Asian Journal of Biochemistry, Genetics and Molecular Biology

Volume 16, Issue 3, Page 8-14, 2024; Article no.AJBGMB.112907
ISSN: 2582-3698

Early Blood Gas Analysis in SARS-COV-2 Infected Patients Admitted to SMHS Hospital: A Tertiary Care Hospital in Kashmir

Iqra Farooq [a++*], Rafiqa Eachkoti [a*], Amir Mohiuddin [b] and Sabhiya Majid [a]

[a] Department of Biochemistry, Govt Medical College and Associated Hospitals, Karan Nagar, Srinagar, Kashmir, Jammu and Kashmir, 190010, India.
[b] Department of Clinical Biochemistry, University of Kashmir, Hazratbal, Srinagar, Kashmir, Jammu and Kashmir, 190006, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJBGMB/2024/v16i3362

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/112907

Original Research Article

Received: 08/12/2023
Accepted: 12/02/2024
Published: 22/02/2024

ABSTRACT

Inroduction: Blood gases are a measurement of how much oxygen and carbon dioxide is in blood. These determine the acidity of blood. The blood gas testing is generally used for detecting and monitoring lung and kidney problems. The blood gas testing measures partial pressure of oxygen (o2), partial pressure of carbon dioxide (CO2),oxygen saturation(O2Sat), bicarbonate(HCO3) concentration .

Materials and Methods: Here in study Patients aged more than 18 years confirmed Covid 19 positive by reverse transcription, PCR (RT-PCR). Patients suffering from moderate to severe Covid 19 as per WHO diagnostic guidelines and underwent at least one ABG were included in the

---

[++] *PhD scholar;*
**Corresponding author: E-mail: iqrafrq@gmail.com;*

analysis. The ABG test was done on ABG analyzer in department of Biochemistry, SMHS hospital. All the data which was related to study was gathered and recorded in case record forms using files. As well as reports of patients from medical record section.

Results: Alkaline pH was found in 57.33% individuals.36% individuals were having normal pH and the percentage of individuals having acidic pH was 6.66%. Low PaO2 was found in 45.33% individuals. Normal PaO2 levels were found in 21.33% and high PaO2 levels were found in 33.33% individuals .Low PaCO2 (<35 mmHg) were found in 56%, normal (35-45mmHg) levels were found in 37.33% and high levels (>45mmHg) were found in 6.66%. Low HCO3- (<22mmol/L) were found in 16%, normal (22-26mmol/L) in 38.66% individuals and high (>26mmol/L) were found in 45.33% individuals would be expected in the case of respiratory alkalosis.

Conclusion: Regular ABG monitoring can aid in the early detection of silent hypoxia, and respiratory injury. With early management start-up, many lives can be spared with early diagnosis.

Keywords: Blood gases; oxygen saturation; respiratory injury; pneumonia.

