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Research Article

Factors Affecting Mortality in Chronic Obstructive Lung Disease

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Objective: Chronic obstructive pulmonary disease (COPD) is a progressive lung disease causing inflammation and airflow limitation. COPD is a major cause of death worldwide. In Türkiye, COPD represents a significant health concern, ranking as the third leading cause of mortality. This study investigates factors predicting mortality in stable COPD patients. We aim to identify factors beyond respiratory function tests that can guide prognosis in these patients.

Materials and Methods: We analyzed data from 75 deceased COPD patients and 98 age-matched living patients with COPD. Pulmonary function tests and blood tests were reviewed. Statistical analysis identified potential relationships between lung function, co-morbidities, and mortality in COPD.

Results: While no significant differences in demographics (gender, age, smoking history, BMI) were found, lung function (%FEV1, %FVC, PEF, MEF25-75) was significantly associated with mortality in deceased patients. Deceased patients also had lower hemoglobin, hematocrit, and higher sedimentation/CRP levels. Eosinophil levels were significantly higher in living patients. Multivariate logistic regression analysis revealed heart failure and lung cancer as significant factors for COPD mortality.

Discussion and Conclusion: This study investigated the factors predicting mortality in COPD. Elevated inflammatory markers in stable COPD patients suggested persistent inflammation. Our findings indicate that Pulmonary Function Tests, eosinophil count, hemoglobin, hematocrit, CRP, and sedimentation rate may be valuable predictors of mortality in these patients. These markers offer advantages due to their affordability, rapid accessibility, and practicality for follow-up.

Keywords: Chronic obstructive pulmonary disease, Mortality, Pulmonary function test

1. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable chronic disease in which harmful gases and particles cause inflammation in the lungs and airways, leading to progressive air restriction. It is responsible for most of the deaths caused by the respiratory system diseases. COPD is a serious airway disease that causes the death of 3 million people every year in the world. It is thought that this number will be 4.5 million in 2030[1]. According to the World Health Organization, COPD is predicted to be the third leading cause of death in 2030. The prevalence of COPD in Türkiye is 19.1%. It is the 4th most common disease causing mortality in the world and the 3rd cause in Türkiye[2].

The disease progresses with exacerbations. Exacerbations cause the disease to progress. In COPD, where there is a chronic inflammatory response to harmful gases and particles, inflammation is not only limited to the lung but also shows systemic features. The disease is common in smokers and its frequency increases with age. Comorbidities accompanying COPD contribute to the progression of the disease, make the management of the disease difficult, and contribute to the severity and mortality of COPD. These include diseases such as cardiovascular diseases, osteoporosis, muscle weakness, endocrinological and metabolic diseases, and cancer3. Mortality is a diagram that shows the death rate for a target population over a specific period of time. Accurate prediction of mortality is important, thus helping to identify patients for

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whom therapeutic measures will improve outcomes. The following factors are important in showing mortality in COPD: respiratory function tests, patient age, gender, body mass index, six-minute walk test, arterial hypoxemia, hypercapnia values, exacerbation frequency and comorbid diseases[4].

Studies on biomarkers indicating mortality in stable COPD patients are limited. Our aim is to examine the factors that predict mortality in patients who come to the regular outpatient clinic for routine check-ups other than COPD attacks.

2. MATERIAL AND METHODS

886 patients diagnosed with COPD who applied to Kahramanmaraş Sütçü İmam University Chest Diseases Polyclinic and came for routine control were analysed retrospectively. A total of 75 deceased COPD patients who came to our hospital within the last 6 months and had Pulmonary function test (PFT) and blood tests performed were included in the study. Among the living COPD patients, 98 age-matched COPD patients were added to the study. The medical records of deceased patients were retrospectively reviewed. The blood parameters of the patients included in the study were evaluated in the stable period, not during the acute attack period. Patients were excluded from the study if they did not have PFT or if their PFT results did not meet the international GOLD criteria for COPD, had chronic kidney failure, hematological diseases, cirrhosis, or non-COPD lung pathologies (interstitial lung diseases, bronchiectasis). However, patients admitted during an acute exacerbation were not included in the study. Causes of death in COPD patients were also not considered. Pulmonary function testing was performed in COPD patients using the ZAN 500 spirometer. In accordance with the GOLD criteria, a forced expiratory volume in one second (FEV1)/forced vital capacity (FVC) ratio of <70% was used as the diagnostic threshold for COPD. COPD severity was categorized into four stages based on FEV1 values (≥80% predicted, mild; 50% ≤ FEV1 <80% predicted, moderate; 30% ≤ FEV1 <50% predicted, severe; FEV1 <30% predicted, very severe).

