ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

Original Research Article

A Cross Sectional Study on Comparision of ABG Analysis of Severe Acute Bronchial Asthma with Normal Reference Values

Dr. Sridevi SVSMN[1], Dr. Vundinty Sadanandam[2], Dr. Santosh Jagtap[3]

[1]2nd year Post Graduate, Department of Physiology, Government Medical College, Suryapet, Telangana
[2]Associate Professor, Department of Physiology, Government Medical College, Khammam, Telangana
[3]Associate Professor, Department of Biochemistry, Symbiosis Medical College for Women, Symbiosis University Hospital and Research Center, Symbiosis International University, Pune

Corresponding Author: Dr. K. S.S. Sarojini Devi, Professor and Head, Department of Physiology, Dr.YSR Government Medical College, Vizianagaram, Andhra Pradesh

ABSTRACT:
Background: Arterial blood gas analysis (ABG) is the gold standard test which measures the amount of oxygen and carbon dioxide in the blood as well as the acidity (pH) of the blood. Blood gas studies are usually done to assess respiratory disorders and other conditions that effects the lungs. In addition, the acid base component of the test provides information on renal function. This test indicates how well lungs and kidneys are interacting with each other to maintain normal pH i.e.; how effectively compensatory mechanisms are interacting to restore homeostasis. The component of respiratory system that balances pH is dissolved CO2. So the present study is undertaken to assess ABG analysis in severe acute bronchial asthma.
Aim and Objectives: To compare and correlate the values of arterial blood gas analysis in severe acute bronchial asthma with that of normal reference values.
Materials and Methods: A cross sectional observational study was done on 45 patients of age group 21-80 years who are admitted into a tertiary care hospital with severe acute bronchial asthma. Both male and female patients aged between 21 to 80 years presented to a tertiary care hospital were included in the study.
Results: The partial pressure of oxygen was normal in 35.5% of total study population (i. e;16 patients), and was decreased in 64.44% of total study population (i.e.; 29 patients) indicating hypoxemia. The partial pressure of carbon dioxide levels showed clear cut respiratory acidosis in 34 patients (75.55%) with PaCO2 levels more than 45 mmHg and pH less than 7.35. **Conclusion:** This study revealed that there are disturbances in acid base status, ventilation in severe acute bronchial asthma. Therefore, it serves as good guide for physician in crucial decisions regarding treatment.

Keywords: Severe acute bronchial asthma,Acid-base balance,Ph
Study Resign: Observational study

1. Introduction

Arterial blood gas analysis (ABG) is the gold standard test which measures the amount of oxygen and carbon dioxide in the blood as well as the acidity (pH) of the blood. The advent of arterial blood gas analysis has revolutionised the field of Respiratory medicine especially bronchial asthma. An ABG analysis is chosen to observe acid base status, partial pressure of

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

oxygen, carbon dioxide, bicarbonate levels in asthmatic patients with acute severe attack at the time of admission in hospital. Blood gas studies are usually done to assess respiratory disorders and other conditions that effects the lungs. In addition, the acid base component of the test provides information on renal function. This test indicates how well lungs and kidneys are interacting with each other to maintain normal Ph i.e.; how effectively compensatory mechanisms are interacting to restore homeostasis. The component of respiratory system that balances ph is dissolved CO2.The component of renal system that balances ph is dissolved bicarbonate. So if ph is out of balance due to any respiratory disorder, it is the renal system which corrects the ph and vice-versa. Fundamentally arterial blood gas analysis is recommended if the physician suspects that the patient has significant aberration in oxygen or carbon dioxide gas exchange or acid base balance. Most reviews point out that the entire therapeutic approach to patients with bronchial asthma and especially those with impending respiratory failure is based on the presence and extent of blood gas and pH abnormalities.

