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THE ARTERIAL BLOOD GAS ANALYSIS IN SEPTIC SHOCK PATIENTS

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ABSTRACT

Objective: In this study our main goal is to evaluate the arterial blood gas analysis in septic shock patients. **Method:** This cross-sectional study was carried out at the ICU Department of Jalalabad Ragib Rabeya Medical College Hospital, Sylhet from January 2019 to June 2019. Total 40 patients admitted to the medical intensive care unit (MICU) aged 18 and older who fulfilled the definition of severe sepsis or septic shock were screened for enrollment. The criteria for exclusion were cardiopulmonary arrest, pregnancy, prisoner or other ward of the state, and absence of a central venous catheter. **Results:** During the study, most of the patients used tobacco 60% followed by 36% had CAD, 34% had diabetes mellitus, 21% had peripheral vascular disease, 9% had kidney diseases, 1% had cirrhosis. Intraclass correlation between arterial and venous blood gas measurements among patients with severe sepsis or septic shock where a significant correlation, in each of the three pairs, was found for pH, pCO_2, HCO_3, and BE, with an ICC > 0.85 found. Also, in arterial blood gas mean pH was 7.35 ± 0.09, mean pCO_2 was 39.9 ± 11.2 mm Hg, mean pO_2 was 115 ± 61.0 mmHg, mean Bicarbonate was 21.6 ± 6.4 mmol/L. where as in pVBG, peripheral venous blood gas mean pH was 7.32 ± 0.10, mean pCO_2 was 45.8 ± 12.9 mm Hg, mean pO_2 was 62.0 ± 33.8 mmHg, mean Bicarbonate was 23.0 ± 6.6 mmol/L. and in cVGB, central venous blood gas mean pCO_2 was 45.2 ± 11.1 mm Hg, mean pO_2 was 52.3 ± 20.1 mmHg, mean Bicarbonate was 22.8 ± 6.6 mmol/L, mean pH was 7.31 ± 0.09. **Conclusion:** Adequate correlation and agreement between ABG/pVBG, ABG/cVBG, and pVBG/cVBG comparisons was found only for pH. The current level of evidence does not support the use of venous blood gas sampling in this setting.

KEYWORDS: Blood gas, septic shock, severe sepsis.

INTRODUCTION

Sepsis, in association with multisystem organ failure and shock, may lead to respiratory failure, acute kidney injury, organ dysfunction, metabolic acidosis, and shock; thus, evaluation and management of acid-base status is frequently required.[1-2] Traditionally, acid-base status is assessed with an arterial blood gas (ABG); however, venous blood samples are frequently taken for other reasons. This has prompted some to evaluate whether acid-base status could be assessed using a venous blood gas (VBG).[3] The correlation and agreement between VBG and ABG have been described in prior studies evaluating diabetic ketoacidosis, chronic obstructive pulmonary disease, acute respiratory failure, trauma, and cardiac arrest and in studies with miscellaneous or unknown disorders. As a result of these previous investigations, our institution experienced a progressive increase in the utilization of VBGs.[4] In this study our main goal is to evaluate the arterial blood gas analysis in septic shock patients.

OBJECTIVE

To evaluate the arterial blood gas analysis in septic shock patients.

METHODOLOGY
Study type

This was a cross sectional type of study.

Study period and place

This study was carried out ICU department at Jalalabad Ragib Rabeya Medical College Hospital, Sylhet from January 2019 to June 2019.

Study population: A total of 40 patients admitted to the medical intensive care unit (MICU) aged 18 and older who fulfilled the definition of severe sepsis or septic shock were screened for enrollment. The criteria for exclusion were cardiopulmonary arrest, pregnancy, prisoner or other ward of the state, and absence of a central venous catheter.

METHOD
During the study, all patients were collected for medical history after admission, closely and continuously monitored for vital signs and disease condition. Fluid infusion, acid-base balance, and water-electrolyte balance were performed by giving sodium bicarbonate, liquid potassium, and isotonic sodium chloride. Besides, conventional treatments such as intravenous insulin was carried out for reducing blood glucose and ketone bodies.

Data analysis
Statistical analysis was performed using the Statistical package for social science SPSS version 23.0. A descriptive analysis was performed for clinical features and results were presented as mean ± standard deviation for quantitative variables and numbers (percentages) for qualitative variables.

RESULTS
In table-1 shows age distribution of the patients where most of the patients belong to 41-60 years age group, 45.5%. The following table is given below in detail.

Table 1: Age distribution of the patients.

Age	Percent
21-40 years	24.3
41-60 years	45.5
61-80 years	28.5
>80 years	1.9
Total	100.0

In figure-1 shows gender distribution of the patients where 66.5% were male, 33.5% were female. The following figure is given below in detail.
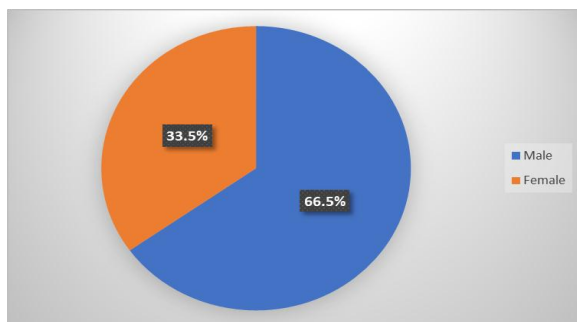

Figure 1: Gender distribution of the patients.

