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Search completed for: COPD patients with acidotic exacerbation or type 2 respiratory failure, given noninvasive ventilation. Does ear lobe blood gas monitoring give comparable results to arterial blood gas monitoring?

Search completed on: 7th August 2012
Search completed by: Richard Bridgen

Search details

COPD patients with acidotic exacerbation or type 2 respiratory failure, given noninvasive ventilation. Does ear lobe blood gas monitoring give comparable results to arterial blood gas monitoring?

Resources searched

NHS Evidence; TRIP Database; Cochrane Library; CINAHL; EMBASE; MEDLINE; Google Scholar

Database search terms: COPD; "chronic obstructive pulmonary disease"; chronic obstructive pulmonary disorder; exp PULMONARY DISEASE, OBSTRUCTIVE; exp LUNG DISEASES, OBSTRUCTIVE; chronic adj2 airflow adj2 obstruct*; obstruct* adj2 lung adj2 disease*; obstruct* adj2 lung adj2 disorder*; acidotic; acidosis; ACIDOSIS; ACIDOSIS, RESPIRATORY; "type 2" adj2 "respiratory failure"; RESPIRATORY INSUFFICIENCY; respiratory adj2 failure; respiratory adj2 insufficien*; type2; "type 2"; "type two"; respiratory adj2 depression*; ventilator adj2 depression*; "non-invasive ventilat*"; "non invasive ventilat*"; NIV; NIVPP; CPAP; BiPAP; "continuous positive airway pressure"; CONTINUOUS POSITIVE AIRWAY PRESSURE; "noninvasive positive pressure ventilation"; non invasive positive pressure ventilation*; non invasive positive pressure ventilation*; "bi-level positive airway pressure"; "bi-phasic continuous positive airway pressure"; "biphasic intermittent positive airway pressure"; "arterial blood" adj2 gas*; BLOOD GAS ANALYSIS; OXIMETRY; artery; arteries; capillary; capillaries; "ear lobe"; earlobe*; CAPILLARIES; ear*; EAR; EAR, EXTERNAL; EAR CARTILAGE; ARTERIES; EAR, LOBE

Evidence search string(s): (COPD OR "Chronic Obstructive Pulmonary Disease" OR "chronic obstructive lung disease") (acidosis OR acidotic OR "type 2 respiratory failure") ("noninvasive ventilation" OR NIV OR NIVPP OR CPAP OR BiPAP) ("blood gas" (analyse* OR review* OR evaluate* OR method* OR outcome* OR measure*)) arter* earlobe

Google search string(s): (~"Chronic Obstructive Pulmonary Disease" OR ~"chronic obstructive lung disease") (~acidosis OR "type 2 respiratory failure") ~"noninvasive ventilation" (~"blood gas" (~analyse OR ~review OR ~evaluate OR ~method OR ~outcome OR ~measure)) ~artery ~earlobe

Summary

There is some research on the efficacy of ear lobe blood gas analysis, but few studies
comparing it with arterial blood gases and none in the specific case of COPD patients with
acidotic exacerbation or type 2 respiratory failure being given noninvasive ventilation.
NICE guidance says that ear lobe measurement may not accurately reflect PaO2 but are
acceptable for PaCO2 and the European Respiratory Society says that pulse oximetry
generally correlates well with arterial co-oximetry, with a 1–2% error. I have included
general research on the efficacy of ear lobe blood gas measurement to enable you to draw
some conclusions despite the lack of studies comparing methods in this group of patients.

**Guidelines**

**European Respiratory Society**

*Standards for the diagnosis and treatment of patients with COPD* 2004

Arterial blood gas (ABG) is the preferred measure and includes acid-base information;
arterial oxygen saturation as measured by pulse oximetry (SpO2) is adequate for trending.

*Standards for the diagnosis and management of patients with COPD* 2004

Pulse oximetry generally correlates well with arterial co-oximetry, with a 1–2% error.

**NICE**

CG101 Chronic obstructive pulmonary disease (update) 2010

1. Radial stabs to obtain blood for arterial blood gas analysis are not more painful
   than arterialised ear lobe gases.

2. Arterialised ear lobe gases may not accurately reflect PaO2 but are acceptable for
   PaCO2.

**Evidence-based reviews**

None found.

**Published research**

1. Effect of recording site on pulse oximetry readings

Author(s) Barnett E., Duck A., Barracough R.

Citation: *Nursing times*, January 2012, vol./is. 108/1-2(22-23), 0954-7762 (2012 Jan 10-16)

Publication Date: January 2012

Abstract: Ambulatory oxygen requirements are routinely assessed and titrated using
portable finger pulse oximetry. However, movement artefacts from hands moving or
reduced circulation may adversely affect the accuracy of measurement. At Wythenshawe Hospital, we decided to use an ear oximeter routinely in addition to the finger oximeter. To
evaluate and compare the use of portable oximetry measurements taken from the ear and finger during ambulatory assessments. Before, during and after a six-minute walking test, 304 patients had ear and finger pulse oximetry measurements recorded. There was a
significant difference between ear and finger measurements before and after exercise
(p<=0.001 for both). The differences would have altered the clinical outcome in 27% of
those assessed.

Source: EMBASE

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Available in print at Louth County Hospital Medical Library

Available in print at Pilgrim Hospital Staff Library

Author(s) Nicolini A, Ferrari MB

Citation: Annals of Thoracic Medicine, October 2011, vol./is. 6/4(217-20), 1998-3557;1998-3557 (2011 Oct)

Publication Date: October 2011

Abstract: BACKGROUND: Non-invasive measurement of oxygenation is a routine procedure in clinical practice, but transcutaneous monitoring of PCO(2)(PtICO(2)) is used much less than expected.METHODS: The aim of our study was to analyze the value of a commercially available combined SpO(2)/PtCO(2) monitor (TOSCA-Linde Medical System, Basel, Switzerland) in adult non-invasive ventilated patients with acute respiratory failure. Eighty critically ill adult patients, requiring arterial blood sample gas analyses, underwent SpO(2) and PtCO(2) measurements (10 min after the probe was attached to an earlobe) simultaneously with arterial blood sampling. The level of agreement between PaCO(2) - PtCO(2) and SaO(2) - SpO(2) was assessed by Bland-Altman analyses.RESULTS: Both, SaO(2) from blood gas analysis and SpO(2) from the transcutaneous monitor, and PaCO(2) and PtCO(2) were equally useful. No measurements were outside of the acceptable clinical range of agreement of +/- 7.5 mmHg.CONCLUSIONS: The accuracy of estimation of the TOSCA transcutaneous electrode (compared with the "gold standard" blood sample gas analysis) was generally good. Moreover, TOSCA presents the advantage of the possibility of continuous non-invasive measurement. The level of agreement of the two methods of measurement allows us to state that the TOSCA sensor is useful in routine monitoring of adults admitted to an intermediate respiratory unit and undergoing non-invasive ventilation.

Source: Medline

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3. Comparison of forehead and digital oximetry in critically ill shocked patients requiring high dose vasopressors

Author(s) Frenel J.-V., Nesseler N., Morcet J., Launey Y., Seguin P., Malledant Y.

Citation: Intensive Care Medicine, September 2011, vol./is. 37/(S229), 0342-4642 (September 2011)

Publication Date: September 2011

Abstract: INTRODUCTION. Pulse oximetry (SpO<sub>2</sub>) in ICU is currently used to monitor oxygenation. However, conventional devices measuring SpO<sub>2</sub> at digital or ear sites by transmission modems may fail in situations of hypoperfusion such as hypothermia, hypotension, and peripheral vasoconstriction (induced or not by vasopressors). Forehead reflectance sensors recently developed might be useful in these circumstances. Indeed, forehead's perfusion is better preserved under conditions of hypoperfusion, and is less sensitive to vasoconstriction.OBJECTIVES. The aim of our study was to compare SpO<sub>2</sub> obtained by reflectance foreheadoximetry and conventional digital oximetry to arterial oxygen saturation (SaO<sub>2</sub>) measured simultaneously by arterial blood gases in critically ill patients requiring vasopressors.METHODS. The study was approved by the local institutional ethical committee which waived informed consent. During 6 months, from May 2010 to December 2010, adult patients who received by vasopressors (epinephrine or norepinephrine >0.1 mug/kg/min) were included. When an arterial blood gas was performed, the forehead (OxiMaxMAXFAST, Pleasanton, CA, USA) and digital (OxiMax DS-100A, Pleasanton, CA, USA) SpO2 were recorded simultaneously.A maximum of five data collections per patient was collected. Forehead and digitalSpO<sub>2</sub> were compared to SaO<sub>2</sub> by the Bland and Altman statistical method. In addition, the number of outliers defined by the difference
SaO$_2$-SpO$_2$[+-3%, was noted. Fisher's exact test was used to compare the number of outliers between the two methods. Data are expressed as mean +/- standard deviation.

RESULTS. Among the 32 patients included, 24 were in septic shock, 4 in cardiogenic shock, 4 in hypovolemic or hemorrhagic shock. The population characteristics were age = 64 +/- 13, SAPS II = 58 +/- 21, SOFA = 10 +/- 4, vasopressors = 0.7 +/- 0.5 µg/kg/min. 140 data collections were analyzed (4 +/- 1 per patient), 4 digital SpO$_2$ being uninterruptable. Analysis was therefore based on 140 and 136 paired data for forehead SpO$_2$ and digital SpO$_2$, respectively (Table presented).

CONCLUSIONS. Forehead reflectance oximetry appears more relevant in critically ill patients who receive vasopressors. It might be an attractive alternative to conventional transmission measurement.

Source: EMBASE

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4. Influence of the site of measurement on the ability of plethysmographic variability index to predict fluid responsiveness.


Citation: British Journal of Anaesthesia, September 2011, vol./is. 107/3(329-35), 0007-0912;1471-6771 (2011 Sep)

Publication Date: September 2011

Abstract: BACKGROUND: Plethysmographic variability index (PVI) is an accurate predictor of fluid responsiveness in mechanically ventilated patients. However, the site of measurement of the plethysmographic waveform impacts its morphology and its respiratory variation. The goal of this study was to investigate the ability of PVI to predict fluid responsiveness at three sites of measurement (the forehead, ear, and finger) in mechanically ventilated patients under general anaesthesia.

METHODS: We studied 28 subjects after induction of general anaesthesia. Subjects were monitored with a pulmonary artery catheter and three pulse oximeter sensors (the finger, ear, and forehead). Pulse pressure variation, central venous pressure, cardiac index (CI), and PVI measured at the forehead, ear, and finger (PVI( forehead), PVI(ear), and PVI(finger)) were recorded before and after fluid loading (FL). Subjects were responders to volume expansion if CI increased >15% after FL. RESULTS: Areas under the receiver-operating curves to predict fluid responsiveness were 0.906, 0.880, and 0.836 for PVI( forehead), PVI(ear), and PVI(finger), respectively (P<0.05). PVI( forehead), PVI(ear), and PVI(finger) had a threshold value to predict fluid responsiveness of 15%, 16%, and 12% with sensitivities of 89%, 74%, and 74% and specificities of 78%, 74%, and 67%, respectively. CONCLUSIONS: PVI can predict fluid responsiveness in anaesthetized and ventilated subjects at all three sites of measurement. However, the threshold values for predicting fluid responsiveness differ with the site of measurement. These results support the use of this plethysmographic dynamic index in the cephalic region when the finger is inaccessible or during states of low peripheral perfusion.

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5. Validity of arterialized earlobe blood gases at rest and exercise in normoxia and hypoxia.


Citation: Respiratory Physiology & Neurobiology, July 2010, vol./is. 172/3(179-83), 1569-9048;1878-1519 (2010 Jul 31)
Abstract: The purpose of this study was to compare arterial and arterialized blood gases during normoxic and hypoxic exercise. In the same conditions, earlobe pulse oximetry $O(2)$ saturation (Sp($O_2$)) was compared to arterial oxygen saturation (Sa($O_2$)). Ten men performed incremental cycle ergometer tests, in normoxia and hypoxia (FI($O_2$) = 0.127). Blood samples were drawn simultaneously from the radial artery and pre-warmed earlobe capillary blood of subjects at rest, submaximal and near maximal exercise. R($2$) between the two samples were 0.99 for P($O_2$) and S($O_2$), 0.86 for P(CO$_2$) and 0.97 between Sp($O_2$) and Sa($O_2$). Earlobe P($O_2$) mean was 4.4+/-3.6 mmHg lower than Pa($O_2$) in normoxia but in hypoxia only 1.1+/-2.2 mmHg low. The mean difference were low in normoxia between Sa($O_2$) and Sp($O_2$) and increased in hypoxia, were acceptable for P(CO$_2$), S($O_2$), pH in all conditions. In conclusion, except for P($O_2$) in normoxia, pre-warmed earlobe capillary blood is a good substitute to arterial blood to allow measurement of blood gas values in normoxia and hypoxia at rest and exercise. Copyright 2010 Elsevier B.V. All rights reserved.

