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A Study of Significance of Serial Sofa Scores in Predicting Prognosis in ICU Patients

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Abstract-
Introduction: *Emergency physicians constantly have to choose the most accurate therapeutic plan for the patients based on the severity and prognosis of the disease andalso deal with the worries and concerns of the patients' relatives. Sequential Organ Failure Assessment (SOFA) is one of the scoring systems used for assessing the severity of disease in critically ill patients and predicting their outcome.It is based on evaluating the function of six vital organs.*
Aim: *The present study was aimed to assess the ability of SOFA score to predict mortality in the ICU of a tertiary care hospital in central Maharashtra.*
Results*In our study the mean SOFA score correlated most closely with mortality (as p<0.05), followed by the highest SOFA score, followed by Δ-SOFA 48-0 score.The mean SOFA score had a better prognostic value than the other SOFA derived variables.*
Discussion: *SOFA scoring system is easy to use and evaluates the status of the mentioned organs systematically and continuously during hospitalization.*
Conclusion: *Knowledge of the trends in SOFA score over time could facilitate decision making regarding the appropriateness of instituting organ support.*
Keywords: *SOFA, ICU, ORGAN FAILURE, PROGNOSTICATION*

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I. Introduction

Emergency department (ED) is one of the most important hospital departments and the frontline of facing critically ill patients(1).Emergency physicians constantly have to choose the most accurate therapeutic plan for the patients based on the severity and prognosis of the disease and deal with the worries of the patients relatives(2).Having a correctcriterion for triaging patients is of great importance for providing special care for critically ill patients and help reducing health and financial burdens of diseases(3,4).A number of scoring systems have been devised to mathematically predict the outcome of the critically ill patients in casualty and in ICU setting. The most common critical care predictive scoring systems are the Acute Physiologic and Chronic Health Evaluation (APACHE)(5),Simplified Acute Physiologic Score (SAPS)(6), Mortality Prediction Model (MPM)(7). Sequential Organ Failure Assessment (SOFA), introduced in 1996, is one such scoring system used for assessing the severity of disease in critically ill patients and predicting their outcome(8, 9,10)). Most of these scores use numerous variables which is inconvenient in a setting where evaluation needs to be prompt in rapidly changing medical condition of the patients. SOFA, on the other hand, is based on evaluating the function of 6 vital organs viz respiratory, coagulation, cardiovascular and circulatory, liver, central nervous system and renalthus offers fast evaluation. This tool is easy to use and evaluates the status of the mentioned organs systematically and continuously during hospitalization(11).Though, main goal of SOFA is prognostication of patient's status, it also helps to assess outcome of various interventions and quality of care. This scoring system has been validated in both medical and surgical ICUs where mortality is directly proportional to the SOFA scores(11).The scores are calculated at 24 h after admission to the ICU and every 48 h thereafter.The present study was aimed to assess the ability of SOFA score to predict mortality in the ICU of a tertiary care hospital in central Maharashtra.

II. Aims And Objectives

1. To study the significance of SOFA score in determining the in-hospital mortality.
2. To ascertain the prognostic significance of serial measurements of the SOFA score to refine outcome prediction in such patients.

III. Methodology

It was a descriptive cross-sectional study, carried out in MICU over a period of six months. A total 256 patients were included in the study.

INCLUSION CRITERIA

- Patients aged more than 18years of either sex
- Admitted for more than 24h
- Consent given by the patient or NOK.

EXCLUSION CRITERIA

- Patient age less than 18 years.
- Patients taken out from ICU against medical advice or whose investigations could not be done.
- Patients or NOK not willing to give informed consent.

SAMPLING

- Data was collected by using following parameters-Demographic, laboratory and clinical.
- SOFA score was calculated, at 24 h of admission and every 48 h thereafter(Table 1).
- The worst value for each parameter in 24 h period was used for calculation of the score. For missing value, the average of the nearest two values was taken.

