Original Article

Evaluation of Total Antioxidant Capacity and Total Oxidant Status in Patients with COVID-19

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Abstract

The COVID-19 is spreading rapidly over the globe disease . A deadly global pandemic of Coronavirus sickness (COVID-19) has caused significant morbidity and mortality in a number of locations. Oxidative stress appears to play a role in COVID-19. The goal of this case-control study was to compare the levels of total antioxidant capacity (TAC), total oxidant status (TOS), and lipid peroxidation products like malondialdehyde (MDA) in the serum of COVID-19 infection patients to a healthy control group, with a scientific interpretation of the results. The data was gathered from (90) participants who were classified into two categories : patients and controls. The CUPRAC procedure evaluates A spectrophotometric reader was used to determine the total oxidant status (TOS). With a p-value of 0.05, the results revealed that there were significant variations in TOS levels between the COVID -19 and control groups (0.009). TAC levels differed significantly between the patient and control groups, with a p-value of (0.012), while TAC levels in the patient group dropped. (1.24±0.15), compared to (1.55±0.31) in the control group; moreover, oxidative stress is higher in covid-19, with MDA levels of (6.45±1.14), compared to (3.22±0.69) in the control group, with a significant p-value (0.002). Conclusions: Based on the data, it seems that levels of (MDA) are higher in the COVID-19 group than in the control group due to Infection with a virus and a storm of the immune system In addition to acting as an anti-inflammatory mediator, (MDA) is a biomarker for lipid peroxidation, and an increase in free radicals causes oxidative stress, resulting in an increase in (MDA) levels. (TAC) levels were also lower in patients than in the control group, and our findings revealed that patients had higher (TOS) levels than the control group.

Keywords: COVID-19, TOS, TOS, MDA

Introduction

The universal disease has been appeared on December of 2019 the WHO declare new virus is corona virus is consider highly danger and life threating between many contraries and corona virus is very contagious viruses, is belong to RNA single positive strand family is high-risk for individuals especially elderly, those with weakened immune systems, and those with other chronic diseases the virus, also known as COVID-19, is cause symptoms such as high fever, cough, and asthenia, and may progress to severe lung injury some cases be asymptomatic infection [1]

About million person have get COVID19 but in 85–95% of cases, the signs and symptoms of infection be mild like light fever, headache, no smell, and nasal obstruction ,only about 15% of infected patients had high severity of infection with dyspnea, hypoxemia[2].

COVID19 infection different between symptoms or asymptomatic infection may be appeared in certain persons with severe pneumonia, acute respiratory distress syndrome and following with multi-organ dysfunction leading

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to respiratory failure and death include a wide range of symptoms, ranging from asymptomatic sickness to severe respiratory failure. Only around 10% of the time, major sickness, multi-organ failure, and death occur. [3][4].

When the generation and accumulation of oxygen reactive species (ROS) in cells and tissues exceeds the biological system's ability to detoxify these reactive products, oxidative stress ensues. It's suspected to play a part in malt disease pathogenesis. The purpose of this study is to assess oxidative stress and antioxidant status in COVID 19 patients and controls by assessing blood total antioxidant capacity (TAC) and lipid peroxidation products such malondialdehyde (MDA)[5].

Small amounts of ROS are constantly generated aerobic metabolism in organisms (ROS) serve both good and negative effects. Many metabolic functions require low levels of ROS, while oxidative stress results from excessive production or inadequate clearance of ROS. Reactive oxygen species (ROS) interact with biological macromolecules including protein, lipid, and DNA to induce oxidative damage, which leads to a variety of clinical conditions include cardiovascular failure and neurological ailments. To protect the organism from the detrimental effects of oxidative stress, cells have evolved enzymatic and non-enzymatic methods for converting oxidants into non-toxic molecules. Lipid peroxidation is initiated, propagated, and terminated in oxidative stress. NADPH oxidase, xanthine oxidase, and nitric oxide synthase activities cannot initiate LPO, but they can produce peroxynitrite, which can start chain reactions[6].

