The Clinical Importance of Some Hematological Parameters in Patients After Healing COVID-19: a Study in the Middle of Iraq.

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Abstract
The pancreas is infected with SARS-CoV-2 via Angiotensin_Converting Enzyme 2 (ACE2), Which is overexpressed as compared to certain other organs. Thus, the goal of this research is to offer an introduction to the prospective relationship among COVID-19 patients and Hyperglycemia, as well as specific hematological parameters as risk factors for those recovering from covid-19. The results:90 patients (G1: Healthy, G2: cardiac disease, G3: Respiratory disease, And G4: Healing from COVID-19 Groups). the result of this study revealed a high significance in the concentration of Fasting blood sugar in the G3 and G2 groups compared with the G4 and G1 in Male and Female Groups. But the result of white blood cells revealed a significant drop in the G2, G3, And G4 groups in comparison to the G1 group in males and females. As well as the Lymphocytes were found at low significant levels in the G4, G2, and G3 compared with the G1 group in males and females. Finally, The PLT, RBCs, HCT, and Hb tests revealed a significant drop in the G2, G3, and G4 groups in comparison to the G1 group in males and females. According to current research, COVID-19 illness may harm pancreatic function and blood parameters.
Keywords: COVID-19, Hyperglycemia, Red Blood Cells, SARS-CoV-2, White Blood Cells.

1. Introduction

In the final part of 2019, discovered the first condition of pneumonia in a hospital in Wuhan, China1. A Noval Coronavirus is one of the coronaviruses family, first appearing and the cause of mild colds 1. While Severe-Acute-Respiratory-Syndrome Coronavirus (SARS) was discovered in 2002 in china and spread to many countries,2 more than 8,000 people were infected with the disease and 774 people died. In addition, coronavirus has discovered in Saudi Arabia as the Middle East-Respiratory-Syndrome Coronavirus (MARS) in 2012,3 1,200 people have infected with the disease and 449 of them died. And finally. An outbreak of COVID-19 that went from an epidemic to a pandemic, with the first cases appearing in China and spreading to much of the world, the symptoms Like pneumonia, and it was dubbed SARS-CoV2. The SARS-CoV-2 are enveloped in Positive_Sense, Single_Strand RNA beta-coronaviruses with some evolutionary similarities4. The way possible transmission is thought to be respiratory droplet and direct contact 5. COVID-19 mostly affects people between the ages of 40 and 65, with men being more susceptible to the condition6. Extrapulmonary symptoms of COVID-19 include Acute Cardiac damage, Arrhythmias, Acute Kidney Injury, Acute Brain Injury, Endocrine Failure, Multiple Organ Failure, and Even Death7. Several people show Changes in some hematological parameters such as (White-Blood Cells (WBCs), Lymphocytes, Red-Blood cells (RBCs), and Platelet (PLT)), and biochemical parameters like serum glucose were reported in COVID-19 patients8-9. Diabetes Mellitus (DM) is an endocrine defect Characterized by Hyperglycemia, Polyuria, Polydipsia, and weight lack as a result of Insulin excretion and-or action abnormality. Diabetes is frequently linked with metabolic, macro-vascular, and micro-vascular problems, all of which enhance morbidity and death in various viral infections10. COVID-19 has been linked to hyperglycemia, which is thought to be a direct predictor of disease's poor prognosis and an increased chance of mortality11. The ACE2-receptor, which is abundantly expressed in the Lung, Liver, Brain, Placenta, and Pancreas, serves as the location and entry point of SARS-binding CoV-2. SARS_CoV-2 infects the Pancreas through ACE2, causing Pancreatic injury, impaired insulin production, and the development of hyperglycemia in non-DM patients12. Previous research has SARS_CoV, which is closely linked to SARS_CoV-2, has been demonstrated, to cause During epidemic-derived pneumonia, there is temporary hyperglycemia and impairment of pancreatic -cell function13. Induced oxidative stress and hyperglycemia, as well as glucolipotoxicity, all contribute to pancreatic-cell function impairment 14-15. that is leading to high levels of serum glucose. because of an increased number of COVID-19 patients studies Several studies were conducted in Iraq to investigate aspects associated with the COVID-19 pandemic utilizing the SIR model by Yunus16 and the clinical decision support system (CDSS) by Salah 17. the CDSS This method

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divides infected persons into four groups depending on their immune system risk level (very high, high, moderate, and normal), as well as two indices of age and current health state such as diabetes, heart disease, or hypertension. the detection of COVID-19 in patients.

This study evaluated the data of WBCs, lymphocytes, RBCs, HCT, Hemoglobin (Hb), and (PLT), and Fasting Blood Sugar (FBS) of COVID-19 patients after healing in Salah Al-deen, Iraq. also looked at the relationships between blood analysis items in the various groups.

