Impact of Guideline Implementation on Transfusion Practices in a Surgical Intensive Care Unit

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Background: **Anemia is a common clinical problem in cardiac surgery patients in the postoperative period and may result in transfusion in up to 90% of this population. There is tremendous variation in transfusion rates by hospital and individual physician. It is unknown if implementation of a clinical practice guideline lowers unnecessary transfusion in hospital practices that already have a restrictive transfusion culture .**

Objective: **To evaluate transfusion practice before and after implementation of a clinical practice guideline.**

Design: **Pre/post intervention study.**

Setting: **Sixteen bed surgical intensive care unit in an academic hospital.**

Participants: **Four hundred ninety-five adult patients undergoing cardiac surgery.**

Interventions: **Implementation of an anemia clinical practice guideline reinforced with education and retrospective audit/feedback.**

Measurements and Main Results: **A total of 252 preintervention and 243 postintervention cases were examined. Unnecessary transfusion occurred in 14.7% of preintervention patients and decreased to a rate of 8.1% after guideline implementation ($p = 0.016$).**

Conclusions: **This study suggests that clinical guideline implementation utilizing guideline development, education, and compliance audit/feedback may reduce unnecessary transfusion in cardiac surgery patients. A fully powered prospective trial would be necessary to validate these findings.**

KEY WORDS: guideline, quality improvement, anemia, cardiac surgery, transfusion

ANEMIA IS DEFINED by the World Health Organization as a hemoglobin concentration less than 12 grams/deciliter (g/dL) in men and less than 13 g/dL in men.[1] Anemia is a common clinical problem in cardiac surgery patients in the postoperative period for a variety of reasons, including bleeding due to coagulopathy, bleeding due to surgical causes, decreased red blood cell production, premature destruction, and sequestration. Decreased red blood cell production is more commonly a problem in the patient who becomes chronically critically ill in the postoperative period.[2] As many as 90% of patients in the United States who undergo cardiac surgery may receive at least one blood product transfusion during their hospital stay.[3] Transfusion of packed red blood cells (PRBC) in the postcardiac surgical period is highly variable and ranges from 8.8% to 92.8% in the United States.[4] Factors contributing to this variation in transfusion rate include hospital volume, academic status, geographic location, and case mix.

Blood transfusions are associated with altered immune function, increased infection rates, increased risk of organ failure, increased length of stay in the ICU, and increased mortality.[5,6] The American College of Cardiology Foundation/American Heart Association 2011 Guideline for Coronary Artery Bypass Graft Surgery recommends instituting a multimodal approach to limit transfusion, including transfusion algorithms, point-of-care testing, and a focused blood conservation strategy;[7] however, it is notable that publication of these guidelines has had minimal effect on transfusion practice patterns.[8] There is almost no scientific evidence to support uniform hemoglobin-based transfusion triggers, but more advanced measures of oxygen extraction ratios and carrying capacity require invasive monitors. In addition, the most modern studies have used hemoglobin triggers to establish transfusion thresholds.

The care of cardiac surgery patients at this hospital is reviewed on a monthly basis by a multidisciplinary process improvement team. This team regularly reviews overall blood transfusion rates and seeks ways to minimize unnecessary transfusion. Before implementation of a clinical practice guideline, the transfusion triggers for cardiac surgery patients were as follows: (1) Patients with no evidence of organ ischemia or pressor requirement were transfused for hemoglobin levels less than 7 mg/dL. (2) Patients with evidence of organ ischemia or pressor requirement were transfused for hemoglobin levels less than 8 mg/dL.

These transfusion triggers were based on a number of studies demonstrating the safety of a restrictive transfusion strategy.[3,9–11] Patients were excluded from this restrictive strategy if they were considered to have postoperative hemorrhage defined as chest tube output ≥250 mL/hour or alternative evidence of hemorrhage, evidence of organ ischemia despite transfusion to a hemoglobin of 8 mg/dL, or shock. These transfusion triggers were not documented in an official guideline, nor were they used by every physician admitting cardiac surgery patients to the ICU. In addition, no individual audit or feedback was provided to individuals regarding individual transfusion practices.

Review of the transfusion practices in the postoperative period by the process improvement team demonstrated variable levels of physician and physician extender agreement with a restrictive transfusion strategy. To minimize variations in care,

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the cardiothoracic surgery process improvement team developed and implemented a transfusion clinical practice guideline (CPG) for the cardiac surgery patients in the postoperative period using the triggers listed above. The CPG implementation included education of the guideline followed by audit and feedback of compliance. The educational portion of the implementation included a brief review of a selection of the available studies on anemia and the definition of anemia requiring treatment as defined by the CPG.[3,4,7,9] (Fig 1) Transfusion guidelines alone have a poor history of compliance unless accompanied by education, audit, and feedback.[12] Clinician transfusion practice usually is driven by culture and prior training.[13] Investigators sought to understand if transfusion practices differed in the pre- versus the post-CPG era. The hypothesis was that implementation of a clinical practice guideline for red blood cell transfusion would decrease unnecessary red blood cell transfusion. This manuscript will report the practice changes and guideline compliance associated with this process.

