The production cycle of blood and transfusion: what the clinician should know

O ciclo de produção do sangue e a transfusão: o que o médico deve saber

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ABSTRACT

Since the history of mankind, blood has been associated with the concept of life. However, improper use of blood and blood products increases the risk of transfusion-related complications and adverse events to recipients. It also contributes to the shortage of blood products and possibility of unavailability to patients in real need. **Objective:** this study aims to describe the history of blood transfusion and correct way of using hemotherapy, aiming to clarify to medical students and residents, as well as interested doctors, the importance of this knowledge when prescribing a hemo-component. **Methodology:** the topics described correspond to the summary of knowledge taught during the training courses offered by the Hemominas Foundation for medical students and residents. **Conclusion:** the doctor's performance is undeniably linked to the scientific conception of his fundamentals gradually and continuously obtained since the beginning of medical training. In this perspective, a better training of medical professionals and development of educational curricula in accordance with the most recent advances in hematology can improve the medical knowledge related to transfusion medicine.

Key words: Blood; Blood Transfusion; Hemotherapy Service; Education, Medical; Blood Banks/organization & administration.

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RESUMO

Desde a história da humanidade, o sangue foi associado ao conceito de vida. Entretanto, o uso inadequado do sangue e produtos sanguíneos aumenta o risco de complicações relacionadas à transfusão e eventos adversos para os destinatários. Também contribui para a escassez de produtos derivados do sangue e a possibilidade de não estarem disponíveis, quando necessário, para outros pacientes que deles realmente necessitem. ***Objetivo****: este estudo visa a descrever o histórico da transfusão de sangue e a maneira correta de se utilizar a hemoterapia, visando esclarecer, aos estudantes de Medicina e residentes, bem como médicos interessados, a importância desse conhecimento ao se prescrever um hemocomponente.* ***Metodologia****: os tópicos descritos correspondem ao sumário do conhecimento ministrado durante os estágios oferecidos pela Fundação Hemominas para estudantes e residentes de Medicina.* ***Conclusão****: a atuação do médico está inegavelmente ligada à concepção científica de seus fundamentos, obtidos, gradual e continuamente, desde o início da formação médica. Nessa perspectiva, melhor capacitação dos profissionais médicos e a elaboração de currículos educacionais, em conformidade com os mais recentes avanços em hemoterapia, podem melhorar o conhecimento médico relativo à medicina transfusional.*

Palavras-chave*: Sangue; Transfusão Sanguínea; Serviço de Hemoterapia; Educação Médica; Bancos de Sangue/organização & administração.*

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INTRODUCTION

The lack of medical knowledge in hemotherapy can reduce transfusion safety and cause serious harm to the patient. Thus, competent action becomes an essential requirement in transfusion medicine, preventing possible complications and transfusion reactions.[1]

Considering that transfusions are becoming increasingly important as therapies and that they are not procedures without risk, careful attention is necessary not only on the quality of transfused blood, whose acquisition starts from searching candidates for blood donation, as well as knowing the origin and purpose of the collected blood to increase transfusion safety.

The prescription of a blood component mobilizes a complex structure through a cyclical process starting with public awareness, involving the selection of suitable candidates for blood donation, and finally processing and storing the collected blood components. This precious product will be available later to the patient who needs a blood transfusion by a precise indication, pre-transfusion selection, and appropriate clinical support.

This study aims to review and update the specific knowledge about hemotherapy for undergraduates and residents, as well as interested doctors, contributing to improve training in this area. The topics described correspond to the summary of knowledge taught during courses offered by the Hemominas Foundation for Medical School students and residents as well as physicians responsible for transfusion centers. The trainings are performed in units of the Hemominas Foundation, especially in cities where there are Medical Schools.

The following sectors correspond to the blood cycle: donor recruitment and awareness, clinical and hematological screening, and blood collection, fractionation, and distribution. The apheresis sector is also part of the blood center, which conducts the individualized collection of blood components, medical care service for the donor (SAMD), assisting the serologically unfit donor, and the ambulatory where blood transfusions are performed, and there is a specialized follow-up of patients with anemia sickle cell disease and coagulation disorders.

The activity in the training of undergraduate students and residents is developed in the clinical screening sector involving the application of standardized questionnaires adopted by the institution, and physical examination of candidates for blood donation who voluntarily come to the blood center.

