EXCHANGE TRANSFUSION

Consult Transfusion Medicine Protocols for more detailed information as required.

This technique changes the composition of the circulating blood by adding or removing one or more of its constituents, whilst maintaining a constant or nearly constant blood volume. Advocated for infants with:

- Hyperbilirubinaemia (Rhesus/ABO incompatibility) to prevent kernicterus
- Anaemia/ Hydrops
- Polycythemia ie. partial exchange
- Hyperkalaemia
- Drug toxicity/overdose
- Disseminated intravascular coagulation
- Maternal Antibodies

KEY POINTS

- Talk to the parents. Obtain and document consent (MR417). Be aware of issues relating to religious beliefs. A WNHS Leaflet ‘Blood Transfusion for your Baby’ is available for the parents to read. Parents may stay with their infant during an exchange transfusion at the discretion of the medical staff involved.

- For further information regarding types of donor blood to use consult Transfusion Medicine Protocols

- The infant should be NBM and a gastric tube inserted. Gastric contents should be aspirated and the tube left insitu to open drainage. Infant may vomit (especially if ionised calcium low).

- Ensure blood warmer is set at correct temperature to ensure that the blood being infused is between 35 and 37°C.

- Infant should not need sedation but should be stable prior to starting. If appropriate use a means of restraint. – e.g. ‘Circumstraint’ (moulded plastic tray in which the infant’s limbs can be immobilised comfortably to reduce sudden movement.)

- A checked resuscitation trolley must be nearby. If the infant's condition deteriorates acutely for any reason, the procedure must be suspended pending involvement of the consultant on call. Continuous monitoring in required.

- If essential infusion line interrupted – insert separate IV line

- If the exchange has to be stopped for any reason, always leave anti coagulated-donated blood in the line. Always leave the infant's blood volume in balance - i.e. volume removed = volume replaced.
Perform bedside administration check and monitor and record observations as per WNHS hospital policy. Consult Transfusion Medicine Protocols for more detailed information as required.

THE EXCHANGE EQUIPMENT

The volume of blood required for exchange is dependent on the reason for the exchange.

1. Single blood volume exchange for anaemia:
   - Term infant – 80 -100mls /kg
   - Preterm infant – 100mls/kg
   Volume exchanged (ml) = Wt (kg) x Blood Volume x (Hb desired – Hb initial)
   Hb of red blood cells – Hb initial

2. Double volume exchange for jaundice: (Approx 2 x 85 mls/kg)
   - Term infant – 200 -250 mls/kg or 80 – 85 mls/kg x 2/3
   - Preterm infant – 300 mls/kg or 100 – 120 mls/kg x 2/3

3. Partial exchange for polycythemia (using normal saline)
   Volume exchanged(ml) = (Wt in kg) x (Blood volume) x (Hct of patient–DesiredHct)
   Hct of patient

PROCEDURE

An exchange transfusion is a sterile aseptic technique procedure and can be carried out using either of two techniques. The likelihood of an uncomplicated exchange is increased if care is taken to have good arterial and venous access, and to have all equipment checked and ready prior to commencing.

1. The 'PUSH-PULL METHOD' via a catheter in a major vessel, usually performed through the umbilical vein. Involves the serial withdrawal and injection of aliquots (5-20 mls). Each cycle should take about 1min. This is the traditional method, not often used now except when arterial access is a problem. Takes 60 – 120 minutes.

2. The 'ISOVOLUMETRIC METHOD' is the slow removal of aliquots (10mls usually) from an artery (central or peripheral) and simultaneous infusion into a vein (central or peripheral). This is the preferred method as it should not cause wide fluctuations of blood volume and pressure. Takes 60 – 90 minutes.

