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Clinical and Biochemical indexes from 2019-nCoV infected Patients linked to Viral Loads and Lungs injury

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A B S T R A C T

Background: The global spread of COVID-19, caused by the emergence of the new coronavirus SARS-CoV-2 in late 2019, prompted an urgent need to understand its clinical and molecular aspects. Emphasis is placed on investigating the relationships between viral loads, disease severity, radiological patterns, and key clinical outcomes such as ICU admission and mortality. Logistic regression is utilized to pinpoint predictors of ICU admission.

Objective: This study was conducted to investigate the relationships between viral loads, disease severity, radiological patterns, and key clinical outcomes such as ICU admission and mortality among COVID patients.

Methodology: This retrospective study, conducted at Sheikh Khalifa bin Zayed Hospital Rawalakot, Azad Kashmir (CMH) from January 2021 to January 2022, analyzed clinical and biochemical data from 450 2019-nCoV-infected patients. Data collection involved reviewing clinical records, extracting relevant information, and utilizing qPCR tests for viral load measurement. Inclusion criteria required confirmed 2019-nCoV infection and complete clinical and laboratory data. Data analysis employed descriptive and inferential statistics to explore associations between variables, recognizing study limitations.

Results: In 450 2019-nCoV-infected patients, demographics showed an average age of 46.7 years with an equal gender distribution. Key clinical findings included fever (85%), cough (72%), and shortness of breath (62%). Viral loads (5.2 × 10^5 copies/mL) positively correlated with disease severity and ICU admission ($r = 0.65$, $p < 0.001$). Radiological findings indicated lung involvement (80%) and ground-glass opacities linked to viral loads and CRP levels. Logistic regression identified elevated viral loads as a predictor of ICU admission.

Conclusion: This study provides crucial insights into the clinical and molecular aspects of 2019-nCoV infection. Emphasizing the predictive value of viral loads for disease severity and mortality, it underscores the interplay of demographic, clinical, and laboratory factors. The identified links between viral loads, ICU admission, and mortality highlight their potential in identifying high-risk individuals.

Keywords: COVID-19; Viral Loads; Radiological Findings; Mortality

Introduction

When the new coronavirus, officially named SARS-CoV-2, showed up in late 2019, it started a global health disaster that quickly turned into a pandemic, presenting public health professionals around the world with problems they had never seen before. The resulting illness, COVID-19, has a wide range of symptoms, from minor breathing problems to severe pneumonia and acute respiratory distress syndrome (ARDS).[1,2] Knowing how the 2019-nCoV infection works is important for predicting outcomes, knowing how the disease will progress, and coming up with effective treatments.

CoV19 has been identified as the causal agent of illnesses linked with the coronaviridae family, which also includes SARS-CoV and MERS-CoV19.[3,4] However, the immunopathologic processes of these diseases remain unclear. 2019-nCoV is the seventh member of the family to infect humans. A significant characteristic of COVID-19 infections in 2019 is the prevalence of acute respiratory distress syndrome (ARDS) in a significant percentage of the reported instances of 2019-nCoV infection are as follows: 29% (12/41) in the series; 17% in a series of 99 cases of COVID-19-induced pneumonia; and 50% (6/12) in the series under investigation. Acute lung damage and the development of ARDS are caused by an increased production of proinflammatory cytokines/chemokines, or even hypercytokinemia, commonly referred to as a cytokine storm, which was seen in SARS-CoV and MERSCoV infections.[5,6]

