Four Types of Pulse Oximeters Accurately Detect Hypoxia during Low Perfusion and Motion.

Anesthesiology. 2017 Dec 4. doi: 10.1097/ALN.0000000000002002. [Epub ahead of print]

Louie A(1), Feiner JR, Bickler PE, Rhodes L, Bernstein M, Lucero J.

Author information:

(1)From the School of Medicine (A.L.), Department of Anesthesia and Perioperative Care (J.R.F., P.E.B., J.L., L.R.), University of California, San Francisco, California; and Physio Monitor LLC., San Ramon, California (M.B.).

BACKGROUND: Pulse oximeter performance is degraded by motion artifacts and low perfusion. Manufacturers developed algorithms to improve instrument performance during these challenges. There have been no independent comparisons of these devices.

METHODS: We evaluated the performance of four pulse oximeters (Masimo Radical-7, USA; Nihon Kohden OxyPal Neo, Japan; Nellcor N-600, USA; and Philips Intellivue MP5, USA) in 10 healthy adult volunteers. Three motions were evaluated: tapping, pseudorandom, and volunteer-generated rubbing, adjusted to produce photoplethsmogram disturbance similar to arterial pulsation amplitude. During motion, inspired gases were adjusted to achieve stable target plateaus of arterial oxygen saturation (SaO2) at 75%, 88%, and 100%. Pulse oximeter readings were compared with simultaneous arterial blood samples to calculate bias (oxygen saturation measured by pulse oximetry [SpO2] - SaO2), mean, SD, 95% limits of agreement, and root mean square error. Receiver operating characteristic curves were determined to detect mild (SaO2 < 90%) and severe (SaO2 < 80%) hypoxemia.

RESULTS: Pulse oximeter readings corresponding to 190 blood samples were analyzed. All oximeters detected hypoxia but motion and low perfusion degraded performance. Three of four oximeters (Masimo, Nellcor, and Philips) had root mean square error greater than 3% for SaO2 70 to 100% during any motion, compared to a

root mean square error of 1.8% for the stationary control. A low perfusion index increased error.

CONCLUSIONS: All oximeters detected hypoxemia during motion and low-perfusion conditions, but motion impaired performance at all ranges, with less accuracy at lower SaO2. Lower perfusion degraded performance in all but the Nihon Kohden instrument. We conclude that different types of pulse oximeters can be similarly effective in preserving sensitivity to clinically relevant hypoxia.