Original Article

The Prevalence of Anemia and Hematological Findings in COVID-19 Patients in Saudi Arabia

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ABSTRACT

Objectives: The aim of this study was to estimate the prevalence of anemia among COVID-19 patients in Saudi Arabia and evaluate their hematological parameters. **Materials and Methods:** A descriptive, cross-sectional, hospital-based study was conducted between February 2021 to March 2021, data collection covered the period between September 2020 to March 2021. All the patients were hospitalized for confirmed COVID-19. **Results:** A total of 6048 COVID-19 patients included in our study, 2358 (48.9%) were anemic, 3666 (60.61%) were normal HGB level, and only 24 (0.49%) were having polycythemia. Hemoglobin level ranged from 5 g/dL to 18 g/dL with a median (interquartile range) of 11.8 g/dL (8.9 to 13.1) g/dL. The median for male (interquartile range) was for anemic patient's 9.8 g/dL (8.5 to 11.4) g/dL, normal 14 g/dL (13.5 to 14.8) g/dL, and polycythemia 17.4 g/dL (17.2 to 17.7) g/dL. The median for female (interquartile range) was for anemic patient's 9.1 g/dL (8.2 to 10.2) g/dL, normal 13.5 g/dL (12.5 to 14.5) g/dL, and polycythemia 17 g/dL (16.82 to 17.2) g/dL. Hematological parameters detected are indicative of severe complications in anemic patients compared to non-anemic patients. **Conclusion:** Our findings were consistent with other studies that reported poor outcomes of anemia in COVID-19 patients.

Keywords: Anemia, Polycythemia, COVID-19, Hematological factors, CBC.

INTRODUCTION

In the recent decades respiratory tract infection were the etiological factor for many pandemics. SARS-CoV, H1N1, MERS-CoV, and currently SARS-CoV-2 in 2019. With the current pandemics that arose from Wuhan-Hu1, the WHO has announced an international concern and many countries have enforced strict laws to stop this pandemic and stop the spread of this virus, however the mortality and morbidity are increasing especially among high-risk group. Many countries have endured huge losses, especially the public health sector.

COVID-19 patients were isolated for 14 days, and several laboratory tests were applied to generate a perception about the patient health condition. As COVID-19 affect the respiratory system, anemic patients can endure severe symptoms compared to non-anemic. Anemic patients suffer from less capability in their blood circulation for oxygen carrying. This is due to low red blood cells (RBC) mass, low hemoglobin (HGB), and low hematocrit (HcT).[1] Recent studies have detected high prevalence of anemia and HGB decrease in intensive clinical conditions among COVID-19 patients.[2-3] These can lead to poor medical outcomes and higher risk of mortality. If these conditions worsen and not treated properly it may lead to increase hospitalization time and organ failure. Anemic patients are at risk of developing pneumonia and death.[2]

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Our previous study on have detected prevalence of anemia among cancer patients in Taif city,[4] Therefore, it is important to study the prevalence of anemic patients who were infected by SARS-CoV-2 in Saudi Arabia and evaluate their hematological findings to support and build a proper treatment plan for future pandemics affecting the respiratory system. Therefore, our study assesses the prevalence of anemia among COVID-19 patients in Saudi Arabia.

MATERIALS AND METHODS

Study Population

Our data were collected from Prince Mohammad Bin Abdelaziz Hospital in Riyadh, and King Faisal Hospital in city of Taif, Saudi Arabia. For the period between September 2020 to March 2021. All those patients were hospitalized for confirmed COVID-19, and in Saudi Arabia RT-PCR is the official method for COVID-19 diagnoses.

Data collection

The targeted patient's data were as follows, after the patients were hospitalized for confirmed COVID-19, age, sex, and blood tests were collected. Patients were diagnosed with anemia when HGB levels were <11.5 g/dL (females) and <13.0 g/dL (males).[5] Hematological parameters include red blood cells (RBCs) (male 4.3 – 5.8, female 4.2 – 5.4), Hematocrit (HcT) (male 0.4 – 0.5, female 0.36 – 0.48), mean corpuscular hemoglobin (MCH) (26.7 – 34.2), mean corpuscular hemoglobin concentration (MCHC) (316 – 354), mean corpuscular volume (MCV) (81 – 100), mean platelet volume (MPV) (7.5 – 12), white blood cells (WBC) (3.5 – 9.5), and red cell distribution (RDW) (12.2-16).

