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"Quick SOFA" Score in Sepsis: Prediction for Outcome in Critical Care Patient

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Abstract

The organ dysfunction defined as an increase in the Sequential (Sepsis-related) Organ Failure Assessment (SOFA) score or ≥2, and this was associated with a 10% mortality risk. The aim of the presented study was to Use of qSOFA as a useful predictor of sepsis and evidence of multiorgan failure in critically ill patients in and Comparing the predictive value of qSOFA score with that of SOFA score and APACHE II in sepsis and outcome in critically ill patient **.**This was a prospective comparative study that was conducted on 100 patients with sepsis and evidence of Multi-Organ Failure (MOF) with clinical suspicion of infection to evaluate the quick Sequential Organ Failure Assessment score for predicting Outcome in septic patients. Following admission all patients were subjected to the following: The quick sequential organ failure assessment (qSOFA) Score (day0 and day1). The acute physiology and chronic health evaluation II "APACHE II" (day0). The sequential organ failure assessment (SOFA) Score (day1, 3and day7). qSOFA utilization on admission was significantly related to the higher mortality as well as APACHE II and SOFA-1, SOFA-3 and SOFA-7, Estimated mortality by qSOFA-1 was the higher than qSOFA 0.qSOFA > 1 is a specific for predicting in-hospital mortality as a cut off value with 78% sensitivity, 86% specificity and highly significant p value of < 0.01. The SOFA is a superior prognostic tool for predicting mortality and organ failure than qSOFA among sepsis patients admitted to the ICU.

1. Introduction

Despite the advances in its diagnosis and management, sepsis remains a leading cause of death in critically ill patients [1].

It is established now that early identification and timely therapeutic interventions are the cornerstone in outcome affection [2].

Sepsis remains a major challenge for intensive care clinicians, researchers and health care systems worldwide due to its high mortality rate, and ongoing challenges in early identification. Robust epidemiological assessments project that there are 31.5 million cases of sepsis annually worldwide, resulting in approximately 5.3 million deaths per year. Hospital mortality rates for patients with sepsis are estimated to be as high as 35.3%. [3].

Sepsis is now defined as a "*life-threatening organ dysfunction caused by a dysregulated host response to infection"*. The organ dysfunction defined as an increase in the Sequential (Sepsis-related) Organ Failure Assessment (SOFA) score or ≥2, and this was associated with a 10% mortality risk [4].

Increased awareness of the problem of sepsis and compliance with Surviving Sepsis Campaign (SSC) bundles have led to improvements in diagnostic procedures, the early administration of broad-spectrum antibiotics and more aggressive supportive therapy, with a resultant decrease in sepsis-related mortality in recent years [5].

Most patients presenting to the hospital with sepsis are initially assessed in the emergency department (ED). Those with established organ failure (severe sepsis) and septic shock are resuscitated according to established consensus guidelines [6].

However, because of a lack of familiarity with SOFA outside of the ICU, and because SOFA requires laboratory values which may not be rapidly available, the quick SOFA was developed to provide an abbreviated version that can easily be performed at the bedside by the non-specialist [4].

The quick Sequential Organ Failure Assessment (Quick SOFA) Criteria is **Respiratory rate ≥22/min, Systolic blood pressure ≤100 mmHg, and Altered mentation.**

The main utility of qSOFA appears to be for the characterization of patients with suspected or known infection, in whom sepsis should be considered, who are at a higher risk of developing a poor outcome if they have at least 2 of clinical criteria, and who may benefit from more frequent observations and targeted interventions [4].

The aim of the presented study was to Use of qSOFA as a useful predictor of sepsis and evidence of multiorgan failure in critically ill patients in and Comparing the predictive value of qSOFA score with that of SOFA score and APACHE II in sepsis and outcome in critically ill patient.

2. Patient and method

This is a prospective comparative observational study was done at "Benha university hospital"and "Maadi military hospital "and "Elsheikh zayed specialized hospital" in 6 months (from march 2020 to September 2020). On 100 adults. critically ill patients attended to ICU with clinical suspicion of infection.

