Blood transfusion

Blood is the most biological therapy ,however remain therapeutic procedure involving a risk.

Blood transfusion never be ordered or given unless it is worth the risk .KARL LANDSTEINER.

The principles of WHO and ISBT of blood transfusion:

1-Blood donation shall in all circumstances be voluntary.

2-Blood transfusion is a community responsibility rather than individual responsibility.

3-financial profit should never be a motive for the donor or for those collecting blood.

4-The donor should sever no harm.

5-Blood components never harm the recipients.

Measures to protect the blood donor

A- ***Selection of donor fit for blood donation.***

1-Good medical history and physical examination.

2-identification of full name, address ,and telephone.

3-Age of donor between 18—65 year old.

≤18 year ;High risk of iron deficiency anaemia with low hemoglobin level, from increase iron for increase body mass in addition for normal physiological needs.

≥ 65 year; increase incidence of donation accidents ,from increase risk of diseases of elderly (cardiovascular diseases).

4-Sex : Both sex can give blood put not from lactating and pregnant women(due to increase incidence of iron deficiency anemia).

(12 month after normal weaning time to accept blood donation)

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5- Body weight more than 50 kg for both sex.

6-Pulse rate 50—100 PPM and regular .

7-Blood pressure ; systolic 80—180 mmHg . diastolic 50—100 mmHg

8- Minimum hemoglobin level :Male 13.5g!dl(N. value 12.5—17.0 g!dl). Female 12.5g!dl(n. value 11.5-15.5 g!dl)

(each pint of blood increase or decrease total hemoglobin 2 grams .

(2 ml whole blood or 1 ml packed red blood cells contain 1 mg iron ,and one pint whole blood ,450±50 ml contain 200 mg iron).

9- Volume of blood taken per donation =450±50 ml blood.

10- Donation intervals ;3 month in USA(four donation ! year)

4 month in UK (three donation ! year).

B- *Prevention of unwanted complications during or post veinsection. They are:*

1-Early fainting (2—5% of donation , mostly in young and those with first donation)

2-Delayed fainting; more serous and contraindicated for donation

Drivers should not return to work on day of donation.

3- Nausea and vomiting.

4-Hematoma at site of veinesection.

5-Convulsion from Brain hypoxia.

6-Cardiac arrhythmia.

Measures to protect the Recipient (patient) of blood transfusion

1) Selection of healthy donor for healthy blood from blood born diseases.

2) post donation laboratory work (investigation of donated blood);

a-ABO blood group and Rh –d phenotype.

b-HBsag, HB Anb, HC Anb, HIV Anb, syphilis.

c- screening for the presence of irregular antibodies in donor with previous blood transfusion, multiple pregnancy, organ transplantation.

3) Pretransfusion laboratory work (compatibility investigation)

a-Rechecking blood group of donated selected blood and patient(recipient) blood.

b- Blood compatibility test (in vitro) to avoid in vivo incompatibility.

c-Screening for irregular antibodies by direct and indirect Coombs test, especially for patients with multiple transfusion, organ transplantation, multiple pregnancy ,autoimmune diseases

4) Closed observation through process of transfusion for expected complication of blood transfusion.

1) Selection of healthy donor for healthy blood

This is through donor accept ion or donor exclusion or deferral permanently or temporarily .

Permanent deferral (rejection); Donor from ;

1- AIDS group (abnormal sexual behavior ,drug abuser, tattwing).

2-History of viral hepatitis (A, B, C).

3-Malignancy, convulsion, chronic sever diseases, hematologic and non hematlogic diseases.

4-Transfusion dependent patients , sickle cell disease, abnormal bleeding tendency

Temporary deferral ;

a-3 years ; residence in area endemic for malaria.

b- 1 year ; sever illness and vaccination.

c-6 month ; close contact with hepatitis patients (A, B, C),tattoo, blood recipient, surgical history, infection with intracellular bacteria, Herpes viruses and rotavirus infection.

d- 3 month ; cold ,flue, any febrile illness .

e- 72 hours ; use of drugs (insulin, antibiotics, aspirin), last attach of asthma.

f- donation intervals(to avoid risk of iron deficiency).

