1 History and organization of blood management

With this introductory chapter the reader will be given a glimpse into the organization of blood management and its history—a history that is still extremely active and changes day to day.

Objectives of this chapter

1 Identify historical developments that led to today's concept of blood management.
2 Demonstrate the benefits of blood management.
3 Identify blood management as "good clinical" practice.
4 Show that blood management and its techniques should be used in all cases that qualify.
5 Help understand how a blood management program works.

Definitions

Bloodless medicine and surgery: Bloodless medicine is a multimodality, multidisciplinary approach to safe and effective patient care *without* the use of allogeneic blood products. Bloodless medicine and surgery utilizes pharmacological and technological means as well as medical and surgical techniques to provide the best possible care without the use of donor blood.

Transfusion-free medicine and surgery: Since "bloodless medicine" is kind of a misnomer, the term "transfusion-free medicine" was coined and is used instead.

Blood conservation: "Blood conservation is a global concept engulfing all possible strategies aimed at *reducing* patient's exposure to allogeneic blood products" [1]. This concept does not exclude the use of allogeneic blood entirely.

Blood management: Blood management is the philosophy to improve patient outcomes by integrating all available techniques to reduce or eliminate allogeneic blood transfusions. It is a patient-centered, multidisciplinary, multimodal, planned approach to patient care. Blood management is not an "alternative," it is the standard of care.

A brief look at history

History of bloodless medicine, transfusion-free medicine, blood conservation, and blood management

The term "bloodless medicine" is often associated with the belief of Jehovah's Witnesses to refrain from the use of blood, therefore ruling out the option of blood transfusion. The essence of bloodless medicine, and lately, blood management, however, is not restricted to the beliefs of a religious group. To get a better understanding as to what bloodless medicine and blood management means, let us go back to the roots of these disciplines.

One is not completely wrong to attribute the origin of the term "bloodless medicine" to the endeavor of Jehovah's Witnesses to receive treatment without resorting to donor blood transfusion. Their attitude toward the sanctity of blood greatly influences their view of blood transfusion. This was published as early as 1927 in their journal *The Watchtower* (December 15, 1927). Although the decision to refuse blood transfusion is a completely religious one, the Witnesses frequently used scientific information about the side effects of donor blood transfusion. The booklet entitled *Blood, Medicine and the Law of God* (published in 1961) addressed issues such as transfusion reactions, transfusion-related syphilis, malaria, and hepatitis.

Refusing blood transfusions on religious grounds was not easy. Repeatedly, patients were physically forced to take donor blood, using such high-handed methods as

incapacitation by court order, strapping patients to the bed (even with the help of police officers), and secretly adding sedatives to a patient's infusion. In the early 1960s, representatives of Jehovah's Witnesses started visiting physicians to explain the reasons why transfusions were refused by the Witness population. Often, during the same visit, they offered literature which dealt with techniques that were acceptable to the Witness patients, informing physicians of the availability of the so-called transfusion alternatives. After a few years of work, the governing body of Jehovah's Witnesses announced the formation of Hospital Liaison Committees (1979). These continued to "support Jehovah's Witnesses in . . . *their* determination to prevent their being given blood transfusions, to clear away misunderstandings on the part of doctors and hospitals, . . . to establish a more cooperative spirit between medical institutions and Witness patients" and to "alert hospital staff to the fact that there are valid alternatives to the infusion of blood" (italics ours). Occasionally, the Witnesses even went to court to fight for their rights as patients. In a great number of cases, the Witnesses' position was upheld by the courts.

Although many physicians had difficulty with the concept of bloodless medicine, there were some physicians who took up the challenge to provide the best possible medical care without the use of blood transfusions. These were in fact the earliest blood managers. As their experience in performing "bloodless" surgery increased, more complex procedures such as open heart surgery, orthopedic surgery, and cancer surgery could be performed. Even children and newborns could successfully be treated without transfusing blood. Not before long, those pioneering physicians published their results with Witness patients, thereby encouraging other doctors to adopt the methods used in performing such surgical interventions.

