ACİL SERVİS VE KAN GAZI ANALİZLERİ

ARTERİYEL Mİ?

VENÖZ MÜ?

TÜRK BİYOKİMYA DERNEĞİ

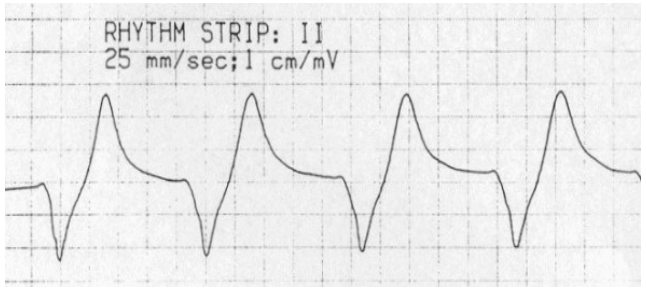
PREANALİTİK EVRE SEMPOZYUMU

17 NİSAN 2019, ANKARA

A C İ L S E R V İ S L E R 7/24

→YENİ GELİŞEN/AKUT KLİNİK TABLOLAR

→KRİTİK HASTALAR



→ İlk müdaheleler/tedaviler

→ Tablonun anlaşılması/bulmacanın çözülmesi

→ Hızlı çözümler/sonuç odaklı çalışma

→YATIRILAMAYAN HASTALAR

→SEVK EDİLEMEYEN HASTALAR

→ Yakın bakım ve takip planı

→ Uygun bakım ve takip kriterlerini/yönlendirici tetkikleri kullanma

Acil Serviste
Kan Gazları Analizi

Ventilasyon, Oksijenizasyon

&

Asit-Baz Durumu

‘ Metabolik Ortam ‘

↓

↓

Takip ve Tedavi Planlaması

Acil Servis

-Dispne

KOAH, PTE, Pnömoni,…

-Mekanik ventilasyon

Noninvaziv, İnvaziv

-Siyanoz

-Senkop?- Konvülziyon?

-Şuur değişiklikleri

-KBY, ABY

-DKA

-Sepsis

-İntoksikasyonlar

Metil alkol, Salisilat….

-Travma

-Diğerleri

Arteriyel Kan Gazı (AKG)

Altın Standart

pH, pCO_2, pO_2, HCO_3,

BE, doku hipoperfüzyonu/laktat

Arteriyel Kan Gazı (AKG)

pH	**7.35 - 7.45**
pO2	**> 80 mmHg**
pCO2	**35 - 45 mmHg**
SO2	**> % 96** (oda havasında)
HCO3	**22 - 28 mol/L**
BE	**(-2) - (+2)**
Laktat	**0.4 - 1.5 mmol/L**

Arteriyel Kan Gazları

Dezavantajları

-Ağrı

-Kanama, hematom

-Psödoanevrizma

-Fistül

-Enfeksiyon

-Sinir yaralanması

Arteriyel Kan Gazları

- **Parmak iskemisi**
- **Personelin yaralanma riski**
- **Bakımda gecikme**
- **Seri numune alımlarında zorluklar**

VENÖZ KAN GAZI (VKG)

Emergency Medicine Journal
2001; 18: 340-342

ORIGINAL ARTICLES

Venous pH can safely replace arterial pH in the initial evaluation of patients in the emergency department

A-M Kelly, R McAlpine, E Kyle

Abstract
***Objective*—This study aims to determine the extent of correlation of arterial and venous pH with a view to identifying whether venous samples can be used as an alternative to arterial values in the clinical management of selected patients in the emergency department.**
***Methods*—This prospective study of patients who were deemed by their treating doctor to require an arterial blood gas analysis to determine their ventilatory or acid-base status, compared pH on an arterial and a venous sample taken as close to simultaneously as possible. Data were analysed using Pearson correlation and bias (Bland-Altman) methods.**
***Results*—Two hundred and forty six patients were entered into the study; 196 with acute respiratory disease and 50 with suspected metabolic derangement. The values of pH on arterial and venous**

risk of transmission of blood borne viruses such as hepatitis C and HIV.

Over the past several decades, a number of small studies have shown that pH can be accurately estimated from venous blood and "arterialised" venous blood.[1-7] It has been reported that venous pH is almost identical to arterial pH.[1 6 7] This is supported by a recent small study of patients with diabetic ketoacidosis that showed that venous blood could be substituted for arterial in the assessment of acidosis.[8] Despite this evidence, arterial blood sampling remains the common method of determining acid-base status. There is no published evidence regarding the accuracy of venous pH measurement in the population of emergency department (ED) patients requiring assessment of their acid-base status.

This study aims to determine the extent of correlation of arterial and venous pH with a view to identifying whether venous samples can be used as an alternative to arterial values

***Conclusion*—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.**

(*Emerg Med J* 2001;18:340–342)

Keywords: venous pH; blood gas analysis

Official Journal of the Asian Pacific Society of Respirology
Respirology

REVIEW

Peripheral venous and arterial blood gas analysis in adults: are they comparable? A systematic review and meta-analysis

ANTHONY L BYRNE,[1] MICHAEL BENNETT,[2,3] ROBINDRO CHATTERJI,[3] REBECCA SYMONS,[3] NATHAN L PACE[4] AND PAUL S THOMAS[1,5]

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ABSTRACT

Peripheral venous blood gas (PVBG) analysis is increasingly being used as a substitute for arterial blood sampling; however, comparability has not been clearly established. To determine if the pH, PCO_2 and PO_2 obtained from PVBG analysis is comparable with arterial blood gas (ABG) analysis. A search was conducted of electronic databases as well as handsearching of journals and reference lists through December 2012 to identify studies comparing PVBG with ABG analysis in adult subjects. A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. A meta-analysis using a random effects model was used to calculate the average difference (bias) and the limits of agreement for the venous and arterial pH, PCO_2 and PO_2. A total of 18 studies comprising 1768 subjects were included in the meta-analysis. There was considerable heterogeneity between studies with I^2 approaching 100%. There was little difference between the pH obtained from the PVBG and the ABG, with the arterial pH typically 0.03 higher than the venous pH (95% confidence interval 0.029–0.038). The venous and arterial PCO_2 were not comparable because the 95% prediction interval of the bias for venous PCO_2 was unacceptably wide, extending from −10.7 mm Hg to +2.4 mm Hg. The PO_2 values compared poorly, the arterial PO_2 typically 36.9 mm Hg greater than the venous with significant variability (95% confidence interval from 27.2 to 46.6 mm Hg). PVBG analysis compares well with ABG analysis for pH estimations in adults but not to the PCO_2 or PO_2. These differences are sufficiently large to be of clinical significance.

