

Spectrum of Chest Computerised Tomography (CT) findings of Covid 19 in Indian Population

Date of Receiving: 12/01/2021

Date of Peer Review: 5/02/2021

Date of Acceptance: 16/02/2021

DOI:10.47799/pimr.0901.09

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ABSTRACT:

Background: To analyze the chest computed tomography (CT) features in patients with coronavirus disease 2019 (COVID-19) pneumonia.

Methods: This was a prospective descriptive study comprising 202 consecutive reverse transcriptase polymerase chain reaction (RT-PCR) positive patients who underwent CT chest. For 25 patients, follow-up CT scans were obtained. The CT images were evaluated for the number, type and distribution of the opacity, and CT severity scoring was done

Results: Among the total study cohort of 202 patients, 152 were males and 50 were females .From July 07, 2020, to september07, 2020, totally 202 laboratory-confirmed patients with COVID-19 underwent chest CT. For 25 patients, follow-up CT scans were obtained. The CT images were evaluated for the number, type and distribution of the opacity, and the affected lung lobes. Furthermore, the initial CT scan and the follow-up CT scans were compared. Results were patients (98.5%) had two or more opacities in the lung and 3 (1.5%) patients has negative chest CT. 183 (90.6%) patients had only ground-glass opacities; 13 patients (6.4%) had ground-glass and consolidative opacities; and 3 patients (1.5%) had only consolidation. A total 192 of patients (96.5%) showed two or more lobes involved. The opacities tended to be both in peripheral and central 7 (3.5%) or purely peripheral distribution 192 (96.5%). 177 patients (88.9%) had the lower lobe involved. 8 patients showed complete resolution of lung findings.

Conclusion:

In this study population, the typical CT features of COVID 19 pneumonia are ground glass opacity with or without consolidation, which is patchy and peripheral, predominantly in lower lobes.

Introduction

Since December 2019, dozens of unexplained pneumonia cases have occurred in Wuhan City, Hubei Province, China, and there are few reports suggesting that the outbreak is related to exposure at the Wuhan South China Seafood Market. In subsequent months, pneumonia has spread in China and globally. Studies have shown that a new betacoronavirus known as COVID-19 (formerly known as 2019-nCoV). COVID-19 was listed as a public health emergency by the World Health Organization (WHO) on January 30, 2020

Coronaviruses are enveloped nonsegmented positive sense RNA viruses belonging to the family Coronaviridae and the order Nidovirales and broadly distributed in humans and other mammals (1).The most common CT manifestations are bilateral, peripheral/sub pleural, posterior GGOs with or without consolidations with a lower lobe predominance (2) The aim of the present study was to report the chest CT imaging manifestations of SARS-CoV-2 infection in Karimnagar, India.

2. MATERIAL AND METHODS

2.1. Patient cohort and study design:

This was a cross sectional study from July 07 2020 to September 07 2020 conducted in Karimnagar, India, 202 consecutive symptomatic patients were subjected to chest CT after obtaining nasopharyngeal swab for RT-PCR

2.1.1. Inclusion criteria:

Patients with symptoms such as fever, cough, fatigue, sore throat and/or dyspnoea with RT-PCR confirmed SARS-CoV-2 infection.

2.1.2. Exclusion criteria:

Non consenting patients

2.2. CT acquisition protocol:

Non-contrast chest CT was performed with the following parameters: tube voltage 100–120 kVp, tube current 90–130 mA s.The CT images were acquired in a single inspiratory breath-hold. Images were reconstructed using increment of 0.7 mm into 1 mm thick slices. Decontamination of the CT suite was performed using 70 % ethanol or 0.1 % sodium hypochlorite. After each CT examination, passive air exchange was allowed for 60 sec.

