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Distribution of Chest Computed Tomography Findings in 202 Saudi Patients with COVID-19

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Abstract

Background: Computed tomography (CT) is one radiographic imaging modality that plays an essential role in detecting, characterizing, and assessing the complications of COVID-19. The aim of this study was to determine the distribution of chest CT findings in 202 Saudi patients with COVID-19.

Methods and Results: Medical records of 202 patients diagnosed in Ohod and Al-Madinah National Hospitals (Al-Madinah Al-Monwarahwith) with positive COVID-19 infection from February 1 to March 1, 2021, were analyzed in this retrospective study. A verbal ethical agreement was obtained from the radiology department in these hospitals. Patients' demographic data and chest CT findings were evaluated.

The majority of the sample was male 128(63.4%), and the largest age group was 50–64 years (41.1%). The typical chest CT findings for COVID-19 pneumonia (ground-glass opacification) were bilateral in peripheral lung fields (91.58%), subpleural zones (1.98%), and central zones (0.59%). Among COVID-19-associated findings, septal thickening was found in 4(2.0%) cases, air bronchogram in 13(6.4%) cases, lung fibrosis in 3(1.5%) cases, the atelectatic in 5(2.5%) cases, pleural effusion in 15(7.4%) cases, and pulmonary embolism in 1(0.5%) case. There was no significant difference in the COVID-19-associated findings among different age groups and genders.

***Conclusion*:** Pleural effusion and air bronchogram were the most common findings associated with ground-glass opacification in unenhanced chest CT in Saudi patients with COVID-19. (**International Journal of Biomedicine. 2023;13(2):250-254.**)

Keywords: COVID-19 • computed tomography • ground-glass opacification • plural effusion

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) presents a substantial and extreme threat to global health.[1,2] In Saudi Arabia, the first reported case was on March 2, 2020, according to the Ministry of Health.[3] As of March 29, 2023, the cumulative number of confirmed COVID-19 cases in KSA was 832,709.[4] The most common clinical symptoms of COVID-19 are fever, cough, and shortness of breath. Additional to the reverse transcription polymerase chain reaction (RT-PCR) test, radiological examination of the chest has an important role in clinical diagnostic criteria for COVID-19.[5] Most of the patients on chest radiography have abnormal findings, from subtle to extensive unilateral and bilateral abnormalities.[6,7]

Computed tomography (CT) is one radiographic imaging modality that plays an essential role in detecting, characterizing, and assessing the complications of COVID-19. Chest CT is the gold standard imaging modality for COVID-19 pneumonia; in some situations, chest X-ray or ultrasound may be an effective alternative,[8] but chest CT can detect abnormalities in the early stage of COVID-19, even when RT-PCR assay is negative.[9] The lesions on the chest CT are distributed peripherally and considered a characteristic distribution pattern of COVID-19.[10,11] The common findings of COVID-19 in CT images include bilateral multilobar ground-glass opacification (GGO) with a peripheral or posterior distribution; most of these opacities are in the lower lobes and less frequently within the right middle lobe.[12] Furthermore, there are atypical findings considered unusual in some studies, like pleural effusion and pneumothorax, and some associated findings, like pericardial effusion, lymphadenopathy, and cavitation, considered rare and related to disease progression.[13]

The aim of this study was to determine the distribution of chest CT findings in 202 Saudi patients with COVID-19.

Materials and Methods

Medical records of 202 patients diagnosed in Ohod and Al-Madinah National Hospitals (Al-Madinah Al-Monwarahwith) with positive COVID-19 infection from February 1 to March 1, 2021, were analyzed in this retrospective study. A verbal ethical agreement was obtained from the radiology department in these hospitals. Patients' demographic data and chest CT findings were evaluated (location, distribution, typical and associated findings).

Statistical analysis was performed using the statistical software package SPSS version 23.0 (SPSS Inc, Armonk, NY: IBM Corp). Baseline characteristics were summarized as frequencies and percentages. Group comparisons with respect to categorical variables are performed using the chi-square test with the Yates' correction. A probability value of $P<0.05$ was considered statistically significant.

Results

The majority of the sample was male 128(63.4%), and the largest age group was 50–64 years (41.1%) (Table 1). The typical chest CT findings for COVID-19 pneumonia (GGO) were bilateral in peripheral lung fields (91.58%), subpleural zones (1.98%), and central zones (0.59%) (Figure 1). Among COVID-19-associated findings, septal thickening was found in 4(2.0%) cases, air bronchogram in 13(6.4%) cases, lung fibrosis in 3(1.5%) cases, the atelectatic in 5(2.5%) cases, pleural effusion in 15(7.4%) cases, and pulmonary embolism in 1(0.5%) case. No COVID-19-associated findings were found in 161(79.7 %) cases (Figure 2). Pleural effusion and air bronchogram were the most common findings associated with GGO. There was no significant difference in the COVID-19-associated findings among different age groups and genders (Table 2 and Table 3). We present CT images (Figure 3-5) of COVID-19 patients with permission from Ohod and Al-Madinah National Hospitals.

