Motion and Low Perfusion Induced Failures of New Generation Pulse Oximeters - Failure Rates and Recovery Times in Volunteers.

Shah N., Estanol L., Patel V. *Anesth Analg*. 2006;102:S-108.

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 compares the recovery time for SpO2 and PR for three major brands of new PO technologies.

Methods

Following informed consent, 11 ASA-1 volunteers (5F/6M) ages 18 through 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 lowered to 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. 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 rates (FR) is defined as % time the POs displayed values off by 7% for SpO2 and 10% for PR of the control value at the end of motion. ANOVA with Fischer's post hoc test and Chi-square analysis as appropriate were performed with $p<0.05$ considered statistically significant.

Results

There were a total of 176 motion tests (88 during MG and 88 during SG) when POs could fail. The table shows our results.

RT and FR of POs during MG and SG

PO	Motion	Mean RT Sec (range)	# of times fail/total	FR	Mean RT sec (range)	# times fail/total	FR
Masimo	MG	18 (18)	1/88	1.1%	9 (6-12)	4/88	4.5%
Nellcor	MG	13.2 (3 -21)	13/88*	14.8%	22.4 (6-66)	27/88*	30.7%
Datex Ohmeda	MG	23.1 (12-30	10/88*	11.4%	25.2 (12-48)	18/88*	20.5%
Masimo	SG	12.3 (12-15)	2/88	2.2%	10.3 (6-21)	14/88	15.9%
Nellcor	SG	15.3 (9-24)	19/88*	21/5%	19.0 (6-33)	37/88*	42.0%
Datex Ohmeda	SG	24.3 (12-36)	12/88*	13.6%	23.4 (9-45)	19/88*	21.5%

***p=<0.05 compared to Masimo**

Conclusion

Although none of the POs tested worked perfectly, Masimo had the shortest RT and the lowest FR for SpO2 and PR during motion and low perfusion. Thus, Masimo may serve better for patient safety.