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Original Article

Determining the Adequacy of CURB-65 and qCSI Scores in Predicting the Necessity of the ICU for COVID-19 Patients

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ABSTRACT

Objective: In this study, the adequacy of the Quick COVID Severity Index (qCSI) and CURB-65 scoring systems in predicting the prognosis and need for intensive care in patients who were admitted to the emergency room and hospitalized due to Coronavirus Disease 2019 (COVID-19) were examined.

Methods: The files of all adult patients over the age of 18 years who were hospitalized with the diagnosis of COVID-19 between January 1 and June 1, 2021 were reviewed retrospectively. Patients with negative reverse transcriptase-polymerase chain reaction test results, patients transferred from another hospital, and patients whose data to be used in the two risk scores could not be reached were excluded from the study.

Results: A total of 325 people were included in the study, with an average age of 58.2±17.2%, 48.3% male and 51.7% female. As a result of the ROC analysis of the CURB-65 score in estimating the need for hospitalization in the intensive care unit (ICU), the area under the curve (AUC) was found to be 0.843 (95% confidence interval [CI]: 0.799–0.881), and the Youden index was 0.584, p value was 0.001. As a result of the ROC analysis of the qCSI score in estimating the need for ICU hospitalization, the AUC was found to be 0.921 (95% CI: 0.886–0.948), and the Youden's index was 0.7520, p value was 0.001. When the value of the two scores in predicting the need for ICU admission was compared, it was found that the qCSI score was more successful than the CURB-65 score.

Conclusion: In this study, the predictive powers of qCSI and CURB-65 scores in predicting the ICU requirement of COVID-19 patients admitted to the emergency department were compared. It was concluded that the qCSI score was superior to CURB-65.

INTRODUCTION

Cases of pneumonia with an unknown cause were first noticed in the Wuhan, located in Hubei province, China, in December 2019. In January 2020, it was stated that the causative agent detected in these cases was a new coronavirus that had not previously been identified in humans. The initial designation for this novel coronavirus was 2019-nCoV when it first emerged, but it was later renamed Severe Acute Respiratory Syndrome (SARS)-CoV2 because of its similarity to SARS. The virus led to the identification of a new illness named Coronavirus Disease 2019 (COVID-19).[1-3] The rapid increase in the number of patients necessitated the identification of which patients were more at risk and would require intensive care services.

Scoring systems are crucial in emergency departments (ED) as they aid in effective patient prioritization based on the severity of symptoms or conditions, ensuring patients requiring immediate medical attention are attended to promptly. These systems also enhance efficiency by aiding health professionals to better manage their resources and time, thus reducing overall waiting times. Furthermore, the use of scoring systems ensures a standardized approach to patient assessment and treatment, minimizing bias and enabling the provision of consistent care across different health-care providers, shifts, and locations. Scoring systems are instrumental in predicting patient outcomes, determining the level of care required, predicting mortality risk, and identifying the requirement for an intensive care unit (ICU) or the likelihood of certain difficulties. They also provide an objective measure of illness severity, which is useful for quality assurance

and clinical research, ensuring comparable patient groups. Finally, scoring systems facilitate communication among health-care professionals by quickly conveying a patient's condition and urgency, a factor that is particularly crucial in busy or stressful situations. Overall, scoring systems in ED are indispensable tools for ensuring patients receive appropriate and timely care.[4]

CURB-65 is a scoring system that helps determine the location of treatment, whether it be the ward, intensive care, or outpatient, for patients diagnosed or suspected of pneumonia. It stands out with its simplicity and high sensitivity. The limited number of variables allows us to categorize patients quickly according to their discharge, admission, and intensive care necessity.[4,5]

The Quick COVID Severity Index (qCSI) score was created using data from COVID-19 patients who were hospitalized in the United States. Its main purpose is to forecast the occurrence of severe respiratory illness, characterized by a high requirement for oxygen, non-invasive ventilation, or invasive ventilation, within a 24-h time frame.[6,7]

The aim of this study was to evaluate the accuracy of the qCSI and CURB-65 scoring systems in predicting the intensive care requirements of COVID-19 patients who were admitted to the ED of a tertiary health institution that also functioned as a pandemic hospital.

