Blood Conservation

Jeremiah T. Martin, MBBCh, FRCSI, FACS, and Victor A. Ferraris, MD, PhD

Patient blood management requires multi-modality and multidisciplinary collaboration to identify patients who are at increased risk of requiring blood transfusion and therefore decrease exposure to blood products. Transfusion is associated with poor postoperative outcomes, and guidelines exist to minimize transfusion requirements. This review highlights recent studies and efforts to apply patient blood management across disease processes and health care systems.

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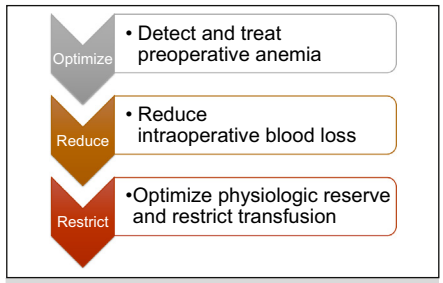

Improved outcomes requires attention to more than transfusion triggers.

Central Message

Patient blood management is a multimodal, multidisciplinary approach to reduce and eliminate the need for blood products..

INTRODUCTION

In the current economic climate, there is heightened awareness of the need to focus on quality, which is a function of cost and outcomes. Transfusion practice is historically very disparate; however, applied in the right setting can be lifesaving. Indiscriminate use of blood products is associated with morbidity, mortality, and increased health care costs and represents a waste of a limited resource.[1-4]

Guidelines exist to facilitate decision making for the cardiothoracic surgeon.[5,6] Strategies to limit blood transfusion focus on action items in the preoperative, intraoperative, and postoperative period.[4] Risk stratification includes management of anticoagulation and identification of particularly high-risk patients. Patients older than 70 years, with low red blood cell volume (due to anemia, low body size, or both), and those undergoing emergent surgery are at increased risk of needing a transfusion.[5] Excellent operative technique is further augmented with the use of minimally invasive approaches when possible, and judicious application of topical hemostatic agents. Postoperatively, the use of algorithms, defined transfusion triggers, and a team approach rather than individual management results in lower transfusion rates.

Division of Cardiothoracic Surgery, University of Kentucky, Lexington, Kentucky

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Address reprint requests to Jeremiah T. Martin, MBBCh, FRCSI, FACS, Thoracic Surgery, University of Kentucky, A301 740 South Limestone, St. Lexington, KY 40536. E-mail: j.martin@uky.edu

OUTCOME OF PATIENTS WHO REFUSE TRANSFUSION AFTER CARDIAC SURGERY: A NATURAL EXPERIMENT WITH SEVERE BLOOD CONSERVATION

Pattakos G, Koch CG, Brizzio ME, Batizy LH, Sabik JF, Blackstone EH, et al: Archives of internal medicine. 172 (15):1154-60, 2012.

Pattakos et al[7] compared outcomes between Jehovah's Witness patients (Witnesses) undergoing cardiac surgery and a carefully matched group of non-Witnesses. This comparison serves as a natural experiment: Witnesses hold beliefs that disallow blood product transfusion and thereby force clinicians to employ extreme blood conservation measures. A prospective database maintained at the Cleveland Clinic was augmented with data from the Social Security Death Index. Of 96,162 patients who underwent cardiac surgery during the study period, 322 Witnesses were identified. A carefully matched group of non-Witnesses who did receive blood transfusions after cardiac surgery were compared.

Witnesses were found to have fewer acute complications (myocardial infarction = 0.31% vs 2.8%, $P = 0.01$; reoperation for bleeding = 3.7% vs 7.1%, $P = 0.03$; prolonged ventilation = 6% vs 16%, $P = 0.001$) and a shorter length of stay (intensive care unit median = 25 vs 48 hours, $P < 0.001$; hospital length of stay median = 7 vs 8 days, $P < 0.001$) than matched patients who received transfusions. Additionally witnesses were found to have better 1-year survival (95% vs 89%, $P = 0.007$) but similar 20-year survival (34% vs 32%, $P = 0.90$).

Although this study is limited by its retrospective nature, and propensity matching cannot control for unmeasured confounders, the methodology remains robust. The conclusions indicate

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that aggressive blood conservation is not associated with worse outcomes and indeed suggests improved short-term outcomes.