Among the first ones who rose to the challenge was the heart surgeon Denton Cooley of Texas. In the early 1960s, his team devised methods to treat Witness patients. Reporting on his early experiences, he published an article in a 1964 issue of *The American Journal of Cardiology*. In the article "Open heart surgery in Jehovah's Witnesses" his team described the techniques used. In 1977, Cooley reported his experiences with more than 500 patients [2].

Cooley's example was followed by many other courageous physicians. For instance, in 1970 Dr Pearce performed bloodless open heart surgery in New Orleans. His efforts did not go unnoticed. Newspapers reported on these spectacular cases. Perhaps out of curiosity or out of the earnest desire to learn, many colleagues visited Dr Pearce's team in the operating room to learn how to do "bloodless hearts." Dr Jerome Kay, from Los Angeles, also performed bloodless heart surgery. In 1973 he reported that he is now performing bloodless heart surgery on the majority of his patients. The call for bloodless treatments spread around the whole world. Dr Sharad Pandey of the KEM hospital in Mumbai, India, adopted bloodless techniques from Canada and tailored them to fit Indian conditions. Centers in Europe and the rest of the world started adopting those advances as well.

It is understandable that Witness patients preferred the treatment of physicians who had already proven their willingness and ability to treat them without using donor blood. The good reputation of such physicians spread and so patients from far away were transferred to their facilities. This laid the foundation for organized "bloodless programs." One of the hospitals with such a program was the Esperanza Intercommunity Hospital in Yorba Linda, California, where a high percentage of patients were Witnesses. Dr Herk Hutchins, an experienced surgeon and a Witness himself, was known for his development of an iron-containing formula for blood-building. Among his team was the young surgeon Ron Lapin. Later, he was famed for his pioneering work in the area of bloodless therapies. Critics labeled him a quack. Nevertheless, he continued and was later honored for opening one of the first organized bloodless centers in the world, as well as for publishing the first journal on this topic, and for his efforts to teach his colleagues. During his career, he performed thousands of bloodless surgeries.

All of those pioneers of blood management had to rise to the challenge of using and refining available techniques, adjusting them to current needs, and individualizing patient care. They adopted new technologies as soon as this was reasonable. Much attention was paid to details of patient care, thus improving the quality of the whole therapy. They also fought for patients' rights and upheld those rights. Many involved in the field of blood management confirm the good feeling of being a physician in the truest sense. There is no need to force a particular treatment. Such an attitude is a precious heritage from the pioneers of blood management. Now, at the beginning of the twenty-first century, this pioneer spirit can still be felt at some meetings dedicated to blood management.

Military use of blood and blood management

Over the centuries, the armies of different nations contributed to what is now available for blood management, but not on religious grounds. It can actually be said that

the military made many crucial contributions to blood management by taking care of the thousands of wounded operated on before transfusions became feasible. In fact, every surgery performed before the era of blood transfusion was, strictly speaking, a "bloodless surgery." Surgeons were confronted with blood loss, but had no way to replace blood. This meant it was imperative to stop hemorrhage promptly and effectively and to avoid further blood loss. During the centuries, battlegrounds were the places where surgeons were massively confronted with blood loss and it was on the battlefield that hemorrhage was recognized as a cause of death. Hemorrhaging victims needed surgery. It was then that techniques of bloodless medicine and blood management were invented. The experience of the early surgeons serving near the battlefield is applicable in today's blood management schemes. William Steward Halsted, a surgeon on the battlefield, described uncontrolled hemorrhage [3] and later taught his trainees at Johns Hopkins the technique of gentle tissue handling, surgery in anatomic ways, and meticulous hemostasis (Halstedian principles). His excellent work provides the basis of the surgical contribution to a blood management program.

As soon as transfusions became somewhat practical, the military used them for their purposes. Since war brought about a deluge of hemorrhaging victims, there was a need for a therapy. The First World War brought the advent of blood anticoagulation. This made it possible to transport blood to the wounded and reduced the use of living donors in the field. But there were other problems. Storage times and problems with logistics called for improvements in blood therapy. During the Second World War, the problem of storage of blood was partly overcome by the advent of blood banks. Another development was due to Cohn's fractionation of blood, which led to the production of plasma as a volume expander for war victims. The United States extensively used plasma for volume expansion in World War II.

