



**INTERPRETATION OF HRCT FINDINGS OF NOVEL CORONA (COVID-19)
PNEUMONIA IN HOSPITALIZED PATIENTS CORRELATED WITH RT-PCR**

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ABSTRACT

Background: High resolution computed tomography scan can be used as an important modality for corona virus disease 2019(COVID -19)being a useful adjunct to RT-PCR specially in asymptomatic and RT-PCR negative patients. **Purpose:** To Evaluate the efficacy of high resolution CT scan in diagnosis and prognosis of COVID 19 and to see the sensitivity specificity, accuracy, positive and negative predictive value. We also aimed to compare HRCT findings with RT-PCR in COVID 19 patients to find out the severity and staging of COVID-19 corona virus disease. **Materials and Method:** This cross sectional prospective observational study was carried out in department of Radiology and imaging, Dhaka Medical College Hospital Dhaka, Bangladesh in collaboration with department of Virology and COVID unit, Dhaka Medical college Hospital, Bangladesh. **Observations and Results:** Total 151 patients were evaluated with HRCT findings and correlated with RT-PCR as gold standard. Sensitivity was about 96% for chest CT, specificity 65%, PPV 91% accuracy 90% and NPV 84%. **Conclusion:** Due to high infectivity and asymptomatic transmission, until a highly sensitive and specific COVID 19 test is developed, HRCT should be incorporated into the severity assessment of the patients who are hospitalized. It is an important indicator for future prognosis. Combination of RT -PCR with HRCT evaluation can increase the sensitivity and specificity of diagnostic testing to greater than 90%. HRCT will curb the false negativity of sole RT-PCR.

KEYWORDS: HRCT SCAN, RT-PCR, COVID 19, Sensitivity, Specificity, Corona virus.

INTRODUCTION

Corona virus disease 2019 (COVID 19) outbreak was first reported in China has rapidly spread around the world with in short period causing global public health emergency.

HRCT scan of chest is an important diagnostic test and an useful alternative for RT- PCR when PCR is negative in symptomatic patients. COVID 19 is a highly infectious disease caused by severe acute respiratory syndrome corona virus 2 (SARS -COVID-2) WHO has declared this pandemic as a global health emergency on February. First case was reported in 8th March 2020 in Bangladesh and first death was recorded in 18th March 2020. In diagnosis of COVID -19 RT-PCR of viral nucleic acid is regarded as the reference standard. However recent studies evaluated the significance of CT chest specially HRCT in suspected and false negative COVID patients. According to many studies the sensitivity is about 98%^[1] is not only important in

diagnosis but also monitoring the disease process and therapeutic efficacy. Chest CT can help determine the temporal disease stage and severity of COVID Pneumonia.^[2] The reference method for COVID 19 diagnosis, SARS COV-2 PCR is highly specific but has variable sensitivity as low as 70%.^[2]

We evaluated typical and atypical CT manifestations of COVID – 19 infection in our hospital. Our aim was to strengthen the recognition of features with clinicians and help them make a quick and reliable diagnosis. Typical findings were ground glass opacities, crazy paving, consolidation and intra and inter-lobular septal thickening and few emerging manifestations' like pleural changes, fibrosis and nodules in COVID 19 patients. CT scan of chest may asses the progression of disease with prognosis and future outcome. Chest CT can be used for a rapid triage of patients in multiple emergency departments during COVID 19 epidemic.

Bi lateral distribution of ground glass opacities with or without consolidation in basal, posterior segment, peripheral in distribution was the hallmark of COVID - 19^[3] with the progression of disease many interesting new CT findings like crazy paving pattern, vascular changes, consolidation has been identified. We aim to publish the experience of COVID 19 imaging interpretation with typical and unusual findings and to evaluate the severity of disease progression and future outcome.^[4]

In case of mild symptomatic patients, CT findings were less severe. Only finding was ground glass opacity.

