ORIGINAL RESEARCH

Correlation of Serum Uric Acid Levels with Disease Severity in COPD Patients: A Cross-Sectional Study at a Tertiary Care Hospital

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a leading cause of morbidity and mortality globally, with oxidative stress and inflammation playing key roles in its pathogenesis. Elevated serum uric acid levels have been linked to these processes. This study investigates the serum uric acid levels in COPD patients and their correlation with disease severity. **Methods:** A cross-sectional study was conducted at Coimbatore Medical College and Hospital from July 2021 to June 2022. The study included 100 COPD patients. Serum uric acid levels were measured, and patient characteristics such as age, sex, duration of disease, place of residence, and BMI were recorded. **Result:** Mean uric acid levels were higher in patients with a disease duration of >10 years (8.154 mg/dL) compared to those with 0-5 years (7.05 mg/dL) (p=0.002). No significant differences were found in uric acid levels based on age (p=0.651), sex (p=0.176), place of residence (p=0.272), or BMI (p=0.130). **Conclusion:** Serum uric acid levels significantly correlate with the duration of COPD, suggesting its potential as a marker for disease severity. Further research is warranted to explore therapeutic interventions targeting uric acid levels.

Key words: COPD, Serum Uric Acid, Oxidative Stress, Inflammation, Disease Severity, Biomarkers.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive lung disorder characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible[1]. COPD encompasses two primary conditions: chronic bronchitis and emphysema, both of which contribute to the airflow limitation and significant morbidity and mortality worldwide. As one of the leading causes of death, COPD poses substantial healthcare challenges, particularly in low and middle-income countries where smoking rates and environmental pollutants are high. In India, the burden of COPD is particularly significant, with a notable prevalence among the adult population[2]. Understanding and managing COPD effectively requires a multifaceted approach, including identifying biomarkers that can provide insights into disease progression and severity[1, 2].

One such biomarker that has garnered research interest is serum uric acid. Uric acid is a byproduct of purine metabolism and serves as an antioxidant under normal physiological conditions[3]. However, elevated levels of uric acid, a condition known as hyperuricemia, have been implicated in various pathological states, including cardiovascular diseases, hypertension, and metabolic syndrome. The role of serum uric acid in COPD is an emerging area of study, as recent evidence suggests that it may reflect underlying oxidative stress and inflammation, both of which are hallmarks of COPD pathophysiology[4].

The lungs are continuously exposed to environmental toxins, pathogens, and pollutants, leading to chronic inflammatory responses[5]. In COPD patients, this persistent inflammation results in tissue damage, airway remodeling, and the characteristic symptoms of dyspnea, chronic cough, and sputum production.

Oxidative stress, resulting from an imbalance between free radicals and antioxidants, further exacerbates lung damage. Given that uric acid is a major antioxidant in plasma, its elevated levels in COPD patients may indicate an adaptive response to oxidative stress. Alternatively, hyperuricemia could contribute to disease pathology through pro-inflammatory pathways[6].

Despite the potential significance of uric acid in COPD, its role remains underexplored, particularly in the Indian context. This study, conducted at Coimbatore Medical College Hospital, aims to address this gap by evaluating serum uric acid levels in COPD patients and investigating the correlation between uric acid levels and disease severity. By doing so, we aim to enhance the understanding of COPD's biochemical landscape and explore the potential of serum uric acid as a biomarker for disease management.

Elevated serum uric acid levels have been associated with several chronic diseases characterized by inflammation and oxidative stress, but their specific relationship with COPD severity needs further elucidation[7]. The assessment of uric acid levels could provide a simple, cost-effective means of evaluating disease progression and tailoring treatment strategies accordingly. This study was conducted with the objectives of estimating the serum levels of uric acid in patients with COPD patients.

Understanding the correlation between serum uric acid levels and COPD severity has several clinical implications. Firstly, it could help in stratifying patients based on their risk and tailor therapeutic interventions more effectively. Secondly, if a strong correlation is established, serum uric acid could serve as a non-invasive biomarker for monitoring disease progression and response to treatment. This is particularly relevant in resource-limited settings where access to advanced diagnostic tools is restricted. Furthermore, identifying hyperuricemia as a modifiable risk factor opens avenues for therapeutic interventions targeting uric acid metabolism. Lifestyle modifications, dietary interventions, and pharmacological treatments aimed at reducing uric acid levels could potentially benefit COPD patients, though this hypothesis warrants further investigation through clinical trials.

