

Pattern of lobar distribution of high-resolution computed tomography manifestations of covid-19 positive patients

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Abstract

Introduction: COVID-19 is a viral infectious disease that was announced to be a pandemic. It is caused by Coronavirus or SARS-CoV. Early diagnosis and treatment help with controlling the spread of this disease. Imaging has been considered to complement clinical evaluation and laboratory parameters in the management of patients already diagnosed with COVID-19.

Material and methods: A cross-sectional descriptive study was carried out in 100 COVID-positive cases. High-resolution CT of the chest was done in positively tested COVID-19 patients using a 32-slice CT machine. The HRCT lung manifestations and related signs of these patients were analyzed.

Results: Ground glass opacities (98%) were the most encountered pattern followed by pulmonary consolidations in (72%), crazy paving pattern (33%), reversed halo (5%), and fibrosis (24%). 71% of patients had ground glass opacities along with consolidation. Lower lobes were predominantly involved. (41%) patients had moderate disease, (30%) of patients had mild disease and (29%) of patients had severe disease. The lesions were predominantly located in only the peripheral subpleural region in (65%) cases, while central and peripheral distribution of lesions were seen in (30%) cases.

Conclusion: Ground glass opacities and consolidation were the most common imaging findings in HRCT of

COVID-19 patients. The lower lobes were more severely involved than the upper and middle lobes.

Lesions were involving the peripheral subpleural locations than the central location.

Keywords: COVID-19, HRCT, ground glass opacities, consolidation, fibrosis, crazy paving pattern, reversed halo.

Introduction

COVID-19 is a viral infectious disease that was announced to be a pandemic. It is caused by Corona virus or SARS-CoV causing various symptoms between fever, dry cough, myalgia, dyspnea, and generalized weakness. The disease is spread by aerosol transmission. The diagnosis was done by reverse transcriptase polymerase chain reaction (RT-PCR) or rapid antigen test (RAT).

Imaging of the chest is a part of the diagnostic workup of patients with COVID-19 disease. Imaging has been considered to complement clinical evaluation and laboratory parameters in the management of patients already diagnosed with COVID-19. [1]

HRCT was done in all positive patients and the imaging findings were documented. The severity score was calculated based on lung involvement percentage for each patient by scoring the percentage of each lobe involvement individually and given a score from 1 to 5 where:

Table 1: Severity scoring of COVID-19

| Score | Lobar Involvement (%) |
|-------|-----------------------|
| 0 | No |
| 1 | <5% |
| 2 | 5–25% |
| 3 | 26–50% |
| 4 | 51–75% |
| 5 | > 75% |

Then, the final score will be the sum of individual lobar scores and will be out of 25 (total score).

The severity of the disease was based on the score with mild being between 1 – 8, moderate being between 9 – 15, and severe being between 16 – 25.

Aims and Objectives

To identify the patterns of imaging findings on HRCT in COVID-19 patients. To study the pattern of lobar distribution of these findings on HRCT.

To identify the severity of the disease based on lobar distribution of findings in COVID-19 patients.

Materials and Methods

A cross-sectional descriptive study was carried out in COVID-positive cases. High-resolution CT of the chest was done in positively tested COVID-19 patients using a 32-slice CT machine with all precautions recommended by Indian Radiological and Imaging Association (IRIA). [2]

This study was performed on 100 patients coming to the department of radiodiagnosis in our tertiary rural health care center.

All CT Requisitions were analyzed for appropriateness before the procedure. Patients were masked during imaging. Two radiology technicians performed the CT scans. One technician used PPE kit (Personal protective equipment) and set up the patient on the CT imaging table, while the other technician operated the CT console. After the CT was performed, the scanner and console room were sanitized with 1% sodium hypochlorite solution. Room downtime was around 40 to 45 minutes. The HRCT patterns of all scanned patients were documented. CT severity scores (out of 25 with a maximum of 5 scores for each lobe) were given for each case.

The collected data were tabulated and analyzed using Microsoft Excel. The categorical data were presented as frequency and percentage tables. Inclusion criteria: COVID-19-positive patients

Exclusion criteria: RT-PCR/RAT negative patients and Patients having a CT severity score of 0.

Results

Chart 1: HRCT Lung patterns.

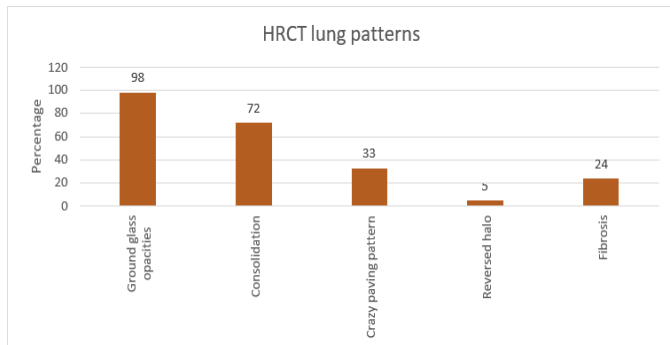


Chart 1: Ground glass opacities were the most commonly encountered pattern of pulmonary changes and were seen in (98%), with pulmonary consolidations in (72 %). Other findings like crazy paving patterns were seen in (33 %), reversed halo in (5%), and fibrosis was evident in (24%). 71% of patients had ground glass opacities along with consolidation.