In moderate cases in addition to GGO, distribution is typically bilateral peripheral sub pleural and posterior predominance. Consolidation was also notable in this situation.^[5]

Severe cases: extreme ground glass with crazy paving, septa thickening almost occupying the whole lung. Multifocal extensive consolidation, pleural thickening/mild effusion and traction bronchiectasis was found.^[6] Some atypical findings were also noted like mediastinal lymph adenopathy, multiple tiny pulmonary nodules, tree in bud, pneumothorax and cavitation. A rapid accurate severity assessment of COVID 19 pneumonia based on CT chest would be feasible and could provide help for making management decision.^[7]

MATERIALS AND METHODS

This prospective observational cross sectional study was carried out in department of Radiology & imaging Dhaka Medical College Hospital in collaboration with Dept of Virology and COVID unit DMCH from March 25th to 30th JULY. Patients who are referred from COVID unit of DMCH were included in the study. Other than COVID and suspected COVIDS were excluded from the study. 165 patients were evaluated with HRCT findings. 14 patients were excluded from the study due to unavailability of RT- PCR report. Total 151 number of patients underwent HRCT scan of chest without contrast in a 128 slice CT scanner in dept of Radiology imaging. DMCH is a 750 bed dedicated COVID hospital. All the patients underwent non contrast CT scan of chest in Scnaria machine with reconstructions of the volume at 0.625mm to 1.5mm slice thickness for high resolution reconstruction scan and scanning time is less than 5 sec. Patients were placed in supine position with head first. Contrast was not used unless clinically indicated. As contrast may interfere with the interpretation of ground glass opacification. Axial data was taken with coronal reconstruction was done.

For each patient HRCT scan of Chest was evaluated for the following characteristics: presence of ground glass opacities consolidation.

Mixed ground glass with consolidation.

Number of lobes affected where either GGO or consolidation.

Degree of involvement of each lung lobe

Overall extent of lung involvement

Nodule

Pleural effusion.

Lymph nodal involvement

Airway abnormality.

Degree of lung involvement^[8]

None: 0%, Minimum (1-25%), mild (26-50%) Moderate (51-75%) and Severe (75-100%).

No involvement – no lobe Score :0

Minimum involvement – 1 lobe – score 1.

Mild involvement –No of lobe 2 – Score 2

Moderate involvement No of lobe 3 –score 3

Severe involvement –No of lobe 4 –score 4.

DISCUSSION

Definitive diagnosis of COVID 19 requires a positive RT-PCR test. Current best practice advises that CT scan of chest is not used to diagnose COVID 19 but helpful in assessing complication and prognosis.

According to Fleischner society consensus statement published on 7th April 2020^[9], that imaging is not indicated in patients with suspected COVID 19 and mild clinical features unless they are at risk of disease progression. Imaging is indicated in a patient with COVID 19 with worsening respiratory status. Imaging is recommended for medical triage of patients with suspected COVID 19 who present with moderate to severe clinical features.

In diagnosis chest computed tomography(CT) manifestations can supplement parts of limitation of real time reverse transcription polymerase chain reaction(RT-PCR) assay.^[10] However, this tests are not readily available in emergency situation. It is time consuming unless the machine is automated. HRCT Scan can be used as an alternative valuable test for diagnosis of COVID pneumonia. The sensitivity of RT-PCR with bronchoalveolar lavage is about 93%. And in sputum 72% and nasal swab about 63%.^[11]

Bernheim et al review the CT findings of 121 symptomatic patients infected with COVID 19 in relation to the of onset of symptoms and the initial CT scan and they find patients who came earlier have fewer GGO and consolidation than intermediate and late appearing patients.^[12] However in many patients the disease severity was not consistent with the course of the disease. Our study analyses the CT findings of COVID 19 based on percentage and degree of lung parenchyma involvement which likely reflects the relationship between HRCT findings and severity of the disease pattern.

Table I: Comparison of HRCT scan diagnosis with RT-PCR as a gold standard test for diagnosis of COVID -19 (n=151).

HRCT	RT-PCR	RT -PCR	Total
	Disease+ve	Disease -ve	
Test(+)ve : 126	TP 115	FP 11	126
Test (-ve):25	TN 21	FN 4	25
Total	136	15	151

Among the 151 patients 126 had positive findings of COVID19 in HRCT. They are positive by HRCT. 25 were negative in CT. Among the 126 patients who were test positive, of them 115 were also positive for RT-PCR. (TP).They are true positive (TP).11of them were false positive(FP) due to other than COVID 19.They were negative in RT-PCR.

