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A Case Control Study: HRCT Presentations of Covid-19 In Patients with Diabetes Mellitus

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ABSTRACT

Aims: To collect information regarding the role of High Resolution CTs, findings and manifestations in patients of COVID 19 disease with Diabetes Mellitus and correlate the severity of the disease with COVID-19 patients without diabetes mellitus.

Materials and Methods:100 patients of COVID 19 disease were included in the study between October 2020 to March 2021. (32 diabetic and 68 non diabetic). The analysis revealed important conclusions regarding the common findings in HRCT in patients of covid 19 disease, with and without diabetes mellitus. Diabetes Mellitus has been identified as an important co-morbidity in COVID-19 disease. The comparison of HRCT findings between COVID-19 patients with or without Diabetes Mellitus revealed some important facts.

Statistical Analysis Used:IBM SPSS Statistics Subscription software (IBM, New York, USA).

Results:A total of 100 patients were included in the study. Cough (61%, 61/100) and fever (54%, 54/100) were the most frequent symptoms. 78% (78/100) patients revealed COVID-19 pneumonia-like abnormalities on HRCT. Majority of patients with Diabetes mellitus (93.7%, 30/32) had more abnormal HRCT findings compared to patients without diabetes (70%, 48/68).

There was a predominant bilateral lung involvement (84.6%, 66/78) with most common findings being GGO (83.3%, 65/78), Interlobular septal thickening (69%),Crazy paving pattern (46.2%), consolidation (32/78, 41%), predominantly in a subpleural (78.2%, 61/78) and peripheral distribution (89.7%, 70/78), involving mainly the lower lobes(Left lower lobe in 87.2% and right lower lobe in 86%). Findings were seen more in the diabetic group as compared to the non diabetic group. The average duration of hospital stay for the cases in our study was 17 days, however the duration of stay among diabetics was 25 days and among non-diabetics was 9 days.

Average CT severity score of diabetic patients were higher (22/25) as compared to non diabetic patients (17/25). After 14 days of discharge, follow up scan revealed persistent GGO predominantly in diabetic patients (11/14, 78.5 %) compared to non- diabetic patients (10/25, 25%).

Conclusions: We believe that the results of this study will help to understand and to identify the role of imaging techniques like HRCT in the evaluation and diagnosis of diabetic patients, their needs and predispositions in the in relation to the COVID-19 pandemic. The results of this study may very well inform the development of an overall standardized system for reporting of HRCT in relation to diabetes mellitus for diagnosis and imaging protocols in pandemic conditions.

KEYWORDS : COVID-19, Diabetes Mellitus, HRCT, Ground Glass Opacities, Interlobar septal thickening, Crazy Paving

INTRODUCTION

Coronavirus disease-19 (COVID-19) is a new global pandemic of viral pneumonia with common symptoms of fever, cough, and dyspnea, with high mortality in patients with comorbidities and elderly age.[1] This outbreak can be traced to a cluster of 27 pneumonia cases with unknown etiology in Wuhan, China in December 2019 from where it spread worldwide over a period of few months.[2]

The diagnosis of COVID-19 requires the detection of the specific viral genetic material in the specimens collected from nose, blood, feces or respiratory secretions, however, the variable sensitivity of this test is a problem that threatens the validity [4]. Lung injury caused by the COVID-19 infection in the form of acute respiratory distress has been seen in about 30% of cases [5]. Chest computed tomography (CT) plays an essential role in the evaluation of COVID-19 even, sometimes before the clinical symptoms become apparent [6]. Chest CT scan shows 97% and 75% sensitivity for the diagnosis of specimen positive and negative patients respectively but with only 25% specificity [7]. There is evidence of the prognostic value of chest

CT which has been shown by recent studies, where a specific score by CT scan could predict the mortality of patients with COVID-19 [8].

