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ORIGINAL ARTICLE

Radiological Involvement among Asymptomatic and Symptomatic COVID-19 Patients - A Cross-Sectional Study

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Abstract:

Background and aims: *The COVID-19 pandemic is a current problem across the world. Evaluation of the radiological involvement is helpful for early detection of the COVID-19 cases, even when RT-PCR is negative. As RT-PCR is a time-consuming procedure, have high false negative rate, and requires a special laboratory set-up, radiological findings can be used for early detection and proper management of the suspected cases. The aim of this study was to evaluate the radiological involvement (HRCT & chest X-Ray) among asymptomatic and symptomatic COVID-19 patients*

Methods: *This cross-sectional study was conducted among suspected and confirmed COVID-19 patients visited at the outpatient department or admitted to the National Institute of the Diseases of the Chest and Hospital (NIDCH), Dhaka, Bangladesh within the period of April 15, 2020 and June 5, 2020. Chest X-Ray and high-resolution computed tomography scan (HRCT) of the chest was done as well as RT-PCR of nasopharyngeal swab for SARS-CoV-2. Sensitivity, Specificity, PPV and accuracy of HRCT and RT-PCR was evaluated.*

Results: *Total 53 cases were enrolled in the study. The mean age was 47.4 years with male predominant (52.8%). RT-PCR was positive in 64.2% cases. Ground glass opacity (GGO) with consolidation was the most common (50.9%) HRCT pattern and the left lower lobe was most commonly involved (60.4%). In chest X-Ray, consolidation was the most common finding (22.6%) followed by GGO (20.8%). HRCT has high sensitivity (73.33%) and specificity (75.0%) in detecting parenchymal abnormality following SARS-CoV-2 infection.*

Conclusion: *Chest X-ray and HRCT can play an important role in the early detection of COVID-19 suspected cases for starting treatment early.*

Key words: *COVID-19, HRCT, radiological involvement, RT-PCR, SARS-CoV-2*

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Introduction:

The novel corona virus or COVID-19 which is also known as SARS-CoV-2 is a current pandemic across the world. Like other viruses, SARS-CoV-2 infects lung alveolar epithelial cells using receptor mediated endocytosis via the angiotensin converting enzyme II (ACE2) as an entry receptor.[1] COVID-19 was declared pandemic by World Health Organization (WHO) on 11th March 2020 following its outbreak as a cluster of pneumonia cases with unknown cause in Wuhan City, Hubei Province, China, in December 2019.[2] Coronaviruses were first described in 1966 by Tyrell and Bynoe, who cultivated the viruses from patients with common colds.[3] The initial clinical sign of the SARS-CoV-2 related disease COVID-19 which allowed case detection was pneumonia. More recent reports also describe gastrointestinal symptoms and asymptomatic infections, especially among young children.[4] Observations so far suggest a mean incubation period of five days and a median incubation period of 3 days (range: 0–24 days).[5] The proportion of individuals infected by SARS-CoV-2 who remain asymptomatic throughout the course of infection has not yet been definitely assessed. In symptomatic patients, the most common clinical symptoms are fever and cough in addition to other nonspecific symptoms including dyspnea, headache, muscle soreness, and fatigue.[6] About 20% of cases are severe, and mortality is approximately 3%.[7] The infection can progress to severe disease with dyspnoea and severe chest symptoms corresponding to pneumonia in approximately 75% of patients, as seen by computed tomography on admission.[5] The patients suspected with corona virus symptoms are firstly tested for reverse transcriptase polymerase chain reaction (RT-PCR), which is time consuming. Meanwhile, to assess the condition of the patient, HRCT (High-Resolution Computerized Tomography) and chest X-Ray may be done. The time delay for the results of nasopharyngeal RT-PCR, sampling site/collection errors, lower sensitivity as compared to CT scan and invasive nature of sampling apart from social reasons, pitches HRCT thorax as a possible alternative to RT-PCR as a screening modality especially in symptomatic cases.[8] CT is important in the diagnosis and treatment of lung diseases. Small preliminary evidence suggests that early use of CT scan may be more efficacious in differentiating COVID-19 from other pulmonary infections based on "classical" COVID-19 specific findings on CT scan.[9] Being a non-invasive modality with rapid test results, high sensitivity, low risk of cross infection, good reproducibility for analysis as compared to RT-PCR, make chest CT worth evaluating as a primary screening modality. HRCT chest is indicated for moderate, severe cases & follow up of patient. In Bangladesh, COVID-19 has also made a great impact. At the time of writing this report, total 954,881 cases are registered along with 15,229 deaths.[10] This study was conducted to assess the radiological involvement (HRCT & Chest X-Ray) among asymptomatic and symptomatic COVID-19 patients.