Key words: arterial, carbon dioxide, meta-analysis, pH, venous.

Abbreviations: ABG, arterial blood gas; ED, emergency department; LOA, limit of agreement; PVBG, peripheral venous blood gas; SD, standard deviation.

INTRODUCTION

The direct measurement of PO_2, PCO_2 and pH by arterial blood gas analysis (ABG) has long been the reference standard for blood oxygen, carbon dioxide and acidity. In addition, derived values such as HCO_3, base excess, anion gap and the alveolar-arterial gradient are obtained from the ABG. These variables provide important and timely clinical information about a patient's metabolic and respiratory function that is vital for patient diagnosis and treatment. While ABG analysis is rapid and reliable, some argue that an arterial puncture carries a risk of haemorrhage and other vascular complications, is painful, and is no longer necessary for diagnosing respiratory failure because of the widespread use of pulse oximetry for measuring oxygen saturations. For these and other reasons (such as ease of collection), peripheral venous blood gas (PVBG) analysis is increasingly being used as a replacement to the ABG, especially in the emergency department (ED).[1,2]

There are conflicting views concerning the reliability of the PVBG and whether it is sufficiently comparable with the ABG to justify widespread clinical use.[3–5] One would expect the PVBG to have a lower PO_2 and pH but a greater PCO_2 than the ABG; however, it is not clear whether this relationship is either constant or predictable. It is also plausible that disease states affecting venous and arterial flow would result in a greater disparity between the measured variables in the PVBG and ABG. Conditions that affect venous

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REVIEW ARTICLE

EMA

Review article: Can venous blood gas analysis replace arterial in emergency medical care

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Abstract

The objectives of the present review are to describe the agreement between variables on arterial and venous blood gas analysis (in particular pH, pCO_2, bicarbonate and base excess) and to identify unanswered questions. MEDLINE search of papers published from 1966 to January 2010 for studies comparing arterial and peripheral venous blood gas values for any of pH, pCO_2, bicarbonate and base excess in adult patients with any condition in an emergency department setting. The outcome of interest was mean difference weighted for study sample size with 95% limits of agreement. The weighted mean arterio–venous difference in pH was 0.035 pH units (n = 1252), with narrow limits of agreement. The weighted mean arterio–venous difference for pCO_2 was 5.7 mmHg (n = 760), but with 95% limits of agreement up to the order of ±20 mmHg. For bicarbonate, the weighted mean difference between arterial and venous values was −1.41 mmol/L (n = 905), with 95% limits of agreement of the order of ±5 mmol/L. Regarding base excess, the mean arterio–venous difference is 0.089 mmol/L (n = 103). There is insufficient data to determine if these relationships persist in shocked patients or those with mixed acid-base disorders. For patients who are not in shock, venous pH, bicarbonate and base excess have sufficient agreement to be clinically interchangeable for arterial values. Agreement between arterial and venous pCO_2 is too poor and unpredictable to be clinically useful as a one-off test but venous pCO_2 might be useful to screen for arterial hypercarbia or to monitor trends in pCO_2 for selected patients.

Key words: *arterial, blood gas, venous.*

Can VBG analysis replace ABG analysis in emergency care?

Anne-Maree Kelly

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ABSTRACT

Blood gas analysis is an integral part of the assessment of emergency department (ED) patients with acute respiratory or metabolic disease. Traditionally ABG analyses have been used, but increasingly, emergency clinicians are using venous blood gas (VBG) analyses. This has been challenged, especially by respiratory physicians, as being too inaccurate. This clinical review, using case examples, summarises the evidence supporting use of VBG to guide management decisions. Arteriovenous agreement for pH is such that values are clinically interchangeable and agreement for bicarbonate is also close. Agreement for pCO_2 is poor with 95% limits of agreement of the order of 20 mm Hg (2.67 kPa); however, there is solid evidence that a venous $pCO_2 \leq 45$ mm Hg (6 kPa) reliably excludes clinically significant hypercarbia. Evidence regarding arteriovenous agreement for base excess is unclear. Given knowledge of the performance characteristics of VBG analyses, integration of the clinical findings with VBG results is often sufficient to safely guide treatment decision making.

importance. The first is the average (or mean) difference, which is the bias or fixed difference between the tests. Weighted mean difference combines the results of a number of studies by weighting the reported mean differences by sample size.

The other key concept is the 95% limits of agreement. This is a measure looking to identify outliers and is calculated as the average difference ±1.96 SDs of the difference. It tells us how far apart measurements by the two methods were likely to be for most individuals. If the width of the 95% limits of agreement is not clinically important, the two methods can be used interchangeably. For example, the reported weighted mean difference for pH is −0.033 with 95% limits of agreement generally ±0.1. So a venous pH of 7.1 would be estimated to reflect an arterial pH of about 7.13 and have a 95% probability of reflecting an arterial pH of 7.0–7.2.

Clinical decision making

The decision to use a VBG or an ABG in a particular patient will hinge on several factors. These might include the level of experience of the clinician, the clarity of the clinical presentation, the

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Correlation of Venous Blood Gas and Pulse Oximetry With Arterial Blood Gas in the Undifferentiated Critically Ill Patient

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Abstract

Rationale: Blood gas analysis is often used to assess acid–base, ventilation, and oxygenation status in critically ill patients. Although arterial blood gas (ABG) analysis remains the gold standard, venous blood gas (VBG) analysis has been shown to correlate with ABG analysis and has been proposed as a safer less invasive alternative to ABG analysis. **Objective:** The purpose of this study was to evaluate the correlation of VBG analysis plus pulse oximetry (SpO_2) with ABG analysis. **Methods:** We performed a prospective cohort study of patients in the emergency department (ED) and intensive care unit (ICU) at a single academic tertiary referral center. Patients were eligible for enrollment if the treating physician ordered an ABG. Statistical analysis of VBG, SpO_2, and ABG data was done using paired *t* test, Pearson χ^2, and Pearson correlation. **Main Results:** There were 156 patients enrolled, and 129 patients completed the study. Of the patients completing the study, 53 (41.1%) were in the ED, 41 (31.8%) were in the medical ICU, and 35 (27.1%) were in the surgical ICU. The mean difference for pH between VBG and ABG was 0.03 (95% confidence interval: 0.03-0.04) with a Pearson correlation of 0.94. The mean difference for pCO_2 between VBG and ABG was 4.8 mm Hg (95% confidence interval: 3.7-6.0 mm Hg) with a Pearson correlation of 0.93. The SpO_2 correlated well with PaO_2 (the partial pressure of oxygen in arterial blood) as predicted by the standard oxygen–hemoglobin dissociation curve. **Conclusion:** In this population of undifferentiated critically ill patients, pH and pCO_2 on VBG analysis correlated with pH and pCO_2 on ABG analysis. The SpO_2 correlated well with pO_2 on ABG analysis. The combination of VBG analysis plus SpO_2 provided accurate information on acid–base, ventilation, and oxygenation status for undifferentiated critically ill patients in the ED and ICU.

