

Original Research Article

# Dyselectrolytemia in acute exacerbation of chronic obstructive pulmonary diseases patients - An Observational Cross-sectional Study

**Dr. Bhavesh Patel<sup>1</sup> (Associate Professor), Dr. Princee Patel<sup>2</sup> (3<sup>rd</sup> Year Resident), Dr. Vijendra Chouhan<sup>3</sup> (M D Respiratory Medicine) & Dr. Arti Shah<sup>4</sup> (HOD & Professor)**

<sup>1</sup>*Department of Respiratory Medicine, SBKS MI&RC, Vadodara*

<sup>2</sup>*Department of Respiratory Medicine, SBKS MI&RC, Vadodara*

<sup>3</sup>*Consultant, Vadodara*

<sup>4</sup>*Department of Respiratory Medicine, SBKS MI&RC, Vadodara*

*Corresponding Author: Dr. Princee Patel*

## **ABSTRACT**

**INTRODUCTION.:** Chronic Obstructive Pulmonary Diseases (COPD) is a common preventable and treatable diseases. An Exacerbation of COPD is an acute worsening of respiratory symptoms beyond normal day-to-day variations. It's not only presents with respiratory symptoms, but also with many extra pulmonary manifestations. Disturbance in serum electrolytes is one of an extra pulmonary manifestation. The objective of the study was to find out these serum electrolytes (sodium, potassium) abnormalities in Acute Exacerbation of Chronic Obstructive Pulmonary Diseases (AE COPD) patients.

**AIM.:** To Study Dyselectrolytemia in Acute Exacerbation of Chronic Obstructive Pulmonary Disease Patients.

**MATERIAL AND METHODS.:** The present study was a Observational Cross-sectional study was conducted for a period of one and half year in Respiratory Medicine department. In our Tertiary care Centre. 50 patients with AE COPD in age group more than 40 years, Patients diagnosed with COPD based on GOLD guidelines, on history, clinical examination and spirometry, PEFr were included. Detailed history and demographic data of all patients were taken and relevant clinical and laboratory along with Serum Electrolytes (Sodium & Potassium) tests was performed. The values were analysed using statistical software.

**RESULTS.:** The present study shows sodium and potassium levels below normal limits in patients with AE COPD. The mean Serum Sodium Level in our study was  $130.50 \pm 3.74$  mmol/L and Serum Potassium Level was  $3.26 \pm 0.37$  mEq/L.54%. It was also seen that serum sodium and serum potassium levels were significantly lower in very severe cases. An improvement in PEFr was seen with increase in serum sodium levels whereas no such relation with serum potassium levels.

**CONCLUSION.:** Dyselectrolytemia (Sodium & Potassium) was commonly encountered in patients presenting with acute exacerbation of COPD. Significant correlation was seen between serum electrolytes and various indicators of severity of acute exacerbation of COPD like spirometry for lung function, GOLD index, PEFr. Early detection and specific management will be helpful for prevention of such abnormality.

**KEY-WORDS.:** Chronic Obstructive Pulmonary Diseases (COPD), Acute Exacerbation of Chronic Obstructive Pulmonary Diseases (AE COPD), Dyselectrolytemia, Peak Expiratory Flow Rate (PEFR)

**STUDY DESIGN:** Observational Study.

## 1. INTRODUCTION

Chronic obstructive pulmonary disease (COPD) affects multiple number of patients and is associated with significant morbidity, disability and mortality.<sup>1,2</sup>

An exacerbation of COPD is defined as an event in the natural course of the disease characterised by a change in the baseline dyspnoea, cough with expectoration and beyond normal day to day variations, that is acute in onset and may warrant a change in regular medication in a patient with underlying COPD.<sup>3,4</sup> Exacerbations are the most common cause leading to hospitalization among COPD patients. The economic and social burden produced by acute exacerbation of COPD is extremely high.<sup>3</sup> Majority of the patients experience a temporary or permanent decline in the quality of life due to acute exacerbation of COPD.

