International Journal of Nursing and Health Research
www.nursingjournal.in
Online ISSN: 2664-6420, Print ISSN: 2664-6412
Received: 21-06-2024, Accepted: 22-07-2024, Published: 07-08-2024
Volume 6, Issue 2, 2024, Page No. 25-30

Blood transfusion

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Abstract
Paediatric blood management is underlined by the basic principles of maintaining haemoglobin concentration, optimizing haemostasis, and minimizing blood loss. This article explores these principles and details further the management of iron deficiency in children. Transfusion of red cells is necessary in certain situations and this article explains calculations, practicalities of blood transfusion and consent, as well as the management of major haemorrhage.
There is evidence in the adult population that anaemia is associated with poorer post-operative outcomes, longer hospital length of stay and higher mortality.4 There is now a growing body of evidence that the same is true of the paediatric population; pre-operative anaemia in children is associated with worse peri-operative outcomes as well as an increase in mortality.5 The presence of anaemia pre-operatively is also associated with an increase in requirement for red cell transfusion in theThe emphasis during this phase is on the use of tranexamic acid, good surgical haemostasis and the use of cell salvage when appropriate. These are discussed in detail below. This is often not practical and the volumes collected in the paediatric population will often not be sufficient for processing.18This is an important factor to consider throughout the peri-operative journey. Minimizing losses through a considered approach to diagnostic laboratory testing must be employed as well as the use of non-invasive techniques and point-of-care testing for the monitoring of haemoglobin.2 This is particularly important in small infants.
This is a point-of-care test that provides a rapid result for the haemoglobin. The system consists of micro-cuvettes which contain reagents. Blood is placed in the micro-cuvette and a portable photometer determines the haemoglobin. It is possible that the result obtained is different from the true haemoglobin, provided two samples are taken and are analysed and the results are close then significant errors are unlikely.25speed of result – available within 45–60 seconds. In a stable child undergoing non-cardiac surgery, without major co-morbidity or ongoing blood loss, a threshold of 70 g/litre should be used. This restrictive transfusion practice has no association with an increase in adverse outcomes and is associated with reduced blood use.13 Decisions to transfuse should also anticipate any further drop in haemoglobin, especially if frequent monitoring is not possible. In children undergoing cardiac surgery with non-cyanotic heart disease a restrictive. As with all aspects of good medical practice, the individual needs of the patient must be considered. As outlined previously, in children undergoing elective surgery, a pre-assessment service allows for appropriate preparation prior to surgery. This provides the opportunity to ensure that all aspects of patient blood management are considered preoperatively and allows for these considerations be discussed and shared with children and their families. The consideration of blood transfusion and Given the differing size in paediatric patients, from the neonate with a potentially extremely low birth weight to the teenager, it is clear that one size does not fit all; measurements in units of blood clearly will not suffice. We must therefore calculate a volume to transfuse appropriate to the size of the patient. The below calculation helps us to do this:Volume to transfuse (ml) = (Desired Hb (g/litre) – Actual Hb (g/litre)) × Weight (kg) × Factor/10A factor of 4 is often used (but may be Major haemorrhage Trauma is one of the most common causes of death in children and young people, most notably in the age groups 1–4 years and 10–19 years.29 The management of major trauma has developed considerably over the past 20 years and the development of dedicated trauma centres with standardization of the approach to trauma has improved outcomes significantly.

Keywords: Agglutinin, agglutinogen, air embolism, donor, hemolysis, hypertonic, isotonic, hypotonic, incompatibility, recipient, transfusion

Introduction

A blood transfusion is a safe, common procedure in which blood is given through an intravenous (IV) line in one of the blood vessels. Blood transfusions are required to replace the blood loss, for example, in trauma, acute gastrointestinal hemorrhage or during surgery, anemia haematamisis, leukemia, burns or a serious injury, etc. A transfusion also may be done if your body can't make blood properly because of an illness.

Historical facts regarding the first blood transfusions

In 1818, Dr. James Blundell, performed the first successful blood transfusion of human blood, for the treatment of postpartum hemorrhage. H e used the client's husband as a donor, and extracted four ounces of blood from his arm to transfuse into his wife. He also invented many instruments for the transfusion of blood. In 1840, Samuel Armstrong Lane, aided by Dr. James Blundell, performed the first successful whole blood transfusion to treat hemophilia. Blood transfusions can be grouped into three main modalities which are as follows:-

Homologous transfusion: These are the transfusions using the stored blood of others.

