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The evaluation of sepsis in the emergency department and its association with mortality

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ABSTRACT

Aim: Sepsis is a life-threatening organ dysfunction accompanied by a dysregulated host response to infection. Patients with sepsis may present with different clinical manifestations, and there is no gold standard diagnostic test. Early diagnosis and rapid treatment result in a decrease in sepsis-related deaths. Quick Sequential Organ Failure Assessment (qSOFA) is a scoring system used in diagnosing sepsis through a rapid evaluation at the time of initial presentation. The purpose of this study was to evaluate the relationship between qSOFA scores and mortality in patients presenting to the emergency department with suspected sepsis.

Material and Method: Seventy patients presenting to the Atatürk University Medical Faculty Emergency Department and commencing treatment with a preliminary diagnosis of sepsis between 01.12.2019 and 01.06.2020 were included in the research. Patients' qSOFA scores were calculated, and their demographic data, infection parameters and foci, the clinics to which they were admitted, and outcomes were recorded. The data were analyzed, and the relationships between qSOFA classifications and other infection parameters (CRP, procalcitonin, and lactate) and mortality were examined.

Results: Seventy percent (n=49) of the 70 patients in the study were discharged, while 30% (n=21) were exitus. A statistically significant relationship was present between qSOFA scores and mortality ($p<0.001$). CRP was also significantly related to qSOFA ($p=0.003$). Significant relationships were determined between CRP, procalcitonin and lactate and mortality ($p=0.009$, $p<0.001$, and $p=0.009$, respectively).

Conclusion: The use of qSOFA scores at initial assessment in the emergency department appears to be a simple and rapid means of diagnosing sepsis. qSOFA levels were significantly associated with mortality. CRP, procalcitonin, and lactate levels were also associated with mortality, and CRP was significantly associated with qSOFA. Early diagnosis and treatment can be expected to reduce mortality.

Keywords: Sepsis, qSOFA, Emergency, Mortality

INTRODUCTION

Millions of individuals are diagnosed with sepsis every year. One in four cases followed-up with a diagnosis of sepsis conclude with mortality. Rapid diagnosis of sepsis and the initiation of appropriate treatment affect the disease prognosis (1). New recommendations emerged from the Third International Consensus Definitions for Sepsis and Septic Shock in 2016. Sepsis was defined as a life-threatening organ dysfunction accompanied by a dysregulated host response to infection (2). It represents the body's response to an infection. The resulting exposure leads to the release of proinflammatory and anti-inflammatory mediators. These mediators can lead to organ failure and death in sepsis by affecting endothelial damage, vascular permeability, microvascular dysfunction, and coagulopathies (2, 3). Clinical findings in sepsis are variables associated with the source of the infection. The most widespread infection sites leading to sepsis are the respiratory, gastrointestinal, and genitourinary systems, the skin, and soft tissue. In addition to general clinical symptoms such as fever, hypotension, tachypnea, tachycardia, confusion, anxiety, respiratory difficulty, vomiting, decreased urine output, and hypoperfusion, it can also exhibit findings localized to the region of infection (4,5).

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The level of organ dysfunction occurring in sepsis is evaluated using various scoring systems based on clinical findings, laboratory data, or therapeutic interventions. Sequential Organ Failure Assessment (SOFA) is more frequently used under intensive care conditions, and requires partial arterial oxygen pressure (PaO2), platelet count, and creatinine and bilirubin levels for calculation. Quick SOFA (qSOFA) is a scoring system used in diagnosing sepsis through a rapid assessment at the time of initial presentation. The Third International Consensus Definitions for Sepsis and Septic Shock agreed that qSOFA scores could be helpful to clinicians since they could be applied at the bedside in patients outside the intensive care unit and does not involve laboratory data.

A respiratory rate ≥22 /min, systolic blood pressure ≤100 mmHg, and altered mental state are evaluated, each being scored between 0 and 3 (2). There is no gold standard diagnostic test. However, early diagnosis and rapid treatment result in a decrease in sepsis-related deaths. qSOFA is used as a predictive tool calculating the risk of mortality, rather than diagnosis, at the time of first presentation. The purpose of the present study was to investigate the relationship between qSOFA and mortality and other infection parameters (CRP, procalcitonin, and lactate).

