

Importance of Blood Conservation in Cardiac Surgery and Impact on Patients Refusing Blood Product Transfusions

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The use of blood product transfusion is associated with increased mortality and morbidity in cardiac surgery. The risk of mortality has been shown to be 0.5% per unit of blood transfusion, with approximately an increase by 3 times in overall mortality and by 2 times in occurrence of major complications. There is substantial evidence showing that the amount of blood product transfusions has a major impact on length of hospital stay and overall cost. Respiratory failure, renal failure and increased rate of infections are commonly associated with increased rate of blood product transfusions. Furthermore, blood product transfusions expose to the risk of major and minor transfusion reactions, induce immuno-suppression and cause a systemic inflammatory response, which affect all organ systems [1].

For these reasons minimizing blood product transfusions has represented a major challenge for cardiac surgeons. It is calculated that 50% to 60% of cardiac surgery patients require blood product transfusions in the course of their hospitalization and that this number approaches 100% in face of high-risk and emergent operations [1]. The own nature of cardiac surgery, the frequent occurrence of intra and post-operative bleeding, the use of extra-corporeal circulation are all obvious causes for the almost ubiquitous use of blood product transfusions. Nevertheless, there has been an effort to minimize the utilization of allogenic blood product transfusions in cardiac surgery.

It is unarguable at this point, based on the large body of evidence present in the literature, that blood product transfusions have a negative impact on mortality and morbidity of patients undergoing cardiac surgery.

The question is what are the tools available to minimize the use of blood product transfusions in cardiac surgery? In a recent publication Moskowitz et al. [2] reported the results relative to the implementation of a blood conservation program for cardiac surgery. The study showed that the implementation of a blood conservation program on a patient population of low risk patients undergoing coronary artery by-pass determined a reduction of blood product transfusions from 42.5% to 10.6%. The protocol for blood conservation used [3] is based on: 1. Preoperative optimization of hemoglobin, 2. Intraoperative acute normovolemic hemodilution, 3. Auto-transfusion, 4. Tolerance of permissive anemia (hemoglobin concentration of 6 to 7 depending on patient physiology), 5. Meticulous surgical technique, 6. Endovascular vein harvesting, 7. On-site coagulation monitoring (thromboelastography and heparin concentration determination), 8. Targeted pharmacotherapy (antifibrinolytic agents and desmopressin acetate).

The most current trends in blood conservation seem to be moving away from the practice of auto-transfusions (Preoperative Autologous Donation, PAD) because of high wastage rate (>40%) and incidence of preoperative anemia, which could promote more liberal transfusions policy is the post-operative period. Acute normovolemic hemodilution (ANH), instead, remains an effective practice where 1 liter of blood is replaced with infusion of colloids after anesthesia induction, providing availability of autologous blood that can be re-infused as needed intra or postoperatively. The use of extra-corporeal circulation favors

hemodilution, red blood cell damage and depletion of coagulation factors. Therefore, use of fully coated circuit and the practice of limiting the static priming volume of the cardiopulmonary by-pass machine to 1,200 ml or less are recommended. Also, the use of "mini-pumps" (closed minimized cardiopulmonary by-pass circuits) versus the use of the conventional extracorporeal circulation machine remarkably reduces blood cell damage, coagulopathy and hemodilution with significant impact on intra and post-operative transfusion requirement [4,5]. The practice of "Off-pump" coronary artery surgery (surgery performed without use of the heart-lung machine) also obviates the side effects associated with the use of extracorporeal circulation and has been shown to be successful in reducing the need for blood product transfusions [6,7]. Finally, blood waste in the postoperative period can be somehow impacted by judicious lab draws (minimizing routine daily lab testing to the strict necessity based on case to case need) and use of adequate collection tubing.

In our experience, the only use of the practice of "off-pump" coronary artery surgery has resulted in an overall rate of blood products transfusions of 18%. This patient population included all coronary artery revascularizations, including emergent surgeries, re-operations and high-risk procedures done by a single surgeon in a 3 year period at the University of Iowa Carver College of Medicine. These results, obtained without implementation of a blood conservation program and without existence of a protocol controlling the indications for transfusions and promoting the practices of blood conservation, created within the team a level of competency and awareness that has allowed us to perform "bloodless" cardiac surgery in high-risk patients, including emergencies and re-operations, which are traditionally more at risk for intra and postoperative bleeding, and therefore more susceptible to require blood product transfusions [8].

As today, there is widespread consensus among experts that blood conservation has a significant impact on the outcome of patients undergoing cardiac surgery. However, the practice of blood conservation in cardiac surgery is far from being established. In general, the lack of a level of awareness of the risk related to blood product transfusions, the unfamiliarity with permissive anemia and the other practices of blood conservation among surgeons, anesthesiologists, perfusionists, critical care physicians and nurses can be considered responsible for this occurrence.

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It is believed that blood conservation has to become a culture before being a protocol. The advantages related to this practice are uncountable, having major impact on patient outcomes, resource utilization and hospital cost control.

Furthermore, there is the important consideration in relation to situations where “bloodless” cardiac surgery is not a choice and a goal but becomes a requirement. Jehovah’s Witnesses represent a Christian denomination that currently counts over 2.6 million members worldwide. According to their interpretation of biblical texts they believe that once blood has been removed from the body cannot be returned to it [9], and therefore they refuse any type of blood product transfusion. Cardiac operations are often considered off limits in these patients with the exception of super qualified centers where the familiarity with the practice of blood conservation allows performing cardiac operations with a rate of success very close to that of the general population. In our practice, applying all the measures that are the mainstay for blood conservation we were able to provide cardiac surgery of any level of complexity to this patient group with no mortality [8].

In conclusion, it can be comfortably said that there is overwhelming evidence that limiting blood product transfusions may have a major impact on outcome of patients undergoing cardiac surgery. Besides, the challenge of insufficient supply of blood products and the need to contain costs related to re-supply and storage is being faced daily.

It is strongly believed that starting a culture of blood conservation can be beneficial for the patients and for the health industry. Furthermore, it allows offering routinely cardiac surgery to patients that for religious belief don’t accept blood product transfusions.

Creating this culture is based on the creation of a system where blood conservation becomes a philosophy of pre-operative, intra-operative and post-operative management, based on the use of appropriate

peri-operative anesthesia techniques, such as acute normovolemic hemodilution (ANH), the choice -if possible- of “off-pump” cardiac surgery, the use of appropriate intraoperative surgical techniques, the acceptance and awareness of post-operative permissive anemia, and the prevention of blood waist at any level of the chain of care.

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