Kan Gazları Analizi

Doç.Dr. Eren VURGUN

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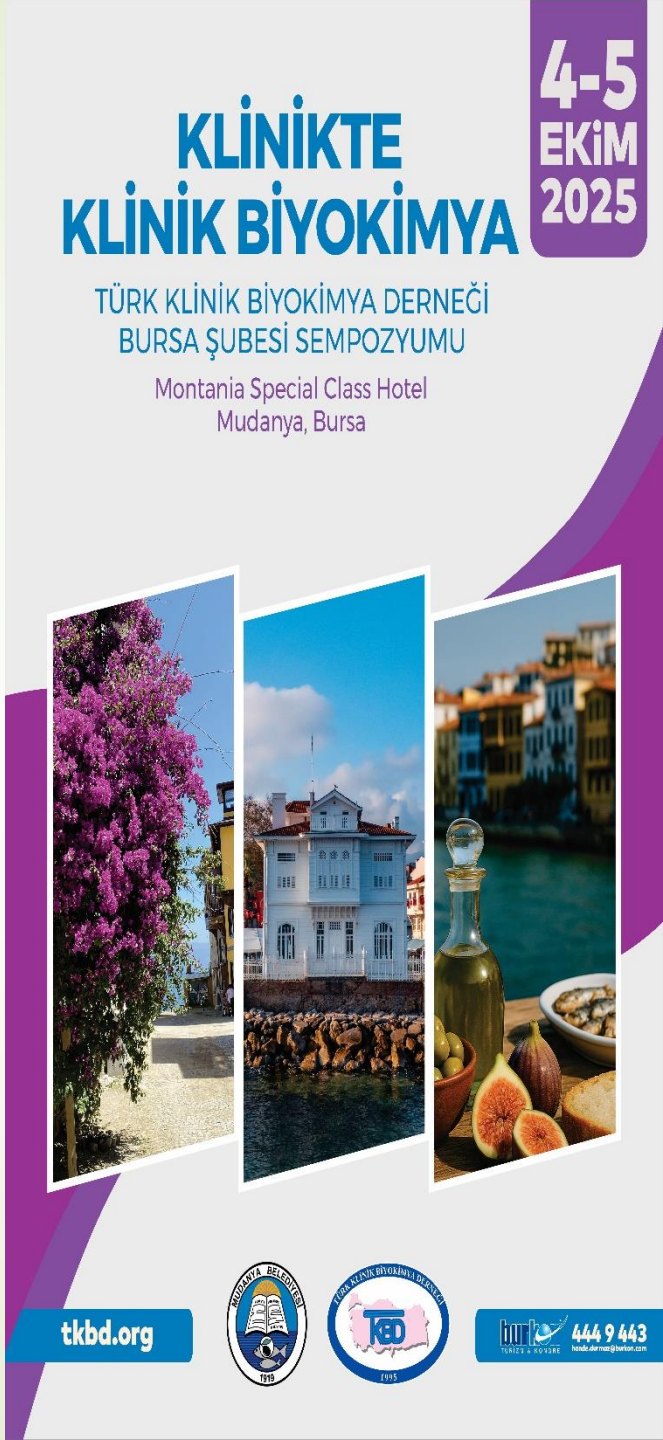
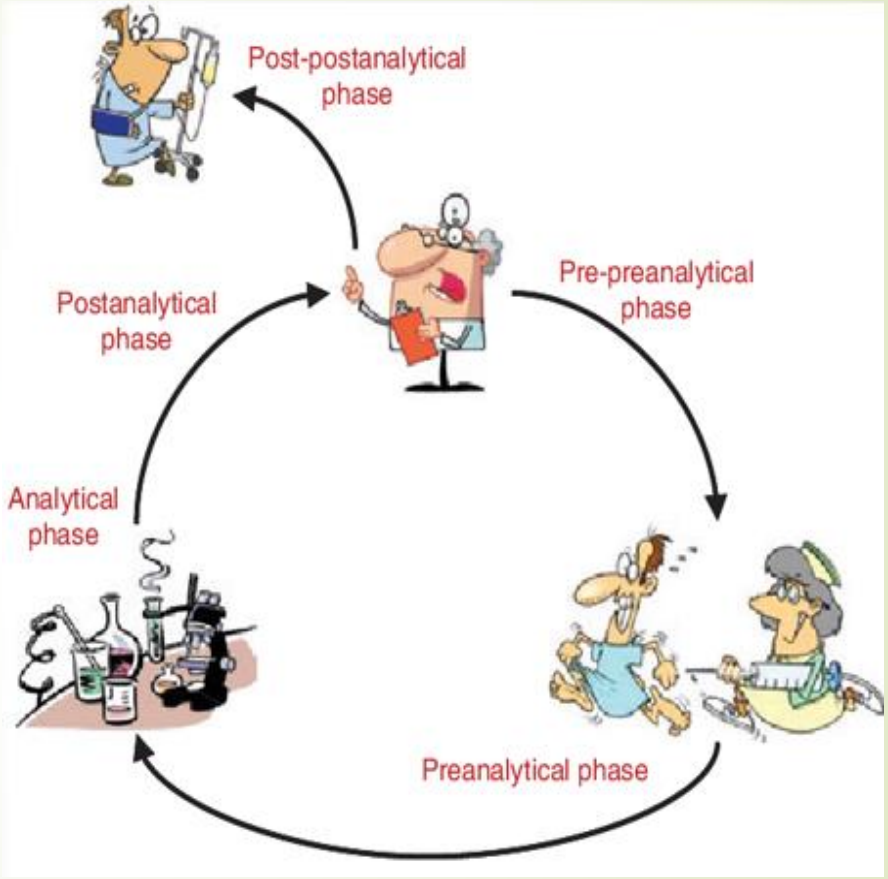
04/10/2025



Sunum İçeriği

- **Pre-preanalitik evre**
  - Uygun test istemi
- **Preanalitik evre**
  - Hata kaynakları
- **Analitik evre**
  - Ölçüm yöntemleri
  - Kalite kontrol
- **Postanalitik evre**
  - Raporlama



- **Post-postanalitik evre**
  - Yorumlama

Kan Gazları Parametreleri ?

- **Kan Gazları**
  - pH ; pO_2 ; pCO_2
  - HCO_3^- (act) ; HCO_3^- (std) ; Baz Fazlalığı (BE) ; p(A-a)O_2 ; **sO_2**
- **Hemoglobin fraksiyonları (Hemoksimetre/Ko-oksimetre)**
  - tHb ; FHHb ; FO_2Hb ; FCOHb ; FMetHb ; **sO_2**
  - ctO_2
- **Elektrolitler**
  - Na^+ ; K^+ ; Cl^- ; Ca^{++} ; Mg^{++}
  - Anyon Açığı (AG)
- **Metabolitler**
  - Glukoz ; Laktat ; Neonatal total bilirubin ; BUN ; Kreatinin

Kullanım Amaçları

- **Ventilasyon**
  - pCO_2

Ko-oksimetre Ø

- **Oksijenizasyon**
  - pO_2 ; $p(A\text{-}a)O_2$; sO_2 ; FO_2Hb ; ctO_2

Ko-oksimetre ?

