



Plasmaelectrolytes and blood gases in patients with chronic obstructive pulmonary disease.

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**Caribbean Journal of Science and
Technology**

ISSN 0799-3757

<http://caribjscitech.com/>

Abstract:

Background: COPD is a chronic inflammatory lung disease that causes obstructed airflow from the lungs. Water retention and hypernatremia are typically observed in the final stages of COPD owing to difficulties of renin-angiotensin axes.

Methods: The present study was conducted to evaluate serum electrolyte levels and blood gases in COPD cases. COPD patients who attended our hospital with acute exacerbations were enrolled in the present study. Plasma electrolyte levels (Sodium and Potassium) and blood gases along with pH were measured.

Results: Two hundred and fifty one cases of COPD and 50 Controls were enrolled in a period of 3 months. Out of these 136 were males (54%) and 115 were females (46%). In control group 22 were males (44%) and 28 were females (56%). The mean age of presentation of COPD patients 62 ± 11.5 yrs (35 to 78yrs) and that of controls was 60 ± 10.8 yrs (32 to 65yrs). Mean plasma sodium and potassium levels in COPD patients were 142.26 ± 10.95 mmol/L and 3.81 ± 1.14 mmol/L respectively. Whereas, the levels in the control group were 140 ± 3.79 mmol/L and 3.57 ± 0.48 mmol/L, respectively.

Conclusion: The results from our study support the hypothesis that chronic hypoxia in COPD patients was associated with deranged PaCO₂ and PaO₂, salt and water retention which activates renin-angiotensin system.

Key words: COPD; hypoxia; electrolyte imbalance; blood gases.

Introduction:

Chronic obstructive pulmonary disease (COPD) is a chronic inflammatory lung disease that causes obstructed airflow from the lungs. Symptoms include breathing difficulty, cough, mucus (sputum) production and wheezing. This may be due to long-term exposure of irritating gases or particulate matter and most often from cigarette smoke. Patients with COPD are at increased risk of developing heart disease, lung cancer and a variety of other life threatening conditions (1).

COPD is one of the major health disorder and varies with age, gender, location, affecting approximately 6-10% of adults and is responsible for 5.1% of all deaths worldwide (2, 3).

These patients present with features of acute respiratory infections (productive cough, dyspnoea) along with number of metabolic disorders which arises due to electrolyte imbalances, hyperbilirubinemia, elevated transaminase, blood urea, creatinine levels (4). Water retention and hypernatremia are typically observed in the final stages of COPD owing to difficulties of renin-angiotensin axes (5). Electrolyte balances the volume of blood and transmit electrical impulses that keep heart breathing rhythmically and electrolyte imbalance in these subjects can cause shortness of breath which may be exaggerated by high altitude (6).

The economic and social burden created by acute exacerbations of COPD are extremely high. It is also important to identify factors associated with poor outcome among COPD cases (7, 8). Based on this the present study was conducted to evaluate serum electrolyte levels and blood gases in COPD cases.

Subjects and Methods:

The present study was conducted in the Department of Biochemistry Govt. Medical College Srinagar. COPD cases were recruited from IPD and OPD of the hospital. Details of the patients were taken and a written informed consent was signed before taking the blood sample. The study was done from January 2018 to March 2018 and was conducted according to the guidelines of the Institute's Ethics Committee.

Patients who attended our hospital with acute exacerbations and with Kashmiri ethnicity were included in the study. Those with respiratory problems other than COPD, the diseases that affect electrolyte levels and the patients with non-Kashmiri Origin were excluded from the study.

Diagnosis of the patients was based on history, clinical examination, chest X-ray, and pulmonary function test. Under strict aseptic conditions, 2ml of fasting blood was collected in a heparinised syringe. Plasma electrolyte levels (Sodium and Potassium) was measured by Abbot Auto-analyser and blood gases along with pH were analysed by GEM Premier 3000 blood gas analyser.

In addition, normal healthy controls were also enrolled. The subjects without any underlying medical history were taken as controls. The detailed biochemical investigations were performed in these healthy subjects.

The data was described as mean \pm SD and percentage. Intergroup comparison of pedigree was done by student's *t*-test, Mann Whitney U-test and F-test (ANOVA). $P < 0.05$ was considered significant. Data was analysed using SPSS Ver. 20.0.