Although the World Wars propelled the development of transfusion medicine, these simultaneously propelled the development of alternative treatments. Tremendous problems with availability and logistics as well as with compatibility of blood made transfusions near the battlefield dangerous, difficult, and expensive. Those problems, as well as inherent risks of transfusions, led to the search for other ways of treatment. Intravenous fluids had been described in earlier medical literature [4, 5], but the pressing need to replace lost blood and the difficulties involved in transfusions provided a strong impetus for military medicine to change practice. In this connection, note the following report appearing in the Providence *Sunday Journal* of May 17, 1953: "The Army will henceforth use dextran, a substance made from sugar, instead of blood plasma, for all requirements at home and overseas, it was learned last night. An authoritative Army medical source, who asked not to be quoted by name, said 'a complete switchover' to the plasma substitute has been put into effect, after 'utterly convincing' tests of dextran in continental and combat area hospitals during the last few months. This official said a major factor in the switchover to dextran was that use of plasma entails a 'high risk' of causing a disease known as serum hepatitis—a jaundice-like ailment. Not all plasma carries this hazard, he emphasized, but he added that dextran is entirely free of the hazard. 'We have begun to fill all orders from domestic and overseas theaters with dextran instead of plasma.'"

Efforts to develop another "blood substitute" were intensified by US military in 1985. Major investments supported research, either by contract laboratories or by military facilities themselves [6]. This time, not the search for a plasma expander but the search for an oxygen carrier was the driving force behind the army's efforts.

Promising products in the sector of blood management were readily introduced to the military. One example is a cell-saving device. The surgeon Gerald Klebanoff, who served in the Vietnam War, introduced a device for autotransfusion in the military hospitals. Another example is the recombinant clotting factor VIIa. Although officially declared to be a product for use in hemophiliacs, the Israeli army discovered its potential to stop life-threatening hemorrhage and therefore included it in their treatment of injured victims.

Also, in recent times, the military showed a keen interest in blood management. After the attack on the World Trade Center in New York on September 11, 2001, physicians of the US military approached the Society for the Advancement of Blood Management and asked about blood management. They were aware that a war in a country like Afghanistan would also require preparation on the part of the physicians. The high costs of transfusions in war times (up to US $9000 must be calculated for one unit of red blood cells when transfused in countries like Afghanistan) and logistic difficulties called for blood-conserving approaches. Consequently, specialists in the field of blood management met together with representatives of the US military, the result of which was an initiative named STORMACT® (strategies to reduce military and civilian transfusion). The consensus of this initiative was a blood management concept to be used to treat victims of war and disaster as well as patients in a preclinical setting.

Transfusion specialists support blood management

Interestingly, right from the beginning of transfusion medicine, the development of blood transfusion and transfusion alternatives were closely interwoven. "Alternatives" to transfusion are as old as transfusion itself.

The first historically proven transfusions in humans were performed in the seventeenth century. The physicians were aiming to cure mental disorders rather than the substitution of lost blood. But the very first transfusion specialists were in fact also the first people to try infusions that were later called transfusion alternatives. For instance, it was reported that Christopher Wren was involved in the first transfusion experiments. He was also the first to inject asanguinous fluids, such as wine and beer. After two of Jean Baptiste Denise's (a French transfusionist) transfused patients died, transfusion experiments were prohibited in many countries. Even the Pope condemned those early efforts. For a long time, transfusions came to a halt.

In the beginning of the nineteenth century, the physician James Blundell was looking for a method of prohibiting the death of female patients due to profuse hemorrhage related to childbirth. His amazing results with retransfusion of the women's shed blood rekindled the interest of the medical community in transfusion medicine. Due to his work with autotransfusion he was named in the list of the "fathers of modern transfusion medicine." This demonstrates again that transfusion medicine and alternatives to allogeneic transfusion are closely related.