- **Asit-Baz Dengesi**
  - pH ; HCO_3^- ; Baz Fazlalığı ; pCO_2

Ko-oksimetre Ø

Yöntem Karşılaştırma

Comparison of electrolyte and glucose levels measured by a blood gas analyzer and an automated biochemistry analyzer among hospitalized patients

Huo-Chun Yi[1] | Wen-Sheng Shi[1] | Yin-Hui Zhang[2] | Xiao-Zhen Zhu[1] | Yang Yu[1] | Xin-Xin Wang[1] | Zhang Dai[1] | Yong Lin[1,3]

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https://doi.org/10.1002/jcla.23291

Abstract

Background: Blood gas analyzers are capable of delivering results on electrolytes and metabolites within a few minutes and facilitate clinical decision-making. However, whether the results can be used interchangeably with values measured by chemistry analyzers remains controversial.

Methods: In total, arterial and matched venous blood samples were collected from 200 hospitalized patients. Arterial blood samples were evaluated using a RAPIDPOINT 500 to test electrolyte and glucose levels, then the samples were centrifuged and the same parameters were measured with an AU5800. Venous blood samples were processed and tested in accordance with standard operation procedures. Data were compared by using a paired *t* test, the agreement between the two analyzers was evaluated by using the Bland-Altman test, and sensitivity and specificity were calculated.

Results: Paired *t* tests showed that all parameters tested were significantly different between the two analyzers except chloride. The biases calculated indicated that blood gas analyzers tend to underestimate the parameters, and the linear regression showed a strong correlation between the two analyzers. The sensitivity, specificity and kappa values demonstrated that the diagnostic performance of blood gas analyzers is not satisfactory.

Conclusion: The significant reduction in parameter estimation and diagnostic performance we observed suggested that clinicians should interpret results from blood gas analyzers more cautiously. The reference interval of blood gas analyzers should be adjusted accordingly, given that values are underestimated.

KEYWORDS
agreement, blood gas analyzers, diagnostic performance, electrolytes, glucose

- Özellikle de hiperglisemi/hiperlipidemisi varsa hastanın, sonuçlar daha da farklı çıkacaktır ➡ **Direkt/İndirekt ISE**
  (Sodyum için düzeltilmiş formülü var ise de klor için yok !)
- Özellikle Stewart yöntemi kullanılacaksa çok çok dikkat çünkü **SID = [Na+] – [Cl-]**

(serum/plazma ve kan olarak ikişer sut kodu olmak üzere) ↔ kalsiyum, sodyum, potasyum, laktat, bikarbonat

L103900	Kan gazları	L101670, L101680, L103820, L103830, L103860, L104890, L104900, L106150, L106160, L106910, L106920 ile birlikte faturalandırılmaz. Tüm parametreler dahildir.	51,47
L103910	Kan gazları ve kooksimetre	L101670, L101680, L103820, L103830, L103860, L104890, L104900, L106150, L106160, L106910, L106920 ile birlikte faturalandırılmaz. Tüm parametreler dahildir.	83,76

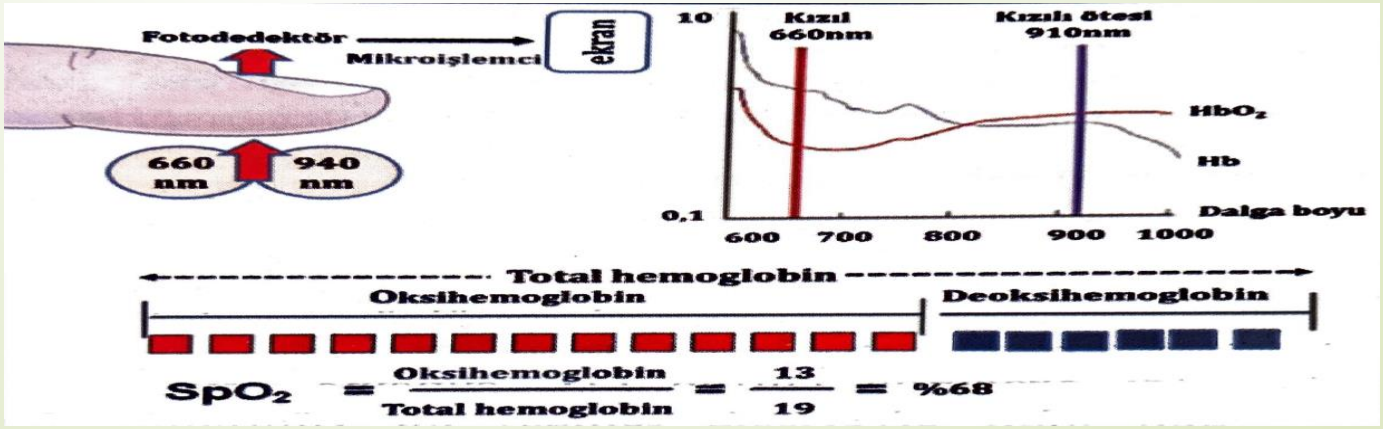
Güncel SUT puanları

İnvaziv Olmayan Yöntemler

Table 1. Non-invasive methods.

Measuring Method	Area of Detection	Measured Parameters	Scope of Application (Selection)	References
Pulse oximetry	Fingertip, earlap, tip of the nose	Oxygen saturation	Evaluation of vital parameters in various settings, esp. respiratory failure	Hafen et al., 2021, ref. [12] Chan et al., 2013, ref. [13]
Capnometry	Endotracheal ventilation tube	Exspiratory pCO_2	Efficiency of CPR, monitoring of intubation, detection of respiratory failure	Nassar et al., 2016, ref. [17] Kupnik et al., 2007, ref. [18]
NIRS (Near Infra-Red Spectroscopy)	Scalp	Brain tissue oxygenation	General surgery, traumatic brain injury (TBI)	Sen et al., 2016, ref. [27] Scheeren et al., 2012, ref. [28]
Bilirubinometry	Skin, mostly forehead/sternum	Subcutaneous bilirubin concentration	Consideration of therapy, continual monitoring	De Luca et al., 2008, ref. [34] Rizvi et al., 2019, ref. [35]

*Bockholt R, et al. Real-Time Monitoring of Blood Parameters in the Intensive Care Unit: State-of-the-Art and Perspectives. J. Clin. Med. 2022, 11, 2408.



