Original Article

Combined accuracy of Procalcitonin and Quick Sequential Organ Failure Assessment (qSOFA) in predicting 3-days in-hospital mortality in suspected sepsis.

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Abstract

Background: Early identification of sepsis is important for initiating appropriate treatment for decreasing the risk of in-hospital mortality. To determine the diagnostic accuracy of procalcitonin (PCT) and quick sequential organ failure assessment (qSOFA) in predicting 3-days in-hospital mortality in suspected sepsis.

Methodology: A cohort study was conducted at the emergency department of Ziauddin University Hospital, Karachi. One-hundred and thirty-two suspected cases of sepsis having age 18-75 years were selected through convenience sampling. PCT level and qSOFA score were obtained for predicting 3-days in-hospital mortality.

Results: Of the study patient, 50.8% were male, and 49.2% were female, with a mean age of 53.7 ± 18.3 years. The mean qSOFA score was 1.8 ± 0.5, and the mean PCT level was 2.7 ± 12.5 ng/ml. The combined QSOFA and PCT 3-days in-hospital mortality prediction was 31.1%, while the actual mortality rate was 28.0%. The combined qSOFA score and PCT level sensitivity was 62.2%, specificity 81.1%, positive predicted value 56.1%, negative predicted value 84.7%, and diagnostic accuracy 75.8%.

Conclusion: The combined use of QSOFA and PCT improves the 3-day in-hospital mortality prediction in suspected cases of sepsis.

Keywords

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Introduction

Sepsis is a complex lethal disorder with diverse clinical manifestations developed due to dysregulated response of the host towards infection[1]. It is one of the leading causes of increased morbidity and mortality worldwide due to its difficult and delayed diagnosis[2]. Globally, 50.9 million cases, including 19.4 million severe cases are reported with approximately 5.3 million deaths per year among hospitalized patients[3]. While 60-80% of the sepsis associated deaths are contributed from developing countries like Pakistan[4].

Sepsis care during the early stages of treatment may be most effective. In the United States, 86% of hospitalized patients are diagnosed with sepsis upon admission, while 80% are treated in the emergency department[5, 6]. Despite advancements in treatment, sepsis has become the highest morbidity and mortality disorder in the emergency department. Even many sepsis survivors never fully recover and suffer from different complications, long-term morbidities, and post-intensive care syndrome[7, 8].

Early diagnosis and appropriate management of sepsis is a major challenge for emergency physicians[9]. According to the third international consensus on sepsis definition, combined use of sequential organ failure assessment (SOFA) and the quick-SOFA (qSOFA) scores are helpful in the early identification of sepsis[1]. In some clinical settings, sepsis diagnosis is not possible with a SOFA score, so a qSOFA score is used[10]. PCT is an infectious disease biomarker that is also effectively used to diagnose sepsis and can be used in place of SOFA score in the emergency department[11, 12].

Thus, it is very difficult to use the appropriate score for early diagnosis of sepsis, its severity, prognosis, and risk of mortality in an emergency[9-12]. Therefore, there is always a need for new diagnostic approaches for the early diagnosis of sepsis and predicting the risk of mortality. Thus, combining the qSOFA score with PCT possibly increases the ability to predict the risk of mortality from sepsis.

Therefore, this study focuses on determining the diagnostic accuracy of PCT and qSOFA in predicting 3-days in-hospital mortality in suspected sepsis.

Methodology

A cohort study was carried out at the emergency department of Ziauddin University Hospital, Karachi from March to August 2021. A total of 132 patients were selected through convenience sampling technique. Patients of either gender, aged between 18-75 years, and cases of suspected sepsis were included. While patients of leucopenia, thyroid disease, malignancy, ischemic heart disease, not willing to be part of the study and leave against medical advice were excluded.

A patient presented with hypotension (systolic blood pressure ≤ 100 mmHg), tachypnea (respiratory rate ≥ 22), or altered mental status (Glasgow coma scale (GCS) < 15) was labeled as a suspected case of sepsis while qSOFA score of ≥2 was used for confirming sepsis. qSOFA score ≥2 and PCT level of ≥ 0.5 ng/mL were combinedly used to predict 3-days in-hospital mortality in suspected sepsis.

The demographics, medical history, clinical and laboratory investigations, including PCT level and qSOFA score, were collected using a validated questionnaire. PCT level and qSOFA score were combinedly used as a predictor of 3-days in-hospital mortality in suspected cases of sepsis. Data analysis was performed on SPSS version 25.0. The combined qSOFA and PCT sensitivity (Sn), specificity (Sp), positive predicted value (PPV), negative predicted value (NPV), and diagnostic accuracy (DA) were calculated. Univariate analysis of 3-days in-hospital mortality was performed where a p-value of ≤ 0.05 was used as significant.

Ethical approval was obtained from the ethical review committee of Ziauddin University Hospital Karachi (Reference code: 2610920TAEM).

