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ORIGINAL RESEARCH

Assessment of serum electrolytes, acid–base balance and need for non-invasive ventilation in patients with hypercapnic acute exacerbation of chronic obstructive pulmonary disease (AECOPD)

[1]Dr. Ajai Kumar Srivastava, [2]Dr. Sanjay Singh

[1]Assistant Professor, Department of TB & Chest, Prasad Institute of Medical Sciences Lucknow, UP, India
[2]Professor, Department of Pulmonary Medicine, Rama Medical College, Kanpur, UP, India

Corresponding author
Dr. Ajai Kumar Srivastava
Assistant Professor, Department of TB & Chest, Prasad Institute of Medical Sciences Lucknow, UP, India
Email: aksdrmed@gmail.com

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ABSTRACT

Background: When breathing is compromised and the amount of carbon dioxide exhaled by the respiratory system is less than the amount of carbon dioxide produced by the tissues, hypercapnia and respiratory acidosis result.The present study was conducted to assess serum electrolytes, acid–base balance and need for non-invasive ventilation in patients with hypercapnic acute exacerbation of chronic obstructive pulmonary disease (AECOPD). **Methods:** 82 patients with (AECOPD) of both genders were selected. Blood investigations such as arterial blood gases (ABG), electrolyte levels (Sodium (Na) and potassium (K) were performed. NIV was performed through oronasal mask with a pressure/ volume ventilator. Support pressure, positive end expiratory pressure (PEEP) was used. **Results:** Out of 50 cases of compensated respiratory acidosis, 10 were NIV positive and 40 were NIV negative. Out of 18 cases with mixed respiratory acidosis and metabolic alkalosis, 15 were NIV positive and 3 were NIV negative. Out of 14 cases with combined respiratory and metabolic acidosis, 12 were NIV positive and 2 were NIV negative. The difference was significant (P< 0.05). The mean sodium level was 135.2 mEq/l and 137.4 mEq/l, potassium level was 4.9 mEq/l and 3.2 mEq/l and bicarbonate level was 29.5 mEq/l and 23.7 mEq/l in NIV positive and NIV negative patients. The difference was significant (P< 0.05). Improvement was seen in 17 cases of compensated respiratory acidosis, 11 cases of mixed respiratory acidosis and metabolic alkalosis and 5 cases of combined respiratory and metabolic acidosis. The difference was significant (P< 0.05). **Conclusion:** While minor AECOPD episodes are usually curable, more severe respiratory failures are linked to a significant death rate and a protracted period of impairment for those who survive.

Keywords: chronic obstructive pulmonary disease, metabolic acidosis, positive end expiratory pressure

INTRODUCTION

When breathing is compromised and the amount of carbon dioxide exhaled by the respiratory system is less than the amount of carbon dioxide produced by the tissues, hypercapnia and respiratory acidosis result.[1] Alveolar hypoventilation is not usually the outcome of lung illnesses that lead to anomalies in alveolar gas exchange. These illnesses frequently cause hypoxia and reflex receptors, which in turn cause ventilation and hypocapnia. Hypercapnia usually happens when respiratory muscles tire or when the condition progresses to a severe degree.[2] (Metabolic acidosis, Pediatric Metabolic Acidosis, and Pediatric Respiratory Acidosis). Acute or chronic respiratory acidosis can occur. When there is acute respiratory acidosis, there is an acidemia (pH less than 7.35) and an increased PaCO2 over the upper limit of the reference range (i.e., >45 mm Hg).[3]

Chronic respiratory acidosis is characterized by excessive serum bicarbonate levels (>30 mEq/L), normal or almost normal pH due to renal compensation, and elevated PaCO2 levels over the upper limit of the reference range. An rapid lack of breathing results in acute respiratory acidosis.[4] The central respiratory center may be depressed for any of the following reasons, leading to this ventilation failure: Diseases of the central nervous system or medication-induced respiratory depression.[5]

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incapacity to breathe enough as a result of paralysis or a neuromuscular illness (such as muscular dystrophy, ALS, myasthenia gravis, or Guillain-Barré syndrome). airway blockage, typically associated with asthma or COPD (chronic obstructive pulmonary disease).Many illnesses, including COPD, may have chronic respiratory acidosis as a secondary condition.[6]The present study was conducted to assess serum electrolytes, acid–base balance and need for non-invasive ventilation in patients with hypercapnic acute exacerbation of chronic obstructive pulmonary disease (AECOPD).