2.1 Inclusion criteria

- Age >18 years.
- Suspected or confirmed infection.
- Two or more of systemic inflammation response syndrome criteria (heart rate >90 beats per minute, respiratory rate >20 breaths per minute, temperature >38°C or <36°C, white blood cell count >12,000 or <4000 cells/mm3or >10% bands).

- Quick SOFA Criteria:
  a) Altered mentation.
  b) Systolic blood pressure≤100mmHg.
  c) Respiratory rate≥22/min.

2.2 Exclusion criteria

- Age <18 years.
- Pregnancy.
- Predetermined illness with death expected within 24 h.
- Terminal malignancy.

2.3 Following admission all patients were subjected to the following

- Full clinical history & physical examination, Bed side chest x-ray**,** & base line 12-leads ECG
- Laboratory investigations:
  - Complete blood picture, CRP, ESR.
  - Serum urea, creatinine. Na^+, K^+.
  - ALT, AST, albumin, total & direct bilirubin.
  - Coagulation profile (PC%, INR, PTT).
  - Arterial & central venous blood gases, Serum lactate.
  - Blood, urine, sputum (or endotracheal if intubated), wound & other (CVP, Chest tube etc...) cultures if present or suspected other source.
  - Random blood glucose level.
- Scoring system evaluation:
  - Quick SOFA scoring system.
  - SOFA scoring system.
  - APACHE II scoring system.
  - GCS scoring system

3. Results

Comparative study between the 2 groups revealed; highly significant increase in baseline APACH-II, SOFA-1, qSOFA-0 scores, in non-survivors group; compared to survivors group; with highly significant statistical difference ($p < 0.01$ respectively).

Comparative study between the 2 groups revealed; highly significant increase in follow up SOFA-3, SOFA-7 and qSOFA-1 scores, in non-survivors group; compared to survivors group; with highly significant statistical difference ($p < 0.01$ respectively).

Table (1) Comparison between the 2 groups as regards predictor parameters using Mann-Whitney's U test.

Variable	Non-survivors group (32)	Survivors group (68)	Mann-Whitney's U test
	Median (IQR)	Median (IQR)	P value
APACHE-II	23 (19 – 26)	14 (12 – 18)	< 0.0001**
qSOFA-0	2 (2 – 3)	2 (1 – 3)	= 0.034*
qSOFA-1	2 (2 – 2)	1 (1 – 1)	< 0.0001**
SOFA-1	10.5 (7 – 12)	5 (3 – 6)	< 0.0001**
SOFA-3	12 (9 – 15)	4 (2 – 5)	< 0.0001**
SOFA-7	12 (9.7 – 14.2)	3 (2 – 4)	< 0.0001**

Comparative study between the 2 groups revealed; highly significant increase in ICU duration in non-survivors group; compared to survivors group; with highly significant statistical difference ($p = 0.027$).

Table (2) Comparison between the 2 groups as regards ICU duration using Mann-Whitney's U test.

Variable	Non-survivors group (32)	Survivors group (68)	Mann-Whitney's U test
	Median (IQR)	**Median (IQR)**	**P value**
ICU duration (days)	9 (8 – 12)	9 (7 – 10)	= 0.027**

Comparative study between the 2 groups revealed; highly significant increase in organ dysfunction in non-survivors group; compared to survivors group; with highly significant statistical difference ($p < 0.01$).

Table (3) Comparison between the 2 groups as regards organ dysfunction using Mann-Whitney's **U** test.

Variable	Non-survivors group (32)	Survivors group (68)	Mann-Whitney's U test
	Median (IQR)	**Median (IQR)**	**P value**
Organ dysfunction (number of failed organs)	4 (3 – 6)	2 (0 – 5)	< 0.0001**

Correlation studies between mortality and organ dysfunction outcomes; and its relative independent predictors (clinical, laboratory, radiological and predictor parameters) was conducted with multiple, logistic regression analysis and Spearman's correlation coefficient (as suitable).

Table (4) Spearman's correlation analysis for basic clinical / laboratory / radiological / predictor parameters associated with organ dysfunction.