MATERIAL AND METHOD

The study was performed following receipt of approval from the Atatürk University Medical Faculty Clinical Researchs Ethics Committee (Date: 26.12.2019, Decision No: B.30.2.ATA.0.01.00/54). Seventy patients aged over 18 presenting to the Atatürk University Medical Faculty Emergency Department and commencing treatment with a preliminary diagnosis of sepsis (Based on anamnesis, state of consciousness, vital signs, laboratory parameters, and clinical status) between 01.12.2019 and 01.06.2020 were included in the research. Age, gender, accompanying diseases, vital findings on arrival, and lactate levels, procalcitonin, and lactate levels were recorded. Altered consciousness, infection foci, and the clinical to which the patient was admitted were also noted. qSOFA scores were calculated on the basis of respiration rate ≥22/ min, altered mental state (a Glasgow Coma Scale score of 13 or less), and systolic blood pressure ≤100 mmHg. Patients were followed-up after admission in the clinic in terms of prognosis and mortality. The relationship between patients' qSOFA classifications and other infection parameters (CRP, procalcitonin, and lactate) and mortality was then examined.

Statistical Analysis

Descriptive methods were employed for demographic data. Normality of data distribution was evaluated using the Kolmogorov-Smirnov test. Data were analyzed on SPSS 23.0.0.1 software (SPSS, IBM, Armonk, NY, USA). The chi-square test and Fisher's Exact test were used in two-group comparisons. Non-parametric continuous data were compared between the groups using the Mann-Whitney U test. p values <0.05 were considered statistically significant.

RESULTS

Women constituted 28.6% (n=20) of the 70 patients in the study . The mean age of the patients was 71.61 years (±12.1 SD) (min 19, max 92). Patients' other laboratory and clinical data are shown in **Table 1**. No correlation with mortality was observed in terms of either gender (r<0.001 p=1.0) or age groups (r=3.630 p=0.057). No significant correlation was also observed between either gender (r=0.488 p=0.784) or age groups (r=0.363 p=0.834) and qSOFA scores. No exitus occurred among the patients with qSOFA scores of 1 in this research (n=9). However, exitus occurred in 13.5% (n=5) of the patients with scores of 2 and in 66.7% (n=16) of those with qSOFA scores of 3 (**Table 2**). Patients' qSOFA scores were significantly correlated with mortality (r=24.011 p<0.001) (**Table 2**).

Table 1. Patients' laboratory and clinical data

Clinical data		
qSOFA	**n**	**%**
1	9	12.9
2	37	52.9
3	24	34.3
Infection focus	**n**	**%**
Pulmonary infection	35	50.0
Urinary infection	22	31.4
Other	13	18.6
Clinic to which admitted	**n**	**%**
Intensive care	48	68.6
Ward	22	31.4
Mortality	**n**	**%**
Discharged	49	70.0
Exitus	21	30.0
Laboratory data		
CRP	**n**	**%**
5-100	18	25.7
100 or above	52	74.3
Total	70	100
Procalcitonin (ng/mL)		
0-5	53	75.7
5 or above	17	24.3
Total	70	100.0
Lactate (mmol/L)		
1-1.5	18	25.7
1.5 or above	52	74.3
Total	70	100.0

The most common infections were pulmonary infections at 50% (n=35), followed by urinary infections at 31.4% (n=22), and other infections at 18.6% (n=13) (**Table 1**). Analysis showed that 68.6% (n=48) of patients were admitted to the intensive care unit from the emergency department, while 31.4% (n=22) were transferred to the wards (**Table 1**). Exitus occurred in 41.7% (n=20) of the patients admitted to the intensive care unit compared to 4.5% (n=1) of those admitted to the wards (**Table 2**). Mortality rates differed significantly between the clinics (r=9.899 p=0.002) (**Table 1**).

qSOFA scores of 3 were determined in only 11.1% (n=2) of the patients with CRP values of 5-100, but in 42.3% (n=22) of those with CRP values exceeding 100. qSOFA scores were significantly correlated with CRP groups (r=11.731 p=0.003) (**Table 1**). No significant association was observed between qSOFA scores and procalcitonin (r=3.708 p=0.157) or lactate (r=4.159 p=0.125) groups (**Table 3**). Exitus occurred in 5.6% (n=1) of the patients with CRP values of 5-100, and in 38.5% (n=20) of those with CRP values exceeding 100. Significant correlation was observed between the CRP groups and mortality (r=6.895 p=0.009) (**Table 4**). Mortality was also significantly correlated with procalcitonin (r=23.089 p<0.001) and lactate (r=6.895 p=0.009) (**Table 4**).

