Original Article

Correlation of Clinical Severity of COVID-19 Infection with Computed Tomography Severity Score in Patients Presenting to a Tertiary Care Hospital of Lahore

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ABSTRACT

Objective: To correlate the clinical severity of COVID-19 infection with computed tomography severity score (CTSS) in a tertiary care hospital of Lahore.

Methodology: This retrospective descriptive observational study was conducted at Chaudhary Muhammad Akram Teaching Hospital, Lahore. One hundred and sixty six real-time polymerase chain reaction (RT-PCR) positive COVID-19 patients were enrolled in this study. Clinical COVID-19 disease severity was classified into asymptomatic, symptomatic, severe, and critical disease. A 25 point computed tomography (CT) severity score was utilized to classify the disease as mild, moderate, and severe. Statistical Package for Social Sciences (SPSS) version 20 was used for statistical analysis. The association between clinical severity of COVID-19 infections was studied with CTSS by applying Kendall's tau-b correlation coefficient.

Results: Out of the 166 patients, 91(55%) were males while 75(45%) were females. The mean age was 58.09±15 years and its range was 20 to 90 years. A statistically significant positive association (τb=0.615 and p=0.01) was observed between the clinical severity of COVID-19 infection and CTSS.

Conclusion: A positive association exists between the severity of COVID-19 infection and CT severity score.

Keywords: *COVID-19. High-resolution computed tomography. Real-time polymerase chain reaction.*

INTRODUCTION

The COVID-19 pandemic has had a great toll on the economy and health sector of the world, which has led to the collapse of health systems everywhere. Real-time polymerase chain reaction (RT-PCR) is used for the diagnosis of COVID-19 infection in suspected patients. The average time duration needed for an RT-PCR test result is 24 hours and has a false negative rate of 54%.[1,2] Lack of RT-PCR facilities, faulty sampling collection technique, delay in reports, and false negative test result rate have compounded the difficulties experienced by the health care professionals. Some patients even got a PCR positive result after discharge from the hospital. Thus diagnosis is missed in some patients because of false negative results which leads to delay in diagnosis and initiation of proper management.[3]

An Iranian study along with many other international studies has recommended to take the help of radiological investigations to aid in making the diagnosis of COVID-19 in patients with a negative PCR result but who have a high suspicion of disease.[4] Chest X-ray (CXR) is an inexpensive and readily available modality in rural and urban health facilities. It exhibits positive findings in 74% of patients with COVID-19 infection. The lung involvement in COVID-19 infection is mostly bilateral, basal with the peripheral distribution. However, CXR findings are usually seen in the later stage of the disease as compared to the early stage of COVID-19 infection.[5] Therefore, CXR is not useful in making a diagnosis or helping in the triage of COVID-19 disease in the early phase as changes are appreciated in only 9% of patients early on in COVID-19 infection while still awaiting RT-PCR results.[6]

Non-contrast high-resolution CT (HRCT) scan chest is another relatively expensive and scarcely available modality that has been utilized in making a prompt diagnosis and monitoring the course of disease in COVID-19 infection worldwide.[7] Although very resource intensive but HRCT can detect lung involvement early on in the disease even in asymptomatic patients in comparison to CXR or RT-PCR.[8] Characteristic findings of acute lung involvement by COVID-19 include peripherally distributed ground-glass opacities with predominant lower-lung involvement and crazy-paving appearance. Interstitial fibrosis is observed as a late sequela of COVID-19 infection.[9]

Moreover, HRCT can aid in the clinical assessment of physicians, which can help them in making timely decisions for the initiation of COVID-19 treatment. Secondly, various scores like COVID-19 reporting and data system (CO-RADS), total severity score (TSS), and CTSS have been developed and used to measure

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the severity of COVID-19 infection early on, while awaiting RT-PCR results. These scores have proved beneficial for early triage, management in proper high dependency unit (HDU)/intensive care unit (ICU) settings, and stratifying disease severity.[10]

Multiple international studies have reported an association of COVID-19 disease severity with HRCT severity. This study was planned to find out if any association exists between CTSS and disease severity of COVID-19 infection in our local settings as data in this regard is scarce. It could help in making timely decisions and could be used for triage and management of COVID-19 patients.

METHODOLOGY

This retrospective descriptive observational study was conducted at Chaudhary Muhammad Akram Teaching Hospital, Lahore. After taking approval from the Hospital ethical committee, 166 patients were enrolled using a convenient sampling technique (Letter No: IRB/ANMC/2021/002, 25-01-2021). The duration of the study was from March to August 2021. A confirmed case was defined as a patient with positive RT-PCR of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in nasopharyngeal swab specimens. Patients with positive RT-PCR of SARS-CoV-2 in nasopharyngeal swab specimens more than 18 years of age were included whereas COVID-19 RT-PCR negative patients less than 18 years of age were excluded from the study. Clinical disease severity of COVID-19 infection was classified as an asymptomatic, non-severe, severe, and critical disease.

Non-contrast enhanced HRCT of patients was performed at the time of admission or during the hospital stay. Each CT scan was analyzed by 2 senior radiologists having more than 5 years of experience. A 25 point CTSS score was utilized to calculate radiological severity in each patient as mild, moderate, and severe disease.[11] Case records of all the patients of the general corona ward, isolation wards, HDUs, and ICUs were studied and recorded on a preformed questionnaire.

STATISTICAL ANALYSIS

Data was entered into Statistical Package for Social Sciences (SPSS) version 20 for statistical analysis. Data contained both qualitative and quantitative variables. Qualitative variables like gender, clinical severity, and CT severity grade were described in frequency and percentage. Whereas quantitative variables like age and CTSS score were calculated as mean±SD. The association between clinical severity of COVID-19 infection was studied with CTSS by applying Kendall's tau-b correlation coefficient.

