Spectrum of HRCT Chest Findings in RT-PCR Positive Asymptomatic COVID-19 Patients at a COVID Designated Hospital in Nepal

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ABSTRACT

Introduction: COVID-19 pandemic is grappling the world with the surge of infection time and again. Clinicians are trying to justify the ethics of public health care. Asymptomatic COVID-19 cases are going undocumented and most of them practice self-isolation. Studies have revealed significant radiological changes among RT-PCR positive asymptomatic COVID-19 cases. The aim of this cross-sectional study was to characterized chest CT findings of asymptomatic RT-PCR-positive patients in one of the COVID-designated hospitals in Nepal.

Methods: This was a cross-sectional observational study where RT-PCR positive COVID-19 asymptomatic-close-contacts were subjected to HRCT chest. The HRCT images were evaluated by two radiologists for (a) characterizing the parenchymal involvement and (b) distribution of the involvement. The CT severity score (0-25) was calculated following the semi- quantitative scoring system which depends on the visual assessment of five lung lobes.

Results: Out of 43, 26 (60.5%) participants had positive Chest CT scan findings consistent with COVID pneumonia. Bilateral lesions were present in 65% and 77% had multifocal lesions. The ground-glass opacities (92%), mixed (ground-glass opacities and consolidation pattern) (30.7%), and consolidation only (34.6%) were common chest CT findings. The median CT score was 3.5 (IQR; 2-6).

Conclusion: Most of the RT-PCR positive COVID-19 asymptomatic patients had CT scan changes in lungs but with lower median CT score value.

Keywords: Chest CT; COVID-19; Viral Pneumonia

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INTRODUCTION

Since the first report of the Corona Virus Disease-2019 (COVID-19) from Wuhan city in China, the cases have been reported from all the seven continents and had already caused deaths in millions. The COVID-19 disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is primarily transmitted through the respiratory droplets and infect lungs.[1] Reverse Transcriptase Polymerase reaction (RT-PCR) is the confirmatory laboratory diagnostic test for SARS-CoV2. The RT-PCR is also recommended in asymptomatic cases especially in close contacts, screening, and early identification of infection in high-risk population and locations like healthcare centers, prior to surgical procedures and prior to receiving immunosuppressive therapy.[2,3]

In a meta-analysis, the pooled percentage of the asymptomatic infection was 15.6%.[4] Asymptomatic cases are less infectious than symptomatic.[5,6] Despite low infectivity, 20 - 50% of the asymptomatic cases had specific changes in the chest computed tomography (CT). But the probability of progression of the asymptomatic cases into clinical pneumonia is very less (<1%).[7,8] CT changes of the asymptomatic patients are important not only to evaluate the chest CT as alternative diagnostic modalities for selected COVID-19 cases but also to evaluate the outcomes of COVID-19 related respiratory pathophysiology, which is mostly unknown.[9]

There has been no research as to the CT scan findings in asymptomatic patients. We conceptualized this study to characterize the chest CT scan features of the RT-PCR confirmed asymptomatic COVID-19 patients in one of the COVID-19 designated hospital in Kathmandu, Nepal.

METHODS

This is a cross sectional study where laboratory proven RT-PCR positive COVID-19 asymptomatic adult (age > 18 years) patients were included and were subjected to the HRCT scan of the chest. All the cases included in this study fulfilled the WHO criteria of the "close contacts" of the COVID-19 confirmed cases. The study was conducted between October 2020 and December 2020 in the Department of Radiodiagnosis, Shree Birendra Hospital, Chhauni, Kathmandu, Nepal. The study was initiated after taking ethical approval from institutional review board of Nepalese Army Institute of Health Sciences. Informed written consent of the patient was taken, and the HRCT scan were acquired in the Hitachi Multidetector 128 slice CT scanner. The parameters used for CT acquisition were helical mode volumetric HRCT with Tube voltage 100 kVp- 120 kVp and tube current 80-500 mA, and slice thickness of 1.0 mm with reconstruction interval, 0.6 mm using a sharp reconstruction algorithm. CT images were obtained with the patient in supine position with full inspiration. Intravenous contrast was not administered. Acquired images were transferred to a separate workstation for further processing. Image was reconstructed in axial, coronal, and sagittal planes to detect the craniocaudal and axial / peripheral distribution of the lung parenchymal involvement.

