Hemoglobin Levels in COVID-19 Patients: A Literature Review

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Abstract

The COVID-19 pandemic is a global health problem that changed the course of the world. The pandemic began in the city of Wuhan, China in December 2019 and was finally declared a pandemic in March 2020 by the World Health Organization. This disease affects the respiratory system, causing various clinical signs and symptoms. The main pathophysiology of COVID-19 is inflammation, and it can affect a number of bodily systems and functions. One of the impacts of COVID-19 inflammation is the change of hemoglobin levels. This change in hemoglobin levels is an important issue that requires attention, because the level of an individual's hemoglobin represents their capability to carry and distribute blood. After reviewing previous research articles, it was found that COVID-19 patients have a tendency for hemoglobin decrease.

Keywords: COVID-19, hemoglobin, anemia

1. Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has been one of the biggest global health problems in the 21st century. The pandemic caused many changes in people's lives mainly because of the mobility restrictions. COVID-19 started in the city of Wuhan in Hubei Province, China in December 2019. The disease was originally spread through a zoonotic manner in Chinese seafood markets, but eventually the infection expanded mainly among human interactions and activities through respiratory droplets. In March of 2020, the World Health Organization (WHO) finally declared COVID-19 as a pandemic across the globe. [1]

COVID-19 is caused by a virus called Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) which infects human respiratory system. This virus is a member of the Coronaviridae family. It is widely known that this virus is still related with another viruses, namely SARS-CoV from 2003 and MERS-CoV from 2012 [2]. Specifically, SARS-CoV-2 infects the ciliated bronchial epithelial cells and type-II pneumocytes by attaching itself to the angiotensin-converting enzyme 2 (ACE-2) receptors [3]. Once infected by this virus, patients can develop a variety of symptoms and illnesses, although some cases show no symptoms at all. Coughing, respiratory distress, and fever are some of the more common symptoms of SARS CoV-2 infection, while others may experience other symptoms such as fatigue, myalgia, a number of gastrointestinal disturbances, and other less specific manifestations. [4]

The disease's pathological development in the human body is mainly through the pathway of inflammation. Some inflammatory mediators that has been reported to be involved in the pathophysiology of COVID-19 are interleukins 1, 2, 4, 7, 10, 12, 13, and 17, granulocyte colony-stimulating factor (GCSF), macrophage colony-stimulating factor (MCSF), hepatocyte growth factor (HGF), interferon-gamma (IFN-γ), and tumor necrosis

factor alpha (TNF-α). These mediators usually promote inflammatory processes in the lower airway and eventually can cause symptoms of lung infection. In some cases, these inflammatory processes could lead into cytokine storms which often make patients fall into critical conditions. [5]

The inflammatory processes in the pathophysiology of COVID-19 can alter a lot of the body systems, including the hematology system. One of the representations of hematologic changes due to COVID-19 is the alteration in hemoglobin (Hb) levels. Hemoglobin itself is a pigment in the red blood cells that plays a significant role in the transport and distribution of oxygen and carbon dioxide in the body. Other than that, hemoglobin also contributes to the regulation of pH in the body. The normal range of hemoglobin is 13-18 g/dL for men and 12-16 g/dL for women. Changes in hemoglobin levels become important because they mark an individual's capability of transporting and distributing oxygen [6]. The purpose of this paper is to review and explore the hemoglobin levels in COVID-19 patients, whether they tend to decrease, increase, or stay within the normal range.

2. Discussion

2.1. Hemoglobin Levels in Previous COVID-19 Cases

Previous studies reported that there is a tendency for hemoglobin levels to decrease in COVID-19 patients. A number of studies found that this decrease in hemoglobin levels tend to occur in some demographic groups. There are also findings which stated that inflammation process played a role in decreasing the levels of hemoglobin in COVID-19 patients. Further information will be stated in following parts.

