Performance Evaluation of a New Pulse Oximetry Technology during Physiological Artifacts.
Jaffe M.B. *Anesthesiology 2000;* 93 (3A): A-560.

Introduction

The newer generation pulse oximeters have incorporated more sophisticated signal processing approaches in order to provide enhanced performance under lower levels of signal to noise than previous generations. Improved pulse oximeter performance with physiological artifacts provides greater confidence in the device as well as a lower incidence of false alarms. The performance of two newer generation pulse oximeters, the Novametrix Model 2001 with MARSpO2™ and Ohmeda Model 2000 with Masimo SET, and a previous generation pulse oximeter, Nellcor NPB-190, were tested during simulated motion artifact (tapping at 2.5 and 4.3 Hz and shivering at 6.0 Hz) with a waveform simulator (Biotek Indek 2 P). Functional testers such as the Biotek Index 2 P can provide a reproducible method of testing a pulse oximeter's function. The BioTek Index 2 P simulator provides an optomechanical finger to interface the pulse oximeter probe. Their software provides presets that span a wide range of saturations, pulse rates, signal strengths and motion amplitudes.

Methods

Testing was performed to determine the performance of the Novametrix Model 2001, Ohmeda Model 2000 with Masimo SET and Nellcor NPB-190 under simulated physiological conditions using the Biotek 2 P simulator. Presets 00 through 12 were used to simulate normal, weak pulse, bradycardia, hypoxia and neonatal conditions without motion and with tapping and shivering motions. A personal computer collected the beat-to-beat saturation and pulse rate data from each tested device during each simulation run. The bias, precision and accuracy of the reported saturation and pulse rate of each unit relative to the 'expected' value from the simulator were computed.

Results

For Novametrix Model 2001 and Ohmeda Model 2000 systems, the bias and precision relative to the expected value is zero for many settings. Both systems provided accuracy (A_{RMS} - calculated as the square root of the sum of squares of the bias and precision) less than the accuracy claims of ±2% saturation (table) and ±1 beat/min for all tested settings. The bias and precision for pulse rate at all tested settings is or essentially zero and thus not shown. However, the Nellcor NPB-190 failed to display saturation or pulse rate values at all tested settings that included either tapping or shivering motion except one setting which displayed values that were significantly different from the expected value.

Conclusion

The use of simulated waveforms allows the performance of new pulse oximeter technology to be evaluated against reproducible conditions. The particular presets tested would challenge many existing pulse oximeters. The Novametrix Model 2001 and Ohmeda Model 2000 with Masimo SET provided accuracy to within ±2% saturation and ±1 beats/min for all tested settings with and without physiological artifact.

					MARSSpO_2			Masimo SET
Waveform	Setting	SpO2 (%)	Bias	Precision	A_{rms}	Bias	Precision	A_{rms}
Normal	-	98	-1.0	0.0	1.0	0.0	0.0	0.0
	Tap	98	-1.0	0.0	1.0	0.0	0.0	0.0
	Shiver	98	-1.1	0.2	1.1	0.0	0.0	0.0
Weak Pulse	-	90	0.0	0.0	0.0	0.0	0.0	0.0
	Tap	90	0.0	0.2	0.2	0.0	0.0	0.0
	Shiver	90	-1.4	0.5	1.5	0.0	0.0	0.0
Bradycardia	-	88	0.0	0.0	0.0	0.0	0.0	0.0
	Shiver	88	-1.0	0.2	1.0	0.7	1.1	1.3
Hypoxia	-	70	1.0	0.0	1.0	-0.9	0.3	1.0
	Tap	70	0.5	0.5	0.7	-0.5	0.5	0.7
	Shiver	70	0.1	0.3	0.3	-0.7	0.5	0.8
Neonate	-	90	0.0	0.0	0.0	0.0	0.0	0.0
	Shiver	90	1.0	0.1	1.0	0.0	0.0	0.0