International Journal of Biomedicine 13(2) (2023) 241-244
http://dx.doi.org/10.21103/Article13(2)_OA6

ORIGINAL ARTICLE

COVID-19

INTERNATIONAL JOURNAL OF BIOMEDICINE

Association of Serum Procalcitonin Level with Severity of COVID-19 among Patients in Ajman, United Arab Emirates

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Abstract

The aim of the current study was to assess the association between the mean level of procalcitonin (PCT), demographic characteristics, and the symptoms, duration, and severity of COVID-19.

***Methods and Results*:** This cross-sectional study included patients with a confirmed COVID-19 infection who visited the Thumbay Hospital in Ajman (UAE) between March and June 2022. A total of 231 COVID-19-positive patient records (170[73.6%] males and 61[26.4%] females) were included in the study. PCT levels were measured upon admission using the Beckman Coulter – UniCel DxI 800 Access Immunoassay System.

The mean patients' age was 47.44±13.460 years, and the length of stay in the hospital was 11.21±8.145 days. The PCT mean level was 0.545±1.739 ng/ml with minimum and maximum values of 0.010 ng/ml and 16.667 ng/ml, respectively. In terms of COVID-19 severity, patients were categorized into mild (121[52.4%]), moderate (59[25.5%]), and severe 51(22.1%]). We found no association between age categories and COVID-19 severity. There was a statistically significant difference in the mean PCT level among the severity groups. The mean PCT level increased with increasing severity of COVID-19: 0.0569±0.0324, 0.1736±0.0594, and 2.134±3.254 ng/ml for mild, moderate, and severe COVID-19, respectively (P=0.0000) There was a statistically significant, moderate positive correlation between PCT level and disease severity (r=0.433, P=0.001). The linear regression results revealed that PCT level is a significant factor in COVID-19 severity.

Conclusion: The current study demonstrates that the serum PCT level may be a marker of disease severity in patients infected with SARS-CoV-2.(**International Journal of Biomedicine. 2023;13(2):241-244.**)

Keywords: SARS-CoV-2 • COVID-19 • procalcitonin • disease severity

For citation: Ali R, Elnour S, Higazi H, Osman AL, Ismail M, Altoum AA, Alfeel AH, Kandakurti PK, Moamen NKA, Hussein SEO, Ali A. Association of Serum Procalcitonin Level with Severity of COVID-19 among Patients in Ajman, United Arab Emirates. International Journal of Biomedicine. 2023;13(2):241-244. doi:10.21103/Article13(2)_OA6

Introduction

The COVID-19 pandemic has led to 1,049,828 confirmed cases, including 2,348 deaths, in the UAE as of February 06, 2023.[(1)] From the start of the COVID-19 pandemic, it was clear that some people who were infected with the coronavirus were experiencing more severe illness than others, which increased their chances of being hospitalized.[(2,3)]

According to the WHO, COVID-19 can lead to a range of symptoms, including fever, cough, fatigue, body aches, shortness of breath, and loss of taste or smell. Severe cases can progress to pneumonia, acute respiratory distress syndrome, septic shock, and multiple organ failure.[(4)]

The severity of COVID-19 symptoms can vary widely, with some patients experiencing mild symptoms, while others may become critically ill and require hospitalization (CDC, 2021).[(5)] The severity and mortality of COVID-19 disease have been linked to higher levels of inflammatory markers.[(6)] Specific inflammatory, biochemical, and immunological indicators have been shown in prior research to have

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predictive significance in individuals infected with SARS-CoV.[7] The use of biomarkers to predict disease severity has proven essential for resource allocation, particularly for respiratory support needs.[8,9]

The aim of the current study was to assess the association between the mean level of procalcitonin (PCT), demographic characteristics, and the symptoms, duration, and severity of COVID-19.

Materials and Methods

This cross-sectional study included patients with a confirmed COVID-19 infection who visited the Thumbay Hospital in Ajman (UAE) between March and June 2022. Using clinical data collected from the medical record, we compared the mean procalcitonin (PCT) level, demographic characteristics, and the symptoms, duration, and severity of the disease.

A total of 231 COVID-19-positive patient records (170[73.6%] males and 61[26.4%] females) were included in the study. PCT levels were measured upon admission using the Beckman Coulter – UniCel DxI 800 Access Immunoassay System.

