

Research Article

Validity of pneumonia severity index/pneumonia outcome research trial and Curb-65 severity scoring systems in community acquired pneumonia in Indian setting

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Received: 22 January 2016

Revised: 01 March 2016

Accepted: 09 March 2016

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ABSTRACT

Background: The symptoms of CAP begin outside the hospital or within 48 hours of admission into the hospital in patients who has not resided in a health care facility for at least 14 days before the onset of the symptoms. Pneumonia severity index (PSI) and the CURB-65 rule for CAP have been developed to identify the relevant prognostic factors might be useful for early identification of patients at high risk requiring intensive care treatment. This study was conducted to determine prognostic factors associated with mortality in and to test the validity of PSI/PORT (pneumonia outcome research trial) and CURB-65 severity scoring systems in community acquired pneumonia (CAP) in Indian setting.

Methods: Complete detailed clinical history was taken from 150 patients suspected of community acquired pneumonia patients and they were subjected to thorough physical examination, including X rays, ECG blood tests for various parameters. PSI and CURB-65 scores were taken for all the patients.

Results: Maximum no. of patients, i.e.33.33% were in the age group of 60-69. Of 150 patients, 16 died accounting for a mortality rate of 10.7%. This group included 12 (8%) patients who died in hospitals and four (2.67%) who died within 30 days of discharge. All 16 patients (100%) in death group were of PSI risk class \geq IV. Mortality in PSI class I to III was 0% in class IV 14.04% and Class V 34.78%. Mortality in CURB-65 risk class 0 to II was 0%, in risk class III it was 9.52%, 47.82% in Class IV and 50% in Class V.

Conclusions: PSI and CURB-65 have excellent sensitivity for predicting death but low specificity albeit specificity of CURB-65 was better than that of PSI. Because of its simplicity and ease of use, in addition to higher specificity, CURB-65 may be better suited than PSI as a severity scoring system in CAP in developing countries with limited resources.

Keywords: CAP, PSI, CURB-65

INTRODUCTION

Pneumonia is an inflammation and consolidation of the lung tissue due to an infectious agent. Community acquired pneumonia (CAP) refers to pneumonia contracted by the person with little contact with the

healthcare system. The symptoms of CAP begin outside the hospital or within 48 hours of admission into the hospital in a patient who has not resided in a health care facility for at least 14 days before the onset of the symptoms.¹

The cause of pneumonia can be a variety of bacteria, fungi, viruses, parasites causing a group of specific infections each with a different epidemiology, pathogenesis, clinical presentation, and clinical course.²

Community acquired pneumonia (CAP) is a common disorder with an incidence in developing countries of about 20 to 30% compared to an incidence of 3-4% in developed countries. It is estimated that India together with Bangladesh, Indonesia and Nepal account for 40% of global acute respiratory infection mortality of which 90 % are due to pneumonia, mostly bacterial in origin.³ In the United States, CAP is the 6th leading cause of mortality affecting approximately 4 million adults annually, with >600,000 of these requiring hospitalization.⁴ A high mortality rate of 4-21% was observed with CAP patients.⁵⁻⁷

The annual incidence of CAP in those aged over 65 years has been estimated to be between 24 to 44 cases per 1000.⁸ About 15 million children die each year as a consequence of acute respiratory infection, 1/3rd of them from pneumonia. 96% of these occur in developing countries.^{9,10}

The symptoms of CAP can range from mild to highly severe in presentation many times leading to mortality. There are many signs and symptoms which depend on the progression of this infection. The common symptoms may be fever with tachycardia, chills and / or sweats and productive or non productive, mucoid, purulent or blood tinged cough. In case of the involvement of pleura, chest pain may be observed. Upto 20% of the patients may experience gastrointestinal symptoms, such as nausea, vomiting, and/ or diarrhea, fatigue, headache, myalgia, arthralgia.¹¹

It is hoped that the knowledge of relevant prognostic factors might be useful for early identification of patients at high risk requiring intensive care treatment. Prognostic scoring systems, such as pneumonia severity index (PSI) and the British thoracic society rule, which has recently been modified to the CURB-65 rule for CAP have been developed to address these issues.¹²⁻¹⁴ While the PSI scoring system is used to identify low mortality risk patients to CAP along with the comorbidities, while CURB-65 approach is ideal for identifying high mortality risk patients with severe illness due to CAP who might otherwise be overlooked without formal assessment of subtle aberrations in key vital signs.¹⁴

However, the major deficiency of the CURB-65 approach is that it does not generally account for comorbid illness, and thus may not be easily applied in older patients who may still have substantial mortality risk, even if a mild form of CAP destabilizes a chronic, but compensated, disease process. Thus, both tools offer a valuable assessment of patient illness, but from different perspectives, and each is best at identifying patients at opposite ends of the disease severity spectrum.

