What is Autotransfusion?

Autotransfusion or autologous blood recovery refers to the reinfusion of one’s own blood and is an alternative to donor (allogeneic) blood transfusions. The blood donor and recipient are the same during autotransfusion.

Why Should Autotransfusion be Utilized?

Autotransfusion provides immediate benefits to the surgical team and most importantly provides many patient advantages. Autotransfusion utilizes a blood resource that would otherwise be lost and makes blood immediately available for use. Autotransfusion decreases the demand on the allogeneic blood supply and conserves that blood supply. Autotransfusion is a safe and reliable cost effective method of returning red blood cells to the patient.

Patient Advantages:

Some of the patient advantages for autotransfusion include that it:

• Reduces the risks associated with blood borne pathogens (Hepatitis A,B and C and other infectious agents)
• Is a source of blood for patients who have developed alloantibodies due to previous transfusion or pregnancy
• Reduces the possibility of patients receiving incorrect blood due to clerical errors
• May provide a source of blood for those patients with religious objections to transfusions with banked blood
• Eliminates transfusion related immunomodulation (TRIM) that can lead to postoperative infections and tumor recurrence

When Can Autotransfusion be Considered for Patient Use?

A qualified physician may consider autotransfusion in the following procedures:

• When it is anticipated that the surgical blood loss will be ≥20% of the total blood volume in adults and ≥15% for pediatric patients
• When two units of blood are routinely cross-matched
• In surgeries where 20% of the patients require transfusion
• In surgeries when mean transfusion volume exceeds two units

What are the Basic Principles of Hematology as They Apply to Autotransfusion?

Red blood cells transport oxygen and carbon dioxide waste. Hemoglobin, the large protein found in red blood cells, has a high affinity for oxygen and carries approximately 99% of the circulating oxygen. In order for hemoglobin to function properly it must be carried by undamaged red blood cells. Damaged red blood cells decrease the oxygen carrying capacity of the blood. Damaged red blood cells that are no longer intact release hemoglobin. The free hemoglobin may bind to oxygen, but in an ineffective manner. The role of the autotransfusion device is to recover and process the intact red blood cells.

Hemoglobin is made up of two identical α-globin and β-globin chains. Each chain contains an iron atom that binds oxygen. 2,3-diphosphoglycerate (2,3-DPG) is a by-product of sugar metabolism within the red blood cell and helps regulate oxyhemoglobin affinity by maintaining the appropriate distance between the β-globin chains.

![Figure 1 - Changes in oxygen affinity](image)
When the β-globin chains are farther apart, the affinity for oxygen is decreased. When they are closer together, the affinity is increased. The hemoglobin molecule tends to return to its natural state when the chains are closer together. The 2,3-DPG interposes itself between the β-globin chains to physically block the return to close proximity and encourage more oxygen release. To fulfill this function the 2,3-DPG must be present in the red cell in about the same concentration as hemoglobin.

If the amount of 2,3-DPG in the red blood cells is decreased, the ability of hemoglobin to return into a high affinity state is decreased. 2,3-DPG concentration in donor blood decreases with age. It can take 18-36 hours for the 2,3-DPG concentration in red blood cells to return to normal levels after transfusion. During this time the red blood cells will not release their normal oxygen load to the tissue beds as effectively as normal.

Recovered and processed red blood cells from autotransfusion instruments are ‘fresh’ in terms of 2,3-DPG content and may be functionally more capable to support oxygen transportation, compared to red blood cells that have been stored in the blood bank. This is an important benefit of autotransfusion.

**Storage Defects**

Recent studies have demonstrated that the longer blood is stored, the ability of this blood to deliver oxygen to the tissues is greatly diminished. In addition to deficits in 2,3-DPG, stored red blood cells are associated with increases in plasma-free hemoglobin, potassium and inflammatory cytokines.

Red blood cells that are stored beyond 7-10 days also become misshapen and poorly deformable which greatly affects their ability to perfuse capillary beds.

The end result of these storage defects is inefficient delivery of oxygen to the tissues. Of even more concern are animal and human studies that show no increase or even a decrease in tissue level perfusion after the transfusion of blood that has been stored longer than 2 weeks.

**Complement Activation**

The complement system, an enzymatic reaction cascade that can contribute to red blood cell destruction, works with the body’s immune system to defend against infection and foreign substances. Complement activation can be triggered by the following:

- Trauma
- Foreign surfaces such as cardiopulmonary by-pass circuits, hemodialysis tubing and membranes
- Bacteria
- Viruses

Autotransfusion can be useful for removal of substances that cause complement activation. Careful recovery and processing of the blood from the surgical or trauma site is important to ensure that autotransfusion does not contribute to complement activation.

**What are the Basic Principles of Autotransfusion?**

**Recovery Methods**

There are five basic recovery methods used in autotransfusion:

- **Perioperative Pre-donation** – The blood is collected prior to the patient’s surgery with the last donation occurring at a minimum of 72 hours prior.
- **Perioperative Platelet and Plasma Sequestration** – The collection and separation of autologous platelets and plasma directly before surgery.
- **Intraoperative Hemodilution** – Whole blood is donated immediately before surgery and delivered to the patient perioperatively.
- **Intraoperative Blood Recovery** – The collection of shed blood from a surgical site or cardiopulmonary by-pass circuit.
- **Postoperative Blood Recovery** – The recovery of blood from drains placed within the surgical or trauma site.
Techniques

There are three basic techniques for Intraoperative and Postoperative collection and reinfusion of shed blood:

- **Semi-continuous Flow Centrifugation Systems** – This is the most commonly used system. The shed blood is aspirated from the surgical field, mixed with anticoagulant, filtered, centrifuged and processed.