1. INTRODUCTION

In December 2019, the COVID-19 outbreak began in a seafood market in Wuhan, Hubei Province, China. It has since spread to over 215 countries/territories/areas, becoming a global pandemic. The World Health Organization declared it a Public Health Emergency of International Concern on January 30, 2020, and officially labeled it a pandemic on March 11, 2020 [1]. Individuals who have contracted the virus display a wide range of symptoms, ranging from mild to severe. These symptoms can include a fever, upper respiratory tract infection symptoms like a dry cough and sore throat. In more severe cases, the immune system becomes dysregulated, leading to hyperinflammation and the development of acute respiratory distress syndrome (ARDS). Patients may also experience a variety of other health issues such as respiratory, digestive, liver, and neurological problems, including ARDS, acute heart damage, or secondary infections [2]. Individuals with chronic kidney disease, chronic respiratory disease, diabetes, cardiovascular disease, obesity, or cancer are at a higher risk of experiencing severe illnesses that could potentially result in death [3]. Derangement in acid-base homeostasis is common in severely ill patients. In the majority of cases, acid-base abnormalities are moderate and infrequently symptomatic and seldom have a propensity to affect organ homeostasis. On the contrary, moderate-to-severe acid-base abnormalities may lead to severe multiorgan consequences [4]. The virus’s tropism for the lungs and kidneys might result in frequent acid-base changes as a result of pneumonia and kidney impairment, respectively [5,6]. The virus's preference for the lungs and kidneys could lead to frequent changes in acid-base balance due to pneumonia and kidney impairment. Throughout different stages of COVID-19, several pathological mechanisms, including fever, widespread inflammation, blood clot formation, respiratory tract infections, and carotid body suppression, may occur. The blood's acid-base equilibrium may shift towards acidosis or alkalosis depending on the underlying processes [7].The major respiratory symptom of COVID-19 is arterial hypoxia, which causes significant pulmonary mechanics abnormalities (decreased lung compliance) [8,9]. Hypoxemia caused by COVID-19 is often accompanied by an elevated alveolar-to-arterial oxygen gradient, which indicates either ventilation-perfusion mismatch or intrapulmonary shunting [10]. Arterial blood gas (ABG) analysis can help in predicting mortality among COVID-19 patients, managing the ventilatory settings for better outcomes in these patients, and can help in predicting underlying comorbid conditions in COVID-19 patient [11]. To date, different laboratory findings were detected as risk factors that can aid in disease monitoring, staging, therapy, and prognosis of COVID-19 patients. The bulk of these investigations, however, have concentrated on hematological and biochemical laboratory markers, with very little available data on ABG analysis.

2. MATERIALS AND METHODS

The study was conducted in the Department of Biochemistry Government Medical College (GMC) Srinagar and its associated SMHS Hospital between October 2020 and November 2021. Total 100 patients (RT-PCR confirmed SARS-CoV-2 positive) and twenty control subjects (RT-PCR confirmed SARS-CoV-2 negative) were included in this cohort study. The patients were diagnosed as per standard WHO/CDC criteria 2020 for Covid-19 disease. The study was initiated only after obtaining approval from Ethical committee of Government Medical College, Srinagar (IEC/GMC-Sgr/27,19th December). Written informed consent and response questionnaire from patients and healthy controls were documented and recorded as per hospital protocol. The patients were followed twice (14th day and 28th day) for a period of 28 days for either death or .Patients aged more than 18 years confirmed Covid 19 positive by reverse transcription ,PCR (RT-PCR) .Patients suffering from moderate to severe Covid 19 as per WHO diagnostic guidelines and underwent at least one ABG were included in the analysis. The ABG test was done on ABG analyzer in department of Biochemistry,SMHS hospital.All the data which was related to study was gathered and recorded in case record forms using files as well as reports of patients from medical record section.

i. Inclusion criteria

a) **Patients group:** 75 SARS-CoV-2 infected (confirmed by positive RT-PCR of the swab) patients admitted to the hospital for treating covid-19 of varying severity during the course of the study. The patients were followed until death or discharge for a maximum of 28 days.
b) **Control group:** 20 healthy individuals that were negative for SARS-CoV-2 confirmed by negative RT-PCR of the swab.

ii. Exclusion criteria

Immuno-compromised or patients with any immunological disorders.

Method: ABG analyzer was used for blood gas analysiswas used.

Statistical analysis: The data was analyzed using STATA software 17 (standard edition). Descriptive statistics was performed and data was presented as frequency (N) and percentage (%). P value was also calculated. A p- value of less than 0.05 was considered statistically significant.

