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Predictors of progression of renal functions in patients with chronic obstructive pulmonary disease (COPD)

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Abstract:

Introduction: Chronic obstructive pulmonary disease (COPD), is a prevalent, treatable, and preventable illness marked by persistent respiratory symptoms and restricted airflow because of abnormalities in the airways and alveoli that are typically brought on by prolonged exposure to harmful particles or gases. In addition to producing a wide range of cytokines, pulmonary cells can target other organs, enter the systemic circulation, and cause inflammation. Angiotensin-converting enzyme (ACE) expression and pulmonary vascular permeability can both be impacted by renal ischemia. This can impair the function of ion channels, which are in charge of the re-absorption of fluids at the level of the pulmonary alveoli.

Aim of the study: To estimate the impairment of renal function in individuals suffering from COPD.

Subjects and Methods: The study was conducted on one hundred patients with COPD between March 2022 and February 2023, either during their admission to the chest department of Fayoum University Hospital or during their follow-up in the outpatient clinic.

Results: There was a correlation between FEV1 and creatinine in COPD patients during the study (p =0.019, <0.05). There was neither a significant correlation with the COPD class nor with FEV1 (p =0.359, 0.477). There was no significant statistical correlation between FEV1 or classes of COPD patients with regard to eGFR (P = 0.095, 0.554, <0.05), respectively.

Conclusion: Compared to normal populations, COPD patients are more likely to develop chronic kidney disease (CKD), which can be evaluated using a variety of techniques, such as laboratory measurement of blood creatinine, uric acid, albumin, and eGFR.

Keywords: COPD; Renal; Creatinine; Uric acid; CKD.

1. Introduction

Chronic obstructive pulmonary disease, or COPD, is a prevalent, treatable, and preventable illness marked by persistent respiratory symptoms and restricted airflow because of abnormalities in the airways and alveoli that are typically brought on by prolonged exposure to harmful particles or gases [1]. Compared to the general population, COPD patients have a higher chance of getting CKD [2]. Common risk factors for the beginning of chronic kidney disease (CKD) include ageing, diabetes, arterial hypertension, and obesity [3].

COPD patients have a higher risk of developing CKD than the general population [3]. The most prevalent risk factors for the new start of chronic kidney disease (CKD) are age, diabetes, arterial hypertension, and obesity. Atherosclerotic damage from the activation of pro-inflammatory and pro-oxidant pathways that result in pathologic alterations in renal circulation is one of the causes of chronic kidney disease (CKD) [4].

Pulmonary cells can produce many cytokines, reach the systemic circulation, target other organs, and also produce inflammatory effects [5].

Atherosclerotic damage from the activation of pro-inflammatory and pro-oxidant pathways that result in pathological alterations in renal circulation is one of the causes of chronic kidney disease (CKD) [4]. In addition to producing a wide range of cytokines, pulmonary cells can target other organs, enter the systemic circulation, and cause inflammation [5]. Angiotensin-converting enzyme (ACE) expression and pulmonary vascular permeability can both be impacted by renal ischemia. This can impair the function of ion channels, which are in charge of reabsorption of fluids at the level of pulmonary alveoli [6]

So, the current study aimed to forecast the decline in renal function in individuals suffering from COPD.

2. Subjects and methods

2.1. Subjects

From March 2022 to February 2023, a case-cohort study was carried out in the hospital's chest department at Fayoum University to predict how patients with COPD will see their renal functions progress. One hundred COPD patients were involved in the study; they were diagnosed and categorized into four groups: mild stage (12 patients), mod stage

(33 patients), severe stage (37 patients), and very severe stage (14 patients) [1]. Additionally, four patients had mixed restrictive and obstructive abnormalities.

Exclusion Criteria

- People with acute kidney injury, severe renal failure (baseline eGFR <30 mL/min/1.73 m2), extensive liver disease, and aggressive malignancy.
- The existence of systemic autoimmune diseases or chronic inflammation.
- Gout treatment using xanthine oxidase inhibitors.

