



HEALTH HOLDING

HAFER ALBATIN HEALTH
CLUSTER
MATERNITY AND
CHILDREN HOSPITAL

Department:	Neonatal Intensive Care Unit (NICU)		
Document:	Multidisciplinary Policy and Procedure		
Title:	Blood Exchange Transfusion for Neonate		
Applies To:	All NICU staff and Blood Bank		
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1. PURPOSE:

- 1.1 Treatment of immune-mediated haemolytic disease to stop hemolysis and bilirubin production by removing partially hemolyzed and antibody-coated red blood cells (RBCs), unattached maternal antibodies as well as other potential toxic by-products of the haemolytic process and replace them with donor RBCs lacking the sensitizing antigen.
- 1.2 Prevent bilirubin encephalopathy and kernicterus by removing toxic levels of bilirubin.
- 1.3 To correct anaemia and improve heart failure in hydropic infants with haemolytic disease.

2. DEFINITIONS:

- 2.1 **Exchange transfusion** is replacing an infant's blood with donor blood by repeatedly removing and replacing small aliquots of blood over a short time period.
- 2.2 **Acute bilirubin encephalopathy** is the clinical manifestation of bilirubin toxicity in the neonate. Its clinical presentation can be divided into three phases:
 - 2.2.1 Early phase: Hypotonic, lethargy, high-pitched cry, and poor suck.
 - 2.2.2 Intermediate phase: Hypertonia of extensor muscles (with opisthotonus, rigidity, oculogyric crisis, and retrocollis), irritability, fever, and seizures. Many infants die in this phase. All infants who survive this phase develop chronic bilirubin encephalopathy.
 - 2.2.3 Advanced phase: Pronounced opisthotonus (although hypotonia replaces hypertonia after approximately one week of age), shrill cry, apnea, seizures, coma and death.
- 2.3 **Chronic bilirubin encephalopathy (kernicterus)** is marked by athetosis, partial or complete sensori-neural deafness, limitation of upward gaze, dental dysplasia, and intellectual deficits.
- 2.4 **Bronze infant syndrome** is a clinical complication of that occurs in some infants with cholestatic jaundice when exposed to phototherapy. They may develop a dark, grayish-brown discoloration of the skin, serum, and urine. Pathogenesis of this syndrome is unknown, but it may be related to an accumulation of porphyrins and other metabolites in the plasma of infants who develop cholestasis.
- 2.5 Abbreviations:
TSB: Total Serum Bilirubin.

3. POLICY:

- 3.1 Physician will identify the indications for exchange transfusion:
 - 3.1.1 Significant unconjugated hyperbilirubinemia in the newborn due to any cause, when intensive phototherapy fails to prevent a rise in unconjugated bilirubin to toxic levels (greater than threshold values for exchange transfusion on the graphs shown in appendices 7.1 for infants > 35 weeks of gestational age and appendices 7.2 for neonates < 35 weeks gestation & do not subtract direct-reacting (conjugated) bilirubin level from the total. In unusual situations in which the direct bilirubin level is > 50% or more of the total bilirubin, consult pediatric gastroenterology/hepatology.
 - 3.1.2 Immediate exchange is done if:

- 3.1.2.1 Infant shows early signs of acute bilirubin encephalopathy (e.g. significant lethargy, hypotonia, poor sucking, or high-pitched cry) or if TSB is > 5mg/dl above the exchange levels, there is risk of kernicterus.
- 3.1.2.2 Infant manifests the signs of the intermediate to advanced stages of acute bilirubin encephalopathy (hypertonic, arching, retrocollis, opisthotonos, fever, high-pitched cry) even if the TSB is falling.
- 3.1.3 Infants with a TSB greater than the exchange values who have not yet been discharged since birth, exchange transfusion is done if the TSB reaches the exchange level despite intensive phototherapy.
- 3.1.4 Infants who have been discharged from the hospital and have TSB concentrations that are approaching or exceed threshold values for exchange, are initially treated with intensive phototherapy. If TSB remains above the threshold TSB after about six hours of intensive phototherapy, then exchange transfusion is indicated.
- 3.1.5 Correct anemia and improve heart failure in hydropic infants with hemolytic disease.
- 3.1.6 Partial exchange transfusion for polycythemia.
- 3.2 In infants with isoimmune hemolytic disease and TSB level rising despite intensive phototherapy or within 2-3 mg/dl (34-51 mmol/L) of exchange level, administer intravenous immunoglobulin 0.5-1g/ kg over 2 hours and repeat in 12 hours if necessary.
- 3.3 If the TSB is at the exchange transfusion level or is 25 mg/ dl (428 mmol/L) or higher at any time, it is a medical emergency and intensive phototherapy should be initiated immediately, followed by very close monitoring to decide the need for exchange transfusion.
- 3.4 Blood used for exchange should be: As fresh as possible < 5-7 days old,
 - 3.4.1 Irradiated, leukocyte reduced, CMV negative and sickle cell negative, reconstituted whole blood (hematocrit 45-50%) made from packed red blood cells group O negative suspended in AB fresh frozen plasma (or infant's type) collected in citrate-phosphate-dextrose.
 - 3.4.2 In Rh haemolytic disease, if blood is prepared before delivery, it should be type O Rh-negative cross-matched against the mother. If the blood is obtained after delivery, it also may be cross matched against the infant.
 - 3.4.3 In ABO incompatibility, the blood should be type O Rh-negative or Rh compatible with the mother and infant, be cross-matched against the mother and infant, and have a low titre of naturally occurring anti-A or anti-B antibodies. Usually, type O cells are used with AB plasma to ensure that no anti-A or anti-B antibodies are present.
 - 3.4.4 In other isoimmune hemolytic disease, the blood should not contain the sensitizing antigen and should be cross-matched against the mother.
 - 3.4.5 In non-immune hyperbilirubinemia, blood is typed and cross-matched against the plasma and red cells of the infant.

4. PROCEDURE:

- 4.1 Inform the Consultant on duty.
- 4.2 Inform parents and explain the procedure to them.
- 4.3 Stabilize the infant cardiovascular status as needed before starting exchange transfusion.
- 4.4 Communicate with the blood bank to ensure that blood will be available in a timely manner.
Quantity of blood needed for double volume exchange transfusion =
80-85ml X weight in kg X 2 + volume for tubing in exchange transfusion tray~35 ml
- 4.5 Obtain appropriate line for double volume exchange transfusion:
 - 4.5.1 Insert umbilical venous catheter for 2-volume exchange transfusion by push-pull method using a pre-assembled tray.
 - 4.5.2 If it is not possible to insert the catheter in the umbilical vein, exchange can be done through a central or peripheral intravenous line that is at least 23 gauge to infuse blood and a umbilical artery catheter or peripheral artery e.g. the radial artery to withdraw blood.
Isovolumetric exchange (simultaneously pulling blood out of the umbilical artery and pushing new blood in the umbilical vein) may be tolerated better in small, sick, or hydropic infants.
- 4.6 Insert peripheral line for intravenous fluids and possible medications.