MATERIALS AND METHODS

We performed a retrospective observational study of 100 COVID-19 positive patients admitted in a tertiary care Indian hospital in a state capital from October 1, 2020 to March 10, 2021. The retrospective study was approved by our Institutional review board. COVID-19 infections were confirmed through a reverse transcriptase polymerase chain reaction (RT-PCR) assay of nasopharyngeal swabs and throat swabs.This study conducted by the Department of Radiology, Gauhati Medical College and Hospital aimed to collect information regarding the role of High Resolution CTs, findings and manifestations in patients of COVID 19 disease with and without diabetes mellitus. All HRCTs were acquired using a 16 Slice CT machine in the Radiology Department. Consultant radiologists reviewed the findings and were unaware of the medical history of the patient.

A total of 100 COVID – 19 positive patients were included in the study, out of which 32 were diabetic and 68 were non diabetic. The patients were divided into decadal age groups from 13-75 years of age. The patients were subjected to HRCT Thorax examination and a CT severity score was given to each patient.CT severity score is achieved by scoring the percentages of each of the five lobes that is involved: 1:< 5% involvement, 2: 5%-25% involvement, 3: 26%-49% involvement, 4: 50%-75% involvement and 5: > 75% involvement. The total CT score is the sum of the individual lobar scores and can range from 0 (no involvement) to 25 (maximum involvement). 14 out of 32 diabetic patients and 30 out of 68 non diabetic patients were followed up after 14 days of discharge with a repeat HRCT thorax examination.

STATISTICAL ANALYSIS

Statistical analysis was performed with IBM SPSS Statistics Subscription software (IBM, New York, USA).

RESULTS

Patient characteristics

76% (76/100) of the patients were males and 24% females (24/100) with a mean age of 44 years (range 13 to 75 years). Cough (61/100, 61%) and fever (54/100, 54%) were the two most frequent symptoms. Other symptoms included sore throat (34/100, 34%), myalgia (28/100, 28%), dyspnea on exertion (21/100, 21%), dyspnea at rest (12/100, 12%). 32% (32/100) patients were diabetic and 68% (68/100) patients were non diabetic. All patients were admitted in Covid Isolation ward of the hospital. 14 out of 32 diabetic patients and 30 out of 68 non diabetic patients were followed up after 14 days of discharge with a repeat HRCT thorax examination.

Table 1: Gender

Age	Male	Female
23-32	10	1
33-42	10	4
43-52	22	9
53-62	23	8
63-72	10	2
73-75	1	0

Table 2: Diabetic vs Non Diabetic

Age	Diabetic	Non-Diabetic
23-32	1	11
33-42	0	10
43-52	16	25
53-62	12	12
63-72	2	8
73-75	1	2

Table 3: Clinical Symptoms

Age	Percentage
Cough	61
Fever	54
Sore Throat	34
Myalgia	28
Dyspnea on Exertion	21
Dyspnea at Rest	12

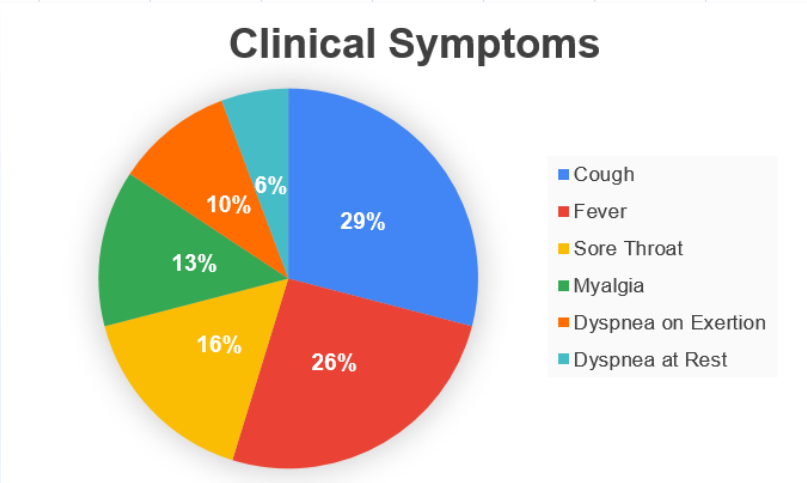

Fig. 1. Pie chart showing the percentage of clinical symptoms

HRCT features:

78% (78/100) patients revealed COVID-19 pneumonia-like abnormalities on HRCT.More patients with Diabetes mellitus (93.7%, 30/32) had abnormal HRCT findings compared to patients without diabetes (70%, 48/68).

