ORIGINAL RESEARCH ARTICLE

First and Second Waves of Coronavirus Disease: A Retrospective Observational Study of HRCT Chest Findings in COVID -19 Virus Pandemic in Tertiary Center in Western India

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A B S T R A C T

Introduction: Corona virus disease (COVID-19) has spread in a rampant manner all over the World. Two waves had already traumatized India severely and the first wave of covid pandemic period in August -October of 2020, and the second between April and May 2021.

Material and methods: This retrospective study included 134 patients (admitted and OPD based) including 70 patients infected within the first wave and another 64 patients infected in the second waves to our institute with a diagnosis of COVID-19 infection by RT-PCR testing. Patients underwent high-resolution CT (HRCT) chest examination and images were evaluated for presence of lung lesions & CT severity score was assigned to each patient based on lung lobes involved.

Results: Ground-glass opacities with or without consolidation, interlobular septal thickening, the "reversed halo" sign were common CT features of COVID-19 in both waves. Unexpectedly, pulmonary thromboembolism found in first wave and other atypical radiological signs were only encountered through the second pandemic wave, including bronchiectasis and fibrotic changes, pneumothorax, cavitation due to fungal infection and pleural effusion. The most frequent signs and symptoms in both waves were fever, dyspnea, and cough, and the most relevant comorbidities were cardiovascular diseases and type 2 diabetes mellitus.

Conclusion: Chest HRCT can be a very useful and standard imaging method to assess the severity and progression of the disease in COVID-19 and thereby optimizing the management of these patients. These results might help to understand the characteristics of the both wave of COVID-19 in India with their behavior and danger.

Keywords: Atoll Sign; Coronavirus; COVID-19; Crazy Paving; Ground Glass Opacities; Fungal Infection; RT-PCR; SARS-CoV-2

INTRODUCTION

Corona virus disease 2019 (Covid 19) is an infectious disease caused by severe acute respiratory syndrome coronavirus -2 also known as the 2019 novel coronavirus. First case came in Wuhan china in December 2019 and the outbreak was officially recognized as a pandemic on 11 march 2020.[1] Sars-cov-2 is a member of beta coronavirus genus and sars-cov-2 is indirectly zoonotic it originally arose from an animal species (bat) but transmission is now primarily inter human and the cause of death is usually respiratory failure secondary to alveolar injury.[2] Common symptom include fever, cough and dyspnea while the disease has potential to cause a host severe and potential fatal cardiorespiratory complication in vulnerable population-particularly the elder with comorbid condition.[3,4]

Disease was first reported in India on January 30, 2020, and the total number of cases in India has reached 1.9 lac with 5500 fatalities as of May 31, 2020.[5] Prompt recognition of disease is invaluable to ensure timely treatment and from a public health perspective, rapid patient isolation is crucial for containment of this communicable disease.[5,6] Because of primary involvement of the respiratory system and with growing global concerns about the covid -19 outbreak, a comprehensive understanding of the diagnostic imaging hallmarks chest radiographic imaging is essential for effective patient management and treatment. [6]

We performed this observational retrospective study using HRCT chest to highlight the radiological differences between the first and second pandemic waves and correlate them to the clinical status. In this study, we characterize chest HRCT findings in 134 patients (70 patients from 1st wave that happened in mid of 2020 and 64 patients from 2nd wave that occurred in April-May 2021) infected with

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COVID-19 in the Kota District of Rajasthan State of India. The aim of our study is to evaluate the spectrum of HRCT findings in COVID-19 infected patients and we also evaluate the performance of HRCT in the diagnosis of COVID-19 infection. We further assess the severity of disease based on HRCT findings, to establish the role of HRCT chest as an investigative modality of choice for prognosis of COVID-19 infected patients.

MATERIAL AND METHODS

Retrospective study was done in Department of Medicine and Dept. of Chest & TB of our Institute in August to October 2020 and April- May 2021. Sample size was 134.

Inclusion criteria

All patients diagnosed to be COVID-19 infected by RT-PCR testing method tested at Gov. approved laboratory at the Dept. of Microbiology of our institute.

