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Clinical analysis study of COVID-19 patients between arterial blood gases and some hematological and biomarkers parameters by cohort study in alfurat alawst at 2021

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***Abstract*---**Background Public health officials throughout the world have declared a worldwide public health emergency due to the COVID-19 coronavirus illness caused by the SARS-CoV-2 virus. China and other countries have been infected with the COVID-19 virus since December 2019, when the first case was confirmed in Wuhan city, Hubei province. Coronviruses are non-segmented, positive-sense RNA enveloped viruses that belong to the family Coronaviridae and the order Nidovirales, respectively .Method: The current study included eighty-four COVID-19 patients who were attending in Al-Hakim General Hospital, Al-Shahid Hassan Hallous al_Hatmi Hospital/Al_amal in Najaf city; Marjan teaching hospital in Babylon Iraq. In period from November 2020 to march 2022. Results: the results show 30 patients with COVID-19 are normal in the first 10 days, while 24 patients are fully compensated. On the other hand, 18 patients are Partially compensated respiratory acidosis. Among them 6 of the patients are uncompensated metabolic alkalosis while 6 patients are partially compensated metabolic and respiratory alkalosis. In the subsequent follow up the results shows decrease in the number of normal patients and elevated in fully compensated the hematological parameters of included patients. Lymphocytes percentage were significantly increased in moderate and severe in comparison to mild COVID-19 cases (p=0.008,), while PCV decrease in severe and moderate groups when compare with mild (p=.031). Conclusion: The arterial blood gases show high proportion in the fully compensate in all intervals followed by partially compensate respiratory acidosis than the other interpretation in COVID-19, and

although the study was showed significant correlation among arterial blood gas and hematological parameters in COVID-19 patients with severe illness was higher than those mild illnesses.
***Keywords*---**Coronavirus, Severe acute respiratory syndrome, Middle East respiratory syndrome, arterial blood gases.

Introduction

Public health officials throughout the world have declared a worldwide public health emergency due to the COVID-19 coronavirus illness caused by the SARS-CoV-2 virus. First incidence of COVID-19 pneumonia reported in Wuhan, Hubei Province, China in December 2019 has spread fast throughout China and abroad (1). Nidovirales is a family of nonsegmented, positive-sense RNA coronaviruses that are enclosed (2).

Severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV) outbreaks, each with a fatality rate of 10% and 37%, have produced more than 10,000 cases in the last two decades (3).

Wuhan was the site of the first reported epidemic. According to the WHO's daily report, China has had 78,630 cases and 2,747 fatalities from the SARS-CoV-2 outbreak, which has now spread to 46 other countries and resulted in a total of 3,664 cases as of February 27, 2020. Human-to-human transmission seems to be the most likely scenario (4).

For severely sick patients in intensive care units, arterial blood gas analysis is essential to their treatment (5). Bicarbonate concentration is determined using the modified Henderson equation pH= pKa + log(HCO3 /CO2) in ABG analysis, although pH and pCO2 are measured. The bicarbonate-pH diagram, also known as the Davenport diagram, is a visual representation of the connection between pH, pCO2, and bicarbonate to illustrate respiratory and metabolic acid–base imbalances. Davenport's diagram is seldom utilized in the clinical context. Because it is reliant on variations in pCO2 (6), the bicarbonate concentration measure is only helpful in individuals with normal breathing.

An artery-based glycemic index (ABG) test. ABG analysis measures a patient's PaO2 and CO2 partial pressures (PaCO2). PaO2 and PaCO2 give information about oxygenation and ventilation, respectively (chronic or acute respiratory failure). Among the factors that influence PaCO2 are hyperventilation, hypoventilation, and acid-base balance. Physicians in emergency medicine, intensive care, anesthesiology and pulmonology routinely prescribe arterial blood gases, but they may also be required in other therapeutic situations. ARDS, severe sepsis, hypovolemic shock, diabetic ketoacidosis, renal tubular acidosis, acute respiratory failure, heart failure and cardiac arrest, asthma, and inborn errors of metabolism are among conditions that may be examined by an ABG (7).