Those who were(25)test negative by HRCT, among them 21 was also negative for RT-PCR. They are true negative (TN). Rest of the 4 were false negative(FN) but they were positive for RT-PCR. Sensitivity was 96% specificity 65% PPV 91% and NPV 84% respectively. Multiple studies published in journal of Radiology, sensitivity for diagnosis of COVID 19 in 1014 hospitalized patients – concluded that Chest CT has a high sensitivity of diagnosis of COVID 19 corona virus disease. Chest CT may be considered as a primary tool for the current COVID 19 detection in epidemic areas.

Most important imaging findings were ground glass opacities & consolidation with bi lateral distribution. They found that chest CT was positive in 88% cases, RT-PCR was positive among 59% cases. In our study we found ground glass opacities with consolidation, bilateral in distribution with basal posterior and peripheral predominance. Nodules were found in 21 patients. Pleural effusion and lymphadenopathy were found in 13 and 9 patients.

In patients with negative RT- PCR, 75% had positive chest CT findings using RT -PCR as a reference standard, sensitivity HRCT was 97% and specificity is about 25% respectively.

Table III: Degree of Involvement on The Basis Of Hrcr Findings(N=151).

Degree of involvement	Number of patient	Percentage	Number of lobe involvement
None	24	0%	0
Minimum	20	1-25%	1
Mild	36	26-50%	2
Moderate	40	51-75%	3
Severe	31	75-100%	4
Total	151		

Among the total of 151 patients degree of involvement was mild in 38, moderate in 40 patients and severe infection was found in 31 hospitalized patient

A single negative RT -PCR should not exclude COVID 19 specially if a clinical suspicion is high. The combination of clinical findings, typical imaging features and dynamic changes must be considered to identify COVID 19 with high sensitivity.^[9] Recent studies demonstrates that the extension of lung disease assessed using a quantitative method has a significant relationship with severity of disease. We observed that number of the lung segment, lobe, frequency of consolidation, crazy paving, air bronchogram increased in more severe cases. A rapid accurate severity assessment of COVID19 based on CT SCAN of chest would be feasible and could provide help for making management decision.

Table II: Findings of HRCT scan of chest(n= 151).

Absence of both ground glass opacities and consolidation	25
Presence of either GGO or consolidation	26
Presence of GGO without consolidation	45
Presence of consolidation with crazy paving	55
	Total 151

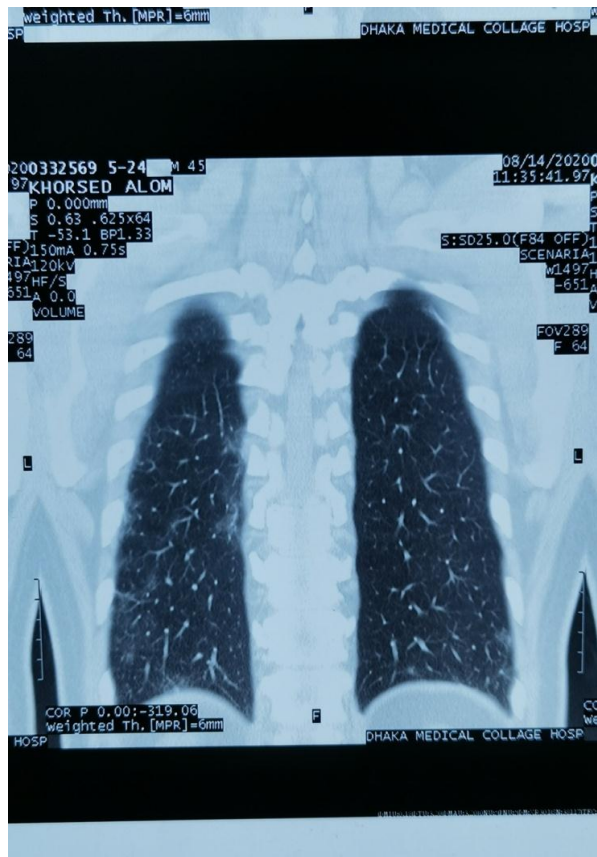


Figure 1: Multi focal bi lateral peripheral ground glass hazes in apical-posterior segment of left upper lobe and lateral basal segment of right lower lobe.

