

Assessment of Clinical Symptoms, Serum Interleukin-6 Levels, and HRCT Lung Involvement in COVID-19 Positive Patients Admitted to a Tertiary Care Hospital in South Gujarat: A Secondary Data Analysis

Bhavin Katariya¹, Bansari Baldaniya², Jaydeep Katariya³, Mahesh G Solu⁴

¹Assistant Professor, Bharati hospital and research centre, Pune, Maharashtra, India. ²Infectious Disease fellow, Department of General Medicine, Bharati hospital and research centre, Pune, Maharashtra, India. ³Consultant Prosthodontist, Katariya Dental and implant center, Surat, Gujarat, India. ⁴Additional Professor, Government medical College Surat, Gujarat, India

Abstract

Background: Coronavirus disease 2019 (COVID-19) has a broad clinical spectrum from asymptomatic infection to severe respiratory failure and death. An exaggerated inflammatory response and cytokine release syndrome are key for disease progression. Interleukin-6 (IL-6) has been found to be an essential indicator of inflammation, whereas High-Resolution Computed Tomography (HRCT) is a useful technique to detect pulmonary involvement. The association of IL-6 levels, HRCT results and clinical outcome can help to early risk classification and better management of patients. The objective is to analyze clinical symptoms of patients with COVID-19 and to evaluate correlation of serum IL-6 levels, HRCT lung involvement, illness severity and outcome of patients. **Material and Methods:** Retrospective secondary data analysis of 300 adult COVID-19-positive admitted patients of New Civil Hospital, Surat. Demographic profile, clinical features, serum IL-6 levels, HRCT findings, severity of the disease and outcomes were reviewed from hospital records. Statistical analysis was done using SPSS version 26. Associations were assessed using chi-square testing and $p < 0.05$ was considered statistically significant. **Results:** The mean age was 52.5 ± 16.82 years. 67.3% of the sample was male. The most frequent presenting symptoms were cough (99.3%), pyrexia (67.3%) and dyspnea (47.7%). Mild, moderate, severe and critical illness was seen in 40%, 36%, 17% and 7% of patients correspondingly. IL-6 was elevated (>40 pg/mL) in 36% of patients. There was 11% mortality rate. There were significant relationships between clinical severity and IL-6 levels ($p < 0.001$), clinical severity and HRCT lung involvement ($p < 0.001$), IL-6 levels and mortality ($p = 0.00077$), HRCT lung involvement and mortality ($p = 0.001$) and disease severity and mortality ($p < 0.001$). **Conclusion:** Increased IL-6 levels and HRCT lung involvement were highly linked with severity of disease and mortality in COVID-19 hospitalized patients. Simultaneous assessment of inflammatory and radiological indicators may assist early detection of high risk individuals and better clinical decision making.

Keywords: COVID-19; Interleukin-6; HRCT; Lung involvement; Disease severity; Mortality; Biomarkers.

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INTRODUCTION

The Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) triggered the Coronavirus disease 2019 (COVID-19) and quickly developed into a global pandemic, presenting an unprecedented challenge to healthcare systems around the world.^[1,2] The majority of infected persons have moderate symptoms, but a significant proportion develop severe pneumonia, acute respiratory distress syndrome (ARDS), multi-organ failure, and mortality.^[3,4] The etiology of severe COVID-19 is defined by dysregulated immunological activation with increased production of pro-inflammatory cytokines and chemokines leading to cytokine release syndrome (CRS).^[5] IL-6 is one of the most prominent mediators of inflammation and cytokine storm syndrome in COVID-19 among different cytokines.^[6] Elevated levels of IL-6 have been linked to respiratory failure, intensive care unit (ICU) admission, mechanical ventilation and mortality.^[7,8] Herold et colleagues demonstrated that elevated IL-6 levels can be used to predict respiratory failure and disease progression in patients with COVID-19 who are

hospitalized.^[9]

High resolution computed tomography (HRCT) of the chest is a significant diagnostic and prognostic technique in the diagnosis of COVID-19 pneumonia.^[10] The typical HRCT findings include bilateral ground-glass opacities, consolidation, interlobular septal thickening, and crazy-paving patterns.^[11] Several studies have shown that the degree of lung involvement on HRCT corresponds closely with oxygen need, severity of disease, need for ICU admission and mortality.^[12,13] Yang et al. observed that CT severity scores were substantially related to severe illness and

Address for correspondence: Dr. Mahesh G Solu, Additional Professor, Government medical College Surat, Gujarat, India. E-mail: drmaheshgsolu@yahoo.in

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bad clinical outcomes.^[14]

While there is growing evidence of the role of inflammatory biomarkers and radiological findings, there is minimal data from Western India studying integrated relationships between serum IL-6 levels, HRCT lung involvement, disease severity and clinical outcomes. Hence, the present investigation was aimed to evaluate the clinical features of COVID-19 and to investigate the association of serum IL-6 levels and HRCT findings with disease severity and outcomes in hospitalized patients of COVID-19.

MATERIALS AND METHODS

Study Design: Retrospective secondary data analysis.

