Clinical Research

Use of q-SOFA Scores to Assess Prognosis in COVID-19 Patients

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ABSTRACT

Objective: The quick sepsis-related organ failure assessment (q-SOFA) scores were determined, and the relationship between disease severity was investigated in COVID-19 patients.
Material and Method: Ninety COVID-19 patients were subgrouped according to disease severity, as each group consisted of 30 patients and was named the mild, moderate, and severe groups. q-SOFA scores were determined, and groups were compared. The effect of the q-SOFA score on mortality was determined with binary logistic regression analysis.
Results: The q-SOFA score of severe patients was higher than that of patients in both the mild and moderate groups ($p < 0.05$ for both comparisons). The regression model revealed that the q-SOFA score could explain 93.3% of the variance in mortality ($p < 0.001$).
Conclusion: The q-SOFA score may be used to predict disease severity as an easy and rapid tool in COVID-19 patients.

Keywords: *COVID-19, Inflammation, q-SOFA.*

ÖZ

COVID-19 Hastalarında Prognoz Takibinde q-SOFA Skorlarının Kullanılması

Amaç: COVID-19 hastalarında q-SOFA (quick sepsis-related organ failure assessment) skorları belirlendi ve hastalık şiddeti ile ilişkisi araştırıldı.
Gereç ve Yöntem: Doksan COVID-19 hastası, her bir grupta 30 hasta olacak şekilde hastalık şiddetine göre alt gruplara ayrıldı (hafif, orta ve şiddetli grup). q-SOFA puanları belirlendi ve gruplar karşılaştırıldı. q-SOFA skorunun mortalite üzerindeki etkisi ikili lojistik regresyon analizi ile belirlendi.
Bulgular: Şiddetli hastaların q-SOFA skoru hem hafif hem de orta gruptaki hastalardan daha yüksekti (her iki karşılaştırma için $p < 0,05$). Regresyon modeli, q-SOFA skorunun mortalitedeki varyansın %93.3'ünü açıklayabildiğini ortaya koydu ($p < 0.001$).
Sonuç: q-SOFA skoru, COVID-19 hastalarında kolay ve hızlı bir araç olarak hastalık şiddetini tahmin etmek için kullanılabilir.

Anahtar Sözcükler: *COVID-19, Enflamasyon, q-SOFA.*

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COVID-19 infection caused by SARS-CoV-2 was first seen in Wuhan, China, in December 2019, and in a short time, it affected the whole world, causing a pandemic. The spectrum of COVID-19 ranges from asymptomatic infection to mild flu symptoms, acute respiratory failure requiring intensive care, and even death (1). Although the most common clinical findings are fever, cough and fatigue, endothelial damage may occur in many vital organs due to excessive and uncontrolled production of proinflammatory cytokines synthesized by T lymphocytes and macrophages, especially in some patient groups. This picture, called a cytokine storm, can result in multiple organ failures and mortality (2).

Defining scoring systems to predict prognosis, prevent unnecessary hospitalizations, and reduce the burden on healthcare systems worldwide is crucial. Studies have shown that scoring systems based on age, sex, and comorbidity successfully predict mortality (3). In addition, laboratory parameters such as CRP, D-dimer, ferritin, LDH, and INR can be used to determine prognosis and predict mortality in COVID-19 patients (4, 5). Studies to develop new biomarkers in COVID-19 patients are also ongoing. Although biomarkers guide the decision of hospitalization, follow-up and predicting the need for intensive care, there is a need for scoring systems that clinicians can easily apply at the bedside. Quick sepsis-related organ failure assessment (q-SOFA) is a low-cost, bedside clinical scoring system to facilitate early sepsis detection (6). The q-SOFA score was calculated by evaluating blood pressure, respiratory rate, and mental status. It is crucial that it can be easily used in any healthcare institution. Studies have shown that q-SOFA scoring can help in the diagnosis of sepsis at an early stage. q-SOFA scoring, which has been used mainly in recent years, constitutes an important alternative in the early diagnosis and treatment of sepsis. A high q-SOFA score (meeting two or more criteria) indicates a poor prognosis, especially in patients with suspected sepsis (6, 7).

