

ROLE OF HRCT IMAGING IN DIAGNOSIS AND PROGNOSIS OF NOVEL CORONA (COVID-19) PNEUMONIA, RADIOLOGISTS EXPERIENCE IN DHAKA MEDICAL COLLEGE HOSPITAL CORRELATED WITH RT-PCR.

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Abstract:

Background: High resolution computed tomography scan can be used as a effective modality for corona virus disease 2019(COVID -19) being a useful alternative to RT-PCR specially in hospitalized 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, prognosis 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 200 patients were evaluated with HRCT findings and correlated with RT-PCR as gold standard. . Sensitivity was about 96% for chest CT, specificity 66% , PPV 97% accuracy 90% and NPV 62%.

Conclusion: HRCT scan of chest is a useful modality for COVID -19 patients for the purpose of diagnosis and response to treatment. It is an important indicator for future prognosis . HRCT can be an important alternative of RT-PCR in symptomatic patients when RT-PCR is negative where facilities are available . It is important for the radiologists and clinicians to be familiar with different manifestations on CT . It will help in management planning for these patients .

Key words: HRCT scan, RT-PCR , covid 19 , GGO, PPV, NPV.

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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

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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 hospitalized COVID patients. According to many studies the sensitivity is about 98%¹is not only important in diagnosis but also monitoring the disease process and therapeutic efficacy .HRCT can help determine the temporal disease stage and severity of COVID Pneumonia².The reference method for COVID 19 diagnosis , SARS COV-2 PCR is highly specific but has variable sensitivity as low as 70%. Nowadays, asymptomatic and false negative cases make up 30% in Bangladesh which aren't diagnosable by RT-PCR for low viral load. HRCT of chest can play very significant role for diagnosing this patient. We evaluated typical and atypical CT manifestations of COVID – 19 infection in our hospital Dhaka Medical college. 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 & inter lobular septal thickening and few emerging manifestations' like pleural changes, fibrosis and nodules and reverse halo sign 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 .Early diagnosis of COVID -19 is crucial for disease treatment and control. Compared to RT-PCR chest CT specially HRCT of chest imaging may be a reliable practical rapid method to diagnose and asses COVID-19 corona virus disease .

Bi lateral distribution of ground glass opacities with or without consolidation basal, peripheral posterior segment in distribution was the hallmark of COVID -19³. With the progression of disease many interesting new CT findings like crazy paving pattern ,vascular changes ,consolidation and reverse halo sign 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 staging and future outcome. ⁴

In case of mild symptomatic patients, CT findings were less severe. Only finding was ground glass hazes due to interstitial edema.

In moderate cases in addition to GGO, distribution is typically bilateral peripheral sub-pleural and posterior predominance. Consolidation was also notable in this situation⁵ .In this stage non cardiogenic pulmonary oedema comprises interstitial oedema ultimately progresses to alveolar oedema evidenced by ground glass opacification, consolidation and crazy paving .

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 30 th to 15th August .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. 200 patients were evaluated with HRCT findings. 14 patients were excluded from the study due to unavailability of RT- PCR report. Total 186 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 opacities with consolidation
- Number of lobes affected where either GGO or consolidation

Degree of involvement of each lung lobe

Overall extent of lung involvement

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.

Four stages are observed in COVID-19 pneumonia .

Early initial stage (0-4 days) Normal CT findings or GGO only.

Progressive (5-8 days) Increased GGO and crazy paving appearance .

Peak stage (9-13 days) consolidation with mixed GGO.

Absorption stage (>14 days) Fibrotic stripes

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 and severity assessment. Many authors suggested, 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 , HRCT manifestations ca supplement parts of

limitations of real –time reverse transcription polymerase chain reaction (RT-PCR) assay.¹⁰

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 patients¹² 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=186)

HRCT	RT-PCR Disease+ve	RT –PCR Disease –ve	Total
Test(+)ve : 170	TP 165	FP 05	170
Test (-ve):16	TN 10	FN 6	16
Total	175	11	186

Among the 186 patients 170 had positive findings of COVID19 in HRCT . They are positive by HRCT . 16 were negative in CT .Among the 186 patients who were test positive , of them 165 were also positive for RT-PCR. (TP).They are true positive (TP).05of them were false positive(FP) due to other than COVID 19.They were negative in RT-PCR. Those who were(16)test negative by HRCT, , among them (10) was also negative for RT-PCR S.They are true negative (TN).Rest of the(6) were false negative(FN) but they were positive for RT-PCR .Sensitivity was 96% specificity 66% PPV 97% and NPV 62% and Accuracy 90% 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 11 patients . Pleural effusion and lymph adenopathy were found in 22 and 14 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.

