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Original article

Evaluation of thorax computed tomographic findings in COVID-19 variant cases

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ABSTRACT

Background: Because of genetic mutations occurring during viral replication, new SARS-CoV-2 variants will continue to emerge. Throughout the COVID-19 pandemic, thorax computed tomographic (CT) findings have played a crucial role in the diagnosis and follow-up of patients with COVID-19. In this study, we compared the thorax CT findings of patients infected with SARS-CoV-2 variants (variant group) with those of patients infected with the non-variant strain (non-variant group) to assess if thorax CT findings may be utilized to discriminate between the groups. Furthermore, we compared demographic and laboratory data between the groups.

Methods: The study comprised a total of 77 patients who presented to our hospital with a preliminary diagnosis of COVID-19 based on clinical symptoms, a positive oropharyngeal/nasopharyngeal swab RT-PCR testing, and thorax CT examinations. Patients' laboratory and demographic features as well as thorax CT findings were retrospectively evaluated, and the results were grouped according to RT-PCR results.

Results: There were 42 patients in the non-variant group and 35 patients in the variant group. The average age of patients infected with the non-variant strain, alpha variant, and gamma variant was 63.52 ± 14.87 years, 54.86 ± 14.31 years, and 59.4 ± 17.79 years, respectively. The average age of the variant group was significantly lower than that of the non-variant group. There was no significant difference in thorax CT findings between the groups, and consolidation, ground glass densities, and cobblestone pattern in the bilateral lower lobes and peripheral areas were the most common thorax CT findings in both the groups.

Conclusion: There is no significant difference in thorax CT findings between the variant and non-variant groups. Therefore, clinical and laboratory characteristics should take precedence over thorax CT findings for distinguishing between patients infected with SARS-CoV-2 variants and the non-variant strain.

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1. Introduction

Throughout the ongoing coronavirus disease 2019 (COVID-19) pandemic, numerous SARS-CoV-2 variants have emerged. Among them, both the alpha and beta/gamma variants have been found in Turkey. In a study by Dao et al., the clinical findings of patients infected with SARS-CoV-2 variants (variant group) and the non-variant strain (non-variant group) were compared, and the incidence rates of fever, rhinitis, and anosmia and hospitalization rate were found to be significantly higher in the variant group than those in the non-variant group [1]. Because each variant has a different impact on morbidity and mortality and raises concerns about the performance of vaccines, it's critical to distinguish between their properties early on [2,3].

Thorax computed tomographic (CT) findings have been reported to be useful for the diagnosis, prognostic assessment, and detection of complications of COVID-19 infection [4]. CT severity score assessed based on the percentage of lung involvement has been shown to be a good prognostic predictor in patients with COVID-19 [5]. Using dual energy CT (DECT), another study has shown an association between lung perfusion deficits and CT severity score [6]. Therefore, for the diagnosis of COVID-19, thorax CT imaging is commonly combined with real-time polymerase chain reaction (RT-PCR) using nasal swab as specimen.

In this study, we compared the thorax CT findings of the variant group with those of the non-variant group to assess if thorax CT findings could be used to distinguish between the two groups. To the best of our knowledge, this is the first study in the English literature that compares variant strains and the non-variant strain in terms of thorax CT findings and laboratory results.

2. Materials and methods

This retrospective observational study was undertaken at a tertiary health care facility in Turkey between January 1, 2021 and May 1, 2021. Patients who were hospitalized with fever and the clinical symptoms of respiratory tract infection (e.g., cough and shortness of breath) and patients who had a positive RT-PCR result for SARS-CoV-2 and thorax CT scan were included in this study. Eight hospitalized patients who did not undergo thorax CT examinations or had negative RT-PCR results for SARS-CoV-2 were excluded from the study. On admission, oropharyngeal/nasopharyngeal swabs of all patients were analyzed using RT-PCR to detect SARS CoV-2 RNA. RT-PCR can detect the mutations in both the alpha and beta/gamma variants. All patients in our hospital underwent thorax CT examinations using 16-slice and 128-slice CT scanners within 10 days after diagnosis, and CT images were assessed retrospectively by experts blinded to RT-PCR results. In addition, patients' laboratory and demographic findings were evaluated retrospectively; the results were classified into two groups based on RT-PCR results and compared between the groups. Informed consent was obtained from all patients, and the study protocol was approved by the Institutional Ethics Committee of Ankara Training and Research Hospital, Ankara, Turkey (approval no.: 649; September 15, 2021).

3. Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 20.0 for Windows (IBM SPSS Inc., Chicago, IL, USA). Conformity of the data to normal distribution was assessed using the Kolmogorov-Smirnov test. Normally distributed and non-normally distributed quantitative variables were presented as mean ± standard deviation (SD) and median (range), respectively. Categorical variables were expressed as number and percentage. Differences between the variant and non-variant groups were analyzed using the Student's *t*-test and Mann—Whitney *U* test. The chi-square test was used to compare the percentages of findings between the groups.

A two tailed p value of <0.05 was considered statistically significant.

4. Results

The study population consisted of 77 patients with a median age of 60 years (range 18–92). There were 43 (55.8%) male patients. There were 42 (54.5%) patients in the non-variant group and 35 (45.5 %) patients in the variant group. The variant group had 30 (85.7%) cases of the alpha variant and 5 (14.2%) cases of the beta/gamma variants. Table 1 shows patients' demographic characteristics.

The mean age of patients infected with the non-variant strain, alpha variant, and gamma variant was 63.52 ± 14.87 years, 54.86 ± 14.31 years, and 59.4 ± 17.79 years, respectively. The mean age of the variant group was significantly lower than that of the non-variant group ($p = 0.003$) (Table 1).

There was no difference in sex between the groups ($p = 0.11$) (Table 1).

Table 1 – Patients' demographic characteristics.

Group	Variant	Patients[a]	Sex[a]		Age (years)[b]
			Female	Male	
Variant	Alpha variant	30(%39)	9(%11,7)	21(%27,3)	54.86 ± 14.31
	Beta/gamma variants	5(%6,5)	2(%2,6)	3(%3.9)	59.4 ± 17.79
Non-variant		42(%54,5)	23(%29,9)	19(%24,6)	63.52 ± 14.87

[a] Data are presented as number (percentage).
[b] Data are presented as mean ± standard deviation.

Table 2 – Laboratory findings of the variant and non-variant groups.

Group	Laboratory findings			
	WBC[a] count (10^9/L)	Lymphocyte count (10^9/L)	CRP[b] level (mg/L)	D-dimer level (ng/mL)
Variant	5700	1200	18	450
Non-variant	5625	995	38	765

[a] White blood cell = WBC.
[b] C-reactive protein = CRP.

Although the median levels of C-reactive protein (CRP) and D-dimer in the non-variant group were significantly higher than those in the variant group ($p = 0.002$), there were no significant differences in leukocyte and lymphocyte counts between the groups ($p = 0.23$) (Table 2).

Only five (6.5%) patients had no CT findings. Among them, two patients belonged to the variant group (one patient infected with the alpha variant one patient infected with the beta variant), and three patients were in the non-variant group (Figs. 1 and 2).

No significant differences were observed in bilateral ($p = 0.53$) and multilobar involvement ($p = 0.39$), ground glass densities and/or the presence of consolidated areas, and CT severity index values ($p = 0.43$) between the groups; the lower lobes were the most affected lobes in both the groups (Figs. 1 and 2).

Other signs of COVID-19 infection in the lungs such as vascular enlargement, cobblestone appearance, halo sign, and air bubble showed no significant differences between the groups.

5. Discussion

COVID-19 has spread worldwide since it was first detected in December 2019. Because of the rapid dissemination of SARS-CoV-2, new strains have emerged. Among them, the alpha variant and beta variant are the most well-known ones. The impact of variants on clinical manifestations and prognostic outcomes affects the early diagnosis and treatment of patients with COVID-19 and, most importantly, the preventative approaches to reduce viral circulation in the population [7].

