SHORT COMMUNICATION

C-reactive protein, D-dimer, erythrocyte sedimentation rate, and troponin in intensive care unit patients with COVID-19 in Iran

Hassan Salehi[1], Bahram Pakzad[2], Marzieh Salehi[3], Saeed Abbasi[4], Mohammad Mahdi Salehi[5], Maryam Kazemi Naeini[6]

[1]Infectious Diseases and Tropical Medicine Research Center, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran, [2]Department of Internal Medicine, Division of Rheumatology, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran, [3]Department of Internal Medicine, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran, [4]Anesthesiology and Critical Care Research Center, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran, [5]Department of Oral Health Science, Faculty of Dentistry, University of British Columbia, Endowment Lands, Canada, [6]Department Biostatistics and Epidemiology, School of Health, Isfahan University of Medical Sciences, Isfahan, Iran

Background: The coronavirus disease 2019 (COVID-19) pandemic in Iran has led to a lack of intensive care unit (ICU) facilities. This study examines C-reactive protein (CRP), D-dimer, erythrocyte sedimentation rate (ESR), and troponin in ICU patients with COVID-19 in comparison to COVID-19 patients admitted to the wards in Iran. **Materials and Methods:** In a case–control study, troponin, CRP, ESR, and D-dimer were compared in the case samples of 109 COVID-19 patients admitted to the ICU, and in the control group, 140 COVID-19 patients admitted to the wards. **Results:** The mean of CRP ($P < 0.001$) and D-dimer ($P < 0.001$) was higher, whereas troponin ($P < 0.001$) was lower in patients admitted to the ICU, but no significant difference was observed between the values of ESR ($P = 0.292$) in the two groups. **Conclusion:** This study showed that the values of CRP and D-dimer were higher in patients admitted to the ICU, but no significant difference was observed between the values of ESR in the two groups.

Key words: Coronavirus disease 2019, intensive care unit admission, prognostic factors

How to cite this article: Salehi H, Pakzad B, Salehi M, Abbasi S, Salehi MM, Naeini MK. C-reactive protein, D-dimer, erythrocyte sedimentation rate, and troponin in intensive care unit patients with COVID-19 in Iran. J Res Med Sci 2023;28:56.

INTRODUCTION

The coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome, has evolved into a pandemic, infecting over 219 million people.[1] The rapid expansion has placed a significant strain on an already overburdened healthcare system. In making triage decisions, it is critical to understand the risk factors for intensive care unit (ICU) admission.[2]

C-reactive protein (CRP) is a nonspecific, acute-phase marker of inflammation or infection that has been demonstrated to correlate with disease severity and treatment response in a wide range of infectious and noninfectious diseases. CRP levels in the blood have been found to be predictive of clinical severity and consequences.[3]

COVID-19 has been related to increased levels of D-dimer, a protein that is involved in the production and lysis of cross-linked fibrin. It has been linked to hemostatic problems, and nonsurvivors who tested positive for the drug had significantly increased levels.[4]

High troponin levels are a strong predictor of 30-day inhospital death in patients with COVID-19. A simple risk score can be used to assist in stratifying patients who are at risk. Close monitoring of these indicators, as well as early action in the event of changes, is critical.[5,6]

Access this article online

Quick Response Code:

Website: www.jmsjournal.net

DOI: 10.4103/jrms.jrms_352_22

Address for correspondence: Dr. Hassan Salehi, Infectious Diseases and Tropical Medicine Research Center, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: h_salehi@med.mui.ac.ir

Submitted: 12-May-2022; **Revised:** 03-Feb-2023; **Accepted:** 22-Feb-2023; **Published:** 28-Jun-2023

The erythrocyte sedimentation rate (ESR) increased in a confirmed COVID-19. Even after the patient recovered from COVID-19, the patient's ESR remained elevated for a long time. Although the elevated ESR cannot be explained by all the available data, it may be linked to aberrant pathologic alteration.[7]

It has been concluded that laboratory test findings at the time of ICU admission may be used to differentiate severe COVID-19 patients. We aimed to evaluate CRP, D-dimer, ESR, and troponin in ICU patients with COVID-19 in comparison to COVID-19 patients admitted to the wards in Iran.

