BloodNews
News & Information for our Hospital Customers

Blood Systems
Blood Services

Perioperative Autologous Blood Transfusions

By Chris Gresens, MD, Division Chief Medical Officer for Blood Centers of the Pacific, BloodSource, and United Blood Services California. The author discloses no conflicts of interest.

The perioperative collection and transfusion of autologous blood plays an important role in effective patient blood management.[1-3] As with all treatment modalities, however, its application should be limited to instances where the benefits, risks, and costs are suitably balanced; examples include surgery where transfusion is highly likely and support of patients requiring very rare allogeneic units that are frequently in short supply.

Autologous blood is collected from a patient with the intention of reinfusing it if/when needed. Autologous collections can be divided into: (1) patient blood collected well before surgery (*preoperatively* collected autologous blood, which will not be a focus of this review), and (2) blood collected immediately before, during, and after surgery (*perioperatively* collected autologous blood). Perioperative autologous blood can be categorized further into: (a) acute normovolemic hemodilution, (b) intraoperative blood salvage, and (c) postoperative blood salvage. Each can contribute to improved patient outcomes when used wisely.[1-3]

Table 1: Pros and Cons of ANH

Pros	Cons
Reduces the: Need for allogeneic blood transfusions Risk of transfusing the wrong unit	Adds time to the pre-surgery preparations
Freshly acquired blood is associated (as compared to stored blood) with: Functional platelets Normal clotting factors levels Minimal negative storage effects	Requires trained staff
Diluted nature of patient's post-phlebotomized blood results in: Reduced viscosity (leading to more efficient blood flow) Potentially reduced RBC loss associated with surgical bleeding	Less likely to benefit patients undergoing lower blood loss procedures
Useful in some emergencies (which is not the case for preoperative deposits) and is relatively simple and inexpensive	

Key Points

- Perioperative autologous transfusions are comprised of: (1) acutenormovolemic hemodilution (ANH), (2) intraoperative blood salvage (IBS), and (3) postoperative blood salvage (PBS).
- ANH is most effective for pre-planned surgical patients expected to lose large volumes of blood perioperatively and those for whom allogeneic units may be difficult to find.
- IBS also is useful when treating patients expected to lose substantial blood, including those for whom insufficient time exists to perform ANH (or for whom ANH is contraindicated).
- PBS can be effective in very specific situations where substantial, uncontaminated postoperative bleeding is expected.
- Tables 1-3 summarize the pros and cons of these modalities.

Acute Normovolemic Hemodilution (ANH)

Principles and rationale: Phlebotomy of whole blood from apatient immediately prior to surgery—and replacing itsimultaneously with comparable volumes of fluid—reduces the patient's hemoglobin/hematocrit levels. With subsequent surgical bleeding, the total quantity of red blood cells (RBCs) lost will be proportionately less than it would have been otherwise; additionally, (1) the patient's lowered, post-phlebotomy blood viscosity supports more efficient cardiac output and blood flow, and (2) the re-infused autologous blood contains (in addition to the RBCs) near-maximally functional platelets and plasma.[1-5]

Mechanism: Multiple units of whole blood are collected into typical donor blood collection bags immediately prior to surgery; this is accomplished in either the preoperative area or the operating room. Crystalloid and/or colloid fluid replacement is administered in association with the collection to maintain normovolemia. The autologous blood is held for up to 8 hours (usually at the patient's bedside) until reinfusion is indicated. It is then administered similarly to a "routine" transfusion.[1-5]

Frequent indications include surgeries expected to be associated with significant blood loss (e.g., ≥ 1,000-1,500 mL in an adult). Examples include: (1) cardiac surgery (*e.g.*, "redo" coronary artery bypass grafting and heart transplant); (2) major orthopedic surgery (e.g., involving complicated spinal repair); and (3) vascular surgery involving major reconstruction (e.g., repair of an abdominal aortic aneurysm).[1-5]

Contraindications include sepsis as well as significant and severe preexisting cases of: (1) acute myocardial ischemia (2) anemia, (3) cardiac failure, (4) coagulopathy (especially if preexisting, active bleeding is present), (5) hemoglobinopathy accompanied by hemolysis, (6) hypovolemia, (e.g., hemorrhagic shock, where ANH could worsen the hemodynamic instability), (7) renal failure, and (8) respiratory failure.[4,5] ANH's advantages and disadvantages are summarized in Table 1.

America's Blood Centers It's About Life.

This edition of *BloodNEWS* is a reprint of *Blood Bulletin*, issued periodically by America's Blood Centers. Publication Committee Chair: Chris Gresens, MD; Editor: Lisa Spinelli. The opinions expressed herein are opinions only and should not be construed as recommendations or standards of ABC, ABC SMT Committee, or its board of trustees. Publication Office: 725 15th St., NW, Suite 700, Washington, DC 20005. Tel: (202) 654-2982; Fax: (202) 393-1282; E-mail: abc@americasblood.org.

