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Original Research Article

Comparative study of CURB-65, Pneumonia Severity Index and IDSA/ATS scoring systems in community acquired pneumonia in an Indian tertiary care setting

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ABSTRACT

Background: Few comparative studies regarding prognostic scoring systems for community acquired pneumonia (CAP) are available from Indian context.
Methods: Hospital-based prospective study to test the comparison between confusion, urea, respiratory rate, blood pressure, age over 65 years (CURB-65), Pneumonia severity index (PSI) and infectious diseases society of America/American thoracic society criteria (IDSA/ATS) scoring systems in patients with community acquired pneumonia.
Results: CURB-65 class ≥III, PSI class ≥IV and patients who needed admission to intensive care unit (ICU) based on IDSA/ATS criteria were having sensitivity of 41.7%, 91.7% and 87.5% in predicting ICU admission with a specificity of 89.5%, 59.2% and 73.7% respectively. Their sensitivity in predicting death were 44.4%, 88.9% and 83.3% with a specificity of 87.8%, 54.9% and 68.3% respectively. In both PSI score and IDSA/ATS criteria risk scoring systems, mortality rate, need for ICU admission increased progressively with increasing scores but CURB-65 score did not show this correlation. The PSI class ≥IV was more sensitive in predicting ICU admission than CURB-65 and IDSA/ATS criteria.
Conclusions: PSI was most sensitive in both predicting ICU admission and death whereas CURB-65 is most specific in predicting ICU admission and death. But CURB-65 is least sensitive in both predicting ICU admission and death. Even though IDSA/ATS criteria did not have highest sensitivity and specificity as single criteria it had modest sensitivity and specificity in predicting ICU admission and death.

Keywords: Community acquired pneumonia, CURB-65, IDSA/ATS criteria, Pneumonia severity index

INTRODUCTION

According to recent data from WHO pneumonia is the third leading cause of death in the world and fourth leading cause of death in middle income countries, in spite of advancement of medical science and vast number of good antibiotics which represents a significant burden to country.[1]

Despite being the cause of significant morbidity and mortality, pneumonia is often misdiagnosed, mistreated, and underestimated. Pneumonia is an infection of the pulmonary parenchyma and pneumonia that develops outside the hospital is considered as community acquired Pneumonia.

New radiographic infiltrate in the presence of evidence of infection (fever, purulent sputum, leucocytosis) with onset at least 72 hours after hospital admission is called Nosocomial pneumonia.[2]

Little information is available from India regarding prognostic factors in patients with CAP and moreover only few studies are conducted till date in India, even with extensive laboratory testing and invasive procedures etiology is being achieved from sputum samples is ≤50%.[3]

Prognostic scoring systems for CAP were developed to assess severity of illness and classify patients on basis of mortality risk, as appropriate management requires prompt recognition of seriously ill patients and proper triage for hospital admission and ICU admission is needed.

These scoring systems also provides meaningful information for physicians to discuss prognosis with patient's family. Moreover, only PSI and CURB - 65 have been studied in Indian patients and there is little information regarding comparisons of the three old scoring systems, there is a need for further study to assess the accuracy of these tools in predicting severity and planning therapy.

METHODS

The study was done in tertiary care institute in Karnataka during 2012 to 2014. The study was designated as a Prospective, observational, cohort study, which include 100 cases of CAP selected after fulfilling the inclusion and exclusion criteria.

Inclusion criteria

A. Subjects 18 years or more
B. CAP diagnosed based on.

- Presence of infiltrates on CXR consistent with consolidation and associated with respiratory symptoms
- And (any 2 out of 3).

a. Fever
b. Cough
c. Neutrophilia or elevated Total leucocyte counts.

Exclusion criteria

- Opportunistic pneumonia
- Active pulmonary TB
- Immunosuppressed patients (HIV patients, solid organ transplant, post splenectomy, on steroids or chemotherapy)
- Hospital acquired pneumonia (hospitalized within previous 14 days or developed >72 hours after admission)
- Lung malignancies.

Method of collection of data

A detailed proforma was filled up for each patient, including age, sex, IP number, detailed history and clinical examination was done. Laboratory parameters including complete blood counts, blood glucose, renal function tests, liver function tests, blood gas analysis, HIV ELISA, blood culture, ECG and routine urine examination were done.

- Patient was investigated for chest x-ray, sputum for gram stain, culture and sensitivity pattern and AFB
- BAL, CT thorax, pleural fluid analysis was done only for required cases
- All patients were clinically and radiographically reassessed after 48 hours to look for development of complications or to assess amount of improvement.

