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Original Research Article

A comparative study between curb-65 and psi/port score as predictors for ICU admission and mortality in community acquired pneumonia patients presenting to a tertiary care hospital

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ABSTRACT

Background: Despite recent advances in clinical medicine, mortality due to CAP has remained relatively the same. Therefore, early recognition for ICU admission plays a pivotal role in management of CAP. PSI/PORT (Pneumonia Severity Index/ Pneumonia Patient Outcome Research Team) score and CURB-65 (Confusion, Uremia, Respiratory rate, BP, Age > 65 years) are the two severity assessment scores that have extensively been used by the clinicians to distinguish between high risk and low risk patients. This study aims at comparing the predictive value of these two scores for ICU admission and mortality.
Materials and Methods: The information required for calculating CURB-65 and PSI was extracted with careful history taking, patient assessment and necessary investigations. Patients with >18 years of age, diagnosed clinically and radiologically with CAP were included in the study.CURB-65 and PSI scores were determined in a total of 131 patients on admission. Based on careful clinical assessment and judgment of treating physician 60 patients were admitted in ICU whereas 71 patients were admitted in medical ward.
Results: Out of 60 patients admitted in ICU 23 died. The ability to predict ICU admission was almost similar for PSI/PORT score (AUC 0.9605; 95% CI 0.9277-0.9933) and CURB-65 (AUC 0.9694; 95% CI 0.9368-1.9714). The ability to predict mortality was almost similar for PSI/PORT score (AUC 0.9196; 95% CI 0.8670-0.9722) and CURB-65 (AUC 0.9214 95% CI 0.8696-0.9732).
Conclusions: CURB-65 score was found almost similar in predicting ICU admission amongst patients coming with CAP to our hospital when compared to PSI/PORT score and when predicting mortality in patients with community-acquired pneumonia, CURB-65 and PSI/PORT score appear to have comparable specificity and sensitivity. Considering the simplicity, CURB-65 score could be preferred over PSI/PORT score. However, larger studies are required to know the exact Indian scenario.
Key message: Despite of recent advances in the field of medical science the mortality due to CAP has remained relatively the same. Therefore, early diagnosis and admission to ICU with standard treatment play a pivot role in management of patients with CAP. Two scoring system, PSI/PORT score and CURB-65 score, are widely being used to differentiate between low risk and high risk patients. We undertook this study for comparing the predictive value of these two scores for ICU admission and mortality.

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1. Introduction

Pneumonia, a frequently encountered respiratory infection in a clinical setup, is responsible for significant mortality and morbidity in suffering patients.[1] The timely commencement of antibiotic treatment has been linked to a decrease in overall mortality rates in instances of community-acquired pneumonia, including those categorized as severe and complicated by sepsis or septic shock.[2] Diagnosing pneumonia is challenging because of multiple differential diagnosis.[3] Community-acquired pneumonia (CAP) can be defined as an acute infection of the lungs that involves the alveoli and that occurs in patients without any prior healthcare exposure history. The patients suffering from CAP may present with a wide clinical spectrum of the disease ranging from walking pneumonia in otherwise healthy individuals to life threatening necrotizing or multi-lobar disease leading to septic shock.[4] Despite of advances in medicine in recent decades, the mortality because of CAP has remained relatively same over the past years.[5] Pneumonia is the third leading reason for hospital admission, accounting for around 5,44,000 hospitalizations from the emergency department annually. Given the high prevalence of CAP and its potential to cause severe illness, accurate assessment of the severity is necessary for the initial management of CAP and to plan empirical treatment. The PSI/PORT score and CURB-65 are two widely utilized severity assessment tools among clinicians to differentiate high-risk patients necessitating in-hospital management from those who can be managed as outpatients.[6] The pneumonia severity index (PSI)/PORT score, initially developed by Fine et al.,[7] serves as a prognostic model, Assessing the severity of illness involves evaluating 20 specific patient attributes, which encompass underlying comorbidities among other factors.. On the other hand, the CURB-65 score comprises five parameters, encompassing confusion, uremia, respiratory rate, blood pressure, and age $\geq$ 65 years. Originally established by the British Thoracic Society in 1987 as the CRB criteria,[8] it was subsequently modified to include uremia and age, resulting in the CURB-65 criteria, which was validated by Lim et al.[9] Both the PSI/PORT and CURB-65 models are endorsed by the American Thoracic Society for assessing disease severity,[10] while the CURB-65 model specifically is recommended by the British Thoracic Society for severity assessment.[11] For predicting the outcome PSI/PORT score has been shown to be slightly more accurate even though CURB-65 is more simple to use.[9,12] This study aims at comparing the predictive value of CURB-65 and PSI/PORT score for ICU admission and mortality at a rural population catering tertiary care center.