Source: Medline

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6. Validity of pulse oximetry in detection of hypoxaemia in children: Comparison of ear, thumb and toe probe placements

Author(s) Bilan N., Behbahan A.G., Abdinia B., Mahallei M.

Citation: Eastern Mediterranean Health Journal, February 2010, vol./is. 16/2(218-222), 1020-3397 (February 2010)

Publication Date: February 2010

Abstract: This study of paediatric intensive care patients aimed to determine where pulse oximetry probes should be placed to obtain the most accurate and reliable readings of peripheral oxygen saturation (SpO$_2$). Using arterial blood gas analysis (SaO$_2$) as the gold standard and SpO$_2$ < 92% and SaO$_2$ < 90% as indicators of hypoxaemia, negative predictive values of SpO$_2$ were 96%, 98% and 98% at the ear, thumb and big toe respectively in 110 children, and 93% at all 3 sites in 90 neonates. The highest clinical agreement between SaO$_2$ and SpO$_2$ was for ear probes in children ( = 0.70) and the lowest was for big toe probes ( = 0.57 and 0.28 in children and neonates respectively).

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7. Optimal clinical time for reliable measurement of transcutaneous CO2 with ear probes: Counterbalancing overshoot and the vasodilatation effect

Author(s) Domingo C., Canturri E., Moreno A., Espuelas H., Vigil L., Lujan M.

Citation: Sensors, January 2010, vol./is. 10/1(491-500), 1424-8220 (January 2010)

Publication Date: January 2010

Abstract: OBJECTIVES: To determine the optimal clinical reading time for the transcutaneous measurement of oxygen saturation (SpO$_2$) and transcutaneous CO$_2$ (TCPO$_2$) in awake spontaneously breathing individuals, considering the overshoot phenomenon (transient overestimation of arterial PaCO$_2$). EXPERIMENTAL SECTION: Observational study of 91 (75 men) individuals undergoing forced spirometry, measurement of SpO$_2$ and TCPO$_2$ with the SenTec monitor every two minutes until minute 20 and arterial blood gas (ABG) analysis. Overshoot severity: (a) mild (0.1-1.9 mm Hg); (b) moderate (2-4.9 mm Hg); (c) severe: (>5 mm Hg). The mean difference was calculated for
SpO$_2$ and TcPCO$_2$ and arterial values of PaCO$_2$ and SpO$_2$. The intraclass correlation coefficient (ICC) between monitor readings and blood values was calculated as a measure of agreement. RESULTS: The mean age was 63.1 +/- 11.8 years. Spirometric values: FVC: 75.4 +/- 6.2%; FEV1: 72.9 +/- 23.9%; FEV1/FVC: 70 +/- 15.5%. ABG: PaO$_2$: 82.6 +/- 13.2; PaCO$_2$: 39.9 +/- 4.8 mmHg; SaO$_2$: 95.3 +/- 4.4%. Overshoot analysis: overshoot was mild in 33 (36.3%) patients, moderate in 20 (22%) and severe in nine (10%); no overshoot was observed in 29 (31%) patients. The lowest mean differences between arterial blood gas and TcPCO$_2$ was -0.57 mmHg at minute 10, although the highest ICC was obtained at minutes 12 and 14 (>0.8). The overshoot lost its influence after minute 12. For SpO$_2$, measurements were reliable at minute 2.

CONCLUSIONS: The optimal clinical reading measurement recommended for the ear lobe TcPCO$_2$ measurement ranges between minute 12 and 14. The SpO$_2$ measurement can be performed at minute 2. 2010 by the authors.

8. [Inducibility of arterialized capillary blood gases and acid-base balance determination ].

Author(s) Nefedov VB, Shergina EA, Samorukova MV

Citation: Problemy Tuberkuleza I Boleznej Legkih, 2009, vol./is. 7(37-41), 1728-2993;1728-2993 (2009)

Publication Date: 2009

Abstract: The reproducibility of determining gases and acid-base balance (ABB) in the arterialized capillary blood taken by 1 and 2 earlap punctures at an 3-15-min interval for up to 7-28 days was studied in 171 subjects (16 healthy individuals and 155 patients with tuberculosis and other diseases of the lung. No relationship was found between the reproducibility of paO$_2$, PaCO$_2$, and SO$_2$, the duration test intervals and that for BE, SB, and pH. The opinion as to the time course of changes in arterialized capillary blood gases and ABB may be regarded as justified only with the changes in paO$_2$ > 4 mm Hg, paCO$_2$ > 2 mm Hg, SO$_2$ > 1%, BE > 0.5 mmol x l($-1$), SB > 0.6 mmol x l($-1$), and pH > 0.01 at shorter test intervals, BE > 1.1 mmol x l($-1$), SB > 0.8 mmoll x l($-1$), and pH > 0.02 at longer test intervals.

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9. Longtime performance and reliability of two different PtcCO$_2$ and SpO$_2$ sensors in neonates.

Author(s) Bernet V, Doll C, Cannizzaro V, Ersch J, Frey B, Weiss M

Citation: Paediatric Anaesthesia, September 2008, vol./is. 18/9(872-7), 1155-5645;1460-9592 (2008 Sep)

Publication Date: September 2008

Abstract: OBJECTIVES: Blood gas monitoring is necessary in treatment of critically ill neonates. Whereas SaO$_2$ can be estimated by pulse oximetry, PaCO$_2$ is still most often assessed from blood samples.AIM: To compare long time performance of an ear sensor for combined assessment of transcutaneous carbon dioxide (PtcCO$_2$) and oxygen saturation (SpO$_2$) (TOSCA Monitor; Radiometer, Switzerland) with a conventional PtcCO$_2$ monitor (MicroGas 7650-500 rapid, Radiometer, Switzerland) in critically ill neonates.METHODS: Prospective, observational study. Twenty critically ill neonates were monitored for PtcCO$_2$ and SpO$_2$ using the Tosca and the MicroGas monitor for 24 h. TOSCA ear sensor was changed to the other ear lobe after 12 h and the MicroGas sensor four hourly on the trunk. Values obtained were compared with SaO$_2$ and PaCO$_2$ from arterial blood gas analysis using Bland-Altman analysis. Data are presented as median (range).RESULTS: Eighty-two paired measurements were obtained. Median age of the 20 patients was 4.5 days (1-26 days) and weight was 3.05 kg (0.98-3.95 kg). Bias and precision between PaCO$_2$ and PtcCO$_2$ were 0.14 and 1.45 kPa for the Tosca monitor and -0.08 and 1.2 kPa for the
MicroGas monitor, respectively. The two biases were significantly different (P = 0.0036). SpO2 assessment by TOSCA was comparable to SaO2 values (bias 0.26% and precision 4.14%). CONCLUSION: The TOSCA monitor allows safe estimation of PtcCO2 and SaO2 in neonates. Measurements of PtcCO2 were less reliable with TOSCA compared with conventional monitoring but still allow assessing a trend of ventilation status in newborn patients.

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Author(s) Chemla D, Teboul JL, Richard C
Citation: Current Opinion in Critical Care, June 2008, vol./is. 14/3(317-21), 1070-5295;1531-7072 (2008 Jun)
Publication Date: June 2008
Abstract: PURPOSE OF REVIEW: To briefly review recent advances in the noninvasive assessment of arterial pressure (indirect methods) in the field of critical care.RECENT FINDINGS: Automated oscillometric measurements underestimate intraarterial systolic blood pressure. Digital photoplethysmography has led to conflicting results, although the obtained respiratory pulse pressure variation correlates with the fluid-challenge-induced changes in stroke volume. The pulse oximetry photoplethysmographic signal recorded at the digital or ear level may be useful in monitoring respiratory arterial pressure variations, although technical improvements and clarifications are needed. Arterial tonometry is increasingly used in the cardiovascular field to reconstruct central aortic pressure. A recent study has shown that radial artery tonometry is feasible in hemodynamically stable patients and that peripheral pulse pressure reflects the combined influences of arterial stiffness and stroke volume, especially in elderly patients. The limitations of this technique include the potential bias related to the use of a generalized transfer function and the difficulty in obtaining reliable recordings in hemodynamically unstable patients.SUMMARY: Intraarterial blood pressure must be preferred over noninvasive blood pressure recordings when critical decisions are required. In hemodynamically stable patients, valuable information may be obtained by using noninvasive techniques, amongst which arterial tonometry seems especially promising.
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11. The ear as an alternative site for a pulse oximeter finger clip sensor
Author(s) Haynes J.M.
Citation: Respiratory care, June 2007, vol./is. 52/6(727-729), 0020-1324 (Jun 2007)
Publication Date: June 2007
Abstract: BACKGROUND: Finger clip pulse oximetry sensors are commonly used to obtain functional oxygen saturation readings (S(pO2)), but these sensors may perform poorly if the digit is poorly perfused or there is excessive hand movement. I have increasingly witnessed clinicians obtaining S(pO2) readings by placing the finger clip sensor on the patient's ear when an S(pO2) reading cannot be obtained from a finger. OBJECTIVE: Determine if reliable S(pO2) readings can be obtained from a finger clip sensor placed on the ear. METHODS: This was a prospective study with patients undergoing pulmonary function testing. The calculated functional oxygen saturation values from arterial blood gas analysis (S(aO2)) were compared with S(pO2) readings from a finger clip sensor placed on a finger (finger S(pO2)) and on the upper portion of an ear (ear S(pO2)). S(pO2) data were included in the study only if (1) the pulse rate from finger S(pO2) and ear S(pO2) differed by < or = 5 beats/min and (2) the photoplethysmographic waveform was stable and acceptable. RESULTS: Data were obtained from 30 adult white patients. The number of
S(pO2) readings that differed from the S(aO2) values by > or = 3% were 1 (3.3%) finger S(pO2) reading and 24 (80%, 95% CI 61%-92%) ear S(pO2) readings (p < or = 0.001). Bland-Altman analysis showed better agreement between S(aO2) and finger S(pO2) (mean +/- 2 SD limits of agreement -2.35 to 2.35) than between S(aO2) and ear S(pO2) (limits of agreement -7.24 to -0.08) or finger S(pO2) and ear S(pO2) (limits of agreement -7.56 to -0.23). CONCLUSION: A pulse oximeter finger clip sensor placed on the ear does not provide clinically reliable S(pO2) readings.

Source: EMBASE

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Author(s) Zavorsky GS, Cao J, Mayo NE, Gabbay R, Murias JM

Citation: Respiratory Physiology & Neurobiology, March 2007, vol./is. 155/3(268-79), 1569-9048;1569-9048 (2007 Mar 15)

Publication Date: March 2007

Abstract: A meta-analysis determined whether capillary blood gases accurately reflect arterial blood samples. A mixed effects model was used on 29 relevant studies obtained from a PubMed/Medline search. From 664 and 222 paired samples obtained from the earlobe and fingertip, respectively, earlobe compared to fingertip sampling shows that the standard deviation of the difference is about 2.5x less (or the precision is 2.5x better) in resembling arterial PO(2) over a wide range of arterial PO(2)'s (21-155 mm Hg ). The lower the arterial PO(2), the more accurate it is when predicting arterial PO(2) from any capillary sample (p<0.05). However, while earlobe sampling predicts arterial PO(2) (adjusted r(2)=0.88, mean bias=3.8 mm Hg compared to arterial), fingertip sampling does not (adjusted r(2)=0.48, mean bias=11.5 mm Hg compared to arterial). Earlobe sampling is slightly more accurate compared to fingertip sampling in resembling arterial PCO(2) (arterial versus earlobe, adjusted r(2)=0.94, mean bias=1.9 mm Hg ; arterial versus fingertip, adjusted r(2)=0.95, mean bias=2.2 mm Hg compared to arterial) but both sites can closely reflect arterial PCO(2) (880 total paired samples, range 10-114 mm Hg ). No real difference between sampling from the earlobe or fingertip were found for pH as both sites accurately reflect arterial pH over a wide range of pH (587 total paired samples, range 6.77-7.74, adjusted r(2)=0.90-0.94, mean bias=0.02). In conclusion, sampling blood from the fingertip or earlobe (preferably) accurately reflects arterial PCO(2) and pH over a wide range of values. Sampling blood, too, from earlobe (but never the fingertip) may be appropriate as a replacement for arterial PO(2), unless precision is required as the residual standard error is 6 mm Hg when predicting arterial PO(2) from an earlobe capillary sample.

Source: Medline

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13. [Accuracy analysis of pulse oximetry based on dynamic spectroscopy].

