## Original Article

# Computed Tomography and Clinical Features for Diagnosis of COVID-19 Pneumonia and Differentiating from Common Viral Pneumonia

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## ABSTRACT

**Introduction:** HRCT chest has high sensitivity in diagnosis of corona virus disease 2019 (COVID-19) in a screening population, but it is thought to be nonspecific. The study aimed to determine the predictive features of computed tomography (CT) and clinical features for diagnosing COVID-19 pneumonia and differentiating it from non-COVID -19 viral pneumonia.

**Methodology**: A retrospective study was done on 21 patients with confirmed COVID-19 pneumonia (group 1). In addition, 16 patients with confirmed cases of other common viral pneumonia (group 2) during the first and second wave to analyse characteristics of COVID-19 pneumonia were included in the study. Patients with laboratory confirmed RTPCR test positive and undergone CT scan were included.

**Results**: The factors including size of ground glass opacity (GGO), GGO with reticular and/or interlobular septal thickening, vascular enlargement, "tree-in-bud" opacity, centrilobular nodules, and stuffy or runny nose were associated with group 2 (COVID-19) of viral pneumonia. Only GGO with reticular and/or interlobular septal thickening, centrilobular nodules, and stuffy or runny nose remained independent risk factors in multinomial logistic regression analysis for COVID-19 pneumonia.

**Conclusion:** GGO with reticular and/or interlobular septal thickening, absence of centrilobular nodules on computed tomography, and absence of stuffy or runny nose are presented in patients with COVID-19 pneumonia.

**Keywords:** Computed tomography, COVID-19 pneumonia, Ground glass opacities.

## INTRODUCTION

The disease infected by *SARS-CoV*-2 was named COVID-19 by the World Health Organization (WHO) on January 12, 2020.[1,2] Since the outbreak of COVID-19, the transmission among people was quick. Early diagnosis and early treatment are crucial for successful treatment and prevention of transmission. The sensitivity of *SARS-CoV-2* nucleic acid detection is poor. COVID-19 mainly affects the lungs. According to current experience, thin-section CT is objective and sensitive for screening the COVID-19 pneumonia.[1]

With the emergence of COVID-19 cases during the influenza season, an accurate differentiation of COVID-19 pneumonia from common viral pneumonia is crucial and decreases the cost of treatment.[3-10] However, most viral pneumonia patterns exhibit similarity of CT findings.[11-14] When taken with clinical symptoms, the diagnostic yield should be much higher in differentiating COVID-19 pneumonia from other viral pneumonias. Furthermore, investigation regarding the imaging and clinical differentiation of COVID-19 pneumonia from common viral pneumonia is lacking.

In this study, we retrospectively reviewed the CT findings and clinical data of patients with COVID-19 pneumonia and common viral pneumonia to identify the predictive features for differential diagnosis. Previous studies have not directly compared chest CT patterns of COVID-19 with those of common viral pneumonia at chest CT. The purpose of this study was to assess the performance of CT findings in differentiating COVID-19 from non-COVID-19 common viral pneumonia in chest HRCT.

## METHODS

A retrospective study was carried out on 21 confirmed COVID-19 pneumonia patients. In addition, 16 patients with confirmed other common viral pneumonia in first and second wave were included to analyse characteristics of COVID-19 pneumonia.

Inclusion criteria of COVID-19 pneumonia were patients with laboratory confirmed COVID-19 and patients with thin section chest CT examination who demonstrated pneumonia.

The criteria of common viral pneumonia were patients with laboratory confirmed pneumonia infected by other viruses (*respiratory syncytial virus, adenovirus*, and *influenza virus*) and were negative *SARS-CoV-2* during the outbreak of COVID-19. A review of clinical data including age, sex, white blood cell (WBC) count, and lymphocyte (LYM) count, fever, dry cough, stuffy or runny nose, headache, sore throat, fatigue, myalgia, and diarrhoea was done.