2. Materials and Methods

The study did a comprehensive evaluation on the clinical characteristics and blood routine findings of COVID-19 patients after healing. The GENEX count 60 hematology analyzer and its original matched reagents were used for routine blood testing.

It was carried out at the COVID-19 Epidemic Center/Salah Al-din general hospital/ Salah Al-din province/Iraq. The current study was approved by Samarra University (Approval No. 3.7.1653) and the health ministry (Approval No. 1269).

Blood samples were collected from 90 persons from the 15th of October 2021 to the middle of January 2022, of which 24 cases were nonpatients type as the control group, 22 cases were severe type including Cardiac disease and respiratory disease After healing from COVID-19, and 22 cases were COVID-19 After Healing.

All cases were defined by the Resident Doctor's diagnosis in addition, a Rapid test for Positive / Negative COVID-19 results in IgG / IgM.

-The groups of control persons were performed according to the following guideline: G1(coronavirus non-infection and without a vaccine).

-The groups of Cardiac disease patients: G2 (healing from COVID-19, have complications in the cardiovascular system).

-The groups of respiratory disease patients: G3 (healing from COVID-19, have complications in the respiratory tract).

- The groups of healing from COVID-19 patients: G4 (healing from COVID-19, Without Clinical symptoms).

Sample data were gathered from the Epidemic Center six to eight weeks following the beginning of symptoms, respectively. From admission through discharge, all clinical records and blood procedures of patients were scrupulously recorded.

Statistical Evaluation

The information was analyzed by the IBM SPSS 26 statistical pack applications.

The shapiro_wilk test was used to determine the data distribution normality. The Duncan test and a histogram were used to examine the patients' categorical data, and a ($P < 0.05$) was statistically significant.

3. Results

The impact of Coronavirus on Fasting Blood Sugar (FBS).

The results in Fig. 1 show that 33 (37. 5%) of Male COVID 19 healing patients and 33 (37.5%) were female, Divided into Three Groups (G2, G3, and G4), while 12 (12.5%) of the Control group were male and 12 (12.5%) were female that one Group (G1). COVID-19 patients ranged in age from 18 to 75 years old. The results presented in fig. 1 revealed a considerable rise ($P < 0.05$) in the FBS test in Male which included concentrations of G3:155.82±4.96, G2:121± 4.06 respectively, compared with the control and healing of COVID-19 groups G4:102.27±3.82, and G1:96.92±1.98 mg/dl respectively. However, the results are similar in females' concentration $P<0.05$, G3:146.64±4.65, G2:126.73± 4.66 respectively, compared with the control and healing of COVID-19 groups G4:105.36±3.64, G1: 98.92±1.13 mg/dl respectively.

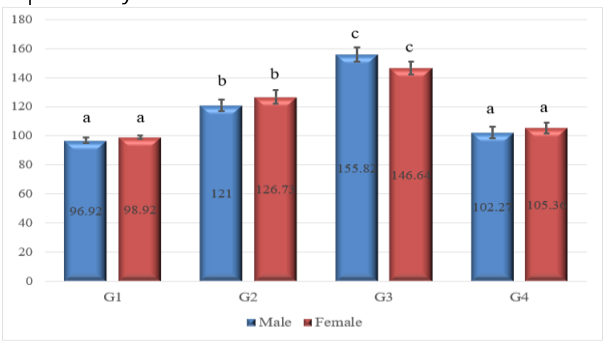

Figure.1 The Level of Fasting Blood Sugar to Four Groups.

**At $P < 0.05$, the various letters manifestation a significant difference.*

The results presented in fig. 2 revealed that there was a significant drop ($P <0.05$) In the level WBCS test in Male which included concentrations G2:6.19± 0.21, G3:6.09±0.42, and G4:7.01±0.20 respectively, compared with the control group G1:7.48±0.41 (109/L). As well as the results are similar in females' concentration $P<0.05$, G2:6.37± 0.39, G3: 6.20±0.27, and G4:6.29±0.21 respectively, compared with the control group G1: 7.45±0.29 (109/L).

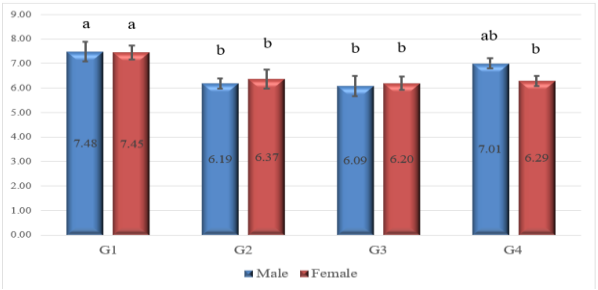

Figure.2 The Level of WBCS to Four Groups.