Objectives:

This study was conducted to assess the radiological involvement (HRCT & chest X-Ray) among asymptomatic and symptomatic COVID-19 patients. We also assessed the sensitivity and specificity of CT compared to RT-PCR for the diagnosis of COVID-19 pneumonia.

Methodology & Materials:

This cross-sectional study was conducted among patients attended to the outpatient and inpatient department of the National Institute of Diseases of the Chest and Hospital (NIDCH), Dhaka, Bangladesh within the period between 15 April, 2020 and 5 June, 2020. Total 53 patients were enrolled purposefully according to the following inclusion and exclusion criteria.

The inclusion criteria:

- The patients with a suspicion of COVID-19 disease (positive contact history, but no symptom at presentation).
- Symptomatic patients, who needed admission.

The exclusion criteria:

- The patients who were mentality unstable were excluded from this study.
- The patients who were not interested in sharing their experience, medical records or opinion related to this study.

The measurement of oxygen saturation, thermal screening, and RT-PCR from nasopharyngeal swab was done. Chest X-ray was advised initially. If the chest X-ray findings were suggestive of COVID pneumonia, the patient underwent HRCT chest depending upon the severity of disease for more

accurate staging and CT severity scores in Radiology Department. Follow up of HRCT chest was advised for severe grade and critical patients. Clinical information, hematological parameters, and radiological findings (HRCT and chest X-Ray) were collected with written consent from the patients or guardian of the patients. Besides, all patients detail history were collected from the hospital's record keeping authority accepting all the terms and conditions. CIOMS guidelines were maintained during the research processes. This study was approved by the ethical committee of the National Institute of Diseases of the Chest and Hospital (NIDCH), Dhaka, Bangladesh. Unpaired z- test was used as a test of significance; with p value < 0.05 was taken to be significant. Standard formulae were used and statistical analysis of the result was obtained by using windows-based computer software devised with Statistical Package for Social Science (SPSS-22) and Microsoft Excel 2007.

Results:

More than half of the patients were within the age group of 31-50 years and a fairly large group of patients (20.75%) were above 60 years with the mean age 47.4±14.5 years. Most of the patients (52.8%) were male and came from urban area (86.8%) [Table-I]. Majority of the patients (64.2%) were tested positive RT-PCR for SARS-CoV-2 [Figure-1]. Fever was the most common presenting complaint (79.2%), followed by cough (66%). Most of the cases (83%) had normal finding on chest auscultation [Table–2]. Diabetes was the most common co-morbidity (32.1%), followed by hypertension (28.3%) and asthma (15.1%) [Table-III]. We observed that more than half of the patients (50.9%) had ground glass opacity (GGO) with consolidation in HRCT, whereas 17% patients had thickened vessel. Lower lobes of both lungs were most commonly involved, left lower lobe and right lower lobe was involved in 60.4% and 52.8% cases respectively. In 39.6% cases, there was peripheral involvement and in 24.5% cases there was diffuse disease [Table-IV]. Similar findings were seen in chest X-Ray, where consolidation was found in 22.6% cases and GGO in 20.8% cases [Table-V]. Sensitivity and specificity of HRCT in detecting parenchymal abnormality following SARS-CoV-2 infection was 73.33% and 75.0% and that of RT-PCR 67.27% and 56.25% respectively. Positive likelihood ratio of HRCT was 2.93% and that of RT-PCR 1.77%. Positive predictive value of HRCT was 98.24% and RT-PCR 86.11%. HRCT was found more accurate (98.65%) than RT-PCR (75.47%) in detecting disease [Table-VI].

