

Noninvasive Measurement of Hemoglobin Concentration in Children with Sickle Cell Disease

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Background

Hemoglobin is frequently monitored in children with sickle cell disease (SCD) with acute complications and during and after transfusions. Pulse CO-Oximetry is FDA approved for the noninvasive measurement of total hemoglobin (SpHb), but has not been evaluated in SCD. Objectives: To evaluate the accuracy of SpHb measurement in children with SCD.

Design

We performed a prospective study of both untransfused and transfused children with SCD. A ReSposable SpHb sensor (R2 20a or R2 25a by weight; rev E) was placed on the index or ring finger and connected to the Rainbow Pulse CO-Oximeter (software version 7.6.0.1) (Masimo Corporation, Irvine, CA). Total hemoglobin (tHb) was measured by spectrophotometry (Sysmex XE2100, Mundelein, IL) on venous blood collected within two hours of the noninvasive measurements. Transfused participants had paired measurements before and 10 minutes after the transfusion. Data was plotted on a Bland Altman plot.

Results

We collected 223 paired measurements from 42 children (37 HbSS, 1 HbSC, 3 HbS β -thalassemia, 1 HbSD). There were 23 males and 19 females with a median age of 11 years (range 2 -17.7 yr.) Total hemoglobin was 6.4 to 15 g/dL when measured with the Sysmex analyzer. The mean bias between SpHB and tHb measurements was 0.7 g/dL, standard deviation was 1.4 and limits of agreement of -3.4 to 2.1.

Conclusion

These data demonstrate the feasibility and potential of noninvasive measurement of hemoglobin by Pulse CO-Oximetry in both transfused and untransfused children with SCD.

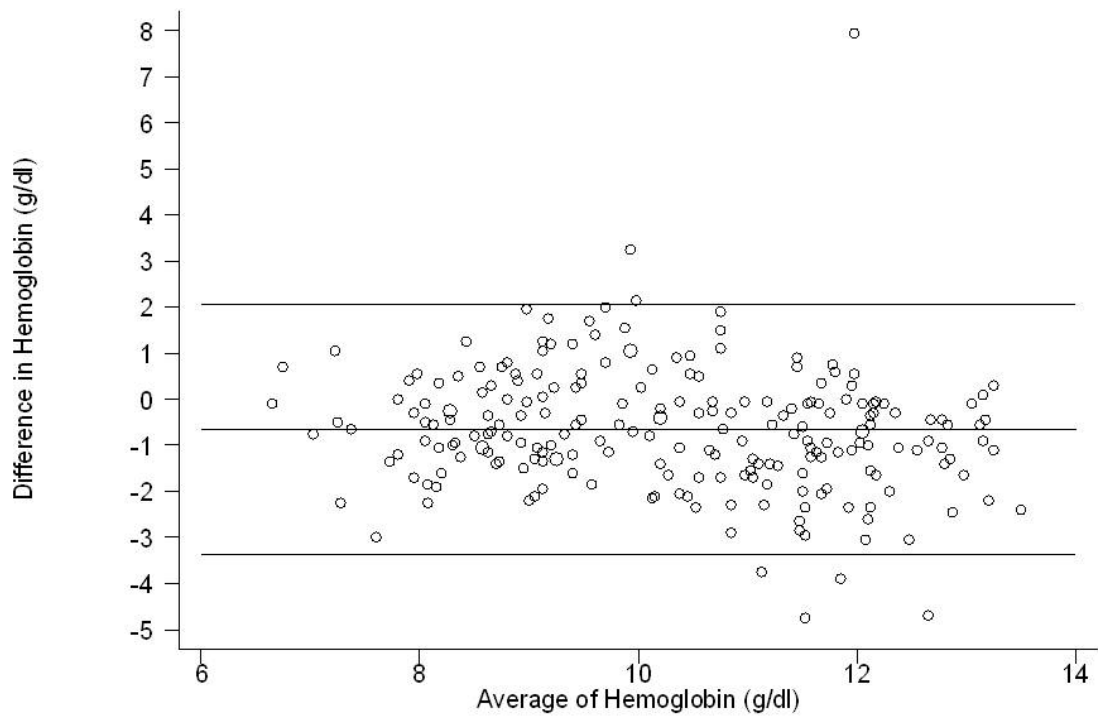


Figure: Bland Altman Plot of Difference in Hemoglobin Measured by the Rainbow Pulse Co-Oximetry (SpHb, g/dL) - Total Hemoglobin Measured by Spectrophotometry (tHb, g/dL), versus Average of Hemoglobin Measurements ($[\text{SpHb} + \text{tHb}]/2$, g/dL)