

Does Machine Generated or Volunteer Generated Motion Influence Accuracy of Motion Resistant POs?

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Introduction

New generation "Motion Resistant" Pulse Oximeters (PO) have been studied in volunteers with machine generated motion (MGM) and volunteer generated motion (VGM). It is unclear whether test methodology affects POs performance. This study evaluated the effects of MGM and VGM using three motion resistant POs, during normoxia and hypoxia in presence of low perfusion during motion in volunteers.

Methods

Following informed consent, 10 ASA-I volunteers (5F & 5M) between 18-40 years old, were enrolled. POs tested were Masimo Radical (V5.0), Nellcor N-600 (V1.1.2.0), and Datex Ohmeda TruSat. Sensors were randomly placed on index, middle, and ring fingers of left hand (test), and right hand (control), and were optically shielded. The room temperature was lowered to 16-18°C to reduce peripheral perfusion. A Masimo Radical PO on the right ear served as the control during hypoxia. Volunteers were tested during separate room air and desaturation (employing a disposable re-breathing circuit with a CO₂ absorber to a SpO₂ of 75% on control PO, and the subject was then given 100% oxygen until the control SpO₂ reached 100%) events. Volunteers were subjected to random tapping (with sensor disconnect/reconnect) and random rubbing motions. Motions were machine generated (MGM) and volunteer generated (VGM) (volunteers were instructed to perform tapping and rubbing on their own instead of employing machine). The sensors were rotated laterally and tested on all three fingers during the room air events. A computer recorded SpO₂ & pulse rate (PR) data. A missed event ("ME", false negative/sensitivity) was defined as the inability of the PO to detect desaturation and to recover from a desaturation by the time the control reached 100%. A false alarm ("FA", false positive/specificity) was recorded during the normoxic phase, and defined as a SpO₂ ≤ 90% during motion. Failure rates (FR) is the % of time POs were off by 7% ("E7") for SpO₂ & off by 10% ("E10") for PR. Recovery time (RT) is defined as time required for the POs to recover SpO₂ and PR to control value. Zero Out (% of time when the POs zero out SpO₂ and/or PR) was calculated. A Zero Out also included the time when the monitor displayed "--". ANOVA and Fischers post hoc test were performed for statistical analysis. P<0.05 was considered statistically significant.

Results

There were a total of 160 motion tests; 40 with desaturations and 120 on room air; 80 during machine generated and 80 during self-generated motions. We detected FA 34 times with MGM vs. 20 with VGM. There were 23 ME with MGM, and 28 with VGM. The table shows the remaining results. We did not find any statistically significant difference between MGM and VGM in any of the recorded or calculated parameters.

Machine generated vs. Volunteer generated motion - effects on Pulse Oximeter Performance (mean ± SD)

MOTION	Recovery Time SpO ₂ % (min.)	Recovery Time PR (min)	E7 (min.) SpO ₂	E10 (min.) PR	Zero Out (min.) SpO ₂	Zero Out (min.) PR
MGM	.44 ± .80	.65 ± .92	2.5 ± 2.8	3.8 ± 2.7	.35 ± 1.1	.80 ± 1.8
VGM	.60 ± 1.1*	.87 ± 1.1*	2.3 ± 2.3*	3.5 ± 2.7*	.60 ± 1.6*	1.3 ± 2.3*

* = Statistically Non Significant compared to MGM

Conclusions

MGM was found to be similar to VGM during evaluation of motion resistant POs, hence either methodology can be utilized to evaluate the performance of new generation motion resistant POs.