Original Article

Relationship Between Blood Tests, CURB–65 Score and Prognosis in Pneumonia Patients

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ABSTRACT

Objective: One of the most frequently used scoring systems routinely to determine whether pneumonia patients need inpatient treatment is the CURB-65 score. Recently, studies conducted with simple, cheap, and rapid blood tests such as hemogram and biochemistry parameters, which every clinician can easily interpret, have gained popularity. This study examined the relationship between blood tests requested in the emergency department (ED) and pneumonia severity and prognosis.

Methods: The study examined the files of patients who came to the ED with complaints of fever, cough, phlegm and fatigue between January 1 and December 31, 2017. Pneumonia severity according to thorax tomography and CURB-65 score at admission were evaluated. The patient's vital signs, hemogram, biochemistry and blood gas parameters were examined. It was compared with the ward they were admitted to and their 30-day prognosis.

Results: The files of 117 patients were examined. The age of the patients was significantly higher in the group with severe pneumonia than mild and moderate pneumonia groups. In the group with moderate and severe pneumonia, comorbidities were significantly higher than the mild pneumonia group. The rate of intensive care admission and ex in the group with severe pneumonia was significantly higher than in mild and moderate pneumonia groups. In the ex-group, the CURB-65 score, neutrophil-lymphocyte ratio (NLR), C-Reactive Protein (CRP)/Albumin and pneumonia severity were significantly higher than the other group.

Conclusion: NLR and CRP/Albumin ratios may be as effective as CURB-65 scoring in predicting 30-day mortality, and ED burden can be reduced with simple blood tests.

INTRODUCTION

Pneumonia is the leading cause of hospitalisation worldwide.[1] It causes the death of more than 4 million people every year.[2] Cough, sputum production, and chest pain may be seen in most patients. Still, findings such as increased oxygen demand, dyspnea, and impaired consciousness can be guiding in predicting the severity of pneumonia, and these rapidly developing symptoms may lead to emergency department admission.

Clinical findings are guiding for diagnosing pneumonia in the emergency department. Routine blood tests and lung imaging are usually ordered. Various scores can be used to estimate disease severity and prognosis, but this may be difficult to predict in patients with mild symptoms. In addition, different symptoms may develop in people with comorbidities and older age, and the clinician may move away from diagnosing pneumonia.

C-reactive protein (CRP) is an acute-phase protein synthesised in hepatocytes in response to pro-inflammatory cytokines during infectious processes.[3] The albumin concentration is negatively associated with the systemic inflammatory response due to increased catabolism and downregulation of hepatic synthesis by the cytokine tumour necrosis factor-alpha (TNF-α).[4] There is data in studies on hypoalbuminemia, which is associated with inflammation and nutritional status that negatively affects survival.[5] Also, in the literature, data show that the neutrophil-to-lymphocyte ratio (NLR) increases the severity of infection, and as this ratio increases, the risk of 30-day mortality increases.[6] Infectious processes can progress rapidly, like pneumonia. Such tests can speed diagnosis and reduce emergency room crowding.

One of the most frequently used scoring systems routinely to determine whether pneumonia patients need inpatient treatment is the CURB-65 score. It is a practical calcula-

tion method combining the patients' state of consciousness, examination findings, and tests. It may be difficult to predict the severity of pneumonia, the unit to be followed, and its prognosis in the emergency department. For this reason, we are investigating whether the tests taken and the scoring systems used effectively predict prognosis. Recently, studies conducted with simple, cheap, and rapid blood tests such as hemogram and biochemistry parameters, which every clinician can easily interpret, have gained popularity. This study examined the relationship between blood tests requested in the emergency department and pneumonia severity and prognosis.

MATERIALS AND METHODS

This study was approved by the Local Ethics Committee of the University (595/19.12.2017). The study examined the files of patients who came to the Emergency Department with complaints of fever, cough, phlegm, and fatigue between January 1 and December 31, 2017. Among these patients, patients over 18 who requested pulmonologist consultation and were diagnosed with pneumonia were included. Patients who had symptoms but were not diagnosed with pneumonia, who were diagnosed with pneu-

monia by chest radiography, who had an atypical image on thorax computer tomography (CT), or who did not have a pneumonic area were excluded from the study. CT images were classified according to the reports in the archive system. According to the Japanese Respiratory Society guideline, patients with symptoms of infection in less than ⅓ of both lungs are classified as mild, patients with infection in ⅓ or more of the lungs are classified as moderate, and patients with infection in ⅔ or more of the lungs are classified as severe.

Pneumonia severity at admission was evaluated according to the CURB-65 score. The patient's vital signs, hemogram, biochemistry, and blood gas parameters were examined. It was compared with the ward they were admitted to and their 30-day prognosis.

