

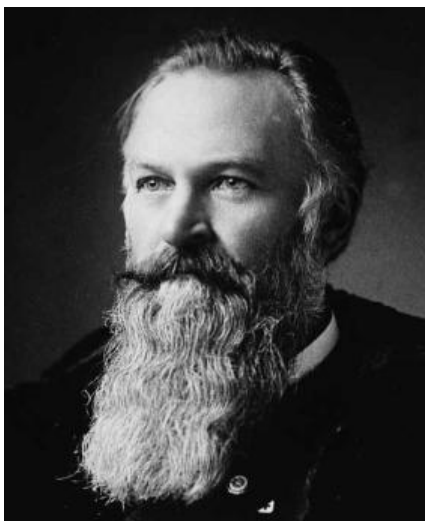


# Alternatives to Blood Transfusions

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Bloodless surgery is a term that was popularized in the early 1900s by the practice of an internationally famous orthopedic surgeon, Dr Adolf Lorenz, who was known as “the bloodless surgeon of Vienna.” At that time, carbolic acid was routinely used in the operating room to clean a surgeon’s hands. Due to Lorenz’ allergic reaction to carbolic acid, he began treating his patients with non-invasive techniques. Thus the term “bloodless surgeon of Vienna.”<sup>10</sup>

Dr Lorenz developed a huge reputation for his ability to treat clubfeet. He was able to stretch even to the point of breaking the tendons, ligaments and epiphyseal plates until the foot was appropriately aligned. He then would apply a cast until the foot healed in that position.



Dr Adolf Lorenz

He was also involved with the treatment of scoliosis, but was most famous for his treatment of congenital dislocation of the hip. His technique involved manipulating the hip in young children under light anesthesia and holding them in a body cast as

## LEARNING OBJECTIVES

- ▲ Identify alternatives to blood transfusions
- ▲ List the types of methods and procedures used as alternatives for these procedures
- ▲ Examine the various intraoperative surgical techniques and instruments that can be used
- ▲ Recall the risks associated with these types of procedures
- ▲ Define hypotensive anesthesia as related to bloodless surgery



they matured.<sup>10</sup> The New York Times, in December of 1902, wrote about a case involving double dislocation of the hip bones in which he was able to reduce one of the deformed hips in one minute and 25 seconds.

Since those early years, there has been an increased surge of interest in bloodless surgery for a variety of reasons. It is well known in the field of transfusion medicine that some patients do not believe in receiving blood transfusions due to religious or personal convictions. For example, Jehovah's Witnesses refuse on religious grounds the transfusion of whole blood, packed red blood cells, plasma, white blood cells, platelets, auto transfusion of pre-deposited blood or any technique that involves blood storage. In some instances they will accept transfusions of products that have minor blood fractions. Much of the earliest data available on bloodless surgery were collected from patients who refused blood transfusions for religious reasons, primarily Jehovah's Witnesses. Dr Denton Cooley, a pioneering American heart surgeon who graduated from the University of Texas, performed the first bloodless open heart surgery on a Jehovah's Witness patient in 1962. He continued his work with bloodless surgery performing intricate heart operations and vascular surgery without blood on both adults and children. He felt that the risks involved in surgery without blood were no greater than the risks with blood at the time.<sup>16</sup>

Those who perform bloodless surgery do transfuse products made from allogeneic blood and they also make use of pre-donated blood for autologous transfusion. Others define bloodless surgery as a procedure in which techniques and steps are used to help the body compensate for blood loss before, during and after surgery, without the use of donor blood. Also, the use of pharmaceutical agents, intravenous fluids and improved diagnostic procedures and surgical techniques can prevent and lessen anemia associated with surgery and other medical procedures. When possible, patients who wish to have surgery without

blood should be evaluated for anemia and any indication of this should be treated before surgery.

Kenneth Kipnis, PhD, from the Department of Philosophy at the University of Hawaii in Manoa, acknowledges that "health care providers have not always been as respectful of patient rights as they should be. Patients who refuse transfusions historically have been considered heretics in the cathedrals of medicine. This attitude, which, unfortunately has been common in the medical community, disregards patient autonomy."<sup>22</sup>

#### ALTERNATIVES FOR PATIENTS WHO DO NOT CONSENT TO BLOOD TRANSFUSIONS

If the loss of blood is rapid and great, a person's blood pressure drops, and he or she may go into shock. What is primarily needed is for the bleeding to be stopped and the volume in his or her system to be restored. This action will serve to prevent shock and keep the remaining red cells and other components in circulation.

