

Research Article

Study of serum electrolytes in acute exacerbation of chronic obstructive pulmonary disease patients

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ABSTRACT

Background: Acute exacerbation of chronic obstructive pulmonary disease (COPD) is associated with significant morbidity, mortality and decreased quality of life. Due to lack of awareness of precipitating factors and predictors of prognosis in acute exacerbation of COPD in developing countries by most treating physicians, often leads to fatal outcomes. Aim of the study was to study of serum electrolytes in acute exacerbation of COPD Patients.

Methods: In our study, we assessed the levels of serum sodium and potassium in subjects with acute exacerbation of COPD and their healthy controls.

Results: We found a significantly low level of serum sodium (132 ± 5.65 Meq/lit) and potassium (3.29 ± 0.96 Meq/lit) in subjects with acute exacerbation of COPD than their healthy controls ($\text{Na}^+ = 140 \pm 2.28$ Meq/lit and $\text{K}^+ = 4.51 \pm 0.02$ Meq/lit ($p < 0.05$)).

Conclusions: Our study findings suggest that, serum sodium and potassium levels may get deranged in subjects with acute exacerbations of COPD which should be routinely checked for to avoid fatal outcomes.

Keywords: COPD, SIADH, AVP, Hyponatremia, Hypokalemia

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) affects large number of patients and is associated with significant morbidity, disability and mortality.^{1,2} COPD is complicated by frequent and recurrent acute exacerbations, which are associated with enormous health care expenditures and high morbidity.

An exacerbation of COPD is defined as 'event in the natural course of the disease characterised by a change in the baseline dyspnea, cough and/or sputum 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.^{3,4} Exacerbations are categorized in terms of either clinical presentations (number of symptoms) or healthcare utilization.^{3,4}

In addition to the financial burden required to care for these patients, other 'costs' such as days missed from work and severe limitation in quality of life (QOL) are important features of this condition.^{5,6} Although respiratory infections are assumed to be the main risk factors for exacerbation of COPD, other conditions, including industrial pollutants, allergens, sedatives, congestive heart failure, and pulmonary embolism, have been identified.^{3,4,7,8}

The cause of an exacerbation of COPD may be multifactorial, so that viral infection or levels of air pollution may exacerbate the existing inflammation in the airways, which, in turn, may predispose to secondary bacterial infections.

There may be a number of metabolic derangements arising out of the disease process or as a consequence of the therapy of COPD (i.e. beta2 agonists and steroids)

instituted can cause hyponatremia, hypokalemia, hyperbilirubinemia, elevated transaminases, elevated blood urea and serum creatinine etc Mohan et al.⁹ Though most of these features are correctable, very often they are missed or confuse the diagnosis.

Thus simple overlooking of the coexistent metabolic abnormalities may contribute to a great morbidity and mortality. Thus early recognition and prompt correction of these metabolic abnormalities are crucial. Aim of study was to study of serum electrolytes in acute exacerbation of COPD Patients.

METHODS

This prospective Study was conducted on 62 patients of acute exacerbation of COPD admitted in the the Department of Pulmonary Medicine at Chalmeda Anand Rao Institute of Medical sciences, Karimnagar, Telangana. Age-sex matched twenty healthy community controls were taken. Institutional Ethical Committee approval and informed consent from the subjects or their legal relatives were taken.

Inclusion criteria

Diagnosed cases of COPD with exacerbation of symptoms.

Exclusion criteria

Other causes of dyselectrolytemia were excluded from the study like chronic renal failure, diabetic ketoacidosis, adrenocortical insufficiency, cerebral salt wasting.

Fasting blood samples from all the subjects were collected for the estimation of serum electrolytes like sodium and potassium in auto analyzer. Data were analyzed by SPSS Microsoft Excel software. Significance of differences of average sodium and potassium levels in two groups were evaluated statistically using Student's test. (p value <0.05 was considered to be significant).

RESULTS

Total 62 patients of COPD, 48 were males and 14 were females. And out of 20 age- sex matched healthy controls 15 were males and 5 were females.