This study was conducted to determine prognostic factors associated with mortality in and to test the validity of PSI/PORT and CURB-65 severity scoring systems in community acquired pneumonia in Indian setting.

METHODS

This study was conducted in the Department of TB and respiratory Medicine in Mediciti institute of medical sciences, Telangana, India on 150 patients during the period of Two years. 150 patients suspected for community acquired pneumonia were included into the study.

Patients who were known HIV positive, those chronically immunosuppressed and on oral steroid treatment, or those who were hospitalized for the past 14 days or more were excluded from the study.

Table 1: PSI - severity of scoring system.

Patient characteristics	Number of points
Demographic factors	
Age	
Men	Age in years
Women	Age in years-10
Nursing home resident	Age plus ten
Coexisting illnesses (definitions listed below)	
Neoplastic disease	30
Liver disease	20
Congestive heart failure	10
Cerebrovascular disease	10
Renal disease	10
Physical examination findings	
Altered mental status	20
Respiratory rate >30/min	20
Systolic blood pressure <90 mmHg	20
Temperature <35°C (95°F) or >40°C (104°F)	15
Pulse rate >125/min	10
Laboratory and roentgenographic findings	
Arterial pH <7.35	30
Blood urea nitrogen >30 mg/dL (11 mmol/L)	20
Sodium <130 mmol/L	20
Glucose >250 mg/dL (14 mmol/L)	10
Hematocrit <30%	10
Partial pressure of arterial oxygen <60 mmHg	10
Pleural effusion	10

Complete detailed clinical history was taken from all the patients and they were subjected to thorough physical examination. X-rays of posteroanterior and lateral view, electrocardiogram was taken for all the patients apart from arterial blood gas, pH and serum electrolytes estimation. Sputum and blood were collected for gram's stain and cultures. Blood was also collected for complete blood counts, blood urea and creatinine, fasting blood glucose

bilirubin, AST, ALT, ALP, total proteins, serum albumin and LDH levels.

PSI and CURB-65 scores were taken for all the patients according to the (Tables 1, 2, and 3). Other Investigations like Pleural fluid analysis, CT chest, BAL were done depending on the clinical scenario of the patient.

Table 2: Risk class in the pneumonia severity of illness scoring system.

Risk class	Criteria
I	Age <50 years No existing illnesses or vital sign abnormalities
II	<70 points
III	71 – 90 points
IV	91 – 130 points
V	>131 points

The CURB -65 was calculated according to the following Table 3.

Table 3: CURB-65 rule severity of illness scoring system for community-acquired pneumonia.

Confusion	New mental confusion
Urea	>7 mM/L or > 42 mg / dl
Respiratory rate	>30 breaths per minute
Blood pressure	Diastolic BP <60 mmHg or systolic blood pressure <90 mmHg
Age	≥65 years of age
Group 1	0 or 1 of the above -- Likely suitable for treatment at home.
Group 2	2 of the above -- Hospitalization for treatment.
Group 3	3 or more of the above -- Likely requires admission to ICU.

D-Dimers within 24 hours of presentation were done only in those patients who did not have suspicion of pulmonary embolism, thromboembolic disease or DIC in the past, vasculitis or rheumatologic disease, coagulation or bleeding disorder, hematologic or other malignancies, CHF, CKD, or CLD, pregnancy, recent trauma or surgery.

RESULTS

In our study, out of the 150 patients of CAP, 89 (59.33%) were males and 61 (40.67%) females with a male:female ratio of approximately 3:2 (Figure 1).

The mean age was 55.71 years. Maximum no. of patients, 50 (33.33%) were in the age group of 60-69 years followed by 36 (24%) in 70-79 year age group. Only 43 (28.66%) of patients were less than 50 years of age (Table 4).