Numerous studies that classified patients using the Global Initiative for Chronic Obstructive Lung Diseases (GOLD) Spirometry grading systems have been conducted.<sup>5-7</sup> These studies demonstrate that exacerbation rates vary greatly between patients<sup>7</sup> and even during follow-up visits.<sup>8</sup> The best predictor of having frequent exacerbations (defined as two or more exacerbations per year) is a brief history of earlier treated events.<sup>7</sup>

There are a number of metabolic derangements arising out of the disease process or as a consequence to the therapy of COPD instituted, which can cause hyponatremia, Hypokalaemia. Though most of these features are correctable, very often they are missed or will lead to misguide the diagnosis. Common causes of hyponatremia include hyperglycaemia, use of thiazides or non-steroidal anti-inflammatory drugs, bi- ventricular failure, chronic renal failure, and low oral intake<sup>9</sup> whereas hypokalaemia can be caused by diarrhoea, abuse of laxative, vomiting, some diuretics, drugs like insulin, beta-2 agonists, and theophylline<sup>10</sup>.

Thus simple overlooking the coexistent metabolic abnormalities may contribute to a large number of morbidity and mortality. Thus early recognition and prompt correction of these metabolic abnormalities is important.

## 2. MATERIALS AND METHODS

The present study was an observational cross-sectional study conducted for One and Half years in Respiratory Medicine Department, Dhiraj Hospital, Vadodara, Gujarat, India. In the Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease presenting at outdoor, indoor patients of our department or Emergency. Institutional Ethical Committee approval and informed consent from the subjects or their legal relative was taken.

### Objectives

1. To evaluate level of Serum Electrolytes (Sodium and Potassium) in Acute Exacerbation of Chronic Obstructive Pulmonary Disease patients.
2. To correlate dyselectrolytemia (Sodium and Potassium) with Peak Expiratory Flow Rate or Pulmonary Function Test in Acute Exacerbation of Chronic Obstructive Pulmonary Disease patients.

### Inclusion Criteria

- Age group >18 years patients

- Patients who are ready to give written consent.
- COPD patients presenting to outdoor, indoor patients department or emergency with acute exacerbation.
- Patients with acute exacerbation of COPD (an increase cough, sputum production, worsening dyspnoea, or sputum purulence within 3 weeks) requiring ICU admission.

### Exclusion Criteria

- Age group <18 years patients
- Patients refusing to give written consent
- Presence of malignancy or any other serious comorbidities that would prevent the study completion
- Patient with active pulmonary tuberculosis.
- Other causes of dyselectrolytemia which were excluded from this study are:
  - Chronic renal failure
  - Diabetic ketoacidosis
  - Sepsis
  - Adrenocortical insufficiency
  - History of vomiting/diarrhoea/Gastro intestinal losses
  - Cerebral wasting syndrome

### Data Collection

50 patients with AE COPD were studied Patients diagnosed with COPD on the basis of GOLD guidelines, on history, clinical examination and spirometry, PEFr were included Detailed history and demographic data of all patients were taken and relevant clinical and laboratory along with Serum Electrolytes (Sodium & Potassium) tests was performed. Serum electrolyte values of serum sodium and serum potassium were recorded for comparison. The electrolyte values in venous blood sample was noted. Reference range for normal values for Serum Electrolytes <sup>11</sup> :-

- Serum Sodium: - 135 – 145 mMol/L
- Serum Potassium: - 3.5 – 5.5 mMol/L

Peak expiratory flow rate (PEFR) (liter/minute) was measured in all the patients using a Breathometer (Cipla Ltd., India) with European Union (EU) scale. Reference range for PEFr used is <sup>12</sup> :-

- Male: - 450 – 550 liter/minute
- Female: - 320 – 470 liter/minute

The severity of disease has been assessed based on the airflow limitation classification as in the GOLD guidelines. <sup>13</sup>