Autologous transfusion: These are the transfusions using the client's own stored blood. Transfusion of plasma expanders and blood components.

The procedure usually takes 1 to 4 hours, depending on how much blood you need. Blood transfusions are very common.

Each year, almost 5 million Americans need a blood transfusion Blood is made up of various parts, including red blood cells, white blood cells, platelets (PLATE-lets), and plasma. Blood is transfused either as whole blood (with all its parts) or, more often, as individual parts.

Definitions

- Blood transfusion is the intravenous administration of the whole blood or a component such as plasma, packed red blood cells or platelets to a patient.
- **According to medical dictionary:** Blood transfusion may be defined as the administration of whole blood or a component, such as packed red cells, to replace blood lost through trauma, surgery, or disease.

- **According to WHO:** Blood transfusion is the transfer of blood or blood components from one individual (donor) to another (recipient). A blood transfusion can be a life-saving procedure, and health services are challenged to maintain an adequate supply of safe blood, and to ensure that it is used appropriately.

- **Related anatomy and physiology:** Blood makes up 70% of body weight (about 5.6 liters in a 70 kg man). This proportion is less in women and considerably greater in children, gradually decreasing until the adult level is reached. Blood in the blood vessels is always in motion because of the pumping action of the heart. The continual flow maintains a fairly constant environment for the body cells. Blood volume and the concentration of its many constituents are kept with in narrow limits by homeostatic mechanisms.

Composition of blood: Blood is composed of a straw-colored transparent fluid, plasma, in which different types of cells are suspended. Plasma constitutes about 55% and cells about 45% of blood volume.

Plasma: The constituents of plasma are water (90 to 92%) and dissolved substances, including:

- Plasma proteins – albumins, globulins, clotting factors and fibrinogen.
- Inorganic salts.
- Nutrients, principally from digested foods.
- Waste materials.
- Hormones.
- Gases.

Cellular content of blood: There are three types of blood cells.

- Erythrocytes (red cells)
- Platelets (thrombocytes)
- Leukocytes (white cells).

Blood groups

Human blood is classified into four main groups. (A, B, AB, O) based on the type of antigens (agglutinogens) present in the erythrocytes, as well as the type of antibodies (agglutinins) present in the plasma.

Table 1: Blood groups and their respective antigens

Group	Agglutinogens in the red cells	Agglutinins in the plasma
AB	A and B	No agglutinins (-)
A	A	Beta agglutinins(b)
B	B	Alpha agglutinins(a)
O	No agglutinogens	Both alpha and beta(ab)

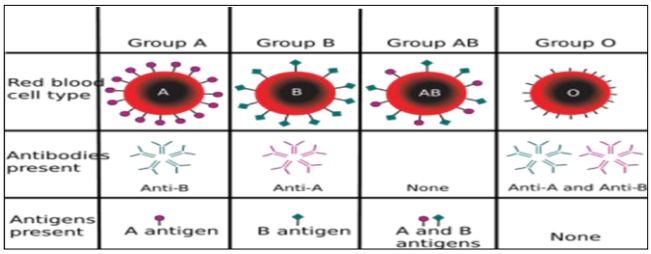

Fig 1

The hemolytic reactions: - When similar agglutinogens and agglutinins come in contact with each other, agglutination (clumping) and hemolysis (rupture) of the red cells occur. This produces a fatal response, called hemolytic reaction. In order to avoid hemolytic reaction in blood transfusion, the blood cells of the donor are cross-matched with the plasma of the recipient and the plasma of the donor with the cells of the recipient. If no agglutination is taking place, the blood is said to be compatible.

Purposes

- To increase client's hematocrit and hemoglobin for improved circulation and oxygen distribution.
- To increase circulating blood volume.
- To increase the number of red blood cells.
- To provide plasma proteins and clotting factors to help in controlling bleeding.
- To combat infection due to decreased or defective white cells or antibodies.
- To restore the blood volume when there is sudden loss of blood due to hemorrhage.
- To improve the leucocytes count of blood as in agranulocytosis.

