

## The Mortality Rate and Affecting Factors in Patients with Community-Based Pneumonia Requiring Hospitalization

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### Abstract

**Objective:** The aim of this study is to determine the mortality rate and affecting factors in patients with community-acquired pneumonia (CAP) requiring hospitalization.

**Material and Methods:** 150 cases with CAP were evaluated retrospectively. Age, gender, hospital mortality, presence of concomitant disease, smoking history, history of intensive care unit and invasive mechanical ventilation, hospitalization time, arterial oxygen saturation (SaO<sub>2</sub>), CURB-65 score, sputum culture results, values of pulse, arterial blood pressure, fever, respiratory rate, confusion status, hemogram, urea, creatinine, C-reactive protein (CRP) and procalcitonin (PCT) values were recorded from our hospital's database system.

**Results:** The hospital mortality rate was 12.7% (n = 19). The mean age, CURB65 scores, fever, respiratory rate, neutrophil counts, urea, CRP levels and PCT positivity were statistically increased and SaO<sub>2</sub> levels, systolic TA, diastolic TA, lymphocytes and platelet counts were statistically decreased in CAP patients with died in-hospital. Logistic regression showed that need for invasive mechanical ventilation, confusion status and PCT positivity were significantly associated with in-hospital mortality.

**Conclusion:** Advanced age, high neutrophil ratio, high CURB-65 score and low systolic TA values are related factors with hospital mortality in patients with CAP requiring hospitalization. In addition, invasive mechanical ventilation, confusion status and PCT positivity are independent risk factors for hospital mortality in CAP patients.

**Key Words:** Community-acquired pneumonia, Mortality, CURB-65

## Hastaneye Yatış Gerektiren Toplum Kökenli Pnömoni Olgularında Mortalite Oranı ve Etkileyen Faktörler

### Öz

**Amaç:** Çalışmamızda hastaneye yatış gerektiren Toplumda Gelişen Pnömoni (TGP) olgularında mortalite oranının ve mortaliteyi etkileyen faktörlerin belirlenmesi amaçlanmıştır.

**Gereç ve Yöntem:** 150 TGP'li olgu retrospektif olarak değerlendirilmiştir. Yaş, cinsiyet, hastane mortalitesi, eşlik eden hastalık varlığı, sigara öyküsü, yoğun bakım ve invaziv mekanik ventilasyon öyküsü, hastane yatış süresi, arteriyel oksijen saturasyonu (SaO<sub>2</sub>), CURB-65 skoru, balgam kültür sonuçları, nabız, arteriyel kan basıncı, ateş, solunum sayısı, konfüzyon durumu, hemogram, üre, kreatinin, C-reaktif protein (CRP) ve prokalsitonin (PCT) değerleri kaydedilmiştir.

**Bulgular:** Hastane mortalite oranı %12.7 (n=19) olarak saptandı. Hastanede ölen TGP olgularında ortalama yaş, CURB-65 skoru, ateş, solunum sayısı, nötrofil sayısı, üre, CRP düzeyleri ve PCT pozitifliği istatistiksel olarak artmış ve SaO<sub>2</sub>, sistolik TA, diastolic TA, lenfosit ve trombosit sayısı istatistiksel olarak azalmıştı. Lojistik regresyon analizine göre invaziv mekanik ventilasyon gereksinimi, konfüzyon varlığı ve PCT pozitifliği hastane mortalitesi ile anlamlı düzeeyde ilişkili olarak bulundu.

**Sonuç:** İleri yaş, yüksek nötrofil oranı, yüksek CURB-65 skoru ve düşük sistolik TA değerleri

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hastaneye yatış gerektiren TGP olgularında mortalite ile ilişkili faktörlerdir. Ek olarak invaziv mekanik ventilasyon, konfüzyon varlığı ve PCT pozitifliği TGP olgularında hastane mortalitesi için bağımsız risk faktörleridir.

**Anahtar kelimeler;** Toplumda gelişen pnömoni, Mortalite, CURB-65

## **Introduction**

Community-acquired pneumonia (CAP) is a common health problem which cause of morbidity and mortality (1). Incidence and mortality of CAP are depending on age and comorbidity (2,3). Hospitalized patients with CAP have mortality rate is approximately 13% (4). The most important early prognostic parameters of CAP are acute respiratory insufficiency and acute extra pulmonary organ dysfunction due to sepsis or comorbidities (5-7).