Exclusion criteria

Pregnant patients and debilitated patients requiring ventilator support not in a position to be shifted to CT Department

Our institute was categorized as a dedicated COVID tertiary care Hospital by the administration. Institutional Ethics committee approval was taken. From August to October, 2020 and April- May 2021, 134 COVID-19 positive patients OPD based and admitted to our hospital in Kota district of Rajasthan State of India who undertook chest HRCT were included in our study. We additionally collected information related to age, sex and clinical history. All patients were tested for COVID-19 infection with real-time reverse- transcriptase polymerase chain reaction (RT-PCR) of secretions obtained by nasopharyngeal swab. All CT scans were performed on GE CT Scan Brightspeed slice CT scanner (GE Healthcare, USA). HRCT thorax was performed with the patient in the supine position during end-inspiration without contrast injection, however we performed contrast study in pulmonary thromboembolism suspected cases. The patients who were referred from wards to CT Department and the CT technicians who performed CT of patients with suspected COVID-19 wore personal protective equipment (PPE) and N95 masks. Standard CT protocol was used with topogram length of 512 cm, 120 kV and 35 mA. Images were attained in axial mediastinal and lung window and reconstructed in thin 0.625-1.25 mm lung window. All CT images were reconstructed to 0.625-1.25-mm thin slices. At work station Multiplanar images were acquired using the multiplanar reformatting (MPR) technique. Our CT department was fumigated for at least 3-4 hours using 20% Baccishield, then followed by cleaning of CT gantry, CT table and floor of gantry room by 1% hypochlorite solution and left to dry for 30-40 minutes after the CT scans of all daily appointed COVID-19 positive patients.[7] For each patient, the chest CT scan was thoroughly evaluated for presence of ground glass opacities, consolidation, interlobular septal thickening and other lung pathologies.[8] Each of the five lung lobes were assessed for degree of involvement, which was classified as none (0%), minimal (1%–5%), mild (5-25% and 26%–50%), moderate (51%–75%), or severe (76%–100%). If there is no involvement of lobe then associated to a lobe score of 0, minimal involvement to a lobe score of 1, mild involvement to a lobe score of 2 &3, moderate involvement to a lobe score of 4, and then severe involvement to a lobe score of 5. An overall lung total severity score was all-inclusive by summing the five lobe scores which ranges from of possible scores 0 to25. [8, 9, 10]

CT evaluation

Multi-planar reconstruction (MPR) and maximum intensity projection (MIP) reconstruction was performed for CT images and utilized for nodular and reticular assessment, while the minimum intensity projection (Min-IP) reconstruction was utilized for airway assessment and mosaic attenuation characterization.

The following CT findings were evaluated between the patients throughout the first and second COVID-19 pandemic waves: [8, 9, 10]

A.-Preexisting lung comorbidity; including Chronic obstructive pulmonary disease, Interstitial lung disease, lung neoplasms and miscellaneous conditions i.e. TB and Sarcoidosis.

B.-Multi slice CT findings during the first two weeks of infection demonstrated following imaging findings, including:

Ground-glass opacities with or without consolidative changes.

"Atoll sign" revealed as central ground-glass attenuation with peripheral consolidation.

"Crazy-paving pattern" present as ground-glass attenuation with septal thickening

Cavitary changes due fungal infection.

Airway involvement including bronchial wall thickening, bronchiectasis and tree in bud nodules and peri-lobular fibrosis.

Substantial mediastinal or hilar lymph node expansion (Short axis diameter more than 1 cm).

Pleural effusion

Pneumo-mediastinum which includes spontaneous if not preceded by oxygen therapy or due to post intubation.

Pericardial effusion

Signs of secondary bacterial or fungal infection.

C: CT severity score in mild (1-8), moderate (9-15) and severe (16-25).

RESULTS

In the present conducted study, 134 cases were enrolled who fulfilled the inclusion criteria. We have taken patient data from 1st wave of covid pandemic that happened in India in mid of 2020 and 2nd wave that occurred in 2021(April, May). Among them 70 patients from 1st wave of covid pandemic, highest number of cases presented were in the age group of 41-60 years (28 cases – 40%), followed by 21-40 years (21 cases-30%), and followed by more than 60 years age group (19 cases-27.14%). Sixty-four patients were taken from 2nd wave of covid pandemic and highest number of cases presented in the age group of 41-60 years (28 cases –51.56%), followed by more than 60 years age group (15 cases-23.43%), and then followed by 21-40 years (13 cases-20.31%). The study included 42 males (61.53%) and 28 females (38.47%)

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from 1st wave and 35 males and 29 females from second wave (Table 1).