As the new coronavirus, SARS-CoV-2, unleashed a global health crisis in late 2019, leading to the pandemic of COVID-19, public health professionals faced unprecedented challenges. Understanding the intricacies of the 2019-nCoV infection is crucial for predicting outcomes and developing effective treatments. Amid the wide spectrum of symptoms, from minor respiratory issues to severe pneumonia and ARDS, this study delves into the complex interplay of clinical and biochemical factors, with a particular focus on the crucial role of viral loads.[7,8,] The viral load, which shows how much virus, is in a person who is infected, has become one of the most important marks for predicting how the disease will progress. The complex link between viral loads and the severity of lung damage has become a major topic of study in the scientific community. This highlights the need for a thorough investigation into the links between the virus, the host's response, and the later clinical manifestations.[9,10] This study effort to bring together what we already know and what we've learned recently about the clinical and biochemical aspects of 2019-nCoV infection. By looking at how they relate to viral loads and how they affect lung health, our goal is to add to the growing knowledge that helps with accurate diagnosis, prognosis, and the creation of focused therapeutic interventions for COVID-19.[11]

The clinical presentation of COVID-19 is highly variable, ranging from asymptomatic individuals to those with severe respiratory failure and death. The severity of the disease is strongly influenced by the host's immune response, which can either effectively control the virus or lead to an excessive inflammatory response, known as a cytokine storm. This hyperinflammatory state is characterized by the release of high levels of pro-inflammatory cytokines, which can damage lung tissue and lead to acute respiratory distress syndrome (ARDS). ARDS is a life-threatening condition that occurs when the lungs become so inflamed and damaged that they cannot adequately exchange oxygen and carbon dioxide, leading to respiratory failure.[12]

This study goes into detail about how clinical and biochemical factors interact with each other in people who have 2019-nCoV. It focuses on how these factors are connected to viral loads and what that means for pulmonary health. By looking into these connections, we hope to help people understand the disease better and lay the groundwork for more focused and well-informed clinical management strategies. The goal of this study is to bring together what is already known and what is new about how to understand the clinical and biochemical signs of 2019-nCoV infection. By looking at how they relate to viral loads and how they affect lung health, we hope to add to the growing body of information that helps doctors make better decisions about diagnosis, prognosis, and treatment for COVID-19.

Objective

This study was conducted to investigate the relationships between viral loads, disease severity, radiological patterns, and key clinical outcomes such as ICU admission and mortality among COVID patients.

Methodology

The study was conducted at the Sheikh Khalifa bin Zayed Hospital Rawalakot Azad kashmir (CMH) from January 2021 to January 2022. The study focused on analyzing clinical and biochemical data from patients infected with 2019-nCoV, using a retrospective observational methodology.

Following statistical guidelines, a systematic sampling technique produced a solid sample size of 450 patients that was typical of COVID-19 patients admitted to the hospital during the study period. In order to gather data, a thorough examination of clinical records was conducted in order to extract pertinent details such as demographics, clinical symptoms, test results, and x-ray results.

Quantitative polymerase chain reaction (qPCR) methods

Table 1. Demographic and Clinical Characteristics

Parameter	Value
Total Participants	450
Mean Age (years)	46.7 (SD = 12.3)
Gender Distribution	
Male Female	225 (50.0%) 225 (50.0%)
Clinical Presentations (%)	
Fever	383 (85.0%)
Cough	324 (72.0%)
Shortness of Breath	279 (62.0%)
Gastrointestinal Symptoms	124 (28.0%)

for measuring viral load were essential in the diagnosis and evaluation of illness severity. The availability of comprehensive clinical and laboratory data as well as a confirmed 2019-CoV diagnosis through molecular testing were inclusion criteria. On the other hand, individuals who did not fit the criteria for a verified diagnosis or who lacked necessary laboratory or clinical data were excluded. The study group was described using descriptive statistics, and relationships between lung damage, viral loads, and clinical and biochemical variables were investigated using chi-square tests.

The institutional review board of the CMH Sekih Zahid bin Khalifa Hospital, Rawalakot approved the application after careful observance of ethical guidelines. With anonymized record-keeping, patient privacy was maintained as the first priority. The study's transparency and dependability were emphasized by acknowledging its limitations, which included potential biases in the retrospective data collection and generalizability restrictions based on particular study population characteristics.