All images were viewed on both lung (width, 1500 HU; level, −700 HU) and mediastinal (width, 350 HU; level, 40 HU) settings. The study cohorts had no history of any pulmonary diseases. The chest CT scan was evaluated by two radiologists characterizing the parenchymal involvement based on (a) the characteristic findings and morphology: ground glass opacities, consolidation, linear bands, bronchial wall thickening, nodules and additional findings like pleural effusion and mediastinal lymphadenopathy. (b) the distribution of the involvement: Laterality, craniocaudally distribution, number of the lobes involved, percentage of involvement in each lobe. Then the CT severity score (0 - 25) was calculated following the semi - quantitative scoring system which depends on the visual assessment of the five lung lobes (0 - 0%; - < 5%; 2 - 5 to 25%; 3 - 26 to 50%; 4 - 51 to 75%; 5 - > 75%) that was initially proposed by Pan et al.[10]

RESULTS

In this cross-sectional study, total of 43 RT-PCR positive COVID-19 cases were included. Among the study participants, 26 (60.5%) had positive chest CT scan findings (Figure 1 - 3). The positive chest CT had mostly bilateral (65.3%) and multifocal (77%) lesions. Ground glass opacities (GGO) was present in 92% of them (Table 1). The median global CT score of the abnormal CT scan chest was 3.5 (IQR; 2-6). The mean CT score value was higher in bilateral lung disease than unilateral lung disease (5.3 ± 2.6 in bilateral vs 3.0 ± 1.0 in unilateral lung involvement). The ratio of upper to lower lobe involvement was 2:3. The patients with normal CT scan had higher mean cycle threshold (CT) value of RT-PCR test than

abnormal chest CT scan group (23.8 vs 21.7;). However, the difference was statistically not significant. One patient developed mild COVID-19 symptoms (Cough and headache) during follow up of two weeks post CT scan.

Table 1. HRCT details of the study participants

Particulars	Value
Age (Years)	41.42 ± 11.7 (23 - 66)
Male: Female	3:2
Positive CT findings	60.5% (26 / 43)
Lobar involvement	Right- 7 (27%), Left-2 (8%) and Bilateral -17 (65%)
Number of focus	Single- 23% (6 / 26); Multiple – 77% (20 / 26)
Characteristic Chest HRCT scan findings	Consolidation 34.6%; (9)
	Ground Glass opacities (GGO) 92%; (24)
	GGO and Consolidation 30.7% (8)
	Atelectatic Band 19% (5)
	Septal thickening 30.7%; (8)

Figure 1. Multifocal predominantly peripheral consolidative and ground glass opacities in bilateral lung. Interspersed areas of interlobular septal thickening seen in the inferior lingual segment of left upper lobe.

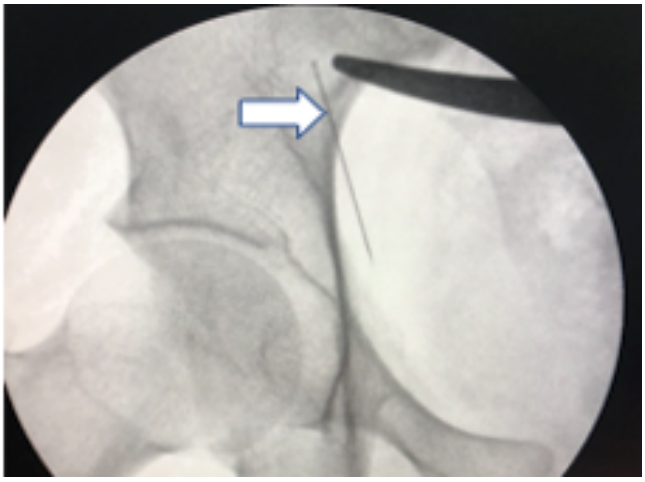

Figure 2. Patchy peripheral ground glass opacity with focal traction bronchiectasis within the affected area