Table 4 : Laterality of Involvement

Laterality	Total	Diabetics	Non-Diabetics
Unilateral	12/78	3/30	9/48
Bilateral	66/78	27/30	39/48

HRCT revealed both unilateral (15%, 12/78) and bilateral (84.6%, 66/78) lung involvement, however bilateral involvement was seen in majority of patients compared to unilateral involvement.

Table 5: Predominant HRCT patterns of involvement

Predominant CT pattern	Total	Diabetics	Non-Diabetics
GGO	65/78 (83.3%)	26/30 (86%)	39/48 (81.2%)
Consolidation	32/78 (41%)	15/30 (50%)	17/48 (35.4%)
Interlobular septal thickening	54/78 (69%)	21/30 (70%)	33/48 (68.7%)
Crazy Paving	36/78 (46.2%)	17/30 (56%)	19/48 (39.5%)
Reverse Halo Sign	5/78 (6.4%)	3/30 (10%)	2/48 (4.16%)
Fibrosis	17/78 (21.8%)	12/30 (40%)	5/48 (10.4%)

The most common HRCT abnormality was ground glass opacities (83.3%, 65/78). 86% of the diabetics showed GGO in comparison to 81.2% of the non-diabetics. Interlobular septal thickening (69%) and Crazy paving pattern (46.2%) were the next most common findings, with both of these findings being more prevalent in the diabetic group as compared to non diabetics. Consolidation was seen in 41% of all cases. Consolidaton was seen more commonly in diabetics at 50% as compared to 35.4% in non-diabetics. Fibrosis was seen in 21.8% cases, out of which most patients belonging to the diabetics group (40%) as compared to the non-diabetics (10.4%).

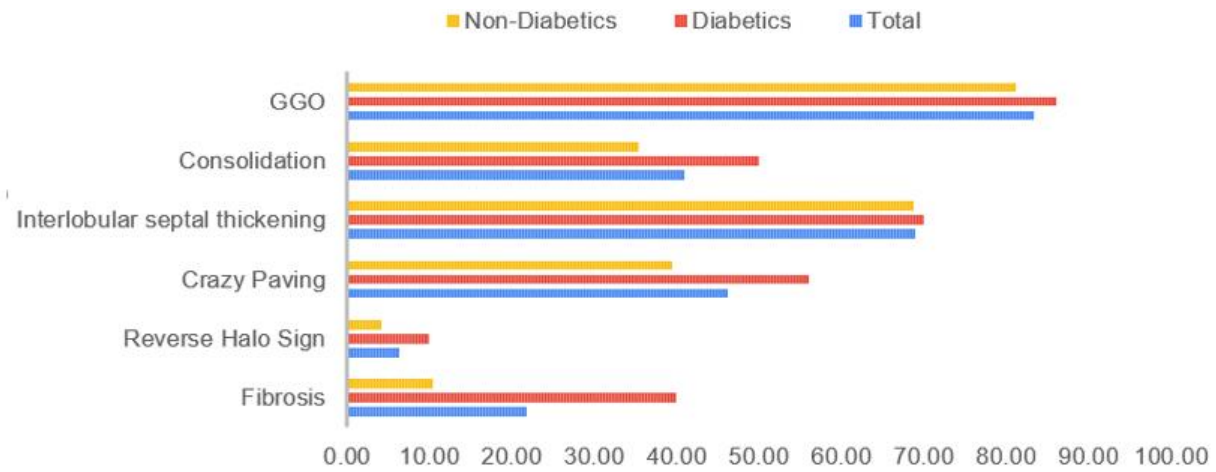

Fig 2. Predemominant HRCT patterns of involvement

Table 6: Pattern of distribution

Peripheral	70/78 (89.7%)
Subpleural	61/78 (78.2%)
Peribronchovascular	12/78 (15.3%)
Perihilar	4/78 (5.1%)

The findings mentioned above were seen predominantly in a subpleural (78.2%, 61/78) and peripheral distribution (89.7%, 70/78) than central distribution like peribronchovascular (12%) or Perihilar (5.1%) location.

