



STUDY OF ARTERIAL BLOOD GAS PARAMETERS AND THEIR RELATION TO POOR OUTCOME IN PATIENTS ADMITTED WITH ACUTE EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Medicine

Dr. Azhar Ali Khan MD Medicine, Professor Department of Medicine, BRD Medical College Gorakhpur , Uttar Pradesh, India

Dr. Sudheer Yadav MD Medicine, Associate Professor, Department of Medicine, BRD Medical College Gorakhpur, Uttar Pradesh, India

Dr. Bechan Kumar Gautam MD Medicine, Assistant Professor, Department of Medicine, BRD Medical College Gorakhpur, Uttar Pradesh, India

Dr. Rohit Sharma* Junior Resident, Department of Medicine, BRD Medical College Gorakhpur, Uttar Pradesh, India *Corresponding Author

ABSTRACT

Introduction: COPD is a global health challenge affecting over 251 million people worldwide, with acute exacerbations accounting for recurrent ICU admissions in 2 % to 19 % patients. This study evaluated the impact of severity of hypercapnia, hypoxemia and dyselectrolytemia on clinical outcomes in AECOPD patients admitted in ICU. **Materials & Methods:** A one-year cross sectional prospective observational study was conducted at B.R.D. Medical College involving 200 patients with acute exacerbation of chronic obstructive pulmonary disease (AECOPD) admitted to department of medicine between 1 June 2023 to 1 June 2024. Data on electrolytes, arterial blood gases, and clinical outcomes were collected and analysed. **Results:** Elevated PCO₂ (>70mmHg) at presentation correlated with poor GCS scores, increased duration of BIPAP requirement, higher intubation rates and increased mortality. Low PO₂ levels (<60mmHg) at presentation correlated with increased duration of BIPAP requirement, higher intubation rates and mortality. Sodium and potassium disturbances, particularly hyponatremia and hyperkalemia were more prevalent in patients with PCO₂ levels >70 mmhg. pH≤7.25 and hyperkalemia at presentation were associated with increased mortality. **Conclusion:** The levels of PCO₂, PO₂ and electrolytes at admission play an important role in prognostication and predicting the outcomes in COPD patients during exacerbations.

KEYWORDS

COPD; AECOPD; hypercapnia; hypoxemia; electrolyte disturbances; clinical outcomes.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is marked with acute exacerbations (AECOPD), which increase hospitalization rates, ICU admissions, healthcare costs, and patient mortality. Sodium and potassium disturbances are common in AECOPD and can adversely affect the prognosis. However, the impact of these disturbances on clinical outcomes such as hospital stay duration, requirement for mechanical ventilation, and mortality is not well understood. Additionally, hypercapnia and hypoxemia indicative of severe respiratory failure are associated with worse outcomes but require further study to estimate their impact on AECOPD prognosis. This study aimed to assess the impact of hypercapnia and hypoxemia at presentation on clinical outcomes in AECOPD patients and their correlation with sodium and potassium imbalances and to improve management strategies in patients experiencing AECOPD.

MATERIALS & METHODS

This cross sectional prospective observational study was conducted in the Department of Medicine at B.R.D. Medical College, Gorakhpur enrolling 200 patients diagnosed with acute exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD) between June 1, 2023 and June 1, 2024. Patients with diagnosis of COPD aged above 18 years were included, excluding those with conditions known to cause electrolyte disturbances or post-tuberculosis, post-COVID, or interstitial lung disease. Data were collected at admission and regular intervals using blood gas analysers, electrolyte analysers, and spirometry to measure arterial blood gases parameter and electrolyte levels. The primary outcomes included the need for mechanical ventilation, duration of BIPAP requirement, intubation and mortality. Statistical analysis, including chi square test and Kaplan-Meier survival analysis, was conducted to identify predictors of clinical outcomes, with a p-value <0.05 considered significant.

RESULTS

The socio-demographic characteristics of the study population, detailing both age groups and gender distribution among 200 participants were studied. Age-wise, the majority (58.5%) of participants fall within the 51-70 years. Gender distribution is relatively balanced, with males representing 53.0% and females 47.0% of the study population. All the data is summarised in table 1.

The correlation between pCO₂ levels, GCS score, duration of BIPAP and intubation needed and mortality was studied. There is statistically significant correlation ($p < 0.05$) existed between pCO₂ levels and GCS scores. Notably 25.5% patients with severe GCS score (≤ 8), exhibited elevated pCO₂ levels (>70mmhg). Conversely, 74.5% participants with pCO₂ levels less than 70mmhg displayed mild to moderate GCS scores. The study also correlated pCO₂ levels and duration of BIPAP required which is statistically significant ($p < 0.05$) that indicates patients with pCO₂>70mmhg required longer duration of BIPAP (51.85%).

