

Transfusion Medicine

Perinatal Issues

Neonatal and Pediatric Issues

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April 19, 2017

Hemolytic Disease of the Fetus and Newborn (HDFN)

- Maternal Allo RBC antibodies (IgG)
- Paternal RBC antigens
- Decrease RBC survival
- Erythroblastosis fetalis
 - ↑erythropoiesis, ↑nucleated precursors
- Hydrops fetalis
 - Organomegaly, portal hypertension, organ failure, high output failure

Alloimmunization

- Hemorrhage of fetal RBC into maternal circulation
- Transfusion
- Antigen
 - Rh(D)
 - 200 ml → 85% yes and 15% no (1/2 no with repeat exposure)
 - Mom Rh neg + Fetus Rh pos = 16%
 - C, c, Fy^a
 - K (HDFN & Suppress fetal erythropoiesis)
 - ABO (Dangerous O donor; Mismatch ↓alloimmunization)
- Allow husband to give a directed donation...

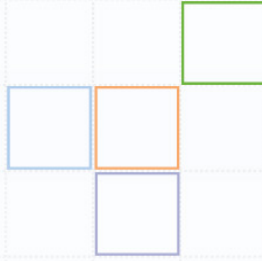
Diagnosis and Management

- Serological and Molecular typing
 - Maternal ABO, Rh, Ab screen
 - Paternal ABO, Rh
 - Titer
 - $\leq 8, 16, 32$
 - anti-K?
 - Change in titre
 - q 4-6 weeks
 - Intervention at 18-24 weeks
 - When do you do molecular typing? On who?
 - Mom, Dad, Fetus?

Diagnosis and Management

- Historically – monitor by amniocentesis
- Fetal Middle Cerebral Artery (MCA) peak blood flow velocity correlates with severity of anemia
- Intrauterine transfusion: cordocentesis
- Attributes of blood for transfusion

Intrauterine Transfusion



- Irradiated...why?
- CMV neg...why?
- Sickle neg...why?
- Group O and antigen negative
- Fresh...why?

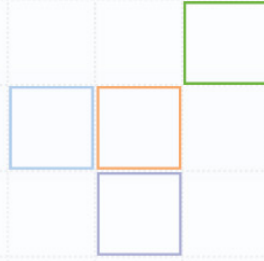
Cord Blood

- ABO forward type, no back type..why?
- Rh...false negative...why?
- DAT...eluate?...why?
- Check Mom....for what?
- Why does Mom have negative AB screen with positive newborn DAT?

Rh IgG

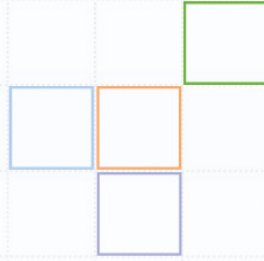
- 50 ug and 300 ug but use 300 ug
- 28 weeks, birth, and as needed for “events”
- ≤ 72 hours after birth
- Rosette test ≥ 10 ml
- 300 ug neutralizes 15 ml RBC or 30 ml WB
- Kleihauer-Betke (acid/elution)
 - Resistance of fetal Hbg to acid treatment

Rh IgG Dose for FM Bleed



- $\% \text{ fetal cells} * \text{TBV (5L)} = \text{Fetal Bleed}$
- 1 vial of 300 ug for each 15 ml RBC or 30 ml whole blood
- Round up or down + 1 vial

ABO HDFN



- IgG antibodies
- O mothers
- ABO antigen on fetal RBC poor developed
- ABO tissue and soluble antigen neutralize Ab

Hemolytic Disease of the Fetus and Newborn (HDFN)

- 24 yo F Gravida₁Para₁ Abortus₀(G₁P₁A₀) just gave birth to a healthy term infant. Mother types Group O Rh negative, antibody screen negative, Anti-A titer 1/128, and Anti-B titer 1/128
- Newborn types Group A Rh negative, antibody screen negative, Anti-A titer 1/1, Anti-B titer 1/1.
- Why does infant have both anti-A and anti-B?
- What is the source of infant's antibodies?
- Why is the antibody titer in the infant lower than Mom's titer?
- What class of immunoglobulin is involved? What would be the optimum temperature for antibody activity?

Hemolytic Disease of the Fetus and Newborn (HDFN)

- Two years later, 26 yo F Gravida₂Para₂ Abortus₀(G₂P₂A₀) just gave birth to a slightly jaundiced term infant. Mother types Group O Rh negative, antibody screen negative, Anti-A titer 1/4096, and Anti-B titer 1/128
- Newborn types Group A Rh negative, antibody screen negative, Anti-A titer 1/4096, Anti-B titer 1/1. Direct-antiglobulin test is positive.
- Why is the infant jaundice?
- What is the source of infant's antibodies?
- What would eluate show?
- Does Mother's negative antibody screen bother you?
- Why is the Mother's titer of anti-A so high?
- What class of immunoglobulin is involved? What would be the optimum temperature for antibody activity?

