

Assessment of COVID-19 Severity Using Chest CT Severity Score on High-Resolution Computed Tomography Chest in Pakistani Patients

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ABSTRACT

Objective: The current review aims at portraying the high-resolution CT (HRCT) chest findings of corona virus pandemic that emerged in 2019 amongst the COVID-19 patients, admitted to the tertiary healthcare facilities in Punjab, Pakistan. It also aims to study the imaging features and dispensation of COVID-19 infection in different segments of the lungs. Moreover, a survey was also conducted for the job to analyze the chest CT severity score index (CT-SS) aims at identifying those patients with acute infections.

Methods: This cross-sectional descriptive analysis led from May 15, 2020 to November 26, 2021, incorporates 97 diagnosed patients of the COVID-19 who received the HRCT scan in the tertiary healthcare facilities in Punjab, Pakistan. The HRCT chest of the infected patients was collected following the proper protocol. Each case was assessed for the presence of imaging features such as ground glass opacities (GGOs), consolidation, mixed pattern, crazy paving appearance and other findings along with their distribution in lung segments. Furthermore, to determine the CT-SS we divided each lung into 20 sub segments. The Linkert Score system of degree of 0,1 and 2 was provided. This indicates the intensity of involvement. It states that zero score indicates no involvement, whereas the Linkert figure 1 shows the involvement which is less than <50%. However, the remaining figure Linkert indicator figure 2 indicates the intensity of involvement if more than >50% by one zone. The total range of score for this test lies between 0-40. This score helps us to categories the patients based on their mild and severe cases. Here the score of less than <20 indicated mild infection, whereas, the score which appears more than >20 indicates the severity of the case.

Results: The ground glass opacities which are trailed by consolidation of 49.4% and that of crazy paving by 21.64% was recorded as the most recognized finding. In most of the patients, the distribution of disease, with basal predilection, was recorded as bilateral, peripheral as well as multilobar. The ratio of vascular dilatation was recorded 19.5% and that of bronchiectasis was noted at 13.4% in patients. 3% of the patients showed the Halo, whereas reverse halo sign was noted in 1% of patients. None of the patients was seen to be carrying the Pleural effusion. Lung cavitation was seen in 2% of patients and isolated lobar consolidation without GGO was seen in 1% of patients. The segment which was most commonly involved bilaterally was the posterior segment of the lower lobes. As per the data collected from CT-SS, 80(82.4%) patients had mild and 17 (17.4%) patients had an acute disease symptoms respectively.

Conclusion: GGOs are the most common imaging findings of COVID-19 pneumonia on HRCT chest having multilobar, bilateral and peripheral involvement with basal predilection. This proves CT-SS as a useful mechanism in placing pneumonia patients as mild and acute types. This helps categorizing the distinguishing the acute or severe patients from mild and to manage them accordingly.

Keywords: Covid-19, CT-SS, HRCT chest, ground glass opacities, consolidation, crazy paving

INTRODUCTION

The worldwide burden of COVID-19 has been advancing quickly and experts from the wide range of medical services and professions are poised to contribute their skills with respect to early diagnosis of the disease. The primary or gold standard for diagnosing the COVID-19, is the Reverse transcriptase-polymerase chain reaction (RT-PCR) test². Even the virus itself, or in any pathogen, the basic purpose of the test Rt-PCR is to look for the genetic material and for this reason hence, this test is labeled as a nuclear-derived method³. However, there sure are many limitations to this test. There are various studies which depicts the presence of ow sensitivity at 60-71%^{4,5} and can give false-negative results. More studies that are recent have shown that CT can be utilized as a supplement to RT-PCR for diagnosing and assessing disease severity of COVID-19⁷. Common imaging findings of COVID-19 on CT chest incorporate ground-glass opacities (GGOs) and consolidations, multilobar, bilateral and peripheral involvement with basal predilection⁶. A large portion of the accessible writing on this point is available from Far East^{6,8,9}. Lung findings seen on chest CT are like those experienced in other viral pneumonias; inspite of sensitivity this tool lacks specificity. In this review, we depict the common imaging findings and severity of COVID-19 pneumonia by using chest CT severity score in patients introducing to a tertiary care medical facility in Punjab, Pakistan. Current study also discusses the atypical imaging findings on CT chest of COVID-19 patients, not mentioned in previous literature of Pakistani patients, thus helping the clinicians in management of disease.

