Original Article

Spectrum of Chest Computerized Tomographic Findings in Novel Coronavirus Disease-19

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Abstract

Background: Coronavirus disease-19 (COVID-19) is a zoonotic viral disease caused by nonsegmented, enveloped, positive-sense, single-strand ribonucleic acid coronavirus. Recent outbreak started in Wuhan, China, where a new type of coronavirus was isolated from respiratory samples such as bronchoalveolar lavage and sputum of patients developing respiratory symptoms. The World Health Organization declared COVID-19 a pandemic on January 20, 2020. On April 6, 1,288,080 were infected with this virus with 70,567 deaths. Computerized tomography (CT) is the investigation of choice for diagnosing, managing, and accessing temporal changes in COVID-19. **Objective:** The objective of this study is to describe the chest CT findings in documented nCovid-19-positive patients. **Methodology:** This was a retrospective observational study done in Government Medical College, Chest Disease Hospital from February 20 to April 25, 2020. Forty-eight patients with COVID-19 reverse transcriptase-polymerase chain reaction-positive test were scanned on 64 slice Somatom CT scanner and findings analyzed. All patients with previously underlying chest disease were excluded. **Results:** The various chest findings in the nCovid-19-positive patients include ground glassing, (81.25%), consolidation (56.25%), nodules (43.75%), halo sign (31.25%), crazy paving pattern (50%), air bronchogram (12.5%), air bubble sign (6.25%), vascular enlargement (25%), reversed halo sign or atoll sign (18.75%), bronchial wall thickening (6.25%), and mosaic attenuation (6.25%). None of the patients had pleural effusion. **Conclusion:** Characteristic CT findings of COVID-19 can help radiologists in the early diagnosis of symptomatic patients in whom testing is awaited. Bilateral peripheral ground-glass opacities with consolidation in dependent parts of the lung along with the absence of pleural effusion were the most common abnormality.

Keywords: Coronavirus, mosaic attenuation, reverse transcriptase-polymerase chain reaction

Introduction

Coronavirus disease-19 (COVID-19) is a zoonotic viral disease caused by nonsegmented, enveloped, positive-sense, single-strand ribonucleic acid coronavirus.[1] Recent outbreak started in Wuhan, China, where a new type of coronavirus was isolated from the respiratory samples such as bronchoalveolar lavage, sputum of patients developing respiratory symptoms. Major symptoms of Covid-19 are fever, cough, breathlessness, and fatigue. The mean incubation period is 5.2 days, with high human-to-human transmission.[2] Before nCovid-19, coronavirus has been associated with middle east respiratory syndrome (MERS), severe acute respiratory syndrome (SARS) coronavirus, and other milder respiratory symptoms. SARS was transmitted through large droplets and direct inoculation.[3] MERS coronavirus is transmitted mainly through nonhuman, zoonotic sources such as bats and camels.[4,5] The World Health Organization declared COVID-19 a pandemic on January 20, 2020.[6] On April 6, 1,288,080 were infected with this virus with 70,567 deaths.

Computerized tomography (CT) is the investigation of choice for diagnosing, managing, and accessing temporal changes in COVID-19.[7] Virus binds to angiotensin-converting enzyme-2 (ACE2) receptor starting with pulmonary interstitial changes followed by parenchymal changes.[8] Bilateral peripherally distributed ground-glass opacities (GGO) with or without consolidation in posterior aspect of lungs has been characteristic imaging finding on CT.[9,10]

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Objective

The objective of this study is to describe the chest CT findings in documented nCovid-19-positive patients.

Methodology

This was a retrospective observational study done in Government Medical College, Chest Disease Hospital from February 20 to April 25, 2020. Forty-eight patients with COVID-19 reverse transcriptase-polymerase chain reaction (RT-PCR) positive test was scanned on 64 slice Somatom CT scanner. All patients with previously underlying chest disease were excluded. We describe chest CT Imaging findings in these cases. Chest CT findings vary with time course and severity of disease.[11,12] Categorical values were presented with absolute and relative frequencies (%).

Results

Most of our patients were in the age group of more than 60 years with predominance of male patients [Tables 1 and 2]. The various findings found in our study patients are summarized in Table 3.

