International Journal of Multiphysics
Volume 18, No. 3, 2024
ISSN: 1750-9548

Severity Assessment of Patients Having Community-Acquired Pneumonia by Using CURB-65 Scoring System.

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Abstract

Globally, pneumonia is the most common infectious cause of death, and the second leading cause of life years lost. The CURB-65 score helps in classifying patients having community-acquired pneumonia (CAP) according to the mortality risk and their management. We aimed to assess the severity of patients having CAP by using CURB 65 scoring system. This was a prospective observational, hospital-based study included 102 patients with CAP admitted to Atbara teaching hospital, Sudan. We collected sociodemographic data, co morbidities, presenting symptoms, clinical, laboratory and imaging findings and followed the patients till reach their outcomes. Most of participants were males 62 (60.8%) and belonged to age group more than 55 years in 57 (59.9%). Hypertension (HTN) and diabetes mellites (DM) were the most common co-morbidities 23 (22.5%) and 19 (18.6%) respectively. Seventeen patients (16.7%) were managed as outpatients and had CURB score 0-1. Whereas, 70 (68.6%) of them managed at medicine wards and 15 (14.7%) of them were admitted to intensive care unit (ICU). Regarding patients' outcomes, 14 (13.7%) of participants died in which 1 (2.9%) of low-risk group, 3 (10%) of intermediate risk group and 10 (27%) of high-risk group. ***Conclusion:*** CURB 65 scoring system is a quick and easy tool and it could be effective categorizing system used in a crowded emergency departments to identify the low-risk patients who could benefit from outpatient management.

Keywords: Categorizing System; Community-Acquired Pneumonia; CURB-65, Severity Assessment; Specialized Hospital.

Introduction

Community-acquired pneumonia (CAP) is commonly defined as an acute infection of the pulmonary parenchyma that is associated with symptoms and signs of acute infection accompanied by the presence of an acute infiltrate on the chest x-ray in a patient who has not resided in a healthcare facility in the previous 14 days [1]. CAP is one of the most common infectious diseases and is an important cause of mortality and morbidity worldwide. CAP is usually acquired via inhalation or aspiration of a pathogenic organism [2]. In high-income countries, increasing age is clearly the dominant risk factor for CAP. In the United States, overall incidence in adults is around 2.5 per 1000 person years, rising to 6.3 and 16.4 per 1000 person years in adults aged 65–79 and 80 years or older, respectively [3]. In low-income settings, population-level pneumonia incidence data are sparse, but the major burden of disease is highlighted by hospital registry data in which pneumonia is amongst the most common reasons for adult hospitalization [4, 5]. In a prospective surveillance study of adults in Central Vietnam, the incidence of all cause of CAP was estimated at 0.81 per 1000 person years, rising to 6.95 per 1000 person years in those aged 75 or older [6]. In sub-Saharan Africa, the incidence of CAP is dominated by the effect of human immunocompromised virus (HIV) which, if untreated, is associated with a 17- to 35-fold increase in pneumococcal pneumonia [7, 8]. In a community surveillance study in rural Kenya, the incidence of pneumococcal acute respiratory infection (defined as a respiratory symptom with fever, hypoxia 2 or hospitalization) was estimated at 5 and 67 cases per 1000 person years in HIV negative and positive individuals, respectively [9]. Globally, pneumonia is the most common infectious cause of death, the fourth most common cause of death overall and the second leading cause of life years lost [10]. In 2015, the Global Burden of Disease Study estimated that lower respiratory tract infection (LRTI) caused 2 million adult deaths and an estimated 37 million years of loss life [11].

In this study, we aimed to assess the severity of patients having CAP by using CURB-65 scoring system and its usefulness in managing CAP patients.