MATERIAL AND METHODS

Study design: Cross-sectional descriptive analysis.

Inclusion criteria: Confirmed COVID-19 patients who went through HRCT chest at a tertiary healthcare center in Punjab, Pakistan, from May 15, 2020, to November 26, 2021, were incorporated in the review.

Exclusion criteria: Non-willing patients were excluded from the study.

Data collection and analysis: HRCT chest was acquired utilizing the proper protocol after taking informed written consent from the patients. Multidetector (16 slice) Toshiba - Aquilion CT scanner with tube voltage of 120 kvp and current set at 250 mA was used for scanning. Full inspiratory, 1mm thin slices were obtained in supine position from apices to base of lungs. Two radiologists studied the radiological findings independently. To locate and analyze the presence of Halo sign, pleural effusions, Reverse Halo signs, consolidations, ground glass opacities, vascular thickening, crazy paving, mixed pattern, bronchiectasis and other findings were accessed n other studies. Distribution of disease process i.e., central/peripheral/unilateral/bilateral/ multilobar/posterior involvement was also assessed.

GGO indicates an area, which helps see the structure of bronchial and vessels. This area is of hazy increased lung opacity. When the alveolar airspaces are being filled with fluid is better known as consolidation (exudate/transudate/blood). When ground glass opacities are thickened with superimposed septal, this indicates the evidence of crazy paving. The peripheral section of the lung was the outer one-third proportion, whilst central segment is the rest of the lung. CT-SS was calculated for every patient. In the test, there were 20 portions being created for two lungs. The

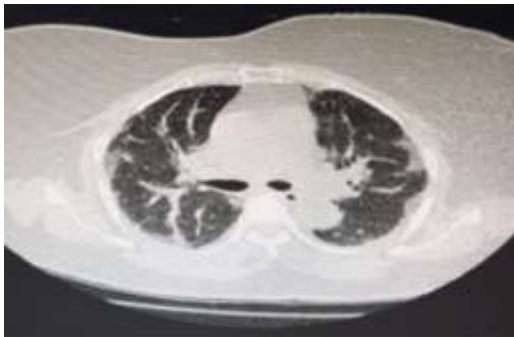
solitary zones are considered by each lung segment. However, this was not the case with upper left lobe of apicoposterior segment. Here there were two separate zones were created as apical and posterior. Additionally, the lower left lobe which were considered as two separate zones; as medial and posteromedial basal segment. A The Linkert Score system of degree of 0, 1 and 2 was provided. This indicates the intensity of involvement. It states that zero score indicates no involvement, whereas the Linkert figure 1 shows the involvement which is less than <50%. However, the remaining figure Linkert indicator figure 2 indicates the intensity of involvement if more than >50% by one zone. The total range of score for this test lies between 0-40. This score helps us to categories the patients based on their mild and severe cases. Here the score of less than <20 indicated mild infection, whereas, the score which appears more than >20 indicates the severity of the case.



Non-contrast CT images of a patient with COVID-19 pneumonia showing bilateral areas of ground glass opacities and septal thickening, giving crazy paving appearance.



Non-contrast chest CT image of a patient with COVID-19 pneumonia. CT image shows typical bilateral peripheral ground glass opacities.



Non-contrast chest CT images of another patient with COVID-19 pneumonia. CT images show bilateral peripheral areas of ground glass opacities.



Non-contrast chest CT images of a patient with COVID-19 pneumonia. CT images show bilateral areas of consolidation surrounded by ground glass haze, giving "halo sign"



Non-contrast chest CT images in a 50-year-old male patient having severe COVID-19 pneumonia. Chest CT images show bilateral areas of ground glass opacities and consolidation with vascular dilatation.

RESULTS

97 total patients have successfully satisfied the inclusion criteria, who went through HRCT of the chest. 45(46.4%) of those patients were females and 52(53.6%) of them were males. 45 years however was recorded as the average age.

