CT Chest Severity Index in SARS CoV2 - A Tool to Predict Clinical Outcome

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Abstract: <u>*Background*</u>*: The novel coronavirus, belonging to the beta coronavirus has been responsible for a shake in the world. Its main effect is on the pulmonary system where it ranges from a mild upper respiratory tract infection to a severe acute respiratory distress syndrome. Staging and identification as per High - resolution computerized tomography (HRCT) scan of changes has expedited the identification of complications of the disease.* <u>*Aim*</u>*: Correlation of inflammatory markers to HRCT findings.* <u>*Material and Methods*</u>*: A retrospective cross - sectional study performed on patients during a month period looking at the HRCT score and the changes in the inflammatory markers to assess the correlation in predicting severity of the two widely used resources. Results: There was a statistically significant correlation between the serum Lactate dehydrogenase, Ferritin, D dimer and the HRCT score findings. In addition, a statistically significant association between antibiotic escalation and ICU admission was established; no statistical significance was established with the use of steroids in patients with a higher HRCT score.* <u>*Conclusion*</u>*: HRCT could play a pivotal role in aiding physicians to stratify patients and its correlation with the severity of illness could be useful in predicting treatment and ICU need.*

Keywords: HRCT score, SARS CoV 2, inflammatory markers, antibiotic

1. Introduction

COVID - 19 is a pandemic viral infectious disease caused by a strain of coronavirus (SARS - CoV - 2). In late 2019 the disease spread globally and was announced as pandemic by the World Health Organization on 11th March 2020. The first case of COVID – 19 infection reported in India was from Kerala on 30 January 2020. Lockdown was announced in India from 25th March 2020.

The Diagnosis of COVID - 19 is made by the RTPCR test based on the nasal and throat sampling worldwide, and it is considered as a most effective test for the diagnosis of COVID – 19 [1]. The RT PCR test is 50 – 62 % sensitive for COVID – 19 infection. In a study conducted by He et al the RTPCR has shown the highest number of sensitivity i. e.79 % [2], But still a substantial number of missed diagnoses are seen with COVID - 19. The accuracy of RT - PCR results is affected by a number of issues, and these include the respiratory tract viral load, samples source, the procedures, and timing of samples acquisition, as well as the intrinsic features and quality of the testing kits. [3].

Consequently, the RT - PCR test alone would be debatable to be an independent and a sole tool for screening of COVID - 19 suspected individuals and hence complementary tools like clinical picture, CT scan examination, and blood tests needed to participate in the screening and diagnosis of COVID - 19 infection in addition to the PCR test examination. [2]

A better understanding about the imaging findings of COVID - 19 pneumonia will help to identify the stage of the disease. Initiation of antiviral therapies in the early stages of the disease decreases the duration of illness and prompts early recovery. In the present study, imaging findings were analyzed during different phases of COVID - 19 infection and severity using CT severity score was assessed.

Aim: To study the correlation between the CT severity score and clinical outcome and clinical condition.

Objectives
1) To assess the reliability of chest HRCT in determining prognosis in COVID 19.

2) To quantify the role of chest HRCT in estimating severity in COVID 19 in comparison to inflammatory markers.

Methodology

It was a retrospective observational cross - sectional study conducted in a tertiary care hospital Aster CMI, Bengaluru Karnataka from August 2020 to November 2020.

Inclusion criteria:

1) Patients admitted to the COVID ward/ ICU
2) COVID RT PCR positive
3) Patients who have undergone HRCT chest diagnostic test
4) Patients whose chest X ray has a dilemma
5) Call for changing treatment modality in patients.

Exclusion criteria:

1) Age < 14 years
2) COVID RT PCR negative
3) Patients who refused HRCT
4) Shorter duration of stay
5) DAMA or discharged before the test was done
6) Asymptomatic
7) Pregnant and infants
8) Those who refused other laboratory parameters.

Data analysed from the electronic medical records of patients includes:
1) Laboratory parameters considered for the study: D dimer, CRP, LDH, ferritin neutrophil/lymphocyte ratio.
2) Chest CT findings estimating score using the 25 - point scoring system and Ct findings were obtained.

The parameters considered for predicting severity in COVID in the study includes
1) Oxygen requirement via non - invasive ventilation or face mask
2) Number of days of stay in the hospital
3) Shifted to the ICU.
The patients were classified as mild, moderate and severe as per WHO criteria and their CT findings. Laboratory parameters and parameters determining severity in our study were

a) Oxygen requirements requiring ICU admission
b) Increased number of days of stay in the hospital
c) The clinical condition of the patient will be correlated to determine the reliability of the tests quantitatively in order to predict prognosis in patients with COVID 19.

