Innovative Journal of Medical and Health Science
Received 20 Oct 2021 | Accepted 10 Nov 2021| Published Online 25 Dec 2021

DOI: https://doi.org/10.15520/ijmhs.v11i6.3423
I Jour Med Health Science 11 (06), 4002–4007 (2021)

ISSN (O) 2589-9341 | (P) 2589-9341 IF:1.6

ORIGINAL ARTICLE

An Analytical retrospective study of CT Severity scores among COVID Vaccinated subjects

Dr. Rajendra Bhojwani[1] | Dr Ramesh Jain[2*]

[1]Associate Professor , Department of Radio diagnosis , Raipur Institute of Medical Sciences, Raipur , CG , India

[2]Associate Professor, Department of Radiodiagnosis , Raipur Institute of Medical Sciences, Raipur , CG , India

Abstract

Introduction: The role of HRCT scan in making a diagnosis of COVID-19 has been emphasized as being a problem-solving modality in patients with complications, diagnostic dilemmas, and poor response to therapy. This study aims to observe for any difference in CT severity scores in COVID-19 patients or suspects amongst vaccinated and non-vaccinated cases.

Methods: This was a Retrospective Analytical study of 400 subjects . The vaccine status was noted for each case. The HRCT study was reported, and CT severity score allotted by experienced radiologists. These subjects were divided into three age categories, 18–44, 45–59 and ≥60 years. The data for each case was then tabulated in an Excel spreadsheet. Medians of the scores in different age groups were compared amongst vaccinated and non-vaccinated individuals The results were finally evaluated with help of various statistical tests.

Results: The mean age was 45.72 ±13.38 years The mean CT severity score was 7.64 ± 4.81. 53% were in the age group of 18–44 years, (26%) were in the age group of 45– 59 years, & 21% were in the age group ≥60 years. The difference in the medians amongst the vaccinated and non-vaccinated groups was significant, p-values being < 0.001 in all age categories.

Conclusion: The difference in median CT-SS amongst vaccinated and non-vaccinated individuals was significant. Pair-wise comparison of median CT-SS revealed significant difference between vaccinated (1 and 2 doses) and non-vaccinated subjects.

Key Word : CT Severity score , HRCT , COVID -19 , Vaccine .

1 | INTRODUCTION

The role of HRCT scan in making a diagnosis of COVID-19 has been emphasized as being a problem-solving modality in patients with complications, diagnostic dilemmas and poor response to therapy.

Vaccination is believed to decrease the severity of the disease, even when it cannot prevent infection. Since the first outbreak, different strains of the SARS-CoV-2 virus are now being identified and the concern remains as to whether these vaccines can provide protection from the new strains.[1-5]

The nasopharyngeal swab RT-PCR (reverse transcriptase- polymerase chain reaction) test is the preferred diagnostic test for confirmation of the COVID-19 disease.4 In developing countries such as India, where the healthcare system has been stretched thin, particularly during the second wave of the disease; it is at times difficult to get a RT- PCR test report in time. In such a setting, a non-contrast high-resolution CT (HRCT) scan of the thorax has become an essential investi- gation in diagnosing the disease, particularly when RT-PCR1-5 test is false-negative. HRCT, additionally helps in aiding the management and predicting the severity of the disease.[5,6]

Typical imaging findings in COVID-19 pneumonia patients include (1) bilateral, peripheral ground glass opacities with or without consolidation or septal thickening, (2) multi-centric ground glass opacities of rounded morphology with or without consolidation or visible septal lines and (3) reverse halo opacities.[7]

A semiquantitative assessment of CT involvement in COVID-19 disease has been described with a 25-point scoring system.8 This scoring system assesses the severity score/involvement score and can anticipate the disease prognosis. It is therefore invaluable in aiding patient management, especially when healthcare resources are limited.8 This study aims to observe for any difference in CT severity scores in COVID-19 patients or suspects amongst vaccinated and non-vaccinated cases.

