

qSOFA Scores Versus SIRS Criteria and SOFA Scores for Sepsis in the Emergency Department; A Prospective, Observational, and Cohort Study

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ABSTRACT

Objective: Sepsis is a syndrome of physiologic, pathologic, and biochemical abnormalities that is induced by infection. Sepsis constitutes 5,2% of total hospital and 0,4% of emergency department admissions, and has high mortality rates (as high as 28%).

Materials and Methods: In the application to the emergency department, patients' comorbid disorders and demographic information indicated by patients and their relatives; blood pressure, pulsation, body temperature, respiratory rate, white blood cell count, platelet count, bilirubin level, creatinine level, urine output; and GCS score, SIRS criteria, SOFA and qSOFA scores and culture results were saved to the form prepared for the study.

Results: 59% of the patients were male and 41% of them were female. Mean age of the patients was 62,25±16,48 years. According to diagnosis, SIRS criteria and SOFA scores had higher sensitivity rate than qSOFA scores. According to the mortality, SOFA score had highest sensitivity and NPV, qSOFA had highest specificity and PPV. SIRS criteria, SOFA and qSOFA scores and mortality rate were examined, there was a moderate positive relationship ($r=0.44$) only between SOFA scores and mortality rate.

Conclusion: As a result it was concluded that usage of qSOFA scores is more optimal in emergency department for giving fast decision. However it was found that the qSOFA scores have low sensitivity for diagnosis and prediction of the mortality.

Keywords: Emergency department, qSOFA, sepsis, SIRS, SOFA

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INTRODUCTION

Sepsis is pathological and biochemical abnormalities and life-threatening organ dysfunction caused by a dysregulated host response to infection.^[1] Patients with septic shock can be clinically characterized with a vasopressor requirement to maintain a mean arterial pressure of 65 mm Hg or higher and serum lactate level greater than 2 mmol/L (>18 mg/dL) in the absence of hypovolemia. Sepsis constitutes 5.2% of total hospital and 0.4% of emergency department (ED) admissions and has high mortality rates (as high as 28%).^[1-3]

In 1991–1992, systemic inflammatory response syndrome (SIRS), which consists criteria of tachycardia, tachypnea, hyperthermia or hypothermia, leukocytosis or leucopenia, or Bandemia had been defined for sepsis.^[4] Lastly, in 2021, these criteria were updated by Sepsis Surviving Campaign to increase the specificity for predicting mortality or intensive care unit (ICU) admission. This was done by adapting the criteria to the concepts of pathophysiology (in particular, organ dysfunction), and by removing the concept of SIRS and using Sepsis-related Organ Failure Assessment (SOFA), National Early Warning Score, and Modified Early Warning Score.^[1,5]



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The SOFA score is intended to be used in the ICU and to a lesser extent in the ED.^[6] Nevertheless, the SOFA requires laboratory values and they are usually unavailable at ED triage. Because of these limitations, in 2016, the task force suggested the use of the qSOFA score, which consist of respiratory rate, Glasgow coma scale (GCS), and systolic blood (SBP) pressure, at ED to identify patients with suspected of sepsis.^[1,6]

Regardless of definition, sepsis is still underdiagnosed or delayed diagnosed in the pre-hospital emergency setting and in the ED.^[5,7,8] The ED serves as a primary site of initial identification and treatment and plays a central role to improve outcomes.^[9] In this study, we aimed to asses SIRS criteria, SOFA, and qSOFA scores of septic patients in emergency room; to determine and compare their correlation with diagnosis, blood culture, and mortality. We also aimed to improve knowledge and practice of emergency physicians on sepsis and contribute to early diagnosis and treatment.

MATERIALS and METHODS

This study was performed prospectively between November 08, 2016, and May 08, 2017, in the department of emergency medicine of a university hospital with annual 60.000 patients admission. The study was approved by the Cerrahpasa Faculty of Medicine Ethical Review Committee date of November 08, 2016, and number of 31887016-604.01.01-402667.