STAGE	SEVERITY	POST BRONCHODILATOR (FEV1)
GOLD-1	MILD	FEV1 > 80% Predicted
GOLD- 2	MODERATE	50% ≤ FEV1 < 80% Predicted
GOLD- 3	SEVERE	30% < FEV1 < 50% Predicted
GOLD- 4	VERY SEVERE	FEV1 ≤ 30% Predicted

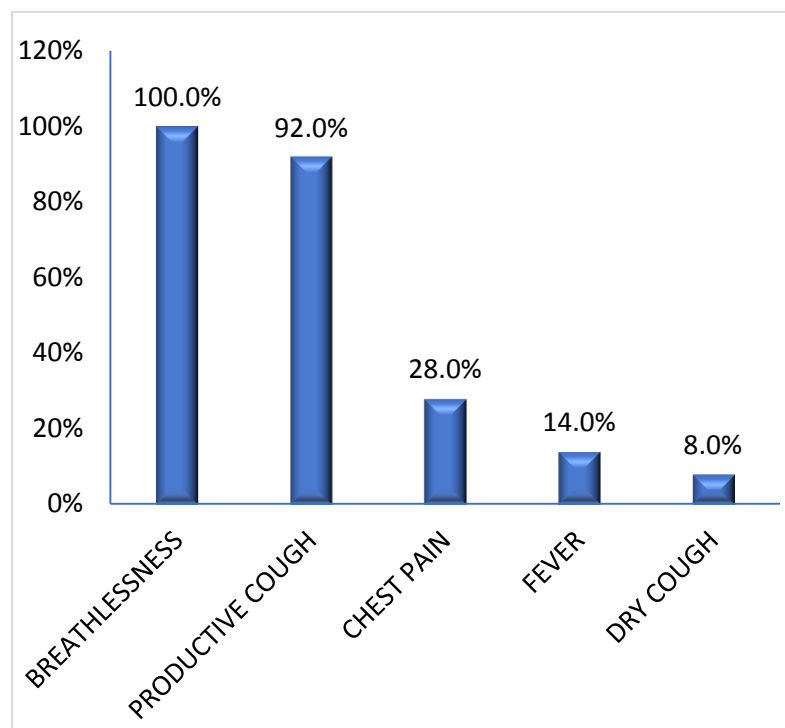
### Statistical Analysis

All the data obtained were entered in Microsoft (MS) Excel and Statistical analysis was done using Statistical Packages for Social Sciences (SPSS) 22 software. Frequencies and

proportion represented categorical data. The ANOVA, chi-square test, Pearson correlation were performed as applicable and was conducted as test of significance on qualitative results. Mean and standard deviation (SD) were used for continuous variables to be represented. To compare two quantitative variables as a measure of significance, the independent t test was also used. After assuming all the rules of statistical test, p value (Probability that the result is true) of <0.05 was considered to be statistically significance.

