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Pneumonia Severity Index In Predicting Outcome In Elderly Patients With Community Acquired Pneumonia At A Tertiary Level Hospital In Mumbai.

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ABSTRACT

Background: Prognostication of patients with community-acquired pneumonia (CAP) is important from clinical, research, and quality-improvement perspectives. The pneumonia severity index (PSI) is a rigorously studied prediction rule for prognosis that objectively stratifies patients into quintiles of risk. The present study aimed to assess whether PSI can predict mortality, need for intensive care and ventilator support. **Methods**: An observational study of fifty patients aged 60 years or higher who were admitted in the general medicine ward of Department of Medicine, Lokmanya Tilak Municipal Medical College and General Hospital, Sion, Mumbai from April 2014 till September 2015 was conducted. A questionnaire with demographic information, clinical signs and symptoms, laboratory and radiographic findings was completed for each patient. Patients were classified according to PSI risk classification and their clinical outcome was noted. **Results:** Mean age of the patients was 66.5± 6.3 years; 68% were males, and 32% were females. The sensitivity, specificity, positive and negative predictive value of PSI risk class IV in predicting ICU admissions was 100%, 55.9%, 40.9% and 100%, respectively. Similarly, the sensitivity and specificity of PSI in predicting death and ventilator support to patient were maximum for PSI class IV. Defervescence time significantly correlated with PSI score (Spearman's rho = 0.563, p value = 0.001). **Conclusion:** PSI was a good predictor of mortality, need of ICU admission and mechanical ventilation. Future studies are needed to support our findings and should further assess the long term outcome in these patients.

Keywords: Community-acquired pneumonia, outcome, sensitivity, PSI

INTRODUCTION

Community-acquired pneumonia (CAP) is an acute symptomatic infection of the lower respiratory tract, which develops outside a hospital or nursing home. CAP is one of the most common life-threatening infections, which results in deaths mostly in the developing countries.[1] In Asia, one million adult deaths per year have been estimated due to CAP.[2] Though the main burden of disease is in children, but CAP is an important cause of mortality in adults as well, especially the elderly and those with chronic diseases. Understanding the prognosis of community-acquired pneumonia (CAP) is important from clinical, research, and quality- improvement perspectives. Reasonably accurate prognostication allows physicians to inform patients about the expected outcomes of their acute illness, and also assists them with their initial treatment decisions.[3] The pneumonia severity index (PSI) is a rigorously studied prediction rule for prognosis that objectively stratifies patients into quintiles of risk for short-term mortality on the basis of 20 demographic and clinical variables routinely available at presentation. This system allows categorization of patients with pneumonia into five strata, with increasing risk for mortality from risk class I to V. However, as evident from the scarce literature, PSI has not been validated in developing countries where population demographics and health-care delivery systems are totally different from the developed world. Therefore, the present study aimed to study the demographic, clinical and survival profile of elderly patients with community acquired pneumonia and to assess whether PSI can predict mortality, need for intensive care and ventilator support.

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MATERIALS AND METHODS

Study Design and sampling

An observational study of fifty patients aged 60 years or higher who were admitted in the general

medicine ward of Department of Medicine, Lokmanya Tilak Municipal Medical College and General Hospital, Sion, Mumbai from April 2014 till September 2015 was conducted. Community acquired pneumonia was defined as acute lower respiratory tract infection acquired within 48 hours of admission, with two or more of the symptoms and signs plus any new opacity on chest radiograph and lack of an alternate diagnosis. Symptoms included for the diagnosis were cough, pleuritic chest pain, shortness of breath, temperature ≥38 deg C and crackles or bronchial breathing on chest auscultation. Patients aged less than 60 years, with PSI risk class I, positive HIV status, having hospital acquired pneumonia and those hospitalized within previous 14 days were excluded from the study. Pneumonia developing 48 hours or more after admission to hospital was considered nosocomial, or hospital acquired.

