Original Research Paper

Volume -10 | Issue - 4 | April - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Haematology

USE OF BLOOD AND ITS COMPONENTS FOR CLINICIANS AND INTRAVENOUS THERAPISTS: (A REVIEW)

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ABSTRACT Blood transfusion can be a life saving intervention.However, like all treatments it may result in acute or delayed complications and carries the risk of transfusion transmissible infections. The safety and effectiveness of transfusion depends on two key factors. 1.A supply of blood and its components that is safe and accessible at reasonable cost and adequate to need national needs. 2. The appropriate clinical use of blood and its components.Blood and its components are an important part of patient management protocols and like drugs have property to cause adverse reactions in the recipients. However, it is in its judicious use that lays its real benefit.

KEYWORDS :

Important steps in the administration of blood components start with the correct identification of the patient and cross match and end with the collection of the right blood to the right patient at the right time. Each step is important and must be subject to written procedures and quality management. Processes must be in place to ensure that all the steps are adhered to and any divergence from procedure is corrected. All staff must be trained and familiar with the procedure which should be regularly updated. Any breakdown in procedures should be investigated and corrected even if the recipient of the transfusion is unharmed (1) Blood transfusion can be fatal if administered incorrectly. Errors most frequently occur in: 1, patient identification. 2, sampling /labeling of the pre-transfusion specimen.3, removal of blood from the blood refrigerator before transfusion, checking the identification of both the patient and the blood component at the bed side. Written policies/protocols must exist. Stafftraining to implement these policies is critical. Each institution should have or participate in a local transfusion committee. (2)The administration of blood and its components involves more than 70 steps and each of these may be subject to error. (3)Utilization of Standard protocols for the administration of blood to minimize the potential for error. These protocols should be in place in each institution and should conform to standard practice as outlined in these guide lines. A Quality management system should exist in each institution(4)This should include an active transfusion committee, a process to correct protocol and practice when deficiencies are identified in local and regional audit and in the national hem vigilance program.

Blood transfusion is an essential part of modern health care. Used correctly it can save life and improve health. However, the transmission of infectious agents by blood and blood products has focused particular attention on the potential risks of transfusion. The different constituents of blood are defined asunder :(5)

- Whole blood: un- separated blood collected into an approved container containing an anticoagulant preservative solution.
- Blood product: Any therapeutic substance prepared from human blood.
- Blood component: A constituent of blood separated from whole blood such as red cell concentrate, red cell suspension, plasma, platelet concentrate, plasma or platelets collected by aphaeresis, cryoprecipitate prepared plasma rich in factor viii and fibrinogen.
- Plasma derivative Human plasma proteins prepared under pharmaceutical manufacturing conditions such as Albumin, coagulation factor concentrate, immunoglobulin

The WHO has developed the fallowing integrated strategies to promote global blood safety and minimize the risk associated with transfusion. (2, 5)

- The establishment of nationally coordinated blood transfusion services with quality system in all areas.
- The collection of blood only from voluntary non-renumerated blood donors from low risk populations.
- The screening of all donated blood for transfusion-transmissible infections, including the HIV, hepatitis virus, syphilis, and other infectious agents and good laboratory practice in all aspects of blood grouping, compatibility testing, component testing, component preparation, storage and transportation of blood and blood components.
- The reduction in unnecessary transfusion through the appropriate clinical use of blood and blood components and the use of simple alternatives to transfuse, wherever possible.