Symptoms noticed in patients were fever, cough, sore throat, shortness of breath, malaise and diarrhea. Fever with cough reported 71.42% of cases in 1st wave and 65.62 % of case in 2nd wave. Shortness of breath 42.85% of cases in 1st wave and 59.37% of cases in 2nd wave. Sore throat occurred in 57.14 % of cases in 1st wave and 43.75 % cases in 2nd wave. Generalized malaise seen in 40% patients in 1st wave and 46.87% cases in 2nd wave. Diarrhea cases reported in 8.57 % case in 1st wave and 15.6 % cases in 2nd wave (Table 2).

	No. of Patients			
Age	**1st wave**	**1st wave percentage**	**2nd wave**	**2nd wave percentage**
0-20	2	2.85	3	4.68
21-40	21	30	13	20.31
41-60	28	40	33	51.56
> 60	19	27.14	15	23.43

Table-1: Age wise distribution in covid 19 patients

HRCT examination ranging from ground glass opacities to GGO's with consolidation or crazy paving appearances affecting one or multiple lobes. Based on HRCT findings and on subsequent clinical evaluation the clinicians placed these patients under close clinical monitoring and hospitalization for 14 days. HRCT chest with findings were reported in 55 patients from 1st wave and 49 patients from 2nd wave, among them bilateral lung involvement seen in HRCT findings in 45 patients of 1st wave and 41 patients of 2nd wave. While 7 had only right lung involvement and 3 had only left lung involvement in 1st wave and 4 had only right lung involvement and 5 had only left lung involvement in the 2nd wave.

Ground glass opacities (GGO's) were the most common finding seen in almost all patients who showed finding on HRCT chest. In 1st wave 18 patients (25.71%) out of 70 patients showed only ground glass opacities in their HRCT lung and 5 (7.34%) cases HRCT showed only consolidation changes, Ground glass opacity and consolidation with septal thickening seen in 27 (38.57%) patients out of 70, Consolidation with reverse hallo (atoll sign) seen in 3 patients (4.28%). Pulmonary embolism cases seen in 3 (4.28%)

	No. of patients			
	1st wave	**1st wave percentage**	**2nd wave**	**2nd wave percentage**
Fever with cough	50	71.42	42	65.62
Shortness of breath	30	42.85	38	59.37
Sore throat	40	57.14	28	43.75
Diarrhea	6	8.57	10	15.62
Malaise	28	40	30	46.87

Table-2: Clinical Symptoms in COVID-19 Patients

	No. of Patients			
	1st wave	**1st wave percentage**	**2nd wave**	**2nd wave percentage**
Only Ground Glass Opacity	18	25.71	14	21.87
Only consolidation	5	7.14	4	6.25
Both Ground Glass Opacity and Consolidation with septal Thickening	27	38.57	26	40.62
Ground Glass Opacity with Consolidation and Reverse Halo Sign	3	4.28	2	3.12
Pleural Effusion	0	0	2	3.12
Mediastinal Lymphadenopathy	0	0	0	0
Fibrosis, Traction bronchiectasis Volume Loss	4	5.71	6	9.37
Cavity with Bird Nest	0	0	4	6.25
Pulmonary embolism	3	4.28	0	0
Pneumothorax	0	0	1	1.56
Calcified nodule	3	4.28	2	3.12

Table-3: HRCT chest findings in covid 19 patients

	No. of patients			
	1st wave	**1st wave percentage**	**2nd wave**	**2nd wave percentage**
Right Upper Lobe	30	42.85	32	50
Left upper Lobe	27	38.57	25	39
Right Middle Lobe	25	35.71	24	37.5
Right Lower Lobe	45	64.28	40	62.5
Left Lower Lobe	46	65.71	42	65.62

Table-4: Pattern of lung lobe involvement in COVID 19 Patients

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patients. Fibrosis changes with traction bronchiectasis seen in 4 patients (5.71%) and 3 (4.28%) patients also show calcified nodule, in retrospective these patients were found to have history of pulmonary tuberculosis, so above findings signified Koch's sequel (Table 3 and Figure 1).

