AUDIT ARTICLE

Assessment and comparison of APACHE II (Acute Physiology and Chronic Health Evaluation), SOFA (Sequential Organ Failure Assessment) score and CURB 65 (Confusion; Urea; Respiratory Rate; Blood Pressure), for prediction of inpatient mortality in Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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Abstract

Objective: To assess and compare the role of Acute Physiology and Chronic Health Evaluation, Sequential Organ Failure Assessment, and Confusion Urea Respiratory Rate Blood Pressure scores in predicting inpatient mortality for patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease.

Design: The retrospective study was conducted at the Jinnah Post-graduate Medical Centre, Karachi, and comprised data of all consecutive Acute Exacerbation of Chronic Obstructive Pulmonary Disease patients from December 1, 2013, to December 31, 2014. Logistic regression model and non-parametric tests were employed using SPSS 22.

Results: There were 95 patients whose medical records were studied. The overall mean age was 60.79±12.39 years. Mortality rate was of 26(27.6%). Median hospital stay was 11.5 days (interquartile range: 9-17 days) in survivors and 4 days (2-8 days) in non-survivors. Out of the three scales used, Confusion Urea Respiratory Rate Blood Pressure-65 score showed the greatest difference between survivors and non-survivors ($p<0.05$). Significant higher scores were observed in non-survivors with Type 2 than Type 1 respiratory failure ($p<0.05$). There was significant association of mortality with baseline partial pressure of oxygen and oxygen saturation ($p<0.05$ each).

Conclusion: Confusion Urea Respiratory Rate Blood Pressure-65score determined at the time of admission had significant ability to predict inpatient mortality.

Keywords: Area under the Receiver Operating curves, AUC, SOFA, CURB 65, APACHI II, AECOPD.

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Introduction

Chronic obstructive pulmonary disease (COPD) is predicted to be the third leading cause of mortality worldwide by 2020.[1,2] COPD exacerbation is defined as an acute event characterised by worsening of patient's respiratory symptoms that is beyond normal day-to-day variations and leads to a change in medication.[2] Acute exacerbations of COPD (AECOPD) are not only a cause of high mortality in these patients[3] but are also responsible for significant number of unscheduled hospital visits[4] and thus increased healthcare expenditure. Although mild cases of AECOPD are preferred to be treated on an outpatient basis, 3% to 6% of these patients need hospitalisation. The in-hospital mortality rate is estimated to be 3% to 10%[5] and is reported up to 30% in patients over 65 years of age and those who got admitted in intensive care unit (ICU).[5] Several severity assessment tools have been validated and are being used in clinical practice for stable COPD, but none has been recommended for AECOPD.[6] Studies have shown good predictive value of certain individual factors in determining mortality among patients with AECOPD like low body mass index (BMI), poor functional status, use of steroids, respiratory rate (RR), partial pressure of carbon dioxide (PaCO2) level, long-term oxygen therapy (LTOT), presence of co-morbid conditions, increasing age, history of repeated

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exacerbations and serological variables like C-reactive protein (CRP) and serum amyloid A protein levels,[7,8] but there is a dire need to formulate a simple validated risk stratification tool for these patients. Such a model can play an important role in site-of-care decision, need of supportive or aggressive treatment, and follow-up plan after discharge.[1,8] Attempts have been made to design a new dedicated risk assessment tool for AECOPD patients, but the studies conducted for this purpose lack validation and exhibit great variability in terms of patient population, study design and variables studied.[1,9] Thus, no bed-side prognostic model could be established on the basis of these studies.[7]

The current study was planned to assess and compare three validated severity scores in the shape of Acute Physiology and Chronic Health Evaluation (APACHE II), Confusion, Urea, Respiratory Rate, Blood Pressure (CURB 65) and Sequential Organ Failure Assessment (SOFA) scoring systems. To our knowledge no such comparative study has been conducted previously utilizing these three severity scores in the target patient group.

Materials and Methods

The retrospective study was conducted at the Jinnah Post-graduate Medical Centre (JPMC), Karachi, and comprised data of all consecutive AECOPD patients from December 1, 2013, to December 31, 2014. Data was retrieved from the Chest Medicine Department records. AECOPD cases were defined as per the Global Initiative for Obstructive Lung Disease (GOLD) guideline 2014.[2] Data of patients with coexisting co-morbidities like chronic kidney disease (CKD), congestive cardiac failure, chronic liver disease, multi-organ dysfunction syndrome (MODS) and other pulmonary conditions, like pneumonia, pneumothorax, pulmonary embolism and pleural effusion was excluded. Also excluded was data of patients with unknown final outcome, like those who signed leave against medical advice (LAMA) form. Approval was taken from the institutional ethics committee.

The ICU files contained information for all components of the CURB-65, SOFA and APACHE II scores, including physiological data collected on admission, the worst values in the first 24 hours, biometric data, on-admission diagnosis and length of stay at hospital (LOS). Data was collected and scores were calculated by single senior Pulmonary Medicine resident trained in the same department. A Proforma was used to record all information from the files. It had three sections; demographic information, clinical and laboratory parameters, and outcome details.