3. RESULTS

A retrospective Arterial Blood Gas (ABG) data of total 75 covid -19 patients was collected and analysed. The ABG analysis showed the following results: It was found that out of total patients, 26.6% individuals were males an 77.33% were females. Most of covid-19 patients were >60 years of age (82.33%).Most of patients were of urban residence (60%). In this research it was found that 88% of patients were severe (severerness was determined on the basis of oxygen saturation levels (<90%).Fever was most common symptom found (84% of patients).Cough was found in 89.33% of patients and pneumonia was found in 96% of patients. Alkaline pH was found in 57.33% individuals. 36% individuals were having normal pH and the percentage of individuals having acidic pH was 6.66%. Low PaO_2 was found in 45.33% individuals. Normal PaO_2 levels were found in 21.33% and high PaO_2 levels were found in 33.33% individuals .Low $PaCO_2$ (<35 mmHg) were found in 56%, normal (35-45mmHg) levels were found in 37.33% and high levels (>45mmHg) were found in 6.66%. Low HCO_3^- (<22mmol/L) were found in 16%, normal (22-26mmol/L) in 38.66% individuals and high (>26mmol/L) were found in 45.33% individuals would be expected in the case of respiratory alkalosis.

4. DISCUSSION

ABG tests are routine lab procedures that serve as the gold standard for identifying respiratory failure and issues with acid-base balance. ,In our research it was found that alkalosis was predominant in patients which were under study(57.33%).It was found that a significant no. of patients were having low PaO_2. Although not significant a good no. of patients were having low $PaCO_2$ .The HCO_3^- levels were found >26 in 45.33% of individuals suggesting respiratory alkalosis. To explain why respiratory alkalosis was predominant in most patients, many theories were put forth. According to one of the theory, covid Covid 19 reduces hyperventilation and, as a result, CO_2 buildup in the blood by inhibiting the carotid body's response to oxygen deprivation.

The involvement of ACE2 receptors in the carotid body is likely related to this process, as the virus that causes COVID-19 has been found to have an affinity for these receptors [5]. This virus leads to the collapse of the air sacs in the lungs of patients, rather than filling them with fluid or pus, resulting in hypoxia. However, the normal ability of the lungs to expel carbon dioxide is not affected during this process, and patients do not experience shortness of breath due to the absence of CO2 buildup [12]. The most prevalent finding in this investigation, which was comparable to that of a study done in Italy The socalled "quiet" or "happy" hypoxia is caused by hypocapnic hypoxia, which is shown by a positive association between PaO2 and PaCO2. Air hunger is not a symptom of hypocapnic hypoxia; instead, a sense of calm and wellbeing may develop, making it challenging to assess the severity of the illness and delaying hospitalisation. Hypocapnia in COVID19 disease may potentially result from activating carotid chemoreceptors. It is significant to note that all of the patients had a severe version of the illness, and several of them had SOB, which caused air hunger and hypercapnia. Notwithstanding their rarity, a small proportion of COVID19 patients also showed signs of respiratory acidosis, which is normal in cases of air hunger.A Similar results were also observed in an intubated COVID19 patient who had hyperpyrexia and obstructive lung disease [13]. In addition to diarrhoea, vomiting, and dehydration, many COVID19 patients also showed signs of those conditions, which can cause metabolic alkalosis because of a potassium deficit. By activating the mineralocorticoid system, prior usage of corticosteroids at home or in any other hospital setting can also result in metabolic alkalosis. In this study,% of patients experienced metabolic acidosis.The primary cause of metabolic acidosis in the COVID19 patient was multiorgan failure, including acute kidney. Although metabolic alkalosis predominated, a significant positive correlation between PaCO2 and standard bicarbonate shows that patients with hypocapnia also have low bicarbonate levels, which can cause metabolicacidosis. This compensatory metabolic acidosis may be present in some patients.

The arterial carbon dioxide pressure (PaCO2) value provides information about the ventilation state (acute or chronic) and the acid-base condition, whereas the arterial oxygen pressure (PaO2) value provides information about the oxygenation state. The pH is the first parameter examined when examining arterial gases, and it stays within the range of (7.35–7.45). The concentration of hydrogen ions changes in response to a little change in pH. In the present investigation, patients with covid-19 had varying PO2 and SO2 levels, demonstrating the well-known effect of covid-19 on the respiratory system.

