The Management of Adult Jehovah's Witnesses in Anaesthesia and Critical Care

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INTRODUCTION

Jehovah's Witnesses are widely known for their refusal to accept blood transfusions thus creating a potential obstacle to optimal medical therapy in situations such as trauma, obstetrics and surgery. Such refusal limits the clinician's clinical freedom and may have both medicolegal and ethical consequences. When the consequence of treatment limitation results in an otherwise unavoidable death, feelings of guilt, frustration, anger and anxiety may occur and create an emotional burden for the care givers.

Working within the restrictions imposed by Jehovah's Witness patients may also incur additional financial cost to both the hospital and state what with the, not infrequent, requirements for recombinant activated factor VII, prothrombinex concentrate, tranexamic acid and recombinant erythropoietin. In addition there is the cost of cell salvage techniques, additional theatre time to complete bloodless surgery safely and the requirement for consultant anaesthetic and surgical personnel to be present. Transfer of these patients to tertiary centres, or rarely, centres with hyperbaric oxygen facilities are likewise, an otherwise avoidable cost.

In addition, the requirement for limited resources such as intensive care or high dependency beds peri-operatively may deny access to other patients with a medically indicated need for them. This social injustice can create further ethical conflict for the physician.

RELIGIOUS BELIEFS AND THE PHYSICIAN

It is estimated that approximately 1000 Jehovah's Witnesses die annually worldwide and as many as 100,000 may have died by abstaining from blood transfusions since the blood ban was introduced in 1945. Despite this, as physicians we must be aware that every adult competent patient is entitled to refuse to consent to medical treatment for good reason, bad reason or no reason at all. Refusal to accept blood products should not adversely affect the quality of other cares provided.

THE JEHOVAH'S WITNESS FAITH

As the most rapidly growing religion in the western world, Jehovah's Witnesses number some 7 million members in over 230 countries worldwide, with approximately 64,000 in Australia. In view of the rapidly growing membership all hospital physicians should be prepared to manage these patients well.

Their origins can be traced to a bible study group founded in the USA in 1869 by Charles Taze Russell.[1] Some 10 years later, in 1879, the first issue of "The Watchtower", their illustrated religious magazine, was published. Although originally known as "Zions's Watchtower Tract Society", they adopted the name "Jehovah's Witnesses" in 1931.

Members are of the Christian faith. They are politically neutral, do not salute flags, enlist in the military nor vote in public elections. They celebrate neither Christmas nor birthdays and must satisfy a minimum monthly time requirement to their ministry.

OBJECTION TO MEDICAL TREATMENTS

Although best known for their refusal to accept blood transfusions, Jehovah's Witnesses originally had objections to other medical treatment such as vaccination (including the small pox vaccine) and transplantation. Vaccination has been permitted since 1952. Transplantation has been allowed since 1980, with the first solid organ transplant to a Jehovah's Witness recipient occurring in 1986.

In 1945 the governing body of the Jehovah's Witnesses "The Watchtower", introduced the blood ban, based on the strict literal interpretation of several biblical passages, including "you are to abstain... from blood.." (Acts 15) and "none of you may eat blood.." (Leviticus 17).

In 1961 the Watchtower Society issued a statement that Jehovah's Witnesses who consciously accept a blood transfusion violate the blood ban and are subject to expulsion, so called "disfellowshipping".2 Other members of the faith are then instructed to shun and ostracise the expelled member, even if they are family members.3

According to a 1994 document, the Watchtower Society disfellowships approximately 40,000 members, or 1% or its membership, each year.• The consequences include isolation from family and friends who are members and may even include separation from spouses.

In 1995 a policy change occurred such that acute normovolaemic haemodilution and red cell salvage were permitted. Later, in 2000, the Watchtower Society issued a directive stating that the Jehovah's Witness organisation would no longer excommunicate members who did not comply with the blood ban; rather such an individual "revokes his own membership by his own actions, rather than the congregation initiating the step".

Despite the media declaring this to be a major policy change, the end result was unchanged, that such an individual would be considered to revoke his or her religious affiliation.

