

Children are not just compressed adult: Special needs of pediatric patients

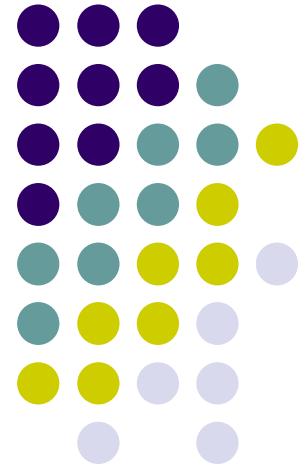


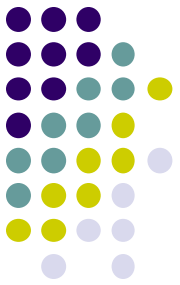
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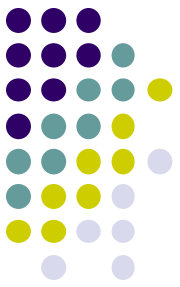
Definitions

- **British committee for Standards in haematology (BCSH) 2016**
 - Neonates : < 28 days
 - Infants : < 1year
 - Child : <16 years
- For the purpose of Blood Transfusion, child <4 months of age required similar consideration as a neonates

Outline of the topic



1. Uniqueness of Neonates and pediatric age.
2. Pre transfusion testing
3. Selection of different blood components
4. Special consideration



1. Uniqueness of Neonates & Pediatric age

a. Neonatal physiology



- Newborn has Limited blood volume, 70-80ml/kg of body wt
- Poor & delayed bone marrow response to compensate anemia
- Poor cardiovascular system to compensate anemia ,thus susceptible for dyspnoea
- Poor thermoregulation will become hypothermic with large blood amount
- Poorly tolerate K,lactate present in blood

b. Humoral immunity of neonate and infants

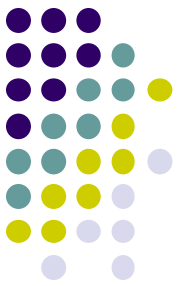


- Immune system is not fully developed and inresponsive to antigenic stimulation during first 4 months of age
- Not capable of producing alloantibodies when exposed to transfused red cells
- Antibody in a neonate are transferred through placenta.

c. Cellular immunity of neonate and infants

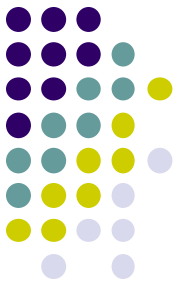


- Is also not fully developed especially in preterm infants
- Neonates are susceptible for transfusion associated GvHD following IUT, if irradiated products are not used , especially from first or second degree relatives as donors



2. Pre-transfusion testing for neonates & infants

Fetal and neonatal blood grouping



- differs from adult because
 - ABO group antigens in neonates are poorly expressed
 - Corresponding ABO red cell antibodies are usually not well developed
 - Neonatal plasma possess maternal ABO (IgG)antibody passed through placenta
 - Prophylactic Anti-D antibody also crosses the placenta

Ab screening of a neonate represents the screening of maternal Ab rather than the neonatal own Ab.

Pre-transfusion testing-1

< 4 months



Whenever possible ,samples from both mother and infant should be obtained for Initial ABO and Rh

Pre-transfusion testing-2

< 4 months



- **Investigation on Mother sample:**
 - ABO RhD
 - Screening of Irregular Antibodies (ICT)
- **Investigation on the Neonate sample**
 - ABO & RhD by cell group only
 - DCT on neonates red cells
 - Neonates serum for irregular Antibodies by ICT (In the absence of maternal serum)



