

ORIGINALARTICLE

A Hospital Based Study on Arterial Blood Gas Analysis in ICU Patients

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Abstract:

Background: In critically ill patients, arterial blood gas (ABG) analysis is a frequently requested test. It is routinely carried out without having an impact on patient care. As a result, the present study was conducted to evaluate the ABG test's usefulness in our critical care unit (ICU). **Material and Methods:** This retrospective cross-sectional study included 210 ICU patients. ICU patients included critical patients of known cases of Chronic Kidney Disease (CKD), Diabetic Ketoacidosis (DKA), Hypertension (HTN), Myocardial Infarction (MI), Liver Cirrhosis, and Chronic Obstructive Pulmonary Diseases (COPD) & Covid-19 Disease. The study was conducted from June 2021 to November 2021 at tertiary teaching hospital. Patients' radial arterial blood samples were collected and processed for ABG analysis. **Results:** Out of 210 ICU patients, 35.24 % patients had metabolic acidosis, 30.47 % patients had metabolic alkalosis, and 19.05 % had respiratory acidosis whereas 15.24 % had respiratory alkalosis. **Conclusion:** From our study results we conclude that various acid-base abnormalities have been observed in ICU patients. Metabolic acidosis is most common acid-base abnormality in ICU patients. Males suffered with acid base disorder than females.

Keywords: ABG, ICU patients, Acidosis, Alkalosis, Electrolyte imbalance

Introduction:

One of the most often requested tests in the ICU is an arterial blood gas (ABG) study. When the results are likely to affect patient management, an ABG sample should ideally be acquired.^[1] The evaluation of patient respiration, the necessity to quantify the response to therapeutic or diagnostic interventions, the monitoring of the severity and progression of a known disease process, and the assessment of acid-base balance are common indications for the ABG test.^[2] Increased expenses, blood loss, the introduction or spread of

infection, and patient discomfort are all linked to repeated ABG readings.^[3] In patients without an intra-arterial catheter, the requirement for numerous unpleasant punctures may result in significant blood loss.^[4] In a large hospital, a research found that only 26.4% of ABG tests were requested following an acuterespiratoryissue.^[1] In a similar vein, other researchers discovered that in their their ICUs, between 42.7 and 66% of ABG procedures were not medically justified.^[5-7]

Material and Methods:

The present retrospective cross-sectional study was conducted in the biochemistry department, Intensive Care Unit (ICU), Medical record department (MRD) at a tertiary care teaching hospital during June 2021 to November 2021. Laboratory reports of 210 patients who were known cases of Chronic Kidney Disease (CKD), Diabetic Ketoacidosis (DKA), Hypertension (HTN), myocardial infarction (MI), liver cirrhosis, Chronic Obstructive Pulmonary Diseases (COPD) & Covid-19 Disease were obtained from Intensive Care Unit, and Biochemistry department of central clinical laboratory of a tertiary care teaching hospital. Paediatric patients and pregnant women were excluded from the study. Informed consent was taken prior to administering the procedure. Radial artery of the patients was located and modified Allen's test was performed. Then, needle was inserted at 30- 40° angle. The needle was advanced into radial artery until a blood flashback appeared. Then, the needle was withdrawn. Followed by putting the piece of cotton on the puncture site, and pressing on it. Then, the sample was labelled and in laboratory, it was processed within 30 minutes of collection.^[8] Estimation of ABG was done by pH-stat Method.^[9] Estimation of serum electrolytes was done by ISE Method.^[10] Direct measurement with ion selective electrode (ISE), Impedance (Hct) and Amperometry (pO₂)^[11] was done in the present study. The data obtained from the study was converted into a master chart in Microsoft excel with the inclusion of range, mean, standard deviation, (data are expressed as means ± SD) were calculated. The ethical approval was to taken from institutional ethical

committee.

