A Comparison Study Between Venous Blood Gas And Complete Blood Count For The Assessment Of Hemoglobin Levels In Trauma Patients :A Single Center Experience

Yousef M AlSofayan, MD, Mahmoud S AlSomali, MD, Mohammad A Junaidallah, MD, Shamim A Bhat, MD, Parameaswari P Jaganathan, PhD, Faisal Y Almazroua, MD

Abstract

Objectives: To assess whether the hemoglobin level in the point of care VBG could be used as a reliable diagnostic tool instead of the hemoglobin level in CBC in trauma patients.

Methods: This is a Prospective diagnostic observational study enrolling 117 trauma patients presented to the Emergency Department (ED) of King Saud Medical City (KSMC) in Riyadh, Saudi Arabia from the period of April 2016 to November 2017. The data were analysed using statistical package for the social sciences (SPSS) 21.Descriptive statistics, Chi square test , t-test, Pearson coefficient of correlation, kappa measure of agreement and the reliability test were used.

Results : The overall mean Hb level in VBG was 14.6 mg/dL and in CBC was 13.9 mg/dL and there existed a statistically significant high positive correlation with Pearson's "$r = +0.84$" (P=0.000).

Conclusion : There is no statically significant difference between the point of care VBG and conventional CBC in the measurement of Hb Levels in multi trauma patients and so can be used as an alternative diagnostic tool.

JK-Practitioner2018;23(1-2): 25-28

Introduction :

The role of CBC in trauma patients has been rising ,and although the Hb level in CBC is not the only indication for blood transfusion we have been relying on it as one of the tools to transfuse blood products in the trauma patients [1]. The use of blood gas analysis has been described in the early 1900s and was used initially to measure the partial pressure of oxygen and carbon dioxide [2]. Later blood gas analysis machines were capable of performing hemoglobin quantitation and cooximetry, as well as measuring electrolytes like (sodium, potassium, chloride, ionized calcium and magnesium), glucose, lactate, and creatinine levels [2]. The advantages of using the point of care VBG is that it is rapid in releasing the results, easy access, cost effective, and special lab workers are not needed to enter the samples [2,3]. The aim of our study is to assess whether the point of care VBG can be used as a reliable tool instead of the conventional CBC in measuring Hb level in multi-trauma patients.

Methods:

This was a diagnostic prospective observational study of 117 patients with multiple trauma injuries meeting the inclusion criteria in a level 1 trauma center at King Saud medical city (KSMC), Riyadh, Saudi Arabia for the period April 2016 to November 2017.

Inclusion criteria's :

Any patient above the age 18 who presented to the emergency

Author Affiliations:

Yousef M AlSofayan, MD, **Mahmoud S AlSomali**, MD, **Mohammad A Junaidallah**, MD, **Shamim A Bhat**, MD, **Parameaswari P Jaganathan**, PhD, **Faisal Y Almazroua**, MD

Department of Emergency Medicine , King Khaled University Hospital , King Saud University

Correspondence:
Yousef M AlSofayan, MD,
Department of Emergency Medicine , King Khaled University Hospital , King Saud University .
 e-mail : y-alsofayan@hotmail.com
Telephone number : 0114670544 , mobile number : 0555720024

KEY WORDS:
Blood Gas, Complete Blood count, Venous Blood

department with multiple trauma injuries (defined by the involvement of 2 or more systems either clinically or by findings in the images e.g. Computed tomography or X-Ray after the patient role in the study) within 4 hours of the injury.

Exclusion criteria's :

Pregnant women or patients with known hematological diseases such as anemia, thalassemia, sickle cell anemia or patients whom received blood in pre-hospital care or in the emergency department prior to sending the samples (CBC, VBG).

Intervention:

All multi-trauma patients presented to Emergency Department at KSMC underwent blood extractions and then samples were sent to the lab to obtain Hb levels from the CBC.A VBG analyzer machine (radiometer abl800 basic + lactate version) was also used to obtain both Hb levels and lactate levels at the same time. (Considering normal values of Hb in males 13.5 ± 3 and in females 12 ± 2 that will be the acceptable difference between the samples from CBC and VBG). The normal reference range for the lactate levels in VBG is 0.5-2.2mmol/L.

