Computed tomography severity scoring of COVID 19 infected young patients: Is the second wave affecting the young lungs more than the first wave in India?

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Abstract

We evaluated the High Resolution Computed Tomography (HRCT) findings in young patients (< 40 years) infected with the COVID 19 virus and tried to find out any difference in the severity of lung involvement between the first and second wave of the pandemic and whether the notion of young population being more severely affected by the second wave holds true.Two-hundred (200) young patients (<40 years) with RT PCR documented COVID infections undergoing HRCT chest at our institute were included. Group A included young patients infected in the first wave (up to 28 February 2021) while Group B included patients beyond this date. Demographic and clinical data was obtained from the medical records department. HRCT scans were retrieved from the archive and were assessed by two radiologists or CT severity scoring. The mean severity scores were calculated and any statistical difference between Group A and B was sought. CT scans of four fully vaccinated patients were also evaluated.The age and gender distribution among the two groups was comparable. A greater number of patients in group B required hospital admission compared to group A (74% VS 53%). In group A, the mean severity score was 10.1±2.1 with 34 patients (34%) in mild category, 46 patients (46%) in moderate group and 20 patients (20%) in the severe group. In group B, the mean CT severity score was 12.6±2.3 with 20 patients (20%) in mild category, 42 patients (42%) in moderate group and 38 patients (38%) in the severe group.Lung involvement in young patients in the second wave is more severe requiring more hospital admissions. Vaccinated population may well have a milder form of the disease.

Introduction

A new virus with extra ordinary contagious nature was first detected in the Chinese city of Wuhan in December 2019.[1]This virus was found to belong to the coronavirus family which is a positive sense RNA virus and was namedsevere acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This virus is highly contagious and has spread to all parts of the world making it a pandemic.[2]The clinical picture of infected persons has been evolving since the time of its inception but predominantly involves the respiratory system. Patients usually present with fever, cough, dyspnea, myalgias, anosmia and loss of taste.[3,4] The diagnosis is usually based on RT-PCR (reverse transcription polymerase chain reaction) of the nasopharyngeal or oropharyngeal swab. This method although quite accurate can have significant false negative results.[5,6]

A High Resolution Computed Tomography (HRCT) of the chest has emerged as a reasonable diagnostic modality which can not only help identify patients infected with the virus but also give an overview of the severity of the lung involvement.[7] HRCT findings including the morphology and extent of lung involvement has been found to correlate with clinical findings and the degree of inflammatory process.[8-10] The age of the patient is an important determinant of the severity of the disease including the need for hospitalization and even ventilation. While the first wave of the COVID-19 obeyed this general rule of age, the second wave with new emerging variants seems to defy this generalization with young patients being affected more with increased mortality and morbidity. Our study aims at investigating the sudden drift in the age of involvement of COVID-19 infected patients in term of their lung involvement on HRCT chest images. The objective lung involvement on chest CT can perhaps help make the population at large and young adults in particular understand the severity of this second wave and perhaps push them towards vaccination and COVID specific protocols.

Materials and Methods

Our study was a retrospective study performed at Sheri Kashmir Institute of Medical Sciences including patients with COVID-19 infection undergoing HRCT chest at our institute. The inclusion criteria were patients with age ≤40 years with RT PCR documented infection with no known co morbidity and whose images were available in our archive. The patients over 40 years of age, with known co morbidities, HRCT features of pleural effusion/superimposed bacterial infection and fully vaccinated individuals were excluded. A total of 200 patients were included in the study and were divided into two time frames, group A including COVID positive patients who underwent a HRCT in the time period from the start of the pandemic up to 28thfebraury 2021 and group B including patients beyond 1st march 2021. The cut off date was selected based on the input of start of the second wave in our region. All the scans were obtained from the archive and were transferred to the work station for evaluation.

