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IMPORTANCE OF BLOOD TRANSFUSION AND ASSSOCIATED RISK FACTORS

Dr. Ramesh Chandra Tiwari[1]* and Dr. Ajay Kumar Sharma[2]

[1]Associate Professor, Deptt. of Agad Tantra, Rishikul Campus Haridwar, Uttarakhand Ayurved University (U.K.),

[2]Associate Professor, Deptt. of Shalya Tantra, Swami Kalyan Dev Govt. Ayurvedic College, Muzaffernagar, U.P.

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***Corresponding Author**
Dr. Ramesh Chandra Tewari
Associate Professor, Deptt. of Agad Tantra, Rishikul Campus Haridwar, Uttarakhand Ayurved University (U.K.),

ABSTRACT

Blood transfusion is a common procedure in which blood is given to you through an intravenous (IV) route, done to replace blood lost during surgery or due to a serious injury. Most blood transfusions go well. Mild complications can occur. Very rarely, serious problems develop. Blood transfusion is an emergency and life saving therapeutic measure, but the therapy involves certain complications. Keeping the risks of blood transfusion in view, it should not be given to a patient who does not consent for the same. Instead, the patient may be treated by other best available methods and a record refusal of transfusion signed by the patient, should be kept to counter any subsequent charge of negligence against the doctor.

KEY WORDS: Blood transfusion, emergency, blood donation, blood doping etc.

INTRODUCTION

Blood transfusion is generally the process of receiving blood products into one's circulation intravenously. Blood transfusions are used to replace blood lost during surgery or a serious injury. Transfusions are used in a variety of medical conditions to replace lost components of the blood. Earlier whole blood was transfused, but modern medical practice commonly uses only components of the blood, such as red blood cells, white blood cells, plasma, clotting factors, and platelets. Units of packed red blood cells are typically only recommended when either a patient's hemoglobin level falls below 10g/dl or hematocrit falls

below 30%; recently this level has been decreased to 7-8g/dl, as a more restrictive strategy to have better patient outcomes. Globally108 million blood donations collected annually, approximately half of these are collected in the high-income countries.[1] In cases where patients have low levels of hemoglobin but are cardiovascular stable, in these patients parenteral iron is a preferred option based on both efficacy and safety. Other appropriate blood products are given as in clotting deficiency disorders. When a patient's own blood is salvaged and reinfused during a surgery, considered a form of auto-transfusion. Before blood transfusion, there are many precautions followed to ensure quality of the blood products, compatibility, and safety to the recipient.

Blood transfusions involves various sources of blood, like one's own blood (i.e. autologous transfusion) or someone else's blood (i.e.homologous transfusion). The latter is more common than the previous one. Using another's blood must first start with donation of blood. Blood is most commonly donated as whole blood intravenously and collecting it with an anticoagulant. In developed countries, blood donations are usually anonymous to the recipient. Blood bank always follows whole cycle of donation, testing, separation into components parts, storage and administration to the recipient. This facilitates management and investigation of any suspected transfusion related disease transmission or transfusion reaction etc. In developing countries, the donor is sometimes specifically enlisted, typically a family member and the donation occurs immediately before the transfusion.

Processing of blood after donation: Donated blood is usually subjected to processing after it is collected, to make it suitable for use in specific patient. Collected blood is then separated into blood components through centrifugation process into red blood cells, plasma, platelets, albumin protein, clotting factor concentrates, cryoprecipitate, fibrinogen concentrate and immunoglobulin's (i.e. antibodies). Red blood cells, plasma and platelets can also be donated individually via a more complex process called aphaeresis.