Table 1.

Patients' demographic data (gender and age distribution).

Variable	Group	n	%
Gender	Male	128	63.4
	Female	74	36.6
Age	20 - 34	18	8.9
	35 -49	55	27.2
	50-64	83	41.1
	65 -80	31	15.3
	>80	15	7.4
Total	202	202	100

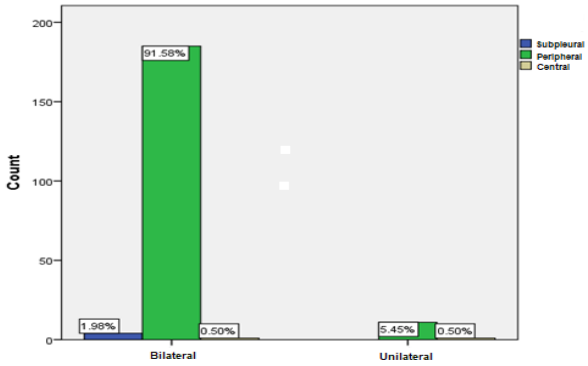

Fig. 1. *Distribution and location of the typical chest CT findings.*

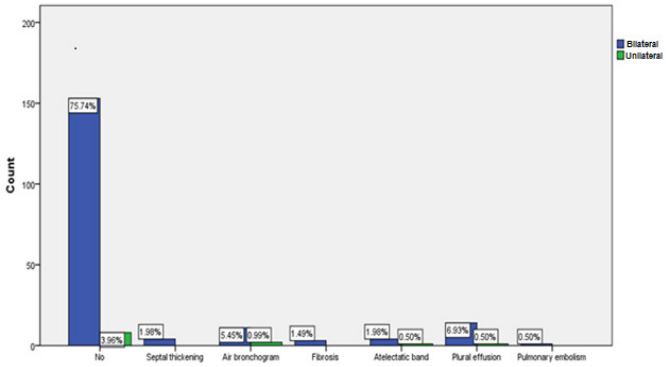

Fig. 2. *Distribution of COVID-19-associated chest CT findings.*

Table 2.

Relationship between COVID-19-associated findings and age.

Finding	Age					Total	Yates' *P*-value
	20-34	35-49	50-64	65-79	≥ 80		
No	14	41	68	24	14	161	0.814
Septal thickening	0	0	4	0	0	4	
Air bronchogram	3	5	4	1	0	13	
Fibrosis	0	0	3	0	0	3	
Atelectatic band	0	2	2	1	0	5	
Plural effusion	1	6	2	5	1	15	
Pulmonary embolism	0	1	0	0	0	1	
Total	18	55	83	31	15	202	

Table 3.

Relationship between COVID-19-associated findings and gender.

Finding	Gender		Total	Yates' *P*-value
	Male	Female		
No	102	59	161	0.911
Septal thickening	3	1	4	
Air bronchogram	10	3	13	
Fibrosis	2	1	3	
Atelectatic band	4	1	5	
Plural effusion	7	8	15	
Pulmonary embolism	0	1	1	
Total	128	74	202	

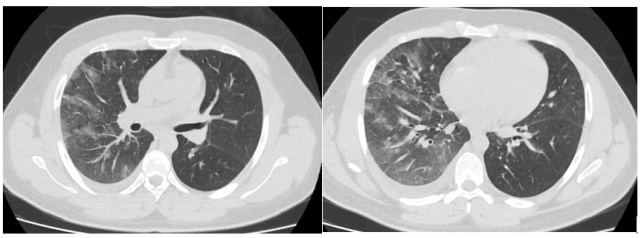

Fig. 3. *A 24-year-old male patient with COVID-19. The axial non-enhanced CT scan of the chest shows diffuse bilateral patchy areas of GGO with air space opacities peripherally located with interlobar septal thickening, more pronounced at lower lung zones and bilateral pleural effusion.*