Author(s) Li G, Li SY, Lin L, Wang Y, Li XX, Lu ZY

Citation: Guang Pu Xue Yu Guang Pu Fen Xi/Spectroscopy & Spectral Analysis, October 2006, vol./is. 26/10(1821-4), 1000-0593;1000-0593 (2006 Oct)

Publication Date: October 2006

Abstract: The pulse oximeter used to measure patients oxygen saturation non-invasively and continuously, has numerous applications in clinic care. The pulse oximetry measurement combines two basic methods, spectrophotometry and photoplethysmography (PPG). The red light and the infrared light are exposed to the ear lobe, finger or other tissue with fluctuation of artery blood, and then detected. The amplitude ratio of the photoplethysmography waveform of red light and infrared light varies with the oxygen saturation of blood. The measuring principle of the pulse oximeter is based on traditional test method, its accuracy is not gratifying due to various factors influencing the measurement result, such as the principle, measuring condition, and individual
discrepancy. In the present paper a new pulse oximetry based on dynamic spectroscopy is introduced. It can promote the accuracy of the pulse oximeter evidently. The dynamic spectroscopy method is able to eliminate the interference of individual discrepancy and measuring condition in principle. This new method can eliminate the measurement error of pulse oximetry theoretically.

Source: Medline

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14. Usefulness of transcutaneous carbon dioxide pressure monitoring to measure blood gases in adults hospitalized for respiratory disease [Spanish] Utilidad de la presion transcutanea del anhidrido carbonico en la valoracion gasometrica de adultos hospitalizados con enfermedad respiratoria

Author(s) Herrejon A., Inchaurrega I., Palop J., Ponce S., Peris R., Terradez M., Blanquer R.

Citation: Archivos de Bronconeumologia, May 2006, vol./is. 42/5(225-229), 0300-2896 (May 2006)

Publication Date: May 2006

Abstract: OBJECTIVE: To evaluate the usefulness of transcutaneous carbon dioxide pressure (TCPCO₂) monitoring in patients hospitalized for respiratory disease.

PATIENTS AND METHODS: We used a SenTec TCPCO₂ monitor that also determines transcutaneous oxygen saturation (SpO₂) by means of a sensor placed behind the ear lobe at a temperature of 42°C. We compared arterial blood gas measurements-PaCO₂ and arterial oxygen saturation (SaO₂)- with transcutaneous measurements and analyzed the correlation, regression line, and agreement between the 2 methods. RESULTS: Thirty patients (20 men and 10 women) with various respiratory diseases and a mean (SD) age of 71 (13) years were included in the study. The median TCPCO₂ was 43.25 mm Hg and the median PaCO₂ was 42.6 mm Hg with no significant differences between the 2 measurements. The correlation was significant (p=0.979; P<.0001) and the corresponding regression equation was TCPCO₂ = -2.475 + 1.058 PaCO₂. The mean difference was 0.16 mm Hg (95% confidence interval [CI], -1.96 SD). The lower limit of agreement (mean -1.96 SD) was -4.64 mm Hg, and the upper limit (mean +1.96 SD) was 4.96 mm Hg. For SaO₂, the median was 94% and for SpO₂, the median difference was 95%. The difference between the 2 medians was significant (P<.004). The correlation was also significant (p=0.822; P<.0001) with SpO₂ = 4.427 + 0.97 SaO₂. The mean difference was 1.14% (95% CI, 0.38% to 1.89%). The lower limit of agreement (mean -1.96 SD) was -2.93% and the upper limit (mean +1.96 SD) was 5.21% CONCLUSIONS: Transcutaneous determination of carbon dioxide pressure and oxygen saturation is useful for patients hospitalized for respiratory disease in view of its good correlation and agreement, although SpO₂ does tend to overestimate SaO₂.

Source: EMBASE

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15. A device for sampling arterialized earlobe blood in austere environments.

Author(s) Russomano T, Evetts SN, Castro J, Dos Santos MA, Gavillon J, Azevedo DF, Whittle J, Coats E, Ernsting J

Citation: Aviation Space & Environmental Medicine, April 2006, vol./is. 77/4(453-5), 0095-6562;0095-6562 (2006 Apr)

Publication Date: April 2006

Abstract: INTRODUCTION: There is currently no effective method of measuring arterial blood gas tensions in austere environments such as in space or at high altitude. An alternative to direct arterial measurement is the sampling of arterialized earlobe blood, an
accurate technique that has been in use in clinical medicine and physiology for more than 50 yr. We, therefore, developed an earlobe arterialized blood (EAB) collector for practical use in extreme environments.

METHODS: The results from the EAB collector were compared with simultaneous samples of blood drawn from the radial artery. Six healthy subjects breathed a gas mixture of 12.8% O2 in N2 during 15 min of 8 degree head-down tilt. The blood samples were analyzed immediately.

RESULTS: The mean differences in Po2 between arterialized earlobe and radial artery samples were 0.25 +/- 1.25 mmHg for Po2 and 1.0 +/- 0.75 mmHg for Pco2; neither difference was significant. There was no difference between the pH values obtained by the two techniques.

CONCLUSION: This study suggests that arterialized blood sampled from the earlobe using the EAB collector may provide sufficiently accurate measurements of the Po2, Pco2 and pH of arterial blood for clinical or research use in extreme environments.

Source: Medline

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16. Transcutaneous Pco2 monitoring in critically ill adults: Clinical evaluation of a new sensor

Author(s) Bendjelid K., Schutz N., Stotz M., Gerard I., Suter P.M., Romand J.-A.

Citation: Critical Care Medicine, October 2005, vol./is. 33/10(2203-2206), 0090-3493 (October 2005)

Publication Date: October 2005

Abstract: Objective: In critically ill patients, arterial blood gas analysis is the gold standard for evaluating systemic oxygenation and carbon dioxide partial pressure. A new miniaturized carbon dioxide tension Pco<sub>-sub</sub>2</sub>-Spo<sub>-sub</sub>2</sub> single sensor (TOSCA, Linde Medical Sensors AG, Basel, Switzerland) continuously and noninvasively (transcutaneously) monitors both Paco<sub>-sub</sub>2</sub> and oxygen saturation by pulse oximetry (Spo<sub>-sub</sub>2</sub>-sub>). The present study was designed to investigate the usability and the accuracy of this device in critically ill patients. Design: Prospective clinical investigation. Setting: A 20-bed, university-affiliated, surgical intensive care unit. Patients: Patients admitted after major surgery, multiple trauma, or septic shock equipped with an arterial catheter. Interventions: The heated (42degreeC) sensor was fixed at the ear-lobe using an attachment clip. Transcutaneous Pco<sub>-sub</sub>2</sub>-sub> and Paco<sub>-sub</sub>2</sub> values (measured using a blood gas analyzer). In addition, the differences between Paco<sub>-sub</sub>2</sub> and TcPco<sub>-sub</sub>2</sub>-sub> values were evaluated using the method of Bland-Altman.

Measurements and Main Results: We studied 55 patients, aged 18-80 (mean 57 +/- 15) yrs. A total of 417 paired measurements were compared. Correlation between TcPco<sub>-sub</sub>2</sub> and Paco<sub>-sub</sub>2</sub> was r = .88 (p < .01) in the range of 24-101 mm Hg. Mean bias (+/-SD) between the two methods of measurement (Bland-Altman analysis) was 1.2 +/- 6.0 mm Hg with TcPco<sub>-sub</sub>2</sub> slightly overestimating arterial carbon dioxide tension. Nineteen percent of the measured values were outside of the acceptable clinical range of agreement of +/-7.5 mm Hg.

Conclusions: The present study suggests that Paco<sub>-sub</sub>2</sub>-sub> can be acceptably assessed by measuring TcPco<sub>-sub</sub>2</sub> using the TOSCA Pco<sub>-sub</sub>2</sub>-sub>-Spo<sub>-sub</sub>2</sub>-sub> sensor. Copyright 2005 by the Society of Critical Care Medicine and Lippincott Williams & Wilkins.

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17. Monitoring carbon dioxide tension and arterial oxygen saturation by a single earlobe sensor in patients with critical illness or sleep apnea.
OBJECTIVES: The purpose of the study was to evaluate a novel, combined sensor for transcutaneous monitoring of arterial oxygen saturation and carbon dioxide tension.

DESIGN: The new monitoring technique was compared to established reference methods.

SETTING: ICU and sleep laboratory of a university hospital.

PATIENTS: Eighteen critically ill adult patients with acute respiratory failure or heart failure, and 12 patients with sleep apnea (mean ± SD apnea/hypopnea index, 43 ± 24 events per hour).

MEASUREMENTS: Continuous measurements were performed over several hours by the novel heated (temperature, 42 degrees C) earlobe sensor (TOSCA; Linde Medical Sensors; Basel, Switzerland), incorporating electrochemical and optical elements for carbon dioxide measurement (PtcCO2) and pulse oximetry (SpO2), respectively. The data were compared to the results of repeated arterial blood gas analyses in critically ill patients and to simultaneous nocturnal pulse oximetry performed with different devices with earlobe or finger sensors in sleep apnea patients.

RESULTS: In critically ill patients, the mean difference and limits of agreement (bias ± 2 SDs) of transcutaneous PtcCO2 vs arterial PaCO2 were 3 ± 7 mm Hg; the corresponding values for changes in PtcCO2 vs PaCO2 were 1 ± 6 mm Hg. The bias ± 2 SDs for pulse oximetric SpO2 vs arterial oxygen saturation (SaO2) were 1 ± 4%. In sleep apnea patients, the combined earlobe sensor identified more transient oxygen desaturations, and the rate of change in oxygen saturation during events was greater compared to those with other tested pulse oximeters, indicating a faster response.

CONCLUSIONS: Due to its ability to accurately assess both ventilation and oxygenation by a single transcutaneous sensor, the described noninvasive monitoring technique is a valuable tool for respiratory monitoring with potential applications in critical care and sleep medicine.

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18. Ear probe pulse oximeters and neonates.

Author(s) Urquhart, C, Bell, G
Citation: Anaesthesia, 01 March 2005, vol./is. 60/3(0-2), 00032409
Publication Date: 01 March 2005
Source: CINAHL
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Author(s) Razafimahefa H., Gatel P.
Citation: Journal de gynécologie, obstétrique et biologie de la reproduction, February 2005, vol./is. 34/1 Suppl(S42-46), 0368-2315 (Feb 2005)
Publication Date: February 2005
Abstract: In newborn and premature infants whose lung immaturity entails a limited capacity for O2 detoxification, the use of supplemental oxygen should be continuously and non-invasively monitored. Pulse oximetry and transcutaneous O2 monitoring are the systems most used in the NICU. Major limitations of pulse oximetry are motion artifact, sensitivity to excessive light, cutaneous hypoperfusion, hypothermia, venous congestion, arterio-venous shunting, strong skin pigmentation, anemia and high percentage of abnormal hemoglobin. Alarm habituation is a further major risk. New oximeters show less motion, artifact and higher accuracy during low oxygen saturation. The accuracy during high oxygen saturation is very dependent on the specific oximeter model used. Transcutaneous O2 monitoring is usually combined with transcutaneous PCO2 monitoring, hence enabling evaluation of oxygenation as well as ventilation. A major risk of this method is related to the heated electrode sensor, which can induce skin burns. A combined ear sensor for pulse oximetry and PCO2 monitoring seems promising.

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20. Evaluation of a new combined transcutaneous measurement of PCO2/pulse oximetry oxygen saturation ear sensor in newborn patients

Author(s) Bernet-Buettiker V., Ugarte M.J., Frey B., Hug M.I., Baenziger O., Weiss M.

