Bloodless Medicine:
A Viable Alternative to Transfusions in Cardiac Surgery

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We all know that blood enhances oxygen-carrying capacity, improves wound clotting, and provides volume support for cardiac output***. Nevertheless, more and more patients are seeking safe and effective alternatives to blood transfusions during surgery – even cardiac surgery – because of religious convictions, medical concerns, or personal preference.*** Those who refuse transfusion on religious grounds tend to find primary components (e.g., packed red blood cells [PRBC], platelets, and fresh frozen plasma) objectionable. Secondary components such as factor concentrates, cryoprecipitate and albumin are generally acceptable.

Physicians are also beginning to prefer bloodless surgery. Mounting evidence suggests that blood transfusions during cardiac surgery portend worse long- and short-term outcomes. Thus, reducing bleeding and limiting blood transfusions have become important elements of quality improvement programs. Bloodless cardiac surgical procedures require special expertise, precise monitoring, state-of-the-art equipment, and innovative techniques. The Bloodless Medicine and Surgery Program at GRU was designed expressly for these reasons.

How big is the problem?

In the United States, surgical procedures account for almost 15 million units of transfused PRBC every year, with cardiac operations consuming as much as 10%–15% of the nation's blood supply. This fraction is increasing, largely because of the increasing complexity of cardiac surgical procedures, especially those involving cardiopulmonary bypass (CPB).

Why do we care?

Concerns regarding the safety and efficacy of allogeneic blood transfusions, the impact on patient outcomes, and the astounding costs and challenges associated with maintaining an adequate supply of blood products has renewed an intense interest in alternative strategies to reduce blood use while meeting the needs of a growing population. In addition to recognized transfusion-related risks such as infections, respiratory failure, and thromboembolic complications, red blood cell (RBC) transfusions may alter a recipient's immune function, impacting long-term survival.

What do we know?

Most patients who have cardiac procedures using CPB have sufficient wound clotting after reversal of heparin and ***do not*** require transfusion. Available evidence suggests that transfusions might not improve the clinical outcomes of stable nonbleeding patients in nearly 90% of the common transfusion scenarios reviewed. Transfusion are deemed appropriate for patients at least 65 years old with comorbidities and a hemoglobin of <8 g/dL.

Current strategies

Preoperative strategies. If possible, drugs that inhibit platelet activity are discontinued prior to surgery. Several tests are run to determine platelet responsiveness and to identify those who can proceed to surgery without a waiting period. Drugs that augment RBC volume (e.g., erythropoietin plus iron) can be given several days before cardiac surgery in patients who are anemic or are likely to require transfusion after surgery.

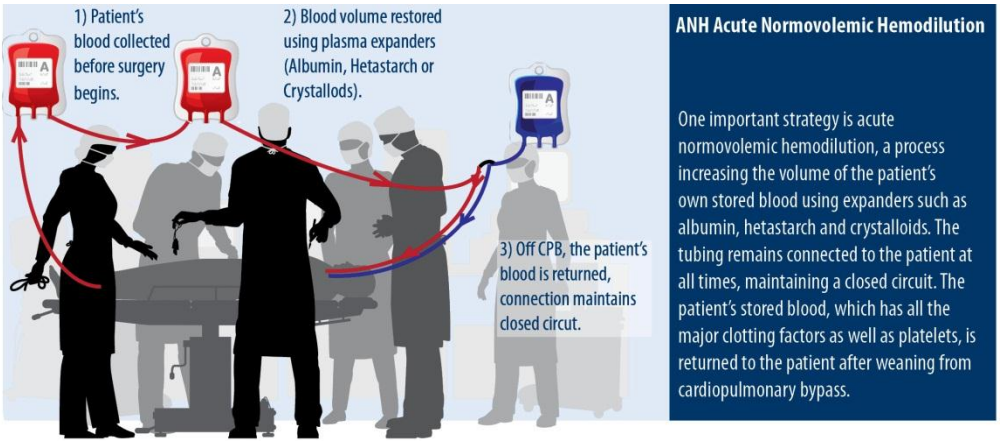
Prothrombin complex concentrates (PCC) which contain vitamin K-dependent coagulation factors (II, VII, IX and X; and protein C and S) are now the agents of choice for rapid reversal of oral anticoagulants rather than fresh frozen plasma.

Intraoperative strategies. During surgery, drugs that reduce total blood loss such as the lysine analogues epsilon-aminocaproic acid (Amicar) and tranexamic acid (Cyklokapron) are also used for blood conservation.

Recent small preliminary clinical studies have suggested that prophylactic administration of fibrinogen concentrates (~2 g) which manage low fibrinogen levels may reduce bleeding after coronary artery bypass graft (CABG) surgery, and larger doses (6–8 g) may treat excessive bleeding after major vascular procedures. Factor XIII concentrate, which is necessary for cross-linking of fibrin monomers to form a stable fibrin clot, may be considered. Factor IX and VIII concentrates control perioperative bleeding in hemophiliacs and also serve as prophylaxis in high-risk patients unable to accept primary transfusion components for religious reasons. Recombinant activated Factor VII can be used to manage intractable nonsurgical bleeding that is unresponsive to routine hemostatic therapy.

