

Comparison of Analysis of Arterial Blood Gas for Ph, Pco₂, K + and B.E with Central Venous Blood Gas Obtained Simultaneously in Patients Presenting to Critical Care Unit and Emergency Medicine

Sumera Mahar^{1*}, Inayat Ali Khan², Tauseef Ali Memon³, Aakash⁴, Maryam Jamil⁵, Ameera Shabbir⁶

¹ Registrar Emergency Department, University Hospital Kerry Ireland
Email: maharsumera@gmail.com

² Consultant Neurosurgeon, Ziauddin University Hospital Karachi Pakistan
Email: inayatbrain@yahoo.com

³ Senior Registrar Emergency department, Sabah Alahmed Emergency centre Kuwait
Email: drtsfali@gmail.com

⁴ Resident Emergency Medicine, Ziauddin University Hospital Karachi Pakistan
Email: akashwadhvani109@gmail.com

⁵ Assistant Professor General Surgery, Ghurki Trust Hospital, Lahore Medical and Dental College (LMDC) Lahore Pakistan
Email: doc.mjamil@gmail.com

⁶ House officer, Ziauddin University Hospital Karachi
Email: ameera9268@zu.edu.pk

Abstract

Objective: The present study aimed at the comparison of central venous blood gas (CVBG) and arterial blood gas (ABG) in the management of the selected patients in the emergency department and critical care unit (CCU). **Study design:** A comparative study. **Place and Duration:** This study was conducted in University Hospital Kerry Ireland from January 2022 to January 2023. **Methodology:** The study included 80 patients that were critically ill and presented to CCU and the emergency room. ABGs and CVBGs measurements of B.E, K+, pCO₂, and pH were taken. Other variables were noted simultaneously. A comparison of values of B.E, K+, pCO₂, and pH of ABG and CVBG was done by application of a t-test. The sample was taken either from the arterial catheter or by a direct puncture. The blood was analyzed by a blood gas analyzer. The venous sample was taken using a central catheter. The amount of blood taken for CVBG analysis was 5 ml out of which, 0.1 ml was carried in a heparinized syringe. **Results:** The study consisted of 80 patients out of which 52 (65%) were male and 28 (35%) were female. 22 (27.5%) were from the age group 18 years to 30 years. 32 (40%) patients were from the age group 31 years to 60 years. The remaining 26 (32.5%) patients were from the age group 61 years to 90 years. According to linear regression analysis, ABG values of pH, B.E, and pCO₂ were correlated significantly with CVBG. Whereas, the value of K+ for ABGs and CVBGs was poorly correlated. **Conclusion:** Central CVBG values for pH, B.E, and pCO₂ can be considered as an alternative to ABG values for making a continuous assessment in critical patients. However, the assessment of potassium levels cannot be done by CVBG values because of the difference in the level of potassium in the arterial and venous blood. The most significant benefit of using central CVBG values instead of ABG values in critically sick patients is the avoidance of recurrent arterial punctures.

Keywords: Venous pH, Blood Gas Analysis, Central CVBG, ABGs

1. Introduction

ABG analysis provides crucial information related to the physiological condition as well as the advancement of the disease [1]. It also provides important information regarding the acid-base balance in the body, metabolic condition, ventilation, and oxygenation. These factors play an important role in the assessment and management

of patients [2]. This procedure is commonly done for the determination of the acid-base condition of patients critically ill. Nonetheless, this procedure is uncomfortable and painful for the patient. The procedure can also cause arterial injury, hematoma, aneurysm, thrombosis, and embolization [3]. Moreover, the procedure also has a risk for the healthcare workers to receive a needle stick injury [4]. On the other hand, taking a sample for CVBG does

not warrant as many punctures as ABG sampling does. This is beneficial in terms of the safety of the procedure for both the healthcare provider and the patient [5].

The most definite benefit of obtaining CVBG in place of ABG is that a simple IV line is enough for drawing a sample. The same IV line can be used to draw blood for other laboratory samples too. This is why, one puncture is enough for sampling [6]. This also decreases the cost of the sampling, the risk of needle stick injury, and labor. Complications like arterial laceration, thrombosis, and hematoma can be negated. Certain conditions can alter the blood gas analysis such as hypo-perfusion after hypertension [7]. Similarly, another condition that affects the results is hyperventilation [8]. In cardiac arrest patients, the value disparity between ABGs and CVBGs is greater because of tissue hypoxia [9].

The composition of ABGs reflects the correlation between perfusion and ventilation. It is an important measure for the assessment of pulmonary function [10]. There are very few studies done in this domain. The current study was carried out to compare the results of CVBG and ABG samples in patients presenting to the emergency department and CCU.