In a study by Taneri and colleagues (2020) involving 57,563 COVID-19 patients, it was reported that there was a somewhat significant number of patients that had a decrease in their hemoglobin levels. The study also stated that hemoglobin decrease tends to happen in older patients, as the average hemoglobin levels were generally lower in elderly subjects. Hemoglobin levels were also lower in patients with a previous diagnosis of diabetes, hypertension, and other comorbid conditions. COVID-19 patients who were admitted to intensive care were more likely to have low hemoglobin levels. [7]

Another study was done by Kuno and colleagues (2022) involving 9467 COVID-19 patients. These patients were distributed into smaller groups based on their hemoglobin levels by the researchers. In this study, it was also found that hemoglobin levels have more tendency to decrease especially in COVID-19 patients who are female and/or having comorbid conditions. [8]

An observational study by Bergamaschi and colleagues (2021) also reported similar results. From 206 observed patients, 61% showed symptoms of anemia and the female patients had lower hemoglobin concentrations. They also divided patients at the hospital admission into two groups, one group is COVID-19-positive while the other group is negative. The results stated that the former group was characterized with lower hemoglobin levels. [9]

2.2. Inflammation and Hemoglobin Levels in COVID-19 Cases

Inflammation can be defined as the bodily reactions to external biological, chemical, or physical stimuli by demonstrating a series of actions performed by inflammatory cells and mediators. The elevation of some substances in the blood can be seen as markers of inflammation, such as C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), lactate dehydrogenase (LDH), and procalcitonin (PCT) [10]. The increase of some inflammatory markers, such as PCT and CRP can be used to detect the severity of COVID-19 [11].

There are some previous findings that connected anemia in COVID-19 patients with higher inflammation. A study by Kuno and colleagues (2022) reported that C-reactive protein and D-dimer levels are found higher in anemic patients [8]. Another study from Wuhan Ninth Hospital stated that anemic COVID-19 patients tend to show more severe inflammatory reactions. The study also found that high levels of CRP, procalcitonin, ESR, and D-dimer are often found more in severe cases of anemia. Anemic COVID-19 patients are also considered more prone to coagulation disorders. [11]. A study from 2021 reported that most of anemic COVID-19 patients had decreased hemoglobin due to inflammation which is characterized by low levels of hemoglobin, normal or high serum ferritin, reduced transferrin, and increased inflammatory markers [9].

2.3. Hemoglobin Level as a Predictor for COVID-19 Prognosis

Prognosis of COVID-19 is often associated with the severity of the symptoms. Asymptomatic patients usually have a high chance to survive, while others who experience worse symptoms could also have a worse prognosis. Anemia is said to be able to predict the mortality of COVID-19 patients independently [12]. Further information regarding this matter will be elaborated in the following parts

A 2022 study showed that COVID-19 patients who have the lowest and highest hemoglobin levels are the ones who have higher in-hospital mortality. Hemoglobin levels that are too high can trigger thrombosis. This study also stated that the incidence of acute kidney injury is lower in non-anemic COVID-19 patients. Other than that, COVID-19 patients who had anemia are also more likely to develop chronic kidney diseases, cardiovascular diseases, COPD, and heart failure. While sex and symptoms were not really associated with the hemoglobin levels of a patient, the prevalence of severe illness in COVID-19 patients with decreased hemoglobin remain higher [8]

A study in Japan involved COVID-19 patients who suffered pneumonia. They were divided into two groups, one for those who need mechanical ventilation, and the other one was for the remaining patients.The former group had an increase in their hemoglobin levels after three days receiving mechanical ventilation efforts, therefore it was concluded that hemoglobin levels are related with receiving mechanical respiration. [13]

An observational research result from 2020 stated that moderately to severely anemic patients had a tendency to suffer from dyspnea and had lower levels of PaO2 and SaO2. NT-pro-BNP, a marker of cardiac failure, was also found significantly higher in anemic COVID-19 patients. Elderly COVID-19 patients who had anemia were also found to exhibit organ injuries, had poorer lung function, myocardial injuries, and renal failures. [12]

In Iran, a study disclosed that mortality and admission rate to intensive care was significantly higher in anemic COVID-19 patients [14]. There is also a finding that reported autoimmune hemolytic anemia (AIHA) is a common sequel in COVID-19 patients [15].

3. Conclusion

There has been a consensus regarding the decrease of hemoglobin levels in COVID-19 patients due to inflammation processes. This decrease could lead to a more severe COVID-19 case in an individual.

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