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THE POSSIBILITY OF REPLACING CENTRAL VENOUS BLOOD GASES WITH ARTERIAL BLOOD GASES IN VENTILATED PATIENTS

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ABSTRACT

Introduction: In many ICUs, in order to evaluate acid- base status in patients, central venous catheter blood sample is used instead of arterial blood samples. In some studies replacing venous blood samples with arterial blood sample is considered invalid. The aim of this study is examining the correlation between the amounts of arterial blood samples and amounts of central venous catheter blood samples in patients who are in ICU.
Materials and methods: 60 ventilated patients who had central venous catheter and wanted to give ABG samples, were appointed in this study. After getting their consent, arterial blood samples and central venous catheter blood samples were taken from them. After sending the samples to the lab and gathering data, analyzing them was carried out by SPSS16 software, statistical T-test and Pearson correlation test.
Findings: results showed, all variables related to arterial blood gases and venous blood gases are widely different from each other. Correlation test showed, all variables except PCO2 in arterial blood sample and venous blood sample are correlated.
Conclusion: Although this study showed there is a correlation between arterial blood sample and venous blood sample, because of low level of correlation, replacing it in ventilated patients is not recommended.

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Introduction

Analyzing Arterial Blood Gases is suggested 50 years ago developed by Clark, Stow and coworkers and became available [1]. From that time it is considered as a golden standard in ICU for examining the respiratory system and acid-base status in patients with respiratory and electrolyte abnormalities [2].

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In order to improve oxygenation and prevent hypoxia side effects in patient who are in ICU, automatic ventilation and giving oxygen with high concentration is essential, but both of them have a lot of side effects [3].
In most cases to eliminate hypoxia and improving oxygenation in ventilated patients, oxygen with high concentration should be used. If we use more than 60% high concentrated oxygen for 24-48 hours, we might face some side effects such as: oxygen poisoning, nitrogen leaching and atelectasis, visual impairment and eye damage [4].
Application this diagnostic tool depends on its interpretation. Acid-base disorder can be caused because of some diseases. Sometimes it is so intense that can turn to a life threatening reason. Having a proper understanding from acid-base balance is necessary for every physician, anesthesiologist and personnel [5].
Measuring Arterial Blood Gases by taking samples from radial and femoral artery will gases by taking samples from radial and femoral artery will have some side effects such as: pain, traumatic damage, thrombosis, terminal ischemia, bleeding, transferring contagious infections like AIDS and Hepatitis [6].
Taking arterial samples from auricle as an alternative method was popular from 1960 which taking blood from auricle vessels was recommended. In children because of spasm in femoral artery, it is better to use to use radial and brachial artery for taking samples, also we should use arterial catheter [7].
Using artery to take blood samples is a very important technique but we might try taking samples several times. It might cause some damages to arteries especially radial artery [8].
Recently some studies about replacing VBG with ABG have been conducted. All of them showed a high correlation in PH, bicarbonate and PCO2 considering acid-base disorders [9].
In a study that was conducted with the aim of examining the replacement of VBG (Venous Blood Gases) with Arterial Blood Gases in patients with COPD, results showed that VBG are very similar with Arterial Blood Gases especially in the amount of PCO2 And PH but we can't replace Venous Blood Gases with Arterial Blood Gases in case of COPD patients [10].
The number of Studies about ventilated patents is low, in some of them such as a study conducted by Tavakoli and et al, peripheral venous blood was use instead of arterial blood [11].
In a study conducted by Mahajan et all the population of patients was limited to septic shock patients and some variables like PO2, O2SAT, HCO3 weren't examined. [12].
Most of patients in ICU have central venous catheter. Using central venous catheter for examining central venous pressure, blood tests and analyzing blood gases is needed [13].
There is no study about different indexes in VBG samples and ABG samples in ventilated patients, so the aim of this study was examining the correlation between the amount of ABG samples and VBG samples in intubated patients in ICU and by considering this fact that taking samples from arteries is more dangerous than taking samples from central catheter, we want to find out "if it is possible to replace taking samples from central venous catheter with taking samples from arteries"

