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COMPARISON OF CLINICAL UTILITY OF DIFFERENT METHODS OF ABG ANALYSIS IN PICKING UP MIXED COMPLEX ACID BASE DISORDERS IN CRITICALLY ILL PATIENTS

Anaesthesiology

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ABSTRACT

Introduction: Interpreting an arterial blood gas (ABG) is a crucial skill for physicians, anaesthetics, nurses, respiratory therapists, and other health care personnel. ABG interpretation is especially important in critically ill patients. The goal of present study is to compare the clinical utility of different methods of arterial blood gas analysis in critically ill patients with mixed complex acid base disorders.

Material and methods: This study was conducted on 200 critically ill patients of 12 to 85 years age, admitted in ICU (medical and surgical) at Govt. medical college and attached M.B.S. Hospitals Kota. All data were collected and studied by Linear regression and Bald and Altman analysis.

Results: Six step approach allowed the detection of additional or different metabolic acid-base alteration in 57.50 % of critically ill patients; and the inclusion of albumin corrected anion gap in the six step analysis based on change in anion gap due to change in serum concentration of albumin in critically ill patients resulted in an 21% more additional or different diagnosis as compared to six step approach.

KEYWORDS

ABG- arterial blood gas, BE- Base excess, acid base disorders.

Introduction

Arterial blood gas (ABG) analysis is an essential part of diagnosing and managing a patient's oxygenation status and acid–base balance. It is an important diagnostic test in critically ill patients. The usefulness of this diagnostic tool is dependent on being able to correctly interpret the results. Disorders of acid–base balance can create complications in many disease states, and occasionally the abnormality may be so severe so as to become a life-threatening risk factor. Mixed disorders when simultaneously present have grave consequences on the management and outcome of the disease.[1] A thorough understanding of acid–base balance is mandatory for any physician, and intensivist, and the anesthesiologist is no exception.[2]

As clinicians opt for less invasive assessments of respiratory function such as capnography, pulse oximetry and spirometry, ABG may be indicated only to confirm the patient's status, for example acute asthma and chronic obstructive pulmonary disease (COPD).[3-6]

The utilization of an ABG analysis becomes necessary in view of the following advantages:

- Aids in establishing diagnosis.
- Guides treatment plan.
- Aids in ventilator management.
- Improvement in acid/base management; allows for optimal function of medications.
- Acid/base status may alter electrolyte levels critical to a patient's status.

Material and methods

This prospective observational study was conducted to compare different approaches of ABG analysis in picking up mixed complex acid base disorders in critically ill patients. Study was conducted after Govt. Medical College, Kota Ethical committee approval in critically ill patients admitted in the ICUs. 200 arterial blood gas samples, and serum electrolytes and serum albumin were measured as a part of patient workup in the intensive care unit.

Design and Setting –

it was a prospective observational study that conducted in medical surgical intensive care units (ICUs) in arterial blood gas samples from 200 patients between 12 to 85 years of age from 01/06/2015 to 31/12/2016.

ABG Machines –

Cobas 221 and **Cobas 121** of **Roche** Company and other ABG machines were used for arterial blood gas analysis.

All the patients (male and female, all age groups) were included in study. Since procedures that were applied are part of the usual diagnostic management, informed consent from patients were waived.

Procedure for arterial blood sampling using radial artery

The most common problems that are encountered include non arterial samples, air bubbles in the sample, inadequate or excessive anticoagulant in the sample, and delayed analysis of a non cooled sample.[7]

The Clinical Laboratory and Standards Institute (CLSI) recommends that ABG specimens collected in plastic syringes should be analyzed within 30 minutes if they are left at room temperature.[2] Guidelines are also available on ABG sampling and analysis. [8-10] samples were collected following standard protocol under aseptic condition.

The sample was immediately transported to the laboratory, following laboratory handling procedures.[11]

Ethics-

The study was approved by institutional ethics committee of Govt. Medical College and attached group of Hospitals Kota, Rajasthan, India.

Statistical analysis-

Acid base will be performed in each patient using

a) Quick step method
b) Systematic six step approach
c) Corrected anion gap for albumin.

Linear regression and Bald and Altman analysis will be performed between the systemic six step approach and albumin corrected anion gap. Arterial blood gases, serum electrolytes, and albumin will be measured in the same blood sample. From the measured pH and pCO_2, $[HCO_3^-]$ will be calculated by the ABG machine using the Henderson-Hasselbalch equation.[12]

Henderson-Hasselbalch Equation-

$pH = pK'a + \log_{10}([HCO_3^-] / 0.03 \times pCO_2)$

Results

In quick step method 18.5% patients having respiratory acidosis out of which all 18.5 % patients had additional or different diagnosis by 6 step method and 4.5 % had different or additional diagnosis by albumin corrected approach.

3% having metabolic acidosis out of which all 3 % patients had

additional or different diagnosis by 6 step method and 1.5 % had different or additional diagnosis by albumin corrected approach.

9.5% patients having respiratory alkalosis out of which all 9.5 % patients had additional or different diagnosis by 6 step method and 3.5 % had different or additional diagnosis by albumin corrected approach.

7% patients having metabolic alkalosis out of which 2 % patients had additional or different diagnosis by 6 step method and 1.5 % had different or additional diagnosis by albumin corrected approach.

The main findings of this study are, first, that 6 step approach allowed the detection of additional or different metabolic acid-base alteration in 57.50 % of the patients; and, second, that the inclusion of albumin corrected anion gap in the 6 step analysis based on change in anion gap due to change in serum concentration of albumin in critically ill patients resulted in an 21% more additional or different diagnosis as compared to 6 step approach.

Table-1 Analysis of different acid-base disorders.

S. No.	Diagnosis	No. Of patients in quick step method		No of patients with additional/different diagnosis by six step method		Missed Disorders		No of patients with additional or different diagnosis than 6 step with albumin correction	
		N	%	n	%	n	%	N	%
1.	Respiratory acidosis	37	18.5%	37	18.5%	0	0	9	4.5%
2.	Metabolic acidosis	6	3.0%	6	3.0%	0	0	3	1.5%
3.	Respiratory alkalosis	19	9.5%	19	9.5%	0	0	7	3.5%
4.	Metabolic alkalosis	14	7.0%	4	2.0%	10	5.0%	3	1.5%
5.	Mixed disorders	124	62.0%	49	24.50%	75	37.5%	20	10%
	Total	200	100%	115	57.50%	85	42.5%	42	21%

Table-2. Comparative study of different methods of ABG-analysis.

200 ABG samples	Quick Step V/S 6 Step Approach		6 Step Approach V/S Albumin Corrected Approach	
	N	%	N	%
Extra or different metabolic disorder	115	57.50%	42	21%
Missed disorder			73	36.5%
	85	42.50%	85	42.50%
Total	200	100%	200	100%

This study coincides with the study of Atul Bhasin , Rajinder Kr Singal (2012)[1] suggests that higher number of mixed disorders were revealed after systematic six-step evaluation. There were 52 % cases of mixed disorders by six-step approach as against 48% with quick-step method.

Conclusion

The study revealed that medical and surgical patients are different in regard to serum albumin and arterial PCO_2. Results suggest that the combined use 6 step approach and albumin corrected might be enough for an adequate evaluation of acid-base status in critically patients. Finally, no metabolic acid-base variable behaves as a reliable prognostic indicator.

In conclusion, one should not regard acid-base chemistry as a closed chapter in clinical medicine. Advances in basic chemistry, mathematics, and computer science may yet provide new insight into an old problem.

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