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Weather VBG Analysis can Replace ABG Analysis in DKA Patients

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Abstract **Introduction:** Endocrinological emergencies such as DKA are known for hyperglycemia, ketone bodies, and metabolic acidosis in the blood and urine. It rarely occurs in type 2 DM patients. ABG and VBG are biochemical parameters used in its research. **Objective:** To evaluate the efficacy of VBG against ABG in DKA patients. **Methodology:** Details on DM type, duration, antidiabetic drug and insulin usage, and past DKA hospitalizations were collected. A complete blood count, ESR, RFT, electrolyte levels (sodium, potassium, calcium, and phosphate), LFT, RBS, UT, ABG, VBGA, microscopy, chest X-ray, ECG, abdominal and pelvic ultrasound are recommended. **Result and Conclusion:** We discovered that the majority of patients pH levels were in the 7.00â€ 7.25 range in both AB and VB (48.7% and 46.1%, respectively) and that the majority of patients' HCO_3 levels were above 15 in both AB and VB (56.6% and 64.5%, respectively). Thus, we found that VBG analysis parameters were similar to ABG analysis parameters. The blood gas analysis parameters pH and $pHCO_3$ exhibited the strongest linear correlation when comparing arterial and venous samples.

Key Words DKA, VBG analysis, ABG analysis, DM type, Biochemical parameters

1. Introduction

DKA is considered to be one of the most severe acute complications associated with diabetes according to many studies [1]–[3]. Researchers have further classified this condition as an endocrinological emergency and is characterized by elevated blood glucose levels, the presence of ketone bodies (specifically acetone, acetoacetic acid, and β-hydroxybutyric acid), and metabolic acidosis [4]. Studies also concluded that this phenomenon primarily manifests in individuals diagnosed with type 1 DM, whereas rare with Type 2 patients [3].

Furthermore, studies have proved that the utilization of arterial blood gas (ABG) analysis is considered essential in patients who exhibit symptoms suggestive of DKA [5]. Through their studies, researchers also concluded that this tool facilitates the detection and diagnosis of metabolic, respiratory, and mixed acid-base disorders. In DKA, where metabolic acidosis is a prominent characteristic, ABG analysis using pH, pCO_2 level, and HCO_3 level might thus point towards a conclusive diagnosis [3].

Studies have concluded that ABGA is a challenging and painful procedure for patients [6]. Furthermore, according to various past studies, ABGA leads to problems such as hemorrhage, pain, damage or thrombosis of an artery, infection, aneurysm formation, and even loss of function of the limbs, and needle stick injuries are seen in ABGA [7], [8]. Due to these drawbacks, many researchers have tried to look for its alternative, wherein scientists have compared ABG & VBG in a range of patients in ICU with metabolic & respiratory illnesses, uremia & DKA [5], [6].

So, this study was done to see if VBG values are related to and agree well with ABG in patients with DKA and if VBGA can be used instead of ABGA in DKA patients.

They studied ABG and VBG in patients with metabolic, respiratory, uremia, and DKA [5], [6]. So the correlation between ABP and VBP, notably pH, is well known [5], [9], [10]. Not all studies demonstrate a correlation. Numerous studies have studied this link in DKA [5], [9].

Ebenezer A. Nyenwe et al.(2014) performed a retrospective analysis on 396 adult patients with DKA wherein the correlation between ApH and VpH values was studied. Here, 59.0% were males with 36.7 $\pm$ 13.3 years. Hence, they developed an equation to predict arterial pH from venous serum HCO_3levels and concluded that it is a reliable way for estimation [11].

To determine whether VBG analysis can replace ABG

analysis in DKA patients.

2. Methodology

We conducted a cross-sectional observational comparative type of study wherein a total of 76 patients were included with DKA in KHMRC, Karad, starting from November 2017 and ending in May 2019.

Inclusion Criteria

1) Patients with a known type 1/2 DM or newly detected DM
2) Patient age $>$ 18 years
3) RBS$>$250mg/dl
4) Urinary ketone bodies test = positive
5) HCO_3 level $<$ 18 mmol/L
6) pH $<$ 7.35

Exclusion Criteria

1) Patient age $<$ 18 years
2) RBS$<$ 250mg/dl
3) Urinary ketone bodies test = negative
4) HCO_3 level $>$18 mmol/L
5) pH $>$7.35

Procedure

A comprehensive assessment of the patient's medical background was conducted, which included gathering information regarding their dietary habits, appetite, sleep patterns, bowel and bladder habits, as well as any history of alcohol, tobacco, chewing or smoking addiction, drug abuse, and, for female patients, their menstrual and obstetric histories. The patient's medical history was assessed to determine if they had a known case of diabetes mellitus. Specific details were gathered regarding the type of DM 1 or 2, the duration of the condition, the use of antidiabetic drugs or insulin, and any prior admissions related to DKA. Additionally, relevant family history was also recorded. A patient examination was done, and necessary investigations were sent, such as blood and urine tests. The recommended investigations include the following: a complete blood count, erythrocyte sedimentation rate (ESR), renal function test (RFT), electrolyte levels (sodium, potassium, calcium, and phosphate), liver function test (LFT), RBS, urine test for ketone bodies, ABG (0.5 to 1.0mL), VBGA (0.5 to 1.0mL), urine routine, microscopy, chest X-ray, ECG, ultrasound of the abdomen and pelvis. The study incorporated a selection of pertinent parameters by its objectives. The patients diagnosed with DKA received subsequent treatment and management per established guidelines for standard care.