Data analysis was performed using the SPSS (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL) 22 software package. Descriptive statistics were presented as n (%) for categorical variables and mean ± standard deviation (Mean ± SD) for continuous variables. Between-group comparisons of categorical variables were conducted using the Pearson Chi-square test, while comparisons of parametric continuous variables were performed using Student's t-test. Multiple logistic regression analysis adjusted for gender and age was carried out to identify risk factors for mortality in COPD patients. The level of statistical significance was set at $p<0.05$ for the analysis.

The study was approved by the Kahramanmaras Sütçü İmam University Ethics Committee (Decision Date: 06.06.2013, Decision No: 79) to ensure ethical compliance. Written institutional permission was obtained from the hospital where the study was conducted.

3. FINDINGS

The study involved 173 patients with chronic obstructive pulmonary disease (COPD), including 75 deceased patients and 98 living patients. Among the deceased patients, 65 (86.7%) were male and 10 (13.3%) were female. In the living patients, 82 (83.7%) were male and 16 (16.3%) were female. The mean age of the deceased patients was 74±9.9 years, while the mean age of the living patients was 71.6±9.8 years. There were no statistically significant differences in mortality based on gender, age, smoking history, or body mass index (BMI) (Table 1).

Table 1.

Demographic findings

	Deceased COPD(n=75)	**Living COPD(n=98)**	**P value**
Sex (Male/Female)	65/10(%86.7/13.3)	82/16(%83,7/16.3)	p=0.59
Age	74±9.9	71.6±9.8	p=0.11
Height	166.7±7.1	166±8.9	p=0.6
Weight	71.9±16.4	73.1±14.3	p=0.61
BMI	25.8±5.5	26.5±5.1	p=0.39
Cigarette pack year	41.3±24.4	36.5±26.8	p=0.41

Abbreviations: BMI: Body Mass Index, COPD: Chronic Obstructive Pulmonary Disease

FEV1 as a percentage of predicted was 51.8 ± 19.4 in deceased COPD patients and 59.5 ± 19.4 in living COPD patients. Our study found a significant association between mortality and FEV1%, FVC%, peak expiratory flow (PEF), and maximal expiratory midflow (MEF25-75)% values ($p < 0.05$) (Table 2).

Table 2.

Respiratory function test and blood results

	Deceased COPD(n=75)	**Living COPD(n=98)**	**P Value**
FEV1	51.8±19.4	59.5±19.4	p=0.011
FVC	67.1±19.8	81.6 ± 21.6	p=0.000
FEV1/FVC	58.8±9.9	57.3±10	p=0.34
PEF	36.8±19.3	44.9±18.7	p=0.007
MEF25-75	38.5±18.7	29.8±14.9	p=0.001
Hemoglobin	13.1±2	14.4±1.2	p=0.000
Hematocrit	39.8±6.3	43.3±3.4	p=0.000
MCV	87.3±7.1	86.8±7.9	p=0.7
Platelet	266.4±111,5	265.5±69.4	p=0.95
MTV	8.3±1.1	8.2±0.9	p=0.3
Sedimentation	38.8±26.1	22,4±15.7	p=0.001
CRP	31.8±33.1	10,6±15.4	p=0.000
Leukocyte	8.9±3.1	8.7±2.1	p=0.74
Neutrophil	6.1±2.9	5.7±1,8	p=0.31
Lymphocyte	1,7±1.1	1.9±0.7	p=0.06
Monosit	1.1±2.1	0.7±0.9	p=0.22
Eosinophil	0.16±0.19	0.27±0.33	p=0.02
Basophil	0.68±0.09	0.08±0.11	p=0.48
Lymphocyte/neutrophil	6.1±8.1	4.1±5.9	p=0.69