The most common symptoms of COVID-19 are fever, dry cough, and malaise/fatigue. Many studies have found that

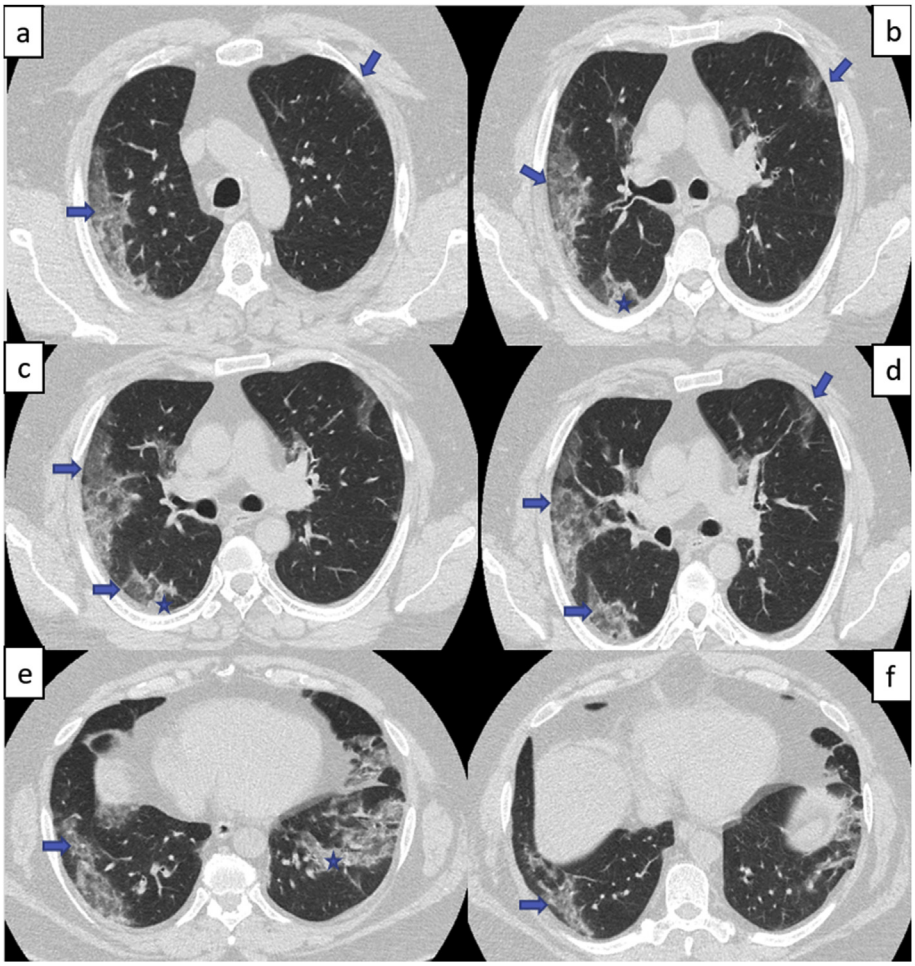

Fig. 1 – Non-variant group: Thorax computed tomographic (CT) images of a 59-year-old male patient in the non-variant group show patchy ground glass densities (arrows) and some consolidations at the periphery of both the lungs (asterisk). He had a CT severity index of 72.

