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Dark skin decreases the accuracy of pulse oximeters at low oxygen saturation: the effects of oximeter probe type and gender

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Abstract

Introduction: Pulse oximetry may overestimate arterial oxyhemoglobin saturation (Sao2) at low Sao2 levels in individuals with darkly pigmented skin, but other factors, such as gender and oximeter probe type, remain less studied.

Methods: We studied the relationship between skin pigment and oximeter accuracy in 36 subjects (19 males, 17 females) of a range of skin tones. Clip-on type sensors and adhesive/disposable finger probes for the Masimo Radical, Nellcor N-595, and Nonin 9700 were studied. Semisupine subjects breathed air-nitrogen-CO2 mixtures via a mouthpiece to rapidly achieve 2- to 3-min stable plateaus of Sao2. Comparisons of Sao2 measured by pulse oximetry (Spo2) with Sao2 (by Radiometer OSM-3) were used in a multivariate model to assess the source of errors.

Results: The mean bias (Spo2 - Sao2) for the 70%-80% saturation range was 2.61% for the Masimo Radical with clip-on sensor, -1.58% for the Radical with disposable sensor, 2.59% for the Nellcor clip, 3.6% for the Nellcor disposable, -0.60% for the Nonin clip, and 2.43% for the Nonin disposable. Dark skin increased bias at low Sao2; greater bias was seen with adhesive/disposable sensors than with the clip-on types. Up to 10% differences in saturation estimates were found among different instruments in dark-skinned subjects at low Sao2.

Conclusions: Multivariate analysis indicated that Sao2 level, sensor type, skin color, and gender were predictive of errors in Spo2 estimates at low Sao2 levels. The data suggest that clinically important bias should be considered when monitoring patients with saturations below 80%, especially those with darkly pigmented skin; but further study is needed to confirm these observations in the relevant populations.

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