Recent changes in the diagnostic methods, therapy and utility of medical products have revolutionized the spectrum of many diseases; similarly significant progress has been made in the technology of blood component preparation and storage. Each unit of whole blood appropriately separated and fractionated can now provide red blood cells, platelets, fresh frozen plasma, stored plasma (plasma depleted of some of the labile clotting factors), cryoprecipitate, factor VIII, albumin, gamma globulin and factor IX concentrate (containing factors II, VII, IX and X). Additionally, other products, such as specific hyper immune gamma globulin preparations, are available to prevent certain infections and specific sensitization (e.g., hemolytic disease of the newborn). Because these blood components are readily available for patient care, the physician can select a blood component appropriate to patient's specific needs, thereby avoiding many of the hazards associated with the use of whole blood. The goal of modern transfusion therapy is to provide appropriate replacement therapy with blood components as opposed to whole blood for patients with specific hematologic deficiencies. A prerequisite of component therapy is, therefore, correct identification of the deficiency. Appropriate use of component avoids many of the hazards associated with the use of whole blood, and at the same time makes maximal use of this valuable resource. Blood components separated from whole blood soon after collection and appropriately stored can, in combination, provide all the factors present in fresh whole blood. Thus, the availability and appropriate use of the various blood products allows not only optimal transfusion therapy for each patient, but also fuller utilization of national blood resources. The blood component implies separation of whole blood into various potential components like packed red cells, platelet rich plasma, fresh frozen plasma, cryoprecipitate and leucocytes. All patients requiring transfusion should have a reliable access to safe blood products, including whole blood, labile blood components and plasma-derived medicinal products, appropriate to their clinical needs, provided in time and administered safely. Data on the use of blood products are limited, but studies suggest that blood products are often over prescribed in both developed and developing countries. (6)

In spite of the sophisticated blood banking services worldwide; indiscriminate use of blood components with either no indication or inappropriate indication continues. Various strategies have been developed to reduce the inappropriate use of blood components. These include guidelines and consensus conferences as well as monitoring of transfusion practice, education, and self-audit by clinicians.(5,7,8,)The clinical practice guidelines for the use of blood components aim to improve the consistency and appropriateness of

transfusion practice; promote the integration of quality management systems into transfusion practice ;reduce the overall number of transfusion-related complications; increase consumer awareness of the benefits and risks of blood component therapy; and conserve a limited resource.(3) This article is designed as a tool for clinicians and intravenous therapists for appropriate utilization of blood and its components.

A.Whole blood:

Unit of issue	One donation or one unit or one bag (450 ml)
Description	• One unit (450ml +63ml CPD-Adenine anticoagulant preservative)=513 ml • Hemoglobin average 12 gm % • Hematocrit 35%-45% • No functional platelets • No labile coagulation factors(V&VIII)
Infection risk	• Depends on donor status and screening method adopted, • risk of transmission of hepatitis,B&C,HIV, Syphilis,Malaria,Chagas disease,CMV
Storage	• Between +20C to +60Cin an approved blood bank refrigerator fitted with alarm and temperature chart • storage time 21 days
Indication	• Acute blood loss • Exchange transfusion in different medical conditions
Precautions	• Check cross match, screening status, heart failure, chronic anemia
Administration	• Must be ABO & Rh compatible • never add medication to any unit of blood • Blood transfused within half hour out of refrigerator • complete transfusion in 04 hours

B. Red cells concentrate: (packed red cells)

Description	• 150-200 ml red cells from which most of plasma has been removed • Hb average 20 gm% • Hematocrit 55%-75%
Unit of issue	One donation
Infection risk	Same as whole blood
Storage	Same as whole blood
Indication	• Replacement of red cell in anemic patients • Use with colloid replacement fluid or colloid solution in acute blood loss
Administration	To improve flow in drip set 50-100 ml normal saline may be added using Y pattern infusion set in blood bank

C. Red cell suspension:

Description	• 150-200 ml red cells with minimal residual plasma to which SAG-M(normal saline,adenine, glucose, manitol) or equivalent red cell nutrient solution has been added • Hemoglobin average 15 gm % • Hematocrit 50%-70%
unit of issue	One donation
Infection risk	Same as whole blood
Storage	Same as whole blood extended time storage 42 days
Indication	Same as red cell concentrate
Contraindication	Not advised for exchange transfusion of neonates
Administration	Same as whole blood, flow rate is better than red cell concentrate no need to add normal saline