After Blundell demonstrated that retransfusion of shed blood saved lives, other physicians followed his example. This gave new impetus to transfusion medicine, and in 1873 Jennings [7] published a report of about 243 transfusions in humans, of which almost half of the cases died. Allogeneic transfusions remained dangerous. Blood groups were not known at that time. Technical problems with the transfusion procedure itself resulted in complications and effective anticoagulants were still unknown. Frustration around this situation led some researchers to look for alternative treatments in the event of hemorrhage. Barnes and Little came up with normal saline as a blood substitute [8]. Hamlin tried milk infusions [9]. The use of gelatin was also experimented with. But soon, normal saline was introduced into medical practice. One of the advocates of normal saline, W.T. Bull, wrote in 1884 [10]: "The danger from loss of blood, even to two-thirds of its whole volume, lies in the disturbed relationship between the caliber of the vessels and the quantity of blood contained therein, and not in the diminished number of red blood corpuscles; and . . . this danger concerns the volume of the injected fluids also, it being a matter of indifference whether they be albuminous or containing blood corpuscles or not."

In the early 1900, Landsteiner's discovery of the blood groups was probably the event that propelled transfusion medicine to where it is today. Some 10–15 years later, when Reuben Ottenberg introduced routine typing of blood into clinical practice, the way was paved for blood transfusions. About that time, technical problems had been solved by new techniques and anticoagulation was in use. Russian physicians (Filatov, Depp, Yudin) stored cadaver blood. The groundwork for the first blood bank was laid in 1934 in Chicago by Seed and Fantus [11], and as already mentioned, the wars of the first half of the twentieth century brought about changes in transfusion medicine. After two World Wars the medical community had a seemingly endless and safe stream of blood at their disposal. Adams and Lundy published an article, suggesting a possible transfusion trigger of a hemoglobin level of 10 mg/dL and a hematocrit of 30. For nearly four decades thereafter, physicians transfused to their liking, convinced that the benefits of allogeneic transfusions outweigh their potential risks.

As time went by, reports about blood-borne diseases increased. In 1962, when the famous article of J.G. Allen [12] again demonstrated a connection between transfusion and hepatitis, an era of increased awareness about transfusion-transmissible diseases began. But the risk of hepatitis transmission did not concern the general medical community, and it became an acceptable complication of banked blood. It was not until the early 1980s that the medical community and the public became aware of the risks of transfusions. The discovery that an acquired immunodeficiency syndrome was spread by allogeneic transfusion heightened public awareness, and the demand for safer blood and bloodless medicine increased. Other problems with allogeneic transfusions such as immunosuppression added to the concerns. Again, as in the centuries before, it was the ones concerned most about transfusion issues who were looking for alternative approaches. Lessons learned from the work with the Jehovah's Witnesses community were ready to be applied on a wider scale. In the United States, the National Institute of Health launched a consensus conference on the proper use of blood. The Adams and Lundy's 10/30 rule was revised, and it was agreed upon that a hemoglobin level of 7 mg/dL would be sufficient in otherwise healthy patients.

With time, the incentives for better blood management and blood conservation change. The role of immunomodulation with allogeneic blood is controversial but, nonetheless, offers a reason for blood conservation;

the incremental increase of blood products is another and lastly, sporadic but serious blood shortages are all good reasons to consider effective blood management.

Blood management today and tomorrow

Currently, there are more than 100 organized bloodless programs in the United States. Many are transitioning to become blood management programs. This is not unique to the United States since many more programs have been established worldwide. Most of them were formed as a result of the initiatives of Jehovah's Witnesses. However, a growing number of those programs have now realized the benefits that all patients can receive from this care. The increasing number of patients asking for treatment without blood demonstrates a growing demand in this field. Concerns about the public health implications of transfusion-related hazards have led governmental institutions, around the globe, to encourage and support the establishment of these programs.

The growing interest in blood management is reflected by these activities described herein. Major medical organizations (e.g., the American Association of Blood Banks, AABB) are now including blood management issues on the agenda of their regular meetings. Many transfusion textbooks and regular medical journals have incorporated the subject of blood management in their publications. A growing body of literature invites further investigation (compare Appendix B). In addition, professional societies dedicated to furthering blood management were founded throughout the world. It is their common goal to provide a forum for the exchange of ideas and information among professionals engaged in the advancement and improvement of blood management in clinical practice. This is done by facilitating cooperation among existing and future programs for blood conservation, transfusion-free or bloodless medicine and blood management; also, by reinforcing the clinical and scientific aspects of appropriate transfusion practice, by encouraging and developing educational programs for health-care professionals and the public, and by contributing to the active continuing medical education of its members. Usually, interested persons from a variety of medical and nonmedical backgrounds are invited to participate.