Statistical Analysis

For statistical analysis, PSPP software developed by GNU Project version 1.4.1 was used for statistical analysis. Variables of this study were assessed for normality, and it has shown that our data do not follow normal distribution. Median (interquartile) and Kruskal–Wallis test were applied to compare between our study groups. *Pearson's chi-squared* test was conducted, and statistical significance was set at a $p \leq 0.05$.

Ethical Consideration

This study was accepted by the directorate of health affair in Taif IRB number HAP-02-T-067. All the personal data in this study were anonymized, and medical data were only used for this study.

RESULTS

Hemoglobin levels evaluation according to gender

A total of 6048 COVID-19 patients included in our study (Figure 1), 2358 (48.9%) were anemic, 3666 (60.61%) were normal HGB level, and only 24 (0.49%) were having polycythemia. Male patients were 863 (39.4%) anemic, 1321 (60.1%) normal HGB level, and 11 (0.50%) were having polycythemia. Female patients were 1495 (38.77%) anemic, 2345 (60.8%) normal HGB level, and 13 (0.34%) were having polycythemia.

Hemoglobin Levels Evaluation According to Age

Analysis of the patients in terms of age (Table 1) revealed the highest group were 51 to 79, and the lowest were ≤30 years old. Anemic patients were the most in males with age between 31 to ≥80 years. And Females with age between 51 to ≥80 years.

HGB Levels Analysis

The HGB levels range d from 5 g/dL to 18 g/dL with a median (interquartile range) of 11.8 g/dL (8.9 to 13.1) g/dL (Figure 2). The median for male (interquartile range) was for anemic patient's 9.8 g/dL (8.5 to 11.4) g/dL, normal 14 g/dL (13.5 to 14.8) g/dL, and polycythemia 17.4 g/dL (17.2 to 17.7) g/dL. The median for female (interquartile range) was for anemic patient's 9.1 g/dL (8.2 to 10.2) g/dL, normal 13.5 g/dL (12.5 to 14.5) g/dL, and polycythemia 17 g/dL (16.82 to 17.2) g/dL.

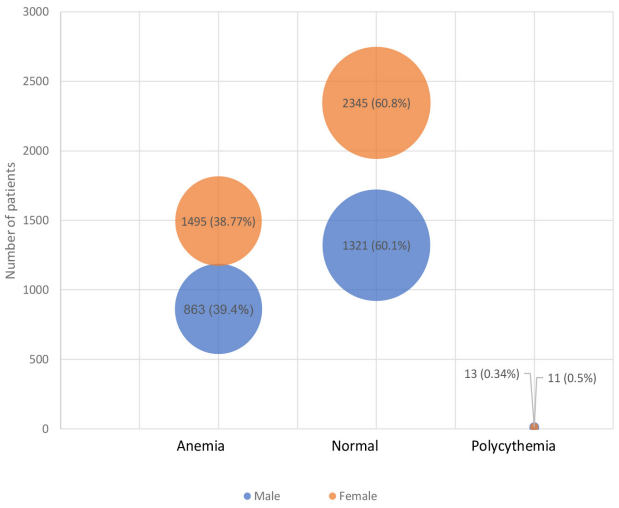

Figure 1: HgB levels compariosn, normal HGB-level patient numbers were higher among our study groups, followed by anemic patients; lastly, patients with <0.5% had polycythemia.
Statistical analysis by *Pearson's chi-squared were* 3376.75, 1208.09, and 2168.97, respectively, with a *p*-value <0.001.

Table 1: HGB levels analysis according to age groups. Statsitcal analysis by *Pearson's chi-squared test.*

Age groups	Male			Female			*P* value	Total
	Anemia	Normal	Polycythemia	Anemia	Normal	Polycythemia		
≤30	11 (17.75%)	50 (80.65%)	1 (1.6%)	59 (51.3%)	56 (48.7%)	0	0.974	177 (2.9%)
31 to 50	709 (69.4%)	306 (29.9%)	6 (0.7%)	265 (34%)	495 (63.69%)	18 (2.31%)	0.001	1799 (29.75%)
51 to 79	621 (64%)	346 (35.6%)	3 (0.4%)	1719 (67.3%)	826 (32.35%)	8 (0.35%)	0.001	3523 (58.28%)
≥80	123 (86.6%)	19 (13.4%)	0	302 (74.2%)	104 (25.5%)	1 (0.3%)	0.01	549 (9.07%)

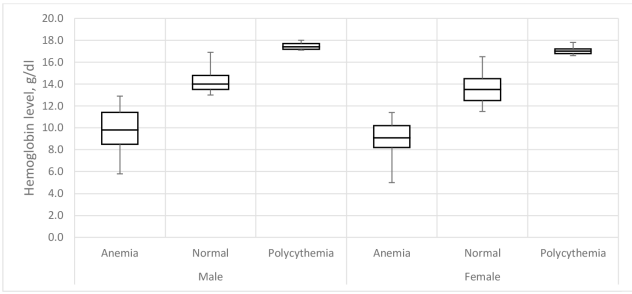

Figure 2: HGB levels analysis between the study groups.