2 | METHEDOLOGY

This Retrospective Analytical study involved Prior Consent from Hospital Authorities / Medical Superintendents of the Local Randomly selected Secondary & Tertiary care Radio-diagnostic Centres / hospitals to see the records of the patients from their Medical Records Departments (MRD). The study was conducted within ethical standards. The Patients who were attending or admitted in randomly selected Diagnostic centres / hospitals in past 1 years were chosen for study . Randomization was done using computer tables in selecting data. All Patients underwent standard clinical examinations, routine biochemical and haematological investigations with HRCT. Medical record numbers were used to generate the data for analysis.

For the purpose of the present study, data of 400 of the randomly selected patients (candidates / study subjects) who seek care were retrospectively identified with age ranging from 18 to 82 years. Using imaging data generated during routine clinical management with the informed consent from the patients has been taken. Non-disclosure of patients' privacy has been ensured during the scripting. Patients with the diagnosis of COVID-19 based on clinical suspicion and a positive reverse transcriptase-polymerase chain reaction (RT-PCR) who underwent an HRCT scan of the chest in our hospital were included in the study. A single-point evaluation of the scan performed between the fifth and eighth day from the onset of clinical symptoms was done, while all preceding or follow-up scans were excluded from the study. HRCT was done for diagnostic workup where RT-PCR results were delayed or initial RT-PCR was negative but there was high suspicion of COVID 19 infection.

Supplementary information The online version of this article (https://doi.org/10.15520/ijmhs.v11i6.3423) contains supplementary material, which is available to authorized users.

Corresponding Author: Dr. Ramesh Jain
Associate Professor Department of Radiodiagnosis Raipur Institute of Medical Sciences Bhansoj Road , Off NH-6 , Near M & M Fun City Godhi, Raipur , CG ,INDIA – 492006

In RT-PCR-positive patients, CT was performed to assess CT severity and guide therapeutic management. Scans showing significant background pre-existing/chronic pulmonary parenchymal diseases were excluded. The vaccinated patients had received either the inactivated virus vaccine BBV152 viz. Covaxin® (Bharat Biotech) or the non-replicating viral vector vaccine AZD1222 (ChAdOx1) viz. Covishield® (AstraZeneca, University of Oxford). The clinical severity of the disease was assigned at the time of CT scan and patients with SpO2 < 94% on room air, respiratory rate > 30 breaths/min, patients who were referred from ICU, and patients referred from ward who were on oxygen support were assigned as severe disease.

The vaccine status was noted for each case. The HRCT study was reported, and CT severity score allotted by experienced radiologists. The data for each case was then tabulated in an Excel spreadsheet. The results were finally evaluated with help of various statistical tests.

CT Protocol

All CT examinations were acquired with a 16-slice helical mode CT scanner (Phillips Brilliance ICT-16). The scan parameters used were a tube voltage of 120 kV and tube current of 235 mAs/slice. The slice thickness was 2.0 mm and interslice gap was 10.0 mm. The images were obtained from the level of thyroid gland to the upper pole of the kidneys. The scans were acquired in end-inspiratory phase. Non- contrast scans were obtained. Images were evaluated by experienced radiologists in both lungs (WL 600, WW 1600) and soft tissue (WL 40, WW 400) windows. The CT dosimetry index (CTDI) was 18.2 mGy.

Typical imaging findings in COVID-19 pneumonia patients include (1) bilateral, peripheral ground glass opacities with or without consolidation or septal thickening, (2) multi- centric ground glass opacities of rounded morphology with or without consolidation or visible septal lines , and (3) reverse halo opacities.[7]

A semiquantitative assessment of CT involvement in COVID-19 disease has been described with a 25-point scoring system.[8] This scoring system assesses the severity score/involvement score and can anticipate the disease prognosis. It is therefore invaluable in aiding patient management, especially when healthcare resources are limited.8 This study aims to observe for any difference in CT severity scores in COVID-19 patients or suspects amongst vaccinated and non-vaccinated cases.

Statistical Analysis

The statistical analysis was done using the SPSS software, version 22.0. Quantitative variable results were illustrated using descriptive statistics. Qualitative variable results were described using frequency and percentage. Kruskal–Wallis H test was used to test the medians of the CT severity scores amongst vaccinated and unvaccinated individuals. Mann–Whitney U test was used to assess pair-wise comparison. A p- value < 0.05 was considered significant. All results were shown with 95% confidence interval.