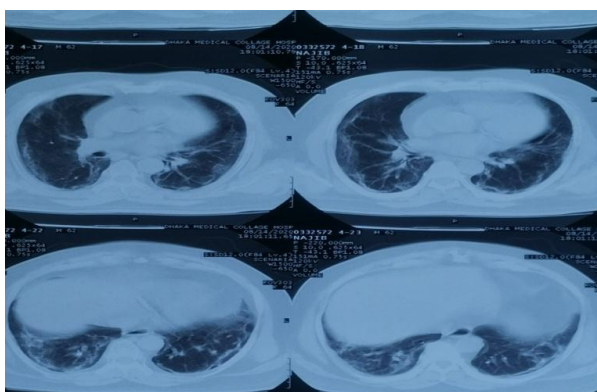


Figure 2: Bilateral multifocal air space densities, ground glass opacities, extensively distributed in both lungs without consolidation mostly in the periphery.

FIGURE

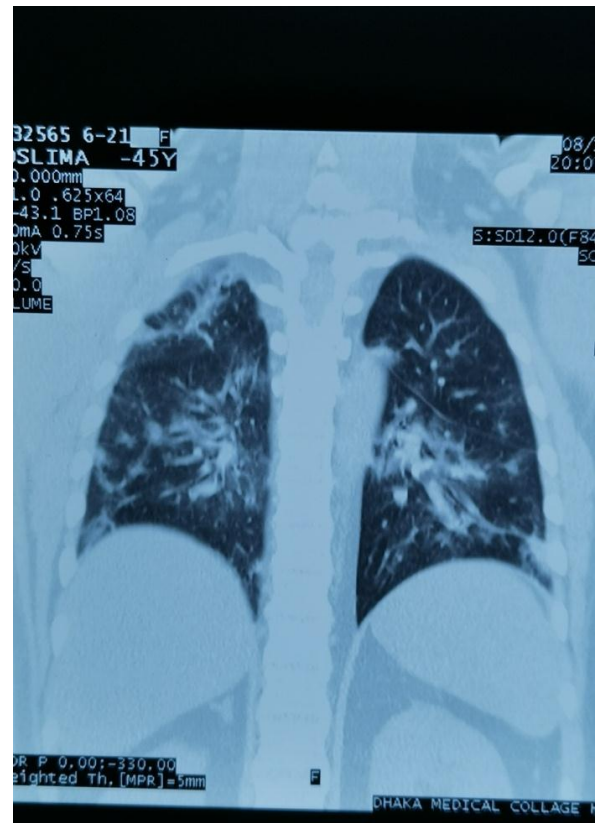
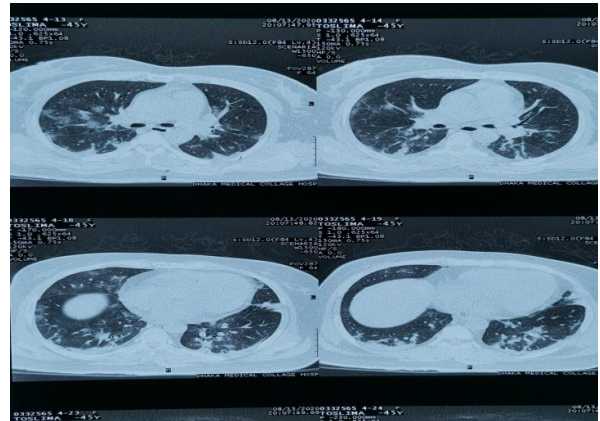


Figure 3: Multiple bilateral air space densities, ground glass opacities with crazy paving pattern and inter lobular septa thickenings are noted in almost zones of both lungs with bilateral pleural thickening is also noted.(Progressive).