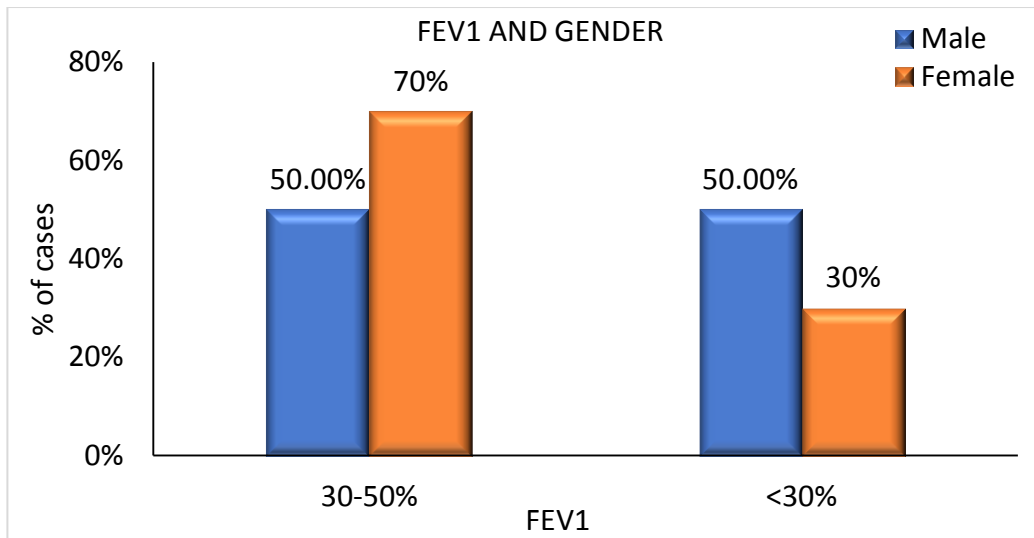
### 3. RESULT

Data of 50 patients were analysed and the mean age distribution was  $57.98 \pm 8.44$  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. In the study 80% were males and 20% were females. 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. Farmer and labourer were the most affected 84%. Breathlessness was the most common symptom (100%), followed by productive cough 46 (92%), chest pain in 14 (28%), fever in 7 (14%) and dry cough in 4 (8%) as seen in **Graph-1**



**Graph 1.: Bar diagram showing Symptoms in AE COPD subjects**

In females 70% had FEV1 30-50% and 30% had <30% FEV1, whereas in males equal number of patients i.e. 50% had <30% and 50% had 30-50% FEV1 as seen in **Graph-2**

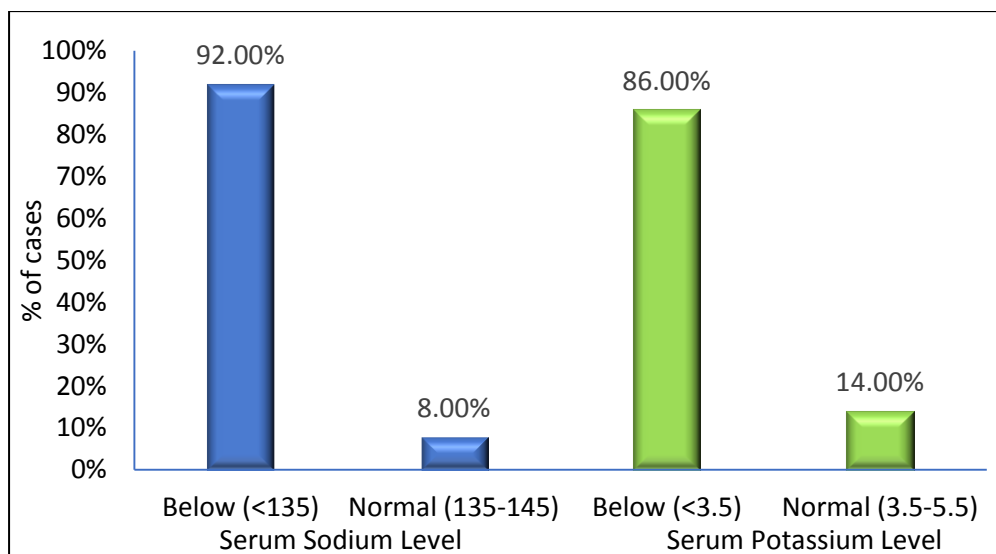


**Graph 2.:** Bar diagram showing Distribution According to FEV1 (POST-BRONCHODILATOR) and Gender in AE COPD subjects

92% of patients had serum sodium levels below normal and 86% had serum potassium levels below normal limits seen in **Table-1** and **Graph-3** with Mean Serum Sodium Level in our study was  $130.50 \pm 3.74$  mmol/L and Serum Potassium Level was  $3.26 \pm 0.37$  mEq/L.