Pulse Oksimetre Performansları

Table 3 Accuracy of pulse oximeters in detecting hypoxaemia (prevalence of SaO_2 ≤90% is 5.1%)

Pulse oximeter	TP/FN	FP/TN	Sensitivity	Specificity	PPV	NPV	Accuracy
AFAC FS10D	9/3	46/174	75 (43–95)	79 (73–84)	16 (11–23)	98 (96–99)	79 (73–84)
AGPTEK FS10C	10/2	39/182	83 (52–98)	82 (77–87)	20 (15–27)	99 (96–100)	82 (77–87)
ANAPULSE ANP 100	10/1	79/112	91 (59–100)	59 (51–66)	11 (9–14)	99 (95–100)	60 (53–67)
Cocobear	10/2	63/151	83 (52–98)	71 (64–77)	14 (10–18)	99 (96–100)	71 (65–77)
Contec CMS50D1	7/5	16/200	58 (28–85)	93 (88–96)	30 (18–46)	98 (95–99)	91 (86–94)
HYLOGY MD-H37	11/1	51/169	92 (62–100)	77 (71–82)	18 (14–22)	99 (96–100)	78 (72–83)
Mommed YM101	9/3	31/186	75 (43–95)	86 (80–90)	23 (15–32)	98 (96–99)	85 (80–89)
PRCMISEMED F4 PRO	8/4	39/182	67 (35–90)	82 (77–87)	17 (11–25)	98 (95–99)	82 (76–86)
PULOX-PO-200	9/3	30/189	75 (43–95)	86 (81–91)	23 (16–32)	98 (96–99)	86 (81–90)
Zacurate Pro Series 500 DL	8/2	19/183	80 (44–97)	91 (86–94)	30 (20–42)	99 (96–100)	90 (85–94)

The values for PPV, NPV and accuracy are dependent on disease prevalence.
FN, false negative; FP, false positive; NPV, negative predictive value; PPV, positive predictive value; TN, true negative; TP, true positive.

*Harskamp RE, et al. Performance of popular pulse oximeters compared with simultaneous arterial oxygen saturation or clinical-grade pulse oximetry: a cross-sectional validation study in intensive care patients. *BMJ Open Resp Res* 2021;**8**:e000939.

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CORRESPONDENCE | VOLUME 10, ISSUE 5, E47-E48, MAY 01, 2022

Can we trust the oxygen saturation measured by consumer smartwatches?

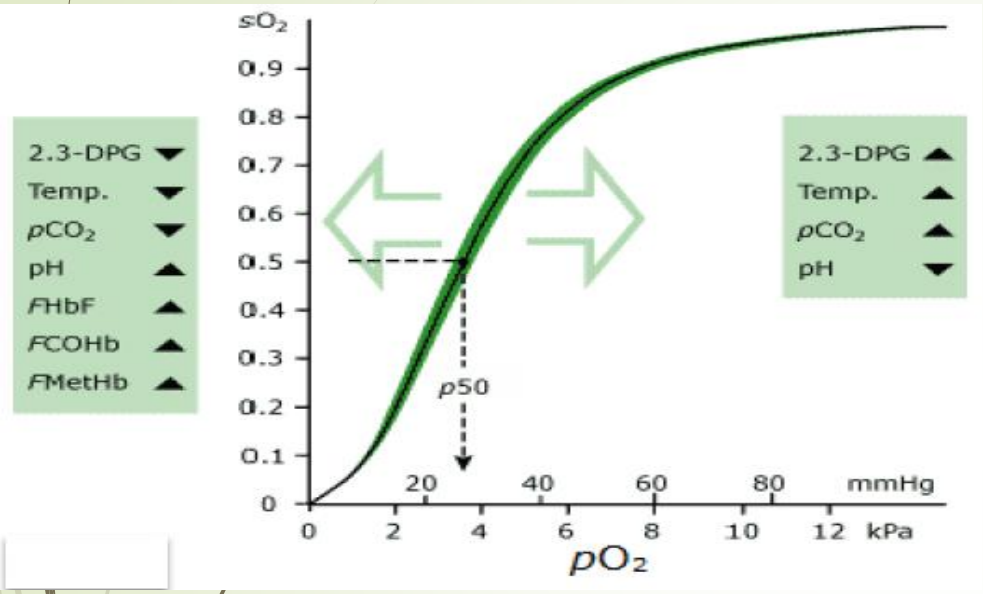
Zhongxing Zhang • Ramin Khatami

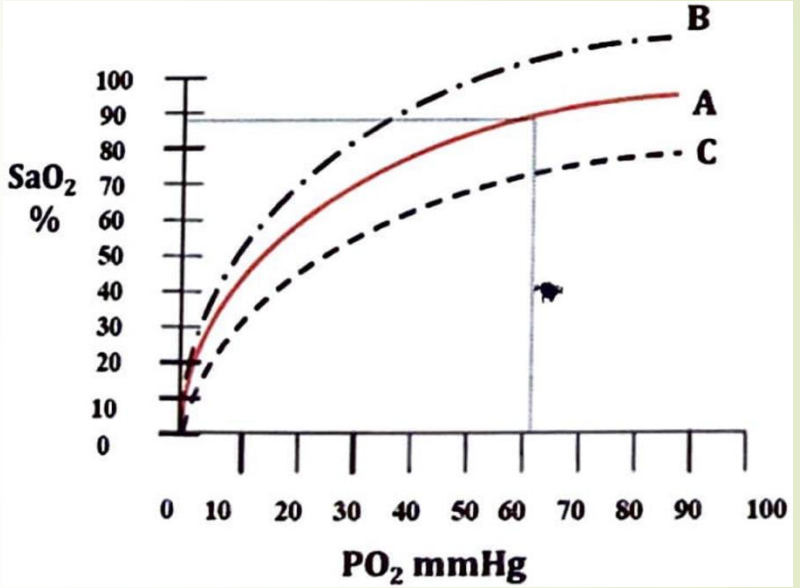
Published: March 28, 2022 • DOI: https://doi.org/10.1016/S2213-2600(22)00103-5

To co-ox or not to co-ox

Robert Chatburn

June 2004





- sO_2 hesaplaması, oksihemoglobin disosiasyon eğrisi üzerinden (pO_2 ölçüldüğü için) elde edilen matematiksel bir formül ile hesaplanmakta.
- Bu yüzden sıcaklık, pCO2 ve pH'dan etkileniyor ancak bunlar da ölçüldüğü için formülde bunlara göre düzeltme uygulanabiliyor.

- $ctHb$ = 10 mmol/L
- $cHHb$ = 0.2 mmol/L
- $cCOHb$ = 3 mmol/L ~ 30 %
- cO_2Hb = 6.8 mmol/L

$$FO_2Hb = \frac{6.8}{6.8+0.2+3.0} \times 100\ \% = 68\ \%$$

$$sO_2 = \frac{6.8}{6.8+0.2} \times 100\ \% = 97\ \%$$

Arteriyel mi Venöz mü ?

Published in final edited form as:
J Intensive Care Med. 2018 March ; 33(3): 176–181. doi:10.1177/0885066616652597.

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

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.

Keywords

blood gas analysis; critical care; oximetry

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ORIGINAL RESEARCH

Can Venous Blood Gas Be Used as an Alternative to Arterial Blood Gas in Intubated Patients at Admission to the Emergency Department? A Retrospective Study

This article was published in the following Dove Press journal:
Open Access Emergency Medicine

Nikola Schütz
Dominik Roth
Michael Schwameis
Martin Röggla
Hans Domanovits

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Open Access Emergency Medicine 2019:11; 305-312

Objective: Blood gas analysis plays an important role in both diagnosis and subsequent treatment of critically ill patients in the emergency department and the ICU. Historically, arterial blood is predominantly used for blood gas analysis. The puncture is painful and complications may occur. The purpose of the present study was to evaluate the agreement between arterial and venous blood gas analysis and whether the sole use of venous blood gas analysis would have changed therapy.

