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STUDY ON SERUM ELECTROLYTES AMONG PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) is one of the most important diseases among adults which is associated with significant morbidity, mortality and quality of life. Presence of electrolyte imbalance affects the outcome of the patients with COPD particularly in those with acute exacerbation of COPD (AECOPD).

Objectives:

1. To find out the prevalence of electrolyte imbalance in patients with COPD
2. To identify the relation between severity of COPD and electrolyte levels.

Methodology: A cross sectional study was conducted for a period of 6 months from January to June 2025. Both male and female patients those who were aged more than 18 years admitted in the in-patient department of General Medical department were included in the study. Patients in all stages of COPD were recruited. All patients were interviewed using a structured proforma and the investigations such as complete blood count (CBC), liver function test (LFT), renal function test (RFT), serum sodium, potassium, calcium, phosphorus, chest X ray and spirometry were done. Appropriate statistical tests were performed.

Results: A total of 100 patients with COPD were included in the study. Mean age of the study participants was 57.8 years. Majority of the participants (78%) were male. Complete blood count, liver function test and renal function test were normal in all the patients. All the patients had hyperinflation of lungs in the X ray. The mean FEV1 (predicted %) in the study group was 57.9% which was ranging from 36 to 75%. Among the total study participants, 74% had moderate COPD and 26% had severe COPD. The mean sodium and potassium level was significantly less among patients with severe COPD than patients with moderate COPD. Serum calcium and phosphorous levels were almost similar between patients with moderate and severe COPD. Among the total 100 patients, 27% had hyponatremia, 12% had hypokalemia, 1% had hypophosphatemia and all the patients had normal calcium levels.

Conclusion: Hyponatremia and hypokalemia were common in patients with COPD. Severity of COPD had significant association with electrolyte levels.

Key words: COPD, sodium, potassium, calcium, phosphorous

Introduction

Chronic obstructive pulmonary disease (COPD) accounted for 3.2 million deaths during the year 2019 making it 3rd leading cause of mortality globally as per the World Health Organization (WHO) report. Almost 90% of deaths due to COPD among individuals of age less than 70 years is estimated to occur in low and middle income countries (LMIC).[1] The prevalence of chronic obstructive pulmonary disease (COPD) of GOLD stage 2 and above is almost 9 to 10% among adults aged more than 40 years.[2] The prevalence of COPD in previous studies have wide variation which is reportedly due to the reason that COPD was diagnosed using different procedures and different classification systems were used resulting in such variation. The term COPD includes chronic bronchitis and emphysema. The estimated national burden of COPD in India was 14.8 million cases based in a multi centre study done by Jindal et al.[3] COPD is of multifactorial origin. The risk factors include genetic factors, environmental factors such as exposure to tobacco smoke, exposure to higher concentration of outdoor air pollutants, indoor air pollution, occupational exposure such as fumes and previous history of tuberculosis, prematurity at birth, asthma in childhood. COPD is associated with respiratory symptoms such as productive cough, sputum production and difficulty in breathing which are persistent and progresses over years.[1] COPD is associated with multiple co-morbidities which include cardiovascular diseases including coronary artery disease, hypertension and heart failure; diseases of metabolic disorders like diabetes mellitus, obesity and metabolic syndrome; osteoporosis, anemia, depression, cachexia and lung cancer.[4,5] Acute exacerbation of COPD is diagnosed based on acute changes that occur in the symptoms of COPD which is well beyond the usual day to day variations. Acute exacerbation of COPD which is termed as AECOPD is reported to be associated with various systemic extrapulmonary manifestations and electrolyte abnormality is one such problem reported in previous studies. Studies have also reported that abnormality in serum potassium, sodium, calcium and magnesium increase the risk of mortality in these patients with AECOPD.[6] Electrolyte imbalance that occur in COPD patients is also reported to be associated with outcome of the disease.[7,8] There are multiple pathophysiological mechanisms involved in occurrence of electrolyte abnormality in COPD. Hyponatremia and water retention that occurs in the later stages of COPD is attributed to the changes in rennin, angiotensin II, atrial natriuretic peptide (ANP), aldosterone and vasopressin.[7] Among the electrolyte abnormalities, lower level of sodium and potassium are the most common problems reported in previous studies. Electrolyte abnormalities may occur due to changes in hormonal balance and/or due to medications prescribed for treatment of COPD. Early and appropriate assessment and early interventions are necessary to prevent morbidity and also mortality associated with such electrolyte abnormalities in COPD patients. The beta 2 agonists used for managing COPD such as formetrol, salbutamol are found to be associated with electrolyte imbalance.[9,10] Serum sodium level in these patients may also occur due to carbon dioxide retention, heart & renal failure and use of diuretics. Since hyponatremia and other electrolyte abnormalities are associated with severe central nervous system (CNS) manifestations such as coma, seizures and cardiac abnormalities, it is essential to study the electrolyte level in patients with COPD and hence the present study was conducted with the aim of identifying the pattern of electrolyte abnormality in COPD patients.

