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HRCT Evaluation of Post Vaccinated RT-PCR Positive COVID-19 Patients at A Dedicated COVID-19 Hospital

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ABSTRACT

Background: **Coronavirus disease 2019 (COVID-19) is a highly infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Large-scale vaccination of risk groups and later the general population is the single most effective public health measure for mitigation of the COVID-19 pandemic.**

Methods and Materials: **This prospective cross sectional study was carried out at Dhaka North City Corporation dedicated COVID-19 hospital, Mohakhali, Dhaka, enrolling 50 (fifty) vaccinated RT-PCR positive COVID-19 patients.**

Results: **Majority of the patients were >50 years old. Most of the patients had bilateral lung involvement and ground glass was the predominant CT pattern. 20% patients had consolidation in HRCT scan. Most of the patients (46%) had mild disease and only 18% patients had severe disease. Severe cases were more common (77.8%) in older (>50years) patients. 20% of the patients had 50-75% and only 6 % patients had more than 75% of total lung involvement. 52% patients had less than 25% lung involvement. Lung involvement was significantly higher in older patients. Patients had to stay an average of 6.2 days in hospital. Older patients had to stay more days in the hospital than younger patients. 2% (1) of COVID-19 patients died after admitting into our hospital.**

Conclusion: **Vaccination can effectively reduce mortality and morbidity of COVID-19 patients by reducing the active number of cases as well as severity of the disease.**

Keywords: COVID-19, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), vaccination.

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I. Introduction

Coronavirus disease 2019 (COVID-19) is a highly infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was firstly reported in Wuhan, Hubei Province, China, and rapidly spread to other domestic cities and countries beyond China [1]. The World Health Organization (WHO) declared this ongoing outbreak as a global public health emergency on January 30, 2020 and raised the risk of COVID-19 to very high at the global level on February 28, 2020 [2]. Large-scale vaccination of risk groups and later the general population is the most effective public health measure for mitigation of the coronavirus disease (COVID-19) pandemic [3]. Lung parenchymal involvement is more common in non-vaccinated patient than vaccinated patients. Vaccine also reduces the severity of the disease as well as symptoms [4]. The lack of effective treatment, the severe burden of COVID-19 infection along with its fast spread highlight the need for rapid vaccine development. This process was record-breaking, entering human clinical trial testing in March 2020 [5] and by April 2020, more than 100 vaccine candidates were being developed using various methods, five of which were in the clinical evaluation stage and 73 at exploratory or pre-clinical stage [5], [6]. Bangladesh began the administration of COVID-19 vaccines on 27 January 2021 while mass vaccination started on 7 February 2021 [7]. The Oxford–AstraZeneca vaccine was the first COVID-19 vaccine which was authorized for emergency use from January to April 2021. Bangladesh ordered vaccines produced by Serum

Institute of India, however it was not adequate [8]. Chest X-ray (CXR) is not a very sensitive tool for the detection of pulmonary abnormalities in the early stage of the disease [9]-[11]. Computed tomography (CT) imaging is considered to be the most effective method for detection of lung abnormalities, especially in the early stage of the disease [9], [12] Moreover, serial chest CT imaging with different time intervals is also effective in estimating the evolution of the disease from initial diagnosis to discharge from hospital [12], [13] RT-PCR is believed to be highly specific, but with sensitivity reported as low as 60-70% and as high as 95- 97%. Thus, false negatives are a real clinical problem [14], [15]. Recent studies have demonstrated that HRCT can play a critical role in the early diagnosis of COVID-19. It has a sensitivity of 97% in diagnosing COVID-19 [16], [17]. Ground-glass patterns in the lung parenchyma have been found even among mildly symptomatic persons. Older age is the strongest risk factor for severe disease and death [18]-[20]. Reference [21] intended to find an objective method to identify significant radiological differences between severe and milder cases of COVID-19 where the overall CT score was the sum of the points from each lobe and ranges from 0 to 25 points. In a study by [4] shows Lung involvement are more common in the unvaccinated population, 160(88%) out of 180 members with CTSI showing 3-21, compare with vaccinated group, in which only three members have lung involvement, 3(12%) with CTSI:3-8 out of 26 members.

