Correlation of TcCO2 Values with PaCO2 Values in a Limited Set of Critically Ill Neonates

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Study Background
Currently, the gold standard to determine the arterial carbon dioxide tension (PaCO2) in critically ill neonates requires periodic arterial blood sampling. A new device, the SenTec Digital Monitor (Therwill, Switzerland), has the ability to obtain continuous, non-invasive transcutaneous carbon dioxide tension (TcCO2). If the TcCO2 and PaCO2 values correlate in a clinically meaningful fashion, the non-invasive and continuous technique of monitoring ventilation would be very useful, especially if it could be safely used on a wide range of neonates.

Objectives
- To assess the correlation of TcCO2 measurements obtained from the SenTec Digital Monitor with the standard of care PaCO2 values obtained from arterial blood gas samples in a limited set of critically ill neonates.
- To determine if there were any negative effects on the skin caused by the device.

Methods
- Inclusion criteria:
  Current weight \( \geq 1000 \) gms, need for mechanical ventilation, arterial access and signed informed consent by parents/legal guardians.
- The SenTec Digital Monitor sensor was placed on the abdominal wall of the patient per directions of the manufacturer. When a routine ABG sample was obtained, the reading on the device was recorded.
- A photograph of the abdomen was taken before placement and after removal of the monitor to evaluate for injury to the skin. Following completion of the study, the photographs were randomized and a blinded reviewer rated them as normal, mild erythema or burn/blistering.
- Study was approved by the IRB.

Results
- A total of 15 patients were enrolled in the study with gestational ages ranging from 27 weeks to term.
- Fig. 1 - Blinded review of photographs confirmed investigators exams revealing no adverse skin changes.
- Fig. 2 – The mean TcCO2 was slightly higher than the mean PaCO2.
- Fig. 3 – The correlation of TcCO2 and PaCO2 values is significant (P<0.0001, R2=0.7119).
- Fig. 4 – The TcCO2 overestimated the PaCO2 level with a mean difference and a S.D. of the differences of 3.45 +/-7.66.
- Fig. 5 – Over time, the absolute difference between the TcCO2 and PaCO2 values tended to improve.

Conclusions
- TcCO2 measurements obtained from the SenTec Digital Monitor sensor correlated with PaCO2 values obtained from arterial blood gas samples in a clinically relevant manner.
- The device was safe, not causing any adverse skin changes in this limited set of critically ill neonates.

Limitations and future directions
- The maintenance of proper probe placement by bedside staff was variable, but improved with familiarity with the device.
- Evaluation of ease of use and cost effectiveness should be considered.
- Efficacy in infants <1000gms should also be evaluated.