Rather than indicating oxygen linked to hemoglobin, arterial oxygen tension (PaO2) is a partial pressure of oxygen that reflects dissolved oxygen in the

bloodstream. PaO2 is typically between 80 and 100 mmHg. An arterial blood gas analyzer measures it (8).

Methodology

The current study included eighty-four patients who were attending in covid – 19 patients who were attending in Al-Hakim General Hospital, Al-Shahid Hassan Hallous al_Hatmi Hospital/Al_amal in Najaf city; Marjan teaching hospital in Babylon Iraq. In period from November 2020 to march 2022. Coronaviruses was classified according computed tomography into (severe, moderate and mild). The demographic, clinical, laboratory, data are extracted from medical records using a standardized data collection form which included age, gender. Routine blood examinations (complete blood count), arterial blood gases tests are done for all patient.

Inclusion criteria: All positive patients with covid-19 according to the real-time reverse transcriptase-polymerase chain reaction (RT-PCR) of nasal and pharyngeal swabs.

Exclusion criteria: Patient with pulmonary disease. Pregnancy women. Patient with Heart and liver disease. Smocking people. Patient with diapitic mulitus and blood pressure. Patient with chronic disease as: (leuckemia-cancer-HIV-hepetitis-veneral disease-thalassemia…etc). Patients who did not complete the follow-up process and dead through it.

Ethical Issue: The information about each case collected from patients and controls was taken with ethical considerations, so to get blood sample, we already informed patients and controls that we would use their blood for research purposes and most of them were cooperative and helpful. The permission had been taken from holly Najaf health directorate, Al-Sadder medical city and Marjan teaching hospital.

Statistical Analysis: Statistical analyses were performed using SPSS statistical package for Social Sciences (version 20.0 for windows, SPSS, Chicago, IL, USA). Quantitative data are represented as mean, standard deviation. Qualitative data are represented as count and percentage. Correlation test was done to test the relation between parameters. ANOVA test was used to test differences among groups. P value of < 0.05 was considered statistically significant.

Blood Sample Processing: Arterial blood was collected by artery puncture from 84 patients, five millimeters of artery were drawing by disposable syringe under sterilization technique. The blood has been collected used for test to determine the arterial blood gases. Health measures and safety were taken when sampling (wearing a mask, gloves, goggles and face shield).

Results

The reference point demographic data present in table (1). a total of 84 patients with COVID – 19 disease confirmed by SARS-COV-2 –specific RT-PCR on Nasopharyngeal (NP) swab specimen were enrolled in this study. According to the

computed tomography, COVID-19 patients were classified in to mild, moderate and severe. Accordingly, the following groups of patients were selected (n=24 moderate and n=47 severe) and (n=13 mild). Among them 24 (28.2%) were males and 60 (70.6%) were females. The mean age was 57.14 years and the age range was between 35 to 84 years. The age was considered as a significant effector in the occurrence of the disease severity. The study show the age of the sample was found to be correlated with the disease severity.as showing in table (1).

Table (1)
Demographic data of the studied groups

Total number	84		*P* value
Gender	Male 24 (28.2%) Female 60 (70.6%)		.000
Age Mean ±SD	57.14 ±12.17		
Age groups	Frequency	Percent	
(35-44)	12	14.1%	.000
(45-54)	24	28.2%	
(55-64)	18	21.2%	
(65-74)	24	28.2%	
(75-84)	6	7.1%	
BMI	Frequency	Percent	
Normal	6	7.1%	0.000
Obese	17	20.0%	
over weight	31	36.5%	
Morbid	30	35.3%	
Patient's Fate	Frequency	Percent	
Heal	18	21.2%	.000
Lying down	18	21.2%	
Deceased	48	56.5%	
Clinical stage	Frequency	Percent	
Mild	13	15.3%	.000
Moderate	24	28.2%	
Severe	47	55.3%	

The table (2) shows the results 30 patients with covid – 19 are normal in the first 10 days, while 24 patients are fully compensated. On the other hand, 18 patients are Partially compensated respiratory acidosis. Among them 6 of the patients are uncompensated metabolic alkalosis while 6 patients are partially compensated metabolic and respiratory alkalosis. In the subsequent follow up the results shows decrease in the number of normal patients and elevated in fully compensated. Moreover, there are difference number in interpretation among the intervals the results were shows as in table (2).