2.3. Image analysis:

All the cases were reviewed by a senior radiologist. The readers assessed the following features: presence or absence of pulmonary opacities; location; type of opacities and the extent of opacities. The location of lesions was specified with regards to involvement of one lung (right, left) or both the lungs. The number of lobes involved was determined. Zonal distribution of the opacities was classified as central (defined as the inner two-third of the lung tissue) and peripheral (defined as outer one-third of the lung). Lung lesions were categorized using Fleischner society glossary of terms for thoracic imaging . GGO (ground glass opacity) was defined as an increase in the density of lung with non-obscuration of bronchial and vascular structures, whereas consolidation was defined as increased density of lung tissue through which vascular and bronchial structures were not visible. Furthermore, the readers also evaluated presence of associated airway, vascular, pleural and mediastinal abnormalities. Each of the five lung lobes was visually scored on a scale of 0 to 5,

with 0 indicating no involvement and 5 indicating more than 75% involvement. The total CT score was determined as the sum of lung involvement, ranging from 0 (no involvement) to 25 (maximum involvement).

3. RESULTS

3.1. Demographics:

Among the total study cohort of 202 patients, 152 were males and 50 were females with mean age of 47.32 ± 12.9years in males and 51.52±14.6 in female (range 24–71 years). In 180 (90%) cases a history of close contact with an infected patient or a history of travel to a high risk zone within or outside the country was forthcoming. Patient demographics are summarized in Table 1.

3.2. Chest CT findings:

Lung parenchyma abnormalities were observed in 199(98.5%) cases, whereas 3(1.5 %) RT-PCR positive cases had a normal chest CT. Among the patients with abnormal CT findings, bilateral lung involvement was the commonest, observed in 192(96.5 %). Multiple lobe involvement was seen more frequently. 164(81.2 %) had involvement of all the 5 lobes whereas two lobe and single lobe involvement was seen in 7 (3.5 %) each. In terms of axial distribution, peripheral distribution was the commonest, seen in 199(98.5 %) cases among which 192 (96.5%) had only peripheral distribution whereas as 7 (3.5 %) had both peripheral and central distribution. Chest CT imaging manifestations are given in Table 2. With regards to the type of opacity, GGO was the dominant abnormality, found in all 199(98.5%) cases. GGO with interlobular septal thickening and intralobular lines, producing crazy paving pattern was seen in 183 (90.6%) and GGO mixed with consolidation was noted in 13(6.4 %) (Figs. 2 and 3). Pure consolidation was noted in 3(1.5%). CT severity score was calculated and a mean score of 8.9 with SD of 4.428 was obtained. A small number of cases showed atoll or reverse halo sign 2(1.1 %)cases, airway secretions in 5(2.5%)cases, cysts 2(1%)cases, pleural effusions3(1.5%)cases,pneumothorax in 1(0.5%) case and pneumomediastinum in 1 (0.5%)case. (Fig. 3). None of the patients showed halo sign or pericardial effusion or mediastinal lymphadenopathy. Follow-up was done for around 25 patients of which 8 patients showed complete resolution of lung opacities.

CT severity scoring was summarized in Table 3.

Table 1:
DEMOGRAPHICS
GROUP STATISTICS

	SEX	Number	MEAN AGE	STANDARD DEVIATION
AGE	MALE	152	47.32	12.907
	FEMALE	50	51.52	14.692

Independent Samples Test

		t-test for Equality of Means		
		t	df	Sig. (2-taild)
AGE	Equi variance assumed	-1.929	200	.055

Table 2: CHEST CT IMAGING MANIFESTATIONS

		TOTAL
BILATERAL OR UNILATERAL	BILATERAL UNILATERAL	192(96.5%) 7(3.5%)
LOBAR INVOLVEMENT	LLL LUL RLL RML RUL TOTAL	42(21.1%) 10(5%) 135(67.8%) 1(0.5%) 11(5.5%) 199(100%)
NO OF LOBES	0 1 2 3 4 5	3(1.5%) 7(3.5%) 1(0.5%) 7(3.5%) 20(9.9%) 164(81.2%)
NO OF LOBES TOTAL	ONE LOBE MORE THAN ONE LOBE	7(3.5%) 192(95%) 199(100%)
DISTRIBUTION	CENTRAL+PERIPHERAL PERIPHERAL TOTAL	7(3.5%) 192(96.5%) 199(100%)
FINDING	ABSENCE OF ANY FINDINGS CONSOLIDATION GGO GGO+CONSOLIDATION	3(0.5%) 3(0.5%) 183(90.6%) 13(6.4%)
ADDITIONAL FINDINGS	CRAZY PAVING AIRWAY SECRETIONS ATOLL SIGN CYSTS EMPHYSEMATOUS CHANGES PLEURAL EFFUSION PNEUMOMEDIASTINUM PNEUMOTHORAX	174(98.9%) 5(2.5%) 2((1%) 2(1%) 2(1%) 3(1.5%) 1(0.5%) 1(0.5%)