Although PEFR and FEV1 can identify asthmatic patients at risk for hypercarbia and respiratory failure, the valve of arterial blood gases cannot be under estimated. Since there are no clinical counterparts to the derangements in blood gases, hence a dangerous level of hypoxia can go undetected. Likewise signs attributable to CO2 retention such as sweating, tachycardia or wide pulse pressure or signs attributable to acidosis such as tachypnoea are not of great value in predicting the presence of hypercapnia or hydrogen ion excess in individual patients, because they are too frequently seen in anxious patients with more moderate disease. Trying to judge the state of an acutely ill patient's ventilator status on clinical grounds alone can be extremely hazardous. So the present study is undertaken to assess ABG analysis in severe acute bronchial asthma.

Aim and Objectives:

To compare and correlate the values of arterial blood gas analysis in severe acute bronchial asthma with that of normal reference values.

2. Materials and Methods:

A cross sectional observational study was done on 45 patients of age group 21-80 years who are admitted into a tertiary care hospital with severe acute bronchial asthma.

3. Results:

Table1: AGE DISTRIBUTION OF PATIENTS PRESENTED WITH SEVERE ACUTE BR ONCHIAL ASTHMA

AGE	NUMBER OF PATIENTS	PERCENTAGE
21-40 YEARS	13	28.88%
41-50 YEARS	7	15.55%
51-60 YEARS	7	15.55%
61-70 YEARS	10	22.2%
71- 80 YEARS	8	17.7%

Graph 1: Sex distribution of the study population

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

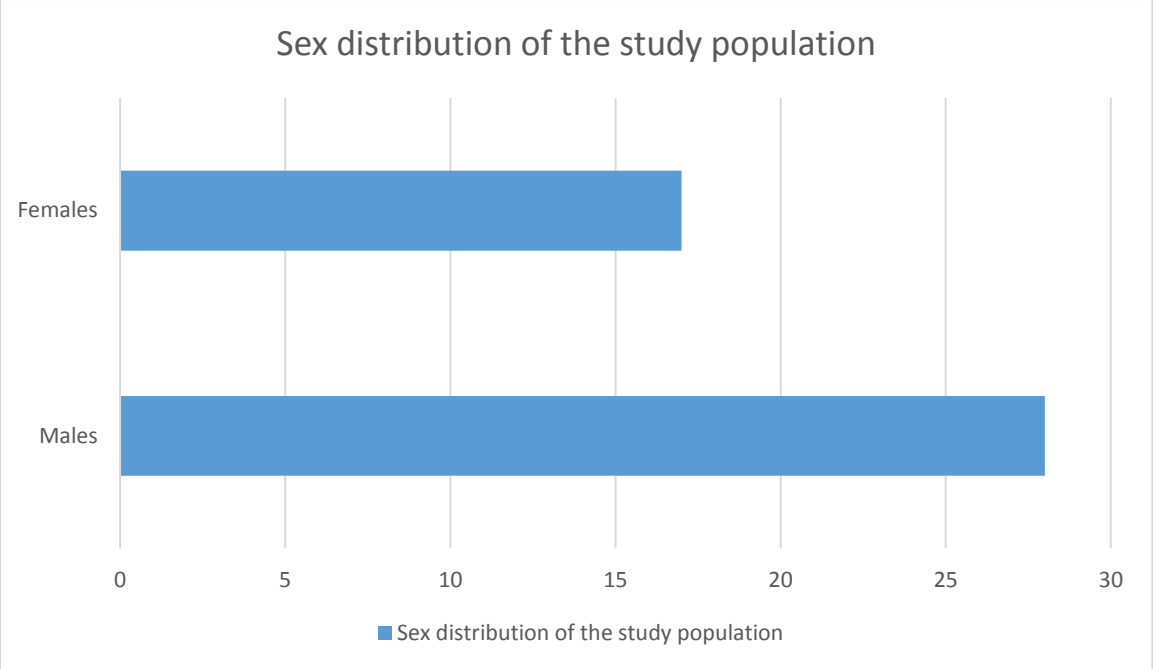

Table 2: ACID -BASE STATUS IN SEVERE ACUTE BRONCHIAL ASTHMA

pH RANGE	Number of patients	percentage
NORMAL	9	20.10%
RESPIRATORY ACIDOSIS	31	68.88%
RESPIRATORY ALKALOSIS	5	11.12%
TOTAL	45	