In 2nd wave of covid pandemic 14 (21.87%) patients showed only ground glass opacities in their HRCT lung of 64 patients, and 4 cases (6.25%) HRCT showed only consolidation changes, ground glass opacity and consolidation with septal thickening shows in 26 (40.62%) patients out of 70, Consolidation with reverse hallo (atoll sign) seen in 2 (3.12%) patients. Fibrosis changes with traction bronchiectasis seen in 6 (9.37%) patients and 2 (3.12%) patients show calcified nodule. Pulmonary embolism cases were not reported in 2nd wave. Atypical findings of covid pandemic are seen only in 2nd wave like pleural effusion in 2 (3.12%) case and pneumothorax in 1 (1.56%) case (Table 3 and Figure 2, 3).

A typical peripheral and subpleural distribution of opacities was the hall mark feature of covid infection while bilateral asymmetrical and multi-lobar involvement particularly of lower lobes was a common finding. Peripheral subpleural pattern of distribution in HRCT lung of 15 (27.27%) patients of 1st and mixed pattern of distribution seen in 40 (72.72%) patients. In 2nd wave Peripheral subpleural pattern of distribution in HRCT lung of 14 (28.57%) patients and mixed pattern of distribution seen in 35 (71.42%) patients. The bilateral lower lobes were the most commonly affected followed by right upper, left upper and then right middle lobe. These findings are seen in both waves. In 1st wave left lower lobe is most commonly affected lobe (65.71%) then followed by right lower lobe (64.28%), then right upper lobe affected (42.85%), then left upper lobe (38.57%) and right middle lobe (35.71%). In 2nd wave of covid-19 pandemic most commonly affected lung lobe is left lower lobe (65.62%) then followed by right lower lobe (62.5%), then right upper lobe affected (50.0%), then left upper lobe (39.0%) and right middle lobe (37.50%) (Figure 1).

The CT severity score directly correlated with clinical severity of disease. In our study we divide CT severity score in mild (1-8), moderate (9-15) and severe (16-25). In 1st wave 16 (29.09%) patients were in mild category and among them 6 patient belongs to 21-40 years age group then followed by 6 patients from 41-60 years age group and 3 patients belongs to more than 60 years age group and 1 patient from 0–20-year age group. In moderate category 11(20%) patients and highest among them from 41-60 years age group followed by 21-40 years age group then followed by more than 60-year age group. Severe category patients were 28 (50.9%) found in 1st wave and highest cases seen in age group of more than

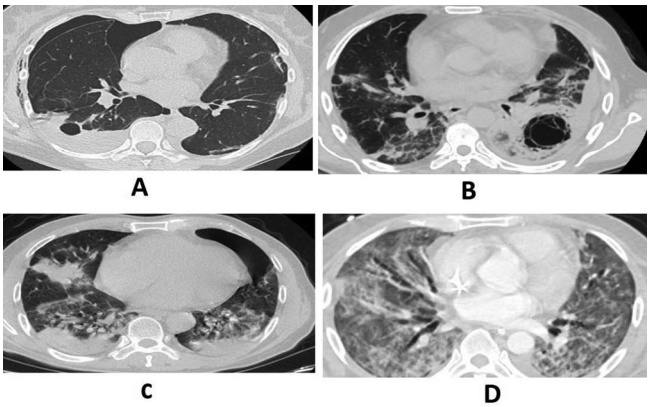

Figure-2: COVID-19 complication CT (A) HRCT Chest show pneumothorax and reticular opacities.(B) reverse halo sign with associated irregular and intersecting areas of stranding or irregular lines within the area of ground-glass opacity(Bird nest sign) (C) Diffuse ground glass and consolidation patches with bilateral hydrothorax and left sided pneumothorax.(D) Bilateral consolidation and ground-glass opacities with air bronchogram and evidence of bronchiectasis more on the right side .

