Original Contribution/Clinical Investigation

Predictors of Outcomes of Community Acquired Pneumonia in Egyptian Older Adults

Hossameldin M. M. Abdelrahman
Amal E. E. Elawam

Ain Shams University, Faculty of Medicine,
Geriatric Department, Cairo, Egypt

Correspondence:
Dr. Hossameldin Mohamed Mohamed Abdelrahman
MD Geriatric Medicine, Lecturer of Geriatric Medicine
Faculty of Medicine, Ain Shams University
Cairo, Egypt.
Email: hossamabdelrahman@hotmail.com

ABSTRACT

Background: Community-acquired pneumonia (CAP) is an acute disease that causes high mortality in the elderly, and is a common cause of medical admission. Poor prognostic factors of CAP include advancing age, multiple co morbid illnesses, poor premorbid functional status and severity of pneumonia.

Objectives: A prospective observational study was conducted to determine the predictors of outcomes of (CAP) in Egyptian older adults.

Subjects and Methods: 170 elderly patients; 72 males and 98 females were recruited from Ain Shams University Hospitals, diagnosed with CAP and required admission to the hospital for treatment. Tools applied were: Comprehensive Geriatric Assessment, Pneumonia Specific Risk Index (PSI), CURB-65, The Charlson Comorbidity Index (CCI), and Barthel Index (BI).

Results: CURB 65 and PSI showed significant differences for all the outcomes (length of stay, ICU admission, ventilation and mortality). Using the logistic regression analysis, BI was found to be a significant predictor for the length of hospital stay (P: .009, odd ratio: 1.043, CI: 1.010 - 1.076) and ICU admission (P: .003, odd ratio: .957, CI: .930 -.985). Regarding the use of ventilator, age, functional condition assessed by BI were significant predictors: (P: .049, odd ratio: .932, CI: .869 - 1.000), (P: .001, odd ratio: .950, CI: .921 - .980) respectively. Regarding mortality, the three variables were significant predictors for mortality; age: (P: .001, odd ratio: 1.110, CI: 1.046 - 1.179), BI: (P: .042, odd ratio: .968, CI: .939 -.999) and CCI: (P: .019, odd ratio: .963, CI: .934 -.994).

Conclusion: PSI, CURB 65, BI and CCI were significant predictors for the outcomes of CAP. So inclusion of these assessment tools in the evaluation of elderly patients suffering from CAP can guide the physicians for the appropriate management and levels of care needed for these critical patients.

Key words: Predictors of outcomes, elderly patients, pneumonia.

Introduction

There are three types of pneumonia in the elderly: community-acquired, nursing home-acquired, and nosocomial pneumonia. Community-acquired pneumonia refers to patients who live in their home; these pneumonia patients present more commonly than nursing home-acquired patients because most elderly live in their own homes. However, nursing home patients are a population deserving of special review as they have different characteristics and tend to be sicker than community pneumonia patients. [1]

Community-acquired pneumonia (CAP) is an acute disease that causes high mortality in the elderly; in-hospital mortality as high as 10% is reported in patients aged 65 and older admitted to the hospital with CAP, and many more die within a month of discharge. Approximately 12% of survivors require placement in a long-term care facility or rehabilitation centre, and when long-term effects of CAP in elderly patients have been investigated, there is a high risk of subsequent mortality for several years. Additionally, pneumonia is among the six-most-frequent discharge diagnoses in patients with severe disability developed in the previous year. Although short-term functional decline has not been well studied in CAP, it has been well documented in nursing-home residents. [2]

Community-acquired pneumonia (CAP) is a common cause of medical admission. There have been many studies on the association between pneumonia and short-term mortality in older patients. Some may use in-hospital mortality as the primary outcome, whereas some may use 30-day mortality. Those in Europe showed a wide range of in-hospital mortality from 6 to 26% due to different inclusion and exclusion criteria. [3]

There are several international guidelines on the prognostic indicators and management of CAP. Poor prognostic factors included advancing age, multiple co morbid illnesses and severity of pneumonia. It was observed that premorbid functional status had a strong bearing on the clinical outcomes of pneumonia. Previous studies agreed that those with better premorbid functional status had a shorter length of stay in hospital and lower short-term and long-term case-fatality rates. Poor functional status was also a risk factor for CAP in immunocompetent old persons. [4], [5]

Old people with lower body weight and recent weight loss had a greater risk of acquiring CAP. It was logical to postulate that poor nutritional status was associated with worse clinical outcomes. [5]

The objective of this study was to prospectively evaluate the effect of the severity of the illness, the multiplicity of comorbidity and functional status on the outcome of elderly patients with CAP. It was hypothesized that these factors would be important factors for the prognosis of CAP in the elderly.