Statistical Analysis:

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi - square test or Fischer's exact test (for 2x2 tables only) was used as test of significance for qualitative data.

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs

P value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.
**Statistical software**: MS Excel

2. Results

Demographic Data

Total reports were scanned out of which 47 patient reports satisfying the inclusion and exclusion criteria were included in the study. Out of the total 47 patients, 27.7 % of the patients belong to the age group of 61 – 70 years, 21.3 % of the patients belongs to the > 70 years, 51 – 60 years and 41 - 50 years age group and only 8.5 % of the patients belongs to the age group of 31 - 40 years.

**Table 1:** Age wise Distribution of the Patients in Different Age Group

Age group	Frequency	Percent
31 - 40yrs	4	8.5
41 - 50yrs	10	21.3
51 - 60yrs	10	21.3
61 - 70yrs	13	27.7
>70yrs	10	21.3
Total	47	100

Fig.1: Age Wise Distribution of the Patients
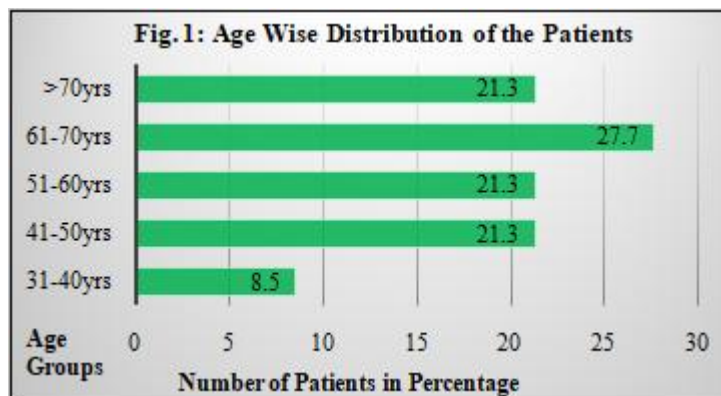
Out of the total 47 patients recruited in the study, 19.1 % were female and 80.9% percent of the patients were male.

Table 2: Gender Wise Distribution of the Patients in the Study

	Frequency	Percent
Female	9	19.1
Male	38	80.9
Total	47	100

Fig 2 :Gender Wise Distribution of the Patients
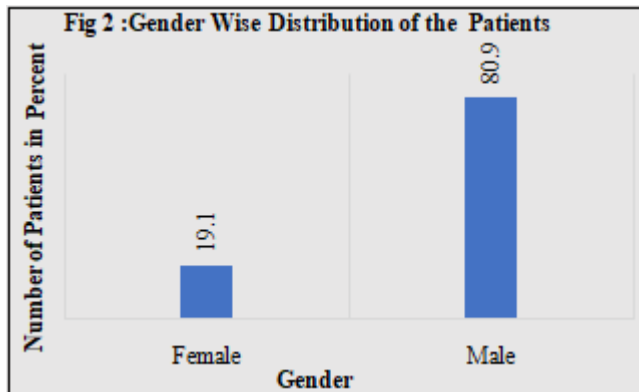
Correlation of HRCT Score with ICU Admission
Out of the 11 mild HRCT score patient's, 100 percent of the patients were not admitted to the ICU. Out of the 9 moderate HRCT score patients, 77 % of the patients were not admitted and 23% of the patients were admitted to the ICU. Out of the total 12 patients, 75% of the patients with SEVERE HRCT score were admitted and 25% of the severe HRCT score patients were not admitted to the ICU. There was a statistically significant correlation between HRCT grading and ICU admission (p value <0.001).

Table 3: Number of Patients Admitted to the ICU According to HRCT classification

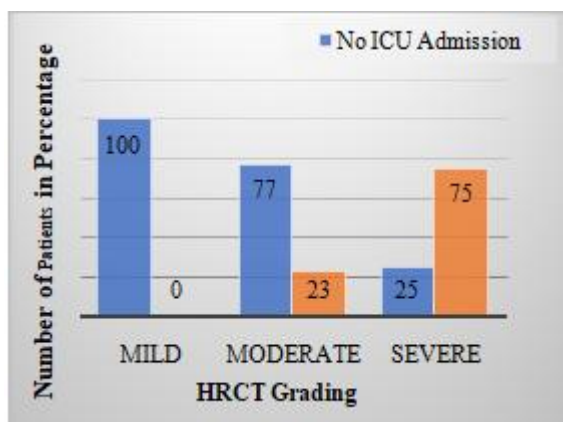| ICU Admission	Mild	Moderate	Severe
No	11	7	3
Yes	0	2	9
Total	11	9	12