DISCUSSION

Early identification and rapid appropriate treatment of sepsis, which is linked to high morbidity and mortality, will yield good results. The present study examined the relationship between qSOFA and mortality. Men constituted 71.4% of the patients taking part. Men have also constituted more than 50% of the patients with sepsis in previous studies (6-7). This distribution has been linked to lower urinary infection rates in women due to better compliance with hygiene rules, occupation exposure in men, and the prevalence of pulmonary infections deriving from smoking (8). The mean age of the patients in research into sepsis is generally greater than 60. Lifetime accumulation of cellular damage and increased comorbid diseases also increase the tendency to sepsis in patients (9-10). The mean age of the patients with sepsis in the present study was 71.6± 12.1 years.

The most common focus of infection in this study, at 50%, was the respiratory system, followed by urinary tract infection at 31.4%. Chen et al. detected pneumonia in 55.8% of patients, and urinary tract infection in 20.9% (10). Our findings are compatible with the previous literature.

In the present study, 68.6% of patients were admitted to the intensive care unit, while 31.4% were followed up on the wards. Mortality rates were 41.7% in the intensive

Table 2. Relationships between patients' qSOFA classes, infection foci, and clinics to which they were admitted, and mortality

Q Sofa	**Mortality**	**n=70**	**%**	
1	Discharged	9	100	
2	Discharged	32	86.5	r=24.011
	Exitus	5	13.5	
3	Discharged	8	33.3	p<0.001
	Exitus	16	66.7	
Infection focus	**Mortality**	**n=70**	**%**	
Pulmonary infection	Discharged	20	57.1	
	Exitus	15	42.9	
Urinary infection	Discharged	19	86.4	r=5.857
	Exitus	3	13.6	p=0.053
Other infection sites	Discharged	10	76.9	
	Exitus	3	23.1	
Clinic to which admitted	**Mortality**	**n=70**	**%**	
Intensive care	Discharged	28	58.3	r=9.899
	Exitus	20	41.7	
Ward	Discharged	21	95.5	p=0.002
	Exitus	1	4.5	

Table 3. Correlations between patients' CRP. procalcitonin. and lactate groups and qSOFA classes

CRP	**Q Sofa**	**n=70**	**%**	
5-100	1	6	33.3	
	2	10	55.6	r=11.731
	3	2	11.1	
100 and above	1	3	5.8	p=0.003
	2	27	51.9	
	3	22	42.3	
Procalcitonin (ng/mL)	**Q Sofa**	**n=70**	**%**	
0-5	1	8	15.1	
	2	30	56.6	
	3	15	28.3	r=3.708
5 and above	1	1	5.9	p=0.157
	2	7	41.2	
	3	9	52.9	
Lactate (mmol/L)	**Q Sofa**	**n=70**	**%**	
1-1.5	1	4	22.2	
	2	11	61.1	
	3	3	16.7	r=4.159
1.5 and above	1	5	9.6	p=0.125
	2	26	50.0	
	3	21	40.4	

Table 4. Correlations between patients' CRP, procalcitonin, and lactate groups and mortality

CRP	**Mortality**	**n=70**	**%**	
5-100	Discharged	17	94.4	
	Exitus	1	5.6	r=6.895
100 and above	Discharged	32	61.5	p=0.009
	Exitus	20	38.5	
Procalcitonin (ng/mL)	**Mortality**	**n=70**	**%**	
0-5	Discharged	45	84.9	
	Exitus	8	15.1	r=23.089
5 and above	Discharged	4	23.5	p<0.001
	Exitus	13	76.5	
Lactate (mmol/L)	**Mortality**	**n**	**%**	
1-1.5	Discharged	17	94.4	
	Exitus	1	5.6	r=6.895
1.5 and above	Discharged	32	61.5	p=0.009
	Exitus	20	38.5	

care unit and 4.5% on the wards. It was seen that the use of clinical, radiological and laboratory results together with the qSOFA score in the patient evaluation in the emergency department provided more accurate referrals and treatment in appropriate clinics. Seymour et al. reported a mortality rate of 4-11% for non-intensive care patients, compared to 18% for those in intensive care (11). The total mortality rate among the patients with sepsis in the present study was 30%, while A charya et al. reported a rate of 40% in patients with sepsis (12), and Khwannimit et al. a rate of 45% among all patients (13).

