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Neonatal Exchange Transfusions - Dearborn Blood Bank

Document Type: Procedure

I. PURPOSE AND OBJECTIVE:

This document is to provide policies and procedures that will be applied when preparing blood for exchange transfusion of infants from birth through four months old.

II. CLINICAL SIGNIFICANCE:

A. Group O, Rh(D) compatible red blood cells (RBCs) are resuspended in group AB plasma by the Blood Bank. The combined RBCs and plasma product is simultaneously infused as the infant's blood is withdrawn. The exchange is performed by a manual method (push-pull method or isovolumetric method).

III. SCOPE:

This document applies only to infants **from birth through four months old**. Exchange transfusion of these infants may be indicated in cases of hemolytic disease of the newborn and/or hyperbilirubinemia. Occasionally an exchange transfusion is used to eliminate toxins, drugs, or other chemicals when they have been administered to the mother near the time of delivery, when toxic doses have been administered to the infant, or if they accumulate at high levels in the infant as a result of prematurity and/or an inborn error of metabolism.

IV. DEFINITIONS/ACRONYMS:

A. BBIS: Blood Bank Information System

B. CMV: Cytomegalovirus

C. Special transfusion requirements: a patient's need for a component that has been modified or

that contains special attributes; i.e., irradiated or antigen negative.

D. FFP: Fresh Frozen Plasma ; plasma that has been frozen within 8 hours of phlebotomy.

E. FP24: plasma that may be frozen up to 24 hours after phlebotomy.

F. RBC: Red blood cell product

G. Thawed plasma: refers to thawed FFP or FP24 (more than 24 hours after thawing) that has an expiration date of 5 days from the time of thawing. Thawed plasma may have a reduced concentration of Factors V and VIII.

V. POLICIES:

A. **Selection of the RBC Unit used for Infant Exchange Transfusion**
A standard neonatal RBC unit should be used for all infant exchange transfusions. The RBC unit should be

1. less than 8 days old (if possible)
2. Irradiated
3. Group O
4. Rh negative
5. Leukocyte Reduced
6. CMV Negative
7. Hemoglobin S (Sickle Cell) negative

B. **Compatibility Testing with the RBC Unit used for Infant Exchange Transfusion**

1. Red cells selected for exchange transfusion of a neonate must always be compatible with the mother, and negative for the antigen against any clinically significant antibodies detected/present in either the neonatal or maternal record. These RBC should be crossmatched in the same manner as they would be for the mother.
2. If the exchange transfusion is due to anti-D, order group O Rh negative blood; if for another antibody, order a group O red cell negative for the corresponding antigen.
3. Red cells for exchange transfusion must be fresh (<8 days old, if possible), leukoreduced, group O, CMV negative, irradiated, and collected in citrate phosphate dextrose (CPD) anticoagulant.
    a. Normal inventory red cells with adenine-saline (AS-1 or AS-5) solution have excessive amounts of mannitol and are not suitable for exchange transfusion without washing.
    b. If no CPD unit is available, a washed unit will need to be obtained from Corewell Health Royal Oak or Versiti.
4. For neonates (less than four months old), refer to Transfusion Medicine policy, Neonatal Compatibility Testing Guidelines.
    a. If there is no history of maternal antibodies a serological crossmatch is not necessary and a Neonatal Assignment crossmatch Test ID (NEO)

should be resulted in the BBIS.

5. For infants greater than four months old and less than one year old, policies and procedures outlined in Transfusion Medicine policies, RBC Crossmatch Guidelines apply.

C. **Policies relating to the Plasma used for Infant Exchange Transfusion**

1. Group AB plasma must be used.
2. Plasma that has been thawed in the 24 hours preceding dispense must be used to reconstitute the RBCs for an infant exchange transfusion.
    a. A freshly thawed unit of AB fresh frozen plasma will be used that has been modified in the BBIS using the "THAW24" modification code.
    b. This policy was adopted to ensure that the plasma used for neonatal transfusion is freshly thawed within 24 hours. Plasma that has been thawed for greater than 24 hours may have a reduced concentration of Factors V and VIII.

