Preoperative Anemia Severity Predicts Complications Following Anterior Cervical Spine Surgery

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INTRODUCTION:

Preoperative anemia is a well-established risk factor for adverse surgical outcomes, with several studies in arthroplasty demonstrating a strong exposure-response relationship between anemia of increasing severity and risk of complications. These findings have led to the integration of anemia screening and optimization protocols into perioperative pathways for total hip and knee arthroplasty. However, despite similar concerns around blood loss, transfusion, and recovery in spine surgery, anemia severity has not been systematically studied in this population. In particular, anterior cervical spine procedures pose unique physiologic demands and may be especially sensitive to hematologic compromise. Understanding how the degree of preoperative anemia influences both short-term complications and longer-term structural outcomes is essential for tailoring perioperative care and implementing patient counseling. This study evaluates the relationship between anemia severity and postoperative outcomes in a large cohort of patients undergoing cervical spine surgery, with 90-day and 1-year follow-up

METHODS:

Using the TriNetX Research Network, adult patients who underwent anterior cervical spine procedures were identified and stratified into four groups based on preoperative anemia severity: severe (<8g/dL), moderate (8-9.9g/dL), and mild (10-11.9g/dL), and no anemia. Propensity score matching (1:1) was performed using the Charlson Comorbidity Index to control for baseline medical complexity across cohorts. Postoperative outcomes were assessed at two time points: 90-day complications (surgical site infection, transfusion, pneumonia, postoperative anemia, and venous thromboembolism (DVT/PE)) and 1-year outcomes (pseudoarthrosis and reoperation). Risk ratios (RR), 95% confidence intervals (CI), and p-values were calculated for each comparison.

RESULTS:

A total of 34,391 patients were included in the analysis. Anemia of any severity was associated with significantly elevated rates of 90-day complications compared to non-anemia patients. Patients with severe anemia had the highest relative risk for transfusion (RR: 7.11, p<0.0001), DVT/PE (RR: 3.70, p<0.00001), and pneumonia (RR: 2.74, p<0.0001). Moderate and mild anemia also demonstrated consistent and significant associations with adverse events, including elevated risk for infection, transfusion, and postoperative anemia. At 1 year, patients with severe and moderate anemia had markedly higher rates of reoperation (RR: 1.54 and 1.93, respectively). Pseudoarthrosis rates were not significantly different across groups.

DISCUSSION AND CONCLUSION:

Preoperative anemia, particularly hemoglobin <10 g/dL, is an independent predictor of both early postoperative complications and 1-year reoperation. The stepwise increase in risk with worsening anemia underscores the need for anemia stratification in preoperative risk models. While anemia is not always modifiable, especially in the setting of chronic disease or malignancy, its presence should prompt heightened perioperative vigilance and transparent discussion with patients regarding surgical risk. Future prospective studies are warranted to determine whether preoperative correction of anemia can reduce complication rates and improve long-term outcomes in cervical spine patients.

Figure 1: Impact of Preoperative Anemia Severity on Postoperative Outcomes Following Cervical Anterior Surgery
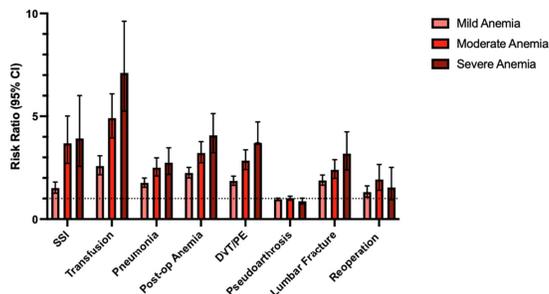
Bar blot showing risk ratios with 95% confidence intervals for postoperative complications in patients with mild, moderate, or severe preoperative anemia, compared to non-anemic patients undergoing anterior cervical spine surgery. The horizontal line at y=1 represents no difference in risk relative to the non-anemic group; bars above this line indicate increased risk associated with anemia.

Figure 2: Lumbar Fracture-Free Survival Following Anterior Cervical Spine Surgery: Severe Anemia vs. No Anemia
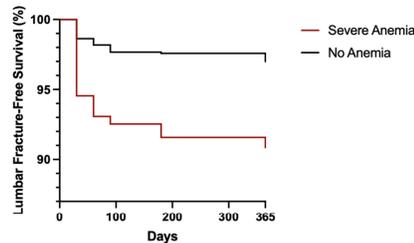
Kaplan-Meier curve comparing postoperative lumbar fracture-free survival between patients with severe preoperative anemia and those with no anemia undergoing anterior cervical spine surgery. The y-axis shows the percentage of patients without lumbar fracture over a 1-year postoperative period.