All blood donors are submitted to an individual and confidential interview through the use of simple and understandable language, under medical supervision, in order to assess medical history and current health status and decide which candidates are deemed fit as donors ensuring that the procedure does not harm donors or those waiting for a blood transfusion.

Candidates approved in the clinical screening, who understood the explanations provided by the screening assistant and agreed to perform the procedure by signing a Free and Clear Consent Form (TCLE) confirming their understanding, agreement, and commitment to the veracity of answers provided in the questionnaire, are sent to the blood screening and blood donation sectors. The records of interviews are stored according to specific legislation.[2]

It is also up to the screening assistant to observe the general appearance of candidates, their behavior and reactions; pale aspect, possibility of anemia, skin and yellowish sclera, indication of jaundice; conjunctival hyperemia, uncertain walking, rambling or nonsensical speech, and characteristic breath suggesting consumption of alcohol or other drugs; swollen faces, which is a chronic alcoholism aspect; non-convincing speech indicating omission of information or embarrassment in giving the required answers.

After the interview and clinical examination, performed in sequence, candidates are informed of the result of the selection process – fit or unfit – those who are considered unfit receive a clear explanation of the refusal reason and period that they must wait before returning. It is noteworthy that in these situations, candidates are referred to specialized medical evaluation when necessary.

Therefore, the establishment of an empathetic relationship with candidates promoting a reliable and credible environment without the existence of prejudice and/or judgments is essential for the screening doctor. In addition, the donor receives additional guidance regarding precautions to be followed during and after donation, being informed of possible adverse reactions, as well as instructed about the possibility of self-exclusion in the donation process in situations when they do not consider safe to use their blood. The self-exclusion occurs from the manifestation of the donor, through a confidential statement after donating blood, requesting that their blood not be used. Thus, the collected bag is discarded.

Unfit candidates are advised, according to their disability, about the period they must wait before

returning, clinical guidelines to follow and, when necessary, sent to specialized treatment in referral centers.

The trainee attends an introductory training for 15 days in preparation for carrying out these activities:

- learning how to use the computerized system for data entry and assistance to donors;
- acquiring knowledge and studying blood center protocols;
- conducting the clinical examination;
- acquiring knowledge about reference services for referral of unfit candidates.

This work will describe the history of blood transfusion and how hemotherapy should be used in order to clarify medical students and residents about the importance of this knowledge when prescribing a blood component.

HISTORY OF BLOOD TRANSFUSION

The evolution of hemotherapy can be divided into two periods: empirical until 1900, and scientific, from 1900 onwards.

Since human history, blood was associated with the concept of life, which became part of the unconscious man's heritage, as evidenced by the wide variety of myths and symbols in world culture.[3]

The first attempts to blood transfusion were empirical, initially between different species: animal-man, with failure and frustration. The process began to be implemented with some success when blood transfusion began between individuals of the same species, in this case, man-man.

From 1900 onwards, blood started to be used as a therapeutic agent, and its use goes through three different moments:

- before the possibility of preserving it *in vitro*;
- after preserving it *in vitro*;
- after the separation of its components, using it more efficiently,[3] as detailed below.

Blood transfusion before the possibility of preserving it *in vitro*: the scientific basis – immunological – to use blood as a therapeutic agent started with the discovery of the ABO blood groups by Landsteiner, identifying its antigens and antibodies and establishing the compatibility and incompatibility between blood from individuals of the human species.[3] Based on these facts, in 1913, Ottenberg and Kaliski conducted blood transfusions in human beings, establishing a basic postulate known as the Ottenberg Law, which defines the following: "transfusion will be theoretically possible if red blood cells from the donor are not agglutinated by the serum in the receiver". Based on these compatibilities and incompatibilities, the concepts of universal donor (group "O") and universal receiver ("AB" group) emerged.[3]

Before the possibility of preserving the blood *in vitro*, blood transfusion was performed directly from donor to the receiver. The first Blood Transfusion Service (STS) was the "Voluntary Service" in 1921 in London, sponsored by the British Red Cross. The STS demonstrated its efficiency, especially in the First World War, helping in the recovery of patients from bleeding, trauma, and shock.[3]

Blood transfusion after preserving it *in vitro*: the first anticoagulant and preserver solution was established since 1914, independently and simultaneously, by Agote, in Buenos Aires, Hustin in Belgium, and Lewisohn in New York. In 1916, Rous and Turner added citrate dextrose, enabling the preservation of blood *in vitro* and its use when adequate.[3] This fact enabled operating facilities and the appearance of a new blood service: the Blood Transfusion Center (CTS). The first CTS was the Central Institute of Hematology and Blood Transfusion in Moscow, founded in 1926.