Indications

- **Blood-loss:** It is sufficient to cause supine hypotension (blood loss more than 500 ml), for example, in trauma, fracture, haematemesis, lower gastrointestinal bleeding, haemoptysis, major surgery, gynecological operations, ante partum and postpartum hemorrhage.

- **Symptomatic anaemia:** For example, hypoxia, hypoxic encephalopathy, obtunded sensorium, heart failure, emergency procedures, operation on several anemic patients, septicemia, thalassemia major, several wound infection.

- **Bleeding disorders:** For example, hemophilia, massive burns, leucopoenia.

- **Exchange transfusion:** For example, Rh incompatibility in fetus, severe plasmodium falciparum malaria, hepatic coma, etc.
- **Diseases:** Liver disease, kidney disease or cancer etc.

General instructions

Selection of the donor

1. Donor shall be free of diseases of heart, kidneys, lungs, liver etc.
2. There should not be any history of cancer, jaundice, hepatitis, tuberculosis, allergies or any transmissible diseases.
3. They have not donated blood within the previous 90 days.
4. They should be physically healthy, and should be between 18 and 65 years of age with an average height and weight.
5. Donor must have a normal temperature, pulse and blood pressure
6. They must not have been pregnant within the last 6 months.
7. Their Hb level must be above 12 mg/dl.
8. Before the blood is transfused, the donor's blood must be cross matched with the recipient's blood.
9. Blood should not be collected empty stomach.

Collection, storage and transportation of blood

1. Collection of blood from the donor is done in the laboratory by the lab technicians.
2. Blood should be collected into a sterile container containing anticoagulant solution (ACD solution – Acid citrate dextrose) or citrate phosphate dextrose.
3. Each donor unit must be labeled in clear, readable letters, bearing the following information to be verified at the time of administration:
   a. Name of the donor.
   b. Donor number.
   c. ABO grouping.
   d. Rh typing.
   e. Date of drawing blood.
   f. Date of expiry.
   g. Result of tests for hepatitis and syphilis etc.
4. Donor's blood, immediately after it is withdrawn, should be placed in the refrigerator. Usually it is stored at 1 to 6 degree Celsius
5. Stored blood shall be inspected daily and prior to use for evidence of hemolysis or bacterial contamination
6. The transportation of the blood in the hospital should be done within 30 minutes after it is taken from the place of storage. If blood is kept in the room temperature, the temperature of the blood will rise above 10 degree Celsius in 30 min. if the blood is not used, it should be returned to the refrigerator within half an hour
7. When blood is transported to distant places, use pre-cooled insulated bags to keep the temperature of the blood below 10 degree Celsius
8. Freezing and heating of blood will destroy the blood cells.

Regarding administration of blood

Blood must be properly grouped and cross-matched (ABO and Rh). Blood should have been aseptically collected and stored. When sending blood for cross matching and grouping, it must be carefully labeled with the following identifications: recipient's name, hospital name, bed number, ward number etc.

1. Blood should have been stored to the right temperature (4 degree Celsius). It must not be outdated (21 days).
2. Inspect the supernatant plasma. It must be clear. Pink plasma suggests hemolysis in the bottle. There should not be clots in the blood.
3. Blood should be warmed at 35 degree Celsius before transfusion.
4. It should be administered with a transfusion set having a filter.
5. Blood should be tested for AIDS.
6. Blood should be administered after informed consent is obtained.
7. The physician's order for transfusion should specify blood component, volume, and rate of infusion.
8. It should be checked by two registered nurses.
9. Use 18 gauge needles for infusion, to prevent damage to the red cells and to provide an adequate rate of flow.
10. No medication should be added to the unit of blood, as they damage the red cells.
11. Once the blood is exposed to the atmosphere (the unit is opened), it should be discarded.
12. Keep the patient warm and comfortable with blanket if necessary.
13. The whole procedure usually takes about 2 to 4 hours, depending on how much blood is needed.