From the patients with pre-diagnosis of sepsis who applied emergency room, those who are above 18, got sepsis diagnosis and sepsis treatment from ED specialist and infection disease specialist after physical inspection and examination results were included in the study. Those who did not get sepsis diagnosis, were under 18, were traumatized patient, and did not want to participate in the study were excluded from the study.

In the application to the ED, patients' comorbid disorders and demographic information indicated by patients and their relatives; blood pressure, pulsation, body temperature, respiratory rate, white blood cell count, platelet count, bilirubin level, creatinine level, urine output; and GCS score, SIRS criteria, SOFA, and qSOFA scores and culture results were saved to the form prepared for the study. The patients who met SIRS criteria, SOFA, and qSOFA scores marked as (+) and the patients who did not meet SIRS criteria, SOFA, and qSOFA scores marked as (-). In hospital mortality was followed up and recorded.

IBM SPSS Statistics for Microsoft 20.0 (SPSS Inc, Chicago, USA) was used for statistical analysis. Kolmogorov-Smirnov were used to check the normal distribution the test. Descriptive statistical methods were used to evaluate the data. Independent samples t-test was used to compare the means of the

Table 1. Mean age of the patients

	Male (n=51)	Female (n=49)	Total (n=100)	p
Mean age	62.58±16.60	61.78±16.50	62.25±16.48	>0.005

groups. Chi-Square test was used to analyze sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Pearson correlation coefficient was used to evaluate the relationship between SIRS SOFA, qSOFA, and mortality. P value under 0.05 was accepted as statistically significant.

RESULTS

In our study, 59% of the patients were male and 41% of them were female. Mean age of the patients was 62.25±16.048 years. There was no statistically significant difference between the mean age of male and female patients (Table 1).

There is no statistically significant difference between male and female patients' vital and biochemical parameters. When vital and biochemical parameters of survivors and non-survivors were compared, statistically significant difference was determined in only bilirubin and GCS levels (Table 2).

When the parameters of the patients with SIRS(+) and SIRS(-), SOFA(+) and SOFA(-), and qSOFA (4) and qSOFA(-) were examined, statistically significant difference was determined in pulse rate and RR for SIRS, in PaO₂/FiO₂ and GCS for SOFA and in bilirubin, MAP, GCS, and SBP for qSOFA (Table 3). About 61% of the patients' culture results were negative, 39% of them were positive. *Staphylococcus epidermidis* was the most frequently detected bacteria in blood cultures with a 12%, *Escherichia coli* comes right after with a 7%, and finally *Staphylococcus hominis* with a 5%.

Patients who meet and do not meet the SIRS criteria, SOFA and qSOFA scores are summarized in Table 4.

About 52% of patients were survived and 48% patients were dead. Furthermore, culture positive patients' mortality rate was 46% and culture negative patients' mortality rate was 49%.

According to the mortality, SOFA score had highest sensitivity and NPV, qSOFA had highest specificity and PPV (Table 5).

When the relationship between patients' SIRS criteria, SOFA and qSOFA scores and mortality rate were examined, there was a moderate positive relationship (r=0.44) only between SOFA scores and mortality rate.

DISCUSSION

Sepsis is a syndrome of physiologic, pathologic, and biochemical abnormalities that is induced by infection. It is a

Table 2. Vital and biochemical parameters of the patients and survivors and non-survivors

