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CORRELATION OF DEMOGRAPHIC PROFILE WITH LABORATORY PARAMETERS AND CLINICAL FACTORS AS PREDICTORS OF COVID-19 SEVERITY: A COMPREHENSIVE ANALYSIS

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Abstract

The COVID-19 pandemic has underscored the importance of understanding the various factors that impact disease severity and patient outcomes. Extensive research has unveiled the intricate relationship between laboratory parameters and the progression of COVID-19, offering vital insights for informed treatment decisions and a deeper comprehension of the virus. The wide spectrum of COVID-19, ranging from mild cases to severe, life-threatening conditions, highlights the urgent need for reliable methods to predict illness severity, crucial for risk assessment and efficient resource allocation, particularly for vulnerable populations. COVID-19 diagnosis relies on diverse methods, while laboratory techniques provide objective assessments of physiological and pathological changes induced by the virus. This study specifically investigates the connection between liver function tests and demographic factors with COVID-19 severity. By examining common laboratory tests and demographic elements like age, gender, and smoking status, this study reveals essential insights into their correlations with COVID-19 severity, particularly emphasizing the significance of liver function tests.

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INTRODUCTION

The COVID-19 pandemic has profoundly impacted the global healthcare system, underscoring the urgency of investigating the intricate factors that determine the intensity of illness and patient outcomes. [1] Extensive research has explored the connection between laboratory factors and the severity of COVID-19, yielding invaluable insights into disease progression, treatment decision-making, and the fundamental characteristics of the SARS-CoV-2 virus. [1,2]

COVID-19 has demonstrated a wide spectrum of clinical manifestations, ranging from mild or asymptomatic cases to severe multi-organ failure and life-threatening respiratory distress, often necessitating urgent medical intervention. Establishing reliable methods for projecting illness severity is of paramount importance, as it can inform risk assessment, optimize resource allocation, and enable early interventions for individuals at higher risk. [3-5]

The COVID-19 pandemic, driven by the virulent SARS-CoV-2 virus, has emerged as a global health crisis. Notably, the majority of individuals infected with COVID-19 recover without the need for hospitalization, though the severity of illness is notably elevated among those aged 65 and older, as well as individuals with underlying conditions such as cancer, diabetes, chronic lung diseases, renal ailments, or cardiovascular disorders. [6]

Diagnosing COVID-19 relies on various methods, including real-time fluorescence reverse transcription-polymerase chain reaction (RT-PCR) results from nasopharyngeal swabs, gene sequencing of respiratory tract secretions, and positive rapid antigen tests. [6,7]

Furthermore, the pathological and physiological alterations induced by COVID-19 infection can be objectively assessed through laboratory techniques. Hematological, biochemical, and immunological indicators have been associated with the severity of illness, shedding light on the immune response, inflammatory processes, organ damage, and the overall health of those combatting the virus. [8]

This study endeavors to explore the impact of laboratory parameters on the severity of COVID-19, aiming to uncover discernible patterns, trends, and correlations in global research. Such insights promise to elucidate the pathophysiology of the illness and guide more informed treatment decisions. The implications extend to enhancing patient care, bolstering public health strategies, and optimizing resource allocation. [9,10]

Ultimately, the knowledge gleaned from this investigation stands to assist healthcare providers in identifying high-risk patients at an earlier stage, facilitating swift interventions, devising personalized treatment regimens, and streamlining resource allocation. [11-14]

In this study, a comprehensive examination of common laboratory tests, including complete blood counts, liver and kidney function tests, inflammatory markers, coagulation profiles, and markers of cardiac damage, will be undertaken. The results of these tests will be compared among COVID-19 patients with varying degrees of disease severity, with the goal of pinpointing dependable markers for gauging the development and prognosis of the illness. [15-16]

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MATERIALS AND METHODS

Study Design: This study follows a prospective observational design and includes all patients admitted with confirmed COVID-19 diagnoses, which were verified through RT-PCR nasal and oropharyngeal swab testing. The study was conducted at the Department of Microbiology in Sharda Hospital, Greater Noida, and Uttar Pradesh.

Data Collection

Demographic details, laboratory parameters, and the outcomes of COVID-19 cases were collected for each patient. Specifically, values of C-reactive protein (CRP), D-dimer, interleukin-6 (IL6), and serum ferritin upon hospital admission were documented.

Data Management

All collected data were meticulously recorded in a Microsoft Excel spreadsheet, which served as the primary tool for data management and analysis.

Study Period

The study was carried out over a one-year period, spanning from January 2022 to January 2023.

Disease Severity Classification

To categorize the severity of COVID-19 cases for the purposes of this study, a classification into mild, moderate, and severe categories was employed.

This classification was determined based on findings from high-resolution computed tomography (HRCT) scans, real-time polymerase chain reaction (RT-PCR) results, and clinical data, including peripheral oxygen saturation (SpO2).

Data Analysis Software

Data analysis was conducted using Microsoft Excel 2019, which is a component of the Microsoft Office Professional Edition (2019). Additionally, MedCalc statistical software, specifically version 18.2.1 developed by MedCalc Software in Ostend, Belgium, was used for more advanced statistical analysis. (http://www.medcalc.org; 2018)

Statistical Analysis

Categorical variables were summarized using counts and proportions where applicable. Continuous variables were expressed in terms of mean and standard deviation (SD) or median and interquartile range (IQR) as appropriate for the data distribution. The normal distribution of continuous variables was assessed using the Shapiro-Wilk test. To ascertain the significance of observations between the three defined groups (mild, moderate, and severe), the Kruskal-Wallis test was employed. To examine associations between categorical variables, the chi-square test was utilized.

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A statistical significance level was set at $p < 0.05$ for all tests conducted.

