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Original Research Article

One and half year prevalence study of respiratory acidosis in acute exacerbation of chronic obstructive pulmonary disorders

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Abstract: Maintenance of acid-base homeostasis is a vital function of the living organism. Deviations of systemic acidity in either direction can impose adverse consequences and when severe can threaten life itself. The present study was done to assess the prevalence rate of the respiratory acidosis among the admitted patients of SMBT medical college and hospital, Ghoti, Nasik. One and half year prospective prevalence study was carried out at SMBT medical college, Ghoti, Nasik. Patients were identified with a respiratory diagnosis or symptoms from the hospital by the two expert researchers. Patients were of the age group of 40 to 75 years. Age, sex, date of admission, and the first arterial blood gas tension were recorded. The date of discharge, intensive care (ICU), use and in hospital mortality were obtained retrospectively from the hospital patient administration system and the ICU computer databases in combination with note retrieval. Statistical analysis was performed with the help of IBM SPSS statistics version 20. All patients admitted are assessed and the details were recorded. Total of 1001 patients were admitted for the complaint of COPD or asthma. Out of these 172 patients (17.18%) had developed respiratory acidosis. There is need to develop the various preventive strategies to control the development of the respiratory acidosis.
Keywords: Respiratory acidosis, COPD, Asthma

INTRODUCTION:

The study of acid–base equilibrium and its relationship to the diet and disease has been a subject of considerable speculation for at least several centuries. But, before the 19th century, little was known about the concepts of acids and bases [1].

The term acidosis is often used interchangeably with the term acidaemia, with the latter referring to a blood pH of less than 7·35. Correctly used, the term acidosis refers to a process, or a trend toward acidaemia, without necessarily reaching a pH of less than 7·35, or actual acidaemia [1].

Arterial blood gas analysis is an important diagnostic test in critically ill patients. In uncomplicated clinical situations, a routine approach based on measurement of pH, PCO2, HCO3–, BE and anion gap, is satisfactory. But in complex disturbances, both alkalinizing and acidifying disturbances may be present1. They may escape detection because of their offsetting effects on the customary indices of the metabolic acid-base status. In a great majority of these apparently single disorders, a second disorder is detected with simple systemic approach and analysis of the ABG samples [2, 3].

Acid-base disorders frequently are encountered in the outpatient and especially in the inpatient setting. Effective management of acid-base disturbances, commonly a challenging task, rests with accurate diagnosis; sound understanding of the underlying pathophysiology and impact on organ function, and familiarity with treatment and attendant complications [4-9]. The present study was done to assess the prevalence rate of the respiratory acidosis among the admitted patients.

MATERIALS AND METHODS:

One and half year prospective prevalence study was carried out at SMBT medical college, Ghoti, Nasik. Patients were identified with a respiratory diagnosis or symptoms from the hospital by the two expert researchers. The notes written were reviewed to identify patients with n acute exacerbation of COPD. Patients were of the age group of 40 to 75 years.

Inclusive criteria:

- Admission diagnosis of COPD/ asthma
- Age of 40 to 75 years

Exclusion criteria:

- Symptoms prior to age 45 years
- No history of tobacco use.

Inter-rater reliability was assessed independently over a three day period by both observers performing the survey. Age, sex, date of admission, and the first arterial blood gas tension were recorded (either in the accident and emergency (A&E) department or ward). Normalization of pH to the range 7.35–7.45 between the A&E department and the ward was recorded.

The date of discharge, intensive care (ICU), use and in hospital mortality were obtained retrospectively from the hospital patient administration system and the ICU computer databases in combination with note retrieval.

Statistical Analysis

Statistical analysis was performed with the help of IBM SPSS statistics version 20.

RESULTS:

All patients admitted are assessed and the details were recorded. Total of 1001 patients were admitted for the complaint of COPD or asthma. Out of these 172 patients (17.18%) had developed respiratory acidosis. The monthly distribution of the patients was shown in table 1 and graph 1. Maximum of 22.91 % patients with respiratory acidosis were observed in month of March, while minimum of 10.81% were found in the month of April.

Variability in admission rates within and between years:

Graph 1 shows the COPD admissions by month. Total admission rates fall in the summer but the rate of respiratory acidosis was more constant at 18 per month (range 10–22).

Association with oxygenation:

For hypercapnic patients a higher PaO2 was associated with worse acidosis. Most of the hypercapnic patients with a PaO2 of >10 kPa were acidotic.

Table 1: Showing distribution of the patients according to the month.

Month	Number of patients admitted for the COPD	Number of patients who were acidotic	Percentage
Jan	67	12	17.91
Feb	45	09	20.0
Mar	48	11	22.91
Apr	87	18	20.68
May	56	11	19.64
Jun	49	09	18.36
Jul	32	06	18.75
Aug	76	12	15.78
Sep	75	11	14.66
Oct	45	06	13.33
Nov	38	05	13.15
Dec	56	08	14.28
Jan	54	09	16.66
Feb	67	13	19.40
Mar	54	09	16.66
Apr	37	04	10.81
May	47	06	12.76
Jun	68	13	19.11
Total	1001	172	17.18