	Male	Female	Survival	Non-survival	Total
Temperature	36.81±1.40	37.14±1.27	37.50±1.22	36.35±1.24	36.95±1.35
Pulse	105.6±23.52	106.4±25.22	107.9±23.48	103.83±24.84	105.9±24.11
RR (min)	25.29±6.16	27.29±6.39	26.37±5.89	26.21±6.74	26.29±6.28
pCO ₂ (mmHg)	32.68±15.49	30.51±12.37	33.04±15.34	30.44±13.03	31.79±14.27
WBC (mm ³)	14.8±11.9	16.2±16.6	14.1±14.9	16.8±12.8	15.4±13.9
PaO ₂ /FiO ₂	304.5±70.85	312.2±77.36	314±72.08	300±74.77	307.7±73.30
PLT (mm ³)	223.6±145.5	236.9±131.4	230±136.3	228±144.1	229.1±139.4
Bilirubin (mg/dL) ^a	1.68±3.07	2.18±5.82	0.93±1.28	2.91±6.06	1.83±4.4
MAP	83.34±19.7	81.1±22.42	83.71±20.34	81.02±21.37	82.42±20.78
GCS ^a	13.10±2.98	13±3.21	13.92±2.4	12.13±3.43	13.06±3.06
Creatinine (mg/dL)	1.7±1.55	1.84±2.04	1.48±1.63	2.06±1.85	1.76±1.75
SBP (mm/Hg)	111.2±24.44	109.3±34.53	111.7±27.25	109.5±30.74	110.6±28.85

^a: Statistically significant difference between survivors and non-survivors. RR: Respiration rate; pCO₂: Partial carbon dioxide pressure; WBC: White blood cell; PaO₂: Partial oxygen pressure; FiO₂: Respired oxygen percentage; PLT: Platelet count; MAP: Mean arterial pressure; GCS: Glasgow coma scale; SBP: Systolic blood pressure

Table 3. Vital and biochemical parameters of patients according to the SIRS criteria, SOFA, and qSOFA scores

	SIRS		SOFA		qSOFA	
	Sepsis(+)	Sepsis (-)	Sepsis (+)	Sepsis (-)	Sepsis (+)	Sepsis (-)
Temperature	36.98±1.37	36.42±0.97	36.95±1.32	36.86±1.76	37.00±1.29	36.88±1.45
Pulse	107.9±23.51	79.00±12.67	105.95±23.81	106.11±28.17	109.7±22.31	101.1±25.66
RR (min) ^a	26.81±6.19 ^a	19.43±2.22 ^a	26.62±6.32	23.00±4.18	27.13±6.54	25.23±5.84
pCO ₂ (mmHg)	31.41±14.45	36.86±11.17	31.96±14.92	30.11±3.18	33.09±17.32	30.14±8.96
WBC×10 ⁹ /L	15.805±14339	10.3±5.4	15.7±14.4	12.4±6.2	15.7±13.7	15±14.3
PaO ₂ /FiO ₂ ^b	306.0±72.29	330.2±88.86	302.7±73.92	357.89±43.75	303.4±81.65	313.1±61.56
PLT×10 ⁹ /L	231.3±139.6	199.4±143.8	223.8±139.8	282.1±130.9	229.6±126.7	228.4±155.59
Bilirubin (mg/dL) ^c	1.72±4.30	4.03±5.30	2.02±4.58	0.48±0.29	0.94±1.13	3.09±6.33
MAP (mm/Hg) ^c	82.68±21.21	79.00±14.59	82.16±21.63	85.00±8.45	75.02±21.59	91.84±15.34
GCS ^{b,c}	13.03±3.10	13.43±2.69	12.87±3.14	15.00±0.01	11.73±3.48	14.75±0.94
Creatinine (mg/dL)	1.807±1.804	1.17±0.84	1.87±1.80	0.66±0.18	2.021±2.06	1.43±1.22
SBP (mm/Hg) ^c	110.9±29.50	106.4±19.08	110.4±19.90	112.4±15.37	99.50±28.13	124.8±23.15

^a: Statistically significant difference between SIRS(+) and SIRS(-); ^b: Statistically significant difference between SOFA(+) and SOFA(-); ^c: Statistically significant difference between qSOFA(+) and qSOFA(-). SIRS: Systemic inflammatory response syndrome; SOFA: Sepsis-related Organ Failure Assessment; RR: Respiration rate; pCO₂: Partial carbon dioxide pressure; WBC: White blood cell; PaO₂: Partial oxygen pressure; FiO₂: Respired oxygen percentage; PLT: Platelet count; MAP: Mean arterial pressure; GCS: Glasgow coma scale; SBP: Systolic blood pressure

significant cause of critical illness and mortality all over the world. In surviving sepsis patients, long-term physical, psychological, and cognitive disorders constitute important health and social issues. Even with minimal organ dysfunction, mortality rate is 10% in the course of diagnosis. Quick identification, early, and appropriate intervention can enhance the prognosis.^[1]

