EURASIAN JOURNAL OF EMERGENCY MEDICINE
Original Article
DOI: 10.4274/eajem.galenos.2021.57338
Eurasian J Emerg Med. 2021;20(4): 259-63

Prognostic Performance of qSOFA in Pulmonary Embolism

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Abstract

Aim: This study aimed to investigate the role of the quick sequential organ failure assessment (qSOFA) score in determining the prognosis of patients with acute pulmonary embolism (PE).

Materials and Methods: This study included patients aged >18 years who were admitted to the emergency department for complaints of shortness of breath and/or chest pain for 3 years and who were found to have acute PE on computed tomography pulmonary angiography. The qSOFA, pulmonary embolism severity index (PESI), and simplified PESI scores were calculated in patients with acute PE. During follow-up, the in-hospital mortality and requirement of intensive care continuation were determined.

Results: In total, 166 patients with acute PE, of which 88 (53%) were female, were included. The mean age of the patients was 67.4±17.3 years, and 26 (15.7%) patients were admitted to the intensive care unit (ICU). The mortality rate was 9% (n=15). The predictive value of qSOFA in predicting in-hospital mortality [area under the curve (AUC) 0.907, 95% confidence interval (CI) 0.852-0.946] was similar to that of PESI (AUC: 0.846, 95% CI: 0.782-0.897) and sPESI (AUC: 0.796, 95% CI: 0.726–0.854) (p=0.23 and p=0.16, respectively). While it was superior to PESI (AUC: 0.794, 95% CI: 0.724-0.852) and sPESI (AUC: 0.721, 95% CI: 0.646-0.787) in determining the admission of patients in the ICU (AUC: 0.882, 95% CI: 0.823-0.927) (p=0.04 and p=0.01, respectively). A positive correlation was found between qSOFA and PESI (r=0.49, p=0.001) and sPESI (r=036, p=0.001).

Conclusion: In this study, we found that the qSOFA score performed well in predicting in-hospital mortality and ICU admission in patients with acute PE admitted to the emergency department.

Keywords: qSOFA, pulmonary embolism, prognosis

Introduction

Pulmonary embolism (PE) is a relatively common emergency condition and associated with severe mortality and morbidity rates (1,2). The risk of mortality can be assessed by considering many factors such as the patient's age, comorbid status, hemodynamic status, presence of right ventricular dysfunction, myocardial injury status, and other clinical and laboratory tests (3,4). Current guidelines recommend the use of the pulmonary embolism severity index (PESI) and its simplified version (sPESI) to both predict prognosis and determine treatment strategy (5,6). Recently, it has been suggested that the sepsis-related quick sequential organ failure assessment (qSOFA) score can be used successfully to support the diagnosis of sepsis and predict mortality in patients with suspected infection outside the intensive care unit (ICU). qSOFA score is formed by evaluating three criteria: respiratory rate ≥22/min, systolic blood pressure ≤100 mmHg and altered mental state (Glasgow Coma Scale <15). Each criterion gets a single score, and the highest possible score is three while the lowest score is zero (7). It has been suggested that a qSOFA score of ≥2 strongly predicts the patient's primary outcome. In the group other than ICU, in-hospital mortality was shown to be 3-14 times higher in patients with qSOFA ≥2 than in patients with qSOFA <2 (8). Since the qSOFA score does not require any laboratory analysis or a special test and can be calculated rapidly (9), it has been investigated in many disease groups in order to evaluate the adverse outcome possibility of patients who were admitted to the emergency department (ED). In this

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Received: 05.02.2021
Accepted: 04.05.2021

Cite this article as: Gürger M, Atılgan FA, Yılmaz M, Ateşçelik M. Prognostic Performance of qSOFA in Pulmonary Embolism. Eurasian J Emerg Med. 2021;20(2):259-63.

study, we aimed to evaluate the role of qSOFA in determining the prognosis, in-hospital mortality and the need for intensive care follow-up of patients diagnosed with acute PE in the ED.

