

Correlation of RT-PCR Cycle Threshold Value and Chest Computed Tomography Scan Severity Score in Patients with COVID-19: A Cross-Sectional Study

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Abstract:

Introduction: The Chest Computed Tomography (CT) scan for Coronavirus Disease-2019 pneumonia is frequently employed, and viral load is estimated by Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) Cycle threshold (Ct) values. The purpose of the current study was to evaluate the correlation between the CT severity score and the RT-PCR Ct value in mild and moderate COVID-19 patients.

Materials and Methods: This prospective study was conducted from January to June 2021 at Fathima Medical College, Kadapa. 40 subjects (20 with mild COVID-19 and 20 with moderate COVID-19) were included in the study. Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) Ct value was estimated using real-time RT-PCR. Based on the chest findings from High-Resolution Computed Tomography (HRCT), the CT severity score was determined. The correlation among the parameters was determined using Pearson's correlation formula.

Results: The mean age in the mild COVID-19 group was 47.64 years and in the moderate COVID-19 group was 53.65 years. The mean RT-PCR Ct value of E gene was 24.48 and Rdrp gene was 24.56 in the mild COVID-19 group; while in the moderate group it was 23.72 for both E gene and Rdrp genes. The correlation between NEWS and Ct value of E gene (r-value=-0.06, p-value=0.68), Ct value of Rdrp gene (r-value=-0.03, p-value=0.79) and the correlation between CT severity score and Ct value of E gene (r-value=-0.05, p-value=0.73), Ct value of Rdrp gene (r-value=-0.06, p-value=0.68) was negative and insignificant. The mean CT severity score in mild COVID-19 group was 3.92, and in moderate COVID-19 group was 9.88. A significant positive correlation was found between the CT severity score and NEWS at admission (r-value=0.55, p-value<0.001)

Conclusion: CT scan may be more useful to detect lung involvement when done nearing or after the first week of symptom onset, irrespective of the viral load. Viral load can be important in predicting transmissibility and to minimize potential spread, whereas chest CT can help identify cases requiring extensive medical care.

Keywords: Coronavirus disease-2019, computed tomography, Total severity score, Reverse transcriptase polymerase chain reaction, viral load.

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Introduction

The first confirmed case of COVID-19 in India was reported from Kerala on 27th January 2020 [1]. The World Health Organization (WHO) declared the outbreak of COVID-19 as a public health emergency of International concern on 30th January 2020 [2]. The utility of microbiological, immunological, biochemical and radiological techniques has come to the forefront in supplementing the clinical diagnosis of COVID-19. While the microbiological methods are used to confirm the diagnosis by definitively detecting the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) viral genome, the radiological methods are often used for differentiating COVID-

19 from other infections and estimating the severity of disease based on the quantification of lung involvement. In this regard, the Reverse Transcription-Polymerase Chain Reaction Cycle threshold (RT-PCR Ct) value and CT Severity Score (CT-SS) have been useful adjuncts in establishing the diagnosis. According to the WHO, the primary and preferred method for diagnosis is collection of upper respiratory samples via nasopharyngeal swabs and detection of SARS-CoV-2 by RT-PCR. A positive result indicates that SARS-CoV-2 Ribonucleic Acid (RNA) has been detected with a Ct value of less than 32 cycles of amplification [3]. The Ct is defined as the number

of cycles required for the fluorescent signal to cross the threshold. The Ct levels are inversely proportional to the amount of target nucleic acid/viral load in the sample (i.e., the lower the Ct level, the greater the amount of target nucleic acid/viral load in the sample). Lower Ct values may be associated with worse course of illness and outcomes and threshold values may be useful in predicting the clinical course and prognosis of patients. Average Ct values across multiple time points during the course of disease were lower in patients who died compared with those who had recovered [4].

Chest CT is an imaging tool for diagnosing pneumonia- is relatively easy to perform and can produce rapid diagnosis of COVID-19. Chest CT can demonstrate typical radiographic features in COVID-19 patients such as ground-glass opacities, multifoca patchy consolidation, and/or interstitial changes with a peripheral distribution [5]. Studies that compare RT-PCR Ct values (viral load) with CT chest severity are limited. This study explores the correlation between TSS of chest CT and Ct values of SARS-CoV-2 of patients and factors associated with high TSS and low Ct value. This may help in predicting the course of hospital stay and outcome of COVID-19 positive patients.

Materials and Methods

This prospective cohort study was conducted in Fathima Medical College, Cadapa from January 2021 to June 2021. The study was conducted in the general wards when the hospital was converted into an exclusively COVID-19 dedicated centre. The study enrolled 50 subjects. Ethical approval was obtained from Institutional ethics committee and an informed consent form was collected from all the participants before the study

Inclusion criteria: Adult (aged >18 years) COVID-19 positive patients, confirmed by either RT-PCR or Rapid Antigen Test (RAT) who presented with an oxygen saturation (SpO₂) of more than 90% on room air were included as subjects after taking informed consent.