WORKING DEFINITION

- **Total SOFA score:** sum of all daily SOFA scores during the ICU stay for each patient.
- **Mean score:** the ratio of total score to the length of stay (LOS) in the ICU.
- **Δ-SOFA score:** difference between 2 scores; (example, the Δ-SOFA score 48-0 hrs was the difference between the 48-hour SOFA score and the admission score).

IV. Statistical Analysis

A χ^2 statistics test (with Yates correction when applicable) was used to evaluate the statistical significance of categorical variables. The results were presented as mean (SD). Odds ratios with 95% confidence intervals were computed using univariate logistic regression model with ICU outcome as the dependent variable. Using EpiInfo1.4.3 all statistical tests were 2-tailed and a *P* value <0.05 was considered significant.

V. Observations

The study included 256 patients with a mean (SD) age of 53 (95-18) years (Table 2). An initial SOFA score of 9 or less predicted a mortality of less than 30% while an initial SOFA score of 11 or more predicted a mortality rate of 99% (Figure A).The highest SOFA score correlated well with high mortality: highest scores of 10 correlated with a mortality rate of 45%. SOFA score higher than 11 were associated with a mortality rate greater than 77% (Figure B). The mean SOFA score over the entire ICU stay also correlated directly with mortality (Figure C). By univariate logistic analysis, the mean SOFA score correlated most closely with mortality, followed by the highest score, Δ-SOFA 48-0 scoreand lastly with the initial score, in that order (Table 3). Trends in SOFA scores during the first 48 hours were also analyzed. Regardless of the initial score mortality rate was 50% or higher when the score increased, 27% to 35% when it did not change and less than 27% when it decreased (Table 4). Differences in mortality were predicted better during the first 48 hours than in the subsequent 48 hours. There was no significant difference in length of stay(LOS)among these groups.

VI. Discussion

The prognosis of any patient admitted to ICU depends on functioning of major vital organs systems mainly respiratory, cardiovascular, central nervous system, renal and hepatobiliary. The presence or severity of a particular organ dysfunction should be easily measurable and needs to readily available in all institutions. In any patient, the organ dysfunction is a dynamic process and will change over time.A good prognostic scoring system needs to be able to take the time factor into account.It is easy to assess the patients' clinical condition with newer prognostic scores like SOFA and MODS as the requiredvariables can be measured repeatedly at fixed time intervals thus allows a more effective representation of the changing aspects of the illness.Moreno *et al* demonstrated that the initial SOFA score can be used to quantify the degree of organ dysfunction or failure present on admission, that the Δ-SOFA score can demonstrate the degree of dysfunction or failure developing during an ICU stay, and that the total maximum SOFA score can represent the cumulative organ dysfunction experienced by the patient(12).

Jansennns*et al*, showed that SOFA is an excellent tool for assessing extent of organ dysfunction.In their study, SOFA score on Day one in non-survivors and survivors was 5.9 ± 3.7 and 1.9 ± 2.3 respectively (P <0.001)(13). Baradari *et al*in their study found that the admission, mean and highest SOFA scores in deceased patients and survived patients were 11.72, 16.38 and 16.45 and 6.52, 5.82 and 6.5 respectively(14).A study by Kin *et al* assessed performance of the SOFA scoring system in intensive care unit. In a sample of 131 patients, the sensitivities, specificities, and accuracies were 86.2%, 82.4%, and 83.2% for the SOFA score, respectively(15).The SOFA score was more useful in predicting mortality, and easier and simpler than the APACHE II and SAPS II.

In our study the mean SOFA score correlated most closely with mortality ($p<0.05$) (Table 3), followed by the highest score followed by Δ-SOFA 48-0 score. Length of stay was not related to outcome prediction. The mean SOFA score had a better prognostic value than the other SOFA derived variables. This may be because patients who present with a limited degree of organ dysfunction and have a long ICU stay still have a high likelihood of survival.

The mean SOFA score gives an indication of the average degree of organ failure over time. Thehighest SOFA score can identify the critical point at which patients exhibit the highest degree of organ dysfunction during their ICU stay. With these two variables, one can define the peak and the total amount of organ damage for any patient or group of patients during their ICU stay. The Δ-SOFA score could be used to reflect patients' response to therapeutic approach and allow the clinician to monitor daily progress and an objective evaluation of treatment responses.