D. **Expiration Date / Time of the Reconstituted Component (Pooled Plasma with RBCs) Used for the Infant Exchange**

1. The expiration date / time of the reconstituted component shall be the shorter of:
    a. 24 hours from the time that the RBCs were pooled (time of spike); see step 12 of the Procedure, or
    b. The expiration date / time of any of the original components that were pooled together to make the reconstituted component.

E. **Documentation on the Infant Exchange Transfusion Worksheet**
The *Infant Exchange Transfusion Worksheet* will be used to document the preparation of the pooled product and will be submitted for supervisory review by a Medical Technologist Lead/ Supervisor.

F. **Documentation of all Welds/Seals**

1. All welds made with the sterile connection device must be inspected for proper alignment. Once the weld is opened, the tubing is inspected for leakage.
2. All seals made with the heat sealer must be inspected for leakage.
3. These inspections are documented on the *Infant Exchange Transfusion Worksheet*.

VI. SPECIMEN COLLECTION AND HANDLING:

Both a neonatal and maternal sample (if available) will be tested. All samples must meet the requirements found in the Transfusion Medicine Policies Triaging and Identifying Acceptable Samples for Testing and Forward Typing Determination of Neonatal ABO and Rh for Patients Less than Four months of Age by Tube Method.

A. **Neonatal Sample Requirements:**

1. Samples may be a capillary sample or may be drawn into an EDTA tube, with affixed

identifying label.

2. Cord blood samples are unacceptable for transfusion purposes.

B. **Maternal Sample Requirements:**

1. The specimen of choice is 6 ml EDTA sample with affixed identifying label.
2. Samples drawn in serum separator tubes are generally not acceptable.

VII. EQUIPMENT:

A. Heat sealer
B. Sterile Connecting Device
C. Plasma Bath
D. Digital Scale
E. Safety Glasses/Shield

VIII. SUPPLIES:

A. Hemostats or clamps
B. Transfer tubing

IX. QUALITY CONTROL:

Quality Control must be performed on day of use for the following:

A. Digital Scale
B. Weld acceptability on the Sterile Connecting Device (each instant of use)

X. PROCEDURE:

A. Before you get started

1. Obtain from the patient's physician the following information:
    a. The name and extension of the physician or registered nurse (RN) who will be our main contact during product preparation.
    b. The time at which the infant exchange transfusion will be performed; this time and the expiration time of the reconstituted whole blood must be considered.
    c. The total volume of reconstituted whole blood requested for transfusion to the infant. An additional 60 mL will be added to this volume to account for dead space in the transfusion tubing. Note: Depending on the volume desired it may be necessary to reconstitute more than one unit in order to obtain the required volume of reconstituted whole blood, for example if a double exchange is requested for the infant.
    d. The desired hematocrit of the final reconstituted product. If the physician is unsure

of the desired hematocrit then ask him or her whether a hematocrit of approximately 55% is acceptable, which is typical for an infant exchange transfusion. Note that the desired hematocrit is used *to* determine the weight of plasma to add to the RBC Unit.

B. Preparation of Blood for Neonatal Exchange Transfusion

1. Obtain a fresh unit of RBCs (less than 8 days old, if possible) and complete any required compatibility testing with the unit.
   Refer to the above policies, *Selection of the RBC Unit used for Infant Exchange Transfusion*, and *Compatibility Testing with the RBC Unit used for Infant Exchange Transfusion.*