All variables were collected and CURB 65 score, PSI score and IDSA/ATS score was calculated for each patient and CLASS was assigned.

Treatment of the patients including the decision for ICU admission, mechanical ventilation and inotropic/ vasopressor support was by the treating physician who was blinded to the prognostic score of the patient. All patients were followed up for following clinical outcomes

- Death (in hospital and post discharge 30 days mortality obtained telephonically)
- ICU admission
- Need for mechanical ventilation
- Hospital discharge without any of above complication.

Statistical analysis

All data were processed and analysed on SPSS software version 16.0 for windows and Microsoft excel. Descriptive statistics i.e., mean and standard deviation for continuous variables and frequency distribution with their percentage for categorical variables were calculated. Sensitivity, specificity, positive predictive value(PPV) and negative predictive value(NPV) were calculated for different CURB 65, PSI and IDSA/ATS grades with qualitative variables(death, ICU admission , mechanical ventilation and hospital discharge) as an outcome. The categorical data were expressed as percentages and were compared using a Chi-square test. P value of less than 0.05 was considered statistically significant.

RESULTS

Patient outcome, demography, risk factors, comorbidities, clinical characteristics (Tables 1 and 2).

Table 1: Outcome of patients (n=100).

Outcome	Number and percentage
Discharge (survived)	82
Deaths	18
ICU admission/with or without ventilator support	24

Table 2: Comparison of various clinical variables in survived and expired patients.

Factor	Survived (82)	Expired (18)	p value
PR	100.5±19.65	105.55±19.78	0.326
SBP	114.09±22.22	106.67±25.89	0.215
DBP	70.98±13.76	69.23±20.84	0.659
SPO_2	92.26±6.94	83.73±14.99	<0.0001
RR	24.99±6.79	31.81±10.18	0.013
BMI	21.19±2.87	22.25±2.24	0.138
TLC	14437.80±8259.49	13722.23±7292.43	0.735
Na levels	134.58±4.99	134.23±5.16	0.789
UREA	50.19±34.08	78.56±56.92	0.006
BUN	23.46±15.93	36.71±26.59	0.006
Albumin	3.54±0.56	3.12±0.45	0.004
AMS	4	6	<0.0001

Present study included 100 cases of CAP, mean age (range) of patients was 54.33±16.87 years (18 to 90). Males were affected more than females almost in ratio of 2:1 in both below and above 65 years. 29% of patients were aged above 65 years. 18% of patients expired during hospital stay.

25 of 100 patients had >1 co-morbid condition. Most common risk factor and comorbidity was smoking and Diabetes mellitus respectively, 2nd most common risk factor was rhinitis (infective/allergic). Least common comorbidity was GERD, Down's syndrome and least common risk factor was home oxygen therapy.

16 pts needed invasive ventilatory support and 2 pts required non-invasive ventilation. 15 pts needed inotropic support. 7 pts had to undergo dialysis secondary to sepsis (5 pts had Acute on CKD and 2 were cases of ESRD).

Out of 18 patients who expired, 17 had Sepsis and MODS, 2 had H1N1, 1 patient died of acute coronary syndrome, 2 patients required prolonged ventilator support and tracheostomy.

Clinical characteristics of survived and expired patients (Table 2) shows the difference of some poor prognostic factors in CAP but only results with saturation, respiratory rate, urea, BUN, serum albumin and Altered mental status (AMS) were statistically significant in predicting death.

On comparison of breathlessness in survived and expired patients it is a bad prognostic symptom, about 16 patients among 18 who died had breathlessness of some grade. As the degree of breathlessness (assessed by ATS Grading) was increasing the rate of mortality is also proportionally increased and statistically the result was significant.

Analysis of scoring systems

Analysis of scoring systems for mortality prediction (Table 3 - 8).

Table 3: Mortality in different PSI classes.

Variable	PSI class					Total
	Class 1	Class 2	Class 3	Class 4	Class 5	
Survived	12	10	23	28	9	82
Expired	1	1	0	5	11	18
Total	13	11	23	33	20	100

Table 4: Sensitivity, specificity, negative and positive predictive values for different PSI classes for predicting death.