SPSS 22 was used for data entry and analysis, with $p<0.05$ being statistically significant. In the descriptive analysis, mean with standard deviation was used for quantitative variables and, when indicated, median with interquartile range (IQR) was used for ordinal variables. In multivariate analysis, binary logistic regression was used to test the discriminating power of individual factors in relation to mortality. Odds ratio (OR) and their 95% confidence intervals (CI) were estimated. The ability of the models in the prediction of inpatient mortality was determined by their discrimination power which was tested by examining the area under the receiver operating characteristics (ROC) curve (AUC) graph with 95% CI. The relationship between the scores of APACHE II and CURB-65 was evaluated statistically with Pearson's correlation coefficients. Mann-Whitney U test and student's t-tests were used to compare non-parametric data and normally distributed continuous variables respectively.

Results

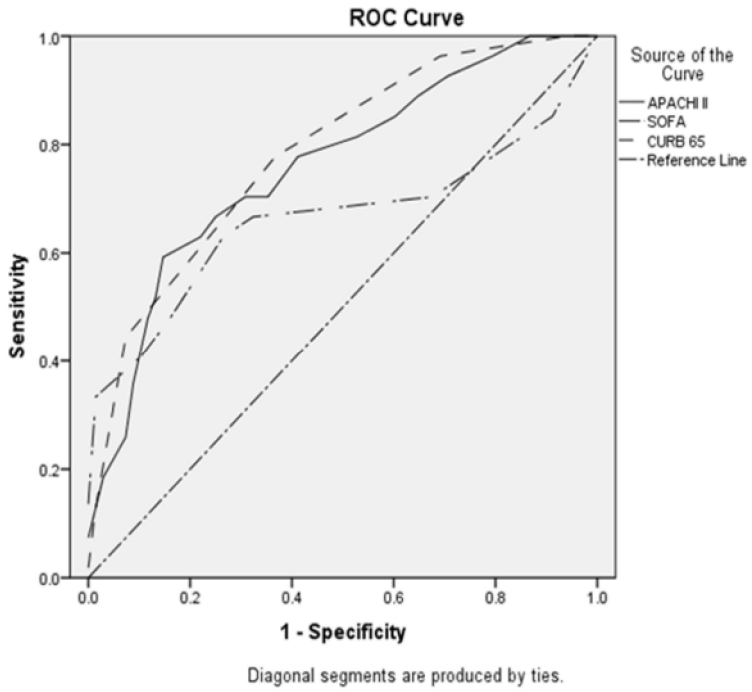
There were 134 patients admitted during the study period, but 95(71%) met the inclusion criteria. Of them, 71(74.7%) were males and 24(25.3%) were females. The overall mean age was 60.79 ±12.39 years. Smoking history was present in 75(78.6%) patients with mean 37.33±27.2 pack-year history. Type 1 respiratory failure (RF) was seen in 21(22.5%) patients and 74(77.5%) had type 2 RF. Overall, 85(89.1%) patients needed non-invasive ventilation (NIV) at some point during hospital stay. Mortality recorded was 26(27.6%).

Mean values of APACHE II, SOFA and CURB-65 scores were calculated and so was the median LOS and stay at the high-dependence unit (HDU) (Table-1).

Table-1: *Median (interquartile range).

	ALL (n= 95)	Survivors (n = 69)	Non Survivors (n = 27)	*p*-value
APACHE II	13.87 ± 7.94	11.65 ± 6.26	19.48 ± 9.02	0.000
SOFA	3.07 ± 2.56	2.46 ± 1.79	4.63 ± 3.47	0.004
Curb 65	2.49 ± 1.32	2.10 ± 1.12	3.48 ± 1.31	0.000
Total Hospital Stay *	11 (6 - 16)	11.5 (9 -17)	4 (2-8)	0.000
HDU Stay *	4 (0.75 - 8)	5 (0-8)	4 (2-8)	0.993

APACHE II: Acute Physiology and Chronic Health Evaluation II, SOFA: Sequential Organ Failure Assessment, CURB-65: Confusion Urea Respiratory Rate Blood Pressure-65
HDU: High Dependency Unit.



APACHE II: Acute Physiology and Chronic Health Evaluation II
SOFA: Sequential Organ Failure Assessment
CURB-65: Confusion Urea Respiratory Rate Blood Pressure-65
CI: Confidence interval

Figure: Areas under the receiver operating characteristics curves (AUC) for predicting inpatient mortality for APACHE II, SOFA and CURB 65(CI 95%).

Table-2: A Binary logistic regression analysis: Individual Variables related with inpatient mortality.

