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Original Article

Quick Sequential Organ Failure Assessment-Mortality (qSOFAm): A New Scoring System to Predict the Mortality of Sepsis Patients

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ABSTRACT

Objective: The aim of this study is to determine whether the addition of decade and gender to quick Sequential Organ Failure Assessment (qSOFA) is superior to qSOFA alone in predicting the mortality of sepsis patients presented to our emergency department.

Methods: We included 300 sepsis patients in our study. The gender with higher mortality received 1 more point. We added the qSOFA score and decade to this value and compared qSOFA and the new scoring system to predict mortality. Furthermore, we determined a cutoff value for age to systolic blood pressure to predict mortality.

Results: Forty-six percentages of our patients were female, and 54% were male. Patients in their 80s (34%) and 90s (26%) comprised the majority of the study group. Mortality rates were higher in males when compared with females. Mortality rate was positively related with age and systolic blood pressure. The cutoff value for age and systolic blood pressure was 0.71 (AUC: 0.799, CI: 0.750–0.848, p=0.00). Patients were at higher risk for mortality if their ratio of age to systolic blood pressure was higher than 0.71 (OR: 2.58). We added a decade and one more point to the qSOFA for the male gender and compared this value with the qSOFA score. The new scoring system (qSOFA+decade+male gender +>0.71) (CI: −2.49–−1.67) was superior to qSOFA alone to predict (CI: −1.20–−0.80) mortality.

Conclusion: Age to systolic blood pressure ratio alone can also predict mortality better than qSOFA. The qSOFAm scoring system may be useful in determining the mortality of sepsis patients.

INTRODUCTION

Sepsis is defined as a life-threatening condition that causes organ dysfunction due to insufficient response of the host to infection. The mortality ratio is high in sepsis patients, and this ratio increases if intervention is delayed. The mortality for septic shock can be as high as 46% if not recognized and treated immediately.[1–3]

Many scoring systems have been devised to predict the prognosis and outcome of sepsis patients, including: systemic inflammatory response syndrome-SIRS, the mortality score in emergency department (MEDS), the sepsis severity score (SSS), the PIRO score (predisposition/insult-infection/response/organ dysfunction-PIRO), the National Early Warning Score (NEWS), Acute physiology and chronic health evaluation score (APACHE II), the Modified

Early Warning Score (MEWS), the Sequential Organ Failure Assessment (SOFA), and the quick SOFA (qSOFA) r.[4–8]

Unfortunately, none of these scoring systems have been enough to predict mortality or a prognosis. qSOFA is easy and applicable for sepsis patients, but this simple scoring system seems insufficient for predicting a prognosis clearly.

In our study, we added the age (decade) and gender (major in mortality) to qSOFA to determine whether this score predicts mortality superiorly to qSOFA alone. We also tried to determine a cutoff value for the ratio of age to systolic blood pressure that can determine mortality better than qSOFA.

MATERIALS AND METHODS

Design and selection of the participants

After ethics committee approval, this retrospective study included adult patients diagnosed with sepsis, presented to our emergency department, and hospitalized in the intensive care unit between January 1, 2019, and December 31, 2019. We excluded patients under 18 years old, pregnant patients, those in cardiac arrest in the emergency department, and patients with missing data.

We noted demographic data (age, gender, and decade), qSOFA (mean blood pressure, respiration rate, and consciousness), systolic blood pressure, blood gas results (pH, base deficit, and lactate) inotrope requirement, length of stay in the emergency department, length of hospitalization, and outcome (exitus or discharged).

Males and females were compared according to mortality. The dominant gender according to mortality received an additional two points, while the other gender received one point. Similarly, the decades of the patients were directly added to the qSOFA score. qSOFA alone and qSOFA+decade+gender scores were compared for predicting mortality with regression analyses.

A cutoff value was determined to predict mortality using the ratio of age to systolic blood pressure. Patients with higher values in this ratio took two points, and the others took one point according to our calculation system.

Statistical analyses

We used the Statistical Package for the Social Sciences (SPSS) 22.0 (SPSS Inc., Chicago, IL, ABD) for the statistical analyses. The Kolmogrov–Smirnov test was used for normal distribution. The t test was used for normally distributed, quantitative data analysis. The Mann–Whitney U-test and Wilcoxon W test were used for non-normally distributed parameters. Chi-square test was used for the analyses of categoric variables. An ROC analysis was used to determine the cutoff value for continuous variables. Regression analyses were used to determine the effect of independent variables on dependent variables. $P<0.05$ provided the basis of significance.

