



VALIDATION OF A TRANSCUTANEOUS $tcPO_2/tcPCO_2$ SENSOR WITH AN OPTICAL OXYGEN MEASUREMENT IN PRETERM NEONATES

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BACKGROUND

Transcutaneous sensors continuously measure PO_2 and PCO_2 diffusing from the locally heated neonatal skin and estimate arterial levels. Conventional technology is hindered by measurement drift, requiring frequent calibration. The new fluorescence quenching technique for measuring oxygen is potentially drift-free.

AIMS

This study aims; 1) to validate a sensor with a new optical transcutaneous PO_2 ($tcPO_2$) and conventional electrochemical PCO_2 ($tcPCO_2$) measurement to arterial blood gas samples, and 2) to determine measurement drift.

CONCLUSION

Agreement of $tcPO_2$ and $tcPCO_2$ with blood gas samples was in line with literature on conventional sensors. Sepsis had negative effects on the agreement of O_2 , but did not affect the agreement of CO_2 . The sensor showed negligible drift for the optically measured $tcPO_2$ during clinical use. This study validates the investigated combined $tcPO_2/tcPCO_2$ sensor for clinical measurements in preterm neonates.

PATIENTS AND METHODS

Preterm neonates (24-32 weeks GA) were measured with the OxiVenT™ Sensor (SenTec AG, Switzerland). Sensor temperatures and site times differed between preterm (≥ 26 GA: $43^\circ C$ 3h) and extremely preterm (< 26 GA: $42^\circ C$ 2h) neonates. $TcPCO_2$ was calibrated when site time elapsed and $tcPO_2$ was calibrated daily to assess measurement drift. $TcPO_2$ and $tcPCO_2$ values were compared to arterial blood gas samples. Unstable measurements (± 3.75 mm Hg value change within 10 min) were excluded. Samples were divided into three groups regarding sepsis:

Sepsis: from one day before positive blood culture until end of antibiotic treatment.

Suspected sepsis: from one week before to one day before a positive blood culture when no normal laboratory results (C-reactive protein, leukocytes) were present and from one day before a negative blood culture until the end of antibiotic treatment.

No sepsis: all other samples.

Bland-Altman analysis was performed for both $tcPO_2$ - PaO_2 and $tcPCO_2$ - $PaCO_2$ comparisons. Bias and 95% limits of agreement (LoA) were calculated separately for the three groups. The LoA are calculated according to Bland (2007)¹. Results are presented as median (IQR).

RESULTS

Sixty-nine patients were included with a GA of $26\frac{4}{7}$ ($25\frac{2}{7}$ - $27\frac{4}{7}$) weeks. A total of 656 blood samples were collected with a median of 9 (4 - 14) samples per patient. Samples were excluded because of; unstable measurements ($n=413$) and elapsed site times ($n=5$). A total of 238 samples were analyzed; sepsis ($n=64$), suspected sepsis ($n=142$) and no sepsis ($n=32$). 197 samples were taken with a sensor temperature of $43^\circ C$, 41 samples at $42^\circ C$. The agreement between arterial O_2 and CO_2 values and all stable transcutaneous O_2 and CO_2 values are shown in Bland-Altman plots (figure 1). The absolute drift of $tcPO_2$ and $tcPCO_2$ was 1.34 ($0.5526 - 2.42$) mm Hg/day and 7.92 ($3.12 - 17.28$) mm Hg/day, respectively.

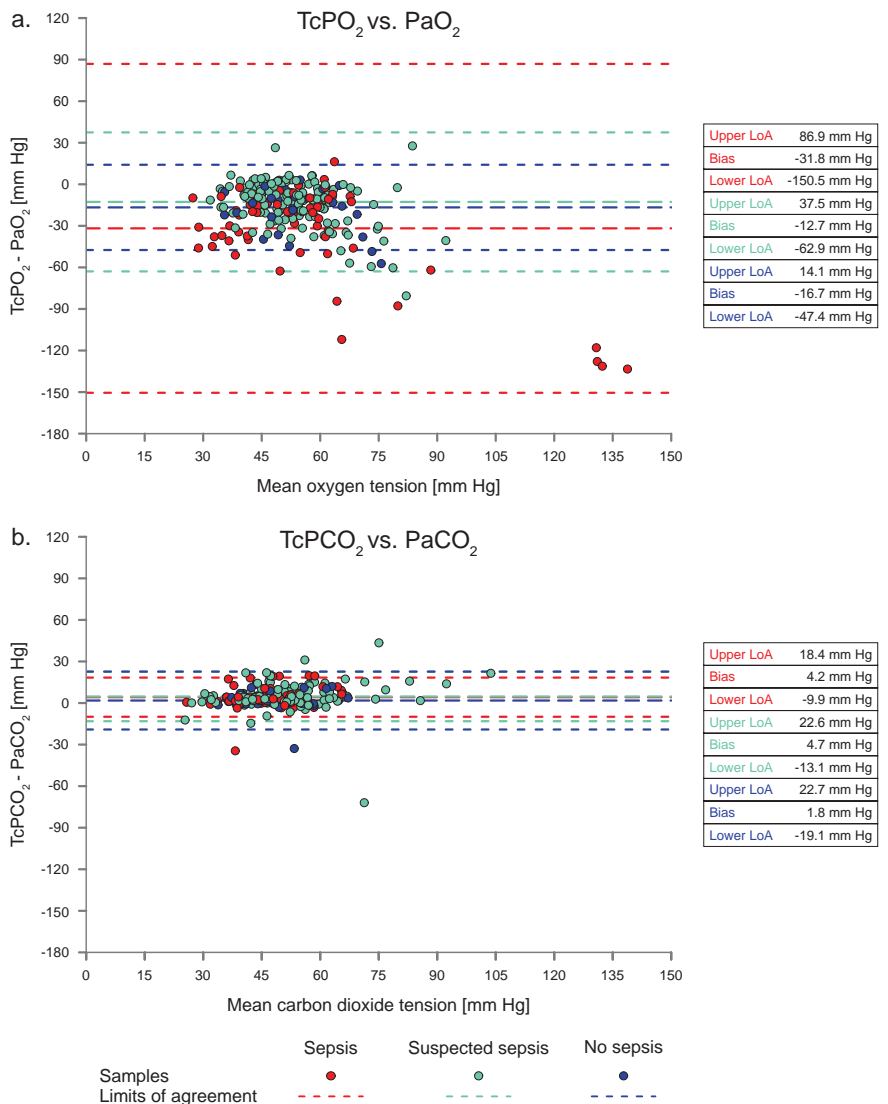


Figure 1: Bland-Altman plot of the agreement of transcutaneous measurement of **a)** the optically measured $tcPO_2$ with PaO_2 and **b)** the electrochemically measured $tcPCO_2$ with $PaCO_2$

¹ Bland, J. Martin and Altman, Douglas G., (2007) 'Agreement Between Methods of Measurement with Multiple Observations Per individual', *Journal of Biopharmaceutical Statistics*, 17:4, 571 - 582