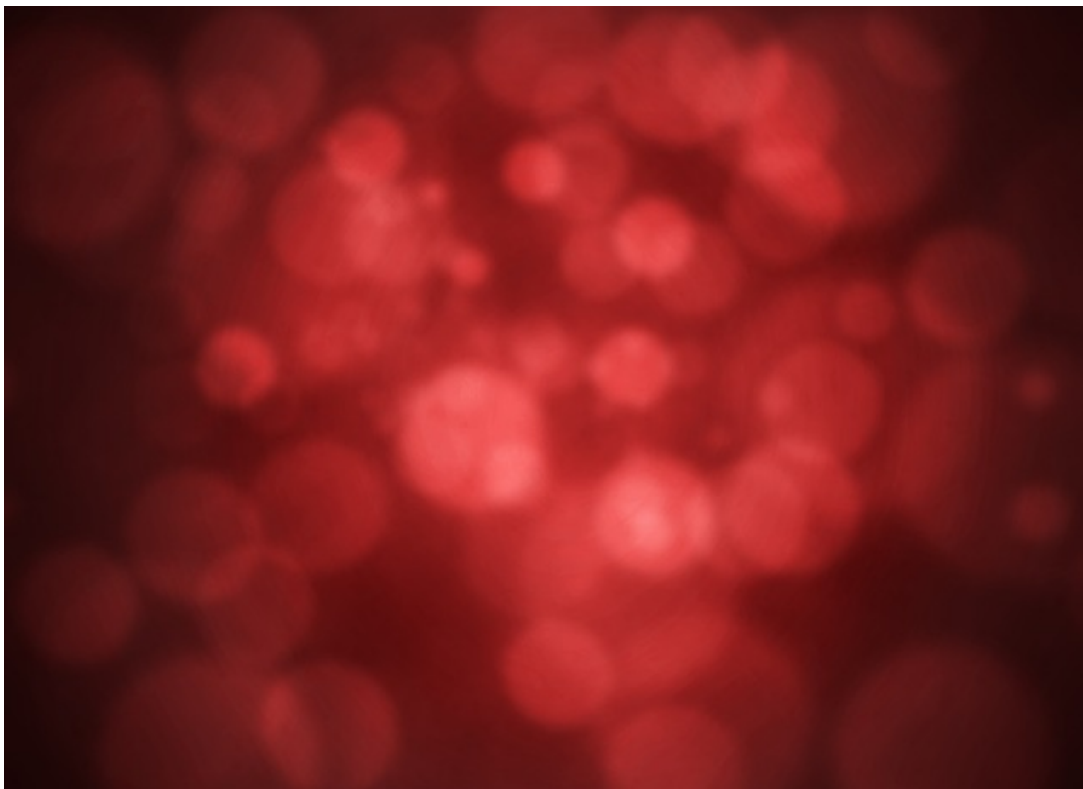


## Blood Transfusion: ABO and Rh Blood Group System

[See online here](#)

**Blood transfusion is a common and safe procedure where blood and/or blood products are transferred from the circulation of one person (known as a donor) to the circulation of another person (known as a recipient) or to the circulation of the patient himself (autologous transfusion) at a different time. It helps to replace blood loss following trauma, surgery, or hematologic illnesses, e.g., leukemia.**



### Overview

Depending on the indication, a transfusion may involve either:

- Whole blood.
- Packed red blood cells.
- Fresh frozen plasma
- Platelets concentrate
- Cryoprecipitate

**Although life-saving, a blood transfusion can be associated with acute and delayed complications.**

### Various products have different indications as follows:

- **Whole blood** that is preferred in acute transfusion where massive volume replacement is needed.
- **Packed red blood cells:** used for routine transfusion.
- **Fresh frozen plasma:** indicated for bleeding diathesis where all clotting factors are needed.
- **Platelets concentrate:** administered for blood loss in the setting of thrombocytopenia.
- **Cryoprecipitate:** made up of fibrinogen and factor VIII thus considered in the setting of hemophilia and von Willebrand disease.

## Indications for a Blood Transfusion

1. Hemorrhage following accidental trauma, e.g., car crashes, fractures, war or following surgery, e.g., cardiac surgery
2. Hematologic diseases, e.g., severe Iron deficiency anemia, leukemia, Thalassemias, Aplastic anemia, Sickle cell anemia
3. Bleeding diathesis, e.g., thrombocytopenia, hemophilia

## ABO System of Blood Transfusion

**Each red blood cell (RBC) in humans expresses ABO blood group antigens.** These antigens are also expressed by other cells in the human body. The function of the ABO antigens is unknown, but they are clinically significant because they are extremely reactive.

The **immune system forms antibodies against the ABO antigen which is absent on an individual's RBC.** As seen in the accompanying table, an individual with Group A antigens will have anti-B antibodies, while an individual with Group B antigens will have anti-A antibodies. Serum of individuals with Group O has anti-A as well as anti-B.

Genotype	Blood group	Antigen on RBC	Antibodies in serum
AA/AO	A	A	Anti-B
BB/BO	B	B	Anti-A
AB	AB	A and B	None
OO	O	Anti-A and Anti-B	OO

## Rh System of Blood Transfusion

The Rh or rhesus antigen is expressed only on the RBC membrane and helps to maintain its integrity. These antigens may carry the D-antigen (RhD) or C or c antigen (RhC or Rhc). An **absence of the Rh antigen may lead to an alteration in the shape of the RBC with increased fragility**, decreased lifespan on the RBC and mild **hemolytic anemia**.