METHODS

Development of the guideline included consensus development by the physicians involved in the care of cardiac surgery patients, including cardiology, cardiac surgery, anesthesiology, and intensivists, on the scientific basis for the transfusion triggers and which patients to exclude from the guideline.[3,9–11,14] The physicians decided to maintain the transfusion triggers in the guideline that had been used previously by some of the physicians practicing in the ICU (Fig 1). This transfusion CPG was implemented on January 1, 2011 in the surgical intensive care unit (SICU) (Fig 2). Implementation of the guideline during the month of January 2011 included educating all practitioners involved in the continuum of care of cardiac surgery patients. During the study period, 4 cardiac surgeons admitted patients to the surgical intensive care unit. Numerous other physicians and physician extenders were involved directly in the care of the ICU patients, including 4 anesthesiology intensivists, 1 nonoperative cardiac surgeon, 8 surgical residents, and 12 physician assistants and nurse practitioners. The education consisted of e-mail notification of the guideline's existence, and one-on-one or group meetings between the medical director of the SICU and all of the practitioners in the SICU to conduct a brief review of select studies on anemia and the transfusion triggers in the CPG.[3,4,7,9] Most of the educational reviews occurred during multidisciplinary patient rounds. Implementation of this guideline began in the SICU, which is a closed-order-set unit. Daily audit of transfusions by the SICU team was utilized to evaluate compliance with the guideline during rounds; violations of the guideline were reported to the medical director. The medical director of the SICU also reviewed compliance and performed feedback interviews and re-education in the case of guideline noncompliance.

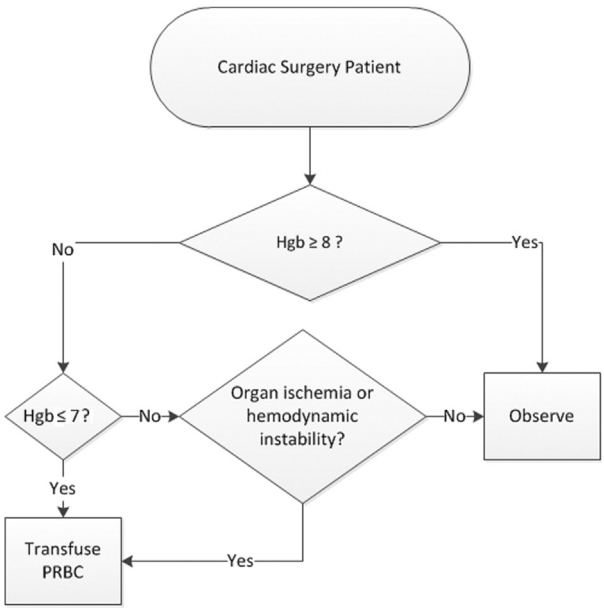

Fig 1. Transfusion algorithm for patients undergoing cardiac surgery. Patients demonstrating shock, ongoing hemorrhage (chest tube output >250 mL/hour or other bleeding source), or organ ischemia were excluded from this algorithm.

After receiving institutional review board approval for this study, all consecutive patients who underwent cardiac surgery from July 1, 2010 to July 28, 2011 were entered retrospectively into a database. The investigators collected and analyzed chart data from a total of 495 patients who underwent cardiac surgery. The period from July 1 to December 31, 2010 was considered the pre-intervention period. January 1, 2011 to January 31, 2011 was considered the guideline implementation washout period, and February 1 to July 28, 2011 was considered the post-intervention period. The length of time for the post-intervention period was chosen because this was the period of time that the medical director rigorously performed the audit/feedback strategy. The pre-intervention period length of time was chosen to represent a length of time and patient population size similar to the post-intervention group. A patient's transfusion history was analyzed and compared with lab and chart data to assess for appropriate transfusion indications.

Adherence to the protocol was collected for the pre- and post-intervention time periods. Adherence to the guideline was determined by analyzing the patient's hemoglobin before ordering transfusion. All transfusions associated with a hemoglobin (hgb) < 7.0 mg/dL were considered to be in compliance with the guideline. If a patient was transfused with an hgb from 7 mg/dL to 7.9 mg/dL, then the chart was analyzed for evidence of organ ischemia or pressor requirement. Transfusion associated with an hgb from 7 mg/dL to 7.9 mg/dL without evidence of organ ischemia, shock, pressor requirement, or hemorrhage as evidence by chest tube output >250 mL/hour or documentation of alternate evidence of hemorrhage was considered guideline noncompliance. All transfusions for an hgb >8.0 mg/dL were considered guideline noncompliant if there was no evidence for hemorrhage as evidence by a chest tube output >250 mL/hour or documentation of alternate evidence of hemorrhage. De-identified data were entered utilizing the Research Electronic Database Capture (REDCap, Vanderbilt Institute for Clinical and Translational Research, Nashville, TN) online database application, which facilitated patient identity protection.[15]

Descriptive statistics, including frequencies, proportions, means, and standard deviations of patient and procedure characteristics were calculated. Pre- and post-intervention values were compared using the Student's t test for normally distributed continuous data and the Wilcoxin signed-rank test for nonparametric. Binary and categoric data were compared using the χ^2 test (exact methods when appropriate). All reported p values were two-sided with 0.05 considered statistically significant. Statistical analyses were completed with Stata 11.2 Software (StataCorp LP, College Station, TX).

RESULTS

A total of 495 patients underwent surgery during the study period. A total of 252 consecutive patients underwent cardiac