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Sepsis has been defined as life-threatening organ dysfunction caused by a dysregulated host response to infection. Sepsis pathophysiology is an unbalanced host reaction between the proinflammatory and anti-inflammatory responses to infection (8, 9). Although the pathogenesis of COVID-19 has not been fully explained, data from hospitalized patients revealed that serum cytokine and chemokine levels are high in severe COVID-19, similar to sepsis (10,11). Sepsis associated with COVID-19 is an important cause of mortality in COVID-19.

In this study, we investigated the usability of the q-SOFA scoring system in predicting prognosis and mortality in COVID-19 patients.

MATERIAL AND METHOD

The study was approved by the local clinical ethics committee. Ninety patients who admitted to the emergency department between June 2021 and June 2022 and were diagnosed with COVID-19 were included in the study. The COVID-19 test was carried out by taking a nasopharyngeal swab, and samples were analyzed with real-time PCR.

The hospital records of the patients were retrospectively reviewed by the responsible clinicians. Patient data, including laboratory investigations, medical history, comorbid conditions, complications, demographics, treatments initiated, and outcomes, were collected and carefully analyzed.

Ninety patients were divided into three groups according to disease severity: mild, moderate and severe; each group consisted of 30 patients. The classification of the patients according to their weight was made according to the current adult diagnosis and treatment guideline of the Ministry of Health of the Republic of Turkey, COVID-19. The mild group consisted of outpatients with normal chest X-ray images. The moderate group consisted of patients treated by hospitalization with pneumonia (not severe pneumonia). The severe group consisted of patients treated in intensive care units with macrophage activation syndrome and severe pneumonia that fit any of the following conditions: respiratory rate ≥ 30 breaths/min, SpO2 ≤ 92%, and pulmonary infiltration rate >50%.

q-SOFA scores were determined in the first 24 hours of admission [10]. A high q-SOFA score was defined as a q-SOFA score ≥ 2, while a low score was defined as a q-SOFA score <2. Parameters used in q-SOFA scoring are decreased mental status (GCS<15), increased respiratory rate (≥22/min), and decreased systolic blood pressure (<100 mmHg), and each parameter is one point (12).

The inclusion criteria were age 18 and 75 years and female and male sex diagnosed with COVID-19. The exclusion criteria are; patients who were not diagnosed with COVID-19 and who developed complications due to their comorbidities despite being diagnosed with COVID-19 were excluded from the study. In addition, patients who had trauma, whose data could not be accessed or who had missing data were not included in the study.

Statistical Analyses

The minimum number of patients required for the study was calculated in the G Power sample calculation program (version 3.1.9.4). Since there is no available study in the literature similar to this study, Cohen's effect size was used (Cohen, J. (1988). Statistical power analysis fort he behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum). G-power program inputs were: a priori calculation for one-way anova test, α =0.05, power (1-β): 0.92, effect size 0.40 (large). Accordingly, the minimum sample size was calculated as 30 for each group, a total of 90 patients.

Statistical analyses were performed by using SPSS 25.0 package program (SPSS, Chicago). The normality of the data was checked with the Kolmogorov–Smirnov test. The mean±standard deviation was used for normally distributed data, and the median (minimum-maximum) was used for nonnormally distributed data. Comparisons of biochemical results of groups for normally distrubuted parameters were performed by using one-way ANOVA test. A post hoc Tukey test was used to determine the differences between subgroups following one-way ANOVA. Comparisons of biochemical results of three groups for non-normally distrubuted biochemical and hematological parameters and q-SOFA scores were performed with the Kruskal–Wallis test, and the Mann–Whitney U test with Bonferroni correction was used to perform pairwise comparisons. Binary logistic regression analysis was performed to examine the effect of the q-SOFA score on mortality.