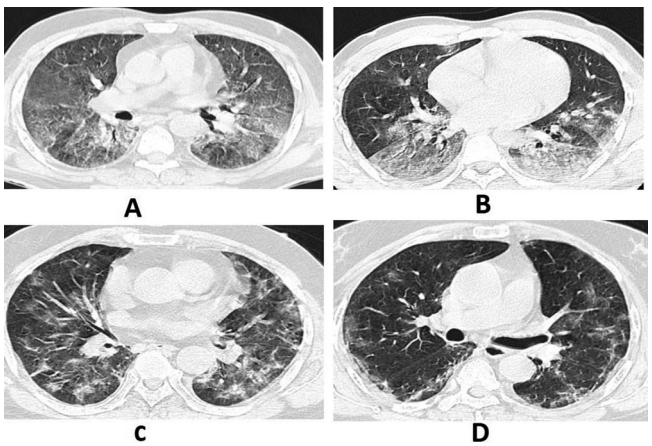

Figure-1: Typical COVID-19 CT signs (A) Bilateral lower lobar ground glass patches with evolving right basal small consolidative changes (B) Bilateral ground glass opacities with interlobular and intralobular septal thickening forming a "crazy paving" pattern (C) GGOs and thickened pulmonary interstitial structures with a reticular pattern and fibrous stripes in both lower lobes ((D) Healing of the ground-glass patches by curvilinear fibrotic bands.

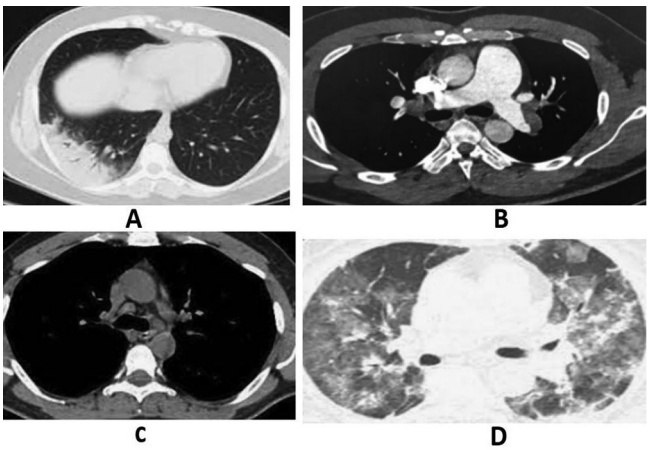

Figure-3: COVID-19 CT (A) Non segmental parenchymal consolidation with air bronchogram in right lower lobe.(B) Bilateral acute pulmonary embolism of the right pulmonary artery and a segmental branch of the left upper lobar branch (C) Mediastinal lymph nodes shown in mediastinal window (D) Mixed pattern showing diffuse ground glass opacities with interlobular and intralobular septal thickening and patches of consolidation.

60 years then followed by 41-60 age group. In 2nd wave 11 (22.44%) patients in mild category and 4 patients from 21-40 age group and then followed by 41-60 years age groups. In moderate category 12 (24.48%) patients, highest among them from 41–60-year age groups then followed by 21–40-year age group. In severe category 27 (55.1%) cases founds in 2nd wave and highest number. of cases seen from 41-60 age group then followed by more than 60 years age group and 21–40-year age group (Table 4).

In our study we found comorbidity like diabetes mellitus, hypertension/cardiovascular disease, respiratory diseases and renal diseases in covid patients in both waves. In 1st wave 22 known case of diabetes mellitus seen and among them 13 had severe CT severity score. In 2nd wave 20 known cases of diabetes mellitus and among them 15 had severe CT severity score. Combined cardiac disease and diabetes mellitus seen in 9 cases of 1st wave and 6 among them had severe CT severity score. In 2nd wave 12 had combined diabetes mellitus and cardiac disease and 8 out of them had severe CT severity score.

DISCUSSION

India reported an average more than 65,000 new cases of COVID-19 per day on august and September, 2020 and more than 1,00,000 case were reported in April, May 2021.[11] During this pandemic time HRCT thorax was considered as gold standard for diagnosis as well as establishment of severity of covid 19 infection. Furthermore, we witnessed several atypical radiological features through the second pandemic wave, either early at the active infective stage or delayed at the post-infectious convalescent period. We believed every radiologist should be familiar with these features. Therefore, we performed this retrospective study on 134 patients using multi-slice computed tomography (MSCT) to highlight the radiological differences between the first and second pandemic waves and to report their impact on the clinical status.

