# TITLE: Blood Gas Analysis in SARS-COV-2 Infected Patients Admitted to SMHS Hospital: a TERTIARY CARE Hospital in Kashmir

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**Abstract**

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 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 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 and we concluded, 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.

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. [Cascella et al.,2022]. 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. [Drosten et al.,2003]. 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. [Lu et al.,2012].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 [Kaplan et al.,2005]. 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 [Ronco etal.,2020;Zu et al.,2020]. 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 [Mondal et al .,2021].The major respiratory symptom of COVID-19 is arterial hypoxia, which causes significant pulmonary mechanics abnormalities (decreased lung compliance) [Yang et al.,2020;Bhat raju et al .,2020]. 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 [Tobin et al.,2012]. 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 patients [Lakhani et al., 2021].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 [Bezuidenhout et al.,2021].

1. **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.

1. **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 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

# Discussions:

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 PaO2. Although not significant a good no. of patients were having low PaCO2 .The HCO3- 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,covidCovid 19 reduces hyperventilation and, as a result, CO2 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 [Ronco et al., 2020]. 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. [Bertolino et al.,2022].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 [Castro et al.,2022]. 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.

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.(Jubran.,20-15).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.(18).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 (Kovesdy.,2014). 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(Raphael et al.,2013). 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.

1. **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.

**Limitation(s):**

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.

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***Declarations***

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**Table 1: represents socio demographic features and clinical features in SARS-CoV-2 patients**

|  |  |  |
| --- | --- | --- |
| PARAMETER  AGE | FREQUENCY(n=75) | PERCENTAGE% |
| <60  >60 | 13  62 | 17.33%  82.66% |
| SEX  Male Female | 17  58 | 22.66%  77.33% |
| RESIDENCE  Rural Urban | 30  45 | 40%  60% |
| SEVERNESS  Moderate Severe | 9  66 | 12%  88% |
| SYMPTOMS | | |
| FEVER  Yes No | 63  12 | 84%  16% |
| COUGH  Yes No | 67  8 | 89.33%  10.66% |
| PNEUMONIA  Yes  NO | 72    3 | 96%  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 |