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An Association between CT Score and the Severity of COVID-19

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Author's contribution

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: COVID-19 has changed the world fabric. While many still haven't recovered from the grief of losing their loved ones; the virus continues to mutate leaving the world to deal with a social and economic pandemic. In this study we aim at determining an association between CT SCORE and the severity of COVID-19 thereby understanding the prognosis/severity of disease in patients.
Method: A prevalidated google questionnaire was used to obtain data. The study population consisted of people who tested real time RT-PCR COVID-19 positive.
Results: A statistically significant correlation was seen between CT score and outcome of disease.
Conclusion: Routine CT scan of suspected COVID-19 cases gives early diagnosis; it could also guide in hastening the treatment received by the patient and improve overall prognosis be used as a guide for the management of the patients and hence improve overall prognosis.

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1. INTRODUCTION

The Coronavirus disease 2019 (COVID-19), was declared a global pandemic by World Health Organization on March 11, 2020. Since then, the virus has known no bounds as it swept rapidly across major continents causing an alarming rise in the number of cases and overwhelming the health care system of many countries.

Chest CT has proven to be a useful supplement to real time RT-PCR and has been shown to have high sensitivity to diagnose the disease. Apart from being a diagnostic tool, CT can also potentially help in prognostication and evaluation of disease progression.

The CT severity score index is a scoring system used to assess the lung changes and involvement by COVID-19 based on approximate estimation of pulmonary involved areas. Each of the five lung lobes has been visually scored from 1 to 5:

Score 1: <5% lobar involvement.
Score 2: 5–25% lobar involvement.
Score 3: 26–50% lobar involvement.
Score 4: 51–75% lobar involvement.
Score 5: > 75% lobar involvement.

The final score is calculated by the summation of the individual lobar scores. The maximum (total) lobar score is 25. The total lung involvement is obtained by multiplying the total score by 4 [1].

Mounting evidence from across the globe seems to suggest that CT score could play a role in determining the severity of disease in an individual due to COVID-19 [1].

CTs conveniently provide diagnosis in Emergency Medicine because the results are obtained immediately, and alternate diagnoses can be excluded. In addition, using a CT severity score has shown to correlate with disease severity, and it can be used as a prognostic marker [2, 3, 4, 5].

Rapid and accurate diagnosis is essential to profile patients and utilize scarce resources adequately. However, this is hampered by limited sensitivity of real time RT-PCR [6, 7]. Although real time RT-PCR is considered the gold standard for diagnosis of COVID-19 infection, time required to get the report of real time RT-PCR is a huge problem. CT has an advantage of immediate reporting. It has also shown to be of diagnostic importance in cases of false negative results of real time RT-PCR. Besides being a diagnostic tool, it also has an immense role in monitoring disease progression and evaluating therapeutic efficacy [8].

The precise patients' categorization and radiological severity scoring are essential for appropriate management, especially in mild cases before patient deterioration. Chest X-ray is seen to have very low sensitivity in early-stage disease, CT is therefore the primary imaging tool [9].

Additionally, there is evidence that sensitivity of combined nasal and pharyngeal swabs may be inadequate if obtained at a single point of time, and also depends on the technical characteristics of the test and method of specimen collection [10, 11]. The relatively long turnaround time (TAT) for viral testing together with the low sensitivity of a single real-time reverse-transcriptase polymerase-chain reaction (RT-PCR) assay of nasal and pharyngeal swab specimens also implies that a large number of SARS-CoV-2 patients would not be quickly identified and may not be appropriately managed.

In retrospective studies, sensitivity of chest CT for COVID-19 is excellent, and it may even be greater than that of PCR [12].

Whereas some studies also suggest that there is no correlation of CT score with severity of disease [13].

Therefore, this study aims at determining, if any relationship exists between CT score and severity of disease.

2. METHODOLOGY

2.1 Study Design and Data Collection

This is a Cross sectional, questionnaire-based study. The study was conducted between 30th April 2021 to 30th June 2021 after obtaining Ethics committee approval. A prevalidated google questionnaire was prepared and circulated to people through various social media platforms. Relatives of deceased individuals

were asked to fill the questionnaire on behalf of them. Data collected from google questionnaire was assessed and correlation was established.