Exclusion criteria: Patients with shock, Multiorgan Dysfunction Syndrome (MODS) or Acute Respiratory Distress Syndrome (ARDS) and patients admitted in Intensive Care Unit (ICU) were excluded. Severe COVID-19 patients (who had a SpO₂ of less than 90% on room air) were also excluded

The subjects were divided into two groups of 20 each:

- Mild COVID-19 patients whose SpO₂ was $\geq 94\%$ on room air
- Moderate COVID-19 patients whose SpO₂ was 90-93% on room air.

The RT-PCR sample was sent to be analysed for SARS-CoV-2, and the Ct values of the E gene and the Rdrp gene were obtained. On the basis of the severity of lung involvement, a High Resolution Computed Tomography (HRCT) chest was performed, and the CT-Severity Score (CT-SS) was calculated. In the event that clinical deterioration was observed, the appropriate blood markers were sent to confirm.

Statistical Analysis: The collected data was analysed using the Statistical Package for Social Sciences (SPSS) version 23.0. The Student's t-test was used to compare continuous variables that were reported as mean and standard deviation.

Categorical variables were reported in the form of frequencies and percentages. For all tests, p-values less than 0.05 were considered significant. Pearson's correlation formula was used to calculate the relationship between Ct value and CT severity score.

Results

The mild COVID-19 group had a mean age of 47.64 years, while the moderate COVID-19 group had a mean age of 53.65 years. According to the gender distribution, 75% (30/40) of the subjects were men, whereas 25% (10/40) were females. Table 1 depicts the age distribution of patients.

Table 1: Age wise distribution of patients

Age group	Mild COVID-19 (N %)	Moderate COVID-19 (N %)	Total
21-30	5 (25%)	3 (15%)	8 (20%)
31-40	2 (10%)	2 (10%)	4 (10%)
41-50	3 (15%)	7 (35%)	10 (25%)
51-60	5 (25%)	3 (15%)	8 (20%)
61-70	4 (20%)	4 (20%)	8 (20%)
>70	1 (5%)	1 (5%)	2 (5%)

The analysis of RT-PCR Ct values revealed that the mean Ct value of the E gene in mild COVID-19 patients was 26.32 \pm 6.14 and that of the Rdrp gene was 24.46 \pm 4.89.. The mean Ct value of Rdrp genes in mild COVID-19 patients was 26.84 \pm 6.54 and

that of the Rdrp gene was 24.56 \pm 5.94.. There was statistically significant difference in the Ct values of both E gene (p-value=0.57) and Rdrp gene (p-value=0.54) between the groups. The mean CT severity score in mild COVID-19 patients was

significantly lower than in the moderate COVID-19 patients as shown in Table 2.

Table 2: Mean RTPCR Value, CT severity score in the participants

Parameters	Mild COVID-19	Moderate COVID-19	P-value
Ct value E gene			
Mean±SD	26.32±6.14	24.46±4.89	<0.01
Ct value Rdrp gene			
Mean±SD	26.84±6.54	24.56±5.94	<0.01
CT severity score			
Mean±SD	4.12±4.84	8.96±6.75	<0.01

There was a negative and insignificant correlation between CT-SS and Ct values of E gene and Rdrp gene. The correlation between Ct values of E gene and Rdrp gene was also negative and insignificant [Table 3].

Table 3: Correlation between RT-PCR Ct value and CT severity score

Ct value		Ct severity score
E-gene	r-value	-0.04
	p-value	0.52
RdRp gene	r-value	-0.05
	p-value	0.72

Discussion

The purpose of the study was to evaluate the relationship between CT-SS, a measure of COVID-19's radiological severity, and RT-PCR Ct value, a marker of viral load. In comparison to the mild COVID-19 group, the mean CT-SS in the moderate COVID-19 group was significantly higher. Similar results were seen in other research; for example, Abbasi B et al. found a link between clinical severity and mortality and the CT severity score [6].

The correlation between the RT-PCR Ct values for the E and Rdrp genes and the CT severity score was negative but not statistically significant. In a related study, Bakir A et al. examined the association between the chest CT score and Ct value as a proxy for viral load; the findings revealed a positive correlation between the two variables [7]. Since chest CT score and CT-SS are identical measurements used to quantify lung involvement in COVID-19, our findings are consistent with those of other studies.

Another study by Liu Z et al. [8] examined the relationship between Lung Severity Score (LSS), which is comparable to CT-SS and RT-PCR Ct value and found that LSS was negatively correlated with Ct value. It has been suggested that viral load is essential for predicting whether an individual is highly contagious [9] and can be used to reduce the risk of transmission, whereas chest CT can help identify cases requiring intensive medical care.

Conclusion

In comparison to the mild COVID-19 group, the mean CT-SS in the moderate COVID-19 group was significantly higher. Viral load can be important in predicting transmissibility and to minimize

potential spread, whereas chest CT can help identify cases requiring extensive medical care.

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