further, the comprehensive analysis of the RBC parameters (size, shape, and quality of RBC) with many samples would be helpful for early identification and better management of COVID-19 disease.

CONCLUSIONS

To conclude, this study highlighted and compared haemoglobin and MCV, MCH and MCHC examinations of COVID-19 patient cases in Kendari City Hospital. Our study results indicate that there is no correlation between the results of haemoglobin and MCV, MCH and MCHC examinations.

AUTHOR CONTRIBUTIONS

Sri Aprilianti dan Firdayanti: conceptualization, writing-reviewing, validation. Muh. Azdar Setiawan: data analysis, methodology. Susanti: data collection.

ACKNOWLEDGEMENTS

We would like to thank the Kendari City Regional General Hospital and the Bina Husada Kendari Politeknik.

CONFLICT OF INTEREST

There are no conflicts of interest

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