Correlation between Chest CT Severity Scores and the Clinical Severity of Patients with Covid-19 in South India

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ABSTRACT

Introduction: In December 2019, a series of cases of pneumonia of unknown causation emerged in Wuhan,
Hubei, China, and quickly raised intense attention around the world. A novel bat-origin coronavirus, 2019 novel coronavirus, was identified by means of deep sequencing analysis.
Our study correlates the CT severity score with the clinical severity of the patients who were confirmed to have COVID-19 disease.

Material and methods: We retrospectively collected the records of patients admitted with COVID-19 in Sri Venkateshwaraa Medical college hospital and research centre. The informed consent was waved off as per the ethics committee. We collected clinical and laboratory data for analysis derived from an electronic medical record system, from March 2021 to May 2021. CT images of patients who were suspected to have COVID-19 infection and underwent a chest HRCT scan were obtained from Radiology department. 70 patients were enrolled in our study.

Results: The mean age was 49.74 ± 14.52 years (range 18–70 years; 45 males (64.3%), 25 females (35.7%)). Our results showed no significant correlation between CT severity score and the clinical outcome. The HRCT scans were mild disease was seen in 25/70 (35.7%) patients, moderate in 30/70 (42.9%), and severe in 15/70 (21.4%) patients. These findings were found to have statistically non-significant correlation with the CT severity score ($p < 0.75411$).

Conclusion: CT scans can have a pivotal role in assisting physicians in the management plan and work as an
indicator for disease severity and possible outcome. CT severity score is not correlated with clinical severity and oxygen requirement in patients with COVID-19 infection. However, more research is needed to further clarify the value of chest CT for prognostication in COVID-19 disease, including correlation with patient outcome.

Keywords: CT Severity, Clinical Severity, Covid-19, RT-PCR.

INTRODUCTION

In December 2019, a series of cases of pneumonia of unknown causation emerged in Wuhan,
Hubei, China, and quickly raised intense attention around the world.[1] A novel bat-origin coronavirus, 2019 novel coronavirus, was identified by means of deep sequencing analysis.[2] The virus, named severe acute respiratory syndrome coronavirus2 (SARS-CoV-2)[3], is phylogenetically closest to bat SARS-like coronavirus but in a separate clade, which means that a novel coronavirus is spreading.[2] As of February17, 2020, 72,436 laboratory-confirmed cases were consecutively reported in 31 provinces (municipalities and regions) in China, including 11,741 severe cases, 1868 fatal cases, and 6242 suspected cases.[4] After the first reported case in Wuhan, several exported cases were confirmed in Thailand, Japan, South Korea, and the United States.[5–8] On January 31, 2020, the World Health Organization[9] declared the outbreak of coronavirus disease (COVID-19) a Public Health Emergency of International Concern. Given the striking speed of virus transmission, the ongoing COVID-19 outbreak has undoubtedly been linked to panicked memories of two previous beta coronavirus outbreaks in the21st century: SARS-CoV[10,11] and Middle East respiratory syndrome coronavirus (MERS-CoV).[12,13] SARS-CoV-2 proved to have the ability for efficient human-to-human transmission.[14–16] The explosion of confirmed cases of COVID-19 has been overwhelming, even though the mortality of COVID-19 is lower than that of SARS-CoV and MERS-CoV infections.[17] COVID-19 is an infection that has widely and rapidly spread all over the world and became a pandemic with significant impacts upon the sociopolitical milieu and healthcare delivery systems.[18] The clinical presentations vary from asymptomatic carriers to patients requiring assisted ventilator support, and ICU admissions with increased mortality made it an unusual and unprecedented challenge.[19,20] Nasopharyngeal swab RT-PCR test has been the diagnostic test used as the standard of reference for disease confirmation.[21]

A non-contrast high-resolution CT chest imaging plays a pivotal and essential role in the early disease detection, particularly in patients with false-negative RT-PCR results, as well as in managing and monitoring the course of disease.[22] Moreover, the disease severity can be ascertained from the imaging findings, significantly supporting the clinicians in their clinical judgment and ensuring effective and timely management.[23] Prognosis can also be affected by the severity of the disease in the critically ill patients allowing appropriate selection of early involvement of the intensive care.[24,25]

Multiple studies have explored the pulmonary involvement

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on the chest CT images using both visual and software quantitative assessments.[26,27] Imaging plays an important role in the diagnosis and management of COVID-19pneumonia. CT is considered the first-line imaging modality in highly suspected cases and is helpful for monitoring imaging changes during treatment. Therefore, CT has been identified as an efficient clinical diagnostic tool for people with suspected COVID-19.[28] It has potential for identifying people with negative results of a reverse transcription–polymerase chain reaction (RT-PCR)assay but in whom COVID-19 is highly suspected.[29,30] COVID-19 pneumonia is the most common clinical presentation ofCOVID-19. The findings on CT images may reflect the severity of disease. Previous studies[31–33] have shown imaging features in small sample sizes. The detailed imaging features and differences in imaging features between the four clinical types (mild, common, severe, fatal)[28] have not been well studied for this disease.