Sepsis affects both gender almost equally. In performed studies, male and female patients ratio were found 55.4%–

44.6, 59.1%–40.9%, and 52%–48%, respectively, which was similar to our study.^[10–12] Sepsis also affects more older people than younger. In performed studies, also the mean age of the patients was found 67.4±17.6, 62.9±17.4, and 58.3±17.1 years, respectively, and which was also similar to our study.^[10,11,13]

Even if sepsis is induced by infection, positive culture results are seen low than expected. *E. coli* and Gram-negative bacteria are the most frequent bacteria in seen sepsis

Table 4. Number of the patients who met and did not meet the SIRS criteria, SOFA, and qSOFA scores

Criterion	≥2 points (n)	<2 points (n)	Total	Sensitivity (%)
SIRS	93	7	100	93
SOFA	91	9	100	91
qSOFA	56	44	100	56

SIRS: Systemic inflammatory response syndrome; SOFA: Sepsis-related Organ Failure Assessment

patients with culture positive.^[11,14] We also found low culture positive percentage with 39% but the Gram-positive bacteria consist 74% of these cultures. *S. epidermidis* was the most frequently detected bacteria with a 12%, *E. coli* comes right after with 7%. This deviation can be explained by asserting *S. epidermidis* possibly as contamination. If we accept *E. coli* as the most frequent, then we found similar results with the literature.

Lower SBP and GCS were found as the important indicator of mortality.^[12] We found low temperature, SBP, and higher bilirubin levels in non-survived patients differently. Low GCS in non-survived patients was same with the literature. Hence, the common result is that patients with low GCS have higher mortality rate.

In performed studies, sensitivity of SIRS criteria and SOFA scores which was over 90% was found higher than qSOFA scores which was lower than 60%.^[5,11,14–16] In our study, SIRS criteria and SOFA scores have higher sensitivity (92%, 98%) than qSOFA scores (62%). According to our findings, the last update of the Sepsis Surviving Campaign in 2021 does not recommend the use of qSOFA criteria to detect and recognize sepsis despite its simplicity and briefness.

General mortality rate of sepsis is high and was found 40% and 45% in performed studies like was our study.^[14,15,17] In performed studies, mortality rate of SIRS(+) patients was found 20%, 31% and 56%, SOFA(+) patients was found 20%, 33%, and 58% and qSOFA patients was found 22%.^[10,11,18] Furthermore, the patients with met these criteria and scores have higher mortality rate like in our study.

Performed studies usually showed that SIRS, SOFA had high sensitivity (89% between 97%) and low specificity (2.3% between 16%) in terms of mortality like was in our study. However, qSOFA has a lower sensitivity (22–42%) and higher specificity (90%) than SIRS criteria and SOFA scores.^[19–21] These results make SIRS criteria and SOFA scores more useful than qSOFA scores to predict the mortality.

Table 5. Sensitivity, specificity, PPV, and NPV values of SIRS, SOFA, and qSOFA for mortality

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
SIRS	92	6	47	43
SOFA	98	15	52	90
qSOFA	62	50	54	59

PPV: Positive predictive value; NPV: Negative predictive value; SIRS: Systemic inflammatory response syndrome; SOFA: Sepsis-related Organ Failure Assessment

CONCLUSION

As a result, it was concluded that usage of qSOFA scores is more optimal in ED for giving fast decision. However, it was found that the qSOFA scores have low sensitivity for diagnosis and prediction of the mortality. In ED for giving fast decisions, we need criteria which has high sensitivity and specificity.

Disclosures

Ethics Committee Approval: The study was approved by the Cerrahpasa Faculty of Medicine Ethics Committee (No: 31887016-604.01.01-402667, Date: 08/11/2016).

Informed Consent: Written informed consent was obtained from all patients.

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