Volume replacement can be accomplished without using whole blood or blood plasma. Various non-blood fluids are effective volume expanders. The simplest is saline (salt) solution, which is both inexpensive and compatible with human blood. There are also fluids with special properties, such as dextran, Haemacel and lactated Ringer's solution.



Photo courtesy of Martind

Hetastarch (HES) is a newer volume expander. Such fluids have definite advantages. "Crystalloid solutions [such as normal saline and lactated Ringer's solution], Dextran and HES are relatively nontoxic and inexpensive, readily available, can be stored at room temperature, require no compatibility testing and are free of the risk of transfusion-transmitted disease."<sup>8</sup>

Since those early years, there has been an increased surge of interest in bloodless surgery for a variety of reasons. It is well known in the field of transfusion medicine that some patients do not believe in receiving blood transfusions due to religious or personal convictions.

The accepted "rule" was to transfuse a patient before surgery if his hemoglobin was below 10 (or 30 percent hematocrit). The Swiss journal *Vox Sanguinis* reported that "65% of [anesthesiologists] required patients to have a pre-operative hemoglobin of 10 gm/dl for elective surgery." This point of view was debated by Professor Howard L Zauder, MD, PhD who asked, "How Did We Get a 'Magic Number?'" He stated: "The etiology of the requirement that a patient have 10 grams of hemoglobin (Hgb) prior to receiving an anesthetic is cloaked in tradition, shrouded in obscurity, and unsubstantiated by clinical or experimental evidence."

One such case supporting Dr Zauder's comment was a team of British doctors who treated a woman who had lost so much blood that her haemoglobin fell to 1.8 g/dlitre. She was with oxygen concentrations and transfusions of large volumes of gelatin solution and had an excellent outcome.<sup>1</sup>

A few of the methods and procedures for those that refuse blood transfusions include:

- **Neupogen:** A man-made form of protein that stimulates the growth of white blood cells in the body. White blood cells help the body fight against infection.<sup>7</sup>
- **Granulocyte Macrophage Colony Stimulating Factor:** GM-CSF is a cytokine (protein) molecule that functions as a white blood cell growth factor.<sup>4</sup>
- **Neumega** is used to stimulate the bone marrow to produce platelets in order to prevent low platelets that may be caused by chemotherapy. Platelets are blood cells that allow the blood to clot, and prevent bleeding. It may be given to decrease the need for platelet transfusions.<sup>13</sup>

- **Oxygent:** An intravascular oxygen carrier designed to temporarily augment oxygen delivery in patients at risk of acute tissue oxygen deficit due to transient anemia, blood loss or ischemia. Oxygent can be used in patients of any blood type. Oxygent is heat sterilized to prevent bacterial contamination; blood and hemoglobin cannot be heat sterilized. Oxygent does not transmit viruses or other infectious agents; can be stored for about two years (versus whole blood, which can be stored for about 21 days); and it delivers twice as much oxygen twice as fast as an equal amount of blood's hemoglobin. Alliance completed Phase III of their Oxygent study in Europe in May of last year.<sup>6</sup>
- **Recombinant factor VIIa:** Rombinant factor VIIa was initially developed for the treatment of hemorrhagic episodes in hemophilic patients. After its introduction, it also has been used to enhance hemostasis in non-hemophilic patients who experience bleeding episodes not responsive to conventional therapy. Anecdotal reports also suggest that the product is safe and effective in controlling bleeding in nonhemophilic patients. The product is still under investigation.<sup>12</sup>
- **Recombinant Human Erythropoietin:** A synthetic hormone used to stimulate the bone marrow to produce more red blood cells. This hormone is naturally produced by the kidneys. This drug can be used both preoperatively and postoperatively to help increase the production of red blood cells. It can be administered subcutaneously or intravenously, and it can be given either weekly, starting 3 weeks before surgery and ending on the day of surgery, or daily, beginning 9 days before surgery and continuing for 4 days after surgery.
- Another drug that is inexpensive and has been used to reduce heavy bleeding during menstrual cycles is **tranexamic acid**. TA has been found to be highly effective in trauma patients and those undergoing minimally invasive total knee arthroplasty. The Network for Advancement of Transfusion Alternatives states that studies conducted on TA have demonstrated a reduced amount of red blood cell transfusions in total knee arthroplasty. Tranexamic acid is a synthetic derivative of the amino acid lysine. It is an anti-fibrinolytic. It works by preventing blood clots from breaking down too quickly. This helps reduce excessive bleeding.<sup>3</sup>

