UCSF Health

NEONATAL
NURSING PROCEDURE

EXCHANGE TRANSFUSION DOUBLE VOLUME – ICN

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Critical Points

1. Indications for a double-volume exchange transfusion (DVET) include:
    a. Hyperbilirubinemia: When serum bilirubin level reaches a level which places the infant at risk for central nervous system toxicity if left untreated, exchange removes bilirubin and provides plasma volume and albumin for bilirubin binding.
    b. Hemolytic disease of the newborn: This results from destruction of fetal red blood cells by passively acquired maternal antibodies. Exchange transfusion removes antibody-coated RBCs.
    c. Sepsis: Exchange can help remove bacteria, toxins, and acids and provide immunoglobulins, coagulating factors, and adult white blood cells.
    d. Disseminated intravascular coagulation (DIC): Exchange can provide coagulation factors and help reduce underlying etiology for abnormal coagulation.
2. DVET is performed by medical providers in the Intensive Care Nursery (ICN). Patients on Newborn Nursery or Pedi-Medicine teams need to be transferred to the ICN medical team for this procedure.
3. Blood for double-volume exchange is:
    a. CMV negative, irradiated, HbS negative, and washed
    b. ≤ 14 days old (≤ 5 days is preferred)
    c. Reconstituted by Blood Bank using packed red blood cells (RBCs) and plasma to reach a final hematocrit of approximately 50%
4. Exchange transfusion volume = [patient estimated blood volume (mL/kg, as below)] x [weight (kg)] x 2
    - Estimated blood volume in term newborns is 80ml/kg
    - Estimated blood volume of preterm infants is 100ml/kg

5. Aliquot volume for removal and infusion is determined by infant's weight. Ideal rate of withdrawal and infusion is 2-4 mL/kg per minute as tolerated by infant.

Infant's Weight (kg)	Aliquot Volume (mL)
<0.85	1-3
0.85-1	5
1-2	10
2-3	15
>3	15-20

6. The preferred route of exchange is through an umbilical venous catheter (UVC) and umbilical arterial catheter (UAC) in good placement. Refer to Umbilical Arterial Catheter (UAC) and Umbilical Venous Catheter (UVC) Nursing Procedure
    A. Peripheral Intravenous Catheter (PIV) may be used if a UVC is not available. A large bore PIV (22g) is preferred to decrease hemolysis.
    b. Peripheral Arterial Line (PAL) may be used if a UAC is not available.
7. Techniques:
    A. Isovolumetric exchange: A UAC or PAL is used to withdraw blood and venous catheter (UVC or PIV) is used to infuse blood. Two operators simultaneously withdraw and infuse blood to maintain cardiovascular stability.
        I. Preferred method: Umbilical arterial catheter to withdraw blood and umbilical venous catheter to infuse blood.
    B. Push/Pull technique: This method is used when only a single catheter is available. Determine volume for each aliquot and alternate instilling with removing blood and/or normal saline.
        ii. Instill the first aliquot before removing first aliquot.
8. Reconstituted RBCs used for the exchange is warmed using a warming device (Hotline HL-90) to a target of 37-38°C, not to exceed 38°C (at which point hemolysis can occur). Refer to Hotline HL-90 Blood & Fluid Warmer Procedure
9. Exchange transfusions are associated with an increased risk of infection due to repeated line access. A closed IV tubing system and aseptic technique will be utilized whenever possible. Sterile technique will be utilized for central

line insertion and during exchange procedure when a closed IV tubing system is not feasible (i.e., line will be directly accessed by provider without use of a needleless connector or microclave).

10. Duties are as follows:
    A. **Provider:**
        I. Obtains informed consent for procedure and blood administration**.**
        II. Orders reconstituted RBCs, fluids, medications, and laboratory tests for procedure**.**
        III. Withdraws aliquots of blood and administers aliquots of blood during the procedure**.**
        IV. Documents procedure in the medical record.
    B. **RN:**
        I. Prepares and assembles equipment and supplies**.**
        II. Provides 1:1 assessment and monitoring during and after procedure**.**
        III. Documents all fluids, medications, and blood aliquots administered and discarded throughout procedure and sends ordered labs**.**
11. Potential complications of a double volume exchange transfusion include:
    a. Rebound hypoglycemia due to increased insulin levels
    b. Hypoglycemia due to citrate preservative in donor blood
    c. Acidosis due to acid load in donor blood
    d. Alkalosis due to citrate in donor blood
    e. Dilutional thrombocytopenia due to low platelet count in donor blood
    f. Fluid overload, arrhythmias, and cardiac arrest due to elevated potassium levels
    g. Hypo- or hypertension, intraventricular hemorrhage (premature infant)
12. State Newborn Screen will be obtained prior to exchange transfusion. If drawing prior to 12 hours of life, newborn screen will need to be repeated 48 hours after DVET.
13. In order to avoid delay in diagnosing inherited disorders of hemolysis, please draw any blood for genetic studies (e.g., G6PD) prior to performing exchange transfusion.