Pre-transfusion testing-3

Algorithm in < 4 months

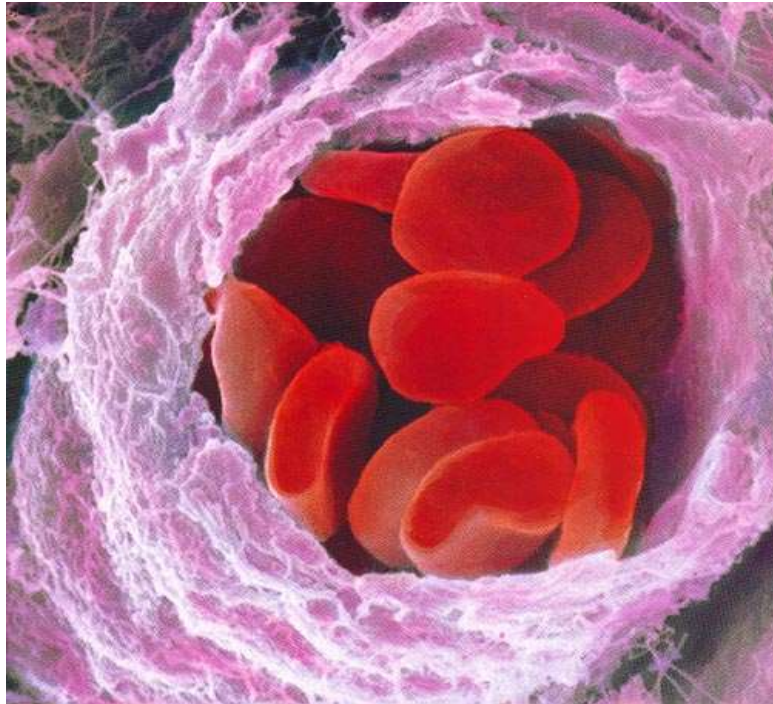
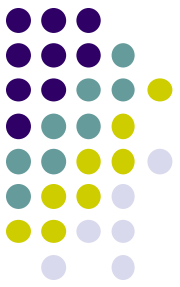
- DAT - ,Antbody screening –
No further serologic testing upto 4 months
- DAT + ,Ab -
- DAT + ,Ab +
- DAT - , Ab +

suggest HDN /passive transfer of prophylactic Anti D

Pre-transfusion testing-4 beyond 4 months



- pre-transfusion testing and compatibility procedures should be performed with extended red cell phenotyping or genotyping prior to transfusion
- as a minimum red cells should be matched for Rh (D, C, c, E, e) and K antigens.



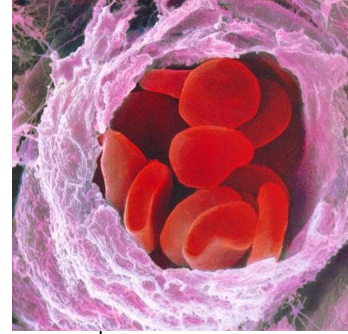
3. Blood and Blood components in neonates



Red cells <4 months

Rule 1:

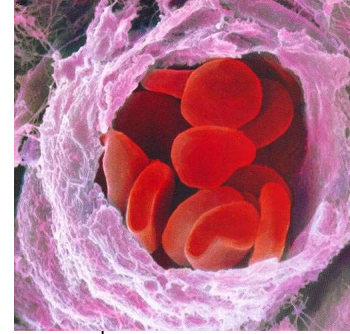
**Red cells should have same ABO
& Rh as of neonates or an
alternative compatible group**



Red cells <4 months

Rule 2:

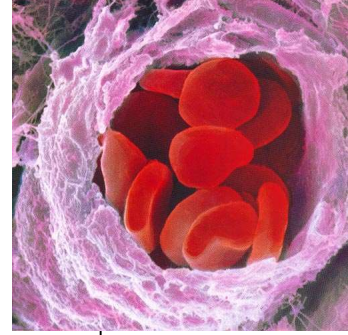
**Red Cells should be compatible
with antibody present in the
maternal plasma**



Red cells <4 months

Rule 3:

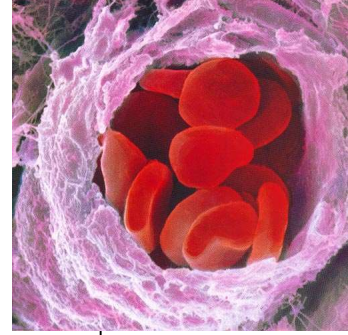
Group O red cells with low titre of Anti-A and anti-B can be given to neonate of any ABO group.



FFP/Plasma <4 months

Rule 1:

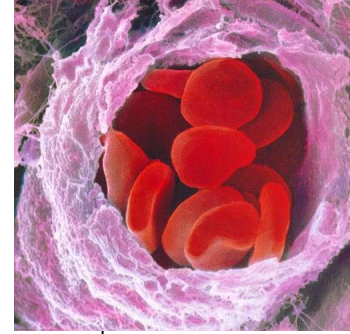
**Plasma should be compatible with
ABO of neonates**



FFP/Plasma <4 months

Rule 2:

Group O plasma should only be given to patients of group O, however group AB plasma can be given to neonates of any ABO Gr.