About 62.8% of the patients were seen to be carrying the most findings of GGOs. The next common finding were the consolidations and their percentage was 49.4%. Last but not least is the crazy paving which was recorded as common finding with percentage of (21.64%) [Table 1]. The percentage of those patients who pageanted a mixed pattern of ground glass haze and consolidation was recorded as show 39.17% [Table 1], Peripheral

and bilateral distribution was found to be the most common distribution of the disease [Table 1]. 19 of these patients were found to be including the vascular dilatation and 23 of them have bronchiectasis in diseased parenchyma respectively. Pleural effusion was not noted in any of the patients, while 03 patients showed halo sign and only 01 patient exhibited reverse halo sign. Lung cavitation was noted in 02 and isolated lobar consolidation was seen in only 01 patient. [Table 1]. Mediastinal lymphadenopathy was seen in 02 patients.

Table 1: Characteristics and manifestations of COVID-19 on high-resolution CT chest

Imaging characteristics	Number of patients (% of total)
Ground glass opacities (GGO)	61 (62.88%)
Consolidation	48 (49.48%)
GGO + consolidation	38 (39.17 %)
Crazy paving pattern	21 (21.64%)
Halo sign	03 (3.09%)
Reverse halo sign	01 (1.03%)
Bronchiectasis	13 (13.40%)
Vascular thickening	19 (19.58%)
Fibrotic bands(curvilinear opacities)	13 (13.40%)
Centrilobular nodules (tree in bud appearance)	---
Lung cavitations	02 (2.06%)
Isolated lobar/segmental consolidation without GGO	01 (1.03%)
Enlarged lymph nodes	2 (2.06%)
Pleural effusion	---
Distribution	
Peripheral	56 (57.73%)
Central	---
Peripheral + central	41 (42.26%)
Unilateral	0 (0%)
Bilateral	97 (100%)
Posterior	48 (49.48%)
Multilobar	54 (55.67%)

Lower lobes in the right lung of 86 patients and in the left lung of 84 patients, carry posterior segment as the most common lung segment. Total CT-SS of these segments was 93 and 88 respectively. Superior basal segment in both lungs was the second most common lung segment to be involved by disease process.

As indicated by CT-SS, 80(82.47%) patients had mild disease and 17(17.52%) patients had extremely severe disease lung score [Table 2].

Table 2: Disease severity based on total CT severity score

Disease severity	Number of patients	%age
Mild disease lung score <20	80	82.47%
Severe disease lung score >20	17	17.52%

DISCUSSION

The population impacted by the COVID-19 infection has been on the ascent since the last month of 2019. The range of the symptoms goes from asymptomatic to mild disease to severe acute respiratory disorder^{8,10,11}. World Health Organization accepted the disease burden as a result of COVID-19¹². COVID-19 can affect all systems of body but the most commonly involved is respiratory system¹³. Respiratory difficulties related to the oxygen dependence and prevailing dry cough were the most common issues of respiration in the effected patients^{8,14,15}. Consequently, the CT output of the chest can assume a vital part in the diagnosis and the disease severity of the COVID-19 pneumonia patients in addition to the gold standard diagnostic test reverse transcription-polymerase chain reaction (RT-PCR).

The current review demonstrates that the prevalent finding in CT chest of COVID-19 patients is ground glass opacities (62.8%) followed by consolidation (49.4%). These results are comparable to the other similar study done in July 24, 2020 in Pakistani patients¹. The previous study in Pakistani patients did not show

“Halo Sign” and “Reverse Halo Sign”. In our study Halo Sign was noted in 3% and Reverse Halo Sign was seen in 1% of patients.

Comparable to other diseases, our study shows that 100% of patients pageanted bilateral disease^{1,5,6,20}. However, none of these patients were observed to be carrying the unilateral disease. Also, in the patients, the periphery of the lung was involved by 57.73%. However, the amalgamation of both disease patterns as central and peripheral was recorded at the percentage of 42.26 % in these patients. Isolated lobar consolidation was seen in 1% and lung cavitation was noted in 2% of patients in contrary to previous study on COVID-19 patients in Pakistan.

CONCLUSION

From the above results and study, we can conclude that the GGOs with basal, peripheral and bilateral, and multilobar distributions on the lungs were observed to be the most common manifestations of Corona on HRCT. To divide the pneumonia patients into acute one in comparison with mild victims, the CT-SS appears to be a useful tool. This helps the clinical experts to manage the disease accordingly.

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