Computed tomography imaging was performed in all patients using a 16-slice spiral CT (Philips MX-16). The imaging parameters were 120 KV, 150 to 300 mA of automatic adjustment, a pitch of 1.5, 0.625 mm of collimation, 512×512 of matrix. Axial and coronal multiplanar reconstruction images with 1 to 5 mm thick were obtained with lung or mediastinum windows.

**Imaging Analysis:** Two experienced radiologists reviewed the CT scan data independently. Computed tomography imaging features like lesion involvement, number of lesions, distribution, size of ground glass opacities (GGO), pure GGO, GGO with reticular and/or interlobular septal thickening, GGO with consolidation, vascular enlargement in lesion, air bronchogram in lesion, "tree-in-bud" opacity, centrilobular nodules, bronchial wall thickening in lesion, bronchiectasis in lesion, adjacent pleural thickening, and thoracic lymphadenopathy were included. Ground glass opacity was defined as hazy increased attenuation of the lung with preservation of bronchial and vascular margins. Consolidation was considered as lesions in which broncho-vascular structures were obscured. Lesion distribution was classified as peripheral and central distribution. The size of GGO was measured in maximal dimension of the largest lesion on the transverse plane. The optimal cut-off value for the size of GGO was 4.0 cm. Thoracic lymphadenopathy was considered present if the short-axis diameter of lymph node was larger than 1 cm.

Statistical analysis was done to determine the predictive value of the CT and clinical features. The patients were categarised into 2 groups: Group 1 with COVID-19 pneumonia and group 2 with the common viral pneumonia. The CT imaging features included for analysis were: Lung involvement (single or bilateral), number of lesions (single or multiple), distribution (peripheral or central), size of GGO (≥4.0 cm or <4.0 cm), pure GGO (absent or present), GGO with reticular and/or interlobular septal thickening (absent or present), GGO with consolidation (absent or present), vascular enlargement in lesion (absent or present), air bronchogram in lesion (absent or present), bronchiectasis in lesion (absent or present), bronchial wall thickening in lesion (absent or present), "tree-in-bud" opacity (absent or present), centrilobular nodules (absent

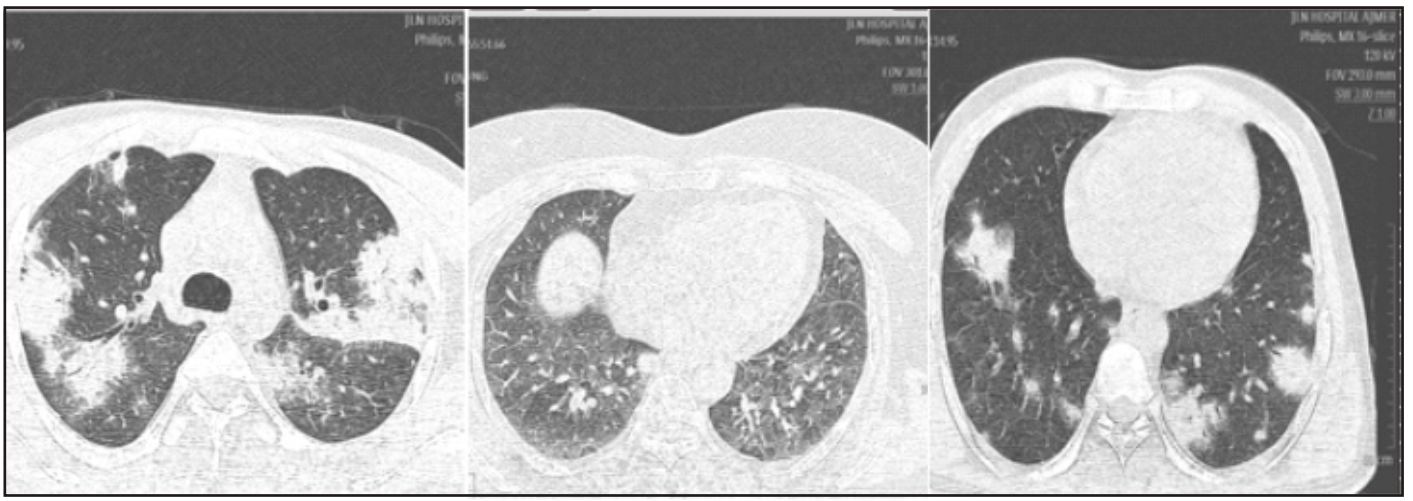

Figure 1: CT images of patients with COVID-19 pneumonia in bilateral lung. Axial thin-section CT images show multiple lesions of pure GGO, GGO with consolidation, GGO with reticular and/or interlobular septal thickening, and air bronchogram (arrow) in lesion.

