



**INTERPRETATION OF ARTERIAL BLOOD GAS TESTS OF ICU PATIENTS IN A
TERTIARY CARE TEACHING HOSPITAL OF MAHARASHTRA**

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ABSTRACT

Background: Intensive care unit (ICU) patients are often investigated for their arterial blood gas levels in order to diagnose the underlying cause and provide prompt and appropriate treatment and thus avoid the future consequences. **Methods:** Results of arterial blood gas investigations of ICU patients were obtained from the laboratory and analysed to detect the common derangements in blood. **Results:** The diagnostic yield of the study is 96.05 %. Out of 1063 patients, 355 of them had an acidic blood pH and 256 patients had an alkaline blood pH. 812 of them turned out positive for respiratory balance disorders and 863 of them had metabolic acid-base balance disorders. **Conclusion:** Arterial blood gas estimation is an efficient tool in diagnosing and treating the patients of an intensive or critical care unit. Proper and timely estimation thus, can reduce the complications and prove effective in controlling the disorders.

KEYWORDS: ICU, Arterial Blood Gas, Metabolic Acidosis, Metabolic Alkalosis, Respiratory Acidosis, Respiratory Alkalosis.

INTRODUCTION

Intensive Care medicine or Critical Care medicine is the branch of medicine concerned with diagnosis and management of life-threatening conditions that may require sophisticated life support and monitoring. Patients suffering from respiratory imbalance, cardiac dysfunctionings, renal failure, major trauma, multiple organ failure and those after major surgeries are kept in ICU to monitor recovery. Amongst the various investigations carried out in ICU patients, Arterial Blood Gas monitoring is of utmost importance. It helps in diagnosing the underlying imbalance in acid-base system or respiratory balance. It is essential to correct these changes in order to avoid the ill-effects on various internal organs and homeostasis of the body.

MATERIALS AND METHODS

Accurate results for an ABG estimation depends on the proper manner of collecting, handling, and analysing the specimen.^[1] The site for puncture is usually the radial artery or femoral artery or brachial artery. About 2 ml of blood is collected in a heparinized syringe under strict anaerobic conditions and kept at 0°C until the sample is processed.^[2]

A retrospective type of study was carried out from the data of 1063 patients admitted to the ICU of Dr. Bhausaheb Sardesai Talegaon Rural Hospital, Talegaon

Dabhade, Pune. The arterial blood sample was sent well-packed in ice packs to the Central Clinical Laboratory (CCL) within 30 minutes of collection. The sample was immediately analysed in the laboratory by ISTAT to obtain values of various parameters like blood pH, partial pressure of dissolved oxygen in blood (pO₂), partial pressure of carbon dioxide in blood (pCO₂), base excess in the extra cellular fluid (beecf) and bicarbonate ion level in blood (HCO₃⁻). The results obtained were tabulated and recorded accordingly.

The normal ranges for the estimated arterial blood gas parameters are given below.^[3] [Table 1].

Table. 1: Reference ranges for the Arterial Blood Gas parameters.

Sr. No.	Parameter	Reference Range
1	Blood pH	7.35 – 7.45
2	Partial pressure of O ₂ (pO ₂)	75 – 100 mm Hg
3	Partial pressure of CO ₂ (pCO ₂)	35 – 45 mm Hg
4	Base excess in e.c.f (beecf)	-2 – 2 mmol/L
5	Bicarbonate ions (HCO ₃ ⁻)	22 – 26 mmol/L

RESULTS

Although it is generally believed that most cases of acid–base derangement are mild and self-limiting, extremes of blood pH in either direction, especially when happening quickly, can have significant multi-organ consequences. Advances in evaluating acid–base balance have helped in understanding the impact of fluids in the critically ill.^[4] The various disorders detected amongst the study participants are compiled below. [Figure 1].

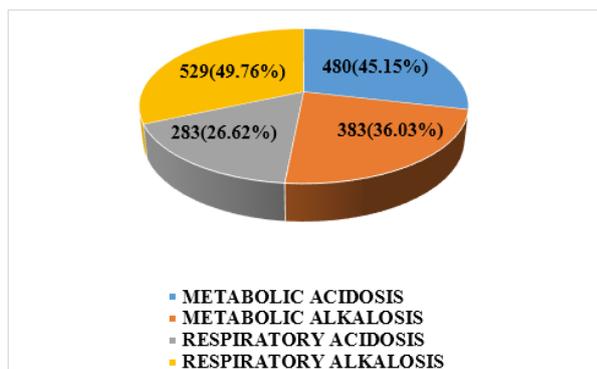


Figure. 1: Disorders detected amongst ICU patients.