Clearly, out of humble beginnings as an outsider specialty, blood management has evolved to be in the mainstream of medicine. It improves the outcome for the patient, reduces costs, and brings satisfaction for the physician—a clear win–win situation. Blood management is plainly good medical practice.

What are the future trends in blood management? As long as there is a need for medical treatment, blood management will develop. Many new drugs and techniques are on the horizon. To date, there are many techniques available to reduce or eliminate the use of donor blood that it is not necessary to wait for the future. A commitment to blood management is what will change the way blood is used. The authors of this book hope that the information provided by its pages will be another piece in the puzzle that will eventually define future blood management by a new generation of physicians.

Blood management as a program

The organized approach to blood management is a program. These programs are named according to the emphasis each one puts on different facets of blood management, such as bloodless programs, transfusion-free programs, blood conservation programs, or global blood management programs. No matter what a hospital calls its program, there are some basic features that good quality programs have in common.

The administration

The basis for establishing a program is not primarily a financial investment but rather a great deal of commitment on the part of the hospital. Administration, physicians, nurses, and other personnel need to be involved. Only the sincere cooperation of those involved will make a program successful.

The heart and soul of a program is its coordinator with his/her in-hospital office [13, 14]. As a historical prospective, coordinators are often members of Jehovah's Witnesses. However, as such programs are more widely accepted, there is an increasing number of coordinators with other backgrounds. Usually, coordinators are employed and paid by the hospital.

During the initial phases of development of the program, the coordinators may be burdened with significant workload. Together with involved physicians, the coordinator has to recruit additional physicians who are willing and able to participate in the program. Since successful blood management is a multidisciplinary endeavor, specialists from a variety of fields need to be involved. (What, for instance, is the use of a dedicated anesthesiologist if surgeons do not participate?) The coordinator meets with the heads of the clinical departments and works toward mutual understanding and cooperation. Each physician

willing to participate needs to meet with the coordinator to affirm the physician's commitment to the program and to enhance his/her knowledge of basic ethical and medical principles involved. To ensure a lasting and dependable cooperation between physicians and the program, both parties sign a contract. This contract outlines the points that are crucial for blood management with its legal, ethical, and medical issues.

The coordinator is also instrumental for the initial and continuous education of participating and incoming staff. She/he may use in-service sessions, invite guest speakers, collect and distribute current literature, get information on national and international educational meetings, and help staff interested in hands-on experience in the field of blood management. Ideally, participating staff members take care of their education themselves and contribute to the success of the program.

From the beginning of the program, there needs to be a set of policies and procedures. Guidelines as to cooperation with other staff members need to be worked out. It is prudent to have the hospital lawyer review all such documents. Each individual hospital must find a way to educate patients, document their will, and make sure that patients are treated according to their will and they are clearly identifiable. Transfers of patients to and from the hospital need to be organized. A mode of emergency transferal needs to be established. Procedures already in existence such as storage and release of blood products and rarely used drugs for emergencies need to be reviewed. Most probably, there are many medical procedures already available in the hospital that just need to be adapted to the needs of the program. Additional blood management procedures and devices are to be introduced to the hospital staff. The use of hemodilution, cell salvage, platelet sequestration, autologous surgical glue, and other methods needs to be organized. Besides, departments not directly involved in patient care can contribute to the development of policies and procedures. This holds true for administrative offices, the blood bank, laboratory, technical department, pharmacy, and possibly the research department. There are also a variety of issues that need legal and ethical clarification. In keeping with national and international law, issues involved with pediatric and obstetric cases need to be clarified well before the first event arises. Forms need to be developed and a protocol for obtaining legal consent and/or advance directive must be instituted.

