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Original Research Article

Testing Patients with Chronic Obstructive Pulmonary Disease for Vital Mineral, Alkaline Phosphatase, and Insulin Resistance Measurements

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Conflict of interest: Nil

Abstract:

Background: Chronic Obstructive Pulmonary Disease (COPD) is a severe respiratory condition causing significant morbidity and mortality worldwide, primarily due to long-term exposure to harmful particles or gases, particularly cigarette smoke.

Aim: This study aims to evaluate zinc levels, ALP activity, and RBS measurements in patients with COPD, with the goal of understanding their roles as potential biomarkers for systemic effects and disease management.

Results: The study found that COPD patients and healthy controls had similar average ages, RBS levels, ALP levels, and zinc concentrations. However, when comparing the two groups using indicators like RBS, ALP, and serum zinc levels, a statistically significant difference was found. In the COPD patient group, there was a positive correlation between ALP and zinc, while in the control group, there was a positive association between ALP and zinc.

Conclusion: Monitoring COPD patients' zinc, alkaline phosphatase, and random blood sugar levels can reveal systemic impact, comorbidities, inflammation, and immune response impairment. Monitoring these indicators helps develop effective treatment strategies and reduce systemic consequences, enhancing patient care and overall outcomes.

Keywords: Chronic Obstructive Pulmonary Disease, alkaline phosphatase, random blood sugar; oxidative stress, zinc, immunology.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a progressive and debilitating respiratory condition characterized by persistent airflow limitation that is not fully reversible. It is a leading cause of morbidity and mortality worldwide, primarily driven by long-term exposure to noxious particles or gases, most notably cigarette smoke. In addition to its hallmark pulmonary symptoms, such as chronic cough, sputum production, and dyspnea, COPD is increasingly recognized as a systemic disease with widespread metabolic and inflammatory implications [1-3]. These systemic manifestations influence the overall health status and prognosis of affected individuals, making them critical areas of investigation [4].

The pathophysiology of COPD involves a complex interplay between inflammation, oxidative stress, and tissue damage. Persistent inflammation in the lungs spills over into the systemic circulation, contributing to the development of comorbid conditions, such as cardiovascular disease, diabetes, osteoporosis, and metabolic syndrome [5,6]. Among the various systemic markers of interest in COPD research, zinc levels, alkaline phosphatase (ALP) activity, and random blood sugar (RBS) measurements have gained attention for their potential roles in understanding the disease's multifaceted nature. Zinc is an essential trace element involved in numerous physiological processes, including enzymatic reactions, immune function, and oxidative stress modulation [7]. Zinc deficiency has been implicated in impaired respiratory function and increased susceptibility to infections, which are common complications in COPD patients [8,9].

Furthermore, zinc plays a crucial role in regulating inflammation and maintaining epithelial barrier integrity, both of which are compromised in COPD. Assessing zinc levels in COPD patients may provide insights into the nutritional and

immunological aspects of the disease. ALP is an enzyme found in various tissues, including the liver, bones, and lungs. It plays a vital role in bone mineralization and phosphate metabolism [10]. Elevated ALP levels have been associated with systemic inflammation and metabolic disturbances, both of which are prevalent in COPD [11]. Additionally, increased ALP activity may reflect underlying bone health issues, such as osteoporosis, which is a frequent comorbidity in COPD patients due to systemic inflammation, corticosteroid use, and physical inactivity. Investigating ALP levels in COPD patients could help elucidate the links between inflammation, bone health, and systemic metabolic changes in this population. RBS measurement is a straightforward and widely used marker of glucose metabolism. The association between COPD and glucose dysregulation is increasingly recognized, with chronic inflammation, hypoxemia, and the use of systemic corticosteroids contributing to insulin resistance and hyperglycemia. Hyperglycemia can exacerbate oxidative stress and inflammation, thereby perpetuating the vicious cycle of disease progression in COPD. Monitoring RBS levels in COPD patients may help identify those at risk of developing metabolic complications, such as diabetes, and enable timely interventions to mitigate their impact on disease outcomes.

This study aims to evaluate zinc levels, ALP activity, and RBS measurements in patients with COPD, with the goal of understanding their roles as potential biomarkers for systemic effects and disease management. By exploring these parameters, this research seeks to contribute to a more comprehensive understanding of the metabolic and inflammatory dimensions of COPD and their implications for patient care.

