Blood Transfusion Prediction Using Continuous Non-invasive Hemoglobin Monitoring
Galvagno S., MacKenzie C., Grissom T., Qasim Z., Gao C. American Society of Anesthesiologists 2014; A3096.

INTRODUCTION

Hemorrhage after injury remains the most common cause of death in both military and civilian settings. The aim of this study was to examine whether noninvasive pulse-oximetry-derived continuous hemoglobin (SpHb) can predict the need for blood transfusion in the first twenty-four hours of trauma patient resuscitation. We hypothesized that trends in continuous SpHb, combined with easily derived patient-specific factors, can identify the immediate need for transfusion in trauma patients.

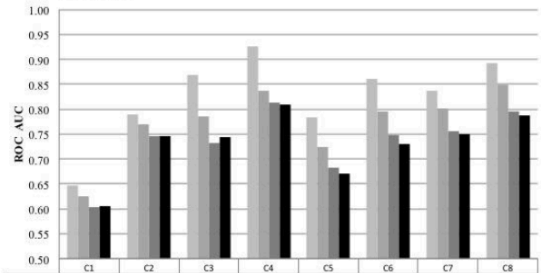
METHODS

Subjects were enrolled if directly admitted to the Trauma Center, >18 years of age, and with a Shock Index (heart rate / systolic blood pressure) >0.62. Upon admission, A Masimo Radical-7 co-oximeter sensor (Masimo Corporation, Irvine, CA) was applied, providing measurement of continuous non-invasive hemoglobin (SpHb) levels. Demographic information and both prehospital and admission vital signs were collected. The primary outcome was transfusion of at least one unit of packed red blood cells < 24 hours after admission. Eight regression models (C1-C8) were evaluated for the prediction of blood use by comparing area under receiver operating curve (ROC AUC) at different time intervals after admission.

RESULTS

677 subjects had continuous vital signs waveforms to record heart rate, SpHb and SpO2 trends. When SpHb was monitored for 15 minutes, SpHb did not increase ROC AUC for prediction of transfusion. The highest ROC was recorded for model C8 (age, sex, prehospital shock index, admission heart rate, SpHb and SpO2) for the prediction of blood products within the first 3 hours of admission. When data from 15 minutes of continuous monitoring were analyzed (Figure), significant improvement in ROC AUC occurred as more variables were added to the model; however, the addition of SpHb to any of the models did not improve ROC AUC significantly for prediction of blood use within the first 3 hours of admission. Training and testing was performed using leave-one-out methodology for all models.

Figure: ROC Analysis of 8 prediction models (C1-C8) for the prediction of blood transfusion (pRBC) after 30 minutes of data collection



	C1	C2	C3	C4	C5	C6	C7	C8
pRBC 1-3	0.65	0.79	0.87	0.93	0.78	0.86	0.84	0.89
pRBC 1-6	0.62	0.77	0.79	0.84	0.72	0.80	0.80	0.85
pRBC 1-12	0.60	0.75	0.73	0.81	0.68	0.75	0.76	0.80
pRBC 1-24	0.61	0.75	0.74	0.81	0.67	0.73	0.75	0.79

C1- Age + Sex + prehospital heart rate
C2- C1 + **SpHb**
C3- C1 + SpO2 + heart rate on admission
C4- C1 + **SpHb** + SpO2 + heart rate on admission
C5- Age + Sex + prehospital shock index
C6- C5 + **SpHb**
C7- C5 + SpO2 + heart rate on admission
C8- C5 + **SpHb** + SpO2 + heart rate on admission

(pRBC: denotes need for transfusion within 1 to N hours)

DISCUSSION

The results demonstrate that SpHb monitoring, accompanied by continuous vital signs data and adjusted for age and sex, has good accuracy for the prediction of need for transfusion; however, SpHb did not enhance predictive models in comparison to use of features extracted from conventional pulse oximetry. Nor was shock index better than conventional oximetry at discriminating hemorrhaging and prediction of casualties receiving blood.