VII. Conclusion

The Sequential Organ Failure Assessment (SOFA) is good, easily measurable and repeatable prognostic scoring system for critically ill patients. Knowledge of the trend in SOFA score over time could facilitate decision making regarding the appropriateness of instituting organ support. A decreasing SOFA score is associated with an improved outcome should boost the clinician's confidence in correctness of the management approach while an increasing score may indicate that a different and may be, a more aggressive therapy is needed.

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Table 1 The Sequential Organ Failure Assessment (SOFA) score[a]

Organ system	SOFA score				
	0	1	2	3	4
Respiratory, PO_2/FiO_2, mmHg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory
Coagulation, Platelets, $\times10^3/mm^3$	≥150	<150	<100	<50	<20
Liver, Bilirubin, mg/dL	<1.2	1.2–1.9	2.0–5.9	6.0–11.9	>12.0
Cardiovascular	MAP ≥70 mmHg	MAP <70 mmHg	Dopamine <5 or dobutamine (any dose)[b]	Dopamine 5.1–15 or epinephrine ≤0.1 or norepinephrine ≤0.1[b]	Dopamine >15 or epinephrine >0.1 or norepinephrine >0.1[b]
Central nervous system, Glasgow Coma Scale	15	13–14	10–12	6–9	<6
Renal, Creatinine, mg/dL. Urine output, mL/d	<1.2	1.2–1.9	2.0–3.4	3.5–4.9 <500	>5.0 <200

[a], adapted from Vincent *et al*. (7); [b], Catecholamine doses are given as μg/kg/min for at least 1 hour. FiO_2, fraction of inspired oxygen; MAP, mean arterial pressure; PO_2, partial pressure of oxygen.

TABLE 2: DEMOGRAPHIC CHARACTERISTICS OF STUDY POPULATION

CHARACTERISTICS	VALUES		
Number of Patients	256		
Age (in years)Range, Mean (SD)	18-95,59(17)		
SEX	**Men**		**Women**
	172		84
Length of ICY Stay (in days)	**Range**	**Mean**	**Median**
	1- 56	6.5	4.0
Numberof Deaths (and %)	44(17%)		

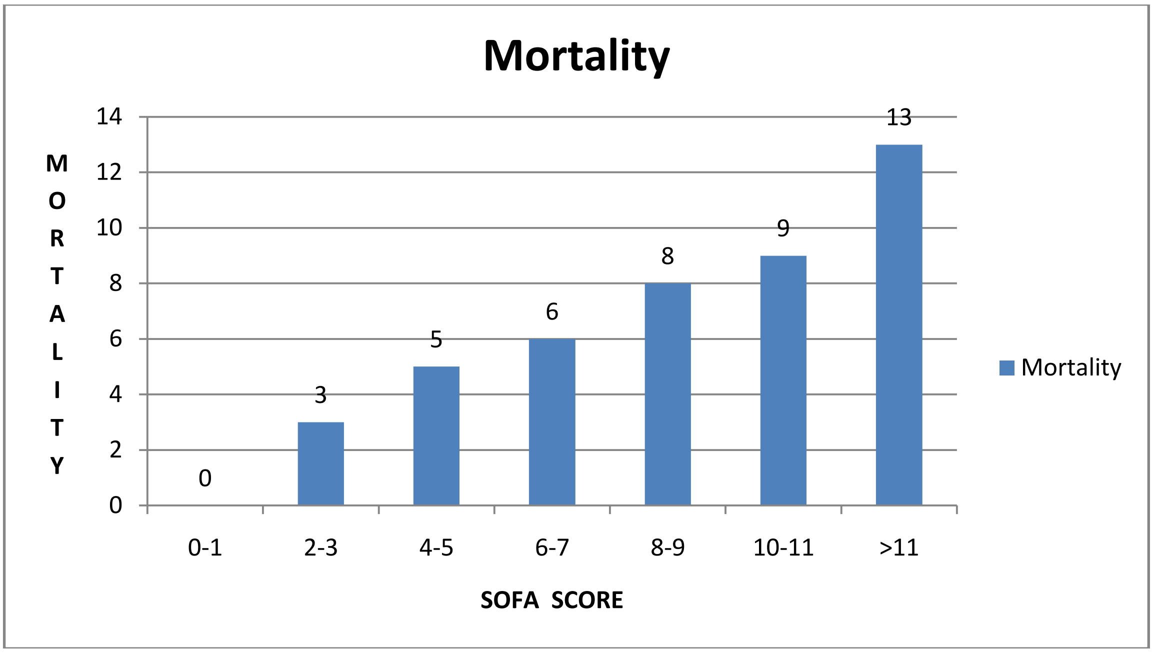
TABLE 3: UNIVARIATE LOGISTIC REGRESSION ANALYSIS OF LENGTH OF STAY AND SOFA DERIVED PARAMETERS AS PREDICTORS OF MORTALITY