A few of the intraoperative surgical techniques and instruments that are available are:

- **Gamma knife** is a minimally invasive surgical technique that delivers a high dose gamma radiation. The affected tissue receives a precisely focused dose while the surrounding tissue absorbs little radiation. This technique is mostly used for brain surgery.
- **Electrocautery** is a safe procedure that is routinely used in surgery to remove unwanted or harmful tissue. It can be used to burn and seal blood vessels, which helps to reduce or stop massive bleeding.
- **Harmonic scalpel:** This device can be used for open or laparoscopic procedures. The harmonic scalpel cuts via vibration. The scalpel surface cuts through tissue by vibrating in the range of 20,000 Hz. The vibration cuts through tissue and seals it using protein denaturation, rather than heat. Blood vessels are sealed at a lower temperature than is needed for electrosurgery and lasers. Because it can be used in multiple configurations, it is a great tool for a number of procedures, such as dental, ophthalmic, OB-GYN and general surgery.
- **Argon beam:** A pen-like instrument that sprays argon gas on the surgically cut tissue thereby reducing blood loss. The flow of gas blows away blood and debris from the surgical field and produces a coagulated surface that is more uniform and shallower than that produced in standard electrosurgical coagulation. The argon beam quickly coagulates profuse bleeding tissues. Rapid hemostasis results in minimal blood loss reducing costs and risks associated with transfusions. In addition, argon gas prevents oxidation. This results in less charring, tissue destruction and formation of necrotic tissue. This results in optimal healing.<sup>15</sup>

#### HYPOTENSIVE ANESTHESIA

Moderate hypotensive anesthesia was found to significantly decrease the average blood loss by nearly 40%, reduce the need for transfusion by nearly 45% and shorten the average operating time by nearly 10%.<sup>17</sup>

Hypotension can be induced using peripheral vasodilators and inhalation agents.

The three most commonly used vasodilators are: sodium nitroprusside (SNP), nitroglycerin (NTG) and trimethaphan.

**SNP** acts as a vascular smooth muscle relaxant which acts quickly but has a brief duration of action. Its primary

influence is on arteriolar and venous vessels, but without significant myocardial effects.

**NTG** reduces blood pressure by relaxing venous smooth muscle and, like SNP, has rapid onset of action but short duration. NTG is less toxic than SNP; however, it is more difficult to fine-tune the degree of hypotension with NTG since it is less potent than SNP in its capacity to reduce blood pressure.

**Trimethaphan** that produces hypotension is also short acting and provides control of blood pressure. Commonly used inhalation agents, or volatile anesthetic agents, include halothane, isoflurane and enflurane. The concentration of a volatile anesthetic agent produces a dose-dependent decrease in mean arterial pressure.<sup>9</sup>

**Intraoperative blood salvage:** This is also known as the cell saver. It is used intraoperatively if the bleeding becomes heavy. This allows the patient to recover shed blood as it flows through the device, filters debris, washes red cells as they circulate and can save as much as 15% of blood that would have been lost. It is used if blood loss is expected to be greater than one liter or more in adult patients. Some types are even good to be used on infants.<sup>11</sup> The cell salvage method, along with acute normovolemic hemodilution, may be acceptable to many including those who object due to religious reasons.

As of 2011, in the US, there are at least 12 hospitals that specialize in bloodless surgery for infants, and more than 160 hospitals that have a dedicated full-time Bloodless Surgery Program.

Acute normovolemic hemodilution involves removing and storing several units of blood in the operating room just before surgery. The patient's remaining blood is then diluted with either crystalloids or colloids to maintain a normal circulating blood volume. Any of this diluted blood that is lost during surgery will have fewer red blood cells and lowered levels of clotting factors. The whole fresh blood that was stored is then re-administered after surgery, or, if necessary, during the procedure. Jehovah's Wit-

ness patients may accept this method if it is modified. If the blood does not completely leave their system but remains in a continuous circuit with their circulatory system it may be considered as an option.<sup>14</sup>

#### BLOODLESS SURGERIES ON THE RISE

There are an increasing number of medical professionals who are beginning to utilize these alternative methods as standard of practice. In January 2010, the United States Defense Department granted Englewood Hospital in New Jersey a total of \$4.7 million to train the entire US military and civilian physicians in bloodless surgery and other medical procedures. Dr Shandler (a director of the Englewood Institute) encourages using less blood. He believes that withholding blood is a viable and preferable choice for most patients. This benefits patients and “tests surgeons in their willingness to depart from tradition.” It is possible that as more medical professionals are trained in bloodless alternatives, patients who do not consent to blood transfusions will meet less resistance.

