

The Effects of Motion on the Performance of Pulse Oximeters in Volunteers (Revised Publication).

Barker S.J., Shah N.K. *Anesthesiology*. 1997 Jan;86(1):101-8.

Background

Pulse oximetry is considered a standard of care in both the operating room and the postanesthetic care unit, and it is widely used in all critical care settings. Pulse oximeters may fail to provide valid SpO₂ data in various situations that produce low signal-to-noise ratio. Motion artifact is a common cause of oximeter failure and loss of accuracy. This study compares the accuracy and data dropout rates of three current pulse oximeters during standardized motion in healthy volunteers.

Methods

Ten healthy volunteers were monitored by three different pulse oximeters: Nellcor N-200, Nellcor N-3000, and Masimo SET (prototype). Sensors were placed on digits 2, 3, and 4 of the test hand, which was strapped to a mechanical motion table. The opposite hand was used as a stationary control and was monitored with the same pulse oximeters and an arterial cannula. Arterial oxygen saturation was varied from 100% to 75% by changing the inspired oxygen concentration. While SpO₂ was both constant and changing, the oximeter sensors were connected before and during motion. Oximeter errors and dropout rates were digitally recorded continuously during each experiment.

Results

If the oximeter was functioning before motion began, the following are the percentages of time when the instrument displayed a SpO₂ value within 7% of control: N-200 = 76%, N-3000 = 87%, and Masimo = 99%. When the oximeter sensor was connected after the beginning of motion, the values were N-200 = 68%, N-3000 = 47%, and Masimo = 97%. If the alarm threshold was chosen SpO₂ less than 90%, then the positive predictive values (true alarms/total alarms) are N-200 = 73%, N-3000 = 81%, and Masimo = 100%. In general, N-200 had the greatest SpO₂ errors and N-3000 had the highest dropout rates.

Conclusions

The mechanical motions used in this study significantly affected oximeter function, particularly when the sensors were connected during motion, which requires signal acquisition during motion. The error and dropout rate performance of the Masimo was superior to that of the other two instruments during all test conditions. Masimo uses a new paradigm for oximeter signal processing, which appears to represent a significant advance in low signal-to-noise performance.