Platelets < 4 months

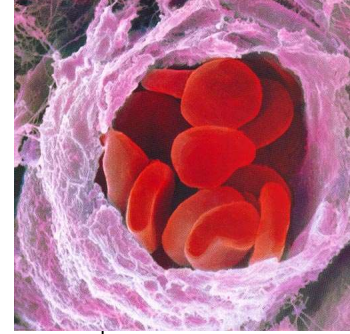
- Platelets sh. be of same ABO blood group wherever possible,
- but if necessary ,alternative groups (AB) platelets can be issued to all group recipients



FFP/Plasma <4 months

Rule 3:

D compatibility is irrelevant for FFP and cryoprecipitate due to negligible residual red cells



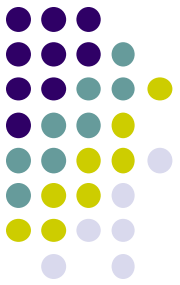
Platelets < 4 months

- D NEG recipients should not receive D POS. platelets because of the risk of allo-immunisation to the D antigen.
- If D-positive platelets are given in emergency , prophylactic anti-D should be considered if the recipient is female.

Algorithm of blood and components for administration in neonates



Infant's Group	ABO of component to be transfused		
	Red cells	Platelets	FFP
O			
1 st choice	O	O	O
2 nd choice	-	A	A,B,AB
A			
1 st choice	A	A	A,AB
2 nd choice	O	O	-
B			
1 st choice	B	B	B,AB
2 nd choice	O	O	-
AB			
1 st choice	AB	AB	AB
2 nd choice	A,B,O	A	A



4. Special consideration

Special consideration: Donors



- Components for neonates and infants must be prepared from blood donated by repeat donors (within 2 years from last donation) which was negative for mandatory infectious markers.

Special consideration: Leucocyte depletion



All cellular blood component except granulocyte concentrate should be leucocyte depleted ($<5 \times 10^6$ per unit).

Special consideration: Cytomegalovirus



- All blood transfusion during first year of life should be Cytomegalovirus (CMV) seronegative .
- Component that have been leucodepleted to $<5 \times 10^6$ per unit have significant reduction in risk of CMV transmission

Special consideration: Irradiation



- Blood component should be irradiated prior to transfusion for
 - intrauterine transfusion ,
 - Exchange transfusion,
 - top up transfusion,
 - blood collected from a first or second degree relative
 - Proven immunodeficient neonates.

Special consideration:

Irradiation



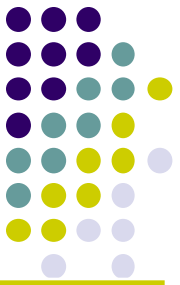
- Irradiation affects the expiry of red cells due to increase in potassium level.
- for IUT, exchange transfusion and large volume transfusion ,irradiated red cells must be used within 24 hrs of irradiation.
- for top up small volume transfusion in stable neonates may be used upto 14 days.

Fresh blood vs stored blood



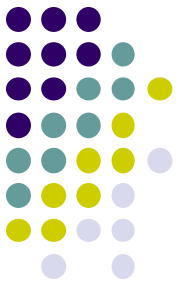
- Premature infants often suffers from anemia and require frequent small volume transfusion. Traditional method of dispensing blood from fresh unit (<5 days old) to prevent post transfusin hyperkalemia ,led to use of multiple units of blood for each infant with results in multiple donor exposure and wastage of blood

Biochemical changes in Stored Blood –DGHS Mannual



Days	0	7	21	35	42
Viable cells%	100	98	80	79	76
pH	7.16	6.94	6.84	6.73	6.6
ATP(% of initial value)	100	90	86	56	55
2,3,DPG(% of initial value)	100		44	10.6	5
Na	169	162	157	153	152
K	4.2	12.3	21.6	27.3	50

Risk of post transfusion hyperkalemia

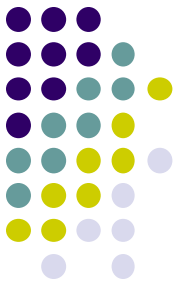


Bioavailability of K	=0.15
Daily need of neonate	=2-3 mEq/kg/d
Therefore:	
K dose	=Insignificant
Risk	=Negligible



