The Comparison Study of Lung Computerized Tomography Severity Score and Vaccination Status in Covid-19 Patient's

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Abstract

In the COVID-19 pandemic, HRCT chest is often used by clinician to determine extent of their lung involvement. The aim of this study is to assess the severity of lung involvement in confirmed/suspected COVID-19 patients and its correlation to vaccination status, with either COVISHIELD or COVAXIN, in a tertiary care center. This is a retrospective study, in which our data is analyzed from 1st April 2021 to 30th April 2021, to identify patients (>16 years) who had confirmed (positive RT-PCR or antigen test) and received a HRCT Chest within 1st week (Avg <3.5 days) of RT-PCR Positive test, to determine the extent of their lung involvement using the CT severity score (CT-SS). Patients were classified in 3 groups based on their vaccination status to determine its correlation with the CT-SS score: fully vaccinated (received 2 doses of vaccine), partially vaccinated (one dose of vaccine), and unvaccinated. Basic descriptive statistics, Student t test and ANOVA test were done using Epi-info 7.1 software M.S.Windows.

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1 Introduction

oronaviruses are a family of viruses that usually causes illness such as the common cold, severe acute respiratory syndrome (SARS).In March of 2019, a new coronavirus was identified as the cause of a pneumonia outbreak that originated in China. This Causative virus was initially termed as "Novel corona virus 2019" ,by WHO, later a coronavirus study group (CSG) Renamed the virus as "Severe acute respiratory syndrome corona virus 2" aka "SARS-CoV-2" and the it causes is called as "Corona virus disease 2019" aka "COVID-19". In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic. The virus spreads by direct means such as droplet spread or by indirect means such as airborne spread. Due to longer incubation periods and contagiousness of the disease, the disease spreads rapidly in population cluster. Some patients can also be asymptomatic accelerating the spread of disease.

Elder population are usually at high risk of serious illness from COVID-19.The risk increases with age. There are certain medical conditions that increase risk of serious illness from Covid19, such as Heart disease, Cancer, Chronic obstructive pulmonary disease, Diabetes, Obesity, Hypertension, smoking, chronic kidney disease,

weakened immune system, asthma, liver disease. On HRCT, Ground glass opacities are the areas of the increased lung opacity where underlying broncho vascular markings are not obscured. Ground glass opacity is usually the most common manifestation of Covid-19 pneumonia on HRCT chest imaging. Both lower lobes are the usually the most commonly involved. Often the common finding is multiple focal ground glass opacities in both lung fields. Reversed halo sign is also a typical finding visualized on HRCT. However there a few indeterminate findings noted are Diffuse ground glass opacities without any clear distribution, Nodular opacities with ground glass halo, focal consolidations and centrilobular nodules.

However, COVID-19 pneumonia sometimes, may manifest as unilateral Ground glass opacity, before the onset of symptoms with rapid progression into diffuse disease involving both lung fields. On 1 January 2021, the Drug Controller general of India (DCGI) approved emergency use of the Oxford-AstraZeneca vaccine (local trade name "Covishield"). On 2 January, the DCGI also granted an interim emergency use authorization BBV152 (trade name "Covaxin"), a domestic vaccine developed by Bharat Biotech in association with the Indian Council of Medical research and National Institute of Virology. Both of them require 2 doses for complete vaccination with a interval 30 days in between both the doses.

The main objective of the study is to assess the severity of lung involvement in RT-PCR confirmed COVID-19 patients. And also to assess the severity of lung involvement to vaccination status, with either COVISHIELD or COVAXIN, and also with co-morbidities.

2   II.

3   Materials and Methods

This is a retrospective study done in the Department of Radiology and Imageology in a tertiary care center. The data is analyzed from 1st April 2021 to 30th April 2021, to identify patients (>16 years) who had confirmed (positive RT-PCR + SYMPTOMS) and underwent a HRCT Chest within 1st week (Avg <3.5 days) of RT-PCR Positive test (False positive rate 0.8-1.3%), to determine the extent of their lung involvement using the CT severity score (CT-SS).

All the patients (n=175) have undergone a standardized HRCT chest imaging protocol with single inspiratory breath hold. CT Images of the chest were obtained on a 16slice multidetector CT Unit (Philips Brilliance MRC 600) with 8-120 kVp, 20-40 mAs tube current, slice section of 1.5 mm, rotation 0.5, Matrix 512 x 512. Patients were classified in 3 groups based on their vaccination status to determine its correlation with the CT-SS score: fully vaccinated (received 2 doses of vaccine), partially vaccinated (one dose of vaccine), and unvaccinated.

All the cases were reviewed by two independent radiologist with 15 years and 2 years of experience and were blinded to the history. In all cases, semiquantitative CT severity scoring was calculated per each of the 5 lobes considering the extent of anatomic involvement, as follows: 0-No involvement; 1-< 5% involvement; 2-5-25% involvement; 3-26-50% involvement; 4-51-75% involvement; and 5-> 75% involvement. The resulting CTSI score was the sum of each individual lobar score and (0 to 25). The CTSI scoring was classified into 3 groups (1)mild involvement with CTSI score 1-9 ;(2) moderate involvement with CTSI score 10-17;(3) severe involvement with CTSI score 18-25.