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 sensitivity⁹.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= 186)

Absence of both ground glass opacities and consolidation	29
Presence of either GGO or consolidation	42
Presence of GGO without consolidation	60
Presence of consolidation with crazy paving	55
Total	186

Table-III

Degree of involvement on the basis of hrct findings (n=186)

Degree of involvement	No. of patient	Percentage	No. of lobe involvement
None	30	0%	0
Minimum	30	1-25%	1
Mild	45	26-50%	2
Moderate	43	51-75%	3
Severe	38	75-100%	4
Total	186		

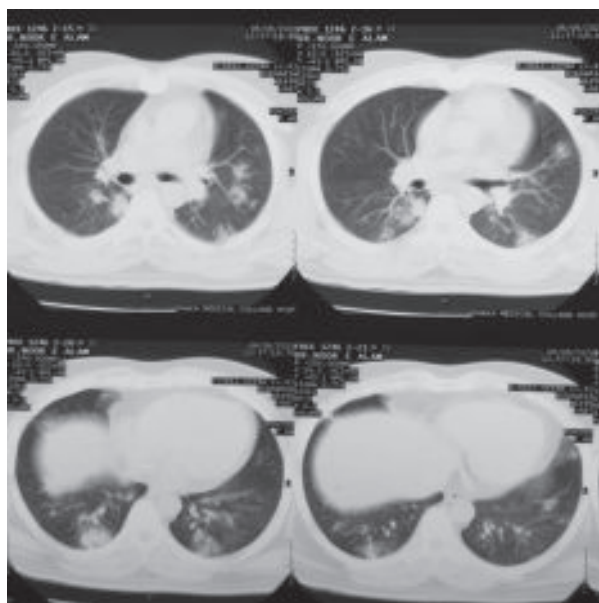


Fig.-1: Multifocal consolidative nodules in almost all segment of both lung fields with ground glass opacification and interstitial thickening relatively sparing right upper lobe.

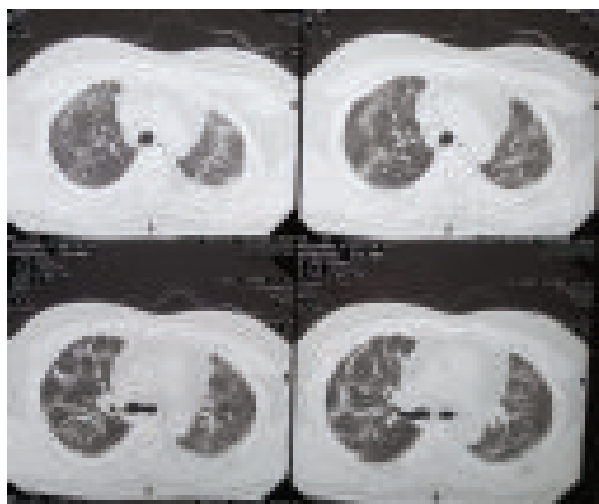


Fig.-2: Multifocal ground opacities with interlobular septal thickenings are noted in both lung fields.

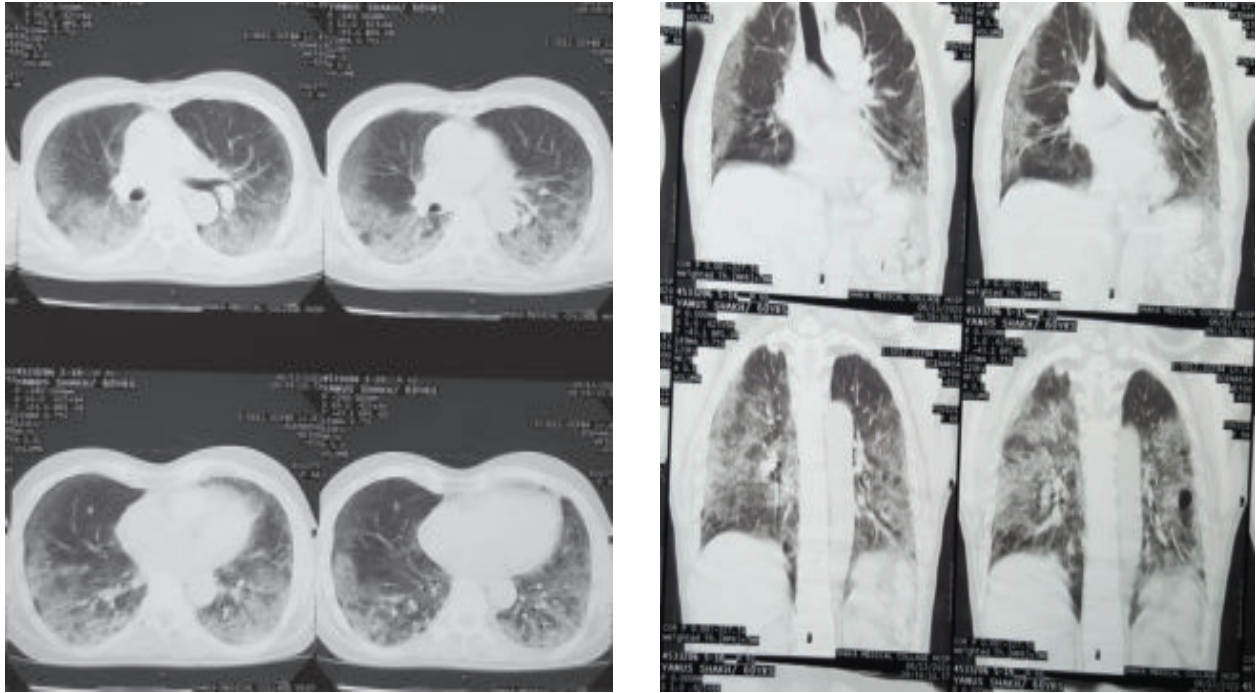


Fig.-3: Bilateral extensive ground glass hazes with consolidation and crazy paving pattern in both lung fields.