The first Blood Bank (BS) appeared in 1937 in the United States. It was organized by Fantus at the Cook County Hospital in Chicago and was characterized by a more complex service, whose operational processes were compared to a bank.[3]

The Spanish War and World War II spread the use of preserved blood and the efficiency of these services. However, due to the indication and indiscriminate use of blood, Transfusion Commissions were created in hospitals aiming to regulate its use.

Blood transfusion after the separation of its components: the deepening knowledge about the morphophysiology of blood components and requirements to preserve them *in vitro* to ensure that they normally survive in the receiver´s body showed the impossibility of keeping them together with the unit of whole blood, stored at 4°C. On the other hand, multiple clinical needs in the use of these components in doses and intervals, and under conditions which are effective, demonstrated the impossibility to supply them with the whole blood transfusion, red cells, and plasma concentrate, products that blood banks

had in their therapeutic arsenal. These requirements led to the need for new resources to enable the safe and efficient separation of blood components to preserve them correctly. Plastic equipment and refrigerated centrifuges emerged, enabling blood collection, separation of its components, and its application in a locked, safe, and versatile system.

Subsequently, the need to obtain only one component in a more concentrated product than that obtained by the conventional process required the creation of a new collection process that would ensure these objectives, which generated the collection by apheresis. In this process – apheresis – blood is collected, and the desired component is immediately separated; other components are reinfused into the donor. This operation is repeated several times in the same session, producing a product with a more concentrated component in less volume. Plasmapheresis was the starting process, soon adapted to platelets (platelet apheresis) and leukocytes (leukocyte apheresis).[3] Thus, the hemotherapy arsenal greatly increased and, given the multiplicity of hemotherapy products available and the characteristics of each one concerning acquisition, preparation, processing, pre-transfusion selection, indications, and doses and schedule, a new medical specialty was created: the hemotherapy.

THE USE OF BLOOD: INDICATIONS AND CONTRAINDICATIONS

The modern hemotherapy was developed based on the rational precept of transfusing only the component that the patient needs based on clinical and/or laboratory evaluation, with no indications for whole blood as a general rule.

The improper use of blood and blood products increases the risks of complications related to transfusion and adverse events in receivers. These factors also contribute to the shortage of blood products and unavailability when needed for other patients in an appropriate environment. Therefore, it is necessary to reduce unnecessary transfusions based on the appropriate clinical use of blood.[4]

The main indications for blood transfusion aimed at restoring and maintaining the oxygen transportation capacity, blood volume, and hemostasis. It should be noted that the clinical conditions, added to laboratory results, are determining factors in transfusion requirements. However, despite all the care used, transfusion also presents risks – including, the transmission of infectious diseases, immunosuppression, and alloimmunization – and it should be performed only if indicated.

It is necessary to highlight that the indication for blood transfusion should be done exclusively by doctors and based mainly on clinical criteria. Furthermore, the benefits of transfusion must overcome the risks.[5,6] The indications and contraindications for blood components currently used in clinical practice are described bellow.

Red blood cells concentrate (CH): it is the ideal component to restore the oxygen transportation capacity, and its indication depends mainly on the patient´s condition.[7] Not every state of anemia requires red blood cell transfusion because the body uses compensatory mechanisms in these situations such as increased cardiac output and decreased hemoglobin affinity (Hb) for oxygen (O_2), measures that many times can reduce the level of tissue hypoxia. Ideally, the transfusion of red blood cells concentrates (CH) should be based on a constellation of clinical and laboratory factors such as age, installation speed of anemia, natural history of anemia, intravascular volume, and physiological cofactors affecting the cardiopulmonary function.[6]

In situations of acute hemorrhage, the blood loss can be classified into:

- **hemorrhage class I –** loss of up to 15% of blood volume;
- **hemorrhage class II –** loss of 15 to 30%;
- **hemorrhage class III –** loss of 30 to 40%;
- **hemorrhage class IV –** loss of more than 40%.

