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Biochemical Features of COVID-19 Patients in Hodeidah, Yemen

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Authors' contributions

This work was carried out in collaboration among all authors. MAA contributed in practice part, writing and revised of manuscript and FAB contribute in writing and submitting the manuscript. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Background: The biochemical parameters are very important for progressive of infection and predicator for severity.
Objectives: Therefore, the study aims to describe the biochemical features of COVID-19 infection.
Methodology: The study was designed in a case series. The study included 49 patients that were confirmed by the RT-PCR test with COVID-19. The study groups were severe and critical cases that admitted and treated in isolation center (inpatient). The biochemical assays included blood glucose, liver function test, renal function test and cardiac function test.
Results: The results showed relationship between the hyperglycemia and severity illness where the diabetics mellitus was reported in 17/49 cases (34.69 %) as controlled patients and 15/49 (30.61 %) as uncontrolled. The average of blood glucose was 370±200 mg/dl and the HbA1C was 9 ± 2 %. On the other hand, renal failure was reported in 2/49 cases (4.08 %) with serum creatinine. In addition, non – significant increase in liver enzymes namely aspartate aminotransferase

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(AST/GOT) and alanine aminotransferase (ALT/GPT) while significant decreasing in albumin 2 ± 0.5 g/dl. The troponin positive was reported in 6/49 patients (12.24 %). In addition, significant increasing in C- reactive protein (CRP) 70 ± 28 mg/L.

Conclusion: The study concluded that the increase in biochemical markers namely blood glucose, HbA1C that were risk factors for exposure to COVID-19 infection and increase in CRP and decrease in serum albumin that were good predicator for progressive and severity illness in COVID-19 infection.

Keywords: COVID-19; biochemical; hodeidah; Yemen.

1. INTRODUCTION

"Coronavirus disease 2019 (COVID-19) is an infectious disease, which has given rise to a global sanitary emergency. The clinical presentation of COVID-19 are varied and can range from an asymptomatic case to a mild, moderate , severe pneumonia and critical case . Recent studies have shown that different laboratory parameters become altered in these patients, and as such are useful as biomarkers to assess the progression of the disease and categorize patients that may present a severe and/or fatal clinical condition" [1]. "There is urgent need for identification of clinical and laboratory predictors for progression towards severe and fatal forms of this illness" [2]. "The laboratory diagnosis of COVID-19 was quickly established utilizing real – time polymerase reaction (RT-PCR) techniques after the disease causing virus has been identified, and its genetic sequence has been determined. In addition to RT-PCR, serological tests were introduced for diagnostic and epidemiologic studies" [3,4]. "Other biochemical investigations include monitoring of white blood cells, platelets count, coagulation assay , cardiac function test, and inflammatory markers such as C- reactive protein (CRP), and cytokines storm are very important in control of COVID-19 pandemic" [5,6]. "Further, accurate and reliable laboratory results for COVID-19 play very important role in the initiation of early treatment and timely management of COVID-19 patients, provide support in clinical decision-making process" [7]. This study aimed to evaluate the biochemical features of COVID-19 patients and their impact on different organs at a hepatic, cardiac, renal and pancreatic level, as well as markers of inflammation, analyzing their implications in the evolution of the disease.

2. METHODOLOGY

2.1 Study Area

Center of Tropical Medicine and Infectious Diseases (CTMID), Al Thawara Public Hospital Authority, Hodeidah, Yemen from 1st June to 31st December 2020. The study area is endemic area for vector – borne diseases that can effect on biochemical parameters [8-12].

2.2 Study Design

This study was designed in a case series. It focuses on the patients who sought care at the emergency team, COVID-19 isolation department.

2.3 COVID-19 Confirmation

49 severe and critical patients were confirmed and admitted in the COVID-19 isolation department, which was located at CTMID. Nasopharyngeal swabs were collected and confirmed by Real Time - Polymerase Chain Reaction (RT-PCR). Also, the clinical features were tested [13-15].

2.4 Biochemical Assays

Biochemical parameters namely blood glucose, and hemoglobin A1C (HbAIC) were analyzed. Also, liver function test namely aspartate aminotransferase (AST/GOT) and alanine aminotransferase (ALT/GPT), albumin, renal function test (creatinine), and C – reactive protein (CRP) were measured (Cobas – Roche).