Methods

This prospective observational, hospital-based study was conducted in Atbara Teaching Hospital, Sudan. This hospital is considered a specialized hospital serving rural and urban patients. We performed a total coverage as a sampling technique to include all patients admitted or presented to the hospital during the study period which extended from October 2021 to January 2022. We targeted all patients seen in the emergency and medical outpatients with clinical and radiological diagnoses of CAP within the study period. The inclusion criteria comprised all adult patients with two or more CAP symptoms and infiltrates on the chest x-ray and who voluntarily consented to participate in the study [12]. Whereas, the exclusion criteria comprised any patients admitted to the hospital in the previous 14 days, patients whose symptoms developed 48 hours after hospital admission, patients with tuberculosis or had a previous chest x-ray which may conflict with a diagnosis of CAP and any patient who was unwilling to participate. According to the mentioned criteria, the sample size reached 102 patients who were eligible to be recruited in the study. We collected patients' data by using a standard questionnaire that include age, gender, presence of co-morbidity, symptoms of CAP, and physical signs (pulse, axillary temperature, respiratory rate, and blood pressure). We collected blood samples from the patients by using a standard methods of blood sampling and according to the hospital protocol [13]. Then, we sent the specimens promptly to the laboratory to investigate full blood count, erythrocyte sedimentation rate, electrolytes, and urea. After we assessed the patients and taking the blood samples, we assessed all patients for mortality risk by using CURB-65 score. We gave one point for each of the following: C = confusion (defined as new disorientation in time, place or person), U = serum urea $\geq$7.0 mmol/L ($\geq$ 42 mg/dl), R = respiratory rate $\geq$30 cycles/min, B = systolic blood pressure (BP) < 90 mmHg systolic or $\leq$ 60 mmHg diastolic, and 65 = age $\geq$ 65 years. Each subject scored a minimum of score of 0 and a maximum of 5. Scores were classified for mortality associated with CAP as 0–1 = low-risk, 2 = intermediate-risk, and 3−5 high-risk. The patients then were placed on antibiotics according to British Thoracic Society (BTS) care guidelines [14]. We followed all patients either who managed at home or in the outpatient clinic, then we documented 30-day outcome for every patient. We monitored and followed every patient who admitted to the ward and transferred to ICU whenever needed. Factors which predict ICU transfer included a high CURB-65 score (3-5), cyanosis, hypothermia or fever not subsiding with treatment, and persistent hypotension. During the follow-up visits, we re-examined every patient and performed the required investigations such as serum urea, chest x-ray, sputum culture, and full blood count accordingly.

Statistical analysis: Data entered, cleaned, and analyzed using SPSS version 25 (IBM 2020. Corporation, Armonk, NY, USA). We conducted descriptive statistics in terms of frequency tables with percentages. We measured means and standard deviations for quantitative data. Severity was assessed using the CURB-65 scoring system. The primary interest was the number of admissions and outpatients depending on the CURB-65 score. We determined the outcomes of interest as 30-day mortality and the need for ICU admission. Event rates were based on the first episode of CAP and did not include multiple events per person. We have applied Chi-squared and Fisher's exact statistical tests and reported the Odds ratio (OR) with p-values. Results were considered statistically significant for a two-sided p-value $\leq$ 0.05.

Ethical considerations: We obtained the ethical clearance and approval to conduct this study from Sudan Medical Specialization Board Ethical Committee and EDC. Also, we obtained a permission from the administration of the hospital to conduct this study. The confidentiality issues were intentionally considered. We obtained a written informed consents from the patients or from their care taker (if they could not).

Results

We recruited 102 patients. The majority of the participants were males 62 (60.8%), and nearly one-third of the participants aged between 66-75 years, while 14.7% of them aged between 15-25 years. Nearly half of the participants were illiterates and only 6 (5.9%) had an educational level of university or above. Moreover, nearly third-fourth of them had a middle socioeconomic status. We noticed that 14 (13.7%) of them were smoker (Table 1).

Table 1: The sociodemographic features and smoking habit of the participants (N=102).

Character		Number (%)
Gender	Male	62 (60.8%)
	Female	40 (39.2%)
Age group	15-25 year	15 (14.7%)
	26-35 year	8 (7.8%)
	36-45year	12 (11.8%)
	46-55year	10 (9.8%)
	56-65year	13 (12.7%)
	66-75year	33 (32.4%)
	76-85year	11 (10.8%)
Educational level	Illiterate	43 (42.2%)
	Primary	35 (34.3%)
	Secondary	18 (17.6%)
	University or above	6 (5.9%)
Socioeconomic status	Low	26 (25.5%)
	Middle	73 (71.6%)
	High	3 (2.9%)
Smoking	Yes	14 (13.7%)
	No	88 (86.3%)

We observed that more than nighty percent of the participants had a productive cough, nearly nighty percent of them had fever [15]. Other symptoms such as dry cough, abdominal pain, and drowsiness were reported by 4% of them [16]. We observed that HTN and DM were the most common co-morbidities 23 (22.5%) and 19 (18.6%) respectively (Table 2).

Table (2): Symptoms of CAP and co-morbidities among the participants (N=102).

Symptoms		Number (%)
Fever	Yes	91 (89.2%)
	No	44 (43.1%)
Productive cough	Yes	96 (94.1%)
	No	6 (5.9%)
Shortness of breathing	Yes	57 (55.9%)
	No	45 (44.1%)
Chest pain	Yes	43 (42.2%)
	No	59 (57.8%)
Other symptoms	Dry cough	1 (1.0%)
	Abdominal pain	2 (2.0%)
	Drowsiness	1 (1.0%)

Co-morbidities	Diabetes mellitus	19 (18.6%)
	Hypertension	23 (22.5%)
	Asthma	8 (7.8%)
	CVA	9 (8.8%)
	CKD	4 (3.9%)
	IHD	4 (3.9%)
	HIV	3 (2.9%)
	PUD	2 (2%)
	Thyroid diseases	3 (2.9%)

Regarding the association between distribution of participants according to their CURB-65 score category and place of management, we found that the proportion of cases admitted was increased significantly as the CURB-65 score increased; 35 (34.3%) of patients were low-risk (CURB-65 score 0–1), 30 (29.4%) were intermediate-risk (CURB-65 score 2), and 37(36.3%) were high- risk (CURB-65 score 3–5) (Table 3).

