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Original Research Paper

Radio-Diagnosis

ANALYSIS OF HRCT CHEST FINDINGS IN CASES WITH INFLUENZA LIKE ILLNESS DURING COVID-19 PANDEMIC

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ABSTRACT

Aim: To evaluate and characterize lung abnormalities on serial thin-section computed tomographic (CT) scans in patients with influenza like illness during COVID-19 pandemic.

Materials And Methods: High resolution thin slice CT (using Siemens SOMATOM scope machine) study were performed in 100 patients with influenza like illness and were assessed for lung abnormalities such as ground-glass opacities, consolidation, interlobular and intra lobular septal thickening , peribroncho vascular thickening etc. Each lobe of affected lung was assessed for CT severity score using lobar method. Summation of scores from all affected lobes were taken using lobar method of scoring* (maximal CT score, 25*). Depending on the score and RTPCR status for COVID-19 a relevant CORADS score was assigned.
And reported accordingly. Since the cases has been increasing in the locality and district ,any CT case with clinical suspicion and if CT shows in.ammatory signs(previously described as atypical as for ex- ample lobar pneumonia) was considered and reported with suspicious as COVID-19 and later correlated with RT PCR laboratory investigations further it is proved to be as such.

Results: HRCT chest of total 100 patients were studied. Out of which 88 patients had ground glass opacity type changes, 67 patients had consolidation type changes, 55 patients had pleural thickening, 8 patients had pleural effusion and 62 patients had bronchiectasis (cystic/ tractional bronchiectasis). Bilateral involvement were seen in 76 cases. Lower lobes affected in 81cases, middle lobes affected in 42 cases, upper lobe affected in 55 cases and peripheral areas affected in 91 cases. CT severity score and CORADS classification were all assessed . Sensitivity of the study is 82.6%, specificity is 77.4%, positive predictive value is 89% and negative predictive value is 66.8%

KEYWORDS :

INTRODUCTION:

COVID-19 is the disease caused by SARS-CoV-2 , strain of CORONA virus. The World Health Organization proclaimed 2019-nCoV a worldwide pandemic by March 12(1).

Most instances of 2019-nCoV contamination are asymptomatic or present with mild clinical symptoms. The most common symptoms showed by infected people are fever, fatigue and cough. Clinical features are similar to that of flu in most cases (7).

The gold standard for the diagnosis of the several infections is the confirmation of viral RNA by real-time reverse transcriptase polymerase chain reaction(RT-PCR) (3).However, based on a previous report on 2019-nCoV, the positive rate of RT-PCR at initial presentation is 30- 60% (2). This may be due to a low viral load, hence the need for repeated testing. The available kits for testing influenza viruses reportedly have a sensitivity of 66-100%[2]. Although not a substitute for RT-PCR in the diagnosis of COVID-19 and influenza, chest computed tomography (CT) has been found to have an increasing use in the assessment of viral pneumonia.

Other imaging methodology, for example, plain chest radiograph is valuable in the assessment of numerous chest problems including viral chest diseases (4). But It has little role in identifying early interstitial lung involvement. Ultrasonography has been utilized in the recognition of interstitial problems, consolidation and effusion but has a lot of subjective variations (5). CT assessment is still the gold standard for assessing various lung pathologies, especially interstitial lung pathologies with clear idea on extent of involvement (6). It is also important to identify peculiar imaging findings or patterns, if any for COVID-19 infections so that a more aggressive clinical management may be followed Based on the severity score.

AIM AND OBJECTIVE:

1. To assess HRCT chest findings of Patients with influenzas like illness during COVID- 19 pandemic.
2. To categorize various lung parenchymal changes in RTPCR + cases of COVID 19and RTPCR -ve cases of Influenza like illness.
3. To calculate CT severity index scores for all cases with lung parenchymal changes.

MATERIALS AND METHODS

The study was conducted in Sree Mookambika Institute of Medical Sciences, Kulasekharam. Clinical information were recorded, containing age, gender, Present history, past history of respiratory illness if any and clinical symptoms were recorded. This study involved 100 patients : 36 (35.71%) females and 64 (65.3%) males ; their age range was 22-79years.71(71%) were known to have chronic diseases (Table1).All patients were from state of tamilnadu.