Table 7: Lobar involvement

Right Upper Lobe	23/78 (29.5%)
Right Middle Lobe	17/78 (21.8%)
Right Lower Lobe	67/78 (85.9%)
Left Upper Lobe	34/78 (43.6%)
Left lower Lobe	68/78 (87.2%)

The most common lobe involvement was bilateral lower lobe (Left lower lobe in 87.2% and right lower lobe in 86% of cases) followed by left upper lobe (43.6%)

The average duration of hospital stay for the cases in our study was 17 days, however the duration of stay among diabetics was 25 days and among non-diabetics was 9 days.

CT severity score is achieved by scoring the percentages of each of the five lobes that is involved: 1:< 5% involvement, 2: 5%-25% involvement, 3: 26%-49% involvement, 4: 50%-75% involvement and 5: > 75% involvement. The total CT score is the sum of the individual lobar scores and can range from 0 (no involvement) to 25 (maximum involvement).

Average CT severity score of diabetic patients were higher (22/25) as compared to non diabetic patients (17/25).

Table 8: Comparison of findings during admission and follow up scan after 14 days of discharge.

	Diabetics (out of 14)		**Non-Diabetics (out of 30)**	
Predominant CT pattern	During Hospital Stay	Follow Up scan after 14 days	During Hospital Stay	Follow Up scan after 14 days
GGO	14	11	25	10
Consolidation	9	5	10	2
Interlobular septal thickening	13	10	17	6
Crazy Paving	11	7	13	2
Reverse Halo Sign	2	-	-	-
Fibrosis	4	4	4	4

14 out of 32 diabetic patients and 30 out of 68 non diabetic patients were followed up after 14 days of discharge with a repeat HRCT thorax examination.

After 14 days of discharge, follow up scan revealed persistent GGO predominantly in diabetic patients (11/14, 78.5 %) compared to non- diabetic patients (10/25, 25%). Similarly, persistant consolidation (5/9), interlobular septal thickening (10/13) and crazy paving (7/11) were seen in the diabetic patients as compared to non-diabetics.

Figure 3a:HRCT thorax of a 54 year old non diabetic male patient shows areas of ground glass opacities (arrow) with interlobular septalthickening (arrowhead) in bilateral lung fields, predominantly in peripheral location. Few fibrotic opacities also noted in left lung.

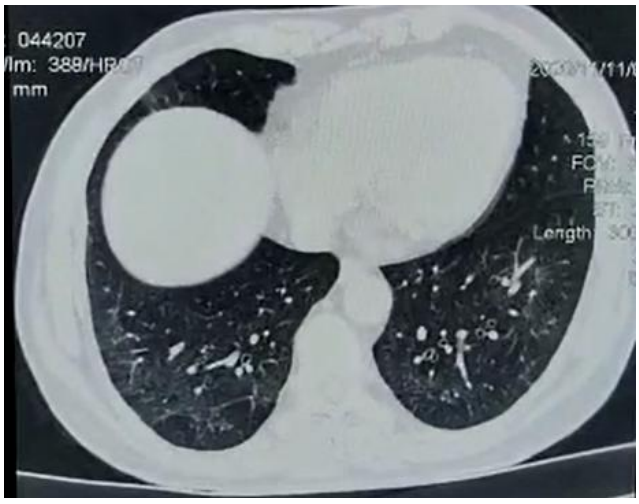

Figure 3b : HRCT thorax of the same person 14 days after discharge: Subtle ground glass opacities in basal segmentsof bilateral lower lobes.

Figure 4: Diffuse ground glass opacities in bilateral lung fields with bilateral pleural effusion in a 60 year old male diabetic patient.

