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Research Article

Factors associated with in-hospital mortality in patients with chronic obstructive pulmonary disease hospitalized to the intensive care unit due to septic shock

Septik şok nedeniyle yoğun bakım ünitesine yatırılan kronik obstrüktif akciğer hastalığı olan hastalarda hastane içi mortalite ile ilişkili faktörler

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Abstract

Aim: This study aimed to evaluate in-hospital mortality-related factors in patients with chronic obstructive pulmonary disease (COPD) who were admitted to the intensive care unit (ICU) due to septic shock.

Material and Methods: This retrospective study included 62 COPD patients diagnosed with septic shock in a tertiary ICU. The Sepsis-3 criteria were used to establish the diagnosis of sepsis shock. Demographic and clinical data, including comorbid conditions, laboratory parameters, inflammatory markers, Acute Physiology and Chronic Health Evaluation II (APACHE II) scores, Sequential Organ Failure Assessment (SOFA) scores, and clinical outcomes were collected from electronic medical records. The modified Charlson Comorbidity Index (mCCI) calculation was based on the available comorbid conditions collected in the prehospital setting.

Results: The mean age of the study population was 70.6 ± 11.0 years, and 67.7% were male. Higher mCCI scores [Hazard ratio (HR): 1.23, $p = 0.002$], along with elevated APACHE II (HR: 1.15, $p < 0.001$) and SOFA scores (HR: 1.35, $p < 0.001$), were independent predictors of in-hospital mortality. Among laboratory parameters, higher procalcitonin (HR: 1.04, $p < 0.001$), and C-reactive protein (HR: 1.03, $p< 0.001$) were associated with mortality in univariate analysis but did not remain significant in multivariate regression. The optimal mCCI cut-off for predicting mortality was ≥7, yielding a sensitivity of 72.5% and specificity of 94.7%.

Conclusion: The mCCI, along with APACHE II and SOFA scores, serves as a significant independent predictor of mortality in COPD patients with septic shock. The mCCI may be a useful tool for risk stratification in this high-risk population.

Keywords: Comorbidity, chronic obstructive pulmonary disease, inflammation, septic shock, survival

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Öz

Amaç: Bu çalışma, septik şok nedeniyle yoğun bakım ünitesine (YBÜ) kabul edilen kronik obstrüktif akciğer hastalığı (KOAH) olan hastalarda hastane içi ölüm ile ilişkili faktörleri değerlendirmeyi amaçladı.

Gereç ve Yöntemler: Bu retrospektif çalışmaya, bir üçüncü basamak yoğun bakım ünitesinde septik şok tanısı almış 62 KOAH hastası dahil edildi. Sepsis-3 kriterleri, septik şok tanısını koymada kullanıldı. Elektronik tıbbi kayıtlar aracılığıyla demografik ve klinik veriler, komorbid durumlar, laboratuvar parametreleri, inflamatuar belirteçler, Akut Fizyoloji ve Kronik Sağlık Değerlendirme II (APACHE II) skoru, Sekansiyel Organ Yetmezliği Değerlendirme (SOFA) skoru ve klinik sonuçlar toplandı. Modifiye Charlson Komorbidite İndeksi (mCCI), hastaların hastane öncesi dönemde sahip olduğu komorbid durumlar kullanılarak hesaplandı.

Bulgular: Çalışma popülasyonunun ortalama yaşı 70.6 ± 11.0 yıl olup, %67.7'si erkekti. Daha yüksek mCCI skorları [Hazard oranı (HR):1.23, p = 0.002], yüksek APACHE II (HR: 1.15, p < 0.001) ve SOFA skorları (HR: 1.35, p < 0.001) ile birlikte hastane içi ölümün bağımsız öngörücüleriydi. Laboratuvar parametreleri arasında, yüksek prokalsitonin (HR: 1.04, p < 0.001) ve C-reaktif protein (HR: 1.03, p < 0.001) seviyeleri tek değişkenli analizde mortalite ile ilişkili bulundu, ancak çok değişkenli regresyon analizinde anlamlılığını korumadı. Mortaliteyi öngörmede mCCI eşik değeri ≥7 olarak belirlendi ve bu değer, %72.5 duyarlılık ve %94.7 özgüllük gösterdi.