Discussion

Ground glassing

Ground glassing is defined as the areas of increased pulmonary attenuation without obscuration of lung markings caused by partial replacement of air in air spaces by fluid, cells, etc.[13] In patients with COVID-19 peripheral, subpleural areas of ground glassing with unilateral or bilateral distribution are most commonly seen.[14-16] GGO as the most common imaging found in 98% cases.[17] In our study, ground glassing [Figures 1-4] was found in 39 out of 48 patients (81.25%).

Consolidation

Consolidation is defined as the areas of increased pulmonary parenchymal attenuation that obscures the margins of underlying vessels and airway walls.[13] Multiple peripheral focal or segmental consolidations in peri-brochovascular distribution with occurrence rate of 2%–64% are seen in Covid patients.[17-19]

Table 1: Age distribution of patients

Age (years)	Number of patients (%)
1-20	3 (6.2)
21-40	10 (20.8)
41-60	14 (29.1)
>60	21 (43.7)
Total	48 (100)

Table 2: Gender distribution of patients

Gender	Number of patients (%)
Males	35 (72.9)
Females	13 (27.1)
Total	48 (100)

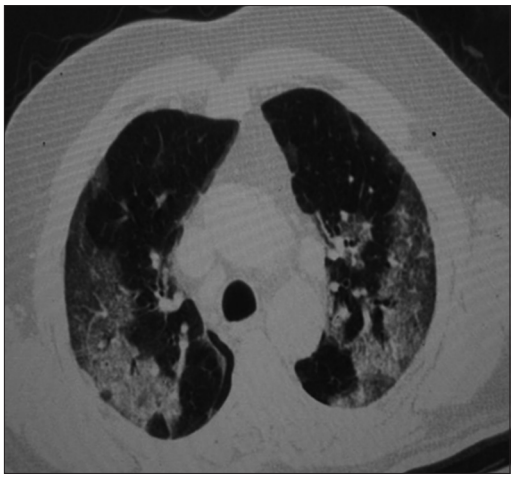

Figure 1: Axial computerized tomography image of lung showing evidence of ground glassing along with crazy paving in posterior segments of bilateral lungs

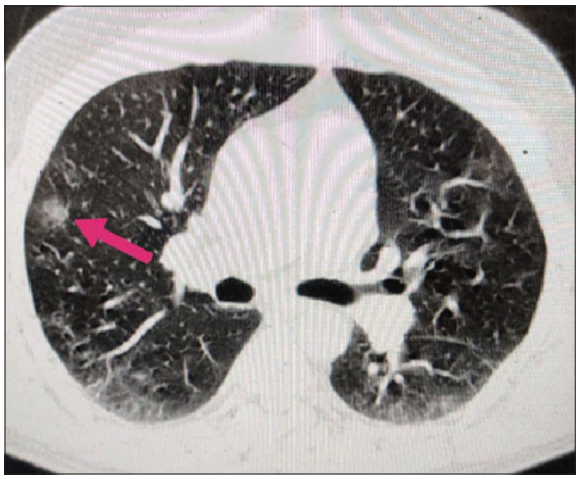

Figure 2: Axial computerized tomography image shows evidence of ground glassing in superior segments of bilateral lower lobes along with Halo sign surrounding nodule in anterior segment of right upper lobe (arrow)

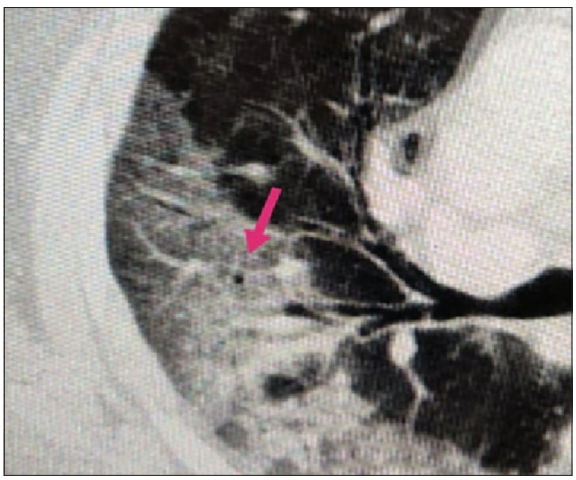

Figure 3: Axial computerized tomography image shows evidence of ground glassing, consolidation along with air bubble sign (pink arrow)

In our study, multiple consolidations [Figures 5-7] was found 56.25% of the total number of patients (27 out of 48 patients).