Supplies

- Reconstituted RBCs as ordered per provider
- Soft tie restraints
- (2) Kit Closed Blood Sampling Safeset (Marvelous Valves Bonded) *(PMM 21945) (located in Blue Zone Procedure Supply room)*
- (3) IV Extension Set *(PMM 5944)*
- (1) Neonatal Transducer for arterial line *(PMM 9522)*
- (1) Blood Tubing Set with 150-micron filter *(PMM 133192)*
- Hotline® blood warmer *(located in Purple Zone Storage)*
- Hotline® fluid warming set (L-90) 20mL priming volume *(PMM 5929) (located in Blue Zone Procedure Supply room)*
- Waste container or absorbent pad for disposal of blood (e.g., empty plastic pitcher to place syringes that contain the blood aspirated from patient or place syringes on chux – to keep count)
- Goggles, gloves, gowns, masks for personnel performing the exchange

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- Exchange transfusion record in EHR
- Blue clamps
- Syringes (5-10ml, based on determined aliquot volume)

Procedure

PRE-PROCEDURE

1. Verify consent has been obtained for blood administration and exchange procedure.
2. Provider to order Reconstituted RBCs through Pedi Blood Administration Addendum order set.
3. Call Blood Bank to verify the order and determine if volume will be provided in in one or two aliquots. General turnaround time for 1st aliquot will be 2 hours.
4. Evaluate need for pre-procedure pain medications or sedation.
5. Patient should be NPO for 2 hours prior to exchange transfusion if possible. If not, aspirate stomach contents prior to beginning procedure.
6. Obtain ordered labs for pre-exchange evaluation (see Appendix C).
    a. If possible, pre-procedure labs should be drawn prior to procedure. Otherwise, labs should be obtained from first aliquot sample drawn.
7. Confirm volume of each “aliquot” for procedure with medical provider.
8. Assist with placement of vascular catheters for procedure, if not already in place.
9. Attach Safeset Closed Blood Drawing system and IV extension set to the UVC and UAC (if not already present).
    - UVC will be disconnected from transducer and IV fluid prior to exchange transfusion.
    - Double lumen UVC: Larger lumen will be used to instill blood, the smaller lumen will infuse IV fluids.
10. UAC will maintain transducer and IV fluid for intermittent blood pressure readings.
11. Obtain supplies and equipment.
12. Assemble supplies and equipment for Hotline warming device and prepare hotline tubing.
13. Spike reconstituted RBCs using 150-micron blood filter tubing set. The syringe will stay attached to the set but will NOT be used. Make sure stopcock is closed to the blood bag. Detach and discard the microbore tubing that comes with the set and attach blood filter set to Hotline tubing. (see Appendix A).
    a. If two bags of blood are needed, the same blood tubing and filter can be used. Change transfusion IV tubing every 4 hours or after 2 blood product transfusions. Refer to Blood Product Transfusion/Administration Nursing Procedure.
    b. Use the Additional Dispense Workflow to request second unit of reconstituted RBCs, if needed, from Blood Bank (refer to Apex Tip Sheet)
14. Add IV extension tubing to distal end of Hotline tubing for added flexibility in connecting to patient. Prime Hotline tubing and extension with blood and watch for leaks. Warm blood to approximately 38 °C. Refer to Hotline HL-90 Blood & Fluid Warmer procedure for warming instructions. Place infant in supine position with use of soft restraints for arms and legs (if needed). (see Appendix B)
15. Obtain set of baseline vital signs, including blood pressure, heart rate, respiratory rate, and oxygen saturation.
16. Perform Time Out.
17. Attach Hotline with extension tubing to UVC when ready to begin. Secure Hotline tubing, Safeset and transducer to bedding using blue clamps. (see Appendix B)