Note: RUL: Right upper lobe, RML: Right middle lobe, RLL: Right lower lobe, LUL: Left upper lobe, LLL: Left Lower Lobe, GGO: Ground-glass opacities

TABLE 3: CT SEVERITY SCORING:

CT SCORE				
	SEX	Number	MEAN	STANDARD DEVIATION
CT SCORE	MALE	149	9.08	4.461
	FEMALE	50	8.42	4.333

INDEPENDENT SAMPLES TEST

T (DF=200) = -0.9, P = 0.36

TOTAL		STATISTIC	STANDARD ERROR
CT SCORE	MEAN	8.91	.314
	LOWER BOUND	8.30	
	95% CONFIDENCE INTERVAL FOR MEAN		
	UPPER BOUND	9.53	
	5% TRIMMED MEAN	8.76	
	MEDIAN	8.00	
	VARIANCE	19.604	
	STANDARD. DEVIATION	4.428	
	MINIMUM	0	
	MAXIMUM	21	
	RANGE	21	
	INTERQUARTILE RANGE	6	
	SKEWNESS	.625	.172
	KURTOSIS	-.112	.343

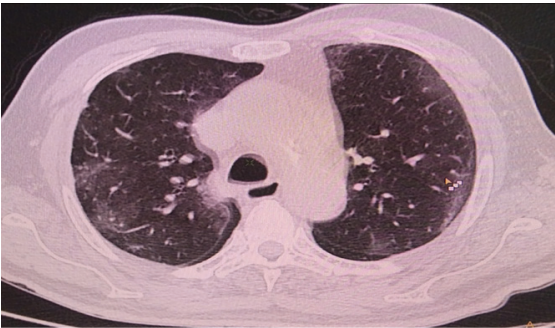
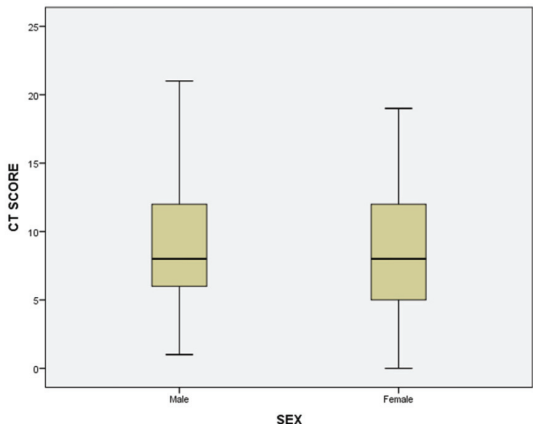


Figure 1: Non contrast Chest CT scan of a 50 year old man with confirmed Covid 19 pnuemonia.Few small peripheral patchy Ground Glass opacities were the only positive findings

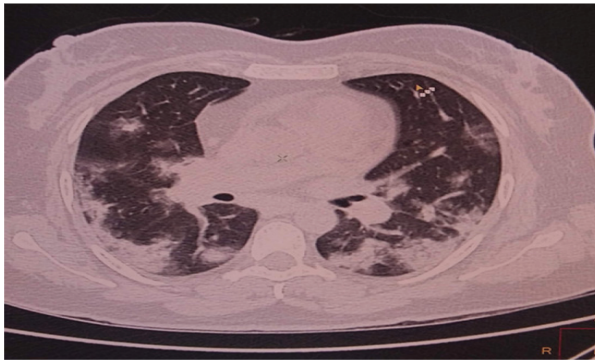


Figure 2: Non contrast Chest CT scan of a 28 year old man with confirmed Covid 19 Pneumonia. Multiple peripheral consolidation are shown bilaterally with patchy and segmental morphology