RESULTS

The patient demographic (age, sex) and clinical characteristics (death ratio, and mechanical ventilation need ratio) are shown in table 1.

Table 1. *Demographic and clinical characteristics of the patients.*

	All (n =90)	Mild (n =30)	Moderate (n =30)	Severe (n =30)
Age (years)	57.9±12.9	52.1±10.8	59.1±12.6	62.4±15.2
Gender, M/F (%)	57/43	53/47	57/43	60/40
Death (%)	11.1	0.0	3.3	29.0
Mechanical ventilation need (%)	5.9	0.0	0.0	17.7

Age is presented as the mean±standard deviation, M/F: male/female.

The mean age of all COVID-19 patients (n =90) was 57.9±12.9 years. Patients in the mild, moderate, and severe groups were similar in terms of age. Comorbidities of patients are shown in Figure 1.

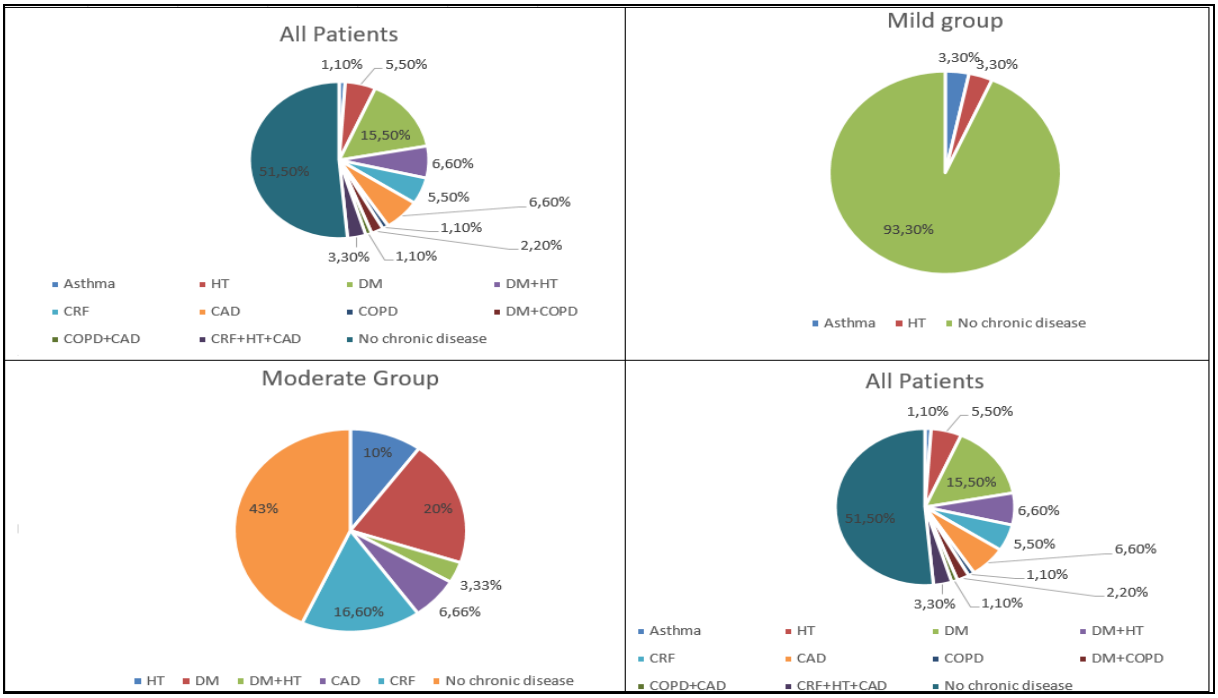

Figure 1. *Comorbidities of patients.*

HT: Hypertension, DM: Diabetes Mellitus, CRF: Chronic Renal Failure, CAD: Coranary Artery Disease, COPD: Chronic obstructive pulmonary disease.