2.5 Data Analysis

The descriptive analysis (percentage , mean , median , standard deviation (SD) and range), the chi-square test and z – test were used to make comparisons among categorical variables. For all statistical analyses, a *p* - value of less than 0.05 was considered statistically significant.

3. RESULTS

3.1 Characteristics of Patients

Nasopharyngeal swabs were collected from 49 children, diagnosed with COVID-19 during the

period from June 2020 to December 2022. All patients had ARDS. The age range of patients was from 3 to 90 years old, where 67.69% of cases occurred more than 50 year where the age had statistically significant (X^2: 20.29 and *p*-value = 0.00044) COVID-19 infection was represented in the males as 81.63 .5% while in the females it was represented as 18.37% (Fig. 1). However, this difference was statistically significant (X^2: 19.62 and *p* - value < 0.00001). In addition, the clinical findings were diagnosed and recorded. 61.2 % of fever, 58.7 % of difficulty breathing, 40.8 % of cough, 32.65 % of joint pains, 28.6 % of sore throat, and 6.12 % of headache. On the other hand, 21 cases (42.85 %) of severe patients and 28 cases (57.14 %) of critical cases.

3.2 Biochemical Characteristics

3.2.1 Blood glucose

The results showed relationship between the hyperglycemia and severity illness where the diabetics mellitus was reported in 17/49 cases (34.69 %) as controlled patients and 15/49 (30.61 %) as uncontrolled. The minimum blood glucose in diabetic patients was 270 mg/dl and the maximum was 550 mg/dl with HbA1C was 9 ± 2 % (Table 1).