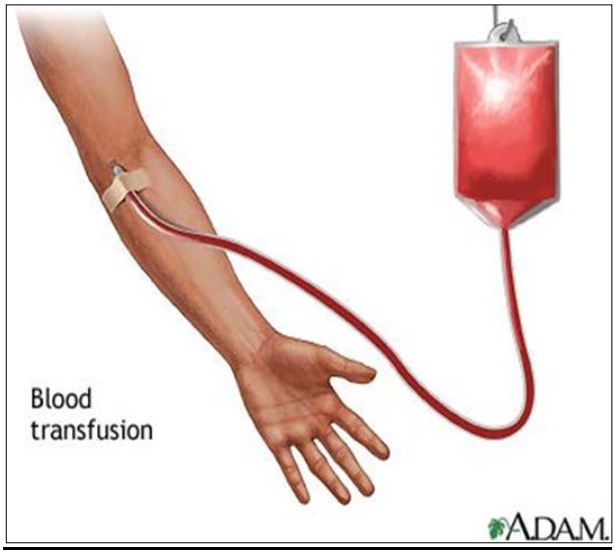

Fig 2

Procedure
Articles required

Table 1

Artıcles	Rationale
A tray containing: - A blood transfusion set. - A mackintosh and a towel. - A tourniquet. - Cotton swabs with antiseptic (spirit). - Adhesive tape and scissors. - Gloves. - A kidney tray/ a paper bag. - I/V stand. - Normal saline. - Blood or any of its components with cover received from the blood bank with the name of the recipient. - Flow sheet for vital signs. - Order sheet for blood.	- To transfuse blood. - To protect the blood. - To constrict the blood vessel. - To clean the site of insulin. - To secure the tubings and needle. - To prevent infection. - To discard the waste. - To hold the blood bottle. - To start the blood transfusion line. - To make sure that the blood sent from blood bank is meant only for this particular patient. - To check any reaction. - To avoid mistake.
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To avoid mistake.	
To transfuse blood.	

Explain the procedure to the patient, blood products which are to be given, length of time and desired outcome of the transfusion.

- Determine whether the patient has undergone prior transfusion and reaction, if any.
- Get an informed consent from the patient / relative.
- Provide a comfortable position.
- Prior to administration of blood, the patient's vital signs should be recorded correctly on the nurse's record to provide a baseline data for further information.
- Offer the bedpan before starting the procedure, if necessary.
- Ask the patient to report chills, headaches, itching or rash immediately so that prompt reporting and discontinuation of transfusion can help in minimizing reaction.

Assessment: -Assessment should focus on the following:

- Baseline vital signs.
- Skin status (e.g. rash).
- Doctor's order for type, amount, and rate of blood administration.
- Size of IV catheter or need for catheter insertion.
- History of blood transfusion and reactions, if any.
- Religious or other personal objections to client's receipt of blood.
- Compatibility of client to blood.

Table 2

Nursing ACTION	Frequency
Patient instruction/review: procedure and s/s reaction	Once: before transfusion
Blood Label check/Blood Band and Patient ID in the presence of the patient	Once: Immediately before transfusion

Vital signs	Baseline (< 15 min. pre transfusion) 15 min. after the start of the transfusion. At completion of transfusion plus PRN if s/s reaction occur
Rate	Initial Rate not to exceed a total infused volume of greater than 50ml in the first 15 min. Remainder of transfusion: PRN to maintain desired rate
Assessment for s/s reaction s/s reaction include: (but not limited to) ▪ chills or fever (increase of > 1ºC from baseline ▪ hives ▪ sudden severe back pain or headache ▪ dyspnea ▪ erythema ▪ sudden abdominal pain	▪ Constant for the first 15 min. ▪ Every 30 min. throughout transfusion ▪ At completion of transfusion If s/s reactions are noted, stop the transfusion immediately and follow steps outlined for transfusion reaction. ▪ Delayed reactions may occur.
Tubing and filter change	24 hours after initiation if the line stays connected with the IV site.

After care of the patient

- Replace all the articles.
- Wash them and make them dry.
- Keep them back at their place.
- Give comfortable position to the patient.
- Set the unit as before.
- Record and report the procedure.
- Check vital signs of the patient after 15 min. for 1st half an hour.
- Check for any transfusion reaction.
- Stay with patient.

Complications of blood transfusion

Table 3: Mild reactions

Signs	Symptoms	Possible cause	Immediate Management
Urticaria/ Rashes	Pruritis	Allergic	- -Stop transfusion - -Assess the client - -Antihistamine may be required. - -Transfusion may be restarted if no signs/symptoms are present.