Figure 3: Patients Admitted to the ICU as per HRCT Grading

Correlation of HRCT Score with Steroid Use
Out of the total 10 mild HRCT score patients, 60 percent were given steroids and 40 percent were not given steroids. Out of the total 9 patients with moderate HRCT, in 11.2% of patient's steroids were not used whereas in 88.8% of patient's steroids were used. Out of the total 12 patients with severe HRCT score, in 8.4 % of the patients' steroids were not used and in 91.6% of the patients' steroids were used. No statistically significant difference was found between HRCT score and steroid use. (p value – 0.103)

Table 4: Correlation of HRCT score and Use of Steroids

Steroid	Mild	Moderate	Severe
No	6	1	1
Yes	4	8	11

Fig. 4: Estimation of HRCT Severity in Relation to Steroid Use
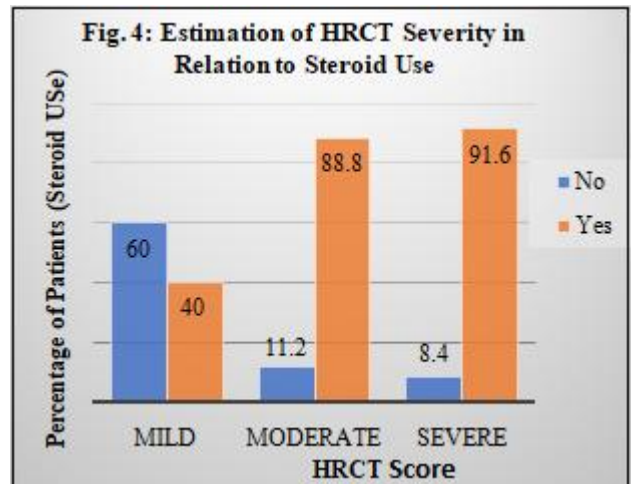
Escalation of Antibiotics Correlation with HRCT Score
Out of the total 10 mild HRCT score patients, in 90 % of patient's antibiotics escalation was not needed and in 10 percent of patients antibiotics escalation was done. Out of the total 9 patients with moderate HRCT, in 55.55 % of patient's antibiotics escalation was done and in 44.44% of patient's antibiotics escalation was done. Out of the total 12 patients with severe HRCT score, in 16.66 % of the patients' antibiotics escalation was not needed and in 83.33% of the patients' antibiotics escalation was done. . A statistically significant correlation was found between the HRCT score and escalation of antibiotics.

Table 5: Correlation of HRCT score and Escalation of Antibiotics

Escalation of Antibiotics	Mild	Moderate	Severe
No	9	5	2
Yes	1	4	10

Fig. 5: Antibitics Escalation Correlation with HRCT Score
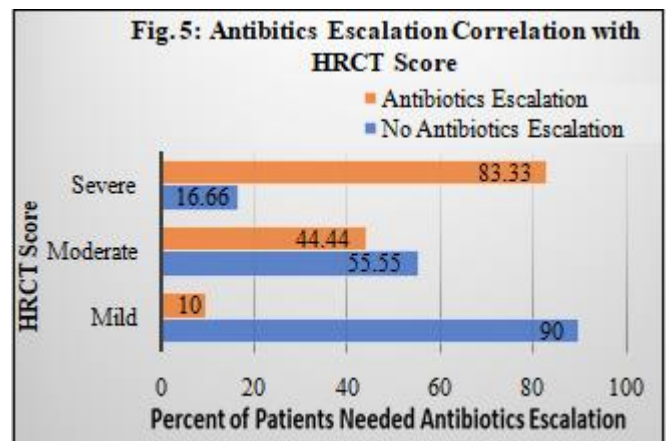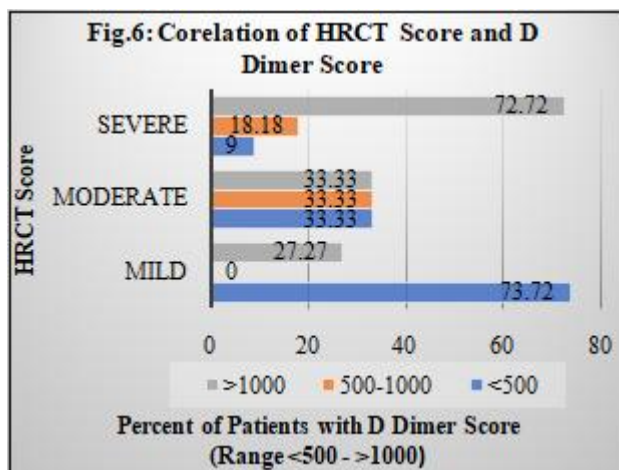
Correlation of HRCT Score with D Dimer
Of the 11 patients with mild HRCT score, 73.72% of patients had D Dimer value <500 and 27.27 % of patients had D Dimer value >1000. Out of the total 11 patients with moderate HRCT score, each 33.33% of the patients had the D Dimer value <500, 500 to 1000 and >1000. Out of the 11 patients with severe HRCT score, 9% of the patients had D Dimer value of < 500, 18.18 % of the patients had the D Dimer value between 500 – 1000 and 72.72% of the patients had the D Dimer value >1000.