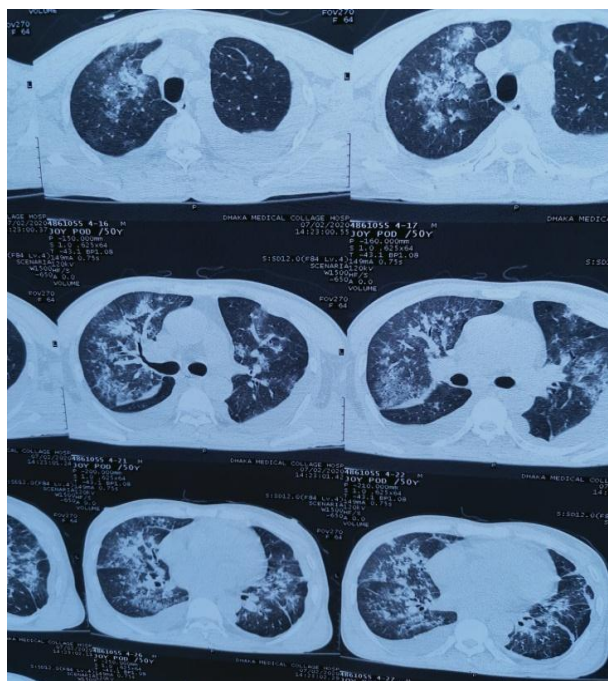


Figure 4: Bilateral extensive air space densification, ground glass opacity and patchy consolidations giving crazy paving pattern in both lungs almost segments sparing left apical posterior and apical segment of right lower zone.

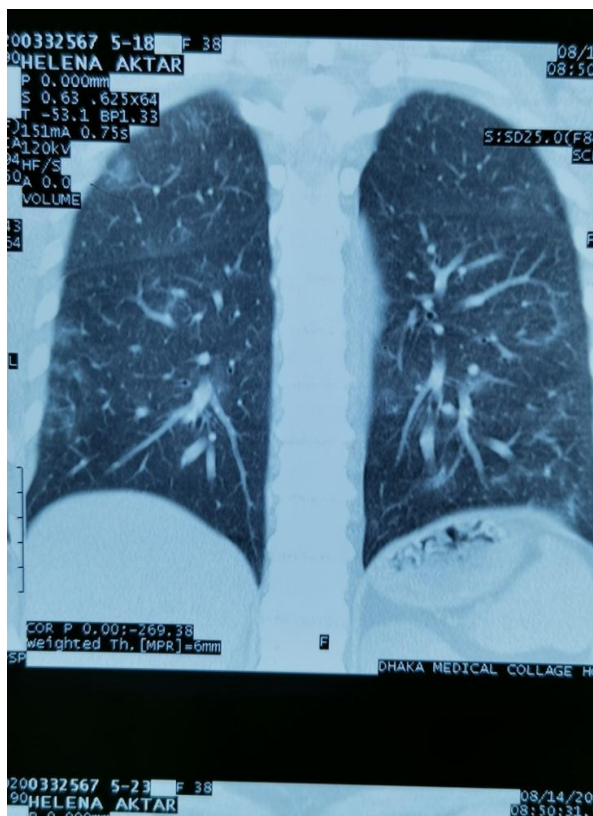


Figure 5: Multifocal peripheral bilateral ground glass opacities are noted in the posterior segment of both upper lobe, apical segment of both lower lobe and poster-basal segment of right lower lobule, intra and interlobular septal thickening with sub-pleural bands. (Resolution).

Table IV: Sensitivity, specificity, Accuracy, Positive and Negative predictive value of CT scan for diagnosis of COVID -19 considering RT-PCR as gold standard test.

Parameter	Value%
Sensitivity	96%
Specificity	65%
Positive Predictive value	91%
Negative Predictive value	84%
Accuracy	90%

In hospitalized patients according to data overall sensitivity, specificity, was 96% and 65%. Positive and Negative predictive value, Accuracy was 91%, 84% and 90% respectively.

CONCLUSION

Due to high infectivity and asymptomatic transmission, until a highly sensitive and specific COVID 19 test is developed, HRCT should be incorporated into the assessment of the patients who are hospitalized. HRCT can be an useful alternative of RT-PCR in symptomatic patients when RT- PCR is negative. It is an important indicator for future prognosis.

Combination of RT –PCR with HRCT evaluation can increase the sensitivity and specificity of diagnostic testing to greater than 90%. HRCT will curb the false negativity of sole RT-PCR.

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