

Preanesthetic Assessment of the Jehovah's Witness Patient

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ABSTRACT

The Jehovah's Witnesses, a religious group of 7 million people in more than 200 countries, teaches its followers to not accept blood, resulting in potentially challenging and ethical dilemmas for anesthesiologists. In recent years, Jehovah's Witnesses changed certain elements of their approach to blood transfusion practice, including accepting autologous transfusions in certain circumstances. We examine mechanisms to resolve ethical conflicts, such as additional medical consultations with other involved physicians, surgeons, and anesthesiologists; short-term counseling or psychiatric consultation for patient and family; case management conferences; consultation with individuals trained in clinical ethics or a hospital-based ethics committee; and discussions with hospital administration. We also discuss treatment options, including certain blood products, anesthetic techniques, and pharmacological interventions.

INTRODUCTION

The Jehovah's Witnesses religion is a millennialist Christian denomination that developed out of the International Bible Students Association, founded in 1872 in Pittsburgh by Charles Taze Russell during the Adventist movement. As millennialists, Witnesses believe they are living in the last of days, and they look forward to the imminent establishment of God's kingdom on Earth.¹ Currently, there are approximately 7 million Jehovah's Witnesses in more than 200

countries.² Certain beliefs of this group provide complex ethical and clinical challenges for medical practitioners.

BELIEFS ABOUT BLOOD TRANSFUSION

The beliefs of Jehovah's Witnesses are governed by their interpretation of scriptural laws and principles. In 1945, the Watchtower Society, the governing council of the Jehovah's Witnesses, prohibited the practice of blood transfusions, specifically referencing 3 biblical passages: Genesis 9:3-4, Leviticus 17:10-16, and Acts 15:28-29. These passages detail the sacredness of blood and the prohibition of blood consumption, which the Jehovah's Witnesses interpret as a ban to intravenous and oral routes. This blood ban includes allogenic whole blood, red blood cell concentrates, white blood cells, plasma, and platelets, as well as any autologous blood that has been separated from the patient's body. Of note, many Jehovah's Witnesses will accept autologous transfusions if the tubing stays connected to them, as in the case of cardiopulmonary bypass or hemodialysis.^{3,4}

However, changes in the blood ban guidelines are outlined in an article entitled "Be Guided by the Living God" in a 2004 edition of *The Watchtower*.⁵ This article details what is unacceptable and what is for the "Christian to decide." The above treatments are still banned, but the administration of blood fractionates from red cells, white cells, platelets, and plasma are permissible and their use is up to the discretion of the individual. These fractionates include albumin, recombinant human erythropoietin (rhEPO), immunoglobulins, and factor concentrates.⁵⁻⁷

Treating a Jehovah's Witness in situations that potentially require blood transfusion or products poses a unique medical challenge, involving the need to provide optimal medical care through alternatives to the standard of care while also respecting the patient's rights, values, and beliefs. It is crucial that physicians present and explain all options to Jehovah's Witness patients.^{6,7} This paper discusses the ethical and legal considerations in addition to scientific and technical challenges for anesthesiologists and surgeons.

ETHICAL AND LEGAL ISSUES

The rejection of blood transfusions causes an ethical dilemma between the patient's freedom to

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accept or to reject a medical treatment even unto death (ie, autonomy) and the physician's duty to provide optimal treatment.³ The landmark case of *Schloendorff v Society of New York Hospital*⁸ in 1914 established the right of any adult with capacity to refuse medical treatment, and many Jehovah's Witnesses carry an advance medical directive card that declares their refusal of any blood transfusions and authorizes family members to carry out their wishes on their behalf.

