A Comparison of the Accuracy of Three New Generation Pulse Oximeters (POs) during Motion and Low Perfusion in Human Volunteers.

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Introduction

POs accuracy is often compromised by low perfusion states and motion artifacts that can jeopardize patients' safety. Accuracy is especially important during hypoxic episodes for absolute patient safety. Many new generation POs claim to perform better during motion and low perfusion. This study compares three new generation POs under conditions of low perfusion and motion in hypoxic and normoxic states.

Methods

After IRB approval, 9 ASA I volunteers (5 M, 4 F) between the ages of 18-40 years were consented and enrolled. Masimo Radical (v. 4.3), Philips CMS (rev C1) and Nonin 9700 (2004) were studied. The left hand was used as test hand and the sensors were placed on index, middle, and ring fingers. Right hand fingers served as their control. All the sensors were covered to prevent optical cross-talk and to shield from extraneous light. The room was cooled down to 16-18 degrees C to reduce peripheral perfusion. All POs were tested on each of the three fingers. A Masimo Radical PO placed on the right ear served as the control for the hypoxia. During normoxemia motion was generated by a motor-driven motion table (MG) to obtain tapping at 3Hz with disconnect and reconnect of the sensors during motion, random tapping, tapping at 3Hz and random rubbing. Self-generated (SG) motion included random tapping with disconnect and reconnect and random rubbing. Hypoxia was induced by employing a disposable re-breathing circuit with a CO2 absorber to a SpO2 of 75% and the subject was then given 100% oxygen until the control SpO2 reached 100%. During hypoxemia, MG consisted of tapping at 3Hz, tapping at 3Hz with disconnect and reconnect of the sensors during motion, random tapping with disconnect & reconnect, and random rubbing. SG included a random tapping with disconnect-reconnect and random rubbing. PR & SpO2 data were recorded on-line for off-line analysis. A missed event (false negative/sensitivity) was defined as the inability of the monitor to recover after the desaturation, by the time the control monitor reached 100%. A false alarm (false positive/specificity) was recorded during the normoxic phase, and defined as a SpO2 of 90% or less during motion.

Results

Missed events were counted out of 54 (36 with MG and 18 with SG) & false alarms out of 135 (81 with MG & 54 with SG) motions. Table shows the results.

Sensitivity and specificity of POs during MG and SG

Device		Missed Event	Sensitivity	False Alarm	Specificity
Masimo Radical (v4.3)	MG	1/36	97%	1/81	99%
Masimo Radical (v4.3)	SG	0/18	100%	0/54	100%
Philips CMS (rev C1)	MG	6/36	83%*	3/81	96%*
Philips CMS (rev C1)	SG	2/18	89%*	4/54	93%*
Nonin 9700 (2004)	MG	13/36	64%*	7/81	86%*
Nonin 9700 (2004)	SG	9/18	50%*	11/54	80%*

*p=<0.05 vs. Masimo Radical

Conclusion

During hypoxic and low perfusion states, Masimo Radical PO (v. 4.3) outperformed Philips CMS (rev C1) and Nonin 9700 (2004) with respect to maintaining accurate readings during motion. Thus Masimo Radical may provide better patient safety by more accurate monitoring of SpO2 and PR.