Percent Change in Blood Hemoglobin is Associated with Increased Perioperative Complications in Spine Surgery Patients

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Disclosures

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- Camilo A. Molina has a consulting relationship with Augmedics.
- Steven M. Frank has consulting relationships with Haemonetics and Medtronic.
- Daniel M. Sciubba has consulting relationships with DePuy Synthes, K2M, Medtronic, NuVasive, Stryker Spine.
Gastrointestinal and cardiac surgery research has shown that delta hemoglobin ($\Delta$Hb) is important to consider for appropriate perioperative blood transfusions.

$\Delta$Hb = (nadir Hb concentration during hospital stay) - (preoperative Hb)

For example, a percentage $\Delta$Hb of 50% or more is associated with a higher risk of ischemic complications (Spolverato 2015).

**Objective:** To determine the perioperative clinical outcomes associated with percent $\Delta$Hb as an independent factor among spine surgery patients.
Methods

- Institutional surgical administrative database was queried for patients who:
  - Underwent spine surgery between December 4, 2008 and June 26, 2015
  - Underwent spinal fusion, tumor related surgeries, and other identified spine surgeries
- **Percent ΔHb** was defined as: \([(\text{first Hb} - \text{nadir Hb})/\text{first Hb}] \times 100\).
- **Primary outcomes:**
  - **Composite in-hospital morbidity** including infection, thrombotic event, renal injury, respiratory event, ischemic event
  - **Length of stay**
Results

- 3,949 patients identified
- 1,204 patients (30.5%) received at least one unit of packed red blood cells (PRBCs)
- Median nadir Hb level was 10.6 g/dL (IQR, 8.7-12.4 g/dL)
- Mean percent ΔHb of 23.6% (SD=15.4%)
• After adjusting for competing preoperative factors on the multivariate analysis, the following factors remained independently associated with a larger percentage $\Delta Hb$ ($P = 0.011$ for ASA class, $P < 0.0001$ for others):

- Age
- Sex
- ASA class
- Surgical group
- Preoperative Hb level
- Nadir Hb <7 g/dL
- PRBC transfusion
- Units of PRBC transfused
- Estimated blood loss
- Crystalloid fluids
- Length of stay
Results

- Perioperative complications occurred in 234 patients (5.9%)
  - Complications were more common in patients with a larger percent ΔHb ($P = 0.017$), even after adjusting for competing perioperative risk factors
Results

Table 1: Predictors of Morbidity and Mortality

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Odds Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlson Comorbidity Index score</td>
<td>1.131 (1.030-1.241)</td>
<td>0.010</td>
</tr>
<tr>
<td>Length of stay</td>
<td>1.141 (1.109-1.174)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Percentage ΔHb</td>
<td>1.024 (1.004-1.045)</td>
<td>0.017</td>
</tr>
</tbody>
</table>

Predictors of Any Morbidity or Death for the Entire Cohort (Multivariate Analysis)
Discussion

• Our findings of worse perioperative outcomes associated with an increased percentage $\Delta$Hb are consistent with research in other surgical specialties.

• Given the apparent risks from $\Delta$Hb and the recognized risks of allogeneic transfusion, perhaps the ultimate risk minimization strategy is derived from methods used to reduce or prevent bleeding
  – e.g., hemostatic agents, antifibrinolytics
  – In other words, prevention is better than the condition (anemia) or the treatment (transfusion).
Summary Points

- Percent ΔHb is independently associated with a higher risk of developing any one perioperative complication.
- Our results suggest that percent ΔHb may be a useful measure to identify patients at risk for adverse perioperative events.