Data Collection and Data Analysis

Patients satisfying the inclusion criteria were enrolled after written informed consent. Information on patient's demographic details and co morbidities were obtained from hospital records. Clinical history and findings of physical examination was noted. Routine and specific investigations deemed necessary by the treating physician were ordered and the results were noted in a pre-designed semi-structured questionnaire. Chest radiographs were taken of all patients on admission to the hospital. The presence of pleural effusion or old tuberculosis (TB) scar was also documented. Other investigations like pleural fluid analysis, computed tomography (CT) of the chest, endotracheal secretion for staining and culture were done depending upon clinical scenario of the patient. The PSI score was calculated based on the patient variables and patients were classified in different accordingly [Figure 1]. All patients were initially treated empirically with intravenous antibiotics and were changed according to sputum culture report. At the clinical end points (hospital discharge or death) the following parameters were recorded: duration of hospital stay; time taken for defervescence, need for mechanical ventilation, need of admission to ICU, final outcome as death or discharge and condition at 30 days after discharge from the hospital. Patient mortality was defined as in-hospital death or death within 30 days of discharge. Defervescence time was defined as the time taken for resolution of fever, chest pain; respiratory rate more than 24 per minute, arterial oxygen saturation (SaO2) of more than 90% while breathing room air, and ability to perform basic daily activities without support.

Using SPSS software version 15, frequency distribution of demographic and clinical data was described. Chi-square test was done to find associations between clinical outcome of the patients (in terms of mortality) and pleural effusion and sputum positivity. Sensitivity, specificity, positive and negative predictive value were calculated for different PSI classes with qualitative variables like death, ICU admissions, need for mechanical ventilation as an outcome and receiver operating curves (ROC) were drawn. The relationship of quantitative variables with PSI classes was assessed by Spearman's correlation co-efficient. P value of less than 0.05 was taken as statistically significant.

RESULTS

Table 1. Baseline characteristics of the patients included in the study (n=50)

Age distribution	N (%)
Less than 70 years	43 (86%)
71-80 years	5 (16%)
More than 80 years	2 (4%)
Gender distribution	
Males	34 (68%)
Females	16 (32%)
Presenting symptoms	
Cough	45 (90%)
Dyspnea	45 (90%)
Fever	32 (64%)
Pleuritic chest pain	25 (50%)
Altered sensorium	10 (20%)
Gastrointestinal symptoms	5 (10%)
Hemoptysis	4 (8%)
Past medical history/risk factors	
Hypertension	16 (32%)
Diabetes mellitus	14 (28%)
Smoking	9 (18%)
Chronic obstructive lung disease	7 (14%)
Others	8 (16%)

Table 2: Findings of various investigations in the patients.

Abnormal vitals	N (%)
Respiratory rate > 30/minute	17 (34%)
Systolic blood pressure < 90 mm Hg	8 (16%)
Temperature < 35 deg C/>40 deg C	1 (2%)
Pulse rate > 125/minute	3 (6%)
Altered mental status	10 (20%)
Abnormal laboratory investigations	
Arterial pH <7.35	18 (36%)
Blood urea nitrogen > 30mg%	22 (44%)
Serum sodium <130 mmol/L	1 (2%)
Blood glucose > 250 mg%	10 (20%)
Hematocrit <30%	4 (8%)
Total leucocyte count >11,000/cumm	32 (64%)
Partial pressure of oxygen < 60 mm Hg	26 (52%)
Radiography	
Lobar pneumonia	36 (72%)
Bronchopneumonia	6 (12%)
Mixed pattern	8 (16%)