PSI class	Sensitivity (%)	Specificity (%)	NPV (%)	PPV (%)	P Value
1	5.5	85.36	80.45	7.6	0.453
2	5.5	87.80	80.89	9.09	0.683
3	-	71.95	76.62	-	0.01
4	27.78	65.86	65.85	15.15	0.602
5	61.12	89.02	91.2	61.12	0.000002

Mortality of CAP was 18% in our study, Table 3 depicts number of patients in different PSI risk classes, most of patients who died were in class ≥4, with class 5(most severe) having highest deaths and Table 4 depicts sensitivity specificity, PPV and NPV of each PSI class, as the severity of pneumonia was increasing sensitivity, specificity of PSI predicting death was improved. But unfortunately, PPV was less except for class 5 which had better PPV compared to other class. NPV was good for all PSI class. On comparison of moderate and high risk CAP with low risk CAP for prediction of death i.e, PSI class ≥4 with other PSI class gave sensitivity - 88.89%, Specificity - 54.88%, PPV - 30.19%, NPV - 95.75% (P Value - 0.00064) in predicting death.

Table 5 depicts the number of patients in different CURB 65 risk classes that large number of patients died were in (moderate risk) class 2 and Table 6 depicts sensitivity specificity, PPV and NPV of each CURB 65 class with low sensitivity and PPV but most of CURB class had good specificity and NPV. On comparison of moderate and high risk CAP with low risk CAP for prediction of death i.e, CURB 65 class ≥3 with other CURB65 class gave us Sensitivity - 44.4%, Specificity - 87.8%, PPV - 44.45%, NPV - 87.8% (P Value - 0.0012).If we compare the sensitivity and specificity of PSI and CURB 65 scores in mortality prediction they look complementary to each other.

Table 5: Mortality in different CURB-65 risk classes.

Variable	CURB - 65 Class				Total
	Low risk	Mod risk	Severe risk	Highest risk	
Survived	45	27	9	1	82
Expired	2	8	4	4	18
Total	47	35	13	5	100

Table 6: Sensitivity, specificity and negative and positive predictive values for different CURB-65 classes for predicting death.

CURB class	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	P Value
1	11.12	45.12	4.2	69.80	0.0006
2	44.45	67.07	22.85	84.62	0.353
3	22.23	89.52	30.77	83.90	0.243
4	22.23	98.48	80.00	85.27	0.0034

Table 7 shows the mortality in both classes of IDSA/ATS score with highest mortality in class which needed ICU admission with sensitivity-83.3%, specificity-68.3%, PPV-36.6%, NPV-94.9% P Value <0.0001 which has modest sensitivity and specificity when compared to other scoring systems.

Table 8 summarizes that PSI has maximum sensitivity and NPV, CURB 65 has maximum specificity and NPV hence both are complementary to each other. While IDSA/ATS has modest sensitivity, specificity and PPV in predicting death in patients with CAP.

Table 7: Mortality in different IDSA/ATS risk classes.

Variables	IDSA/ATS		Total
	ICU Not Needed	ICU Needed	
Survived	56	26	82
Expired	3	15	18
Total	59	41	100

Sensitivity-83.3%; Specificity-68.3%; PPV-36.6%; NPV-94.9%; P Value <0.0001.

Table 8: Sensitivity, specificity, PPV, NPV of all scoring systems in predicting death.

Score	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	P value
PSI (class ≥4)	88.9	54.9	30.19	95.75	0.00064
CURB-65 (class ≥3)	44.4	87.8	44.5	87.8	0.0012
IDSA/ATS	83.3	68.3	36.6	94.9	<0.0001

Analysis of scoring systems for prediction of ICU admission (Table 9 - 14).

In present study 24% of patients with CAP required ICU admission. Table 9 depicts patients of various PSI class who required ICU admission and majority of them belong to class ≥4 we can appreciate that as the severity of CAP increases number of ICU admission has proportionately increased with class 5 having highest sensitivity, specificity and PPV .On comparing moderate and high risk CAP with low risk CAP i.e, PSI class ≥4 with other class requiring ICU admission we got Sensitivity - 91.67%, Specificity - 59.21%, PPV - 41.5%, NPV-82.93% (P Value - 0.00001) in predicting ICU admission.

Table 9: Number of ICU admission in different PSI classes.

Variable	PSI Class					Total
	Class 1	Class 2	Class 3	Class 4	Class 5	
ICU	0	0	2	9	13	24
Ward	13	11	21	24	7	76
Total	13	11	23	33	20	100

Contingency coefficient 0.517; P-Value <0.0001.

Table 10: Sensitivity, specificity, negative and positive predictive values for different PSI classes in predicting ICU admission.

