

Diagnostic Accuracy of High-Resolution Computed Tomography Chest in COVID-19; Our First Pandemic Experience

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ABSTRACT

Background: COVID 19 pneumonia is global pandemic and affects the human life in every aspect. Although RT-PCR test is considered as gold standard for its diagnosis but imaging also plays a pivotal role. **Objective:** The aim of our study was to review the diagnostic accuracy of HRCT scan chest in detecting COVID 19 pneumonia compare with the RT-PCR test and investigate its different features on HRCT scan. **Study Design:** Cross sectional study. **Settings:** Department of Radiology, Ghulam Muhammad Mahar Medical College Sukkur / SMMBBMU, Larkana Pakistan. **Duration:** Ten months from March 2020 till December 2020. **Methods:** All consecutive patients with suspected clinical findings of COVID19 pneumonia or respiratory symptoms who underwent PCR test and chest CT scan were included in the study. Diagnostic efficacy of HRCT scan was calculated and correlated with both CT and RT-PCR results. **Results:** Our study included 112 patients (63 male and 49 female, mean age 42 years \pm 5 years). Among them 55.0% of cases showed CT positive findings and 45.0% of cases showed RT-PCR positive results. Calculated sensitivity, specificity and accuracy of CT scan was 96%, 56% and 74% respectively. Chest CT findings in almost all patients (100%) were patchy areas of ground glass opacities (GGO), associated with involvement of bilateral in 90% and multi-segmental and peripheral distribution in 95% of cases. **Conclusion:** Study concludes that HRCT scan chest appears to have a very high sensitivity and accuracy in detection of various features of lung involvement in symptomatic as well as high risk COVID 19 patients especially with negative PCR test. But it cannot exclude as specificity is low. The most common CT scan feature was patchy areas of ground glass opacity (GGO) in bilateral lung with peripheral and posterior distribution.

Keywords: HRCT chest (high resolution computed tomography), RT-PCR test, COVID 19, GGO (Ground glass opacities).

INTRODUCTION

The (COVID-19) Corona virus disease 2019 is a rapidly communicable disease caused by novel strain of virus (SARS-CoV-2). Disease presents clinically with variable symptoms from mild flu like illness to life threatening respiratory distress. Early diagnosis is helpful to prevent spread of disease and proper management.¹⁻²

At present the gold standard to detect COVID 19 virus is a PCR test called real-time reverse transcriptase-polymerase chain reaction (RT-PCR) of nasal and

oropharynx swab specimens. RT-PCR may be false negative with symptoms, in these patients radiological imaging aids in diagnosis of COVID 19.³⁻⁴

Studies report sensitivity of HRCT scan chest in diagnosis of COVID 19 up to 98%.⁵ The important advantage of CT scanning of the chest is not only its direct availability of results but also helpful in diagnosis and screening of patients presents with pneumonia.⁶⁻⁷

Characteristic findings on Chest CT in early disease includes crazy - paving type of involvement which

showed mosaic distribution of ground glass opacity associated with septal or reticular thickening, and in advance disease process consolidative pulmonary opacities.⁸

The study was conducted to investigate the diagnostic accuracy of HRCT scan in COVID-19

and to elaborate the chest CT features in suspected COVID-19 patients referred for HRCT scan in radiology department, compared with already done RT-PCR test results as gold standard.

METHODS

This was a cross sectional study conducted at Department of Radiology, Ghulam Muhammad Mahar Medical College Sukkur / SMMBBMU, Larkana Pakistan. The duration of the study was 10 months from March 2020 till December 2020. The sample size of the study was 112 patients (63 male and 49 female).

All patients with history of fever, cough and dyspnea or mild respiratory symptoms after their RT-PCR test done referred to radiology department was inclusion criteria of the study.

Chest CT done with contrast medium for other indication or patient refuses for CT examination was exclusion criteria of the study.

All CT scans were obtained on a 16 slice CT scanner (ALEXION Toshiba) with following CT acquisition parameters. High resolutions CT scans were performed with the proper technique includes supine patients position, after full breath in and without IV contrast. All protocols of HRCT scan were followed. Machine voltage 120kvp and current 90mAs, slice thickness and reconstruction interval of 1.0mm. Reconstruction of images were made in mediastinal and lung windows. Standard operating procedures were followed so that spread of disease can be prevented, by decontamination of CT scan room and machine and use of personal protective equipments by both technician and patients. After each examination room of CT scan was disinfected. Chest CT scans were read by two independent consultant radiologists using standardizing reporting formats. CT scan labeled as positive if findings were of bilateral GGO in peripheral and posterior distribution typical of COVID 19 pneumonia. CT scan labeled as negative if they showed normal scan or findings of bacterial pneumonia.

All data analysis was compiled according to SPSS version 21.0. Data of patients variables were descriptively analyzed. Continuous variable like age were reported as medians and ranges and categorical variables like sex and disease involvement as counts and percentages. The Diagnostic accuracy of HRCT scan was investigated after

calculating its sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic efficacy compared with RT-PCR results. P values considered statistically significant was of <0.05. Confidence interval method of 95% was used.