Associated Factor		Organ dysfunction	
		rho	P
Clinical			
Clinical	Age	0.204	=0.041*
	Systolic BP (mmHg)	-0.359	=0.0002**
	Diastolic BP (mmHg)	-0.425	<0.0001**
	HR (beat/min)	0.136	=0.1783
	Temperature	-0.0831	=0.4113
	RR (breath/min)	0.131	=0.1922
	UOP (cc/h)	-0.0113	=0.9114
	CVP (mmHg)	0.289	=0.0035**
	GCS	-0.355	=0.0003**
Laboratory			
Routine lab	Hb (g/dL)	-0.0944	=0.3502
	PCV (%)	-0.175	=0.0821
	TLC (10^3/µL)	0.201	=0.045*
	PLT (10^3/µL)	-0.252	=0.011*
	ESR (mm/h)	-0.0620	=0.5400
	CRP (mg/dL)	0.128	=0.2034
	Lactate (mg/dL)	0.386	=0.0001**
	Urea (mg/dL)	0.418	<0.0001**
	Creat. (mg/dL)	0.566	<0.0001**
	Bil. (mg/dL)	0.433	<0.0001**
ABG	pH	-0.244	=0.014*
	CO2	-0.319	=0.0012**
	HCO3	-0.552	<0.0001**
Urine	Pus (number)	0.0281	=0.7817
	RBCs (number)	0.0129	=0.8990
Radiological			
Echo	EF (%)	0.0749	=0.4805
ICU duration (days)		0.273	=0.0061**
Predictor parameters			
	APACHE-II	0.628	<0.0001**
	qSOFA-0	0.440	<0.0001**
	qSOFA-1	0.654	<0.0001**
	SOFA-1	0.809	<0.0001**
	SOFA-3	0.858	<0.0001**
	SOFA-7	0.630	<0.0001**

rho: Spearman's rho (correlation coefficient).

Multiple regression analysis shows that; after applying (Forward method) and entering some predictor variables; the increase in creatinine, APACHE-II, SOFA-1, qSOFA-0 and SOFA-3 scores; had an independent effect on increasing organ dysfunction; with significant statistical difference ($p < 0.05$ respectively).

Table (5) Multiple regression model for the Factors predicting organ dysfunction using Forward method.

Predictor Factor	β	SE	P
(Constant)	-0.6571		
Creatinine	0.1931	0.07251	0.0096**
APACHE-II	0.02211	0.005876	0.0003**
SOFA-1	0.01699	0.005299	0.002**
qSOFA-0	0.4977	0.1317	0.0003**
SOFA-3	0.02914	0.004613	<0.0001**

--- excluded from the model if (p value > 0.1) --- β: Regression coefficient, SE: Standard error.

Logistic regression analysis shows that; after applying (Forward method) and entering some predictor variables; the increase in APACHE-II, qSOFA-1 scores and ICU duration; had an independent effect on increasing the probability of mortality occurrence; with significant statistical difference ($p < 0.05$ respectively).

Logistic regression analysis shows that; after applying (Forward method) and entering some predictor variables; the decrease in hemoglobin level; had an independent effect on increasing the probability of mortality occurrence; with significant statistical difference ($p = 0.012$).

Table (6) Logistic regression model for the Factors predicting mortality occurrence using Forward method.

Predictor Factor	Coefficient	Std. Error	P value
(Constant)	-10.59325		
GCS	-0.41381	0.23016	0.072
Hb	-0.66647	0.26655	0.012*
APACHE-II	0.13682	0.056761	0.015*
SOFA-3	0.12247	0.065270	0.0606
qSOFA-1	3.57138	1.57064	0.023*
ICU duration	1.02492	0.45478	0.024*

Excluded from the model if (p value > 0.1).

4. Discussion

Sepsis is now defined as a "life-threatening organ dysfunction caused by a dysregulated host response to infection". The organ dysfunction defined as an increase in the Sequential (Sepsis-related) Organ Failure Assessment (SOFA) score or ≥2, and this was associated with a 10% mortality risk [4].

In our study regarding predictor parameters highly significant increase in APACH-II score, SOFA score at day 1, qSOFA score on admission, in non-survivors group with highly significant statistical difference ($p < 0.01$ respectively) which came in concordance with Bai in 2014 Bai et al. [7] reported that Initial serum lactate levels and APACHE II scores were significantly higher in the non-survivors than in the survivors.

