Accuracy of Non-Invasive Hemoglobin (nHgb) Monitoring in an AIS Population

Local Problem: Needle phobia and fear of blood draws are very common in children and adolescents. Noninvasive hemoglobin (nHgb) monitoring in children was first introduced in the Intensive Care Unit (ICU) setting. Later, our total joint arthroplasty colleagues demonstrated that nHgB monitoring was more efficient, less expensive, and preferred by patients compared to invasive hemoglobin (iHgb) monitoring.

Specific Aims: The goal of this Quality Initiative (QI) project is to compare the accuracy and reliability when comparing nHgb monitoring and iHgb (blood draw) in an Adolescent Idiopathic Scoliosis (AIS) population. The purpose was to evaluate the correlation between nHgb and iHgb monitoring and develop a nHgb threshold above which a patient would no longer require a blood draw, thus minimizing resource utilization as well as blood draw-related anxiety and pain during the postoperative period.

Intervention: We enrolled 60 consecutive patients undergoing posterior spine fusion/instrumentation (PSFI) for AIS. Average estimated blood loss (EBL) was 415cc, and 189 cc was returned via cell saver. 2/60 (3.3%) patients required an allogenic blood transfusion perioperatively.

nHgb and iHgb values were obtained within 60 minutes of each other at three separate time points (preoperative, in Post-Anesthesia Care Unit (PACU), and postoperative day (POD 1) at 0700) iHgb and nHgb values were recorded. The results were retrospectively reviewed and analyzed. Paired t tests were utilized to compare mean (n/i) Hgb values. Pearson correlation coefficients were calculated at all three time points. Receiver Operating Characteristic (ROC) curve analysis was performed on the postoperative values to determine a threshold.

Results: There was a moderate positive correlation at all three time points (0.4, 0.59, 0.6) (p= 0.005, <0.001, <0.001).

At all three time points, the mean nHgb value was 1-2 g/dL higher than the mean iHgb value, and this was statistically significant.

Guidelines for an Allogenic Blood Transfusion (ABT) at our institution were developed through consensus between the surgical and anesthesia teams. Indications for a postoperative ABT include iHgb 7.0 – 8.0 g/dL along with clinical signs of anemia such as persistent hypotension, tachycardia, dyspnea, lethargy, confusion, postural dizziness not responsive to a fluid challenge, or iHgb <7.0 g/dL, regardless of signs/symptoms of anemia.

There were not enough data points to correlate nHgb measurements with a patient's need to receive an ABT due to the low occurrence rate (3.3%). Therefore, we focused on a nHgb threshold at which a postoperative venous blood draw would not be necessary.

54/60 patients had a lab value of iHgb ≥ 9.0g/dL at 0700 on POD 1 and only 6 of the 60 patients had an iHgb ≤ 8.0 g/dL. Thus, we chose iHgb ≥ 9.0g/dL as the threshold. Based on data from the ROC curve analysis, a patient with a nHgb value of ≥10.8 g/dL had an iHgb value of ≥9.0 g/dL with 87% sensitivity.

Based on the ABT guidelines stated above, no patient with a nHgb ≥ 10.8 g/dl would require an ABT, therefore a venipuncture would be unnecessary.

Conclusions: Noninvasive Hgb monitoring was found to correlate with iHgb in pediatric AIS patients undergoing PSFI. Surgeons could consider screening AIS patients postoperatively with nHgb monitoring and only order iHgb measurement if the nHgb value is <10.8 g/dL resulting in improvement in the patient experience.