To our knowledge, ours is the first comprehensive study to describe the correlation of chest CT severity scores (CTSS) and the clinical picture of patients with COVID-19 disease in the South Indian region. Our study correlates the CT severity score (CTSS) with the clinical severity of the patients who were confirmed to have COVID-19 disease.

MATERIAL AND METHODS

We retrospectively collected the records of patients admitted with COVID-19 in Sri Venkateshwaraa Medical college hospital and research centre. The informed consent was waved off as per the ethics committee. We collected clinical and laboratory data for analysis derived from an electronic medical record system, from March 2021 to May 2021. CT images of patients who were suspected to haveCOVID-19 infection and underwent a chest HRCT scan were obtained from Radiology department. The diagnosis of COVID-19 was determined with following methods: isolation of SARSCoV-2 or at least one positive results of real-time RT-PCR assay for SARS-CoV-2 or a genetic sequence matched with SARS-CoV-2. A total of 70patients with consecutively laboratory-confirmedCOVID-19 (25 women, 45 men; mean age, 49.74 ±14.52 years; range, 18–70years) who underwent CT in south India, were included in this study. All available clinical, laboratory, and epidemiologic data were collected for all patients. According to the guideline on COVID-19 (trial version 5)[28] issued by the China National Health Commission, patients were divided into four groups: those with mild-type, common-type, severe-type, and fatal-type disease. Because treatment regimens vary by disease type, we regrouped patients into nonemergency (mild and common types) and emergency (severe and fatal types) groups. All patients underwent CT after admission. The mean interval between admission and CT examination was 1 day(range, 0–7 days; median, 1 day).

Chest CT scan

Chest CT imaging was performed using a 6 slice CT scanner (Emotion; Siemens). All patients were examined in the supine position. CT images were then acquired during a single

inspiratory breath-hold. The scanning range was from the apex of the lung to the costophrenic angle. CT scan parameters were as follows: x-ray tube parameters 120 kVp, 350 mAs; rotation

time 0.5 second; pitch 1.0; section thickness 5 mm; intersection space 5 mm; additional reconstruction with a sharp convolution kernel; and a slice thickness of 1.5 mm.

The analysis was performed using SPSS 21.0. Descriptive statistics of patients' demographics, clinical, and laboratory results were reported as numbers and relative frequencies. Frequencies of CT scores were calculated and compared with other clinical variables. The Pearson correlation coefficient test was used for correlations, and *p* value less than 0.05 was defined statistically significant.

RESULTS

The mean age was 49.74 ± 14.52 years (range 18–70 years; 45 males (64.3%), 25 females (35.7%)). The age was further classified into 5 groups: 18-30 years (5 patients), 31–40 years (10 patients), 41–50 years (16 patients), 51–60 years (24 patients) and 61–70 years (15 patients) (table-1).

In our study we found some clinical severity for COVID-19 patients. Dyspnea was found among 11 (15.7) in mild category, 21 (30%) in moderate and 35(50%) in severe categories. Hypoxia was found among 49(70%) in moderate and 70 (100%) in severe categories. Cough was found among 25 (35.7%) in mild, 27(38.5%) in moderate and 28(40%) in severe categories. Respiratory failure was found only among 4(5.7%) in severe category. Multi organ dysfunction was found among 1 (1.4%) in moderate and 2(2.9%) in severe categories (table-2).

Out of the 70 patients, 27 patients (38.57%) did not require any oxygen support. The remaining 33 patients required oxygen supplement as follows: 18 patients (25.74%) required nasal cannula, 10 patients (14.28%) required facemask, 2 patients (2.85%) required non-rebreather mask, 4 patients

Age	Sex		Total	Percentage
	Male	Female		
18-30	4	1	5	7.14%
31-40	7	3	10	14.03%
41-50	10	6	16	22.09%
51-60	15	9	24	34.03%
61-70	9	6	15	21.04%
Total	45	25	70	100%

Table-1: Age and Sex wise distribution

Clinical severity	Mild	Moderate	Severe
Dyspnea	11(15.7%)	21(30%)	35(50%)
Hypoxia	-	49(70%)	70(100%)
Cough	25(35.7%)	27(38.5%)	28(40%)
Respiratory failure	-	-	4(5.7%)
Multi organ dysfunction	-	1(1.4%)	2(2.9%)

