

Arterial Blood Gas Analysis In Chronic Obstructive Pulmonary Disease Cases

Pragnesh J. Patel*, Nandita Mehta**, Sanjay Chauhan***, Piyush Solanki*,

*Assistant Professor, Department of Pathology, GMERS Medical College, Gandhinagar, Gujarat, **Associate Professor, Department of Pathology, B.J. Medical College, Ahmedabad, Gujarat, ***Assistant Professor, Department of Pathology, GMERS Medical College, Sola, Ahmedabad, Gujarat

Abstracts: Background: To understand the incidence amongst the age groups and gender, correlation of this study with the clinical presentation, evaluate the adequacy of ventilation by detecting blood gases, the changes in acid-base balance & compensatory mechanism in chronic obstructive pulmonary disease (COPD) patients, COPD cases were evaluated. **Materials And Methods:** The retrospective study was carried out on the patients with chronic obstructive pulmonary disease who were admitted in Civil hospital, Asarwa, Ahmedabad from July 2000 to October 2003. Arterial blood gas analysis was used as a diagnostic test in 50 cases of chronic obstructive pulmonary disease. **Results:** out of total 50 cases, majority (50%) had emphysema, 30% had mixed clinical picture of chronic bronchitis and emphysema, where as 20% had clinical picture of chronic bronchitis. Mean age group in this study was 55.9±4.4 yrs. Majority (82%) of patients were male. 16% cases were oedematous. Mean partial pressure of CO₂ & O₂ were 50.76 and 66.9 mm of Hg respectively. Range of pH observed was 7.28 to 7.52. **Conclusion:** Smoking of cigarettes (82%), exposure to dust (44%) and urban residence (64%) were the major risk factors. [Patel P NJIRM 2014; 5(1) : 10-12]

Key Words: Arterial Blood Gas Analysis, Chronic Obstructive Pulmonary Disease, Smoking

Author for correspondence: Dr. Pragnesh J. Patel, 548/A/1, Sector:8-B, Gandhinagar, Gujarat, India-382008
E mail: drpragnesh_patel@yahoo.com

Introduction: In the present era of extensive medical research, cure rate of communicable diseases is quite high. But still the prevalence of non-communicable diseases are increasing. Treatment of the respiratory disease is the major part of clinical practice and increasing its importance as a cause of disability & death.

COPD is among a leading cause for mortality and disability worldwide. It was in twelfth position for world wide cause of combined mortality and disability in 1990. But it is expected to become the fifth cause by the year 2020. COPD has a multifactor etiology including environmental influence - higher level of particular population, low socioeconomic status and life-style factors like smoking.¹

Lungs have a large reserve functional capacity, so the symptoms of disease appear late. But the findings of spirometry & blood gas analysis alter much in advance. Act of breathing is best judged by spirometry and function of gas exchange is best guided by arterial blood gas analysis. Spirometry requires patient's co-operation, while age & condition of patient has no bar to blood gas analysis.²

In India, chronic obstructive pulmonary disease (COPD) is on rise because of rising pollution level, increasing smoking habits & industrial dust. This study has been carried out on patients with COPD. To understand the pathophysiology of respiratory disturbances, it is necessary to study blood gas & acid base balance in COPD patients.

Materials And Methods: Design Of Study : The retrospective study was carried out on the patients with chronic obstructive pulmonary disease who were admitted in Civil hospital, Asarwa, Ahmedabad from July 2000 to October 2003. Total cases were 50. The study was designed to describe all presentations of admitted patients experiencing an acute exacerbation of their COPD. This decision was made because the aim was to widen the clinical inquiry into the COPD population by examining variables within the acute presentation and gain underlying interpretation.

Collection of Blood : Arterial blood for blood gas analysis was extracted by a phlebotomist, nurse or respiratory therapist. The blood was commonly drawn from the radial artery. This site of collection had less risk for occlusion and easy to compress for controlling bleeding.³ The femoral artery (or less often, the brachial artery) was also used, especially during emergency situations or with children.