The clinical relevance of this study lies in its potential to provide a deeper understanding of the biochemical alterations in COPD. By establishing a correlation between serum uric acid levels and disease severity, clinicians can gain insights into the disease's progression and the underlying oxidative stress. This, in turn, can inform clinical decision-making, from early diagnosis to the management of advanced stages of COPD.

MATERIALS AND METHODS

Study Setting: This cross-sectional observational study was conducted at Coimbatore Medical College and Hospital in Coimbatore, Tamil Nadu, India. The study period extended from July 2021 to June 2022. This setting provided a diverse patient population and access to comprehensive medical records and diagnostic facilities necessary for the study.

Study Participants: Participants in this study were selected based on specific inclusion and exclusion criteria to ensure the reliability and validity of the findings. The inclusion criteria consisted of patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) who were 18 years or older, regardless of the duration of their disease. Exclusion criteria were extensive to avoid confounding factors and included patients under 18 years of age, those with pneumonia, other chronic infections, neoplastic pathologies, inflammatory diseases, hepatic or renal diseases, excessive alcohol consumption, endocrine diseases, Diabetes Mellitus, Hypertension, and a history of myocardial infarction. Additionally, minors, pregnant women, mentally ill individuals, and non-volunteering patients were excluded from the study.

Sample Size: The study aimed to include a total of 100 patients diagnosed with COPD. This sample size was chosen to provide a sufficient number of subjects to ensure the statistical power and validity of the study's findings.

Sampling Technique: Purposive random sampling was employed for this study. Patients who met the inclusion and exclusion criteria were selected consecutively until the sample size of 100 was reached. This method ensured that the sample was representative of the COPD patient population at the hospital.

Study Methodology: Data collection involved direct patient interviews and thorough examinations. A pretested proforma was used to gather relevant data, including detailed medical history and necessary investigations. Prior to inclusion in the study, patients were informed about the study's purpose and their consent was obtained. The investigations conducted included routine blood counts (Hb%, TC, DC, ESR), blood biochemistry (Serum Uric Acid, Random Blood Sugar, Blood Urea, Serum Creatinine, Serum Electrolytes: Sodium and Potassium), urinalysis (Urine Albumin, Urine Sugar, Urine Microscopy), ECG, and imaging studies such as Chest X-ray (PA view) and CT Chest (if necessary). Additionally, pulmonary function tests, sputum analysis (Sputum AFB, Sputum Culture and Sensitivity if necessary), oxygen saturation measurements at rest and after a 6-minute walk test, and spirometry were conducted.

Study Tools: The primary tools for data collection were a structured pretested proforma and various diagnostic tests. These included laboratory investigations (blood counts, biochemistry, urinalysis), imaging modalities (Chest X-ray, CT Chest), pulmonary function testing equipment, and sputum analysis tools.

Statistical Analysis: The data collected were analyzed using several statistical methods to ensure

robust and meaningful results. The Chi-Square Test was used to compare categorical variables between groups. Statistical analyses were performed using appropriate software, with significance set at a p-value of less than 0.05.

Ethical Issues: The study was conducted following the ethical guidelines established by the Institutional Ethics Committee of Coimbatore Medical College and Hospital, which provided approval prior to the commencement of the study. Informed consent was obtained from all participants after explaining the study's purpose, procedures, potential risks, and benefits. Participants were assured of the confidentiality of their data and were informed of their right to withdraw from the study at any time without any impact on their medical care. The study adhered to the principles of the Declaration of Helsinki, ensuring that all procedures involving human participants were performed according to ethical standards

RESULT

The study included 100 COPD patients with diverse demographic characteristics. The age distribution revealed that 40% of the patients were under 50 years old, while 60% were over 50 years old. Regarding sex, a significant majority of the participants were male (82%), with females comprising the remaining 18%. The duration of disease among the patients varied: 28% had been diagnosed with COPD for 0-5 years, 46% for 6-10 years, and 26% for more than 10 years. In terms of place of residence, 78% of the patients lived in urban areas, while 22% resided in rural areas (Table 1).