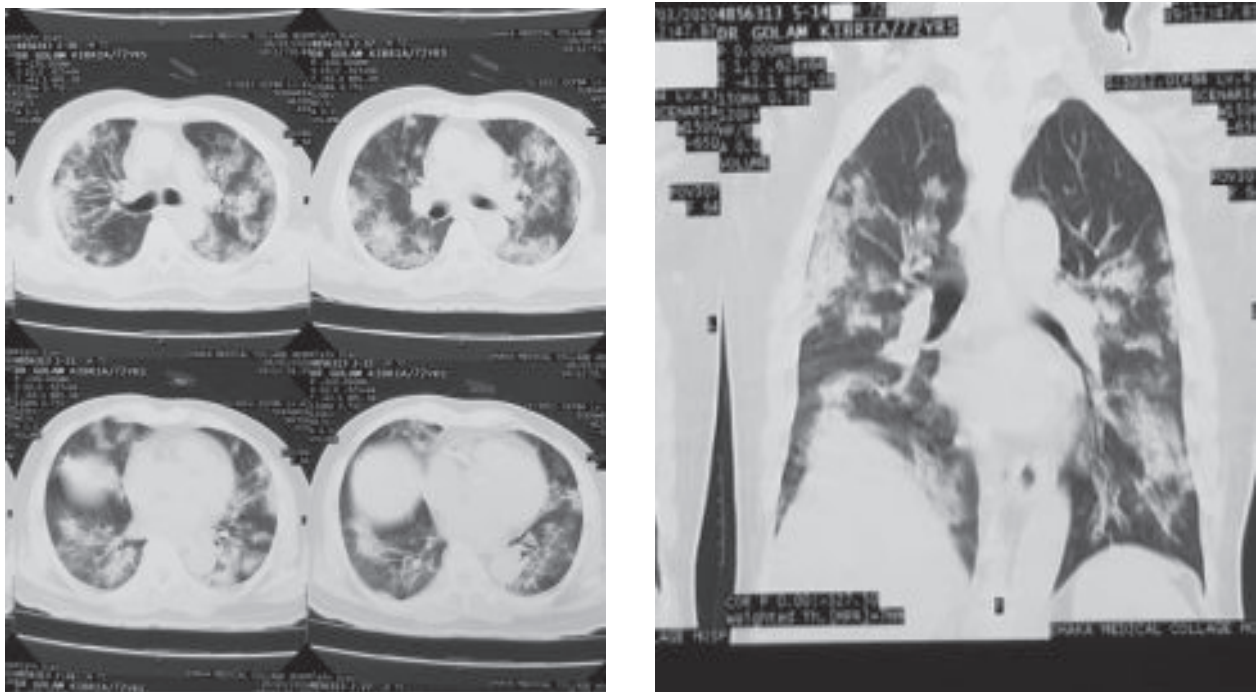


Fig.-4: Diffuse involvement of all lobes sparing both upper lobe. Extensive multifocal consolidation, GGO and crazy paving patterns are noted

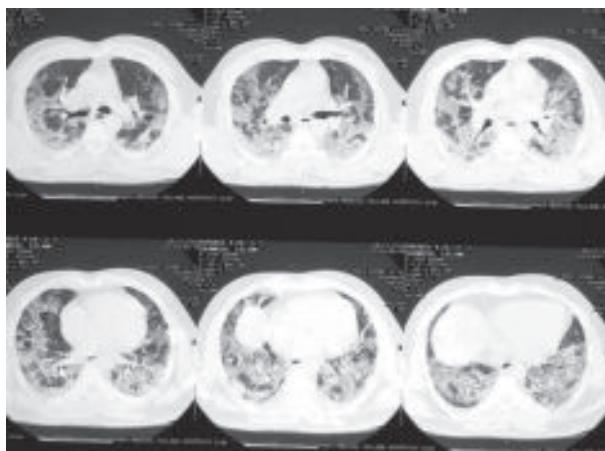


Fig.-5: Diffused involvement of all lobes of both lung with ground glass opacities, intra and inter lobular septal thickening, patchy consolidation giving crazing paving pattern

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

Sensitivity	96.49%
Specificity	66.67%
Positive Predictive value	97.06%
Negative Predictive value	62.50%
Accuracy	90.06%

In hospitalized patients according to data overall sensitivity, specificity, was 96% and 66%. Positive and Negative predictive value, Accuracy was 97% , 62%and 90% respectively.

Conclusion:

HRCT scan of chest is a useful modality for COVID -19 patients for the purpose of diagnosis and response to treatment . It is an important indicator for future prognosis .HRCT can be an important alternative of RT-PCR in symptomatic patients when RT-PCR is negative where facilities are available . It is important for the radiologists and clinicians to be familiar with different manifestations on CT . It will help in management planning for this patients . 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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