Subjects and Methods

Design of study: Prospective observational study.

Sample:

The study included 170 patients aged 60 or more; 72 males and 98 females diagnosed with CAP and were recruited from Ain Shams University Hospitals over a period of 6 months. The subjects included in the study were diagnosed with CAP and required admission to the hospital for treatment.

Inclusion criteria:

- Patients aged 60 or more.
- Diagnosed with new onset of abnormal infiltrates on chest radiographs (interstitial shadowing, consolidative changes or pleural effusion) and two of three clinical features: fever (temperature ≥ 37.8°C), chest symptoms (shortness of breath, cough and increase in sputum production or purulence) and abnormal chest signs on physical examination (crepitations, bronchial breathing or pleural effusion).

Exclusion criteria:

- Acute-care hospitalization for 72 hours or more within the previous 15 days.
- Nursing-home residence.
- Non-oral feeding (nasogastric tube or percutaneous gastrostomy).
- Final diagnosis other than pneumonia (acute heart failure, pulmonary fibrosis, mesothelioma, bronchiolitis obliterans, pleural effusion, patients with urinary tract infection and patients with pulmonary infiltrates due to pulmonary metastasis).

Clinical data recorded:

1. Informed oral consent.
2. Comprehensive Geriatric Assessment including medical history and physical examination.
3. Laboratory and radiological data were collected from patients' files to evaluate the severity of pneumonia and to confirm their co morbidities.

All cases were treated with the same plan of management according to the British Thoracic Society Guidelines for the management of community acquired pneumonia in adults: 2009 update [6]

Analyses:

From these data, four indices were calculated for studying each patient in a complete and standardized way.

1. A validated Pneumonia Specific Risk Index (PSI):

This index assigns a score based on 20 items that include demographic factors, coexisting illnesses, physical examination findings, and laboratory and radiographic findings. Elderly patients are classified into four risk classes; Class I (no predictor for mortality) was not used in this analysis, outpatient care is recommended for Class II patients (< 71 points), brief inpatient observation for patients in Class III (71-90 points), and traditional inpatient care for patients in Classes IV (91-130 points) and V (>130 points). [7]

2. CURB-65:

Is a modification of the original British Thoracic Society (BTS) rule and is designed to predict mortality in hospitalized patients. [8]

The score is an acronym for each of the risk factors measured. Each risk factor scores one point, for a maximum score of 5

• Confusion of new onset
• Urea greater than 7 mmol/l (19 mg/dL)
• Respiratory rate of 30 breaths per minute or greater
• Blood pressure less than 90 mmHg systolic or diastolic blood pressure 60 mmHg or less
• Age 65 or older

The risk of death at 30 days increases as the score increases:

0-0.7%	1-3.2%
2-13.0%	3-17.0%
4-41.5%	5-57.0%

The CURB-65 is used as a means of deciding the action that is needed to be taken for that patient.
• 0-1: Treat as an outpatient.
• 2-3: Consider a short stay in hospital or watch very closely as an outpatient.
• 4-5: Requires hospitalization with consideration as to whether they need to be in the intensive care unit.

3. The Charlson Comorbidity Index (CCI): [9]
The CCI predicts the ten-year mortality for a patient who may have a range of comorbid conditions, such as heart disease, AIDS, or cancer (a total of 22 conditions). Each condition is assigned a score of 1, 2, 3, or 6, depending on the risk of dying associated with each one. Scores are summed to provide a total score to predict mortality. Clinical conditions and associated scores are as follows:

• **1 each:** Myocardial infarct, congestive heart failure, peripheral vascular disease, dementia, cerebrovascular disease, chronic lung disease, connective tissue disease, ulcer, chronic liver disease, diabetes.
• **2 each:** Hemiplegia, moderate or severe kidney disease, diabetes with end organ damage, tumor, leukemia, lymphoma.
• **3 each:** Moderate or severe liver disease.
• **6 each:** Malignant tumor, metastasis, AIDS.

It scores from 1 to 6 for each of 18 specific medical diagnoses, representing increasing levels of illness. It has been shown to correlate with long-term survival after acute medical illness.