PSI	Sensitivity (%)	Specificity (%)	NPV (%)	PPV (%)	P Value
1	-	82.89	72.41	-	0.034
2	-	85.52	73.03	-	0.061
3	8.3	72.36	71.42	8.6	0.055
4	37.50	68.42	77.61	27.28	0.59
5	54.17	90.78	86.25	65.0	0.000002

Table 11: Number of ICU admissions in different CURB-65 risk classes.

Variable	CURB 65 class				Total
	Low risk	Moderate risk	Severe risk	Highest risk	
ICU	4	10	5	5	24
Ward	43	25	8	0	76
Total	47	35	13	5	100

Contingency coefficient 0.566; P Value <0.0001.

Table 12: Sensitivity, specificity, negative and positive predictive values for different CURB-65 classes for predicting ICU admission.

CURB-65	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	P Value
1	16.67	43.42	8.5	62.26	0.0008
2	41.67	67.10	28.57	78.46	0.432
3	20.83	89.47	38.46	78.16	0.190
4	20.83	100.0	100.0	80.0	0.00004

Table 13: IDSA/ATS scoring system in predicting ICU admission.

Variables	IDSA/ATS		Total
	Admitted in ICU	Not admitted in ICU	
ICU Needed	21	20	41
ICU not needed	3	56	59
Total	24	76	100

Sensitivity-87.5%; Specificity-73.7%; PPV-51.2%; NPV-94.9% (P Value-0.0000001).

Table 11 shows the number of ICU admissions in different CURB 65 class with class 2 having highest number, Table 12 depicts prediction of ICU admission for class 5 is having highest and best specificity and

NPV, on comparing moderate and high risk CAP with low risk CAP i.e, CURB 65 class ≥3 we got Sensitivity - 41.67%, Specificity - 89.5%, PPV - 55.55%, NPV - 82.93% (P Value - 0.00054), even with prediction of ICU admission PSI and CURB 65 were complementary to each other (Table 14). IDSA/ATS Score had Sensitivity-87.5%, specificity-73.7%, PPV-51.2%, NPV-94.9% (P Value-0.0000001) in predicting ICU admission for CAP which had modest sensitivity, specificity and PPV among all three.

Table 14: Sensitivity, specificity, PPV, NPV of all scoring systems in predicting ICU admission.

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	P Value
PSI (class ≥4)	91.7	59.2	41.5	82.9	0.00001
CURB-65 (class≥3)	41.7	89.5	55.55	82.93	0.00054
IDSA/ATS	87.5	73.7	51.2	94.9	0.0000001

DISCUSSION

PSI, CURB 65 are already validated in many Indian and international studies. Our study has made sincere attempt to add more information regarding prognostic factors of CAP, giving special emphasis on PSI, CURB 65 score and IDSA/ATS score in an Indian context which makes it unique by comparing all the three systems. Being one of the most important life threatening illness in most part of India and the world CAP needs a better prognostic index for deciding site of hospital care and proper management.

In a study by Woodhead et al of 301, 871 CAP cases the mortality was 49.4%, there was significant mortality in those admitted to the ICU within 2 days of hospital which increased on delaying the decision of ICU care.[4]

The mortality of CAP in hospitalized patients is 14% but increases to 20% to 50% in patients who require ICU care.[5-7] Our study had in hospital mortality of 18%, which was similar to study by Mohanty S et al which had 13.38%.[8] In study by Bansal S et al mortality was 11% and they were particularly elderly people.[9] In study by DEY et al had mortality of 25.38% which are comparable with our study shows the need of a good prognostic index for Indian setting.[10]

CURB 65 was derived from modified BTS rule by Lim and co-workers.[11] Fine et al introduced the pneumonia severity index (PSI), a product of the pneumonia PORT study of ambulatory and hospitalized patients with CAP.[12] The variables in this study were originated from more than 50,000 patients, the largest study ever done in CAP research. IDSA/ATS criteria refers to the Infectious Diseases Society of America/American thoracic society consensus guidelines on the management of CAP in adults.[13]

Present study included 100 cases of CAP, of which 18% expired during hospital stay, 24% of patients required ICU admission, 16% needed Invasive ventilatory support and 2 pts required non-invasive Ventilation. 15% needed inotropic support. Our study shows that incidence of pneumonia increases with increasing age which was consistent with previous study by Mohanty S et al.[8] Patients in this CAP study had wide range of distribution varying from 18 to 90 in males and 18 to 82 in females, the mean age was 54.33±16.87. These results were almost similar to a study done in Shimla, India by Bansal S et al which was 52.77±18.1 years and a Turkish study by Aydogdu et al which was 68±16 years and also in one more study done in AIIMS, India by DEY et al, which was 50.6 years.[9,10,14]