Sonuç: Septik şoklu KOAH hastalarında, mCCI, APACHE II ve SOFA skorlarıyla mortalitenin önemli bir bağımsız öngörücüsü olarak belirlendi. Bu yüksek riskli popülasyonda, mCCI risk sınıflandırması için yararlı bir araç olabilir.

Anahtar kelimeler: Eşlik eden hastalık, kronik obstrüktif akciğer hastalığı, inflamasyon, septik şok, sağkalım

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a prevalent respiratory condition characterized by persistent airflow limitation and chronic inflammatory responses in the airways and lungs [1]. Patients with COPD are at an increased risk of developing severe infections, including sepsis and septic shock, leading to higher morbidity and mortality rates [2, 3]. In fact, COPD is one of the most common chronic comorbidities observed in patients with sepsis [4]. Mortality risk in sepsis is influenced by multiple factors, including disease severity, underlying comorbidities, infection source, and associated complications [5, 6]. Hence, accurately predicting mortality risk at an early stage in ICU-admitted COPD patients is vital for effective disease management and improving survival rates.

Several factors contribute to the elevated mortality observed in COPD patients with sepsis or septic shock. Many of these patients tend to be older and have significant comorbid conditions that compromise their physiological reserve. Comorbid cardiovascular diseases are especially prevalent in COPD and have been linked to poor outcomes in critical illness [7]. It has been demonstrated that septic patients with COPD exhibit a greater burden of comorbidities compared to those without COPD [8]. The Charlson Comorbidity Index (CCI) is a validated tool used to predict mortality by classifying and weighting comorbid conditions. In COPD populations, a higher CCI has been associated with increased mortality [9, 10]. Similarly, a study in septic patients found that age-adjusted regression analysis showed a 2.3-fold increase in mortality risk among patients with moderate CCI scores and a 4.2-fold increase in those with high CCI scores, compared to those with low CCI scores [11]. The modified CCI (mCCI) version incorporates age as an additional factor, providing a more comprehensive assessment of a patient's overall health status [12]. A recent investigation in septic shock patients demonstrated that a mCCI score ≥ 6 was associated with significantly higher 30-day mortality [13].

In addition to comorbidities, elevated inflammatory biomarkers have been linked to worse prognoses in these patients. A systematic review and meta-analysis found that COPD patients with high C-reactive protein (CRP) and procalcitonin levels had a significantly higher risk of long-term mortality compared to those with lower CRP levels [14-17]. However, a thorough analysis that includes mCCI and other laboratory parameters in predicting mortality among ICU-admitted COPD patients with septic shock has yet to be performed.

Given the significant overlap and interplay between COPD, comorbidities, and the septic inflammatory response, it is crucial to identify which factors most strongly influence survival in COPD patients facing septic shock. Therefore, this study aimed to investigate the in-hospital mortality-related factors in COPD patients admitted to the ICU due to septic shock.

Material and Methods

This retrospective study was carried out at the ICU of Internal Medicine in University of Health Sciences Konya City Hospital between June 2023 to June 2024, adhering to the ethical principles outlined in the Declaration of Helsinki. Approval was obtained from the Medical Faculty of the Non-Drug and Non-Medical Device Research at KTO Karatay University Faculty of Medicine (Date: 26.09.2024, Decision No: 2024/005). Given the retrospective nature of the study, the Local Ethics Committee waived the requirement for informed consent.

