

Accuracy of Non-invasive Hemoglobin Measurement by Pulse CO-Oximetry at Various Peripheral Circulatory States

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Background

Recently, a non-invasive continuous measurement of hemoglobin with pulse co-oximetry (SpHb) using Radical-7® (Masimo Corporation, CA, USA) has been introduced. The accuracy of SpHb in case of hemodilution has been reported in healthy volunteers (1). In this study, we investigated the accuracy of SpHb at various conditions of peripheral circulation during general anesthesia.

Methods

Thirty-two patients undergoing surgery under general anesthesia were included in this study. Besides routine monitors, SpHb, direct radial arterial blood pressure and skin surface temperatures of the forearm and fingertip were monitored. A sensor for SpHb, an arterial catheter and two thermometers were placed at the ipsilateral arm. Arterial Hb by co-oximeter (Radiometer ABL 720; Radiometer, Copenhagen, Denmark) and SpHb were simultaneously obtained and analyzed as paired data. The data were shown as mean±SD. Comparison of the mean differences was analyzed by Student-t test. P value <0.05 was considered statistically significant.

Results

A total of 123 time-matched SpHb and arterial Hb were analyzed. SpHb ranged from 5.9 to 13.7g/dl. The mean difference (SpHb - arterial Hb) was -0.61 ± 1.19 g/dl. Ranges of temperature at the forearm and fingertip were 38.7 - 32.5°C and 38.5 - 27.3°C respectively. Skin-surface temperature gradients (forearm - fingertip) ranged from -2.6 to 3.5°C . Skin-surface temperature gradients were less than 1°C in 74 pairs, 1 - 1.9°C in 19 pairs, 2 - 2.9°C in 19 pairs, and more than 3°C in 11 pairs. The mean difference between SpHb and arterial Hb when skin-surface temperature gradients were more than 3°C (-0.75 ± 1.11 g/dl) was significantly greater compared with those under 3°C (-0.01 ± 1.18 g/dl) ($p=0.04$), as well as those under 1°C (0.16 ± 1.21 g/dl) ($p=0.01$).

Conclusion

Our study showed that SpHb measured by Radical-7® varied from arterial Hb measured by Radiometer ABL720® depended on peripheral circulation. The larger skin-surface temperature gradient caused the greater difference between SpHb and arterial Hb. This result suggests that peripheral vasoconstriction may decrease the accuracy of SpHb. Although non-invasive continuous hemoglobin measurement by pulse co-oximetry is clinically useful in operating room (2) and intensive care unit (3), actual hemoglobin measurement using blood samples may remain to be necessary when peripheral circulation is deteriorated during anesthesia.

Reference (1) *Anesth Analg* 2010; 111:1424-6, (2)*Anesthesiology* 2012; 116:65-72, (3) *Critical Care Med* 2011; 39: 2277-82