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Comparison of Different Scoring Systems Used in the Intensive Care Unit

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Abstract

Scoring systems are used in the Intensive Care Units (ICU) to provide clinical information about the severity of a disease and an estimate in hospital mortality rate. Scoring systems involves the collection of medical and clinical data regarding a patient and each data variable is assigned points. The data includes information such as organ specific information, diseases, treatments, comorbidity, and interventions. The data variables are often stratified in tables for allocating points. These points are then summated and adjusted with different weighting to give the overall score.

Keywords: SOFA; Scoring systems

Introduction

Scoring System consists of two parts: a severity score – which is a number (higher the score; higher the severity) and a calculated probability of mortality [1].

The usually used scoring systems are Acute Physiology and Clinical Health Evaluation (APACHE), Simplified Acute Physiology Score (SAPS), Mortality Prediction Model (MPM), Glasgow Coma Score (GCS), Logistic Organ Dysfunction Scoring (LODS), Multiple Organ Dysfunction Score (MODS) and Sequential Organ Failure Assessment (SOFA) [2,3].

Many studies have been published regarding the use of scoring systems; there is a paucity of its use as a clinical tool to predict mortality even in well-established Intensive Care Units. This may be because of the lack of resources, lack of data available on the first day of admission to ICU and also the time required for filling in the scoring systems. Most of the scoring systems are developed in the West and is not validated for intend patients.

Aim of this study was to compare the ability of different organ dysfunction scoring systems in predicting the outcome of the Intensive Care Unit. Logistic Organ Dysfunction Score (LODS), Multi Organ Dysfunction Score (MODS) and Sequential Organ Failure Assessment (SOFA)

Methodology

This study was a Prospective Observational study conducted at the Intensive Care Units at Kasturba Hospital, Manipal. Study period was April 2014 to December 2014

We included all patients admitted to the Surgical and Medical ICUs in Kasturba Hospital, Manipal, Udupi District, Karnataka based on inclusion and exclusion criteria

Inclusion criteria: All patients getting admitted to Medical and Surgical ICU, Age >18yrs, ICU stay >12 hrs.

Exclusion criteria: Patients for whom lab investigations are not taken on daily basis.The study was approved by institutional ethical committee.

A prospective Cohort Study was conducted in 17 bedded Surgical ICU and 15 bedded Medical ICU. There were total 500 patients, out of which only 157 patients met the inclusion criteria. Patient's demographic data, medical history, clinical data (biochemical and Haematological measurements) and worst vital signs were noted within 24 hours of enrolment. Then the points to each score were applied and calculated. MODS and LODS were taken on the day of admission while SOFA was calculated daily until patient got discharged from the ICU.

Statistical Analyses

Sample size were calculated ($n=\mathbf{Z}^2_{1-\alpha/2}\, pq/p(d)^2$) with sensitivity and specificity at 80% and 70%. Categorical data was compared using Chi square test while continuous data was represented as mean ± SD. P value of <0.05 was considered as significant. Discernment was assessed with receiver-operating characteristic (ROC) curves. An AUC of 0.5 (a diagonal line) is equivalent to random chance, whereas an AUC of 1.0 implies perfect discrimination. All data were analysed using SPSS for Windows (version 20.0; SPSS Inc.) (Flow Charts 1 and 2).

Scores were calculated using online calculator:

www.sfar.org/scores2/**sofa**2.html

www.sfar.org/scores2/**mods**2.html

www.sfar.org/scores2/**lods**2.html

Predictive mortality was calculated by taking the average of individual scores for individual patient.

A total of 500 subjects were enrolled in the study, among which only 157 patients met the inclusion criteria. Baseline characteristics are given in Table 1.

Table 2 represents the mean mortality and survival scores of SOFA, MODS and LODS among Medical and Surgical ICU patients and also for the study population on whole.