RESULTS

In our study, there were 138 females (46%), and 162 males (54%), with a total of 300 patients included. The mean age of our study group was 74.91±12.91 (min: 19 and max: 100). The majority of patients were in 8th (34%) or 9th (26%) decade.

qSOFA score distributions for the patients were: qSOFA=0 24.7% (n=74), qSOFA=1 37% (n=111), qSOFA=2 22.7% (n=68), and qSOFA=15.7% (n=47).

Two-hundred sixteen patients (72%) did not receive in-

Table 1. Data of continious variables according to mortality

Parameter	Mortalite						
	Mortality (-) (n=140)		Mortality (+) (n=160)		p-value	95% CI	
	Mean	SD	Mean	SD		Lower	Upper
Age (years)	71.91	13.63	77.54	11.68	<0.000	−8.53591	−2.72302
Temperature (°C)	37.47	0.81	37.54	0.81	0.438	−0.25862	0.11219
Heart rate (per minute)	103.47	21.16	114.64	24.14	0.000	−16.36477	−5.97988
Systolic blood pressure (mm-Hg)	119.57	23.0	97.43	21.55	0.000	17.06837	27.19949
Diastolic blood pressure (mm-Hg)	75.82	16.07	61.25	14.78	0.000	11.06396	18.07890
Respiration rate (per mi-nute)	19.35	3.41	20.95	3.88	0.000	−2.43604	−0.77646
pH	7.35	0.09	7.35	0.12	0.930	−0.02690	0.02459
Base deficit	0.54	9.19	−1.59	8.45	0.036	0.13847	4.15010
Initial lactate	24.78	16.04	38.13	29.84	0.000	−18.70545	−7.98562
Age/Systolic blood press ratio	0.62	0.15	0.83	0.20	0.000	−0.25037	−0.16611
Length of stay in the Emergency Department	6.25	4.73	6.25	4.22	1.000	−1.01836	1.01836
Hospitalization length (day)	10.11	4.66	11.62	7.98	0.044	−2.97736	−0.04242
Student's t test							

Table 2. Analyses of gender, qSOFA, and introp requirement according to mortality

Parameter	Mortality				p-value*
	Mortality (-)		Mortalite (+)		
	n	%	n	%	
Gender					
Males	72	24	90	30	0.403
Females	68	22.7	70	23.3	
qSOFA					
0	62	20.7	12	4	<0.001
1	54	18	57	19	
2	20	6.7	48	16	
3	4	1.3	43	14.3	
Inotrope requirement					
(+)	14	4.7	70	23.3	<0.001
(-)	126	42	90	30	

*Pearson Chi-square test. qSOFAm: Quick Sequential Organ Failure Assessment-Mortality.

Table 3. qSOFAm criteria

Criteria	Point
Respiratory rate ≥22/dk	1 point
Systolic blood pressure ≤100 mmHg	1 point
Unconsciousness (GCS <15)	1 point
Age/Systolic blood pressure >0.71	2 points
Age/Systolic blood pressure <0.71	1 point

qSOFAm: Quick Sequential Organ Failure Assessment-Mortality; GCS: Glasgow coma scale.

otrope treatment, and 28% (n=84) of the patients received inotrope treatment.

Mean length of stay in the ED was 6.25±4.46 (min:3, max:35) hours.

When we evaluated patients according to their outcome, 46.7% (n=140) of the patients were discharged, and 53.3% (n=160) died.

Mortality was related to older age, initial serum lactate levels, pH, and base deficit in our study (Table 1).

Analyses of continuous variables according to mortality showed that the ratio of age to systolic blood pressure was significantly related to mortality (Table 1).

Length of stay in the ED was not related with mortality, but hospitalization length in the ICU was related with mortality (Table 1).

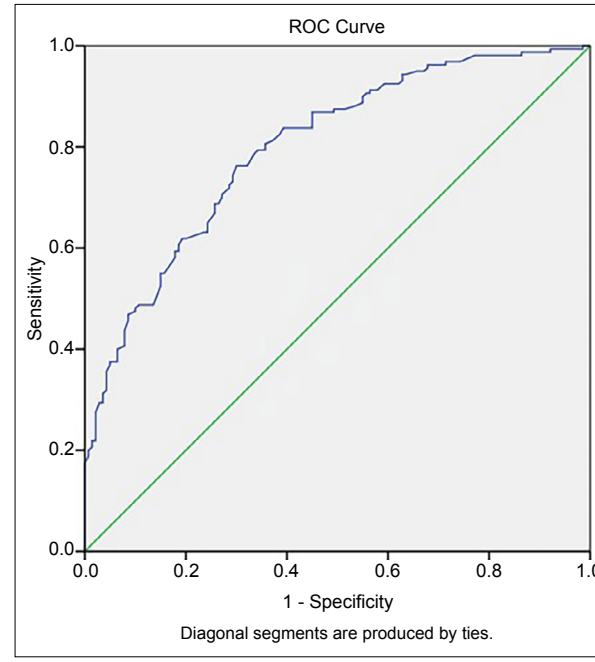

Figure 1. ROC Curve for mortality and age to systolic blood pressure.

