



Role Of HRCT Chest In The Evaluation Of The Covid 19 And Its Correlation With Clinoradiological Outcome

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Abstract

Objectives: To know the spectrum of HRCT chest findings in COVID-19 patients. To calculate the CTSS and correlate it with the clinoradiological outcome.

Materials and methods: An observational study (prospective and retrospective) was done in our hospital JLN Medical College, Ajmer, Rajasthan, from August 2020 to February 2022 on 93 patients with RTPCR positive coronavirus disease. All patients will undergo an HRCT chest scan. CTSS will be assigned according to the lobe involvement, and it will be correlated with the clinoradiological outcome of the patient. The outcome will be determined by hospitals records, three months and six months follow up HRCT scan.

Statistical analysis: All the data is entered in the Microsoft Excel sheet and evaluated accordingly by graphs and charts.

Results: Among the 93 patients studied, the maximum belonged to the age group of 51-70 years, with 67 males and 26 females. Twenty-four patients were asymptomatic, and 69 presented with symptoms, most typical being fever and sore throat. The predominant HRCT finding was ground glass opacification and mixed pattern (GGO admixed with consolidation) in bilateral lung fields. On follow-up of the patients, 57(61.2%) recovered without any residual changes, 24(25.8%) had residual lung changes and 12 (12.9%) succumbed to death, among which 7 had CTSS >20.

Conclusion: GGO with or without consolidation is the predominant HRCT pattern seen among the COVID 19 pneumonia patients. HRCT helps to forecast the clinoradiological outcome of the patients with CTSS.

Keywords: HRCT- High Resolution Computed Tomography, GGO- Ground glass opacity, CTSS- Computed Tomography Severity Score, COVID 19-Coronavirus Disease 2019, RTPCR-Reverse Transcriptase Polymerase Chain Reaction

Introduction

After a cluster of pneumonia cases were identified in Wuhan, China, in December 2019, a novel coronavirus was identified as the causative agent and named Severe Acute Respiratory Syndrome coronavirus-2 (SARS-CoV-2). The associated disease was called coronavirus disease 2019 (COVID-19). Since then, COVID-19 has rapidly spread from Wuhan to throughout the entire world. On January 30, 2020, WHO declared the outbreak a public health

emergency of international concern & it was declared a pandemic on March 11, 2020, by WHO. [1]

COVID-19 manifests with non-specific symptoms of variable severity, mainly involving the respiratory tract. It may also require advanced respiratory support in severe cases. To accommodate the broad spectrum of clinical manifestations caused by SARS-CoV-2, the WHO introduced a rather diffuse name, COVID-19 (coronavirus disease 2019). The COVID-

19 pneumonia is confirmed by laboratory testing through the identification of viral RNA by RT-PCR.

The majority of the COVID-19 patients present with pneumonia and RTPCR also has high false negative rates, thus, leading to chest imaging playing an essential part in the diagnostic workup of patients with probable or suspected COVID-19 disease [2,3,4,5].

Coronavirus causes lung injury by releasing pro-inflammatory cytokines that activate the innate immune system and recruit neutrophils and macrophages to the site of infection at the pulmonary capillary endothelium. Depending on the degree of inflammation, gas exchange decreases, and the need for oxygenation and intubation becomes necessary.

HRCT CHEST plays a significant role in diagnosing the COVID 19 pneumonia and determining the severity of the illness in terms of the extent of inflammation through lung lobe involvement by CTSS.

This study aims to study the spectrum of the HRCT findings of COVID 19 pneumonia, calculate the CTSS, and correlate it with the clinicoradiological outcome of the patient.

Material And Methods

Study design: Observational -retrospective and prospective study

Sample: The study includes the 93 patients referred to the Department of Radiodiagnosis at JLN Medical College, Ajmer, Rajasthan, for HRCT chest.

Duration of study: August 2020 to February 2022

Inclusion criteria: All patients diagnosed with Coronavirus by RTPCR and referred for the HRCT chest scan.

Exclusion criteria: Pregnant females (HRCT scan not done due to risk of harm to fetus by the CT radiations) and patients lost to follow up.

