Validity of Pulse Oximetry during Maximal Exercise in Normoxia, Hypoxia, and Hyperoxia.

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Introduction

During exercise, pulse oximetry is problematic due to motion artifact and altered digital perfusion. New pulse oximeter technology addresses these issues and may offer improved performance. We simultaneously compared Nellcor N-395 (Oxismart XLTM) pulse oximeters with an RS-10 forehead sensor (RS-10), a D-25 digit sensor (D-25), and the Ivy 2000 (Masimo SET)/LNOP-Adt digit sensor (Ivy) to arterial blood oxygen saturation (SaO_2) by CO-Oximetry.

Methods

Nine normal subjects, six athletes, and four patients with chronic disease exercised to maximum oxygen consumption (VO2 max) under various conditions [normoxia, hypoxia inspired oxygen fraction (FiO_2) = 0.125; hyperoxia, FiO_2= 1.0].

Results

Regression analysis for normoxia and hypoxic data was performed (n = 161 observations, SaO2) = 73-99.9%), and bias (B) and precision (P) were calculated. RS10 offered greater validity than the other two devices tested (y = 1.009x - 0.52, R^2 = 0.90, B+/-P = 0.3 +/- 2.5). Finger sensors had low precision and a significant negative bias (D-25: y = 1.004x - 2.327, R^2 = 0.52, B+/-P = -2.0 +/- 7.3; Ivy: y = 1.237x - 24.2, R^2 = 0.78, B+/-P = -2.0 +/- 5.2). Eliminating measurements in which heart rate differed by >10 beats/min from the electrocardiogram value improved precision minimally and did not affect bias substantially (B+/-P = 0.5 +/- 2.0, -1.8 +/- 8.4, and -1.25+/-4.33 for RS-10, D-25, and Ivy, respectively). Signal detection algorithms and pulse oximeter were identical between RS-10 and D-25; thus the improved performance of the forehead sensor is likely because of sensor location.

Conclusion

RS-10 should be considered for exercise testing in which pulse oximetry is desirable.