Citation: Pediatrics, January 2005, vol./is. 115/1(e64-68), 1098-4275 (Jan 2005)

Publication Date: January 2005

Abstract: OBJECTIVE: Arterial oxygen saturation (Sao(2)) and arterial carbon dioxide partial pressure (Paco(2)) are 2 of the most important respiratory parameters in the treatment of critically ill neonates. Noninvasive monitoring of these parameters is desirable for continuous estimating of the respiratory status and reducing blood loss because of repeated blood gas analyses. Transcutaneous measurement of Pco(2) (Ptcco(2)) represents a simple and noninvasive technique for continuous monitoring of ventilation. However, sensor preparation, positioning, taping, and repeated changes of the sensor location make the handling difficult and complicate its use in the neonatal care unit. Recently, a new sensor for combined assessment of pulse oximetry oxygen saturation (Spo(2)) and Ptcco(2) has been introduced (TOSCA Monitor; Linde Medical Sensors, Basel, Switzerland). The monitor combines pulse oximetry and Ptcco(2) measurement in a single ear sensor, which works at 42 degrees C to enhance blood flow in capillaries below the sensor. METHODS: In a prospective, open, nonrandomized study of 60 ill neonates, the new ear sensor for combined assessment of Spo(2) and Ptcco(2) at 42 degrees C was tested. The sensor was adapted to the ear of a neonate with a Varishesive layer (Convatec; Princeton, NJ). Data obtained from the ear sensor were compared with Spo(2) (Finger/Heel), Sao(2), and Paco(2) obtained from arterial blood gas in 30 patients and with a capillary blood gas in an additional 30 patients using Bland Altman bias analysis. Data are presented as median (range). RESULTS: The postconceptual age of the patients was 38.3 weeks (range: 28 5/7-40 5/7) in the arterial group and 37.9 weeks (range: 29 6/7-41 0/7) in the capillary group. Age of the newborns studied was 3.5 days (range: 1-28) in the arterial blood sample group (n = 30) and 6 days (range: 2-28) in the capillary blood sample group (n = 30). Patient weight was 3.02 kg (range: 1.5-4.5) in the arterial group and 2.76 kg (range: 1.0-3.71) in the other group. Three patients had weights of <1500 g. Twenty-one of 60 patients were conventionally ventilated, 4 patients received high-frequency oscillation, and 35 were not ventilated. Mean difference (bias) and precision (2 SD of the mean difference) between Ptcco(2 TOSCA) and Paco(2) were -0.44 kPa (-3.21 mm Hg) and 0.82 kPa (0.62 mm Hg) and between Ptcco(2 TOSCA) and Pcapco(2) were -0.09 kPa (-0.67 mm Hg) and 1.11 kPa (0.87 mm Hg), respectively. Spo(2) assessment by the TOSCA revealed slightly higher values compared with Sao(2) (bias: -0.48%), whereas Spo(2) (Finger/Heel) values were slightly lower than Sao(2) (bias: 0.52%). CONCLUSION: The TOSCA monitor with the ear sensor adapted to ears of neonates allows reliable estimation of Sao(2) and Paco(2). A potential benefit is the reduction in motion artifacts because of less head movement in newborns and that only a single cable leads form the patient to the monitor. In addition, the sensor is not removed for chest radiograph or for nursing the infant on his or her parent's lap. Long-term studies in a large population with continuous measurements are required to confirm these preliminary findings and to elucidate the benefits in detection.
of respiratory deterioration and the potential side effects of this sensor.

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21. Improving the sampling technique of arterialized capillary samples to obtain more accurate PaO2 measurements.

Author(s) Wimpess S, Vara DD, Brightling CE
Citation: Chronic Respiratory Disease, 2005, vol./is. 2/1(47-50), 1479-9723;1479-9723 (2005)
Publication Date: 2005
Abstract: Arterialized earlobe capillary blood samples (ELCS) have been used as a measurement of blood gas status for over 20 years. There is general acceptance that there is a strong correlation and limits of agreement between arterial and arterialized blood samples with respect to pH and PaCO2. Although the correlation between the arterial and arterialized PaO2 is good, the limits of agreement poor. Our aim was to improve the accuracy of this technique in the measurement of PaO2 by simultaneously monitoring the oxygen saturation by pulse oximetry whilst taking an ELCS. We hypothesize that significant discrepancies between the SaO2 and SpO2 highlight either a poorly arterialized sample or an over aerated sample from air bubbles. We compared the SpO2 with the SaO2 of an arterial sample from 27 inpatients. We used the limits of agreement between these samples to define the degree of discordance we would accept between SaO2 and SpO2 before repeat ELCS. Subsequently, 252 consecutive patients attending our respiratory physiology unit over a six-month period had an ELCS and simultaneous SpO2. If there was a discrepancy between SaO2 and SpO2 of > 2% the ELCS was repeated. There was a good correlation and limits of agreement between the SpO2 and arterial SaO2 (r = 0.97, mean difference +/- 95% limits of agreement: 0.34 +/- 2.68). A difference of more than 2% between arterialized SaO2 and SpO2 was identified in 21 patients out of 252 (8.3%) with SaO2 higher in two and lower in 19 (r = 0.96, mean difference +/- 95% limits of agreement: 0.66 +/- 3.1). Repeat ELCS of these 21 samples reduced this discrepancy improving the concordance of the measurements (r = 0.98, mean difference +/- 95% limits of agreement: 0.47 +/- 1.0). In one case a difference of 3% remained between the saturations. We conclude that the addition of simultaneous pulse oximetry with ELCS will identify rogue measurements in about 8% of cases highlighting the need for repeat samples and thus increasing the accuracy of the measurement of PaO2 by ELCS.

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Author(s) Chhajed PN, Heuss LT, Tamm M
Citation: Current Opinion in Anaesthesiology, December 2004, vol./is. 17/6(521-5), 0952-7907;0952-7907 (2004 Dec)
Publication Date: December 2004
Abstract: PURPOSE OF REVIEW: Arterial blood gas analysis is the ‘gold standard’ method to measure the arterial partial pressure of carbon dioxide (PaCO2). However, arterial sampling including arterial catheterization is invasive and expensive. Cutaneous carbon
dioxide tension (PcCO2) measurement is used as a noninvasive surrogate measure of PaCO2, which is used to either estimate PaCO2 or determine trend changes in the measurement. There has been considerable progress in the technical aspects of PcCO2 monitoring in the last few years. In this article, we evaluate recent developments and the renewed interest in the subject of PcCO2 monitoring in adults and discuss the technical aspects, clinical applications and the future outlook for this technique in the clinical setting.

RECENT FINDINGS: With evolution in technology, PcCO2 monitoring is now less cumbersome than before. Combined PcCO2 measurement and pulse oximetry is now possible with a single earlobe sensor. SUMMARY: The clinical settings in which PcCO2 monitoring can be applied include patient monitoring during and after anaesthesia, patients receiving noninvasive ventilation, post extubation, endoscopy under sedation, the sleep laboratory and the lung function laboratory. Although there is an overlap of the clinical indications when both PcCO2 and end-tidal carbon dioxide monitoring may be used, it is our opinion that both these methods have independent indications and are sometimes also complementary to each other in patient care.

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23. Performance of a digital PCO2/SPO2 ear sensor
Author(s) Kocher S., Rohling R., Tschupp A.
Citation: Journal of clinical monitoring and computing, April 2004, vol./is. 18/2(75-79), 1387-1307 (Apr 2004)
Publication Date: April 2004
Abstract: OBJECTIVE: For determining the adequacy of ventilation, conventional pulse oximetry should be amended by PaCO2 (= arterial carbon dioxide partial pressure). This study investigates the precision of carbon dioxide measurements of the first digital ear-clip sensor providing continuous non-invasive monitoring of PaCO2, SpO2 (= functional arterial oxygen saturation as estimated with a pulse oximeter) and pulse rate and compares it to two conventional analog oximeters. METHODS: 30 hypoxemia episodes in 6 adult volunteers were investigated in a standardized protocol. Equipment: Masimo analog finger sensor, Nellcor analog ear sensor, SenTec digital ear sensor. RESULTS: The difference between PCO2 data (= PaCO2 estimated from the measured PcCO2 based on an algorithm by Severinghaus) (PcCO2 = cutaneous carbon dioxide pressure) and the PaCO2 is clinically unimportant. Therefore, we suggest, the two methods of estimating patient's carbon dioxide status can be used interchangeably. CONCLUSIONS: Combined digital SpO2/ PcCO2 ear sensors are very promising to allow for a fast and reliable monitoring of patient's oxygenation, hyper-/hypocapnia and ventilation with one single non-invasive probe. Optimal primary signal processing--amplification and digitalisation within the probe--allow for fast and reliable downstream signal processing algorithms. The resulting short SpO2 response times give the medical staff more time to take appropriate actions.
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24. Combined pulse oximetry/cutaneous carbon dioxide tension monitoring during colonoscopies: Pilot study with a smart ear clip
Author(s) Heuss L.T., Chhajed P.N., Schnieper P., Hirt T., Beglinger C.
Citation: Digestion, 2004, vol./is. 70/3(152-158), 0012-2823 (2004)
Publication Date: 2004
Abstract: Background: We compared the accuracy and practicability of a new combined ear sensor device measuring pulse oximetry and transcutaneous carbon dioxide tension. Methods: Validation studies were done by comparing the results of the combined sensor with arterial blood gas measurements. In an observational part, monitoring data were obtained from 25 patients undergoing colonoscopy, sedated with midazolam and alfentanil and from 8 patients without sedation. Results: There was an excellent correlation between
the oxygen saturation and carbon dioxide tension measurements comparing the combined sensor with arterial blood gas analysis (R 0.96 and 0.93, respectively). A mean rise in transcutaneous carbon dioxide tension of 7.6 mm Hg was detectable during sedation with midazolam/alfentanil and of 2.3 mm Hg without sedation. Conclusion: Combined POX/PcCO$_2$ monitoring at the ear lobe is a novel approach to improve patient safety during sedation and may be helpful in preventing an unintentional slide into a state of deep sedation with impairment of ventilation. Copyright 2004 S. Karger AG, Basel.

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25. Arterialised capillary blood gases in accident and emergency department patients - A reliable alternative to arterial sampling?

Author(s) Shakur F., Mason S.


Publication Date: 2004

Abstract: OBJECTIVES: Many patients with respiratory complaints who present to the Accident & Emergency (A & E) department have an arterial blood gas analysis performed at some point. It is our belief that there is no difference between arterial and capillary blood gas values in patients presenting to the A & E department. It is also anticipated that body temperature and blood pressure may play a part, so these will also be reported and associations will be investigated. METHODS: Patients who require arterial blood gas analysis at any stage during their stay in the A & E department at the Northern General hospital of Sheffield are eligible for inclusion in the study. In total there were 32 patients.

PROCEDURE: Transvasin cream was applied to the ear lobe to improve local blood flow by dilating the capillaries. When ten minutes have elapsed after the application of the Transvasin cream, a capillary sample is taken from the ear lobe by the researchers.

CONCLUSION: From the t-tests conducted, no significant difference was seen between the arterial and capillary blood gas samples for the parameters pO$_2$ and O$_2$ saturation. However, for pCO$_2$, pH and [HCO$_3$] there were significant differences observed. This result seems to disagree with the findings of most other studies that have so far shown stronger correlations generally for pH, pCO$_2$ and bicarbonate, than for oxygen measuring parameters.

Source: EMBASE


Author(s) Dullenkopf A, Bernardo SD, Berger F, Fasnacht M, Gerber AC, Weiss M

Citation: Paediatric Anaesthesia, November 2003, vol./is. 13/9(777-84), 1155-5645;1155-5645 (2003 Nov)

Publication Date: November 2003

Abstract: BACKGROUND: The recently introduced TOSCA monitor (Linde Medical Sensors AG, Basel, Switzerland) combines pulse oximetry (SpO2) and transcutaneous PCO2 (PtcCO2) monitoring in a single ear sensor. The aim of the present study was to evaluate accuracy of the TOSCA monitor to estimate SaO2 and PaCO2 in anaesthetized children.

METHODS: With approval of the hospital ethical committee and after obtaining informed parental consent, the TOSCA sensor was attached to one ear lobe of anaesthetized children in whom arterial access was established for cardiac catheterization or invasive blood pressure monitoring. SpO and PtcCO2 as well as SpO and PECO2 values from the anaesthesia monitoring (AS5; Datex-Ohmeda, Helsinki, Finland) were compared with SaO2 and PaCO2 values from arterial blood gas analysis. Corresponding data were compared using Bland Altman bias analysis.

RESULTS: A total of 111 blood samples were taken from 60 children (median age: 4.41 years; 0.35-16.13 years). SaO2 values ranged from 63 to 100% (median: 98.7%), PaCO2 ranged from 3.8 to 7.3 kPa
(median: 4.6 kPa). Mean difference (+/- 2 sd) between PaCO2 and PtcCO2 was -0.035 kPa (+/-0.74 kPa), between PaCO2 and PECO2 0.002 kPa (0.73 kPa), respectively (1 kPa = 7.3 mmHg). Bias and precision between SaO2 and SpO was -0.63% (+/-2.77%) and 0.13% (+/-4.52%) between SaO2 and SpO.

CONCLUSIONS: In anaesthetized children, the TOSCA ear sensor allows estimation of SaO2 and PaCO2, comparable in accuracy to endtidal capnometry and finger pulse oximetry. This makes the TOSCA monitor a helpful add-on to respiratory monitoring in anaesthetized children, in situations, in which endtidal capnometry is unreliable or difficult to establish.

