The European Research Journal 2023;9(2):244-252 Original Article

DOI: 10.18621/eurj.1211808 *Clinical Microbiology*

Comparison of biomarkers of COVID-19 patients with the alpha variant (B.1.1.7), the delta variant (B.1.617), and no mutation detected

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ABSTRACT

Objectives: We aimed to compare biomarkers of COVID-19 patients with the Alpha variant (B.1.1.7), the Delta variant (B.1.617), and no mutation detected in our study.

Methods: A total of 600 patients with positive COVID PCR test and Alpha, Delta variant and no mutation detected with Covid PCR mutation test were included in the study. Troponin I, creatinine, Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Lactate Dehydrogenase (LDH), fibrinogen, D-dimer, ferritin, number of lymphocytes, lymphocytes (%), platelet (PLT), mean platelet volume (MPV), platelet distribution width (PDW), trombosite ratio in the blood (PCT), C-reactive protein (CRP) values were analyzed retrospectively. The age, gender, and hospitalization of the patients were evaluated concurrently.

Results: Age, troponin, creatinine, LDH, PLT, MPV, and D-dimer were laboratory parameters that vary significantly with COVID-19 virus mutation. Age, troponin, LDH, and MPV values were lower in patients with Delta variant according to patients with the Alpha variant. Lymphocytes (N) and lymphocytes (%) values were lower in hospitalized patients relative to outpatients while age, troponin, LDH, CRP, and D-dimer values were higher in hospitalized patients than outpatients irrespective of mutation. Creatinine values were higher only in hospitalized patients with no mutation detected while ferritin and fibrinogen values were higher in hospitalized patients with Delta variant and no mutation detected.

Conclusions: Age, troponin, creatinine, LDH, PLT, MPV, D-dimer, fibrinogen, ferritin, CRP, lymphocytes (N), and lymphocytes (%) values can guide to evaluate the diagnosis and hospitalization of patients with future different mutations.

Keywords: COVID-19, alpha, delta, mutation, biomarker

As SARS-COV-2 detection increases in the world and new mutant variants emerge, it is becoming necessary to monitor continuously and report quickly genetic changes to support public health control in the management of COVID-19 disease [1, 2]. Variant viruses mutated in the SARS-COV-2 infection can cause the infection to increase, increase in virulence, change in the clinical course of the disease, and decrease the protective effect of reinfections, infections, or antibodies after vaccination [2, 3]. The World

Received: ***December 14, 2022;*** *Accepted:* ***December 29, 2022;*** *Published Online:* ***January 18, 2023***

How to cite this article: *Karadağ Gencer S. Comparison of biomarkers of COVID-19 patients with the alpha variant (B.1.1.7), the delta variant (B.1.617), and no mutation detected. Eur Res J 2023;9(2):244-252. DOI: 10.18621/eurj.1211808*

e-ISSN: 2149-3189

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Health Organization (WHO) classified variants as Variants of Concern (VOCs) which cause more severe disease show a widespread, have been proven to be more contagious, or have decreased neutralizing antibody levels resulting from post-vaccine and post-infectious infection [4].

Alpha variant (VOC202012/01) (UK variant) (B. 1.1.7) was first identified in Kent/England in September 2020. Mutations detected in the Alpha variant were found to be associated with cell attachment, cell entry, infection, and neutralization [5]. Spike protein gene mutation was reported to contain the target gene regions used in PCR tests, causing S-gene target failure andalso increasing the transmission by antagonizing natural immunity with nucleocapsid mutationsin the Alpha variant [6, 7]. By the second half of 2021, the Alpha variant was the variant responsible for the COVID infection in America and many European countries. The studies showed an evident increase in transmission, higher viral load, longer infection time, higher hospitalization rate, and distinct increase in mortality in the Alpha variant [5, 7].

The Delta variant (B. 1.617) was first seen in India in November 2020. Mutations detected in the Delta variant were shown to affect the affinity of connecting to the cell, infection, immunity evasion, vaccination, and neutralization resistance [5]. In June 2021, the WHO reported that the Delta variant spread in many countries, causing high infectious and high mortality [8]. Delta variant in 2021 showed that it was the most contagious variant and spread rapidly in unvaccinated individuals [9]. More infectivity, higher viral load, and higher pathogenicity were detected in the Delta variant than in other varials [10, 11].