This study was approved by the Institutional Review Board Ref.No.(HRC-15-Sep15-01) and waiver of consent was given.This research adhered to the principles of Helsinki Declaration. The data were analysed using statistical package for the social sciences (SPSS™)[4] version 21.

Results:

The results are presented as descriptive statistics – frequency, range, percentage, mean, median and Inter quartile range (IQR). The parameters were tested for its significance at 5% level for the inferential statistics – Chi square, t-test, Pearson coefficient of correlation, kappa measure of agreement and the reliability test.

CBC Hb value is the gold standard measurement and we tested whether VBG Hb values be considered reliable in par with it in this study for trauma patients.The primary outcome of this study is to assess for any difference in Hb level between CBC and point of care VBG in trauma patients. Secondary Outcomes were difference between CBC and VBG in time taken to release results, Correlation of heart rates and blood pressures with different Hb levels in CBC & VBG (We raised the question whether Hb levels in trauma patients will have normal or abnormal heart rates and blood pressures), and correlation of lactate levels with HB levels in VBG.(We raised the

Table 1. Descriptive Statistics

Variables	Range	Median ±IQR
Age in years	18.0 – 64.0	32.0±11.0
SBP mmHg	65 – 195	126.0±27.5
	30 – 139	75.0±21.5
DBP mmHg	55 – 154	95.0±23.0
	4.9 – 19.7	14.9±2.30
Heart Rate	4.3 – 17.5	14.3±1.80
Hb level in g% – VBG	0:46 – 5:58	0:02±0:01
- CBC	1:21 – 3:35	1:00±0:54
Difference in (Extraction Time & Result Time) in Hours: Minutes	0.7 – 14.5	2.9±1.65
- VBG		
- CBC		
Lactate Level in mmol/L		

question whether lactic acid level a tool measuring hypo-perfusion status will increase in trauma patients and whether its correlated with variable Hb levels).

The study involved 106(90.6) males and 11(9.4) females. Table 1 shows the descriptive statistics for all parameters under study of 117 participants. The distribution of patients according to time of trauma reveals high incidence in the early hours of a day from 0:00 to1:30 hours followed by 14:00 to15:00 hours and 8:30 to 9:50 respectively. The average age was 33.8±1.0 years. We observed the major trauma cases between the age 25-35 years with an average SBP 125.9 ± 1.8mmHg, DBP 75.9 ± 1.6mmHg, Heart rate 96.9 ± 1.7 beats per minute and the lactate level of 3.5 ± 0.2 mmol/L.

In VBG, we observed 83(70.9) patients with normal and 34(29.1) abnormal Hb levels where 5(6.1) were females and 78(93.7) males and in CBC, 103(88.0) normal and 14(12.0) abnormal values where 6(5.8) were females and 97(94.2) males. The mean Hb level in VBG was ranging from 4.9 to 19.7g/dL and that of CBC was 4.3 to 17.5g/dL. The student t-test has confirmed that there was no significant difference in the mean Hb levels of VBG and CBC with t=2.12(P=0.035). The reliability test was performed between Hb level of VBG and CBC and observed Cronbach's alpha = 0.909. The measure of agreement between CBC and VBG was moderate Kappa=0.412(P=0.000).

The overall mean Hb levels in VBG was 14.6 ± 0.23 and that of CBC was 13.9 ± 0.19 and there existed a statistically significant high positive correlation with

Pearson's "r = +0.84" (P=0.000) as provided in Fig 1. The mean average time difference between the extract and result was 0:01 ± 0:03minutes for VBG and that of CBC was 1:06 ± 0:04hours. Fig 2 shows the difference between extraction time and result time of VBG and CBC. The student t-test confirmed that there was statistically insignificant difference in the normal Hb levels between males and females t=2.238(P=0.028) and among the abnormal Hb levels t=4.074(P=0.000).

The association between the Primary parameter Hb levels and the secondary parameters Heart rate, Blood Pressure and Lactate levels revealed a negative weak correlation between normal and abnormal Hb levels with Heart rate, a significant positive weak correlation between Hb levels and SBP, DBP respectively. We observed that among 84 with normal Hb levels in VBG, 77(91.7) had abnormal Lactate levels. Hence, we further concentrated on the correlation between the lactate levels and normal Hb levels (10.0 – 16.5) g% and Fig 3 shows a negative weak Pearson coefficient of correlation r= - 0.093(P=0.394), i.e. even among the normal Hb values we observed a level, which is of clinical significance.