Methods: Adult patients who were intubated in the field and received an arterial and venous blood gas analysis within 15 mins after admission to the ED were eligible for inclusion. The values for pH, pCO_2, HCO_3-, base excess and lactate levels were collected retrospectively. Mean differences were calculated by subtracting venous from arterial values. The agreement between venous and arterial measurements was assessed using the method of Bland and Altman. Blood gases were assessed by two independent physicians using a standardized questionnaire to determine whether the use of venous blood gases would have led to a different interpretation of the situation (other diagnostic path) or a change of therapy (eg. respirator adjustment). Acceptable limits were defined before the collection of data started.

Results: Fifty patients (62% male, median age 63years) who were treated at the Emergency Department between June 1, 2014 and December 31, 2014 were included in the study. Following average differences and limits of agreement (LOA) were documented: pH 0.02312 with LOA from −0.048 to 0.094; pCO_2 −3.612 mmHg with LOA from −15 to 8.1 mmHg; BE −0.154 mmol/l with LOA from −3.7 to 3.4 mmol/l; HCO_3−0.338 mmol/l with LOA from −2.27 to 2.9 mmol/l; Lactate −0.124 mg/dl with LOA from −2.28 to 2.03 mg/dl. Using venous blood gas results 100% of the patients with metabolic alkalosis were correctly diagnosed. Metabolic acidosis was detected with a high sensitivity (80.64%), specificity (89.47%) and positive predictive value (92.59%). The answers to lactate and acidosis due to AKI showed a specificity and positive predictive value of 100%. The respiratory adjustment showed a high sensitivity (91.89%) but a low specificity (38.46%).

Conclusion: For pH, bicarbonate, BE and lactate venous blood gases can be used as surrogates for arterial measurements. Venous pCO_2 can be used for screening of hypercapnia and trending. Respirator adjustments may be done too often if the venous blood gas is used.

Keywords: blood gas analysis, intubation, venous and arterial blood sampling, questionnaire

Arteriyel mi Venöz mü ?

Critical Care and Resuscitation

NARRATIVE REVIEW ARTICLE

Comparing Central Venous Blood Gas to Arterial Blood Gas and Determining Its Utility in Critically Ill Patients: Narrative Review

Woon H. Chong, MD,* Biplab K. Saha, MD,† and Boris I. Medarov, MD*

Arterial blood gas (ABG) analysis is used in critical care units to determine the degree of oxygenation, adequacy of ventilation, and the presence and severity of acid-base disturbances in the body. However, arterial puncture may result in complications, and the difficulty in acquiring arterial blood may delay care. Central venous blood gas (VBG) is a potentially more accessible alternative to ABG sampling. Current evidence suggests that pH and Pco_2 obtained via peripheral VBG correlate well with ABG measurement. Nevertheless, the value of using central VBG to guide clinical decisions or as a surrogate for ABG is unclear. The purpose of this review is to explore the relationship between ABGs and central VBGs in critically ill patients. We performed a MEDLINE search using the following search terms: venous blood gas, arterial blood gas, and central venous blood gas. We excluded studies that did not involve human subjects, and only pH and Pco_2 values were reviewed and examined from the studies included. All cited references from included studies were also reviewed to identify relevant literature. We identified 7 studies that met our criteria. In studies of hemodynamically stable patients, the mean difference between arterial and central venous pH and Pco_2 was 0.03 units and 4–6.5 mm Hg, respectively. However, in patients with circulatory failure, the difference between central venous and arterial pH/Pco_2 was 4-fold greater. We concluded that central VBG parameters of pH and Pco_2 are potentially good surrogates for determining arterial pH and Pco_2 in a stable patient without severe acid-base disturbances. Furthermore, central VBG can be used as a useful screening tool for arterial hypercapnia. In addition, we derived an adjustment formula for ABG conversion from central VBG: (1) arterial pH = venous pH + 0.05 units and (2) arterial Pco_2 = venous Pco_2 – 5 mm Hg. (Anesth Analg 2021;133:374–8)

- **Ventilasyon**
- **Asit-Baz Dengesi**

→ Venöz

- Kardiyak unstabil hasta ?

→ Arteriyel

- **Oksijenizasyon**

Hipoksemi varlığında

→ Ko-oksimetre

- Hipoksemi derinleştikçe
- Dishemoglobin şüphesi

Uygunsuz Kan Gazı İstemi

No access | Critical Care and Resuscitation | Other Journal Article | 01 December 2020

Reducing inappropriate arterial blood gas testing in a level iii intensive care unit: A before-and-after observational study

Authors: Oliver M Walsh; Katelyn Davis; Jonathan Gatward

Abstract

Background: Arterial blood gas (ABG) analysis is the most frequently performed test in intensive care units (ICUs), often without a specific clinical indication. This is costly and contributes to iatrogenic anaemia.

 Objectives: To reduce the number of ABG tests performed and the proportion that are inappropriate.

 Design, setting and participants: The indications for ABG analysis were surveyed at a 58-bed level III ICU during fortnightly periods before and after a multifaceted educational intervention which included the introduction of a clinical guideline. The number of ABG tests performed during the period July-December 2017 was compared with that for the period July-December 2018. Tests were predefined as inappropriate if performed at regular time intervals, at change of shift, concurrently with other blood tests or after a treatment was ceased on a stable patient or after ventilatory support or oxygen delivery was decreased in an otherwise stable patient. The study was enrolled on the Quality Improvement Projects Register and ethics approval was waived by the local ethics committee.

 Results: There was a 31.3% bed-day adjusted decrease in number of ABG tests performed (33 005 v 22 408; P < 0.001), representing an annual saving of A$770 000 and 100 litres of blood. The proportion of inappropriate ABG tests decreased by 47.3% (54.2% v 28.6%; P < 0.001) and the number of inappropriate ABG tests per bed-day decreased by 71% (2.8 v 0.8; P < 0.001). Patient outcomes before and after the intervention did not differ (standardised mortality ratio, 0.65 v 0.63; P = 0.22).

 Conclusion: Staff education and implementation of a clinical guideline resulted in substantial decreases in the number of ABG tests performed and the proportion of inappropriate ABG tests.

ORIGINAL ARTICLE

Clinical Utility of Arterial Blood Gas Test in an Intensive Care Unit: An Observational Study

Jagadish Chandran[1], Carol D'Silva[2], Sampath Sriram[3], Bhuvana Krishna[4]

Abstract

Background: Arterial blood gas (ABG) analysis is a common test ordered in critically ill patients. Often, it is performed very frequently without influencing patient care. Hence, we decided to check the utility of the ABG test in our intensive care unit (ICU).

Materials and methods: The data of the previous day ABGs were captured by reviewing the chart in an online pro forma which was filled by the authors. Data relating to patient's details, who ordered ABGs, reason for ordering ABGs, and did the ABG influence patient's management were entered. A total of 985 ABGs were performed in 173 patients for 2 months which was analyzed.

