1.0 PURPOSE AND INTENT:

1.1 To provide guidelines for safe exchange transfusions in newborns performed in Neonatal areas.

2.0 PRACTICE OUTCOME

2.1 Reduce dangerous levels in the blood of red blood cells, bilirubin, medications or other body chemistry elements that have risen due to illness or treatment of illness and to prevent negative long term developmental outcomes that may result.

Note: All recommendations are approximate guidelines only and practitioners must take into account individual patient characteristics and situation. Concerns regarding appropriate treatment must be discussed with the attending neonatologist.

3.0 INDICATIONS

3.1 Alloimmune Hemolytic Disease: Neonates demonstrating clinical evidence of alloimmune hemolytic disease; pallor, petechiae, hepatosplenomegaly, will require an exchange transfusion.

3.1.1 IF immediately after delivery, the CORD BLOOD levels are:
- A hemoglobin of less than or equal to 105 g/L or bilirubin greater than or equal to 80 µmol/L – exchange transfusion within 3 hours of birth
- A hemoglobin less than or equal to 80 g/L or bilirubin greater than or equal to 100 µmol/L – exchange transfusion within 1 hour of birth

3.1.2 Subsequent exchange transfusions will occur under the following conditions:
- Term neonate – indirect bilirubin greater than or equal to 340 µmol/L
- Preterm neonate – at the discretion of the physician
- Hemoglobin less than or equal to 110 g/L in first 7 days of life, with risk for patient heart failure

3.2 Other indications: Neonates may require an exchange transfusion for the following:
- severe sepsis - augmentation of antibody levels, remove bacterial toxins
- maternal autoimmune disease – removal of antibodies
- life-threatening fluid & electrolyte imbalance
- coagulation defects not remedied by single component replacement
- polycythemia – hemoglobin reduction
- removal of: concentrated toxin levels, metabolic products or drugs

4.0 EXCHANGE TRANSFUSION BLOOD PRODUCTS

4.1 A physician calls the Canadian Blood Services (CBS) to request the blood products for exchange transfusion and writes an order for the exchange transfusion. CBS must be notified of the reason for the transfusion so the exchange unit is prepared appropriately.
- If anticipated pre-delivery – the physician responsible for the care of the mother,
- post-delivery – the physician responsible for the neonate’s care

4.2 CBS issues an exchange unit of red blood cells (RBC) that is
- as fresh as possible - less than 5 days old,
- anti-cytomegalovirus (CMV),
- irradiated,
- Antigen negative for maternal immunization (e.g. O Rh negative in Anti-D alloimmunization, crossmatched against maternal plasma)
• Group O, Rh negative blood is the most common choice for neonatal exchange units

**Subsequent transfusions;** use same ABO group as previous transfusion (CBS may use maternal plasma for crossmatch, if available).

4.3 Group AB fresh frozen plasma (FFP) is added to the exchange unit by the Canadian Blood Services to achieve a hematocrit of approximately 0.45 L/L. They will label the bag indicating total volume of the combined RBC and FFP contained in the unit. For double-volume exchanges two units may be issued.

3.4 Any additional products that may be required for the procedure must be ordered from the Blood Bank and will be issued directly to the clinical area with the exchange blood unit.

5.0 **PATIENT MONITORING AND ASSESSMENT**

5.1 Monitor and record vital signs before and q10-15 minutes throughout the procedure and q15-30 minutes post procedure for at least four hours. Infant must be on continuous cardio-respiratory monitor during this time. If there is no arterial line, use non-invasive blood pressure monitoring.

5.2 Perform ongoing assessment of infant for potential immediate and long-term complications including:
- Hemodynamic changes occur with movement of blood in and out.
- Hypothermia
- Blood sugar imbalances
- Thromboembolism
- Transfusion reactions
- Infection
- Necrotizing enterocolitis

6.0 **PREPARATION FOR PROCEDURE**

6.1 Position and restrain infant using restraints or circumcision board. Ensure head is well stabilized if infant is ventilated. 

**For Circumcision Board:** Tie legs with folded diapers. Restrain arms with velcro ties brought underneath board.

6.2 When blood is available, assemble all equipment and supplies listed in Appendix B.
- The nurse ensures exchange blood product unit is available in the Blood Bank and have it brought to area just prior to procedure.
- Double check unit of blood as per policy and document on the Cumulative Blood Product Administration Record. See Policy # 80.120.101 “Blood and Blood Product Transfusion – Autologous and Homologous” found at [http://hscheme.hsc.mb.ca/policies/wordpolicies/80.120.101.pdf](http://hscheme.hsc.mb.ca/policies/wordpolicies/80.120.101.pdf) or Manitoba Transfusion Medicine Best Practice Resource Manual.
- Blood should be out of fridge for a short period prior to use (**do not use blood warmer**)

6.3 Gently agitate blood in bag when hanging and at 10-15 minute intervals until procedure complete.

6.4 Assist physician to insert blood administration set into blood bag to maintain sterility of the tubing. 
The physician maintains sterile technique.

