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Correlation of Serum Biomarkers with Disease Severity in Patients with Chronic Obstructive Pulmonary Disease (COPD): A Cross-Sectional Study.

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ABSTRACT

Chronic Obstructive Pulmonary Disease (COPD) is characterized by persistent airflow limitation and systemic inflammation. Serum biomarkers reflecting inflammatory and metabolic disturbances may correlate with disease severity and could serve as adjunctive indicators for clinical assessment. To evaluate the correlation between serum biomarkers and disease severity in patients with COPD. A cross-sectional study was conducted over one year in a tertiary care hospital involving 42 COPD patients diagnosed according to GOLD criteria. Demographic details, smoking status, and clinical characteristics were recorded. Severity was graded using spirometry and GOLD staging. Serum biomarkers including C-reactive protein (CRP), fibrinogen, interleukin-6 (IL-6), lactate dehydrogenase (LDH), and uric acid were measured. Data were analyzed using descriptive statistics and correlation tests. The majority of patients were elderly males and smokers. Moderate to severe COPD predominated. Biomarker levels were elevated across the cohort, with significantly higher concentrations of CRP, fibrinogen, IL-6, LDH, and uric acid observed in patients with severe and very severe COPD ($p<0.05$). Higher biomarker levels correlated positively with reduced FEV_1 and higher GOLD staging. Serum biomarkers demonstrated a significant association with COPD severity, suggesting their potential role in disease stratification and risk assessment.

Keywords: COPD, Serum biomarkers, Disease severity

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INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive, debilitating respiratory disorder characterized by persistent airflow limitation and chronic inflammation of the airways [1]. It represents a significant global health burden, contributing to substantial morbidity, mortality, and economic expenditure [2]. The World Health Organization identifies COPD as one of the leading causes of death worldwide, with its prevalence rising due to sustained exposure to tobacco smoke, biomass fuels, environmental pollutants, and occupational hazards [3]. Beyond airflow limitation, COPD encompasses a multisystem spectrum with systemic inflammatory responses that influence disease severity, exacerbation frequency, and quality of life [4].

Recent research emphasizes [5-7] the role of biochemical and inflammatory biomarkers in understanding COPD pathogenesis, monitoring disease progression, and predicting adverse clinical outcomes. Biomarkers such as C-reactive protein (CRP), fibrinogen, interleukin-6 (IL-6), and procalcitonin reflect systemic inflammation, whereas serum uric acid, lactate dehydrogenase (LDH), and oxidative stress markers reveal metabolic and cellular derangements. Correlating these biomarkers with clinically graded severity—typically assessed using spirometric indices such as forced expiratory volume in one second (FEV_1), GOLD staging, and symptom scales—may provide valuable insights into disease stratification, prognosis, and personalized management. (8,9) Our cross-sectional study aims to explore the relationship between serum biomarkers and COPD severity, potentially enabling biomarker-based clinical risk assessment and guiding therapeutic decision-making.

STUDY METHODOLOGY

The present cross-sectional study was conducted over a duration of one year in the Department of Pulmonary Medicine at a tertiary care hospital. Patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) as per GOLD criteria were screened for eligibility. Individuals aged 40 years and above, presenting with clinical symptoms and spirometric confirmation of COPD, were enrolled after obtaining informed written consent. Ethical approval for the study was obtained prior to initiation.

A total sample size of 42 patients fulfilling the inclusion and exclusion criteria was selected consecutively during the study period. Patients with active pulmonary infections, malignancies, chronic kidney or liver disease, or recent exacerbations within four weeks prior to recruitment were excluded to avoid confounding biochemical alterations. Demographic information, smoking history, comorbidities, symptom profile, and exposure to risk factors were documented using a structured proforma.

Clinical assessment was performed, and COPD severity was graded using spirometry based on post-bronchodilator Forced Expiratory Volume in one second (FEV_1) values and GOLD staging. Symptom severity and functional status were evaluated using validated scales such as the Modified Medical Research Council (mMRC) dyspnea score and COPD Assessment Test (CAT). Venous blood samples were collected under aseptic precautions for biochemical analysis.

Serum biomarkers including C-reactive protein (CRP), fibrinogen, interleukin-6 (IL-6), uric acid, and lactate dehydrogenase (LDH) were measured using standardized laboratory assays. Biomarker concentrations were correlated with spirometric indices and clinical severity categories. Data were entered and analyzed using appropriate statistical software, employing descriptive statistics, correlation coefficients, and significance testing, with p-values less than 0.05 considered statistically significant.