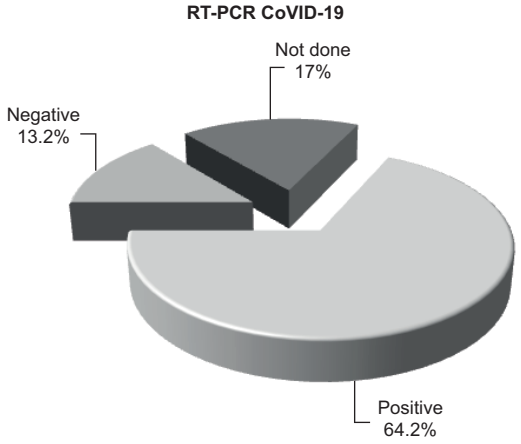

Fig.-1: *RT-PCR findings of the study people. (n=53)*

Table-I

Sociodemographic characteristics of the study people. (n=53)

Characteristics		Frequency	%
Age (year)	≤20	2	3.8
	21-30	3	5.7
	31-40	12	22.6
	41-50	17	32.1
	51-60	8	15.1
	>60	11	20.75
	Mean± SD	47.4±14.5	
	Range	17-80	
Sex	Male	28	52.8
	Female	25	47.17
Occupation	Businessman	10	18.87
	House wife	12	22.64
	Student	5	9.43
	Service	26	49.06
Residence	Urban	46	86.8
	Rural	7	13.2

Table-II

Clinical Profile of the study people. (n=53)

Parameters		Frequency	%
Symptoms	Fever (>100^0 F)	42	79.2
	Cough	35	66.0
	Dyspnoea	15	28.3
	Chest pain	2	3.8
	Flu-like symptoms	5	9.4
	Diarrhea	1	1.9
	Anosmia	6	11.3
	Ageusia	2	3.8
	Body ache	4	7.5
	Hypothyroidism	1	1.9
Auscultatory findings	Wheeze	2	3.8
	Crepitation	7	13.2
	Diminished breathe sound	0	0.0
	Normal	44	83.0

Table-III

Co-morbidities of the study people. (n=53)

Co-morbidities	Frequency	%
DM	17	32.1
Hypertension	15	28.3
IHD	1	1.9
CKD	1	1.9
COPD	2	3.8
Asthma	8	15.1
Bronchiectasis	1	1.9
IGT	1	1.9

Table-IV

*HRCT findings of the study people. (n=53)**

HRCT findings		Frequency	%
HRCT pattern	GGO	10	18.9
	GGO with consolidation	27	50.9
	Reverse halo sign	1	1.9
	Crazy paving pattern	3	5.7
	Thickened vessels	9	17.0
	Reticular and reticulonodular pattern	1	1.9
	Sub-pleural band	2	3.8
	Pleural calcification/ thickening	2	3.8
	Septal thickening	1	1.9
Frequency of lobar involvement	RUL	17	32.1
	RML	19	35.8
	RLL	28	52.8
	LUL	17	32.1
	LLL	32	60.4
Distribution of involvement	Central	0	0.0
	Peripheral	21	39.6
	Diffuse	13	24.5

*Total number may be more than 53, as a patient may have multiple radiological findings and involvement

Table-V

Chest X-Ray findings of the study people. (n=37)

X-Ray findings	Frequency	%
Consolidation	12	22.6
GGO	11	20.8
Patchy opacity	5	9.4
Right sided pulmonary inflammatory	3	5.7
Inflammatory change	2	3.8
Fibrosis	2	3.8
Pleural calcification thickening	2	3.8

Table-VI

Sensitivity, Specificity and Accuracy status of HRCT and RT-PCR

	HRCT	RT-PCR
Sensitivity	73.33%	67.27%
Specificity	75.00%	56.25%
Positive Likelihood Ratio	2.93%	1.77%
Disease prevalence	98%	98%
Positive predictive value	98.24%	86.11%
Accuracy	98.65%	75.47%

Discussion:

In our study, it was found that mean age of the study people was 47.4 years (SD ±14.5), ranged between 17-80 years. Maximum study people (32.1%) were in the age group of 41-50 years. Most of them (52.8%) were male and living in urban area (86.8%). Similar results were found in the study of Kulshrestha V. et al.[11], where among 250 patients, majority (31.2%) were in the age group of 41-50. In the study of Shi H. et al.[12] among 81 study people, majority were male (52%). RT-PCR findings shows that maximum (64.2%) study people had positive result, 13.2% were negative and in 17% cases RT-PCR was not done. Most of the study people (79.2%) had fever (>100^0 F), followed by cough (66%), dyspnoea (28.3%), anosmia (11.3%), flu-like symptoms (9.4%), body ache (7.5%), chest pain (3.8%), ageusia (3.8%), and diarrhea (1.9%). In another study of Inui S. et al.[13] among 104 patients, 11% had fever, 19% had cough, 2% sore throat, 10% had fatigue, 3% had dyspnea, 4% had nasal discharge, 5% had headache, and 2% had diarrhea. Most of the patients (83%) in our study had normal auscultatory findings, 13.2% had crepitation and 3.8% had wheeze. We found that most of the study people (32.1%) had diabetes followed by hypertension (28.3%), asthma (15.1%), COPD (3.8%), IHD (1.9%), CKD (1.9%), bronchiectasis (1.9%) and IGT (1.9%). In another study of Sharma K. et al.[14] among 376 study people, 41% had HTN, 17% had DM, 11% had COPD, and 6% had IHD.