This study intends to find out the effectiveness of COVID-19 vaccine by evaluating HRCT scan of RT-PCR positive vaccinated COVID-19 patients.

II. Materials and Methods

A. Type of Study

This was a cross-sectional study.

B. Place of Study

This study was carried out at the Department of Radiology & Imaging, DNCC dedicated COVID-19 hospital, Mohakhali, Dhaka.

C. Duration of Study

Six month (from April 2021 to September 2021).

D. Study Population

This prospective study was conducted on fifty (50) vaccinated RT-PCR positive COVID patients irrespective of any age and sex. All the vaccinated patients received 2 doses of Covishield (Oxford AstraZeneca COVID Vaccine). All the study population were admitted into DNCC dedicated COVID-19 hospital. CT Scan was done after 7 days of progression of the disease.

E. Sampling technique

Purposive sampling.

F. Selection of Patients

1) Inclusion criteria

- RT-PCR positive vaccinated COVID patients having symptoms for at least 7 days.

2) Exclusion criteria

- Patients having symptoms less than 7 days
- Pregnant patients.
- Patients not interested to do CT scan.

G. Research Instruments

A pre-tested questionnaire, and CT machine.

H. Data Collection Technique & Study Procedure

This cross-sectional study was conducted on 50 vaccinated RT-PCR positive COVID patients who were admitted into DNCC dedicated COVID-19 hospital. Informed written consent of the study subjects was taken before undergoing CT scan. Data capturing master sheet was maintained throughout. At enrollment patient's demographic and baseline characteristics was recorded. Computed Tomographic findings were evaluated. Data was collected by a pre-designed proforma. Patient's information was obtained using information sheet which includes questionnaire, clinical and radiological findings.

I. CT Scanning Technique

CT was performed for all patients 7 days after onset of symptoms. Scan was done with Philips, Ingenuity ,128-slice CT detector without contrast agent. The scanning parameters were as follows: tube voltage, 120 kVp; tube current, 150 mA; rotation time, 0.8 s; slice thickness, 5 mm; slice interval, 5 mm; pitch, 1.2; matrix, 512×512; and breath-holding when fully aspirated.

J. Image Interpretation

Images were interpreted by two certified radiologists. Severity score was done according to [21]. The abnormalities that were considered significant for the disease included the following: ground glass opacity, consolidation, nodule, reticulation, interlobular septal thickening, crazy-paving pattern, bronchial wall thickening, lymph node enlargement, pleural effusion, and pericardial effusion.

Each lobe was awarded a CT score from 0 to 5, depending on the percentage of the involved lobe: score 0- 0% involvement; score 1- less than 5% involvement; score 2- 5% to 25% involvement; score 3- 26% to 49% involvement; score 4- 50% to 75% involvement; score 5- greater than 75% involvement. The overall CT score was the sum of the points from each lobe and ranges from 0 to 25 points.

Up to score 8 was considered as mild disease, score 9-14 was considered as moderate disease and score more than 14 was considered as severe disease.

K. Statistical Analysis

Statistical analyses were carried out by using the for Social Sciences version 23.0 for (SPSS Inc., USA). A descriptive analysis was performed for all data. The mean values were for calculated for continuous variables. The quantitative observations were indicated by frequencies. A "p" value <0.05 was considered as significant.

L. Ethical Consideration

The aims and objectives of the study along with its procedure, risks and benefits were explained in easily understandable local language and then verbal consent was taken from each. It was assured that all information and

records would be kept confidential. By following under mentioned steps confidentiality was maintained:

Research data was coded. Data was stored in a locked cabinet. Only research personnel were allowed to access data. There was no physical, psychological, social, and legal risk during physical examination. Proper consent was taken. For safeguarding confidentiality and protecting anonymity each of the patients was given a special ID number. A signed informed consent was taken from the patient convincing that privacy of the patient will be maintained and they will be compensated for loss of work time if they want.