The HRCT evaluation of cases were done from the beginning of March to the end of 2020. Clinically suspected cases of COVID-19 were taken non-contrast multislice Computed tomography as a part of investigation. The studies were assessed by radiologists with clinical expertise of 4 to 10 years in the field of radio diagnosis.

There were four clinical types as per the seriousness of illness (8)–

Patient State	Descriptor	Score
Uninfected	Uninfected; no viral RNA detected	0

Ambulatory mild disease	Asymptomatic; viral RNA detected	1
	Symptomatic; independent	2
	Symptomatic; assistance needed	3
Hospitalised: moderate disease	Hospitalised; no oxygen therapy*	4
	Hospitalised; oxygen by mask or nasal prongs	5
Hospitalised: severe diseases	Hospitalised; oxygen by NIV or high flow	6
	Intubation and mechanical ventilation, pO_2/FiO_2 ≥150 or SpO_2/FiO_2 ≥200	7
	Mechanical ventilation pO_2/FiO_2 <150 (SpO_2/FiO_2 <200) or vasopressors	8
	Mechanical ventilation pO_2/FiO_2 <150 and vasopressors, dialysis, or ECMO	9
Dead	Dead	10

1. Mild -mild clinical manifestations and no pneumonia found on CT images.
2. Moderate-fever or respiratory indications, and so on and pneumonia found on CT images.
3. Severe type-fulfil any of the following conditions (respiratory distress, respiratory rate (RR) 30 times each moment, resting state oxygen saturation (SpO_2) 93%).
4. Critical severe type- fulfil any of the following conditions (respiratory failure and mechanical ventilation required, Shock, multiorgan failure)

CT scanning:

High resolution thin slice CT (Siemens 16 slice Somatom scope) scan was used. The scout was taken in a supine position with a voltage of 120 volts and a current of 25 milliamperes while holding breath in full inspiration. The following parameters were used to obtain scans: 120 kV, 130-240 mAs, 5 mm beam collimation, 1.25 pitch, 0 gantry tilt, and the FOV depending on the patient's size. The scan was taken from the root of the neck to below diaphragm. Following acquisition of images, images were transferred to dedicated post-processing workstation and by applying the multiplanar reformation function volumetric measurements were obtained)

CT assessment:

Abnormal Pulmonary attenuation, site of involvement , the shape of abnormal attenuation, distribution within the parenchyma (peripheral, central, subpleural) as well as the involved lung lobes, pattern of the lesions (we used Fleischner society glossary of terms for thoracic imaging - 2008(11) as our main reference for identifying and naming the lesions), CT severity score, CORADS classification were assigned based on the findings. If any common accompanying diseases of lung such as bronchiectasis, emphysema etc. present were assessed.

Air bronchus sign, mosaic appearance, bronchial wall thickening, interlobar and interlobular septal thickening, mediastinal lymphadenopathy, pleural effusion, pleural thickening and pericardial effusion were looked for and mentioned in the report.

In all cases, a semi-quantitative CT severity scoring score was determined per each of 5 lobes thinking about the degree of anatomic contribution, as follows in the table below:

SCORE	CONTRIBUTION
0	No association
1	<5%contribution
2	5–25%contribution
3	25-50%contribution
4	50–75% contribution
5	> 75% contribution.

Image Interpretation

Table 1 List of patients had chronic diseases

Disease	Number of patients	Percentage
Systemic hypertension	28	28%
Diabetes mellitus	23	23%
Renal impairment	5	5%

Table 2. Lobar affection

Lobe affected	Number of patients	Percentage
Upper lobe	55	54.76%
Lower lobe	81	80.95
Middle lobe	42	42.85
Lingula	52	52.38

Table 3. The distribution of lesions

Distribution	Number of patients	Percentage
Isolated Peripheral/subpleural	90/100	90%
Patchy	55/100	54.76%
Isolated Central	19/100	19%
Lobar	14/100	14.20%

Statistical methods and data analysis Microsoft Office Excel software program was used for entering data .

