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Original Research Article

CORRELATING CT SEVERITY SCORE WITH CLINICAL OUTCOME AND EVALUATING ITS ROLE AS IMAGING MARKER FOR PREDICTING DISEASE SEVERITY IN COVID 19 PNEUMONIA

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Abstract

Background: As a highly contagious illness, COVID-19 can spread by respiratory droplets and close contacts. The virus takes between two and fourteen days to incubate. Severe pneumonia, intermittent fever, and cough are symptoms of respiratory illness caused by SARSCoV-2 infection. Less frequently observed symptoms include sneezing, rhinorrhea, and pharyngitis. Particularly in the current environment of overworked laboratories, chest computed tomography (Chest CT) is a quick and accessible test that may help in the diagnosis of COVID-19. The aim of study was to correlate the CT chest based CT severity score with clinical outcome in patients with COVID 19 infection and thereby evaluating its role as imaging marker for patient prognosis. We evaluated its potential role in predicting mortality and analyzed relationship between CT chest based CT severity score and commonly used laboratory parameters. **Materials and Methods:** This retrospective study included total 500 confirmed cases of COVID-19 pneumonia. The CT images were first evaluated for the presence of typical findings of COVID-19 pneumonia. The following laboratory abnormalities on blood tests on admission were considered and correlated with CT severity score: C-reactive protein (CRP), erythrocyte sedimentation rate (ESR),white blood cell count (WBC), D-dimer, serum ferritin, and lymphocyte count.The Pearson correlation coefficient test was used for correlations and value less than 0.05 was defined statistically significant. **Result:** A total of 500 patients with COVID-19 disease were assessed. Mean age of the study group was 55.26 years (63% males and 37% females). The most common comorbidity present in the study group was diabetes mellitus, which was present in 21.8% cases. Severity of disease was significantly associated with age of the patient. CT severity score was positively correlated with lymphopenia and raised CRP, D-dimer and serum ferritin levels. A significant statistical correlation was found between CT severity grade and patient survival.**Conclusion:**The COVID-19 patients' chest CT severity score has a positive correlation with inflammatory laboratory markers, making it a useful tool for predicting the severity and prognosis of the illness. Nucleic acid test results, epidemiological data, and CT chest imaging should be incorporated into a thorough evaluation in order to fully explain the management plan for COVID-19 pneumonia.

INTRODUCTION

Adangerous virus was identified in China in December 2019. which subsequently spread over the world, having a major effect on the world's population. Respiratory droplets are considered to be the mode of transmission. Fever or indications of a lower respiratory tract infection are among the symptoms. COVID-19 is the name of the illness caused by the novel pathogen SARS-COV2.[1,2]
Laboratory tests such as the rapid antigen test, RTPCR test, and blood investigations to confirm the presence of Covid-19. These tests can measure various parameters, including C-reactive protein (CRP), d-dimer etc. Pulse oximeter is useful in monitoring the saturation of oxygen .[3,4]

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Individuals with confirmed COVID-19 pneumonia have characteristic imaging characteristics that can be useful in assessing the severity of the illness as well as in the early screening of highly suspected cases. Ground glass opacity or a combination of ground glass opacity and consolidation is present in the majority of COVID-19 pneumonia patients. Peripheral distribution and bilateral involvement with a predominance in the lower lung are more common features of lesions. The severity and scope of the disease can be assessed with the use of a CT chest-based CT severity score.[5] Even when the RT-PCR test is negative, abnormalities on chest CT scans can occur in the early stages of COVID-19, which may aid in the early detection and quick diagnosis of this illness.[6,7]

MATERIALS AND METHODS

This Retrospective analysis was done at Department of Radiology of Shree Krishna Hospital, Karamsad, Gujarat, india. Clinical and laboratory data were obtained from the computer system known as "Solace" and medical record department, Shree Krishna Hospital, Karamsad,Gujarat,India

Data pertaining to CT severity score were obtained from department of radiodiagnosis.

We had reviewed total 641 CT scans done under the radiology department from 1st Feb, 2021 to 31st May,2021. Out of which, 500 CT scan data were included in our study.