Discussion

The SOFA score was generated by the Group on Sepsis-Related Problems of the European Society of Intensive Care Medicine, with the intent of generating an impartial instrument to define separate and cumulative organ failure [4]. The outcomes of this study recommend that the SOFA score functions with fair to good precision for calculating

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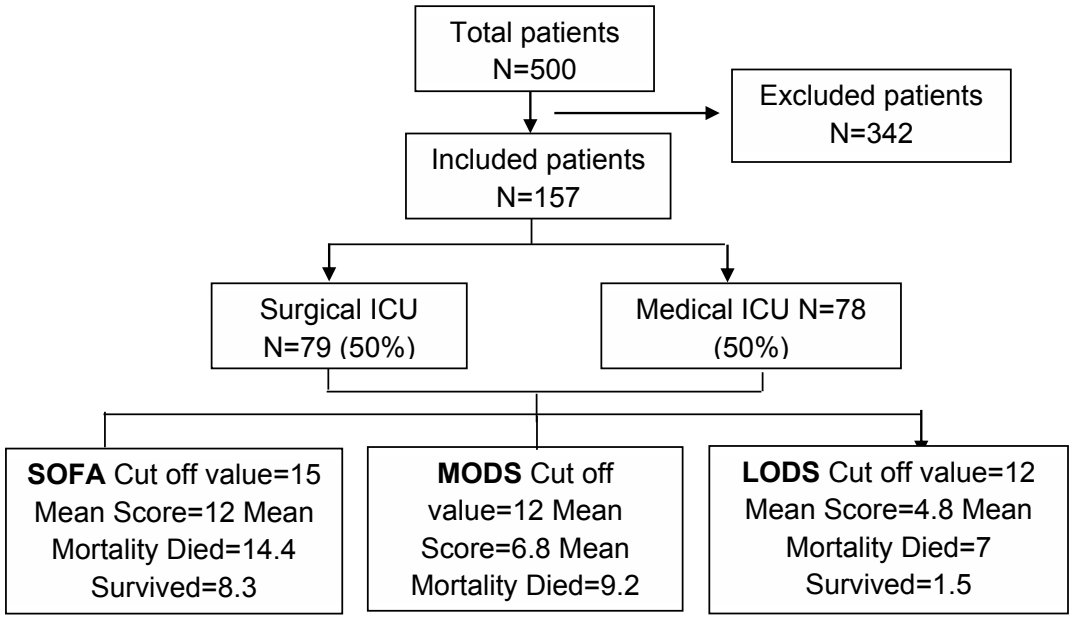
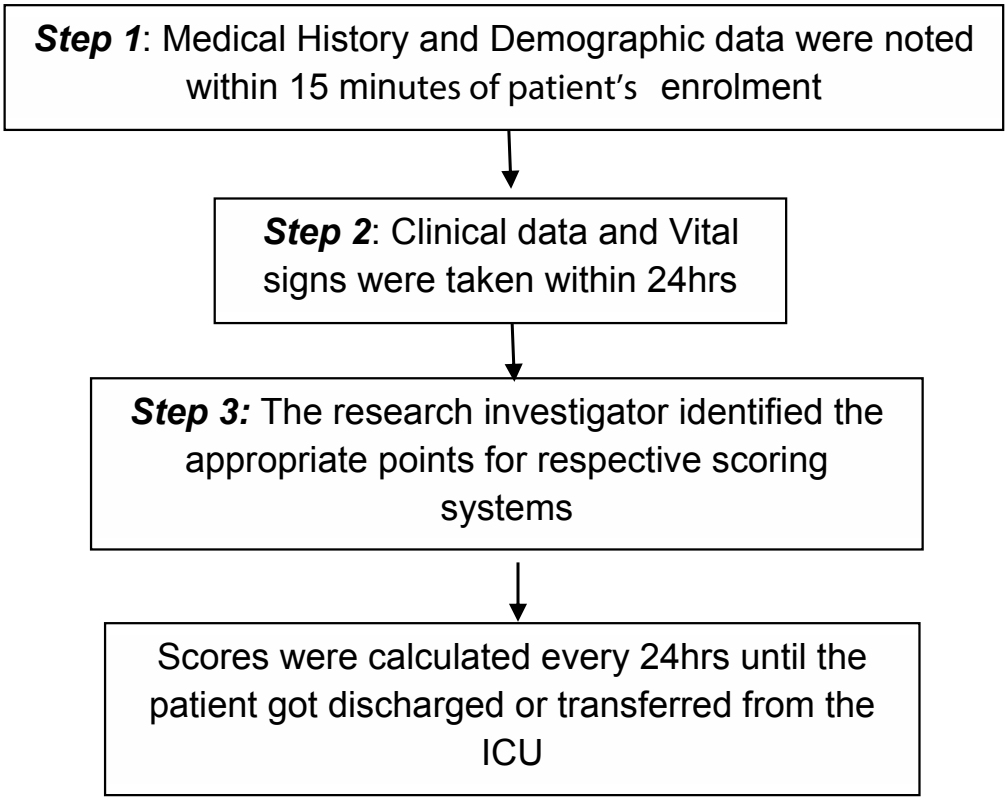


