

High Resolution Computed Tomography Findings and Computed Tomography Severity Index in COVID-19 Infection Correlated with Age and Gender

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ABSTRACT

Introduction:

The new coronavirus disease -19 (COVID-19) is caused by SARS-CoV2 strain of coronavirus. The Computed tomography (CT) severity index is a scoring system used to assess the lung changes and involvement by COVID-19 based on approximate estimation of pulmonary involved areas. This study was done to identify the spectrum of CT chest findings and CT severity index in COVID-19 infection and its correlation with age and gender.

Methods:

Patients with COVID-19 infection with positive PCR results and positive pulmonary CT findings were included in the study. All these patients underwent high-resolution computed tomography (HRCT) of the chest. The CT scan severity score in all of these patients was calculated and the results were analyzed by SPSS version 21.

Results:

A total of 104 patients with confirmed COVID-19 infection were included in this study. There were 59 males (56.73%) and 45 females (43.3%) in this study. There was a higher chest severity score in males compared to females. However, there was no significant correlation between the age and CT chest severity score.

Conclusion:

HRCT chest can help in the early identification of the patients who need intensive care. Early admission and intensive care of the patients with high CT severity scores may help to reduce the mortality of COVID-19 patients.

Keywords: COVID-19; Lung; Polymerase Chain Reaction; Tomography, X-Ray Computed

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INTRODUCTION

The new coronavirus disease (COVID-19) is a pandemic viral infectious disease caused by a strain of severe acute respiratory syndrome coronavirus SARS-CoV-2. SARS-CoV-2 belongs to β -coronavirus, which is a non-segmented, single stranded RNA virus.¹ It was first detected in Wuhan city, Hubei Province, China in December 2019.² The World Health Organization first declared this disease as a Pandemic on 11th March 2020.³ The first case of COVID-19 in Nepal was proved on 23rd January 2020 in a native student, studying in Wuhan who had returned for winter holidays.⁴ Since then several waves of COVID-19 have thrashed the health system of Nepal. Currently, we are on the verge of fighting the Omicron (B 1.1.159) wave in Nepal.

The gold standard for the diagnosis of COVID-19 infection is RT-PCR of the nasal or throat swab sampling. The reported sensitivity of the RT PCR test in COVID-19 is 50-62 %.^{5,6} However, He et al have reported the sensitivity of RT PCR in COVID-19 to be 79%. Several factors affect the accuracy of RT-PCR. These are respiratory tract viral load, samples source, the procedures, and timing of sample acquisition, as well as the intrinsic features and quality of the testing kits.⁸ Hence, there are still a substantial number of missed diagnoses when we solely rely on RT-PCR. So, it is important to correlate the blood investigation along with radiological features of a CT scan of the chest in the proper management of the patient.⁷ The reported sensitivity of HRCT of the chest in COVID-19 has been reported to be up to 98%.⁹ The initial discussion about using CT scans in patients with COVID-19 infection was to assess the spectrum of imaging findings as well as to recognize the pattern of the disease being typical or atypical. So, many classification systems have emerged to homogenize reporting into typical, atypical, indeterminate appearance and negative for pneumonia.¹⁰

The CT severity score index is a scoring system used to assess the lung changes involvement by COVID-19 based on approximate estimation of pulmonary involved areas. Each of the five lung

lobes has been visually scored and given a score from 1 to 5:

- 1: representing less than 5% lobar involvement.
- 2: 5–25% lobar involvement.
- 3: 26–50% lobar involvement.
- 4: 51–75% lobar involvement.
- 5: > 75% lobar involvement.

Then, the final score is the summation of individual lobar scores and will be out of 25 (total score); the total lung involvement is then obtained by multiplying the total score times 4.¹¹ The objective of this study was to observe the spectrum of CT Pulmonary changes in COVID-19 infection and to estimate the CT severity index and its correlation with age and gender of the patients.

METHODS

It was a cross-sectional study conducted in the Department of Radiology of Manipal teaching hospital, Pokhara. The study was conducted over two months from 1th June 2021 to 30th August 2021. Ethical clearance was obtained before the study from the institutional review board of Manipal Teaching Hospital. Informed and written consent was taken from each patient before their enrollment into the study. Patients diagnosed with COVID-19 by polymerase chain reaction (PCR) who had positive pulmonary CT findings were included in the study. Patients whose PCR reports were unobtainable were excluded from the study.

All patients underwent plain CT of the chest using 128 slice CT (PHILIPS). CT scan was done using a standard protocol and standard safety precautions were followed. Axial sections of 3 mm slice thickness and field of view (FOV) of 400 mm were obtained. Tube current of 20–30 mA, tube voltage of 120–140 kV, matrix of 512, pitch of 1.078, and rotation time of 0.75 seconds were used. Sagittal and coronal reformatted images were subsequently obtained. All CT scan images were analyzed and reviewed. The severity score was then calculated based on a percentage of lung involvement.¹¹

The collected data were entered in Microsoft Excel 2013 and analyzed using SPSS version 21

for windows. The categorical data were presented as frequency and percentage tables. Regression analysis was used to calculate the *p*-value; statistically significant results were accepted at *p*-value < 0.05. Pearson correlation test was used to evaluate the correlation of total CT-severity score and patient age. Categorical correlation analysis was used to assess the relationship between CT severity score and the patient gender.