3 | RESULTS

Out of 400 cases included in the study, 86% patients were laboratory confirmed cases of COVID-19 pneumonia, and 14% patients were COVID-19 suspects with typical findings suggestive of COVID-19 on HRCT study. 59% were male, and patients (41%) were female.

The mean age was 45.72 ±13.38 years The mean CT severity score was 7.64 ± 4.81. 53% were in the age group of 18–44 years, (26%) were in the age group of 45– 59 years, & 21% were in the age group ≥60 years.

The mean severity scores in different age groups amongst vaccinated and unvaccinated individuals is described in Table 1. The percentage of mild cases was more in the vaccinated group as compared with the unvaccinated group (1 and 2 doses) in all age categories (Fig. 1).

Table 1 - Mean CT severity scores in vaccinated and unvaccinated groups in different age categories

	a. Age category - 18-44			b. Age category - 45-59			c. Age category ≥ 60		
	N=206	Mean	SD	N=104	Mean	SD	N=84	Mean	SD
0 dose	142	7.05	4.41	45	9.36	4.88	14	9.54	4.84
1 dose	47	5.69	4.42	37	7.04	4.24	51	8.58	4.93
2 doses	17	3.68	2.79	22	7.02	4.52	19	6.74	4.74

In the age group 18–44 years: Medians of the CT severity scores amongst non-vaccinated cases, cases with history of 1 dose and fully vaccinated cases were 7.0, 5.0, and 3.0, respectively. The difference in the medians amongst the 3 groups was highly significant. (p-value <0.001).
In the age group 45–59 years: Medians of the CT severity scores amongst non-vaccinated cases, cases with history of 1 dose and fully vaccinated cases were 9.0, 7.0, and 7.0 respectively. The difference in the medians amongst the 3 groups was highly significant. (p-value <0.001). In the age group ≥ 60 years: Medians of the CT severity scores amongst non- vaccinated cases, cases with history of 1 dose and fully vaccinated cases were 9.0, 8.0 and 6.0 respec- tively. The difference in the medians amongst the 3 groups was highly significant. (p-<0.001).
Pair-wise comparison between the median CT severity scores amongst vaccinated and non-vaccinated individuals (0 dose-1 dose and 0 dose-2 doses comparison) in all the three age groups was significant .
The p- values for pair-wise comparison between subjects who received 1 dose and those who received 2 doses were 0.07 and 0.88 in age categories 18–44 years and 45–59 years, respectively.

Table 2: CT Involvement/severity score[8]

Percentage involvement	Score
< 5	1
5–25	2
25–50	3
50–75	4
75–100	5

4 | DISCUSSION

25-point CT severity score (CT-SS): According to studies by Malpani et al, the involvement in each of the five lobes of lung can be scored from 1 to 5 as described in ►Table 2. 8 The total CT severity score was calculated as a sum of individual lobar scores. The cases were further categorized as mild, moderate, and severe if their scores were ≤9, 10–17. and ≥18 respectively (►Figs. 1–3). According to the study by Malpani et al, the patients who fell into the severe category of CT-SS had higher mortality as compared with mild and moderate groups.8 Thus, this semiquantitative CT-based assessment method helps in the prognosis of patients with COVID-19 and is a useful imaging tool assisting clinicians in patient management in the appropriate setting.

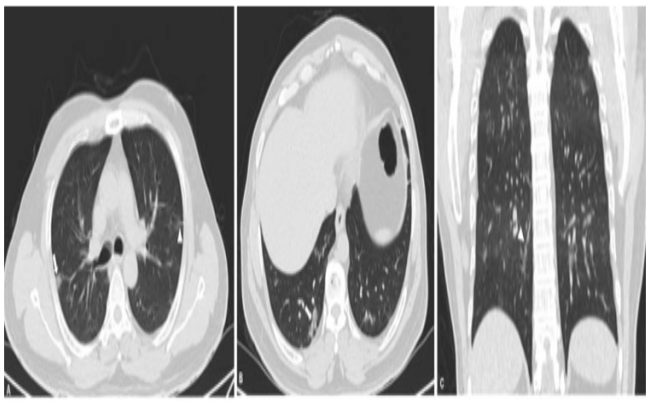

Fig. 1 Axial (A and B) and coronal (C) HRCT thorax images of a COVID-19 RT-PCR-positive, a patient with cough for 5 days. Small peripheral consolidatory changes (white arrows in A and B) and few areas of peripheral septal thickening (white arrowheads in A and C) were typical of COVID-19 pneumonia. CT-SS allotted was 6/25.