RESULTS

All 112 symptomatic and suspected cases with RT-PCR test results and HRCT scan chest done were included during the study period of 10 months. 63 males and 49 females patients were included with age range 25-60 years and mean age of 42.5 years. Out of 112 patients 50 cases showed RT-PCR positive results and 75 patients were labelled as CT positive cases. In 50 PCR positive patients, among these 48 patients showed positive findings on CT scans. In total 62 PCR negative patients 27 patients were labeled as positive on CT scans and 35 patients were CT negative scans. This results in a sensitivity, specificity and accuracy of 96%, 56% and 74% respectively for diagnosing COVID-19 on HRCT. The PPV was 64% and NPV 94%. Table 1

Table 1: Diagnostic accuracy of HRCT in diagnosis of COVID 19 pneumonia with RT-PCR as reference

Total cases (n=112)	RT-PCR			
	Positive n=50		Negative n=62	
HRCT scan	Positive (48)	True Positive	Positive (27)	False positive
	Negative (02)	False Negative	Negative (35)	True Negative

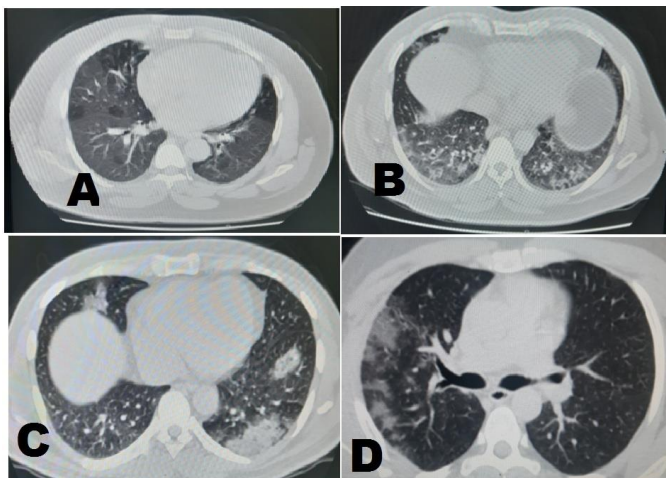
P value = 0.05, Sensitivity = 96%, Specificity = 56%, PPV = 64%, NPV = 94%, Diagnostic accuracy = 74%, Chi square test was applied

On the basis of analysis, the characteristic manifestation of CT positive cases were ground glass opacities (GGO) in 75 (100%) patients, with involvement of bilateral lung in 90% and multi-segmental and peripheral distribution in 95% of cases. Regarding GGO patterns of involvement, crazy paving pattern was seen in 60 (66% of cases), consolidation in 18 cases and linear opacities in 7 cases. Table 2 and figure 1.

Table 2: Various HRCT scan features of PCR positive cases

CT Scan findings	No of cases
1. Ground glass opacity	75 (100%)
a. Crazy paving	60
b. consolidation	18
c. linear opacities	07
2. bilateral lungs	68 (90%)
3. peripheral and multi-segmental	71 (95%)

Figure 1: Shows various HRCT features of COVID 19 patients. (A) showing bilateral ground glass opacities (GGO) without reticulation in mosaic distribution (crazy paving pattern). (B and C) showing bilateral multi-segmental GGO and airspace shadowing in peripheral and posterior distribution. (D) showing unilateral pattern of lung involvement



DISCUSSION

Early and accurate diagnosis of COVID-19 is important in controlling the pandemic. Chest CT can be considered as a first line imaging modality to diagnose COVID-19.

The novel virus SARS-CoV-2 belongs to the family of Coronaviridae and targeted receptors on alveolar epithelium causing pulmonary damage. It causes mild to severe systemic and respiratory tract infections leading to death.⁹

There are various factors to assess the accuracy of HRCT chest in diagnosis of COVID-19, including the study subjects, disease prevalence, stage and severity at the time of imaging and coexisting lung disease.¹⁰⁻¹¹ It has been seen that CT features of COVID-19 are dynamic and appear maximum after patient became symptomatic at around 10 days. About half of the cases remain asymptomatic and labeled as CT-positive. One study from Lin and colleagues showed a patient having positive CT findings of patchy areas of GGOs in the right lung and remains asymptomatic.¹²⁻¹³ There are various manifestations on HRCT of COVID-19 pneumonia but there are some characteristic features through which accurate diagnosis can be made. Although the features can be equivalent to other pulmonary infections however the specific pattern of involvement of lung is diagnostic of COVID-19. Bilateral patchy areas of ground-glass opacification (GGO) in peripheral and posterior distribution is most frequent and earliest pattern.¹⁴

We conducted this study to assess the diagnostic accuracy of HRCT scan chest in detection of SARS-CoV-19. In our

study population the sensitivity and specificity was 96% and 56% respectively. Typical CT features were opacities (GGO) in 75 (100%) of patients, with involvement of bilateral lung in 90% and multi-segmental and peripheral distribution in 95% of cases. In the largest study at Wuhan, China with 1014 patients, the sensitivity of HRCT chest is very high (up to 97%) in diagnosis of COVID-19, and specificity is relatively low (25%).¹⁵ This study's results were similar to our study. Another study from Wuhan included 80 patients who were investigated with both respiratory symptoms and positive results of RT-PCR. Results showed positive Chest CT in around 76 patients (sensitivity of 95%).¹⁶ Li *et al* and Liu *et al* studies correlate the CT results with the severity of illness and found that patients with mild symptoms had normal CT images.^{17,18}

One study from Rome Caruso D *et al* reported moderate specificity (56%) and high sensitivity (97%) of HRCT in comparison with RT-PCR in patients with symptoms.¹⁹ In this study we observed similar results as shown by the Caruso D in his research.

Shi and colleagues' study from Wuhan, showed had GGO (ground glass opacity) on the chest CT in 93% of the 15 patients with no clinical symptoms.²⁰

CONCLUSION

It is concluded that high-resolution computed tomography chest is the good imaging modality for the evaluation of COVID-19. With its typical imaging features and pattern of involvement of lungs we can timely diagnose this life-threatening pandemic disease.

LIMITATIONS

This study has a small sample size. Further studies should be conducted on large samples.

SUGGESTIONS / RECOMMENDATIONS

HRCT should be considered as an investigation of choice for COVID-19.

CONFLICT OF INTEREST / DISCLOSURE

None.

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