

## Chest CT Imaging Findings and Mortality of Coronavirus Disease (COVID-19) In Two Groups of Patients with Positive and Negative Initial RT-PCR Results

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ARTICLE INFO	ABSTRACT
<b>Article type:</b> Original Paper	<b>Introduction:</b> The main aim of the study was to find the most common CT feature in the lungs of patients associated with Delta variant and characterize thoracic computed tomography and report mortality.
<b>Article history:</b> Received: May 31, 2022 Accepted: Aug 07, 2022	<b>Material and Methods:</b> A total of 156 patients with suspected or confirmed COVID-19 infection were randomized in this study which their chest CTs performed at the initial positive and negative RT-PCR. There were two groups of patients involved.
<b>Keywords:</b> COVID-19 Coronavirus Disease Radiation CT SARS-CoV-2 RT-PCR	<b>Results:</b> The patients had typical imaging features such as; coagulation (33 [21.2%]), ground glass opacities (GGO) (140 [89.7%]), vascular enlargement of the lesion (41 [26.3%]). Lesions that appear on CT images are more likely to have peripheral distribution (79 [50.6%]), peripheral and central distribution (61 [39.1%]) and architectural distortion (14 [9%]). Other CT features include pleural effusion (15 [9.6 %]) and crazy-paving pattern (25 [16 %]). Only two patients had tree-in-bud and traction bronchiectasis (2 [1.3%]). In contrast, the overall mortality rate was (19 [12.2%]). <b>Conclusion:</b> The most common CT feature was peripheral GGO (140 [89.7%]) in the lungs of patients with COVID-19. The initial positive RT-PCR group had a higher peripheral distribution, GGO, and frenzy pattern during their CT scan than patients in the group with a negative initial RT-PCR result. Mortality rates were nearly identical between groups with a positive and negative RT-PCR baseline at 10.7% and 13%, respectively. It has been shown that most patients with negative RT-PCR should be considered suspected of having COVID-19.

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### Introduction

A series of pneumonia cases appeared in Wuhan, China in December 2019 and quickly attracted special attention worldwide [1]. It is a disease that can be transmitted from person to person [2].

Respiratory specimens tested by real-time reverse transcriptase polymerase chain reaction (RT-PCR) are considered the gold standard method for detecting SARS-CoV-2 infections according to guidelines recently regulated [3]. However, limited effectiveness is associated with diagnostic kits and barriers to sample management and transport as variables that can affect the sensitivity of RT-PCR levels at baseline vary from 60% and 71%. However, it is still the first choice despite these disadvantages [4-7].

Imaging plays a critical role in the diagnosis and control of COVID-19 pneumonia. Chest radiography is an easy and quick modality and frequently requested due to its low cost and wide availability. But CT takes

into consideration the first-line imaging modality in exceptionally suspected instances [8].

The aim of this study was to describe chest CT findings such as ground glass opacity (GGO) and mixed GGO and consolidation, tree-in-bud, architectural distortion, crazy paving, traction bronchiectasis, vascular enlargement, pleural effusion and report mortality in two groups of patients with positive and negative initial RT-PCR results regarding to the Delta variant.

### Materials and Methods

#### Study population and data collection

In this initial retrospective study, a total of 156 patients with confirmed COVID-19 infection who underwent initial negative and positive RT-PCR chest CT were randomized from Imam Reza Hospital, Kermanshah, Iran. RT-PCR (Reverse transcription polymerase chain reaction) is a laboratory technique

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combining reverse transcription of RNA into DNA and amplification of specific DNA targets using polymerase chain reaction (PCR). The model prime pro 48 (Techne, England) was used for this test. The patients were divided into two groups; 56 patients and 100 patients had negative and positive initial RT-PCR results, respectively.

Patients' CT scans, RT-PCR results, demographic and clinical characteristics were collected. All imaging features including consolidation, tree-in-bud, GGO, mixed GGO, crazy paving, traction bronchiectasis, architectural distortion, vascular enlargement and pleural effusion were reviewed and evaluated by two experienced radiologists at a PACS (Picture Archiving and Communication System) workstation.

All the studied patients were hospitalized and had RT-PCR results for SARS-CoV-2 in laboratory testing of respiratory secretions obtained by nasopharyngeal or oropharyngeal swab and underwent a CT in Imam Reza hospital, Kermanshah, Iran. The clinical outcomes were monitored up to September 25th, 2021, the final date of follow-up. Patients who died for reasons other than COVID-19 were excluded from the study.

