Original Article

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# CT Severity Score in COVID-19 Patients and its Association with Diabetes Mellitus and Hypertension: A Retrospective Study

Radiology Section

HARSHIT KUMAR KOSHTA[1], AKSHARA GUPTA[2], SANJAY DHAWALE[3]



## ABSTRACT

**Introduction:** The Coronavirus Disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), was first identified in Wuhan, China, in December 2019. It is thought that, people who have Diabetes Mellitus (DM) and Hypertension (HTN) are more likely to get a severe COVID-19 infection. High-resolution Chest Computed Tomography (HRCT) has been shown to provide immediate results with high sensitivity and specificity for determining the severity of COVID-19 infection and lung involvement.

**Aim:** To determine the association between chest CT Severity Scores (CTSS) and DM and HTN in COVID-19 patients.

**Materials and Methods:** This retrospective observational study was conducted in the Department of Radiodiagnosis at, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India. The duration of the study was one month, from July 2020 to August 2020. Based on the degree of lung involvement seen on HRCT chest scans. A total of 100 patients (68 males and 32 females) with COVID-19 infection were given a quantitative CTSS. The patients were divided into groups with mild, moderate, and severe lung involvement based on the CTSS. The Chi-square test was used to assess the relationship between DM, HTN, and CTSS. The data was analysed using Statistical Package for Social Sciences (SPSS) version 17.0.

**Results:** The mean age of study participants was 45.7±15.95 years. A total of 72 (72%) of the participants were of normal weight, 8 (8%) were overweight or obese, and 20 (20%) were underweight. COVID-19 patients with a co-diagnosis of DM (61.9%) or HTN (69.2%) had more severe lung involvement than COVID-19 patients without DM (19%) or HTN (21%). DM and HTN were found to be significantly associated with severe lung involvement (p-value <0.01).

**Conclusion:** Diabetic and hypertensive patients are more likely than non diabetic and non hypertensive patients to develop the severe form of COVID-19 and have a higher CT lung involvement score. DM and HTN should be considered as risk factors for the severity of COVID-19 disease.

**Keywords:** Computed tomography, Coronavirus disease-2019, Lung involvement, Severe acute respiratory syndrome coronavirus 2

## INTRODUCTION

Since, the outbreak of COVID-19 began in Wuhan in December 2019 [1], it has spread to every region of the globe, including low income nations. Co-morbidities like HTN, DM, obesity, Cardiovascular Disease (CVD), Cerebrovascular Accident (CVA), pulmonary infections, Chronic Obstructive Pulmonary Disease (COPD), asthma, Chronic Kidney Disease (CKD), and cancer are clearly linked to an increase in severity and/or mortality in COVID-19 patients, according to new research [2]. Amid patients infested with the SARS-CoV-2, DM and hyperglycaemia are self-determining predictors for mortality and morbidity [3]. The conventional nasopharynx/oropharynx Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) testing has been fraught with delays and low sensitivity. Early detection and quantification of lung involvement are made possible by imaging. The ability of chest X-rays to detect the presence and extent of COVID-19 infection-related lung involvement is limited. HRCT, on the other hand, has been shown to provide immediate results with high sensitivity and specificity for determining the severity of COVID-19 infection and lung involvement [4]. Data regarding the association of co-morbidities with the severity of COVID-19 is lacking in the Indian subcontinent. Hence, the present study was conducted with the aim, to determine the association between chest CTSS, DM and HTN in COVID-19 patients.

## MATERIALS AND METHODS

This retrospective observational study was conducted in the Department of Radiodiagnosis, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India. The duration of the study was one month, from July 2020 to August 2020. Statistical analysis was done in September 2020. Approval was taken from the Institutional Ethics Committee of Gajra Raja Medical College (146/IEC-GRMC/2020).

**Inclusion criteria:** Irrespective of age and sex, all patients of COVID-19 positive presented to the department were included in the study.

**Exclusion criteria:** Contraindications to HRCT study like antenatal patients, Claustrophobic or patients with anxiety disorder aggravated by CT were excluded from the study.

### Study Procedure

The diagnosis of COVID-19 infection was deemed confirmed by the RT-PCR results. A multidetector 128-slice CT scanner (Siemens Somatom Definition AS) was used for the lung. The association between diabetes and HTN and COVID-19 severity was determined by retrospectively collecting and analysing the data from 100 HRCT lung studies, that were carried out between July 2020 and August 2020, i.e., during the first COVID-19 wave. Based on the degree of lung lobe involvement, a quantitative CT score was calculated (0: 0%; 1: 75%; range: 5 from 0 for each lobe; range of global scores: 0-25). The patients were divided into three groups based on the CTSS: mild (0-8/25), moderate (9-15/25), and severe (>15/25) lung involvement [5]. The CTSS of the lung parenchyma involvement was compared between diabetic and non diabetic patients and hypertensive and non hypertensive patients. Using CTSS as evidence, the analysed data were used to confirm the hypothesis that, the severity of COVID-19 lung involvement in diabetic and hypertensive patients is greater.

## STATISTICAL ANALYSIS

The data were entered into Microsoft Excel for statistical analysis, and the SPSS version 17.0 (IBM, Armonk, NY) was used to evaluate the results. The Chi-square test was used to determine whether severe COVID-19, DM, or HTN were associated. A p-value <0.05 was deemed statistically significant.