Lower respiratory tract infections rank 5th with 4.2% among causes of death in our country (8). All 1.9% of hospitalizations were constituted by pneumonia patients according to Ministry of Health 2004 health records in our country (9). Mortality of CAP varies between 1%-60% in our country and the mortality rate in hospitalized patients with CAP is significantly higher (10.3-60%) depending on the severity of the disease (10).

The aim of our study is to determine the mortality rate CAP patients and to find out the mortality risk factors in hospitalized patients with CAP.

## **Methods**

### *Study Design and Patients*

This retrospective study was performed at Firat University Chest Disease Department. Our hospital's electronic patient database was searched between January 1, 2018 and May 20, 2019 using the ICD-10 search code "J18.9" for the patients with CAP directly hospitalized in our clinic and 150 patients were included in the study retrospectively. Ethical approval was obtained by the institutional review board (07.02.2019-81527325).

Demographic characteristics, hospital mortality, concomitant disease, smoking

history, history of intensive care and invasive mechanical ventilation, hospitalization time, SaO<sub>2</sub>, CURB-65 score (confusion, urea nitrogen, respiratory rate, blood pressure, age ≥65 years), results of sputum culture, pulse, blood pressure, fever, respiratory rate, confusion, hemogram, urea, creatinine, CRP and PCT values were recruited from our hospital electronic database. Laboratory parameters were obtained at admission and before treatment. Peripheral blood samples were taken into calcium-EDTA tubes, blood counts and differences were analyzed using an auto analyzer.

Patients with a diagnosis of hospital-acquired pneumonia without radiological evidence, an immunocompromised condition (solid organ or bone marrow transplant or immunosuppressive therapy), asthma, active tuberculosis, or other lung disease were excluded in the study.

### *Statistical analysis*

IBM Statistical Product and Service Solutions version 21.0 (IBM SPSS Statistics 21 program, Armonk, NY, USA) software was used to evaluate the data. Variables were expressed using mean ± standard deviation and percentage. Pairwise group variables were statistically compared using Mann-Whitney tests was used because of our data not showing normal distribution. Variables with categorical data were statistically compared using chi-square tests. Calculation of odds ratios (ORs) and 95% CI values for mortality rate, with relation to potential risk factors, was performed with binary logistic regression models. Results are expressed as means ± standard deviations. For the significance level of the tests,  $p < 0.05$  were accepted.

## **Results**

Mean age of the 150 patients was 67.07 ±

16.29 years (range, 21-97), being 40 males and 110 females. The hospital mortality rate was 12.7% (n=19). The baseline characteristics of patients are presented in Table 1. The mean age, CURB65 scores, fever, respiratory rate, neutrophil counts, urea, PCT positivity and CRP levels were statistically increased and SaO<sub>2</sub> levels, systolic TA, diastolic TA, lymphocytes and platelet counts were statistically decreased in CAP patients with died in-hospital (Table 1). Comorbidities, smoking history, invasive mechanical ventilation (IMV), culture

positivity and confusion status in patients with CAP are shown in table 2. The use of IMV and confusion status were statistically higher in non-survivor CAP patients compared with survivor CAP patients ( $X^2$ : 43.395,  $p=0.000$ ;  $X^2$ :68.572,  $p=0.000$ , respectively).

The results of binary logistic analyses are shown in Table 3. Univariate logistic regression showed that need for invasive mechanical ventilation, confusion status and procalcitonin positivity were significantly associated with in-hospital mortality.

**Table 1.** Baseline Characteristics and Clinical Parameters in Patients with CAP.

Variables	Total (n=150)	Survivors (n=131)	Non-survivors (n=19)	p value
Age (years)	67.07±16.29	65.07±16.29	76±14.7	0.004
Male, n (%)	103 (68.7)	90 (68.7)	13 (68.4)	NS
Length of hospital stay (days)	8.72±4.89	8.53±4.74	10±5.84	NS
SaO <sub>2</sub> (%)	88.22±7.41	89.11±6.99	82.1±7.48	0.000
CURB65	1.19±1.12	1.02±1	2.36±1.21	0.000
Pulse	91.3±14.8	90.68±14.8	95.52±14.17	NS
Systolic TA (mmHg)	112.6±16.2	113.89±15.85	103.68±16.05	0.022
Diastolic TA (mmHg)	65.73±9.83	66.33±10.1	61.57±6.88	0.042
Fever (°C)	37.4±0.85	37.3±0.85	37.8±10.81	0.023
Respiratory rate	14.41±2.26	14.2±12.06	15.7±83.06	0.014
Hb (g/dL)	12.88±1.99	12.9±71.97	12.2±32.02	NS
Hct (%)	40.5±6.19	40.7±56.13	38.8±6.49	NS
Leucocyte (10 <sup>3</sup> /μL)	11.61±8.91	11.69±9.37	11.02±4.77	NS
Lymphocyte (10 <sup>3</sup> /μL)	15.9±11.17	16.65±11.40	10.76±7.94	0.014
Neutrophil (10 <sup>3</sup> /μL)	74±13.58	73.09±13.63	80.22±11.73	0.018
Platelet (10 <sup>3</sup> /μL)	284.9±131.9	293.58±134.27	225.1±97.59	0.015
Urea (mg/dL)	51.52±35.11	50.08±36.4	61.67±22.78	0.002
Creatinine (mg/dL)	1.04±0.72	1.03±0.75	1.07±0.51	NS
CRP (mg/dL)	106.29±63.3	100.3±68.91	147.57±58.33	0.005
Procalcitonin positivity, n (%)	46 (30.7)	30 (22.9)	16 (84.2)	0.000