Use first ‘out’ specimen for testing purposes depending on the diagnosis and results from previous investigations:
- Haemoglobin, film, PCV
- Group, Rhesus, Direct Coomb’s test
- PGL
- Urea and electrolytes, calcium, SBR, total and conjugated
- Blood gas
- Coagulations profile
- Newborn screening test
- Hold samples for other tests as indicated, eg. G6PD deficiency, Viral infection, hereditary spherocytosis, metabolic studies.
SET-UP FOR PUSH-PULL METHOD
- UAC tray and catheters
- Sterile drapes
- Blood administration set
- 3-way taps X 2 (white blood in, red for blood out to waste)
- Exchange transfusion recording sheet
- Blood warmer with appropriate coil
- Extension tubing, long - must be wide bore
- Drainage connecting tube
- 5ml, 10ml, and 20ml syringes depending on size of aliquots to be used
- Waste bag
- Calcium gluconate 10% ampoules
- Heparin ampoules 1000 IU/ml or heparinised NaCl 0.9% 50 ml syringe

THE FOLLOWING REFERS TO THE 'PUSH-PULL METHOD'
1. Insert umbilical venous catheter (No 8 in bigger infants, No 5 in smaller). Find a depth where blood is easily withdrawn.
2. Connect giving syringe (size determined by required volume of aliquot's: 5ml /kg ) to two 3-way taps in sequence. (diagram)
3. Connect the line from the blood pack to the proximal tap, and the line to the waste bag to the distal tap.
4. Prime system from blood pack. Withdraw first aliquot with speed rate of 2-3 mls/kg minute (accurately to volume of syringe). Announce "XXmls OUT"; nurse records.
5. Fill syringe accurately from blood pack via proximal tap.
6. Turn taps to allow injection of the aliquot into infant. Announce "XXmls IN"; nurse records. If infant hypovolaemic may start with small aliquot IN first
7. The next 'out' is sent to the waste bag by turning taps appropriately.
8. ‘Ins' and 'Outs' are repeated sequentially.
9. The nurse records every 'In' and 'Out', keeping running totals.
10. Ensure full observations are carried out 15minutely.
11. The nurse announces the running total every 100mls.
12. Consideration is given on whether to give calcium gluconate. Donor blood citrate reduces circulating ionised calcium, causing tachycardia, tall T waves, Q-Tc interval ↑, irritability, vomiting, and apnoea.
13. If calcium is indicated (tachycardia with Peaked T waves) give 1-2 mls of Ca gluconate 10% solution (1ml 10% Calcium gluconate / Kg). INJECT SLOWLY. OBSERVE HEART RATE. GO SLOWER IF RATE DROPS TOWARD 100/MIN. WATCH ECG. Clear line with NaCl 0.9% before continuing with transfusion
14. NB. CALCIUM is not always required and rapid infusion of calcium can cause asystole and clot donor blood.

15. The pack containing the blood being infused should be gently agitated every 5 minutes during the transfusion. This will prevent settling of red blood cells. The supernatant of settled blood leaves the infant anaemic at the conclusion of the exchange.

16. Repeat this process until exchange transfusion complete.

17. Finish in exact balance (or in positive balance if advisable)

18. Collect ‘last out’ specimens for testing as indicated.

**SET-UP 2 UAC/UVC ISOVOLUMETRIC METHOD**
- UAC tray with catheters
- Alaris blood giving set Ref 72980E with dual bag insertion spikes
- Alaris pump
- Ascena syringe pump
- Long extension lead x 2
- Blood warmer with appropriate coil
- Short extension
- 2 x 3 way taps, one red (white blood in, red blood to waste)
- 10ml luer lock syringe
- 30ml syringe x 1
- 50 ml syringe x 1
- Drainage bag and connection 74.5220.007
- Heparinised Saline syringe (pharmacy prepared)
- Calcium Gluconate 10% ampoules