Hematological, biochemical and inflammatory parameters that affect the course of the disease in COVID-19 have been investigated in several studies. High cardiac troponin level was an important biomarker in patients with or without underlying cardiovascular diseases [12, 13]. Increased concentrations of troponin levels in patients with COVID-19 disease were associated with disease severity and prognosis [14, 15]. Also, elevation in troponin levels in COVID-19 patients was associated with admission to the intensive care unit and a higher mortality rate [13]. Thrombocytopenia COVID-19 plays a role in disease development and severity [16-19]. MPV values show the size of the platelets and changes in MPV values can predict inflammation, sepsis, infective endocarditis, and pneumonia [20]. While some studies demonstrate that high MPV values were associated with mortality in intensive care unit patients, some publications indicate that the MPV values were lower [21, 22]. D-dimer and fibrinogen levels which indicate the activation of coagulation pathways and thrombosis were found to be higher in COVID-19 disease. Ferritin was demonstrated as the product of inflammation and defined as a pathogenic mediator in severe COVID-19 patients. D-dimer, fibrinogen, and ferritin values were determined higher in the critical severe patients, especially in the intensive care unit,and were admitted as a low prognostic factor [23-26]. Higher CRP values and lymphopenia were detected in COVID-19-positive patients and found to be associated with disease severity, clinical outcome, progression, and mortality [27-30]. Creatinine values were established higher in critically ill COVID-19 patients and associated with adverse outcomes [31-33]. High LDH values were determined for patients with severe COVID-19 disease [34-36].

In our study, we aimed to compare biomarkers of COVID-19 patients with the Alpha variant (B.1.1.7), the Delta variant (B.1.617), and no mutation detected.

METHODS

Our study was conducted retrospectively at Bursa Yuksek Ihtisas Training and Research Hospital, which serves the South Marmara region with a population of approximately 5 million. 200 patients with positive COVID-19 PCR test and detected Alpha variant (B. 1.1.7) (VOC202012/01) by COVID- 19 mutation test between February and April 2021were included in the study. 200 control patients with positive COVID PCR test with no mutations by COVID-19 mutation testbetween February and April 2021were included in the study.200 patients with positive COVID PCR test and detected Delta (B. 1,617) variant by COVID-19 mutation test were included in the study in August 2021 (600 patients in total). Troponin I, creatinine, Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Lactate Dehydrogenase (LDH), fibrinogen, D-dimer, ferritin, number of lymphocytes, lymphocytes (%), platelet (PLT), mean platelet volume (MPV), platelet distribution width (PDW), trombosite ratio in

the blood (PCT), C-reactive protein (CRP) were analyzed retrospectively. The age, gender, and hospitalization of the patients were evaluated concurrently.

COVID-19 manual RNA extraction was carried out from nasopharyngeal samples of suspected patients in the COVID-PCR laboratory of our hospital. The RNA amplification and COVID-19 PCR analysis were performed on the Qiagen Rotor gene device using the Real-time PCR method. The mutation tests for patients who tested positive for COVID-19 PCR were performed on the Qiagen Rotor equipment using the SARS-COV-2 Variant Plus kit and the SARS-COV-2 Emerging plus kit.

The CRP tests of the patients were analyzed in the immunonephelometry device (Siemens, Behring Nephelometer II, Dade Behring, Inc., Newark, DE, U.S.A.) in the Microbiology laboratory. The number of lymphocytes, lymphocytes (%), PLT, MPV, PDW, and PCT values were analyzed in the hematology analyzer device (Mindray, BC-6000, China)in the hematology laboratory. Troponin I, creatinine, AST, ALT, LDH, fibrinogen, D-dimer, and ferritin tests worked in COBAS 8000 (Roche, Germany) device between February and April 2021 and Architect Plus (Abbott Diagnostics, U.S.A) device in August 2021 in Biochemistry laboratory.