VARIABLES	CO-EFFICIENT MEAN (SE)	ODD'S RATIO(95% CI)	P VALUE
INITIAL SOFA SCORE	0.37(0.05)	1.45(1.32-1.59)	<.001
SOFA SCORE AT 48h	0.37(0.06)	1.45(1.30-1.61)	<.001
SOFA SCORE AT 96h	0.33(0.06)	1.39(1.22-1.57)	<.001
HIGHEST SOFA SCORE	0.46(0.04)	1.59(1.43-1.76)	<.001
MEAN SOFA SCORE	1.12(0.13)	3.06(2.36-3.97)	<.001
Δ SOFA SCORE, 48-0	0.42(0.08)	1.52(1.29-1.78)	<.001
Δ SOFA SCORE, 96-0	0.21(0.09)	1.24(1.04-1.47)	<0.02
LENGTH OF STAY	0.07(0.02)	1.07(1.03-1.11)	<.001
TOTAL SOFA SCORE	0.04(0.01)	1.05(1.03-1.06)	<.001

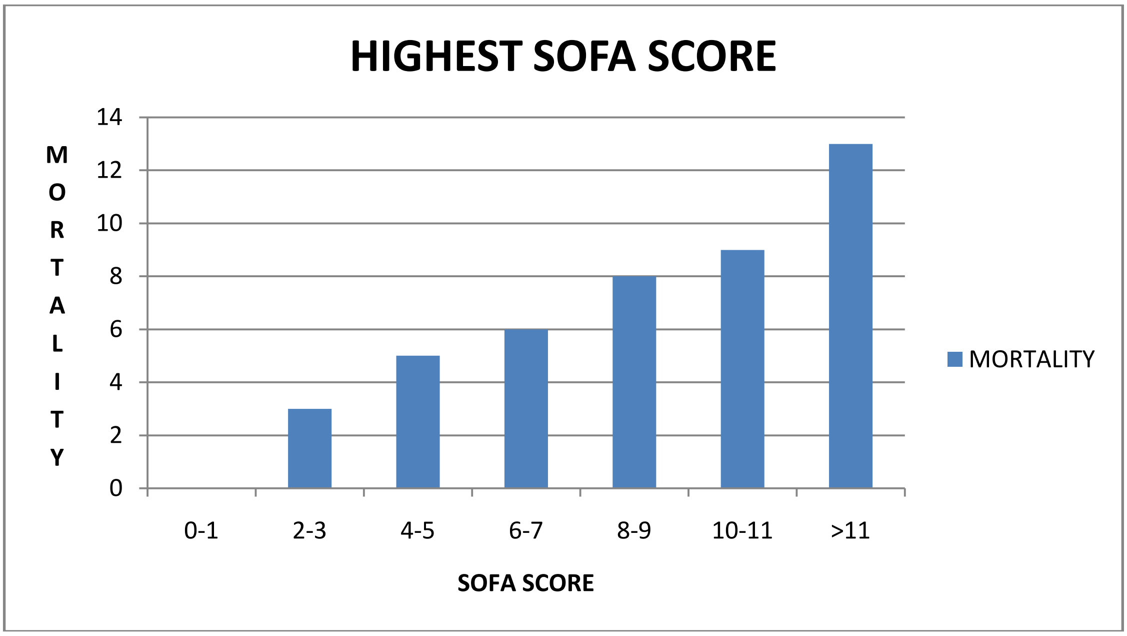
TABLE4: CHANGES IN SOFA SCORE IN RELATION TO OUTCOME

FIRST 48 HRS				NEXT 48HRS				