The correlation of PCO₂ levels, intubation and mortality was also studied which is statistically significant ($p < 0.05$), which means patients with pCO₂>70mmhg had higher intubation rates (31%) and mortality (14%). All the data is summarised in table 2.

This study investigated the relationship between hypoxemia at presentation and clinical outcomes, including duration of BiPAP, intubation, and mortality. There was Statistically significant association ($p < 0.05$) between hypoxemia (pO₂ < 60mmHg) and duration of BiPAP. Hypoxemic patients required longer BiPAP duration and had higher intubation rates (86.36%). Mortality rates were significantly higher in hypoxemic patients (71.42%) compared to non-hypoxemic patients (28.6%). All the data is summarised in table 3.

The association between potassium (K⁺) disturbances and mortality was studied. Patients with low K⁺ levels had no mortality, normal levels had 11.9%, and high levels had 28.3% mortality, with the difference being statistically significant ($p < 0.05$). This data suggests that potassium levels significantly influence mortality outcomes among the patients studied. All the data is summarised in table 4.

Correlation between pH levels at presentation and mortality was studied, which is statistically significant ($p < 0.05$), which implies that pH ≤ 7.25 at presentation is associated with increased mortality (92.85%). The data is summarised in table 5.

Table 1: Socio-demographic Characteristics of Study Population

Socio-demographic Characteristics	Frequency (n)	Percentage (%)
-----------------------------------	---------------	----------------

Age Group (in years)	18-30	1	0.5
	31-50	36	18.0
	51-70	117	58.5
	71-90	44	22.0
	>90	2	1.0
Gender	Male	106	53.0
	Female	94	47.0
Total		200	100

Table 2. PCO₂ Levels, GCS Score, Duration of BIPAP Required, Intubation and Mortality.

Pco ₂ levels at admission			50-70 mmhg	>70 mmhg	Total
		N	38	162	200
		%	19	81	100
GCS	3-8	No.	0	51	51
		%	0	27.7	25.5
	9-12	No.	1	18	19
		%	2.63	9.8	9.5
	13-15	No.	37	93	130
		%	97.36	50.5	65
Duration of BIPAP requirement (days)	≤ 2days	No.	33	78	111
		%	86.84	39	55.5
	> 2days	No.	5	84	89
		%	13.15	42	44.5
Intubation	Yes	No.	0	62	62
		%	0	33.9	31
	No	No.	38	100	138
		%	100	54.9	69
Mortality	NO	No.	38	134	172
		%	100	73.6	86
	YES	No.	0	28	28
		%	0	15.4	14

Table 3. PO₂ Levels, Duration of BIPAP Requirement, Intubation and Mortality.

Po ₂ levels at admission			≤60 mmhg	>60 mmhg	Total
Duration of BIPAP requirement (days)	≤ 2days	No.	12	99	111
		%	27.27	63.46	55.5
	> 2days	No.	32	57	89
		%	72.73	36.53	44.5
Intubation	Yes	No.	38	24	62
		%	86.36	15.38	31
	No	No.	6	132	138
		%	13.63	84.62	69
Mortality	YES	No.	20	8	28
		%	45.45	5.13	14
	NO	No.	24	148	172
		%	54.54	94.87	86

Table 4: Potassium Abnormalities and Mortality Status.

Potassium disturbances at presentation		Mortality				Total	
		YES		NO			
		No.	%	No.	%	No.	%
K+ Levels	<3.5	0	0.0	38	100.0	38	19.0
	3.5-5.5	13	11.9	96	88.1	109	54.5
	>5.5	15	28.3	38	71.7	53	26.5
Total		28	14.0	172	86.0	200	100.0

Table 5. pH Levels and Mortality.

pH levels at admission		Mortality			
		YES		NO	
		No.	%	No.	%
≤ 7.25		136	26	19.11	80.89
> 7.25		64	2	3.12	96.88
Total		200	28	14.0	86.0