Statistical Analysis

Data were expressed by frequency or related percent values. Normality analyzes were done for data (N > 50) with the Kolmogorov-Smirnov test. Comparison of the two groups was done with the independent sample T-test for normally distributed parameters and Mann Whitney U- test for non-normally distributed parameters. Comparison of more than two groups was done with One way ANOVA and Welch tests for normally distributed parameters. Bonferroni and Dunnet'c tests were used for the analysis of the difference. Comparison of more than two groups was done with Kruskal-Wallis tests for non-normally distributed pa-

Table 1. Comparison of biomarkers of patients with the Delta variant, the Alpha variant, and no mutation detected

	Delta variant	Alpha variant	Control (No mutation)	*p value*
Age (years)	41 ± 17	50 ± 17	46 ± 18	**< 0.001[a]**
Troponin (ng/L)	8.4 ± 55.7	19.9 ± 117.8	24.8 ± 169.8	**< 0.001[a]**
Creatinine (mg/dL)	1.01 ± 1.00	0.98 ± 0.74	0.95 ± 0.70	**0.014[a]**
ALT (U/L)	25 ± 22	29 ± 38	34 ± 115	0.909[a]
AST (U/L)	26 ± 18	34 ± 57	39 ± 181	0.313[a]
LDH (U/L)	231 ± 99	277 ± 176	275 ± 418	**0.009[a]**
Fibrinogen (mg/dL)	147.67 ± 234.60	184.54 ± 268.19	214.96 ± 471.85	0.341[a]
Lymphocyte (N)	1.59 ± 0.77	1.50 ± 0.66	2.82 ± 14.95	0.063[a]
Lymphocyte (%)	26.56 ± 11.16	25.03 ± 11.26	25.76 ± 12.59	0.399[a]
PLT (mcl)	212 ± 59	225 ± 149	229 ± 68	**0.019[a]**
MPV (fL)	10.5 ± 1.1	10.7 ± 1.2	10.3 ± 1.3	**0.002[a]**
PDW (%)	16.2 ± 0.4	16.2 ± 0.4	16.2 ± 0.4	0.204[a]
PCT (%)	0.22 ± 0.06	0.24 ± 0.16	0.23 ± 0.07	0.063[a]
CRP (mg/L)	17.45 ± 28.50	26.97 ± 51.50	19.31 ± 33.49	0.163[a]
D-Dimer (µg/mL)	0.52 ± 0.44	0.98 ± 3.34	1.00 ± 5.72	**0.011[a]**
Ferritin (ng/mL)	147.67 ± 234.60	184.54 ± 268.19	214.96 ± 471.85	0.341[a]

Data are shown as mean±standard deviation. ALT = Alanine Aminotransferase, AST = Aspartate Aminotransferase, LDH = Lactate Dehydrogenase, PLT = platelet, MPV = mean platelet volume, PDW = platelet distribution width, PCT = trombosite ratio in the blood, CRP = C-reactive protein

[a]Kruskal-Wallis Test

rameters. Analysis was done in the SPSS program. $P < 0.05$ and $p < 0.01$ were accepted as statistically significant.

RESULTS

Biomarkers of patients with the Delta variant, the Alpha variant,and no-mutation detected (control group) were compared in Table 1. There was a significant difference in age, troponin, creatinine, LDH, PLT, MPV, and D-dimer values of the patients ($p < 0.01$, $p < 0.01$, $p < 0.05$, $p < 0.01$, $p < 0.05$, $p < 0.01$, and $p < 0.05$; respectively). The age, troponin, LDH, and MPV values were detected significantly lower in patients with Delta variant according to patients with the Alpha variant ($p < 0.01$, $p < 0.01$, $p < 0.01$, and $p < 0.05$; respectively). Age, troponin, and PLT values were determined significantly lower in patients with Delta variant according to the control patient group ($p < 0.05$, $p < 0.01$, and $p < 0.05$; respectively). Creatinine values were found to be significantly higher in patients with Delta variant according to the control patient group ($p < 0.01$). The age and MPV values were found to be significantly higher in patients with the Alpha variant than in the control patients ($p < 0.01$ and $p < 0.01$; respectively). PLT and D-dimer values were detected significantly lower in patients with the Alpha variant relative to control patients ($p < 0.05$ and $p < 0.01$; respectively).