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DURING THE PROCEDURE

1. Confirm in and out volumes (aliquots) with provider verbally.
2. Attach appropriate size syringe to the proximal port of Safeset Closed Blood Drawing System on both arterial and venous lines.
3. To administer warmed blood, turn stopcock off to baby, open to the hotline tubing and draw aliquot volume into syringe. Turn stopcock off to the hotline tubing, open to baby to administer.
4. Withdraw and infuse blood aliquots simultaneously over recommended time frame of 2-4mL/kg/min.
5. Announce volumes as they are removed/infused (e.g., call out “10 mL out” and “10 mL in”). Document in Exchange Transfusion flowsheet.
6. Check blood glucose level using blood from first aliquot syringe unless pre procedure labs were drawn within last hour.
7. Document Vital Signs every 15 minutes (HR, RR, BP, O2 Sat) in Exchange Transfusion flowsheet.
8. Obtain labs during the procedure as ordered (see Appendix C). Generally, labs are sent after every 100mL drawn or at halfway point, whichever comes first. Use last aliquot syringe for post-procedure labs.
9. Administer Calcium Gluconate as ordered, generally 50 mg/kg to be administered over ten minutes. Flush line with saline before and after administration.
10. Monitor for signs and symptoms of hypocalcemia, which include prolonged QT interval, tachycardia, jitteriness, and extreme irritability.

POST-PROCEDURE

1. Send post-procedure labs as ordered (see Appendix C) from last aliquot syringe.
2. Document vital signs every 15 minutes for one hour then continuously monitor until 4 hours post-procedure, documenting vital signs per ICN Standards of Care.
3. Monitor blood glucose as ordered, generally at 15 minutes, 30 minutes, 60 minutes post-procedure then hourly until stable.
4. Infant should remain NPO for at least four hours post-procedure or as otherwise ordered by medical provider. Monitor closely for potential early signs of necrotizing enterocolitis, such as abdominal distension and bloody stools.
5. Resume or start phototherapy per order.

DOCUMENTATION

1. Scan blood product and document blood product verification in the EHR within the Blood Administration flowsheet.
2. Document all infused and discarded blood in the Exchange Transfusion flowsheet.
3. Confirm documentation in EHR for labs obtained, medications and fluids administered, and patient tolerance to procedure.
4. Medical provider to document procedure in medical record.

Troubleshooting

Problem	Suspected issue	Action
Provider has difficulty drawing up blood aliquot from blood product bag on infusing line for administration to patient.	• A clamp remains engaged along the tubing from the blood product bag to the infusing Safeset. • There is a break or leak along the tubing from the blood product bag to the infusing Safeset. • There is a blood clot occluding the tubing or the stopcock of the Safeset.	• Check all clamps and tubing connections from the blood product bag to the infusing Safeset. • Check tubing and Safeset stopcock for visible blood clots. Aspire clot(s) through Safeset stopcock if possible. • Replace any defective (leaking, cracked, etc.) tubing components, or components that cannot be cleared of blood clots, as aseptically as possible.
Provider has difficulty drawing up blood aliquot from patient on withdrawal line.	• A clamp remains engaged along one of the extension sets in between the catheter and the withdrawing Safeset. • There is a clot within the catheter, tubing, or Safeset stopcock. • Catheter tip in not in ideal placement.	• Check extension set clamps and direction and function of Safeset stopcock. • Provider may flush line carefully from the flush port of the withdrawing Safeset to assess patency of the catheter. • Provider may re-verify catheter tip placement by ordering a line placement x-ray.

References

Level of Evidence (FAME*)	Level*	Reference
	E4	Gardner, S.L., Carter, B.S., Enzman Hines, M. & Hernandez, J.A. (Eds.). (2016). Merenstein & Gardner's Handbook of Neonatal Intensive Care, 8th Edition (pp 533-534). Elsevier.
	E4	Falciglia, H.S. and Greenwood, C.S. (2013). Double volume exchange transfusion: a review of the "ins and outs". NeoReviews 14 (10), e513-520.
	E4	Murki, S., & Kumar, P. (2011). Blood Exchange Transfusion for Infants with Severe Neonatal Hyperbilirubinemia. Seminars in Perinatology, 35(3), 175-184. doi:10.1053/j.semperi.2011.02.013
	E2	Wani, M. I., Nazir, M., Lone, R., Rafiq, M., Ali, S. W., & Charoo, B. A. (2018). Impact of Double Volume Exchange Transfusion on Biochemical Parameters in Neonatal Hyperbilirubinemia. International Journal of Pediatric Research, 4(2). doi:10.23937/2469-5769/1510038

