Acute Physiological and Chronic Health Examination Scoring System in Prediction of Mortality in Critically Ill Patients and It's Comparison with Other Scoring Systems

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Research Article

Abstract: Predicting the severity of critically ill patients is as essential as management of the patient in intensive care unit . Several scoring systems have been tried in the past with regular modifications. Acute physiological and chronic health examination scoring system (APACHE IV) was used in predicting the mortality and outcome in critically ill patients. APACHE IV scoring system was compared with the older scoring systems, LODS, MPM II_0 and MPM $II_{24,}$. Various statistical tools were used to assess the correlation, significance, and predictability. A total of 181 patients were included in the study. APACHE IV score had the best calibration and discrimination .MPM II_0 score had good calibration and fairly good discrimination .MPM II24 score had the least significant discrimination and calibration.

Keywords: APACHE, LODS, MPM II_0 and MPM $II_{24.}$

Introduction

Scoring systems for use in the intensive care unit (ICU) have been developed from the past 30 years. They are widely used in the field of critical care medicine. They allow a quantification of the severity of illness and a probability of in-hospital mortality. A well performing ICU prognostic model helps to make meaningful comparison of the hospital's current performance with the past. This allows the hospital to identify the weakness and initiate interventions aimed at quality improvement and to allow patients to choose health care providers based on performance. Although the scoring systems have many diverse uses, their use in daily clinical medicine for the clinical outcome and health care delivery is yet to be realized.

Aims and Objectives

1. To compute mortality prediction scores in patients admitted to ICU fulfilling the inclusion/exclusion criteria using APACHE IV scoring system and its comparison with other existing scoring systems like LODS, MPM II_0 and MPM II.
2. To find out which score among APACHE IV, LODS, MPM II_0 and MPM II $_{24}$ is the best mortality predictor in ICU.

Methodology

The present study was carried out in tertiary care medical college hospital over a period of two years.

Source of data Patients admitted in our Hospital ICU with a medical condition, from October 2009 to October 2011 fulfilling the inclusion criteria were included in study. The patients were followed till they were transferred out of the ICU, death or discharge from the ICU. Data was collected in a pretested proforma which included the demographic details of the patients, the vital signs like pulse rate, blood pressure, respiratory rate, temperature, brief clinical examination of all the systems.Investigations like LFT, ABG, CXR, pulse oximetry, blood counts, blood urea, serum creatinine, serum electrolytes, blood cultures and PT INR were done. Diagnosis of malaria was confirmed by QBC examination. All vital signs including ventilatory parameters (if required) were monitored 4th hourly and hourly urine output estimation was measured in all patients. Patients of age less than 18 years ,burns patient, emergency operative or post operative patient, pregnant women , patients who stayed for less than 24 hours were excluded from the study.

Results

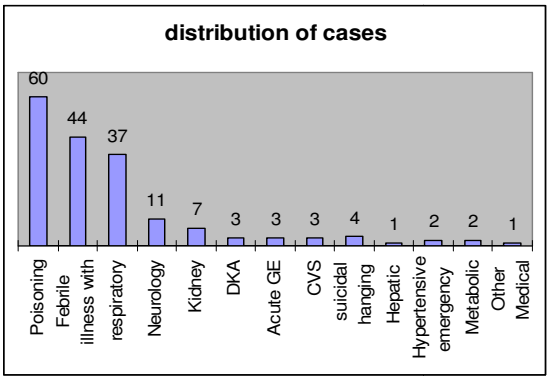
The total number of patients in the ICU during the study period from October 2009 to October 2011 was 267, out of which 181 were included in the study based on inclusion criteria. The mean age of the study population was 43.06 $\pm$ 20.33 years. Males were more in number than females (59.1 % and 40.9 %) The total number of survivors were 129 and non survivors were 52 (table 2).,

with mean age of the survivors 39.06 ± 18.59 years and of the non survivors 52.96 ± 21.24 years. There was no significant gender difference among survivors and non survivors (Table 1)

Table 1: Cross tabulation of outcome of study in percentile (n= 181)

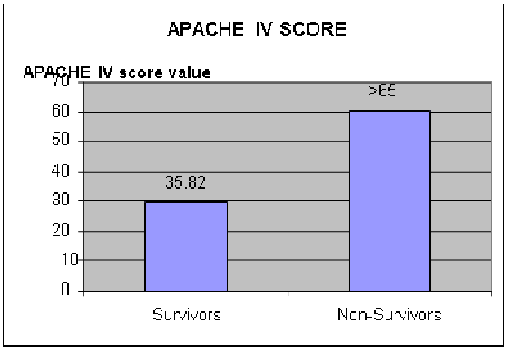
Status	Observed	Outcome in Percentile
Non-Survivors	52	28.7
Survivors	129	71.2

Poisoning comprised of maximum number of cases in the study group(33%), followed by acute febrile illness with MODS (24%). However the neurology and chronic kidney diseases were least in number with 6% and 4% respectively.(graph 1)



Graph 1: Distribution of cases as per diagnosis (n=181)

The mean length of stay was 6.17 days ± 4.10 days. The mean length of stay among survivors was 6.00 ± 4.15 days and mean length of stay among non-survivors was 6.57 ± 3.97 days. The mean APACHE IV score among the patients was 39.20 ± 11.05. It was 35.82 ± 8.43 among survivors and 65.06 ± 9.18 in non survivors . The Mean LOD score among the patients was 6.248 ± 3.57. , with 4.86 ± 2.80 in survivors and 9.69 ± 2.90 in non-survivors. (graph 2)