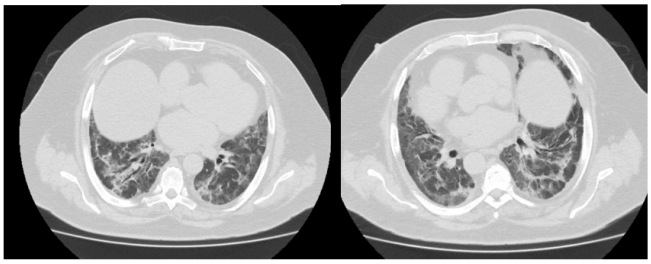

Fig. 4. *A 70-year male patient with COVID-19. The axial non-enhanced CT scan of the chest shows bilateral diffuse GGO associated with interlobular septal thickening, reticular opacity, and traction bronchiectasis.*

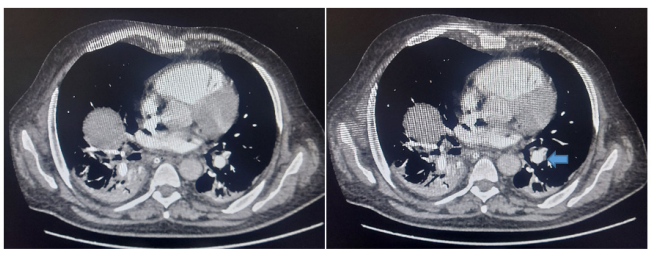

Fig. 5. *A 61-year male patient with COVID-19. The contrast-enhanced CT scan of the chest shows a partial filling defect in the left interlobar artery and segmental branch (arrow), suggesting pulmonary embolism in the left interlobar artery and segmental branch.*

Discussion

The study evaluated typical and COVID-19-associated chest CT findings in 202 patients with positive PCR tests. The most affected patients were males aged between 50 and 64; this finding matches most research on COVID-19. For example, in the studies by Zhou et al.[14] and Aljondi R. et al.,[15] the most infected patients were also men (62.9% and 77.9%, respectively).

Gender differences are frequently observed in many diseases. The relationship between males and COVID-19 rises from different factors, such as gender differences in the activity of the immune system and its modulation by sex hormones, coagulation patterns, and preexisting cardiovascular diseases, as well as effects deriving from smoking and drinking habits.[16] Older patients are more affected by the disease.[17]

Our study found the typical GGO CT findings for COVID-19 pneumonia in both lungs, involving the peripheral zones, in 91.58% of cases. The result of this study is consistent with the data of Wang et al.[11] and Pakdemirli et al.,[18] who found that multi-lobe lesions in both lungs were present in most patients. The justification for the lesion's peripheral distribution is that the virus is more likely to invade bronchioles and alveoli,[19] which causes inflammatory reactions. Moreover, blood vessels and lymphatics rich in immune cells are more abundant in the peripheral and lower areas, so the lesions tend to distribute in the peripheral and lower area of the lungs.[20] Our study found the same atypical COPVID-19-related findings as mentioned by Fang et al.[21]

Some studies reported the presence of subpleural sparing, bilateral pleural effusion, and septal thickening as associated findings of CT in COVID-19 patients,[22] and other studies consider that pleural effusion is a rare manifestation of COVID-19 infection.[23,24] Furthermore, the presence of pleural effusion could serve as an indicator of severe inflammation and poor clinical outcomes and lead to a critical type of COVID-19.[25] Our results are consistent with the data obtained by Wei et al.,[26] who observed pleural effusion in 9.19% of the patients. Patients' circumstances with pleural effusion worsened critically and were associated with increased mortality.

Air bronchogram was defined as a pattern of air-filled (low-attenuation) bronchi on a background of opaque (high-attenuation) airless lung.[27] Air bronchogram is usually a sign of advanced disease and can be seen in both GGO and consolidation. Air bronchogram has variable incidence in different reports ranging from 28 to 80% of patients.[28-30] We found air bronchogram in 13(6.4%) cases.

Bronchial wall thickening, subpleural line, and pericardial effusion manifested beside plural effusion as associated findings of COVID-19 in CT images in a study by Wu et al.[31] that is identical to our study as find the same associated findings in CT scan related to COVID-19. A study by Li et al.[32] found a significantly higher percentage of bronchial wall thickening in patients with severe/critical COVID-19.

Current literature reports pulmonary embolism in 22–30% of patients affected by COVID-19.[33-37] In our

study, we reported one patient with a pulmonary embolism. Nevertheless, pulmonary embolism is considered one of the COVID-19-associated findings in severe cases.

Our study found no significant difference in the COVID-19-associated findings among different age groups and genders.

Conclusion

Pleural effusion and air bronchogram were the most common findings associated with GGO in unenhanced chest CT in Saudi patients with COVID-19.

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Competing Interests

The authors declare that they have no competing interests.

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