CT technique

HRCT scans were done in a separate time slot for COVID positive patients to avoid cross infections. All scans were done on CT 64 SOMATOM scanner with the patient in supine position. Scans were obtained in inspiration with the following parameters: tube voltage (80-120 KV), tube current (80-500 mA), slice collimation (64 X 0.625 mm), width (0.625 X 0.625 mm), pitch (1), and rotation time (0.5 s). The reconstruction was done with following parameters: slice thickness- 1mm, interslice gap- 0.9 mm, kernel- B 90 sharp. The images were transferred and stored in the archive.

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Image evaluation

All images were retrieved from the archive and transferred to a dedicated workstation. The images were separately interpreted by two radiologists with over 5 years of experience. The clinical profile of the patients was kept blinded. The CT of each patient was scored according to 25 point CT severity scoring and the patients were placed in three groups according to the mean score: mild 0-7, moderate 8-15 and severe 16-25. The scoring was done based on the visual assessment of the five lobes (3 lobes of the right lung and 2 lobes of the left lung). Each lobe was given a score of 0-5 based on the percentage involvement of that lobe with ground glass opacities or consolidation typical for COVID pneumonia: 0- no involvement, 1-1-5%, 2-5-25%, 3-26-49%, 4-50-75% and 5->75%. The total severity score was the summation of the score of all 5 lobes. In cases where the two radiologists gave a differing score, the mean of the two scores was taken as the final score.

Statistical analysis

The data was compiled and the patients in the two groups were divided into mild, moderate and severe COVID groups based on the CT severity scores. The CT severity scores between the two groups (group A and group B) were compared for any significant differences. The data was collected and evaluated using SPSS 21.0. Descriptive data was analyzed by frequencies and categorical data by percentages and continuous variables by means and standard deviations. Continuous variables were compared using Student's t test. For all comparisons, p-value of <0.05 was considered statistically significant.

Results

Our retrospective study was conducted over a period of 14 months and included a total of 200 patients who underwent HRCT chest at our institute and were COVID RT-PCR positive.

Patient profile

We divided the patients into two main groups based on their presentation to our institute before or after 1st march 2021- Group A before and Group B after this date. We had 100 patients in each group. The mean age of patients in group A was 33.1 ± 5.9 years and included 63 males and 37 females. The mean age of the patients in group B was 33.2 ± 5.6 years and included 64 males and 36 females.

Clinical profile

All these young adults were otherwise healthy with no underlying co-morbidity. Most of the patients presented with usual symptoms of COVID including fever, dyspnea, anosmia, altered taste and cough. Although the clinical findings were blinded, we found that patients in group B were clinically worse as compared to patients in group A evidenced by increased number of hospital admissions in group B patients (n=74 74%) as compared to group A patients (n=53 53%).

Computed tomography

The HRCT images were evaluated and a CT severity score was assigned to each patient and the patients in each group categorized into mild, moderate or severe disease. In group A, the mean severity score was 10.1 ± 2.1 and it included 34 patients (34%) in mild category, 46 patients (46%) in moderate group and 20 patients (20%) in the severe group. In group B, the mean CT severity score was 12.6 ± 2.3 and it included 20 patients (20%) in mild category, 42 patients (42%) in moderate group and 38 patients (38%) in the severe group (Tables 1 and 2). We also had 4 patients, all medical professionals, who were fully vaccinated and had contracted the virus. In all these patients the CT severity was mild with a mean score 5 and none required hospital admission.

Discussion

We conducted our study using data in our archive with the aim of establishing the vicious nature of the second wave of COVID in our part of the world with special focus on young population below the age of 40 years. Although the clinical features of the patients were not taken into account, the extent of lung involvement on HRCT chest can serve as an indicator of the severity of the disease.[11-13] We found that the majority of the patients in our part of the world were males approximately in the ratio of 2:1(M:F). This male predominance has been previously documented in many studies including those of Jin*et al.*[14]and Li Q *et al.*[15] The male predominance can be explained by the fact that most females in our part of the world are homemakers with less chances of exposure to the virus. Also the severity of the disease in the males can be explained by the increased number of ACE-2 receptors in males, which is believed to be the target for COVID virus.[15]

Age has also been previously studied as an important factor affecting the severity of COVID infection in the population with increasing severity associated with increasing age. This is probably secondary to increased co-morbidities like diabetes, cardiovascular disease, and obstructive airway

Table 1. Mean CT severity scores and hospital admissions among the two groups.