Keywords

blood gas analysis, critical care, oximetry

VKG

VERİLER, SONUÇLAR:

VKG'nın kullanımı artmaktadır (özellikle acil servislerde).

VKG değerleri AKG değerlerinin yerine kullanılabilir.

Değerler arasında yakın korelasyon/uyum mevcut.

ANCAK (!)

VKG

BAZI SINIRLILIKLAR VAR:

Tüm parametrelerde korelasyon ya da uyum mevcut değildir.

Bazı klinik durumlarda kullanılması uygun değil.

Net algoritmalar, kılavuzlar yoktur ancak bazı alışkanlıklar, uygulamalar ortaya çıkmıştır.

pH

Emergency Medicine
Journal
2001; 18: 340-2

2001 … Kelly ve ark.

Acil servise başvuran hastaların (n=246) venöz ve arteriyel kanlarındaki pH değerlerini çalıştılar.

Ortalama fark= 0.04 birim

Uyum: % 95; (-0.11) - (+0.04) birim

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***Methods*—This prospective study of patients who were deemed by their treating doctor to require an arterial blood gas analysis to determine their ventilatory or acid-base status, compared pH on an arterial and a venous sample taken as close to simultaneously as possible. Data were analysed using Pearson correlation and bias (Bland-Altman) methods.**

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risk of transmission of blood borne viruses such as hepatitis C and HIV.

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This study aims to determine the extent of correlation of arterial and venous pH with a view to identifying whether venous samples can be used as an alternative to arterial values

***Conclusion*—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.**

(*Emerg Med J* 2001;18:340–342)

Keywords: venous pH; blood gas analysis

pH

Sonrasında yapılan çalışmalar ……

pH farklılığını 0.03-0.04 buldu.

	Kelly (2001)	McKeeve (2016)	Middleton (2006)	Mccanny (2012)	Byrne (2013)	Kelly (2010)
pH	0.04	0.03	0.03	0.039	0.03	0.035

pH

Diyabetik Ketoasidoz

Arterial Blood Gas Results Rarely Influence Emergency Physician Management of Patients with Suspected Diabetic Ketoacidosis

O. John Ma, MD, Micheal D. Rush, MD, Michelle M. Godfrey, DO, Gary Gaddis, PhD, MD

Abstract

Objectives: To test the hypothesis that arterial blood gas (ABG) results for patients with suspected diabetic ketoacidosis (DKA) do not influence emergency physicians' management decisions and to assess correlation and precision between venous pH and arterial pH. **Methods:** Prospective, observational study of emergency physicians' decision making for consecutive ED patients with suspected DKA. Inclusion criteria were capillary blood glucose equal to or greater than 200 mg/dL, ketonuria, and clinical signs and symptoms of DKA. Venous pH, chemistry panel, and ABGs were drawn before treatment. Attending emergency physicians indicated planned management and disposition on a standardized form before and after reviewing ABG and venous pH results. This study was powered to detect a 10% difference in management decisions (n = 195). Pearson's correlation and Bland-Altman bias plot were used to compare venous pH and arterial pH. **Results:** ABG analysis changed the emergency physicians' diagnosis in 2/200 cases (1.0%; 95% confidence interval [95% CI] = 0.3% to 3.6%), altered treatment in 7/200 cases (3.5%; 95% CI = 1.7% to 7.1%), and changed disposition in 2/200 cases (1.0%; 95% CI = 0.3% to 3.6%). The pH value of the ABGs changed the treatment or disposition in 5/200 patients (2.5%; 95% CI = 1.1% to 5.7%). The Po_2 and Pco_2 results of the ABGs altered treatment and disposition in 2/200 patients (1.0%; 95% CI = 0.3% to 3.6%). Venous pH correlated well with arterial pH (r = 0.951), and bias plotting yielded a bias value of −0.015 (± 0.006 pH units). **Conclusions:** ABG results rarely influenced emergency physicians' decisions on diagnosis, treatment, or disposition in suspected DKA patients. Venous pH correlated well and was precise enough with arterial pH to serve as a substitute. **Key words:** diabetes; diabetic ketoacidosis; arterial blood gas; metabolic acidosis. ACADEMIC EMERGENCY MEDICINE 2003; 10:836–841.

pH

Diyabetik Ketoasidoz

AKG Analizi:

-Tanının değişmesi	(2/200 hasta)	(1.0%; [95% CI] = 0.3% - 3.6%)
-Tedavinin değişmesi	(7/200 hasta)	(3.5%; [95% CI] = 1.7% - 7.1%)
-Sonlanımın değişmesi	(2/200 hasta)	(1.0%; [95% CI] = 0.3% - 3.6%)

AKG'nın pH değeri:

-Tedavi veya sonlanımı değiştirme:	5/200 hasta	(2.5%; [95% CI] =1.1% to 5.7%).

Ma JO, 2003

pH

Diyabetik Ketoasidoz

-DKA'un yönetiminde asidozun takibinde VKG AKG'na tercih edilebilir

-İyi bir korelasyon vardır..

-Ortalama fark (pH): 0.015 birim [95%CI; 0.021 – 0.009 birim]

Ma JO, 2003

pH

- Hastanın O2 durumu ile ilgili bir sorun yoksa, pH VKG ile takip edilebilir.