D. Leukodepleted red cells:

Description	A red cell suspension or concentrate containing <5x10 white cell per pack,prepared by filtration through leukocyte depleting filter 2.Hemoglobin concentration and hematocrit depends on whether the product is whole blood,red cell concentrate or red cell suspension 3.leucocyte depletion significantly reduces the risk of transmission of cytomegalic virus (CMV)
Unit of issue	One donation
Infection risk	Same as whole blood but minimizes for CMV
Storage	
Indications	• Minimize white cell immunization in patients receiving repeated transfusions, to achieve this all blood &blood components used should be leukodepleted • reduces CMV risk in immunosuppressed and transplant patients • patients who have experienced two or more febrile reactions to red cell transfusion
Contraindication	Will not prevent graft vs host reaction: for this purposes blood & component should be irradiatedwith (radiation dose 25-30Gy)
Administration	Same as whole blood
	A leukocyte depleting filter may also be used when leukodepleted blood or blood product is not available
Alternative	• buffy coat removed whole blood or red cell suspension is usually effective in avoiding non hemolytic febrile reaction • The Buffy coat is expressed out under sterile environment (UV hood)in the blood bank before transportation • start and completion of transfusion are same as whole blood

E. Platelet concentrates (prepared from whole blood donation):

Description	Single donor unit in a Volume of 50-60ml of plasma should contain • at least 55x109 • <1.2x109 red cells • <0.12x109
Unit of issue	May as supplied as • Single donor unit plate let prepared from one donation • unit: platelets prepared from 4-6 donor units pooled into one pack to contain an adult dose ofat least 240x109 platelets
Infection risk	• Same as whole blood • Bacterial contamination affects about 1% of pooled units
Storage	• Up to 3-5 days with continuous agitation in platelet agitator at 200C to 240C • Donot store at 20C to 60C • Longer period storage if collected in specialized platelet packs • Longer storage increases the riskof bacterial proliferation and sepsis in the recipient
Indication	• Non immune thrombocytopenia • Platelet functional defects • Critical Immune thrombocytopenia with active bleeding
Contraindications	• Not used as prophylactic for bleeding in absence of thrombocytopenia • Not used in ITP active bleeding and critical thrombocytopenia • Thrombotic thrombocytopenic purpura(TTP) • Untreated disseminated intravascular coagulation • Thrombocytopenia with hypersplenism • Thrombocytopenia in sepsis unless sepsis is treated
Dosage	• One unit of platelet concentrate /10 kg body weight, • 4-6 single donor unit containing at least 240x109/L (should raise the platelet count by 20-40x109/L • Increment is lessif there is splenomegaly,DIC or sepsis
Administration	• Platelet oncentrate should be infused within 4 hrs to prevent bacterial contamination and infusion should finish in 30 minutes • Should not be refrigerated before infusionas it reduces platelet function

	• Special infusion sets not required • Donot infuse platelet concentrate from RhDpositive donor to aRhD negative female recipientwith child bearing potential • Give platelet concentrate that are ABO compatiblewhenever possible
Complication	Febrile non hemolytic reaction and allergic urticarial reactions are not uncommon

F. Platelet concentrate (collected by plateletpheresis):

Description	Volume 150-300ml Platelet content 150 x 500x109 Platelet content, volume of plasma and leukocyte concentration depend on collection procedure
Units of issue	One pack containing platelet concentrate collected by a cell separator device from a single donor
Infection risk	Same as whole blood
Storage	Up to 72 hours at 200C to240C(with continuous agitation) in platelet agitator device.(do not store at 20C to 60C)
Indications	Same as plate let concentrate
Dosage	One pack of plate let concentrate collected from asingle donor by apheresis is usually equivalent to one therapeutic dose equal to 06 units of plateletrich plasma
Administration	Same as recovered platelets, but ABO compatibility is more important: higher titre anti A or anti B in the donor plasma used to suspend the platelets may cause hemolysis of the recipient's red cells