In addition, there is an **increased risk of transfusion reactions** in these patients due to the production of Rh antigens which are highly reactive. Usually, IgG antibodies are formed against the Rh antigens and anti-D, anti-C and anti-c have all been associated with hemolytic disease of the newborn (HDN) and delayed hemolytic transfusion reactions.

# Complications of Blood Transfusion

Complications of blood transfusion can be classified as acute and delayed. Each of these can be further classified as infectious and non-infectious.

**Acute complications are defined as those occurring within minutes to up to twenty-four hours after a blood transfusion.**

Delayed complications can occur within days, months or years following a blood transfusion.

## Non-infectious complications

These are more likely compared to infectious complications as there have been fewer advances in preventing these. Some of these are discussed in more detail below.

### Acute

- Hemolytic reaction
- Allergic reaction
- [Anaphylaxis](#)
- [Disseminated intravascular coagulation](#) (DIC)
- Febrile non-hemolytic reaction
- Bacterial infection
- Circulatory overload
- Transfusion-related acute [lung](#) injury (TRALI)
- Transfusion errors

### Delayed

- Delayed hemolysis
- Iron overload
- Microchimerism
- Post-transfusion purpura
- Undertransfusion or excessive transfusion
- Graft versus host disease related to transfusion
- Transfusion-related immunomodulation

## Infectious complications

Due to the advances in screening tests prior to blood transfusion, the **incidence of infectious complications has decreased drastically**. e.g., [Hepatitis B](#), Hepatitis C, HTLV 1 and 2, [HIV](#), [Creutzfeldt-Jakob disease](#), Human [herpes](#) virus 8, [Malaria](#), Babesiosis, West Nile virus and [Influenza](#) (pandemic form).

### Acute

**Hemolytic reaction:** Usually occurs within 24 hours of the transfusion and can be either due to immune or non-immune causes. Immune causes include ABO incompatibility, Rh incompatibility and are due to antibodies produced following sensitization during a previous pregnancy or transfusion.

**Non-immune causes include improper storage, bacterial contamination, infusing along with non-compatible medications** or through small-bore intravenous tubes. It is clinically characterized by:

- Fever
- Chills
- Nausea
- Vomiting
- Hypotension
- Dyspnea
- Oliguria
- Anuria
- Diffuse bleeding progressing to disseminated intravascular coagulation
- [Renal failure](#)
- Death

Acute allergic reactions can be mild, e.g., [hives](#) or pruritus or severe, e.g., anaphylaxis. **Individuals with IgA deficiency are prone to anaphylaxis** (seen within 15 minutes of transfusion) as they may have circulating anti-IgA which reacts with donor IgA in the transfused blood.

HLA (anti-human leukocyte antigen) antibodies and anti-complement antibodies have also been associated with anaphylactic reactions. Anaphylaxis can be prevented by washing the RBCs and platelets in donor blood prior to transfusing IgA deficient individuals.

**TRALI (Transfusion-related acute lung injury):** Occurs within six hours of transfusion and is characterized by noncardiogenic pulmonary edema with severe [hypoxemia](#). Anti-HLA, anti-neutrophil cytoplasmic antibodies (ANCA) and activated pulmonary neutrophils all contribute to the activation of the recipient's immune system leading to the development of [pulmonary edema](#).

**Acute febrile non-hemolytic reaction:** Is defined as an increase in body temperature by a minimum of 1.80 F over normal body temperature within 24 hours of a blood transfusion. It is **a diagnosis of exclusion and is characterized by rigors, chills and severe discomfort**. It is more commonly seen with platelet transfusions and the removal of white blood cells (leukoreduction) from donor blood which is associated with decreasing its incidence.

**Circulatory overload:** Rapid transfusion can lead to this complication. It is commonly seen in patients who have the pre-existing cardiopulmonary disease, chronic renal failure, chronic anemia, or in the elderly. Typical clinical features include:

- Cough
- Dyspnea
- Elevated central venous pressure
- Pulmonary capillary wedge pressure with hypertension
- Tachycardia

Elevated levels of brain natriuretic peptide help to confirm the diagnosis. It **can be prevented by transfusing slowly in patients known to have cardiac or renal disease** and can be treated with diuretics.

### Delayed

Graft versus host disease can occur in patients with a history of solid organ malignancies, Hodgkin's disease, or following intensive chemotherapy or erythroblastosis fetalis. It is characterized clinically by:

- Fever

- Rash
- Diarrhea
- Pancytopenia
- Hepatic dysfunction within one to six weeks following a blood transfusion

It is fatal in the majority of the affected patients. It **can be prevented by irradiating the blood products to prevent the donor lymphocytes from proliferating.**

## Use of red cell transfusions

They are given for anemia – typically if hemoglobin is < 80 g/l. If the patient is not making any red cells they will need transfusion every 3 weeks. Over the long term, a problem becomes the accumulation of iron. The major concern is that the ABO system is matched.

## Use of fresh frozen plasma

This is generated by taking the plasma off a blood donation and freezing it until it is needed. It contains clotting factors and is often used for patients with blood clotting disorders. It has no value as a blood volume expander.

## References

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