CT severitycategory	Group A (n=100)	Group B (n=100)
Mild (0-7)	34	20
Moderate (8-15)	46	42
Severe (15-25)	20	38
Mean CT severity score	10.1 ± 2.1	12.6 ± 2.3
Need for hospital admission	53	74

Table 2. The results of students t test applied to ascertain the statistical difference between the CT severity scores among the two groups.

t-Test: Two-Sample Assuming Unequal Variances	CT Score New	CT Score Old
Mean	12.55	10.18
Variance	23.62	19.83
Observations	100	100
Hypothesized Mean Difference	0.00	
Degrees of freedom	197	
t Stat	3.59	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.65	
P(T<=t) two-tail	0.00	

diseases being more common in the elderly. The severity of involvement in the younger age group with no associated co-morbidity has been mild with few exceptions. However as indicated in our study, the new wave with its new variants has seen greater involvement of young people. We found in our study that more young patients required hospital admission in the new wave (n=74, 74%) in comparison to the previous wave (n=53, 53%). The increased number of admissions in the first wave was probably due to the initial national guidelines which required even asymptomatic and mild disease patients were admitted to the hospital. With the onset of the new wave (after March 2021), the national guidelines had already been changed and admissions were recommended only for patients with moderate to severe disease. Therefore the increased admissions during the new wave were in view of the increased severity of the disease rather than asymptomatic and mild cases being admitted during the first wave. This clearly indicates that the new wave of COVID 19 is more severe even in young patients with no significant co-morbidities and most of these patients required hospital admission and oxygen administration.

The severity of COVID 19 infection has been graded in terms of clinical features, lab parameters as well as CT severity scoring. Although clinical staging is the standard, CT severity scoring has been found to correlate with clinical features in many studies.[8-10]We identified in our study that the CT severity score in young patients was significantly less as compared to the older counterparts. However a trend that has been seen with the second wave of the virus is the more severe involvement of even the younger patients with no co-morbidities. We found that the mean CT severity score in group A was 10.1 ± 2.1 while that in group B patients was 12.6 ± 2.3 having a statistically significant difference ($p < 0.001$; Tables 1 and 2). The findings in group A were mainly in the form of patchy ground glass opacities and consolidations in the sub-pleural locations (Figures 1 and 2). The patients in group B in addition of having more severe CT scores also had more confluent consolidations and ground glass opacities in the sub-pleural locations (Figures 3, 4 and 5). The increased severity, especially the confluent lung involvement in the group B patients can be attributed to new variants that have emerged probably secondary to the known phenomenon of genetic drifts and shifts. We also had four patients in our study who were fully vaccinated health care workers and were infected in the second wave. However all these patients had no or only mild lung involvement in their HRCT scans. We therefore believe that the new variants of the COVID

Figure 1. 31 year old health care worker with COVID 19 showing mild disease in the form of multifocal patchy ground glass opacities (A,B) and sub pleural linear bands in the right lower lobe (C). CT severity score was 5.

Figure 2. Upper (A), mid (B) and lower level (C) HRCT axial scans in a 30 year young male showing patchy multifocal lung involvement post COVID 19 infection. Total CT severity score was 8.