MATERIALS AND METHODS

This current study was conducted as a retrospective-observational and was conducted at the ED of Kartal Dr. Lütfi Kırdar City Hospital between January 1, 2021 and June 1, 2021. Ethical approval was obtained from the Kartal Dr. Lütfi Kırdar City Hospital for the study (Ethics Committee Decision No: 2021/514/212/16, Date: 27.10.2021).

Total participants aged 18 and over who were admitted to the ED with COVID-19 symptoms, had oropharyngeal/nasopharyngeal swabs taken, and were admitted to the hospital between January 1 and June 1, 2021. Individuals who have received a negative result in a Real-Time Polymerase Chain Reaction test, patients transferred from another hospital, and patients whose data for any of the variables used in the two risk scores were excluded from the study due to a lack of reaching the results.[8]

The data of all participants such as age, gender, vital signs, comorbidities, and laboratory tests were recorded. The CURB-65 score included five variables (confusion, urea, respiratory rate, blood pressure, and age ≥65), and the qCSI score included three variables (respiratory rate, pulse oximetry, and O2 flow rate). All parameters assessed for score calculation were received from ED electronic records. The scores were calculated using the parameters at the time of admission to the ED.

The main goal of the study is to establish the correlation between each scoring system and the requirement for ICU treatment.

Statistical Analysis

The SPSS 19.0 has been employed to analyze data for Windows and MedCalc software. The descriptive statistics have been delivered in terms of means and standard deviations, medians along with minimum and maximum values, and percentage distributions. To verify the normality of the data, the Kolmogorov–Smirnov test was employed. To evaluate the predictive potential of risk scores in determining the necessity of ICU, a ROC curve analysis was conducted.[9] Then, the ROC curves for these risk scores have been compared.

The optimal cutoff value has been calculated using the DeLong method. The Youden's index has been utilized for the area under the curve (AUC), positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (LR+), and negative LR-, as well as the 95% confidence interval (CI).[10] The significance threshold was accepted as $p<0.05$.

RESULTS

A total of 325 patients met the inclusion criteria in the study and the mean age was 58.2±17.2, of which 48.3% were male and 51.7% were female (Table 1).

AUC in the ROC analysis of the CURB-65 score for indicating ICU admission necessities was 0.843 (95% CI: 0.799–0.881); the Youden's Index was 0.584, and the p-value was 0.001. Regarding statistical analysis, it was determined that the CURB-65 score is statistically significant in predicting ICU admission requirements (p=0.001). When the prediction value of the CURB-65 score in prediction the requirement for ICU admission was taken as >1, sensitivity was 73.6%, specificity was 84.9%, PPV was 64.0%, and NPV was 89.8% (Table 2).

AUC in the ROC analysis of the qCSI score in predicting ICU admission requirements was 0.921 (95% CI: 0.886–0.948), Youden's Index was 0.7520, and the p-value was 0.001. Regarding the statistical analysis, it was uncovered that the qCSI score is statistically significant in predicting ICU necessity (p=0.001). When the prediction value of the qCSI score in determining ICU admission was taken as >5, sensitivity was 86.2%, specificity was 89.1%, PPV was 74.3%, and NPV was 94.6% (Table 2).

When comparing the value of the two scores in predicting ICU admission, it was found that the qCSI score was more successful than the CURB-65 score (Table 2 and Figure 1).

DISCUSSION

In this study, CURB-65 and qCSI scores were examined to determine the ICU necessity of patients presenting to the ED due to COVID-19. The qCSI score was found to be superior to the CURB-65 score in determining ICU requirements.