Hematological Parameters Comparison between Anemic and Non-anemic

Comparing of hematological parameters between anemic and non-anemic group with (Table 2) (Excluding polycythemia patients) was performed by applying Kruskal Wallis test to compare the median (interquartile range). RBCs, HcT, MCH, and RDW were higher in normal than anemic patients. MCHC, WBC, and RDW were higher in anemic than non-anemic patients.

DISCUSSION

In the recent decades, several new pandemics have emerged due to viruses that infect the respiratory tract. In 2003, the outbreak of SARS has occurred which was an alert regarding the great impact of this type of pandemics. And when 2019 pandemic started, even rich-developed countries have endured shortage in medical equipment's, staff, proper policies in dealing with such catastrophes, and inflexible bureaucracy to adapt to new protocols against new pandemics. With the globalization any pandemic in any part of the world can spread to other countries in a matter of days. Coordination between countries should be dictated by WHO however the organization was struggling to cope with quick and fast infection rate of SARS-CoV-2. Pathogens with high potential for mutation should be under continues surveillance to avoid any future threat of new pandemics which can have an impact greater than SARS-CoV-2.[6] Respiratory tract infection differentiation is a challenge as they spread quickly and share similar symptoms, therefore, development of diagnostic methods is importance. Moreover, quick reporting of syndromic surveillance is significant to avoid new pandemics.[7]

Coronavirus family transmit from infected patients to other via the mucosa. Which then can reach to any other organ in the body that express angiotensin-converting enzyme 2 (ACE2).[8] And as this receptor expressed on RBCs, SARS-CoV-2 can target these cells and react with the heme leading to hemolysis.[9] When there is a problem with respiratory system, the delivery of oxygen to the body cells and removal of CO_2 is affected. This increase risks of mortality and morbidity. The public health services will endure a great pressure to provide health services to other patients as most hospitals capacities were directed toward COVID-19 patients, which themselves can transmit the infection to high-risk patients leading to death. Anemia is a disorder described as low levels of HGB, HcT, RBCs number, anemic patients have several symptoms due to shortage in oxygen. And with COVID-19 these symptoms can increase and lead to sever outcomes and death.

In our study, we have included an adequate number of patients with a total of 6048 from different cities, and we evaluated the prevalence of anemia and polycythemia in those patients. Most of our study group were normal patients with no anemia or polycythemia, and a small percentage of less than 0.5% were polycythemia patients. The percentage of anemic patients in our study was 48.9%, and it was consistent with another study that detected 48.27% anemic patients.[3] However, this study has detected higher prevalence of anemic females than our findings. Another study has detected 61% prevalence of anemia in COVID19 patients, higher than our study but their sample size was small, also, they detected higher prevalence of anemia among males which is inconsistent with our findings.[10] An earlier study was released in September 2020 have reported 24.7% prevalence of anemia in hospitalized patients.[11] When we compared the age groups, we have detected higher prevalence of anemia in males between 31 to ≥80 years and females between 51 to ≥ 80 years old, which can

Table 2: Hematological parameter comparison between anemic and normal HGB levels in COVID-19 patients. The Kruskal Wallis test was applied; interquartile range (25%–75%).