Biomarkers of patients with the Delta variant, the Alpha variant, and no mutation detected were compared according to gender in Table 2. Troponin, creatinine, ALT, AST, fibrinogen, lymphocyte (N), PDW and ferritin values were found to be significantly higher in males than females in patients with the Delta variant ($p < 0.05$, $p < 0.01$, $p < 0.01$, $p <0.05$, $p <0.01$, $p < 0.05$, $p < 0.05$, and $p < 0.01$; respectively). PCT and D-dimer values were higher in females than malesfor patients with the Delta variant ($p = 0.01$ and $p < 0.01$; respectively). Troponin, creatinine, ALT, AST, fibrinogen, and CRP values were determined higher in males than females for patients with the Alpha variant ($p < 0.01$, $p < 0.01$, $p < 0.01$, $p = 0.01$, $p < 0.01$, and $p < 0.01$; respectively). PLT and PCT values were higher in females than malesfor patients with the Alpha variant ($p < 0.01$, and $p < 0.01$; respectively). Creatinine, fibrinogen, PDW, CRP, and ferritin values were found higher in males than females for non-mutation detected control group patients ($p < 0.01$, $p < 0.01$, $p < 0.05$, $p < 0.05$, and $p < 0.01$; respectively). Troponin, ALT, AST, PLT, PCT, and D-dimer values were found to be higher in females than males for non-mutation detected control group patients ($p < 0.05$, $p < 0.01$, $p < 0.05$, $p < 0.05$, $p < 0.01$, and $p < 0.01$; respectively).

Biomarkers of patients with the Delta variant, the Alpha variant,and no mutation detected were compared according to the hospitalization in Table 3. Age, troponin, LDH, fibrinogen, CRP, D-dimer, and ferritin values were found to be higher in hospitalized patients with the Delta variant than in outpatients with the Delta variant ($p < 0.05$, $p < 0.05$, $p < 0.01$, $p < 0.05$, $p < 0.01$, $p < 0.01$, and $p < 0.05$; respectively). Lymphocytes (N) and lymphocytes % values were significantly lower in hospitalized patients with the Delta variant according to outpatients with Delta variant ($p < 0.01$, and $p < 0.05$; respectively). Age, troponin, LDH, CRP, and D-dimer values were found to be significantly higher in hospitalized patients with the Alpha variant according to outpatients with the Alpha variant ($p < 0.05$, $p < 0.01$, $p < 0.01$, $p < 0.01$, and $p < 0.01$; respectively). Lymphocytes (N) and lymphocytes % values were determined significantly lower in hospitalized patients with the Alpha variant according to outpatients with the Alpha variant ($p < 0.01$, and $p < 0.01$; respectively). Age, troponin, creatinine, LDH, fibrinogen, CRP, D-dimer, and ferritin values were found to be significantly higher in hospitalized patients according to outpatients for non-mutation detected control group patients ($p < 0.01$, $p < 0.01$, $p < 0.05$, $p < 0.01$, $p < 0.01$, $p < 0.01$, $p < 0.01$, and $p < 0.01$; respectively). Lymphocyte (N) and lymphocyte % values were detected significantly lower in hospitalized patients according to outpatients for non-mutation detected control group patients ($p < 0.01$ and $p < 0.01$; respectively).

DISCUSSION

Our study shows that the Delta variant spread more in the younger age groups than the Alpha variant similar to other studies [1, 37, 38]. According to the determination of the Delta variant which was mostly detected in younger patients in our study was the dominant mu-

Table 2. **Comparison of biomarkers of patients with the delta variant, the alpha variant, and no mutation detected compared to gender**