To assure continuing support on the part of the administration and the public, some measures of quality control and assurance need implementation. Statistical data from the time before the establishment of a certain procedure should be available for comparison with those obtained after its institution and during the course of its implementation. This is a valuable instrument to demonstrate the effectiveness of procedures and their associated costs. It also serves as an aid in decision making regarding possible and necessary changes. If records are kept up-to-date, developments and trends can be used as an effective tool for quality assurance and for the identification of strong and weak points in a program. Such records are also helpful for negotiations with sponsors and financial departments, discussions with incoming physicians, and for public relations.

The coordinators, and later their staff, need to be well informed about policies and procedures in their hospital and the level of care the facility can provide. There may be times when burden of cases or the severity of a patient's condition outsize the faculty's capacity or capability. In such cases, a list of alternative hospitals better suited to perform a certain procedure should be available.

Good communication skills are essential for the daily activities of the coordinator since he/she is the link between patients and physicians. The coordinator is in constant contact with the patient and his/her family and is involved in the development of the plan of care of every patient in the program. The coordinator informs the staff involved in the care of the patient about issues pertaining to blood management. In turn, staff members inform the coordinator about the progress of the patient. Planned procedures are discussed and any irregular development is reported. Thus, developing problems can be counteracted at an early stage, thereby avoiding major mishaps.

There is virtually no limit to the ingenuity of a coordinator. She/he is a pioneer, manager, nurse, teacher, host, helper, and friend. No successful program is possible without a coordinator. The last chapter in this book will further describe how the coordinator can work effectively for the development of a blood management program.

The physician's part

Several studies on transfusion practice in relation to certain procedures demonstrate a striking fact: A great institutional variability exists in transfusion practice, for no medical reason. For example, in a study on coronary bypass surgery the rate of transfusions varied between 27 and 92% [15]. What was the reason? Did physicians who transfused frequently care for sicker patients? No, the major differing variable was the institution—and with it were the physicians. This is in fact good news. If the physician's behavior can be modified to appropriately limit the

transfusion rate, then a blood management program can effectively reduce transfusions.

Basic and continuous education is crucial for physicians participating in a blood management program. To start with, physicians should intercommunicate about currently available techniques of blood management which relate to their field of practice and compare their own knowledge and skills with others. The result of such an honest comparison identifies the strong and weak areas in their practice of blood management. Then, new approaches, techniques, and equipment should be added as needed. However, remember that not all techniques fit all physicians and not all physicians fit all techniques. After all, it is not a sophisticated set of equipment that makes good blood management—it is a group of skilled physicians. That is why it is desirable that all physicians in a blood management program be aware of the experiences and skills of their colleagues, in order to make these available to the patients.

Another group of professionals that is essential for the program to succeed are the nurses. Nurses play a vital role as they contribute much to patient identification, education, and care. Nursing staff must therefore also be included in the process of initial and continuing education.

Commitment, education, cooperation, and communication are key factors for a successful blood management program. To make each treatment a success, it requires the concerted effort by physicians, coordinators, nurses, administration, and auxiliary staff on the one side, and the patient with his/her family on the other.

Key points

- Blood management is a good clinical practice that should be applied for all patients.
- Blood management is best practiced in an organized program.
- Blood management improves outcomes, is patient centered, multidisciplinary, and multimodal.
- Respect for patients, commitment, education, cooperation, and communication are the cornerstones blood management builds on.

Questions for review

- What role did the following play in the development of modern blood management: Jehovah's Witnesses, physicians, the military, and transfusion specialists?
- What do the following terms mean: bloodless medicine, transfusion-free medicine, blood conservation, blood management?
- What are the important facets of a comprehensive blood management program?

Suggestions for further research

What medical, ethical, and legal obstacles had early blood managers to overcome? How did they do so? What can be learned from their experience?

Exercises and practice cases

Read the article of Adams and Lundy that builds the basis for the 10/30 rule.

Homework

Analyze your hospital and answer the following questions:
What measures are taken to identify patients?
What is done to comply with legal requirements when it comes to documentation of patients' preferences for treatment?
What steps are taken to ensure the patients' wishes are heeded?

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