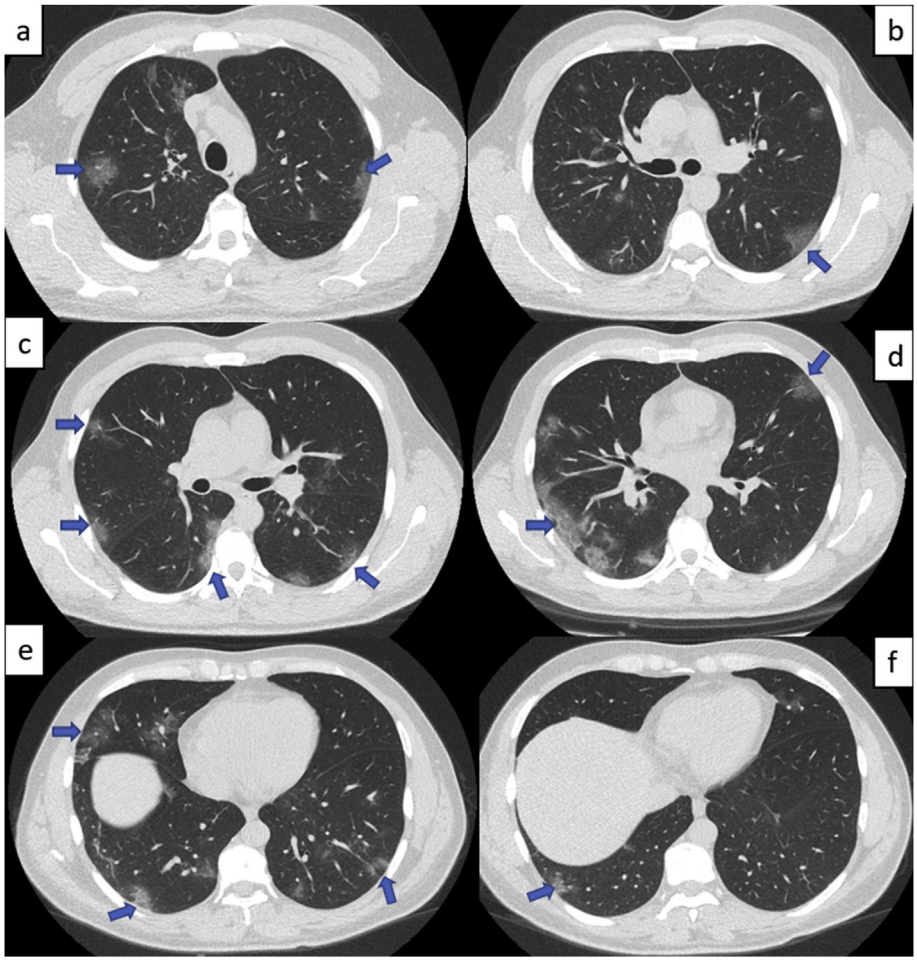

Fig. 2 – Variant group: Thorax CT images of a 38-year-old male patient in the variant group (alpha variant) showing bilateral peripheral-weighted patchy ground glass densities (arrows) similar to those observed in the non-variant group. He had a CT severity index of 44.

COVID-19 infection causes a reduction in white blood cell (WBC) and lymphocyte counts and an increase in CRP and D-dimer levels [8–13]. On the other hand, Amano et al. observed that a lower WBC count was indicative of COVID-19, but lymphocytopenia and D-dimer level were poor predictors of COVID-19 [14]. Typical thorax CT features of COVID-19 pneumonia have also been reported. Bilateral involvement of the basal segments of the lower lobes and peripheral areas is indicative of lung involvement. Patchy ground glass densities, areas of consolidation, cobblestone pattern, and a combination of these features are the most prevalent thorax CT findings in patients with COVID-19 [15]. In a meta-analysis, Khatami et al. reported that the sensitivity and specificity of thorax CT were 83% and 47%, respectively; they also suggested that thorax CT might contribute to the diagnosis of COVID-19 [16]. To the best of our knowledge, no other study in the English literature compares laboratory results between the two groups.

Real-time polymerase chain reaction (RT-PCR) is the most widely used method for detecting virus variants. However, it may not produce correct results in the presence of some mutations, causing diagnostic delays. The diagnostic role of thorax CT in COVID-19 is well understood, and thorax CT has become a significant approach for rapid diagnosis and prognosis of COVID-19 although it is not recommended as the first step in the diagnosis of COVID-19 [7–17]. This is the first study in the English literature that compares thorax CT findings between patients infected with variant strains and the non-variant strain. In this study, we evaluated the efficacy of CT imaging in distinguishing different variants of SARS-CoV-2. We also compared demographic and laboratory features between the groups.

According to our findings, there is no significant difference in thorax CT findings between the groups. The non-variant group had significantly higher median CRP and D-dimer levels than the variant group. Furthermore, the mean age of the variant group was significantly greater than that of the non-variant group. Other findings of the groups were similar.

The study has some limitations. First, this was retrospective study. Second, the inclusion criteria may introduce bias since only patients with COVID-19-like symptoms and thorax CT scans were included in this study. Patients with clinically suspected COVID-19 who had no thorax CT findings and patients who had clinical and thorax CT findings indicating

COVID-19 infection but had negative RT-PCR results were excluded from the study. Third, this study included a small number of patients. Therefore, further studies with large sample size are required to confirm the results of this study.

6. Conclusion

Our findings indicate that thorax CT findings do not differ significantly between the variant and non-variant groups. Therefore, clinical and laboratory features should take precedence over thorax CT findings for distinguishing among SARS-CoV-2 variants.