2. Methodology

The present study is a prospective comparative study that was conducted on 80 critically ill patients. These patients had presented to the emergency department of the hospital and CCU. The samples taken from the patients were quickly analyzed by using a Blood gas analyzer. As per the inclusion criteria of the study, the patients included were critically ill with cardiovascular, neurological, respiratory, hepatic impairment, polytrauma, and renal dysfunction. According to the exclusion criteria of the study, the patients that were going to stay lesser than 2 hours in the hospital, younger than 18 years old, and pregnant patients, were not included

in the study.

The CVBG and ABG values of pCO₂, pH, K⁺ and Base excess were recorded. The samples for ABG and CVBG were recorded at the same time to avoid any error in the result. The arterial samples were taken from femoral or radial arteries through heparinized syringes. The number of samples ranged from 0.5 ml to 1 ml. The sample was taken either from the arterial catheter or by a direct puncture. The blood was analyzed by a blood gas analyzer. The venous sample was taken using a central catheter. The amount of blood taken for CVBG analysis was 5 ml out of which, 0.1 ml was carried in a heparinized syringe. This blood was sent for analysis by a blood gas analyzer. Moreover, demographic and clinical data of the patients were collected. Consent of all the patients was taken in written form after informing them about the method and purpose of the research. The data and results were statistically analyzed using IBM SPSS version 26.

3. Results

The current study included patients who presented to the emergency department and CCU of the hospital. The study consisted of 80 patients out of which 52 (65%) were male and 28 (35%) were female. A total of 22 (27.5%) were from the age group 18 years to 30 years. Overall 32 (40%) patients were from the age group 31 years to 60 years. The remaining 26 (32.5%) patients were from the age group 61 years to 90 years. A total of 14 (17.5%) patients had been diagnosed to have renal disorders. Overall 18 (22.5%) had metabolic disorders, 4 (5%) patients had pulmonary disorders, 8 (10%) had cardiovascular diseases, 4 (5%) had hepatic disorders, 20 (25%) were cases of poisoning and 12 (15%) had sustained stings.

The analysis of pCO₂, pH, K⁺, and BE through CVBG and ABG along with their correlations and significance has been given in Tables 1 and 2.

Table 1. Comparison of mean ABG and CVBG

Values	ABG	CVBG	P value	The mean difference between ABG and CVBG
pH	7.13 ± 0.23	7.05 ± 0.24	0.465	0.12
pCO ₂	39.05 ± 18.8	41.29 ± 19.01	0.853	2.24
K ⁺	4.86 ± 1.23	3.69 ± 1.35	0.580	1.05
B.E	-8.75 ± 7.08	-10.94 ± 7.95	0.725	2.07

Table 2. Correlation between the values of CVBG and ABG

Values	Correlation Coefficient	94% CI	P value
pH	0.93	0.91 to 0.95	<0.0001
pCO ₂	0.95	0.93 to 0.96	<0.0001
K ⁺	-0.15	-0.46 to 1.7	0.331
B.E	0.98	0.92 to 0.93	<0.0001

4. Discussion

For many years, medical researchers are looking for an alternative to arterial sampling due to its complication. An alternative method can reduce these complications and help in maintaining the safety of the patients. The present study was conducted to observe the difference in the values of CVBG and

ABG. This study aims at finding out the differences to conclude if CVBG can be used instead of ABG. The correlation of pH, pCO₂, and BE was found to be significant. However, the values of potassium ions were not significant. The reason behind this difference is arterial and venous blood being used as a sample. There is a great physiological difference between the level of potassium in venous and arterial blood.

Bijapur et al conducted a study in which they included samples of 110 patients to analyze the difference in the values of pH, pCO₂, BE, and potassium levels by taking arterial and venous samples. They intended to compare the values and interpret their results to show that VBG could be considered instead of ABG. Their result and conclusion were similar to the results of the present study. They concluded that the values of pH, pCO₂, and BE were similar. However, the level of electrolytes cannot be relied upon [11].

A similar study was conducted by Yıldızdaş et al. The sample population in their study was pediatric patients. They took arterial, venous, and capillary blood samples and analyzed their blood gases. They concluded that capillary and venous blood can be a good alternative to ABG for the identification of the status of blood gases, however, these samples cannot be relied on for the electrolyte measurement [12].

Treger et al conducted a study to compare venous blood and arterial blood for the identification of differences in the values of ABG and CVBG. The patients taken in the study were the adult population. The results showed that the central and peripheral venous values of pH, bicarbonates, and pCO₂ can replace arterial blood samples [13].

5. Conclusion

The CVBG values of pH, pCO₂ and B.E are a good alternative to values of ABG in critically ill patients. However, potassium level has a major difference in arterial and venous samples. Despite this difference, CVBG is a good alternative to ABG as it does not require puncturing an artery. Other complications of arterial blood sampling can also be avoided.

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