Conclusion:

There is no statistical significant difference between the point of care VBG and conventional CBC in the measurement of Hb level in trauma patients and so can be used as an alternative diagnostic tool. There is a weak negative correlation between Hb levels in CBC&VBG and heart rate, there is also a weak positive correlation between Hb levels in CBC&VBG and blood pressure. Even with normal Hb levels, the lactate levels will be abnormally high which is of clinical significance.

Discussion:

Since the frequency of trauma has been rising, diverse forms of mechanisms have been evolving and is increasing to involve the elderly [5]. The decision to transfuse blood in trauma patients should not only be based on transfusion triggers but should be coupled with adequate knowledge of the clinical symptoms, rate and extent of ongoing blood loss, cardiac function, and the need for operative interventions. The end goal of transfusion is to restore volume and oxygen-carrying capacity. Early use of blood component therapy can help to preserve oxygen delivery and coagulation parameters. However, blood transfusion carries the added risk of transfusion reactions, infections, and several metabolic complications in massive transfusion.[6]
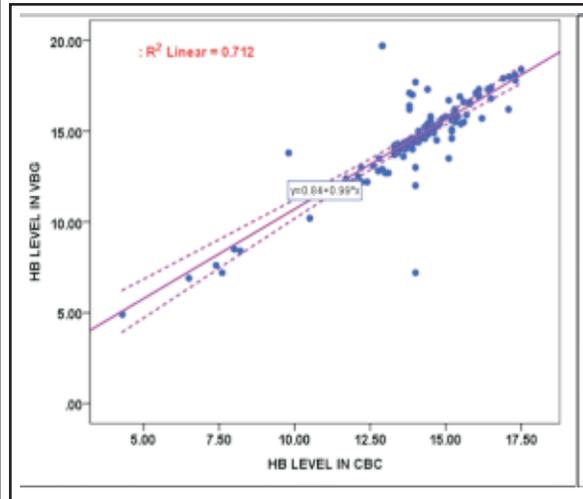
Fig 1. Scatter diagram for Hb level in VBG and CBC

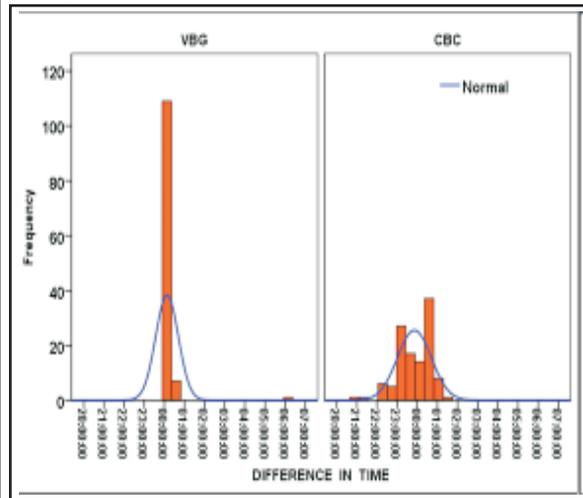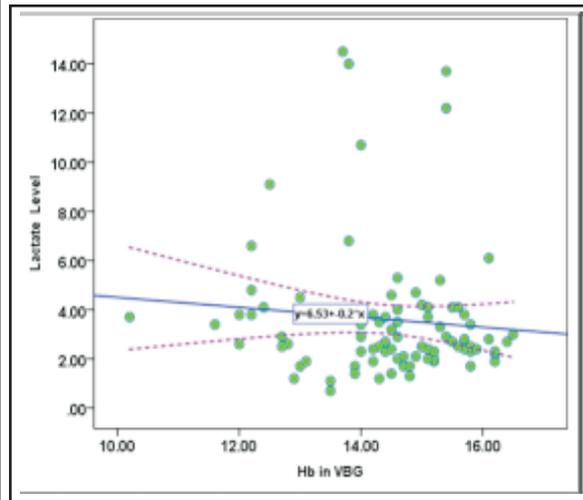**Fig 2. Difference in Time Between Extraction and Result**

Fig 3. Correlation between Normal Hb value in VBG and Lactate Level

It may take time for the Hb levels to start dropping in hemorrhagic shock and so serial measurements are required to detect the need for blood transfusion.[6]

Knowing the advantages of the VBGs over CBCs, these include but are not limited to fast results, easy access, limited quantity of samples required, special lab workers not needed, and lactate levels in the venous blood gas might be used as a reliable alternative diagnostic tool in trauma patients[2,3].