Study Population

Our hospital's internal medicine ICU has a capacity of 45 beds. Throughout the study period, a total of 508 sepsis patients hospitalized in ICU were retrospectively reviewed for study eligibility. The inclusion criteria consisted of COPD patients over 18 years of age with a confirmed diagnosis of septic shock. The Sepsis-3 criteria were used to establish the diagnosis of sepsis shock [18]. Exclusion criteria included patients without COPD, those with metastatic malignancies, those with hematological malignancy, those with acute pancreatitis, those with trauma, recent major surgery, pregnancy, and incomplete data. After applying the exclusion criteria, 62 patients were included in the final analysis.

Data Collection

Demographic, and clinical data were retrospectively collected from electronic patient records. The comorbid conditions of all patients prior to ICU admission were documented, and mCCI scores were calculated accordingly. As described earlier, mCCI is a more simplified form of the CCI, consisting of 12 comorbid conditions with a weighted total score ranging from 0 to 24. The age-adjusted score is determined by adding 1 point for every 10 years beyond the age of 50 [12].

Biochemical parameters were obtained from patient records based on venous blood samples collected at the time of ICU admission. The ratio of partial pressure of oxygen (PaO2) to fraction of inspired oxygen (FiO2) and partial pressure of carbon dioxide (PCO2) was determined using the initial arterial blood gas analysis conducted by ABL90 FLEX PLUS device (Radiometer, Copenaghen, Denmark) in the ICU department. Patients' venous blood samples were evaluated using a Roche Cobas 8000 device (Roche Diagnostics, Mannheim, Germany). Levels of platelet were determined the impedance method, CRP using the immunoturbidimetric method, albumin through the bromocresol green method, and creatinine with the kinetic colorimetric Jaffe method. Acute Physiology and Chronic Health Evaluation (APACHE II) scores, which indicate mortality risk, and Sequential Organ Failure Assessment (SOFA) scores, used as diagnostic criteria for sepsis, were calculated based on the worst clinical and laboratory findings within the first 24 hours of ICU admission. For patients who died within the first 24 hours of ICU admission, APACHE II scores were determined using their most severe clinical and laboratory parameters.

The length of stay (LOS) in both the hospital and ICU was calculated using admission and discharge dates. Clinical outcomes (alive or deceased) in the ICU and hospital were extracted from electronic medical records. Mortality was considered as any death occurring during the 30-day period between the patient's admission to the intensive care unit and discharge.

Statistical Analysis

All data were analyzed with STATA/MP v.16 software (StataCorp LLC, Texas, USA). Numerical data determined to be normally distributed based on the results of Kolmogorov-Smirnov tests are given as mean ± standard deviation values, while non-normally distributed variables are given as median (25th-75th quartiles) values. Univariable Cox regression analysis was used to identify demographic and clinical parameters associated with mortality. Independent predictors of mortality were determined using multivariable Cox regression analysis with the backward Wald method. The results of the regression analysis were presented as hazard ratios (HR) with 95% confidence intervals (CI). The survival plot was created using the Kaplan-Meier method. The receiver operating characteristic (ROC) curve analysis was applied to assess diagnostic performance, and the results of area under the curve (AUROC), standard error (SE), and sensitivity and specificity are reported. The optimal threshold value of the inflammation indices was determined by the Youden index method. Significance was accepted at $P < 0.05$ (*) for all statistical analyses.

Results

A total of 62 patients were included in the study, with a mean age of 70.6 ± 11.0 years. The majority of the population was male (67.7%, n=42), while females accounted for 32.3% (n=20). Comorbid conditions were prevalent among the study population, with hypertension (58.1%) and diabetes mellitus (45.2%) being the most common. Other significant comorbidities included coronary artery disease (48.4%), acute renal failure (35.5%), chronic renal failure (21.0%), congestive heart failure (24.2%), dementia (24.2%), cancer (29.0%), asthma (19.4%), and gastrointestinal bleeding (6.5%). The median mCCI was 5.0 (IQR: 4.0–7.0). Regarding disease severity, the mean APACHE II score was 29.2 ± 7.1, while the median SOFA score was 10.0 (IQR: 8.0–14.0). The median ICU LOS was 9.0 days (IQR: 4.0–17.5), while the median hospital LOS was 19.0 days (IQR: 11.0–26.0). In-hospital mortality rate was 62.9%.