A statistically significant correlation was found between HRCT value and D – Dimer Range <500 to >1000. (p value 0.013).

Table 6: Correlation of ICU Admission and D Dimer Score

D - Dimer	Mild	Moderate	Severe
<500	8	3	1
500 - 1000	0	3	2
>1000	3	3	8

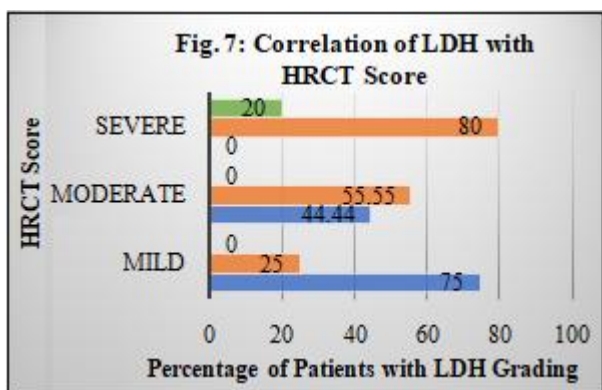Fig.6: Corelation of HRCT Score and D Dimer Score

Correlation of HRCT Score with LDH Grade
Out of the Total 8 patients with mild HRCT score, 75 % of the patients had LDH grade 0 and 25 % of the patients had LDH. Out of the 10 patients with severe HRCT score, 80 % of the patients had LDH grade 1 and 20 % of the patients had the LDH grade 2

There was a statistically significant correlation found between HRCT value and LDH value. (p value 0.011).

Table 7: Correlation of HRCT Score and LDH Grading

LDH	Mild	Moderate	Severe
<230 (0)	6	4	0
230 - 500 (1)	2	5	8
>500 (2)	0	0	2

Fig. 7: Correlation of LDH with HRCT Score

**Correlation of HRCT Score with Ferritin Grade**
Out of the Total 10 patients with mild HRCT score, 60 % of the patients had Serum Ferritin grade 0 and 40 % of the patients had Sr Ferritin grade 1. Out of the total 9 patients with moderate HRCT score, each 44.44% of the patients had Sr Ferritin grade 0 and 55.55% of the patients had Sr Ferritin grade 1. Out of the 11 patients with severe HRCT score, 100 % of the patients had Sr Ferritin grade 1

There was a statistically significant correlation found between HRCT value and SrFerrtin value. (p value 0.017).

Table 8: Comparison of Ferritin according to HRCT classification

Ferritin	Mild	Moderate	Severe
0	6	4	0
1	4	5	11

0: If female<40years of age, ferritin value <120
If male <40 years of age, ferritin value <250
If male or female >40 years of age, ferritin value <260
1: If female<40years of age, ferritin value >120
If male <40 years of age, ferritin value >250
If male or female >40 years of age, ferritin value >260

Fig. 8: Correlation of Ferritin with HRCT Score
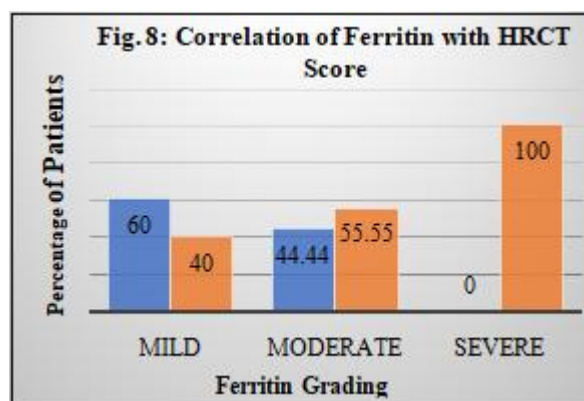
3. Discussion