Statistical analysis was performed using statistical software package SPSS version 25.0 (SPSS Inc, Armonk, NY: IBM Corp). For descriptive analysis, results are presented as mean (M) ± standard deviation (SD). Inter-group comparisons were performed using Student's t-test. Multiple comparisons were performed with one-way ANOVA and Tukey's HSD Post-hoc Test. Correlation coefficients were calculated by linear regression analysis. The frequencies of categorical variables were compared using Pearson's chi-squared test with Yates's correction. A probability value of $P<0.05$ was considered statistically significant.

The study was approved by the Institutional Review Board of Gulf Medical University (Ajman, United Arab Emirates).

Results

All patients were classified into five age groups: 20-29 years (n=18 [7.8%]), 30-39 years (n=47 [20.3%]), 40-49 years (n=73 [31.6%]), 50-59 years (n=48 [20.8%]), and >60 years (n=45 [19.5%]). The mean patients' age was 47.44±13.460 years, and the length of stay in the hospital was 11.21±8.145 days. The PCT mean level was 0.545±1.739 ng/ml with minimum and maximum values of 0.010 ng/ml and 16.667 ng/ml, respectively (Table 1).

In terms of COVID-19 severity, patients were categorized into mild (121[52.4%]), moderate (59[25.5%]), and severe 51(22.1%]) according to WHO recommendations. We found no association between age categories and COVID-19 severity (Table 2).

The most common symptom was fever (93.3%), followed by headache (64.9%), fatigue (61.5%), and abdominal pain (57.1%) (Table 3).

There was no association between COVID-19 severity and headache, fatigue, and fever. In contrast, cough, shortness of breath, and pneumonia symptoms presented statistically significant associations with COVID-19 severity (Table 4).

Table 1.

Descriptive statistics of participant's (n=231).

Variable	Mean ± SD	Minimum	Maximum
Procalcitonin (ng/ml)	0.545 ± 1.739	0.010	16.667
Age (years)	47.44 ± 13.460	15	82
Length of stay (days)	11.21 ± 8.145	1	76

Table 2.

Association between age categories and severity.

Variable	Age group	COVID-19 severity			*P*-value
		Mild	Moderate	Severe	
Age groups	20-29 (n=18)	13 (72.2%)	4 (22.2%)	1 (5.6%)	0.504
	30-39 (n=47)	27 (57.4%)	9 (19.1%)	11 (23.4%)	
	40-49 (n=73)	39 (53.4%)	18 (24.6%)	16 (21.9%)	
	50-59 (n=48)	21 (43.75%)	15 (31.25%)	12 (25.0%)	
	> 60 (n=45)	20 (44.4%)	13 (28.9%)	12 (26.7%)	

Table 3.

COVID-19 symptoms in study patients (n=231).

Variable	Group	n	%
Headache	No	81	35.1 %
	Yes	150	64.9 %
Fever	No	217	93.9 %
	Yes	14	6.1 %
Cough	No	126	54.5 %
	Yes	105	45.5 %
Fatigue	No	89	38.5 %
	Yes	142	61.5 %
Abdominal pain	No	99	42.9 %
	Yes	132	57.1%
Nausea and vomiting	No	125	54.1 %
	Yes	106	45.9 %
Pneumonia symptoms	No	173	74.9 %
	Yes	58	25.1 %
Shortness of breath	No	143	61.9 %
	Yes	88	38.1 %

Table 4.

Association between symptoms and COVID-19 severity (n=231)

Symptoms		Mild	Moderate	Severe	Total	*P*-value
Fatigue	No	46 (51.7%)	24 (27.0%)	19 (21.3%)	89	0.922
	Yes	75 (52.8%)	35 (24.6%)	32 (22.5%)	142	
Fever	No	115 (53.0%)	57 (26.3%)	45 (20.7%)	217	0.295*
	Yes	6 (42.9%)	2 (14.3%)	6 (42.9%)	14	
Headache	No	42(51.9%)	19(23.5%)	20 (24.7%)	81	0.739
	Yes	79(52.7%)	40(26.7%)	31(20.6%)	150	
Cough	No	113 (89.7%)	1(0.8%)	12 (9.5%)	126	0.000
	Yes	8(7.6%)	58(55.2%)	39(37.1%)	105	
Shortness of breath	No	113 (79%)	23(16.1%)	7 (4.9%)	143	0.000
	Yes	8 (9.1%)	36 (40.9%)	44(50.0%)	88	
Pneumonia symptoms	No	114 (65.9%)	58(33.5%)	1(0.6%)	173	0.000
	Yes	7 (12.1%)	1 (1.7%)	50 (86.2%)	58	
Total		121(52.4%)	59(25.5%)	51(22.1%)	231	

*- *Yates' P-value*

In our study, the death rate for the total number of patients was 15(6%). We found a significant association between COVID-19 severity and patients' outcome (*P*=0.01), with a death rate of 60% for severe COVID-19 (Table 5).