4   III.

5   Statistical Analysis

Basic descriptive statistics were reported as frequencies and means. Student t test and ANOVA test were done and p value <0.05 was defined as statistically significant. The analysis was performed using Epi-info 7.1 software M.S.Windows.

6   IV.

7   Results & Observations

A total of n=175 patients were included in the study who have been confirmed cases of COVID -19 pneumonia by RT-PCR test and having symptoms. Almost 116 patients i.e 66.3% of the study population was Males& n=59 patients (33.7%) were females. Majority of the study population i.e, 45.7% was observed in the age group of 45-59 years when compared to other age groups. The Mean age of the study population was 49.03 years $\pm$ 1.11.

Approximately 20% (n=34) of the study participants had taken 2 doses of COVID Vaccine (COVAXIN/COVISHIELD). Approximately 44.6% (n=78) of the study participants were not vaccinated.

The mean CTSI is higher in patients with comorbidities compared to patients with no underlying condition. The mean CTSI in patients with Comorbidities is 13.1 $\pm$ 4, whereas in patients with no comorbidities is 6 $\pm$ 3.2.

The mean CTSI value of the study participants was 7.57 $\pm$ 0.5.Majority (i.e 30 out of 35) of the study participants with no lung involvement were fully vaccinated which was statistically significant (p<0.001). Majority of the study participants (i.e 30/34) who were completely vaccinated had no involvement of lung and only few had mild involvement of the lung. This observation is statistically highly significant (p<0.001).

The CT severity score of the completely vaccinated patients was significantly lower (i.e., between 0 to 2), compared to partially vaccinated (i.e., between 2 to 18) & unvaccinated patients (i.e., between 2 to 23). The

mean CT-SS of vaccinated, partially vaccinated & unvaccinated is 0.23 ± 0.11, 6.98 ± 0.62, & 11.46 ± 0.73, respectively p <0.001.

8 V.

9 Discussion

Approximately 20% (n=34) of the study participants had taken 2 doses of Covid Vaccine, which is higher than the India National average of 9.7% according to WHO. Approximately 44.6% (n=78)of the study participants was not vaccinated, which is less than the National average of 80.3% (according to WHO).The higher average vaccination status can be attributed to the fact that this is tertiary care center in a metro city where most of the population has access to the vaccine. The mean CTSI is higher in patients with co-morbidities compared to patients with ncondition. The mean CTSI in patients with Co-morbidities is 13.1 ± 4, whereas in patients with no co-morbidities is 6 ± 3.2. This observation is statistically significant (p-value<0.05) and is consistent with previous studies.

The mean CTSI value of the study participants was 7.57 ± 0.5. Most of the study population were having mild Lung Involvement based on CTSI. According to the study conducted by Marco et al, the average CTSI in the population is 6.1 ± 1 with mild lung involvement, which is comparable to our study. Majority (i.e 30 out of 35) of the study participants with no lung involvement were fully vaccinated which was statistically significant (p<0.001) Majority of the study participants (i.e 30/34) who were completely vaccinated had no involvement of lung and only few had mild involvement of the lung. This observation is statistically highly significant (p<0.001). Among the vaccinated patients, there was no significant difference in CTSI between COVISHIELD (mean CTSI 0.22 ± 0.8) and COVAXIN (mean CTSI 0.23 ± 0.3).

The CT severity score of the completely vaccinated patients was significantly lower (i.e., between 0 to 2), compared to partially vaccinated (i.e., between 2 to 18) & unvaccinated patients (i.e., between 2 to 23). The mean CT-SS of vaccinated, partially vaccinated & unvaccinated is 0.23 ± 0.11, 6.98 ± 0.62, & 11.46 ± 0.73, respectively p <0.001. This is comparable to the other similar studies done by Jaimin et al., University of Louisville School of Medicine. A multivariate linear regression model showed that partial or fully vaccinated patient's had lower CT severity score compared to vaccinated patients (adjusted R squared = 0.41).

Our study has few limitations. The study is done in a single tertiary care center, thus could have a selection bias affecting the generalizability of the study. Only 20% (40/175) of our study population is completely vaccinated. A study population with higher vaccination status compared to unvaccinated could give a better comparison and analysis VI.

10 Conclusion

CT severity score is higher in patients with Comorbidities compared to patients with no underlying medical condition. CT severity score in fully vaccinated patients is significantly lower compared to partially vaccinated or unvaccinated patients. Complete vaccination could be critical in preventing severe lung disease. However, we found no significant difference in CT-SS of vaccinated patients who had taken either COVISHIELD or COVAXIN.

Figure 1:

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10 CONCLUSION

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