Methodology: All CT scans were performed on 16 slice Phillips G-XL-23662 scanner. We performed the Conventional non-contrast HRCT with the patient in the supine position during end-inspiration. The scan is done with the Standard CT protocol - tube voltage 100-120kVp, tube current 220-250 mAs, slice thickness 1-1.5mm, collimation of 16 x 0.6, and pitch of 0.75. Images were obtained in the

mediastinal window and reconstructed in a thin 1.25 mm lung window. We assessed the HRCT scan for the presence of opacities and lesions in the five lung lobes for the degree of involvement, and given the score from 1 to 5 as follows- <5% =1; 6-25%=2;26-50%=3;51-75%=4;>75%=5, summed up and assigned the CT severity score from 0 to 25.[4]

We followed up the patients through medical records, and we did a follow-up HRCT scan at three- and six-month intervals and evaluated for the presence or absence of residual lung changes.

Results

We did a study on 93 patients who fulfilled the inclusion criteria.

The maximum number of cases were from the age group of 61-70, accounting for 23.6 % cases (22) and 51-60 representing 20.4 % cases (19), followed by 41-50 accounting for 16% cases (15). [Table 1] The study included 67 males (72.1%) and 26 females (27.9%).[Table 2]

Among the 93 cases studied, 24 (25.8%) were asymptomatic and 69 (74.1%) symptomatic, with fever, sore throat, and cough being the predominant symptoms. 21of the symptomatic patients accounting for 22.5% of the study had shortness of breath and were clinically categorized as moderate to severe pneumonia. Only 8 out of the 69 symptomatic cases had CTSS <5. [Graph 1, Table 3 & 4].

Among the 93 patients scanned, 7(7.5%) had no findings on HRCT, and 86(92.4%) cases showed positive HRCT findings.

The predominant HRCT finding amongst the HRCT positive scans was ground-glass opacity observed in 41 cases (46.6%), followed by the mixed pattern (GGO admixed with consolidation) in 35 patients (40.6%). These findings were predominantly peripheral in the distribution in both lung fields and the lower lobes. Ten cases (11.%) showed the Crazy paving pattern, and17 cases (19.7%) had subpleural lines [Graph 2].

The CTSS correlated with the severity of the disease and the clinicoradiological outcome. The 21 cases categorized clinically as moderate to severe pneumonia had CTSS > 15. Forty-eight patients with mild to moderate pneumonia clinically had CTSS ranging between 8 -15. The 24 clinically

asymptomatic cases either had no HRCT findings or had CTSS less than or equal to 7.[Table 3,4,5]

On follow-up, 12(12.9%) succumbed to death, out of which 4 had CTSS of 16-20, and 7 had CTSS of 21-

25. [Table 6] 61.2 % cases (57) showed no or minimal residual lung changes, and 25.8 % cases (24) had residual lung changes on six-month HRCT chest scans. [Table 7, Graph 3]

Involment of lung lobe	Score
>% 5	1
6-24%	2
25-49%	3
50-75%	4
>75%	5

In our study, as per the inclusion criteria, only the RTPCR positive COVID 19 pneumonia cases were studied, all were categorised as CORADS 6.

The CORADS (COVID-19 Reporting and Data System) classification is a standardized reporting system for patients with suspected COVID-19 infection, given by the Dutch Radiological Society based on their efforts for standardization.

It states the level of suspicion of COVID19 infection.

	Chance of COVID19	CT findings
CORADS 0		Incomplete or insufficient scan due to excessive artifacts.
CORADS 1	Highly unlikely	Normal or non infectious abnormalities
CORADS 2	Unlikely	Abnormalities consistent with infections other than COVID 19
CORADS 3	Equivocal	Unclear whether Covid 19 is present
CORADS 4	Probable	Suspicious for COVID 19
CORADS 5	Highly likely	Typical COVID 19
CORADS 6	PCR positive	

Discussion

The WHO (World Health Organisation) reports that "80% of infections are mild or asymptomatic; 15% of infections are severe, which require oxygen; and 5% of infections are critical, requiring ventilation." Most mild patients need supportive treatment only, while severe patients need medical intervention. So,

if some clinical or imaging indicators can differentiate them, it will help the clinicians manage timely.

In our study, 22.5% (21) of patients had clinically moderate to severe pneumonia receiving ICU care. In comparison, 77.5% (72) of cases (asymptomatic or have mild to moderate pneumonia clinically) were

non-severe, receiving general therapy (i.e., supportive therapy, antiviral and antibiotic therapy), thus being consistent with the reported data.