Blood screening

- All donated blood must be screened for infectious diseases like HIV-1, HIV-2, HTLV-1, HTLV-2, hepatitis-B, hepatitis-C, Syphilis (Treponema pallidum), Chagas disease (Trypanosoma cruzi) and West Nile Virus. In addition, platelet products are also tested for bacterial infections due to its higher inclination for contamination due to storage at room temperature. Presence of Cytomegalovirus (CMV) is also tested because of risk to

certain immunocompromised recipients if given, such as those with organ transplant or HIV. However, not all blood is tested for CMV because only a certain amount of CMV-negative blood needs to be available to supply patient needs. Other than positivity for CMV, any products tested positive for infections are not used.[2]

- All donated blood is also tested for ABO grouping and Rh factor, along with the presence of any red blood cell antibodies.

- Leuko reduction is the removal of white blood cells (WBC) by filtration method. Leukoreduced blood products are less likely to cause HLA alloimmunization (development of antibodies against specific blood types), febrile non-hemolytic transfusion reaction, cytomegalovirus infection and platelet-transfusion refractoriness.

- Pathogen reduction treatment involves exposure to UV light has been shown to be effective in inactivating pathogens (i.e. viruses, bacteria, parasites and white blood cells) in blood products by inactivating white blood cells in donated blood products. Riboflavin and UV light treatment can also replace gamma-irradiation as a method to prevent graft-versus-host disease (GVHD).

Testing of blood after donation

Compatibility testing: Before blood transfusion, compatibility testing between donor and recipient blood must be done. The first step before a transfusion to be given is to type and screen the recipient's blood. Typing of recipient's blood determines the ABO and Rh status. The sample is then screened for any alloantibodies that may react with donor's blood. The blood bank technician also checks for special requirements of the patient (e.g. need for washed, irradiated or CMV negative blood) and the history of the patient to see previously identified antibodies and any other serological anomalies.

A positive screening warrants an antibody panel or investigations to determine if it is clinically significant. Donor cells may have homozygous/heterozygous expression or no expression of various antigens. The patient's serum is tested against the various donor cells based on the reactions of the patient's serum against the donor cells, a pattern will emerge to confirm the presence of one or more antibodies. Once the patient has developed a clinically significant antibody it is vital that the patient receive antigen-negative red blood cells to

prevent future transfusion reactions. A direct antiglobulin test (i.e. Coombs test) is also performed as part of the antibody investigation.

If there is no antibody present, an immediate spin cross match or computer assisted cross match is performed where the recipient serum and donor serum are incubated. In the immediate spin method, two drops of patient serum are tested against a drop of 3-5% suspension of donor cells in a test tube and spun in a serofuge. Agglutination or hemolysis (i.e.positive Coombs test) in the test tube is a positive reaction and the unit should not be transfused. If an antibody is suspected, potential donor units must be screened primarily for the corresponding antigen by phenotyping method. Antigen negative units are then tested against the patient's plasma using an antiglobulin/indirect cross match technique at $37^{\circ}C$ to enhance reactivity and make the test easier.

In emergency conditions where cross matching cannot be completed and the risk of dropping hemoglobin outweighs the risk transfusing uncross-matched blood, O-negative blood should be used, followed by cross-match as soon as possible. O-negative is also used for children and women of childbearing age. It is preferable for the laboratory to obtain a pre-transfusion sample in these cases so typing and screening can be performed to determine the actual blood group of the patient and to check for alloantibodies.

World Health Organization (WHO) has defined haemo-vigilance, as a system "to identify and prevent occurrence or recurrence of transfusion related unwanted events, to increase the safety, efficacy and efficiency of blood transfusion, covering all activities of the transfusion chain from donor to recipient." The system include monitoring, identification, reporting, investigation and analysis of adverse events and reactions related to transfusion and manufacturing.[3]

The risks of blood transfusion[4]

1- Serological problem- due to mismatched transfusion.
2- Infection due to wrong technique.
3- Transfusion of infected blood .
4- Transfusion of excess volume.
5- Transfusion of haemolysed blood.
6- Air embolism.

Serological problem

Due to mismatched blood transfusion there may be haemolysis and clumping of blood cells. Mismatching occurs when there is incorrect grouping and cross matching of the donor's or recipient's blood, or when under compulsion, blood from 'O' group donor is transfused to 'A', 'B' or 'AB' group recipient. Apart from signs and symptoms of mismatching in the form of rigor and compression over chest, proper investigations will reveal the mismatched transfusion.