**Table 2.** Comorbidities, Smoking History, Invasive Mechanical ventilation (IMV), Culture Positivity and Confusion status in patients with CAP.

Variables	Total (n=150)	Survivors (n=131)	Nonsurvivors (n=19)	p value
<b>Comorbidities</b>	110 (73.3)	94 (71.8)	16 (84.2)	NS
Diabetes, n (%)	17 (11.3)	15 (88.2)	2 (11.8)	NS
Obstructive Lung Disease, n (%)	45 (30)	39 (86.7)	6 (13.3)	NS
Hypertension, n (%)	12 (8)	12 (100)	0 (0)	NS
Chronic heart disease, n (%)	7 (4.7)	5 (71.4)	2 (28.6)	NS
Other, n (%)	29 (19.3)	23 (79.3)	6 (20.7)	NS
<b>Smoking History</b>				
Current smoker, n (%)	77 (51.3)	64 (48.9)	13 (68.4)	NS
Ex-smoker, n (%)	16 (10.7)	15 (11.5)	1 (5.3)	NS
Newer-smoker, n (%)	57 (38)	52 (39.7)	5 (26.3)	NS
<b>IMV, n (%)</b>	18 (12)	7 (38.9)	11 (61.1)	0.000
<b>Culture Positivity, n (%)</b>	62 (41.3)	53 (40.5)	9 (47.4)	NS
<b>Confusion, n (%)</b>	20 (13.3)	6 (30)	14 (70)	0.000

**Table 3.** Risk Factors Associated with in-Hospital Mortality in Patients with CAP.

Variables	Univariate Regression OR (95% CI)	p value
<b>Comorbidities</b>	19.686 (0.054-7219.173)	0.323
<b>ICU</b>	0.310 (0.022-4.401)	0.387
<b>IMV</b>	18.040 (1.178-276.210)	<b>0.038</b>
<b>Length of hospital stay (≥10 day)</b>	3.250 (0.345-30.250)	0.3
<b>Confusion</b>	47.08 (4.424-501.039)	<b>0.001</b>
<b>Procalcitonin positivity</b>	13.412 (1.950-92.234)	<b>0.008</b>
<b>CURB65 (≥1)</b>	1.263 (0.07-22.851)	0.874
<b>Culture positivity</b>	4.298 (0.467-39.542)	0.198
<b>Neutrophil (≥77) (10<sup>3</sup>/μL)</b>	1.011 (0.145-7.03)	0.991
<b>Urea (≥50) (mg/dL)</b>	1.162 (0.134-10.096)	0.892

CI; confidence interval, OR; odds ratio, IMV; invasive mechanical ventilation, ICU; Intensive Care Unit

### Discussion

Our results showed that invasive mechanical ventilation, confusion status and PCT positivity are independent risk factors for hospital mortality in CAP patients. In addition, increased levels of neutrophil ratio and CURB-65 score and decreased systolic TA values were determined in patients with CAP requiring hospitalization.