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2. Materials and Methods

This comparative study was carried out at the Department of General Medicine and Critical Care at our institute after proper ethical committee clearance. A total 131 patients presenting with CAP were considered for the study and were chosen according to feasibility criteria for the institute and the duration of the study. For the purpose of this study CAP was defined as the development of new shadowing on the chest X-ray and clinical picture that was consistent with pneumonia such as cough, sputum expectoration, breathlessness, fever and pleuritic chest pain. Based on careful clinical assessment and judgment of the treating physician 60 patients were admitted in ICU whereas 71 patients were admitted in the medical ward. The information required for calculating CURB-65 and PSI was extracted with careful history taking, patient assessment and necessary investigations. The obtained data was compiled for data analysis.

The study seeks to conduct a comprehensive comparative analysis of the CURB-65 and PSI/PORT scoring systems to determine their effectiveness as predictors for both ICU admission and mortality among patients presenting with Community-Acquired Pneumonia (CAP) at a tertiary care teaching hospital. By evaluating the performance metrics of each scoring system, including sensitivity, specificity, and overall accuracy, the study aims to identify the most reliable tool for risk stratification and clinical decision-making in the management of CAP patients.

The inclusion criteria for patient selection encompassed adults aged over 18 years exhibiting symptoms consistent with community-acquired pneumonia (CAP), including the presence of a new shadow on chest X-ray and clinical manifestations such as cough, sputum expectoration, breathlessness, fever, or pleuritic chest pain. Conversely, individuals under 18 years of age and those with concurrent infections were excluded from the study.

2.1. CURB-65 and PSI/PORT scoring systems

2.1.1. CURB-65

CURB-65 is a clinical score that has been employed for predicting mortality in community-acquired pneumonia. This score was developed by Dr. W.S. Lim et al in the year of 2002 at the University of Nottingham.[9] The CURB-65 score, derived from the earlier CRB score,[13] is recommended by the British Thoracic Society for assessing pneumonia severity and planning further management.[14] It aids in determining the optimal empirical antimicrobial therapy for patients, as well as whether outpatient treatment (scores of 0 or 1), admission to the ward (score of 2), or ICU admission (score of 3+) is necessary. Despite extensive validation and relative simplicity, the CURB-65 score has limitations. It identifies only about 51% of patients needs ICU admission as having severe disease (score of 3+),

indicating its inadequacy in predicting the need for intensive care.[15] Additionally, approximately 20% of all deaths occur in patients with CURB-65 scores of 2 or less, with an 8% mortality rate among patients with a score of 2 in the British Thoracic Society audit.[15] As a result, other prognostic criteria, such as the IDSA/ATS minor criteria and SMART-COP, have been developed, although they lack the proven validity and simplicity of the CURB-65 score. Furthermore, clinical indicators such as bilateral or multilobar consolidation, acidosis, positive blood cultures, hypoxia, and hypoalbuminemia should be considered to complement the risk stratification provided by the CURB-65 score.[11] Several markers have been investigated for their potential to enhance the risk assessment of patients with CAP, including cytokines, procalcitonin (PCT), C-reactive protein (CRP), and various stress hormones.[16] Among these, CRP stands out as the most accessible and routinely performed, offering additional prognostic information. A CRP level exceeding 100 mg/l is linked to a heightened risk of complication by CPE, while a level below 100 mg/l indicates a lower risk of mortality.[17,18] The score is an acronym for each of the parameters which are measured. Each parameter scores one point, for a maximum score of 5 (Tables 1 and 2).