In our study, most of the cases belonged to the elderly population, mostly over 50 years of age, and more than half of them had additional comorbidities in terms of diabetes, hypertension, and cardiac ailments.

Male predominance in our study was attributed to more exposure risk to them due to outdoor working occupational nature. 25.8 % (24) were asymptomatic, forming a significant chunk of the study, and 51.6% (48) had symptoms mainly fever, cough, and sore throat, referred to as the mild to moderate form of pneumonia clinically. The maximum among them had CTSS less than or equal to 15.

22.5 % (21) had moderate to severe pneumonia clinically, having CTSS >15, among which 11 succumbed to death.

Computed tomography severity score (CTSS) is assigned according to the method given by Li *et al.* The right lung is divided into three lobes (upper, mid and lower) and the left lung in two lobes (upper and lower) and each lobe is given a score out of five according to the involvement of the respective lobe. The overall score is the sum of points from each lobe and ranges from 0 to 25.

The predominant finding on HRCT chest was ground glass opacification with or without consolidation seen in bilateral lung fields distributed peripherally.

Crazy paving and subpleural lines were also amongst the predominant findings.

The findings of the study were consistent with the study done by Swenil A Shah, Meenakshi I Gajbhiye *et al.*, Sonal Saxena, Tanu Sagar *et al.* and Sudhir Bhandari, Meenu Bagarhatta *et al.* [8,9,10] 25.8 % (24) cases showed the residual lung changes, termed the post COVID fibrosing lung changes. These were seen in patients with the CTSS >15 and with the mixed pattern of the HRCT opacification. This may be related to the pathophysiological changes occurring in the lung in terms of chronic inflammation. This was consistent with the study done by Xiaoyu HanXi Jia *et al.* [11]

Thus, HRCT is a very effective tool to monitor the prognosis of patients as radiological clearance of

opacities may not be achieved in all patients who test RTPCR negative on follow-up swabs.

These patients may need further evaluation and treatment.

CT severity score gives an idea of the severity of infection and aggressiveness, thus playing a pivotal role in the management protocols and helps to prevent the morbidity and mortality associated with the disease.

There were some limitations to the study as this study was done in already diagnosed COVID -19 RTPCR positive cases (CORADS 6). Hence sensitivity and specificity of HRCT in making a diagnosis of COVID 19 infection cannot be calculated.

No comparison between RT-PCR and HRCT in diagnosing coronavirus infection was made.

Conclusion

CTSS thus showed a significant correlation with the severity of the illness and prognostication of the clinicoradiological outcome.

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TABLE 1: DISTRIBUTION OF THE CASES ACCORDING TO AGE

AGE	NO OF CASES
1 TO 10	1
11 TO 20	2
21 TO 30	10
31 TO 40	11
41 TO 50	15
51 TO 60	19
61 TO 70	22
71 TO 80	12
81 TO 90	1
91 TO 100	0

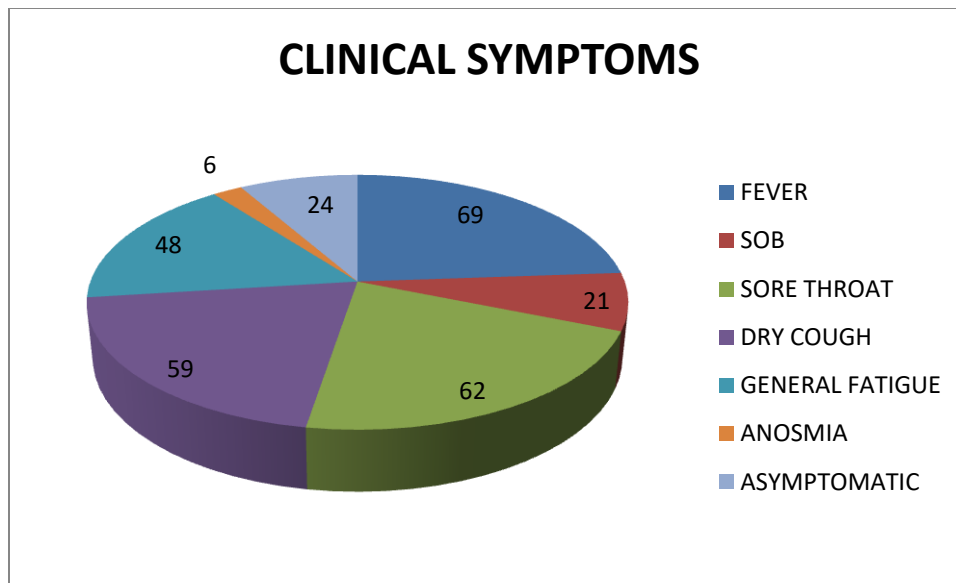
*According to the present study, 41-50 years and 51-60 & 61-70 years age group accounted for maximum number of cases 15(16.31%) & 19 (20.4%) and 22(23.6%) , out of 93 cases.

