

# Newborn Critical Care Center (NCCC) Clinical Guidelines

## Exchange Transfusion Guidelines

Exchange transfusion of the neonate is a potentially life-saving intervention that involves removing aliquots of blood and replacing with donor blood in order to remove abnormal blood components and circulating toxins whilst maintaining adequate circulating blood volume. In the case of the neonate this is primarily performed to remove antibodies and excess bilirubin.

### INDICATION

#### I. **Know** the Reason for Giving an Exchange Transfusion

- A. Hyperbilirubinemia
- B. Polycythemia
- C. Hemolytic disease
- D. Severe anemia with congestive heart failure
- E. Uncommon reasons:
  - 1. Congenital leukemia
  - 2. Extreme thrombocytosis
  - 3. Neonatal hemochromatosis
  - 4. Hyperammonemia
  - 5. Organic acidemia
  - 6. Lead poisoning
  - 7. Renal failure
  - 8. Drug overdose or toxicity
  - 9. Removal of antibodies and abnormal proteins
  - 10. Neonatal sepsis or malaria

### PREPARATION

#### II. **Identify** Critical Personnel

- A. Two medical providers
  - 1. Attending, Fellow, Nurse Practitioner, Resident
  - 2. Two providers required regardless of method
    - a. Providers may rotate; however, two must remain at the bedside at all times
  - 3. Responsibilities:
    - a. Ordering the blood
    - b. Calculating the appropriate volume exchange amount
    - c. Determining the most suitable exchange method
- B. One Registered Nurse
  - 1. Bedside nurse and/or charge nurse
    - a. Nursing may rotate; however, one must remain at the bedside at all times
    - b. Infant should be a one-to-one assignment

2. Responsibilities:

- a. Maintain sterile bubble throughout the entire exchange
- b. Document exchange volumes in EPIC during the procedure
- c. Record all pertinent times accurately
- d. Obtain labs prior to, during, and at the end of the exchange
- e. Maintain 2 PIVs throughout the procedure

III. **Before** the Procedure

**Notify Transfusion Medicine Fellow via paging system AS SOON AS exchange transfusion considered given the labor intensive set up and preparation of blood products.**

- A. Obtain consent from parents for administration of blood products
- B. Order the blood
  1. Ensure the infant has a resulted Type & Screen AND ABO type check
  2. Preparing the blood will take a minimum of 4 hours or longer (especially at night)
  3. Blood should be < 7 days old
  4. Irradiated just prior to exchange (< 24 hours)
  5. Hematocrit of donor (if known)
- C. Order NPO at least 4 hours prior to the procedure
- D. Volume
  1. Use NO MORE than 1 whole unit (~300 mL) if possible to minimum donor exposure
  2. Infant blood volume
    - a. **TERM** infant = 80 - 100mL/kg
    - b. **PRETERM** infant = 100 - 120mL/kg
- E. Calculations

**DOUBLE VOLUME** = 2 x infant's blood volume  
*(exchanges ~ 85% of total blood volume)*

**SINGLE VOLUME** = infant's blood volume  
*(exchanges ~ 60% of total blood volume)*

**PARTIAL EXCHANGE (SEVERE ANEMIA):**  
Volume =  $\frac{\text{infant's blood volume} \times (\text{Hgb desired} - \text{Hgb initial})}{\text{Hgb of pRBC} - \text{Hgb initial}}$

**PARTIAL EXCHANGE (POLYCYTHEMIA):**  
*Optimal dilutional fluid is normal saline rather than plasma or albumin*  
Volume =  $\frac{\text{infant's blood volume} \times \text{desired change in Hct}}{\text{Initial Hct}}$

**Order "over-fill" of at least 30 mL to account for priming the tubing and blood warmer**

F. Access

1. **TERM** infant
  - a. Venous - 8 Fr single lumen catheter preferred; may place a 5 Fr if unable to obtain 8 Fr
  - b. Arterial - 5 Fr single lumen catheter preferred; may place 3.5 Fr if unable to obtain 5 Fr
2. **PRETERM** infant (< 1500 grams)
  - a. Venous- 5 Fr single lumen catheter preferred; may place a 3.5 Fr if unable to obtain 5 Fr
  - b. Arterial - Must place at least a 3.5 Fr arterial line; **DO NOT** place a 2.5 Fr arterial line
3. Infant must have two additional peripheral access lines for:
  - a. Maintenance IV fluids during the procedure
  - b. Emergency / intermittent medications given during procedure
4. Confirm correct placement of catheters via radiograph