- pH bazen ani kararlar da verdirebilir:

‘*Hızlı nefes alıp verme*’ ya da ‘*Bulantı-halsizlik-bunalma*’ veya ‘*karın ağrısı*’ olan bir hastada asidozun saptanması, ayırıcı tanı analizini değiştirebilir.

pH

VKG pH Kullanımında Sınırlılıklar:

- Şoktaki hastalar, hipotansif hastalar *

- Mikst asit-baz bozuklukları

** Şokun fizyopatolojisi: dokularda pCO2 ve asiditenin artması ve bu ürünlerin ortamdan alınmasındaki azalmadan dolayı, VKG'da pCO2 ve asidite düzeyi yüksek çıkmaktadır.*

pCO2

American Journal of Emergency Medicine (2012) 30, 896–900

ELSEVIER

The American Journal of Emergency Medicine

www.elsevier.com/locate/ajem

Original Contribution

Venous vs arterial blood gases in the assessment of patients presenting with an exacerbation of chronic obstructive pulmonary disease☆

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Received 23 March 2011; revised 12 June 2011; accepted 15 June 2011

Abstract

Objective: The purpose of this study was to investigate the clinical correlation between arterial and venous blood gas (VBG) values in patients presenting to the emergency department (ED) with acute exacerbation of chronic obstructive pulmonary disease.

Methods: A prospective study of patients with chronic obstructive pulmonary disease presenting to the ED with acute ventilatory compromise was done. Patients were included if their attending physician considered arterial blood gas sampling important in their initial assessment. Data from arterial and venous samples were compared using Spearman correlation and bias plot (Bland-Altman) methods.

Results: Ninety-four patients were enrolled in the study. Eighty-nine patients had complete data sets for analysis. Arterial hypercarbia was present in 30 patients (33.7%; range, 51-140.19 mm Hg). All cases of arterial hypercarbia were detected using VBG sampling when a screening cutoff of 45 mm Hg was applied (sensitivity, 100%; 95% confidence interval, 88.7%-100% and specificity, 34%; 95% confidence interval, 23.1%-46.6%). Bias plot revealed moderate agreement between arterial and venous P_{CO_2} with an average difference of 8.6 mm Hg and 95% limits of agreement of −7.84 to 25.05 mm Hg. For pH, mean difference between each group was 0.039 (range, −0.12 to 0.03). Linear regression analysis for pH demonstrated very close equivalence with a regression coefficient of 0.955, and Spearman correlation showed significant correlation of 0.826 ($P = .001$).

Conclusion: Venous pH and HCO_3 values show excellent correlation with arterial values. Using a previously validated screening cutoff of 45 mm Hg, venous CO_2 has 100% sensitivity in detecting arterial hypercarbia. There is insufficient agreement between venous and arterial CO_2 for VBG to replace arterial blood gas in determining the degree of hypercarbia.

-Normokapnik hastalar :

AKG PCO2 35-45 mmHg ;

VKG PCO2 41-51 mmHg (fark: 6 mmHg)

-Hiperkarbik hastalar:

Ortalama fark: 8.6 mmHg (venöz PCO2 ↑)

Yetersiz uyum: %95 LOA; (-7.84)-(25.05) mmHg

-Hiperkarbinin dışlanması:

VKG PCO2 < 45 mm Hg ise, hiperkarbi dışlanabilir

(***McCanny 2012***)

pCO2

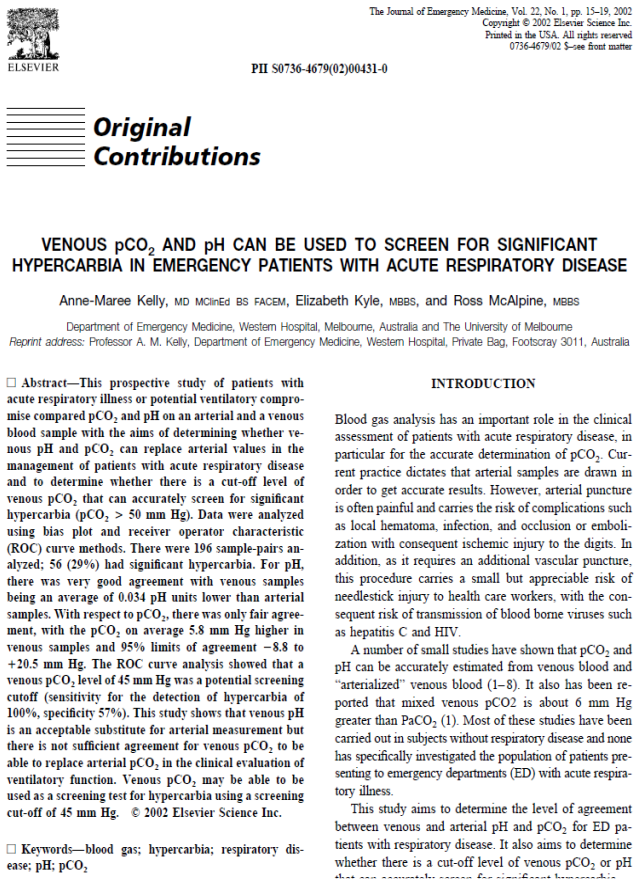
Venöz PCO2 yükseldikçe arteriyel PCO2 ile korelasyon bozulmaktadır.

Kabul edilemeyecek geniş güven aralıkları ortaya çıkmaktadır.

(*Byrne 2014*) (*Kelly 2016*) (*McKeever 2016*) (*Malatesha 2007*)

CO2 retansiyonlu bir hastanın tedaviye yanıtının takibinde PCO2 kullanılamaz.

pCO2



The Journal of Emergency Medicine, Vol. 22, No. 1, pp. 15–19, 2002

0736-4679/02 $–see front matter

ELSEVIER

PII S0736-4679(02)00431-0

Original Contributions

VENOUS pCO_2 AND pH CAN BE USED TO SCREEN FOR SIGNIFICANT HYPERCARBIA IN EMERGENCY PATIENTS WITH ACUTE RESPIRATORY DISEASE

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Department of Emergency Medicine, Western Hospital, Melbourne, Australia and The University of Melbourne

Reprint address: Professor A. M. Kelly, Department of Emergency Medicine, Western Hospital, Private Bag, Footscray 3011, Australia