Aims and Objectives:

1. To find out the prevalence of electrolyte imbalance in patients with COPD
2. To identify the relation between severity of COPD and electrolyte levels.

Materials and Methods:

A cross sectional study was conducted among patients with chronic obstructive pulmonary disease admitted in General Medical department of Acs Medical College and Hospital.

The study was carried out for a period of 6months between January 2025and June 2025.

All patients those who were aged more than 18 years admitted in in-patient department of General Medical department were included in the study. Patients in all stages of COPD were recruited irrespective of the stage. Patients of either gender were recruited.

Informed consent was obtained for the study. A detailed proforma was used by the investigator to obtain information from the patients using the interviews. Information about the name, age, sex and duration since diagnosis of COPD were collected. Investigations such as complete blood count (CBC), liver function test (LFT), renal function test (RFT), serum sodium, potassium, calcium, phosphorus were done. Chest X ray was taken. Spirometry was done after appropriate instructions, with which FEV1 predicted % was calculated.
Statistical analysis was performed with use of SPSS software and the mean and proportion are presented in the result section.

Results:
A total of 100 patients with COPD were included in the study. Mean age of the study participants was 57.8±7.4 years which was ranging between 34 and 70 years. Table 1 describes the characteristics of the study participants.

Table 1: Characteristics of the study population

Variable	Number of participants	Percentage
Age		
34 to 50 years	14	14%
51 to 70 years	86	86%
Gender		
Male	78	78%
Female	22	22%
Complete blood count		
Normal	100	100%
Abnormal	0	0
Liver function test		
Normal	100	100%
Abnormal	0	0
Renal function test		
Normal	100	100%
Abnormal	0	0
Chest X ray		
Normal	0	0
Hyperinflation	100	100%

The mean FEV1 (predicted %) in the study group was 57.9±10.2 with minimum and maximum values of 36 and 75 respectively.
Figure 1 depicts the categorization of COPD based on FEV1 (predicted %). Among the total study participants, 74% had moderate COPD and 26% had severe COPD.