Flow chart: 1



Flow chart: 2

Baseline Characters	
Age (y)	52.2 ± 16.4
Gender	
Male (%)	105 (67)
Female (%)	52 (33)
ICU	
Medical (%)	78 (50)
Surgical (%)	79 (50)
Admission Diagnosis	
CNS (%)	4 (2.5)
CVS (%)	4 (2.5)
Pulmonary (%)	26 (16.5)
Renal (%)	12 (7.6)
Hepatic (%)	14 (8.9)
Carcinoma (%)	15 (9.5)
Infectious (%)	29 (18.4)
Others (%)	37 (23.5)
ICU Stay (Median , IQR)	2 (1 – 3)
Mortality	
Survivors (%)	64 (41)
Died (%)	93 (59)
Mean Scores (Mean ± SD)	
SOFA (average)	12 ± 3.9
MODS (at admission)	6.8 ± 4.5
LODS (at admission)	4.8 ± 3.7

Table 1: Baseline characteristics of study population.

ICU	MEDICAL		SURGICAL		OVERALL	
Mortality	**Died N=50**	**Survived N=28**	**Died N=43**	**Survived N=36**	**Died N=88**	**Survived N=64**
SOFA	14.4 ± 3.9	8.6 ± 3.9	14.3 ± 3.9	8.2 ± 3.9	14.4 ± 3.9	8.3 ± 3.9
MODS	9.2 ± 4.5	3.3 ± 4.6	9 ± 4.5	2.8 ± 4.5	9 ± 4.5	3 ± 4.5
LODS	6.9 ± 3.7	1.5 ± 3.7	7.2 ± 3.7	1.5 ± 3.6	7 ± 3.7	1.5 ± 3.7

Table 2: Mean mortality and survival scores of sofa, mods and lods among medical and surgical ICU patients.

in-hospital mortality when applied to patients who are admitted in medical and surgical intensive care units. The area under the curve (AUC) of SOFA, MODS and LODS were found to be 0.95, 0.89 and 0.92 indicating the discriminative ability of the score. SOFA is found to have more sensitivity and specificity than LODS.

A study was conducted to find the efficiency of organ dysfunction scores and to make an unjust or prejudicial distinction of ICU consequence after admission [5] among patients with severe sepsis and at least one organ dysfunction on the first day in ICU. The level of organ dysfunction was determined by SOFA and the severity of illness by SAPS II within a day of admission. Median SAPS II score on admission was 47 (25th-75th quartiles range, 37-57) and the survival rate was 41%. Distinct results were shown for highest SOFA score on day 3 of ICU. Due to the presence of organ dysfunctions of most of the organs on day 1 of ICU, the outcome was poor. The scores progressively increased during the ICU stay. Neurological and cardiovascular dysfunctions were the independent risk factors for mortality. SOFA found to be accurate in determining the organ dysfunction.

The SOFA score has numerous necessary features for use in the ED, since it is easy to compute at the bedside and contains clinical and laboratory figures that are routinely available in the ED. The SOFA score is more practical for use in the ED, given that it is easy to calculate at the bedside, includes only vital sign and laboratory data that are routinely available, and does not require a definitive final diagnosis of the acute process. These facts, in addition to the equivalent performance of the SOFA score observed in this study, suggest that it may be preferred more than other scores for risk stratification and prognosis.

Acharya et al. [6] predicted the ICU outcome of SIRS patients with SOFA. SOFA was evaluated at 0hrs, 48hrs, 96hrs and until the patient got discharged. They compared initial, mean and highest SOFA that showed SOFA >7, showed 73.9% mortality and SOFA >11 showed 90% mortality.

Bland Altman plot shows that there are out layers and the plot supports SOFA (Figure 1). Previous investigations have reported the usefulness of assessing the change in SOFA during ICU care to assess outcome [7]. This is one of the few studies done in Indian hospitals comparing the scoring systems used in ICU.