During the pandemic period, health systems face exceptional pressure, requiring the proper distribution of

Table 1. Examination of the distribution of some characteristics of hospitalized patients and not required the ICU

			ICU admission			
			Absent	Present	Total	p-value
Gender	Man	Number	112	45	157	0.456
		Percentage	47.1%	51.7%	48.3%	
	Woman	Number	126	42	168	
		Percentage	52.9%	48.3%	51.7%	
Hypertension	Absent	Number	159	57	216	0.827
		Percentage	66.8%	65.5%	66.5%	
	Present	Number	79	30	109	
		Percentage	33.2%	34.5%	33.5%	
Diabetes Mellitus	Absent	Number	214	81	295	0.379
		Percentage	89.9%	93.1%	90.8%	
	Present	Number	24	6	30	
		Percentage	10.1%	6.9%	9.2%	
Ischemic Heart Disease	Absent	Number	193	76	269	0.186
		Percentage	81.1%	87.4%	82.8%	
	Present	Number	45	11	56	
		Percentage	18.9%	12.6%	17.2%	
Cancer	Absent	Number	206	80	286	0.185
		Percentage	86.6%	92.0%	88.0%	
	Present	Number	32	7	39	
		Percentage	13.4%	8.0%	12.0%	
Chronic Renal Failure	Absent	Number	218	83	301	0.245
		Percentage	91.6%	95.4%	92.6%	
	Present	Number	20	4	24	
		Percentage	8.4%	4.6%	7.4%	
Chronic obstructive pulmonary disease	Absent	Number	182	75	257	0.056
		Percentage	76.5%	86.2%	79.1%	
	Present	Number	56	12	68	
		Percentage	23.5%	13.8%	20.9%	

medical resources and treatments. Even in the developed countries, it has been observed that the demands on health systems are not sufficiently met during the current COVID-19 pandemic. Once again, we observed the necessity of utilizing various resources, such as ICU beds, ventilators, and personal protective equipment, by implementing effective strategies.[11] As current hospital systems are not designed for pandemics, not only patients suffering from the outbreak, but also other patients requiring acute care, will be affected in a situation of intense demand. Therefore, using prediction models that will identify patients who will require acute care to ensure the correct use of medical resources would be the right decision.

The CURB-65 score is a rating used to predict 30-day mortality in patients with pneumonia, categorizing patients into low, medium, and high risk and used to decide on outpatient follow-up, hospital ward, or ICU admission. It was first introduced by the British Thoracic Society in 2002. This scoring system includes a total of 5 variables, including the patient's confusion, uremia, respiratory rate, blood pressure, and age. Each variable is calculated as 1 point. As the total score increases, the 30-day mortality rate increases.[12]

According to the CURB-65 score, the 30-day mortality rates are: 0.07% for 0 points, 3.2% for 1 point, 3% for 2 points, 17% for 3 points, 41.5% for 4 points, and 57.7% for

Table 2. Comparison of CURB-65 and qCSI scores in predicting the necessity for ICU

	AUC	Cut-Off	Sensitivity	Specificity	+LR	-LR	PPV	NPV	Youden Index	p-value
CURB-65	0.843 (0.799–0.881)	>1	73.6 (63.0–82.4)	84.9 (79.7–89.2)	4.86	0.31	64.0	89.8	0.584	0,002
qCSI	0.921 (0.886–0.948)	>5	86.2 (77.1–92.7)	89.1 (84.4–92.7)	7.89	0.15	74.3	94.6	0.752	

AUC: Area under the curve; LR: Likelihood ratio; PPV: Positive predictive value; NPV: Negative predictive value.

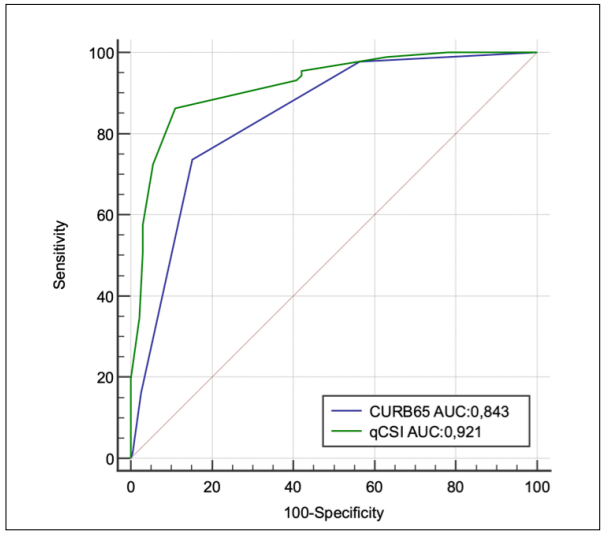

Figure 1. Examining of CURB65 and qCSI scores with ROC analysis in determining the necessity for ICU.