The study population consisted of people who tested real time RT-PCR COVID-19 positive. A sample size of 105 was obtained, of which 71 people tested positive for real time RT-PCR test and 42 of them underwent CT scan. Data was analyzed using Chi-square test and Fischer's test.

Inclusion criteria

- All individuals above 18 years, both genders.
- People who tested real time RT-PCR positive for COVID-19.

Exclusion criteria

- All individuals who did not give consent to participate in the study.

After eligibility to the inclusion and exclusion criteria, 71 patients were included in the study.

3. RESULTS

The study comprised of 105 individuals of which 71 tested positive for COVID-19 and 42 of whom underwent CT scan. There was a total of 36 males (50.7%) and 35 females (49.3%) with varied ages. The age groups were categorised into 4 groups.i.e. <21 years, 21-40 years, 41-60 years and >60 years respectively.

Table 1. Demographic data

	CT Score							
	1-10 n(%)	**>10 n(%)**		**Total CT Scan patient (n)**	**Total Covid patients n(%)**	**Statistical Analysis**	**Recovered**	**Deceased**
Patients	24 (57.1)	18 (42.8)		42	71 (100%)	Chi square=1,	65	6
Age (Years)								
<40	10 (66.6)	5 (33.3)		15	32	df=1, p=1,	31	1
>40	14 (51.8)	13 (48.1)		27	39 (43.7%)	OR=1	34	5
	CT Score							
	1-5 n(%)	6-10 n(%)	11-15 n(%)	>15 n(%)				
Gender						df=3,		
Male	7 (50%)	7 (70%)	8 (66.6%)	3 (50%)	25	36 (50.7%) fisher's exact test,	33	3
Female	7 (50%)	3 (30%)	4 (33.3%)	3 (50%)	17	35 (49.3%) p=0.732	32	3

Table 2. Correlation between ct severity score and type of treatment required

s	Home n(%)	Required hospitalisation without oxygen n(%)	Required hospitalisation with oxygen n(%)	Needed Ventilator/ICU n(%)	Statistical Analysis
<10	17	4	1	2	Chi square=6.763, p=0.009
>10	6	3	4	5	

Data of 42 patients who have undergone CT scan

Significant correlation can be seen between CT score and need for hospitalisation, p==0.009. Out of 24 individuals with CT score less than 10, only 7 needed hospitalisation (29.16%) while 12 out of 18 individuals (66.67%) with CT score more than 10 required hospitalisation

Table 3. Correlation between ct severity score with outcome of patient

CT severity score n(%)	Patients n(%)	Recovered n(%)	Deceased n(%)	Statistical Analysis
<10	24	24	Nil	Fischer's exact test p=0.0035
>10	18	12	6	

Significant correlation can be seen between CT score and outcome of patient, p=0.0035. Recovery rate was 100% for patients with CT score less than 10, whereas recovery rate for patients with CT score more than 10 was only 66.66%

Table 4. Correlation between treatment required with outcome of patient

Type of treatment received	Total patients N=71 n(%)	Recovered n(%)	Deceased n(%)	Statistical analysis
Treatment at home	50	50	0	Fischer's exact
Required hospitalisation without oxygen	9	8	1	test
Required hospitalisation with oxygen	5	4	1	p=0.0001
Needed ventilator/ICU	7	3	4	

Data of all 71 patients with real time RT-PCR COVID-19 positive test

Significant correlation can be seen between treatment required and outcome of the patient, p=0.0001. Recovery rate was 100% for patients treated at home. Whereas mortality rate was 66.66% for patients with ICU admissions

Table 5. Correlation between co-morbidities and type of treatment required

Comorbidity	Type of Treatment required				CT Scan performed	Recovered	Deceased	Total
	Home	Hospitalisation without oxygen	Hospital with oxygen	Ventilator/ ICU				
HTN+DM	5	0	0	5	9	7	3	10
HTN only	4	1	0	1	1	6	0	6
DM only	0	2	1	0	3	2	1	3
Obesity	3	2	1	0	6	6	0	6
Cancer	0	2	0	0	1	1	1	2
Asthma	2	0	0	0	0	2	0	2
No comorbidity	16	2	3	1	22	21	1	22
Total	30	9	5	7	42	45	6	51

Abbreviation: HTN, hypertension; DM, diabetes mellitus

Data of 29 patients with one or more co-morbid conditions of which 20 underwent CT Scan.