The CCI can be used for prediction of 1-year survival, prediction of 10-year survival and estimation of relative risk of death.

In this study we used the predicted 1-year survival rate that was calculated for all subjects through these links:
http://tools.farmacologiaclinica.info/index.php?sid=37148&lang=en&loadsecurity=88
http://tools.farmacologiaclinica.info/index.php

4. Barthel Index (BI): [10]
Dependence in Activities of Daily Living (ADLs) 15 days before the onset of illness was scored using the BI which measures the capacity to perform 10 ADLs and obtains a quantitative estimation of the patient's level of dependence, scoring from 0 (totally dependent) to 100 (totally independent). This index has been proposed as the standard for clinical and research purposes.

Clinical outcomes:
The patients were followed-up throughout their hospital stay; several clinical outcomes were recorded including:
• Improvement and discharge.
• Length of stay in hospital.
• Admission to intensive care unit.
• Use of mechanical ventilation.
• In-hospital mortality.

Statistical Analysis:
All data were entered into the 21st version of SPSS (Statistical Package of Social Science), and analyzed using frequency and descriptive statistics to analyze the study population. Frequency, percentage for all qualitative variables and description of quantitative variables in the form of mean (M) and standard deviation (SD) were performed. Comparison of qualitative variables was done using Chi-square test; it is a test that determines the extent that a single observed series of proportions differs from a theoretical or expected distribution of proportions, or the extent that two or more series proportions or frequencies differ from one another based on the chi-square distribution. Multivariate logistic regression analyses were used to adjust the influence of the analyzed indices on outcomes. The regression analysis included an examination of co-linearity by using variance inflation factor. [11] Logistic regression analysis was performed using the conditional forward elimination procedure. Tests were two-tailed, and statistical significance was determined at the 5% level.

Results

The study was conducted on 170 older patients. Table 1 shows the demographic and the clinical characteristics of the participants: The mean age of the patients was 68.08 ± 5.8 (range: 60 - 88), 72 (42.4%) were males and 98 (57.6 %) were females; the minimum for CCI that predicts 1-year survival rate was 11% and maximum was 92%, the minimum for BI was 10/100 and maximum was 85/100; (mean 53.6, ±16.9), the mean duration of stay in hospital was 6.3 ± 3.2, (range: 1 - 18 days), 131 patients (77.1%) were CURB 65 II - III, while 39 patients (22.9%) were CURB 65 IV - V. We found that 35 patients (20.6%) were PSI II, 83 patients (48.8%) were PSI III, 33 patients (19.4%) were PSI IV and 19 patients (11.2%) were PSI V. 71 patients (41.8%) were admitted in ICU, 62 patients (36.5%) were ventilated and 50 patients (29.4%) died. Table 2 shows that regarding sex, there was no significant difference between males and females in relation to the outcomes except for mortality where sex was a significant factor as mortality among females was 35 and males 15 (P: 0.035). While both indices that were used to determine the severity of pneumonia (CURB 65 and PSI) showed significant differences for all the outcomes (length of stay, ICU admission, ventilation and mortality). Table 3 shows the logistic regression analysis and the patients' variables used to predict the outcomes were; age, functional condition assessed by BI and the severity of comorbidities assessed by CCI. The table reveals that BI was a significant predictor for the length of hospital stay (P: .009, odd ratio: 1.043, CI: 1.010 - 1.076) and ICU admission (P: .003, odd ratio: .957, CI: .930 -.985). Regarding the use of ventilator, age, functional condition assessed by BI were significant predictors: (P: .049, odd ratio: .932, CI: .869 - 1.000), (P: .001, odd ratio: .950, CI: .921 - .980) respectively, Regarding mortality, the three variables

were significant predictors for mortality; age: (P: .001, odd ratio: 1.110, CI: 1.046 - 1.179), BI: (P: .042, odd ratio: .968, CI: .939 -.999) and CCI: (P: .019, odd ratio: .963, CI: .934 -.994).