The diagnosis of COVID – 19 is dependent upon the detection of the SARS COV2 nucleic acid by RT - PCR, but it has been reported that the accuracy of the RT – PCR depends on the viral load. The other most commonly used mode for the diagnosis is chest CT, Chest CT scans are non - invasive and produces a cross - sectional image of many X - ray measurements at different angles across a patient's chest. In one of the systemic review and metanalysis done by Xu B et al [5], it was concluded that the CT chest offers the great sensitivity for the detection of COVID - 19 in a severe epidemic region. The high sensitivity towards the evaluation of SARS – COV - 2 infected patients enhance the clinical decision based on the degree of the affected lung. [6, 7] The WHO have advised to use chest imaging as a part of diagnosis, if the RT – PCR is not available or if the results are delayed or in case of negative result with clinical suspicion of COVID - 19 infection. [8]

In our present study the maximum percentage of COVID - 19 patients i. e., 27.7 % belongs to the age group 61 - 70 years. And the least number of patients were from the age group 31 – 40 years (8.5%).

Similar reporting has been done by the website Statist [9], which suggest the age group more prone to develop infection was between 61 – 70 years. Initially much emphasis was given on the elderly age group and comorbid condition for the occurrence of COVID – 19 infections, [10] the recent studies has suggested though the prevalence of

infection remains same in both the gender, but male are more prone to develop severe COVID – 19 infection than females. [11]

In the present study, twenty three percent of the patients with moderate CT chest grading and 75 % of the patients with severe CT chest grading were admitted to the ICU. In another study conducted by Saeed G et al [8] out of the total patients 22.4% of the patients with mild, moderate and severe CT chest score were admitted in the ICU. In the present study 40 % of patients with mild CT chest score, 88.85 % of patients with moderate CT chest score and 91.6 % of patients with severe CT chest score received corticosteroids for the treatment. In a systemic review and metanalysis by Sarma P et al [12], it was reported that in severe and critical patients; steroid therapy was associated with lowered mortality, decreased mechanical ventilation requirement, and reduced ICU admission.

The hospitalized patients are more prone to develop bacterial superinfections because of old age, immunosuppression and use of corticosteroids. Antibiotics act as a crucial defense against the mortality in COVID – 19 patients. In the present study antibiotics escalation was done in 10 % of mild CT score patients, 44.44 % of the moderate CT score patients and 83.33 % of the severe CT score patients. In one of the review done by Chedid M et al [13, 14, 15] it has been reported from various studies that the pooled secondary infections and co - infections rate in COVID – 19 patients was 7.6 %. It has been seen that 17.6 % of the patients who needed antibiotics had secondary infections or coinfection. In one of the studies conducted by Pan L et al, [16] 67.9 % of the patients with moderate COVID - 19 infection and 100 % of the patients with severe COVID – 19 infection received antibiotics.

In the present study, D – Dimer value >1000 was seen with the moderate CT score in 72.72 % of patients and D – Dimer value of >1000 was seen with the severe CT score >1000. In another study conducted by Wang L et al, [17] D – Dimer Score between 500 – 1000 was seen in the patients with CT score between 8 – 15. Similar result has been seen in another study conducted by Yilmaz A et al, [18] where a positive correlation was established between the rise in D - Dimer Score with elevated CT score.

In the present study, a positive correlation was seen (p<0.01) between rise in LDH level and increased CT score. In a study conducted by Xiong Y et al, [19] similar finding has been reported by the author.

In the present study, In the present study, raised serum Ferritin levels had a positive correlation with CT score. Similar result has been reported by Yilmaz A et al. (p<0.0001)

4. Conclusion

In conclusion, CT Score had a positive correlation with the inflammatory markers like D - Dimer, Sr Ferritin and LDH. Thus, From the above CT score can play a pivotal role in assisting physicians in planning management of COVID - 19 infection patients. It can also act as an indicator of disease severity and possible outcome result that CT score can have a pivotal role in assisting physicians in planning the management and as an indicator for disease severity and possible outcome.

Limitations of the study: The study was performed in a single center, thus studies with a larger sample size and multi - center could prove beneficial.

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