Because of its importance in the immune response to infections, oxidative stress may be a key component in COVID-19 development. A poor redox balance has been associated to viral pathogenesis, resulting in a significant increase in oxidative stress-induced cell death. The purpose of this research is to assess total antioxidant capacity and oxidative cell damage in order to better understand the role of oxidative stress in the diagnosis and progression of this disease. The generation of reactive oxygen species (ROS), as well as the activation of pro-inflammatory cytokines and innate immunity, are all common symptoms of Respiratory Syncytial Virus (RSV) infections[7].

2.Methadology

2.1. Study Design

The case control study started in October 2021 with 90 participants divided into two groups: 45 patients and 45 controls from the Mirjin medical city/Babylon city/Iraq respiratory care unit (RCU). For both the patients and the controls, demographic research criteria were applied (age, gender, and BMI).

2.2. Patients

Patients with COVID-19 infection have been detection with COVID-19 by used the nasopharyngeal swab and sputum samples examined polymerase chain reaction (RT-PCR) for the diagnosed the SARS-CoV-2 based on the study's criteria (age, gender, BMI, severity of disease, and oxygen saturation levels) by a respiratory disease specialist based on CT scans and laboratory tests, and some cases that were The data was acquired at Mirjin Medical City in Babylon, Provence, namely at the RCU and ICU (ICU).

2.3. Control

Medical data for the control group and patients group were collected using the same criteria (age, Gender and BMI).

2.4. Statistical Analysis

The statistical process had been performed by used the (T-test) and the result express as mean and standard deviation for detection the significant differences between the two categories (patients and control) also, with upper and lower confidence intervals for all variables the p-value lower than 0.05.

2.5. Material and Methods

2.5.1. Samples Collection

The sample was made by centrifuging whole blood in a gel tube at 4000 RPM to obtain serum, which was then frozen at -20°C until analysis.

2.6. Evaluation Total oxidant status(TOS)

The concentration of (TOS) in serum of control and patients with COVID19 had been measured by color metric method is spectrophotometric activators in the serum convert the (ferrous ion-o-dianisidine complex) to (ferric ion) the Glycerol particals in the reaction media, aid in the oxidation reaction. The ferric ion produces a complex with xylenol orange in an acidic medium The total number of oxidant molecules in the sample is proportional to the color intensity. The (TOS) test is calibrated by hydrogen peroxide and the results are present at micro molar hydrogen peroxide equivalent /liter (mol H_2O_2 Eq/L)[9].

2.7. Evolution total antioxidant capacity (TAC)

2.7.1.Principle of CUPRAC method

The reaction based on the reduction of divalent cupper ion by antioxidant and converted it to monovalent copper ion and the monovalent copper ion reacted with 2.9-dimethyl-1.1,10phenanthroline to produce the green color complex as in equation below.

Antioxidant + Cu^{2+} ⟶ Cu^{+} ⟶

Cu^{+} + 2.9-dimethyl-1,10-phenanthroline complex (at 450 nm).

2.8. Determination of Malondialdehyde (MDA)

The (MDA) levels in serum of patients and control are measured by spectrophotometric method depend on the color metric reaction of (TBA) acid with (MDA) Figure (2-1)[8].

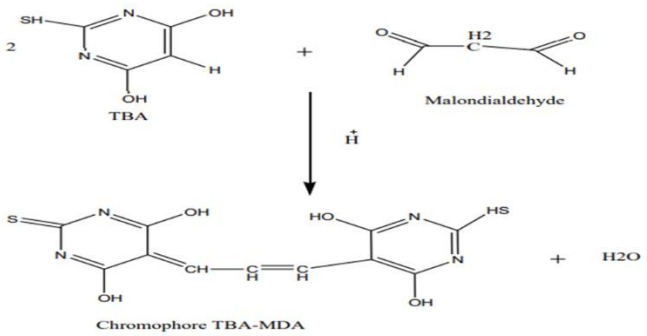

Fig. (2-1): Reaction Between MAD and TBA Acid[8].