Red Blood Cells Immunology

Blood groups antigens

Blood groups antigens or called cells phenotypes are carbohydrate molecules bound to the cells surface membrane proteins in the (red cells, white blood cells ,and platelets). They interact with naturally occurring antibodies like (ABO system) or stimulate the production of antibodies in recipient of blood like (Kell, Kids and Duffy on red blood cells ,and leukocytes antigens , platelets antigens, and plasma proteins antigens).

Approximately 400 rbc antigens have been recognized ,however the most important well known are 14 system . Each system inherited on specific genes on its specific chromosomes.

The most clinical important blood group systems are (ABO, Rh, Kell, Duffy, Kidd, Lutheran, Lewis, P, MN, Li, Diego, colton, Xg).

The arrangements of red blood cells antigens based on their clinical significance which based on the following;

1- The frequency of the antigens on red blood cells membrane.

2-The frequency and the nature of corresponding antibodies.

3-The frequency of blood transfusion reaction might occur.

The ABO blood group system

a- The oldest known system discovered on 1900.

b- Consist of three allelic genes ,with six possible genotypes (OO,AA,AO,BB,BO.AB)

c- The A & B genes control the synthesis of A&B Ag, while the O gene is an a morph ,no OAg.

d- Consist of two major Ags (A & B), with minor basic substance (H antigen),with serological recognition of four phenotypes arranged in order of frequency O,A,B.AB.(46%,42%,9%,3% respectively).

The importance of ABO system

1- Every body over the age of 6 month has clinically significant naturally occurring antibodies found in the plasma corresponding to the lacking A&B antigens on red blood cells.

2-They complicate the most serious hemolytic transfusion reaction from blood incompatibility.

3-The Antigens not only present on red blood cells(cell bound) but can detected on most body cells including white blood cells ,and platelets and also found in soluble form in

secretions and body fluids, example; plasma, saliva, semen, tears, and sweat.

4- The antibodies are immunoglobulin M (IgM) react optimally at cold temperature, although reactive at 37 c, are called cold antibodies

5-The antibodies cannot cross the placenta and not cause hemolytic disease of newborns.

Rh-system; (Rh-D system)

Rhesus blood antigen system discovered on 1939 by Levine, following injection of human erythrocytes in Rhesus monkeys. The monkey developed specific Abs against human RBC. It become well known for its role in hemolytic anemia of newborns babies.

The Rh-system cell bound ,are five antigenic phenotypes(C,c,E,e,D) and the most important is Rh-D which mark the ABO phenotype with (+ or --).

Blood group Antibodies

The antibodies are immunoglobulin's either IgM or IgG circulating in the plasma against specific Antigens. depending on the antigenic stimulus they are divided into :

1- Allo-antibodies; produced by individual against another individual.

2-Auto-antibodies; produced by individual against his own cells.

3-Hetro- antibodies; produced against antigens of another species.

The first two types are of importance in transfusion medicine and the third one of typing reagent in ABO & Rh-D group and in anti-human globulin reagent that raised in animal against human globulin antigen.

Biology And Physical properties of Blood groups Antibodies

Two types of , natural antibodies and acquired antibodies.

Natural antibodies:

1-IgM type immunoglobulin

2- Produced without previous stimuli, so called natural.

3-They are best detects in age of 3-6 month of life ,and reach peak in young adult.

4-They should always investigated thoroughly .

5-they are cold reacting (maximum at 4c), however have wide thermal range even in 37c .

6- Responsible for the most serous transfusion reaction (called blood incompatibility).