Parameter	Anemic Median (25%-75%)		Normal Median (25%-75%)		Kruskal Wallis test
	Male	Female	Male	Female	
RBC m/µL	3.3 (2.92–3.9)	3.2 (2.9-3.7)	4.9 (4.65-5.2)	4.6 (4.32-5.08)	< 0.001
HcT L/L	0.29 (0.26-0.35)	0.29 (0.26-0.33)	0.45 (0.42-0.47)	0.43 (0.39-0.45)	< 0.001
MCH pg	28.8 (27.5-29.8)	28.5 (27.2-29.5)	29 (27.9-30.5)	28.7 (27-29.8)	< 0.001
MCHC g/L	316 (308-326)	311 (302-321)	316 (307-329)	309 (303-317)	< 0.001
MCV fL	89.9 (86.3-93.3)	90.4 (86.7-94.4)	90.55 (87.3-95.5)	91.4 (87-96.4)	< 0.001
MPV fL	8.1 (7.4-8.9)	8 (7.3-9)	8.2 (7.5-8.9)	7.9 (7.3-8.6)	< 0.001
WBC 10^9/L	11.1 (7.7-14.8)	9.98 (7.5-13.3)	9.5 (6.8-12.43)	8.9 (6.4-12.1)	< 0.001
RDW %	15.5 (14.3-16.8)	15.8 (14.4-17.3)	13.4 (12.9-14.23)	13.6 (13-14.4)	< 0.001

lead to sever outcomes in old patients especially with COVID-19 as organs failure can occur.[12]

Several studies have reported RBCs count and HcT were not highly affected by COVID-19,[13-15] which is consistent with our study regarding non-anemic group. However, in our study a clear variation between anemic and non-anemic patients, both males and females have a near range from 2.9 to 3.9 m/mL in anemic patients. Moreover, the effect of anemia is clearly reflected in HcT with lower levels in anemic groups than non-anemic, a study has reported higher level of HcT in anemic patients than our own.[10] MCH and MCHC were lower than what have been reported by another studies.[16-17] MCV was at the same levels with other studies.[10,16-17] MPV is a prognostic marker for cardiovascular disorders, inflammation, and several other disorders like lung damage which is a clinical effect of COVID-19.[18-19] In our study it was lower than other has reported.[20] Several studies have reported different levels of WBCs in COVID-19 patients, in our study anemic patients have higher number than non-anemic and this findings supports the idea that anemic patients endure more sever disease than non-anemic as levels of WBC are higher as reported by another studies.[13,21-23] RDW was reported to increase in CVODI-19 patients and associated with sever outcomes,[24] and our study has detected higher levels of RDW in anemic patients than non-anemic patients, indicating higher severity. This was reported by several studies supporting our findings.[23,25]

In Saudi Arabia, the prevalence of non-anemic COVID-19 patient was higher than in anemic patients. In addition, Polycythemia was detected in a small percentage of the patients. Several studies reported poor COVID-19 outcomes in patients with higher WBCs, RDW, and MPV and low RBCs, HGB, HCT, MCH, and MCHC,[22-23,25-27] which are consistent with our study.

Limitations

Our study has several limitations as some data was not obtained or partially obtained, therefore, not included in this work. Including hospitalization days which we obtained about 4172 of total data collected, mortality rate, inflammatory markers (ferritin, CRP) and mechanical ventilators which were provided by one center only. Data such as chronic diseases such as asthma, liver disease, and kidney disease were not provided.

CONCLUSION

Overall, our study has covered two cities in Saudi Arabia with an adequate number of patients. Our findings were consistent with other studies that reported poor outcomes of anemia in COVID-19 patients. HGB levels is important factor to assess during COVID-19 diseases specifically in anemic patients.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

RBC: Red blood cells; **HgB:** Hemoglobin; **HcT:** Hematocrit; **MCH:** Mean corpuscular hemoglobin; **MCHC:** Mean corpuscular hemoglobin concentration; **MCV:** Mean corpuscular volume; **MPV:** Mean platelet volume; **WBC:** White blood cells; **RDW:** Red cell distribution width**.**

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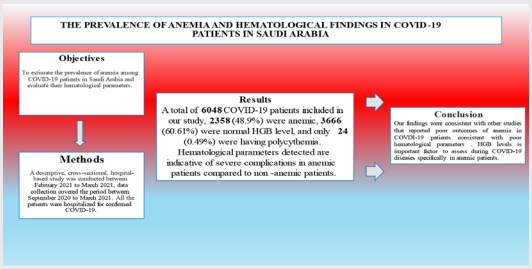
PICTORIAL ABSTRACT



SUMMARY

As SARS-CoV-2 infection can damage the RBCs membrane leading to many sever outcomes including hypoxemic condition leading to mortality. The present study has shown that anemia is common and constitute a relative proportions of COVID-19 patients in Saudi Arabia. While polycythemia is a small percentage of COVID-19 patients. Anemia is common specifically with female patients than male. And hematological parameters among COVID-19 patients are prognostic markers showing poor prognosis among anemic-COVID-19 patients.

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