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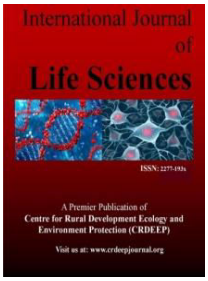

Review Paper

Preliminary Review on Blood Transfusion- A Crucial Therapy to save lives

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ABSTRACT

Blood transfusion is the process of transferring blood products into one's circulation intravenously. Transfusions are used for various medical conditions to replace lost components of the blood. Early transfusions used whole blood, but modern medical practice commonly uses only components of the blood, such as red blood cells, white blood cells, plasma, clotting factors, and platelets. This is usually done as a lifesaving maneuver to replace blood cells or blood products lost through severe bleeding, during surgery when blood loss occurs or to increase the blood count in an anemic patient.

Introduction

A blood transfusion is a way to give blood to someone who needs it. Some people may need blood if they have anemia or lose blood after surgery. The person who receives blood is called the recipient. The person who gives blood is called the donor.

Why blood transfusion is done

Someone with cancer may need a blood transfusion for different reasons. Cancers that involve the bone marrow, such as leukemia, can affect how blood cells are made and mature. This can lead to low blood cell counts. Other cancers, such as digestive tract cancers, can cause bleeding that can lead to anemia. Cancers that affect organs that help maintain blood levels, such as the kidney or spleen, can also affect blood cell counts.

Cancer treatments, including many chemotherapy drugs, can affect blood cells in the bone marrow and cause low blood cell counts. Radiation therapy given to a large part of the skeleton or to the pelvic bones can affect the bone marrow and lead to lower blood cell counts. People who have a stem cell transplant receive large doses of chemotherapy, radiation therapy or both. These treatments destroy the blood-making cells in the bone marrow. These people commonly have very low blood cell counts for 10–20 days after the transplant and may need transfusions of blood products.

Blood transfusions may also be used to treat:

- a sudden loss of blood during or after surgery
- a low hemoglobin level before, during or after surgery
- severe heart or lung disease
- diseases that affect blood cell production such as sickle cell anemia and aplastic anemia

Types of blood transfusions

Blood is made up of different parts, or components. These components include plasma, red blood cells (RBCs), white blood cells (WBCs) and platelets. A blood transfusion may give whole blood, which includes all of the components of blood. A transfusion may also give only part of the blood.

1. *Plasma transfusion*

Plasma is the liquid part of blood that carries the blood cells. It contains many proteins and minerals that help the blood clot. It also carries other components that support the body's immune system.

A fresh frozen plasma transfusion can be given to people who have bleeding disorders, certain types of cancer or liver diseases. It may also be given after bone marrow or stem cell transplants or certain operations in which blood loss is significant. There are 2 main types of plasma transfusion.

2. *Cryoprecipitate transfusion*

Cryoprecipitate is a product made from plasma. It is given to replace several blood-clotting factors. A cryoprecipitate transfusion may be used if certain conditions lower the blood-clotting factors. An example of such a condition is hemophilia, which is when the factor VIII component is missing from the blood. A cryoprecipitate transfusion may also be used if fibrinogen is lowered. Fibrinogen is a major component of blood that helps it clot. Occasionally, people with cancer are given cryoprecipitate if they are bleeding.

3. *Gamma globulin (intravenous immunoglobulin) transfusion*

Gamma globulin is a protein in the blood that acts like an antibody to defend the body against infection. Gamma globulin can be extracted from the plasma. It is sometimes given to people with certain blood-related diseases, such as chronic lymphocytic leukemia (CLL), who have very low gamma globulin levels. Very low levels of gamma globulin can lead to a higher risk of some types of bacterial infections or bleeding.

4. *Red blood cell transfusion*

Red blood cells (RBCs) are made in the bone marrow. They carry oxygen to and carbon dioxide from tissues in the body. RBCs contain hemoglobin, which is a protein that carries oxygen and gives blood its red colour. People who have a low red blood cell count, or anemia, may need a red blood cell transfusion. Bleeding due to trauma, surgery or certain diseases may cause a low RBC count. An RBC transfusion is usually given when a person's RBC count or hemoglobin level is low enough to cause symptoms such as dizziness, fatigue or shortness of breath.

5. *White blood cell transfusion*

White blood cells (WBCs) help the body fight infection and diseases. WBC transfusions are rarely given. They are usually reserved for people who have a low WBC count, called leukopenia or neutropenia, and a severe infection that doesn't respond to antibiotics. Instead of transfusing WBCs, doctors commonly give growth factors. These drugs help the body make its own white blood cells. Different types of growth factors help the body make different types of white blood cells. Granulocyte colony-stimulating factors (G-CSFs) help the body make granulocytes. Granulocyte-macrophage colony-stimulating factors (GM-CSFs) help the body make granulocytes and macrophages. Filgrastim (Neupogen) and pegfilgrastim (Neulasta) are examples of G-CSFs. Sargramostim (Leukine) is an example of a GM-CSF.