**Table 1: Clinical characteristics and univariate analyses of two groups**

| Characteristics | Group 1 (n=21) | | Group 2 (n=16) | | p value |
|---|---|---|---|---|---|
| | No. of patients | % | No. of patients | % | |
| **Sex** | | | | | |
| **Male** | 13 | 62 | 10 | 62.5 | 0.970 |
| **Female** | 8 | 38 | 6 | 37.5 | |
| **Age (Years)*** | 48.54±14.63 | | 41.52±23.61 | | 0.274 |
| **Fever** | | | | | |
| **Present** | 16 | 76.19 | 14 | 87.5 | 0.384 |
| **Absent** | 5 | 23.81 | 2 | 12.5 | |
| **Stuffy or runny nose** | | | | | |
| **Present** | 2 | 9.5 | 6 | 37.5 | 0.040 |
| **Absent** | 19 | 90.5 | 10 | 62.5 | |
| **Headache** | | | | | |
| **Present** | 3 | 14.3 | 2 | 87.5 | 0.875 |
| **Absent** | 18 | 85.7 | 14 | 12.5 | |
| **Sore throat** | | | | | |
| **Present** | 3 | 14.3 | 3 | 18.75 | 0.627 |
| **Absent** | 18 | 85.7 | 13 | 81.25 | |
| **Fatigue** | | | | | |
| **Present** | 2 | 9.5 | 1 | 6.25 | 0.712 |
| **Absent** | 19 | 90.5 | 15 | 93.75 | |
| **Myalgia** | | | | | |
| **Present** | 4 | 19 | 3 | 18.75 | 0.982 |
| **Absent** | 17 | 81 | 13 | 81.25 | |
| **Dry cough** | | | | | |
| **Present** | 7 | 33.3 | 6 | 37.5 | 0.793 |
| **Absent** | 14 | 66.7 | 10 | 62.5 | |
| **WBC ($10^3$/L)*** | 5.65±1.96 | | 7.06±3.49 | | 0.128 |
| **Lymphocytes ($10^3$/L) *** | 1.54±.96 | | 1.54±1.03 | | 1.000 |