Many patients view it not as a last resort but as a preferred treatment. Stephen Geoffrey Pollard, a British consultant surgeon, notes that the morbidity and mortality rates among those who receive bloodless surgery are “at least as good as those patients who receive blood, and in many cases they are spared the postoperative infections and complications often attributable to blood.” In a study of 1,915 patients, those who received a blood transfusion had twice the five-year mortality rate of those who did not. Even after correcting for comorbidities, age and other factors, there was still a 70% increase in mortality. Most research available seems to indicate that reducing or eliminating blood transfusions also results in improved patient outcomes. Many studies document an increase in morbidity and mortality after a blood transfusion.<sup>20</sup>

There is also the cost associated with blood transfusions. Banked blood is a limited resource. The current cost of acquiring and processing a unit of blood is estimated to range from \$337 to \$658 per unit.<sup>14</sup> Other studies put the cost between \$522 and \$1,183 per unit of blood. Most insurances will not reimburse the cost of the first three units of blood given to a patient per year. However, hospitals may be reimbursed for drugs that boost a patient’s red blood cell count. Geisinger Medical Center began a blood conservation program in 2005 and reported a record savings of \$273,000 in its first six months of operation. Cost will continue to rise as more testing for transfusion-transmitted

diseases is implemented and the blood supply continues to decrease because of the increased identification of tainted blood. One hospital that implemented a bloodless medicine program documented a 16% reduction in surgical costs if blood was not used and a 17% reduction in overall costs due to decreased length of stay.

A number of studies have revealed that transfusion-transmitted HIV infection is approximately 50 to 100 times less likely to occur than transfusion error. A case report presented by the University of Cologne in Germany stated that “on the basis of current estimates of the risks of transfusion-transmitted infection and transfusion errors, an anesthesiologist of a major general hospital or trauma center who transfuses an average of 500 U of packed red cells per year can be estimated to transmit HIV infection once in 1000 years, hepatitis C once in 200 years, hepatitis B once in 120 years, and to administer blood to the wrong recipient once in 30 years or once within his professional lifetime.”<sup>25</sup> Human error includes administration to the wrong recipient, phlebotomy errors, testing of wrong specimen and failure to detect at the bedside before transfusion.

#### MOVING FORWARD

It can be said that one advantage of bloodless surgery is that it promotes better-quality care. “The surgeon’s skill is of the greatest importance in the prevention of blood loss,” says Dr Benjamin J Reichstein, a director of surgery in Cleveland, Ohio. A South African legal journal, as many others have admitted, says that in certain instances surgery without blood can be “quicker, cleaner and less expensive. ... Certainly the aftercare treatment in many instances has proved cheaper and less time-consuming.”<sup>18</sup>

These are just a few of the reasons why some 180 hospitals around the world now have programs specializing in bloodless medicine and surgery. Twenty years ago there were less than 60 hospitals in the United States with established Bloodless Medicine and Surgery Programs. As of 2011, in the US, there are at least 12 hospitals that specialize in bloodless surgery for infants, and more than 160 hospitals that have a dedicated full-time Bloodless Surgery Program.

The Wall Street Journal weighed in on the topic by stating: “Originally developed to accommodate Jehovah’s Witnesses, the practice has gone main stream with many hospitals promoting their bloodless surgery programs to the general public.”<sup>19</sup>



## ABOUT THE AUTHOR



Joel Massop, CST, currently works at Lehigh Regional Medical Center, a small community hospital in Lehigh Acres, Florida.

He graduated High Tech North in Cape Coral, Florida, and has been a CST since December 2007 and started working at the hospital in May 2008. He plans to earn his CSFA in the near future.

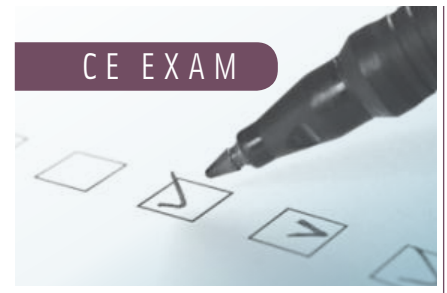
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