In 2000 the Watchtower Society also published the article "Questions from Readers"[5] which redefined the guidelines for the use of blood products. It detailed which products are unacceptable and which are for the Christian to decide.

Unacceptable products included:

1) Pre-operative autologous blood donation

2) Transfusion of the "primary components" of blood, namely whole blood, packed red cells, plasma, platelets and white cells

However, in a policy change, fractions of all the primary components red cells were now permitted as a matter of personal decision; "beyond that, when it comes to fractions of any of the primary components, each Christian, after careful and prayerful meditation, must conscientiously decide for himself.5" The list of acceptable products includes, but is not limited to, albumin, cryoprecipitate, clotting factors, immunoglobulins, recombinant human erythropoietin, interferon, interleukins and even haemoglobin based blood substitutes or oxygen carriers. The most profound impact from this change will be seen if and when haemoglobin based oxygen carriers are introduced into general use.

As can be seen the blood ban is in a state of evolution and change, with the number of acceptable blood products ever increasing.

Indeed, within the Jehovah's Witness faith itself there are dissident groups who believe the blood ban is unacceptable, has no biblical basis and is flawed by inconsistency. One such group is "The Associated Jehovah's Witnesses for Reform on Blood".[6] The founder of this group maintains his status as a Jehovah's Witness but writes under a pseudonym to avoid being expelled or "disfellowshiped". The group argues:

"If the scriptures ban blood transfusions why does the Watchtower Society allow transfusion of all minor blood fractions?"

"Why are minor components like platelets (0.17% blood volume) and white cells (1% blood volume) forbidden yet a larger component like albumin (2.2% blood volume) is permitted?"

Why are Jehovah's Witnesses permitted to accept ever increasing numbers of blood products (and transplants) yet are forbidden from contributing to the donor supply?"

Ultimately it is essential to seek the views of the individual patient. However, many Jehovah's Witnesses are not aware of the numerous blood products that can now be accepted "as a matter of conscious". Without such knowledge, decision making regarding blood products can not be considered "informed" or "autonomous" without undue influence from others. A detailed discussion of the evolution of the blood policy may be necessary before any consent can truly be considered "informed".

The Hospital Liaison Committee for Jehovah's Witnesses is comprised of a group of educated elders, who may assist a patient in making a decision. However it is imperative that Jehovah's Witness patients, where possible, are also interviewed alone (including away from family members) so that they may make a decision free from coercion or guilt.

Some may request to receive a blood transfusion secretly after visiting hours or agree to a contingency plan such that they will only accept transfusion in the event of imminent death without transfusion. Confidentiality in these situations needs to be respected to avoid social and religious repercussions.

THE DANGERS OF BLOOD TRANSFUSION

The lessons learnt from treating Jehovah's Witness patients may benefit society as a whole.

As the deleterious effects of blood transfusion become more apparent, costs escalate and donor numbers decline, there has been an increase in transfusion avoidance strategies.

Many of the techniques developed for use in these patients will likely become standard practice in time, in an effort to conserve low blood stocks and minimise exposure to transfused blood.

The disadvantages of transfusion are many.

a. Infection

Although improvements in screening have reduced the risk of transmission of HIV, HBV and HCV, these infections do still rarely occur. In addition, severe acute respiratory syndrome (SARS), West Nile Virus, protozoa and prion-related disease are the latest to join the list of potentially transmissible diseases.

b. Suppression of Immune System Function

So-called Transfusion Related ImmunoModulation or TRIM, may now be one of the greater disadvantages of transfusion. Transfusion predisposes to infection, as seen in a study of 102 patients undergoing spinal fusion procedures. The patients received either autologous transfusion, allogeneic transfusion or neither. The infection rate of 4% in patients receiving no blood products was comparable to those receiving autologous blood transfusion (3.3%). However, patients receiving allogeneic blood transfusions had infection rates in excess of 20%. The number of allogeneic units transfused was the only significant predictor of in-hospital infection ($p = 0.016$) or days on antibiotics and length of stay.[7]

The effect of immunomodulation on malignancy remains unclear. In animal studies transfusion increases metastatic formation. Human studies are divided, but some have shown a correlation between transfusion and increased risk of tumour recurrence after potentially curative surgery. In particular, perioperative blood transfusion has been demonstrated to be a significant independent prognostic factor for colorectal cancer recurrence.[8]