Statistical Method

Mean, standard deviation, median, lowest, highest, frequency, and ratio values were used in the descriptive statistics of the data. The distribution of variables was measured with the Kolmogorov-Smirnov Test. ANOVA (Tukey Test), Kruskal-Wallis, and Mann-Whitney U tests were used to analyse quantitative independent data. Paired sam-

Table 1. Demographic characteristics of the patients

	Min-Max	Median	Mean±SD/n-%
Age	20.0-97.0	72	68.8±17.3
Gender			
Female			59-50.4%
Male			58-49.6%
Comorbidities			
(-)			64-54.7%
(+)			53-45.3%
Lung disease			15-12.8%
Cardiovascular			22-18.8%
Hypertension			19-16.2%
Neurological			11-9.4%
Endocrine			14-12.0%
Others			15-12.8%
Pneumonia severity			
Mild			77-65.8%
Moderate			24-20.5%
Severe			16-13.7%
Result in ED			
Discharged			77-65.8%
Transfer to service			24-20.5%
Transfer to ICU			15-12.8%
Exitus			1-0.9%
30-day results in the inpatient service			
Discharged			24-61.5%
Exitus			15-38.5%

SD: Standard Deviation; Others: HIV, Breast cancer, Hyperthyroidism, Benign Prostate Hyperplasia, Ulcerative Colitis, Psychiatric Disease; ED: Emergency Department; ICU: Intensive Care Unit.

ple T-test and Wilcoxon test were used to analyse dependent quantitative data. The Chi-Square Test was used to study qualitative independent data, and the Fischer Test was used when the conditions were not met. The effect level and cut-off were investigated with the ROC curve. The SPSS 28.0 program was used in the analyses.

RESULTS

When the files of 117 patients who met the study criteria were examined, the average age was 68.8±17.3, and 50.4% were female. 45.3% had comorbidities. Mild pneumonia was detected at the highest rate (65.8%), and most of them (65.8%) were discharged (Table 1).

In the group with severe pneumonia, the age of the patients was significantly (p<0.05) higher than in the groups with mild and moderate pneumonia severity. In the group with moderate and severe pneumonia severity, the presence of comorbidities was significantly (p<0.05) higher than in the group with mild pneumonia severity. The rate of cardiovascular disease and hypertension (HT) in the group with moderate and severe pneumonia severity was significantly (p<0.05) higher than in the group with mild pneumonia severity. In the group with severe pneumonia, mean arterial pressure, temperature, pulse, respiratory rate, and pneumonia severity were significantly (p<0.05) higher than in the groups with mild and moderate pneumonia (Table 2).

Table 2. Relationship between patients' comorbidities, examination, and pneumonia severity

	Pneumonia severity Mean±SD/n-%			
	Mild	**[1]Moderate**	**[2]Severe**	**p**
Age	65.5±18.5	70.0±11.2	83.3±10.0	0.000[K]
Gender				
Female	37-48.1%	10-41.7%	12-75%	0.092[x2]
Male	40-51.9%	14-58.3%	4-25%	
Comorbidities				
(-)	57-74%	2-8.3%	5-31.3%	0.000[x2]
(+)	20[1,2]-26%	22-91.7%	11-68.7%	
MAP	94.4±10.3	94.6±15.7	85.2±15.7	0.016[K]
Pulse	78.0±10.2	88.7±15.1	103.4±17.6	0.000[A]
Respiratory rate	17.5±2.4	22.1±4.5	31.6±6.5	0.000[K]
Temperature	37.3±0.6	37.9±0.8	37.9±0.3	0.000[K]

K: Kruskal-Wallis (Mann-Whitney U test); X²: Chi-square test (Fischer test); A: ANOVA. [1]The difference with moderate group p<0.05; [2]The difference with severe group p<0.05. MAP: Mean arterial pressure.

Table 3. Relationship between patients' blood test and pneumonia severity

	Pneumonia severity Mean±SD/n-%			
	Mild	**Moderate**	**Severe**	**p**
Leukocyte (x10³)	11.4±4.5	14.0±7.8	16.8±10.8	0.088[K]
Platelet (x10³)	256.5±97.1	249.7±125.5	228.2±117.9	0.624[A]
Neutrophil (x10³)	8.4±4.1	11.2±7.2	14.1±9.8	0.021[K]
Lymphocyte (x10³)	2.04±1.24	1.60±1.11	1.70±1.68	0.018[K]
Creatinine	0.92±0.32	1.35±0.67	1.55±1.35	0.014[K]
AST	26.8±14.5	59.2±78.3	41.0±25.0	0.001[K]
ALT	21.4±21.0	40.8±49.3	22.8±19.4	0.007[K]
CRP/Albumin	20.4±24.5	60.9±53.6	50.2±34.3	0.000[K]
pH	7.40±0.04	7.42±0.05	7.36±0.14	0.055[K]
pCO_2	41.4±5.0	35.9±8.3	45.1±17.3	0.006[K]
SO_2	94.3±2.9	87.7±4.2	77.7±5.3	0.000[K]
Lactate	1.36±0.40	1.67±0.86	2.48±1.06	0.000[K]
HCO_3	25.0±1.9	23.2±3.6	24.5±6.5	0.012[K]

K: Kruskal-Wallis (Mann-Whitney U test); A: ANOVA; AST: Aspartate transaminase; ALT: Alanine transaminase.