In table-2 shows comorbidities of the patients where most of the patients used tobacco 60% followed by 36% had CAD, 34% had diabetes mellitus, 21% had peripheral vascular disease, 9% had kidney diseases, 1% had cirrhosis. The following table is given below in detail.

Table 3: Comorbidities of the patients.

Comorbidities	%
Tobacco abuse	60%
CAD/CHF	36%
Diabetes mellitus	34%
Peripheral vascular disease	21%
Alcohol abuse	16%
Immunocompromised	13%
Chronic kidney disease	9%
Hepatitis B or C	4%
Cirrhosis	1%
Intravenous drug abuse	1%

In table-3 shows blood gas descriptive statistics of the patients with severe sepsis or septic shock where in arterial blood gas mean pH was 7.35 ± 0.09, mean pCO_2 was 39.9 ± 11.2 mm Hg, mean pO_2 was 115 ± 61.0 mmHg, mean Bicarbonate was 21.6 ± 6.4 mmol/L. where as in pVBG, peripheral venous blood gas mean pH was 7.32 ± 0.10, mean pCO_2 was 45.8 ± 12.9 mm Hg, mean pO_2 was 62.0 ± 33.8 mmHg, mean Bicarbonate was 23.0 ± 6.6 mmol/L. and in cVGB, central venous blood gas mean pCO_2 was 45.2 ± 11.1 mm Hg, mean pO_2 was 52.3 ± 20.1 mmHg, mean Bicarbonate was 22.8 ± 6.6 mmol/L, mean pH was 7.31 ± 0.09. the following table is given below in detail.

Table-3: Blood gas descriptive statistics of the patients with severe sepsis or septic shock.

Variable	ABG	pVBG	cVBG
pH	7.35 ± 0.09	7.32 ± 0.10	7.31 ± 0.09
pCO_2 (mm Hg)	39.9 ± 11.2	45.8 ± 12.9	45.2 ± 11.1
pO_2 (mm Hg)	115 ± 61.0	62.0 ± 33.8	52.3 ± 20.1
Bicarbonate (mmol/L)	21.6 ± 6.4	23.0 ± 6.6	22.8 ± 6.6
Base excess (mmol/L)	-3.5 ± 6.7	-3.0 ± 6.9	-3.3 ± 6.8
Oxygen saturation	95.9 ± 4.0	81.7 ± 15.1	79.5 ± 9.8

Where ABG indicates arterial blood gas; pVBG, peripheral venous blood gas; cVGB, central venous blood gas; pCO_2, partial pressure of carbon dioxide; pO_2, partial pressure of oxygen.

In table-4 shows intraclass correlation between arterial and venous blood gas measurements among patients with severe sepsis or septic shock where a significant correlation, in each of the three pairs, was found for pH, pCO_2, HCO_3, and BE, with an ICC > 0.85. The following table is given below in detail:

Table-4: Intra-class correlation between arterial and venous blood gas measurements among patients with severe sepsis or septic shock.

Variable	ABG and pVBG	ABG and cVBG	pVBG and cVBG
pH	0.90 (<0.0001)	0.97 (<0.0001)	0.93 (<0.0001)
pCO_2 (mm Hg)	0.86 (<0.0001)	0.93 (<0.0001)	0.88 (<0.0001)
pO_2 (mm Hg)	0.34 (00.01)	0.18 (0.15)	0.32 (0.02)
Bicarbonate (mmol/L)	0.95 (<0.0001)	0.96 (<0.0001)	0.97 (<0.0001)
Base excess (mmol/L)	0.97 (<0.0001)	0.97 (<0.0001)	0.98 (<0.0001)
Oxygen saturation	0.01 (0.94)	0.11 (0.38)	0.37 (0.01)

DISCUSSION

The comparison of venous and arterial blood gases in sepsis has not been specifically studied. In the only study that indirectly addresses this population, evaluated agreement between cVBG and ABG in a generalized MICU population, which included sepsis as the primary diagnosis in 72.5%. The remaining etiologies consisted of 11 different diagnoses. Subgroup analysis of the sepsis group was not performed.[5]

Though there are no specific recommendations regarding the assessment of acid-base status in the management of sepsis, the pathophysiology of sepsis may impart the need to make such assessment periodically. Acidosis is a frequent consequence of sepsis, particularly with the development of lactic acidosis as well as respiratory or renal dysfunction. One could argue for the assessment of acid-base status as a routine component of the evaluation and management of sepsis. Our study and the previous literature would not support the use of VBGs in the treatment of sepsis, because patients with sepsis frequently have mixed acid-base disorders. Only being able to reliably use the pH from a VBG would realistically provide no clinically meaningful information in sepsis.[6-8]

The findings during the study for pCO_2, pO_2, HCO_3, BE, and O_2 saturation were not found to have correlation and agreement; it is unknown whether pCO_2 has correlation and agreement in the absence of adequate sample size and a power analysis calculated for this study variable. The protocol design allowed for collection of blood gas samples within a 48-hour window of admission to the MICU. During this window, the source of sepsis had been treated with antibiotics, volume resuscitation, and other modalities that may have altered or corrected the initial acid-base state.

CONCLUSION

Adequate correlation and agreement between ABG/pVBG, ABG/cVBG, and pVBG/cVBG comparisons was found only for pH. The current level of evidence does not support the use of venous blood gas sampling in this setting.

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