The biochemical and hematological parameters and comparisons of groups are presented in table 2.

Table 2. *Biochemical and hematological values of patients and comparisons between groups.*

	All (n =90)	Mild (n =30)	Moderate (n =30)	Severe (n =30)
INR	1.28±0.39**	1.02±0.08[a]	1.37±0.34	1.43±0.49[c]
TBIL	1.16±0.63**	0.57±0.23 [a]	1.30±0.46[b]	1.55±0.63 [c]
NE%	76.27±17.15**	61.08±10.86 [a]	82.21±13.67	84.75±15.81[c]
NE	10.32±6.47**	4.31±1.49 [a]	11.51±4.38[b]	14.78±6.84 [c]
PLT	276.04±98.03	264.62±74.88	266.83±108.05	295.64±106.69
Creatine	0.98 (0.50-7.66)**	0.73 (0.50-1.15)[a]	0.99 (0.60-3.10)[b]	1.45 (0.50-7.66)[c]
LY%	16.40 (3.30-46.70)**	28.6 (12.7-46.7)[a]	18.40 (4.70-39.40)[b]	9.60 (3.30-28.90)[c]
LY	0.93 (0.28-3.72)**	1.90 (0.54-3.70)[a]	0.76 (0.29-3.72)	0.73 (0.28-3.04)[c]
Ferritin	390.50 (8.0-3009.0)**	106.0 (8.0-1142.0)[a]	553.0 (20.0-3009.0)	1066.0 (134.0-2731.0)[c]
CRP	10.03 (0.50-220.00)**	3.53 (0.50-141.60)[a]	19.05 (0.50-220.0)	18.0 (3.1-202.0)[c]
LDH	287.0 (145.0-1071.0)**	195.50 (145.0-305.0)[a]	339.0 (190.0-750.0)[b]	480.0 (171.0-1071.0)[c]
Fibrinogen	349.0 (60.0-816.0)*	334 (192.0-630.0)[a]	445.50 (206.0-783.0)[b]	300.0 (60.0-816.0)
D-Dimer	680.50 (168.0-35200.0)**	327.0 (168.0-1007.0)[a]	974.0 (224.0-35200.0)	973.0 (190.0-35200.0)[c]
NLR	8.37 (0.66-59.40)**	2.03 (0.84-5.93)[a]	11.66 (1.23-36.12)	13.62 (0.66-59.40)[c]

*Results are expressed as mean±standart deviation for normally distrubuted parameters and median (minumum-maximum) for non-normally distrubuted parameters. INR: International Normalized Ratio, TBIL: Total bilirubin, NE: neutrophil, PLT: platelet, LY: lymphocyte, CRP: C-reactive protein, LDH: lactat dehydrogenase, NLR: neutrophil/lymphocyte ratio, The results are expressed as the mean±standard deviation; *: p <0.05 for one-way ANOVA or Kruskal-Wallis test; **: p <0.01 for one-way ANOVA or Kruskal-Wallis test; a, b, c, show significant difference (p <0.05) of one-way ANOVA post hoc Tukey test or Mann-Whitney U test P values with Bonferroni correction ([a] Significant difference between mild and moderate patients; [b] Significant difference between moderate and severe patients; [c] Significant difference between mild and severe patients).*

The q-SOFA scores of the patients are presented in table 3.

Table 3. *q-SOFA scores of patients and comparisons between groups.*

	All (n =90)	Mild (n =30)	Moderate (n =30)	Severe (n =30)
q-SOFA Score	0 (0-3) *	0 (0-2)	0 (0-2)[a]	2 (0-3) [b]

*The results are expressed as the median (minimum-maximum); *: p <0,05 for Kruskal–Wallis test; a, b show Mann–Whitney U test with Bonferroni correction p values less than 0,05 ([a] Significant difference between moderate and severe patients, [b] Significant difference between mild and severe patients).*

Binary logistic regression analysis was performed to examine the effect of the q-SOFA score on mortality. Ex status was taken as the dependent variable, and the q-SOFA score was taken as the independent variable. Results are expressed in table 4.