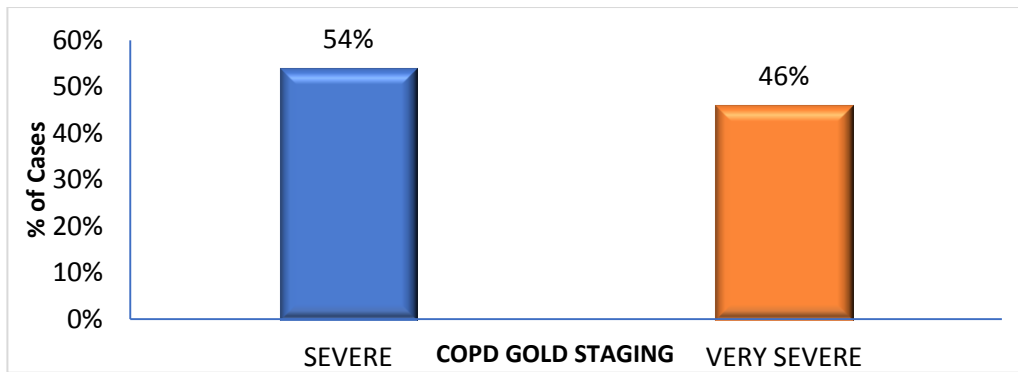
**Table 1: Serum Electrolyte Levels in AE COPD subjects**

		No.	%
<b>Serum Sodium Level</b>	<b>Below (&lt;135)</b>	46	92.00%
	<b>Normal (135-145)</b>	4	8.00%
<b>Serum Potassium Level</b>	<b>Below (&lt;3.5)</b>	43	86.00%
	<b>Normal (3.5-5.0)</b>	7	14.00%



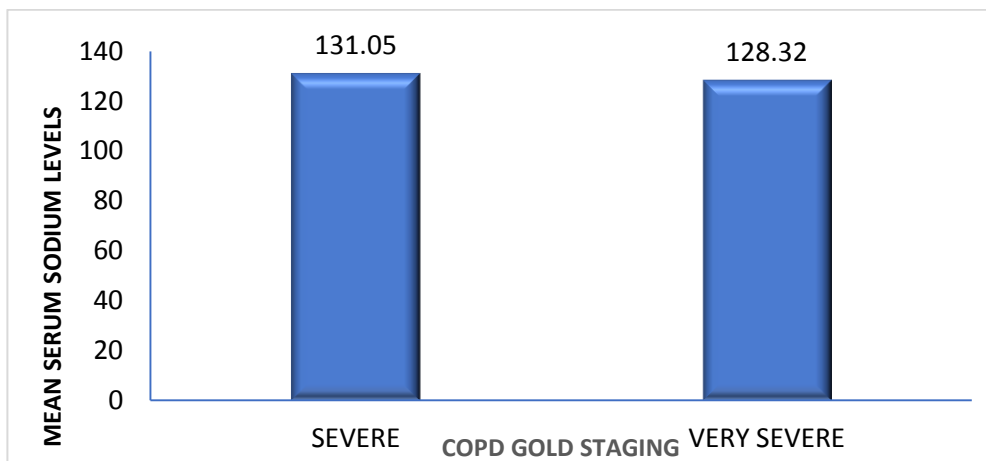
**Graph 3:** Bar diagram showing Serum Electrolyte Levels in AE COPD subjects

In the study 54% had COPD GOLD staging as Severe and 46% had COPD Gold staging as very severe seen in **Graph-4**.



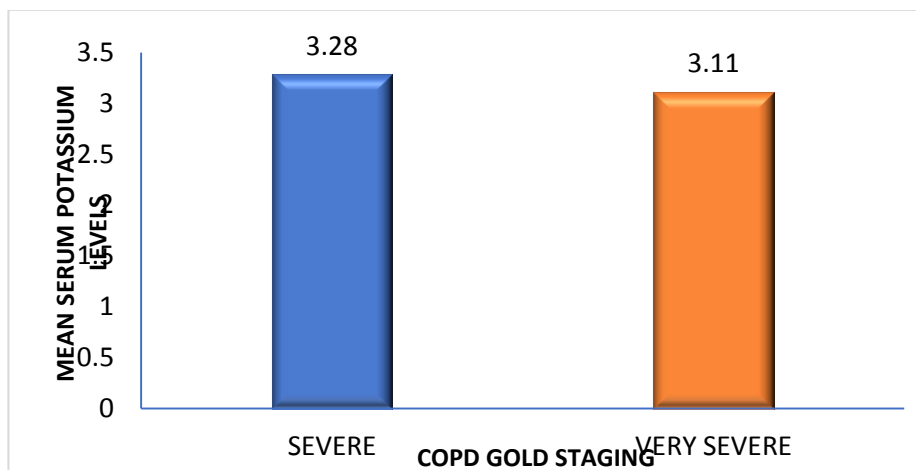
**Graph 4: Bar diagram showing COPD GOLD Staging in AE COPD subjects**