Results: Out of 985 ABGs, in 259 instances (26.29%), interventions were done after reviewing an ABG. The major interventions among these ABGs were ventilator settings adjustment in 134 ABGs (13.6%). A total of 790 ABGs were done routinely with no specific indication (80.20%), while doctors ordered one following an event for 195 ABGs (19.80%).

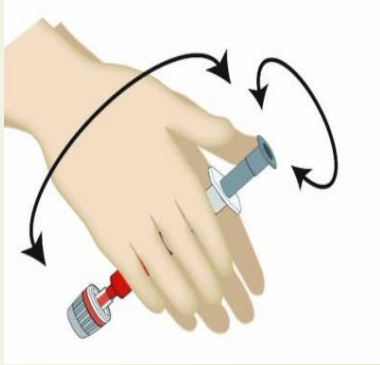
Conclusion: Our data suggest that 80% of ABG tests were ordered as part of a routine test.

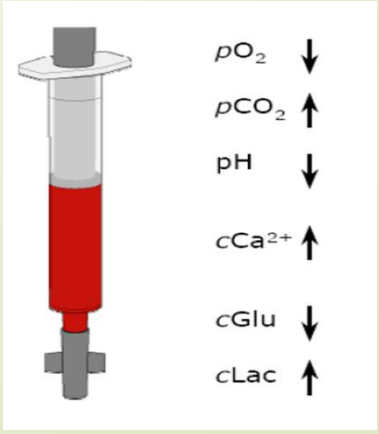
Keywords: Arterial blood gas, Arterial cannula, Clinical utility.

Indian Journal of Critical Care Medicine (2021): 10.5005/jp-journals-10071-23719

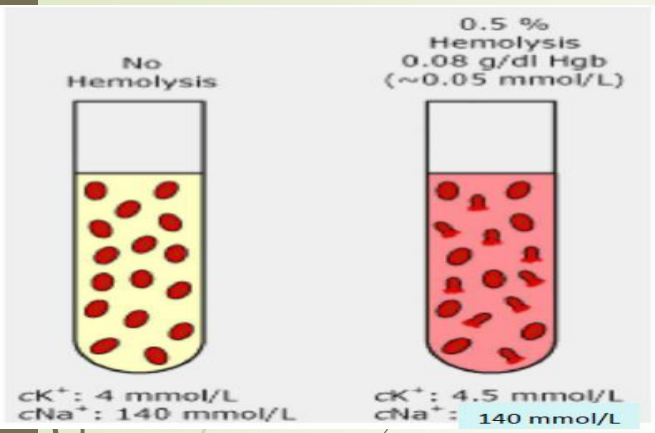
Preanalitik Evre Hata Kaynakları

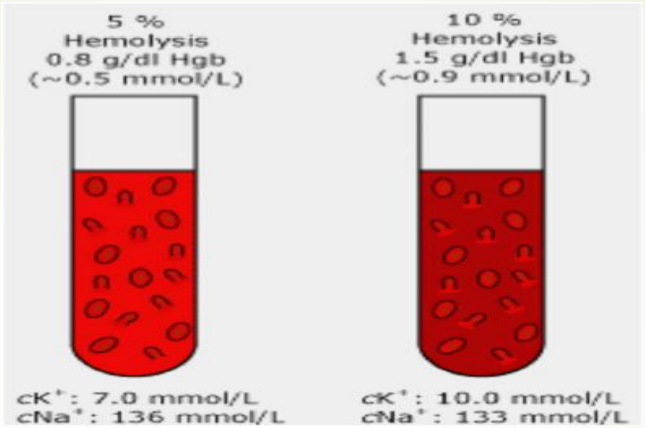
- Hasta ve numunenin doğru tanımlanmaması
- Kararlı durumun beklenmemesi
- Kataterden kontaminasyon
- Sıvı heparin kullanımı
- Hava kabarcığı kontaminasyonu
- Transport/saklama koşulları
- Pnömotik sistem
- Pıhtılı numune
- Analiz öncesi örneğin karıştırılmaması
- Kan alınması sonrasında devam eden metabolizma
- Anormal hücre sayıları (yüksek WBC/RBC/PLT)





Preanalitik Evre Hemoliz ?





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Why hemolysis detection should be an integral part of any near-patient blood gas analysis

Martin Möckel and Peter B. Luppa

From the journal Journal of Laboratory Medicine
https://doi.org/10.1515/labmed-2021-0076

Cite this

Abstract

Blood gas analysis at or near the patient's bedside is a common practice in acute medicine and plays a crucial role in the diagnosis and management of patient's respiratory status, metabolites, electrolytes, co-oximetry and acid–base balance. Pre-analytical quality aspects of the specimens are getting more and more attention, including the presence of potential interferences. Central laboratories have implemented technologies to detect interferences such as hemolysis, lipidemia or hyperbilirubinemia in blood samples to ensure the highest possible quality in results provided to routine care. However, systematic detection for interference due to hemolysis is currently not in place for blood gas analysis at the point-of-care (POC). To apply hemolysis detection solutions at the central laboratory, but not at the POC for blood gas analysis, is a clear contradiction when novel hemolysis detecting technologies are available. The introduction of a system that systematically detects hemolysis in connection to POC blood gas analysis would be imperative to patient safety and costs associated with potential clinical malpractice (leading to wrong, missing and/or delayed treatment) and would also ensure better compliance to CLSI guidelines and ISO standards, and be beneficial for patient and staff.

Keywords: blood gas analysis; hemolysis; patient safety; point-of-care (POC); pre-analytical errors

Preanalitik Evre Stabilite

Table 2. Evaluation of sample storage temperature (25, 4–8, and 0–3.9°C) and duration of biological parameter stability (in minutes) in all samples (overall group–main study)

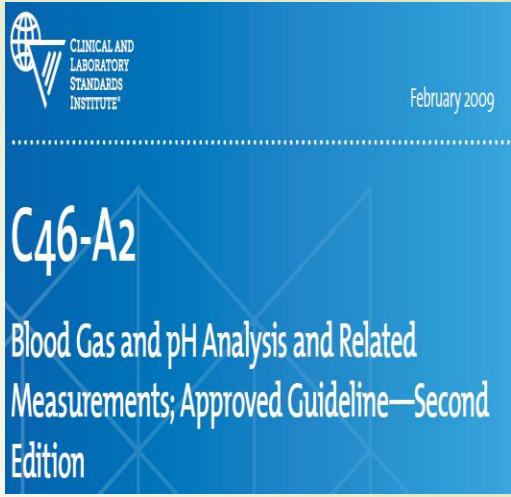
	N	Temperature (°C)	Time (min)	PD (95% CI) (%)*	S (%)†
pH	92	25	30	**-0.090 (-0.114; -0.066)**	0.099
	97	4–8	≤60	**-0.003 (-0.028; 0.022)**	
	89	0–3.9	≤60	**-0.045 (-0.071; -0.019)**	
pCO_2	90	25	≤60	**2.81 (2.15; 3.47)**	3.33
	110	4–8	≤60	**0.405 (-0.043; 0.853)**	
	90	0–3.9	≤60	**0.070 (-0.395; 0.535)**	
pO_2	84	25	<15	10.2 (7.25; 13.1)	9.27
	190	4–8	<15	12.2 (10.7; 13.6)	
	66	0–3.9	45	**8.09 (5.15; 11.0)**	
sO_2	66	25	15	**2.37 (1.56; 3.18)**	3.75
	104	4–8	<15	7.68 (6.59; 8.76)	
	81	0–3.9	≤60	**3.71 (2.57; 4.84)**	
Lactate	65	25	<15	14.0 (10.8; 17.1)	5.89
	39	4–8	<15	8.13 (6.46; 9.81)	
	27	0–3.9	45	**5.22 (3.09; 7.34)**	

PD in bold indicates significant stability time (PD<S). Groups that were stable for the entire study period are identified as ≤60, while those that were not stable for even 15 min are designated as <15.