6. *Platelet transfusion*

Platelets help blood clot. A low platelet count is called thrombocytopenia. A platelet transfusion may be needed if the bone marrow doesn't make enough platelets because of cancer or cancer treatments. It is used to treat a low platelet count or may be given if there is a risk of bleeding due to surgery or other procedures. Sometimes platelet transfusions are not needed when the platelet count is low but there are no signs of bleeding.

Preparing the blood

Blood products used in transfusions are treated in special ways to make them safe and try to prevent reactions. Human leukocyte antigen (HLA) is a protein found on the surface of WBCs and platelets. HLA typing is done before a blood transfusion to make sure that the donor's blood matches the recipient's. HLA-matched blood products are taken from a single donor rather than a number of donors.

Blood products may be treated with radiation before they are transfused. Radiation doesn't affect red blood cells or platelets. But it stops WBCs from functioning. WBCs are part of the immune response. When they don't work properly, there is a lower chance of fevers and chills. There is also a lower risk that the recipient will have a reaction to the transfusion. Special blood filters may also be used when collecting or transfusing the blood product. These filters help remove WBCs. This process is called leukocyte reduction.

Getting a blood transfusion

A blood transfusion is given through tubing connected to a needle or fine tube (catheter) that's in a vein. The amount and part of the blood transfused depends on what the patient needs.

First, blood tests such as a **complete blood count** (CBC) are done to find out if the patient's symptoms are likely to be helped by a transfusion. A CBC measures the levels of components within the blood such as red blood cells, white blood cells, and platelets. Tests of clotting (coagulation) may also be done if abnormal bleeding is a problem. If a transfusion is needed, it must be prescribed by a health care provider. At that point, more blood tests must be done to find a donated blood component that closely matches the patient.

Before a blood transfusion

If you need a blood transfusion, you will have a blood test to find out your blood type and Rh factor. There are 4 blood types: A, B, AB or O. The Rhesus (Rh) factor is an antigen that is on the surface of some red blood cells. If the Rh factor is present, the blood type is described as Rh positive. If the Rh factor isn't present, it's described as Rh negative.

The healthcare team takes precautions before a transfusion is given to prevent a reaction to the blood product. They cross-match the donor's blood to check that it matches, or is compatible with, the recipient's blood type. The healthcare team carefully checks the blood product to make sure the right type of blood is given to the right person.

Before a transfusion, you may be given acetaminophen (Tylenol, Atasol) and antihistamines such as diphenhydramine (Benadryl). These drugs help prevent reactions.

Blood types

Blood types are important when it comes to transfusions. If you get a transfusion that does not work with your blood type, your body's immune system could fight the donated blood. This can cause a serious or even life-threatening transfusion reaction. To be sure no mistakes are made, donated blood is carefully tested to find out what type it is. This is done when it's taken from the donor and again once it's received by the hospital lab. The blood bag is labeled with the type of blood it contains. When a person needs a blood transfusion, a blood sample is drawn from them and tested the same way.

All blood has the same components, but not all blood is the same. People have different blood types, which are based on substances called antigens on a person's blood cells. The 2 most important antigens in blood typing are called A, B, O, and Rh.

- Each person has **an ABO blood type – either A, B, AB, or O** – which means antigen A, antigen B, both antigens (type AB), or neither antigen (type O) is found on their blood cells.
- Each person also is **either Rh-positive or Rh-negative** (you either have Rh or you don't).

These 2 factors can be combined into 8 possible blood types:

A positive	B positive	AB positive	O positive
A negative	B negative	AB negative	O negative

ABO blood types

Two antigens on blood cells (A and B) determine a person's ABO blood type (either A, B, AB, or O). In the United States, the most common blood type is O, followed closely by type A.

- If you have type O blood, you can only get type O red blood cell transfusions. But you can give your red blood cells to people with type A, B, AB, or O blood, which is why you are sometimes called a **universal donor**. (Universal donor blood cells are typically only used in emergencies. For example, if a person is bleeding severely and nearing death, there may no time for testing. In everyday practice, people in the US are almost always given the exact same type of red blood cells that they have.)
- If you have type A blood, you cannot get either type B or AB red blood cells.
- If you have type B blood, you cannot get type A or AB red blood cells.
- If you have type AB blood, you can get transfusions of O, A, B, or AB red blood cells.

Rh factor

Blood is either Rh-positive or Rh-negative, depending on whether the red blood cells have Rh antigens on their surface. A person who has type B, Rh-positive blood is called **B positive**, whereas a person with type B, Rh-negative blood is **B negative**.