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27. Pulse oximeter ear probe.
Author(s) Avidan, A
Citation: Anaesthesia, 01 July 2003, vol./is. 58/7(726-726), 00032409
Publication Date: 01 July 2003
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28. How does the plethysmogram derived from the pulse oximeter relate to arterial blood pressure in coronary artery bypass graft patients?.
Author(s) Awad AA, Ghobashy MA, Stout RG, Silverman DG, Shelley KH
Citation: Anesthesia & Analgesia, December 2001, vol./is. 93/6(1466-71, table of contents), 0003-2999;0003-2999 (2001 Dec)
Publication Date: December 2001
Abstract: Twenty patients scheduled for coronary artery bypass grafting had their ear and finger oximeter and radial artery blood pressure (Bp(meas)) waveforms collected. The ear and finger pulse oximeter waveforms were analyzed to extract beat-to-beat amplitude and area and width measurements. The Bp(meas) waveforms were analyzed to measured systolic blood pressure (BP), mean BP, and pulse pressure. The correlation coefficient was determined between the derived waveforms from the pulse oximeter and Bp(meas) for the first 10 patients. The ear pulse oximeter width (Width(Ear)) had the best correlation (r = 0.8). Linear regression was done between Width(Ear) and Bp(meas) based on slope (b) and intercept (a) values, BP was calculated (Bp(calc)) in the next 10 patients as: [equation: see text] where i = systolic BP, mean BP, and pulse pressure. The initial bias was too large to be clinically useful. To improve clinical applicability a period of calibration was introduced in which the first 50 readings of Width(Ear) and Bp(meas) for each patient were used to calculate the intercept. After calibration the systolic BP, mean BP and pulse pressure bias values were -2.6, -1.88 and -1.28 mm Hg, and the precision values were 15.9 10.09, and 9.94 mm Hg, respectively. The present attempt to develop a clinically useful method of noninvasive BP measuring was partly successful with the requirement of a calibration period. IMPLICATIONS: Statistical comparison was made between measured blood pressure (BP) from arterial line and calculated BP derived from ear pulse oximeter waveform in 10 patients undergoing coronary artery bypass graft surgery. Using 62,077 paired readings, the mean difference for systolic BP, mean BP, and pulse pressure between the 2 methods was -2.6, -1.88, and -1.28 mm Hg, respectively.
29. Use of transcutaneous oxygen and carbon dioxide tensions for assessing indices of gas exchange during exercise testing.

Author(s) Carter R, Banham SW

Citation: Respiratory Medicine, April 2000, vol./is. 94/4(350-359), 0954-6111;0954-6111 (2000 Apr)

Abstract: The slow response characteristics of the combined transcutaneous electrode have been viewed as a major disadvantage when compared with other types of non-invasive assessment of gas exchange during exercise testing. We have previously shown that by using the highest recommended temperature of 45 degrees C to reduce response times, and combining this with an exercise protocol of gradual work load increments, that this allows changes in arterial blood gases to be closely followed by transcutaneous values. In the present study we have validated the use of a transcutaneous electrode for estimation of alveolar-arterial oxygen gradient (AaO2) and dead space to tidal volume ratio (V(D)/V(T)) during exercise, against values calculated from direct arterial blood gas analysis. One hundred measurements were made in 20 patients with various cardiopulmonary disorders who underwent exercise testing. Exercise testing was performed by bicycle ergometry with a specific protocol involving gradual work load increments at 2 min intervals. Transcutaneous gas tensions were measured by a heated combined O2 and CO2 electrode. Arterial blood was sampled at the midpoint of each stage of exercise and transcutaneous tensions noted at the end of each stage. The mean difference of the AaO2 gradient calculated from blood gas tensions obtained by the two methods was 0.14 kPa. The limits of agreement were -0.26 and 0.63 kPa. The same values for V(D)/V(T) calculated from gas tensions measured by the two methods were: mean difference 0.001; limits of agreement -0.0242 and 0.0252. For both these parameters there was an even scatter around the mean value on Bland and Altman analysis. The findings of this study suggest that estimation of parameters of gas exchange using transcutaneous values during exercise testing is reliable, provided the electrode is heated to a slightly higher temperature than usual and the work load increments are gradual, allowing for the latency in the response time of the system. This system allows the assessment of the contribution of ventilation/perfusion inequality to breathlessness on exertion in patients, provided an initial arterial or ear lobe capillary sample is obtained for calibration purposes. This technique is particularly valuable in patients undergoing repeat exercise tests as it circumvents the need for arterial cannulation.

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30. Clinical investigation of a new combined pulse oximetry and carbon dioxide tension sensor in adult anaesthesia

Author(s) Rohling R., Biro P.

Citation: Journal of clinical monitoring and computing, January 1999, vol./is. 15/1(23-27), 1387-1307 (Jan 1999)

Abstract: OBJECTIVE: To test the accuracy of a new combined oxygen saturation and cutaneous carbon dioxide tension (SPO2-PCO2) sensor in a routine adult clinical environment. This probe provides a non-invasive and continuous monitoring of the arterial
oxyhaemoglobin saturation, arterial carbon dioxide tension and pulse rate at the ear lobe. The sensor is intended to measure both relevant respiration/ventilation parameters in one single probe. METHODS: Ten adult patients were consecutively studied during general anaesthesia. During the first 5 min after sensor placement at the ear lobe, arterial blood samples were drawn each minute. Carbon dioxide tension and oxygen saturation measurements were obtained simultaneously at 1-min intervals. After this period, patients were hyper-, normo- and hypoventilated. After 15 min at each setting, the simultaneously obtained cutaneous and arterial carbon dioxide tension values were compared. RESULTS: A total of 80 comparisons between ear lobe SpO2-PCO2 measurement, finger clip pulse oximetry and arterial blood gas values were analysed. Three minutes after sensor placement, there were no significant differences between ear probe (cutaneous) and arterial carbon dioxide tensions (p = 0.367). Comparison of arterial with cutaneous carbon dioxide values demonstrated an excellent linear correlation (r2 = 0.92), and showed a standard error of estimate (SDEE) of 0.26 kPa (1.95 mmHg) only. The mean difference was -0.08 kPa (-0.60 mmHg) with a limits of agreement range of -0.38 kPa to +0.22 kPa (-2.85 mmHg to +1.65 mmHg). Concerning oxygen saturation measurements, the absolute SpO2 value deviated 1% or less from standard pulse oximetry. CONCLUSIONS: During general anaesthesia, postoperative recovery and critical care treatment, both monitoring of oxygenation and ventilation is important. Since pulse oximetry estimates only arterial oxygen saturation, periodic blood sampling is still necessary to determine the patient's arterial carbon dioxide status. We could demonstrate that the difference between cutaneous and arterial PCO2 was clinically unimportant, and therefore we conclude that the two methods of estimating the patient's carbon dioxide status may be used interchangeably. Our results demonstrated that 3 min after sensor placement, the new SpO2-PCO2 sensor prototype proved to be a reliable tool for continuous non-invasive monitoring of oxygenation and ventilation.

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31. Meta-analysis of arterial oxygen saturation monitoring by pulse oximetry in adults

Author(s) Jensen L.A., Onyskiw J.E., Prasad N.G.N.

Citation: Heart and Lung: Journal of Acute and Critical Care, November 1998, vol./is. 27/6(387-408), 0147-9563 (November/December 1998)

Publication Date: November 1998

Abstract: OBJECTIVE: The purposes of the study were to: (1) describe the aggregate strength of the relationship of arterial oxygen saturation as measured by pulse oximetry with the standard of arterial blood gas analysis as measured by co-oximetry, (2) examine how various factors affect this relationship, and (3) describe an aggregate estimate of the bias and precision between oxygen saturation as measured by pulse oximetry and the standard in vitro measures. DESIGN: A meta-analysis was conducted. SAMPLE: Seventy-four studies from 1976 to 1994 met the inclusion criteria of: (1) adult study population, (2) quantitative analysis of empirical data, and (3) bivariate correlations or bias and precision estimates between pulse oximeter and co-oximeter values. RESULTS: There were a total of 169 oximeter trials on 41 oximeter models from 25 different manufacturers. Studies were conducted in various settings with a variety of subjects, with most being healthy adult volunteers. The weighted mean r, based on 39 studies (62 oximeter trials) for which the r statistic and number of data points were available, was 0.895 (var [r] = 0.014). Based on 23 studies (82 oximeter trials) for which bias and precision estimates and number of data points were available, the mean absolute bias and precision were 1.999 and 0.233, respectively. Several factors were found to affect the accuracy of pulse oximetry. CONCLUSION: Pulse oximeters were found to be accurate within 2% (+/- 1 SD) or 5% (+/- 2 SD) of in vitro oximetry in the range of 70% to 100% SaO2. In comparing ear and finger probes, readings from finger probes were more accurate. Pulse oximeters may fail to record accurately the true Sao2 during severe or rapid desaturation, hypotension, hypothermia, dyshemoglobinemia, and low perfusion states.

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32. Pulse oximetry
Author(s) Madigan R.
Citation: Critical care nurse, June 1998, vol./is. 18/3(26-27), 0279-5442 (Jun 1998)
Publication Date: June 1998
Source: EMBASE
Available in print at ULHT journal article requests. Complete the online form to obtain articles.

33. Is the ear lobe a suitable site for probe location in pulse oximetry?... "Pulse Oximetry" by Mary Jo Grap, Protocols for Practice, February 1998... Nellcor Puritan Bennett sensor.
Author(s) Renfro T, Madigan R, Grap MJ, McGaffigan PA
Citation: Critical Care Nurse, 01 June 1998, vol./is. 18/3(25-27), 02795442
Publication Date: 01 June 1998
Source: CINAHL
Available in print at ULHT journal article requests. Complete the online form to obtain articles.

34. Transcutaneous monitoring of blood gases: is it comparable with arterialized earlobe sampling?.
Author(s) Dawson S, Cave C, Pavord I, Potter JF
Citation: Respiratory Medicine, March 1998, vol./is. 92/3(584-7), 0954-6111;0954-6111 (1998 Mar)
Publication Date: March 1998
Abstract: Researchers are increasingly looking for reliable non-invasive methods of assessing blood gas concentrations, and several new techniques have recently become available. Values derived using arterialized earlobe samples have been found to be comparable with conventional arterial samples, and recent studies have compared transcutaneous blood gas analysis with the traditional arterial samples and found a reasonable level of agreement in particular for the partial pressure of carbon dioxide. There are no data comparing oxygen and carbon dioxide partial pressures (pO2, pCO2) derived from arterialized samples with one of the newer transcutaneous techniques. We therefore simultaneously studied arterialized earlobe blood gas samples and values for pO2 and pCO2 obtained by a transcutaneous monitor (TINA, Radiometer, Copenhagen) in 26 subjects with varying blood gas values. There was a close agreement between the two methods for assessment of pCO2 [mean difference (95% C.I.) between transcutaneous and earlobe values 0.25 kPa (-0.004, 0.5 kPa)], but not for pO2 [1.71 kPa (0.35, 3.07 kPa)]. Similarly, the limits of agreement were narrow for pCO2 compared to those for pO2 (-0.98, 1.47 kPa and -6.44, 3.02 kPa respectively). We conclude that transcutaneous measurement of pCO2 using the TINA is acceptable in the research setting, whereas assessment of pO2 cannot reliably be made using this technique.
Source: Medline
Available in print at ULHT journal article requests. Complete the online form to obtain articles.

Author(s) Fajac I, Texereau J, Rivoal V, Dessanges JF, Dinh-Xuan AT, Dall'Ava-Santucci J
Citation: European Respiratory Journal, March 1998, vol./is. 11/3(712-5), 0903-1936;0903-
Abstract: Sampling arterialized earlobe blood is thought to be easier and less painful than direct arterial puncture, and to allow measurement of blood gas values during exercise without the need to insert an arterial cannula. However, arterialized earlobe oxygen tension (PO2) often underestimates arterial PO2 at rest, and is not fully validated during exercise. We have therefore conducted a prospective study to compare values of PO2 and carbon dioxide tension (PCO2) and the discomfort experienced by adult subjects undergoing the two methods of blood sampling during exercise. Seventy consecutive adult patients were studied. Blood samples were drawn simultaneously from the radial artery and arterialized earlobe of each patient during the last minute of an 8 min exercise. Values of PO2 and PCO2 were measured by means of blood gas electrodes. The correlation coefficients between the two samples were 0.92 for PO2 and 0.91 for PCO2. However, the bias and the limits of agreement between the two methods were wide for PO2 (mean+/−2SD of the differences between the two methods: 0.63+/−1.50 kPa (4.7+/−11.2 mmHg)). The bias and the limits of agreement were smaller for PCO2. Patients felt that the earlobe method was not associated with less discomfort than radial artery puncture. We conclude that arterialized earlobe blood oxygen tension is not a good substitute for arterial oxygen tension during exercise, and should not be used to assess arterial oxygen tension in adults during exercise.

Source: Medline

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Available in print at ULHT journal article requests. Complete the online form to obtain articles.

36. Correlation of pulse oximetry and co-oximetry

Author(s) Tittle M., Flynn M.B.

Citation: Dimensions of Critical Care Nursing, March 1997, vol./is. 16/2(88-95), 0730-4625 (1997 Mar-Apr)

Abstract: Pulse oximetry is an important advancement in noninvasive monitoring and assessment of arterial blood oxygenation. The purpose of this study was to assess the correlation of arterial oxygen saturation (SaO2) and pulse oximetry (SpO2) in critically ill patients using the ear and finger probes. Arterial oxygen saturation was measured simultaneously by pulse oximetry with a finger and ear probe and an arterial blood gas sample. Results indicated that SpO2 does trend SaO2 but it appears that SpO2 measured by the finger probe is more closely correlated to SaO2 than SpO2 measured with an ear probe in this study sample.