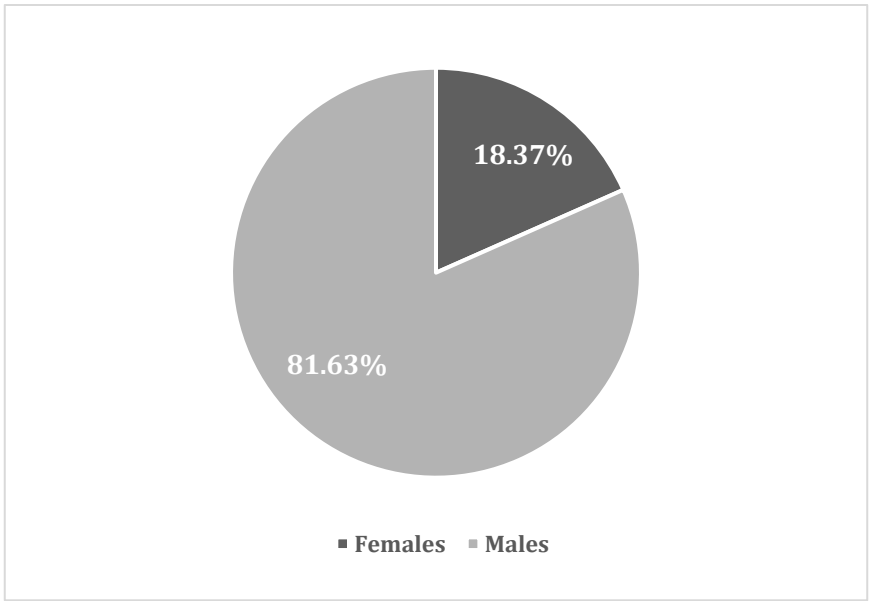

Fig. 1. Sex and COVID-19

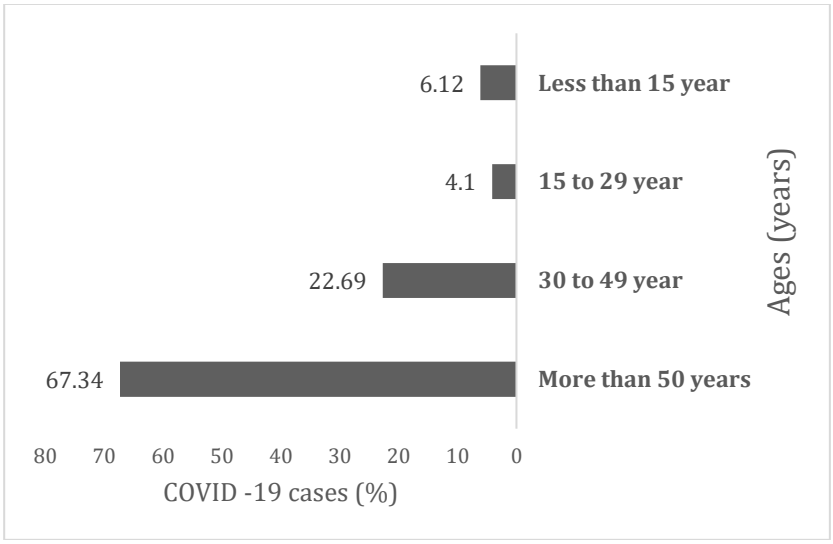

Fig. 2. Age and COVID-19

3.2.2 Liver function

In addition, non – significant increase in liver enzymes (GOT and GPT) while significant decreasing in albumin 2.2 ± 0.5 g/dl (Table 2).

3.2.3 Renal Function

On the other hand, renal failure was reported in 2/49 cases (4.08 %) with serum creatinine was 7 mg/dl (Table 3).

3.2.4 Cardiac Function

The troponin as good predictor marker for cardiac disorder and 6/49 patients (12.24 %) was reported with positive troponin (reactive).

3.2.5 Immunological markers

Routine immunological marker assay revealed increased CRP level ($p < 0.05$) in severe and critical patients (49/49 cases; 100 %) with average 70 ± 28 mg/L.

Table 1. Results of blood glucose and HbA1C

Parameters	Mean ± SD (N = 49)	*p* - value
Blood glucose (mg/dl)	370±200	
Median	270	$p < 0.05$*
Rang	120-550	
Normal values	5.5±1.0	
HBA1C (%)	9±2	
Median	8	$p < 0.05$*
Rang	5.5 -11	
Normal values	5.5 ± 6.5	
* : Significant *p* – value less than 0.05		

Table 2. Results of liver function tests

Parameters	Mean ± SD (N = 49)	*p* - value
GOT (IU)	45.42±26.31	
Median	38.55	$p > 0.05$
Rang	14-117	
Normal values	8-45	
GPT (UI)	45.38 ± 29.31	
Median	33	$p > 0.05$
Rang	14-99	
Normal values	7-56	
Albumin (g/dl)	2.2 ± 0.5	
Median	2	$p < 0.05$*
Rang	1.2-3.5	
Normal values	3.5-5.5	
* : Significant *p* - value less than 0.05		

Table 3. Results of renal function tests

Parameters	Mean ± SD (N = 49)	*p* - value
Creatinine (mg/dl)	1.5 ± 0.5	
Median	1.1	$p > 0.05$
Rang	0.5-7	
Normal values	0.5-1.1	

Table 4. Results of CRP parameter

Parameters	Mean ± SD (N = 49)	*p* - value
CRP (mg/L)	70 ± 28	
Median	48	$p < 0.05$*
Rang	12-98	
Normal Value	0-8	
* : Significant *p* – value less than 0.05		

4. DISCUSSION

"The global COVID-19 has presented major challenges for clinical laboratories, from initial diagnosis to patient monitoring and treatment. The International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) Task Force on COVID-19 has been established to synthesize up-to-date information on the epidemiology, pathogenesis, and laboratory diagnosis and monitoring of COVID-19, as well as to develop practical recommendations on the use of molecular, serological, and biochemical tests in disease diagnosis and management" [16]. "Laboratory tests indicate that the immune and clotting system show marked alterations with hyper-activation, hyper-inflammation, and cytokine storm development. Furthermore, organ-specific biomarkers demonstrate the involvement of cardiac muscle, kidney, and liver dysfunction in many patients" [17,18]. "On the other hand, the biochemical parameters help to determine the risk of infection with COVID-19 is dependent on several risk factors as observed in many studies. Presence of comorbidities like hypertension, diabetes, chronic obstructive pulmonary disease, cardiovascular disease, renal impairment. Diabetes is a metabolic disorder mainly characterized by hyperglycemia. Diabetic individuals are intrinsically prone to infections. COVID-19 infection in patients with diabetes result in β-cell damage and cytokine storm. Damage to the cells impairs the equilibrium of glucose, leading to hyperglycemia" [19]. "Increased levels of several inflammatory biomarkers, including CRP, have been found in COVID-19 patients and associated with an increased risk of severe disease, which is characterized by the so-called "cytokine storm". Also, the increase of cardiac and liver dysfunction biomarkers has been associated with poor outcome" [20].