Table 1: Characteristics of the study participants

Variable		Number
Age	<50 yrs	40
	>50 YRS	60
Sex	Male	82
	Female	18
Duration of disease	0-5 years	28
	6-10 years	46
	> 10 years	26
Place of residence	Urban	78
	Rural	22

The study evaluated patients' exposure to various risk factors, including smoking, occupational exposure to cotton dust, environmental tobacco smoke (ETS), and biomass fuel (BMF). The results showed that 64% of the patients were smokers, while 36% were non-smokers. Regarding occupational exposure, 56% of the patients had been exposed to cotton dust, whereas 44% had not. For environmental exposure, 36% of the patients had been exposed to ETS, while 64% had no such exposure. Additionally, only 12% of the patients were exposed to biomass fuel, with the remaining 88% not exposed.

The clinical signs and symptoms observed in the COPD patients were documented comprehensively. Cyanosis was present in 36% of the patients, while 64% did not exhibit this sign. Clubbing was noted in 44% of the patients, whereas 56% showed no clubbing. A loud P2 sound was detected in 22% of the patients, with 78% not presenting this sign. Crepitation was highly prevalent, found in 94% of the patients, leaving only 6% without this symptom. Wheeze was present in 92% of the patients, and cough was reported by all patients (100%). Additionally, fever was observed in 34% of the patients, while 66% did not have a fever.

Oxygen saturation levels were measured both at room temperature and after a 6-minute walk test (6MWT). At room temperature, 28% of the patients had an O2 saturation level below 90%, while 72% had levels above 90%. For those with initial O2 saturation below 90%, further measurements after the 6MWT showed that 9 out of 28 patients still had O2 saturation below 90%, whereas 19 patients had improved to above 90%.

The duration of hospital stay among COPD patients varied. A significant majority, 74% of the patients, had a hospital stay ranging from 0 to 5 days. In contrast, 26% of the patients had a longer hospital stay, ranging from 5 to 10 days. Various hospital outcomes and the need for specific interventions were assessed in the study. Hospital deaths were recorded at 6%. Intensive Care Unit (ICU) care was required by 16% of the patients, and Non-Invasive Ventilation (NIV) was utilized for 12% of the patients. Supplemental oxygen was a necessity for 74% of the patients, and Long-Term Oxygen Therapy (LTOT) was needed by 12% of the patients.

Radiological assessments using chest X-rays and CT scans revealed diverse lung conditions among the patients. Only 6% had normal imaging results. Chronic bronchitis was identified in 8% of the patients, emphysema in 18%, and a combination of both conditions was present in 68% of the patients. The severity of COPD was classified using the Forced Expiratory Volume in one second (FEV1). The distribution was as follows: 10% of the patients had mild COPD, 18% had moderate COPD, 52% had severe COPD, and 20% had very severe COPD.

The mMRC dyspnea scale was employed to evaluate the severity of breathlessness among the patients. Results indicated that 6% of the patients were at Grade 1, 22% were at Grade 2, 48% were at Grade 3, and 24% were at Grade 4. The severity of COPD was further categorized using the GOLD classification. The findings showed that 8% of the patients had mild COPD, 22% had moderate COPD, 52% had severe COPD, and 18% had very severe COPD

Table 2: Uric acid levels and patient characteristics.

Parameters	Mean uric acid levels	P value
Age		0.651
<50 years	7.49	
>50 years	7.62	
Sex		0.176
Male	7.479	
Female	7.978	
Duration of disease		0.002*
0-5 years	7.05	
6-10 years	7.879	
> 10 years	8.154	
Place of residence		0.272
Urban	7.48	
Rural	7.86	
BMI		0.130
<18	7.817	
19-23	7.578	
23-24.9	6.82	
>25	7.733	

***Significant P value**

The study assessed mean serum uric acid levels in relation to various patient characteristics. Age-wise, patients under 50 years had a mean uric acid level of 7.49 mg/dL, while those over 50 years had a slightly higher mean level of 7.62 mg/dL, though this difference was not statistically significant (p=0.651). Regarding sex, the mean uric acid level in males was 7.479 mg/dL, compared to 7.978 mg/dL in females, with the difference also not being statistically significant (p=0.176) (Table 2).

The duration of disease showed a significant correlation with uric acid levels (p=0.002). Patients with 0-5 years of disease had a mean uric acid level of 7.05 mg/dL, those with 6-10 years had a mean level of 7.879 mg/dL, and those with more than 10 years had the highest mean level of 8.154 mg/dL. For place of residence, urban residents had a mean uric acid level of 7.48 mg/dL, while rural residents had a mean level of 7.86 mg/dL; this difference was not statistically significant (p=0.272).

