

# Accuracy of Pulse Oximeters During Neonatal Motion

Liberman R, Holmes M, Taschuk R, Snelling L. *Respiratory Care* 1999;44(12);1499

## Introduction


There are no accuracy studies on any pulse oximeters on neonates undergoing motion. The authors wished to test the clinical accuracy of two pulse oximeters that specify they are designed for motion.

## Methods

Neonatal sensors from a Masimo SET and an OXISMART (N-295) pulse oximeter were attached to opposing feet of an infant, whose feet were secured to a motion generator. The motion generator provided motion which was configured to simulate a kicking infant in frequency and amplitude. An additional pulse oximeter (N-200) was attached to the infant's right hand, which served as a "stationary" reference site (i.e., not exposed to the motion generator), although the neonate moved voluntarily during the study. ECG heart rate, pulse rate (PR) and SpO<sub>2</sub> were collected every second (1 Hz) by a computerized data acquisition (DAQ) system. A blood specimen (ABG) was drawn after 30 to 120 seconds of motion. The ABG draw time was noted in the DAQ file. The sensors were switched between feet and another ABG obtained after 30 - 120 seconds of applied motion. An AVL OMNI was used for ABG analysis of pH, PCO<sub>2</sub>, PO<sub>2</sub>, total Hb, %COHb, %MetHb, and functional %SaO<sub>2</sub>. The bias and precision of PR versus the ECG monitor heart rate and SpO<sub>2</sub> versus functional %SaO<sub>2</sub> were calculated (Table below). 122 ABG and DAQ samples were analyzed from 14 newborns: gestation of 22 - 40 weeks and weight of 495 - 4100 gms. Ten zero outs (SpO<sub>2</sub> display of 0 %) and one outlier > 6 $\Sigma$  were excluded from the calculations [N-295 (8), N-200 (2), and Masimo (1)].

## Results

The heart rate (via ECG monitor) ranged from 83 to 200 bpm. The ranges of ABG values were: pH of 7.20 to 7.55, PCO<sub>2</sub> of 22.0 to 63.6 mmHg, PO<sub>2</sub> of 44.4 to 111.6 mmHg, total Hb of 9.4 to 17.3, COHb of 0.0 to 4.2 %, MetHb of 0.8 to 2.6%, and SaO<sub>2</sub> of 82.7 to 95.8 %. The arterial oxygen saturation vs. pulse oximeter SpO<sub>2</sub> bias (SaO<sub>2</sub>-SpO<sub>2</sub>) and precision ( $\pm$  1 SD) for the pulse oximeters were: Masimo -0.9 ( $\pm$  2.3), N-295 +5.1 ( $\pm$  8.1), and reference N-200 +0.3 ( $\pm$  4.6). The ECG heart rate vs. pulse oximeter pulse rate bias (ECGHR-PR) and precision ( $\pm$  1 SD) for the pulse oximeters were: Masimo -0.1 ( $\pm$  3.0), N-295 -3.4 ( $\pm$  18.0), and reference N-200 +5.2 ( $\pm$ 20.9).

	 Masimo SET	Nellcor Oxismart
	<b>motion-foot</b>	<b>motion-foot</b>
<b>SpO<sub>2</sub></b>		
<b>Bias (Precision)</b>	<b>-0.9 (<math>\pm</math>2.3)</b>	<b>+5.1 (<math>\pm</math>8.1)</b>
<b>PR</b>		
<b>Bias (Precision)</b>	<b>-0.1 (<math>\pm</math>3.0)</b>	<b>-3.4 (<math>\pm</math>18.0)</b>

## Authors' Discussion and Conclusions

"Most pulse oximeter manufacturers state a precision for pulse rate of  $\pm$  3 bpm and a precision for SpO<sub>2</sub> of  $\pm$  3 % (at a bias of 0) in neonates during non-motion conditions. However, motion is common in this population. Motion adversely affects most pulse oximeters and spurious values can lead to inappropriate care. **Conventional pulse oximeters, including Oxismart, performed much worse than their published accuracy specification in this study. Masimo SET pulse oximetry reflected SaO<sub>2</sub> and ECG heart rate accurately during motion and broad use should improve care.**"