3. Results & Disscution

The medical information collected for confirmed patients and the control categories is explained in Table (1) The data for this table came from patient medical records (1) The information in these two groups clearly differs. Age, BMI, gender, oxygen saturation, length of stay in hospital/day, and CT scan to establish degree of lung injury are some of the criteria. The worth of the patients' group increased significantly when compared to the control group. Specialized doctors defined the severity of the condition into three stages: simple, medium, and severe.

Table 1: Medical data for Patients and Controls.

Medical Variables	*Patients(mean± SD)*	*Controls (mean± SD)*
1- Age	47.75±7.15	46.66±7.44
2- Gender	26 Male/19 Female	25 Male/20 Female
3- Percentage of Lungs damage by CT-SCAN	20.11±12.36	-
4-Dd 4-duration in hospital/ day	10.02±5.51	-
5- Oxygen saturation percent %	89.13±3.98*	99.02±0.69
6- BMI	22.22±2.32	21.73±2.52

*The significance results when P-Value ≤ 0.05.

Cytokine storm in COVID-19 pathogenesis, also the connection between inflammation and oxidative stress in COVID19 patients, oxidative stress markers are greatly raised, which could play main effect in disease progression in the fight againstCOVID19. The total antioxidant capacity (TAC) of the control group (1.55±0.31) was substantially higher than that of the COVID19 group (1.24± 0.15).

Table 2: Result of (TAC)levels.

Biochemical Parameter	*Type Groups*	*N*	*Means ± SD*	*SE*	*95%Confidence Interval*		*P-Value*
					Lower	*Upper*	
TAC	Control	45	1.55 ± 0.31	0.04	0.41	0.20	0.012
	Patients	45	1.24 ±0.15	0.02			

*The significance results when P-Value ≤ 0.05.

High amounts of reactive oxygen species (ROS), an acute inflammatory state, infiltration of inflammatory cells into numerous organs, multiorgan involvement, and low oxygen saturation could all be factors in the differences in TAC levels between the study's different groups. Despite having appropriate oxygen levels, outpatients had lower TAC than healthy participants, suggesting that TAC could be a more potent and reliable predictive indicator[9] .

Patients' oxygen levels may improve after receiving O2 therapy; in these cases, (TAC) could be a useful measure for assessing the patient's condition. Because O2 saturation can change fast and lead to medical misinterpretation, a combination of O2 saturation and TAC may provide a more accurate picture of the patient's health. TAC can also be used to assess the patient's status after TAC treatment and correction, because the patient quickly enters the severe phase of the COVID19 [10].

Table (3) had been appeared the differences in total oxidant status in the control group (100.12±7.93) and the COVID19 group (108.48±7.39), with elevated TOS levels in the patients group due to increase in reactive oxygen species (ROS) production and/or decline in antioxidant production as result of viral action [11][12].

Table 3: Result of (TOS) levels.

Biochemical Parameter	*Type Groups*	*N*	*Means ± SD*	*SE*	*95%Confidence Interval*		*P-Value*
					Lower	*Upper*	
TOS	Control	45	100.12 ± 7.93	1.18	5.14	11.57	0.009
	Patients		108.48 ± 7.39	1.10			

*The significance results when P-Value ≤ 0.05.

Increased utilization of antioxidants to fight the harmful effects of free radicals, COVID-19 patients are high chance to be low antioxidant levels. Free radicals are a harmless by-product of aerobic cell metabolism. In the presence of a secondary infection , such as COVID-19, the high amount of radicals may lead induce tissue damage and disease pathogenesis due to antioxidant depletion[13].

Oxidative stress consider the chiefly cause for develop a variety of disorders due to increase in free radicals occurs when MDA is utilized as a lipid peroxidation measure, resulting high MDA level in COVID19 infection [14].

Table 4: Result of (MDA)levels.

Biochemical Parameter	*Type Group*	*N*	*Means ± SD*	*SE*	*95%Confidence Interval*		*P-Value*
					Lower	*Upper*	
MDA	Control	45	3.22 ± 0.69	0.10	2.83	3.62	0.002
	Patient	45	6.45 ± 1.14	0.17			

*The significance results when P-Value ≤ 0.05.

4-The Iraqi Ministry of Health has given its ethical approval.

5.Study Clash: This one does not conflict with any other research.

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