Material and Methods

This study is cross-sectional. The research society includes ventilated patients in ICU. Every ventilated patient in ICU with stable hemodynamic was studied considering his age (more than 11 years) and underlying disease.
Among ventilated patients in ICU, samples were taken from arteries (femoral and radial) and central venous catheter simultaneously. In case of using radial artery to take direct blood sample, Allen test should be carried out (in order to evaluate the adequacy of the blood flow to the ulnar artery).
Taken sample was by heparinized syringe. The air in syringe will be evacuated after pulling up arterial blood. The paper, sent to lab along with the sample, must include patient's temperature, the level of hemoglobin and patient's fio2. In taking sample from the artery after pulling out the syringe, the location of the needle must be pressed for 5 minutes to prevent from probable damages. In taking sample from the catheter, at first 5cc of blood should be pulled out from the catheter and be disposed because of the serum in the catheter then the sample should be taken. Samples should be kept in ice bags and must be sent to lab to be tested. Amounts of SaO2, HCO3, PO2, PCO2, PH and BE must be determined by using ABG analyzer device [14].

Results

In this study 60 ventilated patients with age between 61.10±18.65 were present. 36 (59.9%) of them were men and the rest was women. 27 (45%) of them were traumatic patients, 16 (26.6) of them had respiratory problems, 17 (28.4%) of them were suffering from other diseases. Amounts of PH, PCO2, PO2, HCO3, BE, O2sat in ABG samples and VBG samples are summarized in **[table 1]**. Results show except PO2, there is a correlation between these factors in ABG and VBG ($P<0.001$). By using Bland, Altman limits of agreement, the difference between VBG and ABG was acquired. **[table 1]**. 95% limit of agreement for PH shows with this PH in VBG we can be sure that PH in ABG is less than 0.13 and more than 0.17 in comparison with PH in VBG.

Table 1: ABG samples and VBG samples are summarized

R-value	Limit of Agreement 95%	Difference in VBG and ABG amounts (Mean ± SD)	VBG (Mean ± SD)	ABG (Mean ± SD)	Blood Gases index

0/78	-0/12	0/17	0/07±0/02	0/12±7/38	0/11±7/4	PH
0/49	-27/5	18/8	11/94±-4/14	10/44±43/16	12/98±39/01	PCO2
0/79	-11/33	7/52	4/64±-1/69	7/2±24/49	7/2±24/49	HCO3
0/49	-6/94	11/67	24/95±14/52	26/94±77/58	26/94±77/58	O2 saturation
0/87	-9/77	6/83	4/2±-1/26	7/74±1/57	8/13±0/3	Base Excess

Discussion

The current study was conducted with the aim of comparing Venous Blood Gases indexes with Arterial Blood Gases indexes in ventilated patients. The results of statistical analyze showed, there is a high correlation between Venous Blood Gases and Arterial Blood Gases especially in BE, HCO3 and PH.

The correlation between Venous Blood Gases and Arterial Blood Gases especially in BE was more than other factors and about O2sat was less than others.

However, by considered acquired limit of agreement, replacing VBG sample with ABG sample in ventilated patients in ICU is not recommended.

Some studies has been conducted about this issue such as study conducted by Razi et al. This study was conducted on 102 ventilated patients and results showed that there is a high correlation between VBG and ABG in amounts of PH, PCO2, HCO3, BE and also the correlation between PO2 and O2sat was low. However researchers don't recommend using VBG samples instead of ABG samples in ventilated patients [15].

In a study conducted by AK et al in turkey, on patients who were suffering from intense COPD, the correlation coefficient between VBG and ABG in amounts of PH, PCO2 and HCO3 was reported more than 0.9 that is similar to the current study [16].

In another study about this topic the correlation coefficient between VBG and ABG in amounts of PH, PCO2, HCO3 and PO2 was reported as 0.91, 0.96, 0.96 and 0.7 [17].

In the investigation carried out by Fabien Lemoël et al on 281 patients who came to emergency, the highest correlation was reported in HCO3 that is similar to the current study [18].

