Can VBG Replace ABG in ER??

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Abstract

Objective: We investigate the correlation between the components of VBG and ABG among patients in emergency department. Design: Prospective comparison of 74 sets of VBGs and ABGs. Setting: Study conducting in ER Department. Subject: The study examines the authenticity between venous VBG and arterial ABG samples for pH, partial pressure of carbon dioxide, oxygen and bicarbonate. Interventions: No interventions were included in the study. Main Outcome Measures: ABG can be replaced by VBG in majority of cases in ER except few cases of asthma, chronic obstructive pulmonary disease and diabetic ketoacidosis, where the ABG provide the details of all components of ABG. Results: The study involved 74 patients where simultaneous venous and arterial blood samples were obtained (47 males, 27 females) mean age of 54 years and mean time difference was 15.6 minutes. For the pH mean SD of ABG was 7.4 - 0.105, and VBG pH 7.37 - 0.109 shows difference of 0.03 higher for ABG. For Bicarbonate, ABG mean SD Bicarb 20.52 - 5.52 and VBG Bicarb 22.02 - 5.91. Shows difference of 1.5 higher for ABG. For electrolytes e.g. Sodium, Potassium and Chloride no significant difference was noticed. Conclusion: Our findings encourage the use of VBG for metabolic evaluation and monitoring gas exchange, but not for monitoring oxygenation. In most occasions, the blood gases are reciprocal therefore when a venous blood sample is taken; a VBG can be performed simultaneously to limit the burden on patient.

Introduction

According to ICH GCP guidelines E6 (good clinical practice) the main principle is prevention of unnecessary harm to patient[1]. This goal can be achieved by providing best management to the patient by healthcare providers, especially in emergency department to handle the patients rapidly and smoothly because the patients are already in pain.

When there is need to perform ABG’s in ER it becomes more painful for the patients and under cover of (E6 Guidelines) minimize human exposure to investigational products [2]. ABG analysis is the gold standard method for assessment of oxygenation and acid base analysis, yielding productive guidance about a mixed bag of disease process. This study is planned to highlight importance of and feasibility of peripheral venous samples for blood gases and acid base status in emergency department.

ABG analysis is frequently requested for care of patients presenting with metabolic or respiratory abnormalities [3]. Arterial blood gas analysis has an important role in determining acid base balance and blood gaseous status in mechanically ventilated patients. ABG can cause arterial injury, infection, local hematoma, thrombosis with distal digit ischemia, hemorrhage, aneurysm formation and very rarely arterial dissection and thrombosis may occur. Further to this VBG sampling is easier, procedure is less complicated, and sample can be obtained when drawing blood for other laboratory investigations [2].

Several studies have reported outstanding correlation between arterial and peripheral venous blood samples. As abnormal acid base balance is among the best predictor of mortality in critically ill patients, this study...
is aimed to describe that, can VBG replace ABG in ER, to assess if venous sample may be a better alternative for initial assessment and resuscitation. An ABG is the long established practice of estimating the systemic carbon dioxide tension and pH, usually for the purpose of assessing ventilation and acid-base status.

**Subject**

The study is to examine the authenticity between venous VBG and arterial ABG samples for pH, partial pressure of carbon dioxide (pco2), bicarbonate, (HCO$_3$-) in emergency patients.

**Materials and Method**

This prospective study was approved by research committee of Liaquat National Hospital & Medical College, Karachi. Most of the patients admitted in emergency department were suffering from septicemia, poisoning (drug over dosages, ingestion of common suicidal agents), respiratory discomfort, congestive cardiac failure, diabetic keto acidosis, and renal failure and seizure disorders.

Arterial and peripheral venous samples were drawn closely in a pre-heparin zed syringe to exclude coagulation. Arterial blood was taken from peripheral easily accessible vein. The results were entered into a specifically designed database and analyzed by SPSS 14 IBM software.

**Results**

The study involved 74 patients where simultaneous venous and arterial blood samples were obtained (47 males, 27 females) mean age of 54 years and mean time difference was 15.6 minutes. For the pH mean-SD of ABG was 7.4 -0.105, and VBG pH 7.37-0.109 shows difference of 0.03 higher for ABG. For pCO$_2$, ABG mean-SD 33.96-14.85, and VBG pCO$_2$ 43.92-51.80 shows 9.96 higher for VBG. For pO$_2$ ABG mean-SD pO$_2$ 98.62-41.27 and VBG pO$_2$ pO$_2$ 53.18-26.64 shows 45.44 lower for VBG.

