Correlation Between Computerized Tomography Severity Score and Patient Prognosis In Cases of Covid-19 Pneumonia: A Retrospective Study

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Abstract

Objective: To find the correlation between CT severity score and patient prognosis in cases of COVID-19 pneumonia in a tertiary care hospital in Lahore.

Method: It was a descriptive observational study, carried out at Chaudhary Muhammad Akram Teaching and Research Hospital, Lahore. We enrolled 80 patients clinically suspected of having COVID-19 pneumonia and showing characteristic HRCT features of the same, using consecutive sampling technique. Patient prognosis was classified into patients recovered and patients expired. A CT severity score (CTSS) consisting of 25 points was deployed to categorize disease as mild, moderate and severe. Statistical package for social sciences (SPSS) version 20 was utilized for statistical analysis. Association between patient prognosis and CT severity score of COVID -19 infection was studied by applying the Pearson correlation.

Results: Nineteen out of 19 (100%) patients with mild CTSS recovered, 32 (80%) out of 40 patients with moderate CTSS recovered while 8 (20%) expired and 11 (52.4%) out of 21 patients with severe CTSS recovered while 10 (47.6%) expired. A statistically significant positive correlation (p = 0.001) was observed between patient prognosis and CT severity score in COVID-19 patients.

Conclusion: A positive correlation exists between CT severity score and patient prognosis in cases of Covid-19 pneumonia.

Keywords: COVID-19, HRCT, CTSS , Pneumonia

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Introduction

Covid-19 spread quickly within weeks and months to become a pandemic, impacting the whole world population.[1] Globally, over 600 million covid-19 cases and over 6.5 million deaths have been confirmed till now.[2] Development of vaccines has slowed down the covid-19 infectivity rates; however, vaccine hesitancy and breakthrough infections still lead to many new cases. Emergence of new variants with higher transmissibility, also poses a continuous risk.[3,4] Covid-19 can present with variable severity and can involve multiple organ systems. Respiratory involvement is the most common feature in majority of the patients, and the disease severity can range from mild cough and flu-like symptoms to acute respiratory distress syndrome and multi-organ failure leading to death.[5,6] Reverse-transcriptase polymerase-chain-reaction (RT-PCR) of nasal swab is considered the diagnostic test of choice. This test has high specificity but only moderate sensitivity, and therefore not all the patients suffering from this disease are positive for this test.[7] High-resolution computed tomography (HRCT) of chest is an easy, noninvasive method with enhanced image resolution, and it has been conventionally used for evaluation of lung diseases. HRCT is not intended to be a diagnostic test but the sensitivity of radiologic findings on HRCT exceeds RT-PCR in even diagnosing Covid-19.[8] These

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findings include ground-glass opacity, consolidation, reticulations, interlobular septal thickening, crazy-paving pattern, linear opacities, sub-pleural curvilinear lines, bronchial wall thickening, lymph node enlargement, pleural and pericardial effusions. A combination of these findings can be presented as a semi-quantitative CT severity score (CTSS), which can help in assessing the radiologic severity of the pulmonary disease in these patients.[9] Different clinical features and laboratory parameters have been independently identified to be associated with worse outcome and death in covid-19 patients.[10] Considering that the pulmonary involvement is the common feature in most of the severe cases, evaluating the radiologic severity of the disease is very important in the context of patients' prognosis. Our study aims to evaluate the CTSS in covid-19 patients and their association with prognosis in our population. This can help the clinicians in correctly identifying the patients at higher risk of worse outcome and devising appropriate treatment strategies accordingly. The objective was to study correlation between CT severity score and patient prognosis in cases of Covid-19 pneumonia.

Material and Methods

This descriptive observational study was approved by ethical committee of Chaudhary Muhammad Akram Teaching and Research Hospital, Lahore. We enrolled 80 patients in our study utilizing consecutive sampling technique. Our study spanned over a period of 3 months from 1st January till 31st March, 2021. Patients aged between 20 to 90 years clinically suspected of having COVID-19 pneumonia and showing characteristic features of COVID-19 pneumonia on HRCT Chest were selected. Patient prognosis was categorized as recovered or expired. HRCT (chest) scans of patients were performed using 16 slice CT scanner. The 3 lung lobes on the right and 2 lobes on the left were individually assessed, and percentage involvement of the lobe was noted based on visual assessment. Visual severity scoring of CT chest was classified as score-1 (< 5% area involved), score-2 (5–25% area involved), score-3 (25–50% area involved), score-4 (50–75% area involved), score-5 (> 75% area involved), making the total score 25. A CTSS was assigned out of 25 based on the percentage area involved in each of the 5 lobes. The total CTSS is measured by the sum of the individual lobar scores and can range from 0 (no involvement) to 25 (maximum involvement), when all the five lobes show more than 75% involvement. CTSS consisting of a 25-point score was used to categorize radiological severity in each case as mild, moderate and severe. Involvement of each lobe was scored between 1 to 5 and scores from individual lobes were then added. A total score between 1 to 8 was considered mild, between 9 to 15 as moderate and more than 15 as severe. Clinical data of patients regarding duration of hospital stay, RT-PCR positivity or negativity and recovery/expiry was collected and documented on a preformed questionnaire. Data was then statistically analyzed using statistical package for social sciences (SPSS) version 20. Correlation between CTSS and prognosis of COVID -19 patients was studied by applying the Pearson correlation test.