Evolution	**No. at risk**	**no of death**	**%of death**	**Evolution**	**No. at risk**	**% of death**	**Total % of death**	**Average % of DeathsoverFirst 96h**
Increased	167	30	68%	**Increased**	77	70	57	>50
				Unchanged	45	8	53	
				Decreased	45	45	50	
Unchanged	75	13	29.5%	**Increased**	40	35	32	27-35
				Unchanged	11	9	27	
				Decreased	24	45	35	
Decreased	14	1	2%	**Increased**	6	31	26	<27
				Unchanged	2	31	25	
				Decreased	6	12	19	

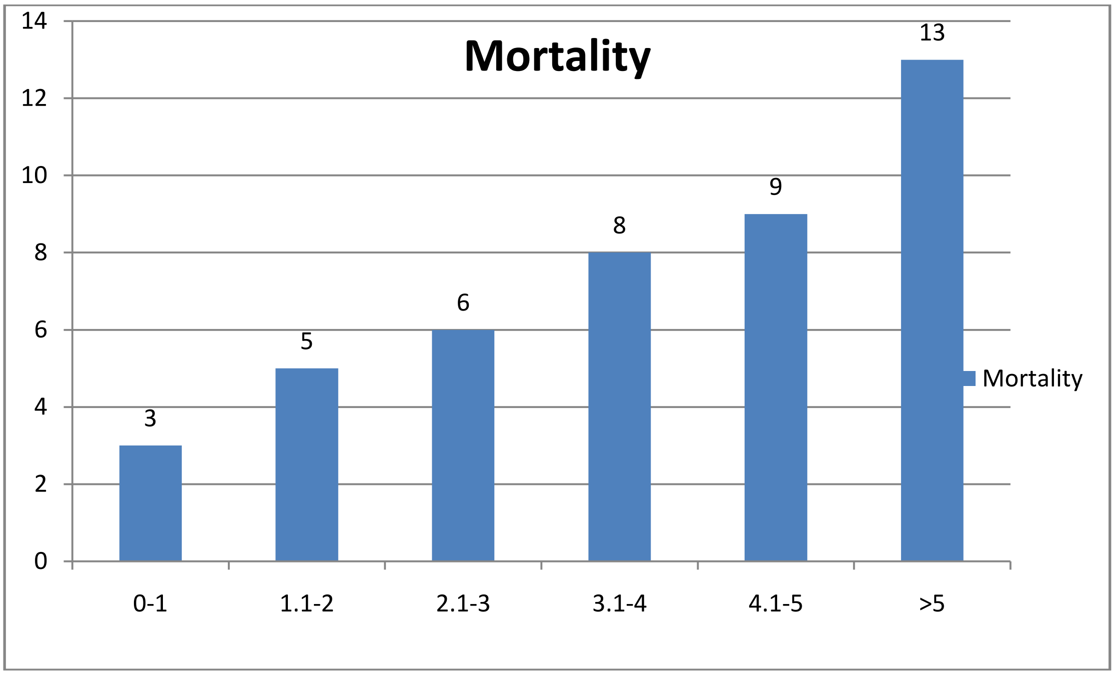
FIGA: CORRELATIONN OF MORTALITY WITHINITIAL SOFA SCORE



FIGB: CORRELATION OF HIGHEST SOFA SCORE WITH MORTALITY



FIGC: CORRELATION OF MEAN SOFA SCORE WITH MORTALITY



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