If you have Rh-positive blood, you can get Rh-positive or Rh-negative red blood cell transfusions. But people with Rh-negative blood should only get Rh-negative red blood cells except in extreme emergencies. This is because an Rh-positive blood transfusion can cause a person with Rh negative blood to make antibodies against the Rh factor, causing a transfusion reaction (discussed below). If an Rh-negative woman makes antibodies like this, it can seriously harm any Rh-positive babies she may have in the future. Her anti-Rh antibodies can attack Rh-positive blood cells in the foetus.

Other antigens

There are other antigens on red blood cells that can lead to transfusion reactions. These are rare because people don't make antibodies against them unless they have had transfusions before. Still, these antigens may become a factor in matching blood for a person who has had many transfusions in the past, as is the case for some people with cancer.

Plasma, platelets, cryo, and blood type

Blood types are also important for plasma transfusions, but the rules are different than the rules for red blood cells transfusions. For example, people with type AB blood are universal plasma donors, and they can only receive type AB plasma. For platelet and cryoprecipitate transfusions, matching the blood type of the donor to the recipient is usually not critical, but labs still try to match them. This may become important for patients who have already had many transfusions or who have reacted to transfusions in the past.

Antibodies and cross-matching

After blood is typed, a test called an **antibody screen** is done to see if a patient's plasma contains other antibodies besides those against A, B, and Rh. If there are extra antibodies, the cross-matching may take longer. This is because some units of donor blood may not fully match the recipient's, even though they have the same ABO and Rh types.

Before a person can get a transfusion of red blood cells, another lab test called a **cross-match** must be done to make sure that the donor blood is compatible with the recipient's.

A unit of the right ABO and Rh type blood is selected, and a drop of donor red cells from the unit is mixed with a drop of plasma from the patient. The mixture is watched to see if the patient's plasma causes the donor blood cells to clump. This may happen if the patient has extra antibodies to a protein in the donor unit. If there are no problems (no clumping), a cross-match takes about 30 minutes.
A cross-match is usually not needed for a platelet or plasma transfusion unless the platelets look like they could contain some red blood cells.

During a blood transfusion

Once the blood is correctly matched, the transfusion is given. A special cream called EMLA may be used to numb the area where the needle will be inserted. An intravenous (IV) needle attached to a tube (catheter) is inserted into a vein in your hand or arm. This will feel like a prick or pinch. The IV is taped carefully in place.

A bag of specially selected and matched blood or blood products is hung on a pole and the catheter is attached to the bag. The blood travels from the bag, through the IV and into the blood vessels. Most of the time, people don't feel any discomfort when the blood goes in. The blood is refrigerated, so it may feel a little cold.

During the transfusion, the nurse will monitor your temperature, blood pressure and heart rate. The nurse will also watch for any rash or signs of an allergic reaction. The transfusion will usually takes 2–4 hours, depending on how much blood is needed.

After a blood transfusion

The healthcare team usually does blood tests after the transfusion to check blood cell counts and your response to the transfusion.
They will give you further instructions, if needed. This may include resting after the transfusion.

Possible risks of blood transfusions

Although blood transfusions can be life-saving, they are not without risks. Infections were once the main risk, but they have become extremely rare with testing and donor screening. Transfusion reactions and other non-infectious problems are now more common than infections.

When you are getting a transfusion of any kind, it's very important that you let your nurse know right away if you notice any changes in how you feel, such as itching, shivering, headache, chest or back pain, throat tightness, nausea, dizziness, trouble breathing, or other problems. You should report any changes that happen in the next few days, too.

Side effects of blood transfusion

Transfusion reactions

Blood transfusions sometimes cause **transfusion reactions**. There are several types of reactions and some are worse than others. Some reactions happen as soon as the transfusion starts, while others take several days or even longer to develop.

Many precautions are taken before a transfusion is started to keep reactions from happening. The blood type of the unit is checked many times, and the unit is carefully matched to be sure that it matches the blood type and Rh factor of the person who will get it. After that, both a nurse and blood bank lab technician look at the information about the patient and the information on the unit of blood (or blood component) before it's released. The information is double-checked once more in the patient's presence before the transfusion is started.

The following are some side effects that can occur with blood transfusions.

1. *Fever*

A fever may develop after a blood transfusion. Chills, a headache or nausea may also develop with the fever. These symptoms can be caused by a reaction between the recipient's immune system and cells in the donor blood. When this happens, doctors may stop the transfusion and give a fever-reducing medicine. When the temperature is back to normal, the transfusion can usually continue.

2. *Allergic reaction*

Allergic reactions can occur during a blood transfusion when the recipient's immune system responds to proteins in the donated blood. These reactions include hives or itching. In rare cases, a blood transfusion can cause anaphylaxis. Anaphylaxis is a severe, sometimes life-threatening allergic reaction.

If an allergic reaction occurs, the transfusion is stopped and the person is given allergy medicines, including antihistamines and steroids. If the reaction is mild, the transfusion can start again. If the reaction is more serious, the healthcare team may take other steps before the transfusion can begin again.