Source: EMBASE

Available in print at ULHT journal article requests. Complete the online form to obtain articles.


Author(s) Tittle M, Flynn MB

Citation: Dimensions of Critical Care Nursing, 01 March 1997, vol./is. 16/2(88-95), 07304625

Abstract: Pulse oximetry is an important advancement in noninvasive monitoring and assessment of arterial blood oxygenation. The purpose of this study was to assess the correlation of arterial oxygen saturation (SaO2) and pulse oximetry (SpO2) in critically ill patients using the ear and finger probes. Arterial oxygen saturation was measured.
38. Is arterialized earlobe blood PO2 an acceptable substitute for arterial blood PO2?
Author(s) Dall'Ava-Santucci J, Dessanges JF, Dinh Xuan AT, Lockhart A
Citation: European Respiratory Journal, June 1996, vol./is. 9/6(1329-30), 0903-1936;0903-1936 (1996 Jun)
Publication Date: June 1996
Source: Medline
Available in fulltext at Highwire Press
Available in print at ULHT journal article requests. Complete the online form to obtain articles.

39. Differences in PO2 and PCO2 between arterial and arterialized earlobe samples.
Author(s) Sauty A, Uldry C, Debetaz LF, Leuenberger P, Fitting JW
Citation: European Respiratory Journal, February 1996, vol./is. 9/2(186-9), 0903-1936;0903-1936 (1996 Feb)
Publication Date: February 1996
Abstract: Arterialized ear lobe blood samples have been described as adequate to gauge gas exchange in acute and chronically ill patients. It is a safe procedure, usually performed by medical technicians. We have conducted a prospective study to verify the validity of this method. One hundred and fifteen consecutive adult patients were studied. Blood samples were drawn simultaneously from arterialized earlobe and radial artery. Values of partial pressure of oxygen (PO2) and of carbon dioxide (PCO2) were measured by means of blood gas electrodes. The correlation coefficients between the two samples were 0.928 for PO2 and 0.957 for PCO2 values. In spite of a highly significant correlation, the limits of agreement between the two methods were wide for PO2. Earlobe values of PO2 were usually lower than arterial values, with larger differences in the range of normal arterial PO2. On the other hand, the error and the limits of agreement were smaller for PCO2. We conclude that, in adult patients, arterialized earlobe blood PO2 is not a reliable mirror of arterial PO2.
Source: Medline
Available in fulltext at Highwire Press
Available in print at ULHT journal article requests. Complete the online form to obtain articles.

40. The effect of a time delay on the measurement of capillary blood gases.
Author(s) Bird CM, Revill SM, Vara DD, Morgan MD
Citation: Respiratory Medicine, February 1996, vol./is. 90/2(107-9), 0954-6111;0954-6111 (1996 Feb)
Abstract: Patients using domiciliary nasal ventilation, or long-term oxygen, require regular assessment which could be carried out in the home. Blood gas analysis may be regarded as an essential part of the assessment. The present study investigated the effect of a 1-h time delay on the measurement of capillary blood gases. Four samples of arterialized earlobe blood were collected from 15 outpatients. One sample was analysed immediately, the other three were stored on crushed ice and analysed at intervals of 30, 45, and 60 min post-collection. In order to examine any range effect, a wide range of PaO2 values were examined. The delay, at all levels, resulted in minor changes in the measurement of PaO2, which would be unlikely to alter clinical management. The technique might be used for the reliable assessment of patients in the home.

Source: Medline

Available in print at ULHT journal article requests. Complete the online form to obtain articles.

41. Arterialised earlobe blood gas analysis: an underused technique.

Author(s) Pitkin AD, Roberts CM, Wedzicha JA

Citation: Thorax, April 1994, vol./is. 49/4(364-6), 0040-6376;0040-6376 (1994 Apr)

Abstract: BACKGROUND: Techniques for sampling arterialised capillary blood from the finger pulp and the earlobe were first described over two decades ago but, although close agreement between arterial values and earlobe samples has been demonstrated in normal subjects, this technique is not in common usage. METHODS: Forty patients with chronic lung disease and a wide range of arterial blood gas values were studied. Simultaneous earlobe and arterial samples were drawn with the patient at rest and analysed in the same blood gas analyser. The respiratory function laboratory staff in 50 UK hospitals with a respiratory department were telephoned and asked whether the technique was used in their hospital and the reasons, if known, for not adopting it. RESULTS: Earlobe and arterial blood gas tensions agreed closely over a wide range of values of arterial pH, PCO2 (mean difference 0.21, 95% confidence intervals -0.24 to +0.67 kPa) and PO2 (mean difference -0.17, 95% confidence intervals -1.09 to +0.75 kPa), especially at arterial PO2 values lower than 8 kPa. Of 50 UK centres surveyed 18% used the arterialised earlobe technique and 4% had plans to introduce it. Reasons for not using it were lack of knowledge in 64%, no blood gas analyser in 6%, the technique was considered inaccurate in 4%, and insufficient staff in 4%. CONCLUSIONS: Although earlobe blood gas analysis is sufficiently accurate to be reliably substituted for arterial sampling in routine clinical practice, most centres in the UK do not use the technique. The main reasons for this appear to be lack of knowledge of its existence and uncertainty over its accuracy.

Source: Medline

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Available in print at ULHT journal article requests. Complete the online form to obtain articles.

42. The response times during anaesthesia of pulse oximeters measuring oxygen saturations during hypoxaemic events.

Author(s) Broome, I J, Harris, R W, Reilly, C S

Citation: Anaesthesia, 01 January 1992, vol./is. 47/1(17-19), 00032409

Publication Date: 01 January 1992

Source: CINAHL

Available in print at ULHT journal article requests. Complete the online form to obtain articles.
43. Inaccuracy of pulse oximetry in patients with severe tricuspid regurgitation.
Author(s) Stewart, K G, Rowbottom, S J
Citation: Anaesthesia, 01 August 1991, vol./is. 46/8(668-670), 00032409
Publication Date: 01 August 1991
Source: CINAHL
Available in print at ULHT journal article requests. Complete the online form to obtain articles.

44. Pulse oximeter probes. A comparison between finger, nose, ear and forehead probes under conditions of poor perfusion.
Author(s) Clayton, D G, Webb, R K, Ralston, A C, Duthie, D, Runciman, W B
Citation: Anaesthesia, 01 April 1991, vol./is. 46/4(260-265), 00032409
Publication Date: 01 April 1991
Source: CINAHL
Available in print at ULHT journal article requests. Complete the online form to obtain articles.

45. Reliability of noninvasive oximetry in black subjects during exercise and hypoxia
Author(s) Zeballos R.J., Weisman I.M.
Citation: American Review of Respiratory Disease, 1991, vol./is. 144/6(1240-1244), 0003-0805 (1991)
Publication Date: 1991
Abstract: The effect of skin pigmentation on the reliability of noninvasive oximetry, especially during exercise and hypoxia, has not been thoroughly investigated. This is the first study, to our knowledge, that specifically addresses this question. Thirty-three young black men performed multistage, steady-state cycle ergometry, breathing gas mixtures simulating different altitudes: 33 breathed gas simulating sea level (Pi(O_2) = 146 mm Hg), 11 breathed gas simulating 2,300 m (Pi(O_2) = 110 mm Hg), and 22 breathed gas simulating 4,000 m (Pi(O_2) = 85 mm Hg). Co-oximeter Sa(O_2) determinations were performed in arterial blood samples obtained concurrently with ear oximetry that was measured using Hewlett-Packard 47201A (HP) and Blox IIA oximeters. The mean error or bias for the [HP - Sa(O_2)] and for [Blox IIA - Sa(O_2)] were: at simulated sea level (Sa(O_2) > 96%): -0.4 +/- 0.3% and 2.1 +/- 0.3%; at simulated 2,300 m (range of Sa(O_2) means, 89 to 94%): -0.8 +/- 0.5% and 3.5 +/- 0.9%; for simulated 4,000 m (range of Sa(O_2) means, 75 to 84%): -4.8 +/- 1.6% and 9.8 +/- 1.8%, respectively. A better coefficient correlation was observed for all the pairs between Sa(O_2) versus HP (r = 0.94, p < 0.001, n = 279) than for the Sa(O_2) versus Blox IIA (r = 0.80, p < 0.001, n = 242). In conclusion, the HP oximeter appears to estimate Sa(O_2) more accurately than the Blox IIA oximeter. The previously described overestimation for the Blox IIA ear oximeter and the underestimation for the HP ear oximeter at low Sa(O_2) values in whites is exaggerated in blacks. Although noninvasive oximetry may be used to follow desaturation trends in blacks, it would be unreliable to estimate absolute Sa(O_2). The clinical utility of noninvasive oximetry in blacks is unacceptable at values of Sa(O_2) <= 85% for the HP and < 90% for the Blox IIA oximeters. The effect of skin pigmentation on the reliability of the many newer pulse oximeters requires further investigation.
Source: EMBASE
Available in print at ULHT journal article requests. Complete the online form to obtain articles.
46. Ear oximetry for polysomnographic investigations in actual practice

Author(s) Aubry P., Jounieaux V., Rose D., Levi-Valensi P.

Citation: The European respiratory journal. Supplement, October 1990, vol./is. 11/(517s-518s), 0904-1850 (Oct 1990)

Publication Date: October 1990

Source: EMBASE

Available in print at ULHT journal article requests. Complete the online form to obtain articles.

47. Reliability of transcutaneous PO2 measurements and ear oximetry at different levels of exercise [French] Fiabilité de la PO2 transcutanée et de l'oxymétrie par pince d'oreille à différents niveaux d'exercice

Author(s) Chailleux E., Caby I., Hervouet A., Ordronneau J., Chollet S.

Citation: Revue des maladies respiratoires, 1989, vol./is. 6/3(229-235), 0761-8425 (1989)

Publication Date: 1989

Abstract: Measurement of transcutaneous PO2 (PtcO2) and of the saturation of hemoglobin by ear oximetry (StcO2) are two non-invasive methods which can be used when performing exercise tests in patients with respiratory failure. To evaluate their reliability, we have compared 18 patients recording the PtcO2 (Radiometer electrode TCM1) and of StcO2 (Biox II A) with arterial samples using a radial artery catheter at rest and at a level corresponding to 50% of the maximal predicted effort and at maximal power (Wmax) obtained at the time of a triangular exercise (increasing the charge at 15 watts/min). The PtcO2 was significantly lower than the PaO2 at rest and on exercise: the variation between PaO2 and PtcO2 was 1.85 kPa at rest (confidence interval -0.25 to 3.96 kPa) but decreased with exercise reaching 1.22 kPa at the last level of exercise (confidence interval -1.2 to 3.65 kPa). The relative raising of PtcO2 in relation to the PaO2 masks a fall in the observed PaO2 on average for the entire group (the PaO2 falls from 9.49 kPa to 8.62 kPa whereas the PtcO2 only falls from 7.64 kPa to 7.39 kPa). The mean StcO2 does not differ from th SaO2 at rest as on exercise. However, the confidence interval of the scatters between SaO2 and StcO2 increase considerably at maximal power: whereas it ranges between -5.5 and 3.5% at rest and in the middle range effort, and is between -13.4 and 11.1% at the last stage.(ABSTRACT TRUNCATED AT 250 WORDS)

Source: EMBASE

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48. Skin color and ear oximetry

Author(s) Ries A.L., Prewitt L.M., Johnson J.J.

Citation: Chest, 1989, vol./is. 96/2(287-290), 0012-3692 (1989)

Publication Date: 1989

Abstract: Measurements of arterial blood oxygen saturation from two ear oximeters were compared with 655 simultaneously drawn arterial blood samples in 187 patients grouped by skin color quantified by the Munsell color system. Technical problems including warning lights and messages with the two ear oximeters were recorded. There were significantly more technical problems in patients with the darkest skin color associated with inability to obtain a reading or warning messages indicating poor tissue penetration of the signal (18 and 15 percent vs 1 percent). When readings could be obtained, the ear oximetry readings were found to be slightly less accurate in the darker patient groups. These findings suggest that dark skin color may affect the performance and accuracy of ear oximeters, including the newer type of pulse oximeters.
49. Accuracy of pulse oximetry to estimate HbO2 fraction of total Hb during exercise

Author(s): Powers S.K., Dodd S., Freeman J., Ayers G.D., Samson H., McKnight T.
Citation: Journal of Applied Physiology, 1989, vol./is. 67/1(300-304), 0161-7567 (1989)
Publication Date: 1989

Abstract: The accuracy of two pulse oximeters (Ohmeda 3700 and Biox IIa) was evaluated during cycle ergometer incremental exercise in 10 healthy subjects. The exercise protocol began at 30 W with the power output being increased 15 W/min until volitional fatigue. Ear and finger probe pulse oximetry measurements of available hemoglobin (%Sp(O2)) were compared with arterial oxyhemoglobin fraction of total hemoglobin (%HbO2) measured directly from arterial blood samples using a CO-oximeter. To provide a wide range of %HbO2 values, four subjects exercised under hypoxic conditions [inspired partial pressure of O2 (P<sub>O2</sub>) = 107 Torr], while the remaining six subjects exercised under normoxic conditions (P<sub>O2</sub>) = 150 Torr). Because carboxyhemoglobin (HbCO) or methemoglobin (MetHb) is not measured by pulse oximeters, %HbO2 was corrected for HbCO and MetHb and expressed as percent arterial O2 saturation of available Hb (%Sa(O2)). Small and insignificant differences (P > 0.05) existed between Sp(O2) (all 3 instruments) and %Sa(O2) at the lowest work rate and the highest power output achieved. Regression analyses of %Sp(O2) vs. %Sa(O2) produced correlation coefficients of r = 0.82 (standard error of the estimate (SEE) = 1.79), r = 0.89 (SEE = 1.48), and r = 0.93 (SEE = 1.14) for the Biox IIa, Ohmeda 3700 (ear), and the Ohmeda 3700 (finger) pulse oximeters, respectively. We conclude that pulse oximetry, within the above limits of accuracy, is useful in estimating %Sa(O2) during exercise in healthy subjects.