Nodules

A nodule is defined as rounded or irregular opacity with well- or poorly defined margins with size <3 cm in diameter.[13] Multiple solid irregular nodules or nodule with surrounding halo have been found in 3%–13% of COVID-19 patients.[14,20] In our study, 43.75% of the patients were found to have nodules [Figure 2].

Halo sign

Halo sign is defined as the area of ground glassing surrounding nodule or mass.[13] Li *et al*.[21] reported a case of halo sign in a 27-year-old female COVID-19 patient. In our study, 15 out of 48 patients had Halo sign [Figure 2] (31.25%).

Crazy-paving pattern

Crazy-paving pattern is defined as areas of inter/intralobular septal thickening with superimposed ground glassing.[13] Crazing paving is seen in 5%–36% COVID-19 patients.[16,18]

Figure 4: Axial computerized tomography showing evidence of bilateral peripheral ground glassing areas with vascular enlargement (pink arrow)

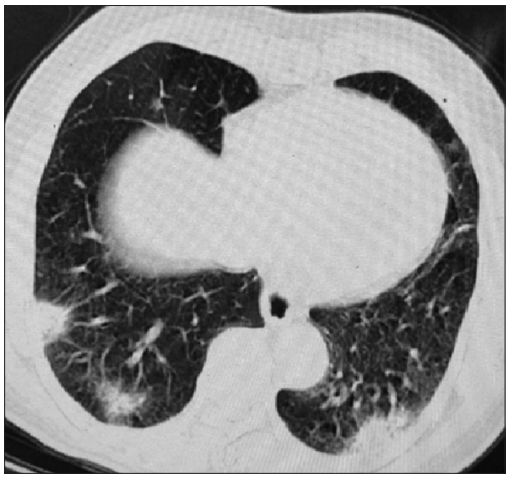

Figure 6: Axial computerized tomography image revealing bilateral peripheral-dependent consolidations

In our study, 50% of the patients were found to have crazy paving patterns [Figure 1].

Table 3: Frequency of findings in Covid positive patients

Findings	Number of patients (%)
Ground-glass opacities	39 (81.25)
Consolidation	27 (56.25)
Nodules	21 (43.75)
Halo sign	15 (31.25)
Crazy paving	24 (50)
Air bronchogram	6 (12.50)
Air-bubble sign	3 (6.25)
Vascular involvement	12 (25)
Reverse halo sign	9 (18.75)
Bronchial wall thickening	3 (6.25)
Mosaic attenuation	3 (6.25)

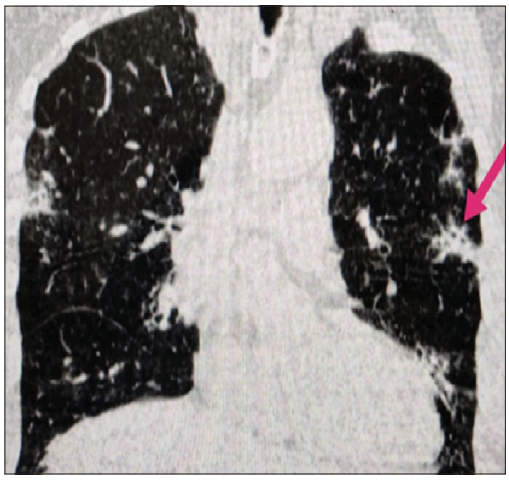

Figure 5: Coronal computerized tomography image revealing the evidence of multiple consolidations in bilateral lung with air bronchogram sign (pink arrow)

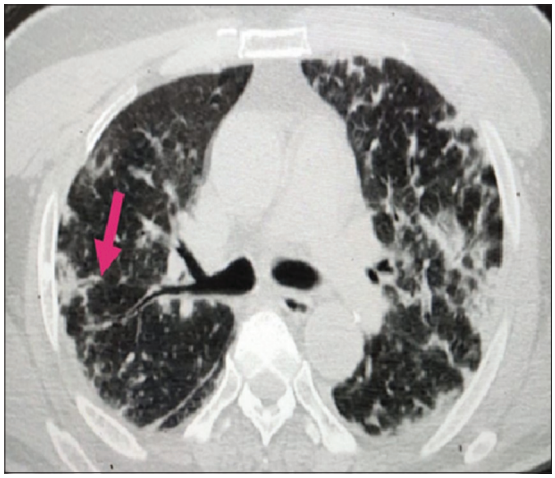

Figure 7: Axial computerized tomography image revealing evidence of bilateral multiple consolidation, interlobular septal thickening, ground glassing with peribronchial thickening (pink arrow) associated with right-sided consolidation