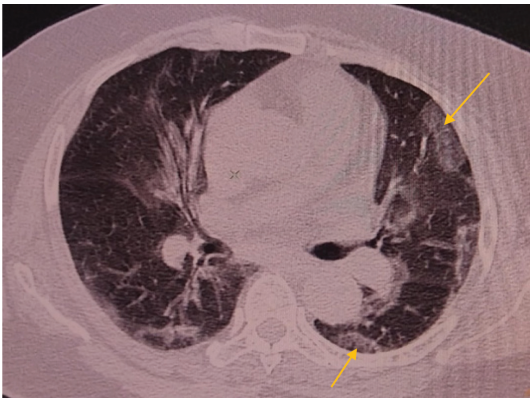


Figure 3: Non contrast Chest CT scan of a 62 year old women with confirmed Covid 19 Pneumonia Showing Patchy ground glass opacity with thickened inter lobular septa creating typical “crazy paving” apperance.

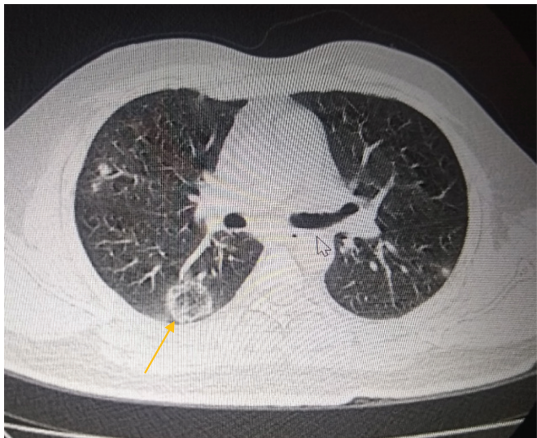


Figure 4: Non Contrast Chest CT scan of a 56 year old man with confirmed COVID 19 Pneumonia. Typical Reverse –halo sign or atoll sign

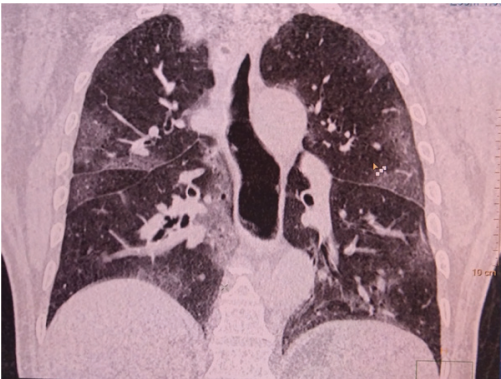


Figure 5: Non Contrast CT of 72 year old showing ground glass opacities with airway secretions

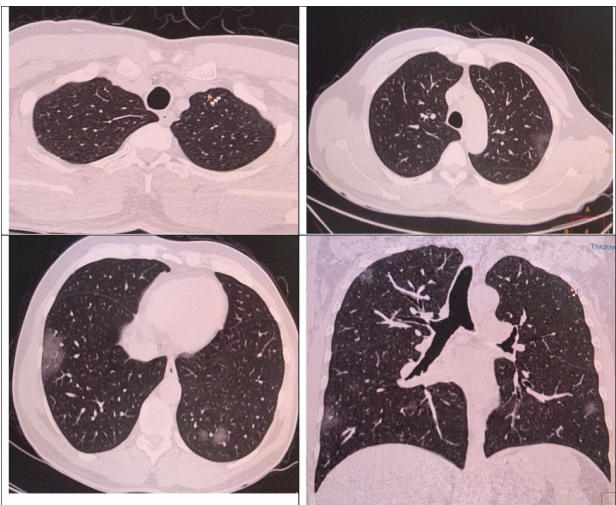
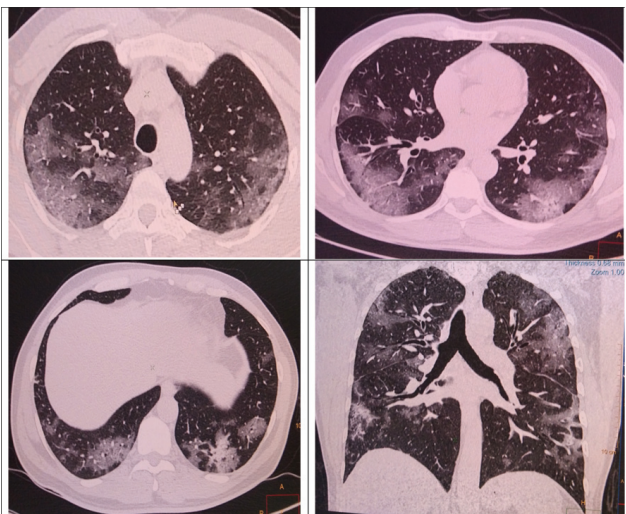