Then data was transferred to the Statistical Package of Social Science Software program, version 23 and analysed statistically Using range, mean, median ,standard deviation, percentage for qualitative ones and interquartile range for quantitative variables and frequency , Data was presented. Diagnostic efficacy will be calculated through Sensitivity, Specificity, PPV, NPV, Positive Likelihood measurements.

RESULTS:

This study involved 100 patients: 35 (35.71%) females and 65 (65.3 %) males; their age range was 22-79 years.

Lesions distribution

Laterality

- **Bilateral affection** -76/100 cases(76.19%).
- **Unilateral affection** –24/100 cases (23.80%) details as follows:
- right lung-14/100(14.28%)
- left lung-10/100(9.5%)

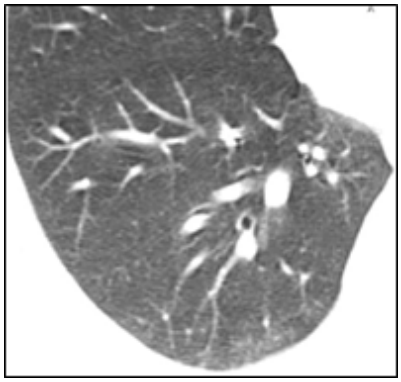

Fig. 1 Male patient 30 years old with COVID-19. axial CT image shows subpleural ground glass opacity with prominent vessels noted in the right lower lobe. (CORADS VI and CT severity score – 4/25 -mild).

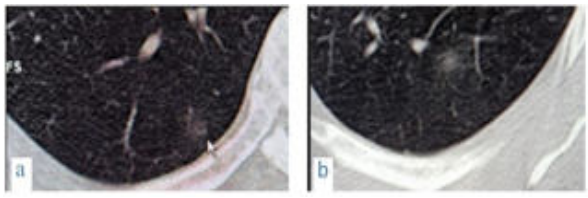

Fig. 2 Female patient (66 years old) with COVID-19, CT chest magnified axial images showing (a)Well defined small subpleural ground glass opacity noted in the right lower lobe (arrow), (b) well defined rounded peripheral small ground glass opacity noted in lower lobe.(CORADS VI and CT severity score – 6/25 -mild).

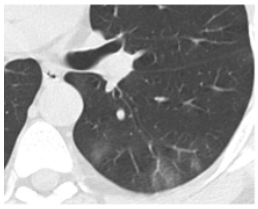

Fig. 3 Magnified axial CT image of Male patient (38 years old)shows subpleural ground glass opacifications with traction bronchiectasis thickening of vascular noted in the left lower lobe (CORADS III and CT severity score – 8/25 - mild).

Lobes affection

- Multilobar affection -83/100 cases(83.33%).
- Single lobe affection –17/100cases(16.66%)

The details are as below

- Single focus in 7cases- (7.14%)
- ground glass opacity-4cases(4.7%).
- Consolidation-2 case(2.38%).
- Multiple foci -10cases(9.5%)
- ground glassopacity-5(4.7%),
- consolidation-5cases (4.7%).

Table 2 shows details of lobes affection. Distribution of parenchymal lesions:

Distribution of parenchymal lesions shown in Table 3 Patterns of lesions:

Common lesions

Ground glass opacities (Figs. 1,2,3,4,5 and 9)

Ground glass opacity with vascular thickening –88/100 cases (88.09%). (subpleural/peripheral)In single lobe affection, ground glass opacities -76/100 (76.5%).

Consolidation (Figs. 5 and 6)- 66/100 cases (66.6%). subpleural/peripheral in location (41.15%), lobar (15.45%) and central (10%) distribution Traction bronchiectasis related to consolidation in 36cases -35.71%.

Crazy-paving pattern (Figs. 7 and 10)

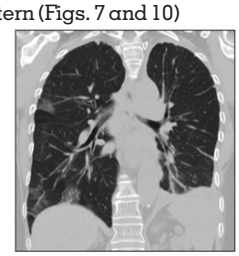

Fig.4, 65 years old male patient with COVID-19. Computer Tomography coronal image shows ground glass opacities(peripheral) with vascular thickening noted in the right lung. Left mild pleural effusion noted (CORADS III and CT severity score – 6/25 -mild).