Table (2)
Interpretation of the arterial blood gases among the studied samples.

Interpretation							
intervals	Normal	Fully compensate	Partially compensate respiratory acidosis	Partially compensate metabolic alkalosis	Uncompensated Metabolic alkalosis	Uncompensated respiratory alkalosis	Partially compensated metabolic and respiratory alkalosis
First	30	24	18	0	6	0	6
Second	12	36	18	0	0	18	0
Third	18	42	12	6	0	6	0
Forth	30	18	12	12	0	0	6
Fifth	18	30	18	0	18	0	0
Sixth	18	36	24	0	6	0	0
Seventh	12	30	30	0	6	6	0
Eighth	6	24	18	12	24	0	0

Table (3) displays the hematological parameters of the individuals involved. In contrast to mild COVID-19 patients, lymphocyte percentages were considerably higher in moderate and severe cases (p=0.008), whereas PCV was lower in severe and moderate groups (p=.031) than in mild. Four times a day. Hemoglobin and the total number of white blood cells did not vary significantly among the three groups of patients.

Table (3)
Comparison mean of the hematological parameters in the studied sample according to the intervals

	Mean±SD				
Intervals	Parameters	Mild N.(13)	Moderate N.(24)	Severe N.(47)	P-value
0-10 days	Hb	12.031±2.5467	11.748±2.3704	11.388±2.4259	.653
	PCV	37.031±36.196	36.196±7.1181	35.115±7.3241	.658
	Lymph.	8.046±4.7674	10.100±6.0131	11.831±5.1992	.068
	WBCs	15.731±6.4089	14.783±5.6217	13.181±6.5572	.346
10-20 Days	Hb	11.731±2.6500	11.187±2.5131	12.363±2.0217	.122
	PCV	35.946±7.7180	34.452±7.2783	38.110±5.7866	.083
	Lymph.	8.185±3.5809	10.570±6.2421	12.956±7.4507	.058
	WBCs	14.571±3.0848	13.849±3.4510	13.608±3.4911	.668
20-30 Days	Hb	11.700±2.5775	11.239±2.4698	11.608±1.3762	.706
	PCV	35.992±7.7591	34.261±6.8431	35.731±4.1345	.537
	Lymph.	9.300±3.8317	11.700±6.5666	13.850±8.1189	.112
	WBCs	15.185±4.8062	14.113±4.2113	14.200±6.0130	.823
30-40 Days	Hb	13.385±2.6381	13.222±2.6892	11.765±2.4822	.031
	PCV	42.054±7.5288	41.317±8.0405	37.825±8.5064	.121
	Lymph.	7.169±4.5908	9.257±6.0694	12.185±5.5296	.008
	WBCs	15.423±6.7891	14.596±5.7327	13.054±7.2420	.446
40-50 Days	Hb	11.792±2.6831	11.400±2.6408	12.494±2.1500	.178
	PCV	36.346±8.0657	34.991±7.6956	38.456±6.4422	.144
	Lymph.	8.708±2.6797	10.070±3.5047	11.104±4.5697	.154
	WBCs	14.546±6.8777	13.996±5.5667	13.817±7.0938	.941
	Hb	12.162±11.448	11.448±2.8964	11.183±2.3374	.476