- 4.7 Collect pre-exchange (base line) TSB, complete blood count, electrolytes, calcium, magnesium, glucose, blood gases and coagulation profile.
- 4.8 Empty gastric content via orogastric tube and leave tube to straight drainage. Assess infant pain profile and provide none-pharmacologic and or pharmacologic pain management if needed. Sedation and pain relief are not usually required. Conscious infants may suck on a pacifier during the procedure.
- 4.9 Ensure that all emergency resuscitation equipment and medications are available at bedside and equipments are functioning.
- 4.10 The assisting nurse should assemble all equipment prior to the procedure.
- 4.11 Identify patient by medical record number and name.
- 4.12 Double check the cross matched blood donor and recipient identification and blood expiry date. Attach blood administration set to blood-warmer tubing and to blood bag. Allow blood to run through blood warmer.
- 4.13 The assistant nurse restrains the baby in the supine position and connects him/her to continuous vital signs monitor, pulse oximetry and blood pressure cuff to ensure continuous monitoring all through the procedure. Obtain baseline vital signs.
- 4.14 The procedure is done under complete aseptic technique. Wear mask, head cover, sterile gown, and gloves.
- 4.15 Double volume exchange transfusion (push-pull method using a preassembled tray (single umbilical venous catheter).
 - 4.15.1 Keep flow slow and as steady as possible and volumetrically equal for infusion and removal to avoid fluctuations in blood pressure. Rapid fluctuations in arterial pressure in the push pull technique may be accompanied by changes in intracranial pressure. Rapid withdrawal from the umbilical vein induces a negative pressure that may be transmitted to the mesenteric veins and contribute to the high incidence of ischemic bowel complications.
 - 4.15.2 Aliquot size and rate of exchange: 5ml/kg over a 30minutes cycle.
 - 4.15.3 Total duration for double-volume exchange transfusion is around 90 to 120 minutes.
 - 4.15.4 If infant is hypovolemic, start exchange with transfusion of aliquot (5 ml/kg) into catheter. If infant is hypervolemia, start by withdrawing pre calculated aliquot.
 - 4.15.5 Perform calculated number of passes, until desired volume has been exchanged and document on the exchange transfusion form.
 - 4.15.6 Clear umbilical line of banked blood and withdraw amount of infant's blood needed for laboratory testing.
 - 4.15.7 Document procedure in patient's medical record.
- 4.16 Isovolumetric double-volume exchange transfusion (double set-up):
 - 4.16.1 You should have one venous site for infusion and one arterial site for withdrawals.
 - 4.16.1.1 Possible venous sites for infusion: Umbilical venous catheter, Peripheral or central intravenous line that is at least 23 gauge or larger.
 - 4.16.1.2 Possible arterial sites for withdrawals: Umbilical artery catheter, Peripheral, usually radial if infant's size permits.
 - 4.16.2 Connect the arterial line to a 3-way stopcock and attach it to the extension set and waste fluid collection bag (from the Exchange Transfusion Tray) and to a 30 ml syringe that will serve for withdrawal of blood aliquots from infant.
 - 4.16.3 Connect 4-way stopcock (provided in Exchange Transfusion Tray) to the blood administration set (from tray). Prime tubing with blood and add sterile 20 ml syringe to the stopcock. Connect to venous line ;instead, you can use a syringe pump connected to the venous line to administer blood.
 - 4.16.4 Withdraw blood from infant and discard from the arterial line. At the same time, exchange product will be infused to infant via venous line at same rate of withdrawal. This technique should be performed by 2 physicians. If this is not possible, an alternative is to infuse the exchange blood by using a syringe IV pump. The rate of blood infusion on the syringe IV pump equals the rate at which the physician withdraw and discard aliquots from arterial line.
- 4.17 Partial exchange transfusion for polycythaemia is performed by replacing the discarded blood from umbilical vein with normal saline in a peripheral vein. Use the following formula for partial exchange transfusion:

Volume of exchange (ml) =

$$\frac{\text{Estimated blood volume/kg} \times \text{Weight (kg)} \times (\text{Observed Hct} - \text{Desired Hct})}{\text{Observed Hct}}$$