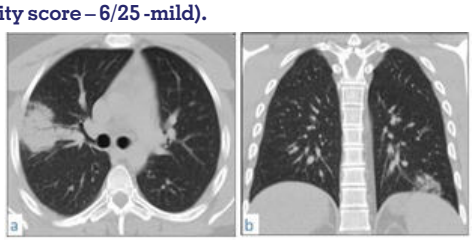

Fig.5A 31-year-old male patient with COVID-19, CT chestaxialimage (a) shows right upper lobe predominantly subpleural consolidation with air bronchogram, coronal image (b) shows left lower lobe subpleural consolidation with tractional bronchiectasis. (CORADS VI and CT severity score – 7/25 -mild).

Crazy paving pattern- 38/100 cases (38.09%)(subpleural location). In this crazy paving pattern, interlobular and intralobar septal thickening noted along with ground glass opacities

Vascular thickening

It is seen along with crazy-paving and ground glass opacities (Figs. 1, 3, 5, 7 and 9).

Tractional bronchiectasis (Figs. 3 and 5)

- 62/100 cases (61.90%) within the lesion.

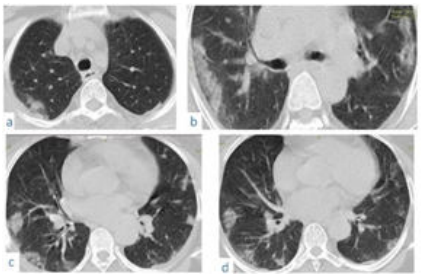

Fig. 6 CT chest axial images (a–d) of a male patient (50 years old) with COVID-19, shows bilateral consolidation predominantly subpleural in location . (CORADS VI and CT severity score – 16/25 -mild).

Signs of architectural distortion (Figs. 9 and 10)

- 38/100 patients (about38.09%).
- Subpleural fibrotic bands – 43/100 cases(43.75%).
- peri lobular fibrosis (arcade–like sign) – 81/100cases (81.25%). [13,14

Uncommon lesions in Table 4 Pleural lesions

- Pleural thickening – 54/100 cases(54.76%).
- Pleural effusion-7/100 cases(7.14%);
- Mild -1 case (4.3%), moderate - 2 cases (8.6%), unilateral - 2 cases(8.6%)
- Bilateral in 1 case (4.3%)

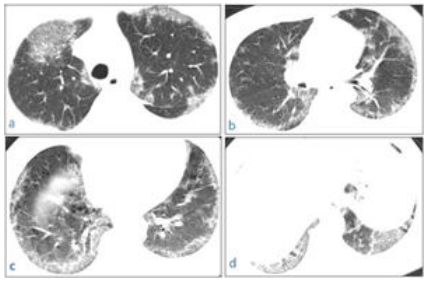

Fig. 7 A (a-d) 56-year-old female patient with COVID-19,HRCT chest axial imagesshow predominantly subpleural crazy paving pattern with vascular thickening noted bilaterally (CORADS VI and CT severity score – 12/25 - mild).

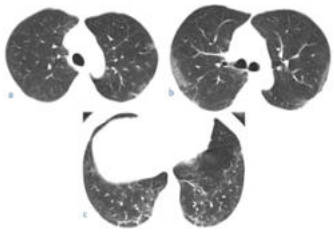

Fig. 8 female patient (40-year-old) of bronchial asthma presented with fever, HRCT chest axial image (a) ground glass opacities subpleural in location with vascular thickening noted in the left upper lobe (b) shows crazy paving pattern bilaterally in subpleural location and (c) shows arcade opacities (perilobular thickening and mild architectural distortion) noted bilaterally in subpleural location.. (CORADS VI and CT severity score – 4/25 -mild).