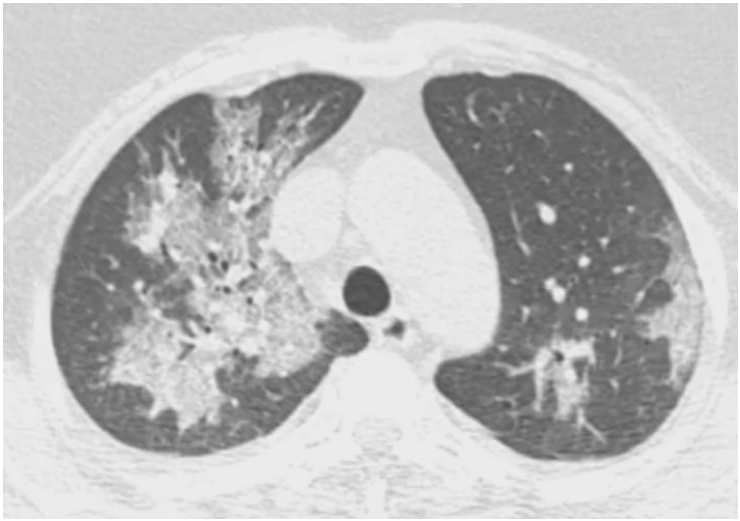

Figure 5: Areas of consolidation with adjacent ground glassing and interlobular septal thickening giving in right upper lobe and apicoposterior segment of left upper lobe in a 50 year old female diabetic patient

Figure 6: HRCT thorax of a 45 year old diabetic male patient shows areas of ground glass opacities with interlobular septal thickening (arrows)and adjacent fibrosis in bilateral lung fields

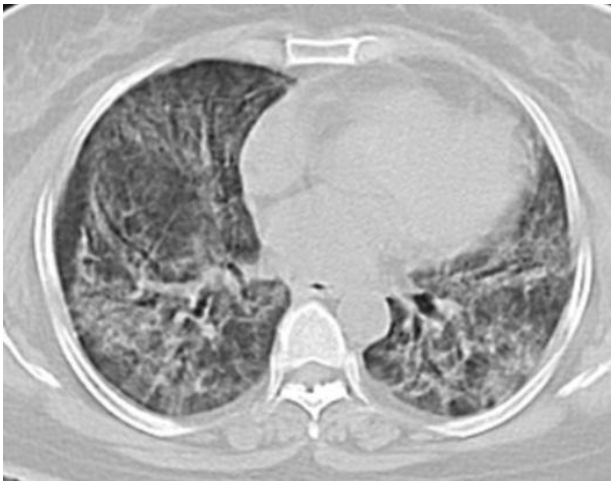

Figure 6b: HRCT thorax of the same diabetic patient patchy areas of ground glass opacities with adjacent fibrosis in bilateral lung fields.

Figure 7: HRCT thorax of 54 year old diabetic female shows patchy areas of GGO with ILST giving a crazy paving appearance (arrows) in bilateral lung fields at places.

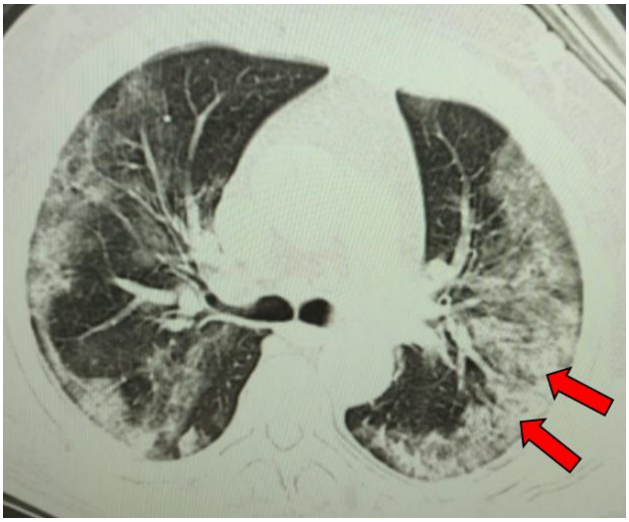

Figure 8: HRCT thorax of a 56 year old diabetic male patient shows patchy areas of consolidation (arrows) with adjacent ground glassing in bilateral lung fields at places.

Figure 9: Areas of consolidation with adjacent ground glassing and interlobular septal thickening giving in right upper lobe and apicoposterior segment of left upper lobe in a 50 year old female diabetic patient

Figure 10 :HRCT thorax of a 53 year old diabetic male patient shows curvilinear fibroatelectatic bands (arrows) predominantly in subpleural location with pleural thickening in bilateral lower lobes. Few areas of ground glass opacities are noted in inferior lingular segment of left upper lobe.

