A Study Of Electrolyte Abnormalities In Acute Exacerbation Of Chronic Obstructive Pulmonary Diseases

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Abstract: Background: Chronic obstructive pulmonary disease / COPD is a multifactorial disease involving various electrolyte abnormalities. This study aimed at evaluating serum electrolyte levels in patients with acute exacerbation of COPD. Material And Methods: This study aimed at evaluating serum electrolyte levels in patients with acute exacerbation of COPD. This study included 100 cases & 100 controls with acute exacerbation of COPD admitted in intensive care unit. All the patients from the cases group were screened for Ca+2 & Mg+2 abnormalities during their intensive care unit stay. In group 1 (cases) correction for abnormal electrolytes were given on the day of admission. Treatment, antibiotics selection, metabolic parameters correction & acid base correction were considered equally in both the groups as per GOLD (Global initiative for chronic obstructive lung disease) guidelines. Symptomatic patients after 48 hours of intensive care unit admission were screened for calcium & magnesium levels & prevalence of hypocalcemia & hypomagnesemia was calculated. Result: It was found out that average duration of intensive care unit stay was reduced significantly in group 1 (cases) in whom the correction of electrolyte imbalance was considered at the time of admission. Also, in the control group, who were still symptomatic after 48 hours of intensive care unit treatment, a significant proportion was found to have hypocalcaemia and hypomagnesaemia (Electrolytes measured after 48 hours). Conclusion: In stable COPD patients there are abnormal serum electrolytes that may get further deranged during acute exacerbations. Thus serum electrolytes level should be monitored routinely in these patients & an attempt should be made to correct them at the earliest to avoid poor outcomes. [Bhansali P Natl J Integr Res Med, 2022; 13(1): 101-104, Published on 26/01/2022]

Key Words: Chronic Obstructive Pulmonary Disease, Intensive Care Unit, Hypocalcaemia, Hypomagnesemia, Mortality

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Introduction: Chronic obstructive pulmonary disease affects a large number of patients & is associated with significant morbidity, mortality and disability due to frequent exacerbations. However, there may be a number of metabolic derangements associated with the aggravation of COPD. Sometimes as a consequence of intense or prolonged therapy for COPD (β agonist & steroids) hypernatremia, hyperkalemia. The simple overlooking of the coexisting metabolic abnormalities may greatly contribute to the overall outcome of treatment. The present study is intended to give preliminary information about the clinical relevance of this hypothesis.

Material & Methods: Study Design: This was an open labelled prospective controlled study that included randomly allocated 200 patients (100 cases & 100 controls) over a period of 1 year from 01/10/2017 to 30/09/2018 at Sheth L.G. General Hospital & AMC MET MEDICAL COLLEGE.
Sample Size: 200 patients.

Inclusion Criteria: All the patients admitted to ICU with. Acute COPD exacerbation in medical unit 4 (Cases). Acute COPD exacerbation in other medical units (Controls). Patients willing to give consent.

Exclusion Criteria: Patients not willing to give consent.

Methodology: After getting admitted in ICU baseline blood samples were collected for routine investigations that are normally done in these patients. Baseline serum calcium & magnesium levels were also noted in the case group. In the control group, similar patients from other units were taken where the baseline electrolyte measurement & corrections of electrolyte abnormalities have not been considered. All patients received standard COPD treatment according to the severity & presence or absence of other comorbidity as per GOLD guideline. Any baseline abnormality in the

calcium & magnesium were corrected appropriately in the case group. The symptomatic improvement (Calculated on the basis of heart rate, respiratory rate, oxygen saturation, dyspnoea scale of 0-10) after 48 hours of admission & average ICU stay were noted in both cases and controls.

Statistical Analysis: Done by students T- test.

Results: Table 1 shows the clinical data of 100 patients (Taken as cases) whose age ranges from 50 to 92 year in whom correction for electrolyte imbalance was given. Table 2 shows the clinical data of 100 patients (Taken as control) whose age ranges from 51 to 93 year in whom correction for electrolyte imbalance was not considered.

Table 1: Age Wise & Gender Wise Distribution Of Cases

Age Group	Males	Females
50-60	51	16
61-70	10	8
71-80	2	5
81-90	6	1
91-100	0	1
Total	69	31

Table 2: Age Wise & Gender Wise Distribution Of Controls

Age Group	Males	Females
50-60	32	13
61-70	20	3
71-80	20	6
81-90	2	2
91-100	2	0
Total	76	24

The mean age of cases was 60.61 ± 10.32 years & the mean age of controls was 64.48 ± 9.78 years.

Table 3: Electrolyte Status On Admission In Both Cases And Controls

Patients	Cases	Controls
Total Patients	100	100
Patients With Normal Electrolytes	60	Not Done
Patients With Hypocalcemia	24	Not Done
Patients With Hypomagnesemia	16	Not Done

The average calcium and magnesium levels in patients with electrolyte imbalance in the case group was found to be 7.53±0.53 & 1.18±0.22 respectively.

Correction of hypocalcemia & hypomagnesemia was given to respective patients in the case group. All the patients from cases as well as control groups were evaluated 48 hours after admission for symptomatic improvement. Both the groups received the standard treatment for COPD acute exacerbation according to GOLD guidelines except for the cases group who received correction of electrolyte imbalance in addition.

After 48 hours of standard treatment 28 patients from the cases group and 52 patients from the control group were still found to be symptomatic.

Amongst 28 patients from cases group 8 received correction for electrolyte imbalance and still didn't improve significantly. 52 patients from the control group, who didn't improve, were evaluated for calcium and magnesium imbalance. 16 patients were found to be hypocalcemic with mean value 7.49±0.35; & 14 patients were found to be hypomagnesemic with mean value 1.32±0.09.