The neutrophil count in the group with severe pneumonia was significantly (p<0.05) higher than in the groups with mild and moderate pneumonia severity. Aspartate aminotransferase (AST) in the group with moderate and severe pneumonia severity was significantly higher (p<0.05) than in the group with mild pneumonia severity. The CRP in the group with moderate and severe pneumonia severity was especially (p<0.05) higher than in the group with mild pneumonia severity. The CRP/Albumin in the group with moderate and severe pneumonia severity was significantly (p<0.05) higher than in the group with mild pneumonia severity. The lactate in the group with severe pneumonia was significantly (p<0.05) higher than in the groups with mild and moderate pneumonia severity (Table 3).

The discharge rate from the emergency department in the group with mild pneumonia severity was significantly (p<0.05) higher than in the groups with moderate and severe pneumonia severity. The rate of intensive care admission and death in the group with severe pneumonia was significantly (p<0.05) higher than in the groups with mild and moderate pneumonia severity (Table 4).

The CURB-65 score, NLR, CRP/Albumin, and pneumonia severity in the ex-group were significantly (p<0.05) higher than in the survivor group (Table 5).

The significant effectiveness of CRP/Albumin [area under the curve 0.736 (0.630-0.843)] was observed in distinguishing patients with mild and moderate-severe pneumonia. The significance of the CRP/Albumin 27 cut-off [area under the curve 0.740 (0.641-0.838)] was observed in distinguishing patients with mild pneumonia severity and moderate-severe pneumonia severity (Figure 1).
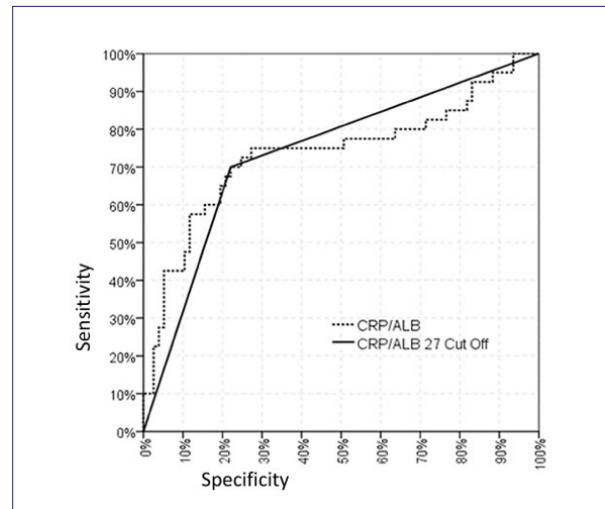

Figure 1. ROC analysis of CRP/Albumin ratio with pneumonia severity.

Table 4. Relationship between pneumonia severity and prognosis

| | Pneumonia severity n-% | | | |
	[1]Mild	[2]Moderate	[3]Severe	p
Result in the hospital				
Discharged	77[2],[3]-100.0%	0-0%	0-0%	
Transfer to service	0-0%	24[1],[3]-100%	0-0%	0.000[X2]
Transfer to ICU	0-0%	0-%0	15[1,2]-93.8%	
Exitus	0-0%	3[1]-12.5%	13[1,2]-81.3%	

[1]The difference with mild group p<0.05; [2]The difference with moderate group p<0.05; [3]The difference with severe group p<0.05; X[2]: Chi-square test (Fischer test).

Table 5. Results predicting prognosis in ex and surviving groups

	Ex group Mean±SD/n-%	Survivor group Mean±SD/n-%	p
CURB-65 score	3.3±1.0	1.3±0.9	0.000[m]
NLR	12.3±7.9	6.3±5.4	0.001[m]
CRP/Albumin	74.0±49.6	26.3±31.1	0.000[m]
Pneumonia Severity			
Mild	0-0.0%	77-76.2%	0.000[X2]
Moderate	3-18.8%	21-20.8%	
Severe	13-81.3%	3-3.0%	

[m]: Mann-Whitney U test; X[2]: Chi-square test (Fischer test).

DISCUSSION

This study determined that NLR and CRP/Albumin ratios could be as effective as CURB-65 scoring in predicting 30-day mortality. Considering that immunity decreases as we age, this may explain the high average age of the patients with severe pneumonia in this study.