*Mean ± SD

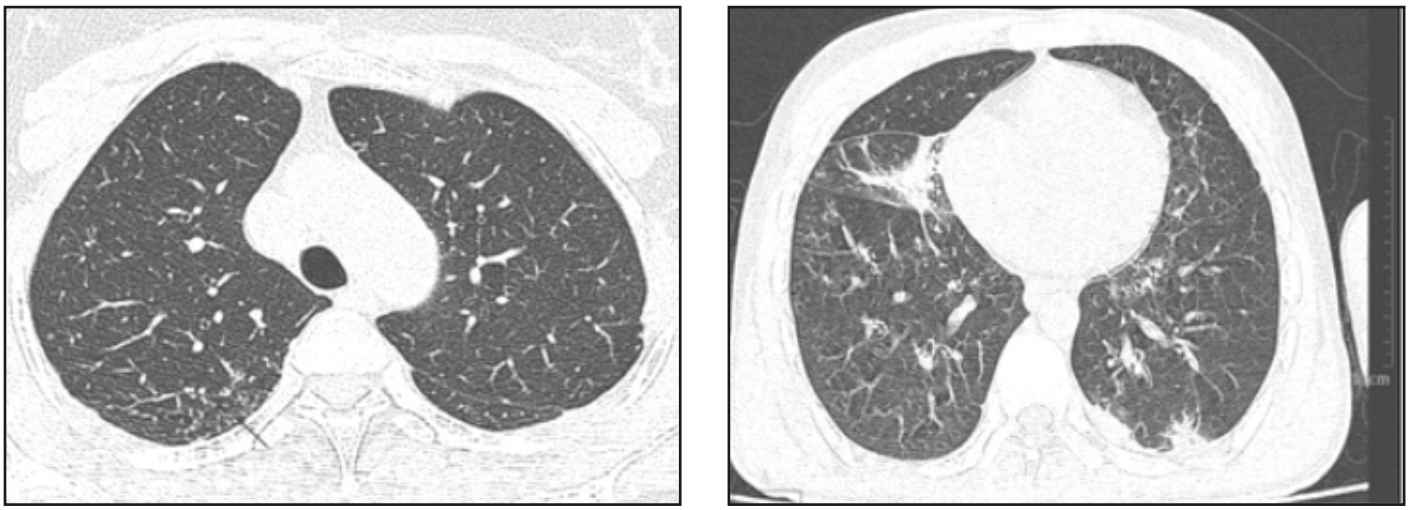

**Figure 2: CT features of two groups.**

or present), and thoracic lymphadenopathy (absent or present).

The clinical data were classified as fever (absent or present), dry cough (absent or present), stuffy or runny nose (absent or present), headache (absent or present), sore throat (absent or present), fatigue (absent or present), and myalgia (absent or present).

Univariate analysis was applied to compare the variables of these imaging findings and the clinical data between the two groups was compared using $\chi 2$ test, or Fisher exact test, or t test. Variables with p value less than 0.05 as determined by the multinomial logistic regression analysis

**Table 2**: **CT features and univariate analyses of two groups**

| CT features | Group 1 (n=21) No. of patients | % | Group 2 (n=16) No. of patients | % | p value |
|---|---|---|---|---|---|
| **Lung involvement** | | | | | |
| **Single** | 8 | 38 | 8 | 50 | 0.468 |
| **Bilateral** | 13 | 62 | 8 | 50 | |
| **No of lesions** | | | | | |
| **Single** | 5 | 23.8 | 4 | 25 | 0.933 |
| **Multiple** | 16 | 76.2 | 12 | 75 | |
| **Distribution** | | | | | |
| **Peripheral** | 19 | 90.5 | 11 | 68.75 | 0.0946 |
| **Central** | 2 | 9.5 | 5 | 31.25 | |
| **Size of GGO** | | | | | |
| **≥ 4.0 cm** | 16 | 71.5 | 4 | 25 | 0.002 |
| **< 4.0 cm** | 5 | 28.5 | 12 | 75 | |
| **GGO with reticular and/ or interlobular septal thickening** | | | | | |
| **Present** | 17 | 81 | 3 | 18.75 | 0.0001 |
| **Absent** | 4 | 19 | 13 | 81.25 | |
| **Thoracic Lymphadenopathy** | | | | | |
| **Present** | 1 | 4.76 | 2 | 12.5 | 0.393 |
| **Absent** | 20 | 95.24 | 14 | 87.5 | |
| **GGO with Consolidation** | | | | | |
| **Present** | 10 | 47.6 | 7 | 43.75 | 0.815 |
| **Absent** | 11 | 52.4 | 9 | 56.25 | |
| **Vascular Enlargement** | | | | | |
| **Present** | 15 | 71.5 | 2 | 12.5 | 0.0003 |
| **Absent** | 6 | 28.5 | 14 | 87.5 | |
| **Air Bronchogram** | | | | | |
| **Present** | 10 | 47.6 | 6 | 37.5 | 0.539 |
| **Absent** | 11 | 52.4 | 10 | 62.5 | |
| **Bronchiectasis** | | | | | |
| **Present** | 4 | 19 | 1 | 6.67 | 0.260 |
| **Absent** | 17 | 81 | 15 | 93.33 | |
| **Bronchial Wall Thickening** | | | | | |
| **Present** | 3 | 14.3 | 5 | 31.25 | 0.214 |
| **Absent** | 18 | 85.7 | 11 | 68.75 | |
| **Bronchiectasis** | | | | | |
| **Present** | 4 | 19 | 1 | 6.67 | 0.260 |
| **Absent** | 17 | 81 | 15 | 93.33 | |
| **"Tree-in-bud" opacity** | | | | | |
| **Present** | 2 | 9.5 | 6 | 37.5 | 0.040 |
| **Absent** | 19 | 90.5 | 10 | 62.5 | |
| **Centrilobular Nodules** | | | | | |
| **Present** | 3 | 14.3 | 7 | 43.75 | 0.0456 |
| **Absent** | 18 | 85.7 | 9 | 56.25 | |