The qSOFA score that emerged from the Third International Consensus Definitions for Sepsis and Septic Shock published in 2016 entered into use after being recommended as a good prognostic factor in predicting mortality in non-intensive care patients and admission to the intensive care unit (2). Examination of the association between qSOFA and mortality in the present study revealed no mortality in qSOFA group 1, a rate of 13.5% in qSOFA group 2, and a rate of 66.7% in qSOFA group 3. Wang et al. investigated 477 emergency department patients diagnosed with infection and reported no difference in 28-day mortality and ICU admission rates between groups with qSOFA scores of 0 and 1. However, an increase was reported in case of qSOFA scores higher than 1. Mortality in patients with qSOFA ≥2 was 2.5 times higher than in those with qSOFA <2, while the rate of admission to intensive care was 2.1 times higher (13). Another study reported qSOFA ≥2 in 24% of patients with infection, with a mortality rate of 70% in that group. A 3-14-fold increase in in-hospital mortality rates was observed in patients with qSOFA ≥2 (10). Freund Y. et al. reported that qSOFA exhibited 70% sensitivity and 79% specificity. Mortality occurred in only 3% of patients with qSOFA <2 (15). The findings of the present study are compatible with the previous literature, and mortality increased in patients with qSOFA ≥2.

Studies have emphasized lactate as an important parameter in the diagnosis and follow-up of sepsis (16). Lactate is continuously manufactured by red blood cells and certain tissue with high glycolysis rates, even at times when tissue perfusion is not impaired. The liver converts the majority of this lactate back to glucose and oxidizes the remainder. Sepsis-related hepatic dysfunction can therefore impair lactate clearance (17, 18).

Lactate was not used in the definition of sepsis in the Third International Consensus. It was only recommended in the definition of septic shock (2). One multi-center retrospective study no significant change in mortality or intensive care outcomes in patients with suspected sepsis at the time of admission, when qSOFA scores at presentation were reassessed with the addition of lactate ≥2 mmol/L to admission (11). Caseserly et al. reported that a combination of lactate ≥4mmol/L and hypotension was a good predictor of prognosis. Those authors also reported that low presentation lactate levels were of low prognostic value, but that serial lactate measurements and treatment being adjusted accordingly reduced mortality rates in patients admitted to intensive care (19). Similarly, in the present study, mortality occurred in only 5.6% (n=1) of patients with lactate levels of 1-1.5 mmol/L, but in 38.5% (n=20) of those with levels of 1.5 mmol/L or above. This difference between the lactate groups in terms of mortality was statistically significant. However, no significant correlation was determined between qSOFA scores and lactate groups. The majority of research has investigated serial lactate measurement rather than lactate values at time of presentation, while post-treatment lactate values have been considered, and interpretations have been produced by combining these with other clinical data (20).

Rather than being used as a diagnostic tool, the international sepsis guideline recommended procalcitonin (PCT) as capable of use in shortening the antibiotic period, and in narrowing and discontinuing treatment (19) Zhenyu et al.'s study of 102 cases of sepsis found that PCT was correlated with mortality (21). Castelli et al. reported that PCT predicted the severity and prognosis of sepsis, and that PCT concentrations were directly related to the criticality of sepsis and positively correlated with SOFA scores (22). In the present study, mortality occurred in 15.1% (n=8) of patients with PCT levels of 0-5 ng/mL, but in 76.5% (n=13) of those with PCT values of 5 ng/mL or above. The difference in mortality rates between the PCT groups was statistically significant. However, no significant association was determined between qSOFA scores and the PCT groups. While PCT elevation can be used as a test supporting diagnosis in patients with suspected bacterial infection, it does not discriminate between complicated and uncomplicated infections. It is not therefore sufficient by itself for use in diagnosis sepsis in the emergency department.

CRP is a well-known biomarker of infection and inflammation. Synthesis of this acute phase reactant is controlled by the liver. Although its principal disadvantage as a biomarker of sepsis in adults is low specificity, it is widely employed for screening early onset sepsis (occurring in the first 24 h), since its sensitivity is generally regarded as very high in that context (23). Saeed et al. determined a mean CRP level of 102 mg/dL in an exitus group, compared to 30 mg/dL in the surviving group (24). Yamamoto et al. suggested that mortality rates were four times higher in patients with CRP values higher than 150 mg/dL compared to those with values of 0-19.9 mg/dl (25). In the present study, mortality occurred in only 5.6% (n=1) of the patients with

CRP values of 5-100, but in 38.5% (n=20) in those with values above 100. Significant differences were observed between the CRP groups in terms of qSOFA and. CRP elevation is a supportive parameter in the early diagnosis and follow-up of sepsis due to its significant relationship with qSOFA and mortality.

CONCLUSION

qSOFA is correlated with mortality, and is a simple, rapid, inexpensive, and valid method of determining sepsis risk rates in patients with suspected infection outside the intensive care unit. However, more reliable and rapid tests than qSOFA are needed in the diagnosis of sepsis.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was performed following receipt of approval from the Atatürk University Medical Faculty Clinical Researchs Ethics Committee (Date: 26.12.2019, Decision No: B.30.2.ATA.0.01.00/54).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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