The doctrine of informed consent is to respect persons by fully and accurately providing information needed to exercise their decision-making rights. Physicians must engage in the process of informed consent with patients before undertaking any medical intervention. Consequently, it is best to discuss with patients the specifics of their blood transfusion refusal if possible.^{9,10} Patients have a moral and legal right to refuse proposed medical intervention, except when the patient has diminished decision-making capacity or a legal intervention mandates treatment.^{11,12} Informed consent protects both the patient and the physician from the consequences of adhering to or refuting the patient's wishes. It is legally regarded as battery if blood products are transfused after the documented refusal of blood products, despite whether the transfusion ultimately ensured the patient's survival. Conversely, a physician will likely not be held liable of malpractice if morbidity or mortality result from not transfusing in accordance with the Jehovah's Witness patient's wishes.¹³ However, in cases of emergent life-threatening situations with no documented advance medical directive, the physician is obligated to administer blood products if indicated.^{6,14}

The medical ethics are further complicated when children of Jehovah's Witnesses are involved. In pediatrics, parents or guardians have the authority to give consent by proxy, based on the assumption that their interests lie in safeguarding the child's welfare. However, the physician's legal and ethical obligation ultimately lies with the child patient and not the desires of the parents.¹⁵ The American Academy of Pediatrics recommends that the physician and other healthcare professionals recognize and respect the importance of religion in personal, spiritual, and social lives of patients and "to avoid unnecessary polarization when conflict over religious practices arises."¹⁶ However, if religious convictions interfere with medical care that is likely to prevent substantial harm and suffering or death, the physician should initiate legal action to override parental objections.¹⁶

The power of the state to intervene is contained in the legal concept of *parens patriae* that allows for the protection of an individual who is not able to make

decisions in his or her own best interest. The first court decision regarding the children of Jehovah's Witness parents actually involved the sale of religious literature in violation of state child labor laws, but this case of *Prince v Massachusetts*¹⁷ has often been cited in subsequent medical-legal disputes.¹³ Justice Wiley Rutledge wrote in the majority opinion, "Parents may be free to become martyrs themselves. But it does not follow they are free, in identical circumstances, to make martyrs of their children before they have reached the age of full and legal discretion when they make that choice for themselves."¹⁷ In a study of 50 court publications concerning parent-physician disagreements over the care of children, court-mandated medical care was likely to succeed, especially when the case called for immediate intervention or when parental objections were based on religion.¹⁸

Mechanisms to resolve ethical conflicts include additional medical consultations with other involved physicians, surgeons, and anesthesiologists; short-term counseling or psychiatric consultation for patient and family; case management conferences; consultation with individuals trained in clinical ethics or a hospital-based ethics committee; and the input of hospital administration.^{13,19} Furthermore, because of the variability between individual beliefs, it is common for a Jehovah's Witness patient to consult the community elders or minister for help in reaching a decision regarding accepting any medical treatment related to blood products.^{13,20}

Although blood components, autologous blood, and banked blood are generally unacceptable to Jehovah's Witnesses, providers should discuss and document specific acceptances and objections, the degree of limitation, and changes to the plan for intraoperative management. It is best to consult each Jehovah's Witness patient individually, whenever possible, to ascertain what treatments he or she will accept to respect any advance directives.^{12,20} Documenting all discussions, conferences, objections, and acceptable interventions crystallizes the patient's wishes and provides legal documentation for the anesthesiologist. Anesthesiologists must be certain they are capable of fulfilling the patient's requests; otherwise, they should not agree to provide anesthesia.^{12,21} Anesthesiologists have the right to refuse to anesthetize an individual in an elective situation, and both anesthesiologist and surgeon should provide nonemergency care to the patient only if all parties can agree on the approach to blood management.

Medical, legal, and ethical issues associated with blood product administration to a Jehovah's Witness patient have triggered continued efforts to reduce blood loss and thus blood transfusions. Numerous techniques and interventions for the preoperative,

intraoperative, and postoperative stages have been developed and used over time.