*PD (%) calculated as $\Sigma\ (Yi\text{-}Xi)/Xi)/n \times 100$. The first ($Xi$) and the second ($Yi$) sample result for each parameter and storage condition; †S (%) calculated as a coefficient of variation (CV) percentage overall (within-run imprecision) × 1.65.

Abbreviations: N, number; Time (minute), elapsed time from baseline; PD, percentage deviation; CI, confidence interval; S (%), acceptance stability limit; pCO_2, partial pressure of carbon dioxide; pO_2, partial pressure of oxygen; sO_2, oxygen saturation.

*Arbiol-Roca A, et al. Stability of pH, Blood Gas Partial Pressure, Hemoglobin Oxygen Saturation Fraction, and Lactate Concentration. Ann Lab Med 2020;40:448-456



- Plastik şırıngalar buza konmamalı
- Oda sıcaklığında 30 dk içinde analiz
- >30 dk olacak ise buzlu su içinde bekletmeyi değerlendir
- p(A-a)O_2 için ise 5 dk içinde analiz

Pre/Post Analitik Evre
Test Tekrarlanabilir mi ?

Review

Blood gas testing and related measurements: National recommendations on behalf of the Croatian Society of Medical Biochemistry and Laboratory Medicine

Lora Dukić*[1,2], Lara Milevoj Kopčinović[1,2], Adrijana Dorotić[1,3], Ivana Baršić[1,4]

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[4]Department of Laboratory Diagnostics, University Hospital Centre Zagreb, Croatia

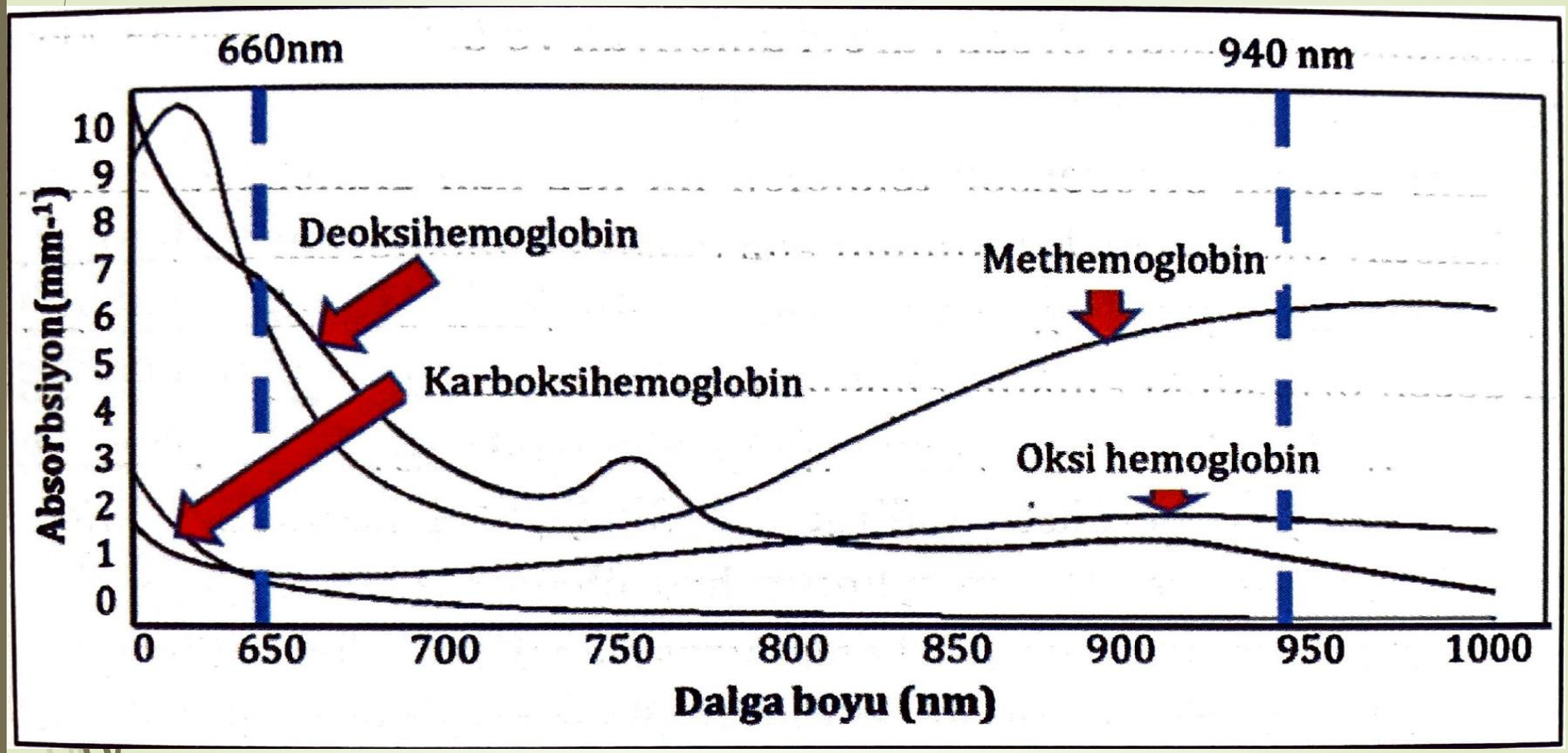
- Enjektör örnekleri aspirasyon yoluyla analizöre alındığında, örneğin kalan kısmında bir hava kabarcığı oluşur. Ölçümün tekrarlanması gerekebileceği durumlar için bu hava kabarcığı derhal uzaklaştırılmalıdır.

- Şüpheli sonuçlar elde edilirse (örneğin hastanın önceki sonuçları veya mevcut klinik durumu ile uyumsuzsa), örnek kalitesinin hızla bozulmaya başlamasından önce, örnek derhal yeniden analiz edilmelidir (mümkünse başka bir analizörde).