□ **Abstract—This prospective study of patients with acute respiratory illness or potential ventilatory compromise compared pCO_2 and pH on an arterial and a venous blood sample with the aims of determining whether venous pH and pCO_2 can replace arterial values in the management of patients with acute respiratory disease and to determine whether there is a cut-off level of venous pCO_2 that can accurately screen for significant hypercarbia (pCO_2 > 50 mm Hg). Data were analyzed using bias plot and receiver operator characteristic (ROC) curve methods. There were 196 sample-pairs analyzed; 56 (29%) had significant hypercarbia. For pH, there was very good agreement with venous samples being an average of 0.034 pH units lower than arterial samples. With respect to pCO_2, there was only fair agreement, with the pCO_2 on average 5.8 mm Hg higher in venous samples and 95% limits of agreement −8.8 to +20.5 mm Hg. The ROC curve analysis showed that a venous pCO_2 level of 45 mm Hg was a potential screening cutoff (sensitivity for the detection of hypercarbia of 100%, specificity 57%). This study shows that venous pH is an acceptable substitute for arterial measurement but there is not sufficient agreement for venous pCO_2 to be able to replace arterial pCO_2 in the clinical evaluation of ventilatory function. Venous pCO_2 may be able to be used as a screening test for hypercarbia using a screening cut-off of 45 mm Hg.** © 2002 Elsevier Science Inc.

□ **Keywords—blood gas; hypercarbia; respiratory disease; pH; pCO_2**

INTRODUCTION

Blood gas analysis has an important role in the clinical assessment of patients with acute respiratory disease, in particular for the accurate determination of pCO_2. Current practice dictates that arterial samples are drawn in order to get accurate results. However, arterial puncture is often painful and carries the risk of complications such as local hematoma, infection, and occlusion or embolization with consequent ischemic injury to the digits. In addition, as it requires an additional vascular puncture, this procedure carries a small but appreciable risk of needlestick injury to health care workers, with the consequent risk of transmission of blood borne viruses such as hepatitis C and HIV.

A number of small studies have shown that pCO_2 and pH can be accurately estimated from venous blood and "arterialized" venous blood (1–8). It also has been reported that mixed venous pCO2 is about 6 mm Hg greater than $PaCO_2$ (1). Most of these studies have been carried out in subjects without respiratory disease and none has specifically investigated the population of patients presenting to emergency departments (ED) with acute respiratory illness.

This study aims to determine the level of agreement between venous and arterial pH and pCO_2 for ED patients with respiratory disease. It also aims to determine whether there is a cut-off level of venous pCO_2 or pH

-Hiperkarbinin tahmin edilmesi:

VKG PCO2 > 45 mm Hg, hastada hiperkarbi vardır.

(CO2 retansiyonunu tahmin etmede % 100 sensitivite, % 100 NPV)

-Hiperkarbili bir hastanın tedavisinin takibinde kullanılması PCO2 uygun değildir.

(***Kelly 2002***)

PCO_2

Arteriyel PCO2’nin gerektiği durumlara örnekler:

- Kafa travmalı hasta
- Arest sonrası dönemdeki hasta
- KOAH alevlenmeli hastanın tedaviye (NIMV) yanıtı

HCO3

Can peripheral venous blood gases replace arterial blood gases in emergency department patients?

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ABSTRACT

Objective: To determine if peripheral venous blood gas values for pH, partial pressure of carbon dioxide (Pco_2) and the resultant calculated bicarbonate (HCO_3) predict arterial values accurately enough to replace them in a clinical setting.

Methods: This prospective observational study was performed in a university tertiary care emergency department from June to December 1998. Patients requiring arterial blood gas analysis were enrolled and underwent simultaneous venous blood gas sampling. The following data were prospectively recorded: age, sex, presenting complaint, vital signs, oxygen saturation, sample times, number of attempts and indication for testing. Correlation coefficients and mean differences with 95% confidence intervals (CIs) were calculated for pH, Pco_2, and HCO_3. A survey of 45 academic emergency physicians was performed to determine the minimal clinically important difference for each variable.

Results: The 218 subjects ranged in age from 15 to 90 (mean 60.4) years. The 2 blood samples were drawn within 10 minutes of each other for 205 (96%) of the 214 patients for whom data on timing were available. Pearson's product–moment correlation coefficients between arterial and venous values were as follows: pH, 0.913; Pco_2, 0.921; and HCO_3, 0.953. The mean differences (and 95% CIs) between arterial and venous samples were as follows: pH, 0.036 (0.030–0.042); Pco_2, 6.0 (5.0–7.0) mm Hg; and HCO_3, 1.5 (1.3–1.7) mEq/L. The mean differences (± 2 standard deviations) were greater than the minimum clinically important differences identified in the survey.

Conclusions: Arterial and venous blood gas samples were strongly correlated, and there were only small differences between them. A survey of emergency physicians suggested that the differences are too large to allow for interchangeability of results; however, venous values may be valid if used in conjunction with a correction factor or for trending purposes.

RÉSUMÉ

Objectif : Déterminer si les valeurs des gaz du sang veineux périphérique pour le pH, la pression partielle du gaz carbonique (Pco_2) et la concentration de bicarbonates résultante calculée (HCO_3) permettent de prédire les valeurs artérielles avec suffisamment de précision pour les remplacer dans un contexte clinique.

Méthodes : Cette étude observationnelle prospective fut menée dans un département d'urgence universitaire de soins tertiaires de juin à décembre 1998. Les patients nécessitant une analyse des gaz du sang artériel furent inclus dans l'étude et furent soumis à un échantillonnage simultané des gaz du sang veineux. Les données suivantes furent notées de manière prospective : âge, sexe,

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This article has been peer reviewed.

Ortalama fark = 1.5 mmol/L (VKG-AKG)

[%95 CI] = (1.3 - 1.7) mmol/L

HCO3

	Kelly (2004)	Middleton (2006)	Malatesha (2007)
HCO3 (mmol/L)	1.2	0.52	0.57

LAKTAT

ACADEMIC EMERGENCY MEDICINE JUL 1996 VOL 3/NO 7

Relationship between Arterial and Peripheral Venous Lactate Levels

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48 hasta, periferik kan:

VKG-AKG

Ortalama fark= 0.18 mmol/L

[% 95 CI; -0.372-(0.012)]

Belirgin ↑ venöz laktat seviyesi, arteriyel hiperlaktikasideminin tahmininde % 100 sensitif, % 86 spesifik.

Laktat düzeyleri arttıkça VKG ve AKG değerlerinin arası açılmaktadır.