* FAME Scale details: See nursing policy *Policy, Procedure, & Competency Development, Review, & Approval*

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Procedure History

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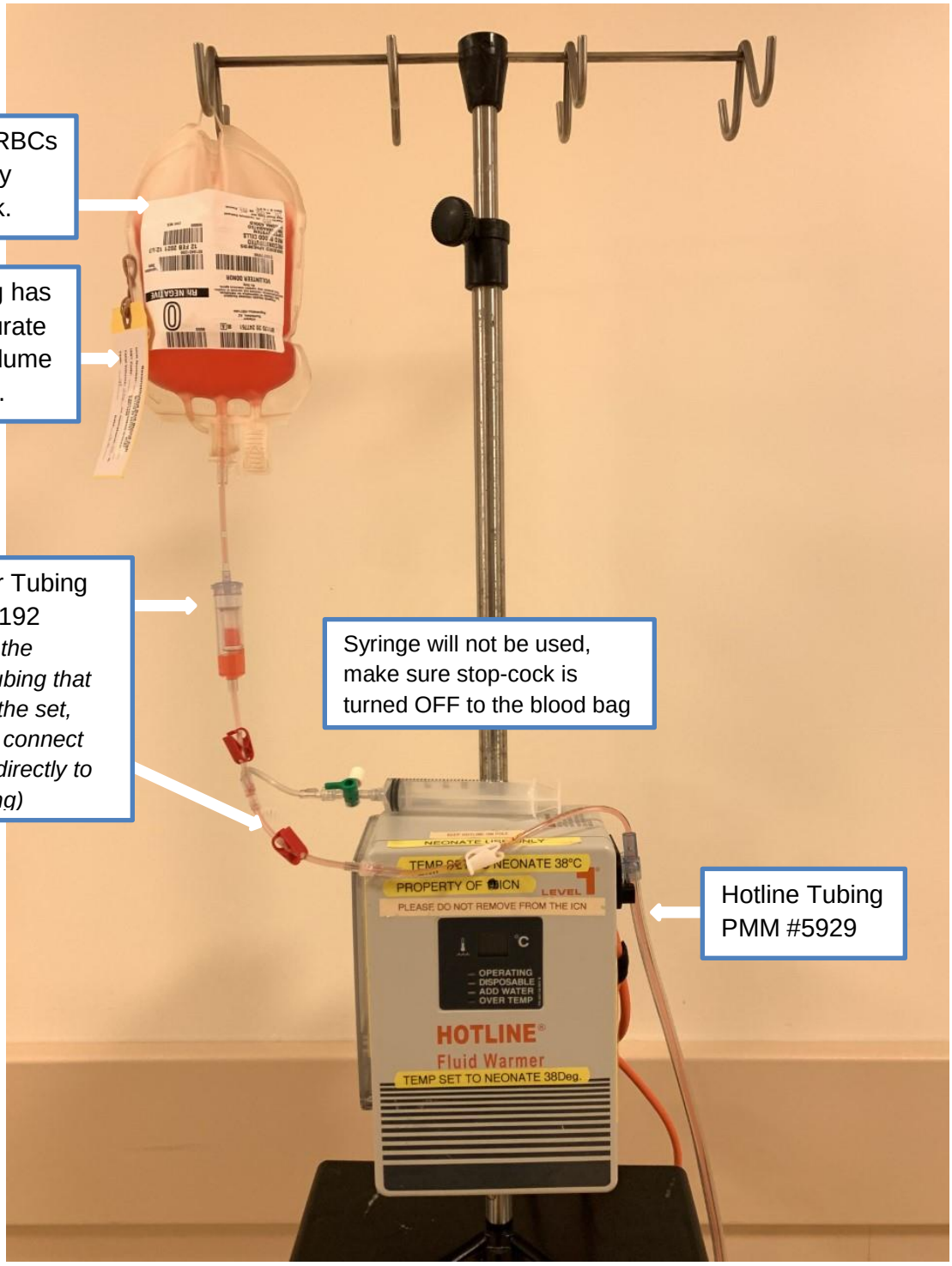
Appendix A: Picture of Blood Warmer Set-Up