Abbreviations: **FEV1**: Forced Expired Volume in 1 Second, **FVC**: Forced Vital Capacity, **PEF**: Peak Expiratory Flow, **MEF25-75**: Maximum Expiratory Flow 25-75% of FVC, **MCV**: Mean Corpuscular Volume, **MTV**: Mean Thrombocyte Volume, **CRP**: C-Reactive Prote

Hemoglobin levels were significantly higher in living patients (14.4 ± 1.2 g/dL) compared to deceased patients (13.1 ± 2.0 g/dL). Similarly, hematocrit levels were also significantly higher in living patients (43.3 ± 3.4%) compared to deceased patients (39.8 ± 6.3%). These findings were statistically significant.

Sedimentation was 38.8±26.1 in deceased patients and 22.4±15.7 in living patients (p<0.01). CRP was 31.8±33.1 in deceased patients and 10.6±15.4 in living patients (p<0.01). Sedimentation and CRP values were significantly lower in living patients.

Eosinophil level was 0.16±0.19 in deceased patients and 0.27±0.33 in living patients, and this finding was significantly higher in living patients (p:0.02). Lymphocyte/neutrophil count was 6.1±8.1 in deceased patients and 4.1±5.9 in living patients. Leukocyte, monocyte, lymphocyte/neutrophil ratio, basophil, platelet and neutrophil ratio were higher in deceased COPD patients but the difference was not statistically significant. Table 2 summarizes the respiratory function test and hemogram results of the study participants.

In multiple logistic regression analysis, heart failure [OR 95%CI: 2.734 (1.097 to 6.818)] and lung cancer [OR 95%CI: 8.116 (1.433 to 45.963)] were identified as significant risk factors for COPD mortality, independent of age and gender (p<0.05). (Table 3)

Tablo 3.

Multiple logistic regression analysis adjusted for gender, age and comorbidities to identify risk factors for mortality in COPD patients.

	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.	
					P Value	OR value	Lower	Upper
Diabetes Mellitus	.048	.693	.005	1	0.945	1.049	.269	4.083
Heart Failure	1.006	.466	4.656	1	0.031	2.734	1.097	6.818
Hypertension	-.869	.473	3.367	1	0.067	.419	.166	1.061
Gastrointestinal diseases	1.073	.630	2.901	1	0.089	2.924	.851	10.054
Lung Cancer	2.094	.885	5.601	1	0.018	8.116	1.433	45.963

Entered variables: Diabetes mellitus, heart failure, Hypertension, Stomach diseases, lung cancer.

4. DISCUSSION

COPD is a prevalent disease with a significant impact on mortality. Several factors contribute to COPD mortality, among which smoking stands out as a primary determinant. Smokers exhibit a steeper decline in FEV1, a key lung function measure, and experience higher mortality rates compared to non-smokers5. In our study, the cigarette pack-year rate was higher in deceased patients compared to living patients; however, this difference did not reach statistical significance.

COPD is more common in men and increases in frequency with age. This may be due to the fact that men smoke more and are more exposed to dust and particles in their professions. In our study, 65 of the 75 COPD patients who died were men, and although not significant, the death rate was higher.

PFT play a crucial role in the diagnosis of COPD and are also necessary for staging the disease. In patients diagnosed with COPD, there is a decrease in FEV1, FVC, MEF25-75, PEF and FEV1/FVC depending on the severity of airway obstruction.