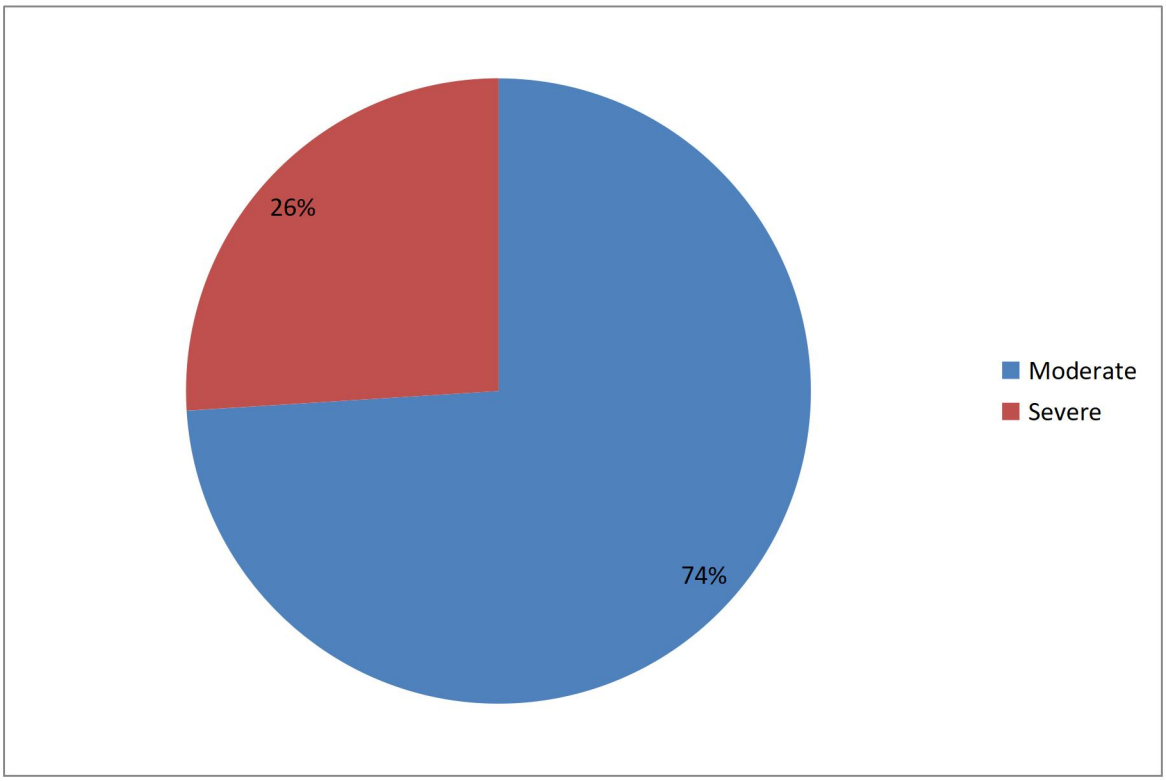

Figure 1: Severity of COPD based on FEV1 (predicted %)

The mean serum sodium level was 136.9±3.7 meq/l which was ranging from 124 to 145 meq/l.
The mean potassium level in the serum was 4.01±0.4 meq/l with a minimum value of 3.2 and maximum value of 4.7 meq/l.
The mean serum calcium level among the study participants was 9.08±0.37, which was ranging between 8.2 to 10.
The average serum phosphorous value was 3.6±0.36 among the study group which was ranging from 2.3 to 4.3.

Table 2: Serum sodium, potassium, calcium and phosphorous in the study group

Parameters	Mean ±SD	Minimum	Maximum
Serum sodium	136.9±3.7	124	145
Serum potassium	4.01±0.4	3.2	4.7
Serum calcium	9.08±0.37	8.2	10
Serum phosphorous	3.6±0.36	2.3	4.3

Table 3: Mean difference in the various parameters between patients with moderate and severe COPD

Parameters	**Category**	**N**	**Mean**	**Std. Deviation**	**P value**
Sodium	Moderate	74	138	3.14	0.0001
	Severe	26	134	3.77	
Potassium	Moderate	74	4.07	.35	0.017
	Severe	26	3.8	.48	
Calcium	Moderate	74	9.07	.38	0.62
	Severe	26	9.11	.35	
Phosphorous	Moderate	74	3.60	.40	0.4

Parameters	Category	N	Mean	Std. Deviation	P value
Sodium	Moderate	74	138	3.14	0.0001
	Severe	26	134	3.77	
Potassium	Moderate	74	4.07	.35	0.017
	Severe	26	3.8	.48	
Calcium	Moderate	74	9.07	.38	0.62
	Severe	26	9.11	.35	
Phosphorous	Moderate	74	3.60	.40	0.4
	Severe	26	3.67	.23	

Table 3 describes the mean difference in serum sodium, potassium, calcium and phosphorous between patients with moderate and severe COPD. The mean serum sodium level was 138 meq/l among patients with moderate COPD which was higher compared to patients with severe COPD in whom it was 134 meq/l. The serum potassium level in patients with severe COPD was 3.8 meq/l which was lesser than the patients with moderate COPD in whom it was 4.07 meq/l. The mean serum calcium level was almost similar in patients with moderate and severe COPD (9.07 vs 9.11). No significant association was found between serum phosphorous level of patients with moderate and severe COPD (3.60 vs 3.67).

Table 4: Serum electrolyte level in the study population

Parameters	Category	Number of patients	Percentage
Sodium	Normal	73	73
	Hyponatremia	27	27
Potassium	Normal	88	88
	Hypokalemia	12	12
Calcium	Normal	100	100
Phosphorous	Normal	99	99
	Hypophosphatemia	1	1

Among the total 100 patients, 73% had normal serum sodium level and 27% had hyponatremia. Of the total 100 patients, 88% had normal serum potassium level and 12% had hypokalemia. All the patients had normal calcium level. Of the total patients, 99% had normal phosphorous level and 1% had hypophosphatemia.