1) Blood PH

The concentration of H⁺ in blood plasma and various other body solutions is among the most tightly regulated variables in human physiology.^[5] There are various buffer systems in the human body that maintain this blood pH – a. Bicarbonate Buffer (H₂CO₃ / NaHCO₃), b. Phosphate Buffer (NaH₂PO₄ / Na₂HPO₄), c. Haemoglobin and d. Proteins.^[6] In this study, 355 (33.34%) patients had acidic blood pH (pH below 7.35) and 256 (24.08 %) of them had alkaline blood pH (pH above 7.45). This indicates that acid-base balance of the body is disrupted. In man the acid-base balance is maintained and regulated by the renal and respiratory systems, which modify the extracellular fluid pH by changing the bicarbonate pair (HCO₃⁻ and PCO₂); all other body buffer systems adjust to the alterations in this pair.^[7]

2) Metabolic Acidosis

Metabolic acidosis is a clinical disturbance characterized by a low arterial pH, reduced plasma HCO₃⁻ concentration and compensatory hyperventilation.^[8] 480 (45.15%) of the patients were positive for this imbalance. It is caused due to renal dysfunctions, ketoacidosis, hyponatremia, hyperkalemia, diarrhoea, etc. If not treated properly, it can lead to decreased cardiac functionings, hypotension, altered mental state, impaired glucose tolerance, etc.^[9]

3) Metabolic Alkalosis

Metabolic alkalosis is characterized by increased HCO₃⁻ concentration in extracellular space with compensatory increase in arterial pCO₂.^[8] 383 (36.03%) of the patients were positive for this imbalance. It is caused due to hypokalemia, vomiting, hypertension, hypercalcemia,

cystic fibrosis, etc.^[10] which needs prompt attention in early detection and treatment to avoid future ill-effects.

4) Respiratory Acidosis

Respiratory acidosis is the abnormal physiologic state which occurs when the blood level of dissolved CO₂, and consequently of carbonic acid, is elevated.^[11] 283 (26.62%) of the patients were diagnosed with this disorder. It is caused due to depressed respiratory drive as in trauma, general anaesthesia, brain tumours, muscle dysfunction, airway flow resistance, chest wall stiffness and lung stiffness.^[12]

5) Respiratory Alkalosis

Respiratory alkalosis is a primary decrease in PCO₂ (hypocapnia) due to an increase in respiratory rate and/or volume (hyperventilation).^[13] 529 (49.76%) of the patients were diagnosed with this disorder. It is caused due to hyperventilation, pneumonia, asthma, heat exposure, laryngospasm, drowning, high altitude, etc.^[12]

6) Combined OR Mixed Disorders

Each of the above mentioned disorders may occur singly or as two or more simple acid-base disorders.^[12] This is particularly obtained in the critically ill patients.

DISCUSSION

Maintenance of acid-base homeostasis is a vital function of the living organism.^[12] Arterial blood gas sample yields information on oxygenation of blood through gas exchange in lungs, carbon dioxide elimination through lungs and acid-base balance or imbalance in extracellular fluid.^[14] Even a slightest deviation in any of the parameters can lead to a potential damage to the human body. From this study it was seen that a majority of the patients admitted to the ICU have either any one or more acid-base balance disorders. Thus arises the need for accurate and speedy analysis of blood to detect such abnormalities and initiate treatment at the earliest possible moment. This can lead to a decline in the death toll and improve the life afterwards.

CONCLUSION

Arterial blood gas estimation is a very common investigation carried out in the ICU apart from other routine tests such as serum electrolytes, complete blood count, serum creatinine, blood urea, liver function test and blood glucose level. This study confirms the fact that it is very much essential in diagnosis of acid-base imbalance disorders and lung functioning. It is still a vital element assessing the patients requiring critical care for better recovery. Thus, it emphasizes that proper sample collection, analysis and reporting will continue to exert their significance in prompt diagnosis and treatment. Also, the availability of arterial blood gas monitoring at primary health centres can lead to better prognosis and medical help in cases requiring urgent medical attention.

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