Older age was significantly associated with increased mortality (HR: 1.05, 95% CI: 1.02 – 1.08, p = 0.002). Among the comorbid conditions, acute renal failure was associated with a higher mortality risk (HR: 2.15, 95% CI: 1.14 – 4.04, p=0.017). Other comorbid conditions did not show a significant effect on mortality. A higher mCCI score was significantly associated with increased mortality (HR: 1.23, 95% CI: 1.07 – 1.40, p=0.002). Similarly, higher APACHE II scores were associated with mortality (HR: 1.15, 95% CI: 1.09 – 1.22, p<0.001), as well as higher SOFA scores (HR: 1.35, 95% CI: 1.21 – 1.50, p<0.001) (Table 1).

Higher leukocyte counts (HR: 1.04, 95% CI: 1.01 – 1.07, p = 0.017), increased count neutrophils counts (HR: 1.03, 95% CI: 1.01 – 1.08, p = 0.035), elevated procalcitonin levels (HR: 1.04, 95% CI: 1.02 – 1.06, p < 0.001), and higher CRP levels (HR: 1.03, 95% CI: 1.01 – 1.05, p < 0.001) were associated with mortality. Other laboratory parameters, including platelet count, glucose, albumin, creatinine, and electrolyte levels, were not significantly associated with mortality (Table 2).

Table 1. Relationship between demographic characteristics and mortality in patients with septic shock.

Variables	Alive	Deceased	HR	%95 CI		P-value
	n=23	n=39		lower	upper	
Gender, n (%)						
Female	4 (17.4)	16 (41.0)	ref			
Male	19 (82.6)	23 (59.0)	1.03	0.54	1.98	0.927
Age, years	62.4 ± 7.1	75.4 ± 10.0	1.05	1.02	1.08	0.002*
Comorbidity, n (%)						
Diabetes mellitus	6 (26.1)	22 (56.4)	1.61	0.85	3.06	0.142
Hypertension	10 (43.5)	26 (66.7)	1.11	0.56	2.18	0.764
CHF	5 (21.7)	10 (25.6)	1.01	0.49	2.08	0.973
Dementia	2 (8.7)	15 (38.5)	1.45	0.76	2.76	0.263
CRF	6 (26.1)	7 (17.9)	0.56	0.24	1.32	0.185
ARF	3 (13.0)	19 (48.7)	2.15	1.14	4.04	0.017*
GI bleeding	2 (8.7)	2 (5.1)	0.39	0.09	1.63	0.196
Asthma	6 (26.1)	6 (15.4)	0.88	0.37	2.11	0.776
CAD	9 (39.1)	21 (53.8)	1.17	0.62	2.20	0.622
Cancer	5 (21.7)	13 (33.3)	1.24	0.63	2.44	0.542
mCCI	4.0 (3.5-5.0)	7.0 (5.0-8.0)	1.23	1.07	1.40	0.002*
APACHE II score	24.3 ± 4.3	32.0 ± 6.9	1.15	1.09	1.22	<0.001*
SOFA score	8.0 (6.0-10.0)	12.0 (10.0-17.0)	1.35	1.21	1.50	<0.001*
ICU LOS, days	7.0 (4.0-9.5)	12.0 (3.0-19.5)	0.99	0.95	1.03	0.503
Hospital LOS, days	23.0 (17.0-30.0)	12.0 (5.5-21.0)	-	-	-	-

Data are mean±standard deviation or median (IQR), or number (%). *p<0.05 indicates statistical significance. APACHE II, Acute Physiology and Chronic Health Evaluation II; ARF, Acute Renal Failure; CAD, Coronary Artery Disease; CHF, Congestive Heart Failure; CI, Confidence Interval; CRF, Chronic Renal Failure; GI, Gastrointestinal; HR, Hazard Ratio; ICU, Intensive Care Unit; LOS, Length of Stay; mCCI, Modified Charlson Comorbidity Index; SOFA, Sequential Organ Failure Assessment.