Vincent et al performed a multicentre prospective observational study of 3534 critically ill patients admitted to 146 western European intensive care units during a 2 week period in 1994. Patients receiving transfusion had an increased intensive care length of stay, organ dysfunction score and overall 28-day mortality (29% vs 14.9%) compared to similar non-transfused patients.[9]

The TRICC trial (Transfusion Requirements In Critical Care) randomly allocated critically ill patients to either a liberal (<1Og/dl) or restrictive (<7g/dl) transfusion threshold. There was a non-significant trend towards lower mortality in the restrictive group overall (18.7% vs 23.3%, p= 0.1). In addition these patients had a lower incidence of multiple organ dysfunction, myocardial infarction and acute pulmonary oedema.[10]

c. Others

Immunological and allergic reactions may complicate transfusion. ABO incompatibility through human error may have disastrous consequences. In addition, the metabolic consequences of transfusion (particularly massive transfusion) are well known and include acidosis, hyperkalaemia, hypocalcaemia and hypothermia.

The storage defect results in red blood cells with increased fragility and reduced ability to transport oxygen. Finally, respiratory failure may complicate transfusion due to either cardiogenic pulmonary oedema, transfusion associated circulatory overload or Transfusion Related Acute Lung Injury (TRALI).

PRINCIPLES OF BLOODLESS SURGERY

The term "bloodless surgery" refers to a series of measures in the pre-, peri- and post- operative care of patients that aims to reduce the need for allogeneic blood transfusion.[11] There are over 230 "Bloodless Hospitals" worldwide[12]; however there is only 1 in Australia, Kaleeya hospital, East Fremantle, West Australia; it is a small hospital without an intensive care unit and provides mainly day surgery.

Bloodless surgery requires a coordinated multidisciplinary approach. Medical, anaesthetic and surgical teams, phlebotomists, pharmacists, physiotherapists and dieticians all need to be involved, where available.

Senior surgical and anaesthetic staff should be made aware of a pre-operative Jehovah's Witness patient as soon as possible. A thorough discussion between patient, surgeon and anaesthetist should occur, detailing the risks, including intensive care stay and death. Which products will and will not be accepted should be documented in the notes and witnessed. The patient may agree to a contingency plan should death without transfusion become inevitable. The patient should be interviewed both with friends/ family and alone to avoid coercion. If the risk of bleeding and death is high, consider involving the hospital ethics committee, legal department, risk management group and Hospital Liaison Committee for Jehovah's Witnesses.

Both anaesthetists and surgeons have the right to refuse to anaesthetise or operate on an individual in the elective situation provided they refer the case to a suitably qualified colleague who would be prepared to accept it.13

In the emergency situation however, both the anaesthetist and surgeon are obliged to provide care and legally must respect the patients' views with respect to blood products.[14]

To administer a blood product to a competent adult after it has been explicitly refused is both illegal and ethically unacceptable.

PRE-OPERATIVE MANAGEMENT

Pre-operative patient assessment should include a thorough history and examination to allow estimation of physiological reserve and ability to withstand hypovolaemia and anaemia. Pre-existing cardiac and respiratory disease should be optimised. Medications that may promote bleeding, such as antiplatelet agents, heparin, warfarin, dabagatrin, NSAIDS and fish oil, should be reviewed and ideally stopped. Coagulopathy should be corrected. Nutritional status should be reviewed and optimised with the use of enteral nutritional supplements and even consideration given to total parenteral nutrition if nutritional status is poor.

Enhanced haematopoiesis requires supplementation of iron, folate, vitamin 812 and ascorbic acid. Even in the absence of anaemia, recombinant human erythropoietin (rhEPO) can be used to improve red cell mass. The use of erythropoietin requires additional iron supplementation, usually intravenous, to be most effective. Erythropoietin has been demonstrated to half the rate of exposure to blood transfusion but requires approximately 4 weeks for maximal erythropoiesis to occur. Erythropoietin however is not devoid of side effects, with hypertension and thrombosis complicating its use.