Serum sodium levels were significantly lower in very severe GOLD staging patients as compared to severe GOLD stage patients. The mean serum sodium level with severe GOLD stage was 131.05 and that with very severe GOLD stage was 128.32 mmol/L seen in **Graph-5**.



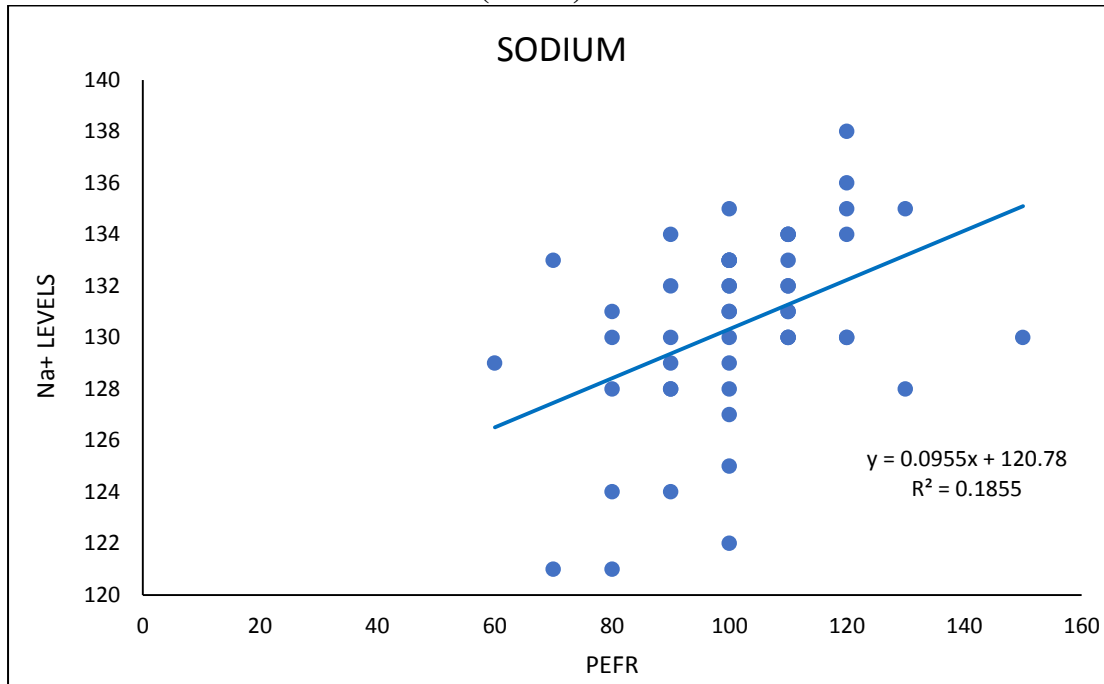
**Graph 5: Bar diagram showing Association between Association between COPD GOLD Staging with Serum Sodium Levels**

Serum potassium levels were significantly lower in very severe GOLD staging patients as compared to severe GOLD stage patients. The mean serum potassium level with severe GOLD stage was 3.28 and that with very severe GOLD stage was 3.11 mEq/L seen in **Graph-6**.