Table 1. Represents socio demographic features and clinical features in SARS-CoV-2 patients

Parameter Age	**Frequency(n=75)**	**Percentage%**
<60	13	17.33%
>60	62	82.66%
Sex		
Male	17	22.66%
Female	58	77.33%
Residence		
Rural	30	40%
Urban	45	60%
Severness		
Moderate	9	12%
Severe	66	88%
	Symptoms	
Fever		
Yes	63	84%
No	12	16%
Cough		
Yes	67	89.33%
No	8	10.66%
Pneumonia		
Yes	72	96%
No	3	4%

Table 2. Represents arterial blood gas analysis in SARS-CoV-2 patients (n=75)

Parameter	Frequency	P Value
pH		
Acidosis(<7.35)	5	0.342
Normal(7.35-7.45)	27	
Alkalosis(>7.45)	43	
PaCO2(mmHg)		
Acidosis(>45)	5	0.614
Normal(35-45)	28	
Alkalosis(<35)	42	
PaO2(mmHg)		
Low(<75)	34	P<0.001
Normal(75-100)	16	
High(>100)	25	
HCO3(mmol/L)		
Low(<22)	12	0.378
Normal(22-26)	29	
High(>26)	34	

Pneumonia is the most common symptom of COVID-19 and is almost always identified in hospitalized patients. Bilateral ground-glass opacities with or without consolidations are a frequent symptom [14]. A shift in The most prevalent COVID-19 symptom, pneumonia, is virtually invariably found in hospitalized minute ventilation and interference with respiratory gas exchange are two factors that make extensive pneumonia a potentially lethal infectious disease. As a result, problems in our COVID-19 group were predicted to be acid- base imbalances of respiratory origin. Metabolic alkalosis population, it was challenging to identify the underlying cause of this disease. Dehydration brought on by a fever, dyspnea, and a lack of appetite is the most plausible scenario. Compared to patients with normal pH, no statistically significant differences in pulmonary gas exchange or diuretic were identified. Our study's participants had an average age of 64.94 years, and 22.66% of them were male. 66 people were discovered to be really ill. The very ill patients were mostly females. It is unknown why such a high number of COVID-19 ICU patients had alkalemia, which is thought to be unusual in critical care [15]. Certainly, alkalemia produced at the kidney level appears to be the most plausible cause, with increased mineralocorticoid activation (endogenous or exogenous) being a potential. COVID-19 is thought to upregulate the conventional RAS pathway and produce metabolic alkalemia. The RAS is largely responsible for regulating blood pressure, hydration balance, electrolyte concentrations, and the body's acid-base condition. It has two well-defined arms: the conventional vasoconstrictive route and the protective pathway. Alternately, due to its impact on the mineralocorticoid system, corticosteroid medication could be a contributing cause. Dexamethasone has received a lot of attention for its usage in critically sick patients receiving ventilator support, where higher survival rates have been seen. The activation of mineralocorticoids will cause hypertension, alkalemia, and hypokalemia [16]. It is interesting to note that in the current study most of the patients have high blood sugar levels and worse prognosis. In COVID-19, diabetes is linked to poorer outcomes, including a larger percentage of ICU admissions, ARDS, and mechanical ventilation (Gauthier et al., 2002). The retrospective nature of the study, the small number of patients, and the lack of a control group limit the generalizability of these findings. Larger investigations are thus required to establish the distribution of acid-base abnormalities in COVID-19 patients and to confirm the potential link between metabolic acidosis and death risk in this subset of patients.

5. CONCLUSION

Patients with COVID19 frequently experience an acidbase imbalance. Although respiratory alkalosis predominated, the study also found respiratory acidosis with mixed metabolic acidosis and alkalosis. The study discovered a strong relationship between pH and PaCO2 as well as PaCO2 and HCO3. Regular ABG monitoring can aid in the early detection of silent hypoxia, and respiratory injury. With early management start-up, many lives can be spared with early diagnosis.