	Delta variant		*p value*	Alpha variant		*p value*	Control (No mutation)		*p value*
	Female	**Male**		**Female**	**Male**		**Female**	**Male**	
Age (years)	42 ± 17	41 ± 17	0.758[b]	52 ± 17	49 ± 17	0.346[b]	45 ± 19	47 ± 18	0.399[b]
Troponin (ng/L)	2.0 ± 4.1	14.1 ± 76.3	**0.044[b]**	6.4 ± 8.9	33.6 ± 166.1	**0.003[b]**	30.4 ± 225.1	18.3 ± 59.6	**0.022[b]**
Creatinine (mg/dL)	0.91 ± 1.19	1.10 ± 0.78	**< 0.001[b]**	0.83 ± 0.80	1.12 ± 0.65	**< 0.001[b]**	0.84 ± 0.62	1.07 ± 0.76	**< 0.001[b]**
ALT (U/L)	23 ± 22	27 ± 22	**0.002[b]**	22 ± 20	36 ± 49	**0.004[b]**	35 ± 155	32 ± 29	**< 0.001[b]**
AST (U/L)	25 ± 20	27 ± 15	**0.013[b]**	27 ± 22	41 ± 77	**0.010[b]**	48 ± 246	28 ± 15	**0.030[b]**
LDH (U/L)	223 ± 88	237 ± 107	0.429[b]	262 ± 161	291 ± 189	0.073[b]	289 ± 561	259 ± 130	0.360[b]
Fibrinogen (mg/dL)	81.17 ± 122.05	207.20 ± 289.63	**< 0.001[b]**	95.95 ± 153.59	274.05 ± 324.70	**< 0.001[b]**	148.29 ± 448.48	292.61 ± 488.76	**< 0.001[b]**
Lymphocyte (N)	1.49 ± 0.80	1.69 ± 0.74	**0.015[b]**	1.48 ± 0.60	1.52 ± 0.71	0.827[b]	3.82 ± 20.37	1.65 ± 0.76	0.504[b]
Lymphocyte (%)	27.22 ± 11.14	25.97 ± 11.19	0.432[a]	25.84 ± 10.60	24.23 ± 11.87	0.315[a]	26.76 ± 13.07	24.60 ± 11.97	0.229[a]
PLT (mcl)	217 ± 62	207 ± 56	0.208[b]	249 ± 192	202 ± 83	**0.001[b]**	238 ± 69	217 ± 66	**0.013[b]**
MPV (fL)	10.7 ± 1.1	10.3 ± 1.2	0.072[b]	10.7 ± 1.1	10.7 ± 1.3	0.792[a]	10.4 ± 1.2	10.2 ± 1.3	0.249[b]
PDW (%)	16.2 ± 0.3	16.3 ± 0.4	**0.013[b]**	16.2 ± 0.4	16.3 ± 0.4	0.065[a]	16.1 ± 0.3	16.3 ± 0.4	**0.036[b]**
PCT (%)	0.23 ± 0.06	0.21 ± 0.05	**0.010[b]**	0.26 ± 0.20	0.21 ± 0.07	**0.001[b]**	0.25 ± 0.07	0.22 ± 0.07	**0.006[b]**
CRP (mg/L)	14.96 ± 18.21	19.68 ± 35.20	0.586[b]	16.14 ± 40.70	37.59 ± 58.53	**< 0.001[b]**	16.27 ± 29.04	22.81 ± 37.85	**0.044[b]**
D-Dimer (µg/mL)	0.57 ± 0.41	0.47 ± 0.46	**0.002[b]**	0.75 ± 1.22	1.21 ± 4.56	0.330[b]	1.36 ± 7.77	0.58 ± 0.90	**0.007[b]**
Ferritin (ng/mL)	81.17 ± 122.05	207.20 ± 289.63	**< 0.001[b]**	95.95 ± 153.59	274.05 ± 324.70	**< 0.001[b]**	148.29 ± 448.48	292.61 ± 488.76	**< 0.001[b]**

Data are shown as mean ± standard deviation. ALT = Alanine Aminotransferase, AST = Aspartate Aminotransferase, LDH = Lactate Dehydrogenase, PLT = platelet, MPV = mean platelet volume, PDW = platelet distribution width, PCT = trombosite ratio in the blood, CRP = C-reactive protein

[a]Independent T test, [b]Mann-Whitney U test

Table 3. Comparison of the biomarkers of patients with the delta variant, the alpha variant, and no mutation detected according to hospitalization

