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The Biochemical and Hematological Patterns of Hospitalized COVID-19 Patients in Mongolia

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Objectives: The impact of COVID-19 prompted a race to find a treatment that would reduce its mortality. This study aimed to analyze how the clinical and laboratory characteristics reflect the disease process and progression of COVID-19 cases in hospitalized patients of Mongolia, which could be informative in managing patients with COVID-19.

Methods: A cross-sectional study was conducted on the prescription patterns of drugs given to hospitalized patients diagnosed with COVID-19. A total of 1012 participants were recruited in the study. These were identified from the reported positive cases by polymerase chain reaction or antigen reactivity performed in Ulaanbaatar.

Result: A total of 1096 patients participated in this study. The mean age was 51.86 ± 16.98 for male patients and 52.23 ± 16.4 for female patients. It has been revealed that there are statistically significant differences between male and female patients. RBC was 4.56 ± 0.79 M/UL and 5.08 ± 1.36 M/UL, men and women respectively. The levels of C-reactive protein (CRP) in female COVID-19 patients were significantly higher (46.75 ± 72.83 mg/dL) compared to male patients (33.94 ± 47.96 mg/dL). The platelet count (PLT) was 245.32 ± 77.71 for male patients, while there was a significant reduction in PLT count in female patients (229.30 ± 71.59).

Conclusions: Patients with COVID-19 in Mongolia appeared to remain in the hospital for 6.86 ± 2.43 days, shorter than in other countries. Hematological analysis showed that female patients had elevated C-reactive protein levels and decreased PLT count.

Keywords: Virus, COVID-19, Blood Platelet, C-reactive protein, Anti-Bacterial Agents

Introduction

The type 2 coronavirus that causes severe acute respiratory syndrome (SARS-CoV-2) is the cause of the 2019 coronavirus disease (COVID-19). The World Health Organization has declared it a global pandemic due to its significant fatality cases [1]. As of 24 September 2023, over 770 million confirmed cases and over 6.9 million deaths have been reported globally. In Mongolia, according to the Health Ministry, almost 1 million people have contracted and more than 2 thousand people have died from COVID-19. COVID-19 has generated an extraordinary burden on health systems around the world in the form of a more significant number of hospital admissions and high demands for intensive care unit beds, advanced respiratory support, renal replacement

therapy, and other interventions for life support and medical care [2]. Also, the pandemic has put extraordinary stress on the healthcare system in each country, requiring a strict balance between the supply and demand of services in order to expand the number of hospital beds as well as public health policies [3-5].

It has been defined by the Centers for Disease Control and Prevention (CDC) COVID-Net that hospitalization of COVID-19 as any patient admitted to the hospital within 14 days of a laboratory-confirmed diagnosis of SARS-CoV-2 infection, regardless of the reason for the admission. Early in the pandemic, COVID-19 cases were significantly correlated with hospitalizations, and many patients had underlying medical conditions [6-7]. Moreover, the patient's age, gender, ethnicity, and health history had also been associated with increased risk of COVID-19 severity.

Numerous studies have demonstrated the clinical demonstration of COVID-19 from asymptomatic to chronic respiratory and multi-organ failure patients. For example, the published literature showed that about 15% of the patients experienced thrombocytopenia [8-9] as platelets play a prominent role in the development of respiratory distress following lung injury; in the meta-analysis of Jiang et al., a lower platelet count in severe COVID-19 infection and was associated with a 3-fold increase in the risk of developing severe COVID-19 [10]. A platelet count inversely correlates with C-reactive protein, representing an essential systemic inflammation index. In the study of Smilowitz et al., C-reactive protein is strongly associated with venous thrombo-embolism, acute kidney injury, and the mortality of COVID-19 patients [11]. Another study by Wang et al revealed that compared with non-severe patients, the aggravated patients had much higher levels of CRP (43.8 mg/L vs 12.1 mg/L; P = .000). A regression analysis showed that CRP was significantly associated with aggravation of non-severe COVID-19 patients, with an area under the curve of 0.844 (95% confidence interval, 0.761-0.926) and an optimal threshold value of 26.9 mg/L [12].