2.1.2. PSI/PORT score

Fine et al. introduced the PSI/PORT score, a predictive tool utilizing 20 distinct clinical variables to assign a score. These scores categorize patients into five classes, each indicating an escalating risk of mortality. This predictive model has undergone independent validation and received broad recognition and endorsement in clinical practice. (Tables 3 and **??**).[19–22]

2.2. Statistical analysis

All the patients were carefully examined and necessary investigations were sent for parameters used in CURB-65 and PSI/PORT scores. The data collected was organized in MS Excel for subsequent statistical analysis, with all requisite statistical procedures carried out. In order to assess the predictive capability of various scores for ICU admission or mortality, ROC curves were constructed. The statistical methodologies were validated, with a significance level set at $p<0.05$ and a high significance level at $p<0.001$.

3. Results

CURB-65 and PSI/PORT scores were determined in a total of 131 patients. Out of 131 patients 60 patients were admitted in ICU and 71 patients were admitted in the ward. 80 males and 51 females were included in the study making a total of 131 patients (Table 4).

Out of 131 patients admitted 23 (17.6%) patients died whereas 108 (82.4%) patients survived. Out of 60 patients admitted in ICU 23 patients died whereas 37 patients survived. PSI/PORT score was evaluated for all participating 131 patients, out of these 131 patients included in the study 15 patients belonged to class 1, 20 patients belonged to class 2, 28 patients belonged to class 3 whereas 68 patients belonged to class 4 and 5. CURB-65 scores were also determined for 131 total patients out of which 23 patients belonged to low risk category, 40 cases belonged to moderate risk category and 68 patients belonged to high risk category. In terms of PSI class, a statistically significant contrast was observed between patients admitted to the ward and those admitted to the ICU, with a higher PSI class noted in the ICU group compared to the ward group. The majority of cases admitted to the ICU were predominantly classified as classes IV and V, whereas cases admitted to the ward primarily fell within classes I, II, and III. Conversely, there was a statistically significant difference observed between the two groups regarding the CURB-65 score, with a notably higher score identified in the ICU group compared to the ward group. Most cases admitted to the ICU were categorized as classes III or higher, while the majority of cases admitted to the ward were classified as classes I and II. Additionally, there was a statistically significant discrepancy between the two groups regarding the PSI/PORT score, which was notably higher in the non-survivor group with a mean of 141.39 ± 29.93, in contrast to the survivor group where it was lower with a mean of 92.23 ± 30.44. (Tables 5 and 6).

In this study it was found that for prediction of ICU admission CURB-65 had a sensitivity of 96.77%, specificity of 88.40%, PPV of 88.23% and NPV of 96.28%. On the other hand PSI/PORT score had a sensitivity of 95.23%, specificity of 88.23%, PPV of 88.23% and NPV of 95.23%. While for mortality prediction CURB-65 had a sensitivity of 100%, specificity of 82.30%, PPV of 77.83% and NPV of 100%. On the other hand PSI/PORT score had a sensitivity of 100%, specificity of 79.50%, PPV of 75.20% and NPV of 100% (Table 7).

Table 1: CURB-65 scoring system. Adapted from Lim et al.[9]

Risk factor	Score
Confusion of new onset (defined as an AMTS ≤ 8)	1
Blood Urea nitrogen > 7 mmol/L (19 mg/dL)	1
Respiratory rate ≥ 30 breaths/minute	1
Blood pressure < 90 mmHg systolic or diastolic blood pressure < 60 mmHg	1
Age ≥ 65 years	1

ROC curves were used to assess ICU admissions and mortality for the two prediction scoring methods PSI/PORT score and CURB-65 score.

The ability to predict ICU admission was almost similar for PSI/PORT score (AUC 0.9605; 95% CI 0.9277-0.9933) and CURB-65 (AUC 0.9694; 95% CI 0.9368-1.9714)

Table 3: PSI/PORT scoring system[23]

Factor	Score
Demographic factors	
Male	Age
Female	Age-10
Long-term care facility resident	+10
Accompanying disease	
Neoplastic disease	+30
Liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Chronic kidney disease	+10
Symptoms at diagnosis	
Acute psychosis	+20
Breathing rate >30/min	+20
Systolic pressure <90 mm of Hg	+15
Body temperature <30°C or ≥40°C	+15
Heart rate ≥ 125/min	+10
Laboratory measurements	
Arterial blood pH <7.35	+30
BUN ≥ 30 mg/dL	+20
Serum sodium <130 mEq/L	+20
Serum Glucose >250 mg/dL	+10
Hb <9gm/dL (Hct <30%)	+10
PaO_2<60 mmHg or SaO_2<90%	+10
Pleural effusion	+10