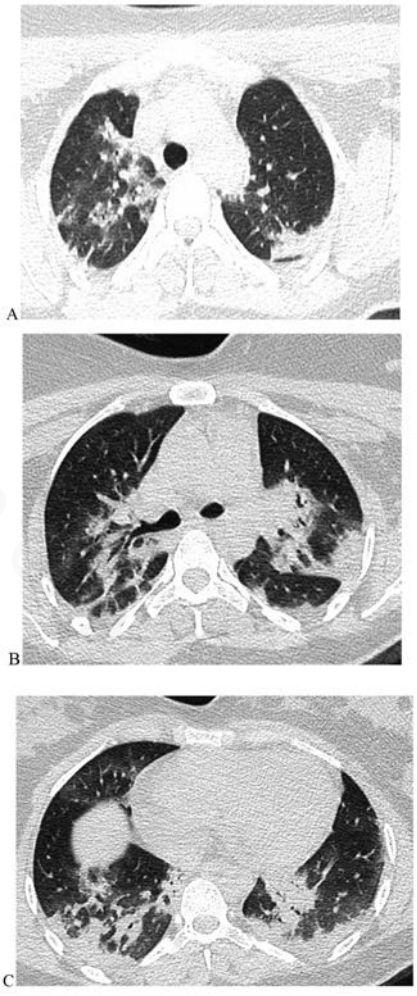

Figure 3. 25 year old female with moderate CT severity score of 14. HRCT scans at upper, mid and lower levels (A,B,C) showing multifocal confluent subpleural consolidations and ground glass opacities diffusely involving both lung fields.

virus are emerging that can infect and adversely affect the young patients in contrast to the earlier notion of elderly population being most commonly involved. This further emphasizes the role of prevention in the form of COVID standard operating procedures (masks, hand washing, good hygiene) in curbing this pandemic, not only for the elderly but also for young people irrespective of any co-morbidity. The CT severity scores in the four fully vaccinated patients, although a small number indicates the role of vaccination in bringing down the severity of the disease in the infected population. However a larger study may be required to establish this fact. To the best of our knowledge no similar study has been conducted in our region whereby the CT severity scores have been compared between the first and the second wave of the COVID 19 infection.

The limitations of our study obviously include the lack of clinical data in the form of oxygen requirements and the lab findings in these young patients. Also there is no follow up CT scans available which can give us an idea about the chronic effects of this viral infection on the lungs in the form of any fibrosis.

Conclusions

The second wave of COVID 19 infection is definitely affecting the young patients more than in the previous wave. The lung involvement in the form of CT severity score is more severe with the new wave with increased need for hospital admissions. Vaccination can act as the answer to reducing the severity of the disease in COVID infected patients.

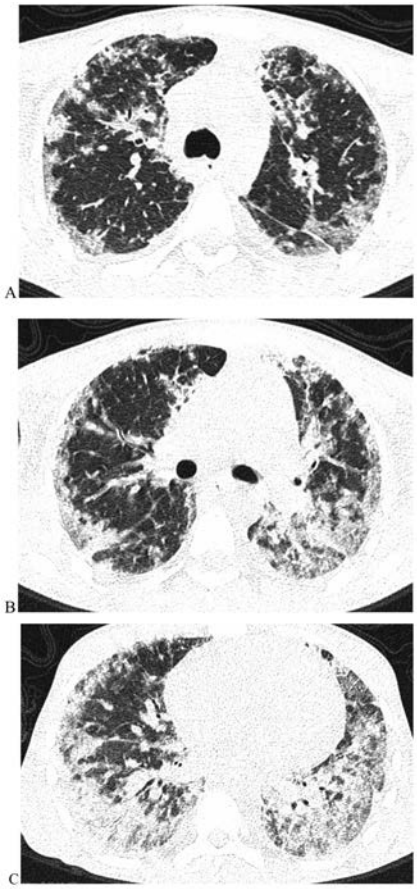

Figure 4. HRCT axial images at different levels (A,B,C) in a 20 year old male RT PCR positive COVID 19 patient showing extensive confluent subpleural consolidations and ground glass opacities. CT severity score in this patient was 16.

Figure 5. 27 year old COVID positive female. HRCT axial scans at upper(A), middle(B) and lower lobe (C) levels showimg extensive confluent consolidations predominantly involving lower lobes with a total CT severity score 15.

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