INTRA-OPERATIVE MANAGEMENT

1. Surgery

With respect to intra-operative surgical technique; only senior personnel should perform procedures that carry a significant risk of bleeding. Where possible a minimally invasive technique should be employed, such as laparoscopic, endoscopic or staged procedures. For example a bilateral procedure should be performed as 2 separate unilateral procedures to minimise acute blood loss at each surgery.

Meticulous haemostasis is essential. The use of diathermy dissection or the harmonic scalpel can minimise bleeding depending on operator expertise.

Local haemostatic agents such as bone wax, fibrin glue, cellulose and collagen may also reduce haemorrhage. Where possible, drains should be placed to facilitate early detection of post operative bleeding.

2. Anaesthesia techniques

With respect to anaesthetic technique, again senior or consultant personnel should be involved. The patient, room and fluids should be warmed to prevent hypothermia and subsequent coagulopathy.

Venous congestion and venous ooze may be minimised by careful positioning and avoidance of high intra-thoracic pressures and hypercapnia.

Where feasible, tourniquets and infiltration of vasoconstrictor agents should be used.

Regional techniques, where possible, will minimse blood loss.

Serial measurement and correction of coagulation profile and ionized calcium should be considered in long cases.

Invasive monitoring should be considered to optimise tissue oxygen delivery, which is dependent upon haemoglobin concentration, cardiac output and haemoglobin saturation. These factors may be manipulated using fluids, inotropes and increasing the Fi02.

0_2 delivery (DOJ = cardiac output x (1.39 x Hb x SaOJ + 0.02 x $Pa0_2$

3. Anaesthesia drugs

A number of drugs may be used peri-operatively to minimise bleeding.

a. Systemic antifibrinolytic agents, including tranexamic acid and eicoso-aminocaproic acid, inhibit plasminogen activity and promote coagulation. Tranexamic acid is given as a 1g infusion followed by 1g QBH. The infusion rate should not exceed 1OOmg/min.

b. Desmopressin or DDAVP induces the release of Factor VIII, prostacyclin, tissue plasminogen activator and von Willibrand Factor from vascular endothelium. It has been demonstrated to reduce peri-operative blood loss associated with uraemic and aspirin-induced platelet dysfunction.[15] The dose given is 0.3mcg/kg as an infusion over 30 minutes.

c. Prothrombin Complex Concentrate or Prothrombinex contains recombinant factors II, VII, IX and X. It may be acceptable to some Jehovah's Witness patients. The recommended dose is 25-501U/kg. It is relatively deficient in factor VII so works best when given along with a small amount of FFP and/ or rFVIla.

d. Recombinant activated Factor 7 or Nova? (rFVIla) is reported to be effective in clinical situations associated with severe haemorrhage including cardiac surgery, trauma and obstetrics, but controlled clinical trials are scarce. Most case reports claim its use is associated with a reduction in blood loss and/ or transfusion requirements. Randomised controlled trials using rFVIla in intra-cerebral haemorrhage demonstrate reduced growth of the hematoma but no improvement in survival or functional outcome.[16] Likewise trials in blunt trauma demonstrate benefit on blood loss and transfusion requirements but not mortality.17 Its use is complicated by the occurrence of arterial and venous thromboses, especially in the elderly population and those with risk factors for peripheral vascular disease. As it is an off-license indication, there is no recommended dose, but between 50 and 90mcg/kg is generally given.

e. Individual clotting factors may be acceptable to some Jehovah's Witnesses.

f. Haemoglobin based oxygen carriers (HBOCs) could be employed in the future where available. They have been in development for over 70 years; however interest has been renewed since the 1980's, prompted by both the emergence of HIV and the death of trauma victims from exsanguination in the pre-hospital setting; including at accident scenes, in ambulances and on the battlefield. Despite this there are currently no haemoglobin based oxygen carriers approved for human use in Australia, the US or European Union; reflecting both a controversial history and the challenge of creating an ideal blood substitute.