Table 3: PaO_2 VARIATIONS IN SEVERE ACUTE BRONCHIAL ASTHMA PATIENTS

PaO2	NUMBER OF PATIENTS	PERCENTAGE
NORMAL	16	35.55%
DECREASED PaO2	29	64.44%

Table 4: $PaCO_2$ VARIATIONS IN SEVERE ACUTE BRONCHIAL ASTHMA PATIENTS

PaCO2	NUMBER OF PATIENTS	PERCENTAGE
NORMAL	4	8.8%
HYPOCAPNIA	7	15.55%
HYPERCAPNIA	34	75.55%

4. Discussion:

Asthma is a disease of public health importance. In this condition there occurs inflammation of air passages and effects the sensitivity of nerve endings in airways so that they become easily irritated causing the airways to swell and narrowing, thus decreasing the flow of air in and out of lungs. Severe acute bronchial asthma is a life threatening condition where the airways are very much narrowed effecting the ventilation and the change in ventilation alters the chemical composition of blood especially PaO2, PaCO2, Ph. Hydrogen ion concentration and respiratory gas composition of arterial blood profoundly influence respiration. The morbidity and mortality due to asthma has been greatly increasing, in spite of vast research the cause for increased mortality and morbidity is still unknown. Therefore, the clinician should relay on the best investigations that gives information about oxygenation and

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

ventilation status of patients, which helps in his/her further plan of treatment management, arterial blood gas analysis is one of them.

The arterial blood gas analysis gives us information regarding oxygenation and ventilation status of an individual. So these tests can be done on critically ill patients to derive information regarding their oxygenation and ventilation status. In the present study Ph, PaO2,PaCO2, bicarbonate levels were estimated in the patients presented with an attack of severe acute bronchial asthma.

In the present study of arterial blood gas analysis in severe acute bronchial asthma at the time of admission in hospital consisting of 45 patients aged between 21-80 years consists of 13 patients between 21-40 years thus accounting for 28.88% study population,7 patients between age group 41-50 years accounting for 15.55% of study population ,7 patients between age group of 51-60 years accounting for 15.55 % of study population ,10 patients between age group 61-70 years contributing to 22.2% of study population and 8 patients between 71-80 years accounting for 17.7% of study population.
Out of 45 patients in study group 17 patients are females accounting for 37.7% and 28 patients out of 45 are males accounting for 62.2% of study population. The pH was less than normal range in 31 patients (68.88%), and was within normal range in 9 patients and was above normal range in 5 patients (11.1%).
The partial pressure of oxygen was normal in 35.5% of total study population (i. e;16 patients), and was decreased in 64.44% of total study population (i.e.; 29 patients) indicating hypoxemia. The partial pressure of carbondioxide levels showed clear cut respiratory acidosis in 34 patients (75.55%) with PaCO2 levels more than 45 mmHg and pH less than 7.35.

From the above results it was clearly indicating that the presentation of arterial blood gas analysis in severe acute bronchial asthma is not a uniform process. Statistical correlation of arterial blood gas analysis together with signs and symptoms serve as reliable guide for physician in monitoring the treatment and serve as prognostic factor. In the initial stages of disease hypoxemia due to ventilation perfusion mismatch and hypocapnia due to hyper ventilation. Therefore, in a patient with severe acute bronchial asthma initial hyperventilation with hypocapnia (i.e.; decreased partial pressure of carbon dioxide) i.e., respiratory alkalosis appears to be contradictory. This is explained as follows: The change in ventilation and perfusion alters the chemical composition of blood mainly PaO2, PaCO2 and pH. The hydrogen ion concentration and alterations in respiratory gas composition profoundly influence respiration. Response to carbon dioxide and blood pH depend on central chemo receptors located in brain and response to hypoxia depends mostly on peripheral chemoreceptors located in aortic carotid bodies. In severe acute bronchial asthma there occurs marked airway inflammation resulting in airway narrowing. This causes increased resistance to air flow through airways (i.e.; resistance is inversely proportional to radius). But this increased resistance is not uniform throughout, resulting in preferential direction of inspired air to areas of lowest resistance. Thus relatively small volume of less than 30% of total lung volume hyperventilate receiving more than 80% of inspired air resulting in washing out excess of carbon dioxide resulting in hypocapnia, hyperventilation and increase in ventilation perfusion ratio and respiratory alkalosis. The rest of 75% of lung volume having higher airflow resistance will receive less amount of inspired air and fall in ventilation perfusion ratio resulting in hypoxemia. This hypoxemia can’t be compensated by very few hyperventilating units, thus resulting in fall in partial pressure of oxygen. Partial pressure of carbon dioxide will be low if the hyperventilating units wash off excess CO2.It will be normal when there is a balance between hypo ventilating and hyperventilating units.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