Materials and Methods

The study was initiated after the ethics committee's approval (Fırat University Noninvasive Researches Ethics Committee; no: 415001, date: 30.09.2020). Patients older than 18 years old who were admitted to the ED with complaints of shortness of breath and/or chest pain for 3 years and found to have acute PE on computed tomography pulmonary angiography were included in the study. The files of the patients were analyzed retrospectively. The qSOFA, PESI and sPESI values were calculated for all patients diagnosed with acute PE. Those with a qSOFA score of ≥2 were considered positive qSOFA. During the follow-up, in-hospital mortality and the requirement of intensive care continuation were determined. Patients with missing data and those who were transferred to another hospital during their follow-up were excluded from the study.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS v.22, Chicago, IL, USA) and MedCalc (Version 10.1.6.0) package software were used for statistical analysis. Results were presented as mean ± standard deviation if they were within normal distribution, and as median (interquartile range) if they were not within a normal distribution. Categorical variables are given as numbers (percentages). Chi-square test was used for non-measurable parameters, Student's t-test was used to compare parameters between groups, Mann-Whitney U test was used to compare non-parametric groups, and Pearson correlation test was used to examine the relationship between parameters in groups. $p<0.05$ values were accepted as the lowest significance level.

Results

One hundred and sixty-six PE patients were included in the study. The mean age of the patients was 67.4±17.3 and 88 (53%) of them were women. During the follow-up, 26 patients (15.7%) were admitted to the ICU. Mortality rate was 9% (n=15). The clinical and laboratory values of the patients are summarized in Table 1.

There was a positive correlation between qSOFA and PESI (r=0.49, p=0.001) and sPESI (r=036, p=0.001). A high qSOFA score was associated with mortality and ICU admission. The receiver operating characteristics curve in determining in-hospital mortality and admission to ICU are shown in Figures 1 and 2. The predictive value of qSOFA in determining in-hospital mortality [area under the curve (AUC): 0.907, 95% confidence interval (CI): 0.852-0.946] was similar to PESI (AUC: 0.846, %95 CI: 0.782-0.897) and sPESI (AUC: 0.796, 95% CI: 0.726-0.854) (p=0.23 and p=0.16 respectively). While it was superior to PESI (AUC: 0.794, 95%

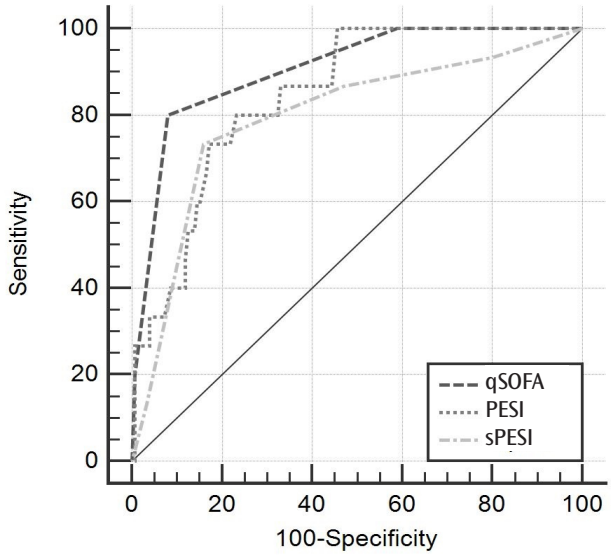

Figure 1. Areas Under the Receiver Operating Characteristics (ROC) Curve for in-mortality

qSOFA: Quick sequential organ failure assessment, PESI: Pulmonary embolism severity Index, sPESI: Simplified pulmonary embolism severity Index

Table 1. Clinical and laboratory values of acute pulmonary embolism patients

Data of patients	
Age (years) (mean ± SD)	67.4±17.3
Gender (female/male)	88/78
SBP (mmHg) (mean ± SD)	124.6±23.5
DBP (mmHg) (mean ± SD)	74.7±12.9
Heart rate (bpm) (mean ± SD)	100±22.4
Respiratory rate (mean ± SD)	21.7±4.3
sO_2 (%) (mean ± SD)	88.3±8.2
Glasgow Coma Score (mean ± SD)	14.8±0.6
Wells Score (mean ± SD)	3.8±2.1
Revised Geneva Score (mean ± SD) qSOFA (median) (IQR)	6.3±2.8 1 (0-1)
PESI (median) (IQR)	104 (79.7-123.2)
sPESI (median) (IQR)	2 (1-2)
D-dimer (µg/L) (median) (IQR)	3,208 (1,680-4,977)
Troponin (ng/mL) (median) (IQR)	0.1 (0-0.05)
Lactate (mg/dL) (median) (IQR)	1.3 (1-2)

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, qSOFA: Quick sequential organ failure assessment, PESI: Pulmonary embolism severity Index, sPESI: Simplified pulmonary embolism severity Index, IQR: Interquartile range, SD: Standard deviation