Table 4: Distribution of cases

S. No.	Location	Number of patients
1	ICU	60
2	Medical ward	71
Total		131

Table 5: Comparison between survivors and non-survivors

Parameters	Survivors	Non-survivors
Gender		
Male	62/108(57.40%)	18/23(78.26%)
Female	46/108(42.60%)	05/23(21.74%)
Age	51.63 ± 13.67	61.29 ± 14.23
Comorbidity		
Present	27/108(25%)	17/23(73.91%)
Absent	81/108(75%)	6/23(26.09%)
PSI/PORT score	92.23 ± 30.44	141.39 ± 29.93
CURB-65 score	2.57 ± 1.00	3.04 ± 1.14

Table 6: Comparision between ICU and ward admissions

Parameters	ICU admissions	Ward admissions
Gender		
Male	37/60(61.66%)	43/71(65.56%)
Female	23/60(38.34%)	28/71(39.44%)
Age	56.86 ± 13.76	50.08 ± 13.99
Comorbidity		
Present	19/60(31.66%)	11/71(15.49%)
Absent	41/60(68.34%)	60/71(84.51%)
PSI/PORT score	125.68 ± 32.21	79.88 ± 22.45
CURB-65 score	3.03 ± 0.95	2.33 ± 1.01

Table 7: Comparision of the two scoring systems

Scoring System	Sensitivity	Specificity	PPV	NPV	AUC
CURB-65 (ICU admission)	96.77%	88.40%	88.23%	96.28%	0.9694
PSI/PORT (ICU admission)	95.23%	88.23%	88.23%	95.23%	0.9605
CURB-65 (Mortality)	100%	82.23%	77.83%	100%	0.9214
PSI/PORT (Mortality)	100%	79.50%	75.20%	100%	0.9196

PPV: Positive predictive value; NPV: Negative predictive value; AUROC: Area under the receiver operating characteristic

Table 2: CURB-65 scoring system interpretation [9,20]

CURB-65 Score	Risk	30 day mortality risk
0	Low	0.7%
1	Low	3.2%
2	Moderate	13%
3	High	17%
4	High	41.5%
5	High	57%

(Figure 1).

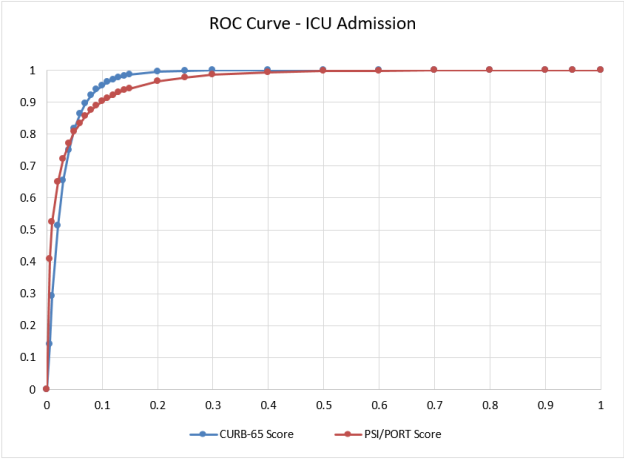

Figure 1: The curve illustrating the sensitivity and specificity of CURB-65 and PSI/PORT can be depicted through a Receiver Operating Characteristic (ROC) curve. Within this graph, the true positive rate (sensitivity) is contrasted against the false positive rate (specificity) across various cut-off points. Each plotted point on the ROC curve corresponds to a specific sensitivity/specificity pair, linked to a particular decision threshold. An ideal test, demonstrating perfect discrimination without overlap between the distributions, would yield an ROC curve passing through the upper left corner, signifying 100% sensitivity and100% specificity. Thus, the closer the ROC curve approaches this upper left corner, the greater the overall accuracy of the test. For the CURB-65 score ≥ 3, the ROC curve (depicted in blue) exhibits an area of 0.9694 (standard deviation of 0.0163) with a 95% confidence interval ranging from 0.9368 to 1.9714. Conversely, the ROC curve (displayed in red) for PSI/PORT score ≥ 91, intended for predicting ICU admission, show cases an area of 0.9605 (with a standard deviation of 0.0164) and a 95% confidence interval spanning from 0.9277 to 0.9933.