Table 4: Immediate adverse effects of transfusion and their management

Signs	Symptoms	Possible cause	Immediate Management
▪ Urticaria ▪ Flushing ▪ Rigors ▪ Fever ▪ Restlessnes ▪ Tachycardia	▪ Anxiety ▪ Pruritis ▪ Palpitation ▪ Mild dyspnea ▪ Headache	▪ Allergic febrile non hemolytic transfusion reaction ▪ Antibodies to white cells or platelets and/or proteins possible contamination with pyrogens and/or bacteria.	Stop transfusion and maintain I/V line with normal saline. Contact medical officer. Client may require antihistamine and/or paracetamol. Further investigation and management according to the clinical features. If investigation required complete the transfusion reaction form and send blood pack, form and samples to the blood bank.

Table 5: Life threatening reactions

Signs	Symptoms	Possible Cause	Immediate Management
▪ Rigors ▪ Fever ▪ Restlessness ▪ Hypotension ▪ Tachycardia ▪ Dark Urine ▪ Unexplained bleeding	▪ Anxiety ▪ Chest pain ▪ Pain at infusion site ▪ Respiratory distress ▪ Low back pain ▪ Headache ▪ Dyspnea	▪ Acute intravascular hemolysis ▪ Bacterial contamination and septic shock ▪ Fluid overload ▪ Anaphylaxis ▪ Transfusion related to acute lung injury	Stop transfusion and maintain I/V line with normal saline.Contact medical officer Manage immediate needs: ▪ Fluid for hypertension ▪ Oxygen administration ▪ Adrenaline for anaphylaxis ▪ Diuretic for fluid overload ▪ Complete transfusion reaction form and send blood pack. Form and samples to the blood bank. ▪ Further management according to the physician.

Nurse's role

- Observe the patient closely for the first ten minutes of transfusion. Since these reactions occur very rapidly, the rate of flow should be minimal.
- Discontinue the blood immediately when reaction is assessed.
- Inform the physician and implement treatment as prescribed.
- Inform the laboratory to do grouping and cross matching of the blood. The donor blood is sent back to the lab and the specimen of the recipient's blood is re-tested to confirm the diagnosis.

- Maintain 5% glucose or saline using a new IV set. Large quantities of fluid are given to promote diuresis and to counteract shock.
- Monitor vital signs every 15 minutes to assess shock and collapse.
- Record the fluid intake and output to assess the degree of kidney functions.
- Oxygen inhalation is given to relieve dyspnea.
- Reduce patient's anxiety with reassurance.

Refrences

1. Delmar s. "Fundmental and Advanced Nursing Skills" publisher Altman Gaylene, 2000.
2. Tnai. "Fundamentals of Nursing" publisher secretary general, 2009.
3. Perry Potter. "Fundamentals of Nursing" 6th edition, publisher Elsevier, 2008.
4. Sr Nancy. "Principle and Practice of Nursing" 6th edition, publisher N. R. publishing house, 2008.
5. KM Musallam, *et al*. Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study Lancet, 2011.
6. HC Sullivan, *et al*. The pillars of patient blood management: key to successful implementation (Article, p. 2840) Transfusion, 2019.
7. S Goobie, *et al*. Society for the advancement of blood management administrative and clinical standards for patient blood management programs. 4th edition (pediatric version) Paediatr Anesth, 2019.
8. Sabm Administrative and clinical standards for patient blood management programs®. 4th edition, 2018.
9. D Faroni, *et al*. Relationship between preoperative anemia and in-hospital mortality in children undergoing noncardiac surgery Anaesth Analg, 2016.
10. Centre for Perioperative Care Guideline for the management of anaemia in the perioperative pathway, 2022.
11. World Health Organization. Anaemia in women and children. Available at: Anaemia in women and children (who.int)
12. M Munoz, *et al*. International consensus statement on the peri-operative management of iron deficiency and anaemia Anaesthesia, 2017.
13. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity, 2011.
14. Association of Paediatric Anaesthetists of Great Britain and Ireland Best Practice Guidance: Preassessment services for children undergoing surgery or procedures.