MATERIALS & METHODS

The study was carried out on 82 patients with (AECOPD) of both genders. All gave their written consent to participate in the study.

Data such as name, age, gender etc. was recorded. Blood investigations such as arterial blood gases (ABG), electrolyte levels (Sodium (Na) and potassium (K)were performed. NIV was performed through oronasal mask with a pressure/ volume ventilator. Support pressure, positive end expiratory pressure (PEEP) was used. Results thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Assessment of arterial blood gases

Acid–base disturbance	Need for non-invasive ventilation		P value
	NIV positive (37)	NIV negative (45)	
Compensated respiratory acidosis(50)	10	40	0.05
Mixed respiratory acidosis and metabolic alkalosis (18)	15	3	
Combined respiratory and metabolic acidosis (14)	12	2	
PO_2	55.1	64.3	0.04
PCO_2	64.7	48.2	0.05

Table I shows that out of 50 cases of compensated respiratory acidosis, 10 were NIV positive and 40 were NIV negative. Out of 18 cases with mixed respiratory acidosis and metabolic alkalosis, 15 were NIV positive and 3 were NIV negative. Out of 14 cases with combined respiratory and metabolic acidosis, 12 were NIV positive and 2 were NIV negative. The difference was significant (P< 0.05).

Table II Assessment of electrolytes finding

Electrolytes	Need for non-invasive ventilation		P value
	NIV positive (37)	NIV negative (45)	
Sodium (mEq/l)	135.2	137.4	0.75
Potassium (mEq/l)	4.9	3.2	0.04
Bicarbonate (mEq/l)	29.5	23.7	0.05

Table II, graph I shows that mean sodium level was 135.2mEq/l and 137.4mEq/l, potassium level was 4.9mEq/l and 3.2mEq/l and bicarbonate level was 29.5mEq/l and 23.7mEq/l in NIV positive and NIV negative patients. The difference was significant (P< 0.05).

Graph I Assessment of electrolytes finding

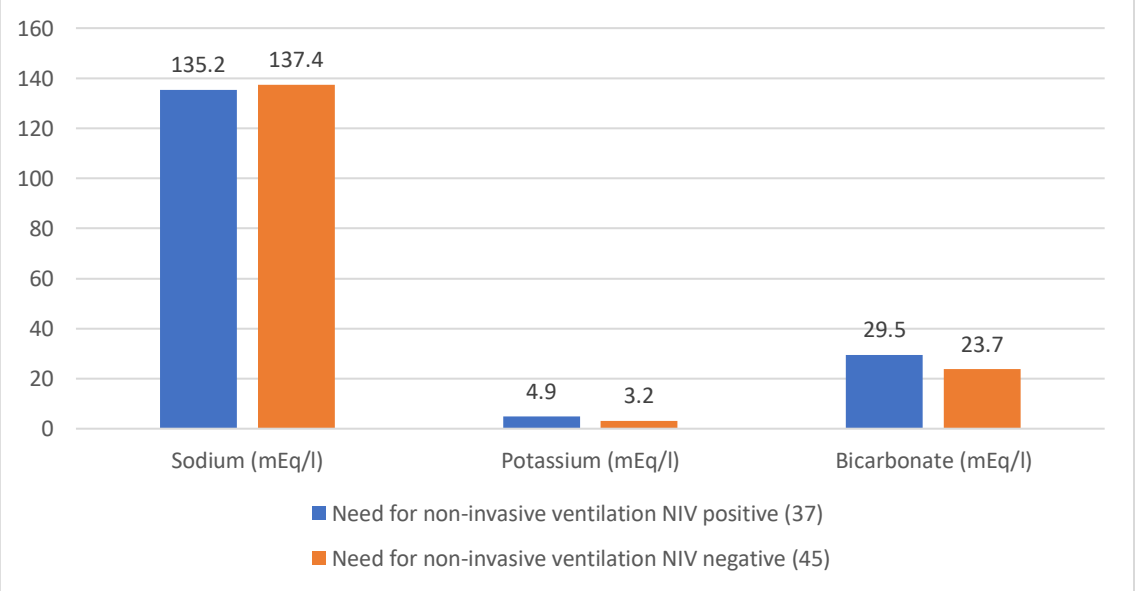

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Table III Outcome

Acid–base disturbance	Improved (33)	Failed (4)	P value
Compensated respiratory acidosis	17	2	0.05
Mixed respiratory acidosis and metabolic alkalosis	11	1	
Combined respiratory and metabolic acidosis	5	1	

Table III shows that improvement was seen in 17 cases of compensated respiratory acidosis, 11 cases of mixed respiratory acidosis and metabolic alkalosis and 5 cases of combined respiratory and metabolic acidosis. The difference was significant (P< 0.05).

