

Relationship Between Percent Change in Hemoglobin and Perioperative Adverse Events Among Spine Surgery Patients

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Objective

To characterize the association between percent delta hemoglobin—or the difference between preoperative Hb and in-hospital nadir Hb concentrations—and perioperative adverse events among spine surgery patients.

Introduction

- To the authors' knowledge, no study has examined the association between percent change in hemoglobin (delta Hb) and perioperative morbidity in spine surgery patients.
- We thus aimed to determine the perioperative clinical outcomes associated with percent delta Hb as an independent factor among spine surgery patients.

Methods

- Patients who underwent spine surgery at our institution between December 4, 2008 and June 26, 2015 were eligible for this retrospective study.
- Patients undergoing the following procedures were included: atlantoaxial fusion, subaxial anterior cervical fusion, subaxial posterior cervical fusion, anterior lumbar fusion, posterior lumbar fusion, lateral lumbar fusion, excision of intervertebral disc, and excision of spinal cord lesion.
- Data on intraoperative transfusion were obtained from an automated prospectively collected anesthesia data management system. Data on postoperative hospital transfusions were obtained through a Web-based intelligence portal.
- Percent delta Hb was defined as: ((first Hb nadir Hb)/first Hb) x 100.
- Clinical outcomes included in-hospital morbidity and length of stay associated with percent delta Hb.

Results

A total of 3,949 patients met the inclusion criteria.

- Between December 4, 2008 and June 26, 2015, these patients underwent atlantoaxial fusion (49 [1.2%]), subaxial anterior cervical fusion (788 [20.0%]), subaxial posterior cervical fusion (297 [7.5%]), anterior lumbar fusion (101 [2.6%]), posterior lumbar fusion (1733 [43.9%]), lateral lumbar fusion (107 [2.7%]), disc excision (553 [14.0%]), and excision of spinal cord lesion (321 [8.1%]).
- A total of 1204 patients received a packed red blood cell (PRBC) transfusion (at least 1 unit of PRBCs), yielding an overall transfusion rate of 30.5%. In patients receiving PRBC transfusions, the median number of PRBC units transfused was 3 (IQR, 2-6 units).
- The median preoperative Hb level for all patients was 13.8 g/dL (IQR, 13.1-14.6) and the median nadir Hb level was 10.6 g/dL (IQR, 8.7-12.4), yielding a mean percent delta Hb level of 23.6±15.4% (mean ± SD).

Factors Associated with Percent Change in Hemoglobin

- The impact of preoperative patient characteristics on a larger percent delta Hb for patients undergoing spine surgery was also assessed.
- Univariate analyses indicated that age, gender, ASA class, CCI score, surgical group, preoperative Hb level, nadir Hb level <7 g/dL, PRBC transfusion, units of PRBC transfused, estimated blood loss (EBL), crystalloid fluids, and length of stay (LOS) were associated with an increased percent delta Hb (all P <0.0001).
- After adjusting for competing preoperative factors on multivariate analysis, age, gender, ASA class, surgical group, preoperative Hb level, nadir Hb level
 7 g/dL, PRBC transfusion, units of PRBC transfused, EBL, crystalloid fluids, and LOS remained independently associated with a larger percent delta Hb (ASA class P = 0.011, all others P <0.0001).

Association of Percent Change in Hemoglobin With Perioperative Morbidity

- Overall, 5.9% of all patients (n=234) experienced at least one perioperative complication. Most common among these were thrombotic events (n=87, 2.2% of all patients) and kidney injury (n=62, 1.6% of all patients). Hospital-related infection occurred in 60 patients (1.5% of all patients).
- Upon univariate analysis, age, ASA class, CCI score, surgical group, nadir Hb level <7 g/dL, PRBC transfusion, units of PRBC transfused, EBL, crystalloid fluid volume, LOS, and percent delta Hb were associated with the development of at least one complication (all except age, P <0.0001; age, P =0.016). After adjusting for competing perioperative risk factors, CCI score (P =0.010), LOS (P <0.0001), and percent delta Hb (P =0.017) remained independently associated with the development of a complication.
- Upon multivariate analysis and after adjusting for competing risk factors, LOS (P <0.0001) and percent delta Hb (P =0.001) remained independently associated with the development of infection. Percent delta Hb in particular was found to be associated with infection, with 1.057 times higher odds of infection (95% CI, 1.023-1.093).

Conclusions

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