During the study period 50 patients were included in the study. Mean age was 66.5± 6.3 years; 68% were males, and 32% were females [Table 1]. Patients presented with both typical and atypical symptoms. Among the typical respiratory symptoms, cough and dyspnea was present in 90% patients, fever in 64%, pleuritic chest pain in 50% and hemoptysis in 8% patients. Among the atypical symptoms, altered sensorium was present in 22% patients and

gastrointestinal symptoms of anorexia, nausea, vomiting, or diarrhea in 10% patients. Among the predisposing conditions, hypertension was the most common, followed by diabetes mellitus, smoking and chronic obstructive lung disease. Less commonly reported were neurologic diseases, congestive cardiac failure, renal diseases, chronic liver disease, and malignancy. Among the abnormal vitals of the patients, temperature < 35°C or > 40°C was noted in 2% patients, respiratory rate > 30/min in 34%, pulse rate > 125/min in 6% patients and systolic blood pressure < 90 mm Hg was noted in 16%. Leucocytosis defined as total leucocyte count >11,000/cumm was the most common abnormal laboratory parameter noted in 64% patients. Other abnormal laboratory parameters were acidosis, blood urea nitrogen >30 mg/dl, partial pressure of oxygen < 60mmHg or oxygen saturation < 90%, hyponatremia, blood glucose >250 mg/dl and hematocrit < 30% [Table 2]. Lobar pneumonia was the most common radiographical findings in the patients. Bacterial etiology was identified in the sputum of 48% of the elderly patients. Streptococcus pneumonia was the most common organism isolated, followed by Pseudomonas, Acinatobactor, Hemophilus influenza, Mycobacterium. tuberculosis, Enterococcus, Klebsiella pneumonia, Methicillin resistant staphylococcus aureus (MRSA) and human influenza. Pseudomonas, MRSA, Acinatobactor and Enterococcus were exclusively present in cases who were admitted in intensive care unit (ICU). Pleural effusion was present in 10 patients and was not associated with patients' survival [Table 3]. Sputum positivity for bacterial infection was found to be significantly associated with patients' survival (p = 0.011).

Table 3. Association of pleural effusion and sputum positivity with clinical outcome in patients

	Clinical outcome		p value
Pleural effusion	Survived	Death	
Yes	8	2	0.86
No	31	9	
Sputum positivity			
Yes	15	9	0.011
No	24	2	

The sensitivity, specificity, positive and negative predictive value of PSI risk class IV in predicting ICU admissions was 100%, 55.9%, 40.9% and 100%, respectively [Table 4]. Similarly, the sensitivity and specificity of PSI in predicting death and ventilator support to patient were maximum for PSI class IV. The receiver operating curves of PSI in prediction of ICU admission, mortality and ventilatory support are shown in [Figure 2]. PSI was not significantly correlated with duration of hospital stay (Spearman's rho = 0.066, p value = 0.64). However, defervescence time significantly correlated with PSI score (Spearman's rho = 0.563, p value = 0.001).

Table 4. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of PSI in predicting ICU admissions, mortality and ventilator support

Class	Sensitivity (%)	Specificity (%)	Negative predictive value (%)	Positive predictive value (%)
Pneumonia Severity Index class and ICU admissions				
II	100	18.5	100	22.2
III	100	38.9	100	30.9
IV	100	55.9	100	40.9
V	48.7	89.9	80.8	71.8
Pneumonia Severity Index class and death				
II	100	13.5	100	9.1
III	100	29.6	100	12.8
IV	100	46.7	100	16.7
V	32.8	69.8	81.9	28.5
Pneumonia Severity Index class and ventilator support				
II	100	28.2	100	30.3
III	100	55.9	100	48.9
IV	90.5	68.9	100	60.8
V	70.2	82.3	92.5	72.2

Characteristic				Points assigned	
Demographic factor					
Age					
Men				Age (yr)	
Women				Age (yr)-10	
Nursing home resident				+10	
Coexisting illnesses					
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 mm Hg				+20	
Temperature <35°C or >40°C				+15	
Pulse >125/min				+10	
Laboratory and radiographic findings					
Arterial pH <7.35				+30	
Blood urea nitrogen >30 mg/dl (11 mmol/liter)				+20	
Sodium <130 mmol/liter				+20	
Glucose >250 mg/dl (14 mmol/liter)				+10	
Hematocrit <30%				+10	
PaO_2 <60 mm Hg or Oxygen saturation <90%				+10	
Pleural effusion				+10	
Risk	Low	Low	Low	Medium	High
Class	I	II	III	IV	V
Score	<51	51-70	71-90	91-130	>130

