UPDATE ON BLOOD TRANSFUSION IN CARDIAC SURGICAL PATIENTS

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HISTORICAL PERSPECTIVE

Every day, cardiac surgeons, cardiac anesthesiologists and intensivists ponder the dilemma of whether or not to perform a blood transfusion on their patients. Transfusion practice in the United States varies widely, with several studies showing a 10-92% range for perioperative transfusion in cardiac surgical patients.1-4 These results may reflect a longstanding threshold of 10/30 (hemoglobin of 10g/dl and hematocrit of 30%) to initiate a transfusion in surgical patients.5-8 In fact, cardiac surgery cases account for approximately 10-20% of all blood transfusions, while a small sub-group of high-risk patients (10-20%) consume the other 80% of this scarce resource.9 In general, blood transfusion to treat moderate anemia is not looked upon as a major intervention with significant consequences, especially since immediate adverse side effects may not be apparent.

RISKS OF BLOOD TRANSFUSION

There are well-documented studies showing that administration of blood can have an adverse medical and financial impact, especially in critically ill patients.10 Several of these studies are listed in Table 1.

In addition, a recent study by Koch et al. of 11,963 patients who underwent coronary artery bypass showed that red blood cell transfusion was the single factor most consistently associated with increased mortality, renal failure, prolonged ventilatory support, serious infection, cardiac complications and adverse neurological events.11

STRATEGIES TO REDUCE BLOOD TRANSFUSION

In 1995, the American Society of Anesthesiologists (ASA) published Practice Guidelines for Blood Component Therapy that provided recommendations to reduce transfusions. An update to these guidelines, prepared by the ASA Task Force on Perioperative Blood Transfusion and Adjuvant Therapies, was published in July, 2006.12 Some of the pertinent recommendations include the following:

1. Preoperative evaluation and laboratory testing, e.g. more focused assessment and use of thromboelastogram;
2. Preoperative patient preparation, e.g. delaying surgery until drug effects dissipate (e.g. clopidrogel), using erythropoiten to prevent or reduce perioperative anemia, aucologous blood collection, and administering drugs (e.g. aprotinin) to promote coagulation in high-risk surgery;
3. Intraoperative and postoperative interventions, e.g. monitoring for inadequate perfusion and oxygenation, monitoring for transfusion indications, transfusion of allogenic erythrocytes, and transfusion of autologous blood for intra- and postoperative red blood cell recovery;
4. Management of coagulopathy, e.g. treating excessive bleeding with drugs such as topical hemostatics (thrombin gel, fibrin glue), factor seven (Novoseven), and desmopressin; and
5. Monitoring and laboratory resting for transfusion reactions, e.g. urine output and color, peak airway pressure for detecting transfusion-related acute lung injury, or TRALI.

The complete text of these practice

Transfusion-Related Risks	Studies
1. Increased long-term mortality	Engoren MC, et al. Ann. Thorac Surg. 2002
2. Increased short-term mortality	Michalopoulos A, et al. Chest. 1999
3. Transmission of infection	Schreiber GB, et al. N Engl J Med. 1996
4. Multiple organ failure	Moore FA, et al. Arch Surg. 1997
5. Renal dysfunction	Ranucci M, et al. Perfusion. 1994
6. Increased ICU and hospital length of stay	Malone DL, et al. J Trauma. 2003; Taylor RW, et al. Grit Care Med. 2002
7. Increased post-operative infection	Zacharias A, Habib RH. Chest. 1996; Chelemer SB, et al. Ann Thorac Surg. 2002
8. Pulmonary dysfunction and pneumonia	Leal-Naval SR, et al. Chest. 2001; Vamvakas EC. Vox Sang. 2002
9. Increased development of and increased mortality in ARDS	Gong MN. Grit Care Med. 2005

Table 1. A list of negative medical and financial risks of blood transfusion with supporting studies.