PREOPERATIVE STRATEGIES

Providers can take steps preoperatively to minimize or plan for the risk factors associated with transfusions, such as discontinuing anticoagulation therapy, administering antifibrinolytic therapy, and correcting preoperative anemia.^{22,23} In cases of trauma and critical care, the physician must have a higher index of suspicion of blood loss and take a more aggressive approach to clinical management, including earlier surgical intervention.^{6,19} Ideally, the preoperative evaluation should include a medical chart review; questioning regarding bleeding history (previous surgical complications, bleeding complications after trauma, bleeding after dental procedures, and family history of bleeding disorders) and current medications or herbal supplements that may cause coagulopathy (eg, nonsteroidal antiinflammatory drugs [NSAIDs], fish oil); and laboratory testing that includes hemoglobin, hematocrit, platelet count, and coagulation profile.^{22,24} In addition, providers should question the Jehovah's Witness patient on specific blood product interventions that the physician may or may not use.

Considerations Regarding Anemia

Typically, transfusion of packed red blood cells (RBCs) is reserved for patients who are actively bleeding and for patients with severe and symptomatic anemia; however, a Jehovah's Witness patient should be approached differently.²⁵ The 3 main causes of anemia are blood loss, hemolysis, and decreased erythropoiesis. The World Health Organization criteria for anemia use hemoglobin cutoffs of 12.0 g/dL for nonpregnant women older than 15 years and 13.0 g/dL for men older than 15 years.²⁶ In an acute setting, transfusion is usually recommended when hemoglobin levels fall below 10 g/dL and is almost always required for hemoglobin below 6 g/dL, with the understanding that a certain low level of hemoglobin puts the patient at an unacceptable risk.^{22,27} However, a multicenter, randomized, controlled clinical trial demonstrated that a restrictive transfusion strategy (maintenance of hemoglobin concentration at 7-9 g/dL) had a lower 30-day mortality compared to a liberal strategy (maintenance of hemoglobin at 10-12 g/dL).²⁸

Additionally, there is a physiological ability to adapt to low hemoglobin levels, and studies have shown that healthy individuals tolerate an acute isovolemic drop in hemoglobin as low as 4-5 g/dL with no signs of tissue hypoxia.^{29,30} Thus, treatment for anemia is based in large part on how well the

patient tolerates the anemia, particularly for a Jehovah's Witness patient who may be severely anemic yet stable.³¹ To maintain isovolumic status, Jehovah's Witness patients should be infused with isotonic crystalloid or colloid solutions to maintain systolic blood pressure and tissue perfusion.³²

Assessment of adequate oxygen (O₂) delivery can be measured with mixed venous O₂ levels and O₂ extraction ratios; adequate O₂ should especially be examined in patients with cardiac or vascular disease. Also, the anticipated degree and rate of blood loss and O₂ consumption (affected by body temperature and pharmaceutical agents) should be considered.³³ This increased tolerance for normovolemic anemia is a key part of the management of Jehovah's Witness patients.

Prior to an elective surgery, the red cell mass of anemic Jehovah's Witnesses should be increased preoperatively if the hemoglobin level is below 7 or 8 g/dL by administering rhEPO during the 3-4 weeks prior to surgery. In addition, high-dose oral iron should be supplemented to correct any iron deficiency, and folate and vitamin B₁₂ should be administered secondary to increased erythropoiesis.³⁴ Several studies have shown rhEPO to be useful in the survival of Jehovah's Witnesses from trauma and surgery, including open heart operations.³⁵⁻³⁹ Another simple method to reduce blood loss is to restrict phlebotomy, including the use of pediatric collection tubes.³⁴

Correction of Coagulopathy

Although a review of the literature recommends against routine preoperative anticoagulation screening for patients with negative bleeding history,⁴⁰ coagulation profiles should be identified for Jehovah's Witnesses.^{22,24} Any anticoagulants, including but not limited to aspirin, NSAIDs, antiplatelet agents, and warfarin, should be discontinued for a sufficient time period for coagulopathies to correct. The American Society of Anesthesiologists (ASA) Task Force on Perioperative Blood Transfusion and Adjuvant Therapies recommends administration of vitamin K or other warfarin antagonists if clinically acceptable.²² Oral administration of vitamin K is preferred over the intravenous form because of the severe anaphylaxis that has been reported with the latter, despite slow infusion rate and high dilution.^{14,41}