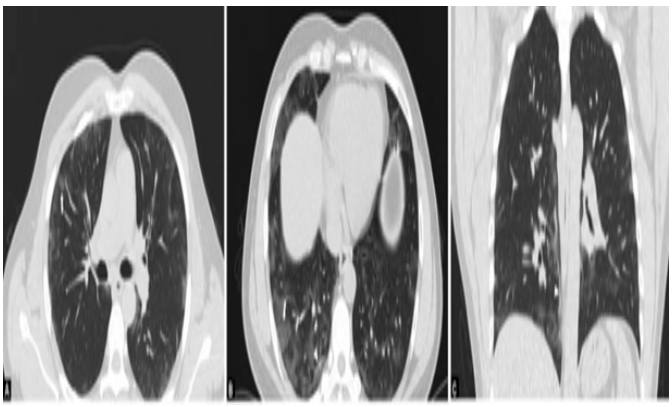

Fig. 2 Axial (A and B) and coronal (C) HRCT thorax images of a COVID-19 RT-PCR-positive, a patient with fever for 8 days. Peripheral ground glass opacities (white arrows in A and B) and subpleural bands (white arrowheads in B and C) were identified, consistent with COVID-19 pneumonia. Pulmonary changes were more marked in lower lobes. CT-SS allotted was 11/25.

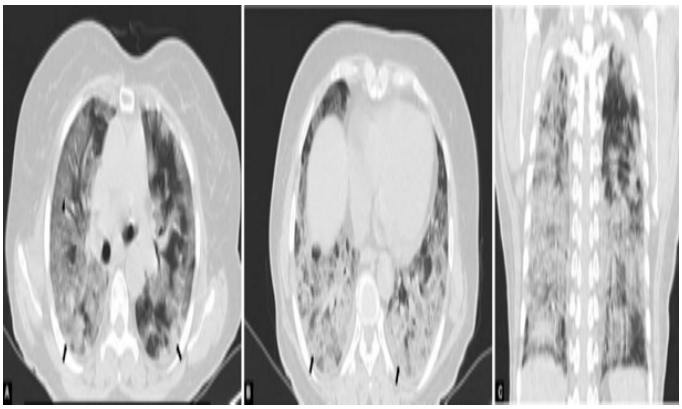

Fig. 4 Axial (A and B) and coronal (C) HRCT thorax images of a COVID-19 RT-PCR-positive, a hospitalized patient breathlessness for 9 days and inability to maintain oxygen saturation on room air. Widespread consolidatory changes (black arrows in A and B) were present in both the lungs with pulmonary opacities being more marked in peripheral areas and in lower lobes. Few ground glass opacities with intervening septal thickening (black arrowhead in A) were also seen. CT-SS allotted was 23/25.

COVID vaccines: Throughout the world, several different vaccines against COVID-19 disease have been introduced with the Pfizer/BioNtech Comirnaty vaccine being the first vaccine to be approved for the WHO emergency use on December 31, 2020. The different available vaccines can be classified into four types9:

1. Inactivated or weakened virus with an inactivated/weak- ened form of the virus that can induce immune response without causing disease.
2. Protein-based vaccines which use harmless protein frag- ments that mimic COVID-19 virus.
3. Viral vector vaccine which uses a safe virus as a vector to deliver coronavirus proteins.
4. RNA and DNA vaccines that use genetically engineered RNA/DNA to produce a protein that can safely incite immune response.

India launched a mass vaccination drive in January 2021 with two vaccines being approved for emergency use. The COVISHIED vaccine which is a viral vector vaccine and the COVAXIN which is an attenuated virus vaccine. These vaccines protect against COVID-19 disease by gen- erating an immune response against the virus. This reduces the risk of developing COVID-19 disease and its complica- tions. The vaccines also aid the human body to fight the virus once infected and are thus believed to reduce the disease severity as well in case the patient gets infected.