Hemolytic Disease of the Fetus and Newborn (HDFN)

- Three years later, 29 yo F Gravida₅ Para₃ Abortus₂ (G₅P₃A₂) just gave birth to a very jaundiced term infant. Mother types Group O Rh negative, antibody screen positive, Anti-A titer 1/1024, and Anti-B titer 1/128
- Newborn types Group O Rh positive, antibody screen positive, Anti-A titer 1/2000, Anti-B titer 1/1. Direct-antiglobulin test is positive.
- Why is the infant jaundice?
- What would eluate show?
- What is the source of infant's antibodies?
- How was mother immunized?
- What class of immunoglobulin is involved? What would be the optimum temperature for antibody activity?

Hemolytic Disease of the Fetus and Newborn (HDFN)

- What is genotype of Father and Mother?
- Mother phenotypes: Group O Rh negative
- Children phenotypes:
 - Group A Rh negative
 - Group A Rh negative
 - Group O Rh positive

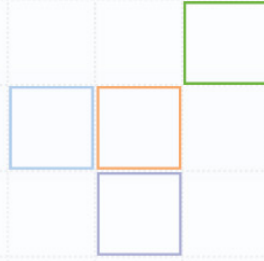
Hemolytic Disease of the Fetus and Newborn (HDFN)

- What is genotype of Father and Mother?
- Mother phenotypes: Group O Rh negative
- Children phenotypes:
 - Group A Rh negative
 - Group A Rh negative
 - Group O Rh positive
- Mother genotype: OO neg neg
- Father genotype:
 - AA neg neg, AA neg pos, AO neg pos, AO neg neg

Platelet Antibodies

- Immune thrombocytopenic purpura (ITP)
 - Mother signs and symptoms of low plt count
 - Steroids and IVIgG
- Fetal/Neonatal Alloimmune thrombocytopenia (FNAIT)
 - First born
 - Mild thrombocytopenia and mild bleeding
 - Subsequent pregnancy

Platelet Antibodies



- Laboratory tests
 - New born
 - CBC, antibody?
 - Mother
 - Platelet antigen, molecular typing, alloantibody
 - Father
 - Platelet antigen, molecular , zygoty
 - Fetus
 - Molecular typing
- Cordocentesis

Neonatal and Pediatric Transfusion

- “Physiologic anemia of infancy and prematurity”
- Hgb 16.9→8.0 g/dl and 15→7.0 g/dl
 - Issues with EPO, fRBC survival, and blood volume
- Mild ↓Plt (< 150K)
 - NICU with impaired production, increased destruction

Neonatal and Pediatric Transfusion

- Blood volume
 - Full term 85ml/kg, preterm newborn 100ml/kg
 - Inadequate CV response to 10% ↓ bld vol
 - ↓ cardiac output and ↑ vascular resistance
 - Circulatory overload
- Epo response
 - Response to hypoxia blunted (kidneys vs. liver)
 - Level of Epo for each degree of anemia blunted
- Cold stress
 - ↑ metabolic rate, ↓ glucose, acidosis, apnea

Neonatal and Pediatric Transfusion

- Immune Status
 - Depends on maternal IgG
 - Cellular response blunted – TA-GVHD
- Citrate
 - Acidosis
 - Calcium
- Metabolic Issues
 - K⁺
 - 2,3 DPG

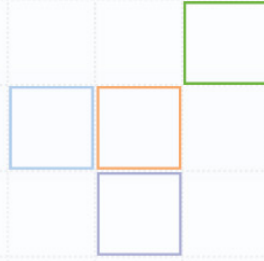
Neonatal and Pediatric Transfusion

- PRBC attributes
 - Fresh
 - Precise aliquots
 - Leukoreduced
 - Irradiated
 - CMV neg
 - Reduced supernatant or washed
- Administration
 - Warmed
 - Metered - slow flow

Small Volume Transfusion*

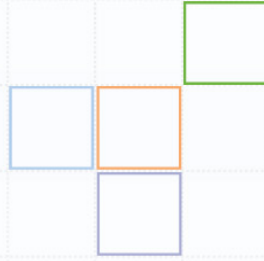
- PRBC 10-15ml/kg (additive solution AS-3)
 - 2 - 3 g/dl rise in Hgb
- FFP 10-15 ml/Kg
 - 15 - 20% rise in factor level
- Platelets 5-10 ml/Kg
 - 50 - 100K rise in platelet count
- Cryoprecipitate AHF 1-2 units/Kg
 - 60 - 100 mg/dl rise in fibrinogen

RBC Guidelines for < 4 Months Small Volume Transfusions*



- <45% Hct for severe CP disease
- <35% Hct for moderate CP disease
- <35% Hct for major surgery
- <20% Hct for symptoms of anemia

RBC Guidelines for >4 Months*



- <40% Hct for severe CP disease
- <24% Hct for symptomatic anemia

Adverse Effects of Transfusion

Immunologic

- Hemolytic reactions
 - Acute and delayed
 - Incompatible Plasma*
- Febrile reactions
- Allergic reactions
- Anaphylactoid reactions
- Alloimmunization* (RBC/HLA)
- TRALI, TRIM
- GVHD* (Neonates/Irradiation)
- Post-transfusion Purpura

Non-immunologic

- Transmission of Viral Infections
 - CMV* (<1,200 g)
- Bacterial Contamination
- Circulation overload*
- Hypothermia*
- Metabolic complications*
 - Ca⁺⁺, K⁺
- Iron overload
- Non-immunologic hemolysis

* **Special Pediatric Issue**