The correction of coagulopathies traditionally involves transfusion of platelets, fresh frozen plasma, and/or cryoprecipitate; however, these treatments are unacceptable to Jehovah's Witness patients. As an alternative, prothrombin complex concentrate can be administered if the Jehovah's Witness patient will accept blood fractionates. Prothrombin complex contains only coagulation factors II, VII, IX, and X.¹⁴

A more acceptable coagulation factor product is recombinant activated factor VII (rFVIIa) that is produced without using any human blood or plasma. Several trials have shown rFVIIa helps control bleeding from surgery or severe trauma, reducing the need for RBC transfusions and improving hemostasis.^{19,22,42,43} Case reports have shown successful use of rFVIIa during gastrointestinal bleeding, cardiac surgery, postpartum hemorrhage, and head trauma in Jehovah's Witness patients.^{19,44-48}

INTRAOPERATIVE MANAGEMENT

The most prominent challenge of intraoperative management of a Jehovah's Witness patient is minimizing blood loss. As with most surgeries, monitoring blood loss and coagulopathy through visual assessment, laboratory tests, and perioperative monitoring (eg, heart rate, blood pressure, oxygen saturation, and urine output) is essential. Blood loss is traditionally quantitatively assessed by checking suction canisters, surgical sponges, and drains. Assessment of ongoing coagulopathy requires the concerted effort of both surgeon and anesthesiologist to visually examine the surgical field for excessive microvascular bleeding, indicating ongoing coagulopathy, and the use of laboratory testing of prothrombin time/international normalized ratio or activated partial thromboplastin time.⁴⁹ Coagulopathy can be corrected intraoperatively as discussed earlier.

Surgeons can reduce blood loss by direct control of bleeding sources, use of hemostatic devices such as electrocautery and the ultrasonic scalpel, infiltration of the surgical wound with local vasoconstrictors, and application of topical hemostatics such as fibrin glue or thrombin gel. Also, patient positioning, such as elevation of the surgical site, and tourniquets can have profound effects on the rate of bleeding.^{19,34}

Transfusion Practices

Autologous Transfusion. In contrast to allogeneic blood, which is collected from someone other than the patient, autologous blood transfusion is the collection and reinfusion of the patient's own blood or blood components. Autologous transfusion has been shown to be effective in reducing reactions caused by donor recipient incompatibility. Autologous transfusion also precludes the risk of transmission of infectious disease and preserves the allogeneic blood reserves. Jehovah's Witness acceptance of autologous donation and reinfusion remains at the discretion of the individual and often hinges on ensuring that the diverted blood is maintained in continuity with the circulatory system at all times. Of the 3 main techniques for autologous transfusion—preoperative autologous blood donation (PAD), acute normovole-

mic hemodilution (ANH), and intraoperative and postoperative blood salvage—PAD is unacceptable to Jehovah's Witnesses.

In PAD, typically 4 units of whole blood are drawn from the patient, processed, and stored weeks prior to the elective surgery.^{50,51} A relative contraindication to PAD is advanced patient age as well as the duration the blood can be stored. However, approximately 50% of patients who undergo PAD are anemic on the day of surgery.⁵² *The Watchtower* prohibits predonation because of the separation of blood from the body; however, physicians should always consult the patient regarding specifics.

ANH is a blood conservation technique that avoids allogeneic blood exposure and preserves all components of blood. It is done by collecting the patient's whole blood at the induction of anesthesia with simultaneous infusion of a crystalloid or colloid solution to maintain a normovolemic status.^{6,51} ANH works on the premise of volume expansion and dilution of RBCs; thus, fewer cells are lost during intraoperative blood loss, leading to the conservation of RBCs.^{53,54} A Jehovah's Witness patient can then be reinfused at any time during or after the surgery, granted the patient finds the method acceptable (ie, if done in a continuous circuit).²³ Several other advantages have been described. ANH reduces blood viscosity, leading to less systemic vascular resistance, and therefore cardiac output can increase with a lesser degree of myocardial O₂ consumption. In addition, the reinfusion of the patient's platelets and coagulation factors will correct any coagulopathies from perioperative blood loss.⁶

