

Correlation of Peripheral Perfusion Index with Site To Site Delays in Detection of Desaturations.

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Introduction

Differences in site-to-site response time (STSRT) for detecting arterial oxyhemoglobin desaturation have been evaluated. Severinghaus showed these differences in 1987¹. Differences in STSRT have been suggested to occur during poor perfusion conditions. No one has compared measured peripheral blood flow with STSRTs. Pulse-oximetry based perfusion index (PI) correlates with fingertip blood flow². We determined the relationship of STSRTs and the level of peripheral perfusion, as measured by PI.

Methods

Following IRB approval, adult volunteers provided informed consent. Studies were conducted in a cold room, with forced cool air (62°C) inducing peripheral vasoconstriction. Subjects breathed FiO₂ of 0.10 to induce desaturation. SpO₂ was monitored using 4 sensors from 2 oximeter brands; a Nellcor RS-10 on the forehead (FH), a Nellcor D-25 on either the index or ring digit (Dn), both attached to Nellcor N395 oximeters; a Masimo LNOP Ear sensor on the ear (E) and a Masimo LNOP Adt on the index or ring digit (Dm) of the same hand as Dn, both attached to Masimo SET V3.0 oximeters. The Dm and Dn were optically shielded. PI was obtained from Dm and E(PIE). All data was continuously digitally recorded. STSRT differences were calculated: FH-Dn, E-Dm, and E-FH. Regression analysis compared the PI with each STSRTs. P value of <0.05 determined significance.

Results

10 desaturations were studied. PI ranged from 0.30 to 2.37. E and FH sites responded faster than Dn or Dm. There was a significant negative correlation between PI and both the FH-Dn, and the E-Dm, see table. The mean (SD) for the E-FH was 0.22 (0.16) min (ear faster). There was no correlation between the PI and the E-FH (R=0.49, p=0.15) or between PI and PIE (R = 0.31, p = 0.38).

Discussion

The STSRT differences for the FH-Dn and E-Dm, demonstrate a significant negative correlation, E or FH detects desaturations faster than digits. This difference, constant for brands tested, demonstrates a physiologic response. The lack of correlation between E-FH and PI shows the difference between E and FH is independent of PI. The lack of correlation between E-FH and the PI suggests neither E nor FH respond to cold induced vasoconstriction. This is supported by Awad, who showed ear waveform does not respond to cold pressor tests³. Ear and forehead, may offer performance advantages when decreased peripheral perfusion exists, but other factors (venous pulsation in supine patients) must be considered.

Perfusion Index	STSRT		
Range	E - Dm	FH - Dn	E - FH
1.0 - 2.37 %	0.30 - 0.85 mins	0.15 - 0.50 mins	0.10 - 0.25 mins
0.30 - 1.0 %	0.70 - 1.15 mins	0.40 - 1.05 mins	0.20 - 0.40 mins

Table demonstrates range of site to site delays detecting desaturation at various ranges of PI.