50-60 Days	PCV	37.877±9.0432	34.930±8.2684	34.500±7.0251	.374
	Lymph.	10.777±5.5487	13.048±6.3453	12.729±6.9636	.579
	WBCs	13.546±3.5580	13.296±3.6636	13.323±5.1199	.986
60-70 Days	Hb	11.700±2.1229	11.604±1.9448	11.921±1.7625	.784
	PCV	36.231±6.4986	35.683±5.6053	36.885±5.2409	.686
	Lymph.	8.631±3.1396	10.548±5.8685	12.171±7.6057	.211
	WBCs	14.477±5.3836	13.596±4.4354	13.352±5.3816	.783
70-80 Days	Hb	11.038±3.1450	10.461±3.0053	11.573±1.5549	.166
	PCV	33.985±9.2023	32.504±9.1588	35.796±4.7733	.172
	Lymph.	8.362±5.4975	10.374±6.0592	10.740±6.4167	.472
	WBCs	15.269±5.1658	14.343±4.2550	13.904±6.1542	.731

In table (4) The study was showed positive significant correlation among arterial blood gas and serum ferritin, D- dimer and sugar parameters. according to sugar there was positive significant correlation of arterial blood gas in 1,5 and 6 intervals (r= .232*, p= 0.034 , r=.487**, p=0.000, r=.523**, p=.000).

Table (4)
Pearson's Correlation Coefficients among ferritin, D- dimer and sugar with arterial blood gas in studied samples according to the intervals

Parameter	Correlation of ABG according to the intervals								
	PC & P-value	ABG1	ABG2	ABG3	ABG4	ABG5	ABG6	ABG7	ABG8
Ferritin	R	-.064-	-.002-	.165	-.417-**	-.160-	-.423-**	-.082	-.166
	P	.562	.983	.133	.000	.146	.000	.458	.132
D- dimer	R	.000	-.160-	-.126-	.188	-.228-*	-.171-	-.250-*	-.340**
	P	.999	.146	.254	.088	.037	.121	.022	.002
Sugar	R	.232*	-.075-	-.416-**	-.375-**	.487**	-.175-	.523**	-.308-**
	P	.034	.497	.000	.000	.000	.111	.000	.004

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

In table (5) The study was showed non-significant correlation among arterial blood gas and clinical stage. According to patient's fate there was negative significant correlation with arterial blood gas in 8 intervals (r=-.590**, P=0.000). Moreover, there was negative significant correlation of arterial blood gas with nutritional status in the 3, 6 and 8 intervals (r= -.502**, p= 0.000 , r=-.444**, p=0.000, r= -.338**, p= .002)

Table (5)
Pearson's Correlation Coefficients of arterial blood gas with the nutritional status, Patients fate and Clinical stage in studied samples according to the intervals

Interpretation	Correlation			
	PC & P-value	Nutritional status	Patients fate	Clinical stage
ABG1	R	.054	.168	.155

	P	.622	.127	.160
ABG2	R	-.142	-.060	-.136
	P	.198	.585	.219
ABG3	R	-.502**	.201	-.207
	P	.000	.067	.059
ABG4	R	.199	.130	.062
	P	.069	.238	.573
ABG5	R	-.075	.051	.083
	P	.499	.646	.451
ABG6	R	-.444**	-.036	.194
	P	.000	.748	.077
ABG7	R	.095	-.043	.016
	P	.388	.696	.887
ABG8	R	-.338**	-.590**	-.104
	P	.002	.000	.346

on the Table (6) The results of the research revealed Researchers found that arterial blood gas and hematological parameters had a strong association in the research results. A negative association between hemoglobin and ABG (r=-.490-**, p=0.000) was seen in four and six intervals (r=-.648-**, p=0.000). It should be noted that there was a negative connection between packed cell volume and ABG (r=-.466-**, p=.000) and that association was much stronger between the fourth and sixth time points. As shown by ABG and total white blood cells (r=-.346-**, p.00001) there was an unfavorable connection between the two variables in five out of seven instances. A favorable association between arterial blood gas and the total white blood cells and lymphocytes in the sixth intervals was found, however.