Class	Description
Class 1	Evidence or general agreement that given procedure or intervention is useful or effective
Class 11	Conflicting evidence exists about the usefulness of an intervention or procedure
11a	Weight of evidence favors intervention or procedure
11b	Usefulness of intervention or procedure is less well established but consensus favors acceptance of intervention or procedure
Class 111	Evidence exists that intervention/procedure is not useful and /or is possibly harmful

Preoperative Interventions	Class of Evidence
Identify high-risk patients (elderly, non-CABG, redo, small body size, renal failure, female, anticipated prolonged operation) and optimize blood conservation strategy.	1
Institute multimodality blood conservation program.	1
Preoperative autologous donation augmented with erythropoietin is likely to provide blood conservation in selected patients whem possible.	1
Avoid preoperative anti-platelet and anti-thrombotic drugs when possible.	11a/11 b
Limit preoperative blood drawing and use alternatives to blood sampling (e.g. oximetry).	11a
Treat preoperative anemia or high-risk patients with erythropoietin if drug can be administered a few days before operation.	11a/11b
Use surgical closure devices for catheterization sites within 48 hours of cardiac operation.	11b
Perioperative Interventions	
High dose aprotinin is likely to optimize blood conservation, especially in high-risk patients.	1
Routine use of cell-saver is likely to be helpful for pump salvage and harvest of mediastinal blood.	1
Transfusion algorithms with point-of-care testing are recommended for blood conservation.	1
Off-pump coronary artery bypass is indicated to limit blood transfusion provided that emergent conversion to on-pump is unlikely.	11a
Transfuse fully warmed postoperative patients with Hgb:,; 7.0.	11a
Transfuse non-red blood cell products based on clinical indications, not specific transfusion triggers, but supplemented with point-of-care testing.	11a
Transfuse patients with Hgb:,; 6 gm/di (or with:,; 8 gm/di in elderly) on CPB.	11a
Institute TOM process to assess effectiveness of blood conservation program.	11a
Open venous reservoir membrane oxygenator systems are preferred during CPB.	11b
Centrifugal system for blood pump is preferred because of perfusion safety features.	11b
Retrograde autologous priming of the CPB circuit is likely to be helpful.	11b
Topical sealants that provide mechanical strength are most often helpful in very high-risk operations (e.g. left ventricular rupture or type A aortic dissection), but evidence is limited.	11b
Lysine analogues are helpful to limit blood transfusion after operation but not to decrease the risk of return to the operating room.	11b/111

guidelines is available on the ASA Web site at www.asahq.org/publicacionsAnd-Services/BCTGuidesFinal.pdf.

N I H consensus conferences and other national societies have been working to raise awareness about issues related to blood transfusion. Continued scarcity of resources and increasing scientific data, e.g. The CRIT Study, are forcing physicians and institutions to reevaluate their transfusion practices.13 Newer technologies, such as computerized physician order entry, may play a role in institutional protocols and decision support leading to a reduction of inappropriate red cell transfusions.[14]

The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists recently developed draft guidelines for Perioperacive Blood Transfusion & Blood Conservation in cardiac surgery. Although not yet finalized and published, these guidelines are listed in Table 2.

CURRENT STATUS AT THE METHODIST DEBAKEY HEART CENTER

Ac the Methodist DeBakey Hean Center in Houston, Texas, cerrain initiatives are underway in both che cardiovascular operating rooms (CVOR) and che cardiovascular intensive care unit (CVICU) to minimize blood transfusion in cardiac surgical patients. These include: 1) education and awareness about blood transfusion; 2) high threshold for transfusion; 3) use of aprotinin in high-risk patients; 4) avoiding overzealous cryscalloid administration; 5) use of factor seven (Novoseven) for severely coaguloparhic, bleeding patients; 6) no routine use of blood produces to achieve certain laboratory values; 7) feedback to physicians

Table 2 (left). Preliminary guidelines for perioperative blood transfusion and blood conservation in cardiac surgery, developed by The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists.

about blood usage; and 8) off-pump coronary arrery bypass surgery.

As a tertiary referral center with an active heart transplant and assist device program, the Methodist DeBakey Heare Center has a patient population that is at risk to receive blood produces. Internal audits conducted by the center's transfusion committee have shown that "appropriate" use of blood products in the CVOR and the CVICU, according to hospital transfusion guidelines, is currently at about 95%, a significant improvement from previous experience. These updated guidelines are being reviewed and incorporated into the electronic medical record and physician order entry system that has recently been implemented. The ultimate goal of these initiatives is to improve the appropriate use of blood products and decrease overall usage.

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