The decrease in FEV1 is more pronounced than the decrease in FVC. FEV1 is a measure of the severity of airflow obstruction and is among the determinants of mortality. It is the most commonly used parameter to predict mortality[6]. In our study, we found that spirometric parameters FEV1 and FVC were significantly associated with mortality. FEV1 and FVC were significantly lower in COPD patients who died ($p<0.05$). PEF is the maximum airflow rate obtained during forced vital capacity (FVC) maneuver. It is used to assess obstruction in the large airways and is correlated with FEV1. A study by Jithoo et al. found that pre-bronchodilator PEF measurement was effective in identifying patients with moderate to severe COPD[7]. In our study, PEF was found to be significantly lower in patients who died ($p=0.007$). MEF25-75 reflects airflow in small airways and is reduced in COPD patients[8]. COPD leads to small airway disease. One study mentioned that MEF25-75 may be falsely high in patients with severe obstruction because the expiration time is shortened[9]. In our study, MEF25-75 was significantly higher in deceased COPD patients ($p=0.001$), and this finding may be due to shortened of expiration time.

Age-related changes in the lungs are similar to those in COPD. As people age, lung function deteriorates, and the incidence of disease and mortality increases[10]. In our study, the age of the deceased patients was not significantly different, but was found to be higher.

Low hemoglobin levels lead to reduced exercise tolerance, increased dyspnea, and impaired quality of life. A study has shown that low hemoglobin is associated with increased mortality[11]. In our study, hemoglobin and hematocrit values were found to be significantly higher in living COPD patients, which is consistent with the literature ($p<0.01$). Higher hemoglobin and hematocrit levels observed in surviving patients highlight the importance of managing anemia to improve patient survival.

Sedimentation and CRP are used as clinical markers of acute inflammation. In chronic diseases such as COPD, elevated CRP levels can be observed due to chronic inflammation. Inflammatory markers are important for monitoring COPD prognosis and predicting exacerbations. CRP is an acute phase reactant that increases in inflammation. It has been shown to be elevated in COPD patients in both stable and exacerbation phases[12]. A study found a slight to moderate increase in plasma concentration to be associated with mortality in patients with stable COPD[13]. Some studies in COPD patients have found increased CRP to be associated with mortality and decreased lung function[14]. In our study, CRP and sedimentation rate were significantly higher in patients who died ($p<0.01$).

A study found that eosinophil levels were twice as high in outpatient COPD patients compared to hospitalized patients[15]. Another study reported that COPD patients with eosinophilia had higher lung function and fewer exacerbations[16]. In our study, eosinophil levels were significantly higher in living COPD patients ($p = 0.02$). In early stages of COPD, lung cancer and heart failure are the most significant causes of mortality, while in later stages respiratory failure is the leading cause of death[17]. In our study, the presence of heart failure and lung cancer was found to be significantly associated with increased mortality ($p<0.05$). Presence of comorbidities such as heart failure and lung cancer significantly worsened the prognosis of patients with COPD. These comorbidities are frequently found in conjunction with COPD and can increase disease severity and mortality risk.

Our findings highlight the complex interplay of factors such as age, sex, lung function parameters, hematologic indices, inflammatory markers, and comorbidities significantly influence mortality. The higher hemoglobin and hematocrit levels observed in surviving patients highlight the importance of managing anemia to improve patient survival. By addressing modifiable risk factors, optimizing medical management, and implementing early intervention strategies, we can improve the prognosis of COPD patients and reduce mortality rates.

Although our study offers valuable information regarding factors associated with COPD mortality, several limitations should be considered. The retrospective nature of the study and its relatively small sample size may restrict the generalizability

of our results. Moreover, the absence of detailed data on specific variables, including environmental exposures and medication adherence, could have affected the outcomes.

5. CONCLUSION

Chronic inflammation plays a crucial role in the pathogenesis of COPD. In our study, elevated levels of inflammatory markers such as CRP and sedimentation rate in stable COPD patients indicate the persistence of inflammation. Our data suggests that SFT, eosinophil count, hemoglobin, hematocrit, CRP, sedimentation and comorbidities such as heart failure are valuable predictors of mortality in the follow-up of stable COPD patients. The affordability, rapid accessibility, and practicality of these tests during follow-up constitute an advantage.

Article Information Form

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Authors' Contribution

Idea and design in our researches H.Ş and H.K; Supervision; H.Ş and H.K, Collection and Processing of Data; H.Ş and H.K, Analysis and Interpretation of Data; H.Ş and H.K, Writing of the Manuscript; All authors agreed to be responsible for the accuracy and completeness of the study

The Declaration of Conflict of Interest/ Common Interest

No conflict of interest or common interest has been declared by authors.