HBOC DEVELOPMENT

Haemoglobin based oxygen carriers contain purified haemoglobin derived from either bovine red cells, expired human red cells or from recombinant technology. Free human haemoglobin has a tetrameric structure of 2 alpha and 2 beta polypeptide chains. It rapidly dissociated into alpha/beta dimers which are cleared by glomerular filtration with an intravascular half life of only 30 minutes. Dissociated haemoglobin causes renal failure and scavenges nitric oxide causing hypertension. In addition, due to low concentrations of 2,3 DPG, free haemoglobin is ineffective at oxygenation due to its high affinity for oxygen, with a P50 of 10 to 14mmHg. In order to become therapeutically useful, free haemoglobin requires modification by polymerisation and/ or cross-linkage to prevent dissociation into alpha/beta dimers, right shift the oxyhaemoglobin dissociation curve and to increase its half life in the circulation. The modified haemoglobin is then incorporated into an electrolyte solution.

HBOC ADVANTAGES

Haemoglobin solutions have the advantage of being non-immunogenic. They do not contain any intact red blood cells, which express ABO antigens, therefore cross-matching the product or typing the patient is not necessary.

The products undergo an extensive purification process to remove potential contaminants including proteins, red blood cell stroma, bacteria, endotoxins, viruses and prions and are therefore guaranteed to be disease free.

Haemoglobin based oxygen carriers may be stored far longer than the 42 days permitted for packed cells, between 12 months to 3 years, depending on the product. Hemopure is the easiest product to store and transport as it does not require refrigeration and may be stored for up to three years at room temperature.

Haemoglobin solutions are developed to right shift the oxyhaemoglobin dissociation curve compared to native haemoglobin. Hemopure contains bovine haemoglobin; it has a P50 of 40mmHg compared to 27mmHg for human red blood cells. It therefore releases oxygen more readily to the tissues and, on a gram-for-gram basis, restores oxygenation three times more effectively than a transfusion of stored human red blood cells. PolyHeme contains human haemoglobin, it has a P50 of 20-22mmHg which is comparable to packed cells.

HBOC DISADVANTAGES

There are a number of disadvantages of haemoglobin based oxygen carriers compared to blood. Despite modification, they have a short intravascular half life of 16 to 24 hours, compared to 60 to 90 days for red blood cells, making repeat administration necessary. Cost is also higher than transfused red blood cells when compared on a unit-to-unit basis.

Use of haemoglobin based oxygen carriers also interferes with many common laboratory tests, especially those which are measured spectrophotometrically. Albumin, alkaline phosphatase, bilirubin and creatinine may all be inaccurate. Optical methods of measuring coagulation will be misleading. Plasma will have a pink discoloration and routine laboratory tests will not be able to differentiate between haemolysis and the presence of a haemoglobin solution. Plasma free haemoglobin levels are measured to determine the amount of haemoglobin based oxygen carrier present in the specimen but the decision to give additional doses must be determined clinically.

The incidence of adverse effects is not insignificant (approximately 5%), with complaints of jaundice, nausea, mild to moderate increases in blood pressure, vomiting, oliguria, dysphagia and flatulence.

There are also reports of serious adverse events including myocardial infarction and death, however these risks may be acceptable when allogeneic blood is either not available or effective or not acceptable to the patient.

Furthermore, haemoglobin solutions have a maximum recommended dose, reflecting the maximum dose studied in clinical trials to-date, which may provide temporary oxygen-carrying support, or an "oxygen bridge" but may not be sufficient to completely avoid red cell transfusions in patients experiencing massive or continued blood loss.

HBOC PRODUCT HISTORY

There have been a number of haemoglobin oxygen carriers in production over the last 30 years but PolyHeme is probably the most controversial and Hemopure possibly the most promising.

PolyHeme is a haemoglobin based oxygen carrier derived from human hemoglobin and developed by Northfield Laboratories, Inc. Northfield was predominately a research and development company; PolyHeme was their only product. PolyHeme was the first blood substitute to reach a Phase Ill clinical trial in the US.