Improving the understanding of factors driving healthcare utilization could be helpful in clinical and public health guidance, facilitating messaging to high-risk groups and allowing for better evaluations of clinical and public health resource needs. Understanding the contribution of the above-mentioned clinical demonstrations of COVID-19 is extremely important to prevent the worsening of the patient's symptoms. Numerous studies have been focused on investigating strategies for COVID-19 through clinical laboratory parameters, but it is still unclear if these parameters are observed consistently across studies. For example, some reports concluded that socio-demographic profiles such as age and gender could be associated with worsening outcomes in COVID-19 patients. Still, others showed no significant difference in gender between non-survivor and survivor patients. Further, until now, no study has been conducted in Mongolia with COVID-19 outcomes based on laboratory data of hospitalized patients. Therefore, we aimed, in the present study, to understand how the clinical and laboratory characteristics reflect the disease process and progression of COVID-19 cases in the hospitalized patients of Mongolia, which could inform the management of patients with COVID-19 according to sex, age group, and geographical region of Mongolia.

Materials and Methods

Study design and subjects

A cross-sectional study was conducted on the prescription patterns of drugs given to hospitalized patients with a diagnosis of COVID-19. A total of 1012 participants were recruited in the study. These were identified from the reported positive cases by polymerase chain reaction or antigen reactivity performed in Ulaanbaatar. From this population, patients with a first confirmed diagnosis of COVID-19 were selected, of any age, sex, and city of residence between 2020 and 2021 who were treated in hospital in emergency services, in the general ward, or in the ICU. With this identified patient list, information on the use of medications was obtained from the dispensing company [23].

Sociodemographic: Sex, age (Clinical: comorbidities (arterial hypertension, chronic obstructive pulmonary disease, obesity, dyslipidemia, diabetes mellitus, depression, anxiety, chronic kidney disease, asthma, heart failure, ischemic heart disease, among others) and clinical manifestations (cough, dyspnea, fever, fatigue, odynophagia, precordial pain, asthenia/adynamia, among others).

Place of care: Emergency room, general ward, or ICU. 4. Supplemental oxygen: oxygen requirement, mechanical ventilation, and need for tracheostomy. 5. Medications that have been used in patients with COVID-19 include systemic corticosteroids (dexamethasone, hydrocortisone, methylprednisolone, prednisolone, betamethasone, prednisone), anticoagulants (unfractionated heparin, low molecular weight

heparins), antimalarials (chloroquine, hydroxychloroquine), ivermectin, lopinavir/ritonavir, colchicine, tocilizumab, nitazoxanide, tofacitinib and remdesivir (not available in the country). 6. Comedications: they were grouped into the following categories: (a) antidiabetics, (b) antihypertensives and diuretics, (c) lipid-lowering drugs; (d) antiulcer drugs, (e) antidepressants, (f) anxiolytics and hypnotics, (g) thyroid hormone, (h) antipsychotics, (i) antiepileptics, (j) antiarrhythmics, (k) antihistamines, (l) antiplatelets, (m) analgesics and anti-inflammatories, (n) systemic antibiotics, (o) bronchodilators and inhaled corticosteroids, (p) vasopressors and inotropic, (q) muscle relaxants, (r) hypnotics and sedatives, and (s) others.

Statistical Analysis

A descriptive analysis was performed by calculating frequencies and proportions for the qualitative variables and measures of central tendency and dispersion for the quantitative variables, depending on their parametric behavior, as shown by the Kolmogorov–Smirnov test. Quantitative variables were compared by unpaired t-test and the χ^2 test for categorical variables. The level of statistical significance was $p < 0.05$.

Ethical Statement

The study was approved by the Research Ethics Committee of the Mongolian National University of Medical Sciences (No.2021/3-13). All patients provided written informed consent before participating in this study.