Intraoperative and postoperative cell salvage is the collection and reinfusion of blood lost during and after surgery. This process involves suctioning blood from the operative field with the addition of heparinized saline. The salvaged anticoagulated blood is then filtered and centrifuged into blood components to obtain the RBCs. The RBCs are washed and filtered across a semipermeable membrane, resulting in RBCs suspended in normal saline with a hematocrit level of 50%-80%. The process removes free hemoglobin, plasma, coagulation factors, platelets, heparin, cytokines, and activated leukocytes.⁵⁵ Coagulopathy resulting from the reinfusion of a solution free of platelets and coagulation factors was demonstrated to only occur when volumes larger than 3 L were reinfused.⁵⁶ Other possible complications of cell salvage include nonimmune hemolysis; air embolus; febrile nonhemolytic transfusion reactions; mistransfusion; contamination with drugs, cleansing solutions, and infectious agents; and incomplete washing leading to reinfusion of activated leukocytes and cytokines.⁵⁷ However, a 5-year retrospective study

conducted by the Cleveland Clinic suggested that cell salvage is safer than allogeneic blood transfusion; the incidence of adverse events of cell salvage was 0.027% compared to 0.14% with allogeneic transfusion.⁵⁸

Cell salvage and autologous transfusion are considered safe and efficacious for orthopedic and cardiac surgeries. The evidence for their use in obstetrics or malignancy is less strong, but when used with leukocyte depletion filters (LDFs) that remove white blood cells, tumor cells, amniotic fluid, and microorganisms, cell salvage has improved safety and fewer side effects than cell salvage alone without the use of LDFs.⁵⁵ In cases where contamination with enteric contents is possible, the use of cell salvage has been traditionally contraindicated. However, the use of LDFs resulted in significant reductions of bacterial contaminants, and numerous studies have shown no adverse outcomes and no increase in postoperative infectious complications with microbiologically contaminated salvaged blood.⁵⁵

Because conventional cell savers process the blood in batches, thereby breaking continuity with the body, they are not acceptable to Jehovah's Witness patients. However, newer technology that processes in continuous fashion is able to sustain an uninterrupted circuit of blood, increasing acceptability among these patients.⁶ Cell salvage is usually a safe and cost-effective technique when used in a well-strategized multimodal blood conservation plan.

Synthetic Hemoglobin Substitute. One route of research to avoid allogenic and autologous transfusions is the development of a synthetic hemoglobin substitute.^{4,59} Hemoglobin-based oxygen carriers (HBOCs) are chemically modified hemoglobin solutions containing polymerized, conjugated, or liposome-encapsulated hemoglobin.⁶⁰ Currently, HBOCs are not approved by the U.S. Food and Drug Administration (FDA) and remain in clinical trials. While reports showed that HBOCs may improve chances of survival from anemia secondary to acute bleeding or hemolysis,⁶¹ studies also found an increased chance of adverse events, including myocardial infarction and pulmonary hypertension.⁶⁰ Numerous case reports have described the successful use of HBOCs on a compassionate basis in severe anemia to act as a bridge to maintain adequate oxygenation in Jehovah's Witness patients until erythropoiesis recovers.⁶²⁻⁶⁴ However, HBOCs currently require further research development before they are routinely used to manage anemic Jehovah's Witness patients, and the choice to accept HBOCs on a compassionate basis would be an individual decision.^{6,14,19}