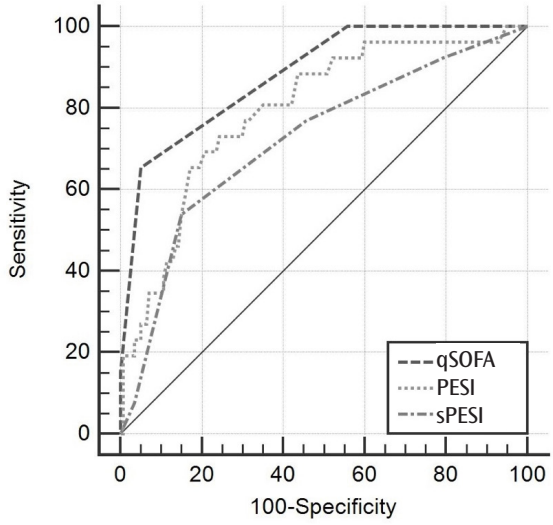

Figure 2. Areas Under the Receiver Operating Characteristics (ROC) Curve for ICU admissionICU: Intensive care unit, qSOFA: Quick sequential organ failure assessment, PESI: Pulmonary embolism severity Index, sPESI: Simplified pulmonary embolism severity Index

CI: 0.724-0.852) and sPESI (AUC: 0.721, 95% CI: 0.646-0.787) in determining the inclusion of patients in ICU (AUC: 0.882, 95% CI: 0.823-0.927) (p=0.04 and p=0.01 respectively).

The sensitivity and specificity of a qSOFA score ≥2 for predicting in-hospital mortality were 80% and 92%, respectively. The sensitivity and specificity of patients in ICU admission were 65.4% and 95%, respectively. While the sensitivity of qSOFA in determining in-hospital mortality and admission to ICU was lower than PESI and sPESI, its specificity was higher. The sensitivity and specificity of qSOFA, PESI and sPESI for in-hospital mortality and admission to the ICU are presented in Tables 2 and 3.

The qSOFA score was positive in 14.5% (n=24) of the patients at admission to the ED. Median PESI [137 (interquartile range (IQR): 73-206) and sPESI (2 (IQR):1-3)] values of patients with a positive qSOFA score had a higher median than those with qSOFA <2 [PESI: 98.5 (IQR: 27-208), sPESI: 1 (IQR: 1-2)] (p-value 0.001 and 0.005, respectively). Similarly, mortality (50%) and ICU admission rate (70.8%) were higher in patients with positive qSOFA than those with qSOFA <2 (6.3% ICU admission rate, 2.1% mortality rate) (p=0.001) (Table 4).

Table 2. Performance of qSOFA, PESI and sPESI in determining in-hospital mortality in patients with acute pulmonary embolism

Score	AUC	%95 CI	Cut-off	Sensitivity (%)	Specificity (%)
qSOFA	0.907	0.852-0.946	≥2	80	95
PESI	0.846	0.782-0.897	≥86	100	35
sPESI	0.796	0.726-0.854	≥1	93.3	20.7

qSOFA: Quick sequential organ failure assessment, PESI: Pulmonary embolism severity Index, sPESI: Simplified pulmonary embolism severity Index, AUC: Area under the curve, CI: Confidence interval

Table 3. Performance of qSOFA, PESI and sPESI in determining ICU admission in patients with acute pulmonary embolism

Score	AUC	%95 CI	Cut-off	Sensitivity (%)	Specificity (%)
qSOFA	0.882	0.823-0.927	≥2	65.4	95
PESI	0.794	0.724-0.852	≥86	96.2	35
sPESI	0.721	0.646 -0.787	≥1	92.3	20.7

qSOFA: Quick sequential organ failure assessment, PESI: Pulmonary embolism severity Index, sPESI: Simplified pulmonary embolism severity Index, AUC: Area under the curve, CI: Confidence interval

Table 4. Patients' qSOFA scores and in-hospital mortality and intensive care unit admission rates

qSOFA scores (n)	Mortality rate (%)	ICU admission rate (%)
0 (62)	0	0
1 (80)	3.8	11.3
2 (20)	45	65
3 (4)	75	100
qSOFA ≥2 (24)	50	70.8
qSOFA <2 (142)	2.1	6.3

qSOFA: Quick sequential organ failure assessment

Discussion

In our study, we found that qSOFA score was strongly associated with in-hospital mortality and ICU acceptance in patients with acute PE who were admitted to the ED. In-hospital mortality and ICU admission rates were 0% in patients with a qSOFA score of 0, while those with a qSOFA score of 3 were 75% and 100%, respectively. In-hospital mortality and ICU admission rate for those with positive qSOFA scores were 50% and 70.8%, respectively. In addition, the qSOFA score was positively correlated with PESI and sPESI, which are used to determine both the prognosis and treatment strategy of PE patients.

