Early blood Gas Analysis in SARS-COV-2 infected Patients admitted to SMHS Hospital: aTERTIARYCAREHospitalinKashmir,India

Abstract

Introduction:Blood gases are a measurement of how much oxygen and carbon dioxide is in blood. These determine theacidity of blood. The blood gas testing is generally used for detecting and monitoring lung and kidneyproblems.Thebloodgastestingmeasurespartialpressureofoxygen(o2),partialpressureofcarbondioxide(CO2),oxygensaturation(O2Sat),bicarbonate(HCO3)concentration.**Materials and methods:**Here in study Patients aged more than 18yearsconfirmedCovid19positivebyreversetranscription,PCR(RT-PCR)Patientssufferingfrommoderateto severe Covid 19 as per WHO diagnostic guidelinesand underwent at least one ABG were included in theanalysis. 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 wellasreportsofpatientsfrommedicalrecord section.**Results:**Alkaline pH was found in 57.33% individuals.36%individualswerehavingnormalpHandthepercentageofindividualshavingacidicpHwas6.66%.LowPaO2wasfoundin45.33%individuals.NormalPaO2levelswerefoundin21.33%andhighPaO2levelswerefoundin 33.33% individuals .Low PaCO2(<35 mmHg)were found in 56%, normal (35-45mmHg) levels werefoundin37.33%andhighlevels(>45mmHg)werefoundin6.66%.LowHCO3-(<22mmol/L)werefoundin16%,normal(22-26mmol/L)in38.66%individualsandhigh(>26mmol/L)werefoundin45.33%individualswouldbeexpected inthe caseof respiratoryalkalosis**Conclusion:**Regular ABGmonitoring can aid in the early detection ofsilent hypoxia, and respiratory injury. With early managementstart-up,manylivescan bespared withearly diagnosis.

Key words: COVID-19 patients, Arterial blood gas, Metabolic acidosis, Blood gas testing

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

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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". [17] The bulk of these investigations, however, have concentrated on haematological and biochemical laboratory markers, with very little available data on ABG analysis.

2. Materialsandmethods:

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

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.Patients aged more than 18yearsconfirmedCovid19positivebyreversetranscription,PCR(RT-PCR).Patientssufferingfrommoderateto severe Covid 19 as per WHO diagnostic guidelinesand underwent at least one ABG were included in theanalysis. 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 filesas wellasreportsofpatientsfrommedicalrecord section.

i. **<u>Inclusion criteria:</u>**

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. **<u>Exclusion Criteria:</u>**

Immuno-compromised or patients with any immunological disorders

Method: ABGanalyser was used for blood gas analysiswas used.

Statistical analysis: The data was analysed 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 analyzed.TheABGanalysisshowed thefollowing results:Itwasfound thatoutoftotalpatients,26.6%individualsweremalesan 77.33%werefemales.Mostofcovid-19 patients were>60 years of age(82.33%).Most of patients were of urban residence(60%).In this researchit was found that 88% of patients were severe(severeness was determined on the basis of oxygen saturationlevels(<90%).Fever was most common symptom found (84% of patients).Cough was found in 89.33% ofpatients and pneumonia was found in 96% of patients. Alkaline pH was found in 57.33% individuals.36%individualswerehavingnormalpHandthepercentageofindividualshavingacidicpHwas6.66%.LowPaO2wasfoundin45.33%individuals.NormalPaO2levelswerefoundin21.33%andhighPaO2levelswerefoundin 33.33% individuals .Low PaCO2(<35 mmHg)were found in 56%, normal (35-45mmHg) levels werefoundin37.33%andhighlevels(>45mmHg)werefoundin6.66%.LowHCO3-(<22mmol/L)werefoundin16%,normal(22-26mmol/L)in38.66%individualsandhigh(>26mmol/L)werefoundin45.33%individualswouldbeexpected inthe caseof respiratoryalkalosis

4. Discussions:

ABG tests are routine lab procedures that serve as the gold standard for identifying respiratory failure andissues with acid-base balance. ,In our research it was found that alkalosis was predominant in patients whichwereunderstudy(57.33%).Itwasfoundthatasignificantno.ofpatientswerehavinglowPaO2.Althoughnotsignificant a good no. of patients were having low PaCO2 .The HCO3- levels were found >26 in 45.33% ofindividuals suggesting respiratory alkalosis.To explain why respiratory alkalosis was predominant in mostpatients,manytheorieswereputforth.Accordingtooneofthetheory,covidCovid19reduceshyperventilationand, 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 CO_2 buildup. [12].The most prevalent finding inthisinvestigation, which was comparable to that of a study done in Italy The socalled "quiet" or "happy"hypoxiaiscausedbyhypocapnichypoxia,whichisshownbyapositiveassociationbetweenPaO2andPaCO2 .Air hunger is not a symptom of hypocapnic hypoxia; instead, a sense of calm andwellbeing may develop,making it challenging to assess the severity of the illness and delayinghospitalization. Hypocapnia inCOVID19 disease may potentially result from activating carotid chemoreceptors. It is significant to note thatall of the patients had a severe version of the illness,and several of them had SOB, which caused air hungerand hypercapnia. Notwithstanding their rarity, a small proportion of COVID19 patients also showed signs ofrespiratory acidosis, which is normal in cases of air hunger.A Similar results were also observed in anintubatedCOVID19patientwhohadhyperpyrexiaandobstructivelungdisease[13].Inadditiontodiarrhoea,vomiting, and dehydration, many COVID19 patients also showed signs of those conditions, which can causemetabolicalkalosisbecauseofapotassiumdeficit.Byactivatingthemineralocorticoidsystem,priorusageofcorticosteroids 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 COVID19patientwas multiorgan failure, including acute kidney.Although metabolic alkalosis predominated, a significantpositive correlation between PaCO2 and standard bicarbonate shows that patients with hypocapnia also havelow bicarbonate levels, which can cause metabolicacidosis.This compensatorymetabolic acidosis may bepresentin somepatients.