CT Severity Score and the vaccines: In patients who were infected despite taking the vaccine, results from our study revealed that the administered vaccine was able to decrease the CT severity score in all the three age groups. Also, the percentage of mild cases as compared with the moderate and severe cases was more in the vaccinated group (1 and 2 doses) than in the non-vaccinated group. As CT severity score reflects clinical prognosis, it can thus be concluded that in those patients that contracted the infection, the vaccine ensured reduced severity of the COVID-19 disease.

Our study had a few limitations. The first scan of the patient was used for CT-SS evaluation and any subsequent scans were not considered. The CT-SS might have changed over a period of time. Also, because it was a hospital-based study and not a population-based study, comorbidities in our subjects may have been more than in the general population affecting the CT-SS.

Because the vaccination for the age categories 45–59 and ≥60 years was started earlier, the sample size was larger in this category as compared with the 18–45 years age category. This study was done on the Western–Indian population and hence results obtained cannot be used to reflect the global scenario. Also, we were unable to consider the number of days since vaccination, as we could not get a dependable history of the same. This could have affected the immune-status of the patients and hence the CT-SS.

5 | Conclusion

In the present study, we were able to deduce that the mean CT-SS was less in vaccinated subjects. The difference in median CT-SS amongst vaccinated and non-vaccinated individuals was significant. Pair-wise comparison of median CT-SS revealed significant difference between vaccinated (1 and 2 doses) and non-vaccinated subjects. However, the difference in median CT-SS amongst subjects who received 1 dose and those who received 2 doses was significant only in the ≥ 60 years age group.

We could not find any similar published article, but it is recommended that similar studies are undertaken with larger cohort and at multiple centers. Through this study we assert that the population at large should get vaccinated mandatorily to reduce infection rate/disease severity.

ACKNOWLEDGEMENTS

We would like to thank all the participants, Hospital Authorities & Dean sir for their always available guidance and support.

Funding: No funding sources

Conflict of interest: None declared

Ethical standards: Yes

REFERENCES

1. CoWIN Dashboard [Internet]. [cited 2021 Jun 6]. Accessed September 19, 2021 from: https:// dashboard.cowin.gov.in/

2 Administration of AstraZeneca COVID-19 Vaccine/COVISHIELD Vaccine. Accessed September 19, 2021 from:https://www.health.gov.on.ca/en/pro/programs/publichealth/coronavirus/docs/vac-cine/COVID-19_AstraZeneca_Vaccine_admin.pdf

3 Thiagarajan K. What do we know about India's Covaxin vaccine? BMJ: British Medical Journal (Online) 2021;20:373

4 Corman VM, Landt O, Kaiser M, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Euro Surveill 2020; 25(032000045. Doi: 10.2807/1560-7917.ES.2020.25.3.2000045

5 Bernheim A, Mei X, Huang M, et al. Chest CT findings in coronavi- rus disease 2019 (COVID-19): Relationship to duration of infec-tion. Radiology 2020;295(03):200463

6 Liu J, Yu H, Zhang S. The indispensable role of chest CT in the detection of coronavirus disease 2019 (COVID-19). Eur J Nucl Med Mol Imaging 2020;47(07):1638–1639

7 Simpson S, Kay FU, Abbara S, et al. Radiological Society of North America Expert Consensus Document on Reporting Chest CT Findings Related to COVID-19: Endorsed by the Society of Tho- racic Radiology, the American College of Radiology, and RSNA. Radiol Cardiothorac Imaging 2020;2(02):e200152

8 Malpani Dhoot N, Goenka U, Ghosh S, et al. Assigning computed tomography involvement score in COVID-19 patients: prognosis pre-diction and impact on management. BJR Open 2020;2(01):20200024

9 Vaccines and immunization: What is vaccination? [Internet]. [cited 2021 Jun 6]. Accessed Sept 19, 2021 from: https:// www.who.int/news-room/q-a-detail/vaccines-and-immuniza-tion-what-is-vaccination

How to cite this article: Dr. R. Bhojwani , Dr R. Jain ,An Analytical retrospective study of CT Severity scores among COVID Vaccinated subjects, Innovative Journal of Medical and Health Science. 2021;4002−4007. https://doi.org/10.15520/ijmhs.v11i6.3423