Table 2. Relationship between laboratory paramters and mortality in patients with septic shock.

Variables	Alive	Deceased	HR	%95 CI		P-value
	n=23	n=39		lower	upper	
Leukocytes, 106/μL	10.8 (8.8-13.8)	15.7 (10.9-21.7)	1.04	1.01	1.07	0.017*
Neutrophils, 106/μL	8.8 (7.2-12.1)	13.6 (6.3-15.9)	1.03	1.01	1.08	0.035*
Lymphocytes, 106/μL	1.0 (0.5-1.1)	0.8 (0.4-1.3)	1.00	0.98	1.02	0.290
Platelets, 103/μL	197.0 (122.0-234.0)	123.0 (75.0-192.0)	0.99	0.98	1.03	0.698
Glucose, mg/dL	132.0 (103.0-224.5)	129.0 (89.5-216.0)	1.00	0.98	1.03	0.934
Lactate, mmol/L	2.8 (2.3-4.0)	3.6 (2.5-4.5)	1.02	1.01	1.04	0.022*
Procalcitonin, μg/L	1.0 (0.5-5.9)	2.5 (0.8-6.4)	1.04	1.02	1.06	<0.001*
Albumin, mg/dL	2.8 ± 0.6	2.6 ± 0.5	1.05	0.56	1.99	0.872
CRP, mg/L	98.4 (37.3-176.7)	132 (64.0-201.7)	1.03	1.01	1.05	<0.001*
Creatinine, mg/dL	1.2 (0.8-2.4)	1.7 (1.0-3.0)	1.13	0.92	1.39	0.242
Sodium, mg/dL	138.5 ± 7.1	136.0 ± 7.9	0.96	0.92	1.01	0.106
Potassium, mg/dL	4.5 ± 0.6	4.6 ± 1.1	1.32	0.93	1.86	0.123
INR	1.3 (1.1-1.5)	1.4 (1.3-2.3)	1.19	0.91	1.55	0.207

Data are mean±standard deviation or median (IQR), or number (%). *p<0.05 indicates statistical significance. CI, Confidence Interval; CRP, C-reactive protein; HR, Hazard Ratio; INR, International Normalized Ratio.

The multivariate regression analysis, which accounted for all potential risk factors, identified higher mCCI, increased APACHE II scores, and elevated SOFA scores as independent predictors of mortality. Notably, each one-point rise in mCCI was linked to a 1.28-fold increase in mortality risk, independent of other contributing factors (Table 3). Each of the three scoring systems exhibited comparable diagnostic performance in predicting mortality (Figure 1) (Table 4). For predicting mortality, the optimal mCCI threshold was ≥7, yielding a sensitivity of 72.5% and a specificity of 94.7% (AUROC = 0.85) (Table 4). Patients with mCCI ≥7 exhibited a 2.92-fold increased risk of mortality compared to those with mCCI <7 (Figure 1).

Table 3. Independent predictors of mortality in patients with septic shock.

Variables	HR	%95 CI		P-value	-2 Log Likelihood
		Lower	Upper		
mCCI	1.28	1.10	1.49	0.002*	228.6
APACHE II score	1.11	1.04	1.19	0.003*	
SOFA score	1.23	1.09	1.39	0.001*	

*p<0.05 indicates statistical significance. APACHE II, Acute Physiology and Chronic Health Evaluation II; CI, Confidence Interval; Hazard Ratio; HR, Hazard Ratio; mCCI, Modified Charlson Comorbidity Index; SOFA, Sequential Organ Failure Assessment.

Table 4. Diagnostic performance of independent predictors associated with mortality.