- **Canister Collection Technique** – Blood is collected in the same manner as above in a rigid reservoir with a disposable liner. The liner is removed and the blood is reinfused with or without washing.

- **Single or Multiple-use, Self-contained Devices** – The blood is collected and anticoagulated. The blood is then reinfused to the patient through a filter without being washed.

Why Wash Recovered Blood?

Washing serves the purpose of removing all other substances except the red blood cells from collected blood. The removed substances can include:

- Plasma-free hemoglobin
- Hemolyzed red blood cells
- Pharmacologic agents
- Bone fragments
- Activated platelets
- Irrigation solutions
- Activated clotting factors

Unwashed blood has higher concentrations of contaminants in comparison to washed blood. These contaminants include:

- Tissue debris
- Activated platelets
- Activated leucocytes
- Thrombin and other pro-coagulants
- Activated complement proteins
- Fibrin degradation products
- Red cell stroma
- Micro-aggregates
- Surgical debris
- Anticoagulant solutions

Unwashed systems are not designed to collect the rapid blood loss associated with cardiovascular or trauma surgery. In addition, the quality of washed blood is directly related to patient outcomes.

Blood Management Programs

Blood management programs have been established within hospitals that may have multiple services such as trauma, cardiac surgery, orthopedics, transplant and oncology. In addition to the blood bank, other ancillary services that are actively involved with the program may include the clinical laboratory, risk management, pharmacy and finance. These blood management programs are designed to:

- Promote transfusion safety
- Improve patient care
- Manage patients at risk for transfusion
- Optimize the utilization of blood and other resources
- Achieve consistency in transfusion practices
- Create transfusion cost savings

What are the Potential Complications and Contraindications for Autotransfusion?

Potential complications of autotransfusion include the following:

- Hemolysis
- Air embolism
- Dilution coagulopathy
- Protein loss
- Contaminants

Potential contraindications for autotransfusion may include the following:

- Citrate-based anticoagulants in patients with impaired liver function
- Gross contamination or septic procedures
- Surgery within a malignant area
- Biological contaminants
- Contamination of blood with drugs not intended for intravenous administration
- Collagen based hemostatic agents
- Certain coagulopathies
- Titanium prosthesis
Why Use the Medtronic autoLog™ Autotransfusion System?

The autoLog™ Autotransfusion System is a sophisticated and effective processing system with a fully automated design. It consistently produces a high-quality end product that offers simplicity of operation and elimination of operator variability.

The autoLog™ System features that improve quality include: self-starting capability, unique bowl design and two-stage filling cycle with variable-speed wash process. The intuitive design and easy system set-up result in time and cost savings. Convenient, compact design and small foot print provide ease-of-portability. A built-in vacuum source eliminates the need to be near wall suction. These enhanced features make the autoLog™ Autotransfusion System perfect for use in crowded areas.

Medtronic autoLog™ Autotransfusion System Supporting Literature

Medtronic autoLog™ Autotransfusion: Comparative Wash Quality and Clinical Assesment; Timothy Hannon, MD, Medical Director, Autotransfusion Service, Naval Medical Center, San Diego, CA

• The low volume, 135cc bowl of autoLog allows for earlier return of RBC’s.

• The autoLog™ System has a fast processing time with one of the highest PRBC mass/minutes volumes of the instruments tested.

• Well received by the operating room staff because of its simple set-up and ease of use.

“From a clinical standpoint, the compact design, economy, ease of set-up, and simplicity of operation are major advantages of the autoLog™ Autotransfusion System showing its wash program to be fast, sophisticated and quite efficient, the autoLog has proved to be a very capable and desirable autotransfusion machine.”

T. Hannon MD

New Developments in Autotransfusion Systems;
P. Gieger, K. Platow, A. Barti, C. Volk. K. Junker, and H.H. Mehrkens

• All devices, based on in vitro and in vivo studies, can be used in daily clinical routine

• Clinical operating and handling is optimized by computerized automation and simple priming

• The autoLog™ had favorable results with contaminant elimination and transfusion rates

• The autoLog™ had favorable RBC volume and recovery rates

“With regards to a homogenous quality of all processed RBCs, the autoLog™ system placed in the first range.”

P. Geiger MD et al.

Recommended Resources

• aaBB Standards for Blood Banking and Transfusion Service

• aaBB Standards for Perioperative Autologous Blood Collection and Administration

• aaBB Guidance for Standards for Perioperative Autologous Blood Collection and Administration

• aaBB Guidelines for Blood Recovery and Reinfusion in Surgery and Trauma
References

1. Autotransfusion Symposium Reference Manual; Co-presented by The office of Continuing Medical Education of The University of Colorado School of Medicine and The University of Colorado School of Nursing


3. Suttner S, Piper SN, Kumle B et al. The influence of allogeneic red blood cell transfusion compared with 100% oxygen ventilation on systemic oxygen transport and skeletal muscle oxygen tension after cardiac surgery. Anesth Analg 1998;86(Suppl. 2)


Additional Resources