Blood was also collected from an arterial catheter already placed in one of these arteries.

Blood Sample Handling and Transfer : The syringes were pre-packaged and contain a small amount of heparin, to prevent coagulation or needs to be heparinised, by drawing up a small amount of heparin and squirting it out again.⁴ Once the sample was obtained, care was taken to eliminate visible gas bubbles, as these bubbles can dissolve into the sample and cause inaccurate results. The sealed syringe was taken to a blood gas analyzer. If the sample could not immediately analyzed, it was chilled in an ice bath in a glass syringe to slow metabolic processes which could cause inaccuracy. Samples drawn in plastic syringes were not iced and were analyzed within 30 minutes.

Blood Gas Analysis : The blood gas analysis were done in the AVL COMPACT 2 which was a fully automatic, microprocessor controlled pH /blood gas analyzer with an integrated thermo printer for quantitative "in vitro" measurement of pH , PCO₂, PO₂. A complete pH/ blood gas analysis was performed on only 100 µl of whole blood. Quick and precise analysis was completed within 20 seconds from sample introduction to result.⁵ Data collected and analysed with Microsoft excel software.

Results: The present study was carried out on fifty cases of COPD. Severity of patients ranged from asymptomatic patient with only wheeze to acute respiratory insufficiency rendering them hospitalized. Study included cases of chronic obstructive pulmonary disease in the adult age group of both the sexes. From a total of 50 patients, 10(20%) patients had prominent chronic bronchitis (CB); 25(50%) had predominant emphysema (E) and 15(30%) had a mixed picture (CB+E). This show, COPD was more common in middle age group (40-59 yrs) 54% cases. Mean age group in this study was 55.9±4.4 years. Mean age for E group (58.2 years) was higher than mean age for CB group (56 years).

COPD was more common in male (82%) patients. History of smoking was present in all males except in one case in whom exposure to irritant was present. Patients of CB group had a longer history

of smoking (mean 31.1 years) compare to group E (mean 23.17 years).

Table :1 Age Distribution

	CB	CB+E	E	Total	Percentage
<40 yrs	1	2	2	5	10
40-59 yrs	5	8	14	27	54
>59 yrs	4	6	8	18	36
Mean age (Yr)	56	53.3	58.2		

Table:2 Clinical features

Findings	Percentage
Dyspnea	100
Cough	100
Anemia	52
Cyanosis	8
Pedal edema	16
ECG abnormality	46
X- Ray abnormality	70

Hypoxemia (PaO₂<80 mmHg) was present in 41 patients (82%). The mean PaO₂ was 66.9 mmHg. The mean PaCO₂ observed was 50.76 mmHg. A low PaCO₂ less than 35 mmHg (lower limit of normal) was not seen in any case. A normal PaCO₂ (35-45 mmHg) was seen in 16 cases & hypercapnea (more than 45 mmHg) in 34 cases. Range of pH observed was 7.28 to 7.52. A pH within normal range (7.35 to 7.45) was seen in 34 cases (68%). Acidemia was seen in 12 cases (24%). Alkalemia was seen in 4 cases (08%). 26.7% of hypercapnea patients had alkaline pH & 73.3% had acidic pH. When PaCO₂>65 mmHg, out of 4 patients no one had alkaline pH. In present study chronic respiratory acidosis and acute respiratory acidosis were found in 28 cases and 3 cases respectively. In 19 cases, no acid base disturbances were found.

Discussion: In present study 50 patients were included. The mean age in present study was 55.9±4.4 years while in other studies⁶⁻⁹ it was ranging from 59-72 years, correlate with present study. Male: female ratio in patients of COPD in this study was 4.6: 1. Such male predominance was also seen in studies of Rupmate et al¹⁰ & Burrows et al.¹¹ This male predominance is attributed to smoking and exposure to environmental dusts & irritants. Dyspnoea and cough with expectoration were present in all the cases which were comparable with other studies.⁸⁻⁹ In present study smoking was present in 82% of cases. All men were

having history of smoking except one, who had environmental exposure to irritant. Fletcher et al¹² also observed smoking in all the cases of COPD. According to Crofton¹³, the disease is more common in urban areas & among industrial workers. In present study also, 64% patients lived in urban areas. Relation of hypercapnea with other study is mentioned in table 3.