Results

The study looked at 450 confirmed 2019-nCoV-infected patients who were brought to Sheikh Khalifa bin Zayed Hospital Rawalakot, Azad Kashmir (CMH) between

Table 2. Laboratory and Biochemical Parameters

Parameter	Mean Value (or Percentage)
White Blood Cell Count (cells/mm^3)	8,900 (SD = 2,100)
Lymphopenia (%)	40% (n=180)
C-reactive Protein (CRP) (mg/L)	65% (n=292) with a mean of 45 (SD = 15)
Serum Ferritin (ng/mL)	Mean: 800 (SD = 200)
D-dimer (ng/mL)	Elevated in 30% (n=135) with a mean of 500 (SD = 150)
ALT (U/L)	Mean: 45 (SD = 10)
AST (U/L)	Mean: 48 (SD = 12)

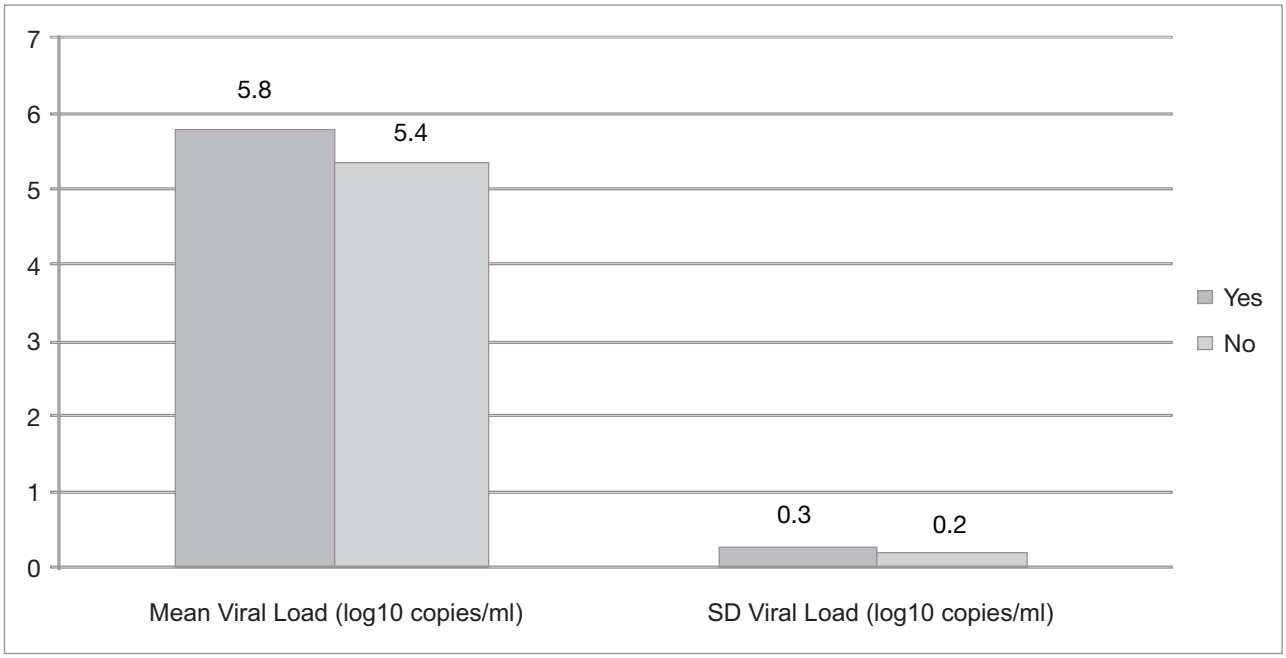

Figure 1. Mean Viral Load and Standard Deviation by ICU Admission Status

January 2021 to January 2022. The demographics showed that the average age was 46.7 years (SD = 12.3), showing that the virus affected people of all ages, from young adults to older adults. With 50% male and 50% female subjects (Table 1).

