

HRCT SPECTRUM IN POST VACCINATION COVID POSITIVE PATIENTS

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ABSTRACT

OBJECTIVES: To analyse the spectrum of findings as seen on HRCT in COVID positive patients who have turned positive inspite of vaccination. **MATERIALS AND METHODS:** The different patterns of findings seen on HRCT in 100 patients who had been vaccinated with recent COVID vaccines but still got infected with SARS-CoV-2 as detected by RT PCR / RAPID antigen test were analysed retrospectively. Scoring of the findings was also done. **RESULTS:** No positive findings to suggest any lung involvement were seen in 52 % of cases. Only ground-glass opacities (GGO) were seen in 18 % cases. GGO and crazy-paving patterns were seen in 11 % cases. GGO and reticulations were seen in 09 % cases. Only consolidations were seen in 05 % cases. Consolidations undergoing cavitation in 02 % cases. GGO and pneumomediastinum in 01 % cases. GGO, pneumothorax and pneumomediastinum in 01 % cases. GGO reticulations and pleural effusion were seen in 01 %. CT severity score was 00/ 25 in 52 % cases, upto 05/25 in 35 %, 04-09/ 25 in 06 % and 10-15/25 in 05 % and 20/25 in 02%. **CONCLUSION:** Post vaccination Covid positives were seen more in younger population. The elderly patients were found to be less infected in this scenario of COVID 2.0. Normal HRCT scans were more common in these cases. Amongst the positive HRCT scans of such cases, mild findings of ground glass opacifications were the most predominant.

Keywords: COVID- 19, Coronavirus Disease; Second Wave, COVID 2.0, HRCT, GGO, Pneumonia, Covid Vaccination.

Introduction

By May 28, 2021, a total of 168,599,045 confirmed COVID-19 cases, including 3,507,477 deaths have been reported worldwide to the World Health Organization (WHO) and a total of about 1,545,967,545 vaccination doses have been administered.¹ Indian contribution to this global statistics has been 27,555,457 confirmed cases and about 318,895 deaths and a total of about 20,57,20, 660 vaccination doses have been administered.²

With increasing diagnostic data being available for

COVID-19 pneumonia, globally consensus has been developing amongst professionals and various guidelines are being put forth for timely diagnosis and prompt treatment.³ Prior studies have shown higher sensitivity of CT (> 95%) than RT-PCR results (60-70%)^{4,5} to pick up the lung manifestations. Therefore, gradually CT has become vital in screening and follow up for suspected COVID-19 pneumonia. Though it has debatable chances of radiation induced oncology problems,⁶ it is usually recommended as

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the benefits outweighs the risk. This retrospective study analyzed the spectrum of HRCT findings in 100 RT-PCR confirmed COVID-19 cases which has received vaccination recently.

Material and Methods

Patients and chest CT:

This retrospective observational study was approved by the institutional ethical committee.

Symptomatic RT PCR positive COVID-19 infected patients between April to May, 2021, were included using the following criteria:

- Positive RT-PCR for SARS- CoV-2 obtained with nasopharyngeal/oropharyngeal swabs or COVID positive on RAPID antigen test
- Received two doses of vaccination for COVID.
- HRCT scan done.

A total of 100 patients were included in the study. All patients were > 45 years of age as per the vaccination rules prevalent in India at present.

All patients were imaged using a multidetector 16 slice GE CT scanner. Following were the scanning parameters: X-ray tube parameters- 140 KVp; 234 mAs; rotation time - 0.5 s; pitch - 1.0; section thickness- 1 mm; intersection space- 5 mm.

The clinical, demographic and imaging data of all the patients were recorded and various parameters were compared.

CT image analysis:

HRCT images were analysed for patterns as per the Fleischner Society Glossary,⁷ such as pure ground-glass opacity (GGO), crazy-paving pattern, consolidation, reticular pattern, GGO with consolidation, GGO plus reticulations, bronchiectasis and pleural thickening.

The number of lesions was noted as single or multiple (>1) lesions.

A semi-quantitative CT severity scoring⁹ was used for each of the five lobes, based on anatomic involvement: 0: No involvement; 1:< 5% involvement; 2: 5-25% involvement; 3: 26-50% involvement; 4: 51-75% involvement; and 5:> 75% involvement. The total CT score was the sum of each lobar score (0 to 25).

Statistical analysis:

Numerical data were expressed as a percentage (%)

of the total. Relevant data was expressed in tabular form.

Results

Demographic and clinical characteristics: These are listed in (Tab.1).

Imaging features of HRCT: These are listed in (Tab.2). CT Score and Severity Grade: These are listed in (Tab.3).