6. LIMITATIONS

Very ill COVID-19 patients who had been hospitalised to the ICU participated in the trial.

It would have been preferable to include ABG analysis of patients who were just mildly and moderately unwell. The association between ABG and patient outcomes in terms of survival and the alteration in ABG report pattern over time with illness progression were not covered in the current study, which calls for more investigation. The discovery of operational causes of pulmonary alkalosis in the study constituted a significant limitation. Although all ABG reports were obtained at the time of ICU admission, many patients were already receiving home oxygen assistance or were even receiving BiPAP (Bilevel Positive Airway Pressure) treatment from some other nursing homes before admission. They could have overcorrected for natural respiratory acidity, resulting in the findings of the current investigation.

ETHICS COMMITTEE APPROVAL

The work was ethically approved by the ethical committee of GOVT Medical College and associated SMHS Hospital. Approval no: Ref No. IEC-GMC-Sgr/27.

ACKNOWLEDGEMENTS

The author is acknowledge Multi-disciplinary research unit (MRU), GMC Srinagar. Department of Biochemistry, GMC Srinagar.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Cascella M, Rajnik M, Aleem A, et al. Treasure Island, FL: StatPearls Publishing; Features, evaluation, and treatment of coronavirus (COVID-19); 2022.
2. Drosten C, Günther S, Preiser W. AIdentification of a novel coronavirus in patients with severe acute respiratory syndrome. N Engl J Med. 2003;348:1967–1976.
3. Lu R, Yu X, Wang W, et al. Characterization of human coronavirus etiology in Chinese adults with acute upper respiratory tract infection by real-time RT-PCR assays. PLoS One. 2012;7:0
4. Kaplan LJ, Frangos. Clinical review: Acid-base abnormalities in the intensive care unit -- part II. S. Crit Care. 2005;9:198–203.
5. Ronco C, Reis T, Husain-Syed F. Management of acute kidney injury in patients with COVID-19. Lancet Respir Med. 2020;8:738–742.
6. Zhu N, Zhang D, Wang W, et al. N Engl J Med. A novel coronavirus from patients with pneumonia in China. 2019. N Engl J Med. 2020;382:727–733.
7. Mondal S, Das TK, Bhattacharya S, Banerjee S, Hazra D. J Blood gas analysis among covid-19 positive patients: A single centre, retrospective, observational study. Clin Diagn Res. 2021;15:0–4.
8. Yang X, Yu Y, Xu J, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. Lancet Respir Med. 2020; 8:475–481.
9. Bhatraju PK, Ghassemieh BJ, Nichols M, et al. Covid-19 in critically ill patients in the Seattle region - case series. N Engl J Med. 2020;382:20122022.
10. Lakhani J, Kapadia S, Pandya H, Gill R, Chordiya R, Muley A. Arterial blood gas analysis of critically ill corona virus disease 2019 patients. Asian J Res Infect Dis. 2021;6:51–63.
11. Tobin MJ, Laghi F, Jubran A. Ventilatory failure, ventilator support, and ventilator weaning. Compr Physiol. 2012;2:2871–2921.
12. Bertolino L, Vitrone M, Durante-Mangoni E: Does this patient have COVID-19? A practical guide for the nternist. Intern Emerg Med. 2020;15:791-800: 17.
13. Castro D, Patil SM, Keenaghan M: Arterial blood gas. StatPearls publishing, Treasure Island, FL; 2022.

14. Jubran A: Pulse oximetry. Crit Care. 2015;19:272.
15. Kovesdy CP: Metabolic acidosis as a possible cause of CKD: what should clinicians do?. Am J Kidney Dis. 2014;64: 481-3.
16. Raphael KL, Zhang Y, Wei G, Greene T, Cheung AK, Beddhu S: Serum bicarbonate and mortality in adults in NHANES III. Nephrol Dial Transplant. 2013;28:1207-13.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/112907