The ability to predict mortality was almost similar for PSI/PORT score (AUC 0.9196; 95% CI 0.8670-0.9722) and CURB-65 (AUC 0.9214 95% CI 0.8696-0.9732)(Figure 2).

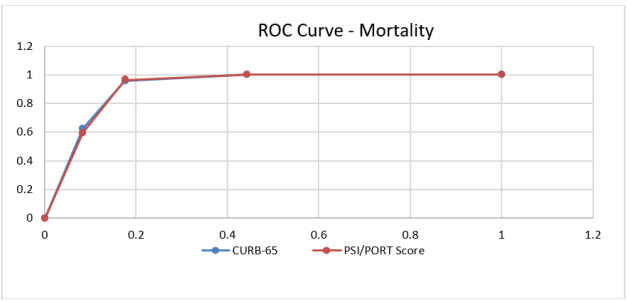

Figure 2: The graph depicts the sensitivity and specificity curves of CURB-65 and PSI/PORT for predicting mortality. Within a ROC curve, the sensitivity is plotted against the specificity across various cut-off points. Each plotted point on the ROC curve represents a sensitivity/specificity pair corresponding to a particular decision threshold. A test demonstrating perfect discrimination, characterized by no overlap between the two distributions, would yield an ROC curve passing through the upper left corner, indicating 100% sensitivity and 100% specificity. Consequently, the closer the ROC curve aligns with this upper left corner, the higher the overall accuracy of the test. For the CURB-65 score ≥ 3, the ROC curve (depicted in blue) exhibits an area of 0.9214 (with a standard deviation of 0.0259) and a 95% confidence interval ranging from 0.8696 to 0.9732. Conversely, the ROC curve (shown in red) for PSI/PORT score ≥ 91, intended for predicting ICU admission, showcases an area of 0.9196 (with a standard deviation of 0.0263) and a 95% confidence interval spanning from 0.8670 to 0.9722.

4. Discussion

Overall, in our study CURB-65 score was found slightly superior in predicting ICU admission amongst patients coming with CAP to our hospital when compared to PSI/PORT score. When predicting mortality in patients with community-acquired pneumonia, CURB-65 and PSI/PORT score appear to have comparable specificity and sensitivity

In a study conducted by Man et al., similar outcomes were observed. They employed ROC curves to evaluate 30-day mortality predictions using three scoring methods: PSI, CRB-65, and CURB-65. The analysis indicated no significant variance in the area under the ROC curves for PSI

(0.728, 95% CI 0.662–0.793), CURB-65 (0.713, 95% CI 0.639–0.788), and CRB-65 (0.654, 95% CI 0.572–0.736). Furthermore, the study found no notable distinctions between PSI, CURB-65, and CRB-65 in forecasting 30-day mortality.[24] On the contrary a similar study was done by Michelle et al.which suggested PSI classes IV/V were significantly better than CURB-65 score ≥ 3 for predicting patients who died within 30 days (94% vs 62%; $p < 0.001$), and those that needed ICU (86% vs 61%; $p = 0.01$).[25] In a similar study published by Madhu S et al, PSI/PORT score was found out to be more sensitive in both predicting ICU admission and death.[26]

5. Conclusion

In conclusion, CURB-65 score was found almost similar in predicting ICU admission amongst patients coming with CAP to our hospital when compared to PSI/PORT score and when predicting mortality in patients with community-acquired pneumonia, CURB-65 and PSI/PORT score appear to have comparable specificity and sensitivity. Considering the simplicity, CURB-65 score could be preferred over PSI/PORT score. However larger studies are required to know the exact Indian scenario.

6. Consent Form

As per international standards or university protocols, the authors have obtained written consent from patients and have diligently preserved these documents.

7. Ethical Approval

In adherence to international or university standards, written ethical approval has been obtained and meticulously preserved by the author(s).

8. Abbreviations

CAP: Community Acquired Pneumonia; CURB-65: Confusion, Uremia, Respiratory rate, BP, Age > 65 years; PSI: Pneumonia Severity Index; PORT: Pneumonia Patient Outcome Research Team; AUC : Area Under the Curve.

9. Source of Funding

None.

10. Conflict of Interest

None.

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