DISCUSSION

In this study we investigated the role of High Resolution CTs focusing on the findings and manifestations in patients of COVID 19 disease with Diabetes Mellitus which was correlated with non diabetics among the patients admitted to our hospital between October 2020 to March 2021.

In our study, out of 78/100 cases showing HRCT findings COVID 19, there weremore patients with Diabetes mellitus (93.7%) with abnormal HRCT findings compared to patients without diabetes (70%).

On HRCT imaging, the most common abnormality was ground glass opacities (83.3%). 86% of the diabetics showed GGO in comparison to 81.2% of the non-diabetics. Interlobular septal thickening (69%) and crazy paving pattern (46.2%) were the next most common findings, with both of these findings being more prevalent in the diabetic group as compared to non diabetics.

A study by Raoufi M et al [10] compared the differences of imaging findings among poorly controlled and well controlled diabetics, and that study also

found The most common chest CT pattern to be GGO (51.3%) followed by consolidation (35%). Their study also concluded that findings like GGO, consolidation, crazy paving appearance were more prevalent in the poorly controlled diabetes group in comparision to the well controlled diabetis group.

In our study, consolidation was seen in 41% of all cases. Consolidaton was seen more commonly in diabetics at 50% as compared to 35.4% in non-diabetics. Fibrosis was seen in 21.8% cases, out of which most patients belonging to the diabetics group (40%) as compared to the non-diabetics (10.4%).

In our study, it was quite evident that there is usually bilateral involvement of lungs with a predominantly subpleural and peripheral distribution of lung findings in COVID 19 pneumonia with a significant higher involvement of the lower lobes, these findings were more severe in diabetics when compared to non-diabetics. Similar findings have been described in study by Raoufi M [10] where peripheral distribution was seen in 85% cases. These findings also described in study by Zhao W [11].

The average duration of hospital stay for the cases in our study was 17 days, however the duration of stay among diabetics was 25 days and among non-diabetics was 9 days.

Average CT severity score of diabetic patients were higher (22/25) as compared to non diabetic patients (17/25). This is comparable to a study by Guo W et al [9] which found that chest CT scores were significantly higher in diabetic patients when compared with patients without diabetes.

14 out of 32 diabetic patients and 30 out of 68 non diabetic patients were followed up after 14 days of discharge with a repeat HRCT thorax examination.After 14 days of discharge, follow up scan revealed persistent GGO predominantly in diabetic patients (11/14, 78.5 %) compared to non-diabetic patients (10/25, 25%). Similarly, persistant consolidation (5/9), interlobular septal thickening (10/13) and crazy paving (7/11) were seen in the diabetic patients as compared to non-diabetics.

It is quite evident by the findings our study, that diabetes plays a role in higher severity and morbidity of patients in cases of COVID 19 pneumonia. Although these finding are intriguing, these results should be interpreted with caution and more comprehensive studies on larger populations are required.

CONCLUSION

High resolution computed tomography is an useful tool to evaluate the patients during this COVID-19 pandemic due to its advantage of detecting subtle lung changes. A significant number of COVID-19 patients showed CT abnormalities. Diabetic patients were more likely to have higher CT severity scores than non diabetic patients. Common CT abnormalities among COVID 19 patients were bilateral/unilateral, ground glass opacity or consolidation in subpleural and peripheral distribution, predominantly in lower lobes. On follow up of the patients after 14 days, there was mild regression of CT findings and clinical symptoms in diabetic patients as compared to non diabetic patients. Hence, it was concluded that patient with co morbidity like diabetes mellitus was more severely affected with the virus than patients without co morbidities. Inspite of limitations, the study reveals clear cut signs of increased severity of COVID 19 disease in diabetic patients as compared to non-diabetics with delayed resolutions of clinical symptoms and HRCT findings in the diabetic group.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

LIMITATIONS

All the cases could not be followed up due to lockdown and travel restrictions. Also, this was a single center study with a limited sample size of 100 cases.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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