In some studies, it is recommended to use VBG instead of ABG such as a study, conducted by Kelly et al, it is announced Venous pH estimation shows a high degree of correlation and agreement with the arterial value, with acceptably narrow 95% limits of agreement. Venous pH estimation is an acceptable substitute for arterial measurement and may reduce risks of complications both for patients and health care workers [19].

In a study conducted by Sing et al on children hospitalized in ICU, similar to current study, there was a،b high correlation between PH in VBG and ABG .these researchers suggest. It is possible to use VBG instead of ABG [20].

Bloom et al, in their review article mentioned that the agreement between VBG and ABG in amounts of PH and bicarbonate is acceptable but about PCO2 and other variables this arteriovenous agreement is weak [21].

Kelly et al mentioned in their article that most of studies imply that according to PH and HCO3, it is possible to use VBG instead of ABG but about PCO2 this is not very likely or about BE it is very vague [22].

In patients who are not dependent to ventilator, according to studies, it is possible to use VBG instead of ABG, but in ventilated patients in ICU, by considering the results, it is not possible to replace ABG sample with VBG sample and we need to use ABG sample. [23]

Conclusion

However, analyzing Venous Blood Gases especially in amounts of BE, HCO3, PCO2 and PH show a significant correlation with ABG, but considering the acquired agreement and low correlation, replacing VBG with ABG in ventilated patients in ICU is not recommended.

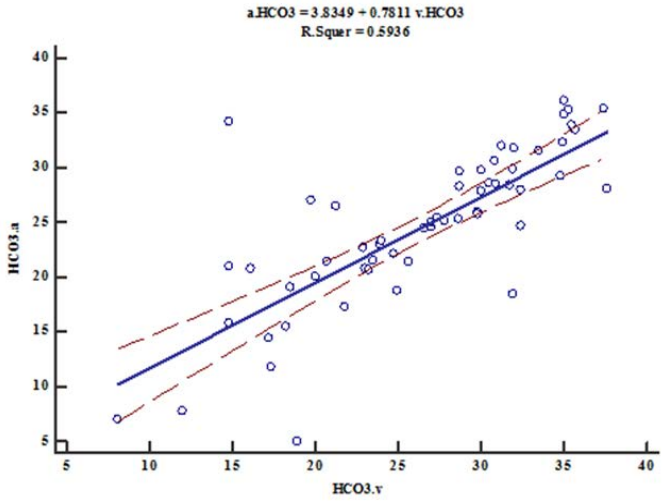

Diagram 1-A: Diagram that show the correlation of HCO3 in ABG and central catheter