DISCUSSION

In our study the age distribution showed that the majority of participants (58.5%) were aged between 51-70 years. Goli et al.¹⁰, conducted a study on serum electrolytes in acute exacerbation of COPD patients and found that 60% of their participants were aged 51-70 years. These results align closely with our findings. Our study found that higher PCO₂ levels (>70 mmHg) were associated with lower GCS scores, increased intubation rates and higher mortality. Mendez et al.¹² observed that PCO₂ levels above 70 mmHg correlated with severe outcomes, including lower GCS scores. Our findings also indicated that patients with PCO₂ levels above 70 mmHg were more likely to

have sodium and potassium disturbances, hyponatremia (39%) and hyperkalaemia (40.74%). This aligns with Ogan et al.¹¹, who noted elevated PCO₂ levels linked to higher electrolyte disturbances. We observed that higher PCO₂ levels necessitated longer BiPAP support, supported by Ogan et al.¹¹ who found that COPD patients with a median PCO₂ of 52.9 mmHg (range 32.4 to 86.0 mmHg) experienced significant deterioration and a greater need for prolonged non-invasive mechanical ventilation, comparable to BiPAP. Our findings highlight that low PO₂ levels significantly associate with increased duration of BIPAP support, higher intubation rates and mortality, consistent with Miravittles et al.⁹ and Goli et al.¹⁰, emphasizing the importance of managing PO₂ and PCO₂ levels in COPD patients. Our study also indicated that low pH at presentation (≤ 7.25) was associated with increased mortality which is consistent with Parvaiz A Koul¹⁴, who noted low pH (<7.35) and elevated PCO₂ levels (>45mmhg) at presentation were associated with increased mortality rates.

CONCLUSION

The study highlighted the significant impact of elevated PCO₂ levels and low PO₂ levels at presentation on AECOPD outcomes, including increased duration of hospital stay, higher intubation rates and increased mortality. Electrolyte disturbances, particularly hyponatremia and hyperkalemia were common in patients with hypercapnia. So, this study underscores the importance of managing PCO₂ levels, PO₂ levels and electrolyte levels to improve clinical outcomes in COPD patients.

REFERENCES

- Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global Strategy for the Diagnosis, Management, and Prevention of COPD. Available at: [GOLD Report](https://goldcopd.org/2023-gold-report-2/). 2023
- World Health Organization. Chronic Obstructive Pulmonary Disease (COPD). Available at: [WHO COPD](https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)). 2020.
- Sinha V, Aggarwal S. Prevalence and risk factors of COPD in urban Delhi. Indian J Public Health. 2018;62(1):10-15.
- Sharma V, Gupta A. COPD prevalence in rural Jammu. J Med Res. 2013;5(2):78-85.
- Vijayan VK. Chronic obstructive pulmonary disease. Indian J Med Res. 2013;137(2):251-269.
- Houben-Wilke S, et al. COPD and systemic consequences-comorbidities network study (COSYCONET). BMC Pulm Med. 2017;17(1):159.
- Levin K, et al. Arterial blood gas use in community-acquired pneumonia. J Emerg Med. 2016;51(1):17-24.
- Maestri R, et al. Characteristics and outcomes of COPD patients in pulmonary rehabilitation. Respir Med. 2019;158:33-40.
- Miravittles M, et al. An update on the pharmacological treatment of chronic obstructive pulmonary disease (COPD). Eur Respir J. 2009;34(2):520-530.
- Goli G, Mukka R, Sairi S. Study of serum electrolytes in acute exacerbation of chronic obstructive pulmonary disease patients. Int J Res Med Sci. 2016;4(8):3324-27.
- Ogan N, Günay E, Baha A, Çandar T, Akpınar EE. The Effect of Serum Electrolyte Disturbances and Uric Acid Level on the Mortality of Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease. Turk Thorac J. 2020;21(5):322-328.
- Mendez Y, Ochoa-Martinez FE, Ambrosii T. Chronic obstructive pulmonary disease and respiratory acidosis in the intensive care unit. Curr Respir Med Rev. 2019;15(2):79-89.
- Agarwal A, Batra S, Prasad R, Verma A, Jilani AQ, Kant S. A study on the prevalence of depression and the severity of depression in patients of chronic obstructive pulmonary disease in a semi-urban Indian population. Monaldi Arch Chest Dis. 2018;88(1). https://doi.org/10.4081/monaldi.2018.902.
- Parvaiz A Koul, Hilal A Dar, Rafi A Jan, Sanaullah Shah, and Umar Hafiz Khan Two-year mortality in survivors of acute exacerbations of chronic obstructive pulmonary disease: A North Indian study Lung India. 2017 Nov-Dec; 34(6): 511–516. doi: 10.4103/lungindia.lungindia_41_17