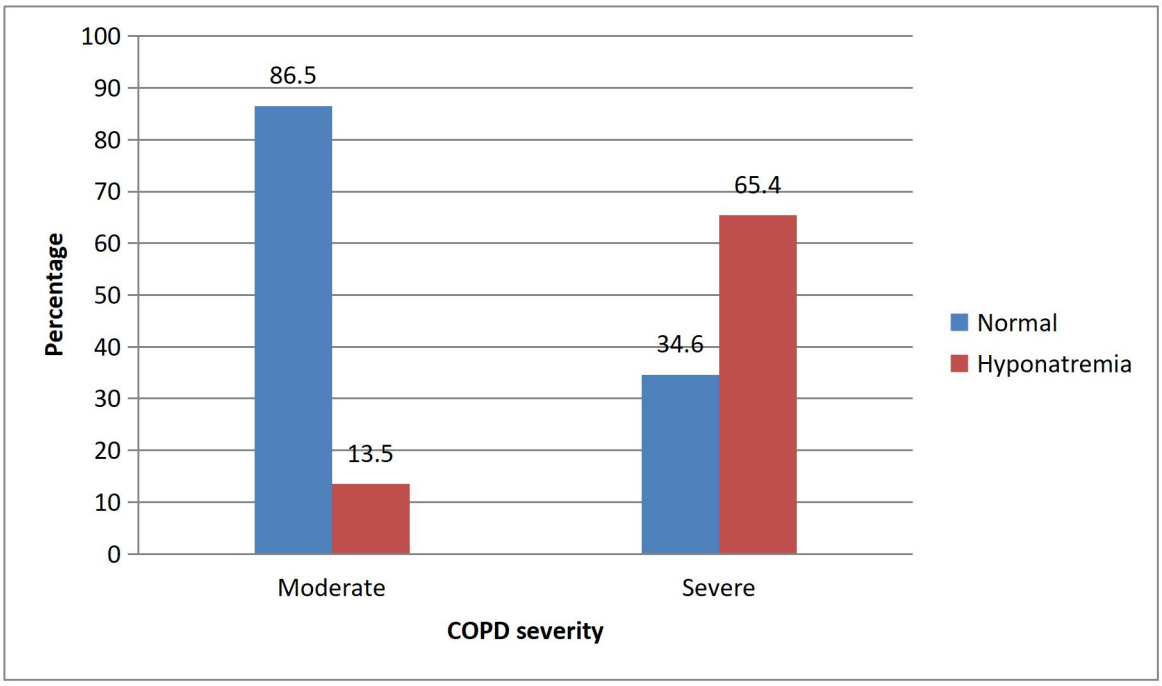

Figure 2: Association between severity of COPD and serum sodium level

Among the 26 study participants with severe COPD, 65.4% had hyponatremia and 34.6% had normal serum potassium level. Among the total 74 patients with moderate COPD, 13.5% had hyponatremia and 86.5% had normal sodium level (p<0.0001).

