NON-INVASIVE CARDIAC OUTPUT AND OXYGEN DELIVERY MEASUREMENTS IN ACUTE CRITICAL ANEMIA

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ABSTRACT

We present the first ever report describing the use of non-invasive cardiac output (CO) monitor with a continuous sensor of oxygen delivery (DO2) during blood transfusion.

HYPOTHESIS

The presumptive diagnosis of acute critical hemolytic anemia secondary to GHD deficiency was made. In the ED it was immediately given oxygen and received 3 units of PRBC. The patient was intubated in the Medicine Intensive Care Unit for altered mental status and shock but never required isotropic support. The non-invasive CO and CaO2 monitors were applied as described below after stabilization and continued for 65 hours. He received a total PRBC transfusion of 35 ml/kg over 24 hours.

RESULTS

Figure 1A
Top: Hemodynamic data measured in Patient 1: acute anemia temporarily complicated with PRBC transfusion. Figure 1A right represents the time course of Hb transfusion rate of 1.25 ml/kg in the ICU.

Bottom: Time course of Hb and Hgb concentration from presentation in ED (14:00) and during ICU. The blue circle represents laboratory blood Hb levels. The solid red line represents non-invasive Hb measurements from the CO monitor. The green line represents Hgb levels that trend with baseline with increasing Hb levels.

Patient 2: Chronic critical anemia

The second patient was an 80-year-old female (weight 111 kg, and BSA 1.51 m2) of Vancouver descent who presented to our ED with pulse and a one year history of failure to thrive. Vital signs were notable for RR of 156, and MAP 78. Her labs also revealed a Hb of 17 g/dL, hemoglobin 11.9%, and hematocrit 31.8%. She had a mild metabolic acidosis (pH 7.49 mmol/L) and normal renal function. Chest radiograph showed perihilar pulmonary congestion and cardiomegaly. Her serum iron studies were consistent with iron deficiency.

She was admitted to the Intensive Care Program and PRBC transfusion was initiated. The patient received a total of PRBC transfusion of 15 ml/kg over 26 hours and given a dose of IV iron dextran. Daily serial non-invasive CO measurements and serial hemoglobin measurements were recorded and Patient 2 was discharged home 37 hours after presentation with a Hb of 5.4 g/dL.

Comparison of Acute Anemia and Chronic Anemia

<table>
<thead>
<tr>
<th>Acute Anemia</th>
<th>Chronic Anemia</th>
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<tbody>
<tr>
<td>B</td>
<td>80-year-old female</td>
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<tr>
<td>Hb</td>
<td>11.9 g/dL</td>
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<tr>
<td>CO</td>
<td>1.25 ml/kg</td>
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SUMMARY

Non-invasive CO and CaO2 monitors suggest that these two patients were compared at: 1) initial recording (pre) transfusion levels of 5 g/dL and 2) final readout (post). Data from Patient 1’s acute anemia is presented in blue and data from Patient 2 with chronic anemia is presented in green.

In Patient 1, we observed decreases in Hb (<25%), SV, and CO (<4%) and an increase in SVR (>16%) at recovery. In contrast, in Patient 2, we observed a decrease only in Hb (<9%) while increases in SV (<15%), CO (<50%), and SVR (<25%) at recovery. Heart rate of Patient 1 normalised with a high of ~110 ml/min 2 hours after transfusion and had no evidence of renal organ dysfunction.

CONCLUSIONS

Non-invasive CO and CaO2 monitors suggest that these two patients were compared at: 1) initial recording (pre) transfusion levels of 5 g/dL and 2) final readout (post). Data from Patient 1’s acute anemia is presented in blue and data from Patient 2 with chronic anemia is presented in green.

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Non-invasive oxygen delivery monitoring in critically ill patients is possible with native monitoring of physiologic monitors and may be applied in both critically ill and ambulatory pediatric patients.

The validation of these monitors for use in DO2 algorithms e.g. transfusion targets warrants further investigation.

References


We present the first ever report describing the use of non-invasive cardiac output (CO) monitor with a continuous sensor of oxygen delivery (DO2) during blood transfusion.

The family reports three days of progressive lethargy, decreased appetite, pallor, jaundice and dark stools. His parents report having introduced fava beans into diet approximately five days prior to presentation.

ED Vital: T 17.5, HR 147, RR 56, MAP 64 (2 X 97%) on NC (weight 10 kg and BSA 0.44 cm2)
Lethargy
Pallor, jaundiced without cyanosis
Sclera: –
sclera
Hypertonic procedures with usual
Tachycardia: 120 Bpm, in jugular
Abdominal examination: milder
Coated metalized externalizers

O: Lactic acid levels dramatically decreased in the first two hours of presentation. Oxygen delivery (DO2) measurements as calculated from arterial oxygen content. Open blood transfusion replenished sufficient DO2 through use of stored red blood and blood high in antibodies with CO measurements from CO monitor. Continuous rates were represented on the Scope through combination of the uncalibrated oxygen content and the CaO2 monitor and CO measurements from CO monitor. The device acquired a mean of 10,000 – 15,000 waveform readings per minute. The device acquired a mean of 10,000 – 15,000 waveform readings per minute.