Patients with hemorrhages class III and IV may progress to death by multiple organ failures if they are not subjected to resuscitation schemes in the first hour. The hematocrit (Ht) is not a good parameter for guiding the transfusion since it only begins to drop one to two hours after the bleeding starts. In acute hemorrhages, the patient should be immediately transfused in the presence of the following signs and symptoms: heart rate above 100-120 bpm, low blood pressure, decrease in urine output, increased respiratory rate, capillary perfusion higher than two seconds, and changes in the level of consciousness.[6,7]

In normovolemic situations, anemia in which the Hb level is greater than 10 g/dl (hematocrit above 30%) is well tolerated. However, when Hb is less than

7 g/dl, there is a high risk of tissue hypoxia with vital functions impairment. In cases where Hb is between 7 and 10 g/dl, transfusion depends on the assessment of the clinical condition of the patient. In critically ill patients with low oxygen extraction measured by volumetric and blood gas parameters, and in patients with severe respiratory failure, Hb levels should be maintained above 10 g/dl. Similarly, patients with unstable coronary artery disease or in postoperative cardiovascular surgery, Hb should be maintained above 9-10 g/dl. In patients older than 65 years old, transfusion with Hb levels lower than 10 g/dl is acceptable.[8]

The cause of anemia should be considered. Nutritional anemia such as iron, or folate, or vitamin B12 deficiencies, usually respond very well to the administration of these elements. However, chronic renal failure (CRF) adequately responds to treatment with recombinant erythropoietin, avoiding transfusions. CH transfusion to promote increased sense of well-being, or for wound healing, should be discouraged as well as for prophylactic use or volume expansion in the presence of an adequate O^2 uptake. CH is prepared from whole blood (ST) by centrifugation, and the final product contains hematocrit between 65 and 80% and volume between 250 and 350 mL. Each unit of CH contains enough hemoglobin to increase the concentration of hemoglobin in about 1 to 1.5 g/dL and further increase hematocrit in 3 to 4% in a patient weighing approximately 70 kg.[7]

Leukocytes are considered contaminants in red blood cells concentrates because they may release cytokines and break up over time resulting in non-hemolytic febrile reactions. The transfusion contaminated with leukocytes also causes the formation of antibodies against leukocyte antigens (anti-human lymphocyte antigen system – HLA, human leukocyte antigen – and anti-granulocytic). The leukocytes removal is a procedure executed to decrease these responses. Moreover, some viruses in leukocytes, such as cytomegalovirus (CMV) and human T cells lymphotropic virus (leukemia/lymphoma) (HTLV, human T-cell lymphotropic virus) may have reduced transmission rates using blood components without leukocytes.[7]

Platelets concentrate (PC): platelets can be obtained by blood fractionation collected from voluntary donations or when the donation occurs through an apheresis machine – apheresis procedure. The platelet concentrates collected by apheresis has several advantages because the chance of causing alloimmunization and transmission of diseases is decreased.[7] Platelets are essential for normal hemostasis and indications for platelets concentrate transfusion (CP) are associated with thrombocytopenia caused by bone marrow failure; transfusion in thrombocytopenia caused by peripheral destruction or congenital abnormalities of platelet function are rarely indicated.[6]

In situations of thrombocytopenia associated with bone marrow failure (blood disorders and/or chemotherapy and radiation therapy), prophylactic transfusion is often indicated: a) if count is less than 10,000/uL in the absence of risk factors; b) if count is less than 20,000/uL in the presence of factors associated with hemorrhagic events such as fever (>38°C), minor hemorrhagic manifestations (petechia, ecchymoses, gingival bleeding), transplantation versus host disease, splenomegaly, use of medications that shorten platelet survival (some antibiotics and antifungals), hyper leucocytosis (count greater than 30,000/mm^3), other hemostasis alterations such as acute promyelocytic leukemia, or in case of rapid drop in platelet count. In other cases where thrombocytopenia caused by bone marrow failure has a chronic nature, such as severe aplastic anemia or myelodysplastic syndrome, the observation of patients without CP transfusion is recommended. This would be indicated prophylactically only if counts are less than 5,000/uL or less than 10,000/uL in the case of bleeding manifestations.[6]