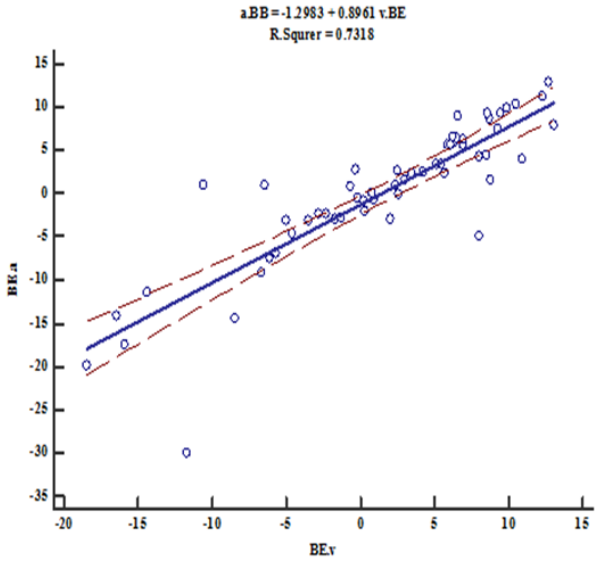

Diagram 1-B: Diagram that show the correlation of BE in ABG and central catheter

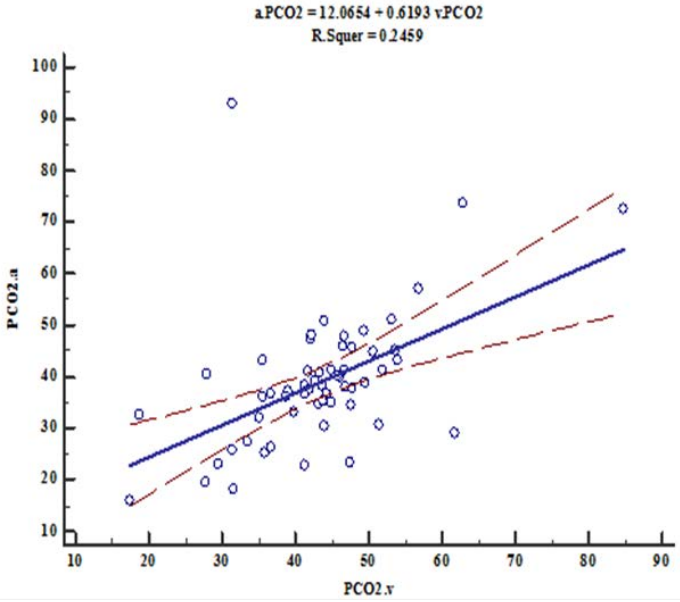

Diagram 1-C: Diagram that show the correlation of PCO2 in ABG and central catheter

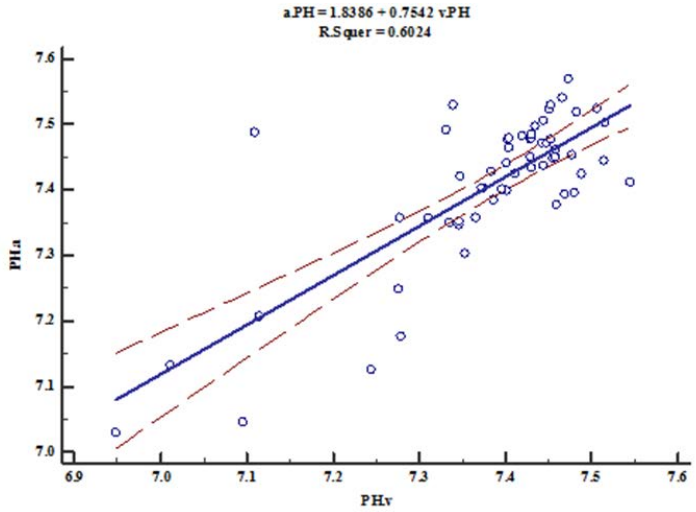

Diagram 1-D: Diagram that show the correlation of PH in ABG and central catheter

Reference:

