Study of Serum Electrolytes in Acute Exacerbation of COPD Patients

Abstract

Background: Electrolyte disturbances, particularly hyponatremia and hypokalemia, are frequently observed in patients experiencing acute exacerbations of Chronic Obstructive Pulmonary Disease (AECOPD). These imbalances may have a direct association with the severity and prognosis of the disease.

Objective: To evaluate the prevalence of hyponatremia and hypokalemia in AECOPD patients and to assess their correlation with clinical indicators of disease severity.

Methods: A prospective observational study was conducted on patients admitted with AECOPD. Serum sodium and potassium levels were measured and correlated with oxygen saturation, spirometry results, GOLD staging, illness duration, and Peak Expiratory Flow Rate (PEFR).

Results:

In this study of 50 patients with acute exacerbation of COPD, the mean age was 57.98 ± 8.44 years, with 80% males and 92% from rural backgrounds. Tobacco exposure was seen in 80% of cases, and breathlessness was the most common symptom (100%). The mean BMI was 51.90 ± 10.19 and mean PEFR was 111.60 ± 29.64 L/min. Hyponatremia and hypokalemia were observed in 92% and 86% of patients, respectively, with mean serum sodium at 130.50 ± 3.74 mmol/L and potassium at 3.26 ± 0.37 mEq/L. Electrolyte levels showed no correlation with age, gender, or MMRC grade, but were significantly lower in patients with very severe COPD. A negative correlation was found between disease duration and electrolyte levels, while serum sodium positively correlated with exacerbation frequency and PEFR.

Conclusion: Electrolyte imbalances, particularly hyponatremia and hypokalemia, are prevalent among hospitalized AECOPD patients and are closely linked with disease severity. Early detection and prompt correction of these abnormalities are crucial for reducing morbidity and mortality in such patients.

Keywords:COPD,Serum electrolytes,Serum Sodium,Serum Potassium

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a heterogeneous lung condition characterized by chronic respiratory symptoms (dyspnea, cough, sputum production and/or exacerbations) due to abnormalities of the airways (bronchitis, bronchiolitis) and/or alveoli (emphysema) that cause persistent, often progressive, airflow obstruction.

Acute exacerbation of COPD episodes not only worsen lung function but also significantly impair the quality of life, increase hospitalization rates, healthcare expenditures, and are

associated with high morbidity and mortality [5]. Nearly 75% of exacerbations are infection-driven—approximately 25% are viral, 25% bacterial, and another 25% are mixed infections [4,6].

In addition to respiratory symptoms, patients often exhibit systemic and metabolic disturbances, including significant electrolyte imbalances such as hyponatremia and hypokalaemia, as well as renal and hepatic dysfunction [7,8]. These disturbances can be attributed to both the underlying disease process and the pharmacological interventions commonly employed—such as β2-agonists, corticosteroids, and diuretics [9].

Hyponatremia, frequently observed in the later stages of COPD, is associated with neurohormonal dysregulation involving antidiuretic hormone (ADH), renin-angiotensin-aldosterone system, and atrial natriuretic peptide, often triggered by hypoxia and hypercapnia. This condition leads to water retention and reduced renal blood flow, potentially culminating in edema and worsening outcomes [10]. Clinical manifestations may include confusion, seizures, cardiac arrhythmias, and even coma [11].

Similarly, hypokalaemia may develop due to respiratory acidosis, metabolic alkalosis, or the chronic use of β2-agonists and corticosteroids. Hypokalaemia can lead to neuromuscular weakness, arrhythmias, and impaired respiratory muscle performance, thereby exacerbating respiratory failure [12].

Electrolyte imbalances, though often overlooked, play a pivotal role in determining the prognosis of AECOPD. Timely identification and correction of these abnormalities are essential to reducing mortality, minimizing hospital stays, and improving clinical outcomes in COPD patients.

This study was conducted to evaluate the prevalence and clinical significance of serum electrolyte disturbances in patients presenting with acute exacerbations of COPD, with a focus on sodium and potassium abnormalities, and their impact on disease progression and patient outcomes

Methodology

This prospective observational study was conducted in the Department of Respiratory Medicine at Government medical college , Kota, Rajasthan for a period of one year from 2024 January to 2024 December. The study enrolled patients admitted with acute exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD). AECOPD was defined as an acute worsening of respiratory symptoms such as increased cough, sputum production, dyspnea, or change in sputum purulence occurring within the previous three weeks.

Patients were included if they were diagnosed cases of COPD experiencing an acute exacerbation requiring Intensive Care Unit (ICU) admission and had provided written informed consent. Exclusion criteria included refusal to consent, presence of malignancies or severe comorbidities interfering with study completion, active pulmonary tuberculosis, and known causes of dyselectrolytemia such as chronic renal failure, diabetic ketoacidosis, sepsis,

adrenocortical insufficiency, history of significant gastrointestinal fluid loss (vomiting or diarrhea), and cerebral salt-wasting syndrome.