Ethics approval and consent to participate

The study was approved by the Institutional Ethics Committee of Ankara Training and Research Hospital, Ankara, Turkey (approval no.: 649; September 15, 2021), and written informed consent was obtained from all patients.

Conflict of Interest

The authors have no conflicts of interest.

REFERENCES

[1] Dao TL, Nguyen NN, Delerce J, Chaudet H, Levasseur A, Lagier JC, et al. Clinical outcomes in COVID-19 patients infected with different SARS-cov-2 variants in marseille, France. Clin Microbiol Infect 2021;27:1516.e1–6.
[2] Shen Z, Xiao Y, Kang L, Ma W, Shi L, Zhang L, et al. Genomic diversity of severe acute respiratory syndrome-coronavirus 2 in patients with coronavirus disease 2019. Clin Infect Dis 2020;71:713–20.
[3] Lazarevic I, Pravica V, Miljanovic D, Cupic M. Immune evasion of SARS-CoV-2 emerging variants: what have we learnt so far? Viruses 2021;13:1192.
[4] Aydin S, Unver E, Karavas E, Yalcin S, Kantarci M. Computed tomography at every step: long coronavirus disease. Respiratory Investigation 2021;59:622–7.
[5] Francone M, Lafrate F, Masci GM, Coco S, Cilia F, Manganaro L, et al. Chest CT score in COVID-19 patients: correlation with disease severity and short-term prognosis. Eur Radiol 2020;30:6808–17.
[6] Aydin S, Kantarci M, Karavas E, Unver E, Yalcin S, Aydin F. Lung perfusion changes in COVID-19 pneumonia: a dual energy computerized tomography study. Br J Radiol 2021;94.1125:20201380.
[7] Matta S, Rajpal S, Chopra KK, Arora VK. Covid-19 vaccines and new mutant strains impacting the pandemic. Indian J Tubercul 2021;68:171–3.
[8] Xiong Y, Sun D, Liu Y, Fan Y, Zhao L, Li X, et al. Clinical and high-resolution CT features of the COVID-19 infection: comparison of the initial and follow-up changes. Invest Radiol 2020;55:332–9.
[9] Rostami M, Mansouritorghabeh H. D-dimer level in COVID-19 infection: a systematic review. Expet Rev Hematol 2020;13:1265–75.
[10] Yao Y, Cao J, Wang Q, Shi Q, Liu K, Luo Z, et al. D-dimer as a biomarker for disease severity and mortality in COVID-19 patients: a case control study. Journal of intensive care 2020;8:1–11.
[11] Li Y, Zhao K, Wei H, Chen W, Wang W, Jia L, et al. Dynamic relationship between D-dimer and COVID-19 severity. Br J Haematol 2020;190:e24–7.
[12] Wu J, Liu J, Zhao X, Liu C, Wang W, Wang D, et al. Clinical characteristics of imported cases of coronavirus disease 2019 (COVID-19) in Jiangsu Province: a multicenter descriptive study. Clin Infect Dis 2020;71:706–12.
[13] Abbasi-Oshaghi E, Mirzaei F, Farahani F, Khodadadi I, Tayebinia H. Diagnosis and treatment of coronavirus disease 2019 (COVID-19): laboratory, PCR, and chest CT imaging findings. Int J Surg 2020;79:143–53.
[14] Amano Y, Kage H, Tanaka G, Gonoi W, Nakai Y, Kurokawa R, et al. Diagnostic prediction of COVID-19 based on clinical and radiological findings in a relatively low COVID-19 prevalence area. Respir investig 2021;59:446–53.
[15] Li L, Yang L, Gui S, Pan F, Ye T, Liang B, et al. Association of clinical and radiographic findings with the outcomes of 93 patients with COVID-19 in Wuhan, China. Theranostics 2020;10:6113.
[16] Khatami F, Saatchi M, Zadeh SST, Aghamir ZS, Shabestari AN, Reis LO, et al. A meta-analysis of accuracy and sensitivity of chest CT and RT-PCR in COVID-19 diagnosis. Sci Rep 2020;10:1–12.
[17] Gezer NS, Ergan B, Barış MM, Appak Ö, Sayıner AA, Balcı P, et al. COVID-19 S: A new proposal for diagnosis and structured reporting of COVID-19 on computed tomography imaging. Diagn Interventional Radiol 2020;26:315.