6.5 Obtain blood for one biochemistry and one hematology tube for hemoglobin and hematocrit, bilirubin total and direct. Label tubes **PRE-EXCHANGE** and record time on requisition.

7.0 **EXCHANGE TRANSFUSION PROCEDURE**

7.1 A physician performs the procedure under sterile conditions with a nurse assisting.
The volume required is determined by the physician before the procedure begins:

- Double–volume exchange: 170 ml/kg (haemolytic disease)
- Single-volume exchange: 80 – 90 ml/kg (coagulation disorders, anemia with heart failure)

Two methods can be used for the procedure; push-pull method or isovolumetric method. For step-by-step description of equipment set-up and methods see Appendix C. Before beginning procedure identify which line(s) will be used. The total time of procedure should be approximately 1-2 hours.

**7.3.1 Push-Pull Method (See Appendix B):** This is the traditional method where a single umbilical venous catheter is used. It is usually an umbilical vein (UVC), but in exceptional circumstances can be an umbilical artery catheter (UAC). The tip of the UVC should be at or just above the diaphragm. Blood is withdrawn in aliquots of 3-10 mL depending on baby’s size, and then replaced with equal volume from the exchange unit. A closed system with tubings and stopcocks is used. Withdraw blood at a rate of 1.5-2 mL/kg/minute. During the procedure document each aliquot “in” and “out”.

**7.3.2 Isovolumetric Method (See Appendix C):** Blood is infused via a large volume infusion pump (like the Colleague) through a vein (peripheral or umbilical) at a steady rate of 1.5-2 mL/kg/minutes while at the same time being removed in aliquots of 3-10mL from an artery (peripheral or umbilical) or umbilical vein. If a peripheral vein is used the catheter must be at least 22 gauge. Before the procedure compute the amount required, the amount to withdraw, the frequency of withdrawal and the rate of blood infusion. During the procedure document amount infused “in” every 5 minutes and each aliquot removed “out”.

Halfway through the procedure check the ionized calcium.

When the procedure is complete obtain blood for one biochemistry and one hematology tube for hemoglobin and hematocrit, bilirubin total and direct. Label tubes POST-EXCHANGE and record time on requisition.

Position the infant supine or side lying following the procedure in order to observe the condition of the lines.

**8.0 PRIMARY AUTHORS**

8.1 Senior Technologist, Crossmatch Laboratory, Canadian Blood Services.
8.2 Dr. John Baier, Assistant Medical Director NICU, Health Sciences Centre
8.3 Karen Bodnaryk, Nurse Educator, NICU, HSC
8.3 Doris Sawatzky-Dickson, Clinical Nurse Specialist, NICU, HSC

**9.0 REFERENCES**


APPENDIX A: EQUIPMENT

- Exchange transfusion blood unit – The Blood Bank will issue the exchange unit as required.
- Cumulative Blood Product Administration and Assessment Record (#85592)
  - Exchange Transfusion Form (x 4)
  (HSC: #NS0026, SBH: 7102-4286-9)
- Large movable cart or portable table
- IV pole
- Portable spotlight
- Sterile - gown, gloves, towel
- Surgical masks & Blue operating room caps
- 4 restraints or circumcision board, velcro restraints, 2 diapers, 1" gauze bandage
- Exchange Transfusion Tray (Pharmaseal 4110B)
  Contains:
  - Straight blood set (has one med port)
  - Specialized stopcock
  - 20 mL syringe x2 (one for withdrawing waste blood and the other for saline flush)
  - 5 mL syringe x2
  - Waste bag with extension tubing
  - 5Fr & 8Fr umbilical catheters
  - Sterile gauze
- 6 alcohol prep packs
- 1 - 50 cc syringes normal saline OR 500 ml bag N/S with decanting set (for flush solution)
- 1 cross match tube (Canadian Blood Services)
- 2 Haematology tubes with requisitions
- 2 Biochemistry tubes with requisitions