A detailed clinical history and demographic data were recorded for all participants. Each patient underwent a comprehensive clinical examination along with relevant laboratory and radiological investigations. Venous blood samples were analyzed for serum sodium and potassium levels using an automated electrolyte analyzer (NuLYTE SMART), with reference ranges of 135–145 mMol/L for sodium and 3.5–5.5 mMol/L for potassium.

Pulmonary function was assessed by measuring Peak Expiratory Flow Rate (PEFR) using a Breathometer (Cipla Ltd., India), calibrated to the European Union (EU) standards. The reference PEFR values were 450–550 L/min for males and 320–470 L/min for females.

Chest radiographs were obtained to evaluate for radiological features indicative of COPD. Additionally, electrocardiograms (ECG) were performed on all patients to assess for signs of P pulmonale, defined as increased P-wave amplitude in leads II, III, and aVF, suggestive of right heart strain or cor pulmonale commonly associated with COPD.

Results

Table 1: Age Distribution of Subjects with Acute Exacerbation of COPD

Age Group (Years)	Number of Patients	Percentage (%)
41–50	13	26%
51–60	14	28%
61–70	19	38%
>70	4	8%
Total	**50**	**100%**

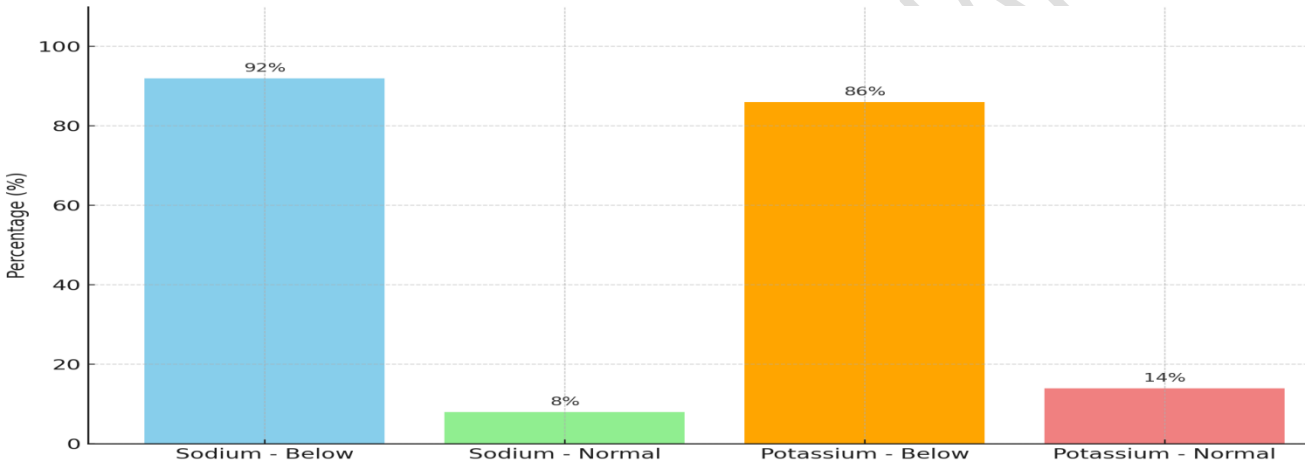
The mean age distribution was 57.98 ± 8.44 years. Maximum number of individuals were in the age group of 61 to 70 years accounting to 17 (38%) followed by 14 (28%) in the age group of 51-60 years.

Table 2: Serum Electrolyte Levels in AE COPD Subjects

Electrolyte	Level	No. of Patients	Percentage (%)
Serum Sodium	Below (<135)	46	92.00%
	Normal (135–145)	4	8.00%
Serum Potassium	Below (<3.5)	43	86.00%
	Normal (3.5–5.0)	7	14.00%

The analysis of serum electrolyte levels in patients with acute exacerbation of COPD revealed that hyponatremia was prevalent in the majority of cases. Specifically, 92% (46 patients) had serum sodium levels below 135 mEq/L, indicating low sodium levels, while only 8% (4 patients) had normal sodium levels within the range of 135–145 mEq/L.

Similarly, hypokalemia was observed in a significant portion of the study population. A total of 86% (43 patients) had serum potassium levels below 3.5 mEq/L, whereas only 14% (7 patients) maintained normal potassium levels within the range of 3.5–5.0 mEq/L. These findings highlight a high prevalence of dyselectrolytemia among COPD patients during acute exacerbations.