Figure 1: Pneumonia Severity Index

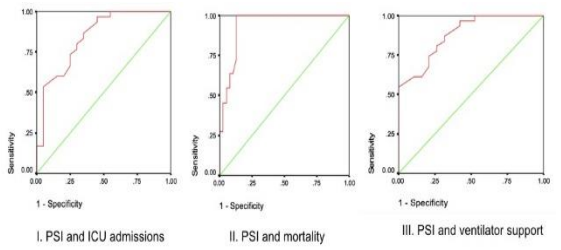

Figure 2: Receiver Operating Curves for prediction of mortality, ICU admission and ventilator prediction using PSI

DISCUSSION

Pneumonia is common in the extremes of age. Elderly patient may present with typical as well as atypical symptoms, though the later ones are more commonly described in elderly than in younger patients.[4] The PSI scoring system has been shown to be a useful tool for assessing the risk of death

from pneumonia in patients.[5] It should be noted, that PSI scoring system was primarily designed to identify patients who had a low mortality risk and this could be treated in the outpatient clinics. Therefore, PSI can be used to predict the probability of dying from pneumonia for populations at risk, but it does not allow for predicting individual cases. Moreover, PSI uses an extensive list of patient variables in predicting patient outcomes and its implementation needs various clinical and para-clinical information. Therefore, its predictive value depends on the environment and the type of patient population in which it is used.

In concordance with previous studies, PSI scoring system in our study also showed high negative predictive value and low positive predictive value in predicting the need for ICU admission.[6] PSI class IV displayed the highest sensitivity and specificity in predicting ICU admissions at 100% and 55.9% respectively. Class V had a higher specificity but the sensitivity halved. For predicting ICU admission in pneumonia patients, other indices such as SMART-COP (systolic blood pressure, multilobar involvement, albumin, respiratory rate, tachycardia, confusion, oxygenation, pH), IDSA/ATS (Infectious Diseases Society of America/American Thoracic Society) and modified ATS have been shown to perform better than PSI, as these indices were originally designed to assess ICU admission rather than the risk of death from pneumonia.[7] Furthermore, Shah et al demonstrated that PSI was more sensitive in predicting ICU admission than CURB-65 (confusion, urea, respiratory rate, blood pressure, age 65).[8] This may be because of the limited applicability of CURB-65 system in the elderly as it does not consider decompensated co-morbidity due to community-acquired pneumonia.[9] Similarly, for predicting mortality among patients in the present study, sensitivity and specificity was highest for PSI class IV. For PSI class V, specificity increased to 69.8% but sensitivity decrease to 32.8% as compared to cut off class IV. Man et al had a similar observation that the sensitivity and specificity were maximum for a PSI class IV for predicting mortality in pneumonia patients (83.9% and 50.2% respectively). For PSI class V, specificity increased to 84.8% but sensitivity decrease to 46%. This findings was supported by the results of study by Shah et al who also found the most favourable sensitivity and specificity for PSI class IV.

There are a few limitations of this study. Firstly, the sample size in our study was small. CAP is more prevalent in elderly population and using a larger sample would have increased the generalizability of the results of this study. Secondly, our study was conducted at a single centre and hence the sample population might not represent the general population.

Thirdly, our hospital is a tertiary care hospital in Mumbai. So the patients coming or being referred to this hospital might be in much more serious condition than other centres, which might have affected our results and conclusions. Lastly, PSI scoring system includes only 20 different demographic and clinical variables. Many other co-morbid conditions and variables were not considered.

CONCLUSION

PSI was a good predictor of mortality, need of ICU admission and mechanical ventilation. It helps in guiding the site of treatment decision of patients with pneumonia. Future studies are needed to support our findings and should further assess the long term outcome in these patients. These studies should also focus on the addition of new biomarkers to existing scoring systems, reassess different severity scores in varied populations, and evaluate the impact of using such scoring systems on hospital's patient load and work mechanics.

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