Materials & Methods

The Hind Institute of Medical Sciences in Sitapur, India, at Mau, Ataria, conducted the study. Forty healthy individuals, matched for age and gender, were part of the control group. All of them had normal glycemic status. Forty COPD patients undergoing treatment were part of the group. We identified the COPD disease according to the guidelines established by the World Health Organization. General medicine specialists evaluated the members of the COPD group. We excluded people with type 2 diabetes or its complications, as well as those with type 1 diabetes. A healthy control group would not have diabetes, take no supplements, and be free from any other health problems.

Approach to sampling:

Before aseptically drawing 5 ml of random venous blood into gray and flat vials using a disposable syringe and needle, the study group participants gave their written consent. We separated the blood from the serum by centrifuging it at 3000 rpm for 20 minutes. In aliquots, samples were stored at -20°C until analysis. We used a glucose oxidase and peroxidase (DPEC-GOD/POD) kit that we got from Arkray Healthcare Pvt Ltd. to find out how much glucose was in the plasma.

We prepared the reagents according to the instructions provided in the handbook. Span Diagnostics assessed the serum alkaline phosphatase using the King & King technique. Coral Clinical Systems developed the colorimetric method for measuring serum zinc levels. We immersed the glassware in 1.6 mol/L of nitric acid for 24 hours, and then washed it four times with water. We cleaned the micropipette tips with 0.8 mol/L nitric acid, rinsed them three times with water, and allowed them to dry on absorbent paper to prevent sample contamination before usage.

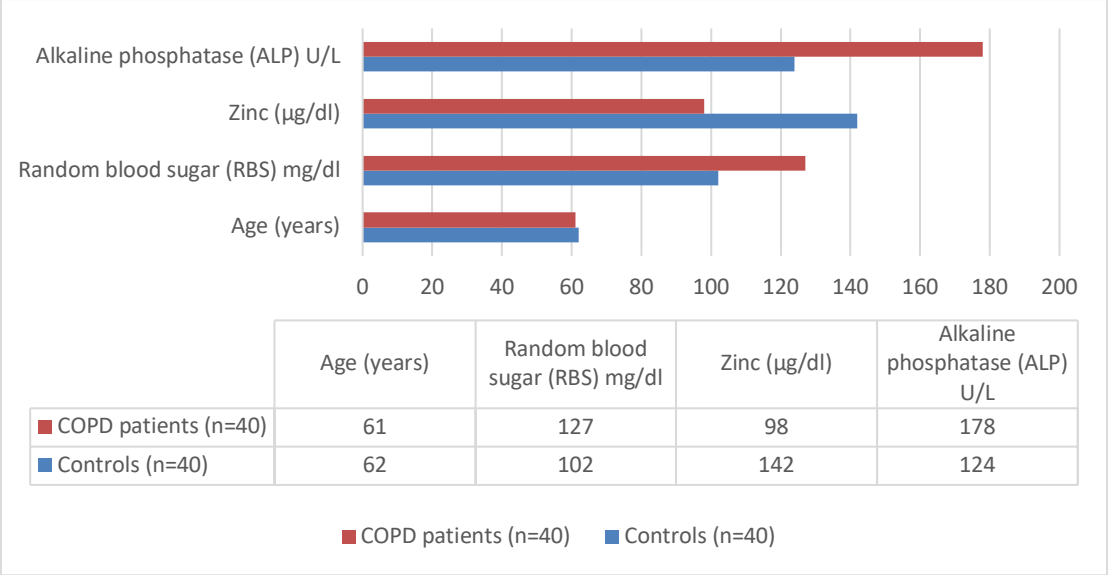
Statistical analysis:

For the statistical analysis, Excel was used. To compare the means of the two groups' variables, the unpaired t-test was employed. To find the connection between two variables, we used Pearson's correlation. The significance level was determined to be $P < 0.05$.

Results

Figure 1 shows that COPD patients and healthy controls had similar average ages, RBS levels, ALP levels, and zinc concentrations. As part of our investigation, we looked at the ages of the two groups and found no significant difference. However, when we compared the two groups using indicators including RBS, ALP, and serum zinc levels, we found a statistically significant difference ($P < 0.001$).