The mortality ratio was higher in males, but this value was not statistically different. Similarly, the qSOFA score and mortality were positively related with mortality (Table 2).

qSOFA was not statistically related with length of hospitalization.

The ratio of age to systolic blood pressure was significantly related with mortality. The cutoff value for age to systolic blood pressure was 0.71 (sensitivity: 76%, specificity: 71%, AUC: 0.799 [0.750–0.848]) (Fig. 1).

We added two points for male gender and two points for patients, whose ratio of age to systolic blood pressure was >0.71 (Table 3).

The AUC, sensitivity, and specificity values for predicting the mortality of qSOFA, qSOFA+71, decade+gender+71, qSOFA+decade+gender, and qSOFA+decade+gender+71 were calculated. The highest AUC value was determined in QSOFA+71 (Table 4).

DISCUSSION

Sepsis is a common clinical condition that requires immediate diagnosis and treatment. Reliable criteria and diag-

Table 4. The AUC, sensitivity, and specificity values for predicting the mortality of qSOFA and qSOFAm

Score	AUC (95% CI)	Cutoff	p-value	Sensitivity (%)	Specificity (%)
qSOFA	0.778 (0.726–0.830)	1.5	<0.0001	57	83
qSOFAm	0.805 (0.756–0.854)	2.5	<0.0001	80	69

AUC: Area under curve; qSOFAm: Quick Sequential Organ Failure Assessment-Mortality; CI: Confidence interval.

nostic tests have been warranted to recognize and predict the prognosis and mortality of this disease. Despite the improvements in diagnosis, sepsis is still an important cause of mortality and health costs.[9,10] Our aim, in this study, was to determine the prediction level of a new criterion by adding a decade and gender to the qSOFA score to maintain a new, easy applicable, and practical scoring in the emergency department.

Sepsis is especially common in the elderly age group.[11,12] Similar to study groups in other literature, our study group mostly consisted of patients in their 8th (34%) and 9th decades (26%). Longer average lifespan causes a rise in sepsis frequency. In the US, the frequency of sepsis was 143/100,000 in 2000, but this value was 323/10,000 in 2008.[13] According to Stoller et al.,[14] the frequency of sepsis rose from 346/100,000 (mean age: 69) to 436/100,000 (mean age: 68) between 2008 and 2012. An observational study suggested that sepsis occurs 20.4% times more in patients over 65 years old when compared with the patients under 65 years old.[15] Similarly, sepsis is the most common reason for hospitalization of older populations in intensive care units.[16]

Despite improvements in the diagnosis and management of sepsis, mortality ratios are still high.[17] In-hospital mortality is 30–60% for patients over 65 years old and 40–80% for those over 85 years old. Age is an independent factor for mortality from sepsis.[10,18,19]

In the literature, it has been reported that sepsis and severe sepsis are common among males.[20,21] Similarly, in our study, 54% of the patients were males.

The role of gender as a factor in prognosis and mortality from sepsis has not been researched enough, and there is a lack of data in the literature.[10] In our study, the mortality ratio for sepsis patients was 30% for males and 23.3% for females. Although some studies have reported that mortality did not differ between genders,[11,20,22] others have shown a higher mortality among females.[12]

qSOFA provides an easy scoring system and tool for diagnosis and prediction of hospitalization length and mortality in sepsis patients.[23,24] In our study, however, qSOFA was insufficient to determine hospitalization length. Mortality is higher in patients whose qSOFA score ≥2.[25] Mortality ratios according to qSOFA scores, in our study, were as follows: 4% for 0 points, 19% for 1 point, 16% for 2 points, and 14.3% for 3 points. This easy scoring system, qSOFA, has not been researched enough in the older population.

Mean initial systolic and diastolic blood pressure values in our study group were 107.75 mmHg and 68.05 mmHg, respectively. Mean initial systolic and diastolic blood pressure values for patients who were discharged from the intensive care unit were lower when compared with the patients who died. One of the targets is the maintenance of mean arterial pressure above 65 mmHg, but the ideal target for mean arterial pressure is not clear. In one study, 28 days of mortality ratios were compared according to maintenance of two different mean arterial pressure targets (80–85mmHg vs. 65–70 mmHg). However, there was no statistical difference between the two targets (36.6% vs. 34%).[26]