REFERENCES

1. Singh D, Agusti A, Anzueto A, Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Lung Disease: the GOLD science committee report 2019. *European Respiratory J*. 2019;53(5). doi:10.1183/13993003.00164-2019
2. Bingöl Z, Çağatay İ. Exacerbation causes in patients with chronic obstructive pulmonary disease (COPD): Diagnosis, treatment, and awareness of risk group patients. *Klinik Tıp Aile Derg.* 2016;8(5).
3. Rabe KF, Wedzicha JA. Controversies in treatment of chronic obstructive pulmonary disease. *The Lancet*. 2011;378(9795):1038-1047. doi:10.1016/S0140-6736(11)61295-6
4. Halpin DMG, Peterson S, Larsson TP, Calverley PMA. Identifying COPD patients at increased risk of mortality: Predictive value of clinical study baseline data. *Respiratory medicine*. 2008;102(11):1615-1624. doi:10.1016/J.RMED.2008.05.007
5. Leuzzi G, Galeone C, Taverna F, Suatoni P, Morelli D, Pastorino U. C-reactive protein level predicts mortality in COPD: A systematic review and meta-analysis. *European Respiratory Review*. 2017;26(143). doi:10.1183/16000617.0070-2016
6. Traver GA, Cline MG, Burrows B. Predictors of mortality in chronic obstructive pulmonary disease. A 15-year follow-up study. *The American review of respiratory disease*. 1979;119(6):895-902. doi:10.1164/ARRD.1979.119.6.895
7. Kocabaş A, Atış S, Çöplü L, Turkish Thoracic Society COPD Study Group. Kronik obstrüktif akciğer hastalığı (KOAH) koruma, tanı ve tedavi raporu. *Türk Toraks Derneği.* Published online 2014.
8. Pellegrino R, Viegi G, Brusasco V. Interpretative strategies for lung function tests. *European Respiratory Journal*. 2005;26(5):948-968. doi:10.1183/09031936.05.00035205
9. Ulubay G, Dilektaşlı AG, Börekçi Ş. Turkish Thoracic Society Consensus Report: Interpretation of Spirometry. *Turkish thoracic J*. 2019;20(1):69-89. doi:10.5152/TURKTHORACJ.2018.180175
10. Corsonello A, Scarlata S, Pedone C. Treating COPD in older and oldest old patients. *Current Pharmaceutical Des*. 2015;21(13):1672-1689. doi:10.2174/1381612821666150130121229
11. Budnevsky A V., Esaulenko IE, Ovsyannikov ES, Zhusina YG. [Anemias in chronic obstructive pulmonary disease].

Terapevticheskii Arkhiv. 2016;88(3):96-99. doi:10.17116/TERARKH201688396-99

12. Pepys MB, Hirschfield GM. C-reactive protein: A critical update. *J Clin Invest*. 2003;111(12):1805-1812. doi:10.1172/JCI18921
13. Barnes PJ, Celli BR. Systemic manifestations and comorbidities of COPD. *Eur Respir J*. 2009;33(5):1165-1185. doi:10.1183/09031936.00128008
14. Dahl M, Vestbo J, Lange P, Bojesen SE, Tybjærg-Hansen A, Nordestgaard BG. C-reactive protein as a predictor of prognosis in chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 2007;175(3):250-255. doi:10.1164/RCCM.200605-713OC
15. Doğan D, Arslan Y. Hafif ve orta derece Koah alevlenmelerinde eozinofilinin rolü. *İzmir Göğüs Hastanesi Derg.* 2019;33(3):169-75
16. Bozkurt N, Bozkurt Aİ. Which is more valuable in the follow-up and evaluation of stable COPD cases; CRP or Eosinophil or Leukocyte? *Akdeniz Med J*. Published online 2022. doi:10.53394/akd.1013390
17. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global strategy for the diagno- sis, management, and prevention of chronic obstructive pulmonary disease: 2021 Report.