

Noninvasive Hemoglobin Monitoring: Absolute and Trend Accuracy and Impact on Blood Management

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Background and Goal

The aim of this study was to determine the absolute and trend accuracy of continuous, noninvasive hemoglobin monitoring by Pulse CO-Oximetry (SpHb) compared to laboratory measurements (tHb) and to evaluate SpHb monitoring impact on red blood cell (RBC) transfusions in high blood loss surgery.

Methods

Control group (n = 61) received typical anesthesia care including estimated blood loss (EBL) assessment and intraoperative Hb measurements from the central lab. Blood samples were taken when EBL was $\geq 15\%$ of total blood volume. RBC transfusion was initiated if Hb was ≤ 10 g/dL and continued until the EBL was replaced and Hb > 10 g/dL was confirmed. SpHb group (n = 45) was monitored with a Pulse CO-Oximeter and SpHb sensor (Radical-7, ver 7748, R2-25 adult ReSposable sensor rev "E", Masimo, Irvine, CA) and the same transfusion practice was followed except the anesthesiologist was guided by the addition of SpHb. Lab values were taken pre and post transfusions. Bias $\pm$ SD of SpHb compared to tHb was calculated. Scatterplot of consecutive changes in SpHb to tHb was used to assess trend. The mean $\pm$ SD of the % of patients transfused, amount of blood transfused per patient, change from pretransfusion tHb to post transfusion tHb and time to transfusion after the need was established (transfusion delay) were calculated. Potential cost saving resulting from reduced blood usage per 1000 surgeries was estimated.

Results

Bias $\pm$ SD from 83 SpHb-tHb data pairs was 0.03 ± 0.8 g/dL. Trend plot had a R² of 0.96 demonstrating excellent trend accuracy. There was no difference in the number of patients transfused (p = 0.700) or in pretransfusion tHb values (p = 0.385), but the difference in the average units transfused in all patients (0.9 units; p < 0.001) and transfused patients (1.6 units; p = 0.004) and the change in tHb pre to post transfusion (0.75 g/dL; p = 0.02) differed significantly. The transfusion delay was 50.2 ± 7.8 min in the Control group and 9.2 ± 0.7 min in SpHb group (p < 0.001). Using activity based costs [1], our hospital could save between \$469,800 - \$1,064,700 per 1000 surgeries performed.

Conclusions

SpHb monitoring showed excellent trending compared to lab measurements and when added to standard practice resulted in a significant decrease in the amount of RBCs transfused. Based on the RBC reduction shown, SpHb monitoring could improve patient care and safety and significantly reduce costs.

Reference

[1] Shander et al. *Transfusion.* 2009;50:753-65.