Validation of a Non-Invasive Hemoglobin Estimation in Patients with Sickle Cell Disease

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Introduction

The care of patients with Sickle Cell Disease (SCD) is frequently complicated by difficult venous access complicating blood sampling for laboratory investigations including hemoglobin (Hb) measurement. Non-invasive hemoglobin concentration monitoring is a potential solution, albeit not validated yet in patients with SCD. The primary objective of this study was to validate non-invasive pulse CO-oximetry based hemoglobin estimation in this patient population.

Methods

We conducted a prospective observational study on patients with SCD admitted to the inpatient wards over 4 weeks in a tertiary care hospital. We estimated a spot Hemoglobin (SpHb) measurement using Masimo Pronto-7 Pulse CO-oximetry device (two measurements per patient) and compared it to a venous sample Hb (Reference Hemoglobin; Ref Hb) measured using Abbott CELL-DYN Sapphire hematology analyzer. We calculated Pearson correlation coefficient and coefficient of determination (R2). The multivariable linear regression model of predicting the estimation differences included age, gender, weight, height, blood pressure and reference hemoglobin.

Results

We enrolled 98 patients (45 males, 53 females) with a mean age of 26 years (SD 8.8; 14–75) and a mean Ref Hb of 9.2 g/dL (SD 1.5; 5.3–13). The mean SpHb was 10.1 g/dL (SD 2.0; 5.3–14.5). The correlation coefficient between the SpHb and Ref Hb was 0.54 (R2 = 29%) with a mean difference of 0.9 g/dL (SD 1.7; –4.8 to 4.5). In the multivariable model, gender ($p = 0.042$) and Ref Hb level ($p = 0.001$) were statistically significant predictors for the difference in measurement. A strong correlation between the two CO-oximetry Hb measurements was obtained (correlation coefficient = 0.81, R2 = 65%).

Conclusions

Our study demonstrated the validity of the CO-oximetry Hb measurement in adult patients with SCD. Larger prospective studies are needed to confirm our results.