	Delta variant		*p value*	Alpha variant		*p value*	Control (No mutation)		*p value*
	Outpatient	Hospitalized Patients		Outpatient	Hospitalized Patients		Outpatient	Hospitalized Patients	
Age (years)	41 ± 17	61 ± 26	**0.049**[b]	49 ± 17	59 ± 13	**0.032**[b]	44 ± 17	65 ± 15	**< 0.001**[b]
Troponin (ng/L)	3.4 ± 11.5	203.2 ± 314.1	**0.013**[b]	8.9 ± 26.1	141.2 ± 390.5	**0.007**[b]	9.5 ± 34.1	168.2 ± 527.7	**< 0.01**[b]
Creatinine (mg/dL)	1.01 ± 1.01	0.94 ± 0.47	0.431[b]	0.91 ± 0.44	1.59 ± 1.80	0.092[b]	0.87 ± 0.48	1.58 ± 1.52	**0.028**[b]
ALT (U/L)	24 ± 19	61 ± 67	0.082[b]	27 ± 24	53 ± 97	0.386[b]	25 ± 22	105 ± 347	0.696[b]
AST (U/L)	25 ± 13	73 ± 67	0.052[b]	30 ± 23	73 ± 168	0.223[b]	26 ± 14	150 ± 554	0.493[b]
LDH (U/L)	225 ± 90	450 ± 177	**0.001**[b]	254 ± 129	486 ± 343	**< 0.001**[b]	236 ± 110	632 ± 1,273	**0.001**[b]
Fibrinogen (mg/dL)	139.15 ± 225.21	478.30 ± 369.98	**0.046**[b]	158.44 ± 202.80	451.60 ± 571.15	0.091[b]	127.91 ± 186.55	1,030.43 ± 1,142.49	**< 0.001**[b]
Lymphocyte (N)	1.62 ± 0.77	0.62 ± 0.31	**0.001**[b]	1.54 ± 0.65	1.11 ± 0.55	**0.004**[b]	3.01 ± 15.80	1.19 ± 1.28	**< 0.001**[b]
Lymphocyte (%)	26.84 ± 10.93	15.68 ± 15.71	**0.027**[a]	26.01 ± 10.88	16.21 ± 10.95	**< 0.001**[a]	27.28 ± 12.10	12.85 ± 8.74	**< 0.001**[a]
PLT (mcl)	212 ± 56	203 ± 127	0.537[b]	213 ± 70	330 ± 414	0.264[b]	225 ± 62	260 ± 102	0.137[b]
MPV (fL)	10.5 ± 1.1	11.1 ± 1.4	0.365[b]	10.7 ± 1.2	10.5 ± 1.3	0.539[a]	10.3 ± 1.3	10.6 ± 1.5	0.238[b]
PDW (%)	16.2 ± 0.4	16.3 ± 0.4	0.349[b]	16.2 ± 0.4	16.1 ± 0.5	0.169[a]	16.2 ± 0.3	16.3 ± 0.6	0.752[b]
PCT (%)	0.22 ± 0.05	0.21 ± 0.12	0.581[b]	0.23 ± 0.07	0.34 ± 0.44	0.287[b]	0.23 ± 0.07	0.27 ± 0.09	0.073[b]
CRP (mg/L)	14.91 ± 20.72	115.96 ± 83.95	**< 0.001**[b]	17.65 ± 25.90	109.01 ± 114.70	**< 0.001**[b]	15.70 ± 30.03	52.90 ± 44.92	**< 0.001**[b]
D-Dimer (µg/mL)	0.49 ± 0.37	1.50 ± 1.31	**0.006**[b]	0.82 ± 3.33	2.49 ± 3.17	**0.007**[b]	0.51 ± 0.55	5.88 ± 18.56	**< 0.001**[b]
Ferritin (ng/mL)	139.15 ± 225.21	478.30 ± 369.98	**0.046**[b]	158.44 ± 202.80	451.60 ± 571.15	0.091[b]	127.91 ± 186.55	1,030.43 ± 1,142.49	**< 0.001**[b]

Data are shown as mean ± standard deviation. ALT = Alanine Aminotransferase, AST = Aspartate Aminotransferase, LDH = Lactate Dehydrogenase, PLT = platelet, MPV = mean platelet volume, PDW = platelet distribution width, PCT = trombosite ratio in the blood, CRP = C-reactive protein

[a]Independent T test, [b]Mann-Whitney U test

tant type in the period (in the second half of 2021) after the Alpha variant (in the first half of 2021) in our country, our study emphasizes the importance of vaccination in the young population [39-41]. According to our study, the result of hospitalized patients with the Delta variant, the Alpha variant, and no mutation was detected were older ages than outpatients indicating that the older age was an important criteria at hospitalization regardless of mutation. In similar studies, hospitalization was increasing in older patients with Delta mutant, Alpha mutant and no mutation was detected [42-45].