How much blood should be collected? From 2 to 4 units of approximately 500 mL each (15–20 mL/kg) is typical for adults, with the goal being to achieve a post-phlebotomy hematocrit of 18–28%, depending upon the procedure and the patient's condition. The collection of fewer than 2 units from a typically sized adult patient is unlikely to be appropriate.[4,5]

Who performs the phlebotomies and where should the blood be stored? Usually anesthesiology staff perform the collections. The collected blood is labeled appropriately and stored at room temperature near the patient. This blood is not typically removed from the operating room.[1-3]

When and how should reinfusion occur? Reinfusion may occur according to established transfusion guidelines (often, though not always, at the end of the surgical procedure) and should proceed in a sequence opposite to the order of collection, e.g., the unit drawn last should be reinfused first and so on.[1-3]

Table 2: Pros and Cons of Intraoperative Blood Salvage

Pros	Cons
Provides a theoretically unlimited supply of autologous RBCs that otherwise would be lost (but instead are "recycled")	**Sophisticated nature of this procedure requires:** Special (and expensive) equipment and supplies Highly skilled operators
Usable during emergencies (which is not an option for preoperative autologous donation or, in many cases, for ANH)	**Risks include:** Electrolyte imbalances Dilutional coagulopathy DIC (salvaged blood syndrome)
In general very safe	**Salvaged blood may contain:** Cell debris Free hemoglobin Micro-aggregate particles

Table 3: Pros and Cons of Postoperative Blood Salvage

Pros	Cons
Especially effective when substantial postoperative bleeding is anticipated	Sometimes over utilized (*e.g.*, such as for cases where both volume of bleeding and hematocrit of collected blood are low)
In general very safe	

Intraoperative Blood Salvage

Principles, rationale, and mechanism: Blood that is shed from the surgical field is collected (generally via suction), centrifuged, washed and reinfused into the patient.[1-3,6] The hematocrit of these units should be approximately 45-50%.[2,3]

Frequent indications include cardiothoracic, orthopedic, neurologic, and trauma surgeries. This approach is particularly attractive for the management of selected patients who refuse other forms of blood transfusions (e.g., some Jehovah's Witnesses).[1-3,6]

Contraindications include sepsis and surgery where contamination of the shed blood is highly likely (e.g., some bowel procedures). Controversial contraindications include malignant disease affecting the operative site (i.e., due to concern about potentially "seeding" distant sites with malignant cells) and obstetrics (primarily due to concerns about risks for amniotic fluid embolism—a concern that has not been borne out across extensive practical applications).[6,7] See Table 2 for a summary of the pros and cons of this procedure.

Postoperative Blood Salvage

Principles, rationale, and mechanism: Blood that is shed from the postoperative surgical field is collected from surgical drains and reinfused into the patient.

Frequent indications include procedures that give rise to relatively large (e.g., ≥ 500 mL for an adult) postoperative drainage, such as cardiac and orthopedic surgery.

Contraindications include potentially infected drainage sites and situations where bleeding is not expected to be significant.

Additional discussion: As the use of antifibrinolytic agents and other modalities has reduced the impact of postoperative bleeding in many patient populations, the application of this technique has in some cases become less valuable. See Table 3 for the pros and cons of this procedure.

Closing

The American Society of Anesthesiologists (ASA) Task Force on Perioperative Blood Management recommends practitioners "[c]onsider ANH to reduce allogeneic blood transfusion in patients at high risk for excessive bleeding (e.g., major cardiac, orthopedic, thoracic, or liver surgery), if possible" [and strongly recommends considering] the reinfusion of recovered [RBCs] as a blood-sparing intervention in the intraoperative and/or postoperative period."[8] As noted above, the use of all of these modalities should be reserved for cases where the benefits, risks, and costs align favorably.

QC requirements: The reader is referred to AABB's *Standards for Perioperative Autologous Blood Collection and Administration* for direction in this matter.[9]

References

1. Walunj A, Babb A, Sharpe R. Autologous blood transfusion. Continuing Education in Anaesthesia, Critical Care, & Pain. 2006; 6: 192-6.
2. Waters JH, Shander A. Editors. Perioperative Blood Management: A Physician's Handbook, 3rd edition. AABB; Bethesda, MD 2014.
3. Ghiglone M, Puca KE. Patient blood management. In: Fung MK, Grossman BJ, Hillyer CD, Westhoff CM. Editors. Technical Manual. 18th edition. AABB, Bethesda, MD, 2014.
4. Barile L, Fominskiy E, Tomasso ND, et al. Acute Normovolemic Hemodilution Reduces Allogeneic Red Blood Cell Transfusion in Cardiac Surgery: A Systematic Review and Meta-analysis of Randomized Trials. Anesth Analg.2017;124(3):743-52.
5. Zhou X, Zhang Z, Wang Y, Yu L, Yan M. Preoperative acute normovolemic hemodilution for minimizing allogeneic blood transfusion: a meta-analysis. Anesthesia & Analgesia. 2015.121:1443-54.
6. Esper SA, Waters JH. Intraoperative blood salvage: a freshlook at the indications and contraindications. Blood Transfusion. 2011; 9: 139-47.
7. Liumbruno GM, Liumbruno C, Rafanelli D. Intraoperative cell salvage in obstetrics: is it a real therapeutic option? Transfusion 2011; 51: 2244-56.
8. Apfelbaum JL, Nuttall GA, Connis RT, et al. Practice guidelines for perioperative blood management: An updated report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management. Anesthesiology. 2015;122: 241-75.
9. Puca KE, Brown S, Buzenius K, et al. Members of Perioperative Standards Program Unit. Standards for PerioperativeAutologous Blood Collection and Administration. 6th edition. AABB, Bethesda, MD, 2015.