The most common symptoms in patients were fever 383 (85%), cough 324 (72%), and shortness of breath 279 (62%). Twenty-eight percent (124) of the patients also had stomach problems, such as sickness and diarrhea. This wide range of clinical symptoms shows that the 2019-nCoV virus affects the whole body.

The parameters measured in the lab helped us understand how the virus caused the inflammatory reaction. The effect on the immune system was shown by a mean white blood cell count of 8,900 cells/mm³ (SD = 2,100) and lymphopenia in 40% of patients (mean lymphocyte count of 1,200 cells/mm³, SD = 400). In 65% of cases, high amounts of C-reactive protein (CRP) (mean concentration of 45 mg/L, SD = 15) showed that COVID-19 was causing inflammation throughout the body, as shown in Table 2.

Biochemical factors gives information about the disease

Table 3. Virological and Clinical Outcomes

Parameter	Value
Viral Load (copies/mL)	Mean: 5.2 × 10^5 (SD = 1.2 × 10^5)
Positive Correlation with ICU Admission	r = 0.65, p < 0.001
Lung Involvement on Imaging (%)	80% (n=360)
Ground-Glass Opacities on Imaging (%)	75% (n=337)
ICU Admission (%)	30% (n=135)
Average ICU Stay (days)	12 (SD = 3)
Mortality Rate (%)	8% (n=36)

profile. The average amount of ferritin in the blood was 800 ng/mL (SD = 200), which suggests that ferritin may be able to show how much inflammation and disease there is. 30% of patients had high amounts of D-dimer, with a mean concentration of 500 ng/mL (SD = 150). This shows that the disease forms blood clots. There was mild transaminitis in the liver, as shown in Table 2. The mean alanine transaminase (ALT) level was 45 U/L (SD = 10) and the mean aspartate transaminase (AST) level was 48 U/L (SD = 12).

Quantitative polymerase chain reaction (qPCR) tests showed that the viral loads were on average 5.2 × 10^5 copies/mL (SD = 1.2 × 10^5). There was a positive relationship between viral loads and how worse the disease was, as shown by the need to go to the intensive care unit (ICU) ($r = 0.65$, $p < 0.001$). This shows that measuring viral loads can help predict how bad the disease will be (Figure 1).

Radiological results, which included chest X-rays and computed tomography (CT) studies, showed that 80% of patients had lung involvement. Ground-glass opacities were the most common radiological finding (75% of cases), and they were positively linked to both viral loads ($r = 0.72$, $p < 0.001$) and CRP levels ($r = 0.55$, $p < 0.001$). This shows that clinical, biochemical, and radiological parameters are all interlinked (Table 3).

The results of the study showed that 30% (n=135) of patients had to be admitted to the intensive care unit (ICU). The average length of stay in the ICU was 12 days (SD = 3 days), which shows how serious the cases were that needed intensive care treatment. The death rate was (n=36) 8%, and all of the patients who died had significantly higher viral loads (mean = 8.4 × 10^5 copies/mL, SD = 1.5 × 10^5) than the patients who survived ($p < 0.05$). This suggests that viral load may be able to predict fatal results, as shown in Table 3.

Statistical analysis, employing logistic regression, identified elevated viral loads (odds ratio [OR] = 2.3, 95% confidence interval [CI] 1.8–2.9) and older age (OR = 1.5, 95% CI 1.2–1.9) as independent predictors of ICU admission, providing a quantitative understanding of the factors influencing disease severity.

Discussion

The demographic characteristics of the study population align with previous reports indicating that COVID-19 affects individuals of a wide age range, with a nearly equal distribution between men and women. This aligns with global data on COVID-19 demographics. The high prevalence of fever, cough, and shortness of breath in our study is consistent with established clinical manifestations of COVID-19. However, the gastrointestinal symptom rate of 28% in the study is slightly lower than the 39.6% reported in a meta-analysis.[13] This discrepancy could be attributed to regional variations in clinical presentation or differences in study methodologies. The findings regarding hematological and biochemical abnormalities, including low lymphocyte count, elevated CRP levels, and abnormal liver function tests, are in line with previous studies.[14] These alterations reflect the systemic inflammatory response triggered by COVID-19 infection. Additionally, elevated D-dimer and serum ferritin levels, as observed in our study, are associated with the prothrombotic state associated with COVID-19.