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Thearterialcarbondioxidepressure(PaCO2)valueprovidesinformationabouttheventilationstate(acuteorchronic)andtheacid-basecondition,whereasthearterialoxygenpressure(PaO2)valueprovidesinformationabout the oxygenation state. The pH is the first parameter examined when examining arterial gases, and itstayswithintherangeof(7.35–7.45).Theconcentrationofhydrogenionschangesinresponsetoalittlechangein pH. In the present investigation, patients with covid-19 hadvarying PO2 and SO2 levels, demonstratingthewell-known effectof covid-19 ontherespiratorysystem.

Pneumonia is the most common symptom of COVID-19 and is almost always identified in hospitalizedpatients. Bilateral ground-glass opacities with or without consolidations are a frequent symptom.[14].A shiftin The most prevalent COVID-19 symptom, pneumonia, is virtually invariably found in hospitalized minuteventilation and interference with respiratory gas exchange are two factors that make extensive pneumonia apotentiallylethalinfectiousdisease.Asaresult,problemsinourCOVID-19groupwerepredictedtobeacid-base imbalances of respiratory origin. Metabolic alkalosispopulation, it was challenging to identify theunderlying cause of this disease. Dehydration brought on by a fever, dyspnea, and a lack of appetite is themost plausible scenario. Compared to patients with normal pH, no statistically significant differences inpulmonarygasexchangeordiureticwereidentified.Ourstudy'sparticipantshadanaverageageof64.94years, and 22.66% of them were male.66 people were discovered to be really ill. The very ill patients weremostlyfemales. It is unknown why such a high number of COVID-19 ICU patients had alkalemia, which isthoughttobeunusualincriticalcare[15].“Certainly,alkalemiaproducedatthekidneylevelappears tobethemostplausiblecause,withincreasedmineralocorticoidactivation(endogenousorexogenous)beingapotential.COVID-19isthoughttoupregulatetheconventionalRASpathwayandproducemetabolicalkalemia. The RAS is largely responsible for regulatingblood pressure, hydration balance, electrolyteconcentrations,andthebody'sacid-basecondition.Ithastwowell-definedarms:theconventionalvasoconstrictive route and the protective pathway. Alternately, due to its impact on the mineralocorticoidsystem, corticosteroid medication could be a contributing cause. Dexamethasone has received a lot ofattention for its usage in critically sick patients receiving ventilator support, where higher survival rates havebeen 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 worseprognosis.InCOVID-19,diabetesislinkedtopooreroutcomes,includingalargerpercentageofICU

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admissions, ARDS, and mechanical ventilation"(Gauthier et al .,2002). The retrospective nature of the study, the small numberof patients, and the lack of a control group limit the generalizability of these findings. Larger investigationsarethusrequiredtoestablishthedistributionofacid-baseabnormalitiesinCOVID-19patientsandtoconfirmthepotentiallink betweenmetabolicacidosisanddeath riskinthissubsetof patients.

5. Conclusion:

PatientswithCOVID19frequentlyexperienceanacidbaseimbalance.Althoughrespiratoryalkalosispredominated, the study also found respiratory acidosis with mixed metabolic acidosis and alkalosis. Thestudy discovered a strong relationship between pH and $PaCO_2$ as well as $PaCO_2$ and HCO_3.Regular ABGmonitoring can aid in the early detection ofsilent hypoxia, and respiratory injury. With early managementstart-up,manylivescan bespared withearly diagnosis.

Limitation(s):

VeryillCOVID-19patientswhohadbeenhospitalizedtotheICUparticipatedinthetrial.

It would have been preferable to include ABG analysis of patients who were just mildly and moderatelyunwell. The association between ABG and patient outcomes in terms of survival and the alteration in ABGreport pattern over time with illness progression were not coveredin the current study, which calls for moreinvestigation.Thediscoveryofoperationalcausesofpulmonaryalkalosisinthestudyconstitutedasignificantlimitation.AlthoughallABGreportswereobtainedatthetimeofICUadmission,manypatientswerealreadyreceivinghome oxygen assistance or were evenreceiving BiPAP(Bilevel Positive Airway Pressure)treatment from some other nursing homes before admission.They could have overcorrected for naturalrespiratoryacidity, resultinginthefindingsof thecurrentinvestigation.

Ethics 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.

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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	17.33%
	62	82.66%
SEX		
MaleF	17	22.66%
emale	58	77.33%
RESIDENCE		
Rural	30	40%
Urban	45	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	PValue
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	

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High(>100)	25	
HCO3(mmol/L)		
Low(<22)	12	
Normal(22-26)	29	0.378
High(>26)	34	

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