A total of 134 patients were involved in this study, 70 from 1st wave and 64 from 2nd wave of Covid pandemic. The predominant symptoms of infection (fever, dyspnea, pneumonia cough) were similar in both waves, although the patients in the second wave presented gastrointestinal symptoms (diarrhea, abdominal pain) more frequently. In this study of 134 patients with confirmed COVID-19 infection, it is noteworthy that 30 of the 134 patients had a normal HRCT scan with complete absence of ground-glass opacities and consolidation, suggesting that real time RT-PCR is positive even in patients with normal chest CT scans. Chest CT therefore cannot be used as a reliable standalone tool to rule out COVID-19 infection. These findings in line with a large study of cases carried out by Yiecheng F et al.[12]and Tao Ae et al.[13]

In the current study we also found the HRCT thorax is rapid investigation as RT-PCT test required more than 24 hrs for result. Moreover, by RT-PCR test we could not get severity of infection.[12, 13]Majority of patients in both waves shows ground-glass abnormality in early disease, followed by development of crazy paving and, finally, increasing consolidation later in the disease course. Coinciding with the universal criteria of COVID-19 radiological diagnosis the typical CT signs of COVID-19 infection were encountered in this study, including ground-glass opacities (GGOs), interlobular septal thickening with or without consolidative changes are encountered in both waves. These findings are steady with the findings of other earlier CT studies together with Omar S et al. [14], Ali TF et al. [15], Emara DM et al. [16], Sabri YY et al, [17], and Mohamed IA et al. [18]. Surprisingly, other atypical radiological findings were encountered in first waves includes pulmonary thromboembolism. In the second pandemic wave, atypical findings were including bronchiectasis changes, cavitation with bird nest pattern suggestive of mucor mycosis, pleural effusion and pneumothorax. These findings are consistent with the CT studies, Emara DM et al. [16] and Sabri YY et al, [17].

The severity of the inflammatory process as depicted on HRCT images is presented and graded as none, mild, moderate and severe. [16, 17] We found in our study moderate and severe CT severity score were more frequent in second COVID 19 wave infections than in first wave infections. Most of the previously recorded radiological findings suggestive COVID-19 infection were noted in the lower zones of both lungs during both the first and second waves of infection. [14, 15, 16, 17]Similarly, findings in our study, represent the CT correlate for the basic pathophysiology of the disease process as it categorized as we observed pattern of ground glass and consolidative pulmonary opacities, often with a bilateral and peripheral lung distribution, predominantly in lower lobes. Most lesions were seen in , where the highest numbers were recorded in the 50–59 year group in the first wave of infection, and in the 40–49 year group in the second wave. This establishes a shift in susceptibility to include the younger age group.

The details for the strong differences between the two periods are not yet known even though it has been suggested that a new variant strain of SARS-CoV-2 occurred in early summer 2020 in India. Co-morbidities recorded on request forms included, diabetes mellitus, hypertension, asthma, deep vein thrombosis and pulmonary embolism.[13, 14, 16, 17] The most frequent co-morbidity in the 2020 group was diabetes mellitus. Hypertension was the commonest co-morbidity in the group of patients in 2021.

Limitations of the study

There are several limitations of this study. Our study being a retrospective study done in diagnosed RT-PCR COVID 19 cases, henceforth it cannot be utilized in knowing the exact sensitivity and specificity of HRCT thorax in making a diagnosis of COVID 19 infection. There is no comparison between RT-PCR and HRCT in diagnosing coronavirus infection. The other limitation of the present study is the small sample size, it is an unicentric study in a medium size hospital, and it covers a relatively small geographical area. In addition, another limitation was that we based our assumption of the different viral strains during the study periods on publications of other molecular tests during the specified periods, and the deficiency of molecular test results approving the strain types of the patients in the study.