Results:

Two hundred and fifty one cases of COPD and 50 Controls were enrolled in a period of 3 months. Out of these 136 were males (54%) and 115 were females (46%). In control group 22 were males (44%) and 28 were females (56%). The mean age of presentation of COPD patients 62 ± 11.5 yrs (35 to 78 yrs) and that of controls was 60 ± 10.8 yrs (32 to 65 yrs). Mean plasma sodium and potassium levels in COPD patients were 142.26 ± 10.95 mmol/L and 3.81 ± 1.14 mmol/L respectively. Whereas, the levels in the control group were 140 ± 3.79 mmol/L and 3.57 ± 0.48 mmol/L, respectively. The biochemical detail is given in table 1.

The mean potassium, PaCO₂, PaO₂ and pH values were statistically significant. About 5 out of 251 cases (2%) had slightly acidic pH at the time of investigations. About 121/ 251 (48 %) patients had normal HcT values (35 % to 51%), HcT < 35 % was present in 119 cases (47 %) and values > 51 % were present in 95 patients (38%).

Discussion:

COPD is considered to be one of the major respiratory problems, characterised by limited air flow. These patients have electrolyte imbalance which is associated with oedema and heart failure (9, 10). Though seen that the glomerular filtration rate in these patients remain normal but oedema is usually due to retention of sodium which has been associated with higher PaCO₂ levels (11). In our study, the mean potassium, PaCO₂, PaO₂ and pH values were statistically significant, when compared with the controls. The elevated PaCO₂ has been described earlier also in the patients with COPD and severe Oedema. Howes et al. had seen that increased electrolytes in these patients lead to decreased blood flow and decreased GFR. They also found that hypercapnia and hypoxic conditions had inverse relation with excretion of sodium and potassium (12).

We hypothesise that hypoxia in presence of hypercapnia plays a very important role in the electrolyte imbalances in patients with COPD. Similar study was conducted by Mannix et al and Sin et al, where they found that sodium retention was influenced by hypoxemia in the presence of hypercapnia (13, 14).

During acute exacerbation of COPD the activation of the renin angiotensin aldosterone system and inappropriately elevated plasma arginine vasopressin worsen the electrolyte imbalance(15).High mortality in hypokalaemia may be attributed to cardiac arrhythmias or hampered nerve-muscle conduction. From our study,hypokalaemia may be associated with the cardiac diseases that needs proper care to avoid fatal outcomes.

The chronic hypoxia in our COPD patients may lead to vasoconstriction which will in-turn lead to pulmonary hypertension and increased right ventricular load (17). Eventually, these patients may develop high pulmonary arterial pressure and severe oedema (6, 17).

Conclusion:

The results from our study support the hypothesis that chronic hypoxia in COPD patients was associated with deranged PaCO₂ and PaO₂, salt and water retention which activates renin-angiotensin system. This will in turn lead to further oedematous conditions in these patients.

Ethical justification:

Informed and written consent (in language they best understood) was taken before collecting data and blood sample. Only those individuals, who volunteered to participate in the study, were selected and the data was kept confidential. The study did not impose any financial burden on the study subjects and the institute, therefore the study was ethically justified.

Conflict of Interests:

The author declares that he has no conflict of interests.

Author`s Contribution:

All authors were involved in the conceptualization of the study. IS and MSZ contributed to the data acquisition and interpretation. IS, RS and SM helped greatly in data analysis and interpretation. IS, MUR and SM drafted the manuscript. All authors have read and approved the submitted version of the manuscript.

Parameters	COPD patients (N = 251) Mean \pm SD	Controls (N = 50) Mean \pm SD	P value
Plasma Sodium(mmol/L)	142. 26 \pm 10.9	140.92 \pm 3.7	0.12
Plasma Potassium(mmol/L)	3.8 \pm 1.2	3.57 \pm 0.48	0.01
pH	7.4 \pm 0.14	7.3 \pm 0.06	<0.001
HcT(%age)	40.4 \pm 17.3	41. 38 \pm 6.4	0.50
PaCO2 (mm Hg)	64.19 \pm 21.42	48.31 \pm 16.82	<0.001
PaO2 (mm Hg)	66.56 \pm 27.98	50.01 \pm 17.09	<0.001

Table 1: The mean values of biochemical parameters.

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