Regarding SOFA score at 3rd day, SOFA score at 7th day and qSOFA score at day 1 revealed; highly significant increase in non-survivors group with highly significant statistical difference ($p < 0.01$ respectively) which came in concordance with Wang in 2016 Wang et al. [8] reported that The average values of APACHE II, SOFA, and qSOFA scores were considerably higher in non- survivors and patients admitted to the ICU than survivors and non-ICU admissions (P<0 .001)

In our study highly significant increase in ICU duration and organ dysfunction in non-survivors group with highly significant statistical difference ($p < 0.05$ respectively) which came in agreement with Tamayo in 2012 [9].

Correlation studies between mortality and organ dysfunction outcomes; and its relative independent predictors (clinical, laboratory, radiological and predictor parameters) revealed that;

Spearman's correlation analysis shows that; organ dysfunction had a highly significant positive correlation with TLC, lactate, urea, creatinine and bilirubin; with highly significant statistical difference ($p < 0.01$ respectively) which came in agreement with Nguyen in 2010 (10), and in agreement with Wang in 2016 [8].

Nguyen et al. [10] Reported that Early lactate clearance as a surrogate for the resolution of global tissue hypoxia is significantly associated with decreased levels of biomarkers, improvement in organ dysfunction and outcome in severe sepsis and septic shock.

Wang et al. [8] reported that among non survivors and patients admitted to the ICU, creatinine was higher (P< .001), whereas PaO2 and PaO2/fraction of inspired oxygen (FIO2) were lower (P< .05). White blood cell (WBC) count was higher among non survivors than survivors.

4.1 Regarding predictor factors

Spearman's correlation analysis shows that; organ dysfunction had a highly significant positive correlation with baseline APACHE-II, SOFA-1 and qSOFA-0 scores; with highly significant statistical difference (p< 0.01 respectively) which came in agreement with Wang in 2016 [8].

Wang et al. 2016 reported that the average values of APACHE II, SOFA, and qSOFA scores were considerably higher in non survivors and patients admitted to the ICU than survivors and non-ICU admissions (P< .001).

Spearman's correlation analysis shows that; organ dysfunction had a highly significant positive correlation with follow up SOFA-3, SOFA-7 and qSOFA-1 scores; with highly significant statistical difference ($p < 0.01$ respectively) which came in agreement with Qiao in 2012 [11].

Qiao et al. [11] Reported that Changes in SOFA score during the first 2 weeks in the ICU are shown, SOFA scores of survivors declined gradually with time, whereas the scores in those who subsequently died increased. The difference between the two groups was statistically significant at all the time points shown ($P < 0.01$).

Spearman's correlation analysis shows that; organ dysfunction had a highly significant positive correlation with ICU duration; with highly significant statistical difference ($p = 0.0061$) which came in agreement with Levy in 2012 [12].

Levy et al. [12] Reported that Most patients at time of ICU admission had multiple organ failure, tissue hypoperfusion (as evidenced by hypotension or hyperlactatemia), required mechanical ventilation, and a longer length of stay.

Multiple regression analysis shows that; after applying (Forward method) and entering some predictor variables; the increase in creatinine, APACHE-II, SOFA-1, qSOFA-0 and SOFA-3 scores; had an independent effect on increasing organ dysfunction; with significant statistical difference ($p < 0.05$ respectively) which came in agreement with Qiao in 2012 [11].

Qiao et al. [11] reported that a clear relationship between organ dysfunction and mortality has been demonstrated in several studies. The SOFA score utilizes physiological variables from respiratory, cardiovascular, hepatic, coagulation, renal and neurological systems to detect organ failure. In the present study the SOFA initial, SOFA48h, SOFA96h, ΔSOFA and SOFAmax scores were significantly lower in survivors than in patients who subsequently died. The APACHE II and SOFA scores were mutually complementary in the prediction of outcome for critically ill elderly patients.

The independent predictors of mortality determined by logistic regression were the increase in APACHE-II, qSOFA-1 scores and ICU duration with significant statistical difference ($p < 0.05$ respectively) and the decrease in hemoglobin level increasing the probability of mortality occurrence; with significant statistical difference ($p = 0.012$).

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