7- Large size antibodies , so rarely by-pass the placenta to cause hemolytic disease of newborn

8- Strong Anti-A & Anti-b hemolysin present in sera persons with blood group O(Universal donor) make transfusion of group –O blood to non-O recipient should be strongly discourage

9- Pre transfusion testing require compatibility testing which consist of mixing and incubating the patient serum and donor red cells in vitro .

Immune antibodies (acquired or silent antibodies):

1-They are IgG type immunoglobulin

2-The called immune, irregular. Incomplete, or warm antibodies.

3- produced by immunization ,like blood transfusion ,pregnancy, and some are autoantibodies.

4-Mostly are warm reacting antibody(37c).

5- small size , capable of transplacental passage from mother to fetus.

6- Usually detected by indirect anti globulin test .

7- Most common example is the Rh-D antibody(anti-D).

Blood group serology

Blood groups serology includes the following;

1-The determination of blood cells phenotypes (ABO & Rh-D), by using of serum containing antibody reagents of known specify Like Ant-A, Anti-B, and Anti-D.

2-The screening for antibodies by using of cells of known phenotypes.

3-Compatibility testing: Mixing of patients serum against donor (RBC) of the selected group specific (ABO) pint of blood and observe for any signs of incompatibility like, strong hemolysis or any degree of agglutination.

Complications of blood transfusion

The overall incidence 2-5% and 50% of these are caused by ABO incompatibility.

Classification:

Transfusion complications classified into immunological and non-immunological and these are classified into early and delayed onset complications.

Early transfusion complications

1-Early immune transfusion reactions:

a- *Early immune hemolytic transfusion reaction*(Major hemolytic transfusion reaction):

result from reaction of natural antibodies in patient serum against red blood cells ABO Ag on donor blood with compliments fixation and sever intravascular reaction with release of donor red blood cells contents lead anaphylactic reaction with or without disseminated intravascular coagulopathy with multiple organ failure and patient death.

clinical features : occur within few drops to few milliliter of transfused blood up to few hours post transfusion. Clinical feature include patient discomfort, irritability, urticaria, lumber pain flushing, shortness of breath, vomiting, rigor, and hypotension. Renal tubular necrosis and oliguria.

Immediate measures;

1- stop blood transfusion and give proper ant allergic medication.

2- Rechecking for blood group of patient and donated blood.

3- repeat the cross-match.

d-perform a direct coombs test on post transfusion sample.

4- check the plasma urine sample for free hemoglobin.

5- check for any miss-labiling or clerical errors .

causes; clerical errors in the handling of donor or recipient blood sample for cross-match.

b- *early immune non-hemolytic febrile transfusion reaction:*

This is because of sensitization to antigens on leukocytes, platelets, and plasma proteins in patients with multiple pregnancy , previous transfusion or organ transplantation. The clinical features are pyrexia, urticaria, rigor, and dyspnia. Stop blood transfusion and check for possibility of mis-matched blood ,and give proper medication. Leukocytes filter and use of washed red blood cells is the best to avoid the reaction.

2-Early non-immune transfusion reaction

a-febrile transfusion reaction from bacterial contamination.

b-Post-transfusion circulatory overload, mostly occur in extreme of life (infancy, early childhood and elderly).

c- electrolytes disturbances; hyperkalaemia from stored blood and hyocalcaemia from massive transfusion with high dose of anticoagulant(citrate toxicity).

d- bleeding tendency due to massive transfusion of stored whole blood containing low platelets.

e-embolisms , mostly air embolism.

Delayed transfusion complications

1- delayed immune transfusion complication :

a-immune hemolytic anaemia ; low hemoglobin, jaundice, increase reticulocyte count, positive coombs test, and history of blood transfusion.

b-transfusion associated graft-versus-host disease.

2-delayed non immune complications:

a- infections : viral(hepatitis A,B,C, and others CMV, HIV), Bacteria(brucella and salmonella). Parasites (malaria and toxoplasmosis).

b-iron-overload: 200-250mg iron/ unit(450 ml) whole blood.