G. Methodology

1. Single Catheter Exchange  
[“Push – Pull” Method](#)
  - a. Venous access only
  - b. **Never** arterial access
2. Dual Catheter Exchange  
[“Isovolumetric” Method](#)
  - a. Venous (UVC / PIV) and Arterial (UAC / PAL) access
  - b. **DO NOT USE A DOUBLE LUMEN UVC**

H. Laboratory Values

1. Order entire laboratory panel prior to beginning the procedure
2. Nursing to obtain and be responsible for sending samples to core lab

<b>LABORATORY EVALUATION SCHEDULE</b> <i>Order ALL labs STAT prior to beginning procedure</i>			
PRE-PROCEDURE	HALFWAY POINT <i>(Determined by number of passes completed/volume of blood exchanged)</i>	POST-PROCEDURE	FOUR (4) HOURS POST PROCEDURE
Arterial blood gas (VBG if only venous access) iCal	Arterial blood gas (VBG if only venous access) iCal	Arterial blood gas (VBG if only venous access) iCal	Arterial blood gas (VBG if only venous access) iCal
Basic Metabolic Panel Glucose	Basic Metabolic Panel Glucose	Basic Metabolic Panel Glucose	Basic Metabolic Panel Glucose
CBC with differential	CBC with differential	CBC with differential	CBC with differential
Neobilirubin			Neobilirubin
<b>Coagulation Studies:</b> PT PTT INR Fibrinogen			

#### IV. **Gather Supplies** for Procedure

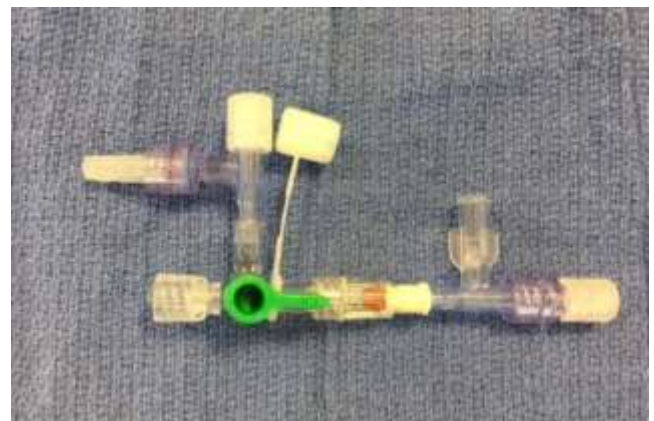
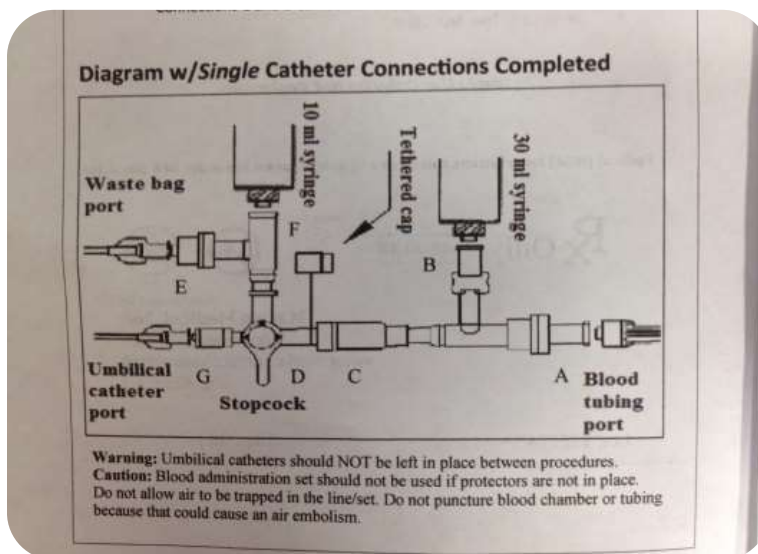
- A. One Neonatal Exchange Transfusion Kit (Marian Medical Inc)
  1. Shuttle
  2. 20mL syringe (for donor blood obtainment and distribution)
  3. 10mL syringe (for withdrawal and waste of patient's blood)
  4. Waste bag
  5. Blood tubing extension set
  6. Blood tubing with spike and blood micro-filter
- B. Use full barrier sterile precautions (sterile gloves and gown, hat, mask)