Table:3 Hypercapnea study

PaCO ₂ (mm Hg)	In present study %	Strihow et al ¹⁴ %
35 - 45	32	23.7
45 - 65	60	69.0
> 65	08	07.3

The mean PaO₂ was 66.9 mmHg and the lowest observed value was 34.3 mmHg. Severe hypoxemia (PaO₂<39 mmHg) was observed in 2 cases, both expired.

Table:4 Correlation coefficient

	Present study	Rupwate ¹⁰	Palmer ²
PaO₂Vs PaCO₂	-0.59	-0.70	-0.66

Results from present study are comparable to the study of Rupwate & Palmer, indicating consistent strong inverse correlation between PaO₂ and PaCO₂.

Conclusion: Emphysema type was most common. Smoking of cigarettes (82%), exposure to dust (44%) and urban residence (64%) were the major risk factors. Cyanosis when present was a reliable indicator of hypoxia. All the cases of cyanosis showed oxygen saturation below 80%. Hypoxemia was observed in 41 cases and PaO₂<40 mmHg indicate bad prognosis. PaO₂ and PaCO₂ have a strong negative correlation with each other. Acid-base imbalance was common. Measurement of pH alone, without concomitant PaCO₂ or HCO₃ measurement would give false sense of security. Thus ABG analysis is indicated in acute exacerbations, during assisted ventilation and to decide prognosis. It should become an integral part of patient management.

References:

- Decramer M, Rossi A. Series "contributions from the European respiratory monographs" number 2 in this series. Eur Respir J. 2001;17:982-994.
- Palmer K, Diament M. Spirometry and blood gas tensions in bronchial asthma and chronic bronchitis. The Lancet. 1967 August;2(7512):383-384.
- Setchenow J. 'Neuer apparat zur gewinnung der gase ans dem blute'. Z. Rat. Med. 1865;23:16-20.
- Bancroft J. The gaseous metabolism of the submaxillary gland. Part I. On methods, with a description of an apparatus for gas analysis. J. Physiol. 1900 Apr;25(4): 265-282.
- Haldane J. A contribution to the chemistry of hemoglobin and its immediate derivatives. J. Physiol. 1897; 22: 298-306.
- Barrow B. Clinical and physiological findings in 175 patients and their relationship to age and sex in COPD. Relationship of clinical and physiological findings to severity of airway obstruction. British medical journal 1964;665-677:521-539.
- Burrow B, Earle RH. Course and prognosis Of COPD, a prospective study of 200 patients. N Engl J Med. 1969;280(8):397-404.
- Isoaho R, Puolijoki H, Huhti E, Kivela SL et al: Prevalence of COPD in elderly Finns. Respiratory Medicine. 1994; 88:571-580.
- Mohan A. Clinical presentation & prediction of outcome of patients with severe obstructive pulmonary disease on 116 patients, Am.J.Critical Care Medicine. 2002;165.
- Rupwate RU, Vaidya PR, Kamat SR. Correlation of ventilator tests and arterial blood gases in chronic bronchitis. Lung India. 1989;1(8):23-25
- Burrows B, Fletcher CM, Heard BE, Jones NL, Wootliff JS. The emphysematous and bronchial types of chronic airways obstruction. The Lancet. 1966 April;287:830-835
- Fletcher C, Peto R. Natural history of chronic airflow obstruction. BMJ. 1977;1:1645-1648
- Crofton and Douglas's respiratory diseased, fifth edition, Blackwell science, 2000,P:730-732
- Ingram R, Miller RB, Tale LA. Arterial CO₂ changes during voluntary hyperventilation in COPD. Chest. 1972;62(1):14-18

Conflict of interest: None

Funding: None