In the present study 7 patients are showing decreased partial pressure of carbon dioxide indicating early stage of severe acute bronchial asthma. Out of 7 patients with decreased PaCO2 levels 5 cases are having decreased partial pressures of oxygen indicating that some bodily mechanisms have taken place, i.e.; hyperventilation but this results are indicating that hyperventilating units are able to wash off additional CO2 levels from body but can't compensate for severe hypoxemia.

In the present study PaCO2 levels are raised in 34 patients accounting for 75.55% of study population indicating typical cases of respiratory acidosis in which their condition is worsened and overall ventilation perfusion is altered. In the present study $PaCO_2$ levels are normal in 4 patients indicating an equilibrium between hypo ventilating and hyper ventilating units.

In the study conducted by E. Tai and John Reed on 12 patients with severe acute asthma ,5 patients out of 12 had hypoxemia with PaO2 ranging between 39 to 62mmHg ,7 patients out of 12 presented with hypercapnia with PaCO2> 50mmHg and the patients are having low pH less than7.301 at the time of presentation indicating that most of the patients with severe acute bronchial asthma generally present with respiratory acidosis. In our study partial pressure of oxygen is decreased (hypoxemia)in 29 patients (64.44%)out of 45 patients, partial pressure of carbon dioxide is increased in 34 patients (75.55%) and decreased in 7 patients (15. 5%).pH is decreased in 31 patients (68.88%), normal in 9 patients (20%), increased in 5 patients (11. 1%).This study showed closed correlation with our study that in severe acute bronchial asthma most of the patients present with respiratory acidosis with hypoxemia. However, some patients presented with normal pH and decreased PaC02 indicating some compensatory mechanisms are taking place in response to altered ventilation due to severe airway obstruction.

In a study conducted by Odhiambo J. A and Chawla R. D on 40 patients, majority of patients showed marked hypoxemia with PaO2 levels less than 60 mmHg and hypocapnia with mean partial pressure of carbondioxide less than 34 mmHg.Majority of patients showed apparently normal pH with mean pH around 7.384. The partial pressure of carbon dioxide was mostly normal or less in severe phases of asthma in their study based on which they concluded that very high partial pressure of carbon dioxide indicates very severe form of disease and therefore assessing arterial blood gas analysis appears crucial as it alerts the physician to potentially explosive situations.

In a study conducted by Tai and Reed decreased oxygen tension was observed in 91% of patients and decreased carbon dioxide tension was observed in 50% of patients out of total 64 patients investigated. In a study conducted by Williams and Zohmann on 15 patients ,11 patients out of 15 were observed to have hypoxemia and 8 out of 15 patients had hypercapnia at the time of presentation. In a study conducted by H. Simpson regarding arterial blood gas analysis in 21 children, all the children were found to be hypoxemic with PaO2 less than 85 at the time of admission in hospital and partial pressure of carbon dioxide was raised in 11 out of 21 patients accounting for 55% of study population and half of the patients presented with low pH less than 7.35, which correlates with my study.

When the arterial blood gas analysis of severe acute bronchial asthma is made with normal reference values the pH showed variable presentation in severe acute bronchial asthma. Based on severity of airway obstruction, alteration in ventilation perfusion ratio the patients were showing respiratory acidosis and respiratory alkalosis.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

5. Conclusion:

Arterial blood gas analysis is widely used investigation in clinical practice while dealing with respiratory diseases especially bronchial asthma as it gives information regarding oxygenation, ventilation which are seriously disturbed in bronchial asthma.