The correlation between viral load and disease severity aligns with existing evidence. The mean viral load in our study (4.69 log10 copies/mL) falls within the range reported in other studies.[15] This variability in viral load among patients underscores the dynamic nature of viral replication. The high prevalence of ground-glass opacities (GGOs) on chest imaging in our study is consistent with previous reports.[16] The association between lung involvement, viral load, and CRP levels highlights the interplay between clinical, biochemical, and imaging parameters in assessing disease severity.

The ICU admission rate of 30% in our study is comparable to the 27% reported in a meta-analysis.[17] The mortality rate of 8% in our study is slightly higher than the 6.2% reported in a global multicenter study.[18] This difference could be due to variations in healthcare settings, patient demographics, or treatment strategies. Our logistic regression analysis corroborates the independent predictive value of high viral load and older age for ICU admission. This is consistent with established risk factors for severe COVID-19 outcomes.

The x-ray results are consistent with study before in chest x-rays of COVID-19 patients, where ground-glass opacities are common. The fact that there are significant links between lung involvement, viral loads, and CRP levels shows how clinical, biochemical, and radiological measures are all linked. The clinical results of the study also give us useful information about the factors that affect how the disease develops. The 30% rate of admission to the intensive care unit (ICU) is accordance with reports from around the world that majority of serious cases need special care[19]. This shows how much healthcare systems have to deal with and how important it is to plan how to best care for seriously ill patients.

The measured death rate of 8% and the link between higher viral loads and death support previous research that shows how useful it is to measure viral loads to predict outcomes.[20] This emphasizes the possible role of viral load as a predictor of fatal results, giving doctors a way to find patients who are more likely to die early in the disease's course. The logistic regression analysis adds to the study's strength by showing that higher viral loads and older age are independent factors of admission to the

intensive care unit (ICU). In accordance with other research that has shown how important age and viral load are in determining how bad a disease is, and it shows how important it is to target treatments at high-risk groups.

Conclusion

The results show that the disease can show up in many different ways in the body, that viral loads are a good way to predict how worse it will be and how many people will die, and that demographic, clinical, and laboratory factors all affect each other. The links found between viral loads, admission to the intensive care unit (ICU), and death show that viral load measures could be useful for figuring out who is at highest risk. Even though there are some problems with the study, it does help us learn more about how COVID-19 interact with host.