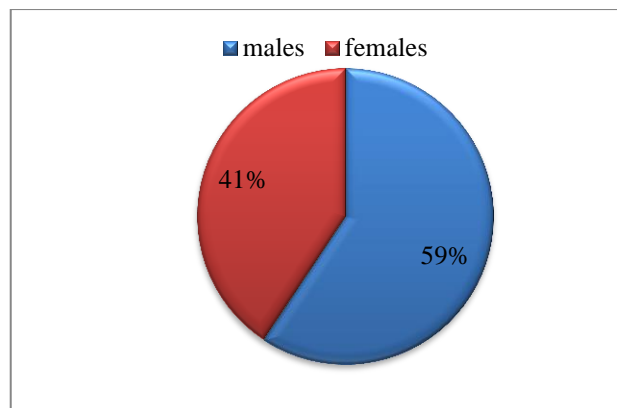


Figure 1: Age wise distribution of patients.

Table 4: Age and sex distribution of patients in different age groups.

Age in years	Gender		Total
	Males	Females	
<40	9 (10.11%)	22 (36.07 %)	31(20.66 %)
40-49	6 (6.74 %)	6 (9.84 %)	12 (8 %)
50-59	9 (10.11 %)	6 (9.84 %)	15 (10 %)
60-69	29 (32.6 %)	21 (34.42 %)	50 (33.33 %)
70-79	30 (33.7 %)	6 (9.84 %)	36 (24 %)
≥80	6 (6.74 %)	0 (0 %)	6 (4 %)
Total	89 (100 %)	61 (100 %)	150 (100 %)

Of 150 patients, 16 died accounting for a mortality rate of 10.7%. This group included 12 (8%) patients who died in hospitals and four (2.67%) who died within 30 days of discharge. Out of 16 patients who died 13 (81.25%) were Males and only three (18.75%) were females. Maximum No. of deaths, 11 (68.75%) occurred in the age group of 70-79 years followed by five (31.25%) in 60-69 years. All patients who died were above 60 years of age.

89 patients had one or more comorbidities. The most common comorbidity was hypertension followed by diabetes mellitus. COPD was present in 9 patients of which 5 were in death group. 89 patients (59.33%) were smokers that included 74 (83.15%) males and 15 (24.60%) females. All 16 patients (100%) who died were smokers. 95 patients (63.33%) had received empiric antibiotics prior to hospitalization and this group included all the 16 patients (100%) who died.

Chest X-Ray revealed unilobar involvement in 131 (87.33%) patients. Radiological extension was found in 8 (5.33%) patients of which 5 belonged to death group and 3 from survivor group. The most common complications among the patients who survived was synpneumonic effusion while among the patients who died, it was acute renal failure (Table 5).

Out of the cultures that were sent, 27 (18%) were positive for bacterial growth. Of them, the most common

organism was *Staphylococcus aureus* in 15 (10%) of the patients (Figure 2).

Table 5: Comparison of various clinical variables and complications in survivor group and death groups.

Clinical feature	Survivor group (n=134)	Death group (n=16)
Smokers	73 (54.5%)	16 (100%)
Cough	119 (88.8%)	16 (100%)
Purulent sputum	101 (75.4%)	15 (93.75%)
Hemoptysis	19 (14.2%)	0 (0%)
Chest pain (pleuritic)	61 (45.5%)	0 (0%)
Confusion	33 (31.3 %)	14 (87.5%)
D-dimer positive**	77 (57.5%)	16 (100%)
Hypertension	46 (34.3%)	8 (50%)
Diabetes mellitus	22 (16.4%)	2 (12.5%)
COPD	4 (3%)	5 (31.3%)
Synpneumonic effusion	43 (32.09 %)	1 (6.25 %)
Abscess	2 (12.5 %)	0 (0 %)
GI bleed	0 (0 %)	2 (12.5 %)
Shock	3 (2.2 %)	0 (0 %)
Pneumothorax	4 (2.67 %)	0 (0 %)
Stroke	3 (2.2 %)	0 (0 %)
Empyema	3 (2.2 %)	0 (0 %)
Collapse lung	3 (2.2 %)	0 (0 %)
CCF	7 (5.2 %)	2 (12.5 %)
ARF	6 (4.5%)	11 (68.75 %)

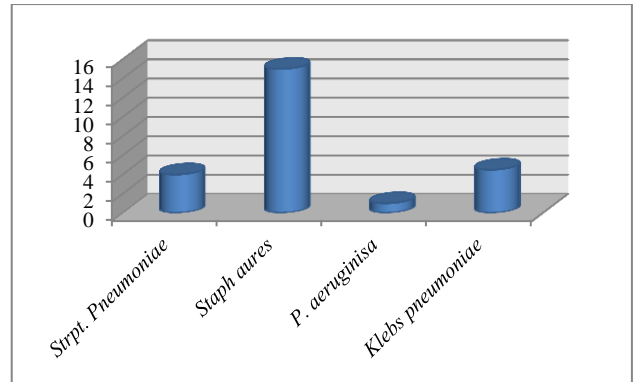


Figure 2: Bacterial etiology of positive cultures.