1. Marik PE. Arterial Blood Gas Analysis. Evidence-Based Critical Care: Springer; 2015. p. 329-47.
2. Boulain T, Garot D, Vignon P, Lascarrou J-B, Benzekri-Lefevre D, Dequin P-F. Predicting arterial blood gas and lactate from central venous blood analysis in critically ill patients: a multicentre, prospective, diagnostic accuracy study. British Journal of Anaesthesia. 2016;117(3):341-9.
3. Baker DJ. The Management of Respiratory Failure: Airway Management and Manual Methods of Artificial Ventilation. Artificial Ventilation: Springer; 2016. p. 77-106.
4. Gopalratnam K, Forde IC, O'Connor JV, Kaufman DA, editors. Less is more in the ICU: resuscitation, oxygenation and routine tests. Seminars in respiratory and critical care medicine; 2016: Thieme Medical Publishers.
5. Rajawat MS, Rathore S, Choudhary M. pH disorders and mortality in surgical intensive care unit patients. International Surgery Journal. 2016;3(2):905-7.
6. Mahto HL, Somanathan N, Deepak B. Effect of Using Different Sizes of Needle along with Cryoanalgesia on Pain Associated with Arterial Blood Gas Sampling: A Prospective Study. Indian Journal of Respiratory Care. 2016;5(1):683-6.
7. Verghese ST, Hannallah RS. 9 Vascular Access in Children. Perioperative Fluid Therapy. 2016:107.
8. Wade RG ,Crawfurd J, Wade D, Holland R. Radial artery blood gas sampling: a randomized controlled trial of lidocaine local anesthesia. Journal of Evidence-Based Medicine. 2015;8(4):185-91.
9. McKeever TM, Hearson G, Housley G, Reynolds C, Kinnear W, Harrison TW ,et al. Using venous blood gas analysis in the assessment of COPD exacerbations: a prospective cohort study. Thorax. 2015:thoraxjnl-2015-207573.
10. Adhikari S, Shrestha S, Srivastava B, KC N, Singh B, Bhattarai M. CORRELATION OF ARTERIAL BLOOD GAS MEASUREMENT WITH PERIPHERAL VENOUS BLOOD GAS VALUES IN ADULTS PATIENTS ADMITTED IN ICU. Journal of Chitwan Medical College. 2015;5(13):11-7.
11. Tavakol K, Ghahramanpoori B, Fararouei M. Prediction of arterial blood pH and partial pressure of carbon dioxide from venous blood samples in patients receiving mechanical ventilation. Journal of medical signals and sensors. 2013;3(3):180.
12. Mahajan RK, Peter JV, John G, Graham PL, Rao SV, Pinsky MR. Patterns of central venous oxygen saturation, lactate and veno-arterial CO2 difference in patients with septic shock. Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine. 2015;19(10):580.
13. Yeung J, Gonzalez M, Lee D, Apergis G, Arancibia R. Confirmation Of Central Line Placement In A Timely Manner Using Blood Gas, Ultrasound Guidance, Central Venous Pressure Versus Portable Chest X-Rays: A Prospective Study On Patients In The Intensive Care Unit. C103 OPTIMIZING LIMITED ICU RESOURCES: Am Thoracic Soc; 2015. p. A5209-A.

14. Gershengorn HB, Garland A, Kramer A, Scales DC, Rubenfeld G, Wunsch H. Variation of arterial and central venous catheter use in United States intensive care units. The Journal of the American Society of Anesthesiologists. 2014;120.64-650:(3)
15. Razi E, Nasiri O, Akbari H, Razi A. Correlation of Arterial Blood Gas Measurements with Venous Blood Gas Values in Mechanically Ventilated Patients. Tanaffos. 2012;11(4):30.
16. Ak A, Ogun CO, Bayir A, Kayis SA, Koylu R. Prediction of arterial blood gas values from venous blood gas values in patients with acute exacerbation of chronic obstructive pulmonary disease. The Tohoku journal of experimental medicine. 2006;210(4):285-90.
17. Mohan N, Karunanithi K. Can Venous Blood Gases Replace Arterial Blood Gases in Diabetic Ketoacidosis/Renal Failure Induced Metabolic Acidosis? Universal Journal of Medical Science. 2015;3(3):65-9.
18. Lemoël F, Govciyan S, El Omri M, Marquette C-H, Levraut J. Improving the validity of peripheral venous blood gas analysis as an estimate of arterial blood gas by correcting the venous values with SvO 2. The Journal of emergency medicine. 2013;44(3):709-16.
19. Kelly A. Agreement between arterial and venous blood gases in emergency medical care: a systematic review .Hong Kong Journal of Emergency Medicine. 2013;20(3):166.
20. Singh NG, Prasad S, Manjunath V, Nagaraja P, Adoni PJ, Gopal D, et al. Evaluation of adjusted central venous blood gases versus arterial blood gases of patients in post-operative paediatric cardiac surgical intensive care unit. Indian journal of anaesthesia. 2015;59(10):630.
21. Bloom BM, Grundlingh J, Bestwick JP, Harris T. The role of venous blood gas in the emergency department: a systematic review and meta-analysis. European Journal of Emergency Medicine. 2014;21(2):81-8.
22. Kelly A-M. Can VBG analysis replace ABG analysis in emergency care? Emergency Medicine Journal. 2014:emermed-2014-204326.
23. Maria Mohammadizadeh, Seyed Hassan Ahmadi, Eghbal Sekhavati*, kobra ahani jegar, Studying Noise Pollution Effect of Flour Factory in Lamerd City on Workers' Hearing, Journal of Medicine and Life *(ISSN:* 1844-3117*)*, Romania. (PubMed.)