LAKTAT

ORIGINAL ARTICLE

Agreement between arterial and central venous values for pH, bicarbonate, base excess, and lactate

P Middleton, A-M Kelly, J Brown, M Robertson

Emerg Med J 2006;**23**:622–624. doi: 10.1136/emj.2006.035915

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Accepted for publication 21 April 2006

Objective: This study aimed to determine the extent of agreement between central venous and arterial values for pH, bicarbonate, base excess, and lactate in a group of intensive care unit (ICU) patients.
Methods: A prospective study of a convenience sample of patients deemed by their treating doctor to require blood gas analysis as part of their clinical care in ICU. It compared pH, bicarbonate, base excess and lactate on arterial and central venous samples taken within five minutes of each other. Data were analysed using bias (Bland–Altman) methods.
Results: A total of 168 matched sample pairs from 110 patients were entered into the study. All variables showed close agreement. The mean difference between arterial and venous values of pH was 0.03 pH units, for bicarbonate 0.52 mmol/l, for lactate 0.08 mmol/l, and for base excess 0.19 mmol/l. All showed acceptably narrow 95% limits of agreement.
Conclusion: Central venous pH, bicarbonate, base excess, and lactate values showed a high level of agreement with the respective arterial values, with narrow 95% limits of agreement. These results suggest that venous values may be an acceptable substitute for arterial measurement in this clinical setting.

167 hasta; santral ven

VKG-AKG

Ortalama fark: 0.08 mmol/L

[% 95; -(0.27) - 0.42]

LAKTAT

Determination of the Effect of In Vitro Time, Temperature, and Tourniquet Use on Whole Blood Venous Point-of-care Lactate Concentrations

Alan E. Jones, MD, Matthew M. Leonard, MD, Jackeline Hernandez-Nino, MD, Jeffrey A. Kline, MD

Abstract

Objectives: The authors sought to determine the effect of in vitro time, temperature, and removable tourniquet use on changes in venous point-of-care lactate concentrations.

Methods: This was a prospective randomized trial on healthy volunteers. Subjects were randomized to one of three groups: group 1 had venous lactate concentrations measured on blood drawn without a tourniquet and the sample placed in ice (−1°C), group 2 had lactate concentrations measured on blood drawn without a tourniquet and the sample left at 23°C, and group 3 had lactate concentrations measured on blood drawn with a tourniquet placed 5 minutes before venipuncture and the sample placed in ice (−1°C). Lactate concentrations were measured on a point-of-care device at time 0, 3, 6, 9, 12, and 15 minutes in all three groups. Mean lactate concentrations were analyzed using a two-way repeated-measures analysis of variance.

Results: Eighty subjects were randomized, with complete data available in 63 (21 per group). Over the 15-minute period, lactate concentrations increased 10% (0.14 ± 0.12 mmol/L) in group 1, 25% (0.33 ± 0.003 mmol/L) in group 2, and 6% (0.08 ± 0.22 mmol/L) in group 3. No significant differences in mean lactate concentrations were found between any group or time point by analysis of variance ($p > 0.90$). A 50% relative increase in lactate concentrations between time 0 and 15 minutes occurred in zero of 21 subjects in group 1, four of 21 in group 2, and one of 21 in group 3 ($p = 0.05$ group 1 vs. group 2, Fisher's exact test).

Conclusions: Whole blood point-of-care lactate concentrations in healthy subjects do not change significantly over 15 minutes at either −1°C or 23°C, and the use of a tourniquet has no appreciable effect on lactate concentrations.

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Keywords: lactate, lactic acidosis, whole blood measurement

Group 1 (n=21) **: Turnikesiz.**
Numune buzlu ortama (-1 ^{0}C) **alınıyor.**

Group 2 (n=21) **: Turnikesiz.**
Numune oda ortamına (23 ^{0}C) **alınıyor.**

Group 3 (n=21) **: Turnike kullanılıyor.**
Kan alımından önce -turnikeli- 5 dk bekleniyor.
Numune buzlu ortama (-1 ^{0}C) **alınıyor**.

Yatakbaşı bir cihazla 0, 3, 6, 9, 12 ve 15. dakikalarda laktat değerleri çalışılyor.

LAKTAT

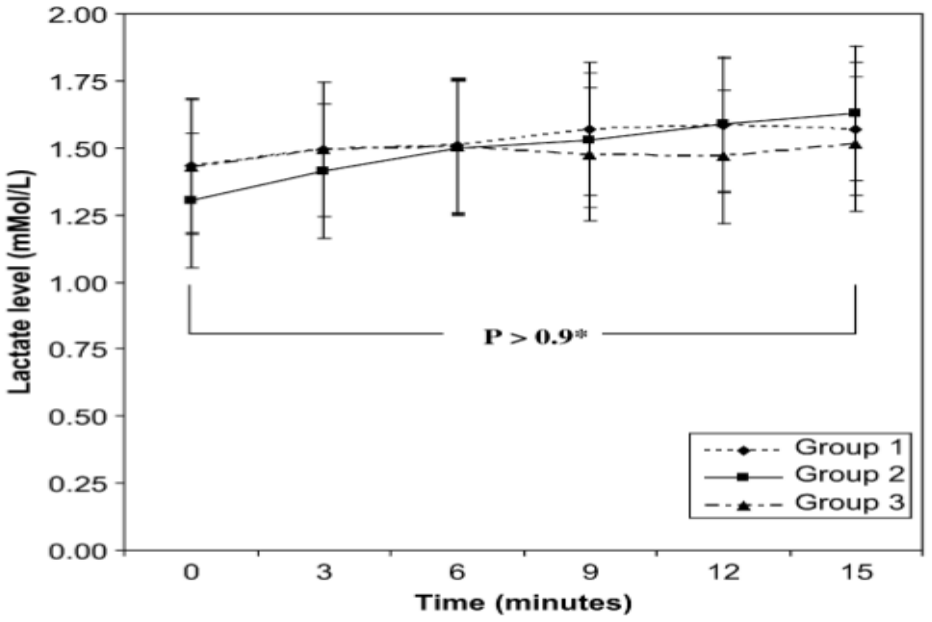


Figure 2. Changes in point of care lactate concentrations in each of the three groups at the six study time points. In group 1, no tourniquet was used and the sample was on ice (−1°C); in group 2, no tourniquet was used and the sample was at room temperature (23°C); in group 3, a removable tourniquet was in place for 5 minutes before venipuncture and the sample was on ice. Differences between means and changes in lactate concentrations both between groups and over time were analyzed with a two-way repeated-measures analysis of variance test with intent to use the time factor p-value to detect within-group changes over time and the group factor p-value to assess for between-group differences. *p-value reported for within-group differences over time and between-group differences. This does not represent the time-group interaction p-value.