Table 1: Demography and characteristics of the study sample:

Sample characteristics:	*Mini.*	*Max.*	*Mean*	*SD*
Age:	60	88	68.08	± 5.8
CCI	11%	92%	59.4	± 17.8
Barthel Index:	10	85	53.9	± 16.9
Duration of stay (days):	1	18	6.3	± 3.2
Sample characteristics	*Number of patients (Total 170)*		*Percentage (Total 100%)*	
Sex :	Males:	72	42.4%	
	Females:	98	57.6 %	
CURB 65	II – III:	131	77.1 %	
	IV – V:	39	22.9 %	
PSI risk class	II:	35	20.6 %	
	III:	83	48.8 %	
	IV:	33	19.4 %	
	V:	19	11.2 %	
Length of stay	1 – 3 days:	27	15.9 %	
	4 – 7 days:	89	52.4 %	
	8 ≥ days :	54	31.8 %	
Ventilator	Ventilated:	62	36.5 %	
	Not ventilated:	108	63.5 %	
ICU	Admitted:	71	41.8 %	
	Not admitted:	99	58.2 %	
Mortality	Died:	50	29.4%	
	Improved:	120	70.6 %	
Total		85	100%	

Table 2: Predictors of outcomes: analysis of patients' qualitative variables:

Outcomes:	Patients' variables	Sex		CURB65		PSI risk class			
		Male	Female	II – III	IV – V	II	III	IV	V
		N = 72	98	N = 131	39	N=35	83	33	19
Length of stay: 1 – 3 days:		12	15	24	3	14	8	3	2
4 – 7 days:		40	49	78	11	16	55	11	7
8 ≥ days :		20	34	29	25	5	20	19	10
		X^2: 0.91	P: 0.63	X^2: 24.4	P: 0.000	X^2: 37.1		P: 0.000	
ICU admission:									
Admitted:		30	41	40	31	9	20	25	17
Not admitted		42	57	91	8	26	63	8	2
		X^2: 0.00	P: 0.89	X^2: 29.6	P: 0.000	X^2: 47.8		P: 0.000	
Ventilation:									
Ventilated:		27	35	31	31	8	16	24	14
Not ventilated:		45	63	100	8	27	67	9	5
		X^2: 0.05	P: 0.81	X^2: 40.4	P: 0.000	X^2: 43.4		P: 0.000	
Mortality									
Improved:		57	63	100	20	28	67	18	7
Died:		15	35	31	19	7	16	15	12
		X^2: 4.4	P: 0.035	X^2: 9.08	P: .003	X^2: 20.1		P: 0.000	

Table 3: Predictors of outcomes: analysis of patients' quantitative variables: Results of the Logistic Regression Analyses

Outcomes	Predictors	B	Wald Statistics	Std Error	P– value	Odds Ratio	95% Confidence Interval
Length of stay	Age	.046	1.835	.034	.175	1.047	.980 - 1.119
	Barthel I	.042	6.904	.016	.009	1.043	1.010 - 1.076
	CCI	-.001-	.004	.015	.948	.999	.970 - 1.029
ICU admission	Age	-.002-	.004	.033	.949	.998	.935 - 1.065
	Barthel I	-.044-	8.936	.015	.003	.957	.930 - .985
	CCI	-.018-	1.592	.014	.207	.982	.956 - 1.010
Ventilation	Age	-.070-	3.882	.036	.049	.932	.869 - 1.000
	Barthel I	-.051-	10.777	.016	.001	.950	.921 - .980
	CCI	-.040-	2.213	.031	.121	1.007	.978 - 1.018
Mortality	Age	.104	11.671	.031	.001	1.110	1.046 - 1.179
	Barthel I	-.032-	4.141	.016	.042	.968	.939 - .999
	CCI	-.037-	5.459	.016	.019	.963	.934 - .994

Discussion

Our result showed that the mortality rate among the participants was 29.4% and that advanced age was a significant predictor for the use of ventilator and mortality and female gender was a significant predictor for mortality only while high scores in both indices that were used to determine the severity of pneumonia (CURB 65 and PSI) were predictors for all the outcomes (length of stay, ICU admission, ventilation and mortality). Also functional impairment was a predictor for all the outcomes (length of stay, ICU admission, ventilation and mortality), while severity of co morbidities was a predictor for mortality only.

This was agreed with by El-Solh et al., 2001 [12] who reported that the mortality rate for older patients in hospital-based studies of community-acquired pneumonia (CAP) were as high as 30%.

Also Kaplan et al., 2002 [13] who studied 623,718 hospital admissions for community-acquired pneumonia found that the overall mortality was 66,045 (10.6%) and added that mortality had doubled with age from 7.8% in those aged 65-69 years to 15.4% in those aged 90 and older.