				95% C.I.for EXP(B)	
		Sig.	Exp(B)	Lower	Upper
Step 1	Age	0.214	0.961	.902	1.023
	MAP	0.145	0.959	.907	1.014
	RR	0.446	0.966	.883	1.056
	FiO2	0.228	0.898	.753	1.070
	GCS	0.863	1.025	.778	1.350
	pH	0.561	0.132	.000	121.552
	PaCO2	0.214	0.967	.916	1.020
	PaO2	0.065	0.955	.910	1.003
	Creat	0.645	1.383	.348	5.495
	Hct	0.625	1.021	.940	1.108
	APACHEII	0.059	1.228	.993	1.520
	CURB65	0.022	2.476	1.140	5.377
	SOFA	0.408	0.805	.481	1.346
	Constant	0.543	10659771.030		

APACHE II: Acute Physiology and Chronic Health Evaluation II, SOFA: Sequential Organ Failure Assessment, CURB-65: Confusion Urea Respiratory Rate Blood Pressure-65 MAP: Mean arterial pressure, RR: Respiratory Rate, FiO2: Fraction of inspired Oxygen GCS: Glasgow Comma Scale, pH: Potential of Hydrogen, PaCO2: Partial pressure of carbon dioxide, PaO2: Partial pressure of Oxygen, Creat: Creatinine, Hct: Haemotacrit

The AUC of CURB-65, APACHE II and SOFA was 0.78, 0.76 and 0.66 respectively for the prediction of ICU mortality (p<0. CURB 65 showed the best results (Figure)

The logistic regression model identified 4 variables associated with inpatient mortality (Table-2).

Discussion

The initial assessment of severity on admission would enable physicians to triage patients to suitable level of care and help them to better communicate with family and caretakers regarding predictable outcome. The present study demonstrates effectiveness of CURB-65 and APACHE II in predicting probability of in-hospital mortality in AECOPD patients.

CURB-65 is a simple bed-side scoring system based on simple variables like confusion, serum urea, respiratory rate, blood pressure and age. The system already has been successfully validated in community-acquired pneumonia (CAP) to assess severity[7] and prediction of mortality.

Chang et al. conducted a prospective study on patients hospitalised over a period of one year with AECOPD and found CURB-65 to be useful in stratifying patients into different management groups and also demonstrated statistically significant results for in-hospital mortality.[7] Another study conducted in the United States[10] demonstrated ROC of 0.76 (95% CI: 0.75-0.77) for CURB-65, that is consistent with our results. Another advantage CURB-65 offers, when compared with other scores, even with APACHE, is that it utilises simple, easily available variables. Course of the disease can be confidently predicted in the first few hours of admission when comprehensive investigation results are still pending, and help in allocating the patient to the suitable site and level of care without any delay which can affect the outcome.

SOFA is a simple objective scoring tool to predict morbidity and to some extent mortality based on parameters of six organ systems, namely respiratory, cardiovascular, neurological and renal systems along with coagulation and liver function.[11,12] Effectiveness of SOFA is well established in medical ICU[13] but its role in AECOPD has not been assessed comprehensively. Although SOFA exhibited statistically significant differences in scores

among survivors and non-survivors in the present study, its discriminatory power as predictor of in-patient mortality was shown to be much less when compared to the other two scoring systems. Recently, a study reported SOFA to be a good predictor of prognosis in elderly AECOPD patients with MODS[14] in China but these results cannot be compared to our results because MODS was part of the exclusion criteria in the present study.

Patients with pneumonia, pneumothorax and other co-morbidities were excluded from the study because patients with concomitant conditions respond differently to treatment and have higher mortality rates compared to patients with only AECOPD.[1,15]

The current study also identified two individual variables with statistical significance in predicting in-hospital mortality, namely oxygen saturation and Partial pressure of oxygen (PaO2). These results are consistent with prior studies.[5,16,17] On the other hand, Age, low potential of hydrogen (pH),[5,17] low mean arterial pressure (MAP), haematocrit and high blood urea nitrogen (BUN) levels[5] at admission were identified to be associated with high mortality previously, but the current study did not find any significant association. A study[18] in India also found no relation between these factors and mortality.

Overall mortality rate in the present study was higher compared to those reported from the Western world (1.8 to 20.4%),[1] but was similar to regional data of 25%.[18] Wide variation in mortality rates between hospitals is not easy to explain on the grounds of adverse predictors alone, and suggest the presence of some unidentified factors. Possible explanation of high mortality in the present study is severe baseline disease supported by overall high proportion of type 2 RF in the study population and short median LOS among the non-survivors. Patients with type 2 RF who succumbed to the disease had mean CURB-65 score of 4, putting them into the 'very severe' category. Other possible reasons contributing to the high mortality could be ongoing smoking and biomass fuel exposure, non-compliance of the advised treatment and unavailability of medicines due to economic reasons and possible late presentation to hospital. Though these factors were observed during data collection, they were not a formal part of the proforma used. Further studies are needed to address these possibilities to improve the mortality rate.

There are a few limitations of this study. Firstly, it is a retrospective analysis with a comparatively small sample size, thus serial assessment of patients' severity scores was not possible. Also, long-term mortality cannot be assessed due to the lack of follow-up record. Secondly, despite the fact that the chosen centre is one of the biggest tertiary care centres of the country, results cannot be applied to the general population.

Conclusion

Compared to CURB-65 and APACHE II, SOFA scoring system did not seem to be as effective in predicting mortality. Serial assessment of severity scores in admitted patients followed by outpatient follow-up to assess long-term morbidity and mortality is required for further validation of CURB-65.

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