15 dk'lık süre boyunca laktat konsantrasyonları ↑ :

Grup 1: % 10 (0.14 +/- 0.12 mmol/L),

Grup 2: % 25 (0.33 +/- 0.003 mmol/L)

Grup 3: % 6 (0.08 +/- 0.22 mmol/L)

Herhangi bir grupta ya da zaman noktasında ortalama konsantrasyonlarda anlamlı fark bulunamadı. (varyans analizi, p>0.90).

0 ve 15. dk arasında konsantrasyonlarda rölatif ↑ tespit edildi:

Grup 1: 0 hasta

Grup 2: 4 hasta

Grup 3: 1 hasta

Baz Fazlalığı (BE)

***Tanım*: Tam oksijenlenmiş kanın, standart şartlar altında** (*37 C'de ve 40 mmHg pCO2'de*) **pH'sının normal değere** (*pH 7.40*) **gelmesi için gereken asit veya baz miktarıdır.**

Metabolik durumu yansıtır.

BE < 3 : metabolik asidoz

BE >+3 : metabolik alkaloz

BE normal değerleri : (-3) – (+3)

BE

POSTER SESSION

Correlation of Central Venous and Arterial Blood Gas Measurements in Mechanically Ventilated Trauma Patients

Darren J. Malinoski, MD; Samuel R. Todd, MD; D. Sue Slone, MD; Richard J. Mullins, MD; Martin A. Schreiber, MD

Hypothesis: Central venous blood gas (VBG) measurements of pH, P_{CO_2}, and base excess can be substituted for the same values obtained from an arterial blood gas (ABG) analysis in mechanically ventilated trauma patients, obviating the need for arterial puncture.

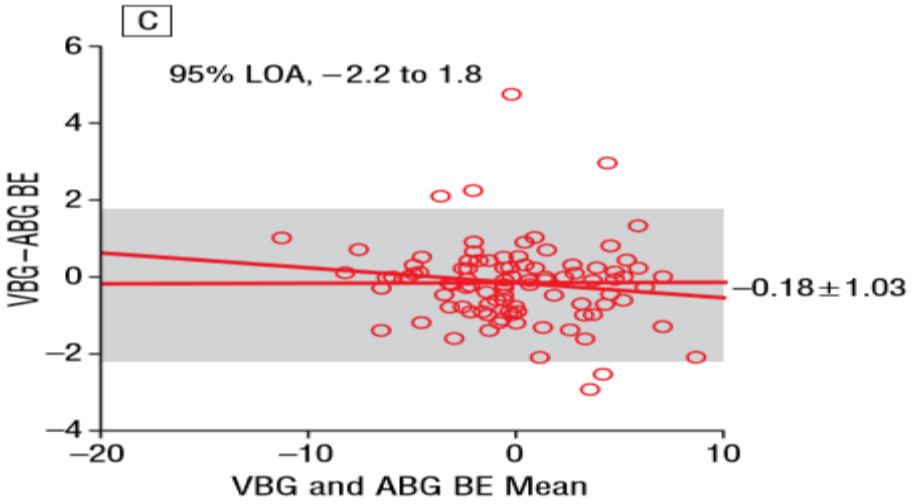
Design and Setting: Prospective comparison of 99 sets of VBGs and ABGs at a level 1 academic trauma center.

Patients: A consecutive sample of 25 trauma patients admitted to the intensive care unit who required mechanical ventilation and had both central venous and arterial catheters.

Main Outcome Measures: Pearson correlations and Bland-Altman limits of agreement (LOAs) for pH, P_{CO_2}, and base excess values from each set of VBGs and ABGs.

pH had $R=0.92$, $P<.001$, and 95% LOAs of −0.09 to 0.03; P_{CO_2}, $R=0.88$, $P<.001$, and 95% LOAs of −2.2 to 10.9; and base excess, $R=0.96$, $P<.001$, and 95% LOAs of −2.2 to 1.8. A receiver operating characteristic curve showed that a central venous P_{CO_2} of 50 mm Hg had 100% sensitivity and 84% specificity for determining significant hypercarbia (arterial $P_{CO_2}>50$ mm Hg).

Conclusions: Central venous and arterial P_{CO_2}, pH, and base excess values correlate well, but their LOAs represent clinically significant ranges that could affect management. Although VBGs cannot be substituted for ABGs in mechanically ventilated trauma patients during the initial phases of resuscitation, clinically reliable conclusions can be reached with VBG analysis.



25 hasta, 99 numune seti

VKG–AKG

Ortalama fark: −0.18 ± 1.03

Uyum : % 95; −2.2 to 1.8

BE

ORIGINAL ARTICLE

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Conclusion: Central venous pH, bicarbonate, base excess, and lactate values showed a high level of agreement with the respective arterial values, with narrow 95% limits of agreement. These results suggest that venous values may be an acceptable substitute for arterial measurement in this clinical setting.

165 hasta, santral ven

VKG-AKG

Ortalama fark: 0.19 mmol/L

[% 95; -(1.86) – 2.24]

PO_2

VKG ve AKG PO_2 değerleri arasında korelasyon yoktur.

(***Malatesha 2007, Byrne 2014***)

Arteriyel PO_2 > Venöz PO_2

Ortalama fark: 36.9 mmHg

[27.2 - 46.6 mmHG ; % 95 CI]

Venöz kanda oksijen değerlendirmesi yapılamaz.