Table 3: The relationship between place of management and CURB-65 Score category (N=102).

CURB-65 Risk class	Place of management		Total	P value
	In patient	Out-patient		
Low-risk (score 0-1)	18 (21.2%)	17 (100%)	35 (34.3%)	0.001
Intermediate-risk (score 2)	30 (35.3%)	0 (0.0%)	30 (29.4%)	
High-risk (Score 3-5)	37 (43.5%)	0 (0.0%)	37 (36.3%)	
Total	85 (%)	17 (%)	102 (100%)	

In regards to the outcome of the participants, we found that 14 patients were died at the end of the study, while 88 of them were alive (nearly seventy percent of them were hospitalized, treated and discharged in a good condition, while the 16.7% were treated at home successfully). As the CURB-65 score increased, there was a significant increase in the percentage of deaths [17]. The findings show that death was significantly higher in the high-risk group when the patients were divided into low, intermediate, and high-risk categories. Chi-square test was performed to determine the association of the place of treatment and outcome (including 30 days mortality) and the place of treatment as (outpatient and inpatient) with the CURB scores, we found that the result was statistically significant (p=0.001, 0.009 and 0.001) respectively. When the age-specific case fatality rate was computed, those aged 76-85 years had the greatest rate (36.4% percent). Patients aged 36-75 years had 14.7% mortality, while those aged 15-35 had zero percent mortality. Co-morbidities were present in nearly two-thirds of the patients. Those with co-morbidities had 15.3 % 30-day mortality rate, compared to only 11.6 % for those without comorbidity (Table 4).

Table 4: The relationship between outcome (thirty- day mortality) and CURB-65 score category, age, and co-morbidity(N=102).

Character		Outcome		Total	P value
		A live (n=88)	Died (30-day mortality) (n=14)		
CURB-65 Risk class	Low-risk (score 0-1)	34 (38.6%)	1 (7.1%)	35 (34.3%)	0.009
	Intermediate-risk (score 2)	27 (30.7%)	3 (21.4%)	30 (29.4%)	
	High-risk (Score 3-5)	27 (30.7%)	10 (71.4%)	37 (36.3%)	
	15-25	15 (17%)	0 (0%)	15 (14.7%)	0.177

Age group (years)	26-35	8 (9.1%)	0 (0%)	8 (7.8%)	
	36-45	10 (11.4%)	2 (14.3%)	12 (11.8%)	
	46-55	8 (9.1%)	2 (14.3%)	10 (9.8%)	
	56-65	11 (12.5%)	2 (14.3%)	13 (12.7%)	
	66-75	29 (33%)	4 (28.6%)	33 (32.4%)	
	76-85	7 (8%)	4 (28.6%)	11 (10.8%)	
Co- morbidity	Yes	50 (84.7%)	9 (15.3%)	59 (100%)	0.412
	No	38 (88.4%)	5 (11.6%)	43 (100%)	

In regards to, the CURB-65 score's positive and negative predictive values of 30-day mortality. The CURB-65 score has a low positive predictive value and a high negative predictive value (Table 5).

Table 5: shows positive predictive value and negative predictive value for each CURB-65 score category (N=102).

CURB-65 Score	Positive predictive value	Negative predictive value
Low-risk (score 0-1)	2.9	80.6
Intermediate-risk (score 2)	10	84.7
High-risk (Score 3-5)	27	93.8

When logistic regression test was performed to predict the determinants of the mortality, we found that the categories of the CURB score had statistically significant association with the presence of the mortality among the patients with CAP [18]. Furthermore, we found that those with CURB score of 3-5 were more likely to die by 12 times that those with CURB score of 0-1 (OR=12 (CI, 1.4-100), (P=0.022). In addition, smokers were more likely to die by 1.6 times than non- smokers in spite the results were statistically insignificant (OR=1.6, p=0.555) (Table 6).

Table 6: The comparison between smoker and non-smoker, and CURB-65 score (N=102).