Determination of factors associated with mortality may improve treatment strategies and management of hospitalized CAP patients. Nearly 20–25% of patients with CAP require in-patient treatment (11). Early mortality has been reported in some CAP studies between 2.3%- 26.9% (4, 12, 13). Risk factors associated with short-term mortality in CAP patients were evaluated in a meta-analysis showed that

seventeen factors (male sex, altered mental status, dyspnea, tachypnea, hypotension, hypothermia, congestive heart failure, alcohol abuse, diabetes mellitus, immunosuppression, neoplastic disease, coronary artery disease, neurologic disease, leukopenia, bacteremia, multi-lobar radiographic pulmonary infiltrate, and azotemia) were significantly related with higher risk of short-term mortality in these patients (14). In addition, increased age, altered mental status, multi-lobar pneumonia, shock at admission, pneumococcal bacteremia, discordant empiric antibiotic therapy, increased IL-6 and TNF- $\alpha$  levels were found a risk factors for early (within the first 48 hours to 7 days after hospital admission) mortality in CAP (12, 15). Baek et al determined that chronic lung disease, mechanical ventilation, hemodialysis, and albumin were associated with in-hospital mortality of CAP in elderly patients (16). In addition, the area under the curve in pneumonia for predicting mortality was 0.61 for the CURB-65 score in this study. The severity scores of CAP have different strengths and weaknesses. CURB-65 had high specificity to determine of patients at high risk of requirement for ICU (17). In a systematic review and meta-analysis showed that severity scales to predicting mortality in CAP patients had good negative predictive values for mortality (18).

In multiple previous studies found that pretreatment levels of PCT have been associated with short-term mortality and mostly providing moderate to high prognostic value (19, 20). Increased admission levels of PCT was associated with adverse short-term outcome (intensive care unit admission and 30-day mortality) in addition to determines to bacterial etiology of CAP (21).

In one study which evaluated to prognostic factors of CAP in elderly patients, hospital mortality was 3.2% in  $\leq 65$  years and 9.8% in  $> 65$  years old. This study results showed that advanced age ( $> 83$  years old), presence of neurological disease, suspected aspiration,

short clinical history ( $\leq 3$  days), absence of cough, arterial hypotension, tachypnea ( $> 35$  breaths/min), metabolic acidosis (arterial pH  $< 7.35$  and actual bicarbonate level  $\leq 18$  mEq/L), hypoxemia (PaO<sub>2</sub>  $< 52$  mmHg with ambient FiO<sub>2</sub>), hypocapnia (PaCO<sub>2</sub>  $< 25$  mmHg), elevated serum urea nitrogen, hypernatremia, hyperpotassemia, hyperphosphoremia, hypoalbuminemia, multi-lobar radiographic involvement, risk class V (patients scoring  $> 130$  on Fine's index), use of two or three antibiotics at the time of admission, admission to the intensive care unit, and the need for mechanical ventilation are associated with a higher risk of in-hospital death in elderly CAP patients (22). In another study included 2.320 CAP patients found that advanced age, and a high comorbidity burden were common in patients who died in hospital. It has been shown in many previous studies that the presence of comorbidity is associated with especially long-term mortality in CAP patients (23-25). In a retrospective multicenter study performed in our country, CAP cases between 2011 and 2013 were evaluated. This study included 785 CAP patients and short-term mortality was found as 9.2%. Higher PSI and BUN/albumin ratios, CURB-65, Charlson comorbidity scores and lower hematocrit levels were related with 30-day mortality (26). In our study results showed that invasive mechanical ventilation, confusion status and PCT positivity are independent risk factors for hospital mortality in CAP patients. Also, neutrophil ratio and CURB-65 score were increased and systolic TA were decreased in patients with CAP requiring hospitalization. Systolic hypotension was found in patients with non-survivor CAP patients compared with survivors but we did not determine the relationship between comorbidities and mortality in our study. Little is known about the causes and factors associated with mortality in the first 48 hours to 7 days of CAP. Moreover, the associated risk factors and the causes of mortality in patients with CAP can vary according to the time in which mortality is evaluated.

Our study has some limitations. First, it was a retrospective study. The second limitation of our study is the fact that it is based on a single center with relatively small sample size. The third limitation of our study is evaluation of only culture positivity. Unfortunately, since it is a retrospective study, the factors that produced in culture could not be determined. In addition, causes of early mortality and antibiotherapy were not reported in patients with CAP.

In summary, CAP is a serious public health problem because it still has a high incidence and mortality rate despite the progress made in terms of mortality-related parameters in CAP patients. Our study are described some laboratory and epidemiological characteristics of patients with hospitalized CAP as regional data. We think that better understanding of predictors of hospital mortality may improve strategies for management of CAP.

In conclusion, short-term mortality in patients with hospitalized CAP is high level. Mechanical ventilation, confusion status and PCT positivity are independent risk factors for hospital mortality in CAP patients. In addition, increased levels of neutrophil ratio and CURB-65 score and decreased systolic TA values have a significantly increased possibility of short-term mortality in these patients. In future studies, larger sample sizes and participation from several healthcare centers can provide results that can be generalized further.

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