qSOFA has been proposed as a simple reference guide to identify septic patients and predict patient prognosis (9). Since the day it was defined, the benefit of the qSOFA score in different patient groups admitted to the ED was evaluated. PE is a relatively common condition with high mortality in EDs (10). In PE patients, the qSOFA score can be calculated easily and quickly with the vital signs of the patients at the bedside, without the need for any laboratory test. The Sepsis 3 study group recommended the use of the qSOFA score to determine the in-hospital mortality of patients with suspected infection, except for ICU (7). It has been suggested that the qSOFA score can be used as a potential tool to predict clinically significant outcomes in ED patients, regardless of whether an infection is suspected or not (9). In a study of 11,205 patients with suspected infection in ED, it was shown that positive qSOFA patients had a 2-fold increase in ICU stay and a 5-fold increase in-hospital mortality compared to negative qSOFA patients, and the sensitivity of positive qSOFA in determining in-hospital mortality was 61% and its specificity was 80% (11). In another study, 22,530 patients admitted to the ED with and without suspected infection were examined and it was reported that qSOFA scores were associated with inpatient mortality, hospitalization, admission to ICU, and length of stay, and it was suggested that it may be useful in forecasting the outcomes. In this study, they found AUC: 0.76 (%95 CI: 0.73-0.78) in determining mortality and AUC: 0.61 (%95 CI: 0.59-0.63) at admission to ICU. When the qSOFA score is ≥2, they found the sensitivity and specificity at admission to ICU as 10% and 97%, respectively, and the sensitivity as 29% and specificity as 97% in determining mortality (9). Shu et al. (12) found the sensitivity of the qSOFA score of 2,292 patients transported by ambulance as 40.6% and specificity as 91.9% in determining in-hospital mortality and reported that higher qSOFA score was associated with higher hospitalization and ICU admission. In another study in which 42,722 trauma patients were examined, it was shown that the pre-hospital qSOFA score was strongly associated with in-hospital mortality in trauma patients (13). In a study in which 1,849 patients transported by helicopter were examined, it was shown that the in-hospital mortality rate increased significantly as the qSOFA scores of the patients increased (14).

However, some studies have reported that qSOFA does not perform well enough in determining the patient's mortality and admission to ICU. In a review of 27 studies examining 380,920 patients, Lo et al. (15) found that qSOFA was not a clinically useful prognostic tool for one-month mortality or ICU admission. Garbero et al. (16) investigated 184 patients who admitted to ER with suspected infection and reported that the qSOFA score did not perform well as a screening tool to predict poor prognosis in sepsis and emergency services but showed reasonable sensitivity to predict negative outcomes and that qSOFA≥2 scores were associated with poor prognosis.

In our study, we found the AUC value of qSOFA score to be 0.907 (95% CI: 0.852-0.946) in determining in-hospital mortality in patients with PE. The sensitivity and specificity of positive qSOFA were 80% and 92%, respectively. In determining the admission of patients to ICU, we found AUC: 0.882 (95% CI: 0.823-0.927), and the sensitivity and specificity of positive qSOFA as 65.4% and 95%, respectively.

In a study in which 1,318 patients with acute PE were examined, the role of qSOFA and ECG parameters in determining the risk of cardiovascular collapse was investigated (17). In this study, it was shown that all patients who died met the qSOFA ≥2 criterion. It has been shown that the qSOFA score, when used in combination with the diagnosis of tachycardia in ECG, S1Q3T3, right bundle branch block and T wave inversion of leads V1-V3, effectively contributes to the identification of patients with acute PE who need possible reperfusion therapy and have a hemodynamic collapse. In our study, we found that the qSOFA score of the patients revealed a positive correlation between PESI and sPESI score, which reliably establishes the 30-day mortality risk of the patients. It also performed well in admitting patients to ICU and determining in-hospital mortality.

Study Limitations

Since our study is a retrospective study, there may be errors in inputting the data.

Conclusion

As a result, we found that the qSOFA score performed well in determining in-hospital mortality and ICU admission in acute PE patients admitted to the ED. In our study, the increase in qSOFA score was strongly associated with ICU admission and in-hospital mortality.

Ethics

Ethics Committee Approval: Fırat University Noninvasive Researches Ethics Committee was approved this study (no: 415001, date: 30.09.2020).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.G., F.A.A., M.Y., Concept: M.G., F.A.A., M.Y., M.A., Design: M.G., M.Y., M.A., Data Collection or Processing: M.G., F.A.A., Analysis or Interpretation: M.G., M.Y., Literature Search: M.G., M.A., Writing: M.G.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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