TABLE 2: DISTRIBUTION OF THE CASES ACCORDING TO GENDER

SEX	NO OF CASES
MALE	67
FEMALE	26

†Of the total 93 cases, 67 patients (72.1%) were males and 26 patients (27.9%) were females. There was male preponderance.

GRAPH 1: FREQUENCY OF THE SYMPTOMS



‡Most of the cases presented with fever sore throat and dry cough.

Shortness of breath was seen in 22% cases. Anosmia was reported by 6.

24 (25.8%) cases presented with no symptoms but were RTPCR positive and showed HRCT findings consistent with Covid-19 pneumonia

TABLE 3 & 4: HRCT FINDINGS IN RELATION TO CLINICAL SYMPTOMATOLOGY

Clinically	HRCT Negative or CTSS<5	CTSS>5	Total
Asymptomatic	17	7	24
symptomatic	8	61	69

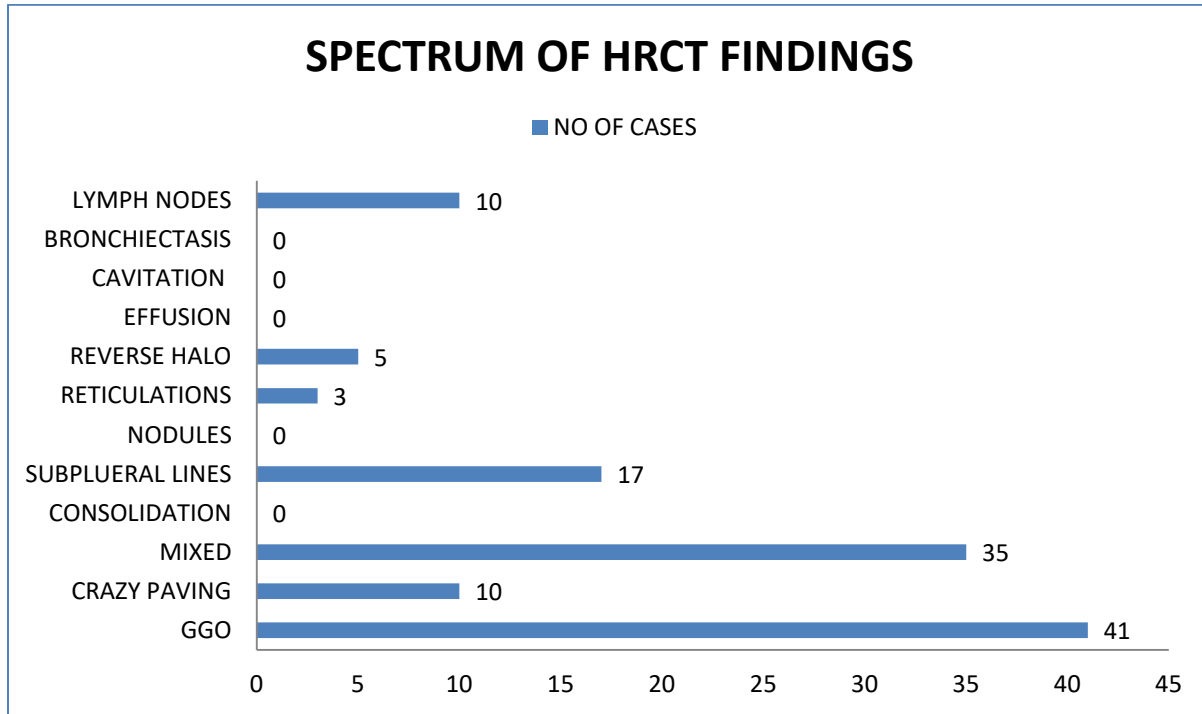
§Most of the symptomatic patients showed positive HRCT Chest findings.