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Results

Out of 132 suspected cases of sepsis, male patients were 67 (50.8%), and female patients were 65 (49.2%). Most of the patients, 89 (67.4%), were over 50 years, while 43 (32.6%) patients were either 50 years of age or younger with a mean age of 53.7 ± 18.3 years. 91 (68.9%) patients had a history of diabetes mellitus. The mean qSOFA score was 1.8 ± 0.5, while the qSOFA score was ≥ 2 in 36 (27.3%) suspected sepsis cases. The mean PCT level was 2.7 ± 12.5 ng/ml, while the PCT level was ≥ 0.5 ng/mL in 89 (67.4%) suspected sepsis cases (Table 1).

Table 1: Baseline characteristics of the study population.

Variables		N=132
Gender	Male	67(50.8)
	Female	65(49.2)
Age (Years); Mean ± SD		53.7 ± 18.3
Age Group	≤ 50 years	43(32.6)
	> 50 years	89(67.4)
Diabetes Mellitus	Present	91(68.9)
	Absent	41(31.1)
qSOFA	Mean ± SD	1.8 ± 0.5
	Positive	36(27.3)
	Negative	96(72.7)
PCT (ng/mL)	Mean ± SD	2.7 ± 12.5
	Positive	89(67.4)
	Negative	43(32.6)

The most commonly reported single infection was respiratory tract infection 60 (45.5%), followed by urinary tract infection 16 (12.1%), intra-abdominal infection 6 (4.5%), and hepatobiliary infection 3 (2.3%). In contrast, two or more infections were reported in the remaining 47 (35.6%) patients. Most commonly reported combined infection was intra-abdominal infection along with urinary tract infection 13 (9.9%) followed by intra-abdominal infection along with respiratory tract infection 11 (8.3%), respiratory tract infection along with urinary tract infection 9 (6.9%), respiratory tract infection along with hepatobiliary and urinary tract infection 4 (3.0%), intra-abdominal infection along with respiratory tract and urinary tract infection 4 (3.0%), intra-abdominal infection along with hepatobiliary 2 (1.5%), hepatobiliary along with intra-abdominal and urinary tract infection 2 (1.5%) and hepatobiliary along with respiratory tract infection 2 (1.5%).

The combined qSOFA and PCT sensitivity was 62.2%, specificity 81.1%, positive predicted value 56.1%, negative predicted value 84.7%, and diagnostic accuracy 75.8% (Table 2).

Table 2: Diagnostic accuracy of qSOFA and PCT in predicting 3-Days in-hospital mortality.

Variables		3-Days Mortality n(%)		Total n(%)	p-value
		Yes	No		
Predicted Mortality	Yes	23(62.2)	18(18.9)	41(31.1)	<0.001*
	No	14(37.8)	77(81.1)	91(68.9)	
Sensitivity (Sn)		62.2% (43.46-76.86)			
Specificity (Sp)		81.1% (72.00-88.49)			
Positive Predicted Value (PPV)		56.1% (42.79-66.64)			

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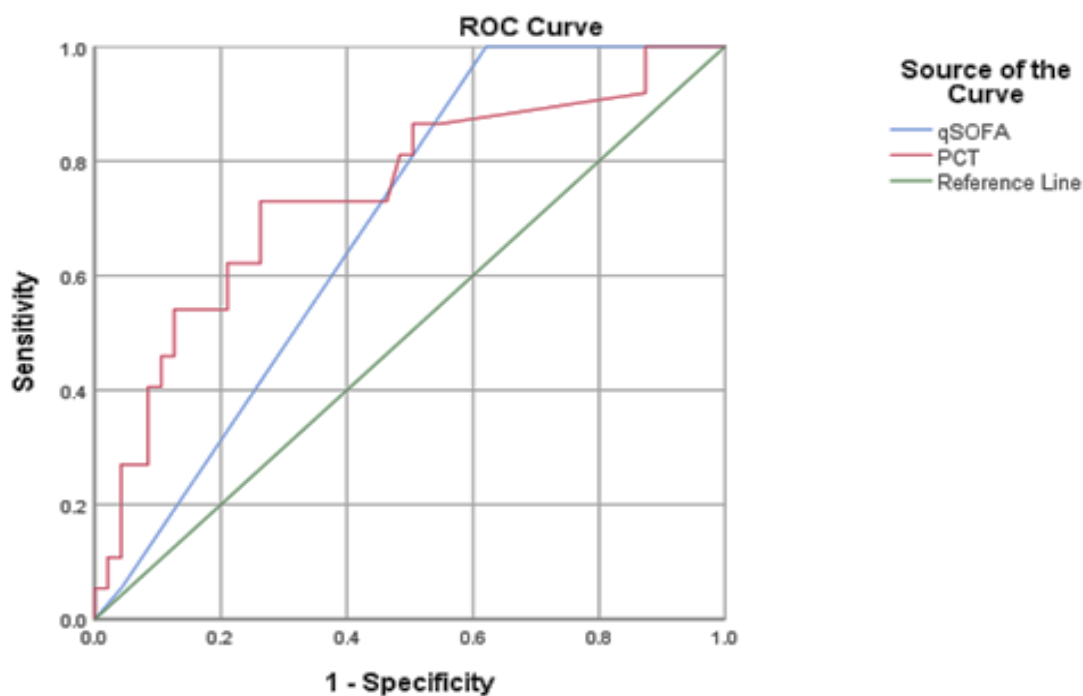|	
Negative Predicted Value (NPV)	84.7% (78.53-89.46)
Diagnostic Accuracy (DA)	75.8% (67.53-82.79)
Area under the curve (AUC) for qSOFA	0.685 (0.59-0.77)
Area under the curve (AUC) for PCT	0.744 (0.64-0.84)

Figure 1: qSOFA and PCT curve for prediction of mortality.