DISCUSSION

Acid/base (AB) balance abnormalities are linked to multi-organ impairment in hypercapnic respiratory failure, a complex clinical and functional disease.[7] The kidney, respiratory system, red blood cells, blood proteins, and bicarbonate buffering system are among the physiological systems that regulate the acid-base balance.[8] The hydro-electrolytic (HE) balance and the AB balance are intimately associated. When CO2 levels rise (respiratory acidaemia), a metabolic alkalosis counteracts the increase.[9] This is mostly accomplished by a complex excretion system involving ions in the urine. Therefore, knowledge of the intricate regulatory processes governing AB diseases is essential for their management.[10,11]The present study was conducted to assess serum electrolytes, acid–base balance and need for non-invasive ventilation in patients with hypercapnic acute exacerbation of chronic obstructive pulmonary disease (AECOPD).

We found that out of 50 cases of compensated respiratory acidosis, 10 were NIV positive and 40 were NIV negative. Out of 18 cases with mixed respiratory acidosis and metabolic alkalosis, 15 were NIV positive and 3 were NIV negative. Out of 14 cases with combined respiratory and metabolic acidosis, 12 were NIV positive and 2 were NIV negative. Schiavo et al[12]evaluated acid–base and hydroelectrolite alterations in these subjects and the effect of non-invasive ventilation and pharmacological treatment. They retrospectively analysed 110 patients consecutively for acute exacerbation of hypercapnic chronic obstructive pulmonary disease. On admission all patients received oxygen with a Venturi mask to maintain arterial oxygen saturation at least >90 %, and received appropriate pharmacological treatment. Non-Invasive Ventilation (NIV) was started when, despite optimal therapy, patients had severe dyspnea, increased work of breathing and respiratory acidosis. Based on Arterial Blood Gas (ABG) data, we divided the 110 patients in 3 groups: A = 51 patients with compensated respiratory acidosis; B = 36 patients with respiratory acidosis + metabolic alkalosis; and C = 23 patients with respiratory acidosis + metabolic acidosis. 55 patients received only conventional therapy and 55 had conventional therapy plus NIV.The use of NIV support was lower in the patients belonging to group B than in those belonging to group A and C (25 %, vs 47 % and 96 % respectively; $p < 0.01$). A statistically significant association was found between pCO_2 values and serum chloride concentrations both in the entire cohort and in the three separate groups.

We observed that the mean sodium level was 135.2 mEq/l and 137.4 mEq/l, potassium level was 4.9 mEq/l and 3.2 mEq/l and bicarbonate level was 29.5 mEq/l and 23.7 mEq/l in NIV positive and NIV negative patients. Improvement was seen in 17 cases of compensated respiratory acidosis, 11 cases of mixed respiratory acidosis and metabolic alkalosis and 5 cases of combined respiratory and metabolic acidosis. Krishna et al[13]analyzed 74 patients for hypercapnic AECOPD. Based on arterial blood gas finding, we categorized our patients into three main groups: the first group comprised 44 (59.4%) patients who had compensated respiratory acidosis, and the majority of them (35 patients) received medical treatment only. The second group comprised 17 (22.97%) patients, who had mixed respiratory acidosis and metabolic alkalosis. Overall, 13 patients needed non-invasive mechanical ventilation with the medical treatment. The third group comprised 13 (17.5%) who had combined respiratory and metabolic acidosis. Of them, 11 patients needed non-invasive mechanical ventilation with the medical treatment

The shortcoming of the study is small sample size.

CONCLUSION

Authors found that while minor AECOPD episodes are usually curable, more severe respiratory failures are linked to a significant death rate and a protracted period of impairment for those who survive.

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