In the study the mean age distribution was 57.98 ± 8.44 years with 80% male patients and remaining 20% female, 92% of the total number of subjects belonged to the rural area. 80% of the total subjects were exposed to bidi/cigarette, whereas 20%were exposed to biogas. Breathlessness was the most common symptom (100%), BMI the subjects was 51.90 ±10.19 and mean PEFR was 111.60 ±29.64 1/min. 92% of the total patients had sodium levels below normal and 86% has serum potassium level below normal limits. The mean Serum Sodium Level in our study was 130.50 ± 3.74 mmol/L and Serum Potassium Level was 3.26 ± 0.37 mEq/L. The variation in serum sodium and potassium level had no correlation with age and gender. 60% of the patients had MMRC grade 3 and 40% had MMRC grade 4 and no correlation of them was seen with serum sodium or potassium levels. 54% had COPD GOLD staging as severe whereas 46% had COPD GOLD staging as very severe and it was seen that serum sodium and serum potassium levels were significantly lower in very severe cases. The study showed a negative correlation between the duration of illness and serum sodium and potassium levels. A minimum of 2 exacerbations per year were seen in our patients with a strong positive correlation with serum sodium levels and no correlation with serum potassium levels. An improvement in PEFR was seen with increase in serum sodium levels whereas no such relation with serum potassium levels. In our study, E.C.G. changes and CXR findings were seen more with very severe COPD staging. Severe spo2 fall findings were seen with very severe COPD staging.

Discussion

This hospital-based observational study was conducted over 1.5 years at Dhiraj Hospital, Pipariya, and included 50 patients with Acute Exacerbation of COPD (AE-COPD). The analysis focused on demographic, clinical, and biochemical profiles, particularly evaluating serum sodium and potassium levels in relation to disease severity.

Age and Gender Distribution

The mean age of patients was 57.98 ± 8.44 years, with the highest proportion (38%) in the 61–70 years age group. These results are consistent with findings by Saha et al. (mean age 58.13 years) and Abinaya et al. (mean age 58.35 years). There was a clear male predominance (80%), consistent with Saha et al. (84%) and Abinaya et al. (60%).

Residential and Occupational Profile

A majority of patients (92%) were from rural areas, and most were farmers or laborers—groups with higher exposure to environmental irritants. This rural and occupational profile aligns with similar studies reporting a higher COPD burden in rural working-class populations.

Smoking and Other Exposures

In this study, 80% had a history of smoking (bidi/cigarette), and 20% reported alcohol use or exposure to biomass fuels. These trends mirror findings by Prasad et al. and Abinaya et al., who also reported a high prevalence of smoking among COPD patients.

Clinical Presentation

All patients (100%) presented with breathlessness, followed by productive cough (92%), chest pain (28%), fever (14%), and dry cough (8%). These findings are comparable to Prasad et al., who noted dyspnea (90%), cough (89%), and sputum production (38%).

Nutritional Status (BMI)

The mean BMI was 22.74 ± 2.36 kg/m². Based on Indian guidelines, 76% of patients had normal BMI and 24% were overweight. Similar BMI trends have been noted in other Indian COPD studies.

Serum Electrolyte Levels

A significant finding was the high prevalence of dyselectrolytemia. Hyponatremia was seen in 92%, and hypokalemia in 86% of patients. The mean serum sodium was 130.50 ± 3.74 mmol/L, and potassium was 3.26 ± 0.37 mEq/L. Comparable findings were reported by Prasad et al. and Saha et al., both noting frequent electrolyte disturbances in AE-COPD patients.

Electrolytes and Demographic Variables

Serum sodium and potassium levels were slightly lower in females and older age groups, but these differences were not statistically significant, consistent with Abinaya et al..

Electrolytes and Symptom Severity (MMRC Grade)

In our study, 60% of patients had MMRC Grade 3, and 40% had Grade 4. Grade 4 patients had slightly lower sodium (129.45 mmol/L) and potassium (3.19 mEq/L) levels than Grade 3 (131.13 mmol/L and 3.21 mEq/L), but these differences were not statistically significant.

Electrolytes and GOLD Staging

54% of patients were in severe and 46% in very severe GOLD stages. Electrolyte levels were significantly lower in the very severe group: sodium (128.32 mmol/L) vs 131.05 mmol/L, and potassium (3.11 mEq/L) vs 3.28 mEq/L. This indicates a direct correlation between COPD severity and electrolyte depletion, similar to observations by Abinaya et al..

Duration of Illness and Electrolyte Levels

Patients with longer disease duration showed more severe dyselectrolytemia. Those with >20 years of COPD had the lowest serum sodium (127.75 mmol/L) and potassium (3.06 mEq/L). This inverse relationship was statistically significant, indicating that chronic disease duration contributes to worsening electrolyte imbalance, a finding also supported by Saha et al. and Abinaya et al.

Conclusion

Hyponatremia and hypokalaemia were commonly encountered in patients presenting with acute exacerbation of COPD. Direct relationship and significant correlation were seen between serum electrolytes and various indicators of severity of acute exacerbation of COPD like oxygen saturation, spirometry for lung function, GOLD index, duration of illness, Peak Expiratory Flow Rate (PEFR).Cases with reduced Spo2 level at the time of admission with advanced age had significant hyponatremia and hypokalaemia requiring mechanical ventilation.

A significant number of patients those are hospitalized due to acute exacerbation of COPD have chance of electrolyte imbalance such as hyponatremia, hypokalemia. Detection of such abnormality is very important. Preventive measures and specific management will be helpful for the reduction of mortality & morbidity in near future.

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