Univariate analysis shows that odds of 3-days in-hospital mortality was 2.07 times higher in female patients (95% CI: 0.95-4.51, p-value: 0.066), 13.29 times higher in patients having age > 50 years (95% CI: 3.02-58.47, P-value: 0.001) and 12.19 times higher in patients having diabetes mellitus (95% CI: 2.77-53.67, p-value: 0.001) (Table 3).

Table 3: Univariate analysis of 3-days in-hospital mortality.

Variables		OR(95% CI)	p-value
Gender	Male	Reference	0.066
	Female	2.07(0.95-4.51)	
Age (Years)	≤ 50	Reference	0.001*
	> 50	13.29(3.02-58.47)	
Diabetes Mellitus	Present	12.19(2.77-53.67)	0.001*
	Absent	Reference	

*p<0.05 is considered significant.

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Discussion

Sepsis is among the greatest challenges managed by emergency doctors, responsible for increasing visits of patients to the emergency department, admissions in the emergency department as well as in intensive care units followed by a prolonged stay in the hospital, increased health care expenditures and also increases the mortality rate[13, 14]. In most cases, sepsis presented with a variety of clinical indications that make it difficult for physicians to diagnose sepsis early that ultimately results in the progression of sepsis, development of its complications, and finally, death[15-17].

Sepsis is a complex disorder with diverse clinical manifestations. Previously sepsis was diagnosed on the basis of systemic inflammatory response syndrome (SIRS), but with time different new approaches have been developed for early identification of synopses, such as SOFA score, qSOFA score, and PCT level, which helps inappropriate management of sepsis. But the incidence and mortality rate with sepsis is still rising, which shows the requirement of new diagnostic approaches not only for early diagnosis of sepsis but also for predicting mortality that will be helpful in decreasing incidence and mortality[18-20].

Therefore, this research focuses on determining the diagnostic accuracy of PCT level and qSOFA combinedly in predicting 3-days in-hospital mortality in suspected sepsis at the emergency department of Ziauddin University Hospital Karachi. The use of qSOFA in combination with PCT is supposed to be helpful in predicting in-hospital mortality and allow physicians to identify patients at risk. This can help in initiating early therapy and reduce morbidity and mortality.

In the current study, a combination of PCT level and qSOFA score was used for predicting 3-days in-hospital mortality in suspected sepsis. The combined qSOFA score and PCT level sensitivity was 62.2%, specificity 81.1%, positive predicted value 56.1%, negative predicted value 84.7%, and diagnostic accuracy 75.8%. Xia et al., in the year 2020 also worked on the effective combined role of qSOFA score and PCT level in predicting in-hospital mortality in sepsis patients and found the higher sensitivity and PPV (83.2% and 92.47%) with lower specificity and NPV (54.9% and 33.03%) respectively[18]. Yu et al. also worked on the effective combined role of qSOFA score and PCT level in predicting in-hospital mortality in sepsis patients and also found the higher sensitivity and NPV (86.5% and 95.8%) and lower specificity and PPV (47.5% and 20.5%) respectively[19]. Similar studies on the combined role of qSOFA score and PCT level suggest that they can be used effectively for early screening of severe sepsis and can also be used in predicting mortality due to higher sensitivity. Early identification of severe sepsis and risk of mortality will be helpful in providing appropriate treatment that will decrease the risk of mortality and progression of the disease.

Increased rate of mortality in sepsis patients was also observed in the current study. About 28.0% of sepsis patients died within three days of hospitalization. Similar studies such as Xia et al.,[18] Yu et al.,[19] and Spoto et al.,[20] reported a much lower rate of mortality 21.07% within 28-days, 13.5% within 30-days and 8.0% within 30-days respectively. In our study, the rate of three days in-hospital mortality was much higher than other studies because of delay in visiting the hospital at an early stage of disease, low standard of living, lack of aseptic environment, limited access to health care facilities, and lack of financial resources in the hospital setting.

The study findings favor the hypothesis of study that PCT level and qSOFA combinedly have a great role in predicting three days in-hospital mortality in suspected sepsis. As in our study, the rate of three days in-hospital mortality was much higher than in other studies, so combined use of PCT level and qSOFA will be helpful in the early identification of the severity of sepsis and mortality that will not only be helpful in decreasing the risk of mortality but also decrease the hospital stay and enhance the quality of life.

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Conclusion

The combined use of QSOFA and PCT improves the 3-day in-hospital mortality prediction in suspected cases of sepsis. They will be helpful in early screening of the severity of sepsis that will not only increase the management of sepsis but also help in decreasing the risk of mortality.

Conflicts of Interest

The authors have declared that no competing interests exist.

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