**At $P < 0.05$, the various letters manifestation a significant difference.*

The results presented in fig. 3 revealed that there was a significant drop ($P <0.05$) In the level Lymphocytes test in Male which included concentrations G4:26.84±1.20, G2:16.29± 0.39, G3:11.90±0.87 respectively, compared with the control group G1:32.72±1.09 (%). However, the results are similar in females' concentration $P<0.05$, G4:27.91±0.8, G2:13.88± 0.58, G3: 10.57±0.37,

respectively, compared with the control group G1: 29.96±0.83 (%).

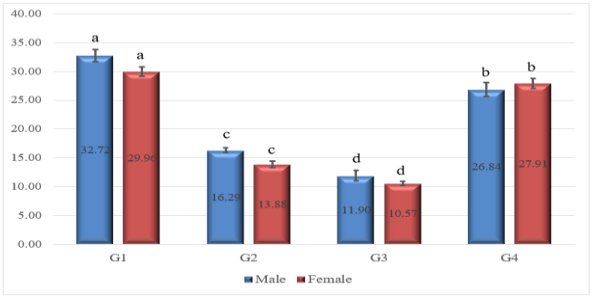

Figure.3 The Level of Lymphocytes to Four Groups.

**At P < 0.05, the various letters manifestation a significant difference.*

The results presented in fig. 4 revealed that there was a significant drop (P <0.05) In the level PLT test in Male which included concentrations G2:183.27± 2.57, G4:181±5.61, G3:172.27±5.36 respectively, compared with the control group G1:231.08±5.28 (109/L). As well as the results are similar in females' concentration P<0.05, G2:203.73± 5.21, G4:186±4.65, G3: 180.73±4.37 respectively, compared with the control group G1: 214.67±4.77 (109/L).

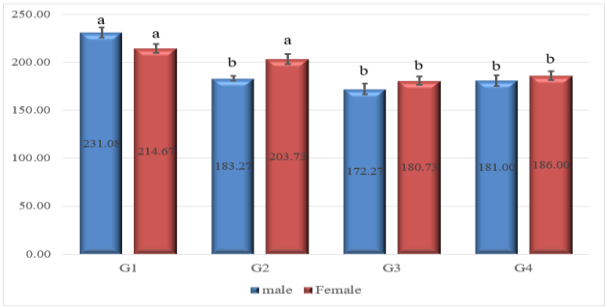

Figure.4 The Level of PLT to Four Groups.

**At P < 0.05, the various letters manifestation a significant difference.*

The results presented in fig. 5 revealed that there was a significant drop (P <0.05) In the level RBCs test in Male which included concentrations G4:5.05±0.13, G2:4.82± 0.16, G3:4.50±0.29 respectively, compared with the control group G1:5.15±0.13 (10^{12}/L). As well as the results are similar in females' concentration P<0.05, G4:4.75±0.13, G2:4.27±0.28, G3: 4.19±0.23 respectively, compared with the control group G1: 4.88±0.10 (10^{12}/L).

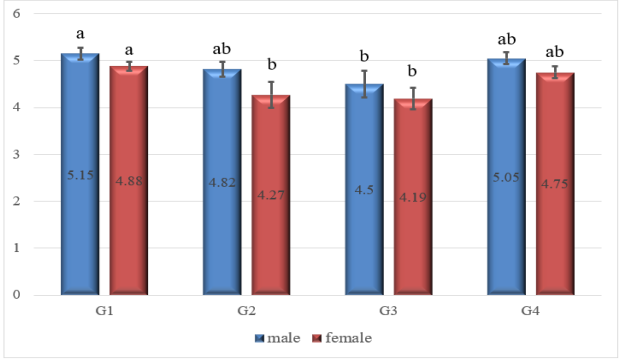

*Figure.5 The Level of RBCs to Four Groups. *At P < 0.05, the various letters manifestation a significant difference.*

The results presented in fig. 6 revealed that there was a significant drop (P <0.05) In the level HCT test in Male which included concentrations G4:42.43±1.02, G2:39.55±1.14, G3:38.7±2.2 respectively, compared with the control group G1:44.31±0.8 %. However, the results are similar in females' concentration P<0.05, G4:39.16±0.57, G2:33.06±1.30, G3: 32.97±1.36 respectively, compared with the control group G1: 38.74±0.69 %.

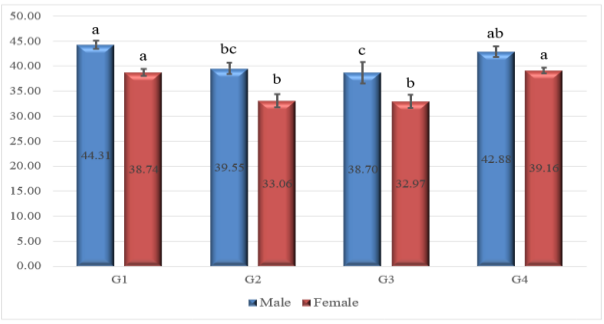

Figure.6 The Level of HCT to Four Groups.