Results

A total of 1,012 patients from 21 provinces were identified, of whom 626 were men and 386 were women (Table 1). The median age was 51.86 ± 16.98 for male patients and 52.23 ± 16.4 for female patients. 51.1% (n = 320) of male patients had elementary education, and 37.5% had secondary education. As for female patients, 203 (52.5%) had elementary education and 153 (39.6%) had secondary education. In order of frequency, patients were from the Ulaanbaatar (n = 718; 31.6%). There were 29 male patients with extreme severity of COVID-19, while there were 23 patients with the same severity as female patients.

Table 1. Comparison of some sociodemographic, clinical variables by sex, in a group of patients with a confirmed diagnosis of SARS-CoV-2 infection

Characteristics	Men (n=626)	Women (n=386)	Total (n=1012)	P-value
Age, years	51.86 ± 16.98	52.23 ± 16.4	52.0 ± 16.8	0.001
BMI, kg	27.26 ± 5.63	27.95 ± 5.65	27.5 ± 5.6	0.000
Education				
Elementary	320 (51.1)	203 (52.5)	523 (51.6)	0.071
Middle	235 (37.5)	153 (39.6)	388 (38.3)	
High	71 (11.3)	30 (7.8)	101 (9.9)	
Severity				
Minor	63 (10.1)	50 (12.9)	113 (11.1)	0.064
Moderate	459 (73.3)	267 (69.1)	726 (71.7)	
Major	75 911.9)	46 (11.9)	121(11.9)	
Extreme	29 (4.6)	23 (5.9)	52 (5.1)	

Table 2 shows the admission characteristics of the patients. The period of the hospitalization day was 6.94 ± 2.41 for men and 6.72 ± 2.45 for women. Systolic pressure was 127.29 ± 21.41 mmHg for males and 128.60 ± 19.09 mmHg for female patients. The oxygen saturation was 94.71 ± 3.69% and 94.51 ± 3.56% for male and female patients, respectively.

Table 2. Comparison of some clinical and pharmacological variables by sex, in a group of patients with a confirmed diagnosis of SARS-CoV-2 infection

Characteristics	Men (n=626)	Women (n=386)	Total (n=1012)	P-value
Respiratory rate	20.28 ± 3.24	20.30 ± 3.10	20.29 ± 3.18	0.004
Pulse rate	83.15 ± 12.49	83.94 ± 13.97	83.4 ± 13.1	0.000
Body temperature	36.70 ± 0.73	36.73 ± 0.69	36.7 ± 0.72	0.000
Systolic pressure	127.29 ± 21.41	128.60 ± 19.09	127.8 ± 20.56	0.002
SpO_2	94.71 ± 3.69	94.51 ± 3.56	94.6 ± 3.65	0.931
Number of medicines	9.68 ± 3.98	10.06 ± 4.34	9.82 ± 4.1	0.060
Period of hospitalization day	6.94 ± 2.41	6.72 ± 2.45	6.86 ± 2.43	0.054

Table 3 shows hematological parameters. It has been revealed that there are statistically significant differences between male and female patients. RBC was 4.56 ± 0.79 M/uL and 5.08 ± 1.36 M/uL, men and women respectively. The levels of C-reactive protein (CRP) in female COVID-19 patients were significantly higher (46.75 ± 72.83 mg/dL) compared to male patients (33.94 ± 47.96 mg/dL). The platelet count (PLT) was 245.32 ± 77.71 for male patients, while there was a significant reduction in PLT count in female patients (229.30 ± 71.59).

Table 3. Comparison of some laboratorial variables by sex, in a group of patients with a confirmed diagnosis of SARS-CoV-2 infection

Characteristics	Men (n=626)	Women (n=386)	Total (n=1012)	P-value
RBC	4.56 ± 0.79	5.08 ± 1.36	4.75 ± 1.07	0.000
HGB	13.37 ± 1.61	14.98 ± 1.87	13.98 ± 1.88	0.000
PLT	245.32 ± 77.71	229.30 ± 71.59	239.18 ± 75.78	0.000
NEUT	60.21 ± 17.92	62.21 ± 18.74	60.97 ± 18.25	0.041
CRP	33.94 ± 47.96	46.75 ± 72.83	39.07 ± 59.42	0.072