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50. [Reliability of transcutaneous PO2 measurements and ear oximetry at different levels of exercise]. [French] Fiabilité de la PO2 transcutanée et de l'oxymétrie par pince d'oreille à différents niveaux d'exercice.

Author(s): Chailleux E, Caby I, Hervouet A, Ordronneau J, Chollet S
Citation: Revue des Maladies Respiratoires, 1989, vol./is. 6/3(229-35), 0761-8425;0761-8425 (1989)
Publication Date: 1989

Abstract: Measurement of transcutaneous PO2 (PtcO2) and of the saturation of hemoglobin by ear oximetry (StcO2) are two non-invasive methods which can be used when performing exercise tests in patients with respiratory failure. To evaluate their reliability, we have compared 18 patients recording the PtcO2 (Radiometer electrode TCM1) and of StcO2 (Biox II A) with arterial samples using a radial artery catheter at rest and at a level corresponding to 50% of the maximal predicted effort and at maximal power (Wmax) obtained at the time of a triangular exercise (increasing the charge at 15 watts/min). The PtcO2 was significantly lower than the PaO2 at rest and on exercise: the variation between PaO2 and PtcO2 was 1.85 kPa at rest (confidence interval -0.25 to 3.96 kPa) but decreased with exercise reaching 1.22 kPa at the last level of exercise (confidence interval -1.2 to 3.65 kPa). The relative raising of PtcO2 in relation to the PaO2 masks a fall in the observed PaO2 on average for the entire group (the PaO2 falls from 9.49 kPa to 8.62 kPa whereas the PtcO2 only falls from 7.64 kPa to 7.39 kPa). The mean
StcO2 does not differ from th SaO2 at rest as on exercise. However, the confidence interval of the scatters between SaO2 and StcO2 increase considerably at maximal power: whereas it ranges between -5.5 and 3.5% at rest and in the middle range effort, and is between -13.4 and 11.1% at the last stage. (ABSTRACT TRUNCATED AT 250 WORDS)

Source: Medline

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51. Accuracy of response of six pulse oximeters to profound hypoxia.

Author(s) Severinghaus JW, Naifeh KH

Citation: Anesthesiology, October 1987, vol./is. 67/4(551-8), 0003-3022;0003-3022 (1987 Oct)

Publication Date: October 1987

Abstract: Oxygen saturation, SpO2%, was recorded during rapidly induced 42.5 +/- 7.2-s plateaus of profound hypoxia at 40-70% saturation by 1 or 2 pulse oximeters from each of six manufacturers (NE = Nellcor N100, OH = Ohmeda 3700, NO = Novametrix 500 versions 2.2 and 3.3 (revised instrumentation), CR = Criticare CSI 501 + version .27 and version .28 in 501 & 502 (revised instrumentation), PC = PhysioControl Lifestat 1600, and MQ = Marquest/Minolta PulseOx 7). Usually, one probe of each pair was mounted on the ear, the other on a finger. Semi-recumbent, healthy, normotensive, non-smoking caucasian or asian volunteers (age range 18-64 yr) performed the test six to seven times each. After insertion of a radial artery catheter, subjects hyperventilated 3% CO2, 0-5% O2, balance N2. Saturation ScO2, computed on-line from mass spectrometer end-tidal PO2 and PCO2, was used to manually adjust FIO2 breath by breath to obtain a rapid fall to a hypoxic plateau lasting 30-45s, followed by rapid resaturation. Arterial HbO2% (Radiometer OSM-3) sampled near the end of the plateau averaged 55.5 +/- 7.5%. ScO2% (from the mass spectrometer) and SaO2% (from pH and PO2, by Corning 178) differed from HbO2% by +0.2 +/- 3.6% and 0.4 +/- 2.8%, respectively. The mean and SD errors of pulse oximeters (vs. HbO2%) were: (table; see text) The plateaus were always long enough to permit instruments to demonstrate a plateau with ear probes, but finger probes sometimes failed to provide plateaus in subjects with peripheral vasoconstriction. Nonetheless, SpO2 read significantly too low with finger probes at 55% mean SaO2. (ABSTRACT TRUNCATED AT 250 WORDS)

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52. Accuracy of an the ear oximeter Biox-III and its sensitivity to carboxyhemoglobin in Mexico City. [Spanish] Exactitud del oximetro de oido (Biox-III) en la ciudad de Mexico y su sensibilidad a la carboxihemoglobina.

Author(s) Perez-Padilla JR, Bracamonte-Peraza R, Manrique G, Ruiz-Primo ME

Citation: Archivos del Instituto de Cardiologia de Mexico, July 1986, vol./is. 56/4(303-7), 0020-3785 (1986 Jul-Aug)

Publication Date: July 1986

Abstract: Ear oximeters estimate arterial oxygen saturation (SaO2) measuring the characteristics of light transmission through the ear lobe. We tested the accuracy of a new ear oximeter (Biox-III) in Mexico City comparing its estimates (SaO2OXI) with SaO2 measured by a Co-Oximeter, in a simultaneously taken arterial blood sample. We used two indexes in the arterial sample: SaO2 of the total hemoglobin (SaO2T) given directly by the Co-Oximeter and SaO2 of the hemoglobin available for oxygenation (SaO2A) which corrects for the presence of carboxyhemoglobin and metahemoglobin. We studied 21 subjects with a total of 100 simultaneous samples with a SaO2T ranging from 36.2% to 97.2%. The samples were obtained with the subjects resting, during light exercise, during rebreathing and increasing the FiO2. Spearman and Pearson's correlation coefficients between SaO2OXI and SaO2A were 0.97, and between SaO2OXI and SaO2T were 0.96. Linear regression equations were: SaO2T = 2.047 (SaO2OXI) - 8.5 and SaO2A = 1.102 (SaO2OXI) -
9.32. Slopes of the equations and correlation coefficients were statistically significant (P less than 0.001). Mean error of Sa02OXI compared with Sa02T (Sa02T-Sa02OXI) was -4.4% and compared with Sa02A (Sa02A-Sa02OXI) was -0.4%, with a standard deviation of 3.4% and 3.5% respectively. In the presence of carboxyhemoglobin the ear oximeter overestimates Sa02T but not Sa02A. Measurement error increases during rebreathing maybe because error increases at low Sa02 and because of the delay in oximeter’s response in a situation of a continuously falling Sa02. Ear oximeter Biox-III estimates Sa02 in Mexico City as accurately as the Biox-IIA at sea level. Sa02 measurement is quick, easy, continuous and non-invasive, which increase its potential clinical and research application.

Source: Medline

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53. Accuracy of two ear oximeters at rest and during exercise in pulmonary patients.

Author(s) Ries AL, Farrow JT, Clausen JL

Citation: American Review of Respiratory Disease, September 1985, vol./is. 132/3(685-9), 0003-0805;0003-0805 (1985 Sep)

Publication Date: September 1985

Abstract: The accuracy of 2 ear oximeters (Hewlett-Packard 47201A and Biox IIa) was evaluated at rest and during exercise in 116 pulmonary patients. Ear oximetry measurements were compared with arterial oxygen saturation (SaO2) measured from simultaneous arterial blood samples. When used according to the manufacturer’s instructions for stabilization during exercise testing, both oximeters demonstrated comparable accuracy in estimating arterial blood SaO2 both at rest and during exercise in these patients (95% confidence limits, 2 SEE = +/- 4 to 5%). The oximeters were more accurate in measuring a change in SaO2 from a previous reading (95% confidence limits, 2 SEE = +/- 2.5 to 3.5%). COHgb levels greater than 4% and dark skin pigmentation appeared to decrease the accuracy of ear oximetry measurements. Within the limitations of accuracy, both ear oximeters may be useful for clinical exercise testing in pulmonary patients.

Source: Medline

Available in print at ULHT journal article requests. Complete the online form to obtain articles.

54. The accuracy of the Hewlett-Packard 47201A ear oximeter below 50% saturation.

Author(s) Stradling JR

Citation: Bulletin Europeen de Physiopathologie Respiratoire, September 1982, vol./is. 18/5(791-4), 0395-3890;0395-3890 (1982 Sep-Oct)

Publication Date: September 1982

Abstract: The Hewlett-Packard 47201A ear oximeter has been shown to measure arterial oxygen saturation (SaO2) above 50% SaO2 with an accuracy of +/- 5%. Below 50% SaO2, the oximeter underestimates arterial saturation in a predictable way, thus allowing a correction factor to be used: true SaO2 = (oximeter reading + 50)/2.

Source: Medline

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55. Evaluation of ear oximetry in the measurement of arterial oxygen saturation.

Author(s) Cable JA

Citation: Journal of the American Osteopathic Association, October 1981, vol./is. 81/2(107-12), 0098-6151;0098-6151 (1981 Oct)
56. [Mineworker’s dyspnea. 2. Evaluation of blood gas analysis using arterialized blood from the earlobe], [Dutch;French] Bijdrage tot de studie van de mijnwerkersdyspnoe. Tweede deel. Validatie van de bepalingen van de bloedgaswaarden met gearterialiseerd bloed uit de oorlel.

Author(s) Serra P, Minette A


Abstract: The authors compared the results of measurements of blood gases on arterialized blood taken at the earlobe and on arterial blood collected at the brachial artery. The measurements were made at rest and during exercise with the main pre-occupation of the respective feasibility and relevance of both techniques in epidemiology. Ninety-four in-patients suffering from respiratory diseases at various stages of their evolution were concerned by this investigation. The techniques of blood collection were standardized. In particular the authors took care that the blood samples were collected simultaneously at the brachial artery and at the earlobe. All blood samples were taken by the same trained experimenter. All the measurements were performed by the same experienced medical analyst. Both types of samples were compared by means of an apparatus Corning 165. As the authors also had a Corning 175 at their disposal, it was possible to investigate the importance of the factor “apparatus” in the differences which were stated. An approach of the role played by the measurement cells in these differences was possible by studying simultaneously by means of the Corning 165 a same sample of arterial blood before and after transfer in a heparinized capillary. The results suggest that the measurements on arterial and arterialized blood are concordant in in-patients at rest with the applied normalisation. During exercise, the differences are greater; nevertheless they are not large enough to reject the technics on arterialized blood in epidemiology. On the other hand the authors confirmed the observation of numerous other investigators showing that the method on arterialized blood gives on the average rise to underestimation. This might result from the technical characteristics of the measurement cells.

Source: Medline

Available in print at ULHT journal article requests. Complete the online form to obtain articles.

57. Arterial blood gas tensions and pH.

Author(s) Flenley DC

Citation: British Journal of Clinical Pharmacology, February 1980, vol./is. 9/2(129-35), 0306-5251:0306-5251 (1980 Feb)

Abstract: 1 The definition of PO2 and its relationship to the oxygen saturation (SO2) by the oxygen dissociation curve (ODC) is described with details of the ligands of the ODC and the effects of haemoglobinopathies on P50 (the position of the ODC) and the slope of the ODC (Hill’s ‘n’). 2 The definition of PCO2 and description of CO2 transport by blood leads to consideration of the basis of acid base balance. 3 Acid base balance is expressed in terms of arterial blood (H+) (or pH) PCO2 relationship using a non-logarithmic diagram. 4 The measurement of arterial blood gas tensions is described with comments on arterial puncture and available modern automated blood gas electrodes and their calibration. 5 Non-invasive indirect measurements of blood gas tensions, by ear oximetry are described, with calibration figures on the Hewlett-Packard 47021A ear oximeter. End-tidal PO2 and PCO2 measurements by mass spectrometer or infra-red CO2 analyser, and of transcutaneous PO2 measurements by a heated polarographic electrode are described. 6 These measurements are necessary to study the effects of pharmacological agents on the chemical control of breathing, on pulmonary gas exchange, and on acid base balance in
humans. The measurements are in everyday use in clinical practice, both to aid diagnosis of respiratory diseases, assess their severity, and to quantitate the effects of therapeutic agents.