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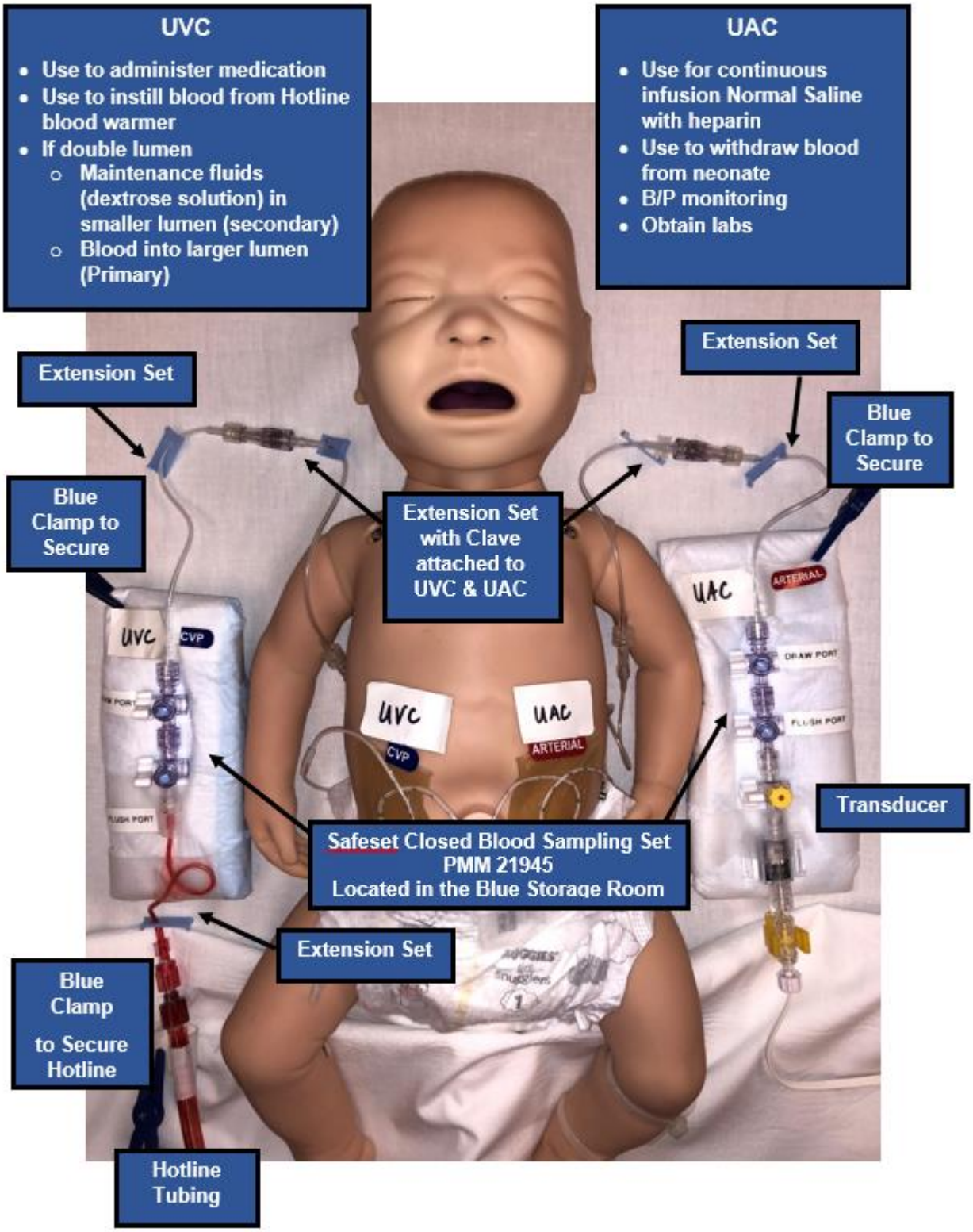
Appendix B: Picture of Baby Receiving Procedure



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Appendix C: Laboratory Studies Pre/During/Post Procedure

Pre-Procedure:

- Type and screen (if not already done)
- Blood gas with electrolytes and ionized calcium
- Blood glucose
- HCT
- Total and direct bilirubin
- Platelet count
- Newborn Screen (if not already done)

During Procedure:

After 100mL drawn or halfway point (whichever comes first) then after every additional 100mL drawn:

- Blood gas with electrolytes and ionized calcium
- Blood glucose

Post-Procedure:

Immediately post-procedure (obtain from last aliquot syringe):

- Blood gas with electrolytes and ionized calcium
- Blood glucose
- HCT
- Platelet count

- **Blood Glucose:** 15 minutes post-procedure, 30 minutes post-procedure, 60 minutes post-procedure, and then hourly until stable

- **Total Bilirubin:** 2 hours post-procedure, 4 hours post-procedure, 6 hours post-procedure