"The COVID-19 pandemic disproportionately affected patients who had comorbid diabetes mellitus. COVID-19 patients with diabetes experience significantly higher rates of complications and mortality. COVID-induced diabetes is a novel phenomenon observed in critically ill patients. The atypical glycemic parameters and increased rates of DKA suggest that COVID-induced diabetes is a novel form of diabetes. A spectrum of COVID-induced diabetes has also been noted. COVID-induced diabetes is associated with remarkably higher mortality rates and worse outcomes compared to COVID-19 patients with pre-existing diabetes. The novel presentation of COVID-induced diabetes could be due to beta cell damage and insulin resistance caused by SARS-CoV-2. Further studies must include follow-up of these patients to better understand the trajectory of COVID-induced diabetes and the best management plan. It is also important to assess the beta cell function and insulin resistance of COVID-induced diabetes patients over time to better understand the underlying biochemical mechanisms" [21].

"Paliogiannis et al reported that lower serum albumin concentrations are significantly associated with disease severity and adverse outcomes in COVID-19 patients. The assessment of serum albumin concentrations might assist with early risk stratification and selection of appropriate care pathways in COVID-19 patients" [22]. "Ramadori reported hypercoagulation is one of the major risk factors for ICU treatment, mechanical ventilation, and death in critically ill patients infected with COVID-19 . At the same time, hypoalbuminemia is one risk factor in such patients, independent of age and comorbidities. His study suggested with COVID-19 infection, albumin infusion may be essential to improve hemodynamics and to reduce the plasma level of the main marker of thromboembolism, namely, the D-dimer plasma level. Albumin is responsible for 80% of the oncotic pressure in the vessels." [23].

De Lima et al reported "changes in liver function markers, such as ALT, AST, LDH, GGT, and ferritin, may be observed in patients who developed long-term COVID-19, especially those hospitalised during the acute phase of the infection. This may be due to the direct injury caused by the virus to the hepatocytes and a persistent systemic inflammatory process. Furthermore, the results of this study suggest that changes in the markers of liver injury in patients with long-term COVID-19 may persist for more than 1.5 years after the resolution of COVID-19. Finally, new studies should be carried out, especially those that involve the long-term monitoring of these patients, to identify whether such findings are permanent or transient, which represents one of the main gaps in current scientific knowledge" [24]. Ochiai et al reported that "elevated ALT was associated with CKD regardless of GGT elevation. Moreover, low AST/ALT ratio was also associated with CKD independent of GGT elevation" [25]. Moon and , Barritt reported that, "early in the COVID-19 pandemic, there was significant disagreement among senior hepatologists with regard to the

cause of abnormal liver biochemistries in a small group of COVID-19 infected patients, but consistency with regard to follow-up recommendations" [26]. In addition, the biochemical parameters play major role in monitoring of therapeutics and follow-up of management [27].

5. CONCLUSION

The study concluded that the increase in biochemical markers namely blood glucose, HbA1C that were risk factors for exposure to COVID-19 infection (high risk for most patients) and increase in CRP and decrease in serum albumin that were good predicator for progressive and severity illness in COVID-19 infection.

CONSENT

As per international standards or university standards, Participants' written consent has been collected and preserved by the authors. The raw data were secured in the Isolation Department of COVID-19 - Center of Tropical Medicine and Infectious Diseases (CTMID), Al-Thawara Public Hospital Authority, Hodeidah, Yemen.

ETHICAL APPROVAL

This study had ethical approval by the Ethics Committee of the Center for Tropical Medicine and Epidemiology Studies, Hodeidah University (CTMES – HU), Hodeidah, Yemen.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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