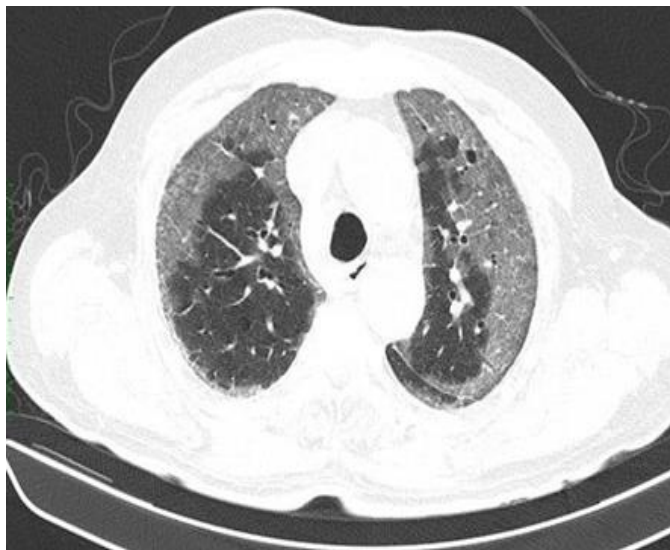


Figure 1: Case of COVID-19-positive patient showing peripheral ground glass opacities in both upper lobes.

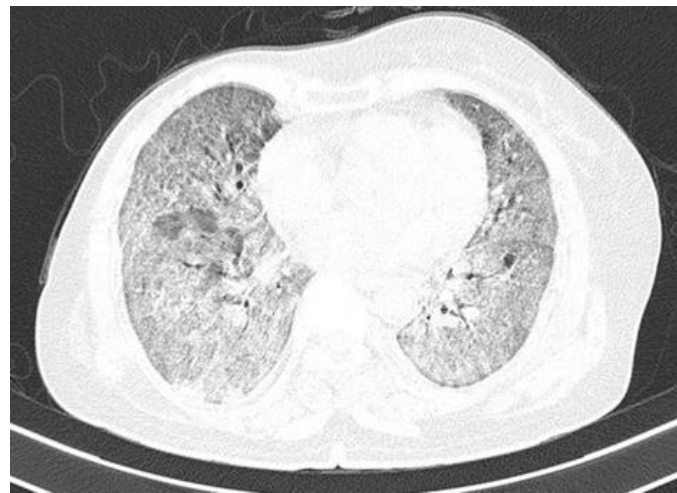


Figure 2: COVID-19-positive patient with patchy consolidation in posterior-basal segments of both lower lobes with diffuse ground glass opacities.

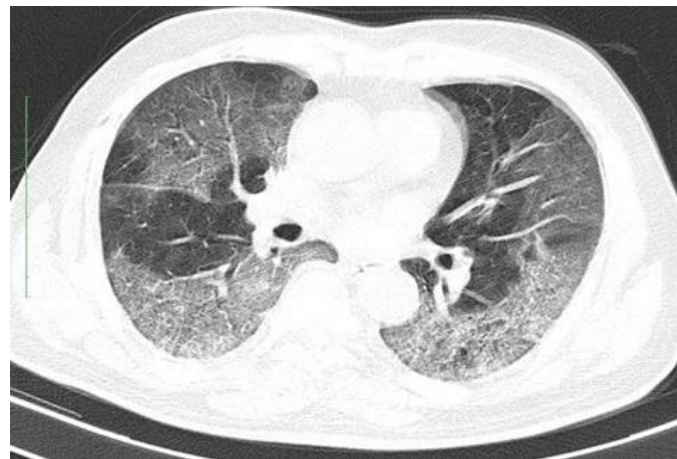


Figure 3: A case of COVID-19-positive patient with diffuse ground glass opacities and crazy paving pattern.



Figure 4: A case of COVID-19-positive patient showing fibrotic bands in both lower lobes.



Figure 5: COVID-19 positive case with reversed halo (à).

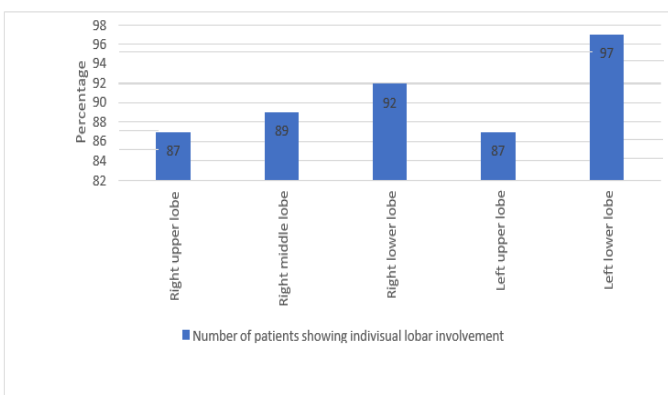


Chart 2: Number of patients showing individual lobar involvement.