Asymptomatic patients mostly, either had normal HRCT scan or CTSS< 5.

Clinically	Cases	CTSS	According to CTSS
Asymptomatic	24	<= 7	MILD
Mild to moderate pneumonia	48	8-15	MODERTE
Moderate to severe pneumonia	21	>15	SEVERE

|| CTSS >= 7 had mild pneumonia, CTSS 8-15 had moderate and CTSS >15 had severe pneumonia.

Graph 2: SPECTRUM OF THE HRCT FINDINGS IN COVID-19 PNEUMONIA



**The most predominant finding was ground glass opacification of lung fields and mixed pattern that is ground glass opacity with consolidation.

TABLE 5: FREQUENCY OF CTSS IN THE CASES

CTSS	NO OF CASES	No pneumonia clinically	Mild to Moderate pneumonia	Moderate to severe
> 5	25	24	1	-
6 TO 10	11	-	11	-
11 TO 15	26	-	26	-
16 TO 20	18	-	10	8
21 TO 25	13	-	-	13

††CTSS correlated well with the clinical symptomatology of the patients.

Moderate to severe clinical pneumonia cases had CTSS > 15.

Asymptomatic cases and mild clinical pneumonia cases had lesser CTSS.

Table 6: CTSS AS A PREDICTOR OF MORTALITY

CTSS	NO OF MORTALITIES
> 5	0
6 TO 10	0

11 TO 15	1
16 TO 20	4
21 TO 25	7
	12

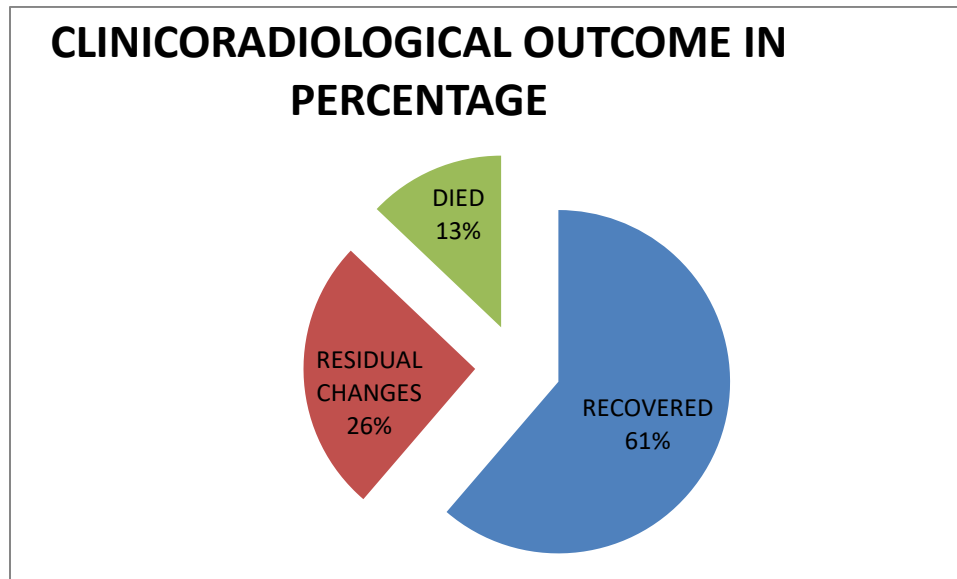
‡‡ 11 of 12 cases who turned morbid had CTSS > 15

TABLE 7: CLINICORADIOLOGICAL OUTCOME ON FOLLOW UP OF CASES

SEQUELAE	NO OF CASES	CTSS <5	CTSS 6-10	CTSS 11-15	CTSS 16-20	CTSS 21-25
RECOVERED	57	25	11	21	-	-
RESIDUAL CHANGES	24	-	-	4	14	6
DIED	12	-	-	1	4	7

§§Cases with higher CTSS had residual lung cases and cases with lower CTSS showed resolution of the HRCT chest findings.