The mean interval between the onset of initial symptoms and CT was 2-4 days.

No positive findings to suggest any lung involvement were seen in 52% of cases. Only ground-glass opacities (GGO) were seen in 18% cases.

GGO and crazy-paving patterns were seen in 11% cases.

GGO and reticulations were seen 09 % cases.

Only consolidations were seen in 05 % cases.

Consolidations undergoing cavitation in 02 % cases.

GGO and pneumomediastinum in 01 % cases.

GGO pneumothorax and pneumomediastinum in 1% cases.

GGO reticulations and pleural effusion were seen in 1%.

The GGO was the most common positive HRCT finding.

CT severity score was 00/ 25 in 52 % cases, up to 05/25 in 35%, 04-08/ 25 in 06% and 09-15/25 in 05% and 20/25 in 02%. The CT severity scores of each of the lung lobes showed highest score in the lower lobe.

Criteria	Male	Female
Gender	56	44
Symptoms		
Fever	45	43
Cough	46	32
Fatigue	50	39
Diarrhoea	10	12
Co-morbidities		
Diabetes	05	07
Hypertension	06	11
Chronic Disease	00	00

Table 1: Demographic, clinical profile of the patients with COVID-19 infection.

Features on HRCT	% (n=100)
CT status	
Positive CT	48
Negative CT	52
CT characteristics Distribution	
Peripheral	32
Central + Peripheral	16
Number of lesions in each lobe	
Single	28
Multiple	20
Patterns	
Pure GGO	18
Crazy-paving	11
GGO + Reticulations	09
Only Consolidation	05
Consolidations with cavitation	02
GGO + Pneumomediastinum	01
GGO + Pneumothorax + Pneumomediastinum	01
GGO + Reticulations +Pleural Effusion	01

Table 2: Findings of HRCT

HRCT Score Maximum 25	Number of Cases Total 100	CT Severity Grade
00 / 25	52	None
<09 / 25	41	Mild
9-15 / 25	05	Moderate
16-25 / 25	02	Severe

Table 3: HRCT score and CT Severity grade

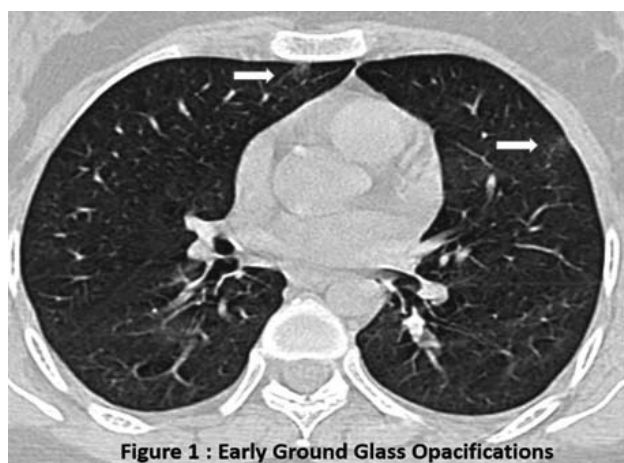


Figure 1: HRCT Axial image showing early ground glass opacifications

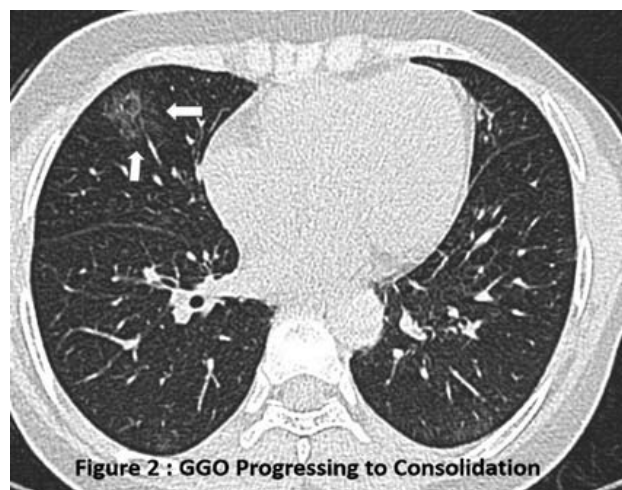


Figure 2: HRCT Axial image showing ground glass opacification progressing to consolidation