Results

Out of the 80 patients 53.8% (n= 43) were male while 46.3% (n =37) were female. Mean age was 56.5 years ± 15 (range from 20 to 90 years). 62 (77.5 %) of patients were discharged from hospital whereas 18 (22.5%) expired during hospital stay. Majority of our patients remained admitted for 7 to 15 days. CTSS was mild in 19(23.8%) patients, moderate in 40 (50%) patients and severe in 21 (26.3%). The distribution of patients with respect to CTSS and other parameters is given in Table 1. A statistically significant positive correlation (0.001)

Table 3: *Comparison of Predictive Values (Bishop Score vs. Cervical Length)*

Parameters		CT severity score (CTSS)		
		Mild (Score 0-8) (N=19)	Moderate (Score 9-15) (N=40)	Severe (Score 16-25) (N=21)
Gender	Male (43)	12	22	09
	Female (37)	07	18	12
Age group	21-40 years (12)	04	06	02
	41-60 years (34)	08	17	09
	61-80 years (27)	07	10	10
	81-90 years (07)	00	07	00
Hospital stay	⩽ 15 days (67)	17	34	16
	> 15 days (13)	02	06	05
PCR result	Positive (69)	15	34	20
	Negative (11)	04	06	01
Prognosis	Recovered (62)	19	32	11
	Expired (18)	00	08	10

was observed between prognosis and CTSS score on applying the Pearson correlation, thus pointing towards a significant relationship between prognosis and CTSS in patients with COVID-19.

Discussion

In our study we analyzed the CT severity score of patients having characteristic features of COVID-19 pneumonia on HRCT chest in order to evaluate the role of CTSS in predicting the overall outcome of COVID-19 patients. CT scan has been used as a valuable tool in quantifying disease burden in patients of COVID-19 pneumonia.[11] CT severity can be quantified visually or by utilizing an automated software.[12,13] We used the visual scoring method in our study. Various scoring systems on CT comprising of 25 and 40 points have been utilized to categorize severity of COVID-19 pneumonia.[14] We used a 25 point scoring system in this study. Our study showed a positive correlation between CTSS and patient prognosis in terms of patient recovery and number of deaths. According to our study 100% of patients with mild CTSS recovered completely as compared to 80% with moderate score and 52.4% with severe score. On the other hand, none of the patients with mild CTSS expired while 20% and 47.6% patients with moderate and severe CTSS expired respectively indicating significant correlation between CTSS and patient outcome. These findings are in harmony with the previous relevant studies.[15,16] According to a study conducted in Abu Dhabi in 2020 there was significant correlation between CT severity score and length of hospital stay as well as clinical outcome. They concluded that patients with milder CT findings had positive outcomes, while increased death rate was observed among those having more severe CT changes.[17] These findings were reproduced in our study. Majority of our patients with moderate and severe CTSS were above 40 years of age indicating that more severe CT changes are associated with older age group. This is in agreement with study conducted by Al-Mosawe et al.[18] Many studies have reported a higher CTSS in male patients as compared to females while a few also reported lower mean CTSS in males[17,18,19,20], however we did not observe any significant correlation between higher/lower CTSS and male gender. This can possibly be attributed to smaller sample size and younger male patients in our study. Our study revealed that out of 80 patients having characteristic features of COVID-19 pneumonia on HRCT Chest 69 (86.25%) patients were RT-PCR positive while 11(13.75%) patients were RT-PCR negative. Similar results were documented by He et al. and Yang et al in their studies.[21,22] Furthermore, 78.9% patients with mild CTSS were RT-PCR positive as opposed to 85% and 95.2% in moderate and severe CTSS group respectively. This implies that patients with moderate to severe disease burden on CT are more likely to be RT-PCR positive as also stated by Al-Mosawe et al.[18] These findings also reflect the importance of HRCT chest as a screening and diagnostic tool for COVID-19 pneumonia especially in patients with mild disease. A similar study conducted by Fang et al. concluded that CT can be used for screening of COVID-19 in individuals clinically suspected of COVID-19 infection but showing negative RT-PCR test result.[23,24]

Conclusion

We conclude that there is a positive correlation between CT severity score and prognosis of COVID-19 patients in our population. CT Chest can also be utilized as a diagnostic tool where RT-PCR test results are inconclusive.

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Authors Contribution

TT: Conceptualization of Project
GN: Data Collection
JS: Literature Search
MJ : Statistical Analysis
AQ: Drafting, Revision
MI: Writing of Manuscript