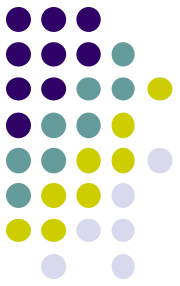
- K =50mEq/l(42d)
- Red cells =80%)
- Dose=15ml/kg
- Plasma=3 ml

Small volume Transfusion



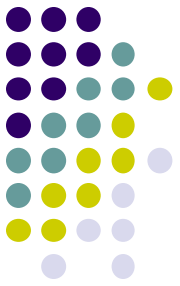
- Most transfusions in neonates are of small volume (10-20ml/kg of body weight) to compensate anemia or to overcome thrombocytopenia.

Small volume Transfusion



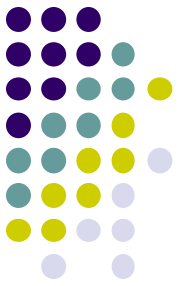
- If multiple aliquots or pentabags are used , crossmatch only first time .
- No need to re-cross match same unit again .
- Aliquot of same unit can be automatically issued until the unit expires or the infant is older than four months.

Large volume Transfusion



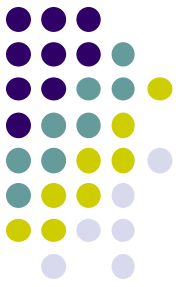
- defined as transfusion of minimum of a single circulating blood volume (80 mL/kg) over 24 hours or 50% of the circulating volume within 3 hours.

Large volume Transfusion

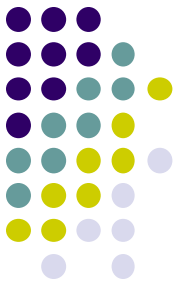


- There is a risk of hyperkalaemia following large volume transfusions,
- large volume transfusions should be < 5 days old
- In case of irradiated blood , than blood must be used within 24 hours of irradiation

Large volume Transfusion



- Serum electrolyte including Ca should be monitored (to prevent hypocalcaemia secondary to citrate overload)
- Blood warmer should be used to avoid the development of hypothermia in a neonate.



Sterility of blood products

- **If the blood bag is opened for transfer of small volume,**
 - component stored between 2- 6C (Red cells ,Whole blood) must be transfused within 24 hrs
 - and component stored at 22 c(Plat) shall be transfused as early as possible and not beyond 6 hrs

Exchange Transfusion (ET)



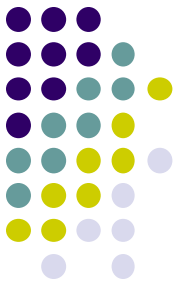
- Group O or ABO compatible with maternal /neonatal plasma
- Rh Negative or identical with mother and neonates
- For ET, O red cells should be used with low titre of Anti A & Anti B ,or
- O red cells suspended in AB Plasma

Exchange Transfusion(ET)



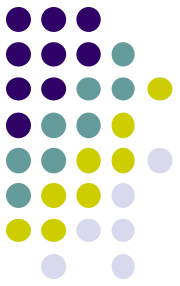
- Blood collected in CPD (Hct of 50-60%) should be suitable for ET to avoid risk of adenine and mannitol
- In case ET is required more than once, subsequent blood transfusion should be of same ABO & Rh type as that of the first time
- <5 days old blood to ensures acceptable plasma K and pH after BT

Effective red cell transfusion



- Transfusion of 1 unit increases about 1 g/dl Hb in adult
- Equivalent amount for neonates is 10-15 ml/kg

Effective platelet transfusion



Transfusion of 1unit of RDP (1 hr post trans.)

Adult(70 kg)	:5-10000/cml
Child(18 kg)	:20000/cml
Infant	:75-100,000/cml
Neonate	:30-100000/cml
(10-15 ml/kg)	

Remarks:1 unit =40-50ml,shelf life= 5 days/kept at room temp

Summary



- Neonates and Infants have special transfusion need, they are not miniature adult
- Cellular components should be compatible to both (neonates and mother). Plasma should be compatible to Baby's ABO
- Product should preferably be leucoreduced & Irradiated

Summary



- For small volume transfusion ,stored blood can safely be given to stable patient up to its expiry from single dedicated unit
- For Large volume transfusion < 5 dyas old blood should be used
- For Exchange transfusion, Group O or compatible group with low level of Anti A or Anti B should be used

Thank you