Analitik Evre
Ölçüm Yöntemleri

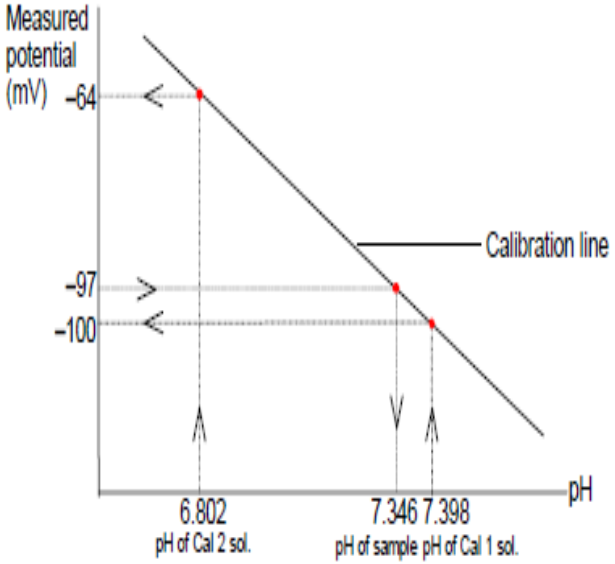
	Elektrokimyasal		Optik
	Potansiyometri (ISE)	**Amperometri**	**Spektrofotometri**
Kan Gazları	pH , pCO_2	pO_2	
Hemoglobin fraksiyonları			FHHb, FO_2Hb, FCOHb, FMetHb
Elektrolitler	Na^+ , K^+ , Cl^- , Ca^{++} , Mg^{++}		
Metabolitler		Glukoz , Laktat	

Analitik Evre
Ölçüm Yöntemleri



- 4 farklı dalga boyunda 4 fraksiyonun da ayrı ayrı ölçümü
- tHb = HHb + O_2Hb + COHb + MetHb

Analitik Evre
Kalibrasyon ve İç Kalite Kontrol



This is a 2-point calibration. In 1-point calibration, only the position of the calibration line is determined. The slope of the calibration line is maintained from the last 2-point calibration.

- 2/4/8 saatte bir iki noktalı kalibrasyon
- 30 dakikada bir tek noktalı kalibrasyon

- 3 seviye
- gaz karışımı ile dengelenen sulu tampon çözeltileri
- 8 saatte bir en az 1 seviye kontrol
- 24 saatte en az 3 seviye kontrol

Analitik Evre
Dış Kalite Kontrol

CLIA 2025 Kan Gazları için kabul edilebilir limitleri	
pCO_2	Hedef değer ± 5 mm Hg veya ± % 8
pO_2	Hedef değer ± 15 mm Hg veya ± % 15
pH	Hedef değer ± 0.04

Clinical Laboratory Improvement Amendments of 1988 (CLIA) Proficiency Testing Regulations Related to Analytes and Acceptable Performance. Fed Reg 2022;87(221): 68912.

Postanalitik Evre
Raporlama – Referans Aralıklar

TABLE 6-7
Reference Values

Test	Specimen Type	Reference Range
Blood Gases		
pH	Arterial	7.35–7.45
pH (newborn)	Arterial	7.25–7.45
pCO_2	Arterial	35–45 mm Hg
pCO_2 (newborn)	Arterial	27–40 mm Hg
pO_2*	Arterial	83–108 mm Hg
pO_2 (newborn)	Arterial	55–90 mm Hg
HCO_3	Arterial	21–28 mmol/L
HCO_3 (newborn)	Arterial	17–24 mmol/L
T CO_2	Venous	22–29 mmol/L
T CO_2 (newborn)	Venous	13–22 mmol/L
sO_2	Arterial	95–98%
sO_2 (newborn)	Arterial	40–90%
Base excess	Arterial	–2 to +3
Base excess (infant)	Arterial	–10 to –2
Chemistry		
Glucose (adult: fasting)	Whole blood, serum, or plasma	60–95 mg/dL
Glucose (infant and child)	Whole blood, serum, or plasma	70–100 mg/dL
Glucose (newborn)	Whole blood, serum, or plasma	50–80 mg/dL
Potassium	Whole blood, serum, or plasma	3.5–5.1 mmol/L
Potassium (newborn)	Whole blood, serum, or plasma	3.0–5.8 mmol/L
Sodium	Whole blood, serum, or plasma	136–145 mmol/L
Sodium (infant)	Whole blood, serum, or plasma	139–146 mmol/L
Chloride	Whole blood, serum, or plasma	98–107 mmol/L
Chloride (newborn)	Whole blood, serum, or plasma	98–113 mmol/L
Hematology		
Hemoglobin (male)	Whole blood	13.5–17.5 g/dL
Hemoglobin (female)	Whole blood	12.0–16.0 g/dL
Hemoglobin (newborn)	Whole blood	10.0–17.0 g/dL
Hematocrit (male)	Whole blood	37–48%
Hematocrit (female)	Whole blood	35–45%

* pO_2 decreases with age and high altitude.

Delost, M.E. Blood Gas and Critical Care Analyte Analysis. In Equipment for Respiratory Care; Volsko, T.A., Chatburn, R.L., El-Khatib, M.F., Eds.; Jones and Bartlett Publishers, Inc.: Sudbury, MA, USA, 2014.

Postanalitik Evre

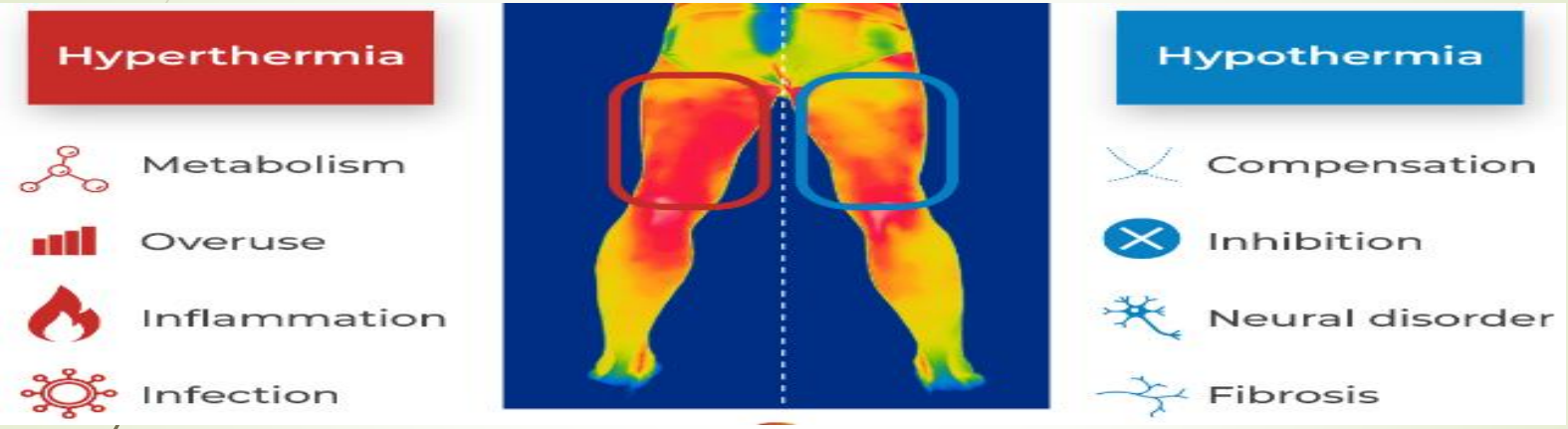
Raporlama – Kritik/Panik Değerler

Test Adı	Numune Türü	Yaş	Alt Kritik Değer	Üst Kritik Değer	Birim
pH, arteriyel ?	Tam Kan	Genel	≤ 7.200	≥ 7.600	pH
pCO_2, arteriyel ?	Tam Kan	Genel	≤ 20.0	≥ 70.0	mm Hg
pO_2, arteriyel	Tam Kan	Genel	≤ 40.0	-	mm Hg
Karbon monoksid (FCOHb)	Tam Kan	Genel	-	≥ 20	%
Sodyum	Serum ?	Genel	≤ 120	≥ 160	mmol/L
Potasyum	Serum ?	Genel	≤ 2.5	≥ 6.0	mmol/L
İyonize kalsiyum	Serum ?	< 1 yaş	≤ 2.0	≥ 6.0	mg/dL
İyonize kalsiyum	Serum ?	≥ 1 yaş	≤ 3.0	≥ 6.5	mg/dL
Glukoz	Serum/Plazma ?	< 4 hafta	≤ 40	≥ 400	mg/dL
Glukoz	Serum/Plazma ?	≥ 4 hafta	≤ 50	≥ 400	mg/dL