Antithrombin (AT) III concentrates reduce plasma transfusion in patients with AT-mediated heparin resistance immediately before CPB. Plasma-derived or recombinant AT III concentrates are approved for patients with hereditary AT deficiency to prevent perioperative thrombotic complications but can also be used to either manage AT-mediated heparin resistance or to prevent perioperative thrombotic complications. Factor concentrates reduce the incidence of bloodborne disease transmission as well as fluid overload compared to fresh frozen plasma.

Acute normovolemic hemodilution (ANH).



ANH is a process by which the patient's own blood is collected and stored in anticoagulant CPDA solution while restoring the patients' blood volume using volume expanders such as albumin, hetastarch and crystalloids. The tubing remains connected at all times, maintaining a closed circuit (as required by Jehovah's Witnesses). After the

major bleeding is over, the patient's own blood, which also has all the major clotting factors as well as platelets, is returned to the patient.

Perfusion interventions

The perfusionists who manage the CPB or heart lung machine play a vital role. They can minimize hemodilution by using minimized CPB circuits which reduce the priming volume, remove excess fluid from the body using modified ultrafiltration, and take advantage of microplegia techniques wherein the patient's own blood is used to mix small quantities of concentrated cardioplegia additives. Vacuum-assisted venous drainage also limits the amount of crystalloid used and biocompatible CPB circuits limit damage to the clotting factors and platelets.

In addition, a practice known as retrograde autologous priming (RAP) is employed where the patient's own blood is used to slowly prime the circuit and displace the crystalloid on both the arterial and venous side. Blood is also salvaged from the bypass circuit and returned to the patient by direct infusion without processing or is processed by ultrafiltration which produces protein-rich concentrated whole blood or centrifugation which produces concentrated red cells mostly devoid of plasma proteins. Topical hemostatic agents that employ localized compression or provide wound sealing such as antifibrinolytic topical agents can be used on the surgical wound to help with hemostasis.

Minimally invasive procedures such as thoracic endovascular aortic repair and off-pump CABG have also be shown to greatly reduce the volume of transfused blood. Because of concerns about graft patency, off-pump CABG is not used routinely. Other monitors such as thromboelastography (TEG) inform us as to which blood component levels are likely to be the cause of bleeding so that we can intervene with the appropriate factor component to prevent this from happening.

Adjunctive agents such as DDAVP may be used in certain patients with demonstrable and specific platelet dysfunction known to respond to this agent. Patients with uremia, cirrhosis, von Willebrand disease, and hemophilia have been known to respond to this agent. Patients requiring prolonged CPB or who are on antiplatelet drugs may also benefit from DDAVP.

Postoperative: The continuous auto transfusion system (ATS) allows continuous autotransfusion of chest tube drainage. This includes a blood compatible infusion pump with a microemboli filter (40 µ) and nonvented intravenous tubing.

How do we involve the patient?

Before surgery, the patient is seen by a member of the blood conservation team and given a form which lists all the factor concentrates. This allows the patient enough time to decide which concentrates can be used during the planned procedure. Our multidisciplinary blood management team, which includes surgeons, anesthesiologists, perfusionists, nurses, intensive care unit care providers, blood bankers, and cardiologists, work together to limit blood transfusions and decrease perioperative bleeding while still maintaining safe outcomes. We now average 25 inpatient and outpatient cases that utilize bloodless medicine techniques across all specialty areas.

About the seminar

The Georgia Regents Medical Center Bloodless Medicine and Surgery Program (BMSP) hosted a community seminar on October 20, 2012, which highlighted techniques that enable medical and surgical treatment without blood transfusions. More than 180 members of the community attended the seminar at the GRU Alumni Center.

After BMSP Program Coordinator Loretta Humes, RN, MS, welcomed the attendees, Dr. Vinayak Kamath, Director of Cardiovascular Services, gave the keynote address. Dr. Colville Ferdinand, Medical Director of the Bloodless Medicine Program, and Dr. Mary Arthur, Associate Professor of Anesthesiology and Perioperative Medicine presented their talks and Justin Resley, CCP, LP, Chief Perfusionist and BMSP Manager, demonstrated the cell saver.

Attendees had very positive comments about the program:

“I am happy to know that there is such a program in operation. Keep up the good work!”

“I have been to the seminar before and the information was very beneficial. I wondered if I would learn something new [this time] and I learned a number of things.”

“What most impressed me was the medical doctors’ care and concern and openness to help me as a Jehovah's Witness.”

“I came having no expectations, just to listen objectively. The seminar got me thinking about my own mortality and decisions I might have to make. I was enlightened on taking responsibility for my health care.”