The Effects of Motion Artifact and Low Perfusion on the Performance of a New Generation of Pulse Oximeters in Volunteers Undergoing Hypoxemia.

Gehring H., Hornberger C., Matz H., Konecny E., Schmucker P. *Respir Care.* 2002 Jan;47(1):48-60.

Introduction

Motion artifact and low perfusion often lead to faulty or absent pulse oximetry readings in clinical practice. *Objective:* Determine the impact of motion artifact and low perfusion on newly introduced pulse oximetry technologies during hypoxemic episodes in healthy volunteers.

Methods

Five different pulse oximeters from 4 manufacturers (the Datex Ohmeda 3900P; the Agilent; the Nellcor N-3000; the Nellcor N-395; and the Schiller OX-1, which is the European version of the Ivy SatGuard 2000 with Masimo SET) were compared with respect to their ability (separated or in combination) to provide accurate readings in the presence of motion artifact and low perfusion. Four of these oximeters represent the latest available oximetry technology, and one (the N-3000) represents a previous generation of oximeters. Oxygen saturation values (SpO_2) and pulse rate from the oximeters were recorded during episodes of induced hypoxemia in 10 healthy volunteers. Standardized and repeatable motion artifacts were generated by a motion machine and by having the test subject perform tapping and scratching motions. Perfusion to the finger was reduced by an inflatable balloon impinging on the brachial artery. The pulse oximetry readings from the test oximeters were compared to readings from control pulse oximeters on the unperturbed reference hand. The pulse rates from the test oximeters were compared to the electrocardiographically-measured heart rate.

Results

The frequency of faulty readings was increased by increasing motion interference and decreasing perfusion. The SpO2 deviation was within +/- 3% of the reference reading > 95% of the time for all instruments during the control desaturation period in the absence of motion and with normal perfusion. With the combination of motion and low perfusion, the SpO2 error was within +/- 3% less than 62% of the time for all oximeters tested. A significant difference in the frequency of large SpO2 errors was observed only in the direct comparison of the N-395 and N-3000. The N-395 exhibited less frequent SpO2 error exceeding 6% of SpO2 in the combination of the most challenging situations (motion and motion with reduced perfusion). In the same situation the Datex-Ohmeda 3900P and Nellcor N-3000 showed significantly higher pulse rate errors than the other devices (Datex-Ohmeda 3900P 53% of the time and N-3000 37% of the time).

Conclusions

The established model of creating motion artifact and low perfusion is capable of simulating a hierarchy of severe clinical situations. With solely motion or solely reduced perfusion the percentage of errors exceeding +/- 3% of SpO2 increased by 20% and 10%, respectively, compared to the control period. Simultaneous presence of motion and reduced perfusion leads to a relative incidence of > 35% of errors > 3% of SpO2 for the various oximeters. In this situation the N-3000 and the Datex-Ohmeda 3900P exhibited differences between estimated pulse rate and electrocardiographically-measured heart rate > 25 beats/min > 37% of the time.