Bilateral basal subpleural areas

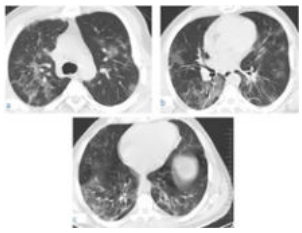

Fig 9. HRCT chest axial images of male patient (35 year old with COVID-19)- (a), (b), and (c) show patchy ground glass opacities , subpleural in location with vascular thickening and subpleural ground glass opacities and architectural distortion noted in bilateral basal lower lobes (CORADS VI and CT severity score – 12/25 -mild).

Fig. 10. HRCT chest axial image of male patient (55-year-old) with COVID-19 shows bilateral subpleural crazy paving, architectural distortion and subpleural band (black arrow). (CORADS VI and CT severity score – 11/25 - moderate).

Table. 4 Summary of uncommon lesions

Type of lesion	Number of Patients	Percentage
Prominent interlobular septa	3	2.38%
Centrilobular nodules and tree-in bud Pattern	5	4.7%
Bronchiectasis	2	2.3%
Sarcoidosis	2	2.3%

DISCUSSION

The study has been conducted on 100 patients. 36 (35.71%) females and 65 (65.3 %) males; their age range was 22-79 years. 71 patients (71%) were known to have chronic diseases - (see Table 1 for details). The study was done from March 2020 to June 2021.

Lesions pattern, localization, and severity was assessed. The common findings such as ground glass opacities, crazy paving, consolidation, tractional bronchiectasis, vascular thickening , architectural distortion signs and the uncommon CT patterns such as tree in-bud- pattern and cysts were assessed .[fig1-10] (9).

The scoringsystemisusefulforclinicalpurposes(follow-up studies)(22).Weapplied the severity score described in the radiology assistant [9].

The role of HRCT chest in the assessment of COVID -19 was debated both in China and worldwide in the early days of the COVID-19 . In April 2020 The Fleischner Society has announced certain rules [11], according to which CT could be done in cases of mild clinical features ,in patients with suspected COVID-19 and moderate-severe clinical manifestations .HRCT chest is considered as an essential for the management of clinically suspected cases of moderate - severe symptomatic cases COVID-19. HRCT is used for `the analysis of abnormal parenchymal attenuation, CT severity score and CORADS classification.

CT Severity Index Score:

Score	CT severity
<8	Mild
9-15	Moderate
>15	Severe

CORADS Classification:

CORADS 1	Highly unlikely	Normal or non-infectious abnormalities
CORADS 2	Unlikely	Abnormalities consistent infections other than COVID-19
CORADS 3	equivocal	Unclear whether COVID-19 present
CORADS 4	Probable	Abnormalities suspicious COVID-19
CORADS 5	Highly likely	Typical COVID-19
CORADS 6	PCR proven	

CONCLUSION

Clinical symptoms of patients directly correlated with CT severity index in 90% of total cases. We found that CT SEVERITY INDEX was helpful for clinicians in managing COVID-19 positive cases. Our data suggests that HRCT chest is useful as a standard method to predict severity, and categorize various lung parenchymal changes in RTPCR + cases of COVID 19 rather than being utilized as an initial diagnostic modality for confirmation of COVID-19 infection. This is because, in some of RTPCR -ve cases of Influenza like illness also had similar findings of COVID 19 infection. However, with use of CT severity index scores and CORADS grading, we were able to ascertain the severity of the disease even for RTPCR -ve cases of Influenza like illness which had helped the clinicians in Triage of such cases.

ABBREVIATIONS

COVID-19: Coronavirus disease 2019; CO-RAD: COVID-19 reporting and data system; COVID-Rad: COVID-19 reporting and data system CT stands for computed tomography, and FOV stands for field of view. Multidetector computed tomography (MDCT) and Multislice computed tomography (MSCT) are two types of computed tomography. RAD stands for "Reporting and Data System." The Radiological Society of North America (RSNA) is a professional organisation dedicated to the advancement of radiology in North America. COVID-19 is caused by SARS-CoV-, a coronavirus of the genus Beta- coronavirus that causes severe acute respiratory syndrome. SPSS stands for Statistical Package for Social Sciences.

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