   Note: If unexpected antibodies are detected present/in either the neonatal or maternal record (current or historical) then the RBC must be negative for any clinically significant antibodies and should be crossmatched in the same manner as they would be for the mother.
2. Irradiate the RBC unit if not already done; modify the RBC in the Blood Bank computer to reflect irradiation.
   Refer to Transfusion Medicine Policy, Irradiation of Blood Components Using the RadSource RS3400 Blood Irradiator
3. Determine the weight of the RBC. Refer to Transfusion Medicine policy, Weighing Blood Products.
4. If time allows, create new segment(s) from the well-mixed RBC unit and take to hematology for a hematocrit as described in steps 13-14 below. If time does not allow, assume hematocrit of 70%. Document on the *Infant Exchange Transfusion Worksheet*.
5. Determine the weight of plasma that will be used to reconstitute the RBCs using one of the following methods.
   a. Refer to the attached nomogram for reconstituting a unit to the desired hematocrit to obtain the volume of plasma to add.
      i. If the weight falls between two numbers on the nomogram, use the smaller volume of plasma
   b. Use the calculation formula on the *Infant Exchange Transfusion Worksheet.*
6. Select and thaw a unit of AB fresh frozen plasma.
   a. In Modification Batch in BBIS, modify the plasma using "THAW24" modification.
   b. Verify the ISBT label and save for labeling the reconstituted whole blood product.
7. Select the RBC and freshly thawed plasma under the appropriate product orders.
8. Use the sterile connection device to attach a transfer pack to the thawed FFP. Refer to Transfusion Medicine Policy, Sterile Connection Device - Operation, Quality Control & Maintenance.
9. Divide the unit of plasma into 2 bags. Refer to Transfusion Medicine Policy, Aliquot Preparation.

a. Plasma Bag 1: contains the plasma that will be used to reconstitute the RBCs (weight was calculated in step 9). Make sure to leave enough tubing attached to the plasma bag for the pooling process.

b. Plasma Bag 2: contains the remainder of the plasma.

10. Modify the plasma in the BBIS to reflect the division.
11. Reprint a 2nd ISBT label for Plasma Bag 1. (This label will be eventually be used in final labeling of reconstituted product in Step 16 below.)
12. Physically pool the RBC and plasma bag 1 as follows:
    a. Make sure you are using proper eye protective device (safety glasses or full face shield before proceeding
    b. Place the RBC unit on the scale.
    c. Hold or hang the unit of plasma (plasma bag 1)above the unit of RBCs.
    d. Using a sterile double spiked transfer set, clamp off the tubing using the pinch roller or a hemostat and aseptically insert one end of the transfer tubing into the bag containing the RBCs, the other end in to the thawed plasma.
    e. Open the pinch roller slowly and allow the plasma to flow into the unit of red blood cells until it reaches the final weight determined in step 4 for the reconstituted RBC.
    f. Close off the pinch roller; mix the newly reconstituted unit thoroughly. Reverse the position of the plasma and the reconstituted unit so that that unit is higher than the plasma.
    g. Open the pinch roller slowly and allow the well-mixed blood to flow back towards the unit of plasma; when the blood reaches the plasma unit, close off the pinch roller.
    h. Seal off the tubing at both the reconstituted unit and plasma side of the transfer set.
    i. Create several segments of well-mixed pooled blood product near the unit end to use for a hematocrit test.
13. Label a plastic test tube or plain microtainer with the donor number, cut several segments, and empty the contents of two or three segments into the tube/microtainer.
14. Take this tube to Hematology and ask for a hematocrit of the unit.
    a. Label the printout obtained from lab with the donor unit number.
    b. Record the results on the *Infant Exchange Transfusion Worksheet*.
    c. The actual hematocrit should be +/- 5% of the desired hematocrit. i.e (50 – 60% for a requested 55% hematocrit)
    d. If the actual hematocrit is not within 5%, contact the attending physician to approve the actual hematocrit.
15. Confirm the final volume of the reconstituted unit.
    a. If the final volume of the unit is 100 mL or short of the total volume needed, consult with the ordering physician to see if it necessary to confirm it is necessary to prepare additional units.

16. The new product now has a new expiration date and time. Refer to Policy, *Expiration Date / Time of the Reconstituted Component (Pooled Plasma with RBCs) Used for the Infant Exchange* above to calculate. Update the RBC unit expiration in BBIS to the new expiration date /time.
    a. Inventory Search > Product ID.
    b. Click *More Details* drop down.
    c. Click *Edit Component* button.
    d. Update the expiration.
    e. Reprint and Verify Product Label.
17. Add a note in the BBIS to the RBC component information stating, "RBC reconstituted with [FFP unit number and product code]".
18. Labeling: In addition to the existing RBC labels on the pooled unit, label the back of the now reconstituted whole blood with the FFP ISBT label for plasma bag 1 retained in Step 11.
19. Assign the FFP unit and RBC unit with appropriate crossmatch (serological vs NEO) to the patient in the BBIS.
    a. Transfusion tags should print for the red cell product and for the FFP aliquot.
    b. Attach both transfusion tags to the reconstituted product.
    c. When issuing, both the RBC and FFP units will need to be issued in the BBIS.
20. Complete the Infant Exchange Transfusion Worksheet, and staple it to the hematocrit results of the unit. Submit these to the Lead Medical Technologist /Supervisor for review.
21. If necessary, repeat all steps of the Procedure to obtain the final volume of reconstituted whole blood requested by the patient's physician.