**Graph 6: Bar diagram showing COPD GOLD Staging with Serum Potassium Levels**

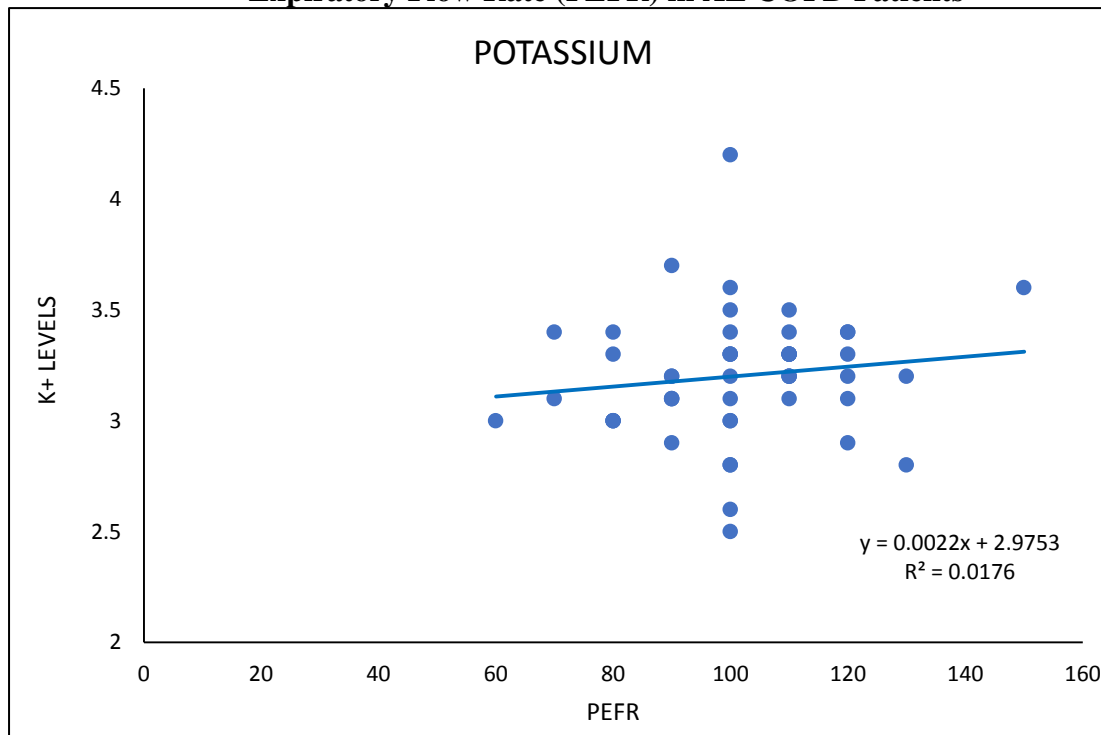
**Graph-7 Scatter plot showing Correlation Between Sodium Level and Peak Expiratory Flow Rate (PEFR) in AE COPD Patients**



[ $r=0.431$ ;  $p<0.001$  (HS)]

As Sodium levels improved in patients their PEFR was also seen to be improving in COPD patients. Thus, there exists positive correlation between sodium levels and peak expiratory flow rate (PEFR) in AE COPD patients ( $p<0.001$ ).

**Graph-8 Scatter plot showing Correlation Between Potassium Level and Peak Expiratory Flow Rate (PEFR) in AE COPD Patients**



[ $r=0.132$ ;  $p>0.05$  (NS)]

No similar improvement in PEFr levels was seen in relation to the potassium levels. Thus, there is no correlation between potassium levels and peak expiratory flow rate (PEFR) in AE COPD patients ( $p>0.05$ ).

#### 4. DISCUSSION

In our study of acute exacerbation of COPD, it has been observed that apart from the signs of exacerbation, there may be number of co-morbid condition like metabolic abnormality dyselectrolytemia can be seen. Though this abnormality is correctable, attempt is not made to correct either due to overlooking or due to lack of lab facility for 24 hrs. Monitoring.