This comprehensive methodology allowed for the systematic collection and analysis of data, as well as the categorization of disease severity and subsequent statistical evaluation to draw meaningful insights from the study.

RESULTS

In the present study involving 219 COVID-19 patients of varying severity, the results were analyzed across multiple parameters, including laboratory tests, age, gender, and smoking status. The majority of participants were males in the age group of 31-60 years, and age did not significantly differ between males and females. Hemodynamic stability, particularly a pulse rate above 100 beats/minute and oxygen saturation below 92% on admission, was found to correlate with severe COVID-19 illness. The study showed positive correlations between smoking status and C-reactive protein (CRP) levels above 6, as well as severity (p-value 0.0051). Further positive correlations were observed between COVID-19 severity and ferritin (p-value 0.056) and D-dimer (p-value 0.0046). No significant correlation was found with IL-6. **(Table 1&2)**

The study provides valuable insights into the correlation between various laboratory parameters and COVID-19 severity, shedding light on the impact of factors like smoking status, ferritin, and D-dimer in the progression of the disease.

Table 1: Laboratory Test Results, Smoking Status, and COVID-19 Severity Correlation

Parameter	Normal Range	Cases Above Upper Limit (%)	Cases Below Lower Limit (%)	Cases Within Normal Range (%)
Total Bilirubin	0.20-1.30	6 (3.8%)	7 (4.4%)	147 (91.9%)
Direct Bilirubin	0.00-0.40	32 (20.0%)	-	128 (80.0%)
Indirect Bilirubin	0.00-1.10	4 (2.5%)	-	156 (97.5%)
AST	0.00-32.0	133 (83.1%)	-	27 (16.9%)
ALT	0.00-50.0	66 (41.3%)	-	94 (58.8%)
Alkaline Phosphatase	38.0-126.0	33 (20.6%)	2 (1.3%)	125 (78.1%)
Total Protein	6.3-8.2	5 (3.1%)	16 (10.0%)	139 (86.9%)
Albumin	3.5-5.0	2 (1.3%)	42 (26.3%)	116 (72.5%)
Globulin	2.0-3.5	20 (12.5%)	1 (0.6%)	139 (86.9%)
A:G ratio	1.10:2.50	38 (23.8%)	-	122 (76.3%)

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Table 2: Demographic Profile

Variables	Sub Categories	Frequency	Percentage
Age (years)	20-30	13	5.9%
	31-40	46	21%
	41-50	51	23.3%
	51-60	40	18.3%
	61-70	41	18.7%
	71-80	24	11%
	81-90	4	1.8%
Gender	Female	154	70.3%
	Male	65	29.7%
Blood Group	A	93	42.5%
	AB	24	11%
	B	57	26%
	O	45	20.5%
Smoking Status	Non-Smoker	146	67%
	Smoker	73	33%

DISCUSSION

A retrospective analysis has revealed the crucial role of age and several biomarkers, including Urea, Creatinine, D-Dimer, CRP, Liver Enzymes, and ferritin, as significant indicators of patient severity and in-hospital mortality in COVID-19 cases. Extensive literature analysis further confirmed that patient severity and the risk of mortality are profoundly affected by age, the presence of comorbidities, and admission with pneumonia. [17,18,19,20] Notably, the study also identified smoking as a determinant of severity and, consequently, mortality in COVID-19 patients.

Du et al. conducted a clinical study in 2020, establishing that individuals over 65 years old were particularly susceptible to COVID-19 pneumonia, with those over 68.7-110.6 years at even higher risk compared to middle-aged or younger patients [18]. Furthermore, in the derivation cohort, patients aged over 50 had a significantly elevated risk of developing severe pneumonia compared to their younger counterparts ($p < 0.05$). Similarly, patients with pre-existing comorbidities such as hypertension, diabetes, asthma, and cardiovascular illnesses exhibited a heightened risk of in-hospital mortality. ($p < 0.05$) [17]

Hyper-inflammation, characterized by a high neutrophil count and dysfunctional lymphocytes, was identified as a key factor contributing to acute respiratory distress syndrome (ARDS). [18,19] The retrospective analysis showed that elevated levels of C-reactive protein (CRP) and D-DIMER played a pivotal role in the early detection of COVID-19 patient severity during hospital admission. Additionally, ferritin levels exceeding 635.7 ng/ml emerged as a critical indicator of the severity of a patient's condition. Sulthana et al. conducted a study demonstrating a strong positive correlation between D-dimer and CRP levels, age, and mortality in a combined dataset of ICU and non-ICU COVID-19 patients. [20] Higher patient age and D-dimer values were significantly associated with ICU admission. [21]

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Ferritin, typically used for diagnosing iron deficits, displayed a multifaceted role in assessing COVID-19 severity. Elevated ferritin levels were linked to several factors, including high cytokine levels, growth factors, hepatocyte cell damage in liver disease, and the severity of pulmonary conditions. The presence of high ferritin levels in a patient's serum was also associated with pneumonia, suggesting its potential use as a diagnostic or prognostic indicator for the severity of the illness. [21,22]

CONCLUSION

In a comprehensive analysis, the significance of age, comorbidities, key biomarkers, and smoking as determinants of COVID-19 patient severity and in-hospital mortality was emphasized. These findings provided valuable insights into factors influencing COVID-19 outcomes, aiding early intervention and patient management during the pandemic. Several laboratory indicators were identified as correlating with the severity of COVID-19, making them effective biomarkers for predicting severity and assessing treatment response. The routine nature of these laboratory tests allowed for their widespread use, even in resource-poor nations, in combating severe forms of the viral illness. This research played a vital role in advancing our understanding of COVID-19.

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