It is necessary to highlight the peculiarities of certain thrombocytopenia situations by peripheral destruction, either by increased consumption and/or destruction by immune mechanisms of platelets, with the transfusion contraindicated in most of these clinical situations. In cases of disseminated intravascular coagulopathy (DIC), the replacement of platelets and coagulation factors is discouraged because there is no evidence of prophylactically beneficial effects. However, in the case of bleeding, even if not severe at the moment, the replacement with fresh frozen plasma (FFP) and CP should be initiated aiming to have counts greater than 20,000/uL. In cases of immune thrombocytopenia, with immune thrombocytopenic purpura (PTT) being the most frequent, platelet transfusion is restricted to situations of severe bleeding, which endanger the lives of patients. Therapy should be aggressive and always associated with specific forms of treatment, such as high doses of corticosteroids and immunoglobulin or even splenectomy. In thrombocytopenic patients who undergo surgical or invasive procedures, there is consensus

that an amount exceeding 50,000/uL is enough in most cases, except for neurosurgical and ophthalmological procedures, where higher levels are required (greater than 80,000 to 100,000/uL).[6]

Platelets transfusions are not indicated in cases of bleeding unrelated to thrombocytopenia when there is platelet destruction, for example, thrombotic thrombocytopenic purpura (PTT) or immune thrombocytopenic purpura (PTI) without active bleeding; and prophylactically in surgeries with cardiopulmonary bypass. Platelet refractoriness, alloimmunization, and febrile transfusion reactions are related to leukocyte contamination in platelet concentrates, just as occurs in red blood cells concentrates.[7]

Fresh frozen plasma (PFC): PFC represents the liquid portion of whole blood, obtained by centrifugation, with the function of maintaining the blood oncotic effect, mediating coagulation and fibrinolysis, and with antiseptic properties. In the deficiency of a single coagulation factor, the PFC should only be used if there is no available purified product, which is safer. In patients with multiple deficiency of coagulating factors (severe hepatic failure, disseminated intravascular coagulation, massive transfusion, and etc.) and in the presence of bleeding or increased risk of bleeding, transfusion is indicated.[8]

The most frequent indications for the use of frozen plasma are:

- patients with of coagulating factors deficiency (prothrombin time and/or partial active thromboplastin time), with active bleeding or invasive pre-procedures;
- transfusions of more than 10 units of concentrated erythrocytes (for adults with an average weight between 60 and 80 kg) or replacement of one or more blood volumes in the patient in a period of 24 hours;
- the need for coagulation correction on in an emergency (pre- or post-operative or invasive preprocedure) in patients using oral anticoagulants;
- in cases of thromboelastography indicating coagulating factors deficiency in bleeding;
- as a replacement fluid in plasma apheresis for specific diseases such as thrombotic thrombocytopenic purpura and hemolytic uremic syndrome;
- in cases of antithrombin III, protein C or S, in significant thrombotic phenomena.

The use of PFC is not recommended when coagulopathy can be corrected with specific therapies such as vitamin K, cryoprecipitate (for fibrinogen), and factor VIIIc concentrate, among others. Alternatively, even as volume expander or nutritional support in hypoalbuminemia patients.

Cryoprecipitate (cryo): cryo contains factor VIII, Von Willebrand factor, factor XIII, fibrinogen, and fibronectin in therapeutic concentrations. It is indicated more often for replacement of fibrinogen and patients with bleedings and congenital or acquired isolated deficits, unavailability of purified concentrate and also in patients with CID and severe low fibrinogen levels. Cryo is also used to replace the Von Willebrand factor (fvW) in patients with Von Willebrand disease when fvW concentrate is unavailable.[8]

Granulocytes concentrate (CG): CGs have migrating, phagocytosis, bactericidal, and fungicide properties and are acceptable in the cases of severe neutropenia (neutrophil <500/uL) or in cases associated with bacterial or fungal sepsis that are non-responsive to antibiotic therapy. CG transfusions are rarely used in medical practice. CGs are not recommended to non-neutropenic infected patients or as a prophylactic in uninfected neutropenic patients.

THE BLOOD CYCLE

Blood is a special tissue, different from those used in transplants because it can be collected and separated into its components. Each component will be one of the several hemotherapy products, which are preserved *in vitro* to be selected and transfused when needed.[3]

Thus, from voluntary blood donation, the blood centers provide blood components to blood services and industry to be processed and headed for the population – users –, constituting the blood cycle (Figure 1).