Table (6)
Pearson's Correlation Coefficients of the Hb, WBCs, Lymphocytes and PCV with arterial blood gas in studied samples according to the intervals

Parameter	Correlation of ABG according to the intervals								
	PC & P-value	ABG1	ABG2	ABG3	ABG4	ABG5	ABG6	ABG7	ABG8
Hb	R	-.013-	-.176-	-.106-	-.490-**	.055	-.648-**	.179	-.138-
	P	.906	.110	.339	.000	.617	.000	.103	.212
PCV	R	-.013-	-.173-	-.108-	-.466-**	.058	-.644-**	.166	-.101-
	P	.905	.117	.328	.000	.601	.000	.131	.361
Lymph.	R	-.076-	-.160-	-.057-	-.171-	-.088-	.357**	-.196-	.026
	P	.491	.146	.608	.120	.427	.001	.074	.813
WBCs	R	-.211-	.149	-.176-	-.170-	-.346-**	.341**	-.333-**	-.190-
	p	.054	.176	.110	.123	.001	.002	.002	.083
**. Correlation is significant at the 0.01 level (2-tailed).									

Discussion

The severity of the condition was linked to the patient's age, according to the researchers. The research indicated that the older the sample, the more severe the condition was determined to be.

In the table, the overall mean of age groups was 57.14 ± 12.17, with a range of (35-84). (4.1). According to Usul et al., the average age of men was determined to be lower than the average age of females in 2020 (9). According to Guan et al.2020 (10), the average patient was 47 years old, with 52.1% of the participants being men. The median age of patients in Li et al., 2020 (11) was 59, with 56% of them being men. In addition, Xu et al.,2020 (12) found that the median patient age was 41, with 56% of patients being men. The older the patient population, the larger their chance of contracting Covid-19, regardless of comorbidities, was shown to be in the cohorts tested for Covid-19. On the other hand, younger adult patients seem to provide some degree of defense (13). The longer a person lived after contracting a virus, the worse their prognosis was. Age and comorbidity, according to Wang et al., may be risk factors for poor outcomes (14). In the aged, cellular immune activity may be weakened and inflammation may last longer, which may explain the link between infection-related mortality and age (15).

Gender was also shown to be linked with the severity of the condition in the research, which comprised 24 men and 60 women, as shown in the table (1), According to the clinical severity rating, males are more likely than women to have life-threatening conditions (16). It has been shown that the incidence of SARS-CoV-2 in men is much higher than that in females, suggesting that males are more vulnerable to SARS-CoV-2 infection than females (17). There was a greater risk of serious events in the COVID-19 patients with pulmonary alkalosis in the research by Brinkman & Sharma. Hypoxic stimulation often results in hyperventilation as a means of correcting hypoxia while also causing a loss of CO2 in patients with respiratory disorders (18).

It was shown that, despite the presence of respiratory alkalosis in patients with normal or low serum HCO3 levels, these individuals did not demonstrate an increase in cardiac or respiratory abnormalities when compared to patients without respiratory alkalosis. For some of these individuals, hyperventilation during sampling may simply be related to their fear; nonetheless, it is possible that this abnormality is indicative of more severe conditions such as underlying brain, heart, or pulmonary problems. If you look at the data from our pre-dialysis blood pH readings, you'll see that those with a pre-dialysis blood pH of 7.40 had a higher mortality risk (19).

We found that there was a significant difference in severity across the three Covid-19 patient groups (severe, moderate, and mild). Patients with severe COVID-19 infection had considerably lower mean WBC and lymphocytic counts than patients with mild to moderate COVID-19, as evidenced by our analysis of the hematological indices of the patients included in this research. There was also a strong correlation between COVID-19 severity and lymphopenia. Leukocytopenia and lymphocytopenia were seen in the majority of COVID-19 patients studied by Fan et al., 2020 (20) and Li and Fan, 2020 (21).

Leukopenia has been linked to a serious sickness in individuals infected with SARS-CoV-2, according to research. To our surprise, we observed that non-survivors had lower mean white blood cell, lymphocyte and neutrophil counts than survivors (4.75, 0.77, 3.04, and 6.62, respectively) (15). Prior to death, the white blood cell (WBC) count had grown dramatically (15.5 109 cells/L) in the research by Bai et al. The severity of the condition was connected with an increase in WBC count. The median neutrophil count was 12.9109 cells/L, and the median lymphocyte count was 0.5109 cells/L, both of which were higher than expected before the patient died (4).