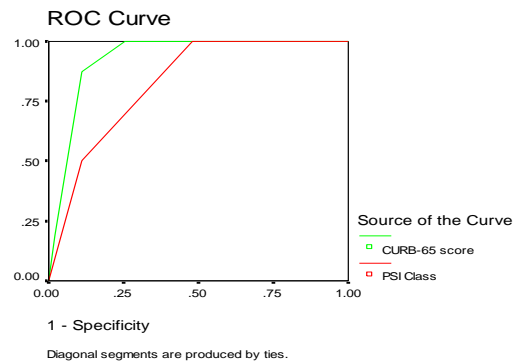


Figure 3: ROC curve for PSI and CURB-65 with death as outcome.

Table 6: No. of patients and outcomes in different PSI risk classes.

	PSI Risk class				
	Class I	Class II	Class III	Class IV	Class V
No. of Patients	25 (16.7 %)	27 (18 %)	18 (12 %)	57 (38 %)	23 (15.33%)
Deaths	0 (0 %)	0 (0 %)	0 (0 %)	8 (14.04 %)	8 (34.78 %)
ICU Adm.	0 (0 %)	0 (0 %)	2 (5 %)	21 (36.84 %)	17 (73.91 %)

Table 7: No. of patients and outcomes for different CURB-65 scores.

	CURB-65 Scores					
	Class 0	Class I	Class II	Class III	Class IV	Class V
No. of Patients	27 (18 %)	31 (20.7%)	42 (28.0 %)	21 (14.0%)	23 (15.3 %)	6 (4.0 %)
Deaths	0 (0%)	0 (0%)	0 (0%)	2 (9.52 %)	11 (47.82 %)	3 (50.0 %)
ICU Adm.	0 (0%)	0 (0%)	5 (11.9 %)	9 (42.86%)	20 (86.96%)	6 (100 %)

All 16 patients (100%) in death group were of PSI risk class \geq IV. Mortality in PSI class I to III was 0% in class IV 14.04% and Class V 34.78% (Table 6).

For CURB-65, number and percentage of patients in different risk classes is given in Table 7. Mortality in risk

class 0 to II was 0%, in risk class III it was 9.52%, 47.82% in class IV and 50% in class V (Table 7).

Area under curve of ROC for PSI with respect to death was 0.825 (Std. Error 0.042). Sensitivity and specificity for PSI risk class $>$ IV to predict death was 100% and 52.23% and PPV and NPV were 20% and 100%

respectively. For CURB-65 area under ROC curve was 0.929 (Std. Error 0.022). Sensitivity and specificity for CURB-65 risk class >III to predict death was 100% and 74.62% while as PPV and NPV were 32% and 100% respectively. While as both risk scoring systems had equal sensitivity to predict death, specificity of CURB-65 was higher than that of PSI. Sensitivity, specificity, PPV and NPV of different severity scoring systems and D-dimers with respect to DEATH are shown in Figure 3.

DISCUSSION

Although CAP is one of the main causes of mortality and considerable morbidity, the prognostic analysis of this condition is rare among the developing countries.¹⁵ Moreover, the commonly employed PORT and CURB-65 pneumonia severity scoring systems have not been validated in developing countries.

In our study, the advanced age was significantly associated with death. Of 16 patients who died, all of them were above 60 years of age. Highest mortality was observed in age group of 70-79 years with 11 patients (67.75%) followed by 5 (31.25%) in 60-69 years. Similar was the case in a study by Lim et al.^{16,17}

In our study all 16 patients (100%) who died were smokers and amongst 134 survivors, 73 (54.5%) were smokers. Smoking was also found to have significant association with need for ICU admission ($p=0.0001$) and prolonged time to defervescence ($p=0.007$). Even though the association of COPD and adverse outcome in CAP is well established as found in study of Restrepo et al, no study till date mentions a direct association between smoking and mortality in CAP.¹⁸

The mortality rate in our study among the patients with community acquired pneumonia was 10.9%. 4 patients died within 30 days from discharge from the hospital and all 4 of them had left the hospital against medical advice.