Table-2: Clinical severity

CT severity		Maximum oxygen requirement						Total
		None	Nasal cannula	Face mask	Non rebreather	HFNC	Intubation	
Mild (≤7)	Count	9	6	4	1	2	3	25
	% within category	36	24	16	4	8	12	100
	% of total	12.9	8.6	5.7	1.4	2.9	4.3	35.7
Moderate (8-17)	Count	12	8	4	1	1	4	30
	% within category	40	26.7	13.3	3.3	3.3	13.3	100
	% of total	17.14	11.4	5.7	1.4	1.4	5.7	42.9
Severe(≥18)	Count	6	4	2	-	1	2	15
	% within category	40	26.6	13.3	-	6.7	13.3	100
	% of total	8.6	5.7	2.9	-	1.4	2.9	21.4

Table-3: CT Severity

(5.71%) required a high-flow nasal cannula (HFNC), and 9 patients (12.9%) required intubation (table-3).

DISCUSSION

The WHO advised the use of chest imaging as part of diagnostic workup of COVID-19 disease whenever RT-PCR testing is not available, in case of delayed test results or when there is a clinical suspicion of COVID-19 with initial negative RT-PCR testing. Clinicians should work hand in hand with the radiologists in order to make the proper choice of imaging modality.[35]

CT scan can be a useful tool in evaluating the individual disease burden.[36] The quantitative severity can be assessed using a visual method (as in our study) or software that determines the percentage of affected lung volumes using the deep learning algorithms.[37,38]

Our population included 70 consecutive patients who were suspected to have COVID-19

infection. Infection with SARS-CoV-2 was confirmed from a nasopharyngeal swab using the RT-PCR COVID-19 Detection Kit, which is a reverse transcriptase-polymerase chain reaction (RT-PCR)test that has received Emergency Use Authorization (EUA)from the US Food and Drug Administration (FDA). RT-PCR testing was performed using Clinical Laboratory Improvement Amendments (CLIAs) diagnostic standards according to current testing guidelines.[39] All patients underwent RT-PCR tests and had a HR CT scan done.

The mean age was 49.74 ± 14.52 years (range 18–70 years;45 males (64.3%), 25 females (35.7%)). The age was further classified into 5 groups: 18-30, 31–40, 41–50, 51–60 and 61–70years.

In our study we found some clinical severity for COVID-19 patients. Dyspnea was found among 11 (15.7) in mild category, 21 (30%) in moderate and 35(50%) in severe categories. Hypoxia was found among 49(70%) in moderate and 70 (100%) in severe categories. Cough was found among 25 (35.7%) in mild, 27(38.5%) in moderate and 28(40%) in severe categories. Respiratory failure was found only among 4(5.7%) in severe category. Multi organ dysfunction was found among 1 (1.4%) in moderate and 2(2.9%) in severe categories.

Out of the 70 patients, 27 patients (38.57%) did not require any oxygen support. The remaining 33 patients required oxygen supplement as follows: 18 patients (25.74%) required nasal cannula, 10 patients (14.28%) required facemask, 2 patients (2.85%) required non-rebreather mask, 4 patients (5.71%) required a high-flow nasal cannula (HFNC), and 9patients (12.9%) required intubation.

Our results showed no significant correlation between CT severity score and the clinical outcome. The HRCT scans showed mild disease in 25/70 (35.7%) patients, moderate in 30/70 (42.9%) and severe in 15/70 (21.4%) patients. These findings were found to have statistically non-significant correlation with the CT severity score ($p < 0.75411$).In other study by GA Saeed et al.[40] CT severity score was found to be positively correlated with lymphopenia, increased serum CRP, d-dimer, and ferritin levels ($p < 0.0001$).

In the mild category9/25 (36%) patients did not require any oxygen support, 6 (24%) required nasal cannula, 4 (16%) required face mask, 1 (4%) required non-rebreather mask, 2 (8%) required HFNC, and 3 (12%)required intubation.12/30 (40%) of patients with moderate severity did not require any oxygen support, 8 (26.7%) required nasal cannula, 4 (13.3%) required face mask, 1 (3.3%) required non-rebreather mask, 1 (3.3%) required HFNC, and 4 (13.3%) required intubation. 6/15 patients (40%) in severe category did not require oxygen support, 4 (26.6%) required nasal cannula, 2 (13.3%) required face mask, none required non-rebreather mask, 1 (6.7%) required HFNC, and 2(13.3%) required intubation.

CONCLUSION

CT scans can have a pivotal role in assisting physicians in the management plan and work as an
indicator for disease severity and possible outcome. CT severity score is not correlated with clinical severity and oxygen requirement in patients with COVID-19 infection. However, more research is needed to further clarify the value of chest CT for prognostication in COVID-19 disease, including correlation with patient outcome.

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