Chart 2: Lower lobes were predominantly involved with left lower lobe (91%) and right lower lobe (92%). Whereas right middle lobe was involved in (89%) cases, right upper lobe was involved in (87%) cases and left upper lobe was involved in (87%) cases.

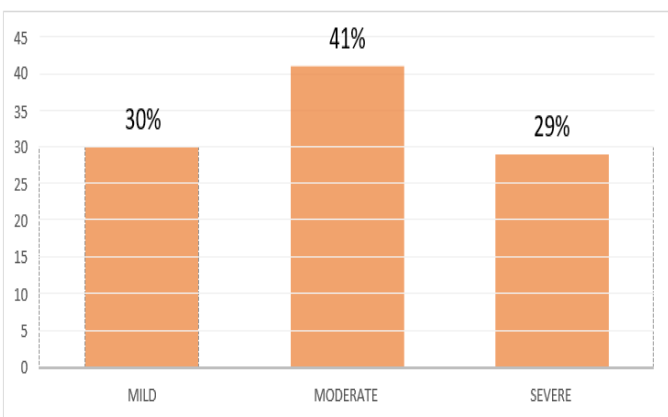


Chart 3: Disease severity.

Chart 3: Based on CT severity scores, (41%) patients had moderate disease, (30%) patients had mild disease and (29%) patients had severe disease.

Chart 4: Central or peripheral distribution of lesions

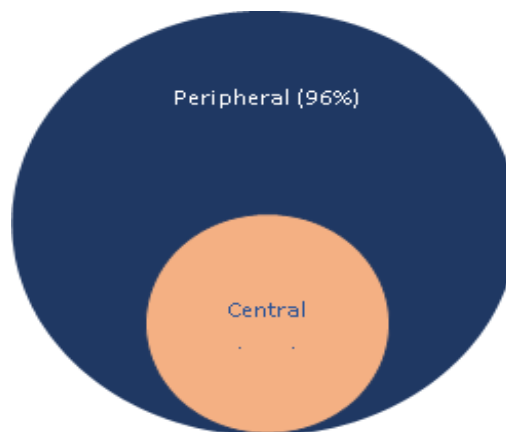


Chart 4: The lesions were predominantly located in only peripheral subpleural region in (65%) cases, while central and peripheral distribution of lesions were seen in (30%) cases.

Discussion

Chest HRCT scans are helpful for screening, treatment, management, and follow-up evaluation of patients with COVID-19 infections. HRCT patterns of COVID 19 infection are related to the pathogenesis of the viral infection [3]. This study shows ground glass opacities and consolidation to be the most common HRCT features (98% and 72% cases respectively), compared to other studies such as, study conducted by Yan Li and Liming Xia also showed singular or multiple irregular areas of ground glass opacities or consolidation or both in 49 of the 51 cases (96.1% patients) [4]. Angiotensin converting enzyme II (ACE II) is essentially involved in the development and progression of acute lung injury [5]. SARS CoV causes direct lung injury by involving angiotensin converting enzyme, which leads to diffuse alveolar damage [3]. This probably explains the pathologic mechanism of ground glass opacities and

consolidation. The ACE II expression is severely downregulated or absent in actively proliferating pneumocytes during lung fibrosis (type I-pneumocytes), that appear replacing the damaged alveolar type II pneumocytes [6]. Crazy-paving pattern defined as thickened interlobular and intralobular septae superimposed on diffuse ground-glass opacities by the Fleischner Society [7] is also commonly seen in around 33% of cases. Crazy paving pattern may indicate interstitial inflammation and alveolar damage in COVID-19, which had been previously noted in patients with Middle East Respiratory Syndrome (MERS) and the Severe Acute Respiratory Syndrome (SARS) [8]. The reversed halo sign or Atoll sign is a central ground glass opacity surrounded by rim of consolidation. This sign was found in approximately 5% of cases which is consistent with other studies such as Bernheim et al. [9] reported in 1.7% cases and Wang et al. [10] study showed this sign in 5.1% cases.

Conclusion

Ground glass opacities and consolidation were the most common imaging findings in HRCT of COVID-19 patients. Lower lobes were more severely involved than upper and middle lobes. Lesions were involving the peripheral subpleural locations than central location.

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Abbreviations

CT: Computed Tomography

HRCT: High resolution Computed Tomography

RT-PCR: Reverse transcriptase polymerase chain reaction
RAT: Rapid antigen test

PPE: Personal protective equipment

ACE II: Angiotensin converting enzyme II
MERS: Middle East Respiratory Syndrome
SARS: Severe Acute Respiratory Syndrome