From our study it was revealed that GGO with consolidation was the most common HRCT pattern (50.9%), followed by GGO (18.9%), thickened vessel (17%), crazy paving pattern (5.7%), sub-pleural band (3.8%), pleural thickening (3.8%), reticular and reticulonodular pattern (1.9%), reverse halo sign (1.9%) and septal thickening (1.9%). In their study, Shah SA and co-workers[15] found that among 216 cases, GGO in 92.2%, both GGO's & consolidation in 9.8%, GGO's with septal thickening/crazy paving pattern in 54%, GGO's with reversed halo or Atoll sign in 17.7%, GGO's with pulmonary nodules in 28.4%, mediastinal lymphadenopathy in 16.7%, fibrosis, traction bronchiectasis, volume loss, calcified granulomas in 7.8% study people. We observed that 1.9% patients had single lobe involvement, 11.3% had 2 lobes, 5.7% had 3 lobes, 9.4% had 4 lobes, and 17.0% had 5 lobes involvement. Shah SA. et al.[15] seen in their study that among 216 patients single lobe involvement in 7 cases, 2 lobe involvement in 31 cases, 3 lobe involvement in 18 cases, 4 lobe involvement in 19 cases, and 5 lobe involvement in 27 cases. We also observed that left lower lobe was most commonly involved (60.4%) followed by right lower lobe (52.8%), right middle lobe (35.8%), and right upper lobe (32.1%) and left upper lobe (32.1%). Peripheral involvement was seen in 39.6% and diffuse involvement was seen in 24.5% cases. Alam SZ. et al.[16] in their study observed that among 128 patients, right lower lobe involvement in 93.75%, left lower lobe involvement in 91.41%, right upper lobe involvement in 87.50%, left upper lobe involvement in 85.94% and right middle lobe involvement in 75.0%, peripheral disease 45.31% and diffuse disease in 50.78% cases. Mean CT severity score of our study was 26.5 (SD± 22.2).

We observed various patterns in chest X-Ray. Consolidation was the most common finding (22.6%). Others had GGO (20.8%), patchy opacity (9.4%), inflammatory change (5.7%), fibrosis (3.8%) and pleural thickening (3.8%). Kulshrestha V. et al.[11] seen that among 250 study people, early GGO in

33.2%, GGO in 46%, consolidation in 26.4%, reticulation in 20.4%, crazy-paving in 10%, pleural thickening in 17.6%, pleural effusion in 10%, lymphadenopathy in 7.6%, nodular lesion in 11.6% and cystic airspace in 4.4% study people.

It was noted that HRCT is a valuable and dependable diagnostic modality in detecting lung parenchymal abnormality and indirectly detecting COVID-19 infection. Sensitivity and specificity of HRCT in detecting parenchymal abnormality following SARS-CoV-2 infection was 73.33% and 75.0%. Though detection of SARS-CoV-2 viral RNA by RT-PCR is gold standard for diagnosis of infection, it has high false negative results. We found that sensitivity and specificity of RT-PCR is 67.27% and 56.25% respectively in detecting COVID-19 disease. Positive likelihood ratio of HRCT was 2.93% and that of RT-PCR 1.77%. Positive predictive value of HRCT was 98.24% and RT-PCR 86.11%. HRCT was found more accurate (98.65%) than RT-PCR (75.47%) in detecting disease. Our observations well match with the findings of other studies.[8,17]

Limitations of the Study:

Sample size was not sufficiently enough to make a firm conclusion. It was a single center study. So, the findings of this study may not reflect the exact scenario of the whole country. Study duration and follow up period were short. Further study is required to have better understanding.

Conclusion and Recommendations:

The most common pattern of COVID-19 on HRCT images are pure GGO, GGO with consolidation and thickened vessels. In the chest X-Ray, consolidation and GGO was most commonly found. HRCT and chest X-Ray play a vital role in the early clinical detection and diagnosis of COVID-19, and can be considered as a diagnostic modality. Chest X-ray may play an initial screening tool in case detection whereas HRCT chest may be recommended for detection of suspected cases where RT-PCR is negative, and for determination of disease severity.

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