#### V. **Set-Up** the Equipment

### SETUP FOR PUSH-PULL METHOD USING A SINGLE CATHETER

#### Neonatal Exchange Transfusion Tray (Marian Medical, Inc)

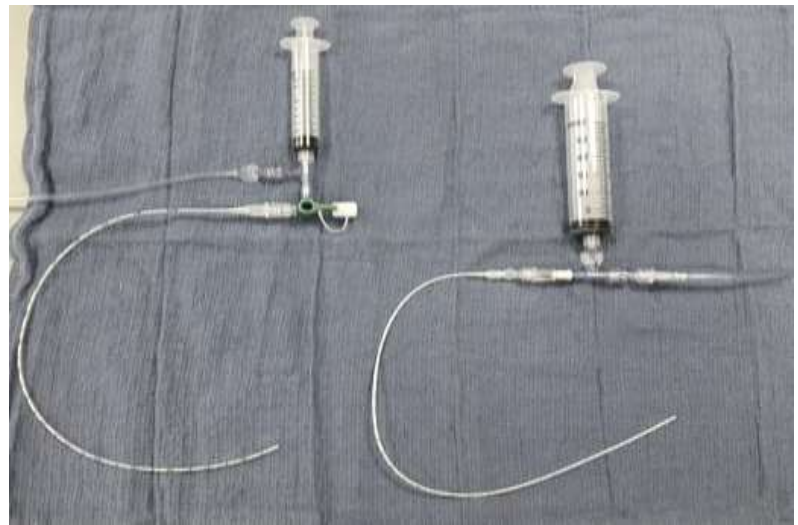
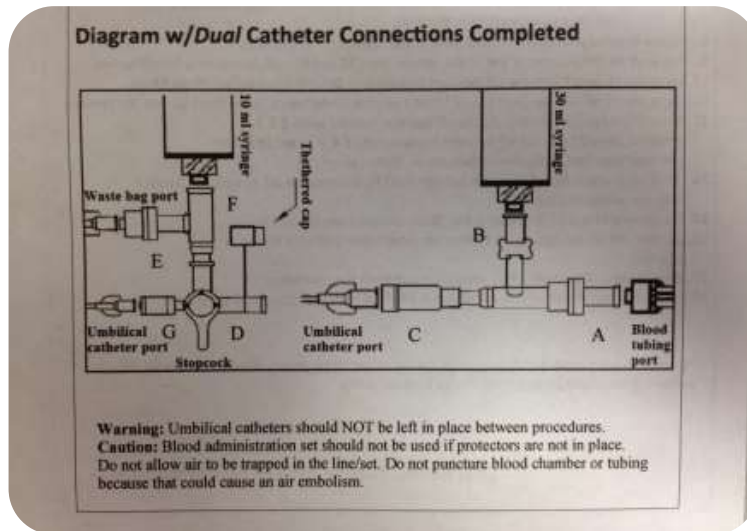
1. Connection set-up
  - A. FLL (female luer lock) blood tubing port with one-way check valve
  - B. Syringe port
  - C. MLL (male luer lock) port with one way check valve
  - D. FLL connection w/tethered cap
  - E. Waste bag port with one way check valve
  - F. Syringe Port
  - G. Umbilical Catheter Port



## SETUP FOR ISOVOLUMETRIC TRANSFUSION USING TWO CATHETERS

### Neonatal Exchange Transfusion Tray (Marian Medical, Inc)

1. Connection Set-up
  - A. FLL blood tubing port with one-way check valve
  - B. Syringe port
  - C. MLL port with one way check valve
  - D. FLL connection w/tethered cap (placed on)
  - E. Waste bag port with one way check valve
  - F. Syringe Port
  - G. Umbilical Catheter Port