**THE FOLLOWING RELATES TO ISOVOLUMETRIC EXCHANGE TRANSFUSION**
1. Commence infusion of blood via peripheral venous (23g cannula) or umbilical venous line at predetermined rate.
2. Turn 3-way tap off to waste bag and on to infant.
3. Slowly aspirate predetermined aliquot into 10ml syringe. DO NOT STOP MOVEMENT OF FLOW WHEN USING A PERIPHERAL ARTERIAL LINE
4. Peripheral arterial line to have heparinised Saline syringe connected to line
5. Do not use excessive suction.
6. Minimal removal 5mls per aliquot, maximum removal of 20mls per aliquot. Size of aliquot depends on size of infant.
7. Rapid changes in blood volume may cause hypotension, cardiac arrhythmia’s, hypoxia and metabolic instability.
8. Alaris Pump rate set to provide volume exchange over pre prescribed time.
9. Usually the procedure to take between 60 – 90 mins
10. Turn 3-way tap off to infant and on to waste bag and discard blood into waste bag. Repeat this sequence, AT ALL TIMES ENSURING THAT VOLUME BEING REMOVED IS KEPT EXACTLY IN PACE WITH VOLUME BEING REPLACED BY PUMP.

11. This can be done in standardised aliquot’s appropriate to size and condition of infant.

12. Rapid withdrawal from UVC induces negative pressure that may be transmitted to mesenteric veins which may contribute to NEC

13. Continue the exchange process until the transfusion is completed. If the umbilical vessel was used for the exchange, consider keeping the infant NBM for 4 hours post exchange, unless otherwise ordered.

**TABLE 1**

Volume of Albumex 4% to add to donor packed cells to obtain Haematocrit of approximately 0.55 within that pack. (Range 0.50 – 0.70) Confirm HCT – sample to lab (quality control)

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**NOTE:** The anticoagulant preservative in stored blood products (citrate phosphate dextrose) produces certain metabolic changes during and after the exchange transfusion. The citrate binds with the ionic calcium and magnesium and produce a significant depression of these cations. The temporary hypomagnesia has not been associated with clinically recognisable problems. The depression of the calcium ion may produce cardiac effects on the Q - T interval (greater than 0.2 seconds). Exchange transfusions have been performed with or without added calcium with no real difference seen. Clinical tetany is rarely seen during an exchange transfusion. The high glucose content of citrate phosphate dextrose may stimulate insulin secretion in the infant and may lead to rebound hypoglycaemia following the transfusion. This hypoglycaemia may occur between 30 minutes to 2 hours after the exchange.
METHOD 1
- Determine amount of Albumex 4% (or FFP if abnormal Coagulation tests) from table 1
- If volume needed is less than 20ml, draw up into syringe and inject through 21-gauge needle via the port. If greater than 20ml use a 21 gauge butterfly.
- After mixing, send sample to laboratory for confirmation of Haematocrit

METHOD 2
- Using dual blood transfusion set
- Blood tested for Ph and HCT and BSL and documented
- First port blood volume noted
- Second port FFP volume noted
- Rate calculated on FFP to deliver appropriate HCT checked at start, after 30mins and 60 minutes, and infant HB HCT and platelets at completion

DOCUMENTATION
Document the volume of blood removed and the volume of blood received. A running total of volume removed and of volume replaced is kept, and the medical officer is informed when a predetermined volume is removed eg: every 100mls.

POST EXCHANGE BLOOD TESTS
The last ‘out’ specimen is saved for testing:
- SBR, Urea & Electrolytes, calcium
- FBP and Cross match for possible subsequent exchange
- Coagulation studies
- PGL
- Blood gas

The timing of the next set of laboratory tests depends on the indication for the exchange, the anticipated rate of rise of bilirubin and the most recent results.

POST EXCHANGE CARE
1. Following an exchange transfusion the infant needs to be monitored closely for 24 hours. This may be able to be done on the postnatal ward with the mother.
2. Phototherapy needs to be continued post exchange and reviewed with the results of the SBR. Further SBR levels at approximately 6 hourly intervals.
3. Continue cardio-respiratory monitoring - Blood pressure at completion of procedure. Hourly: Temperature, apex beat, respirations, for 4 hours. If stable and within normal limits after this time previous observations as per guidelines may be recommenced.
4. Observe the infant’s behaviour and catheter sites for bleeding or signs of infection.
5. PGL as indicated by initial and post exchange results.
6. Appearance of abdomen with routine observations (3 - 4 hourly) for 24 hours. Listen for bowel sounds.
9. Document how the infant tolerated the procedure and ensure the parents are informed.