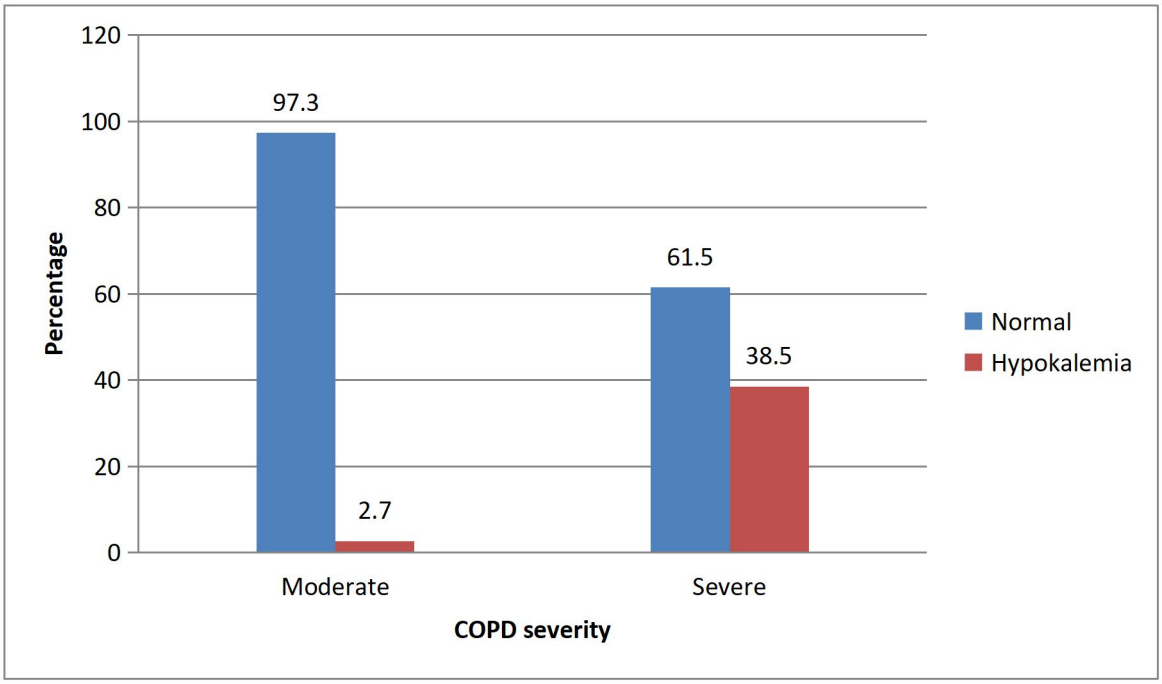

Figure 3: Association between severity of COPD and serum potassium level

Among the total study participants with severe COPD, 38.5% had hypokalemia and 61.5% had normal serum potassium level. Among the total 74 patients with moderate COPD, 2.7% had hypokalemia and 97.3% had normal potassium level (p<0.0001).

Discussion:

The present study was a cross sectional study done among 100 adults with COPD admitted in General Medicine department of Acs Medical College and Hospital. In the present study, mean age of the study patients was 57.8 years. Majority of the study participants were males. Similar to this study, another study by Ouf et al also reported higher proportion of males with COPD in their study.[11] In the current study, mean serum sodium level was 136.9 meq/l. In another study done by Das et al, the serum sodium level was 142 meq/l which was little higher than the current study.[12] Ouf et al had reported serum sodium level of 132.4 meq/l which was lesser than the current study.[11] In another study by Rashid et al also the serum sodium level was lesser than the current study which was 131meq/l which could be due to involvement of patients with acute exacerbation.[13] Another study by Wang Y et al serum sodium level was 139 meq/l among AECOPD patients.[14] The mean potassium level was 4 meq/l in the present study which was lesser than the findings of another study by Das et al.[12] In another study by Ouf et al, the mean potassium level was 3.28 meq/l which was lesser than the current study.[11] In another study by Rashid et al also mean potassium level was lesser than the current study which was 3.2 meq/l which could be due to involvement of patients with acute exacerbation.[13] In their study, Wang Y et al had reported mean serum potassium level was 4.2 meq/l among AECOPD patients.[14] A retrospective study by Ogan el at had found significantly lower levels of serum potassium, sodium, magnesium, phosphorus and calcium in patients with AECOPD than control group. The study also found that the levels of calcium and potassium were significantly lower in AECOPD patients who have died compared to COPD patients who were alive. Few other studies have also reported lower electrolyte levels in patients with acute exacerbation than those without acute exacerbation.

Conclusion:

The present study found lower levels of serum sodium and potassium among patients with COPD. Serum levels of sodium and potassium was lower among patients with severe COPD than those with moderate COPD.

Summary:

A total of 100 patients with COPD both males and females aged more than 18 years were included in the study. 78 of them were male patients, 22 of them werefemale patients. Patients mean age was 57.8+/-7.4 years and the disease was seen mostly in 51-70 yrs age group. Most of the subjects were males. Most of the patients had moderate COPD, according to airflow limitation by spirometry. Almost all patients had hyperinflated lung finding on chest x ray. Low serum sodium level (hyponatremia) was present in a subset of patients, mean serum sodium level recorded was136.9 meq/l. Hyponatremia was more commonly present in severe COPD patients, and was noted more in male patients.

Low potassium level (hypokalemia) was present in some patients. Mean serum potassium level was 4.0 meq/l. Hypokalemia was more commonly present in severe COPD patients. Hypokalemia was most commonly present in 61-70 years of age group patients, and it was more common in males.

Mean serum calcium was 9.08 meq/l. Calcium level was normal in all the patients.

Low serum phosphorus level was present only in one patient.

Combined Hyponatremia and Hypokalemia was present in some
patients, most of them had severe COPD.

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