In our study the mean age distribution was  $57.98 \pm 8.44$  years. Maximum number of individuals were of the age group of 61 to 70 years accounting to 17 (38%) followed by 14 (28%) in the age group of 51-60 years. Similarly, Saha et al.<sup>14</sup> in their study reported among 100 cases, maximum 34 (34%) patients were of the age group of 51-60 years, next 28 (28%) were of the age group of 61-70 years, followed by 26 (26%) were of the age group of 40-50 years and 12 (12%) were above the age of 70 years. Age of the patient ranges from 40 years to 80 years with a mean age of  $58.13 \pm 9.96$  years.

We had 80% of patients as males, 20% were females. In present study maximum number of patients 46 (92%) were from rural area, with an occupation as farmer and labourer were most affected (84%). Saha et al.<sup>14</sup> in their study regarding sex distribution 84 (84%) cases were male and 16 (16%) were female with a male-female ratio of 5.25:1. 80% of the patients in our study had exposure to smoking to bidi/ cigarette, whereas 20% were exposed to biogas. Similar to ours Prasad et al.<sup>15</sup> reported alcohol and cigarette abuse in 41% and 67% of their patients. In a study by Abinaya et al.<sup>16</sup>, 55% of cases were smokers.

In our study all (100%) patients had symptom of breathlessness followed by productive cough 46 (92%), chest pain in 14 (28%), fever in 7 (14%) and dry cough in 4 (8%). Similarly, Prasad et al.<sup>15</sup> in their study noted at the time of admission, patients with AE of COPD had clinical symptoms of dyspnea (90%), cough (89%) and sputum (38%).

In our study 92% of patients had serum sodium levels below normal and 86% had serum potassium levels below normal limits. Mean Serum Sodium Level in our study was  $130.50 \pm 3.74$  mmol/L and Serum Potassium Level was  $3.26 \pm 0.37$  mEq/L. Prasad et al.<sup>15</sup> in their study reported similar to our finding's average serum Na<sup>+</sup> and K<sup>+</sup> levels in patients with COPD were  $133.8 \pm 4.83$  mEq/L,  $3.6 \pm 0.53$  mmol/L, respectively.

Abinaya et al.<sup>16</sup>, Mean FEV1 of cases were 52.23%, controls were 95.36%, statistically significant and Mean FEV/ FVC of cases were 52.1 and controls were 77.56. In our study mean FEV1 was  $39.92 \pm 15.31$ , FEV1/ FVC ratio was  $51.90 \pm 10.19$ .

In our study 54% had COPD GOLD staging as Severe and 46% had COPD Gold staging as very severe. Serum sodium levels were significantly lower in very severe GOLD staging patients as compared to severe GOLD stage patients. The mean serum sodium level with severe GOLD stage was 131.05 mmol/L and that with very severe GOLD stage was 128.32 mmol/L. In our study serum potassium levels were significantly lower in very severe GOLD staging patients as compared to severe GOLD stage patients. The mean serum potassium level with severe GOLD stage was 3.28 mEq/L and that with very severe GOLD stage was 3.11 mEq/L. Abinaya et al.<sup>16</sup> in their study reported cases with COPD GOLD had low serum sodium and potassium levels.



The mean PEFr observed in our study was  $111.60 \pm 29.64$  l/min. It was observed that as sodium levels improved in patients their PEFr was also seen to be improving. Thus, there exists positive correlation between sodium levels and peak expiratory flow rate (PEFR) in AE COPD patients ( $p < 0.001$ ). No similar improvement in PEFr levels was seen in relation to the potassium levels. Thus, there is no correlation between potassium levels and peak expiratory flow rate (PEFR) in AE COPD patients ( $p > 0.05$ ).

## 5. 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 spirometry for lung function, GOLD index, Peak Expiratory Flow Rate (PEFR). A significant number of patients those are hospitalized due to episode of acute exacerbation of COPD have chance of electrolyte imbalance such as hyponatremia, hypokalaemia. 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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