III. Results

Table I shows that majority of the patients belonged to age group >50 years. The mean age was found 49.48±15.66 years. 32 (64.0%) patients were male out of 50 patients. Regarding co-morbidities, history of smoking, DM, HTN, CKD and obesity were not statistically significant (p>0.05). Table III shows that 41 (82.0%) patients had bilateral lung involvement. Table IV shows that ground glass was the predominant density pattern involving 36 (72%) patients. 14 (28%) patients had crazy paving appearance and 10 (20%) patients had consolidation in HRCT images. Table V shows that 23 (46%) patients had mild (≤8) disease while 11 (22%) patients had moderate and 9 (18) patients had severe disease. 7 (14%) patients had no lung involvement. Table VI shows that 19 (38%) patients had 5-25% of lung involvement, 11 (22%) patients had 26-49 % of lung involvement ,10 (20%) patients had 50-75 % of lung involvement and 3 (6%) patients had more than 75% of lung involvement. 7 (14%) patients had 0-4% of lung involvement. Table VII shows that patients had had to stay 6.2 days in the hospital. Table VIII shows that 1 (2%) vaccinated patients died during the hospital stay. Table IX shows that percentage of lung involvement is higher in older group of patients. Table X shows that patients more than 50 years of old had to stay much longer than the younger patients.

Table I: Distribution of the Study Patients by Age And Gender (N=50)

Parameters	Vaccinated Patients (n=50)		P Value
Age years (group)	N	%	
<30	5	10.0	
30-50	21	42.0	
>50	24	48.0	
Mean ± SD	49.48 ± 15.66		0.556^{ns}
Gender			
Male	32	64.0	0.157^{ns}
Female	18	36.0	

ns=not significant, P value reached from unpaired and Chi square test

Table II: Distribution of the Study Patients by Co-Morbidities (N=50)

Co Morbidities	Vaccinated Patients (n=50)		P Value
	N	%	
H/O Smoking	13	26.0	0.334^{ns}
DM	15	30.0	0.096^{ns}
HTN	21	42.0	0.893^{ns}
CKD	1	2.0	0.753^{ns}
Obesity	7	14.0	0.298^{ns}

ns=not significant, P value reached from Chi square test

Table III: Distribution of the Study Patients by Side of Involvement (N=50)

Site of Involvement	Vaccinated Patients (n=50)		P Value
	N	%	
Unilateral	2	4.0	0.382^{ns}
Bilateral	41	82.0	0.065^{ns}

s= significant, ns=not significant, P value reached from Chi square test

Table IV: Distribution of the Study Patients by Pattern of Density (N=50)

Pattern of Density	Vaccinated Patients (n=50)		P Value
	N	%	
Ground glass	36	72.0	0.003^{ns}
Nodular	4	8.0	0.181^{ns}
Cray paving	14	28.0	0.391^{ns}
Consolidation	10	20.0	0.001^{ns}
Mixed	6	12.0	0.001^{ns}

s= significant, ns=not significant, P value reached from Chi square test

Table V: Distribution of the Study Patients by CT Severity Scoring on 25 (N=50)

CT Severity Scoring on 25	Vaccinated Patients (n=50)		P Value
	N	%	
Mild (≤8)	23	46.0	0.001^{ns}
Moderate (9-14)	11	22.0	0.045^{ns}
Severe (≥15)	9	18.0	0.001^{ns}
Normal	7	14.0	0.029^{ns}

s= significant, ns=not significant, P value reached from Chi square test

Table VI: Distribution of the Study Patients by Percentage of Lung Involvement (N=50)

Percentage of Lung Involvement	Vaccinated Patients (n=50)		P Value
	N	%	
0-4	7	14.0	0.029^{ns}
5-25	19	38.0	0.001^{ns}
26-49	11	22.0	0.156^{ns}
50-75	10	20.0	0.001^{ns}
>75	3	6.0	0.037^{ns}

s= significant, ns=not significant, P value reached from Chi square test

Table VII: Distribution of the Study Patients by Hospital Stay (N=50)