Pneumonia severity is directly related to the rate of infected tissue detected in the lung. NLR has been the subject of many studies because it is a value that can be easily calculated with simple tests in each patient. It is already known that neutrophils increase first during infection, but studies have discovered that the increased neutrophil subset suppresses lymphocytes.[7] Therefore, it can be said that the infection burden or mortality rate of patients with high NLR rates has increased. In the study, this may be why the NLR value in the ex-group is higher than in the other group. The NLR value can be used in patients with chronic infections and frequent emergency visits because it is low-cost.[8]

A study by Li Jian et al.[9] showed that the NLR value increases with age, even in the healthy population. In this case, it can be predicted that the NLR level of the elderly group, which is a sensitive population, may change significantly even in a mild infection. Especially in the elderly population, the NLR value can be an alternative to scoring systems such as CURB-65 and can guide the service where the patient will be followed.

In studies, the presence of additional diseases increases the possibility of dying from pneumonia.[10] Similar findings were found in this study. Most of the patients had comorbidities, and pneumonia was severe. Consistent with the literature, the highest rates were cardiovascular diseases and hypertension.[11] Considering that comorbidities are more common in older age, it can be said that pneumonia has a fatal course in this age group.[12]

A study conducted by Ruot et al.[13] in rats found that the rate of albumin synthesis increased during infection, but its plasma concentration was low. They stated that the most important factor causing this may be the limited protein source due to nutrition during infection. This result may explain the high leukocyte, neutrophil, and CRP values and low albumin values in the moderate and severe pneumonia patient group.

Therefore, the CRP-albumin ratio in the mortal patient group was significantly higher than the other group. Additionally, in this group, vital signs liver and kidney function tests were observed to deteriorate more significantly than in the other group. Multiple organ failure develops due to intense infection, thus increasing mortality.

As a result, pneumonia can be fatal in elderly patients. Although many factors affect mortality, they can be predicted with simple tests.

Limitations

The main limitation of this study is that it is a retrospective study. The cause of infection in the development of pneumonia is not specified. Since the classification was planned radiologically, the outcome of the patient's hospitalisation may have varied depending on the factor. In addition, the duration of hospital stay and the type of treatment (such as steroids or the use of appropriate antibiotics according to culture results) were not examined. In this case, it is unclear whether patients additionally develop hospital-acquired pneumonia.

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Pnömoni Hastalarında Kan Testleri, CURB–65 Skoru ve Prognoz Arasındaki İlişki

Amaç: Pnömoni hastalarının yatarak tedavi ihtiyacı olup olmadığını tespit etmek için rutinde en sık kullanılan skorlama sistemlerinden biri CURB-65 skorudur. Son dönemde her klinisyenin rahatça yorum yapabileceği hemogram ve biyokimya parametreleri gibi basit, ucuz ve hızlı kan testleri ile yapılan çalışmalar popülerlik kazanmıştır. Bu çalışmada, acil serviste istenen kan testleri ile pnömoni şiddeti ve prognoz arasındaki ilişki incelendi.

Gereç ve Yöntem: Çalışmada; 1 Ocak-31 Aralık 2017 tarihinde acil servise ateş, öksürük, balgam, halsizlik şikayeti ile gelen hastaların dosyaları incelendi. Toraks tomografisine göre pnömoni şiddeti ve başvuru anındaki CURB-65 skoru değerlendirildi. Hastaların vital bulguları, hemogram, biyokimya ve kan gazı parametreleri incelendi. Hastaların yattığı servis ve 30 günlük prognozu ile kıyaslandı.

Bulgular: 117 hastanın dosyası incelendi. Hastaların yaşı, pnömoni şiddeti ağır olan grupta, pnömoni şiddeti hafif ve orta olan gruplardan anlamlı olarak daha yüksekti (p<0.05). Pnömoni şiddeti orta ve ağır olan grupta, ek hastalık varlığı, pnömoni şiddeti hafif olan gruptan anlamlı olarak daha yüksekti (p<0.05). Pnömoni şiddeti ağır olan grupta yoğun bakım yatış ve ölüm oranı, pnömoni şiddeti hafif ve orta olan gruplardan anlamlı olarak daha yüksekti (p<0.05). Hayatını kaybeden hastaların grubunda CURB-65 skoru, nötrofil-lenfosit oranı (NLR), C-Reaktif Protein (CRP)/Albumin değeri ve pnömoni şiddeti diğer gruptan anlamlı olarak daha yüksekti (p<0.05).

Sonuç: NLR ve CRP/Albumin oranları, 30 günlük mortaliteyi öngörmede CURB-65 skorlaması kadar etkili olabilir, basit kan testleri ile acil servis kalabalıklığı azaltılabilir.

Anahtar Sözcükler: CRP albümin oranı; CURB-65 Skoru; nötrofil lenfosit oranı; pnömoni.