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CONCLUSIONS

Therefore, in summary, in HRCT thorax a typical form of peripheral subpleural more often bilateral and asymmetrical distribution of lung opacities is becoming the hallmark of COVID 19 infection and should help Radiologists to diagnose COVID pneumonias with increasing confidence. The demonstration of ground glass opacities and consolidation as the commonest radiological presentation in both first and second waves, however the radiological presentation of COVID-19 patients showed some differences between its first and second waves. Although the majority of symptoms were similar in both periods, the higher incidence of gastrointestinal symptoms in the second wave stands out as a difference. HRCT Chest should be increasingly used in COVID 19 pandemic as it certainly has a greater role to play in assessing the disease severity and prognosis. HRCT Chest investigations done during COVID 19 pandemic aids in patient management and a better clinico-radiological correlation, would further benefit in dipping the mortality rate associated with COVID-19 infection.

Declaration of patient consent

The authors certify that they have obtained all appropriate given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients comprehend that their names and details will not be published and due efforts will be made to cover their identity, but concealment cannot be guaranteed.

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Department of Microbiology, Department of Medicine, Department of TB & Chest, Government Medical College, Kota.

REFERENCE

1. The 2019-nCoV Outbreak Joint Field Epidemiology Investigation Team, Li Q. Notes from the field: an outbreak of NCIP (2019-nCoV) infection in China — Wuhan, Hubei Province, 2019–2020. China CDC Weekly 2020;2:79-80
2. Yan Bai, MD; Ling sheng Yao, MD; Tao Wei, MD; et al. Presumed Asymptomatic Carrier Transmission of COVID-19. JAMA. 2020;323(14):1406-1407.
3. Huang C,wang,lix et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020.395[10223]497-506.
4. Wang W, Tang J, Wei F. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. J Med Virol 2020;92:441-7.
5. Lam CW, Chan MH, Wong CK. Severe acute respiratory syndrome: Clinical and laboratory manifestations. Clin Biochem Rev 2004;25:121-32.
6. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. Lancet 2020;395:470-3.
7. Mossa-Basha M, Medverd J, Linnau K, Lynch JB, Wener MH,Kicska G, et al. Plicies and guidelines for COVID-19 preparedness:Experiences from the University of Washington. Radiology 2020;296:E26-31.
8. Hansell DM, Bankier AA, MacMahon H, McLoud TC, Müller NL,Remy J. Fleischner Society: Glossary of terms for thoracic imaging.Radiology 2008;246:697-722.
9. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N,et al. Chest CT findings in coronavirus disease 2019(COVID-19): Relationship to duration of infection. Radiology 2020;295:685-91.
10. COVID-19 Imaging findings (2020). The radiology assistant.
11. Situation Report - 28. World Health Organization. Published February 17, 2020.
12. Fang Y, Zhang H, Xie J, Lin M, Ying L, Pang P, et al. Sensitivity of chest CT for COVID-19: Comparison to RT-PCR. Radiology 2020;296:E115-7.
13. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, et al. Correlation of chest CT & RT-PCR testing in corona virus disease 2019 (COVID-19) in China: A report of 1014 Cases. Radiology 2020;296:E32-40.
14. Omar S, Motawea AM, Yasin R (2020) High-resolution CT features of COVID-19 pneumonia in confirmed cases. Egypt J Radiol Nucl Med. 51(1):1–9
15. Ali TF, Tawab MA, ElHariri MA (2020) CT chest of COVID-19 patients: what should a radiologist know? Egypt J Radiol Nucl Med. 51(1):1–6
16. Emara DM, Naguib NN, Moustafa MA, Ali SM, El Abd AM (2020) Typical and atypical CT chest imaging findings of novel coronavirus 19 (COVID-19) in correlation with clinical data: impact on the need to ICU admission, ventilation and mortality. Egypt J Radiol Nucl Med. 51(1):1–9
17. Sabri YY, Fawzi MM, Nossair EZ, El-Mandooh SM, Hegazy AA, Tadros SF (2020) CT findings of 795 COVID-19 positive cases: a multicenter study in Egypt. Egypt J Radiol Nucl Med. 51(1):1–9
18. Mohamed IA, Hasan HA, Abdel-Tawab M (2021) CT characteristics and laboratory findings of COVID-19 pneumonia in relation to patient outcome. Egypt J Radiol Nucl Med. 52(1):1–7

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