The surviving sepsis campaign suggests maintaining a mean arterial pressure higher than 65 mmHg with fluid resuscitation and vasopressor administration in sepsis patients. Patients are under high risk for mortality if their blood pressure is low despite fluid resuscitation and inotrope treatment. In our study group, 28% patients underwent vasopressor treatment in the emergency department, and the mortality ratio was higher in the patients who required inotropes. Unnecessary vasopressor use despite target blood pressure has been researched, and it has been suggested that unnecessary vasopressor administration and inotrope exposure of patients should be avoided, because the redundant use of a vasopressor is related with high mortality. In contrast, better clinical outcomes occur with appropriate doses. Therefore, the best tolerated blood pressure should be provided.[27]

A group of scoring systems (SIRS, MEDS, SSS, the PIRO score, NEWS, APACHE II score, MEWS, SOFA, and qSOFA) have been used in EDs and intensive care units to determine the prognosis and mortality of sepsis patients. All of these scoring systems can be accepted as effective, but it is not easy to select an ideal one due to insufficient sensitivity and specificity ratios. A revision of qSOFA scoring is required for better results in predicting the prognosis and mortality in sepsis patients. In this new scoring system, qSOFAm, we added extra points for decade, gender, and ratio of age to systolic blood pressure, and we evaluated a variety of combinations. The highest AUC was determined to be in the qSOFA+71 score. This scoring system was much more effective, when the ratio of age to systolic blood pressure was added to the qSOFA score.

CONCLUSION

Males had a high mortality percentage in our study. Similarly, mortality rises with older age. It was determined that the addition of a ratio for age to systolic blood pressure to the qSOFA score predicts mortality in sepsis patients. This new scoring system qSOFAm may be helpful for emergency clinicians to predict the prognosis and mortality in sepsis patients.

Ethics Committee Approval

This study approved by the Adana City Training and Research Hospital Clinical Research Ethics Committee (Date: 27.02.2020, Decision No: 730).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: S.B.Y., K.S., A.K., A.A., S.Y.; Design: S.B.Y., K.S., A.A., S.Y.; Supervision: A.A., S.Y.; Data: A.B.U., D.Y., A.K.,

D.M.Ü., S.B.Y.; Analysis: A.B.U., D.Y., A.K., D.M.Ü., S.B.Y.; Literature search: S.B.Y., A.A., S.Y.; Writing: S.B.Y., K.S., A.K., A.A., S.Y.; Critical revision: S.B.Y., A.A., S.Y.

Conflict of Interest

None declared.

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Hızlı Sıralı Organ Yetmezliği Değerlendirmesi-Mortalite (qSOFAm): Sepsis Hastalarının Mortalitesini Tahmin Etmek İçin Yeni Bir Puanlama Sistemi

Amaç: Bu çalışmanın amacı, acil servisimize başvuran sepsis hastalarının mortalitesini öngörmede qSOFA'ya dekat ve cinsiyet eklenmesinin tek başına qSOFA'ya üstün olup olmadığını belirlemektir.

Gereç ve Yöntem: Çalışmamıza 300 sepsis hastasını dahil ettik. Ölüm oranı daha yüksek olan cinsiyet 1 puan daha aldı. Bu değere qSOFA skorunu ve dekatı ekledik ve mortaliteyi tahmin etmek için qSOFA ile yeni skorlama sistemini karşılaştırdık. Ayrıca, mortaliteyi tahmin etmek için yaş için sistolik kan basıncı için bir kesme değeri belirledik.

Bulgular: Hastalarımızın %46'sı kadın, %54'ü erkekti. Çalışma grubunun çoğunluğunu 80'li (%34) ve 90'lı (%26) yaşlarındaki hastalar oluşturdu. Erkeklerde ölüm oranları kadınlara göre daha yüksekti. Mortalite oranı, yaş ve sistolik kan basıncı ile pozitif ilişkiliydi. Yaş ve sistolik kan basıncı için eşik değer 0.71 idi (AUC:0.799, CI:0.750–0.848, p=0.00). Yaşlarının sistolik kan basıncına oranı 0.71'den (OR: 2.58) yüksek olan hastalarda mortalite riski daha yüksekti. Erkek cinsiyet için qSOFA'ya dekat ve bir puan daha eklendi ve bu değer qSOFA puanı ile karşılaştırıldı. Yeni puanlama sistemi (qSOFA+ dekat+erkek cinsiyet +> 0.71) (CI:-2.49–-1.67), mortaliteyi (CI:-1.20–-0.80) öngörmede tek başına qSOFA'dan üstündü.

Sonuç: Yaş/sistolik kan basıncı oranı tek başına mortaliteyi qSOFA'dan daha iyi öngörebilir. qSOFAm skorlama sistemi, sepsis hastalarının mortalitesini belirlemede faydalı olabilir.

Anahtar Sözcükler: Acil servis; mortalite; qSOFA; sepsis; skor.