Subjects of COPD were in the age range of 50-75 years, average age of presentation being 61.22±11.45 years. In the control group, subjects were in the age range of 50-75 years, average age being 61±9.5 years.

Average serum sodium and potassium levels in COPD patients were 132±5.65 meq/lit and 3.29 ± 0.96 meq/lit respectively and the levels in the control group were 140±2.28 mEq/lit and 4.51±0.02 meq/lit respectively. All the data are summarized in Table1 and 2.

Table 1: Age and sex distribution of study and control groups.

Groups	Age (years)	Males	females
COPD	61.22±11.45	48	14
Controls	61±9.5	15	5

Table 2: Serum electrolytes in both study and control groups.

Groups	Serum sodium (Meq/l)	Serum potassium (Meq/l)
COPD	132±5.65	3.29±0.96
Controls	140±2.28	4.51±0.02

DISCUSSION

In a case of acute exacerbation of COPD, it has been observed that besides the signs of acute infection, there may be number of co-morbid conditions like type II respiratory failure and carbon dioxide narcosis, metabolic abnormalities such as dyselectrolytemia, uremia and liver function abnormalities. Though most of the abnormalities are 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, we measured serum electrolytes (sodium and potassium) in COPD exacerbation patients. We found a significantly low level of serum sodium and potassium in the COPD patients (132±5.65 Meq/l and 3.29±0.96 Meq/l respectively) than that of the healthy controls (140±2.28 Meq/l and 4.51±0.02/ Meq/l respectively) (p value <0.05 in each case). Patients with COPD are susceptible to hyponatremia for a number of reasons like development or worsening of hypoxia, hypercapnia and respiratory acidosis and right side heart failure with development of lower limb edema, renal insufficiency, use of diuretics, SIADH (Syndrome of Inappropriate Antidiuretic Hormone Synthesis), malnutrition, and poor intake during acute exacerbations are common contributing factors in such patients. Activation of the renin angiotensin aldosterone system and inappropriately elevated plasma arginine vasopressin (AVP) in COPD may all these factors aggravate the electrolyte imbalance during acute exacerbation of COPD (Bauer et al, Vally et al, Das et al).¹⁰⁻¹²

This is in agreement with the study by Das et al, who measured the serum K⁺ and Na⁺ in 64 patients with acute exacerbation of COPD and compared the results with 20 healthy volunteers.¹² They reported a significant decrease in serum Na⁺ and K⁺ in COPD patients (133±6.86 mEq/lit, 3.39±0.96 mEq/lit respectively) than in normal controls (142±2.28 mEq/lit, 4.52±0.02 mEq/lit respectively, p<0.05). Also, in the study of Teranzo et al Sixty-seven consecutive patients who were hospitalized for hypercapnic COPD exacerbation, Hyponatremia occurred in 11 patients.¹³ hyponatremia with

hypochloremia and hypokalemia occurred in 10 patients, and hypochloremia occurred in 7 patients.

Alcindo et al, studied the relative frequency of hypomagnesaemia and other electrolyte disorders in patients with chronic stable COPD patients taking inhaled b2 agonists and inhaled steroids.¹⁴ Hypomagnesaemia reported in 27% of patients while hypocalcaemia, hypokalemia and hyponatremia reported in 52%, 4.2% and 2.8% of patients respectively.

Beta-2 agonists whether inhaled like formetrol and salbutamol or oral like salbutamol or bumbetrol in addition to oral sustained released theophylline, are the main stay treatment in stable COPD. Unfortunately, all these treatments have been proved to cause some electrolyte disorders in patients with bronchial asthma and COPD. (Yang et al).¹⁵

Comparing COPD patients with electrolyte disorders and those without any electrolyte imbalance on admission, there was a significant decrease in PH, PaO₂ and oxygen saturation in patients with electrolyte disorders, while there was a significant increase in PaCO₂. This means that patients with electrolyte disorders, suffer from further deterioration in arterial blood gases than other group without any electrolyte disorders.