RESULTS

Out of the 166 patients, 91(55%) were males while 75(45%) were females. The mean age was 58.09±15 years and its range was 20 to 90 years. About 69.8% of patients were more than 50 years of age. One hundred and twenty five (75.3%) patients had comorbidities and 36.8%, 61.6%, and 1.6 % of them had critical, severe, and non-severe disease, respectively. The severe and critical disease was seen in 98.4% patients with comorbidities (Table 1). Common comorbidities reported were hypertension (HTN) followed by diabetes and ischemic heart disease. One hundred and twenty eight (77.1%) patients were discharged from the hospital whereas 38(22.9%) died during hospital stay out of whom thirty five (92.1%) had single or multiple comorbidities. The majority of our patients remained admitted for 1 to 2 weeks.

Multifocal involvement in the lungs was seen in 96(57.8%) patients. Ground-glass opacification was seen in every patient followed by consolidation and septal thickening. Fibrosis was seen in only 50(30.1 %) patients. Cavitations were seen in only one (0.6%) patient and two (1.2%) patients had pleural effusion.

Supplemental oxygen/artificial ventilation was required by one sixty one (97%) of our patients whereas only five (3%) patients maintained oxygen on room air.

A statistically significant positive association (tb=0.615 and p=0.01) was observed between clinical severity of COVID-19 infection and CTSS score on applying Kendall's tau-b correlation, thus pointing towards a directly proportional relationship between clinical disease severity and CTSS in patients with COVID-19 infection.

Table 1: Disease Severity and CTSS

Disease Severity	CT Severity Score			Total
	Mild	Moderate	Severe	
Asymptomatic	2(1.2%)	0(0%)	0(0%)	2(1.2%)
Non-Severe	4(2.4%)	1(0.6%)	0(0%)	5(3%)
Severe	15(9%)	71(42.8%)	22(13.3%)	108(65.1%)
Critical	0(0%)	10(6%)	41(24.7%)	51(30.7%)
Total	**21(12.6%)**	**82(49.4%)**	**63(38%)**	**166(100%)**

Table 2: Lung Involvement in HRCT

HRCT		Frequency & Percentage
Lung Involvement	**Unilateral**	9(5.4%)
	Bilateral	157(94.6%)
Total		**166(100%)**
Pattern of Lung Involvement	**Peripheral**	38(22.9%)
	Central	32(19.3%)
	Multifocal	96(57.8%)
Total		**166(100%)**

DISCUSSION

The real-time polymerase chain reaction is considered a standard test for confirming the diagnosis of COVID-19 pneumonia but unavailability, high cost, and above all non-availability of immediate results lead to undue delay in diagnosis.[12] Chest X-rays have been used in Italy to aid in diagnosis but early changes are not visible in them.[13] During this pandemic computed tomography in Egypt was used as the main diagnostic tool for early detection and management of COVID-19 pneumonia.[14] Computed tomography scans have been helpful in detecting minute changes due to COVID-19 but the cost limits its use in developing countries like Pakistan. Multiple CT severity scores comprising 25 and 40 points have been used to gauge the severity and prognosis of COVID-19 infection.[15] We used a 25 point CT scoring system which has been validated by international studies. In this study, lung involvement was mostly bilateral, multifocal with ground-glass opacification (GGO). Ground-glass opacification was seen in the majority of our patients irrespective of duration and severity of the disease. These findings are very similar to the findings of Raoufi et al. who described GGO in 84.6% of their patients. They also unveiled an association between the shape of opacities with increased mortality and reported higher mortality in patients who had linear opacities in comparison to round opacities.[16] Lung involvement was seen more in the lower zones as compared to upper zones which is consistent with other studies.[17,18]

Our patients with severe and critical disease had a CTSS score of more than 15. We found that most of the patients who required high-flow nasal oxygen (HFNO), non-invasive or invasive ventilation in our study had CTSS of more than 15. Our findings are very similar to the findings of Valk et al. They calculated CTSS in their ICU patients who needed artificial ventilation and they concluded that patients who needed artificial ventilation had higher CTSS. Furthermore, they added that higher mortality was observed in patients with higher CTSS.[19] Our findings also support these findings, as we also found high mortality in patients with higher CTSS and severe disease.[20]

We found a positive correlation between clinical disease severity and CTSS. Similar results were found in a South Asian study by Kurri et al. It was conducted on 84 patients suffering from COVID-19 infection. Their findings support our findings with minor differences as they also found a high neutrophil to lymphocyte ratio (NLR) along with a high CTSS to be associated with severe COVID-19 infection.[21]

COVID-19 not only affects the lungs early on but also has long-term consequences. Luger et al. conducted follow-up CT scans periodically over one year in their patients and reported long-term sequel. According to them, resolution of lung opacities occurred over the first six months in the majority of patients, however, they reported lung damage to be a permanent complication afterward in forty percent of their patients.[22]

CONCLUSION

There is a positive association between CTSS and disease severity of COVID-19 infection in our population**.** The score can be efficiently utilized to diagnose and isolate patients with COVID-19 infection. Moreover, it can also be helpful to triage critically ill patients and aid in the management of these patients in a dedicated area from the very start.

LIMITATIONS & RECOMMENDATIONS

In this study, RT-PCR was performed only once, and RT-PCR negative patients were excluded from the study. This is a major limitation of this study. Further studies at multiple centers could assist in deeper understanding of this association.

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