3. *Hemolytic reaction*

Hemolytic reactions sometimes occur when the donor's and recipient's blood types do not match. The recipient's antibodies attack the transfused red blood cells, causing them to break down, or hemolyze. When they break down, the RBCs release harmful substances into the blood. The recipient can develop a fever, chills or chest and lower back pain. This reaction can be mild or more severe. If severe, a hemolytic reaction can result in kidney damage and even death.

4. *Transfusion-related acute lung injury (TRALI)*

TRALI is an immune system reaction to substances in the transfused blood. This reaction damages lung tissue and causes swelling in the lungs, or pulmonary edema. TRALI may be immediate, which means it happens right away. It can also be delayed, which means it develops some time after a blood transfusion. TRALI is a rare but dangerous complication that causes difficulty breathing. Treatment may include giving oxygen. Some people may be put on a ventilator to help them breath.

5. *Graft-versus-host disease (GVHD)*

Graft-versus-host disease (GVHD) occurs when the white blood cells in the donor's blood see the recipient's cells as foreign and start to destroy them. This reaction may cause damage to the skin, intestines and liver. There is no specific treatment for this complication. Treating the blood or blood products with radiation stops WBCs from working and will help prevent this complication.

6. *Infectious diseases*

The blood supply in Canada is extremely safe because blood is tested for infectious organisms and potential donors are carefully screened. There is a very small chance that an infectious disease may be transmitted through a blood transfusion. This may include diseases caused by bacteria, parasites or viruses. Examples of infectious disease that can be transmitted through blood transfusion include hepatitis and cytomegalovirus (CMV), which is a type of herpes that can affect different organs in the body. The human immunodeficiency virus (HIV), which causes acquired immune deficiency syndrome (AIDS), can also be transmitted through blood.

7. *Circulatory overload*

Circulatory overload occurs when the recipient's circulatory system has too much blood or blood products in it. It can cause breathing distress and heart failure. Circulatory overload is more likely to occur in infants, people over 60 years old and those with long-standing anemia or heart problems. It is usually treated by stopping the transfusion, giving oxygen and using a medicine to lower the plasma volume.

8. *Air embolism*

An air embolism occurs when an air bubble blocks a blood vessel. This can occur when a bubble of air enters the blood vessel during blood transfusion. If the air reaches the heart, it can't pump properly to circulate the blood. Treatment includes supportive measures, such as oxygen, mechanical respirator, medicine to help maintain circulation and removing the air bubble.

9. *Isolated hypotensive episode*

Hypotension is low blood pressure. Blood pressure may drop suddenly and rapidly soon after a blood transfusion starts. Catching hypotension early, stopping transfusion and treating symptoms usually return the blood pressure to normal.

10. *Iron overload*

Iron is present in red blood cells. It can build up if repeated blood transfusions are given. Too much iron can damage the heart, liver and endocrine organs such as the pituitary gland, pancreas, ovaries and testicles. Iron overload is usually treated with a chelating agent. Chelating agents bind to the iron and make it water soluble so the body can more easily break it down and pass it in urine.

11. *Post-transfusion purpura*

Sometimes, platelet antigens in the donated blood can break down platelets in the recipient's blood. If the number of platelets is greatly lowered, it can cause abnormal bleeding. When blood vessels under the skin are damaged, purplish patches called purpura can form. Post-transfusion purpura is a delayed immune system reaction that may occur 5–10 days after a blood transfusion. This complication is prevented by transfusing blood that is free of platelet antigens.

12. *Metabolic changes*

Metabolic changes may occur with massive or rapid transfusion. They include citrate toxicity, lowered body temperature and higher potassium levels in the blood.

Sodium citrate is added to the blood as it is being collected during a blood donation. This chemical stops blood from clotting in the transfusion bag. The liver can usually metabolize sodium citrate. But when large volumes of blood are transfused, citrate toxicity can occur. This includes low levels of calcium and magnesium.

Hypothermia is a lowered body temperature. It may occur when large amounts of cold blood are transfused quickly. Hypothermia can be prevented by slowing the rate of blood transfusion or warming the blood before transfusion.

Hyperkalemia is a high level of potassium in the blood. It may result from rapid or massive blood transfusions, especially in infants. The healthcare team will monitor the recipient closely and will stop the transfusion if hyperkalemia occurs.

Conclusion

A blood transfusion is a common, safe medical procedure in which healthy blood is given to you through an intravenous (IV) line that has been inserted in one of your blood vessels. Blood transfusions replace blood that is lost through surgery or injury or provide it if your body is not making blood properly. You may need a blood transfusion if you have anemia, sickle cell disease, a bleeding disorder such as hemophilia, or cancer. For people in critical condition, blood transfusions can be lifesaving.

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