- 4.18 During exchange transfusion of all babies:
- 4.18.1 Monitor vital signs closely every 15 minutes; document temperature, pulse, respiration, blood pressure, and oxygen saturation as well as overall condition of infant.
 - 4.18.2 The assisting nurse documents exchange product aliquots in and out, maintaining on going total balance. She verbalize total of ins and outs of each aliquot infused and withdrawn.
 - 4.18.3 Gently agitate the blood bag every 10 to 15 minutes to prevent red cell sedimentation, which may lead to exchange with relatively anaemic blood towards the end of the exchange.
- 4.19 After exchange transfusion:
- 4.19.1 Continue to monitor vital signs closely for at least 6 hours; every 15 minutes for 1 hour, every 30 minutes for 2 hours, every 1 hour for 4 hours then every 2 hours.
 - 4.19.2 Rewrite orders; adjust any drug dosages as needed to compensate for removal by exchange.
 - 4.19.3 Keep infant NPO for at least 4 hours. Restart feeds cautiously if clinically stable. Monitor abdominal girth and bowel sounds every 3 to 4 hours for next 24 hours if exchange has been performed using umbilical vascular lines. Observe for signs of feeding intolerance.
 - 4.19.4 Check serum bilirubin; total and direct, calcium magnesium, sodium, potassium, creatinine, complete blood count and blood gases after completing exchange then as often as clinically indicated.
 - 4.19.5 A double-volume exchange transfusion (approximately 170 mL/kg) removes about 85% of the infant's red blood cells and up to 110 %of the circulating bilirubin (extravascular bilirubin enters the blood during the exchange), but because at least 50% of the infant's bilirubin is in the extravascular compartment, only about 25% of the total body bilirubin is removed. Post-exchange bilirubin levels are about 60% of pre-exchange levels, and the re-equilibration that occurs between the vascular and extravascular bilirubin compartments produces a rapid rebound of serum bilirubin level (within 30 minutes) to 70% to 80% of pre-exchange serum levels. Further increases in post-exchange bilirubin levels are due to hemolysis of antibody-coated RBC's sequestered in bone marrow or spleen and from senescent donor RBCs.
 - 4.19.5.1 Continue phototherapy and close follow up of serum bilirubin level every 4 hours for 24 hours then as required.
 - 4.19.5.2 Infants with severe haemolytic disease may need a second exchange transfusion
 - 4.19.6 Monitor serum glucose levels after 1 hour then every 2 to 4 hours for 24 hours.
 - 4.19.7 Upon completion of procedure, clamp and disconnect blood tubing, flush umbilical line with normal saline and connect to IV fluids.
 - 4.19.8 The assistant nurse disposes of equipment appropriately.
 - 4.19.9 Document the time the procedure started and completed, infant's status before, during and after procedure, the total volume of blood used and any problem encountered.
- 4.20 Observe for any complication of the procedure that include:
- 4.20.1 Apnea, bradycardia, arrhythmia, hypotension, cardiac arrest, volume overload, embolization with air or clots.
 - 4.20.2 Metabolic; hypocalcemia, hypomagnesaemia, hyperkalemia, hypo or hyperglycaemia, acidosis.
 - 4.20.3 Hematologic: Thrombocytopenia, dilutional coagulopathy, neutropenia, disseminated intravascular coagulation. Massive hemolysis, intravascular sickling, and death have occurred from the use of haemoglobin sickle cell donor blood.
 - 4.20.4 Gastrointestinal: Feeding intolerance, ischemic injury, necrotizing enterocolitis.
 - 4.20.5 Infection: Omphalitis, septicaemia blood borne infections e.g. viral hepatitis, cytomegalovirus.
 - 4.20.6 Complications related to vascular catheter: vasospasm, thrombosis, embolization.
 - 4.20.7 Graft-versus-host disease is prevented by using irradiated blood.

5. MATERIAL AND EQUIPMENT:

- 5.1 Emergency cart, resuscitation equipment (suction, O₂, Resuscitation bag and proper sized mask)
- 5.2 Radiant warmer or incubator
- 5.3 Vital signs monitor with connected pulse oximetry and non-invasive blood pressure cuff
- 5.4 Sterile drapes
- 5.5 Sterile gown, sterile gloves, mask and head cover
- 5.6 Blood for exchange transfusion
- 5.7 Normal saline
- 5.8 Blood warmer
- 5.9 Exchange Transfusion Tray
- 5.10 Laboratory specimen tubes with labels and requisitions
- 5.11 Soft restraints
- 5.12 If using two access method (i.e. arterial and venous), add:
 - three-way stopcock
 - Infusion syringe pump
 - Neonatal blood component set to administer blood

6. RESPONSIBILITIES:

- 6.1 Physician
- 6.2 Nurse
- 6.3 Blood Bank


7. APPENDICES:

- 7.1 Exchange transfusion levels for infants \geq 35 weeks gestation
- 7.2 Exchange transfusion levels for infants <28weeks to 34 weeks

8. REFERENCES:

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9. APPROVALS:

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Appendices 1: Exchange transfusion levels for infants ≥ 35 weeks gestation