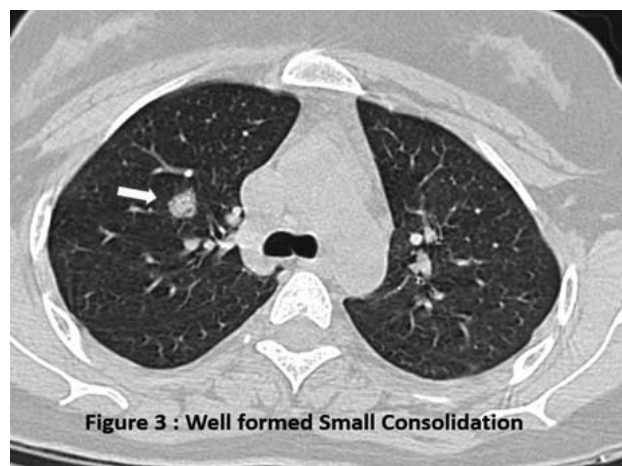


Figure 3: HRCT Axial image showing well formed consolidation

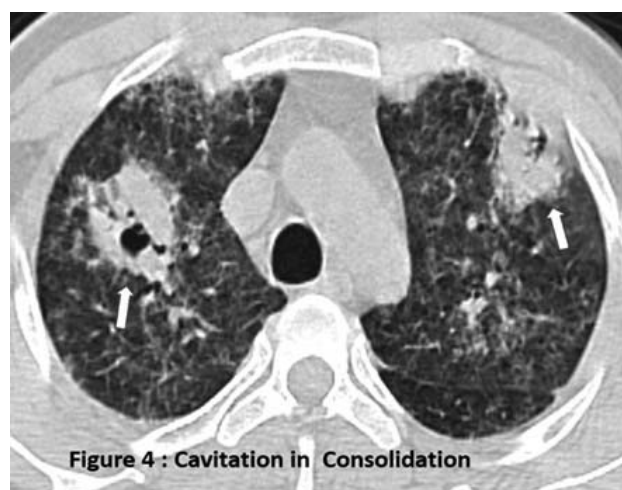


Figure 4: HRCT Axial image showing cavitation in consolidation



Figure 5: HRCT Axial image showing reticular band formation

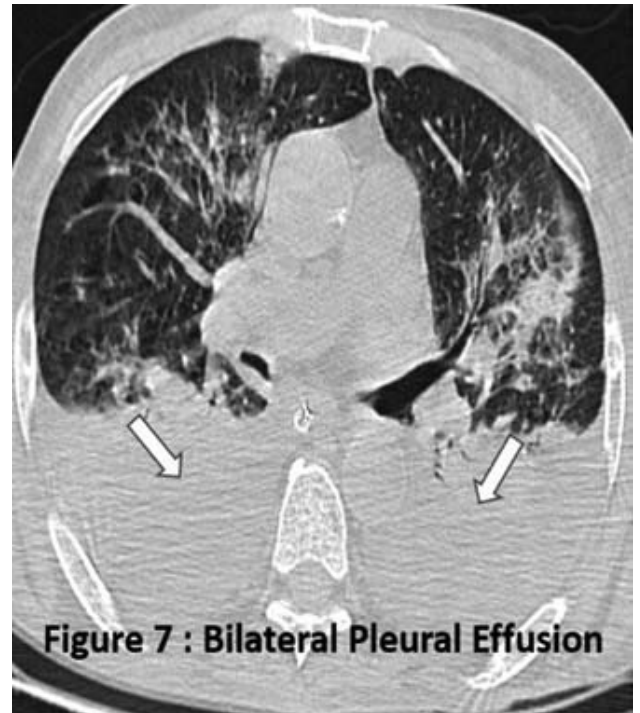


Figure 7: HRCT Axial image showing GGO and pleural effusion

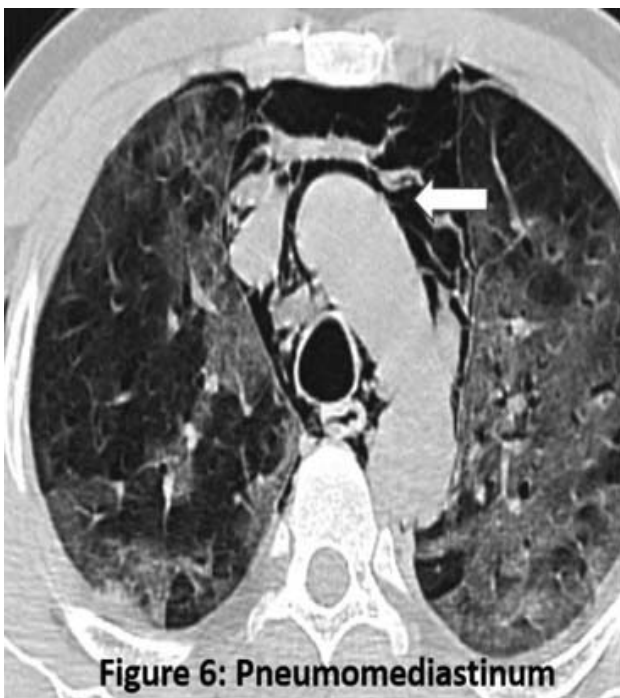


Figure 6: HRCT Axial image showing GGO and pneumomediastinum

Discussion

This study assessed CT imaging features of COVID-19 pneumonia patients who had received two doses of COVID vaccination in a sample of 100 patients. We found an abnormal (positive) CT status in 48/100 (48%) of patients. Although it has been suggested that exact time to get positive HRCT scan is 5 days after the initial symptom onset about the presence of pneumonia,⁹ in this study most of the scans were done within 2-4 days.