In the COPD patient group, we observed a positive correlation between ALP and zinc ($R = 0.5691$, $P = 0.001$), a negative correlation between age and RBS ($R = -0.6481$, $P = 0.001$), and a negative correlation between RBS and serum zinc ($R = -0.0791$, $P = 0.029$). We observed a positive association between ALP and zinc in the control group ($R = 0.5914$, $P = 0.01$).



	Age (years)	Random blood sugar (RBS) mg/dl	Zinc (µg/dl)	Alkaline phosphatase (ALP) U/L
COPD patients (n=40)	61	127	98	178
Controls (n=40)	62	102	142	124

Figure 1: Findings of age, RBS, ALP, and Zinc in COPD and control groups

Discussion

Results showed that the COPD group had aberrant levels of RBS, ALP, and zinc when compared to the healthy control group. There were no statistically significant variations in the ages of the two groups when compared. This experiment involving COPD patients found an inverse association between age and RBS, while the healthy control group showed no correlation. This finding suggests that an individual's old age may primarily cause elevated blood sugar levels in the COPD group [2,3].

Based on research on the disease, COPD is one of the bacterial diseases associated with immunity in the current world. Our study suggests that COPD patients have worries related to aging [12]. COPD is more common in those who have weakened immune systems or who are genetically predisposed to the disease, according to a number of studies [12-15]. There was no statistically significant difference between the ages of the control group and those of the COPD patients. On the other hand, the control group did not show any association between age and glucose levels in the blood. I find this discovery fascinating.

The results of this study show that COPD is more common in people who have a strong genetic predisposition to it compared to those who have a weak one. Unlike people who get sick less from other causes. Despite accounting for the highest frequency of the disease, COPD research studies underrepresent people over the age of 60 [1-4]. This is because COPD is more common in older people and those with a family history. To carry out its typical function, the ALP enzyme requires zinc. Notably, both the COPD and control groups showed a positive correlation between age, zinc levels, and ALP. Furthermore, we observed an inverse relationship between the RBS levels of COPD patients and their age. This seems strange at first glance, but it could be because zinc levels drop as a defense mechanism against the effects of aging and the increased production of free radicals, or because oxidative stress rises in tandem with glucose concentration. COPD patients, compared to healthy controls and age-matched individuals, have elevated levels of oxidative stress, according to multiple studies [4-8].

Despite the lack of an effort to measure free radical concentrations in this study, it is known that oxidative stress is greater in both COPD patients and older controls [5-7]. Our results showed that compared to healthy controls, COPD patients had significantly lower levels of ALP.

Zinc is an essential cofactor for many enzymes involved in glucose metabolism [6-9]. Reduced zinc levels can be caused by immune-related disorders, although zinc insufficiency has also It has been found to increase the likelihood of contracting COPD. A low zinc level is a common hallmark of COPD, according to studies [4-7]. Multiple experiments on animal models show that zinc negatively impacts the insulin signaling pathway.

In a similar vein, several investigations [7, 8] have shown that zinc consumption improves insulin action and glucose metabolism. Two separate studies [7,8] found that zinc consumption was associated with a lower risk of COPD. COPD patients also have impaired glucose homeostasis and insulin sensitivity due to zinc deficiency [12-14]. It also delays the progression of comorbidities such as retinopathy, thrombosis, and hypertension [12-14]. Researchers found that low serum zinc levels strongly predict the development of COPD in a study published in [7-9,12-14]. Multiple

investigations [12,13] found lower serum zinc levels in COPD patients compared to healthy controls. Whichever occurs first zinc deficiency or COPD development neither a conclusive signal nor a theory can say for sure. In the COPD group, we found significantly lower zinc levels compared to the control group, and we also found a significant negative connection between serum RBS and serum zinc. Patients with COPD often experience hyperglycemia, which is the cause of the lower level. Patients with COPD experience an increase in urine frequency due to osmotic diuresis. Research indicates that this process may lead to the loss of zinc [13].

Conclusion

COPD patients' zinc, alkaline phosphatase, and random blood sugar levels reveal important information on the disease's systemic impact and comorbidities. Changes in alkaline phosphatase activity show inflammation and possible bone health problems, whereas elevated random blood sugar levels show glucose dysregulation. Zinc deficiency highlights immune response impairment and oxidative stress. By monitoring these indicators, we can gain a deeper understanding of the progression of COPD, develop more effective treatment strategies, and reduce the risk of systemic consequences. Thorough evaluation of these factors highlights their significance in enhancing patient care and results.

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