SAĞLIK HİZMETLERİ GENEL MÜDÜRLÜĞÜ **TETKİK VE TEŞHİS HİZMETLERİ DAİRESİ BAŞKANLIĞI**, AKILCI LABORATUVAR KULLANIMI KARAR SINIRI (EŞİK DEĞER), KRİTİK DEĞER (PANİK DEĞER)VE ÖLÇÜM BİRİMLERİNİN HARMONİZASYONU, 2018.

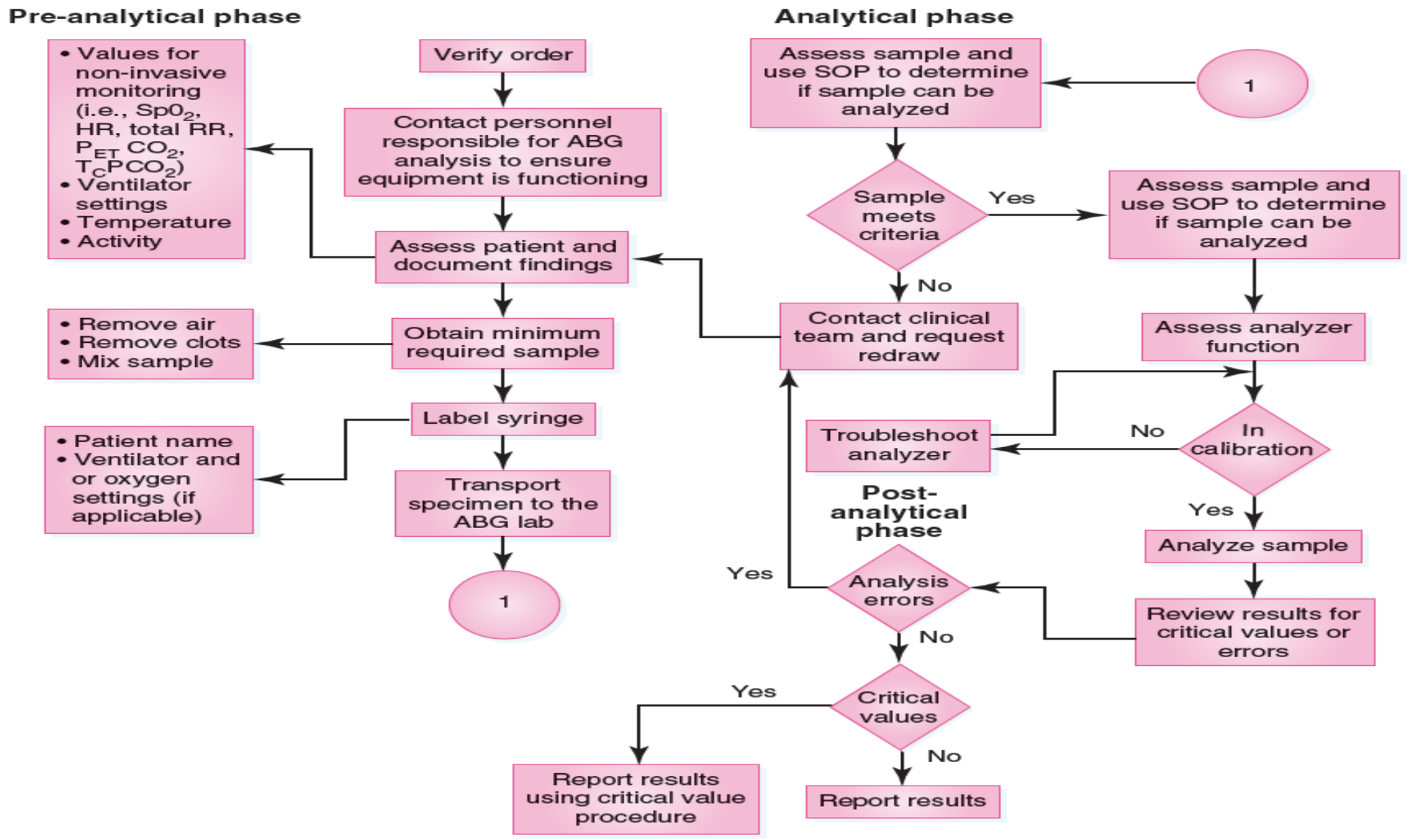
Postanalitik Evre
Sıcaklık Düzeltmesi

- Kan gazı analizörlerindeki ölçümler 37°C'de yapılmaktadır.



- İki yöntem
  - **a-stat** ; sıcaklık düzeltmesi yapılmadan 37°C'deki kan gazları sonuçları verilir.
  - **pH-stat** ; kan gazları (pH, pCO_2, pO_2) hastanın vücut sıcaklığına göre hesaplanarak düzeltilerek verilir.

İŞ AKIŞ ŞEMASI



TEŞEKKÜRLER...

Kan Gazları Testlerinizi;

TAKE LAB MESSAGES…

1. **Arteriyel + Venöz** olarak ayırın

- Referans aralıkları ve kritik değerleri ile birlikte

2. SUT'ta olduğu gibi **Kan Gazları (arteriyel ve venöz)** +

   Kan Gazları ve Kooksimetre (sadece arteriyel) olarak ayırın

- Teknik şartnamelerinizi **kooksimetre ihtiyacınız** açısından değerlendirin

- **ODS** kurun, böylece hem sonuçlar için hem de tekrarlar için hız kazanın

Aslında olması gereken;

TAKE LAB MESSAGES…

3. Hasta başı olmayan analizörlerin teknik şartnamede **çift yönlü LIS iletişimi** olmalı ∅
4. HBYS'nizde alt başlıklar olarak SUT kodları ile birlikte tek tek uygun istem kutucukları (**kan gazları** , **kan gazları + kooksimetre** , **elektrolitler** , **metabolitler**) oluşturun ∅

- Ancak bu durum şu an için maliyeti etkilemediğinden dolayı gerçekleştirmek mantıklı değil

3. Bir veya birden fazla kan gazı analizörü olanlar için; şartnamelere **farklı** analizörler için çalışılacak **test panellerinizi** ihtiyaçlara göre belirleyebilirsiniz