RESULTS

This study enrolled 104 patients of COVID-19 confirmed with RT-PCR. There were 59 (56.7%) males and 45(43.3%) females with age ranges from

19 to 93 years. The mean age of the patients was 60.5± 15.7 years.

The spectrum of HRCT chest finding in COVID-19 infection

The most common finding in COVID-19 infection as seen on HRCT chest was Ground Glass Opacities seen in 99 (90.5%) patients which were followed by vascular dilation in 70.2%. Other findings like consolidation were seen in 66 patients (63.5%), reticulation in 42 patients (40.4%), air bronchogram in 32 patients (30.8%), while crazy paving was evident in 20 patients (19.2%). (Table 1)

Table 1: Spectrum of HRCT chest finding in COVID-19 patients

CT chest findings	Frequency	Percent
Ground glass opacities	99	90.5
Crazy paving	20	19.2
Consolidation	66	63.5
Bronchial dilation	15	14.4
Lung cyst	12	11.5
Air bronchograms	32	30.8
Vascular dilatation	73	70.2
Reticulation	42	40.4
Pleural effusion	14	13.5
Other findings	16	15.4

Involvement of different lung lobes in COVID-19 patients

The disease was more common in the lower lobes as compared to the upper and middle lobes as shown in Table 2.

Correlation of CT severity index with gender

Out of 45 females, 60% had moderate disease with a CT severity score between 8 and 17. Severe disease was seen in 15.6% of females as compared to 28.8% of males as shown in table 3. Severity of lung involvement was significantly higher in males (*p* <0.023).

Table 2: Frequency of lung lobe involvement

Lobes	RUL	RML	RLL	LUL	LLL
Mean score	2.5± 1.25	2.5± 1.28	3.2± 1.17	2.6± 1.16	3.1± 1.27
Minimum score	0	0	0	0	0
Maximum score	5	5	5	5	5

RUL: Right upper lobe, RML: Right middle lobe, RLL: Right lower lobe, LUL: Left upper lobe, LLL: Left lower lobe

Table 3: CT chest severity index correlated with gender

	Mild(<8)	Moderate (8 to17)	Severe(>17)	Total
Female	11(24.4%)	27(60%)	7(15.6%)	45(100%)
Male	4(6.8%)	38(64.4%)	17(28.8%)	59(100%)
Total	15(14.4%)	65(62.5%)	24(23.1%)	104(100%)

Table 4: CT chest severity index correlated with age

CT severity index	Age group			
	<40 years	41 to 60 years	>60 years	Total
Mild(<8)	0(0%)	7(15.9%)	8(15.1%)	15(14.4%)
Moderate (8 to 17)	6(85.7%)	29(65.9%)	30(56.6%)	65(62.5%)
Severe(>17)	1(14.3%)	8(18.2%)	15(28.3%)	24(23.1%)
Total	7(100%)	44(100%)	53(100%)	104(100%)

Correlation of CT severity index and age

In all the age groups, the moderate disease was the most common observation in 62.5%. There was no significant correlation between age group and severity of lung involvement with COVID-19 infection (p-value= 0.49) as shown in Table 4.

DISCUSSION

This study enrolled a total of 104 patients, out of which 59 patients (56.7%) were males and 45 patients (43.3%) were females. In this study, a higher CT severity score in COVID-19 patients was seen in males compared to females similar to the finding of Borghesi et al. and Saeed et al.^{12,13} There was no significant association between the age group and CT chest severity score in patients of COVID-19 in our study. In the study done by Saeed et al., they found that a higher CT severity score was found in the age group of 50 to 59 years of age as compared to 60 to 69 years and more than 70 years of age group.¹³ However, Liu et al. and Al-Mosawe et al. reported that the more severe CT lung changes were significantly higher in the older age group.^{14,15}

This study revealed that ground glass opacities (GGO) were the most common finding in patients of COVID-19 observed in 90.5% of patients. Following GGO, Vascular dilatation was the next common finding observed in 70.2% of patients. This is similar to the finding from studies done by Parry et al., Omar et al. and Adnan et al.^{16,17,18}

Consolidation was seen in 63.5% of patients in this study. Omar et al and Adnan et al reported that consolidation was observed in 23% and 9% of their patients, respectively.^{17,18} This variation in the finding could be due to the timing of the HRCT chest as consolidation with or without GGO is seen during the second and third weeks.

In this study, the lower lobe was the most commonly involved in COVID-19, and a higher frequency of involvement was seen in the right upper lobe as compared to the left upper lobe. Chung et al. did a study on 21 cases of COVID-19 where they also found that the most common involvement was in the right lower lobe (76%), and the least common involvement was in the right middle lobe (57%).¹⁹

We lacked pediatric cases in our study and hence could not study the pattern of involvement in them. We also did not perform lung tissue biopsies for histopathologic correlation in our patients which were the limitations of our study.

CONCLUSION

HRCT chest is an important aid in the fight against the current pandemic. This study reports a higher severity score of COVID-19 in male patients. However, there was no significant association between the age and severity of COVID-19. Chest CT can help to determine the severity early in the course of the disease and helps in the decision of early admission and treatment of severe cases of

COVID-19, hence preventing the morbidity and mortality related to severe disease. Further research is needed to clarify the value of chest CT for prognostication in COVID-19 disease, including correlation with patient outcome.

CONFLICT OF INTEREST

None

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None

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