XI. EXPECTED VALUES:

A. The actual hematocrit of the reconstituted unit should be +/- 5% of the desired hematocrit.

XII. REFERENCES:

1. AABB, *Technical Manual*, current edition.
2. AABB, *Standards for Blood Banks and Transfusion*, current edition.
3. College of American Pathologists, *Transfusion Medicine Checklist*, current edition.

Attachments

Infant Exchange Transfusion Worksheet (rev. 10/18/2024)

Nomogram for Reconstituting Packed RBCs for Infant Exchange Transfusion (rev. 10/04/2024)

Approval Signatures

Step Description	Approver	Date
	Jeremy Powers: Chief, Pathology	10/23/2024
Policy and Forms Steering Committe (if needed)	Kelly Sartor: Mgr, Division Laboratory	10/21/2024
	Kelly Sartor: Mgr, Division Laboratory	10/21/2024
	Christopher Ferguson: Dir, Lab Services	10/21/2024
	Kelly Sartor: Mgr, Division Laboratory	10/21/2024

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Patient
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Infant Exchange Transfusion Worksheet

Product prepared by tech / date: _____

Calculation used to Determine the Weight of Plasma to Add to the RBC Unit
Determine the weight of plasma to add to the washed RBC unit by using the following calculation and the values in the table below; an example is included.

Variable	Description of the Variable	Example	Document Current Values
W	The weight of thawed plasma that will be added to the RBC unit.	The calculation indicates that W = 69 g.	
X	The desired hematocrit of the final reconstituted product. This value will be obtained from the patient's physician.	55%	
Y	Net weight of the RBCs. The net weight = the total weight (including bag) minus the weight of the bag.	210 g	
Z	The hematocrit of the RBC unit (obtained from Hematology, if time allows, or assumed to be 70%)	73%	
Unit # of RBC used:			
Unit # of FFP used:			
Pooled Product Expiration Date / Time (refer to the reverse side of this form for details):			
Total Volume of Pooled Unit:			
SCD wafer lot # or Mfg. & lot # of the transfer tubing used to pool products:			
Inspection of all tubing seals and welds: S for satisfactory or U for unsatisfactory. (S or U / Initials / Date)			

Example:
W = ((Z / X) – 1) (Y)
W = ((73 / 55) – 1) (210g)
W = (1.327 - 1) (210g)
W = (0.327) (210g)
W = 69 g

- Weights of empty bags: approximately 15 g for a 150 ml transfer bag 25 g for a 300 ml transfer bag, and approximately 30 g for a 600 ml Standard RBC unit bag.
- Attach the Hematology printout(s) to this completed form and submit for supervisory review (Medical Tech Lead/Supervisor)

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Patient
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Infant Exchange Transfusion Worksheet