Inclusion Criteria

RTPCR confirmed cases of SARS –CoV-2 who had underwent CT chest examination in the department of Radio diagnosis, Shree Krishna hospital were included

Exclusion Criteria

- Patients with negative RTPCR report for SARS-CoV-2 were excluded.
- Patients for whom clinical and laboratory data could not be obtained or were not available.
- Patient for whom follow up and clinical outcome could not be obtained

Analysis of Laboratory Findings: The following laboratory abnormalities on blood tests on admission were considered and correlated with CT severity score: C-reactive protein (CRP) (Normal Range,N:< 0.1 mg/dL), erythrocyte sedimentation rate (ESR) (N: 0–10 mm per hour), white blood cell count (WBC) (N: 4–10 × 103/ μL), D-dimer (N: 0–200 ng/mL), serum ferritin (N: 23.9–336 ng/ mL), and lymphocyte count (N: 1–3 × 103/ μL).

The first thing that was done was to look for the typical findings of COVID-19 pneumonia on the CT images. Each of the two left and three right lung lobes was evaluated separately, and based on visual evaluation, the percentage involvement of each lobe was recorded.

The CT chest visual severity score was assigned a total score of 25, with scores of Score-1 (less than 5% involved), Score-2 (5–25% involved), Score-3 (25–50% involved), Score-4 (50–75% involved), and Score-5 (more than 75% involved).

Based on the percentage of each of the five lobes' affected areas, a CT severity score of out of 25 was assigned.[7] All five lobes were evaluated on CT and the total CT score was calculated by adding the individual lobar scores, which can range from 0 (no involvement) to 25 (maximum involvement).

Typical findings of COVID-19 pneumonia on the CT images includes subpleural unilateral or bilateral GGOs in the lower lobes with a posterior or peripheral distribution. These GGOs later develop into the crazy-paving pattern and consolidation.[8] According to Pan et al.'s semiquantitative CT severity scoring,[8] the degree of anatomic involvement was taken into account when calculating the semiquantitative scores for each of the five lobes.[9]

We created an excel spreadsheet with the patient records, and we used SPSS software for analysis. Numbers and relative frequencies were used to describe the clinical, laboratory, and patient demographics using descriptive statistics. We computed and compared CT score frequencies with other clinical variables. For correlations, the Pearson correlation coefficient test was employed, with a value of less than 0.05 being regarded as statistically significant.

RESULTS

500 patients with COVID-19 illness who had laboratory confirmation made up the study population. [Table 1] showed the percentage distribution of patients by age group. 42.4% of the patients were between the ages of 61 and 80 year, and 34% were between the ages of 41 and 60 year. The study group's average age was 55.26 (± 15.71) years.

Table 1: Age wise distribution of participant

Age Group(yr)	Number (n)	Percentage (%)
<20 yr	3	0.6
21-40 yr	105	21
41-60 yr	170	34
61-80 yr	212	42.4
>80 yr	10	2
Total	500	100

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Table 2:Gender wise distribution of Covid 19 patients

Age Group(yr)	Number (n)	Percentage (%)
Male	315	63
Female	185	37
Total	500	100

Table 3: Categorisation of patients according to comorbidites

Co morbidities	Number (n)	Percentage (%)
Hypertension	43	11.88
Diabetes Mellitus	109	30.11
Coronary artery disease(CAD)	45	12.43
Chronic kidney disease(CKD)	55	15.19
COPD	108	30.0
Total	360	100

CT severity was graded as mild (grade 1) (< 8), moderate (grade 2) [9-15], and severe (grade 3) (> 15). 54.6% of sample population had grade 1 severity followed by moderate severity in 28% patients, and grade 3 severity was present in only 16.8% patients.