2.2. Methods

Complete medical histories, clinical examinations, BMIs, spirometry, chest X-rays, blood pressure, glycated hemoglobin, fasting plasma glucose (FPG), two hours of postprandial glucose, triglycerides, total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), albumin, creatinine, uric acid, eGFR, and urine analysis were performed on every patient in this study.

A relevant parameter, such as the estimated glomerular filtration rate (eGFR), whose variability correlates with a poor prognosis, was used to assess the decline in renal function [7].

Following each participant's medical consent, the following information was gathered for each patient:

- Full medical history, including the MMRC and CAT scores.
- Clinical examination (both local and general chest exams).
- x-ray chest.
- Spirometry was performed using the (spirobankπ) device in the pulmonary function unit of the chest department at Fayoum University Hospital.
- BMI: Body mass index is a statistical measure that calculates body fat in both males and females of any age by considering a person's height and weight. The formula for calculating BMI is weight (in kilograms) divided by height (in meters squared), or weight (in kg)/height^2 (in m^2).
- eGFR: The estimated glomerular filtration rate is a way to assess the ability of the kidneys to filter toxins from the blood balance of fluids. It is one of the primary diagnostic methods for detecting and managing kidney diseases.
- Assessment of systolic and diastolic blood pressure.
- Diabetic assessment: Measured fluctuating venous plasma glucose -Hpp value in venous plasma ≥200 mg/dl (≥11.1 mmol/l), -Fasting plasma glucose of ≥126 mg/dl (7.0 mmol/l)

(fasting period 8–12 h). -HbA1c = 6.5% (48 mmol/molHb)

- Lab tests include albumin, uric acid, total cholesterol, triglycerides, low-density lipoprotein (LDL), high-density lipoprotein (HDL), albumin, and urine analysis.

To measure HbA1c and chemistry samples, two blood samples were obtained, Chemistry samples were gathered in simple tubes, centrifuged for around 20 minutes at 3000 RPM, and then kept at -20 until analysis. HbA1c was gathered from EDTATUBES. Analysis was completed at Fayoum University's lab.

2.3. Statistical methods

Version 28 of IBM Corp.'s Statistical Package for the Social Sciences (SPSS) is available in Armonk, NY, USA. The mean, standard deviation, frequencies (number of cases), and relative frequencies (percentages) were used to describe the data for the quantitative variables. For regularly distributed quantitative variables, comparisons between groups were conducted using analysis of variance (ANOVA) with multiple comparisons post hoc test; for non-normally distributed quantitative variables, non-parametric Kruskal-Wallis test and Mann-Whitney test were employed [8]. An analysis of categorical data was conducted using the Chi-square ($\chi 2$) test. When the anticipated frequency is less than five, an exact test was utilized instead [9]. Quantifiable variables are correlated using the Spearman correlation coefficient [10]. *P*-values were regarded as statistically significant if they were less than 0.05.

3. Results

In this study, 100 patients were included, consisting of 79 male and 21 female patients diagnosed with COPD. The case group was divided into: 12% as mild, 33% as moderate, 37% as severe, 14% as very severe obstruction, and 4% as mixed obstructive and restrictive abnormalities (**Table 1**).

The table presents a statistical comparison between the study group's FEV1 and creatinine and reveals that: There was a statistically significant difference between the study group's FEV1 and creatinine ($p = 0.019$).

FEV1 as a function of BMI and CAT score differed statistically significantly ($p = 0.022, 0.003$). There was no statistically significant variation in FEV1 with respect to urea ($p = 0.359$).

The table presents a statistical comparison between the study group's FEV1

and creatinine and reveals that: There was a statistically significant difference between the study group's FEV1 and creatinine (p = 0.019). FEV1 as a function of BMI and CAT score differed statistically significantly (p = 0.022, 0.003). There was no statistically significant variation in FEV1 with respect to uric acid (p = 0.359).

Table 1: The statistical comparison between FEV1 in COPD patients and BMI, eGFR, creatinine, and uric acid.