In present study, the mortality gradually increased as the PSI severity increases but the difference which we noticed is, our study had mortality even in PSI 1 and 2 class which was not there in Shah BA et al and this similar linear progression of mortality was not seen in CURB 65 scoring where we had maximum mortality in CURB 65 class 2 but class 3 and 4 also had significant mortality which was different from Shah BA et al which showed linear increase in mortality even with CURB 65 classes.[15]

In comparison of sensitivity, specificity, NPV and PPV for different PSI classes for predicting death as an outcome we had completely opposite results when compared with results of Shah BA et al we had high specificity and low sensitivity but if we consider class ≥4 as one group and class 3 and below as another group sensitivity increases but specificity will be severely compromised and later result was statistically significant.[15]

In comparison of sensitivity, specificity, NPV and PPV for different CURB 65 classes for predicting death as an outcome we had completely opposite results when compared with results of Shah BA et al and sensitivity was severely compromised to compensate this if we consider class ≥3 as one group and class 2 and below as another group sensitivity increased and it was statistically significant, dividing these groups was consistent with and also previously done in many studies like Shah BA et al and Mohanty S et al.[8,15]

PSI and CURB 65 scores have been extensively validated in many Indian and international studies but they never compared these scores with a newer IDSA/ATS criteria, our study has made an effort of comparing these 3 scores which showed that even though IDSA/ATS criteria did not have highest sensitivity and specificity, as a single criteria it had modest sensitivity and specificity with PPV which is better than other scoring systems in predicting both ICU admission and death making it superior to other 2 scores.

In a study by Mohanty S et al which compared PS-CRUXO80, SMARTCOP and IDSA/ATS (minor criteria ≥3 only) 2007 with commonly used CURB65 score showed that in predicting mortality and ICU admission CURB 65 score was inferior to IDSA/ATS 2007 minor criteria which is consistent with our study, but our study used entire IDSA/ATS score.[8]

A Brazilian study by Alavi-Moghaddam M et al infers that CURB-65 showed a better predictive value in foreseeing both the need for ICU admission and mortality than PSI.[16]

An Egyptian study by Eldaboosy SAM et all showed the ability to predict ICU admission was higher for SIPF score compared to PSI and CURB-65 and says SIPF is useful to predict mortality in CAP.[17] But neither of these studies had compared PSI, CURB 65 with IDSA/ATS Scoring system making our study more unique and our study shows that IDSA/ATS scoring system a better scoring system in Indian health care setting and can be used in Indian health care.

An important limitation of the study was the small number of patients included in the study, there were limited number of ICU beds in our hospital, there was a small possibility that few patients may be admitted in emergency wards due to unavailability of ICU beds.

CONCLUSION

CAP continues to be a common clinical problem specially in elderly people and is one of the common diagnosis in patients admitted in ICU and Emergency settings. Both PSI and CURB 65 are complementary to each other in predicting mortality and ICU admission. PSI was most sensitive in both predicting ICU admission and death whereas, CURB-65 is most specific in predicting ICU admission and death. But CURB-65 is least sensitive in both predicting ICU admission and death.

In a hospital where all laboratory reports are available within short span of time PSI can be used and in a setting where it is difficult to get investigations done in short span of time CURB 65 can be used as most parameters are based on clinical assessment. If patient fits in PSI class of 5 or CURB 65 class of 4 and above any one of criteria can be used as both were highly specific in predicting death and ICU admission.

At tertiary and secondary care centres where all laboratory facilities are available within a few hours PSI and IDSA/ATS scoring system can be used as prognostic index whereas in primary care centres where it is difficult to get investigations done in a short span of time CURB 65 scoring system can be used as most of its parameters are based on clinical assessment.

"Present study shows IDSA/ATS criteria can be used in Indian setting. Even though IDSA/ATS criteria did not have highest sensitivity and specificity, as single criteria it had modest sensitivity and specificity with PPV which is better than other scoring systems in predicting both ICU admission and death."

All scoring systems due to low positive predictive value, more patients may land up in ICU. High negative predictive value has been the most consistent finding among the different studies including ours and suggests that these scores could be more relevant in excluding severe CAP than decide ICU admission.

But if patient falls under any of class 4 and class 5 of CURB 65 and PSI respectively, prediction of ICU admission and death will be significant.

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