However, for these objectives to be achieved in blood centers, a sequence of preliminary operations occurs as detailed below before blood components are available and used (Figure 2):

- **blood donor recruitment:** include the various forms of guidance, awareness, and invitations aimed at attracting potential candidates to donate blood. This is a very important step because without candidates the donation does not happen, and the blood cycle is not complete.
- **selection of donors:** it is the operation aimed at identifying and registering donors and their clinical and hematological screening in order to choose fit donors.

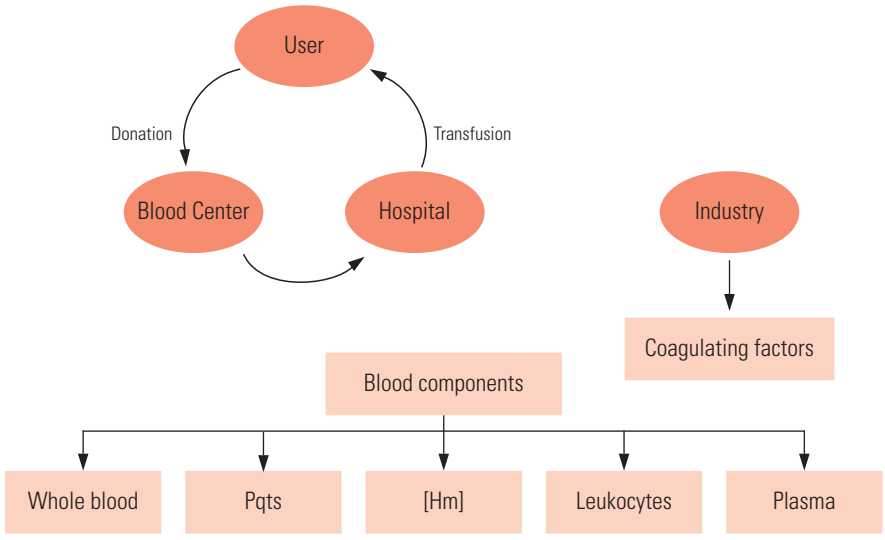

Figure 1 - Blood cycle.