Verify the Following Steps:	Performed / Documented:
Name and extension for RN / Physician requesting exchange transfusion, and the time they called Blood Bank: (Name / extension / time called)	
Give best estimate for the time required for products to be ready (usually at least 1 hour): (✓ / tech)	
Desired hematocrit (Hct) obtained from physician: (%)	
Desired total volume obtained from physician: (volume in ml)	
RBC is fresh, CMV & Sickle Neg,& irradiated prior to pooling: (✓ / tech)	
Hematocrit of RBC unit: (%) Gently and thoroughly mix the RBC unit and create a new segment to take to Hematology for a hematocrit. **Do not use a segment splitter device.** Attach hematology printout. *If time does not permit, assume Hct = 70%	
Net weight of the RBC unit: (weight in grams)	
Modify the RBC volume in the Blood Bank computer system to reflect net weight obtained: (✓ / tech)	
Use the RBC net weight, the RBC Hct, and the desired Hct to calculate the required volume of FFP using the equation on the front of this form: (volume of FFP in ml)	
Fresh AB FFP thawed and modified with THAW24 code in the Blood Bank computer system: (✓ / tech)	
Divide the fresh FFP to get the required volume for pooling. Document the division on the *Blood Product Division / Aliquot Preparation Log.* (✓ / tech)	
FFP modified in the BBIS to reflect product division. (✓ / tech)	
Pool the RBC and FFP aliquot. Mix well and create a new segment for obtaining hematocrit. Attach hematology printout. (✓ / tech)	
Hematocrit of the pooled product (obtained from Hematology) (%)	
Add a note in the BBIS to the RBC unit with details of FFP used to reconstitute. (✓ / tech)	
Update the expiration date/time of the RBC and FFP aliquot in the BBIS as needed to reflect the shorter of the following: • 24 hours from the time the time of pool. • The expiration time of the either product if it became an open system and expires before. Reprint and verify label(s), if necessary. (✓ / tech)	
Place the FFP aliquot label (FFP aliquot pooled with RBC) on the back of the now pooled product. (✓ / tech)	
Print the P-Tags for both products and affix both tags to the pooled product. (✓ / tech)	

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Nomogram for Reconstituting RBC Packed Cells for Infant Exchange

Desired Hct %	Initial Bag Weight	Plasma to Add	Final Bag Weight
40	250	169	419
40	270	184	454
40	290	199	489
40	310	214	524
40	330	229	559
40	350	244	594
40	370	259	629
40	390	274	664
40	410	289	699
40	430	304	734
40	450	319	769

Desired Hct %	Initial Bag Weight	Plasma to Add	Final Bag Weight
45	250	125	375
45	270	136	406
45	290	147	437
45	310	158	468
45	330	169	499
45	350	181	531
45	370	192	562
45	390	203	593
45	410	214	624
45	430	225	655
45	450	236	686

Desired Hct %	Initial Bag Weight	Plasma to Add	Final Bag Weight
50	250	90	340
50	270	98	368
50	290	106	396
50	310	114	424
50	330	122	452
50	350	130	480
50	370	138	508
50	390	146	536
50	410	154	564
50	430	162	592
50	450	170	620

Desired Hct %	Initial Bag Weight	Plasma to Add	Final Bag Weight
55	250	61	311
55	270	67	337
55	290	72	362
55	310	78	388
55	330	83	413
55	350	89	439
55	370	94	464
55	390	100	500
55	410	105	515
55	430	110	540
55	450	116	566

Desired Hct %	Initial Bag Weight	Plasma to Add	Final Bag Weight
60	250	38	288
60	270	41	311
60	290	44	334
60	310	48	358
60	330	51	381
60	350	54	404
60	370	58	428
60	390	61	451
60	410	64	464
60	430	68	518
60	450	71	521

Desired Hct %	Initial Bag Weight	Plasma to Add	Final Bag Weight
65	250	17	267
65	270	19	289
65	290	20	310
65	310	22	332
65	330	23	353
65	350	25	375
65	370	27	397
65	390	28	418
65	410	30	440
65	430	31	461
65	450	33	483

This chart is based on a approximate starting hematocrit of 70% for CPD/CPDA units. The weights in this chart include the total weight of produ weight of the bag itself (approximately 25g for a 600mL product bag).

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Nomogram for Reconstituting RBC Packed Cells for Infant Exchange

Troubleshooting the plasma volume

·If the weight is between two numbers, use the lower weight to determine the plasma to add

·If the weight of the unit is not on the chart, add 1 mL of plasma per 5 gm of packed red blood cells.

Use the RBC net weight (the total weight (including bag) minus the weight of the bag), the RBC Hct obtained from hematol attaching sample collection tubing with the sterile docker, and the desired Hct to calculate the required volume in grams of the equation below.

Formula: $$Amount\ of\ FFP = \left(\frac{Hct\ of\ packed\ RBC}{Desired\ Hct\ of\ resuspended\ unit} - 1\right) \times Wt.\ of\ RBC$$