Table 4: CT severity grading

Score	CT severity	Percentage (%)
<8	Mild	54.6%
9-15	Moderate	28.6%
>15	Severe	16.8%

Table 5: Comparison of CT severity score according to demography and clinical parameters in all patients

Age Group(yr)	No of Cases Percentage (%)			P value
	Mild CTSS	Moderate CTSS	Severe CTSS	
21-40 yr	52(19%)	39(27.85%)	14(16.66%)	0.045
41-60 yr	86(31.5%)	53(37.85%)	31(36.9%)	
61-80 yr	135(49.4%)	45(32.14%)	32(38%)	
>80 yr	0(0%)	3(2.14%)	10(11.49%)	
Total	273(54.6%)	140(28%)	87(17.4%)	
Gender				
Male	95(50.80%)	121(68.75%)	99(72.26%)	0.156
female	92(49.19%)	55(31.25%)	38(27.73%)	
Comorbidites				
Present(360-72.4%)	87(24.16%)	120(33.33%)	157(43.61%)	0.752
Absent(140-28%)	10(7.14%)	60(42.85%)	70((50%)	

Table 6: Biochemical Laboratory finding of Covid 19 participants

Parameters	Normal(%)	Increased(%)
WBC	260(52%)	240(48%)
D Dimer	160(32%)	340(68%)
Ferritin	110(22%)	390(78%)
C reactive Protein	90(18%)	410(82%)
ESR	140(28%)	360(72%)
Absolute Lymphocyte count	425(85%)Decreased	75(15%)Normal

Table 7: Comparison of CT severity score according to biochemical parameters(n=500)

Parameter	Mild (CTSS)Mean	Moderate(CTSS)	Severe (CTSS)	P value
Lymphocyte count (× 103/μL)	1.71 ±0.2	1.1 ±0.3	0.95 ±0.1	0.001
S. Ferritin (ng/mL)	208.1 ±80	566.5 ±95	712.5 ±105	0.002
Leucocytes (× 103/μL)	11.56 ±1.0	12.56 ±1.8	18.6 ±2.5	1.102
CRP (mg/dl)	6.5 ±2.5	6.79 ±2.3	15.2 ±3.6	0.035
ESR (mm 1st hr)	48 ±4	44 ±2	62 ±6	1.03
D-dimer (ng/mL)	845.6 ±50	1105 ±56	2556.6 ±205	0.003

Table 8: Distribution of cases according to CT severity score and survival

CTSS	Number of cases (%)		p value
	Patients died (N=350)	Patients survived(N =150)	
Mild	18(5%)	38(25%)	<0.001
Moderate	35(10%)	60(40%)	
Severe	297(85%)	52(35%)	

Mean of lymphocyte count was 1.71 in mild group of patients, 1.1 in moderate group, and 0.95 in severe group. On comparison with disease severity as per CTSS, mean of lymphocyte count shows decreasing trend with increasing disease severity with significant statistical correlation (p = 0.001).

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Mean of CRP was significantly higher in severe group (15.2) as compared to mild (6.5) and moderate (6.79) group. This finding was also found to have positive statistically significant correlation with CTSS (p = 0.035).

Mean of leucocyte count was 11.56 in mild group of patients, 12.56 in moderate group, and 18.6 in severe group. On comparison with disease severity as per CTSS, mean of leucocyte count shows increasing trend with increasing disease severity, however, with insignificant statistical correlation (p = 1.102).

Mean of ESR count was 48 in mild group of patients, 44 in moderate group, and 62 in severe group. This was found to be statistically insignificant on comparison with CTSS (p = 1.03)

Mean of D-dimer values was 845.6 in mild group of patients, 1105 in moderate group, and 2556.6 in severe group. On comparison with disease severity as per CTSS, mean of D-dimer shows increasing trend with increasing disease severity, with positive statistical correlation (p = 0.003).

Mean of serum ferritin was 208.1 in mild group of patients, 566.5 in moderate group, and 712.5 in severe group. On comparison with disease severity as per CTSS, mean of serum ferritin shows increasing trend with increasing disease severity, with positive statistical correlation (p = 0.002).

Among the patients who died (70%) of COVID-19 disease, 85% had severe disease, and 10% had moderate grade disease, while only 5% has mild grade disease.

This suggested that a significantly higher proportion of cases who did not survive had a severe grade of disease on CT scan. In contrast, the proportion of cases who survived was comparable among all grades of severity on CT scan. This difference between the two groups was statistically significant (p = 0.001). The mean CT severity score among patients who died was significantly higher than patients who survived.