	Vaccinated Patients (n=50)	P Value
	Mean ± SD	
Hospital stays (day)	6.20 ± 4.51	0.001^{s}

s= significant, P value reached from Chi square test

Table VIII: Distribution of the Study Patients by Outcome between Two Groups (N=100)

Outcome	Vaccinated Patients (n=50)		P Value
	N	%	
Death	1	2.0	0.001^{ns}
Alive	49	98.0	

s= significant, P value reached from Chi square test

Table IX: Distribution of Percentage of Lung Involvement according to Age (N=50)

Age Group (years)	Percentage of Lung Involvement					
	0-4	5-25	26-49	50-75	>75	Total
<30	2	2	0	1	0	5
30-50	4	10	3	2	2	21
>50	1	7	8	7	1	24

Table X: Distribution of Hospital Stay according to Age (N=50)

Age Group (years)	Hospital Stay (day)			P Value
	≤7	8-14	≥15	
<30	4	1	0	
30-50	19	2	0	0.025^{ns}
>50	11	10	3	

s= significant, P value reached from Chi square test

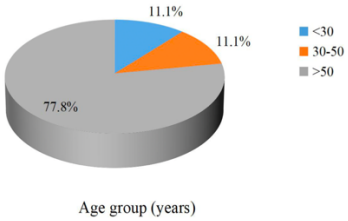

Fig. 1. Distribution of severe cases according to age group (n=9).

IV. Discussion

This cross-sectional study was carried out with an aim to evaluate the effectiveness of COVID-19 vaccine by studying the post CT scan findings of vaccinated RT-PCR positive COVID-19 patients. A total of 50 vaccinated RT-PCR positive COVID-19 patients were studied by CT scan to evaluate the severity of the disease. All the vaccinated patients received 2 doses of Covishield (Oxford AstraZeneca Covid Vaccine). CT Scan was done after 7 days of progression of the disease. In our study it was observed that incidence (48.0%) of COVID-19 was higher in older (more than 50 years) patients. Mean age of non-vaccinated group was 49.48±15.66. Slightly male predominance was seen. 64% patients were male.

26% patients were smoker. Hypertension was the most frequent risk factor followed by DM (30%) & obesity (14%). Regarding lung involvement in CT scan 82% of the patients had bilateral lung involvement. It was observed that ground glass was the predominant CT pattern (72%). 28% patients had crazy paving pattern in CT scan. Only 20% patients developed consolidation. P value was less than 0.05.

CT severity Score is a very important prognostic factor for COVID-19 patients. In this study it was observed that most of the patients (46%) had mild disease. Only 18% patients had severe disease. Severe cases were more common (77.8%) in older (>50years) patients. While 22% patients had moderate disease. P value was <0.05.

Percentage of lung involvement in a strong predictor of prognosis and progression of the disease. It was observed that 20 % of the patients had 50-75 % and only 6 % patients had more than 75% of total lung involvement. 52% patients had less than 25% lung involvement. Lung involvement was significantly higher in older patients.

Regarding hospital stay it was noted that patients had to stay an average of 6.2 days in hospital. Older patients had to stay more days in the hospital than younger patients. P value was less than .05. 2% (1) of COVID-19 patients died after admitting into our hospital.

V. Conclusion

Vaccination can become one of the most important factors for eradicating ongoing COVID-19 pandemic. It not only minimizes the health hazards but also reduces the total length of hospital stay, hence helps the patients to lower the financial burden. It is very satisfying that Bangladesh has already taken the initiatives for mass vaccination. In our study we found that vaccination can effectively reduce mortality and morbidity of COVID-19 patients. In a developing country like Bangladesh it is very important to eradicate COVID-19 as early as possible to ensure social and financial stability. Effective mass vaccination can play a pivotal role in this situation by reducing the active number of cases as well as severity of the disease.

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