Deliberate Hypotensive Anesthesia

Deliberate (or controlled) hypotensive anesthesia is an intraoperative technique to reduce blood loss

and thereby decrease the need for transfusion and improve the visibility of the surgical field. Deliberate hypotension is achieved by decreasing vascular tone or cardiac output. Most studies define the criteria for this technique as a reduction of systolic blood pressure to 80-90 mmHg, a mean arterial pressure (MAP) of 50-65 mmHg, or a 30% reduction in baseline MAP.⁶⁵ The MAP range is based on the lower limits of autoregulation of cerebral blood flow.⁶⁶ In addition to surgeries on Jehovah's Witnesses, deliberate hypotension is also indicated when a clear surgical field is essential: surgeries of the middle ear, endoscopic sinus microsurgery, plastic and reconstructive microsurgery, ophthalmologic surgery, and neurosurgery. Other indications include orthopedic and urologic surgeries that have the potential for large blood loss.⁶⁵ Various pharmacological agents and nonpharmacological means can induce deliberate hypotension.

Pharmacological agents can be categorized by how they are used. Primary agents (used only alone) include inhalation agents (eg, halothane, isoflurane, and sevoflurane), vasodilators (eg, nitroglycerin, sodium nitroprusside, trimethaphan, adenosine, and alprostadil), remifentanyl, and agents used in spinal anesthesia. Secondary agents (used only as adjuncts with primary agents) include angiotensin-converting enzyme inhibitors and clonidine. Also, some agents can be used alone or adjunctively: calcium channel blockers, β -adrenoceptor antagonists, and fenoldopam.⁶⁵ The details of each pharmacological agent are beyond the scope of this paper. In a review article on drug choice in controlled hypotension, Degoute⁶⁵ recommended either the use of an epidural anesthesia balanced with an adaptable continuous epinephrine drip or the combination of remifentanyl with either propofol or an inhalation agent for their ease of use and safety profile. The use of epidural or spinal anesthesia, however, is limited to abdominal or lower extremity surgery.

Two nonpharmacological techniques for achieving hypotension are alterations in body position and mechanical ventilation.⁶⁶ Placing the operation site higher than the heart reduces the hydrostatic blood pressure, thus decreasing the driving pressure for blood extravasation. In addition, the anesthesiologist can cause hyperventilation to produce hypocapnia-induced cerebral vasoconstriction in order to reduce blood loss during neurosurgical procedures.⁶⁵

Deliberate Hypothermia

Deliberate hypothermia, a technique by which a decrease in metabolic O₂ requirements is attained via controlled lowering of body temperature, has been used in Jehovah's Witness patients.⁶⁷ Cooling a patient to 30-32°C decreases total body O₂ consumption by approximately 48% (approximately 7%

for each degree below the basal level) and increases blood-dissolved O₂.^{31,68} Below this target temperature, hypothermia-induced arrhythmias are more likely to occur. Temperature monitoring can be best done using tympanic membrane and/or nasopharyngeal probes because they most closely approximate the temperature of the blood perfusing the brain. Controlled cooling is accomplished by decreasing ambient room temperature, reducing the temperature of intravenous fluids, or using a cooling blanket. Deliberate hypothermia should always be used in conjunction with ANH to counteract hypothermia-induced increases in blood viscosity and systemic vascular resistance.³¹ Although hypothermia causes an increased affinity between oxygen and hemoglobin, it does not impair tissue oxygen extraction.⁶⁹

Deliberate hypotension and hypothermia have been shown to be particularly effective in reducing transfusion requirements in Jehovah's Witness patients, but their usage should be approached with reservation in patients with significant cardiovascular, cerebrovascular, renal, or hepatic disease.

Pharmaceutical Agents

The management of Jehovah's Witness patients involves various pharmaceutical agents. As previously discussed, erythropoiesis can be enhanced preoperatively and postoperatively using erythropoietic agents: rhEPO and oral iron, vitamin B₁₂, and folic acid supplementation. The management of Jehovah's Witness patients also includes the reduction of blood loss using hemostatic agents, such as topical fibrin, thrombin applications, and antifibrinolytics.

