



LETTER TO THE EDITOR

The accuracy of noninvasive total hemoglobin measurement in critically ill patients[☆]



A exatidão da mensuração não invasiva de hemoglobina total em pacientes gravemente enfermos

Dear Editor,

Monitoring Total Hemoglobin (tHb) concentration is especially important in critically ill patients because anemia is common in such populations. The Pronto Pulse CO-Oximeter (Masimo Corporation, Irvine, CA, USA) monitors tHb noninvasively (SpHb). Good correlations between SpHb and tHb in healthy patients have been reported, whereas the relationship in critically ill patients has not been well investigated. Therefore, this study evaluated the accuracy of SpHb in critically ill patients.

We compared SpHb and tHb in patients aged 20 years and older who were admitted to the ICU in our hospital from August 2016 until February 2017. The IRB approval was obtained (no. 2043), and all patients or their families gave written informed consent. Blood was collected at routine blood tests and forwarded to the laboratory, where tHb was measured using a cellular analysis system (UniCel DxH800, Beckman Coulter, Brea, CA, USA). Within 30 min of blood sampling, the Pronto sensor was placed on the appropriate finger to record SpHb values. If an SpHb measurement could not be acquired despite three attempts on other fingers, it was reported as a failure. We compared the measured tHb and SpHb values to assess the accuracy of SpHb. The data were analyzed using Spearman rank-order correlation and Bland–Altman analysis; p -values ≤ 0.05 were considered significant.

SpHb measurements were performed in a total of 34 patients. Eighty-eight measurements out of 110 were successfully obtained. The mean tHb was 10.7 ± 1.6 g·dL⁻¹, and the mean SpHb was 12.2 ± 1.9 g·dL⁻¹. SpHb levels demonstrated a strong correlation with tHb levels ($R = 0.68$,

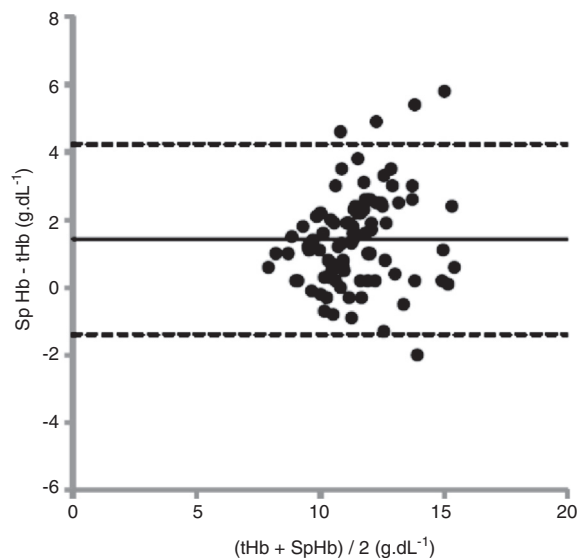


Figure 1 Bland–Altman plot for overall data relationship between the observed differences of hemoglobin measured by laboratory CO-Oximeter (tHb) and noninvasive and continuous hemoglobin monitoring (SpHb) and the mean of the 2 measurements.

$p < 0.001$). To assess the agreement between SpHb and tHb, a Bland–Altman plot was used (Fig. 1). The bias was 1.43 (SD = 1.44 g·dL⁻¹), 95% CI 1.17–1.68 g·dL⁻¹, and 95% Limit Of Agreement (LOA – 1.39–4.24 g·dL⁻¹).

In this study targeting ICU patients, the bias was slightly higher than that in other studies (-0.5 – 1.19 g·dL⁻¹),¹ and the LOA was relatively wide. It is known that the accuracy of noninvasive hemoglobin testing is reduced in the presence of vasoconstriction, which is observed in critically ill patients. This factor may explain the wide LOA observed in the present study. This inaccuracy may not be acceptable because of the importance of tHb in critically ill patients.

In addition, the Pronto sensor failed to capture the SpHb level in 20% ($n = 22$) of the measurements. Several studies have reported that hypoxia and hypothermia were predictors of measurement failure.² As observed in this study, patients in the ICU tend to have such conditions, and we therefore have to take into consideration the possibility of measurement failure when using the Pronto sensor.

[☆] This study, in part, was presented as a poster at Euroanaesthesia, Copenhagen, Denmark, June 2–4, 2018.

The limitation of present study was the diversity of the participants. Our critically ill group included medical and surgical patients, and their general conditions were profoundly different from those of other patients.

Clinicians should carefully consider the wide LOA and the probability of measurement failure when making clinical decisions in critically ill patients based on SpHb measurements alone.

Conflicts of interest


The authors declare no conflicts of interest.

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