Significant correlation can be seen between presence of co-morbidity and mortality rate. Mortality rate is 83.33% (5/6) in patients with one or more co-morbid condition.

Significant correlation can also be seen between presence of co-morbidity and ICU admission. Of the 7 ICU admissions, 6 patients were having one or more co-morbid conditions

4. DISCUSSION

The WHO recommended the use of chest imaging as a part of diagnostic tool for COVID-19 disease in case real time RT-PCR testing is not available, test results are delayed or in patients suspected to have COVID-19 but test negative with real time RT-PCR. Mounting evidence from across the globe seems to suggest that CT score could play a role in determining the severity of disease in an individual due to COVID-19 [14, 15].

Several existing literatures suggest that the more severe CT pulmonary changes (i.e., higher CT severity score) was significantly associated with Males [16,17]. But in our study, we did not find a statically significant correlation with gender. This could be particularly due to small sample size. The possible reason for more males being affected than females could be possibly due to higher circulating ACE2 receptor levels in men than women [18]. Hence, men are more susceptible to acquire the virus than women.

As seen in many existing literatures, elderly people experienced the brunt of the disease and succumbed to the virus more than any other age group [19]. Results of our study show that 48.1% (13/18) patients above 40 years have CT score more than 10. Whereas 33.3% (5/18) patients below 40 years CT score more than 10. The possible reason for increased susceptibility to COVID-19 could be due to increased prevalence of comorbidities with increasing age which weakens one's immune system, as well as due to upregulation of ACE-2 receptors in specific organs particularly in individuals with comorbidities [18].

Results from our study show that the need for hospitalisation increased with higher CT scores. Table 2 shows that oxygen requirements also increased with the increasing CT severity score, consistent with past literature. The increased need for oxygen could be due to severe damage to multiple alveoli by the virus. In our study 22.22% (4/18) individuals with CT score more than 10 required oxygen therapy while only 4.54% (1/22) individuals with CT score less than 10 required oxygen therapy. A statistically

significant correlation was seen between presence of co-morbidity and ICU admission. As shown in Table 5, 85.71% (6/7) ICU admissions had one or more comorbidity. Also, individuals with comorbidities were seen to maximally constitute ICU admissions. It can be seen in Table 5, that 5 deceased patients were from the ICU admissions and each one of them had one or the other comorbidity [20,21].

Presence of co-morbid condition is positively correlated with increasing CT severity score. 61.1% (11/18) patients having CT severity score more than 10, had one or more co-morbid condition.

Additionally, studies have shown that the presence of comorbidities particularly hypertension, diabetes, obesity, and cancer carry a poor prognosis in disease outcome, with even worse outcome when multiple comorbidities are present [17,18]. We can find a similar relation in our study, 5 out of 6 deceased patients were having one or more co-morbid condition.i.e., 3 patients had both HTN and DM (Table 5). As the CT severity score increases, mortality rate also increases, all 6 deceased patients had CT severity score more than 10 (Table 3).

5. CONCLUSION

In conclusion, CT scans can play a pivotal role in assisting physicians in the management plan and is a valuable indicator for disease severity and outcome. In a pandemic, one needs a diagnostic test that provides immediate results to confirm the diagnosis. Real time RT-PCR, though considered the gold standard has long waiting hours for testing and often, test results are delayed or take longer than usual. This delay in obtaining test results could possibly mean that an infected person would continue to infect others in the community and the disease would progress further unchecked. CT Scan if implemented, would provide timely results, and hasten the process of treatment thereby halt the disease progression much before extensive damage to the immune system is caused by the virus. Also, CT score would provide information about severity of the disease and help in deciding further course of action. Findings of our study show a statistically significant corelation between CT score and severity of disease. Individuals with one or more comorbid conditions are more likely to have a higher CT Score and thereby carry poor prognosis. However, more research is needed to further clarify the value of chest CT for prognostication in COVID-19 disease, including correlation with patient outcome.

6. LIMITATIONS

There are several limitations in this study: First, the need for a larger sample size from larger multicentre cohort to increase the accuracy of the findings and second, information about the day of infection when CT scan was done could not be obtained. Finally, the other factors that might contribute to the disease outcome such as lifestyle and relying on self-reporting/underreporting of the comorbidities should be considered.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Author has declared that no competing interests exist.

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