### CT Image Data Acquisition

A chest CT was performed during end-inspiration with the patient in the supine position without intravenous contrast administration. All patients were imaged on a 16-slice CT scanner (Siemens Somatom Scope, Germany) with a slice thickness of 5 mm using a conventional chest protocol. The patients during breath-holding at full inspiration were scanned in a supine position and arm raised. The acquisition parameters

were set at 100–200 mAs; 120 kVp; collimation, 0.625–5 mm; and pitch, 0.75–1.5.

### Statistical Analysis

Statistical analysis was performed using SPSS software (version 25.0, IBM). Normally distributed data were expressed as a mean  $\pm$  standard deviation. Categorical variables of CT features were presented as cases and compared by Fisher's exact test between positive and negative initial RT-PCR results. A p-value of 0.05 or less was considered statistically significant.

### Results

A total of 156 patients from Imam Reza hospital, Kermanshah, Iran (82 women, 74 men; mean age, 57.74 $\pm$ 14.85 [SD] years old; median, 60 years; range, 23–87 years) were selected. The demographic and clinical characteristics are shown in Table 1.

### Chest CT imaging findings

156 patients with COVID-19 pneumonia had typical imaging features such as; consolidation (33 [21.2%]), GGO (140 [89.7%]) and vascular enlargement in the lesion (41 [26.3%]). Lesions appearing on CT images are more likely to have a peripheral distribution (79 [50.6%]), peripheral and central distribution (61 [39.1%]) and architectural distortion (14 [9%]). Other features of CT include pleural effusion (15 [9.6%]) and crazy-paving pattern (25 [16%]). Only two patients had traction tree-in-bud and bronchiectasis (2 [1.3%]). In contrast, the total mortality was (19 [12.2%]).

Table 1. Patient characteristics

General data	PCR+ group (N=100)	PCR- group (N=56)	Overall (N=156)
Sex			
Male	48	26	74 (47.4%)
Female	52	30	82 (52.6%)
Age (year)			
Mean	56.15 $\pm$ 14.51	62.82 $\pm$ 16.39	57.74 $\pm$ 14.85
Range			23–87
BMI (kg/m <sup>2</sup> )	27.15 $\pm$ 3.58	26.09 $\pm$ 3.53	26.76 $\pm$ 3.55

Table 2. Comparison of CT features between groups with initial negative and positive RT-PCR results

Chest CT features	Initial RT-PCR Result		P-value
	Negative (n = 56)	Positive (n = 100)	
Ground-glass opacities present	43 $\pm$ 0.5	97 $\pm$ 0.8	0.001
Location			
Peripheral /central and peripheral	13/17	53/44	0.001
Architectural distortion	5 $\pm$ 0.09	9 $\pm$ 0.6	1.000
Consolidation present	9 $\pm$ 0.8	24 $\pm$ 1	0.245
Tree-in-bud	1 $\pm$ 0.03	1 $\pm$ 0.04	0.676
Crazy-paving pattern	3 $\pm$ 0.01	22 $\pm$ 1	0.007
Traction bronchiectasis	1 $\pm$ 0.02	1 $\pm$ 0.06	0.676
Vascular enlargement	12 $\pm$ 0.5	29 $\pm$ 1.2	0.303
Pleural effusion	4 $\pm$ 0.3	11 $\pm$ 0.9	0.433
Died	6 $\pm$ 0.3	13 $\pm$ 1	0.779

• The difference was statistically significant in comparison of the two groups ( $p < 0.05$ )

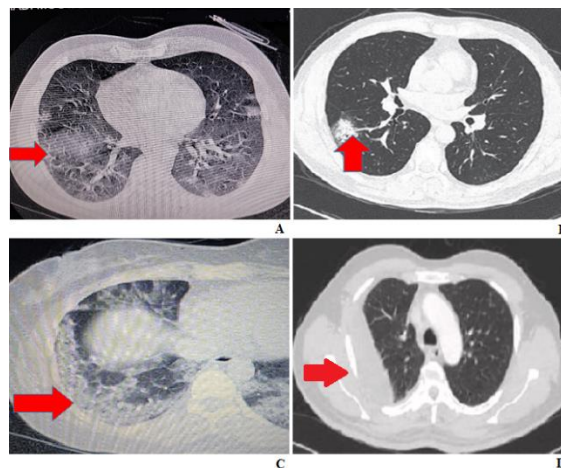


Figure 1. Examples of typical chest CT findings in patients with confirmed corona virus (A) axial chest CT of a 50-year-old man shows GGO, (B) axial chest CT of a 40-year-old woman shows GGO & consolidation, (C) axial chest CT of a 37-year-old woman shows crazy-paving pattern, (D) axial chest CT of a 60-year-old man shows pleural effusion.