The elevated rate of mortality among elderly patients with CAP can be explained on a physiological basis as the maximum function of the respiratory system is reached at approximately the age of 20-25 years. Thereafter, ageing is associated with a progressive decrease in lung performance; however, unless affected by disease, the respiratory system remains capable of maintaining adequate gas exchange during the entire life span. Physiological changes associated with ageing have important consequences on the functional reserve of older people, and their ability to cope with the decrease in lung compliance and increase in airway resistance associated with lower-respiratory-tract infection (LRTI). Lower sensitivity of respiratory centres to hypoxia or hypercapnia in older patients results in a diminished ventilatory response in cases of acute disease such as heart failure, infection, or aggravated airway obstruction, and thus delays important clinical symptoms and signs such as dyspnoea and tachypnoea, which are important for diagnosis of pneumonia and appreciation of the severity of the associated respiratory impairment. [14]

Regarding the gender it was found that female gender was a significant predictor for mortality. While this was disagreed with Hon Ming et al., 2011 [15], yet the higher number of females than males in our study can explain this finding.

Our study revealed that the severity of pneumonia assessed by CURB 65 and PSI showed significant differences for all the outcomes (length of stay, ICU admission, ventilation and mortality).

This was supported by Hon Ming et al., 2011 [15] who studied 488 older patients aged 65 or above; mean age was 81.0 years (±7.9); they were admitted for community-acquired pneumonia. They found that CURB score and co morbidities were the

most powerful predictive factors of mortality of pneumonia.

Also Fine et al., 1997 [16] stated that the PSI was a validated prediction rule for prognosis that identified patients with pneumonia at low risk for 30-day mortality and other adverse medical outcomes. They added that the PSI was a good prognostic score for CAP in adults.

According to Lim et al., 2003 [17] there were two clinical prediction rules often used to determine the prognosis; PSI and the CURB-65. They stated that patients who were assessed to have moderate and high risks of death were admitted to the general ward and the intensive care unit (ICU), respectively, therefore such prediction rules assisted in the appropriate utilisation of limited hospital and ICU resources.

In the current study we found that functional impairment was a predictor for all the outcomes, and that the severity of co morbidities was a significant predictor for mortality.
This was agreed with Kaplan et al., 2002 [13] who studied 623,718 hospital admissions for community-acquired pneumonia; they found that mortality was higher in those with an underlying illness defined by the Charlson-Deyo comorbidity index (11.9% versus 7.6%, $P < 0.006$) using a univariate analysis.

Also regarding functional status, Mody et al., 2006 [18] agreed that those with better premorbid functional status had a shorter length of stay in hospital and also Jackson et al., 2009 [19] found that poor functional status was a risk factor for CAP in immunocompetent old persons.

And Torres et al., 2004 [20] looked at the importance of functional assessment in determining the outcome of CAP. Although they conducted a small study of 99 patients aged 65 or older who had community-acquired pneumonia, it showed that functional status (using the BI) was an independent predictor for short- and long-term mortality.

Also El-Solh et al., 2001 [21] conducted studies used ADL in the construction of a classification tree model for predicting outcome of older patients with CAP requiring mechanical ventilation. These studies suggest the importance of ADL ability in predicting CAP outcome in other settings. Of the analyzed indices, the only independent predictor for short-term mortality was the BI. They found that functional status measures had been shown to be important predictors of hospital outcomes, and ADL dependence had repeatedly appeared as an important predictor in nursing home pneumonia studies.

Such information can be used to assess the severity of pneumonia, particularly on presentation and to be used to guide treatment and the level of care, as well as allow predictions about prognosis. In the elderly, decisions regarding the extent of investigations, treatment (ie, intravenous versus oral antibiotics), and whether intensive care management is appropriate, need to be considered from the outset.

Implementation of these tools for CAP patient's assessment leads to improved ability to predict outcomes in elderly people with CAP, helping clinicians with decisions such as whether to admit to the hospital or to the ICU, and in-hospital interventions for diminishing functional decline.

Conclusion

PSI, CURB 65, BI and CCI were significant predictors for the outcomes of CAP. So evaluation of the severity of pneumonia, functional status, and co morbidity of the elderly patients suffering from CAP using these tools can guide the physicians about the appropriate management and levels of care needed for these critical patients, accordingly. If patients are identified early as being at high risk for complications, then they can receive appropriate treatment in a timely manner, such as hospitalization, ICU admission or ventilator support if necessary.

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