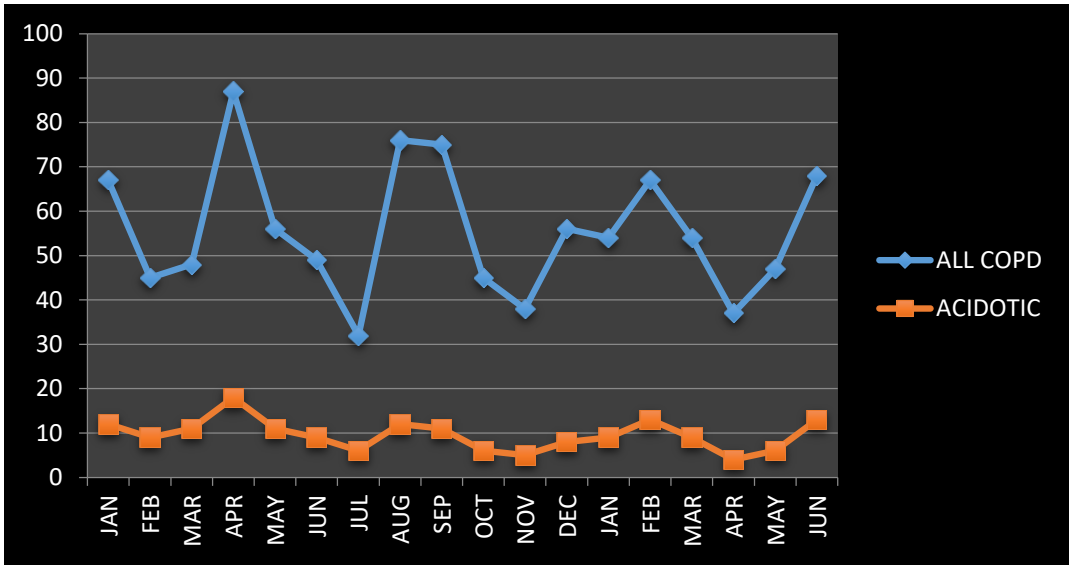

Fig 1: Monthly distribution of the patients of the respiratory acidosis.

DISCUSSION:

Hypercapnic respiratory failure is a complex clinical and functional condition, characterized by an alteration of the acid/base (AB) balance, associated with multi-organ impaired function. Several physiological systems are involved in the control of the AB balance, namely the respiratory system, the kidney, as well as red blood cells and blood proteins, and the bicarbonate buffering system. The AB balance and hydro-electrolytic (HE) balance are closely related, as for any increase in CO2 (respiratory acidaemia), a counterbalancing metabolic alkalosis occurs as main compensatory mechanism achieved by a complex ion urinary excretion mechanism [10, 11].

For the interpretation of AB disorders two approaches can be used: a physical-chemical approach (which relies on the theory of the Strong Ion Difference [SID]) or a pathophysiologic approach (which relies on the compensation laws). Many authors consider the physicochemical approach a complex and unfeasible approach, and poorly matching with the clinical reality. Moreover, it requires many factors to calculate the SID. On the other hand, the physio-pathological approach is easier and much more reliable, because it provides a quantitative measurement of the AB compensatory responses. Many trials, performed in different clinical disorders, have supported its use in humans [12].

Clinical acid-base disorders are conventionally defined from the vantage point of their impact on the carbonic acid-bicarbonate buffer system. This approach is justified by the abundance of this buffer pair in body fluids; its physiologic preeminence; and the validity of the isohydric principle in the living organism, which specifies that all the other buffer systems are in equilibrium with the carbonic acid-bicarbonate buffer pair. Thus, as indicated by the Henderson equation, [H+] = 24 PaCO2/ [HCO-3] (the equilibrium relationship of the carbonic acid-bicarbonate system), the hydrogen ion concentration of blood ([H+], expressed in nEq/L) at any moment is a function of the prevailing ratio of the arterial carbon dioxide tension (PaCO2, expressed in mm Hg) and the plasma bicarbonate concentration ([HCO-3], expressed in mEq/L). As a corollary, changes in systemic acidity can occur only through changes in the values of its two determinants, PaCO2 and the plasma bicarbonate concentration. Those acid-base disorders initiated by a change in PaCO2 are referred to as respiratory disorders; those initiated by a change in plasma bicarbonate concentration are known as metabolic disorders. There are four cardinal acid-base disturbances: respiratory acidosis, respiratory alkalosis, metabolic acidosis, and metabolic alkalosis. Each can be encountered alone, as a simple disorder, or can be a part of a mixed disorder, defined as the simultaneous presence of two or more simple, acid-base disturbances. Mixed acid-base disorders are frequently observed in hospitalized patients, especially in the critically ill [13-19].

A proportion of patients with more severe disease will have a respiratory acidosis (pH<7.35 and PaCO2 >6 kPa) as a result of acute on chronic respiratory failure. Acidosis is associated with increase mortality and also a higher need for intubation.2 3 Non-invasive ventilation (NIV) using a face or nasal mask has been shown in randomized controlled trials to reduce the need for subsequent intubation and mortality in this group of patients.4–6 Two cohort studies have also reported a long term survival advantage [19, 20, 21].

In the context of respiratory acidosis, volume overload, and renal insufficiency, renal replacement therapy, both CRRT and IHD can increase pH and correct solute abnormalities. However, when volume

overload is present in a patient who is hemodynamically unstable, CRRT offers an advantage over IHD. In addition, CRRT offers the ability to "fine tune" a patient's pH. In the patient presented, the pCO2 remained uniformly elevated. When the pCO2 is set in this fashion, pH titration with CRRT and IHD are probably equivocal. However, there are other similar scenarios in which the pCO2 is elevated and rapidly changing. Patients with acute respiratory distress syndrome (ARDS), who are commonly treated with low lung volume therapy, which often results in permissive hypercapnia, suffer from prolonged respiratory acidosis with the pCO2 oscillating as the patient's lung compliance changes [22].

CONCLUSION:

The present study had shown that the control of the acidosis in patients admitted with the complaint of COPD or asthma is more important to prevent the development of the respiratory acidosis. Which is more difficult to control? There is need to develop the various preventive strategies to control the development of the respiratory acidosis.

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