**At P < 0.05, the various letters manifestation a significant difference.*

The results presented in fig. 7 revealed that there was a significant drop (P <0.05) In the level Hb test in Male which included concentrations G2:15.07±0.6, G4:15.07±0.23, G3:13.95±0.48 respectively, compared with the control group G1:15.41±0.31 (g/dl). While the results are similar in females' concentration P<0.05, G2:12.72±0.22, G4:12.40±0.22, G3: 11.54±0.54 respectively, compared with the control group G1: 12.87±0.35 (g/dl).

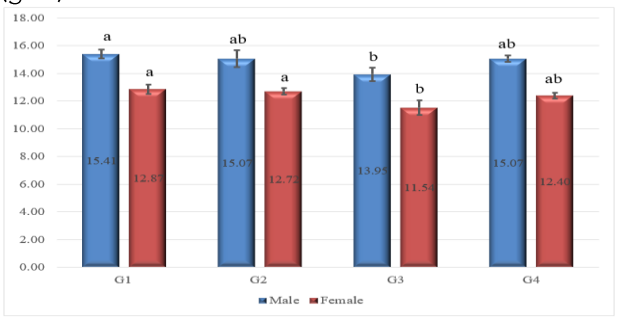

Figure.7 The Level of Hb to Four Groups.

**At P < 0.05, the various letters manifestation a significant difference.*

4. Discussion

The global prevalence of COVID-19 patients has increased. When evaluating the healing of the COVID-19 epidemic, it is critical to assess clinical and hematological signs. Few research has investigated the hematological parameters correlated with COVID_19 healing. As a result, our research looked at hematological and Clinical Parameters. Such As FBS, RBCs, HCT, Hb, platelets, Lymphocytes, and WBCs among others Healthy persons Group, Cardiac disease Group, Respiratory disease Group, and Healing of COVID_19 Group. There was a total of 90 Patients from General Salah Al-din Hospital, Salah Al-din City, Iraq, of which 66

were healing COVID_19 patients but have complications with disease, and 24 people were healthy. This might be due to immunological variations between genders or lifestyle decisions18. Previous research has also found that Males are more sensitive to COVID_19 than Females. but continuous complications after healing of COVID_19, This has been explained by the reduced expression of Angiotensin_Converting Enzyme-2_Receptors for coronavirus in females. Surprisingly, there are immunological differences depending on gender that is governed by X chromosomes and sex hormones19. The recent study's findings show high differences in RBC levels in male and female groups; It might be the cause of lowered levels of important anti_oxidant enzymes (PRDX1, SOD1, and G6PD) and elevated protein degradation indicators20, This outcome is fairly comparable to earlier published investigations 21,22. the significant difference was found ($P < 0.05$) was discovered between this test result group and platelet in Males and Females; the cause might be linked to the importance of inflammatory reactions 23,24.28. Lymphocytes were discovered to be lower in male and female patients who were tested with a CBC in the respiratory disease group and next group in Cardiac disease; the reason may be: never Heal from COVID-19 or continuous inflammation response (Complication with disease) 24. The studies reveal that COVID-19 infection is related to decreased hemoglobin and HCT levels, although the now study analysis did find statistically significant variations between study total points. specials in respiratory disease and Cardiac disease groups in males and females, while the Hb test found differences between the respiratory disease from the healthy groups in male and female respiratory disease groups from healthy and Cardiac disease groups 25.26.27.

5. Conclusions

The SARS-CoV-2 causes disorder and increasing levels of in FBS the patients after healing from COVID-19 in G2, and G3 compared in G1, and G4. while, it is decreasing levels in WBCs, Lymphocytes, PLT, RBCs, HCT, and Hb in G2, G3, and G4 compared to G1. Both genders. It should also plan further studies to establish whether used therapies affect the clinical course and genetic detection of COVID-19-related hematology parameters.

Ethical conduct of research

This study was conducted in accordance with academic laws, requiring clearance from the Ethics Committee of Healthy ministry dated 29/11/2021 and Numbered 35/2021036 and University of samarra dated 1/11/2021 and numbered 1653-07/3.

Conflicts of Interest

The authors indicate that there are no conflicts of interest in the publication of this research.

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Authors' contributions statement:

WIA Abd-al-Wahab designed the experiment. NMM Al-abid conducted the lab work and the data was analyzed. Editing, revision, and proofreading were done by all researchers to improve the language of writing. References. All authors contributed to the article and approved the submitted version.

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