METHODS

This observational case–control study was conducted in Isfahan, Iran, from March 2021 to September 2021. The convenience sampling method was used, and the patients who were qualified were included in the study. The 109 patients with COVID-19 diagnosis (polymerase chain reaction [PCR]+ and high-resolution computed tomography [HRCT] severe and moderate lung involvement) admitted to the ICU with no significant underlying disease requiring ICU admission or the use of anticoagulopathy drugs were included in the study. Furthermore, 140 control group members were hospitalized in wards with COVID-19 with PCR+ and pulmonary involvement similar to the case group without the need for ICU hospitalization and without underlying disease affecting coagulopathy with matching conditions and a similar pulmonary involvement rate in HRCT returns. The duration of the onset of symptoms until hospitalization of the patients in the two groups was matched. The troponin, CRP, ESR, and D-dimer were compared between the case and control groups.

The nonparametric Mann–Whitney *U*-test was used to compare the continuous nonnormally distributed parameters and independent *t*-test for normally distributed in the case and control groups. Furthermore, Chi-squared test was used for comparing categorical data. The statistical significance level of the tests was considered at 0.05. All statistical analyses were performed using the SPSS version 25.0 software package "(IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp).

RESULTS

There were 249 patients admitted as a result of COVID-19. Their average age was 59.11 ± 16.52 years, with the youngest being 18 years and the oldest being 98 years. The patients who were admitted to the ICU (n = 109) had a mean age of 56.15 ± 15.07 years, whereas those who were admitted to the wards (n = 140) had a mean age of 69.18 ± 17.44 (P = 0.007, independent *t*-test). In addition, 34.9% of ICU-admitted patients were female, whereas 65.1% were male (P = 0.096). Among those with comorbidities, the highest number of admitted patients had diabetes, followed by hypertension, and more people with hypertension were admitted to the ICU (P = 0.001).

Table 1 shows clinical parameters in ICU patients with COVID-19 and patients with COVID-19 admitted to the wards [Table 1]. The mean values of CRP and D-dimer were significantly higher in ICU-admitted patients, while the mean value of troponin was lower (P < 0.001). These differences were remained significant after adjusting the potential confounders such as age and gender.

DISCUSSION

It is important to identify COVID-19 individuals who are at risk of becoming very sick early on. This will considerably aid in the control of the epidemic and the prognosis. The results of our study showed that the values of CRP, D-dimer, and the median of troponin were higher in patients admitted to the ICU, but no significant difference was observed between the values of ESR in the two groups.

Many studies have been done on the effects of these parameters on the severity of the disease and the outcome of the disease in different populations.

High troponin levels are a strong predictor of 30-day hospital mortality for patients hospitalized with COVID-19.[6] A study conducted in Turkey showed that D-dimer and CRP levels were used to predict the risk of ICU admission. Bilgir *et al.*'s study was done on the United States of America patients.[5,6]

Table 1: Clinical parameters in intensive care unit patients with coronavirus disease 2019 and patients with coronavirus disease 2019 admitted to the wards

Biochemical parameters	ICU hospitalization		*P*
	No	Yes	
ESR			
Mean±SD	55.29±35.79	52.24±28.23	0.292
Median (IQR)	58.00 (73.00)	54.50 (42.00)	
CRP			
Mean±SD	71.63±46.16	96.90±30.97	<0.001
Median (IQR)	91.00 (97.00)	103.50 (34.25)	
D-dimer			
Mean±SD	3263.77±6519.79	3706.92±10,124.73	<0.001
Median (IQR)	1300.00 (3631.00)	2100.00 (2522.25)	
Troponin			
Mean±SD	130.31±529.16	91.52±195.30	<0.001
Median (IQR)	8.00 (38.50)	12.50 (34.25)	

ICU=Intensive care unit; ESR=Erythrocyte sedimentation rate; CRP=C-reactive protein; SD=Standard deviation; IQR=Interquartile range

There are many parameters that affect the outcome of hospitalization and mortality in patients with COVID-19.[8] According to a systematic review and meta-analysis of observational data, troponin was associated with severe outcomes and death from COVID-19 infection. Cardiac damage is linked with severe results and mortality for patients with this infection.[9,10]

The results of these studies are consistent with our study except for the ESR parameter, which in the meta-analyses performed, the number of studies for this parameter was less. However, in our study, this variable has a significant and fair correlation with the D-dimer variable. That is, both can affect the outcome.