Qualitative D-Dimer estimation was done in all but 6 patients (total 144 out 150) and a positive value was associated with all adverse outcomes studied viz. death ($p=0.002$), admission to ICU ($p=0.0001$), prolonged time taken to defervescence ($p=0.005$), prolonged duration of antibiotics ($p=0.0001$) and prolonged duration of hospital stay ($p=0.041$). All these associations suggest that D-Dimer positivity connotes a severe pneumonia. Sensitivity, specificity, PPV and NPV of D-Dimer positivity with respect to death was 100%, 42.53%, 17% and 100% respectively. The results are comparable to the results obtained by Querol-Ribelles et al in whose study a positive D-Dimer levels was shown to be useful in predicting mortality, with a very high sensitivity of 97.4% and negative predictive value of 98%.¹⁹

Of all associated comorbidities, only COPD was significantly associated with death ($p=0.0001$) as well as admission to ICU ($p=0.0001$). COPD was present in a

total of 8 patients of which only 4 (3%) were in the survivor group and 5 (31.3%) were in the death group. As in our study, a significantly higher mortality associated with COPD and CAP was reported by Restrepo et al and Rello et al.^{18,20}

The study of Falguera M et al demonstrated association between death from CAP and diabetes mellitus and in the same study diabetes was found to be an independent risk factor for development of pleural effusion.²¹ However the results from our study differed in both these respects in that diabetes mellitus was found to have association neither with death ($p=0.689$), nor with development of effusions.

ARF was significantly associated with death in our study where out of 17 affected with ARF, 11 patients died. Association of mortality from CAP with ARF has been reported in a number of studies such as those of Moine P et al and Díaz et al.^{22,23}

Among the culture positive cases, none of them was associated with fatality. *Staphylococcus aureus* was the most common organism isolated in our study in contrast to Lim et al who reported 48% *Pneumococcus* isolated followed by *Chlamydia pneumonia* (13%), *H. influenzae* (7%), *Mycoplasma pneumoniae* (3%). 23% was reported by Tadashi et al in Japan followed by *H. influenzae* (7.4%).^{24,25}

PSI and CURB-65 scoring was done in all patients in an attempt to validate their significance in predicting severity and death in CAP.

PSI risk class was significantly associated with death ($p=0.0001$), admission to ICU ($p=0.0001$), prolonged duration of antibiotics ($p=0.0001$) and prolonged duration of hospital stay ($p=0.0001$) as was the CURB-65 score with similar rate of significance. It is evident that in both PSI and CURB-65 risk scoring systems, mortality rates and need for admission to ICU increased progressively with increasing scores, which was corroborated by Fine et al and Busing KL et al.^{12,26} Although in our study mortality rates in PSI risk class I to III were lower compared to other two studies (23, 69), mortality rates in classes IV to V were higher. This could be because Busing et al studied only in-hospital mortality while our study death group included patients who died within 30 days after discharge also.

The mortality rates by CURB-65 was similar to the PSI score rates in our study and these were in accordance with those of Capelastegui et al and Ewig et al.^{13,27}

It is evident that in the comparison of PSI, CURB-65 and D-DIMERS with respect to sensitivity, specificity and predictive values that while all the three have good sensitivity and NPV, specificity and PPV are less impressive. These results are comparable to those obtained by Shin Yan Man et al specificity of CURB-65

was found to be better than PSI probably because a major limitation of the PSI is the unbalanced impact of age on the score, resulting in a potential underestimation of severe pneumonia, particularly in younger otherwise healthy individuals.²⁸

CONCLUSION

We found in our study that both PSI and CURB-65 have excellent sensitivity for predicting death but low specificity albeit specificity of CURB-65 was better than that of PSI. Because of its simplicity and ease of use, in addition to higher specificity, CURB-65 may be better suited than PSI as a severity scoring system in CAP in developing countries with limited resources.

One important limiting factor in our study was low etiological yield and hence our conclusions regarding lack of association between death and etiology, has to be guarded.

We hope that by using the knowledge of relevant prognostic factors, as obtained from this study, patients of CAP will be better prognosticated as regards severity of their illness with consequently better triaging of patients, utilisation of resources and appropriate treatment to improve the outcome in this disease. Lastly our study differs in one important aspect from other studies in that we could not demonstrate any association between hypotension and mortality from CAP even though hypotension was strongly associated with need for ICU admission.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Ravindranath M, Raju CH. Validity of pneumonia severity index/pneumonia outcome research trial and Curb-65 severity scoring systems in community acquired pneumonia in Indian setting. *Int J Adv Med* 2016;3:338-44.