(***Byrne ve ark. 2014***)

PO_2

Review of a Large Clinical Series

Correlation of Venous Blood Gas and Pulse Oximetry With Arterial Blood Gas in the Undifferentiated Critically Ill Patient

Journal of Intensive Care Medicine
2018, Vol. 33(3) 176-181

DOI: 10.1177/0885066616652597
journals.sagepub.com/home/jic
SAGE

Eli Zeserson, MD[1], Ben Goodgame, MD[1], J. Daniel Hess, MD[1], Kristine Schultz, MD[1], Cynthia Hoon, RN[1], Keith Lamb, RRT[2], Vinay Maheshwari, MD[3], Steven Johnson, MD[4], Mia Papas, PhD[5], James Reed, PhD[1], and Michael Breyer, MD[6]

Abstract

Rationale: Blood gas analysis is often used to assess acid–base, ventilation, and oxygenation status in critically ill patients. Although arterial blood gas (ABG) analysis remains the gold standard, venous blood gas (VBG) analysis has been shown to correlate with ABG analysis and has been proposed as a safer less invasive alternative to ABG analysis. **Objective:** The purpose of this study was to evaluate the correlation of VBG analysis plus pulse oximetry (SpO_2) with ABG analysis. **Methods:** We performed a prospective cohort study of patients in the emergency department (ED) and intensive care unit (ICU) at a single academic tertiary referral center. Patients were eligible for enrollment if the treating physician ordered an ABG. Statistical analysis of VBG, SpO_2, and ABG data was done using paired *t* test, Pearson χ^2, and Pearson correlation. **Main Results:** There were 156 patients enrolled, and 129 patients completed the study. Of the patients completing the study, 53 (41.1%) were in the ED, 41 (31.8%) were in the medical ICU, and 35 (27.1%) were in the surgical ICU. The mean difference for pH between VBG and ABG was 0.03 (95% confidence interval: 0.03-0.04) with a Pearson correlation of 0.94. The mean difference for pCO_2 between VBG and ABG was 4.8 mm Hg (95% confidence interval: 3.7-6.0 mm Hg) with a Pearson correlation of 0.93. The SpO_2 correlated well with PaO_2 (the partial pressure of oxygen in arterial blood) as predicted by the standard oxygen–hemoglobin dissociation curve. **Conclusion:** In this population of undifferentiated critically ill patients, pH and pCO_2 on VBG analysis correlated with pH and pCO_2 on ABG analysis. The SpO_2 correlated well with pO_2 on ABG analysis. The combination of VBG analysis plus SpO_2 provided accurate information on acid–base, ventilation, and oxygenation status for undifferentiated critically ill patients in the ED and ICU.

Puls oksimetre yararlı olabilir.

156 hasta (Acil Servis ve Yoğun Bakım)

(AKG) ve (VKG+SpO2) grupları arasında yakın korelasyon..

(VKG + SpO2) AS ve YB hastalarında asit-baz, ventilasyon ve oksijenizasyon durumlarının tespitinde yararlı.

pO2

Puls oksimetrenin (SpO2) yararsız olduğu durumlar:

Periferik perfüzyon bozukluğu

Şiddetli asidoz

Şiddetli hipoksemi

ARDS

VBG'NİN KISITLILIKLARI

ŞOK/HİPOTANSİYON, KALP YETMEZLİĞİ

MİKST ASİT-BAZ BOZUKLUKLARI

HİPERKAPNİ / pCO2 takibi (tedaviye yanıt)

AKG NE ZAMAN GEREKLİDİR ?

Şok, hipotansiyon, kalp yetmezliği

Mikst asit-baz bozuklukları

Hiperkapnide $PaCO_2$'yi net olarak tespit ve takip etmede
(KOAH'ta tedaviye yanıtın takibi)

Kafa travması, arrest sonrası takipler

Hipoksemik hastalarda/mutlak olarak PO_2 takibi gereken hastalarda

pH

SANTRAL VENÖZ PH

pH ≈ 0.03-0.05 birim düşüktür.

PCO2 ≈ 4-5 mmHg yüksektir.

HCO3: Çok az bir yükseklik vardır ya da bir değişiklik yoktur.

PERİFERİK VENÖZ PH

pH ≈ 0.03-0.04 birim düşüktür.

pCO2≈ 3-8 mmHg yüksektir.

HCO3≈ 1-2 mEq/L yüksektir.

https://www.uptodate.com/contents/venous-blood-gases-and-other-alternatives-to-arterial-blood-gases?*(08.04.2019)*

AKG - VKG
REFERANS ARALIKLARI

https://acutecaretesting.org/en/articles/central-venous-blood-gas-analysis (08.04.2019)

	Arteriyel	Venöz	A-V fark
pH	**7.35 - 7.45**	**7.31 - 7.41**	**~ 0.04**
pCO_2 (kPA)	4.7 - 6.0	5.5 - 6.8	~ 0.6
pCO_2 (mmHg)	**35 - 45**	**41 - 51**	**~ 6**
HCO_3^- (mmol/L)	**22 - 28**	**23 - 29**	**~ 1**
pO_2 (kPA)	10.6 - 13.	4.0 -5.3	~ 8.0
pO_2 (mmHg)	**80 - 100**	**30 - 40**	**~ 55**
SO_2 (%)	**> 95**	**75**	**> 20**

Nasıl yorumlanacağı ve sınırlılıkları bilinirse, VKG'ları yararlıdır.

VKG'daki değerlerin AKG'daki karşılıkları tahmin edilir.

Bu tahmini AKG değerlerine göre değerlendirme yapılır.

Örn:
Venöz pH arteriyel pH'ya göre 0.04 birim daha düşüktür.
Venöz pH: 7.27 ≈ Arteriyel pH: 7.31

VKG Nasıl Okunabilir ?

1. Klinik soru(n) nedir ?

Duruma özel soru :

. Akut solunum zorluğu / Hiperkarbi → var-yok ?

. Hiperglisemi → Asidoz ?

. Metabolik asidoz → var-yok ?

. Bilinç değişikliği

. Tedaviye yanıt/takip (hangi parametreye göre) ?

2. pCO2 için ne düşünüyoruz ?

‘*Çok hassas olmasına gerek yoksa*’ → ‘ *ilk, kabaca*’ değerlendirmede VKG tercih edilebilir.

Daha hassas analiz gerekiyorsa → Arteriyel pCO2.

3. Oksijenizasyon gerekiyor mu ?

Pulsoksimetre her olguda güvenilir değildir.

Skleroderma, şok, periferik arter hastalığı……AKG.

Net oksijen……ABG.

4. Hasta şokta mı ? Hipotansiyon, kalp yetmezliği ?

ÖZET

-**AKG**...Altın standart. Ağrılı bir işlem. Nadir de olsa komplikasyonlar olabilir. Sık numune alınması sorun oluşturabilir.

-VKG... Rutin bir kan numunesiyle çalışılabilir, damar yolu açılırken alınan kandan yararlanılabilir. Sınırlılıkları unutulmamalıdır.

-Hem AKG hem VKG'de **pH, HC03** değerleri açısından kayda değer fark yoktur.

-VKG hastaya/klinik görünüme spesifik olan sorulara göre çalışılmalıdır.