Table 4. *Results of binary regression analysis.*

Variable	-2 Log Likelihood	Wald	Nagelkerke R square	Overall percentage	Hosmer and Lemeshow test P value	Odds Ratio	CI (Confidence Interval)	p
q-SOFA	16.63	39.00	0.679	93.3	1.00	1.01	0.017-60.440	<0.001

When the regression summary was examined, it was seen that the independent variable q-SOFA score could explain 93.3% of the variance in the dependent variable (ex status), and this value was significant ($p < 0.001$). A 0.001 unit increase in q-SOFA score was related with a 1.0% increase in risk of mortality (OR: 1.01 with 95% CI: 0.017-60.440)

DISCUSSION

We investigated the usability of the q-SOFA scoring system in predicting mortality and early intensive care admission in COVID-19 patients. We found that the q-SOFA scores were higher in the severe patient group than in the mild and moderate patients. We found that the q-SOFA score was higher in the severe patient group than in the mild and moderate patients. The q-SOFA scores were below 2 on average in the mild and moderate patient groups. We also showed that the q-SOFA score is an important guide in predicting mortality in COVID-19 patients.

Endothelial damage may develop in many vital organs, usually due to the overproduction of proinflammatory cytokines in patients requiring intensive care hospitalization for COVID-19 infection (2). This picture, which progresses rapidly and has a high mortality rate, is called a cytokine storm. The physiopathology of cytokine storms is similar to that of sepsis (10, 11). Scoring systems are used to predict mortality in sepsis. The sepsis scoring systems used in sepsis are helpful in predicting in-hospital mortality and helping to quickly and simply identify patients at risk (13, 14).

q-SOFA, whose usability we investigated in this study in COVID-19, is one of these scoring systems. The advantage of using q-SOFA in the emergency department is that there is no need to wait for laboratory results, and it can predict poor prognosis. Studies reveal that although the sensitivity of q-SOFA is low, its specificity is generally high in COVID-19 patients (13).

Considering that sepsis is one of the most important causes of mortality in COVID-19, this scoring system helps in the rapid evaluation of patients, especially in emergency departments. In a study, various scoring systems, including q-SOFA, were evaluated at the time of admission to the hospital in COVID-19 patients. In the follow-up of these patients, the mortality rate was higher in patients with a q-SOFA score of 2 and above, which is consistent with our study (15). In another study, the relationship between the q-SOFA scoring system and intensive care hospitalization in COVID-19 was investigated, and it was concluded that the early admission of patients with high scores to the intensive care unit would be beneficial in terms of patient follow-up and treatment (16).

q-SOFA can help clinicians determine treatment plans early in COVID-19. This prognostic marker can prioritize patients requiring intensive care and aggressive management. In addition, according to multivariate analyses in the literature, there are studies in which q-SOFA was found to be an independent predictor of disease severity in COVID-19 cases, consistent with our study (17).

Our study, in which we investigated the relationship of the q-SOFA score with mortality and the course of the disease, was retrospective and was limited to patients diagnosed with COVID-19 only. In addition, more comprehensive studies can be carried out by increasing the number of patients and the follow-up period after hospitalization.

In conclusion, COVID-19 patients with high q-SOFA scores had more severe disease. We determined that the disease was more fatal in patients with high q-SOFA scores. The q-SOFA score can be used as an easy and fast scoring system for clinicians in deciding on intensive care admission, clinical follow-up and treatment of patients. Our study reveals that q-SOFA scoring can be used as a scoring system that shows mortality and prognosis in COVID-19 and can guide new scoring systems that can be developed. Larger studies are needed for scoring methods that can be used to predict mortality and prognosis.

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