The trial was designed to assess the survival benefit of administering PolyHeme to severely injured trauma patients in hemorrhagic shock, beginning in the pre-hospital setting and continuing for 12-hours post-injury in hospital. It had two primary endpoints of superiority and non-inferiority to standard treatment. It was undertaken between January 2004 and July 2006 at 29 Level Itrauma centers across 19 states in the US under a Food and Drug Administration (FDA) special category (21CFR 50.24) that allowed its use without consent. The waived informed consent rule was established by the FDA in 1996 and stipulated that to be used "available treatments .... (must be) unproven or unsatisfactory". The only way to opt out from the study was by wearing a special bracelet prior to needing emergency care. The study was highly criticised due to the absence of consent. Indeed continuation of the study into the in-hospital period was considered unethical as blood was then both readily available and a proven and satisfactory therapy for haemorrhagic shock.

The results were published in the Journal of the American College of Surgeons in January 2009.[18] They concluded there was no significant difference in outcome between the conventionally-resuscitated group and the PolyHeme-treated group. However PolyHeme was associated with an increased risk of myocardial infarction (3% versus 1%).

In May 2009 PolyHeme failed to receive FDA regulatory approval, with the FDA stating the risks of PolyHeme outweighed the benefits. In June 2009 Northfield Laboratories Inc ceased operation and filed for bankruptcy.

Hemopure, or HBOC-201, is developed from highly purified bovine haemoglobin. It is a third generation product developed by Biopure. It has been available for human use in South Africa since 2001 and in Russia since 2011. There is also a "compassionate use" program in the US which makes Hemopure available when a life-threatening situation exists and compatible red blood cell transfusion is either 1) not available 2) not effective or 3) not acceptable to the patient. Approval by the FDA is made on a case-by-case basis.

Following a motor vehicle accident in October 2010, Australian Jehovah's Witness Tamara Coakley received a life sustaining transfusion of 10 units of Hemopure, flown in from the US and made available via this "compassionate use" scheme. Permission to use the product was granted by The Alfred Hospital Ethics Committee and the Therapeutic Goods Administration's special access scheme. The manufacturer OPK Biotech paid for the costs involved.

Hemopure has undergone a Phase Ill clinical trial evaluating its ability to reduce or eliminate perioperative transfusion in orthopaedic patients.[19] Hemopure reduced the need for packed cell transfusion in 59% of patients but was associated with a significantly higher incidence of both adverse events (rate of adverse evenV patient 44% higher, $p<0.03$) and serious adverse events (rate of serious adverse evenV patient 36% higher, $p< 0.016$).

In 2008 a controversial meta-analysis comparing 16 clinical trials involving 5 different HBOC products used on over 3500 patients was published in the Journal of the American Medical Association.[20] The study was led by Charles Natanson, a scientist at the US National Institute of Health. It concluded that patients treated with a HBOC had a 30% increased risk of death and 2.7-fold increased risk of myocardial infarction. Biopure responded by claiming there were fundamental errors in the calculations and analysis. Biopure then sued Natanson, claiming he had made "false and defamatory statements" about Hemopure. Following this South Africa's Medicines Control Council temporarily de-registered Hemopure's approved use for the treatment of acute surgical anaemia.

A 2009 application to the FDA for clinical approval of Hemopure in the US was declined. In August 2009 Biopure ceased operation and filed for bankruptcy.

Biopure has since been bought by OPK Biotech, a Russian owned company who has recently obtained approval for Hemopure to be used in Russia. OPK Biotech has also bought the intellectual property of Northfield Laboratories Inc, the company that developed PolyHeme. These acquisitions will likely make OPK Biotech a leading company in the field of oxygen therapeutics.

ANAESTHESIA BLOOD SAVING TECHNIQUES

In addition to the use of drugs there are a number of anaesthetic techniques available to minimise blood loss.

a. Controlled hypotension or hypotensive anaesthesia is a technique whereby the mean arterial pressure is maintained at a low level during surgery to minimise bleeding. It may decrease bleeding by as much as 50% but is controversial due to the risk of cerebral, renal and myocardial ischaemia. In addition, haemostasis that is adequate during controlled hypotension may not prove adequate when the patient returns to their normotensive, or worse still hypertensive, state.[21] As such, the avoidance of marked haemodynamic shifts intra-operatively is more accepted.