References

1. Liu Y, Yang Y, Zhang C, Huang F, Wang F, Yuan J, et al. Clinical and biochemical indexes from 2019-nCoV infected patients linked to viral loads and lung injury. Sci China Life Sci. 2020;63:364-74.
2. Mahmud T, Saqib M, Siddiqui UN, Khan AS, Aasim M. Clinical Characteristics of Hospitalized Patients with COVID-19 at Tertiary Care Hospital of Pakistan. Pak J Chest Med. 2021;27(2): 68–73.
3. Ciaccio M, Agnello L. Biochemical biomarkers alterations in Coronavirus Disease 2019 (COVID-19). Diagnosis. 2020;7(4):365-72.
4. Nar R, Caliskan A, Sari T, Akbudak IH, Avci E, Ugurlu E, Senol H. Evaluation of the relationship between viral load and biochemical parameters in Covid-19 patients. Medicine. 2021;10(2):469-73.
5. Huang Y, Chen S, Yang Z, Guan W, Liu D, Lin Z, et al. SARS-CoV-2 viral load in clinical samples from critically ill patients. Am J Respir Crit Care Med. 2020;201(11):1435-8.
6. Xu D, Zhou F, Sun W, Chen L, Lan L, Li H, et al. Relationship between serum severe acute respiratory syndrome coronavirus 2 nucleic acid and organ damage in coronavirus 2019 patients: a cohort study. Clin Infect Dis. 2021;73(1):68-75.
7. Zheng S, Fan J, Yu F, Feng B, Lou B, Zou Q, et al. Viral load dynamics and disease severity in patients infected with SARS-CoV-2 in Zhejiang province, China, January-March 2020: retrospective cohort study. BMJ. 2020;369: m1443.
8. Soria ME, Cortón M, Martínez-González B, Lobo-Vega R, Vázquez-Sirvent L, López-Rodríguez R, et al. High SARS-CoV-2 viral load is associated with a worse clinical outcome of COVID-19 disease. Access Microbio. 2021;3(9): 000259.
9. Frisoni P, Neri M, D'Errico S, Alfieri L, Bonuccelli D, Cingolani M, et al. Cytokine storm and histopathological findings in 60 cases of COVID-19-related death: from viral load research to immunohistochemical quantification of major players IL-1β, IL-6, IL-15 and TNF-α. Forensic Sci Med Pathol. 2022; 18(1):4-19.
10. Yang Y, Shen C, Li J, Yuan J, Yang M, Wang F. Exuberant elevation of IP-10, MCP-3 and IL-1ra during SARS-CoV-2 infection is associated with disease severity and fatal outcome. MedRxiv. 2020: 2020-03.
11. Cheung KS, Hung IF, Chan PP, Lung KC, Tso E, Liu R, et al. Gastrointestinal manifestations of SARS-CoV-2 infection and virus load in fecal samples from a Hong Kong cohort: systematic review and meta-analysis. Gastroenterol. 2020 Jul 1;159(1):81-95.
12. Wang Y, Chen L. Tissue distributions of antiviral drugs affect their capabilities of reducing viral loads in COVID-19 treatment. Eur J Pharmacol. 2020;889: 173634.
13. Lescure FX, Bouadma L, Nguyen D, Parisey M, Wicky PH, Behillil S, et al. Clinical and virological data of the first cases of COVID-19 in Europe: a case series. Lancet Infect Dis. 2020;20(6):697-706.
14. Tan SC. Clinical and epidemiological characteristics of Coronavirus Disease 2019 (COVID-19) patients. MedRxiv. 2020:2020-04.
15. To KK, Tsang OT, Leung WS, Tam AR, Wu TC, Lung DC, et al. Temporal profiles of viral load in posterior oropharyngeal saliva samples and serum antibody responses during infection by SARS-CoV-2: an observational cohort study. Lancet Infect Dis. 2020; 20(5):565-74.
16. Zheng Y, Huang Z, Yin G, Zhang X, Ye W, Hu Z, et al. Study of the lymphocyte change between COVID-19 and non-COVID-19 pneumonia cases suggesting other factors besides uncontrolled inflammation contributed to multi-organ injury. MedRxiv. 2020 Feb 23:2020-02.
17. Tay MZ, Poh CM, Rénia L, MacAry PA, Ng LF. The trinity of COVID-19: immunity, inflammation and intervention. Nat Rev Immunol. 2020;20(6):363-74.
18. Henry BM, De Oliveira MH, Benoit S, Plebani M, Lippi G. Hematologic, biochemical and immune biomarker abnormalities associated with severe illness and mortality in coronavirus disease 2019 (COVID-19): a meta-analysis. Clin Chem Lab Med. 2020;58(7):

1021-8.

19. Li L, Zhou Q, Xu J. Changes of laboratory cardiac markers and mechanisms of cardiac injury in coronavirus disease 2019. Biomed Res Int. 2020; 7413673.

20. Chen W, Xiao Q, Fang Z, Lv X, Yao M, Deng M. Correlation analysis between the viral load and the progression of COVID-19. Comput Math Methods Med. 2021; 9926249.