Graph 3: CLINICORADIOLOGICAL OUTCOME ON FOLLOW UP



** Cases with higher CTSS had residual lung cases and cases with lower CTSS showed resolution of the HRCT chest findings.

Illustrations

Fig 1 Axial HRCT chest image in 31year old female shows ground glass opacification in peripheral lung fields bilaterally with CTSS 6/25. Follow up scan showed no residual changes.

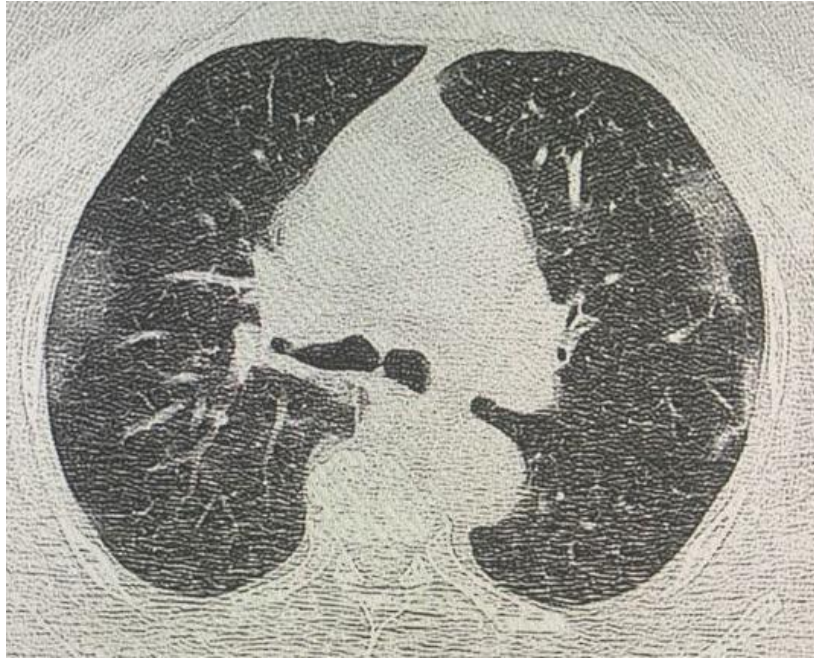


Fig 2: Axial HRCT Chest image in 51 years old male shows the mixed pattern of opacification (ground glass opacity admixed with consolidation) seen in bilateral lung fields distributed peripherally with CTSS 17.

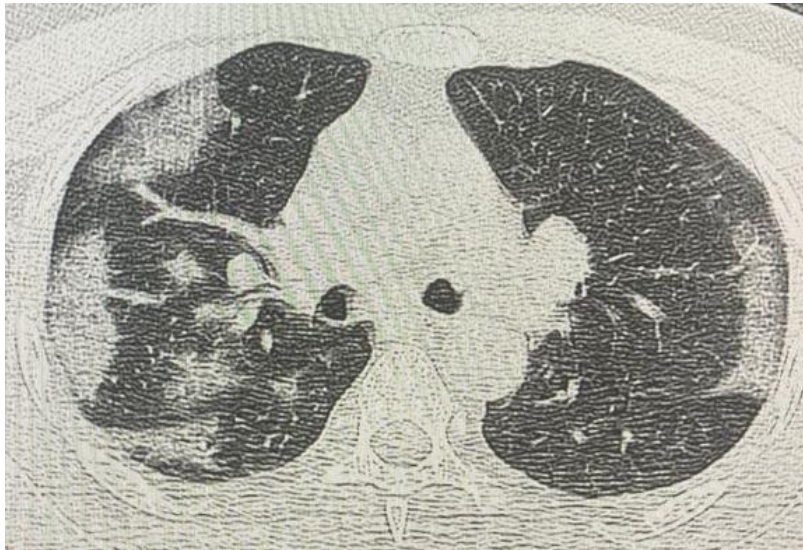


Fig 3 HRCT chest scan on Follow up showed persistence of opacities and interstitial septal thickening.



Fig 4: Axial HRCT chest image in 71 years old male shows the crazy pavement appearance involving almost both the lower lobes and right middle lobe with CTSS 21/25. He succumbed during his hospital stay.