G. Fresh frozen plasma:

Description	• Pack containing the plasma separated from one whole blood donationwithin 6 hrs of collectionand then rapidly frozen to -250or colder • Contains normal plasma levels of stable clotting factors,albumin and immunoglobulin • Factor VIII level at least 70% of normal fresh plasma level
Unit of issue	• Usual volume of pack 200-300 ml • Smaller volume packs for children
Infection risk	• Same as whole blood • Very low risk if treated with methylene blue /ultraviolet lightinactivation
Storage	• At -25 0C or colder for up to one year • Before use should thawed in blood bank in water at a temperature between 300C -370C. • Higher temperature destroys clotting factors and proteins • Once thawed should be stored in are refrigerator at 20C to 60C • Once refrigerated should not be stored at frozen state
Indication	• Replacement of multiple coagulation factor deficiency in : liver disease,warfarin overdose,use of large volume transfusion(for every 5 units blood give one FFP) • Disseminated intravascular coagulation (DIC) • Thrombotic thrombocytopenic purpura (TTP)
Precautions	• Acute allergic reactions are not uncommon,especially with rapid infusions • Occasional anaphylactic reactions • Should not be used as volume expander
Dose	15 ml /Kg
Administration	• Must normally be ABO compatible to avoid hemolysis in recipient • No computability testing required • Infuse with a standard blood infusion set as soon after thawing • Labile coagulation factors rapidly degrade ;use within 6 hours of thawing

H. Liquid plasma:

Description	• Plasma separated from whole blood and stored at +40C • no labile coagulation factors

I. Virus inactivated plasma:

Description	• Plasma treated with methylene blue/ultraviolet light inactivation to reduce the risk of HIV,hepatitis B&C • the cost of this product is considerably higher than conventional fresh frozen plasma
Infection risk	Inactivation of parvovirus B19 and hepatitis A is less effective

J. Cryoprecipitate:

Description	• Prepared from fresh frozen plasma by collecting the precipitate formed during controlled thawing at +40C and resuspending it in 10-20ml plasma • Contains about half of the factor VIIIand fibrinogenin the donated whole blood:e.g. factor VIII 80-100iu/pack;fibrinogen:150-300mg/pack
Unit of issue	Usually supplied as a single donor pack or a pack of 6 or more single donor units that have been pooled
Infection risk	Same as whole blood but a normal adult dose involves at least 6 donor exposures
Storage	At -250C or colder for up to one year
Indication	• As an alternative to factor VIII concentrate in the treatment of inherited deficiency of : von will brand factor, Factor VIII deficiency (hemophilia A)factor XIII • As a source of fibrinogenin acquired coagulopathies:e.g. DIC
Administration	• If possible use ABO compatible product, no compatibility testing required • After thawing,infuse as soon as possible through standard blood administration set • Must be infused within 6 hrs of thawing

Despite this ready availability of all blood components and fractions there is lack of uniformity of approach to blood transfusion therapy. To maximize the effectiveness, safety and utility clinicians and intravenous therapists should be knowledgeable about the potential risk of blood component therapy.

Therefore, the clinician should keep in mind the appropriate indication for ordering blood components there by avoid misuse and unnecessary exposure of the recipient to various infectious and non-infectious complications. The future advances and developments in use of different blood components will be subject of next communication(part ii).

REFERENCES:

1. Voak D,Chapman JF,and Philips P.Quality of transfusion practice beyond the blood transfusion laboratory is essential to prevent ABO –incompatible death. Transfusion Medicine 2000; 10:95-96
2. Guidelines for the administration of blood components; Members of the national blood users group
3. McClelland DBL,McMenamin JJ,Moore's HM, BarbaraJAJ,Reducing risk in blood transfusion: process and outcome.Transfusion Medicine1996; 6:1-10
4. Blood safety in European community:an initiative for optimal use. Conference proceedings. Europeancommission, 2000.ISBN3-00-005705-6conclusions and Recommendations.3-7
5. The clinical use of blood,hand book,world health organizationblood transfusion safety Geneva 2001
6. World Health organization,Blood transfusion safety,safe and rationale use of blood. URL;http://www.emro.who.int/programmeareas blood safety.hmt
7. Rationale use of blood products,European j of cancer.2001:37(18):2421-2425
8. Blood component transfusion guidelines for transfusing physicians.Hand book of blood banking and transfusion medicine. Jaypee brothers medical publishers Ltd, New Delhi, 2006, p122-145