Variables	Correlation coefficient	*P*- value
BMI	0.229	0.022*
eGFR	-0.168	0.095
Creatinine	0.234	0.019*
Uric Acid	0.093	0.359

The mean uric acid values were 6.49 ± 2.07. The level of uric acid<6.5 mg/dl was found in 53% of COPD patients in our study. By evaluating the uric acid level in different classes and according to the severity of airway obstruction, we found that the level of urea acid<6.5 mg/dl is higher in patients with classes B and E (47% and 40%), respectively, but lower in group A (28%). The level of uric acid was <6.5 mg/dl, which is higher in patients with grades III and IV (41.51%) than grade I and II (386.4%) (**Figure 1**).

Figure 1: The level of Uric acid <6.5 in different and grades classes of COPD.

4. Discussion

In this study, 100 patients with COPD were included, consisting of 79 male and 21 female patients. All patients were in the stable phase of their disease, meaning they had not experienced any exacerbations in the previous three months, had not changed their treatment plan, and had not had any lower respiratory tract infections. This was in line with research by Pelaia et al. (2021) that included 707 patients (48.1% of whom were women) and examined the predictors of declining renal function in patients with COPD [11]. In addition, Rumora et al. (2020) enrolled 109 patients with COPD in a study on the use of uric acid and the uric acid-to-creatinine ratio in the assessment of chronic COPD [12]. All of the patients were in the stable phase of the disease, had not experienced any exacerbations in the previous three months, had not changed their treatment plan, and had not developed lower respiratory tract infections.

UA is known to be linked to markers of systemic inflammation, bronchoconstriction through endothelin-1 activation, and oxygen desaturation. Lower and higher levels of UA have been identified as risk factors for obstruction of the airways.

Themeanuric acid values in our study were 6.39±2.07. The following findings were obtained from the assessment of uric acid levels in different classes and in relation to the degree of airway obstruction: -Uric acid levels<6.5 md/dl are greater in patients with classes B and E (47% and 40%, respectively), but lower in group A (28%).

Patients with grades III and IV have greater levels of uric acid (<6.5 md/dl) than those with grades I and II (38.64%). However, we discovered that there is no significant difference between FEV1, or COPD class, and uric acid.

In line with our findings, Rumora et al. (2020) observed no significant correlations between UA levels, COPD-relevant scores, and lung function metrics [12]. Similarly, Sarangi et al. (2017) concurred with our findings, assessing the degree of airflow limitation and its relationship to UA levels [13]. found that the GOLD 4 stage had greater UA concentrations than the previous stages; however, this difference was statistically insignificant.

The study involved the classification of COPD patients into four grades of air flow limits by spirometry. The mean creatinine values were found to be 0.95 ± 0.29, indicating a statistically significant difference between FEV1 and creatinine, which is consistent with the findings of Pelalia et al. (2021), where the group of COPD patients with a rapid

deterioration in renal function had a statistically significant difference in creatinine [11].

Our findings also concur with those of Elmahallawy and Qora (2013), who conducted a study on the prevalence of chronic renal failure in patients with COPD [14]. They found that the mean serum creatinine concentration was 0.85 ± 0.34 mg/dL for all patients, and that the COPD group's mean serum creatinine concentration was significantly lower than the control groups. That mismatches with Nishiki et al. (2021), as there were no appreciable variations in serum creatinine levels between stage III and stage IV COPD patients in spite of a marked decline in pulmonary functioning [15].

Conclusion

Serum creatinine (S.cr) is regularly used to diagnose and evaluate renal injury. Patients with COPD have a higher risk of developing CHD than normal populations. This risk can be determined by a variety of approaches, including laboratory examination of serum creatinine, uric acid, albumin, and eGFR. We recommend that multicentered studies be needed to evaluate, predict the worsening of renal function, and follow up with COPD patients over a period of time to evaluate the progression of renal functions.

Ethical consideration and patient consent: The Faculty of Medicine Research Ethical Committee approved the study's goals, the examination, the investigation that will be conducted, the confidentiality of their information, and their right to decline participation were all explained to the participants.

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Conflicts of Interest: All authors declare they have no conflicts of interest.

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