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Author(s) Girsh LS, Girsh BJ
Citation: Annals of Allergy, January 1979, vol./is. 42/1(14-8), 0003-4738;0003-4738 (1979 Jan)
Publication Date: January 1979
Abstract: A newly developed technique in ear oximetry which can be performed in a doctor's office may obviate the need of sending an asthmatic patient to the hospital for arterial gas blood studies and may be a means of ear marking impending status asthmaticus and respiratory failure.
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Author(s) Krauss AN, Waldman S, Frayer WW, Auld PA
Citation: Journal of Pediatrics, August 1978, vol./is. 93/2(275-8), 0022-3476;0022-3476 (1978 Aug)
Publication Date: August 1978
Abstract: Two noninvasive methods of estimating arterial oxygenation were compared in a group of 48 infants ranging in birth weight from 870 to 4,000 gm, with diagnoses including apnea of prematurity, hyaline membrane disease, meconium aspiration, and congenital heart disease. Both transcutaneous oxygen measurements and ear oximetry gave reasonably accurate estimations of arterial oxygen levels within commonly used clinical ranges (PO2 50 to 70 mm Hg, arterial saturation 90 to 98%). Infants with shock demonstrated a wide range of values for transcutaneous oxygen levels, suggesting that this method has limited usefulness in this situation. Ear oximetry had limited ability to distinguish high, but safe, levels of arterial oxygen from excessively elevated levels. While neither method can be recommended for replacement of arterial oxygen sampling, both methods may be useful in a clinical setting if care is exercised in interpretation of the results and if the values obtained are checked against those from arterial blood.
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60. Ear oximetry in clinical practice.

Author(s) Chaudhary BA, Burki NK
Citation: American Review of Respiratory Disease, January 1978, vol./is. 117/1(173-5), 0003-0805;0003-0805 (1978 Jan)
Publication Date: January 1978
Abstract: The arterial blood O2 saturation measurement obtained by the Hewlett-Packard ear oximeter was compared to that derived from the arterial PO2 in 41 patients with various
pulmonary diseases and in 11 jaundiced patients with serum bilirubin concentrations between 2.7 and 35 mg per 100 ml. There was a good correlation between results obtained with the 2 methods in the jaundiced group ($r = + 0.85, n = 19$) and in the patients with pulmonary disease ($r = + 0.90, n = 57$); however, in the jaundiced patients, the ear oximeter arterial O2 saturation was significantly lower (-6.06 per cent, $n = 19, P < 0.01$) than the arterial O2 saturation derived from the arterial PO2. There was a significant correlation between the serum bilirubin concentration and the magnitude of difference between the oximeter arterial O2 saturation and the arterial PO2-derived arterial O2 saturation ($r = + 0.848, n = 16, P < 0.001$). In the nonjaundiced patients, the difference between the 2 measurements was small when the arterial P(O2) was greater than 61 mm Hg; the variation increased with lower arterial PO2 concentrations, but the difference was not significant.

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61. Ear oximetry: accuracy and practicability in the assessment of arterial oxygenation.
Author(s) Saunders NA, Powles AC, Rebuck AS
Citation: American Review of Respiratory Disease, June 1976, vol./is. 113/6(745-9), 0003-0805;0003-0805 (1976 Jun)
Publication Date: June 1976
Abstract: The accuracy of three ear oximeters (Waters XP-350, Waters 0-1100, Hewlett-Packard 47201A) was evaluated on 52 subjects during acute progressive and steady-state hypoxia. Ear oximeter readings were compared with measured arterial saturation (SAO2) in arterial or "arterialized" capillary blood samples. Hewlett-Packard (HP) 47201A ear oximeter readings most closely approximated measured Sao2 ($y=0.99x - 1.52, r=0.97$), although both the HP 47201A and Waters 0-1100 oximeters provided similarly accurate estimates of SAO2 once the characteristics of the individual oximeters were known (standard error of estimate; 2.52 and 2.98 per cent SAO2, respectively). The HP 47201A ear oximeter was relatively insensitive to changes in ear-piece position and differences in skin pigmentation, and offered the added advantages of comfort, simplicity of operation, and stability of characteristics.
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Author(s) Purschke R., Podlesch I., Schettler D.
Citation: Anaesthesist, March 1973, vol./is. 22/3(81-5), 0003-2417;0003-2417 (1973 Mar)
Publication Date: March 1973
Source: Medline

Author(s) Purschke R., Podlesch I., Schettler D.
Citation: Der Anaesthesist, March 1973, vol./is. 22/3(81-85), 0003-2417 (Mar 1973)
Publication Date: March 1973
64. [Clinical application of blood gas analysis of arterialized capillary vessels of the ear lobe].
Author(s) Osugi T, Shibata M
Citation: Iryo, September 1971, vol./is. 25/9(660-3), 0021-1699;0021-1699 (1971 Sep)
Publication Date: September 1971
Source: Medline
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65. Ear lobe blood samples for blood gas analysis at rest and during exercise.
Author(s) Godfrey S, Wozniak ER, Courtenay Evans RJ, Samuels CS
Citation: British Journal of Diseases of the Chest, January 1971, vol./is. 65/1(58-64), 0007-0971;0007-0971 (1971 Jan)
Publication Date: January 1971
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66. [Analysis of arterialized capillary blood by ear lobe method].
Author(s) Nonaka H, Tsurutani H, Okubo Y, Nagano H
Citation: Iryo, January 1971, vol./is. 25/1(29-32), 0021-1699;0021-1699 (1971 Jan)
Publication Date: January 1971
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67. SMALL BLOOD-SAMPLES FROM EAR-LOBE PUNCTURE: A SUBSTITUTE FOR ARTERIAL PUNCTURE.
Author(s) LANGLANDS JH, WALLACE WF
Citation: Lancet, August 1965, vol./is. 2/7407(315-7), 0140-6736;0140-6736 (1965 Aug 14)
Publication Date: August 1965
Source: Medline
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Some additional results

1. Capillary blood gases in acute exacerbations of COPD by Ross Murphy et al
Author(s) Cramer D.
Citation: Respiratory Medicine, September 2006, vol./is. 100/9(1668), 0954-6111 (September 2006)
Publication Date: September 2006
2. Initial transcutaneous PCO2 overshoot with ear probe at 42 degrees C

**Author(s)**: Kagawa S., Otani N., Kamide M., Gisiger P.A., Eberhard P., Severinghaus J.W.

**Citation**: Journal of clinical monitoring and computing, December 2004, vol./is. 18/5-6(343-345), 1387-1307 (Dec 2004)

**Publication Date**: December 2004

**Abstract**: OBJECTIVE: To investigate an unexpectedly high initial skin CO2 pressure with a new small earlobe probe* heated to 42 degrees C containing both transcutaneous (tcPCO2) and pulse oximeter saturation (SpO2) sensors. METHODS: The probe was mounted on the ear lobe of six patients during abdominal or thoracic surgery and on several awake volunteers. The probe was mounted on a cheek or forearm in two other volunteers. Patients were artificially ventilated under general anesthesia at constant end-expiratory PCO2. RESULTS: In patients, at 8 +/- 3 min after mounting, tcPCO2 peaked 5 mmHg higher than its final value (p = 0.0067, n = 6, paired t-test). After 25 min, tcPCO2 was not different from PaCO2 (arterial). Similar overshoots were recorded with this device when mounted on the arm or cheek and with a standard transcutaneous PCO2 probe set to 42 degrees C, mounted on the ear lobe, arm or chest of awake volunteers. In two volunteers, we found that heating the sensor to 45 degrees C for the first 15 min on the ear, and then decreasing it to 42 degrees C prevented overshoot, and provided valid tcPCO2 data 3 - 5 min after application of the sensor. CONCLUSIONS: A temperature of 42 degrees C may increase local skin temperature and metabolism before vasodilating more remote arteriolar control of sub-sensor capillary flow. We suggest that transcutaneous PCO2 probes be initially set to 44 - 45 degrees C for 5 - 15 min to induce prompt vasodilation to prevent this overshoot and then reduced to 42 degrees C to avoid skin thermal injury in case of long-term application.

**Source**: EMBASE

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3. The clinical utility of arterialized earlobe capillary blood in the assessment of patients for long-term oxygen therapy (multiple letters) [1]

**Author(s)**: Cramer D.

**Citation**: Respiratory Medicine, March 2002, vol./is. 96/3(204), 0954-6111 (March 2002)

**Publication Date**: March 2002

**Source**: EMBASE

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4. The clinical utility of arterialized earlobe capillary blood in the assessment of patients for long-term oxygen therapy

**Author(s)**: Eaton T., Rudkin S., Garrett J.E.

**Citation**: Respiratory Medicine, 2001, vol./is. 95/8(655-660), 0954-6111 (2001)

**Publication Date**: 2001

**Abstract**: The prescription of long-term oxygen (LTOT) is underpinned by the measurement of arterial PO<sub>2</sub>, generally obtained by radial artery puncture. This test is commonly associated with patient discomfort and a test that is reliable, well-tolerated and non-invasive would be advantageous. Cutaneous oximetry has not proved sufficiently accurate. Arterialized earlobe capillary sampling has been proposed, with some authors stating that it is under utilized. However, to date studies have yielded conflicting
results and the clinical utility remains uncertain. Our regional oxygen service based at a specialist respiratory hospital undertook a prospective study of consecutive patients with chronic respiratory disease undergoing assessment for LTOT. Simultaneous radial artery and arterialized earlobe sampling was performed. Rigorous steps were taken to ensure optimal arterIALIZATION of the earlobe samples. Agreement between arterial and arterialized PO<sub>2</sub> and PCO<sub>2</sub> was compared using the Bland-Altman method. One hundred patients were studied. Procedural difficulties (insufficient sample or air in sample) were similar for both procedures, however clotting occurred more frequently in arterialized earlobe samples. Sixty-four sample pairs were available for comparison. The bias and limits of agreement between arterialized and arterial PO<sub>2</sub> were wide, mean (+/- 2 SD), -0.48 (- 2.05-1.09) kPa. The bias and limits of agreement for PCO<sub>2</sub> were smaller. Using the absolute criterion (arterial PO<sub>2</sub> < 7.3 kPa), 9/55 (16%) patients would receive oxygen inappropriately based on the arterialized earlobe sample. Conversely, no patients would have been denied LTOT. Radial artery puncture gave rise to significantly greater discomfort (P < 0.0001) and level of concern (P < 0.0001). Patient preference strongly favoured arterialized earlobe sampling. However, despite rigorous attention to arterIALIZATION earlobe sampling was insufficiently accurate to replace radial artery puncture in the prescription of LTOT. 2001 Harcourt Publishers Ltd.

Source: EMBASE
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5. Blood gas estimations from arterialized capillary blood versus arterial puncture: are they different?.

Author(s) Hughes JM

Citation: European Respiratory Journal, February 1996, vol./is. 9/2(184-5), 0903-1936;0903-1936 (1996 Feb)

Publication Date: February 1996

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6. Sampling for analysing blood gas pressures [12]

Author(s) Pandit J.J., Bernhardt A., Barry P.W., Mason N.P., Collier D.

Citation: British Medical Journal, 1995, vol./is. 310/6986(1071-1072), 0959-8146 (1995)

Publication Date: 1995

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7. Capillary pH and blood gas determinations in asthmatic children.

Author(s) Davis RH, Beran AV, Galant SP

Citation: Journal of Allergy & Clinical Immunology, July 1975, vol./is. 56/1(33-8), 0091-6749:0091-6749 (1975 Jul)
Publication Date: July 1975

Abstract: Earlobe capillary pH and blood gases in asthmatic children were compared to arterial values. Hyperemia of the earlobe was produced by applying thurfyl nicotinate (Trafuril). Approximately 15 min later capillary blood was obtained simultaneously with a radial arterial sample. Earlobe capillary PO2, PO2, and pH correlated well with arterial values. This technique is simple, safe, and appears to be a satisfactory substitute for arterial blood in normotensive asthmatic children.

Source: Medline

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8. Capillary versus arterial blood gases.

Author(s) Sadove MS, Thomason RD, Jobgen E

Citation: Anesthesia & Analgesia, September 1973, vol./is. 52/5(724-7), 0003-2999;0003-2999 (1973 Sep-Oct)

Publication Date: September 1973

Source: Medline

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Available in print at ULHT journal article requests. Complete the online form to obtain articles.


Author(s) Hofford JM, Dowling AS, Pell S

Citation: JAMA, May 1973, vol./is. 224/9(1297), 0098-7484;0098-7484 (1973 May 28)

Publication Date: May 1973

Source: Medline

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