DISCUSSION

Assessing the degree and prognosis of lung involvement can also be done with the help of chest CT (5, 6, 8–10, 13). A number of semi-quantitative CT scoring methods that clearly determine the degree of lung abnormalities in COVID-19 have been proposed.

High-resolution chest CT has been shown to have a sensitivity of 67–100% for detecting COVID-19 in symptomatic patients, which is higher than that of RT PCR, which has a sensitivity of 53–88%, particularly in the early stages of the illness. According to clinical studies, the specificity of CT ranged from 25 to 80%, but if the modest RT-PCR sensitivity is taken into account, it may even be in the upper third [“reverse calculation approach”;[10] Nonetheless, the radiologist's experience and the local incidence of COVID-19 and other respiratory pathogenic viruses affect its specificity. It is not advised for screening due to the radiation exposure, time commitment, and possibly high number of CT scans; however, it can be a helpful tool in helping critically ill patients make decisions by providing a clinical picture of COVID but a negative RT-PCR test.[11,12]

Furthermore, it is well recognized that radiological patterns and changes—which are clearly linked to pathological changes—have prognostic significance in addition to the extent of lung involvement. Consolidation, an air bronchogram, pleural fluid, lymphadenomegaly, and an increase in pulmonary artery diameter have all been linked to a worse prognosis. One potential solution to this issue could be the scoring system employed in the Yuan et al. study.[13] This system considers both the radiological pattern and the degree of lung involvement. Computerized scoring systems with software support that compute the lung volume and air content of a given unit work on this principle.[14] Palumbo et al.'s study,[15] found that non-aerated lung tissue and disease progression were related, and that disease progression was associated with a lower total lung volume. These programs require radiological supervision and are not available in many hospitals, despite the fact that they are highly accurate and can save a significant amount of time when used.[16]

The age range of the majority of cases was 61–80 years, with 41–60 years coming in second. The youngest participant in the study, who was the only case, was eighteen years old. The oldest person there was eighty-seven years old. The study group's average age was 55.26 (± 15.71) years. The mean age of the patients in prior research, according to Bhandari S et al,[17] was 50.40 years, which is extremely close to our findings.This study showed statistically significant correlation between severity of disease and increasing age of the patient.

When compared to severe disease, which was more common in older age groups, a higher percentage of cases with mild disease had younger ages. Numerous factors, including the patients' comorbidities, the state of the pandemic, and the healthcare system's availability, can be attributed for this.

Of the total patients, 72.4% had at least one underlying comorbid condition, such as COPD, hypertension, diabetes mellitus, or another condition. The proportion of cases with comorbidity in mild grade disease was higher in this study, but the difference was not statistically significant. This research carries similarities to Saeed G's earlier work.[18]

According to the degree of lung involvement evaluatedby CT severity score (CTSS) of all the lobes of bothlungs, the patients were classified on the basis of severityof CTSS score as mild (grade1), moderate (grade 2), andsevere (grade 3). In our study population, more than half of the cases had a Mild grading on CT scan. More thana quarter of the

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cases were labeled as moderately severe on CT score, while 84(16.8%) cases had mild severity.

This study demonstrated a statistically significant relationship between increasing CT severity and elevated CRP levels. Additionally, prior research has indicated that CRP may serve as a predictive marker for the chance of disease progression and may help doctors treat patients early on in the course of their illness. In a similar way, serum ferritin serves as an essential mediator of immune dysregulation, as demonstrated by this study, which found a strong correlation between serum ferritin levels and disease severity.[19] Similarly, increased D-dimer levels have been linked to severe illness and may serve as a prognostic marker. Higher CT severity grade was correlated with a higher mortality rate among COVID-19 patients in this study. Patients who passed away had a mean CT severity score that was noticeably higher than that of survivors.

CONCLUSION

The COVID-19 patients' chest CT severity score has a positive correlation with inflammatory laboratory markers, making it a useful tool for predicting the severity and prognosis of the illness. Nucleic acid test results, epidemiological data, and CT chest imaging should be incorporated into a thorough evaluation in order to fully explain the management plan for COVID-19 pneumonia.

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