Figure 8: Axial computerized tomography image revealing evidence of areas of ground glassing, consolidations, and nodules. Note reverse halo sign on the right side (arrow)

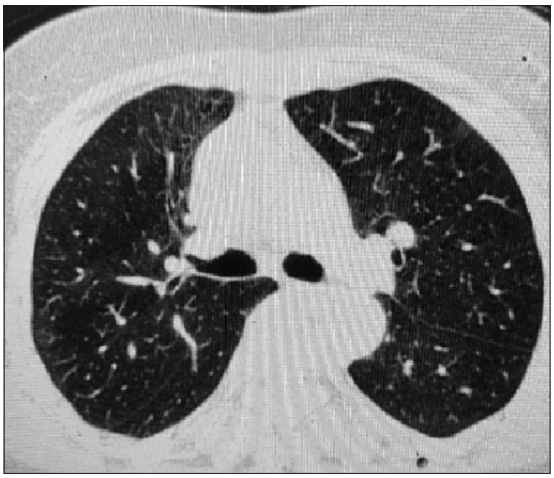

Figure 9: Axial computerized tomography image revealing evidence of mosaic attenuation in right lung (areas of subtle ground glassing with increased lucency)

Air bronchogram

Air-filled bronchi seen within opaque (high attenuation) airless lung/Consolidation has been documented in CT of Covid patients.[15,22] In our study, we found 6 out of 48 patients had air bronchogram sign within consolidations [Figure 5] (12.5%).

Air bubble sign

Air bubble sign refers to a small air-containing space in consolidation or ground glassing. Shi *et al*. termed this sign as round cystic change in their study,[11] whereas Kong *et al*. reported it as cavity sign.[23] In our study, only 3 out of 48 patients were found to have air bubble sign [Figure 3].

Vascular enlargement

The presence of dilated pulmonary vessels around and within the lesions on CT images was found in RT-PCR-negative COVID-19 patient who was admitted to a hospital 6 days after the symptom onset.[24] In our study, we found 25% of the total number of patients having vascular enlargement [Figure 4].

Reversed halo sign or atoll sign

Atoll sign is defined as the area of ground glassing surrounded by a more or less complete ring-like consolidation.[13] It has been seen in several COVID-19 cases representing disease progression or lesion absorption.[18,22,25,26] In our study, 9 out of 48 patients were found to have reverse Halo sign [Figure 8] which accounted for 18.75% of the total number of patients.

Bronchial wall thickening

About 10%–20% COVID-19 patients have inflammatory thickening of bronchial wall.[17,19] The incidence of bronchial wall thickening is more common in severe/critical patients than ordinary patients.[17] In our study, 6.25% (3 out of 48) of the total number of patients had bronchial wall thickening [Figure 7].

Mosaic attenuation

Although mosaic attenuation has not been previously documented in Covid-19 but 3 of our patient had mosaic attenuation [Figure 9], accounting for 6.25%s of the total number of patients.

Absence of pleural effusion

None of the patients had pleural effusion.

Summary and Conclusion

Characteristic CT findings of COVID-19 can help radiologists in the early diagnosis of symptomatic patients in whom testing is awaited. Bilateral peripheral ground-glass opacities with consolidation in dependent parts of lung along with the absence of pleural effusion were the most common abnormality. Majority of the patients had combination of above described findings. Other common CT features include crazy paving, nodules, and halo sign. Less common signs include vascular enlargement, Atoll sign, bronchial wall thickening, air bronchogram, and air bubble sign. However, these findings are nonspecific can be seen in different viral pneumonias. Follow-up CT is not recommended in case of cure from disease.

Teaching point

Findings of Covid-19 are similar to cryptogenic organizing pneumonia, but they occur in acute settings following a viral prodrome of fever, cough, fatigability, etc.

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Conflicts of interest

There are no conflicts of interest.

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