Table 4: Evaluation For Symptomatic Improvement

Patients Having No Symptomatic Improvement 48 Hours After Admission	Cases (Correction Given)	Controls (Imbalance Identified)
Patients With Normal Electrolytes	20	22
Patients With Hypocalcemia	4	16
Patients With Hypomagnesemia	4	14
Total	28	52

As mentioned in above table 4, amongst 28 patients from cases group, 8 received correction for electrolyte imbalance and still didn't improve significantly. 52 patients from the control group, who didn't improve, were evaluated for calcium and magnesium imbalance. 16 patients were found to be hypocalcemic with mean value 7.49±0.35; & 14 patients were found to be hypomagnesemic with mean value 1.32±0.09.

Table 5: Effect Of Electrolyte Imbalance Correction In Cases

Total Patients With Electrolyte Abnormality	40 (24+16) 24 : Hypocalcemia 16 : Hypomagnesemia
Patients Improved After Electrolyte Correction (80 %)	32 (20+12) 20 : Hypocalcemia Corrected 12 : Hypomagnesemia Corrected
Patients Not Improved After Electrolyte Correction (20 %)	8 (4+4) 4 : Hypocalcemia Corrected 4 : Hypomagnesemia Corrected

From Table 5, in the case group, 80% of the patients improved symptomatically after receiving correction for electrolyte imbalance and 20% didn't improve.

Table 6: Controls With Persistent Symptoms After 48 Hours

Patients having no symptomatic improvement 48 hours after admission	52
Total patients with electrolyte abnormality (Correction not given in initial 48 hour) (57.70 %)	30 (16+14) 16 : Hypocalcemia 14 : Hypomagnesemia
Total patients with normal electrolyte (42.30 %)	22

From Table 6, it is observed that in patients with persistent symptoms after 48 hours in the control group 57.70% of the patients were found to have abnormal electrolyte levels.

Discussion: The economic and social burden created by acute exacerbations of COPD is extremely high. Thus, it is important to identify factors associated with exacerbation and poor outcomes. Common causes of hypokalemia include diarrhoea, laxative abuse, vomiting, certain diuretics, drugs like insulin, β agonists, and theophylline.

Thus, COPD patients per se are predisposed to electrolyte imbalance. In turn electrolyte imbalance can cause respiratory muscle weakness, cardiac arrhythmia, low cardiac output, etc. Moreover, acute respiratory failure associated with hypokalemia was found to have a high mortality rate among the COPD patients (Hussain et al)[3].

Also, the potential mechanism for the direct relaxing effects of magnesium on bronchial smooth muscles include calcium channel blocking properties, inhibition of cholinergic neuro-muscular junction transmission with decreased sensibility to the depolarising action of acetylcholine, stabilisation of mast cells and T lymphocytes and stimulation of nitric oxide and Prostacycline. In the study by Bhatt et al.[4], serum magnesium is one of the predictor of in hospital mortality & morbidity in patients with acute exacerbation of chronic obstructive pulmonary disease. In the study by Bhatt et al.[4], serum magnesium is an independent predictor of frequent readmissions due to acute exacerbation of chronic obstructive pulmonary disease.

Even though there are some studies implicating low serum levels of magnesium with exacerbations of chronic respiratory conditions, the cause of this decline is not clearly known. It would be even better if serum magnesium levels are monitored serially in the same cases over a period of time.

In such a setting, variations in the serum magnesium levels can be monitored in the same person over the course of the disease and the possibility of magnesium being a possible predictor for exacerbations can be assessed.

However, this kind of study was not possible because of the time constraint. Thus the presence of electrolyte imbalance leads to significantly poor outcomes among COPD patients. This study aimed at evaluating serum electrolyte levels in patients with acute exacerbation of COPD. In the study conducted by GP Vignan Kumar et al[2], a total of 40 cases were enrolled. In the exacerbation group there were 9 cases whose serum magnesium was < 1.5mg / dl

& 5 cases with magnesium value ranging between 1.5 to 2 mg / dl & 6 cases with value > 2 mg / dl. In the stable group there were no cases recording < 1.5 mg / dl, 4 cases with values between 1.5 to 2 mg / dl & the rest had magnesium values > 2 mg / dl.

The mean serum magnesium value in the stable group was 2.33 mg / dl, whereas in the group consisting of acute exacerbations it was 1.69 mg / dl. There were nine cases of hypomagnesemia in the recorded 20 cases of acute exacerbations whereas none of the cases in the stable group recorded a value < 1.5 mg / dl.

This study included 100 cases and 100 controls with acute exacerbation of COPD admitted in ICU.

All the patients from the cases group were screened for Ca+2 & Mg+2 abnormalities during their ICU stay. In group 1 (cases) correction for abnormal electrolytes were given on the day of admission and both the groups were observed for symptomatic improvement till 48hours of ICU admission.

Treatment, antibiotics selection, metabolic parameters correction and acid base correction was considered equally in both the groups as per GOLD guidelines. Symptomatic patients after 48 hours of ICU admission were screened for calcium and magnesium levels. The prevalence of hypocalcaemia and hypomagnesaemia was calculated in this study.

It was found out that average duration of ICU stay was reduced significantly in group 1 (cases) in whom the correction of electrolyte imbalance was considered at the time of admission. This was in contrast to the group 2 in whom only the acid base correction was given without evaluating the electrolyte imbalance on admission. Also, in the control group, who were still symptomatic after 48 hours of ICU treatment, a significant proportion was found with hypocalcaemia and hypomagnesaemia (Electrolytes measured after 48 hours).

Conclusion: In stable COPD patients there are abnormal serum electrolytes that may get further deranged during acute exacerbations. Thus serum electrolytes level should be monitored routinely in these patients & an attempt should be made to correct them at the earliest to avoid poor outcomes.

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