Table 5.

Association between patients' outcome and COVID-19 severity.

Variable	Group	Mild	Moderate	Severe	*P*-value
Patients' outcome	Alive	117(54.2%)	57 (26.4%)	42 (19.4%)	0.005*
	Dead	4 (26.7%)	2 (13.3%)	9 (60.0%)	

*- *Yates' P-value*

There was a statistically significant difference in the mean PCT level among the severity groups. The mean PCT level increased with increasing severity of COVID-19: 0.0569±0.0324, 0.1736±0.0594, and 2.134±3.254 ng/ml for mild, moderate, and severe COVID-19, respectively (*P*=0.0000) (Table 6). There was a statistically significant, moderate positive correlation between PCT level and disease severity (r=0.433, *P*=0.001) (Table 7). Linear regression coefficients (Table 8) provided the necessary information to predict COVID-19 severity from the PCT level, as well as determine whether the PCT level contributes statistically significantly to the model (*P*=0.00). So, the linear regression results revealed that PCT level is a significant factor in COVID-19 severity. Increasing the PCT level by 0.930 could lead to an increase in the severity.

Table 6.

Comparison of the mean PCT level among severity groups.

Severity group	n	Mean ± SD	One-way ANOVA and Tukey's HSD Post-hoc Test
Mild (1)	121	0.0569 ± 0.0324	F=35.6654 P=0.0000 P_{1-2}=0.8798 P_{1-3}=0.0000 P_{2-3}=0.0000
Moderate (2)	59	0.1736 ± 0.0594	
Severe (3)	51	2.13 4 ± 3.254	
Total	231	0.545 ± 1.739	

Table 7.

Correlation between the mean PCT level and disease severity.

		PCT	Disease severity
PCT	Pearson Correlation	1	0.433
	P-value		0.001
	n	231	231
Disease severity	Pearson Correlation	0.433	1
	P-value	0.001	
	n	231	231

Table 8.

Linear regression coefficients.

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.032	0.241		- 4.290	0.00
	PCT	0.930	0.128	0.433	7.264	0.00
	a. Dependent Variable: COVID-19 severity					

Discussion

In the current study, the severe patients' group had higher PCT levels than the mild and moderate groups, suggesting that PCT could be an early marker of disease severity. Hu et al.[10] analyzed 95 SARS-CoV-2-infected patients, including 62 moderate, 21 severe, and 12 critical COVID-19 patients (6 patients died, all critical) and showed that the mean serum PCT levels were over four times higher in severe patients than in moderate patients and were over eight times higher in critical patients than in moderate patients. The authors also found that in death cases, serum levels of PCT increased as the disease worsened.

Our study showed a statistically significant association between COVID-19 severity and patients' outcome (*P*=0.005,

with a death rate of 60% for severe COVID-19. At the same time, our results revealed no association between age and COVID-19 severity (P=0.504), possibly due to the smaller number of aged patients. In the current study, linear regression revealed that PCT level is a significant factor in COVID-19 severity. Our data are similar to the result of a meta-analysis by Lippi and Plebian.[11] In particular, the pooled OR of four studies[12-15] showed that increased PCT values were associated with a nearly 5-fold higher risk of severe SARS-CoV-2 infection (OR=4.76; 95% CI: 2.74–8.29). Kotula et al.[16] showed that the substantial increase in PCT levels reflects bacterial coinfection in pediatric patients with viral lower respiratory tract Infections. Serial PCT measurement may play a role in predicting the evolution of COVID-19 toward a more severe form of the disease.

In conclusion, the current study demonstrates that the serum PCT level may be a marker of disease severity in patients infected with SARS-CoV-2.

Competing Interests

The authors declare that they have no competing interests.

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