An Evaluation of Three New Generation Pulse Oximeters during Motion and Low Perfusion in Volunteers.

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Introduction

Pulse oximeter (PO) accuracy is often compromised by lower perfusion states and motion artifacts that can jeopardize patient safety in the OR, PACU and ICU. Many new generation POs claim to perform better during motion and low perfusion, especially under hypoxic conditions where accuracy is more critical. This study compared three new generation POs under conditions of low perfusion and motion in hypoxic and normoxic states.

Methods

Following informed consent, 11 ASA-I volunteers (5F & 6M) between 18 and 40 were enrolled. The PO tested were Masimo Radical V4.5, Nellcor N-595,V3100, and Datex-Ohmeda TruSat. Sensors were randomly placed on the index middle and ring fingers of the left hand (test) and the right hand (control) and all sensors were optically shielded. The room temperature was 16-18C to reduce peripheral perfusion. A TOSCA (PtcCO2 + Masimo Radical PO) sensor was placed on the right ear to serve as the control during hypoxia. During separate room air and desaturation (employing a disposable re-breathing circuit with a CO2 absorber to a SpO2 of 75% on the control PO, and the subject was then given 100% oxygen until the control SpO2 reached 100%) events, motion consisted of random tapping (with senor disconnect / reconnect) and random rubbing. Motions were machine- generated (MG) and self-generated (SG). The sensors were rotated and tested on all three fingers during the room air events. A computer recorded SpO2 and PR data. A missed event (false negative/sensitivity) was defined as the inability of the PO to detect desaturation and recover from a desaturation by the time the control reached 100%. A false alarm (false positive/ specificity) was recorded during the normoxic phase, and defined as a SpO2 ≤90% during motion. An ANOVA with Fischer's post hoc test was performed; $p<0.05$ was considered statistically significant.

Results

There were a total of 176 motion tests; 44 desaturation and 132 on room air. Missed events were counted out of 44 (22 with MG and 22 with SG) and false alarms out of 132 (66 with Mg and 66 with SG) motions.

Sensitivity and Specificity of PO during MG and SG

Device	Motion	Missed Events	Sensitivity	False Alarms	Specificity
Masimo Radical	MG	1/22	95%	0/6	100%
Masimo Radical	SG	0/22	100%	2/66	97%
Nellcor N-595	MG	3/22*	86%	16/66*	76%
Nellcor N-595	SG	7/22*	68%	15/66*	77%
Datex Ohmeda TruSat	MG	9/22*	59%	11/66*	83%
Datex Ohmeda TruSat	SG	10/22*	55%	13/66*	80%

*$p<0.05$ compared to Masimo

Conclusion

During hypoxic/normoxic and low perfusion states, Masimo Radical (v 4.5) performed better than Nellcor N-595 (v3100) and Datex Ohmeda TruSat with respect to maintaining accurate reading during motion.