Figure 6: Non Contrast Ct of a 50 year old male came with history of fever and dry cough since 4 days and was in contact with a Covid positive patient



A follow up scan was done 15 days later for the above patient showed progression of lesion, showing bilateral, confluent ground glass opacities with pronounced peripheral and posterior distribution

DISCUSSION:

COVID-19 pneumonia is a huge threat to public health because of its high incidence and rapidly spreading nature. Hence, accurate and early recognition of the disease is crucial. Chest CT is a vital component in the diagnostic algorithm for patients suspected of having COVID-19 infection.

Although chest CT findings of COVID-19 pneumonia overlap with various other infectious or inflammatory lung processes, certain imaging characteristics and patterns exist in recently published data (4-7). Our study, is one of the few available investigations out of China, supports the previously identified typical CT features of COVID-19 pneumonia with the majority of cases demonstrating bilateral lung involvement in form of GGOs, predominantly peripheral distribution with lower lung zone predilection.

We recorded a positive CT in a high proportion (98.5%) of patients with RT-PCR confirmed SARS-CoV-2 in concurrence with studies from China, Korea and Europe which have reported lung parenchymal abnormalities in 61%–100% RT-PCR positive patients [8-10]

Caruso D et.al [10] reported pulmonary findings in 96.6 % of symptomatic cases on CT. Yu M et.al [11] reported a CT positivity rate of 100 % in their study cohort

Ai T et.al [12] reported CT findings in 888 (88.7 %) among the total study population of 1014 COVID-19 patients. They further observed that 3% RT-PCR positive cases with clinical symptoms had a normal CT scan.

Bao C et.al [13] in a meta-analysis of 13 studies with 2378 COVID19 cases found a pooled positive rate of 89.7 % for CT. However study from India by pary et al showed positive findings in only in 34.7% patients contradicts our study [14]

Among the patients with lung parenchymal abnormalities on chest CT, bilateral and multilobar distribution of pulmonary opacities with a peripheral predilection predominantly in lower lobes was commonly observed. Our results fairly corroborate the distribution and type of pulmonary opacities reported in COVID-19 pneumonia.

GGO in the form of pure GGO (90.6%) or GGO admixed with consolidation (6 %) was the most dominant lung parenchymal abnormality encountered in all the cases. These findings are in concordance with the multiple studies summarized in the systematic review by Salehi et al.[16] wherein they found that GGO was present in 88 % cases across 22 studies reported from various countries

Three asymptomatic patients had normal initial chest CT. All of them had a history of exposure to confirmed cases. This emphasizes the importance of the combination of chest CT and RT-PCR, and follow-up chest CT for timely diagnosis in clinically suspected in. Followup CT scans were done for 25 patients of which around 8 of them showed complete resolution of ground glass opacities.

Several limitations should be addressed. In our setting, clinical and laboratory data were limited because of the urgency of the situation. Patient outcomes were not available at the time of this communication. There may have been a selection bias as imaging was performed in all symptomatic cases regardless of the severity of illness. The small size of study population is also a limitation.

In conclusion, the typical pattern of Corona virus Disease 2019 pneumonia on chest CT in Karimnagar, Telangana was characterized by the consistent presence of peripheral ground-glass opacities associated with multilobe involvement and bilateral distribution predominantly involving lower lobes.

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How to cite this article : Boini S,Chennamaneni V,Diddy V K,Kashif Momin . Spectrum of Chest Computerised Tomography (CT) findings of Covid 19 in Indian Population. *Perspectives in Medical Research* 2021; 9 (1): 43-49
DOI:10.47799/pimr.0901.09

Sources of Support: Nil, Conflict of interest: None declared