RESULTS

Table 1: Demographic And Clinical Profile Of Study Participants (N = 42)

Variable	Category	n	%
Age (Years)	40–49	6	14.3
	50–59	12	28.6
	60–69	14	33.3
	≥70	10	23.8
Gender	Male	30	71.4
	Female	12	28.6

Smoking Status	Smokers	32	76.2
	Non-Smokers	10	23.8
Mean Age ± SD	62.1 ± 8.3 years		
Mean Duration of Symptoms	4.5 ± 2.1 years		

Table 2: Distribution Of Copd Severity Based On Gold Staging

GOLD Stage	n	%
Stage I (Mild)	5	11.9
Stage II (Moderate)	18	42.9
Stage III (Severe)	14	33.3
Stage IV (Very Severe)	5	11.9
Total	42	100

Mean post-bronchodilator FEV_1 (% predicted): 52.7 ± 14.6

Table 3: Serum Biomarker Levels Among Study Participants (N = 42)

Biomarker	Mean ± SD	Reference Range
CRP (mg/L)	9.8 ± 3.6	<5
Fibrinogen (mg/dL)	455 ± 85	200–400
IL-6 (pg/mL)	11.5 ± 4.8	<7
LDH (U/L)	286 ± 52	140–280
Uric Acid (mg/dL)	6.9 ± 1.4	3.4–7.0

Table 4: Correlation Of Serum Biomarkers With Copd Severity (Gold Staging)

Biomarker	Mild–Moderate (n = 23) Mean ± SD	Severe–Very Severe (n = 19) Mean ± SD	p-value	
CRP (mg/L)	7.2 ± 2.9	12.1 ± 3.1	<0.001	
Fibrinogen (mg/dL)	410 ± 72	502 ± 65	<0.001	
IL-6 (pg/mL)	8.3 ± 3.2	15.1 ± 4.0	<0.001	
LDH (U/L)	258 ± 41	318 ± 38	0.002	
Uric Acid (mg/dL)	5.9 ± 1.0	7.9 ± 1.2	<0.001	

Diagnostic correlation observed: Higher biomarker levels correlated positively with clinically and spirometrically defined disease severity.

DISCUSSION

In the present cross-sectional study involving 42 patients with Chronic Obstructive Pulmonary Disease (COPD), a significant correlation was demonstrated between serum inflammatory and biochemical biomarkers and disease severity as assessed through GOLD staging and spirometric indices. The demographic profile was consistent with existing epidemiological observations, with a clear predominance of elderly males and smokers. This finding aligns with the well-documented association of tobacco exposure and advancing age with COPD pathogenesis and progression, reinforcing the validity of the study population as representative of typical COPD cohorts [10].

Among serum biomarkers, CRP, fibrinogen, IL-6, LDH, and uric acid levels were elevated across the study group, with markedly higher concentrations observed in patients classified as severe and very severe COPD. Systemic inflammation is a recognized hallmark of COPD, often extending beyond the pulmonary milieu to involve multiple biological pathways. Elevated CRP and fibrinogen levels in severe COPD suggest ongoing acute-phase responses and heightened inflammatory activity, contributing to exacerbations, increased symptom burden, and long-term morbidity. IL-6, a key pro-inflammatory cytokine, also demonstrated a strong positive correlation with COPD severity, supporting its role in systemic inflammation, muscle wasting, and metabolic dysregulation frequently encountered in advanced disease [11].

LDH levels were significantly increased in patients with severe COPD. LDH is indicative of tissue injury and cellular turnover and has been associated with hypoxia-induced metabolic changes and pulmonary vascular remodeling. Similarly, serum uric acid levels were elevated in severe disease, likely reflecting enhanced purine metabolism under hypoxic conditions and oxidative stress. Hyperuricemia has been proposed as a surrogate biomarker for hypoxemia and has been linked to adverse pulmonary and cardiovascular outcomes, suggesting its potential utility in clinical stratification of COPD patients.

These findings collectively indicate that systemic biomarkers may serve as adjunctive tools for assessing disease burden in COPD. While spirometry remains the cornerstone of COPD diagnosis and staging, biomarker evaluation offers additional insights into systemic inflammation, metabolic alterations, and potential prognostic implications. The observed correlations also align with previous reports wherein elevated CRP and fibrinogen levels have been linked to increased exacerbation risk, hospitalization, and mortality. IL-6 and uric acid have similarly been associated with decline in functional status and increased comorbidity load, including cardiovascular disease, which frequently coexists with COPD [12].

However, the study also has limitations. The cross-sectional design precludes causal inference or evaluation of biomarker trajectories over time. The modest sample size may limit external generalizability and statistical power, particularly in stratified analyses. Additionally, the exclusion of patients with recent exacerbations, infections, or systemic illnesses—while necessary to avoid confounding—may underestimate variability in biomarker levels observed in real-world COPD populations. Despite these limitations, the study underscores the clinical value of serum biomarkers as indicators of disease severity and systemic involvement.

CONCLUSION

In conclusion, our study supports a growing body of evidence advocating biomarker-based risk stratification in COPD. Future prospective studies with larger cohorts and longitudinal follow-up are warranted to validate these associations and assess their predictive utility in monitoring disease progression, exacerbations, and therapeutic response.

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