	P value	Odds Ratio (OR)	95% C.I. for OR	
			Lower	Upper
Smoking	.555	1.572	.350	7.059
CURB-65 score	.022	12.006	1.436	100.392
Constant	<.001	.028		

Discussion

The CURB-65 score was used to assess the severity and outcome of CAP in this study, and it was found to be a useful tool for assessing CAP patients. According to the findings of this study, men outnumber women, in contrast to study by Mbata et al., whom addressed the CURB-65 scoring system in severity assessment of Eastern Nigerian patients with community-acquired pneumonia and their result was that Eighty patients were recruited, 39 of whom were men, giving a male to female ratio of 1:1.05 with a slight female preponderance [19]. In agreement to our study Yan et al., who compared three predictive rules for assessing severity of community-acquired pneumonia in Hong Kong, found that male gender was predominant (57.4%) [20]. According to our findings, almost half of low-risk patients were successfully treated at home, while almost half of low-risk patients were hospitalized (which means that other factors could implicated in decision regarding hospitalization of CAP patients participated in our study). Whereas all patients of intermediate and high-risk were hospitalized, but CURB-65 score is still the gold standard for determining whether patients can be treated at home [21]. This is in line with a previous study found that the CURB-65 rule is appropriate for use in the emergency room due to its ease of use and ability to select low-risk individuals [20, 22]. In this study, 14.7% of patients were admitted to the intensive care unit. This slightly close to figures in a previous study undertaken in Spain by Ewig et al., which assess the validation of predictive rules and indices of severity for community acquired pneumonia in which ICU admission rate was 16.7% [23], and slightly different from studies done by Man et al., and Ewig et al., in which ICU admission rates were 4% and 10% respectively [20, 24]. The explanation for the disparity is because ICU admission criteria are differed from hospital to hospital and country to country, and disease severity is not the only consideration. Other considerations that intensive care physicians assess before admitting patients to the ICU include disease prognosis, pre-morbid state, patient age, and the availability of ICU resources [20, 25]. Hence, while it gives an indicator of disease severity, this prediction rule is not very useful in predicting ICU admission. Furthermore, the availability of ICU resources was the main determinant in our study area (Atbara teaching hospital, Sudan).

In this study we identified that 2.8% of the low-risk group died, whereas ten percent of the intermediate-risk group and 27% percent of the high-risk group died. This may highlight that, as the CURB-65 score rose, the 30-day mortality rate will increase. This in agreement with study conducted in Spain by Schaberg et al., which demonstrates that the CURB-65 rule is a useful tool for determining severity in our CAP patients [22]. The result of CAP is known to be influenced by age and co-morbidities [26]. Several evidences were found in other nations are supported by this such as studies at the University of Pittsburgh in the United States found that as people aged 65–69 years to >90 years, the incidence rate of CAP increased five-fold and mortality doubled [27]. Furthermore, the burden of CAP was reported to rise with age in the Spanish Evan-65 study [28]. All of this adds weight to this study results. In which we found that those aged 76-85 years had the greatest rate in more than one-third of the patients, while those aged 15-35 had zero percent mortality.

Hypertension and diabetes were the leading co-morbidities found in this study in contrast to study by Ewig et al., and a study by Menendez et al., where Heart failure, chronic obstructive pulmonary disease (COPD), and malignancies were the leading co-morbidities found [23, 29]. Additionally, in this study asthma is found in 7.8% of patients, and 8.8% of patients had stroke [30]. Patients who have had a stroke may become unconscious and aspirate or have difficulty swallowing, putting them at risk for pneumonia. Ischemic heart disease and chronic kidney disease were equally observed co-morbidities (3.9% each). Co-morbidities were present in nearly two-thirds of the patients. Those with co-morbidities had a 15.3 percent 30-day mortality rate, compared to only 11.6 % for those without, and this in contrast to study by Godwin et al., which showed a significant difference ($p = 0.012$) when comparing mortality in patients with and without co-morbidities [19]. Other studies have shown similar results [20, 31]. This study shows that the CURB-65 rule has high negative and low positive predictive values for 30-day mortality at all cut-off points. Accordingly, it may be able to predict 30-day mortality in CAP patients. The CURB-65 rule has a low positive predictive value for detecting high-risk patients, making it less effective in guiding inpatient care decisions. And this in agreement with Man et al., findings [20]. And when logistic regression test was performed to predict the determinants of the mortality, we found that the categories of the CURB score had statistically significant association with the presence of the mortality among the patients with CAP [32]. Furthermore, we found that those with CURB score of 3-5 were more likely to die by 12 times that those with CURB score of 0-1 (OR=12 (CI, 1.4-100), P=0.022). In addition, smokers were more likely to die by 1.6 times than non- smokers in spite the results were statistically insignificant (OR=1.6, p=0.555).

Conclusion

The CURB-65 scoring system has proven to be a useful method for determining the severity of CAP and can help to predict mortality. Because of its ease of use and ability to select a reasonable number of low-risk patients for potential outpatient care, it is particularly beneficial in a busy emergency room.

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