In this study predominant peripheral pattern of distribution (36/48; 75%) was seen while central plus peripheral involvement (12/48; 25%) was noted. Pathogenesis of the virus has demonstrated that it initially attacks the terminal and respiratory bronchioles, and hence there is predominant peripheral pattern of lung involvement. Similarly highest CT severity score noted in the right lower lobe is likely to be due to shorter right lower lobe bronchial anatomy. A scientific study by Zhou et al.⁸ found the course of COVID pneumonia disease into the early rapid progressive stage: 1 to 7 days after initial onset of symptom, advanced stage: 8-14 days after onset of

symptom and advanced stage: ≥ 14 days after onset of symptoms. Pure GGO, GGO with consolidation were more common during the early rapid stage and consolidation and GGO plus reticular pattern were more common in advanced stage. Reticular pattern and bronchiectasis indicated onset of repairing.

In current study, the spectrum of HRCT was pure GGO, crazy-paving, consolidation, GGO with consolidation, GGO plus reticulations, cavitation and effusions as has been seen in numerous other studies.¹⁰⁻¹² GGO and crazy-paving patterns were most common in current study as in other studies.⁸ Earliest attack of virus is on peripheral vessels and terminal bronchioles that raises intraductal pressure causing exudation, is seen as subpleural pure GGO. As collagen fibres are formed by the proliferating fibroblasts there is interstitial thickening that with ground glass opacities results in crazy-paving pattern. Thickening of lobular septum prevents absorption of the alveolar exudation, causing alveolar consolidation formation. In absorption phase of COVID-19 pneumonia inflammatory cells are reduced collagen fibres are increased by fibroblasts resulting in interstitial fibrosis-reticular pattern (repairing sign) which manifest approximately 14 days after symptom onset.^{8,13}

As per data available on WHO website for COVID, although many vaccines are efficient none are 100% protective. Hence it is likely that few people might not develop the expected protection post COVID-19 vaccination. Also possible is the fact that an individual's age, pre-existent health status and exposure to COVID-19 can also affect the efficiency of vaccine taken by them. As of now it is still unclear how long the immunity will last post vaccination. Hence, in spite of vaccination adherence to safety measures like masks, handwash and physical distance are necessary.¹⁴

Most commonly affected age group in current study was between 45-60 years of age, although no significant difference between the various age groups, was noted in other prior studies.¹⁵ It is likely that this particular age group after receiving vaccination for COVID returned back to their office work and daily chores not caring much for the preventive measures and hygiene. Positive on RTPCR / Rapid Antigen testing but no positive findings on HRCT scans in large number of patients indicates that the patients underwent HRCT in very early phase of infection so

that lung lesions were not developed till that time. This is due to increased public awareness of pandemic, although a small subset might be due to positivity of these tests after receiving vaccination as well.

Covid pandemic can be reduced and stalled by increasing the acquired and resistance immunity but lack of complete knowledge about the spectrum of pathology, recovery, and reinfection is still the limiting factor. Hence it is very much possible that re-infections with COVID-19 would result in worse clinical outcomes and complications. Also, post vaccination immune response might be short lived hence better vaccinations need to be developed.¹⁶ In the current study, post vaccination HRCT showed that percentage of no positive HRCT findings or mild grade findings was predominant. This also coincided with second wave of COVID in our setup.

The study highlights that although vaccinated people can still get infected by Covid. Hence universal safety precautions must be followed up by one and all even after vaccination. Hence, eternal vigilance is mandatory.

The study is limited by its small sample size and absence of follow-up scans. Anti COVID antibody titres were not evaluated. Radiological and Histopathological correlation could not be established due to want of lung biopsy permissions.

Conclusion

Post vaccination COVID positive cases are on rise. Patterns of HRCT involvement show milder distribution as compared to that mentioned in COVID in non-vaccinated cases. Thus, vaccination has a definite role in not only reducing the lung involvement when infected with COVID, but also in reducing the severity of lung findings in such cases.

Conflict of Interest: No

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