Hypoxemia, that is worsen during acute exacerbation of COPD, is reported to induce depletion of intracellular Mg ions. Since the Mg ion is involved in muscle contraction and in the maintenance of muscle tonus, a reduction in Mg ion levels in patients with chronic airflow limitation might represent one more factor that is detrimental to respiratory function or to the recovery of such function, since low levels of Mg induce muscle fatigue (Musch et al).¹⁶ Also, respiratory acidosis with metabolic alkalosis (due to renal compensation) in COPD patients with chronic hypercapnia is the usual cause of Hypochloremia in those patients (Teranzo 2012).¹³ So, patients with severe COPD exacerbation, have factors that influence serum electrolytes levels like hypoxia, respiratory acidosis and hypervolemia, even before starting any type of treatment that may further cause electrolyte imbalance.

The effect of systemic steroids, diuretics, and nebulized Beta2 agonists on serum electrolytes levels has proved in many studies on both COPD and asthma patients (Webb-Johnson and Andrews, Yang et al).^{17,15} Treatment with Beta 2 agonists can reduce serum magnesium levels through urinary loss or intracellular shift (Rolla, and Bucca).¹⁸ Intravenous aminophylline therapy has been recorded to cause hypomagnesaemia, hypocalcaemia and hyponatraemia in susceptible individuals by increasing the urinary secretion of these electrolytes, this in turn may cause increased pulmonary irritability and consequently increased risk of exacerbation (Knutsen).¹⁹

Irrespective of the underlying mechanism of development, hyponatremia itself may be a predictor of

poor outcome in patients of COPD. It may lead to central nervous system dysfunction; confusion, convulsions, coma, reversible cardiac conduction defect, secondary renal insufficiency even death (Suri et al; Porcel et al).^{20,21} Therefore, hyponatremia should be meticulously searched for in every patient with acute exacerbation of COPD and should be actively corrected at the earliest.

Hypokalemia may be another electrolyte abnormality in the subjects with COPD. It may be present independently or concomitantly with hyponatremia. In our study there was a significantly low level of serum potassium in COPD patients than the healthy controls. Hypokalemia in COPD may be attributed to respiratory acidosis and metabolic alkalosis or long standing steroid therapy Saini et al.²² Use of beta 2-adrenoceptor agonist like salbutamol may also contribute to hypokalemia in COPD patients (Yang et al).¹⁵ Moreover, acute respiratory failure associated with hypokalemia was found to have a high mortality rate among the COPD patients (Hussain et al).²³ This may be attributed to cardiac arrhythmias or hampered nerve-muscle conduction. So, it appears from our study that hypokalemia may be a common associated finding in the subjects with COPD that should be corrected promptly to avoid fatal outcomes.

CONCLUSION

In the stable COPD patients there are abnormal serum electrolytes like sodium and potassium levels, they may get further deranged in subjects with acute exacerbation of COPD. Thus serum electrolytes level should be monitored routinely in these patients and an attempt should be made to correct them at the earliest to avoid poor outcomes.

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REFERENCES

1. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. Updated 2013. Global Initiative for Chronic Obstructive Lung Disease website. http://www.goldcopd.org/uploads/users/files/GOLD_Report_2013.pdf. Accessed on May 15th 2014.
2. Brusasco V. Reducing cholinergic constriction: the major reversible mechanism in COPD. *Eur Respir Rev.* 2006;15(99):32-6.
3. Cooper CB, Airflow obstruction and exercise. *Respir Med.* 2009;103(3):325-34 .
4. Public Health Agency of Canada. Chronic pulmonary obstructive disease (COPD). Public Health Agency of Canada website. Available at:

- <http://www.phac-aspc.gc.ca/cd-mc/crd-mrc/copd-mpoc-eng.php>. Accessed on June 28th, 2012.
- Centers for Disease Control and Prevention; National Center for Health Statistics. Deaths: final data for 2009. *Natl Vital Stat Rep.* 2012;60(3):1-117.
 - Centers for Disease Control and Prevention; National Center for Health Statistics. National Health Interview Survey Raw Data, 1999-2011. Analysis Performed by the American Lung Association Research and Health Education Division using SPSS and SUDAAN software. Atlanta, GA: Centers for Disease Control and Prevention 2011.
 - Annino DM, Homa DM, Akinbami LJ, Ford ES, Redd SC. Chronic obstructive pulmonary disease surveillance-United States, 1971-2000. *MMWR Surveill Summ.* 2002;51(6):1-16.
 - Centers for Disease Control and Prevention; National Center for Health Statistics. National Hospital Discharge Survey Raw Data, 1999-2010. Analysis performed by the American Lung Association Research and Health Education Division Using SPSS Software. Atlanta, GA: Centers for Disease Control and Prevention, 2010.
 - Mohan A, Premanand R, Reddy LN, Rao MH, Sharma SK, Kamity R, Bollineni S. Clinical presentation and predictors of outcome in patients with severe acute exacerbation of chronic obstructive pulmonary disease requiring admission to intensive care unit. *BMC Pulm Med.* 2006;6:27.
 - Bauer FK, Telfer N, Herbst H.H. Hyponatremia and increased exchangeable sodium in chronic obstructive lung disease. *Am J Med Sci.* 1965;250:245-53.
 - Vally G, Fedeli A, Antonucci R, Paoletti P, Palange P. Water and sodium imbalance in COPD patients. *Monaldi Arch Chest Dis* Apr. 2004;61(2):112-6.
 - Das P, Bandyopadhyay M, Baral K, Paul R. Dyselectrolytemia in chronic obstructive pulmonary diseases with acute exacerbation. *Nig J Physiol Sci.* 2010;25:25-7.
 - Terzano C, Di Stefano F, Conti V, Di Nicola M, Paone G, Petroianni A, Ricci A. Mixed acid-base disorders, hydroelectrolyte imbalance and lactate production in hypercapnic respiratory failure: the role of noninvasive ventilation. *PLoS One.* 2012;7(4):e35245. Epub 2012 Apr 23rd.
 - Cercineto A, Ferreira Filho OF, Sousa Parreira JD. The relative frequency of hypomagnesemia in outpatients with chronic airflow limitation treated at a referral center in the north of the state of Paraná, Brazil. *J Bras Pneumol.* 2006;32(4):294300.
 - Yang CT, Lin HC, Lin MC, Wang CH, Lee CH, Kuo HP. Effect of beta 2-adrenoceptor agonists on plasma potassium and cardiopulmonary responses on exercise in patients with chronic obstructive pulmonary disease. *Eur J Clin Pharmacol.* 1996;49(5):341-6.
 - Musch W, Vincken W, Noppen M, Gorus F. Metabolic effects of inhaled fenoterol in normal subjects. *Chest.* 1992;102(4):1099-103.
 - Webb-Johnson DC, Andrews JL. Bronchodilator therapy. *N Engl J Med.* 1997;297:476-82.
 - Rolla G, Bucca C. Hypomagnesaemia and bronchial hyperreactivity: a case report. *Allergy.* 1999;44:519-21.
 - Knutsen R, Bohmer T, Falch J. Intravenous theophylline induced excretion of calcium, magnesium and sodium in patients with recurrent asthmatic attacks. *Scand J Clin Lab Invest.* 1994;54:119-25.
 - Suri P, Habeeb K, Alai MS, Rather HA, Jalal S. Hyponatremia Presenting as Cardiac Conduction Defect. *J K Science.* 2009;11(2):85-6.
 - Porcel A, Díaz F, Rendón P. Dilutional hyponatremia in patients with cirrhosis and ascites. *Arch Intern Med.* 2002;162:323-8.
 - Saini V, Saini N, Kaur J, Singh GP. Acid base status in chronic obstructive pulmonary disease patient. *Ind J Clin Biochem.* 2008;28:36-8.
 - Hussain SF, Irfan M, Naqi YS, Islam M, Akhtar W. Acute respiratory failure in Pakistani patients: risk factors associated with mortality. *J Coll Physicians Surg Pak.* 2006;16(4):287-90.

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