5 points. When the CURB-65 score is grouped, the groups are considered low risk for 0–1 point, medium risk for 2 points, and high risk for 3 points and above, with mortality rates of 1.5%, 9.2%, and 22%, respectively.[12]

In the literature, there are studies examining the impact of the CURB-65 score as a predictive tool in COVID-19 patients. A single-center retrospective study conducted by Nguyen et al. examined the correlation between the CURB-65 score and adverse outcomes. The research involved 279 patients, defined a negative outcome as the requirement for mechanical ventilation (including non-invasive ventilation, high-flow nasal cannula, and invasive mechanical ventilation) or mortality within 14 days. It was stated that the CURB-65 score could strongly determine poor outcomes. However, it was observed that poor outcomes occurred in 21.1% of patients with a score of 0 or 1, i.e., low-risk patients. Researchers have suggested that the applicability of the CURB-65 score in decision-making to treat inpatient or outpatient is weak since it does not reliably identify patients who can be treated on an outpatient basis.[13] In a research carried out by Satici et al., it was found that a CURB-65 score of 2 or higher showed a significant ability to predict 30-day mortality. The sensitivity of this score was 73%, with a specificity of 85%. In addition, the PPV was 31% and the NPV was 97%. The AUC was 79, with a 95% CI varying from 72 to 86, and a p<0.001.[14] In a multicenter retrospective cohort where severity indices in COVID-19 pneumonia were evaluated, the CURB-65 score was found to have an AUC of 0.825 (95% CI: 0.815–0.835) in predicting mortality. The same study reported that the CURB-65 score did not have sufficient diagnostic accuracy in predicting patients' necessity for ICU.[15] In light of these findings, the results of our study were found to be consistent with the literature.

The qCSI score has been demonstrated by Haimovich et al., to predict critical respiratory illness within 24 h in COVID-19 patients admitted to the ED. This scoring system defines the critical illness as oxygen requirement (with >10 L/min through low-flow device, high-flow device, and non-invasive or invasive ventilation) or mortality. The score contains three variables (respiratory rate, peripheral oxygen saturation, and oxygen flow rate) that are accepted between 0 and 12. According to this score in predicting critical illness within the first 24 h, scores of ≤3 are ranked as low risk, between 4 and 6 is ranked as low-intermediate risk, between 7 and 9 is ranked as high intermediate risk, and between 10 and 12 is ranked as high risk.[16]

There are studies in the literature where the qCSI score is used to predict in-hospital mortality. In a retrospective observational study with 210 patients conducted by Covino et al., the early prediction performances of the NEWS, COVID-GRAM, 4C Mortality score, and qCSI scoring systems for in-hospital mortality were compared. Although the 4C mortality score had the highest AUC value (0.799), no statistical difference was found among the four scoring systems.[17] In a retrospective cohort examining the predictive powers of the Brescia-COVID Respiratory Severity Scale (BCRSS) and qCSI scores, both scores were found to be successful in predicting both in-hospital mortality (AUC, respectively, 0.804 and 0.847) and ICU requirement (AUC, respectively, 0.842 and 0.851).[18]

In our study, when the values of both scores in predicting the necessity for ICU were compared, it was found that the qCSI score was more successful than the CURB-65 score (p:0.002). In a retrospective study with 313 patients, qCSI, CURB-65, and BCRSS scores were compared. The outcome variables of the study were defined as in-hospital mortality and ICU requirement. In this cohort, while the CURB-65 and qCSI scores were found to be more successful in predicting in-hospital mortality (AUC, respectively, 0.781 and 0.711), the qCSI and BCRSS scores were found to be more successful in predicting the ICU requirement (AUC, respectively, 0.761 and 0.735).[19]

One of the risk factors for COVID-19 is the presence of comorbid diseases. In a systematic analysis, a relationship was found between the presence of comorbid disease and the severity of COVID-19.[20] In a meta-analysis conducted by Zhou et al., it was found that COVID-19 was more severe and the mortality rate was higher in the patient group with comorbid disease.[21] In this study, no statistically significant relationship was found between the presence of comorbidity and the patients who were admitted to the ICU and those who were not. We think that the reason for this difference from the literature is due to our study being completed with a relatively smaller population.