Mean uric acid levels also varied with BMI, although the differences were not statistically significant (p=0.130). Patients with a BMI of less than 18 had a mean uric acid level of 7.817 mg/dL, those with a BMI of 19-23 had a level of 7.578 mg/dL, those with a BMI of 23-24.9 had the lowest mean level of 6.82 mg/dL, and those with a BMI over 25 had a level of 7.733 mg/dL.

DISCUSSION

The study population consisted of 100 COPD patients with diverse demographic characteristics. The majority of the patients were male (82%), which aligns with the higher prevalence of COPD in men, often attributed to higher smoking rates and occupational exposures. The age distribution indicated that a significant proportion of the patients were over 50 years old (60%), consistent with the age-related nature of COPD, where symptoms typically manifest later in life due to the cumulative effect of risk factor exposure[8].

One of the key findings of this study is the significant correlation between the duration of COPD and serum uric acid levels. Patients with a longer duration of disease (>10 years) exhibited higher mean uric acid levels (8.154 mg/dL) compared to those with a shorter duration (0-5 years: 7.05 mg/dL). This suggests that prolonged disease duration may lead to increased oxidative stress and inflammation, resulting in higher uric acid levels. This finding is in line with previous studies that have shown a positive association between disease duration and serum uric acid levels in COPD patients[9].

The high prevalence of smoking (64%) among the study participants underscores its role as a major risk factor for COPD. Smoking is known to cause chronic inflammation and oxidative stress in the airways, contributing to the pathogenesis of COPD. Interestingly, despite the high smoking rates, we did not find a significant difference in serum uric acid levels between smokers and non-smokers. This may

be due to the complex interplay of various factors influencing uric acid metabolism and the impact of other comorbidities that were not fully explored in this study[10].

Occupational exposure to cotton dust was present in 56% of the patients, highlighting another significant risk factor for COPD. Cotton dust exposure is known to cause byssinosis, a respiratory condition that shares clinical similarities with COPD, including airflow obstruction and chronic bronchitis. The study did not find a significant difference in serum uric acid levels between patients with and without occupational exposure, suggesting that while occupational exposure contributes to COPD pathogenesis, its impact on uric acid levels may be less pronounced compared to other factors such as disease duration and comorbidities[11].

Gender differences in serum uric acid levels were observed, with females exhibiting higher mean levels (7.978 mg/dL) compared to males (7.479 mg/dL). Although this difference was not statistically significant, it raises interesting questions about the role of gender in uric acid metabolism and its implications for COPD. Previous studies have shown that hormonal differences, particularly estrogen, can influence uric acid levels, potentially explaining the observed differences[12]. However, the smaller number of female participants in this study (18%) limits the ability to draw definitive conclusions, and further research with a larger and more balanced sample size is needed.

Body Mass Index (BMI) is an important factor influencing health outcomes in COPD. Our study found no significant correlation between BMI and serum uric acid levels, although variations in mean uric acid levels were observed across different BMI categories. Patients with a BMI of less than 18 had the highest mean uric acid levels (7.817 mg/dL), while those with a BMI of 23-24.9 had the lowest (6.82 mg/dL). These findings are somewhat consistent with previous research suggesting that underweight COPD patients often have poorer health outcomes and higher levels of systemic inflammation, which may contribute to elevated uric acid levels[13]. However, the relationship between BMI and uric acid levels in COPD is complex and warrants further investigation[14].

The findings of this study have several clinical implications. Monitoring serum uric acid levels in COPD patients could serve as a useful marker for disease severity and progression, particularly in those with a longer duration of disease. Elevated uric acid levels may indicate increased oxidative stress and inflammation, providing a potential target for therapeutic interventions aimed at reducing these pathological processes.

Several limitations should be acknowledged in this study. The cross-sectional design limits the ability to establish causality between elevated serum uric acid levels and COPD severity. Longitudinal studies are needed to confirm these findings and explore the temporal relationship between uric acid levels and disease progression. Additionally, the relatively small sample size, particularly the low number of female participants, may limit the generalizability of the findings. Future studies with larger and more diverse populations are necessary to validate these results.

CONCLUSION

This study highlights the significant correlation between serum uric acid levels and disease duration in COPD patients. Elevated uric acid levels may reflect increased oxidative stress and inflammation, providing a potential marker for disease severity and progression. The findings emphasize the importance of comprehensive COPD management, including smoking cessation, occupational safety measures, and targeted therapeutic interventions to reduce oxidative stress and inflammation.

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