Table 4. Comparison of some clinical and laboratory variables by age groups

Characteristics	Age group		Total (n=1012)	P-value
	Less than 52 years (n=502)	Older than 52 years (n=510)		
Respiratory rate	20.15 ± 3.39	20.43 ± 2.97	20.29 ± 3.18	0.061
Pulse rate	85.02 ± 12.96	81.90 ± 13.02	83.4 ± 13.1	0.142
Body temperature	36.71 ± 0.68	37.72 ± 0.76	36.7 ± 0.72	0.083
Systolic pressure	122.38 ± 18.83	133.11 ± 20.82	127.8 ± 20.56	0.420
SpO_2	95.62 ± 3.72	94.22 ± 3.52	94.6 ± 3.65	0.601
Number of medicines	9.22 ± 3.81	10.42 ± 4.24	9.82 ± 4.1	0.941
Period of hospitalization day	6.60 ±2.29	7.12 ±2.52	6.86 ± 2.43	0.124

Discussion

COVID-19 is a global pandemic with significant case fatality, often due to respiratory failure. Even though most patients with COVID-19 experience mild symptoms, some develop a more severe disease that requires hospitalization. Approximately 14.2% to 30% of in-patients are further admitted to the ICU, primarily for mechanical ventilation [13-14]. Numerous studies revealed that the mortality in hospitalized COVID-19 patients ranges from 13.2% to 28.3% [15-17].

In the present study, we have characterized the biochemical and hematological characteristics of hospitalized patients with a confirmed diagnosis of COVID-19 treated in Mongolia. A total of 1,012 patients from 21 provinces were identified, of whom 626 were men and 386 were women. The median age was 51.86 ± 16.98 for male patients and 52.23 ± 16.4 for female patients. There were 29 male patients with extreme severity of COVID-19, while there were 23 patients with the same severity as female patients. The period of the hospitalization day was 6.94 ± 2.41 for men and 6.72 ± 2.45 for women. It has also been revealed that there are statistically significant differences between male and female patients. RBC was 4.56 ± 0.79 M/uL and 5.08 ± 1.36 M/uL, men and women respectively. The platelet count (PLT) was 245.32 ± 77.71 for male patients, while there was a significant reduction in PLT count in female patients (229.30 ± 71.59). As mentioned in previous studies, PLT count is a valuable prognostic marker in COVID-19 patients [18]. Yang et al. demonstrated that the lower the PLT level, the poorer the outcome and the higher the mortality risk [19]. In the study of Guan et al., among hospitalized patients with COVID-19, lymphocytopenia was present in 83.2% of the patients, thrombocytopenia in 36.2%, and leukopenia in 33.7% [21].

Further, the levels of C-reactive protein (CRP) in female COVID-19 patients were significantly higher (46.75 ± 72.83 mg/dL) compared to male patients (33.94 ± 47.96 mg/dL) in our present study. Similarly, in the study of Guan et al., most patients had elevated levels of C-reactive protein. In general, most of the findings of this report regarding the hematological parameters of COVID-19 patients in Mongolia were consistent with what has been described in other studies around the world.

Some limitations should be considered when interpreting our results. First, we did not have access to medical records to verify all pathologies and complications during hospitalization, so we could not verify the accuracy of the diagnoses assigned by the doctor nor the severity of COVID-19, among other clinical and paraclinical variables. Second, it is necessary to analyze socio-demographic status, medication use, and underlying medical conditions further to provide predictive values in severe COVID-19 illness. Future research integrating these markers and clinical characteristics needs further investigation and should be used for risk stratification in patients with COVID-19.

Conclusions

Patients with COVID-19 in Mongolia appeared to remain in hospital for 6.86 ± 2.43 days, which is shorter than other countries. Hematological analysis showed that female patients had elevated C-reactive protein levels and decreased PLT count. Further research is needed to investigate more detailed factors, such as sociodemographic parameters, on the hospitalization outcomes of COVID-19 patients in Mongolia.

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