The study was conducted as a single center with a small population, yet, it should be verified in a larger, multicenter group. In addition, as the study was retrospective, the data were received from an electronic record system, which may have insufficient or outdated information.

Conclusion

In this study, the predictive powers of the qCSI and CURB-65 scores were compared to predict the ICU requirement

of COVID-19 patients presenting to the ED. The result was reached that the qCSI score was superior to CURB-65.

A significant experience has been conducted to increase ED admission due to the COVID-19 pandemic. It is crucial for ED physicians to identify patients who will require critical care earlier. Requirement on which patient will be discharged and which patient will be admitted to the control or ICU must ensure the efficient use of hospital resources such as the number of ventilators and ICU beds. In this context, we advise the use of the qCSI score, a practical and effective score that can be used at the bedside to predict ICU admission in COVID-19 patients.

Ethics Committee Approval

This study approved by the Kartal Dr. Lütfi Kırdar City Hospital Clinical Research Ethics Committee (Date: 27.10.2021, Decision No: 2021/514/212/16).

Informed Consent

Retrospective study.

Peer-review

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Authorship Contributions

Concept: A.U.S.; Design: R.A.; Supervision: E.Y.; Fundings: A.U.S.; Materials: E.O., N.B.Ç., M.A.; Data: E.O., N.B.Ç., M.A.; Analysis: E.O., R.A.; Literature search: A.U.S., N.B.Ç.; Writing: E.O., R.A., E.Y.; Critical revision: M.A., N.B.Ç., E.Y.

Conflict of Interest

None declared.

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CURB-65 ve qCSI Skorlarının COVID-19 Hastalarında Yoğun Bakım İhtiyacını Öngörmedeki Yeterliliğinin Araştırılması

Amaç: Bu çalışmada acil servise başvurup Koronavirüs 2019 (COVID-19) nedeniyle hastane yatışı verilen hastalarda, Quick Covid Severity Index (qCSI) ve CURB-65 skorlama sistemlerinin yoğun bakım ihtiyacını ön görmedeki yeterlilikleri incelendi.

Gereç ve Yöntem: 1 Ocak- 1 Haziran 2021 tarihleri COVID-19 tanısı ile hastaneye yatırılmış 18 yaş üstü tüm erişkin hastaların dosyaları retrospektif olarak tarandı. Reverse-transcriptase polymerase-chain-reaction (RT-PCR) test sonucu negatif gelenler, başka bir hastaneden transfer edilen hastalar ve iki risk skorunda kullanılacak verilerinden herhangi birine ulaşılamayan hastalar çalışma dışı bırakıldı.

Bulgular: Çalışmaya toplam 325 kişi alındı, kişilerin yaşları ortalaması 58.2±17.2 idi. %48.3'ü erkek %51.7'si kadındı. CURB-65 skorunun yoğun bakım ünitesine yatış ihtiyacını kestirmedeki ROC analizi sonucunda eğri altında kalan alan 0.843 (%95GA 0.799-0.881), Youden indeksi 0.584 p değeri 0.001 olarak bulundu. qCSI skorunun ise yoğun bakım ünitesine (YBÜ) yatış ihtiyacını kestirmedeki ROC analizi sonucunda eğri altında kalan alan 0.921 (%95GA 0.886-0.948), Youden indeksi 0.7520 ve p değeri 0.001 olarak bulundu. İki skorun YBÜ'ne yatış ihtiyacını kestirmedeki değeri karşılaştırıldığında qCSI skorunun CURB-65 skoruna göre daha başarılı olduğu saptandı.

Sonuç: Bu çalışmada, acil servise başvuran COVID-19 hastalarının YBÜ gereksinimini tahmin etmede qCSI ve CURB-65 skorlarının prediktif güçleri karşılaştırıldı. qCSI skorunun CURB-65'e göre daha üstün olduğu sonucuna ulaşıldı.

Anahtar Sözcükler: COVID-19; mortalite; yoğun bakım ünitesi; skor sistemleri.