This study revealed that there are disturbances in acid base status, ventilation in severe acute bronchial asthma. Therefore, it serves as good guide for physician in crucial decisions regarding treatment.

Most of the patients in this study presented with hypoxemia with respiratory acidosis and remaining number of patients presented with hypoxemia with respiratory alkalosis (i.e.; among those patients having abnormal arterial blood gas patterns). However arterial blood gas analysis alone is not sufficient to evaluate severity of attack it should be supported by further investigations like PEFR, FEV1 along with correlation of signs and symptoms clinically.

6. References:

1. Hofford, J.M. Analysis of Respiratory gases in Blood Del.Med.J. October,1967:39(10):276-8.
2. Dr. John. Varghese A Cross sectional study of acute severe bronchial asthma in relation to arterial blood gases of patients at KLES Hospital Belgaum from September 1999 to September 2000.
3. Jan. Nissl, RN, BS. Susan Van Houteri, RN, BSN, MBA.Specialist Medical Reviewer-R. Steven Tharratt M.D. Arterial Blood Gases-Test Overview. Pulmonology, Critical care, Medical Toxicology July 16,2004.
4. Lavietes M.H. Interpretation of PCO2 in the asthmatic patient. Chest 1991, Feb,99(2): 267-8.
5. ME Khadadah., BO Onadeko, HT Mustafa, KEH Metwali, clinical Features and outcome of Management of severe Acute Asthma in the intensive care unit of tertiary medical center Singapore Med.J.2000, vol.41(5):214-217.
6. Mountain R. D; Sahn S.A. Clinical features and outcome in patient with acute asthma presenting with hypercapnia, Am. Rev Respir Dis.1988 sep;138(3):535-9.
7. Novak R.M., Tomlanovich MC, Sankar DD, kvale PA, Anderson JA, Arterial blood gases and acid base status of adult patients presenting with acute severe asthma at Kenyatta National Hospital, Nairobi. East.Afr.Med.J.1992 June; 69(6):319-22.
8. NICOLA Cooper, Acute care: arterial blood gases. Student BMJ, Volume:12, March 2004 :105-107 27.
9. Odhiambo JA, Chawla, Arterial blood gases and acid base status of adult patients presenting with acute severe asthma at Kenyatta National Hospital, Nairobi.East.Afr.Med.J.1992 June;69(6):319-22.
10. Okumura E, Honda T, Yamaguchi, Analysis of arterial blood gases in patients with bronchial asthma.
11. Peter Driscoll, Terry Brown, Carl gwinutt, Terry Wardle A simple guide to blood gas analysis.
12. Rees H.A. Millar J.S., Donald K.W., A study of the clinical course and arterial blood gas tensions of patients in status asthmaticus.Q.J-Med;1968 Oct ;37(148):541-61.
13. Reinert M, and F. Trendelenburg, Correlation between parameters of breathing mechanics, respiratory gases and blood gases obstruction. Respiration 29:223-228(1972).

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE6, 2024

14. Rudolf M., Riordan JF, Grant BJ, Maberly DJ, Saunders.KB, Arterial blood gas tensions in severe acute asthma.Eur.J., Clin Invest 1980 Feb;10(1);55-62.
15. Shah S.P., Mahashur AA, Kamat SR, Blood gas behaviour in status asthmaticus.J. Assoc Physicians India 1984 October,32(10):851-4.
16. Simpson H, J.O Forfar and D.J. Grubb Arterial blood gas tensions and Ph in acute asthma in childhood. British Medical journal1968,3,460-464.
17. Steven E. Weinberger, Jeffrey M. Drazen Disturbances of respiratory function.
18. Tai E, Read J. Blood gas tensions in bronchial asthma. Lancet 1967 March ,25.
19. Thomas A., RAFFIN, Indications for blood gas analysis. Annals of internal medicine.1986,105:390-398.
20. Udwadia FE., Blood gas studies in status asthmaticus.J.Assoc.phys.Ind., Vol.29; Jan.1981,29(1).