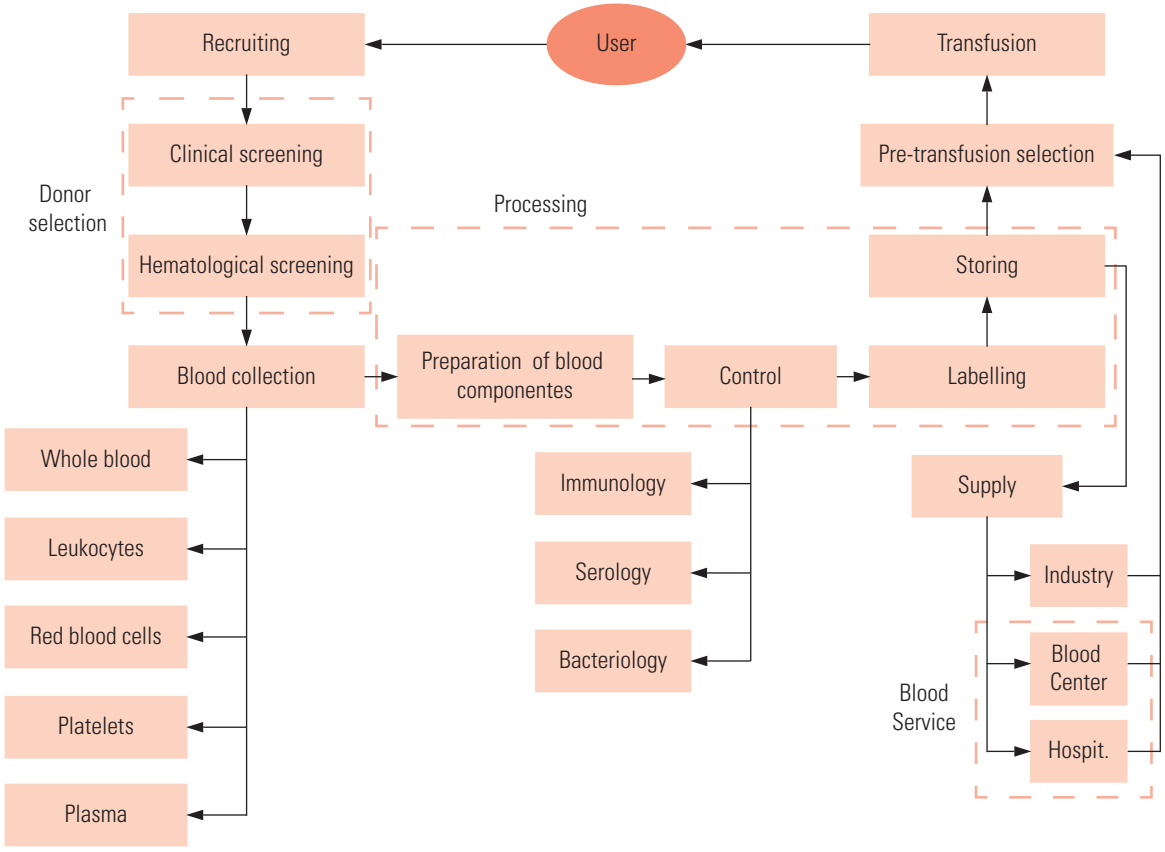

Figure 2 - Blood Center.

- **blood and blood components collection:** aims at collecting blood from the donor deemed fit to donate. Integral blood collection wherein one unit of whole blood is collected or one or two blood components are collected through a process called apheresis. When only plasma is collected, it is called plasmapheresis, when platelets are collected, it is called platelet apheresis; when double

red cell concentrate is collected, it is called erythrocyte apheresis; and when only leukocytes are collected, it is called leukocyte apheresis.

- **processing:** corresponding to all operations after collection and before the pre-transfusion selection. These operations aim to: preparation of blood components, blood control, labeling, and storing.
- **preparation of blood components:** it aims to multiply the value of one donation from the preparation of several hemotherapy units.
- **control:** it examines the following characteristics: a) immune hematological – aiming to classify the ABO and RH antigen by searching for regular and irregular antibodies; b) serological – aiming to eliminate those blood components that may be vectors for syphilis, hepatitis B and C, HTLV, HIV, and Chagas disease; c) bacteriological – to ensure the sterility of hemotherapy products. There are other controls that are mandatory and eventually performed such as biochemical and parasitological controls.
- **labeling:** an operation that aims to identify the characteristics of blood and blood components units.
- **storage:** operation to keep blood and blood components units in adequate conditions for the preservation of their specific characteristics.
- **pre-transfusion selection:** an operation using appropriate laboratory tests in blood and blood components units to select blood components that are compatible with a particular receiver.
- **transfusion:** results from the application of blood and blood components, intravenously and for therapeutic purposes, performed by a qualified professional.
- **supply:** corresponds to the transference of blood and blood components units to the responsibility of another blood service or industry. Because these operations are multiple and complexes, there are services that perform only one or more operations, classified into two basic types: blood transfusion centers or blood banks, and blood transfusion services.
- **blood transfusion centers or blood banks:** a) recruit and select donors, and collect blood; b) process and prepare components; c) store; d) conduct pre-transfusion selection, and in some of them e) apply hemotherapy products through transfusion. They usually provide their products to third parties. They can be in the government or private sectors, or even region, community, hospital, or independent based. Depending on the size and complexity of the blood center, some still perform scientific research and industrialization of blood products. They may have fixed or mobile collection units to facilitate the blood collection operation, which are intended to identify and select donors, collect blood, and send it to the blood center or blood bank.
- **blood transfusion services:** these are usually hospital services storing blood and blood components, which are selected and transfused in hospital medical services. These services do not perform collection and processing; they receive hemotherapy products from a blood center or blood bank to which they are linked by dependence or agreement for the provision of services. However, some hospital blood transfusion services collect and process blood, performing the activities of a blood bank.[3]

HEMOVIGILANCE

Hemovigilance is a relatively new procedure, initially implemented in France in 1993 and later in the UK. In Brazil, hemovigilance began in 2004 following the norms of Resolution RDC 153.[9] Because of its latest character, hemovigilance has not been a theme in medical graduating courses or residency.