Graph 2: APACHE IV score in Survivors and Non-survivors

The mean MPMII$_0$ Predicted Death Rate (PDR) was 31.62 ± 31.41%. It was 20.40± 24.37% in survivors and 59.47 ± 30.01% in non-survivors The mean MPM II$_{24}$ PDR among the study population was 13.31 ± 22.6%., with observed mean of 4.49 ± 10.14% in survivors and 35.18 ± 29.64% in non-survivors **(Table 2)**

Table 2: Mortality Predicted by the 4 scoring systems

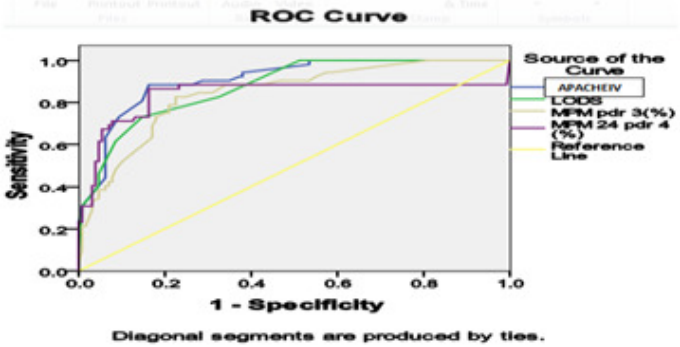
Scoring System	Number	Actual Death Rate (%)	Predicted Death Rate(%)	SMR
APACHE IV	181	29	30.9	0.85
LODS	181	29	35.5	0.82
MPM II$_0$	181	29	31.6	0.92
MPM II$_{24}$	181	29	13.3	2.17

Correlation of the scoring systems

On the basis of linear Regression analysis, the death rates predicted by all the 4 scoring systems correlated with each other**.** The closet correlation was between APACHE IV and MPM IIo (r^2=0.53) followed by LODS and MPM II$_0$ (r^2=0.51), APACHE IV and LODS (r^2=0.47), APACHE IV and MPM II$_{24}$ (r^2=0.34), MPM II$_0$ and MPM II $_{24}$(r^2=0.32), LODS and MPM II$_{24}$ (r^2=0.27).

Calibration of the scoring systems

Calibration of all the 4 scoring systems was tested by the Lemeshow – Hosmergoodness of fit test. The calibration was best for the APACHE IV scoring system with a p value of 0.977, followed by MPM IIo score with a p value of 0.771, LODS score showed less significant p value (0.696). MPM II$_{24}$ score had the poorest calibration with a p value of 0.019. APACHE IV, LODS, MPM II$_0$ scores had good discrimination. The best discrimination was seen with APACHE IV score. However there was no statistical significant difference among 4 scoring systems . (graph 3)



Graph 3: Comparison of ROC curves of all the scoring systems

The Area under the curves for the individual scoring systems is statistically significant, i.e. the ability to discriminate survivors and non-survivors were good for all the 4 scoring systems. But comparison of the AUC's of all scoring system did not reveal any statistical significance over each score.

Discussion

Predictor variables entered in the ICU model should be routinely available, reliable and should be independent of ICU treatment or intervention. The development of an ICU prognostic model requires a large database compiled from representative ICUs. The models should include the important predictor variables that should be tested for their independent contributions and interactions. From the study it is evident that 71% were survivors and 29% were non-survivors. The death rate in our ICU setup was 29%. This was in concordance with the study conducted in France, which showed an overall death rate of 20-30%[1] .The length of stay in the ICU is a significant contributor to the overall mortality. Previous studies have shown that longer the duration of stay in the ICU more the chance of nosocomial infections and multi organ failure and hence more mortality[2]. Poisoning and febrile illness with MODS were among the most common case load in ICU set up. This could be attributed to easy availability insecticides which are commonly used agents to commit suicide. The large number of cases of febrile illness with MODS is due to large number of undiagnosed fevers with MODS from surrounding catchment area. In our study there was no statistical difference in the duration of stay among survivors and non-survivors. This could be because of the low sample size of our population when compared to the international, multicenter studies done in the developed countries. [6] All the scoring systems showed higher score among non survivors compared to survivors due presence of more severe diseases. This condition based score gives directly the Predicted death rate and hence requirement of less variables and easy to compute.

All the scores significantly discriminate survivors from non-survivors. The highest Discrimination was with APACHE IV score (AUC=0.907) followed by LODS (AUC=0.875), MPM II_0 (AUC=0.843) and MPM II_{24} (AUC=0.838).Similar findings were also seen in another study [4.5].

Limitations

1. It was a single center study. Hence it cannot explain and validate the results across a range of population.
2. Sample size was limited in number.
3. Diseases classified according to the diagnostic category in APACHE IV score which may not apply to the other scoring systems.

Conclusions

The main conclusions from the study are

The analysis of the data from present study showed , that APACHE IV scoring system has the best discrimination and calibration of all mortality scoring systems. APACHE IV scoring system predicted the death close to the actual mortality and good discrimination i.e ability to distinguish survivors and non-survivors. Hence routine use of APACHE IV scoring system in ICU's can be recommended for the prediction of mortality. APACHE IV scoring is a 'condition based severity of illness' score making it easy to use as it has no variables to be entered for calculation, minimizing the inter observer variability.

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