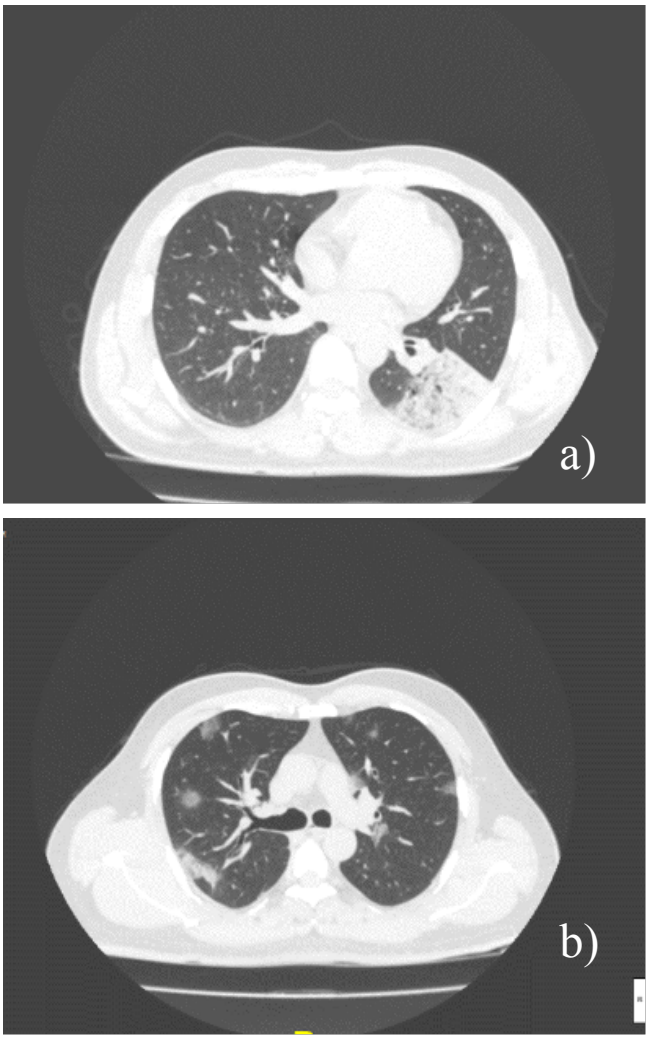

Figure 3. Consolidation (a) Subsegmental (b) Multifocal peripheral rounded morphology

DISCUSSION

Pneumonia is primary manifestation of the COVID-19 disease. WHO has classified symptomatic COVID-19 infection into mild cases, pneumonia, severe pneumonia, and critical disease (sepsis, septic shock and or ARDS).[11] In a large cohort of population-based study, 30 - 40% were asymptomatic young adults.[12] The virus can be cultured from infected individual as early as six days prior to development of the symptoms. Whereas it takes at least a week for CT scan to detect changes in lung parenchyma.[13,14] Study has shown the positivity rate of 1.6% in screening CT chest.[15] In RT-PCR confirmed COVID-19 cases, HRCT helps in prognostication, evaluating the disease progression and monitoring the response to therapy.[16]

With RT-PCR as reference, the sensitivity, specificity, accuracy of chest CT in indicating COVID-19 infection were 97%, 25% and 68% respectively, the accuracy of which is higher in age more than 60 years. Studies have shown that bilateral lung (90%) involvement with GGO (46-50%) and mixed GOO along with consolidation (44-50%), and consolidation only (25%) were the most common pattern in chest CT scan characteristics of COVID-19 patients.[12,14,16,17] Similar pattern of GGO (95%) and consolidation (5%) with predominantly bilateral, sub pleural, and multiple lesion were described among asymptomatic cases.[9,18] Lung consolidation was present in 83% among asymptomatic COVID-19 cases found in the cruise ship "Diamond Princess".[19]

Parenchymal inflammation, endothelial dysfunction, and cytokine release syndrome are responsible for COVID-lung and final radiological manifestations. The pathophysiological pathway can lead to one or more of the following: acute respiratory distress syndrome (ARDS) with diffuse alveolar damage (DAD), diffuse thrombotic alveolar microvascular occlusion and inflammatory mediator-associated airway inflammation.[17, 20, 21]

The median CT severity score in this study was 3.5 with range (range, 1 - 11). Francone et al found significant positive correlation ($p < 0.0001$) of CT score between age of patient, inflammatory biomarkers, and severity of the disease. CT score > 18 has hazard ratio of 8.33 (95% CI, 3.19 - 21.7) for COVID-19 related mortality.[22] The significance of CT score in asymptomatic patients is yet to be evaluated in short and long term follow up.

Based on SARS-COV-1 data of 2003, two third of the survivors suffered from TGF-β-mediated pulmonary fibrosis and SARS-COV-2 is expected to share similar chronic sequel.[23,24] CT chest is widely available modality to assess and follow the pulmonary changes in COVID-19 patients both symptomatic and asymptomatic. During early 2020, asymptomatic or undocumented cases were responsible for 79% of the COVID-19 incidence.[25] Probability of having incidental CT findings among asymptomatic cases is high due to ongoing progression of the pandemic. Though it is difficult to explain the temporal phase of CT changes in asymptomatic cases, screening CT is recommended for all RT-PCR positive COVID-19 patients for the purpose of characterization of the findings and its long-term sequel.[26] The study was conducted during first wave of COVID-19 pandemic in Nepal when the average nationwide case positivity rate was 15.6% and best practice in local setting was evolving. Study with large sample size and follow up scan add more to the scientific evidence on radiological features of COVID-19 asymptomatic cases. Study in a context of higher incidence rate can unfold different data and evidence.

CONCLUSIONS

This study revealed that significant number (approximately two third) of RT-PCR positive asymptomatic COVID-19 cases can have characteristic chest CT changes (ground glass opacities and or consolidation) in their lungs. The findings of this study add to the evidence for chest CT protocol regarding recommendation to regular CT chest in RT-PCR positive asymptomatic COVID-19 cases.

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