In the Iranian population, one study was done by Sadeghi *et al*. in Tehran that ICU admission-associated predictive factors were investigated. They found that CRP and ESR were significantly different between the two groups: ICU admitted and non-ICU admitted. They mentioned that CRP is a predictive factor of ICU admission, and in this study, troponin and D-dimer were not considered.[11] The reason for the difference in this study with ours could be because of a difference in case sample size, which was just 55 in their study, and also different rates of abnormalities. In the current investigation, similar to our results, male gender was found to be an independent predictor of COVID-19-infected patients being admitted to the ICU. The past research has discovered a connection between male gender and ICU admission rates.[12]

Limitations of our study included the inability to match age and gender, which we adjusted by considering them in the regression model and also the lack of complete information on comorbidities and admission time.

CONCLUSION

During the COVID-19 pandemic, the correct treatment of critically ill patients is important to avoid the need for ICU hospitalization. Monitoring of CRP, D-dimer, and troponin might be useful to predict disease progression.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. COVID-19 Map – Johns Hopkins Coronavirus Resource Center. Available from: https://coronavirus.jhu.edu/map.html. [Last accessed on 2021 Nov 18].
2. Auld SC, Caridi-Scheible M, Blum JM, Robichaux C, Kraft C, Jacob JT, *et al.* ICU and ventilator mortality among critically Ill adults with coronavirus disease 2019. Crit Care Med 2020;48:e799-804.
3. Chen W, Zheng KI, Liu S, Yan Z, Xu C, Qiao Z. Plasma CRP level is positively associated with the severity of COVID-19. Ann Clin Microbiol Antimicrob 2020;19:18.
4. Becker RC. COVID-19 update: COVID-19-associated coagulopathy. J Thromb Thrombolysis 2020;50:54-67.
5. Bilgir F, Çalık Ş, Demir İ, Bilgir O. Roles of certain biochemical and hematological parameters in predicting mortality and ICU admission in COVID-19 patients. Rev Assoc Med Bras (1992) 2021;67 Suppl 1:67-73.
6. Manocha KK, Kirzner J, Ying X, Yeo I, Peltzer B, Ang B, *et al.* Troponin and other biomarker levels and outcomes among patients hospitalized with COVID-19: Derivation and validation of the HA (2) T (2) COVID-19 mortality risk score. J Am Heart Assoc 2021;10:e018477.
7. Pu SL, Zhang XY, Liu DS, Ye BN, Li JQ. Unexplained elevation of erythrocyte sedimentation rate in a patient recovering from COVID-19: A case report. World J Clin Cases 2021;9:1394-401.
8. Ashraf MA, Sherafat A, Naderi Z, Sami R, Soltaninejad F, Khodadadi S, *et al.* Association of systemic complications with mortality in coronavirus disease of 2019: A cohort study on intensive care unit patients. J Res Med Sci 2022;27:34.
9. Ghahramani S, Tabrizi R, Lankarani KB, Kashani SM, Rezaei S, Zeidi N, *et al.* Laboratory features of severe versus non-severe COVID-19 patients in Asian populations: A systematic review and meta-analysis. Eur J Med Res 2020;25:30.
10. Parohan M, Yaghoubi S, Seraji A. Cardiac injury is associated with severe outcome and death in patients with coronavirus disease 2019 (COVID-19) infection: A systematic review and meta-analysis of observational studies. Eur Heart J Acute Cardiovasc Care 2020;9:665-77.
11. Sadeghi A, Eslami P, Dooghaie Moghadam A, Pirsalehi A, Shojaee S, Vahidi M, *et al.* COVID-19 and ICU admission associated predictive factors in Iranian patients. Caspian J Intern Med 2020;11:512-9.
12. Grasselli G, Zangrillo A, Zanella A, Antonelli M, Cabrini L, Castelli A, *et al.* Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the lombardy region, Italy. JAMA 2020;323:1574-81.