When comparing the actual mortality and predicted mortality, for 88 patients out of 93 patients SOFA scoring predicted correctly whereas only 5 patients had a wrong prediction with regard to the mortality

Daliana et al. [8] conducted a prospective study comparing the predictive outcome of MODS and SOFA. They found that there were no significant differences between the two scores in terms of mortality prediction. Khwannimit et al. [9] conducted a prospective study comparing all the three organ dysfunction scorings LODS, MODS and SOFA to predict ICU mortality. The data was collected for a period of 2 years on patients who got admitted to the ICU. The MODS, SOFA, and

LODS scores were calculated daily until the patient got discharged from the ICU. The maximum scores` and delta-scores had a relation with ICU mortality. The maximum scores predicted the mortality rate better. The area under the receiver operating characteristic curve (AUC) for maximum scores was highest for LODS. Organ dysfunction assessment on a daily basis was reliable with mortality. The maximum scores were found to be the best predictors of ICU mortality (Figure 2).

Limitations

The main drawback of this study is the sample size. Sample size was 500 but only 157 were included as it was a time limited study. Investigations were not done on daily basis for most of the patients as it was not necessary for them. Bland Altman plot could be assessed only between SOFA and MODS as their total score were same (24) but not for LODS (22). SOFA was taken as a mean score rather than on day one and at last day. This might have affected the comparison with MODS and LODS.

As it was a time limited study only few patients could be studied. A large population with investigations done on daily basis till the patient get discharged or shifted can be done to predict the outcome of ICU using SOFA, MODS, and LODS measured daily in future.

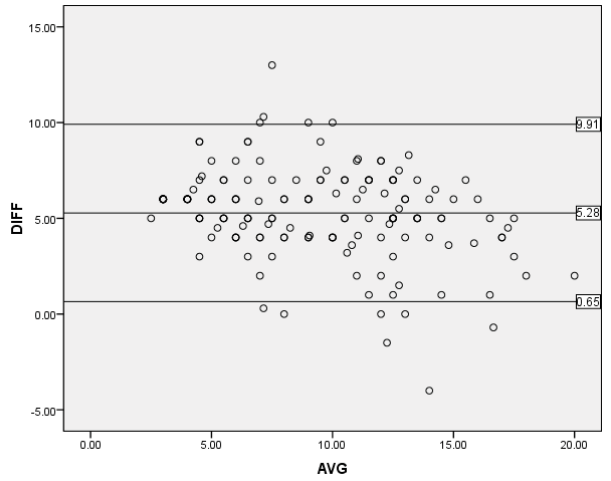


Figure 1: Plot for different scoring systems. Bland Altman plot method is used in analyzing the agreement between SOFA and MODS. The out layers and the plot support SOFA.

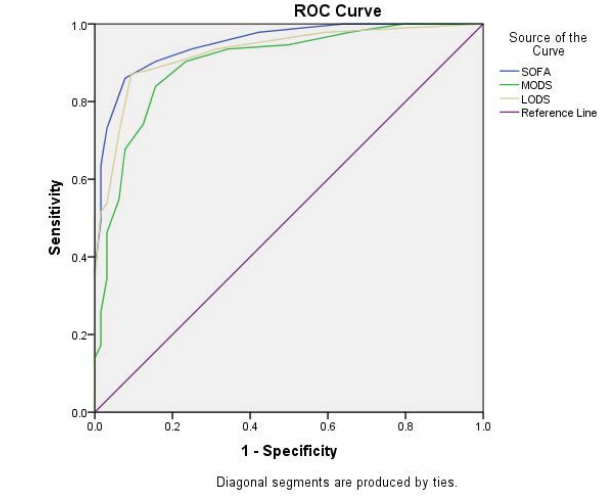


Figure 2: ROC of all the three scores. Discrimination was evaluated comparing SOFA, MODS and LODS with receiver-operating-characteristic (ROC) curves. An AUC of 0.5 (a diagonal line) is equivalent to random chance, whereas an AUC of 1.0 implies perfect discrimination. The area under the curve (AUC) of SOFA, MODS and LODS were found to be 0.95, 0.89 and 0.92 indicating the discriminative ability of the score, i.e., the ability to discriminate survivors from non-survivors with specificity on the X-axis and Sensitivity on the Y axis.

Conclusion

SOFA is a very useful validated tool for predicting mortality in Intensive care Unit, SOFA was more sensitive and specific compared to MODS and LODS. SOFA scoring may be widely used in the ICUs to predict mortality.

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