BLOOD CONSERVATION OPERATIONS IN PEDIATRIC CARDIAC PATIENTS: A PARADIGM SHIFT OF BLOOD USE

Karimi M, Florentino-Pineda I, Weatherred T, Qadeer A, Rosenberg CA, Hudacko A, et al: The Annals of thoracic surgery. 95(3):962-7, 2013.

Karimi et al[8] from Georgia Health Science University studied the implementation of a blood conservation strategy in pediatric cardiac patients. In 2008, a restructuring introduced a comprehensive blood conservation program. Intraoperative management included customization of the perfusion circuit for each patient to minimize circuit length and volume. Auto-transfusion, ultrafiltration, and diuresis were used to preserve red blood cell volume. Postoperatively, transfusion triggers were modified to tolerate a hematocrit of 21% for biventricular repairs, vs 25% for unique ventricular repairs.

A retrospective review of 168 cases stratified the patients into 2 groups based on timing of introduction of blood conservation strategies. Significant findings of the study included a decreased need for intraoperative and postoperative transfusion, lower inotropic scores, decrease ventilator days (1.4 vs 3.3 days, $P = 0.001$), and shorter hospital length of stay (6 vs 10.4 days, $P = 0.0007$). The patients were well matched in terms of preoperative variables, and preoperative hematocrit; however, the postbypass hemoglobin was lower in the blood conservation group as would be expected given restrictive transfusion protocols (9.9 vs 11.3 g/dL, $P = 0.0026$).

The authors concluded that firstly, it is possible to significantly reduce transfusion requirements with modifications to the perfusion circuit and intraoperative management. Secondly, restrictive transfusion practice was associated with lower inotropic scores, decreased ventilator days, and shorter hospital length of stay. Finally, decreased overall complications were seen in the restrictive transfusion group. This is again a retrospective study, with inherent bias and limitations, but demonstrates extension of the potential benefits of blood conservation to the pediatric cardiac population.

BLOOD CONSERVATION IN EXTRACORPOREAL MEMBRANE OXYGENATION FOR ACUTE RESPIRATORY DISTRESS SYNDROME

Agerstrand CL, Burkart KM, Abrams DC, Bacchetta MD, Brodie D. The Annals of thoracic surgery. 99 (2):590-5, 2015.

Extracorporeal membrane oxygenation (ECMO) is increasingly important in the management of patients with advanced cardiac and pulmonary disease. Technological advances have broadened the indications for this therapy. ECMO typically requires multiple blood transfusions, and is associated with bleeding complications. A blood conservation protocol was implemented for patients receiving ECMO for acute respiratory distress syndrome at Columbia University.[9]

The Extracorporeal Life-Support Organization recommends a transfusion trigger of 12-14 g/dL, which typically requires transfusion of multiple units of blood per day. This article reports outcomes after implementation of a 3 part blood conservation protocol. The transfusion trigger was set to a hemoglobin of 7.0 g/dL. Low-dose anticoagulation was used and at the time of decannulation, blood within the circuit was auto-transfused.

During the study period, 38 patients with respiratory failure were treated using this protocol. The median hemoglobin during support was 8.2 g/dL and the median duration of support was 9 days. Median blood transfusion was 1 unit over the entire duration of ECMO support. Overall, 73.7% of patients survived to intensive care unit and hospital discharge.

The authors conclude that a restrictive approach such as this can be employed in patients receiving ECMO support and outcomes compare favorably with those reported in the literature. Importantly, transfusion requirements in this study are remarkably lower than those reported in other series and in the extracorporeal life-support organization guidelines. Transfusions in critically ill patients are associated with poor outcomes, and with the increasing application of ECMO, restrictive practice may offer benefits to these patients.

PATIENT BLOOD MANAGEMENT IN CARDIAC SURGERY RESULTS IN FEWER TRANSFUSIONS AND BETTER OUTCOME

Gross I, Seifert B, Hofmann A, Spahn DR. Transfusion. 55(5):1075-81, 2015.

Gross et al[10] report their experience with implementing patient blood management (PBM) in adult cardiac surgery. A comprehensive PBM strategy was adopted at Eastern Maine Medical Center in 2007 with efforts to implement measures to reduce or eliminate the need for blood products. A risk tool was used to identify patients who might benefit from preoperative optimization including erythropoietin and intravenous iron. Emphasis was placed on single unit transfusion, when transfusion was ordered. The volume of the bypass circuit was reduced intraoperatively and retrograde autologous priming was