Failure Rates & Recovery Times of New Generation POs during Motion and Low Perfusion in Volunteers.

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Introduction

Patient movement and low perfusion due to lower temperature is common in the PACU and OR, especially during extubation. How long the Pulse Oximeter (PO) takes to recover and display accurate SpO2 and Pulse Rate (PR) after motion induced failure is of paramount importance for the safety of patients. Our study compared the recovery time for SpO2 and PR for three major brands of new PO technologies.

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 placed on the right ear served 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 control PO, and the subject was then given 100% oxygen until the control SpO2 reached 100%) events, motion consisted of random tapping (with sensor disconnect/reconnect) and random rubbing. Motions were machine generated (MG) and self-generated (SG). The sensors were rotated laterally and tested on all three fingers during the room air events. A computer recorded SpO2 & pulse rate (PR) data. Recovery times and failure rates were analyzed. Recovery time (RT) is defined as time required for the POs to recover SpO2 and PR to control value. Failure rate (FR) is defined as % of time the POs displayed values off by 7% for SpO2 and 10% for PR of the control value at the end of motion. An ANOVA, with a Fischer's post hoc test, and Chi-square analysis, as appropriate, were used to compare the Recovery Time and Failure Rate results for the three oximeters. Significant differences were detected at the $p<0.05$ level (*) compared to Masimo.

Results

There were a total of 160 motion tests; 40 with desaturations and 120 on room air; 80 during motion generator, and 80 during self-generated motions.

RT and FR of POs during MG and SG

MACHINE GENERATED MOTION (MG)						
Device	SpO2 Mean RT in seconds (range)	SpO2 # of times Fail/Total	SpO2 Failure Rate	PR Mean RT in seconds (range)	PR # of times Fail/Total	PR Failure Rate
Masimo Radical (V5.0)	21	1/80	1.3%	14.5 (6-24)	12/80	15.0%
Nellcor N-600 (V1.1.2.0)	14.3 (6-36)	20/80	25.0%*	21.4 (6-39)	22/80	27.5%*
Datex-Ohmeda TruSat	42.0 (9-180)*	12/80	15.0%*	44.3 (12-168)*	12/80	15.0%
SELF GENERATED MOTION (SG)						
Device	SpO2 Mean RT in seconds (range)	SpO2 # of times Fail/Total	SpO2 Failure Rate	PR Mean RT in seconds (range)	PR # of times Fail/Total	PR Failure Rate
Masimo Radical (V5.0)	17.0 (12-21)	3/80	3.8%	21.3 (6-48)	9/80	11.3%
Nellcor N-600 (V1.1.2.0)	13.0 (6-24)	25/80	31.3%*	20.8 (3-36)	35/80	43.8%*
Datex-Ohmeda TruSat	42.8 (12-288)*	19/80	23.8%*	40.2 (12-270)*	17/80	21.3%*

$p<0.05$ level (*) compared to Masimo

Conclusions

Although none of the POs tested worked perfectly, Nellcor N-600 had the shortest RT with higher FR, while Masimo had the shorter RT and the lowest FR for SpO2 and PR during motion and low perfusion. Thus, Masimo may serve better for patient safety.