3. Stastistical Analysis

The data entry process was conducted using Microsoft Excel 2016, while the subsequent analysis was performed using SPSS version 21.0, developed by IBM. Descriptive statistics were employed using mean, standard deviation, range, and proportions. In our study, we have also applied linear regression (LR) to analyze the relationship between the dependent variable, the difference in arterial and venous values, and the independent variable, the mean between these variables. The adequacy of the model fit and the relationship between the two variables were assessed by utilizing the value of R2.

4. Result

In Table 1, we found that maximum number of patients were from $>$60 years group with male (22) 28.9% and female (9) 11.8% respectively.

Age categories	Sex		Total
	Male	Female	
<20 years	1(1.3%)	1(1.3%)	2.(2.6%)
21-30 years	3(3.9%)	2(2.6%)	5(6.6%)
31-40 years	4(5.3%)	3(3.9%)	7(9.2%)
41-50 years	11(14.5%)	2(2.6%)	13(17.1%)
51-60 years	12(15.8%)	6(7.9%)	18(23.7%)
>60 years	22(28.9%)	9(11.8%)	31(40.8%)
Total	53(69.7%)	23(30.3%)	76(100.0%)

Table 1: Age & Sex Distribution

In Table 2, we found that, 9 (11.84%) patients had type 1 DM whereas 67 (88.15%) had type 2 . Furthermore, out of 76 patients , 59 (77.60%) were from known case of DM whereas 17 (22.40%) were newly diagnosed case of DM.

In Table 3, we have found that, 35(46.05%) was most common clinical symptoms i.e. abdominal pain which was followed by vomiting and breathlessness with 34 (44.73%) and 19(25%) respectively.

In Table 4 we found that , majority of the patients were in mild group upto 46.1%.

In Table 5 we found that,majority of patients were 46.1% with 351-450 mg/dl.

In Table 6 we found that, the majority of the patients had a pH range between 7.00 -7.25 for both AB & VB i.e., 48.7 % & 46.1%, respectively.

In Table 7 we found the ranges ofpCO_2.

In Table 8 we found that, HCO_3 range was $>$15 in both AB & VB i.e. 56.6% & 64.5% respectively.

5. Discussion and Conclusion

Our study aimed to determine if VBGA could be a suitable alternative to ABGA for DKA patients. The relationship

Type of DM	Known case of DM	Newly Diagones DM	Total
Type 1	5(6.58%)	4(5.26%)	9(11.84%)
Type 2	54(71.05%)	13(17.10%)	67(88.15%)
Total	93(77.6%)	17(22.4%)	76(100.0%)

Table 2: History of DM

Clinical Features	Numbers	percent
Vomiting	34	44.73
Abdominal Pain	35	46.05
Breathlessness	19	25.00

Table 3: Clinical Symptoms

Severity of DKA	Numbers	percent
Mild(pH) 7.25-7.35 and HCO_2 15-18	35	46.1
Moderate (pH 7.00=7.25 and HCO_2 10-15	32	42.1
Severe (ph,7.00 and HCO_2<10	9	11.8
Total	76	100.00

Table 4: Severity of DKA on arterial pH & HCO_3

Random Blood Sugar	Numbers	percent
250-350mg/d1	15	19.7
351-450 mg/d1	35	46.1
>450	26	34.2
Total	76	100.00

Table 5: RBS

between ABP and VBP parameters, particularly pH, has been extensively documented [5], [9], [10]. In our study, we found a significant positive correlation between ApH and VpH (Pearson correlation coefficient, R = 0.83), $ApCO_2$ and $VpCO_2$ (R=0.96), and $AHCO_3$ and $VHCO_3$ (R=0.91). Consistent with our research, Gokel et al. reported a significant increase in the correlation between ApH and VpH values in patients with DKA, with R2 values of 0.989 and 0.995 [5]. In their study on 14 patients with DKA.

So, we here concluded that the parameters of VBGA were comparable with those of ABGA. Among all the parameters of BGA of A and V samples, pH and $pHCO_3$ had an LR.

Conflict of Interest

The authors declare no conflict of interests. All authors read and approved final version of the paper.

Authors Contribution

All authors contributed equally in this paper.

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pH Range	Aterial pH		Venous pH	
	Number	Percent	Number	Percent
<7.00	5	6.6	11	14.5
7.00-7.25	37	48.7	35	46.1
7.25-7.35	34	44.7	30	39.5
Total	76	100.0	76	100.0

Table 6: pH in AB & VB

pH Range	Aterial pCO_2		Venous pCO_2	
	Number	Percent	Number	Percent
<10.00	4	5.3	1	1.3
10.01-15.00	4	5.3	3	3.9
15.01-20.00	14	18.4	11	14.5
20.01-25.00	19	25.0	14	18.4
25.01-30.00	13	17.1	21	27.6
30.01-35.00	9	11.8	8	10.5
>35.00	13	17.1	18	23.7
Total	76	100.0	76	100.0

Table 7: pCO_2 range in AB & VB.

pH Range	Aterial HCO_3		Venous HCO_3	
	Number	Percent	Number	Percent
<10.00	4	5.3	1	1.3
5.0-10.00	8	10.5	5	5.6
10.01-15.00	25	30.9	22	29.9
>15.00	43	58.6	49	64.5
Total	76	100.0	76	100.0

Table 8: HCO_3 range in AB & VB.

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