### CT Features between Two Studied Groups

Among 56 patients with initial negative RT-PCR, 43 (76.8%) patients had positive results in CT images and just two patients with positive initial RT-PCR results had no obvious abnormality on CT images. In the positive initial RT-PCR group, the patients had more features such as GGO ( $p<0.001$ ), peripheral distribution ( $p<0.001$ ) and crazy-paving pattern ( $p=0.007$ ), compared with patients in the initial negative RT-PCR group (Figure 1). Table 2 shows the other evaluated CT features. The consolidation, architectural distortion, tree-in-bud, traction bronchiectasis, vascular enlargement and pleural effusion were not significantly different between the studied groups. Moreover, the mortality rate in both groups was approximately similar.

### Discussion

A retrospective study was conducted in Imam Reza hospital, Kermanshah, Iran, comparing RT-PCR to chest CT examination for COVID-19 infection. The RT-PCR test is considered as the standard for the Coronavirus determination, although in some cases it can have undesirable outcomes in the initial stages of the infection [9].

Typical CT findings help early detection of suspicious patients efficiently and assess illness and range COVID-19. In these situations, chest CT can be considered as an outstanding tool to detect current COVID-19 in epidemic areas [10]. Therefore, the CT imaging features and initial RT-PCR results in a series of patients with COVID-19 were investigated and some differences in CT features between the studied groups were found. In this patient sample, the difference in detection rate for initial CT (98%) patients was greater than first RT-PCR (71.2%) patients ( $p<0.001$ ).

Several studies compared the sensitivity of RT-PCR and chest CT in the diagnosis of COVID-19 [11-12]. Fang Y et al. showed that the chest CT is more sensitive compared to RT-PCR in the detection of COVID-19 (98% vs. 71%) [11]. Mahmoudabadi A et al. compared clinical symptoms and CT signs for two groups: the

young and middle-aged group ( $< 60$  years old) and the elderly group but they did not use the PCR test in their comparison [13].

Interestingly, neither of the confirmed cases showed any substantial abnormalities in a first CT scan and it is possible that they occurred at an early stage of COVID-19. Although chest CT is an important tool in diagnosis of COVID 19 infection, it is not the gold standard because when a primary RTPC negative results, general diagnostics are very important.

The results showed that the most common CT feature is peripheral GGO (140 [89.7%]) in the lungs of patients with COVID-19. In this regard, Chen et al. reported that patients with COVID-19 pneumonia usually had consolidation (72%) and GGO (95%), however the disease usually manifests GGO in the early stage and the area of consolidation increases as the disease progresses [14]. The consolidation feature was rarely observed maybe due to the delta variant evaluated cases in this study.

The CT scans of the positive initial RT-PCR group showed more clinical parameters for peripheral distribution ( $p<0.001$ ), GGO ( $p<0.001$ ), and crazy-paving pattern ( $p=0.007$ ) than with patients in the initial RT-PCR negative group.

According to the results, no significant difference in sex ratio was observed between the groups. A recent study conducted in Beijing had a similar result, however, there are other studies that had different results may be due to the different locations [15]. Based on Xu et al. [16] study, most of the COVID-19 patients were male in Zhejiang province.

Mortality in groups with initial negative and positive RT-PCR was approximately similar (10.7% and 13%, respectively). The study showed that most of the patients with negative RT-PCR should be considered as a suspect of COVID-19. That is why in a similar study it has been reported that CT is considered as a routine imaging method in order to monitor and diagnose the patients with COVID-19 [12]. Furthermore, a CT scan can be useful in early detection of lung abnormalities in

order to screen out of suspected patients, especially whom with an initial negative RT-PCR results.

## Conclusion

According to the findings, the most common CT feature was peripheral GGO (140 [89.7%]) in the lungs of patients with COVID-19. The CT scan of the group with a positive initial RT-PCR result showed more peripheral distribution, GGO, crazy-paving pattern compared with patients in the group with a negative initial RT-PCR result. Mortality rates in the groups with negative and positive initial RT-PCR were almost similar (10.7% and 13%, respectively). It has also been shown that most patients with negative RT-PCR should be considered suspected of having COVID-19.

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