The use of arterial blood gas Arterial blood gas (ABG) has been demonstrated to be the most frequently ordered test in intensive care unit and has become so essential in management of critically ill patients. Although used to evaluate many respiratory and metabolic conditions, ABG analysis is not without drawbacks. The most common complication associated with arterial puncture is local hematoma; very rarely arterial dissection and thrombosis may occur. Venous blood sampling may be a useful alternative to ABG sampling, obviating the need for arterial puncture.[7] In a study, the use of a rapid arterial blood gas (ABG) analyzer to estimate blood hemoglobin concentration among critically ill adults showed similar results to our study though it involved the use of ABG instead of VBG and had a different set of critically ill patients.[8]

This study has several limitations one of which is that it was done in a single level 1 trauma center and the results were dependent on the point of care VBG machine, the samples were collected and sent by an emergency nurse with variable timing of blood extractions, processing of the samples, and printing out results. Some samples were hemolyzed prior to the results a factor that might affect the Hb levels and data interpretation.[9]

This study included a special population (multi-trauma) patients with restricted inclusion criteria and so the results are non-generalizable to all critically ill patients[5,10]. Its well known that Hb levels are not reliable on the initial evaluation of trauma patients and limits transfusion requirement based on the first VBG sample[11]. Lactate a measure of hypo perfusion was studied previously in trauma patient and was correlated with the severity of injuries[12], In this study the VBG lactate levels were used and was not compared to the serum lactate levels to determine the accuracy of the results. further research is recommended to validate the VBG machine used in this study and to test the reliability of different VBG machines and to generalize the population included to involve multi centers.

References :

1. Rossaint R, Bouillon B, Cerny V,et al . The European guideline on management of major bleeding and coagulopathy following trauma: fourth edition.CritCare.2016 Apr;20:100 PubMed

2. Baird G. Preanalytical considerations in blood gas analysis. Baird G. Preanalytical considerations in blood gas analysis. Biochemia Medica.2013;23(1):19-27. PubMed

3. Mohammed H, Abdallah D. Easy blood gas analysis: Implications for nursing. Egyptian Journal of Chest Diseases and Tuberculosis.2016 Jan;65(1):369-376 Science Direct

4. IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp'

5. DiMaggio C. Traumatic Injury in the United States: In-Patient Epidemiology 2000–2011.Injury.2016 Jul;47(7):1393–1403 PubMed

6. Kaur P, Basu S, Kaur R, Transfusion protocol in trauma J Emerg Trauma Shock.2011 Jan-Mar; 4(1):103–108. PubMed

7. Awasthi S, Rani R, Malviya D. Peripheral venous blood gas analysis: An alternative to arterial blood gas analysis for initial assessment and resuscitation in emergency and intensive care unit patients. Anesth Essays Res. 2013 Sep-Dec;7(3): 355–358 Anesth

8. Ray J, Post J, Hamielec C. Use of a rapid arterial blood gas analyzer to estimate blood hemoglobin concentration among critically ill adults.CritCare.2002 Nov;6(1):72–75. pubMed

9. Katzman A, Baumann N. Detecting and Handling Hemolysis Using Serum Indices. Clinical Laboratory News.2016 Mar AACC

10. L.Rivas Chirino, J. da Silva Viana, C.A. Tavares,et al. Use of a Blood Gas Analyzer to Measure Blood Hemoglobin During Liver Transplantation: A Study of 935 Paired Samples. Transplant Proc. 2006 Apr;38(3):810–811 PubMed

11. Sierink J, Joosse P. Does repeat Hb measurement within 2 hours after a normal initial Hb in stable trauma patients add value to trauma evaluation? Int J Emerg Med. 2014 Jul;7:26 PubMed

12. Okello M, Makobore P. Serum lactate as a predictor of early outcomes among trauma patients in Uganda. Int J Emerg. 2014 Jul;7:20. PubMed