Troponin values were determined lower in patients with the Delta variant than in patients with the Alpha variant and no mutation was detected in our study. Troponin values were established higher in male patients with Delta and Alpha variants than in females while found to be higher in female patients with non-mutation COVID-19 virus detected than in males. The fact that troponin values were found to be higher in hospitalized patients compared to outpatients with Delta variant, Alpha variant, and no mutation, according to our study, highlights that high troponin level is a parameter that indicates the risk of hospitalization independently of the mutation.

Lower PLT values in patients with the Delta variant and Alpha variant indicate that the risk of serious infections of patients with mutant variants is higher than those of non-mutation detected control group patients in our study.

MPV values were determined higher in patients with the Alpha variant, compared to patients with the Delta variant and control group patients in our study. In contrast to some studies, no difference was found between hospitalized patients and outpatients in platelet count and platelet parameters in COVID patients in our study [46].

D-dimer values in patients with the Alpha variant were determined lower than the control group in our study. D-dimer levels were determined higher in hospitalized patients than in outpatients regardless of mutation in our study. Fibrinogen and ferritin values were established higher in hospitalized patients with the Delta variant and no mutation than in outpatients with the Delta variant and no mutation. But fibrinogen and ferritin values were not differentiated between hospitalized and outpatients with the Alpha variant detected. In conclusion, according to our study, D-dimer, ferritin, and fibrinogen values in COVID-19 patients can be used as a guide to determine the severity of the patient's condition and can be used as hospitalization criteria especially independently of mutation.

In our study, similar to other studies, CRP values were determined higher and lymphocyte (N, %) values were established lower in hospitalized patients than in outpatients independent of mutation.

In our study, while creatinine values were lower in control group patients with no mutation detected according to patients with Delta variant, creatinine values were higher in hospitalized control group patientsthan control group outpatients. According to our study, the detection of higher creatinine values in patients with Delta and Alpha variants was not considered a significant parameter during hospitalization. LDH values were found lower in patients with the Delta variant compared to patients with the Alpha variant in our study,. In addition, in our study, similar to other studies, LDH values were higher in hospitalized patients than in outpatients independent of mutation.

The lack of our study was that the analysis can be determined not only by the laboratory data but with the clinical data of the patients. It was another lack of ability to consult the ICU mortality data to determine the prognosis of patients.

Limitations

The limitations of our study were the inability to evaluate the clinical data of the patients, since the study was retrospective, and the inability to evaluate the development of mortality due to COVID-19 infection, especially in hospitalized patients.

In conclusion, age, troponin, creatinine, LDH, PLT, MPV, D-dimer, fibrinogen, ferritin, CRP, lymphocytes (N), and lymphocytes (%) values can guide to evaluate the diagnosis and hospitalization of patients with future different mutations.

CONCLUSION

As a result; lymphocytes (N) and lymphocytes %, values were determined lower in hospitalized patients relative to outpatients while age, troponin, LDH, CRP, and D-dimer values were established higher in hospitalized patients than outpatients irrespective of mutation. In addition, creatinine values were found higher

only in hospitalized patients with no mutation detected while ferritin and fibrinogen values were determined higher inhospitalized patients with Delta variant and no mutation detected.

Authors' Contribution

Study Conception: SKG; Study Design: SKG; Supervision: SKG; Funding: SKG; Materials: SKG; Data Collection and/or Processing: SKG; Statistical Analysis and/or Data Interpretation: SKG; Literature Review: SKG; Manuscript Preparation: SKG and Critical Review: SKG.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

Financing

The authors disclosed that they did not receive any grant during conduction or writing of this study.

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