Results:

Table No.1: Gender wise distribution of patients

Diagnosis	Gender	
	Male	Female
CKD	15	7
DKA	11	13
HTN	22	20
MI	24	14
Liver Cirrhosis	7	5
COPD	24	22
COVID-19	19	7
Total	122	88

Table No.2 : Age wise distribution of ICU patients

Diagnosis	Age		
	Below 40	40-70	Above 70
CKD	5	16	1
DKA	4	16	4
HTN	5	30	7
MI	3	25	10
Liver Cirrhosis	1	9	2
COPD	6	26	13

Table No. 3: Diagnosis wise distribution of ICU patients

Diagnosis	Cases	Prevalence of Diagnosis
CKD	22	10.48 %
DKA	24	11.43 %
HTN	42	20 %
MI	38	18.10 %
Liver Cirrhosis	12	5.71 %
COPD	46	21.90 %
COVID-19	26	12.38 %
Total	210	100 %

Table No.4: Distribution of Acid base disorders in ICU Patients

Conditions	No. of Cases	Prevalence of Conditions
Metabolic Acidosis	74	35.24 %
Metabolic Alkalosis	59	30.47 %
Respiratory Acidosis	40	19.05 %
Respiratory Alkalosis	32	15.24 %
Total	210	100 %

Table No. 5: Arterial Blood Gas (ABG) Parameters of tests

Parameters (Units)	Mean $\pm$ SD
pH	7.39 $\pm$ 0.09
pCO ₂ (mmHg)	39.8 $\pm$ 8.44
pO ₂ (mmHg)	83.3 $\pm$ 20.6
HCO ₃ (mEq/L)	24.1 $\pm$ 4.3
Anion Gap (mEq/L)	20.1 $\pm$ 7.4
Hct (%)	35.6 $\pm$ 13.4
Na (mEq/L)	141.5 $\pm$ 8.1
K (mEq/L)	4.74 $\pm$ 1.75
Ca (mmol/L)	1.12 $\pm$ 0.26
Cl (mEq/L)	101.3 $\pm$ 10.6

Table 6: Distribution of Diagnosis and Prevalence of Acid base disorders in ICU Patients

Diagnosis	Conditions			
	Metabolic Acidosis	Metabolic Alkalosis	Respiratory Acidosis	Respiratory Alkalosis
CKD	12 (5.72)	10 (4.76)	0 (0)	0 (0)
DKA	12 (5.72)	12 (5.72)	0 (0)	0 (0)
HTN	23 (10.95)	19 (9.05)	0 (0)	0 (0)
MI	20 (9.52)	18 (8.57)	0 (0)	0 (0)
Liver Cirrhosis	7 (3.33)	5 (2.38)	0 (0)	0 (0)
COPD	0 (0)	0 (0)	23 (10.95)	23 (10.95)
COVID19	0 (0)	0 (0)	17 (8.09)	9 (4.29)

Table N0. 7: Electrolyte imbalanced in ICU patients

Diagnosis	Electrolyte Imbalance					
	Hypernatremia	Hypo-Natremia	Hyper-kalemia	Hypo-Kalemia	Hyper-Calcaemia	Hypo-Calcaemia
CKD	20	2	18	0	0	17
DKA	7	13	7	12	0	14
HTN	5	19	4	21	0	5
MI	25	1	36	0	0	7
Liver Cirrhosis	12	0	10	0	0	3
COPD	17	11	13	9	3	21
COVID-19	7	2	3	3	1	11

Discussion:

An Arterial Blood Gas Analysis measures the pH & balance of Oxygen (O₂) & carbon dioxide (CO₂) in blood. This test is used to find out how well your lungs are able to move O₂ into the blood & remove CO₂ from the blood. We have measured different parameters such as, pH, pCO₂, pO₂, bicarbonate, Anion gap, Haematocrit and Electrolytes (Na, Ca, K, Cl). The present study shows that in metabolic acidosis condition pH level decreased, pCO₂ level decreased & HCO₃ level decreased. In metabolic alkalosis condition pH level increased, pCO₂ level increased & HCO₃ level increased. In respiratory acidosis condition pH level decreased, pCO₂ level increased & HCO₃ level increased. In respiratory alkalosis condition pH level increased, pCO₂ level decreased & HCO₃ level decreased. As per present study the mean value of pH 7.39 ± 0.09 . The mean values of pCO₂ are 39.8 ± 8.44 and mean values of pO₂ is 83.3 ± 20.6 . Mean values of HCO₃ is 24.1 ± 4.3 . Mean values of Anion Gap is 20.1 ± 7.4 . Mean values of Hct is 35.6 ± 13.4 . Mean values of sodium is 141.5 ± 8.1 ; Mean values of Potassium is 4.74 ± 1.75 , Mean values of calcium 1.12 ± 0.26 , is Mean values of chloride is 101.3 ± 10.6 . On gender wise distribution of ICU patients, it was observed that there are 122 male patients and 88 female patients. In which CKD have 15 males and 7 females, DKA patients 11 males & 13 females, MI patients 24 males & 14 females, Liver Cirrhosis patients 7 males & 5 females, COPD patients 24 males & 22 females, COVID-19 patients 19 males & 7 females. Among all the diagnosis male patients were more than female, in male patients there are 24 cases of MI & COPD which is followed by HTN & COVID-19 and female has highest no of 22 cases of COPD. Diagnosis wise, in present study there are 46 COPD cases which is highest among the other diagnosis. We found prevalence of COPD is 21.90 %, & HTN is 20 %. In present study, it was observed mainly 4 acid base disorders namely metabolic acidosis, metabolic alkalosis, respiratory acidosis and respiratory alkalosis. We found total 74 cases with metabolic acidosis. Metabolic acidosis has higher predominance in all diseases. Prevalence of Metabolic Acidosis is 35.24 %. In present study, it is found 12 CKD patients, 12 DKA patients, 23 HTN patients, 20 MI patients & 7 liver cirrhosis patients having metabolic acidosis. Similarly, 10 CKD patients, 12 DKA patients, 19 HTN patients, 18 MI patients & 5 Liver Cirrhosis patients were having metabolic alkalosis. 23 COPD patients, 17 COVID-19 patients were having Respiratory acidosis. 23 COPD patients, 9 COVID-19 patients had Respiratory alkalosis.

Prevalence of COPD in respiratory acidosis & Respiratory alkalosis is 10.95 %.^[12] According to electrolyte imbalance, Hyponatremia is higher in MI (25) patients. Whereas hyponatremia is more in HTN cases (19). On the other hand, Hyperkalemia is higher in MI (36), and Hypokalemia is higher in HTN (21). 3 and 21 COPD patients had hypercalcemia as well as hypocalcemia respectively.^[13] In similar study by Ishita Ghatak et.al. Arterial blood gas data in the ICU patient were analysed by ABG analyser using different parameters shows various diagnoses having prevalence of Metabolic Acidosis.^[8]

Conclusion:

The present study included 210 patients with acidosis and alkalosis (metabolic as well as respiratory) from the tertiary teaching hospital. In our study there are main 4 acid-base disorders namely metabolic acidosis, metabolic alkalosis, respiratory acidosis and respiratory alkalosis. The present study shows that in metabolic Acidosis condition pH level decreased, pCO₂ level decreased & HCO₃ level decreased which is a common finding in metabolic acidosis. In metabolic Alkalosis condition pH level increased, pCO₂ level increased & HCO₃ level increased. In respiratory acidosis condition pH level decreased, pCO₂ level increased & HCO₃ level increased. In respiratory alkalosis condition pH level increased, pCO₂ level decreased & HCO₃ level decreased. Diagnosis wise we observed there are 46 no of COPD cases which is highest among the other diagnosis. COPD and HTN were the most common diagnoses in ICU patients. From our study results we conclude that various acid-base abnormalities have been observed in ICU patients. Metabolic acidosis is most common acid-base abnormality in ICU patients. We found total 74 cases with metabolic acidosis. Acid Base disorder is found in critically ill patients in ICU. Commonest acid base disorder was metabolic acidosis, metabolic alkalosis, respiratory acidosis respiratory alkalosis. Most prevalent acid base disorder in our study is metabolic acidosis. This study showed high prevalence of Metabolic Acidosis in ICU patients i.e., 35.24 %. Males suffered with acid base disorder than females.

Limitation of the study:

The sample size of our study is very small to observe prevalence of different acid base disorder.

Sources of supports: Nil

Conflicts of Interest: Nil

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