## PROCEDURE

### VI. *Responsibilities*

#### A. **NURSING** responsibilities

1. Spike the donor blood bag with the blood tubing micro filter extension
2. Prime the blood tubing all the way to the end of the extension tubing
3. Ensure continuous pulse oximetry and cardio-respiratory monitoring
  - a. Obtain and record baseline vital signs
    - Temperature
    - Heart rate
    - Respiratory rate
    - Cuff blood pressure (preferably right upper extremity)
    - SpO2
  - b. Obtain and record vital signs every 15 minutes during procedure
4. Verbalize, record, and document the following:
  - a. One cycle:
    1. Time patient's blood is removed
    2. Volume of patient's blood removed
    3. Time the donor blood is given
    4. Volume of the donor blood given
5. Record time with a stop watch or using the Apgar timer
  - a. **Push / Pull Method**
    - One cycle should equal ~ 5 minutes
    - Volumes will be equivalent though not synchronously withdrawn and given
  - b. **Isovolumetric Method**
    - One cycle should equal ~ 5 minutes
    - Cycles should remain synchronous
6. Agitate the blood bag every 10 to 15 minutes to avoid red cell sedimentation
7. Obtain all laboratory values as required (See [Laboratory Schedule](#))
  - a. Additionally, obtain POC blood glucose values every 30-60 minutes
8. Participate in "call back" during the exchange to verify direction and flow of blood

**REMEMBER:**

*Each cycle should take ~ 5 minutes and don't replace more than 5 mL/kg per cycle*

#### B. **PROVIDER** responsibilities

1. Determine the number of passes needed to exchange the desired volume of blood
2. Connect the pieces of the exchange transfusion set
  - a. Single lumen = single shuttle device
  - b. Double lumen = divide shuttle device into two sections
3. Connect blood extension tubing (fully primed by nursing) to the shuttle
4. Connect syringes, secondary extension, waste bag
5. If infant is **hypovolemic** or has low CVP, start exchange with transfusion of aliquot into catheter. If infant is **hypervolemic**, start by withdrawing precalculated aliquot.

6. Collaborate with the team (second medical provider and nurse) to ensure clear communication with regard to the following:
  - a. Time patient's blood withdrawn
  - b. Volume of patient's blood withdrawn
  - c. Time of donor blood withdrawal
  - d. Volume of donor blood given
7. Maintaining access:
  - a. If the exchange transfusion will be stopped for > 3 minutes, the umbilical lines need to be flushed and heparinized to prevent clot formation
  - b. Intermittently flush arterial line with heparinized saline to clear (heparin solution remaining in tubing will be removed with next withdrawal, reducing the total heparin dose received by the patient)

#### VI. **Post Exchange Transfusion**

1. Flush the catheters completely and heparinize per unit policy
2. Obtain [LABS](#) upon completion of procedure and four hours after the procedure is complete
3. Obtain and record vital signs every 30 min x 4; then every 1 hour until 4-6 hours after the exchange has been completed
4. Follow glucoses every 2 - 4 hours for the next 24 hours
5. Keep infant NPO for a minimum of 4 hours
  - a. Restart enteral feeds when clinically stable
  - b. Record/monitor abdominal girth and bowel sounds every 4 hours during the next 24 hours
  - c. Monitor for signs of feeding intolerance

#### VII. **Complications**

- A. Metabolic:
  1. Hypocalcemia
  2. Hypo or hyperglycemia
  3. Hyperkalemia

**Plan:** Have electrolyte infusions readily available
- B. Cardiorespiratory:
  1. Apnea, bradycardia, desaturation events
  2. Hypotension or hypertension

**Plan:** Have intubation/ventilation supplies and cardioversion/defibrillation equipment available
- C. Hematologic:
  1. Thrombocytopenia
  2. Dilutional coagulopathy / DIC
  3. Neutropenia

**Plan:** Anticipate potential need for additional blood products
- D. Vascular (catheter related)
  1. Vasospasm
  2. Thrombosis
  3. Embolization

**Plan:** If unable to withdraw from the line during the procedure, pull the catheter back to 5 cm ("low lying" position) and finish the procedure

E. Gastrointestinal:

1. Feeding intolerance
2. Ischemic injury
3. NEC

**Plan:** Carefully restart trophic feeds four hours post transfusion at the earliest

F. Infection:

1. Omphalitis
2. Septicemia

**Plan:** Sepsis evaluation with potential for antibiotic therapy

**Reference:**

*Procedures in Neonatology, Fifth Edition.* Ed. MacDonald, M.G., Ramasethu, J. & Rais-Bahrami, K. Lippincott Williams & Wilkins. Philadelphia, PA.2013

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