There are no significant differences in hemoglobin levels across the 19 patient cohorts that were examined. There were no abnormalities in this study's hemoglobin levels, which is consistent with findings from earlier studies (22, 23, 24).

COVID-19 positive individuals had considerably greater hemoglobin levels than COVID-19 negative patients, according to the results of this study. There was no significant difference in hemoglobin levels between female and male patients, however COVID-19 positive male patients had greater hemoglobin levels. Other factors, such as the prevalence of comorbidities or anemia, and behaviors like cigarette smoking, might influence these outcomes. The influence of the patient's medical history on hemoglobin levels was not taken into consideration since the patient files utilized in this investigation lacked this information. Women's hemoglobin levels are also lower than those of their male counterparts (25).

Researchers in 2012 (26) used data from a cohort study of individuals who were clinically suspected of having an embolism to draw conclusions. Patients with a suspicion of PE were evaluated to see how well PE performed in conjunction with a negative D-dimer test. An increased D-dimer was shown to be 95.5 percent specific for PE in a research by Karamat et al., 2017 (27). (28.2 percent). The presence of elevated D-dimers and thromboembolism in these individuals affected these findings.

A rise in D-dimer, which peaked at day seven and subsequently declined, was reported by Vu et al., 2020 (28) in their investigation. D-dimer has been linked to an increased risk of pulmonary embolism in patients with COVID, according to certain studies. There was no correlation between D-dimer and PaCO2 (arterial blood gas) (29). It has been observed by Song et al., 2013 (30) that the serum D-dimer levels are considerably adversely connected to arterial blood gas and favorably related to PaCO2 in patients with COPD paired with respiratory failure.

Findings from studies by Mannino and Yeh reveal that people with COPD have an increased incidence of diabetes and that diabetes is related with decreased lung function.

Patients with covid -19 have a strong association between their arterial blood gas measurements and their blood glucose levels. An initial diagnosis and assessment of hyperglycemia should be made using ABGA. Because of the limited sample size and the study's single-center methodology, there are certain limitations to this investigation. Study with follow-up may potentially be a problem, as may be the

small sample size. To enhance the link between arterial blood gas and this parameter, it is necessary to conduct a prospective, multi-center research with a bigger sample size This is the first research to examine the influence of COVID-19 on the clinical stage and the outcomes of patients in COVID-19. We discovered that among COVID-19 patients who had been in clinical remission for some time, weight loss and the potential for malnutrition were common occurrences. More over half of the patients were at danger of malnutrition due to their weight loss, which was more than 5% of their initial weight.

Studying maternal factors such as body mass index (BMI) and arterial acid base levels was done by Zaigham et al. 2020 (33). Despite the fact that no substantial alterations were seen. The "obesity paradox" previously identified in "classic" ARDS patients seems to be at odds with our findings in critical COVID-19 patients. Patients with ARDS who are obese may have a larger percentage of atelectasis than those who are not (resulting in a more "treatable" profile), or doctors may be more inclined to admit obese ARDS patients to the ICU sooner rather than later out of concern about an adverse course of events (34). They discovered a modest connection between arterial ABG and hematological markers in a research by Uyanik et al., 2015 (35), and Leino & Kurvinen, 2011 (36). However, the findings of the present investigation demonstrated that arterial ABG and hematological markers had varied relationships. ABG findings were shown to be correlated by Jain et al., 2009(37). They also found a link between hematological parameters and arterial BGA values.

Conclusion

The study showed that the serum levels of ferritin and D – dimer are correlation with arterial blood gas in COVID – 19 patients. No significant difference could be seen in hemoglobin and total white blood cells among the three groups of patients. Most of patients are fully compensated followed by partially compensated respiratory acidosis. This study clearly shows that COVID-19 is accompanied by notable changes in hematological and biomarkers profiles, which may help in early identification of COVID-related complications and may facilitate supportive medical care for positive patient outcomes.

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