were chosen as the independent predictor for diagnosis of COVID-19 pneumonia. Odds ratios (OR) as estimates of relative risk with 95% confidence intervals (CI) were obtained for each risk factor. Two sided p value of less than 0.05 was considered statistically significant. Moreover, ROC curve analysis was used to evaluate the multinomial logistic regression model.

## RESULTS

Clinical and laboratory findings of all patients with COVID-19 pneumonia and common viral pneumonia are listed in table 1. Stuffy or runny nose were found to be associated with group 2 and the other clinical manifestations had no significant difference between the 2 groups. There was no significant difference in age, sex, laboratory

data distribution between both the groups.

**Imaging features:** CT findings of COVID-19 pneumonia and common viral pneumonia are summarized in table 2. Computed tomography findings including size of GGO, GGO with reticular and/or interlobular septal thickening, "tree-in-bud" opacity, centrilobular nodules, and vascular enlargement in lesion were found to be associated with group 2 patients of pneumonia. However, there was no significant difference in lung involvement, number of lesions, distribution, pure GGO, GGO with consolidation, air bronchogram in lesion, bronchiectasis in lesion, bronchial wall thickening in lesion, adjacent pleural thickening and thoracic lymphadenopathy between both the groups of viral pneumonia.

## DISCUSSION

Clinically, common symptoms at the onset of COVID-19 were fever, cough, and fatigue.[6,10] Patients with epidemiological risk and clinical features including fever, imaging features of pneumonia, normal or reduced WBC, or reduced lymphocytes in early stages of the disease onset can be suspected COVID-19.[5,15] In the present study, COVID-19 pneumonia was characterized by a fewer frequency of stuffy or runny nose, compared with other viral pneumonia. The most common imaging findings of COVID-19 pneumonia were bilateral lung involvement, multiple lesions, peripheral distribution, pure GGO, GGO with reticular and/or interlobular septal thickening, and GGO with consolidation.[11,12,16,17]

The other viruses usually appear as multifocal patchy consolidation with GGO on chest CT, and centrilobular nodules, bronchial wall thickening, tree-in-bud opacities are also noticed.[18,19] Moreover, multifocal GGO findings suggested viral pneumonia.[19] Results demonstrated that bilateral lung involvement, number of lesions, distribution, pure GGO, GGO with consolidation, air bronchogram in lesion, bronchiectasis in lesion, bronchial wall thickening, adjacent pleural thickening, and thoracic lymphadenopathy have no significant difference between the two groups of viral pneumonia.[20,21,22]

However, GGO was 4.0 cm or greater, GGO with reticular and/or interlobular septal thickening, "tree-in-bud" opacity, centrilobular nodules, vascular enlargement in lesion were found to be associated with group 2 in univariate analysis. Compared with common viral pneumonia, COVID-19 pneumonia was more likely to have GGO of 4.0 cm or greater, GGO with reticular and/or interlobular septal thickening, and vascular enlargement in lesion, while lack "tree-in-bud" opacity and centrilobular nodules.

## CONCLUSION

GGO with reticular and/or interlobular septal thickening, absence of centrilobular nodules on computed tomography, and absence of stuffy or runny nose are presented in patients with COVID-19 pneumonia.

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