## RESULTS

There were 68 (68%) males and 32 (32%) females among those 100 patients. The mean age of patients was 45.7±15.95 years. A total of 72 (72%) of the participants were of normal weight, 8 (8%) were overweight or obese, and 20 (20%) were underweight. It was observed that, 21 (21%) of the 100 patients had DM, and 13 (13%) had high blood pressure. According to the CTSS classification, more than half 51 (51%) of the 100 COVID-19 patients had a milder form of lung involvement; 21 patients (21%) had a score between 8 and 15, which indicated moderate lung involvement; the remaining 28 patients (28%) had severe lung involvement. According to CTSS scores, 48 (60.8%) of the 79 patients without DM had a mild form of the disease, 16 (20.3%) had a moderate form, and 15 (19%) had a severe form of lung involvement. It was observed that, 3 (14.3%) diabetics had a mild disease, 5 (23.8%) had a moderate disease, and 13 (61.9%) had a severe disease [Table/Fig-1].

| Diabetes mellitus | Mild (CTSS 0-8) | Moderate (CTSS 9-15) | Severe (CTSS 16-25) | p-value |
|---|---|---|---|---|
| No | 48 | 16 | 15 | <0.01* |
| | 60.8% | 20.3% | 19% | |
| Yes | 3 | 5 | 13 | |
| | 14.3% | 23.8% | 61.9% | |
| Total | 51 | 21 | 28 | |
| | 51% | 21% | 28% | |

**[Table/Fig-1]:** Association between DM and CT severity.
Chi-square test was used; N=100

The proportion of patients with a severe form of COVID-19 lung involvement was higher in patients with DM (61.9%) compared to patients without DM (19%) (p<0.01). 2 (15.4%) of the 13 people with HTN had mild disease, 2 (15.4%) had moderate disease, and 9 (69.2%) had severe disease (p=0.001) [Table/Fig-2].

| HTN | Mild (CTSS 0-8) | Moderate (CTSS 9-15) | Severe (CTSS 16-25) | p-value |
|---|---|---|---|---|
| No | 49 | 19 | 19 | 0.001* |
| | 56.3% | 21.8% | 21.8% | |
| Yes | 2 | 2 | 9 | |
| | 15.4% | 15.4% | 69.2% | |
| Total | 51 | 21 | 28 | |
| | 51% | 21% | 28% | |

**[Table/Fig-2]:** Association between Hypertension (HTN) and CT severity.
Chi-square test was used; N=100

## DISCUSSION

Diabetes mellitus appears to have a significant impact on COVID-19 patient's clinical outcomes, as evidenced by previous study [6]. The International Diabetes Federation (IDF) said in a statement that, diabetic patients with COVID-19 have symptoms that are similar to those of other COVID-19 patients. According to some reports, CT imaging results can be used to determine the severity of COVID-19 pneumonia because they differ between Intensive Care Unit (ICU) patients, non ICU patients, and recovered patients [4]. CT lung parenchymal involvement score was more in diabetics than those without diabetes [7]. In a Chinese Centre for Disease Control (CDC) study of 44,672 COVID-19 patients, the case fatality rate for diabetics was 7.3%, compared to 2.3% for those without diabetes [8]. SARS-CoV-2 has been shown to down-regulate the Angiotensin-converting Enzyme 2 (ACE2) protein [9], which may account for the poorer clinical outcomes of COVID-19 patients with diabetes. Onder G et al., conducted a study among Italian patients, and the most common co-morbidity for COVID-19 deaths, followed by Ischaemic Heart Disease (IHD) (30%), was diabetes, which accounted for 126 of the 355 COVID-19 deaths (35.5%) [10]. Wang G et al., study says that, diabetes was more common in severe COVID-19 patients than in non severe patients (10.8% vs 5.4%) [11]. Wang D et al., conducted a case series on 138 consecutive Wuhan patients and found that, patients who required ICU treatment (n=36) had a higher risk of diabetes than patients who did not (n=102) (22.2% vs 5.9%) [12]. Wu C et al., a study on 201 COVID-19 patients, of which 84 (41.8%) had developed Acute Respiratory Distress Syndrome (ARDS) [13]. Diabetes was more common in ARDS patients than it was in those without the condition. ARDS was more common in people with co-morbidities like DM, which led to death. Patients with COVID-19 also suffered greatly from HTN. The CTSS was higher in those with HTN than in those without HTN, found by a study carried out by Honardoost M et al., [14]. A study by Fang L et al., showed that, patients with HTN are at higher risk for severe COVID-19 infection [15]. Another study by Yang Q et al., showed HTN leads to increased mortality in patients with COVID-19 [16]. The present study confirms that, the presence of co-morbidities in COVID-19 patients was linked to worse outcomes and a more severe course of illness.

### Limitation(s)

For measuring the pulmonary involvement and severity, quantitative and semi-quantitative methods have been used which may have certain subjectivity.

## CONCLUSION(S)

The current study has demonstrated that, the patients with DM and HTN are more likely to develop the severe form of COVID-19, which has a higher CT lung involvement score, thus, accepting the hypothesis. To avoid potentially fatal complications, COVID-19 patients must therefore, be closely monitored for glucose and blood pressure. DM and HTN should be considered risk factors for the severity of COVID-19 disease, and the best way to reduce morbidity and mortality is to avoid COVID-19 sources, as much as possible.

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**PARTICULARS OF CONTRIBUTORS:**
1. Junior Resident, Department of Radiodiagnosis, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India.
2. Professor and Head, Department of Radiodiagnosis, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India.
3. Professor, Department of Medicine, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India.

**NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:**
Dr. Harshit Kumar Koshta,
Flat No. 105, Achleshwar Mansion, Lalitpur Colony, Lashkar,
Gwalior-474009, Madhya Pradesh, India.
E-mail: koshta06@gmail.com

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