Antifibrinolytics. Fibrinolysis is a physiologic response to control excess fibrin, but premature breakdown of fibrin will promote rebleeding. The normal fibrinolytic response is a localized reaction dependent on the presence of fibrin. Serine proteases (eg, tissue plasminogen activator and plasmin), which degrade fibrin, are rapidly inhibited by endogenous inhibitors during the plasma phase. However, in the presence of a thrombus, the serine proteases are colocalized onto the fibrin by binding to the positively charged lysine residues expressed on fibrin, thereby activating their fibrinolytic activity.⁷⁰ The widely studied antifibrinolytics include the synthetic lysine analogues (ϵ -aminocaproic acid and tranexamic acid) and aprotinin. In 2006, the ASA released practice guidelines²² that recommended the use of antifibrinolytics in cases when significant blood loss is expected. However, in 2008 the Blood Conservation Using Antifibrinolytics in a Randomized Trial (BART)⁷¹—a multicenter, blinded, randomized, controlled study—provided data that questioned the ASA's recommendation.

Aprotinin is a nonspecific inhibitor of serine proteases (eg, trypsin, plasmin, and kallikrein).³⁴ It was formerly the only prophylactic agent with FDA indications to prevent blood loss and transfusion during coronary artery bypass graft surgery.⁷² However, the BART study demonstrated an increased risk of death with aprotinin, secondary to adverse effects on renal and cardiac function, compared to aminocaproic acid and tranexamic acid, despite aprotinin's larger reductions in blood loss, transfusion rates, and reexplorations.⁷¹ After the publication of the BART study, Bayer Pharmaceuticals (Berlin, Germany) recalled the product and limited its use to investigational purposes only.^{73,74}

The lysine analogues, aminocaproic acid and tranexamic acid, act as antifibrinolytic agents through the inhibition of plasmin-mediated fibrinolysis.³⁴ These agents join to the lysine-binding site of the serine protease plasminogen, preventing plasminogen's activation into plasmin when colocalized to fibrin.⁷⁰ Numerous studies since BART provide reliable data suggesting that tranexamic acid and aminocaproic acid are effective agents in reducing preoperative blood loss and transfusion requirements in cardiac surgery.⁷⁵ However, the data are inconsistent with regard to the safety and dosing of these lysine analogues, and further large safety trials are warranted.^{75,76}

Desmopressin. Desmopressin (1-deamino-8-d-arginine vasopressin) is a synthetic analogue of the antidiuretic hormone vasopressin. It has poor vasopressor activity and enhanced antidiuretic activity, but it notably serves as a hemostatic agent. Desmopressin stimulates the endothelial release of factor VIII and von Willebrand factor, enhancing platelet aggregation.³⁴ Its use for hemophilia and von Willebrand disease is well established.⁷⁷ However, evidence does not support its use in patients without bleeding disorders.^{34,70} In addition, desmopressin was associated with a significantly increased risk of myocardial infarction and altered electrolyte levels.⁷⁸

POSTOPERATIVE MANAGEMENT

During the immediate postoperative period, many of the previously discussed methods remain applicable. The noninvasive techniques include close surveillance for bleeding, adequate oxygenation, and restricted phlebotomy. Postoperative cell salvage is effective in managing blood loss and subsequent anemia. Pharmacological methods include the administration of hemostatic agents to stop bleeding, erythropoietic agents to promote RBC production, antihypertensives to reduce rebleeding associated with hypertension, and the conservative use of anticoagulants and antiplatelet agents. Additionally,

maintaining normovolemia with crystalloid or colloid solutions in the face of anemia is crucial to maintaining adequate tissue perfusion.³⁴

CONCLUSIONS

Surgery that involves significant blood loss can still be performed safely in the Jehovah's Witness patient who refuses to receive blood transfusion. The cornerstones of Jehovah's Witness patient management include educating the patient about blood conservation techniques, optimizing cardiopulmonary status, correcting both anemia and coagulopathy preoperatively, collecting autologous blood perioperatively, and minimizing intraoperative blood loss. By using certain preoperative and intraoperative techniques, the anesthesiologist can steer the patient toward the best postoperative outcome.

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