The safety of blood products considering their source, blood donor, and blood use by the receiver is very important.[10] Hemovigilance is an evaluation and alert system, organized in order to collect and evaluate information about undesirable and/or unexpected effects when using blood components in order to prevent the onset or recurrence of these effects.[11] Hemovigilance deals with the blood transfusion chain safety and can be summarized in one sentence: "vein to vein security".[12]

In Brazil, hemovigilance was implemented by the National Health Service in 1999 and defined according to ANVISA, as "a set of surveillance procedures that covers the blood cycle, from donation to transfusion, generating information about adverse events resulting from donation and therapeutic use of blood and blood components". Moreover,: "this information is used to identify risks, improve the quality of products and processes and increase the safety of donors and patients, preventing the occurrence or recurrence of such events". Its importance is noteworthy, for example, in situations of donor

seroconversion to human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV), which are associated with infection in the receiver's blood. The adequate monitoring of these cases will only be conducted through the existence of an active hemotherapy system in the region, a fact that shows the unique importance of this instrument in transfusion safety.[10]

The use of blood components must be accurate. However, because doctors in different specialties are not always fully aware of the issues involved in the act of transfusion, it is necessary that the clinical staff receive updated and permanent guidance on the subject.[13]

In order to ensure that hemotherapy resources are adequately applied, several countries have instituted Hospital Transfusion Committees (CHT). CHTs correspond to medical commissions of different specialties that meet regularly to define and evaluate the transfusion practice in a particular institution.[13]

Typically, a CHT should define and review the practice of transfusion in the institution and issue recommendations and reports to the appropriate authorities. Their activities may include periodic review of transfusion adverse reactions, statistical data on blood and blood components use and discards, evaluation of accredited services, internal and external quality control, facilities, personnel, and equipment adequacy, definition of maximum reserve scales of products for surgeries, definition of criteria, and audit on use of blood components.[13]

CONCLUSION

The Brazilian Ministry of Health estimates that 1.9% of the population donated blood in 2008. However, the World Health Organization (WHO) considers that donation from 1% of the population is generally the minimum to fulfill the most basic transfusion requirement of a nation. The average proportion of donors in developed countries is 3.8% of the population. In transition countries, this ratio is 0.75% and in developing countries 0.23%. These figures reflect an acute imbalance between developing and developed countries in the availability of blood for transfusion. On the other hand, the increase in number and complexity of medical procedures and the extension of human life expectancy considerably increased the need for transfusions.[12,14]

To meet this demand, blood components and blood products are obtained from blood donors. The current processing techniques allow offering only blood components and blood products that patients need, thus minimizing the risks of transfusion. It is important to highlight that all donated blood undergoes screening for blood-borne diseases including HIV, hepatitis B and C, HTLV I/II, Chagas disease, syphilis, and malaria in some regions of Brazil.[15]

The indication, prescription, and transfusion act are exclusive medical procedures. It is important that professionals always assess the indication and risks of transfusion before deciding whether there is a need and what type of blood component will be of benefit to the patient, with the least risk possible.[15]

The analysis of the real needs for a transfusion should be based on risks and cost-effective perspectives. In addition to having a high cost, transfusions can exceptionally cause adverse effects. As in any procedure, the indication must be more important than the occurrence of possible problems.[7]

Individual laboratory parameters should not replace a good and careful clinical evaluation for the indication of blood and blood components transfusions. Laboratory results should be indicators and examined together with the clinical situation, and the transfusion decision should be individual for each case.[7]

The doctor's role is undeniably linked to the intellectual conception of his foundations obtained in the Medical course.[16] However, the acquisition of knowledge does not occur immediately; it starts from the beginning of the medical training. In this perspective, a better training of medical professionals and elaboration of educational curricula by the latest advances in hemotherapy can improve medical knowledge in transfusion medicine.[17] Studies showed that such measures reduce the inappropriate use of blood components and contribute to the rational use of blood and improved management of stocks.[18] Thus, the inclusion of the discipline or specific training in Hemotherapy in undergraduate courses in Medicine, as well as in conferences, courses and, meetings for Intensive Care on topics related to transfusion therapy, or even the availability of educational, practical, and theoretical credits in transfusion medicine could be offered as instruments and incentives to learning during undergraduate and residency training,[17] contributing to the proper medical capacitation.

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