Study Setting: Department of General Medicine, Government Medical College and New Civil Hospital, Surat, Gujarat.

Study Population: COVID-19-positive patients admitted to wards and intensive care units.

Sample Size: 300 patients.

Inclusion Criteria:

- Adult patients (>18 years)
- RT-PCR or Rapid Antigen Test positive for COVID-19
- Availability of serum IL-6 and HRCT records

Exclusion Criteria:

- Missing IL-6 or HRCT records
- Pediatric patients

Data Collection: Clinical records were reviewed for demographic details, symptoms, IL-6 levels, HRCT findings, disease severity, and outcomes.

Statistical Analysis: Data were analyzed using SPSS version 26. Categorical variables were expressed as frequencies and percentages. Associations were assessed using Chi-square tests. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Characteristics of Study Participants

Variable	Value
Sample size	300
Mean age	52.5 ±16.82 years
Male	202 (67.3%)
Female	98 (32.7%)
Mean hospital stay	7.69 ±5.8 days

The majority of participants belonged to the 51–60 year age group (30.6%), followed by 61–70 years (16.7%). Males outnumbered females by approximately 2:1.

Table 2: Clinical Symptoms

Symptom	Frequency (%)
Cough	298 (99.3)
Fever	202 (67.3)
Breathlessness	143 (47.7)
Weakness	6 (2.0)
Headache	5 (1.6)

Cough was the most common symptom followed by fever and breathlessness.

Table 3: Clinical Severity

Severity	n (%)
Mild	120 (40.0)
Moderate	108 (36.0)
Severe	51 (17.0)
Critical	21 (7.0)

Moderate-to-severe disease constituted 60% of all admissions.

Table 4: Serum IL-6 Levels

IL-6 (pg/mL)	n (%)
<20	57 (19)
21–40	135 (45)
>40	108 (36)

More than one-third of patients demonstrated markedly elevated IL-6 levels (>40 pg/mL).

Table 5: HRCT Lung Involvement

HRCT Involvement	n (%)
<10%	73 (24.3)
11–20%	82 (27.3)
21–30%	34 (11.3)
31–40%	26 (8.6)
41–50%	9 (3.0)
51–60%	23 (7.6)

61–70%	18 (6.0)
71–80%	32 (10.6)
>80%	3 (1.0)

Approximately 52% of patients had $\leq 20\%$ lung involvement.

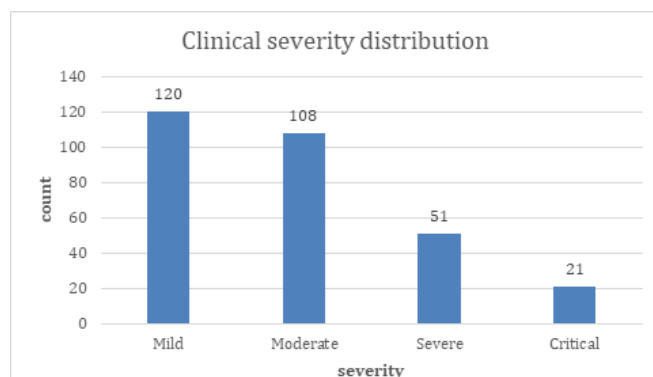


Figure 1: Distribution of Clinical Severity

Association Between IL-6 and Clinical Severity: A significant association was observed between disease severity and serum IL-6 levels ($p < 0.001$). Elevated IL-6 (> 40 pg/mL) was found in 60.2% of moderate cases, 62.7% of severe cases, and 47.6% of critically ill patients.

Association Between HRCT Involvement and Clinical Severity: All mild cases demonstrated less than 21% lung involvement, whereas all critically ill patients exhibited greater than 70% involvement on HRCT. This association was statistically significant ($p < 0.001$).

Outcome Analysis: Of the 300 patients, 266 (89%) were discharged and 34 (11%) died.

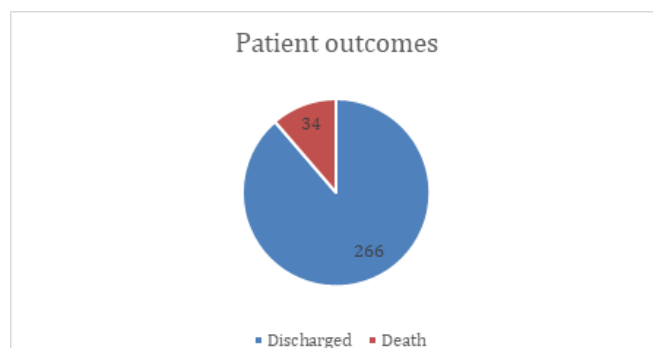


Figure 2: Outcome of Patients

IL-6 and Mortality: Mortality increased progressively with rising IL-6 levels. Death occurred in 3.5% of patients with IL-6 < 20 pg/mL compared with 20.4% among patients with IL-6 > 40 pg/mL ($p = 0.00077$).

HRCT and Mortality: No deaths occurred among patients with less than 20% lung involvement. Mortality reached 62.5% among patients with 71–80% lung involvement and 100% among those with $> 80\%$ involvement ($p = 0.001$).