- There will be free haemoglobin in the blood of the transfused patient.

- Haematin, methhaemalbumin and bilirubin in more than normal ranges in the blood of the patient or the deceased, who was given transfusion, if he had no such thing in his blood before transfusion, are also indicative of mismatched transfusion.

- Blood subjected to microscopic examination may show clumping of the donor's cells.

- If no clumps are observed, Coomb's test may show clumping, suggesting sensitization of donor's cells by recipient's serum factor, which in spite of mismatching, failed to agglutinate the cells due to some reasons. The serum and cells of the pre transfused and post transfused blood of the patient and the serum and cells of the donor's blood should be subjected to further testing by various methods.

- In the recipient's blood, the responsible antibody may not be detected due to wrong preservation or due to neutralization of the antibody by the donor's cells, this is possible in case of transfusion of 'O' group donor's blood in 'A' 'B' or 'AB' group recipient, without proper cross matching.

Infection due to wrong technique and transfusion of infected blood.

Infection may occur in two ways

1. From transfused blood
2. From a contaminated transfusion set.

This will cause corresponding infection in the recipient, particular danger being for hepatitis "B" virus, AIDS virus, malaria, syphilis and in other cases bacteremia. Even if the blood did not contain living pathogenic bacteria, there may be complicated pyogenic reactions like rigor, pyrexia, severe shock etc. In the event of death due to pyogenic reaction there will be

sub-endocardial hemorrhage in the septum of heart and straining of non-pathogenic bacteria in the kidney network.

Transfusion of excess volume: It may cause two risks like A) Overloading of heart, B) Pulmonary edema.

Transfusion of haemolysed blood: The effects are more or less same as in case of transfusion of mismatched blood. The danger of transfusion of haemolysed blood originates due to transfusion of improper preserved blood and when haemolysis occurs due to over cooling or overheating.

Air embolism: During transfusion, air embolism may occur under positive pressure entrance of minimum 60-100 ml of air may be serious.[5] In case of septal defects of heart chambers, very less amount of air may be dangerous.

Other complications

Metabolic alkalosis can occur with massive blood transfusions due to the breakdown of citrate stored in blood into bicarbonate. **Hypocalcaemia** can also occur with massive blood transfusions due to formation of the complexes of citrate with serum calcium.[6]

Blood transfusion associated with hemorrhage

Transfusions with large amounts of red blood cells due to severe hemorrhage or transfusion inefficacy, can lead to an inclination for bleeding due to disseminated intravascular coagulation, along with dilution of recipient platelets and coagulation factors.[7]

Transfusion associated volume overload

It is a common complication, red cell transfusions can lead to volume overload, due to repeated transfusion of insufficient efficacy of blood products. Plasma transfusion is especially prone to cause volume overload due to its hypertonicity.

Hypothermia

Can occur with large quantities of blood transfusions which are normally stored at cold temperatures. Core body temperature becomes down as low as 32°C and can produce physiologic disturbances. Prevention should be done by warming the blood to ambient temperature prior to transfusions.

Blood doping: It is often used by athletes, drug addicts or military persons for increasing physical stamina or simply to remain active and alert during the duty times respectively. However, a lack of knowledge and insufficient experience can turn a blood transfusion into a sudden death. When frozen blood sample is directly transfused this cold blood rapidly reaches the heart, where it disturbs the cardiac rhythm leading to cardiac arrest and sudden death.[8]

DISCUSSION

In emergency conditions blood transfusion is a lifesaving procedure. There are various ways of blood transfusion like whole blood transfusion, component blood transfusion etc. Each and every patient must be assessed for severity of blood loss and blood transfusion product should be selected accordingly. Before transfusion one must carry out proper investigations like blood grouping, typing etc., to prevent complications of blood transfusion. Blood transfusion should not be given to a patient who does not consent for the same.

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