ROC Curve findings	mCCI	APACHE II	SOFA
AUC ± SE	0.85 ± 0.05	0.90 ± 0.04	0.84 ± 0.05
95% CI	0.76-0.95	0.79-0.96	0.73-0.92
Sensitivity, (%)	72.5	76.9	61.5
Specificity, (%)	94.7	86.9	95.6
Threshold	≥7	>26	>10

APACHE II, Acute Physiology and Chronic Health Evaluation II; AUC, area under the curve; CI, confidence interval; mCCI, Modified Charlson Comorbidity Index; SOFA, Sequential Organ Failure Assessment.

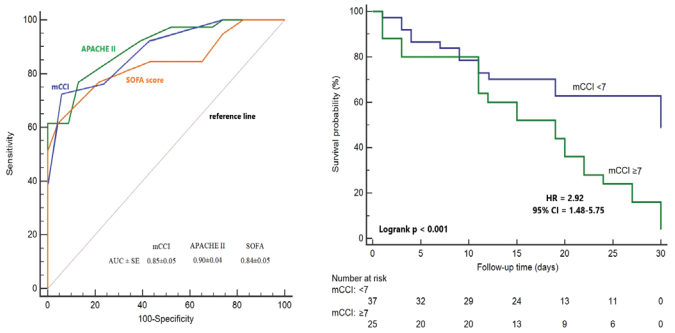

Figure 1. Diagnostic performance of mCCI, APACHE II score, and SOFA score in predicting mortality (left side), and mortality risk according to mCCI threshold value.

Discussion

This study identified several key factors associated with increased mortality in COPD patients admitted to the ICU due to septic shock. Notably, older age, higher mCCI scores, elevated APACHE II and SOFA scores, and increased levels of inflammatory markers such as leukocyte count, procalcitonin, and CRP were significantly associated with higher mortality risk. Among these potential risk factors, mCCI, APACHE II score, and SOFA score were independently associated with mortality, yet they exhibited similar diagnostic performance.

The finding that older age correlates with increased mortality aligns with existing literature, as advanced age often contributes to diminished physiological reserves and a reduced capacity to respond to severe infections [19, 20]. In our study, deceased patients had a higher prevalence of coronary artery disease, cancer, acute renal failure, dementia, hypertension, and diabetes mellitus. However, among these conditions, only acute renal failure was significantly linked to mortality. Previous study noted that coronary artery disease was about twice as common in COPD patients who died in ICU, with CAD nearly tripling the odds of ICU mortality [7]. Similarly, heart failure, diabetes, and renal impairment each showed elevated odds of death in COPD patients with critical illness [8, 21, 22]. Similarly, the association between higher mCCI scores and increased mortality underscores the impact of comorbid conditions on patient outcomes. The mCCI is a well-established tool for predicting mortality by accounting for various comorbidities, and its significance in this study is consistent with previous research demonstrating its prognostic value in critically ill populations. A previous study on critically ill patients with COPD exacerbation reported that 66.7% of deceased patients had sepsis, and the vast majority of these patients had chronic kidney failure, heart failure, and coronary artery disease [23]. In the same study, older age, a higher APACHE II score, an increased CCI score, and elevated lactate levels at admission were defined as independent risk factors for 28-day ICU mortality [23]. A study including 529 patients treated in a mobile ICU reported that 154 patients had septic shock, with the primary suspected source of infection being pulmonary in origin. Analysis of this subgroup revealed that patients with a modified prehospital CCI score greater than 5 had a 1.12-fold higher 30-day mortality risk [13]. Compared to the referenced study, our study identified mCCI threshold for mortality prediction as 7. This variation may be due to the fact that all patients in our study had septic shock. This findings strongly supports that a high comorbidity burden portends worse survival in COPD patients with septic shock, reinforcing the need to account for chronic illnesses when prognosticating and managing these patients.