Disease Severity and Mortality: Mortality increased dramatically with disease severity, ranging from 0% in mild disease to 82.6% among critically ill patients ($p < 0.001$).

DISCUSSION

We examined the association of clinical symptoms, serum IL-6 concentrations, HRCT lung involvement and outcomes in hospitalized COVID-19 patients. The results suggest that inflammatory and radiological markers are highly related with disease severity and mortality.

The average age of participants was 52.5 years and the most number of participants were in the age range of 51–60 years. Such age distributions have been described by various Indian and international research demonstrating that middle-aged and elderly persons continue to be particularly sensitive to severe COVID-19 infection and related consequences.^[3,15] The male preponderance in the present study is also consistent with earlier results which might be due to the differences in exposure patterns, smoking habits, hormonal impacts and immunological responses between sexes.^[16]

Cough and fever were the most common symptoms in the present investigation. These results are consistent with Huang et al. and Guan et al,^[3,4] who described fever, cough, and dyspnea as the main clinical features of hospitalized patients with COVID-19. Almost half of the patients were breathlessness and this was commonly coupled with significant lung involvement and hypoxemia indicating progression to moderate or severe illness. A main finding of this investigation was the strong correlation of serum IL-6 levels with illness severity. IL-6 is a pleiotropic cytokine implicated in acute phase responses, immunological control and inflammatory cascades.^[5] High IL-6 levels are associated with cytokine storm syndrome, endothelial damage, coagulation problems and development to ARDS.^[17] Our findings are in line with earlier research that have reported elevated levels of IL-6 in severe and critically ill individuals. Ulhaq and Soraya, [9,18] found a robust correlation between high IL-6 levels and severe COVID-19 disease. Herold et al,^[9] demonstrated that high IL-6 levels were highly predictive of respiratory failure.

The correlation between lung involvement at HRCT and clinical severity was also striking. All mild instances had $< 21\%$ lung involvement, whereas critically ill individuals always had significant pulmonary disease. HRCT allows a direct evaluation of the pulmonary inflammatory burden and reflects the degree of alveolar injury, interstitial edema and consolidation.^[10,11] Thus, HRCT severity rating may be a useful addition to early risk classification. Similar findings were published by Yang et al. and Francone et al. who showed that the increase in CT severity ratings was substantially associated with disease progression, ICU hospitalization and mortality.^[14,19]

Mortality analysis demonstrated a clear dose-response connection between IL-6 levels and outcome. Patients with IL-6 levels > 40 pg/mL had a significantly increased mortality than those with lower values. This data emphasizes the predictive value of IL-6 as an early biomarker. The elevated levels of IL-6 may help in identifying patients that need active surveillance, immunomodulatory medication, and intensive care support. Similarly, Zhu et al. demonstrated increased IL-6 as an

independent predictor of poor prognosis and unfavorable clinical outcomes.^[20]

Mortality also increased progressively with increasing HRCT lung involvement. Patients with substantial lung injury (>70%) had significantly worse outcome. These results highlight the necessity of radiological examination in determining prognosis. HRCT severity assessment may help doctors to identify individuals at high risk of deterioration even in the absence of severe clinical decline. Higher CT severity scores were independently linked with short-term mortality among hospitalized COVID-19 patients,^[19] according to Francone et al.

In the present investigation, the high association between clinical severity and death is consistent with the natural history of COVID-19. All patients with moderate disease survived while more than four-fifths of critically ill patients died from the disease. This stepwise progression represents the cumulative impact of respiratory failure, cytokine storm, thromboembolic problems and multi-organ dysfunction.^[17,21] Similar increases have been seen in major cohort studies from China, Europe and the United States.^[21,22]

Thus, the combined use of IL-6 measurement and HRCT evaluation may have a better predictive value than either parameter alone. We need to intervene early and monitor closely a particularly high risk subset of patients with high IL-6 levels and significant HRCT abnormalities. The combination of inflammatory biomarkers and radiological assessment could help in early clinical decision making and enhance patient outcomes.

The characteristics of the present study include relatively high sample size and the ability to simultaneously assess clinical, biochemical, radiological and outcome indicators. However, the study had limitations, including its retrospective methodology, single-center setting, and the fact that it only examined one measurement of IL-6. Future multicentric studies should investigate serial monitoring of inflammatory markers for additional prognostic information.

CONCLUSION

IL-6 levels in serum and HRCT lung involvement are highly linked to disease severity and mortality in patients with COVID-19 admitted to hospital. Predictors of unfavorable outcomes in patients include elevated IL-6 levels and significant lung involvement. A combined evaluation of inflammatory biomarkers and HRCT findings can help to stratify risk early, optimize therapeutic care and enhance patient outcomes.

Limitations

1. Single-center study.
2. Retrospective design.
3. Moderate sample size.
4. Single IL-6 measurement evaluated.
5. Potential confounding by coexisting inflammatory conditions.

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Conflicts of interest

There are no conflicts of interest.

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