For Bicarb, ABG mean-SD Bicarb 20.52-5.52 and VBG Bicarb 22.02-5.91. Shows difference of 1.5 higher for ABG. (See Table 1) For Sodium, ABG mean-SD 136.56-14.00, and VBG sodium was 135.85-14.32 shows 0.71 lower sides in VBG. For Potassium, ABG mean-SD 3.63-0.96, and VBG potassium was 3.84-0.99.

For Chloride, ABG mean-SD 103.16-12.39, and VBG chlorides were 103.22-11.85. Clinical diagnosis included respiratory diseases, cardiovascular diseases, renal failure, liver failure, hyperglycemic patients, malignancy, poisonous patients, burns and trauma.

**Table 1: Reference ranges of critical values**

<table>
<thead>
<tr>
<th>Components</th>
<th>ABG</th>
<th>VBG</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td>7.40</td>
<td>7.37</td>
<td>0.03</td>
</tr>
<tr>
<td>pCO$_2$</td>
<td>98.62</td>
<td>53.18</td>
<td>45.44</td>
</tr>
<tr>
<td>pO$_2$</td>
<td>98.62</td>
<td>53.18</td>
<td>45.44</td>
</tr>
<tr>
<td>HCO$_3$</td>
<td>22.52</td>
<td>22.02</td>
<td>0.5</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>95.45</td>
<td>75.43</td>
<td>20.02</td>
</tr>
<tr>
<td>Na$^+$</td>
<td>136.56</td>
<td>135.86</td>
<td>0.71</td>
</tr>
<tr>
<td>K$^+$</td>
<td>3.63</td>
<td>3.84</td>
<td>0.21</td>
</tr>
<tr>
<td>Cl</td>
<td>103.16</td>
<td>103.22</td>
<td>0.06</td>
</tr>
</tbody>
</table>

**Discussion**

There are many reported evidence on agreement between ABG and VBG values [3, 4, 5, 6, 7, 8, 9]. Despite of such researches, the popularity of VBG is low and few studies have even expressed reservations regarding the accuracy of VBG values in patients evaluation [7, 10]. The present study was carried out to determine whether VBG values can replace ABG values (pH, bicarbonate, Pco2, po2, sodium, potassium, chloride) in the initial ED evaluation. We randomly selected 74 patients who were judged to require ABG analysis by treating physician suspecting metabolic derangement [11]. Kelly et al. study on 196 patients with acute respiratory disease 56 (29%) had significant hypercapnia. For pH, a good agreement with venous samples was found, but no sufficient agreement was detected for venous PCO2 to exchange arterial PCO2 in clinical assessment of ventilator function [12].
Rudhikin et al studied 385 trauma patients requiring ABG'S to see if venous pH and calculated base excess (BE) were similar to those values in an ABG. A prior 15 physicians blinded to the study hypothesis set a consensus single threshold of <0.005 pH units and a variant in BE<2 as the greatest accepted difference between an ABG and VBG. The authors acknowledge that these thresholds are purely clinical and are not based on validated outcome measures [13].

Koul et al have compared ABG and VBG analysis to determine whether the latter can be used as an alternative to the former because of easier access, less pain and fewer complications associated with it. The objectives are clinically very relevant. However, the study could have been designed and analyzed to obtain greater information [7].

As review by the authors, in several conditions of metabolic acidosis as well as in acute exacerbation of chronic obstructive pulmonary disease (COPD), ABG and VBG provide similar or predictable results for Ph, PCO2 and HCO3. A venous PCO2 values above 45mmHg detects all cases of significant arterial hypercapnia [11]. In a study by Rang et al. carried out on 218 patients with respiratory and metabolic illness, the mean differences of pH, PCO2 and HCO3 between in arterial and venous samples were: 0.036, 6 mmHg, and 1.5 Meq/L, respectively [14].

Malinoski et al. showed that in mechanically ventilated trauma patients, central venous and arterial PCO2, pH, and base excess values were correlated [15]. In their study, despite of high correlation between arterial and venous blood for Ph, PCO2, and base excess, the 95% limits of agreement were too wide to allow substitution. And objective of our study is that ABG and VBG are clinically interchangeable in initial assessment of critically ill patients of Emergency Department, and conclusion of our study appears agreeable correlation might allow venous sampling to be used for measuring these variables in certain settings such as initial resuscitative measures in critically ill patients and for initial emergency department assessment, preclude the need for arterial sampling. Mean values of our study are shown above.

**Conclusion**

We concluded that there are many situations where VBG could be consider rather than ABG except in most of Asthma and COPD cases where ABG is more appropriate rather than VBG but not in all cases and routine request for ABG should be discouraged.

**Acknowledgment**

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**References**


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