b. Acute normovolaemic haemodilution involves the removal of whole blood from the patient pre-operatively and replacement with crystalloid or colloid to maintain intravascular volume. Blood lost intra-operatively has a reduced haemoglobin concentration resulting in fewer red cells lost overall. Provided the blood is kept in continuity with the patient the removed blood may be re-infused at the end of the case. This technique requires adequate respiratory and cardiac reserve to compensate for acute blood loss.

c. Acute hypervolaemic haemodilution uses the rapid infusion of fluid to achieve haemodilution without venesection. Again blood lost contains fewer red cells. Although acceptable to some Jehovah's Witness patients it is poorly tolerated by those with cardiac disease, due to risks of fluid overload and heart failure.

d. Red cell salvage is a technique that can be used both intra-operatively and in the post-operative period to replace blood in proportion to the volume lost. Shed blood is collected, washed, mixed with anticoagulant and then re-infused via a filter. Many, but not all, Jehovah's Witnesses will accept red cell salvage, again provided the circuit is not interrupted and remains in continuity with the patient. Red cell salvage is relatively contraindicated if there is the possibility of contamination with urine, fat, amniotic fluid, bone chips, bowel contents or infected material. Definite contraindications include re-infusion of anything that results in red blood cell lysis. This would include sterile water, hydrogen peroxide, and alcohol.

POST-OPERATIVE MANAGEMENT

a. Early Detection of Blood Loss

In the post-operative period, early detection of blood loss is essential and can be facilitated by close monitoring in a critical care area and serial clinical examination of both the patient and their drains.

b. Minimise Iatrogenic Blood Loss

Blood loss can be minimised by avoidance of hypertension and marked haemodynamic shifts, and by reducing iatrogenic blood loss by infrequent and low volume blood sampling.

Two epidemiological studies of critically ill ICU patients have demonstrated similar figures for the mean volume of blood taken daily; 42.5ml/day in 1 study[22] and 41.1ml/day in the other.[23] The more unwell the patient, the more blood is likely to be taken.

Unnecessary blood loss can be avoided by abandoning "routine" tests which are not strictly indicated. When available, paediatric or small volume tubes should be used. If these are not available then small volumes should be used for all samples except coagulation profile, which is the only test that requires a full tube. Use of point of care micro-testing should also be employed where available.

c. Promote Haematopoiesis

Haematopoiesis can be enhanced in the post operative period with the use of nutritional supplements, iron, folate, vitamin 812, vitamin C and recombinant erythropoietin if necessary.

d. Maximise Oxygen Delivery

Oxygen delivery can be maximised in several ways.

Supplemental oxygen, chest physiotherapy and routine breathing exercises, such as the use of incentive spirometry, should be available to all patients. Cardiac output may be optimised with the use of fluids and inotropic agents where necessary.

Restoring intra-vascular volume is a controversial area. It may be prudent to avoid fluid resuscitation to euvolaemia if it results in haemodilution of haemoglobin down to a life threatening levels, however end organ hypoperfusion may also result from too conservative resuscitation.

The use of hyperbaric oxygen has been described in extremely severe anaemia, whereby the dissolved oxygen (Pa02) is sufficient to oxygenate tissues. However, there is very little evidence demonstrating a clear improvement in outcome and it is rarely a practical option but it could be considered for Jehovah's Witnesses with inadequate oxygen delivery in whom other therapies have failed.

e. Minimise Oxygen Consumption

Similar to oxygen delivery, oxygen consumption may also be manipulated. The physiological response to pain, cold, anxiety and infection all result in an increase in basal metabolic rate and consequently higher oxygen consumption. Analgesia should be optimised and where appropriate antibiotic prophylaxis or treatment prescribed. Fevers, seizures and rigors should all be detected early and treated. Sedation, ventilation and maintenance of normothermia will all control basal metabolic rate; whilst in extreme cases paralysis and even cooling can be considered until haematopoiesis is maximised.

CONCLUSION

In conclusion, Jehovah's Witnesses refuse blood products not treatment.

Their refusal has led to a greater awareness of blood conservation strategies that are likely to become more common worldwide as the deleterious effects of blood transfusion become more apparent.

Implementation of bloodless surgical programs requires a multidisciplinary approach across all stages of peri-operative care.

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