Two Line (isovolumetric) method
- Straight Type Blood Set (JC7781)
- Y-Type catheter extension set (double pigtail)
- Large volume infusion pump (Baxter Colleague)
- Extension tubing 33" length (X1) – to allow extra length for blood administration from large volume pump

If either umbilical arterial or venous line is not in situ
- 3-way stopcock (if not already attached to umbilical arterial catheter set-up)

If inserting an umbilical catheter as part of the procedure:
- No additional tray is required as the exchange transfusion tray can be used for catheter insertion. The tray has a #8 catheter.
- Chlorhexidine swabs
- 1 - 50 cc syringes normal saline OR 500 ml bag N/S with decanting set (for flushing new line)
- 4.0 silk suture with cutting needle
- Umbilical catheters if physician requests catheter size other than 5Fr or 8 Fr
APPENDIX B: ONE LINE PROCEDURE – (PUSH-PULL METHOD)

UMBILICAL VEIN

1. Identify positions on special stopcock in clockwise rotation. The direction that the handle is pointing indicates the port that is open to the syringe.

2. Stopcock ports (see diagram)
   A. Venous line
   B. Extension tubing to fluid collection (waste) bag
   C. Blood Administration set port
   D. Syringe port
   E. Handle in “OFF” position

3. PORT A –Umbilical venous line

4. PORT B: fluid collection bag and port. Suspend fluid collection bag below bed level

5. PORT C: Attach Blood Administration set (from Exchange Transfusion Tray) after spiking Exchange Blood unit and priming the tubing with blood.

6. PORT D – Attach 20 mL syringe (pull syringe). Once the syringe is well attached, the stopcock and the syringe barrel will rotate as one unit with the handle indicating the open port. Always rotate in clockwise direction to follow the proper sequence.

7. The stopcock allows CLOCKWISE rotation in the following order:
   1. withdraw from patient
   2. clear to waste bag
   3. draw new blood
   4. Inject into patient. Do not turn before withdrawing once again.

8. If the neonate is hypovolemic or has a low CVP, start the exchange with a transfusion of an aliquot of donor blood. If the neonate is hypervolemic or has a high CVP start the exchange by withdrawing a pre-calculated aliquot.

9. Repeat Steps until predetermined volume has been achieved.

10. Communicate each withdrawal and infusion of blood aliquot to assistant for documentation.

11. Flush the line intermittently with normal saline through the rubber port on the blood administration tubing near PORT C.

12. Gently agitate the exchange blood unit every 10-15 minutes to prevent red cell sedimentation. (done by assistant)

13. Withdraw blood samples at end of procedure as last blood aliquot withdrawal.

* See pictures on page 8.
APPENDIX C: TWO LINE PROCEDURE (ISOVOLUMETRIC METHOD)

1. **In Line:** Venous line (peripheral or umbilical)
2. Attach double lead extension (pigtail) to line
3. Spike Exchange Blood unit with Straight Type Blood Set and prime tubing. (this is NOT the blood infusion set found in the disposable tray)
4. Insert tubing into large volume infusion pump channel.
5. Set pump rate as per physician order.
6. **Out Line:** Arterial line or Umbilical Vein
7. Identify positions on special stopcock in clockwise rotation. The direction that the handle is pointing indicates the port that is open to the syringe.
8. Stopcock ports (see diagram)
   - A. Venous line
   - B. Extension tubing to fluid collection (waste) bag
   - C. Not used – apply red cap
   - D. Syringe port
   - E. Handle in “OFF” position
9. **PORT A** – Venous line (umbilical or peripheral)
10. **PORT B**: fluid collection bag and port. Suspend fluid collection bag below bed level
11. **PORT C**: Attach 20 mL syringe of saline.
12. **PORT D** – Attach 20 mL syringe (pull syringe) Once the syringe is well attached, the stopcock and the syringe barrel will rotate as one unit with the handle indicating the open port. Always rotate in clockwise direction to follow the proper sequence.
13. The stopcock allows CLOCKWISE rotation in the following order:
    - 1. withdraw from patient
    - 2. clear to waste bag
14. Communicate each withdrawal of blood aliquot to assistant for documentation.
15. Flush the “out” line intermittently with normal saline through **PORT C**.
16. Gently agitate the exchange blood unit gently every 10-15 minutes.

* See pictures on page 9.
One-Line Set-up

- **Patient Line (UAC or UVC)**
- **To Waste Bag**
- **To Blood bag**

Handle – points to open port
Patient Line (UAC or UVC) → To Waste Bag

Two-Line Set-up

Port not used.

Straight-type Blood set #JC7781
(Not found on exchange transfusion tray)