Elevated APACHE II and SOFA scores were also identified as independent predictors of mortality. These scoring systems are widely used to assess disease severity and organ dysfunction in ICU patients, and their predictive value has been validated in numerous studies [24, 25]. The strong association observed in this study reinforces their utility in prognostication and guiding clinical decision-making. A recent cohort of 128 septic shock patients found that non-survivors had significantly higher APACHE II scores than survivors, and APACHE II discriminated mortality with an AUROC of about 0.78 [26]. A previous study on sepsis patients reported reported SOFA's AUROC around 0.77 for in-hospital mortality, nearly identical to APACHE II's performance (AUROC ~0.78) [27]. Interestingly, in our study, APACHE II and SOFA scores demonstrated higher AUROC values compared to previous reports. This may be attributed to the specific population studied, as our cohort consisted exclusively of COPD patients with septic shock. Previous studies have shown that APACHE II calibration can vary by population, sometimes underestimating actual mortality [26]. On the other hand, the inflammatory response of the patients may have had an impact on the scoring systems.

A decline in procalcitonin during the first 2–5 days signals infection control and improving status; one study reported that a >50% decrease in procalcitonin levels from day 0 to

day 5 was the single independent predictor of survival in multivariable analysis [28]. Likewise, it has been reported that temporal changes in CRP levels serve as a reliable predictor of mortality in ICU-admitted septic patients [29]. Another study demonstrated that a CRP level greater than 100 mg/dL on day 3 was linked to an elevated sepsis-related mortality risk. However, CRP was found to be a less reliable mortality predictor than the SOFA score [30]. In our study, inflammatory markers such as procalcitonin and CRP were associated with mortality in univariate analysis but were not retained as independent predictors in multivariate regression. This may be explained by the stronger prognostic role of organ dysfunction scores, such as SOFA, in septic shock. In previous study conducted on severe sepsis/septic shock patients, baseline serum IL-6 and procalcitonin levels showed a significant correlation with the SOFA score, whereas the APACHE II score correlated strongly only with sTREM-1 (a myeloid cell activation marker) [28]. Another study found that IL-6 levels rise in proportion to organ failure severity: patients stratified by SOFA had significantly different IL-6 – higher SOFA groups had markedly higher IL-6 peaks [31]. These findings may explain why, in our cohort, inflammatory markers did not remain independent predictors after adjusting for disease severity scores.

This study has several limitations. First, it was conducted in a single center, which may limit the generalizability of the findings to other ICU settings with different patient populations and management protocols. Second, the retrospective study design may introduce selection bias and restrict the ability to establish causal relationships between risk factors and mortality. Third, although inflammatory markers such as CRP and procalcitonin were associated with mortality in univariate analysis, their dynamic changes over time were not evaluated, which might have provided additional prognostic insights. Finally, due to the exclusion of patients with hematological malignancies and metastatic cancer, the findings may not be applicable to critically ill COPD patients with advanced oncological diseases. To address these limitations, future research should focus on prospective multicenter studies with larger cohorts, include serial inflammatory biomarker measurements, explore the long-term impact of sepsis in COPD patients, and refine predictive models by integrating additional clinical and laboratory variables.

Conclusion

This study demonstrated that higher mCCI, as well as elevated APACHE II and SOFA scores, were associated with an increased risk of mortality. These results emphasize the critical role of comorbid burden and disease severity and organ dysfunction in determining outcomes for COPD patients with septic shock. Given the compounded effect of pre-existing chronic diseases and sepsis-induced organ failure, early identification of high-risk patients using mCCI and severity scores may facilitate targeted interventions to improve survival.

Ethics Committee Approval

The study was conducted with the permission of the KTO Karatay University Hospital Ethics Committee (Date: 26.09.2024, Decision No: 2024/005).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Authors' contribution

Conceptualization – K.K., Design – K.K., Data curation – K.K. and S.Ö.Ç., Validation – K.K., Formal analysis – K.K. and S.Ö.Ç., Resources – K.K. and S.Ö.Ç., Writing – K.K., Critical review – S.Ö.Ç. All authors read and approved the final version of the manuscript.

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