Exchange Transfusion - Full Clinical Neonatal Guideline – Joint Derby & Burton

Reference no.: NIC HA 06

IMPORTANT NOTE: Users of this guideline must familiarise themselves with the **'Trust policy & procedures for transfusion of blood & blood components CL-RM/2012 010** which lays down essential guidance for ensuring the safe requesting, collection, documentation and transfusion of blood and blood components for the patient.

1. Introduction

Jaundice in neonates is common and occurs in around 20% of newborn, however the potential for developing clinically significant hyperbilirubinaemia is considerably lower and few babies require intensive treatment. Phototherapy is an effective method of producing soluble bilirubin and is sufficient to prevent dangerous accumulation of the molecule in most cases. Rarely, however, the rate of haemolysis is so great that phototherapy alone does not produce a reduction in bilirubin concentrations and so exchange transfusion must be performed to limit the risk of kernicterus.

2. Main body of Guidelines

Screening

Local & National guidelines have provided detailed instructions on when a bilirubin level should be obtained and, furthermore, what action should be taken when high serum concentrations are discovered. Current policy is that all children who are noted to be jaundiced should have a serum bilirubin level determined either by biochemical assay or by transcutaneous photometry. Further action is then decided by use of a treatment chart, provided by the NICE guideline CG98; May 2010 'Neonatal Jaundice', and by clinical judgment as per Guideline **[The Jaundice Guideline; Neonatal/06:13/N6]** which describes in detail the treatment thresholds by the infant's gestational age. The associated interactive 'Treatment Threshold tables; 'Graphs for assessing whether to treat Neonatal Jaundice by phototherapy or exchange transfusion' are also available on the intranet.

Those babies who have demonstrated anaemia by cerebral artery Doppler or those whose mother have high levels of antibodies should have blood tests for serum bilirubin, Full Blood Count and Direct Antiglobulin test (DAT) taken as soon as is possible and should be managed on the NICU from birth.

Exchange Transfusion

The aim of the transfusion in these cases is to reduce the amount of circulating anti-foetal blood cell antibodies and thus decrease the rate of haemolysis. The percentage of new blood (and, hence blood lacking in antibodies and bilirubin) present at any given time during transfusion is estimated by the following equation.

$1-(1-\text{aliquot size/total blood volume})^{\text{time}}$

This shows that the percentage of new blood tails off at around 65% and reveals that the maximum effective transfusion volume is around double the circulating volume.

Indication for Exchange Transfusion

There are numerous indications for an exchange transfusion, however the most common are:

1. Measured serum bilirubin levels are on or above the exchange transfusion line and do not respond to intensive phototherapy
2. Risk factors that influence the risk of Kernicterus are present, i.e.
   - A rapidly rising bilirubin level of greater than 8.5 micromol/litre per hour.
   - Clinical features of acute bilirubin encephalopathy.
3. There is evidence of acute haemolysis
4. There is acute anaemia at birth (Hb <100g/L)
5. Cord Bilirubin > 80umol/L (Cord bilirubin measurement not recommended by NICE)

RH Incompatibility:

Background:

Haemolytic disease of the newborn is usually caused by RH incompatibility (although incidence is now much reduced with antenatal screening and anti D prophylaxis). Haemolysis arises secondary to trans-placental passage of anti D IgG after iso-immunisation from haemorrhage of fetal Rh+ (commonly at birth: commonly from previous pregnancy.

Other blood groups incompatibilities may have similar but usually less severe effects. ABO incompatibility arises from fetal iso-immunisation with (usually) IgG anti A from group O mother. ABO incompatibility results in mild haemolysis and a negative DAT in Northern Europeans but in other ethnic groups (notable Middle Eastern) ABO haemolytic disease is usually more severe than RH incompatibility

Presentation:

Antenatal – anaemia and hydrops foetalis

Postnatal – Hydrops, early jaundice, Kernicterus, hepatosplenomegaly

Maternal blood group and RH incompatibility antibody status are usually checked in early pregnancy. Mothers with elevated or rising titres of Rh antibody may have prompted antenatal management such as serial titres, U/S, fetal blood sampling and intra-uterine transfusions.

Consent

There is a 3 in 1000 risk of death or other morbidity when performing an exchange transfusion. This risk is likely to increase as fewer practitioners are experienced with the procedure as fewer are performed. Parents should be informed prior to starting the procedure and this conversation should be documented.

Preparation

1. Start triple or quadruple phototherapy and IV fluids at 1 day ahead. Phototherapy must continue throughout the procedure. Recheck bilirubin at start of phototherapy for a baseline.
2. Before performing any calculations **contact Blood Bank** to obtain the requisite blood. This will take up to 3hrs to arrive.
3. Prescribe **Intravenous Immunoglobulin (IVIG):** Use IVIG (500mg/kg over 4 hours) as an adjunct to continuous multiple phototherapy in cases of RH incompatibility haemolytic disease or ABO haemolytic disease or when the serum bilirubin rises more than 8.5 micromol/litre per hour. This will reduce the amount of circulating antibodies while you await the blood. Try to arrange this early as it may take some time to arrive.
4. An exchange transfusion will require the full time use of at least one if not two (depending on mode of transfusion) doctors. **Discuss with the on-call consultant** the arrangements for this; it is likely that the consultant will need to attend.
5. **Obtain Access**, you will need either
    a. UVC & UAC (Optimum)
    b. Peripheral Cannula & UAC
    c. Peripheral Cannula x2 & Peripheral Art-Line
    d. UVC Only
6. Decide on the **type of transfusion** required
    a. Double Volume – Performed for hyperbilirubinaemia/kernicterus/haemolysis
    b. Single Volume – Performed for anaemia
    c. Saline exchange – Performed for polycythaemia
7. **Calculate** the required transfusion volume.
    Normal Neonatal Blood Volume = 90mL/kg therefore,

Double Volume Exchange (mLs) = 180 x Birth Weight
Single Volume Exchange (mLs) = 90 x Birth Weight

8. Determine **Transfusion Rate**
    a. You will be giving aliquots of a set size over 5 minute intervals. The aliquot sizes per gestation are as follows:
        i. <28wks, 5mL
        ii. 28-32wks, 10mL
        iii. 33-36wks, 15mL
        iv. >36wks, 20mL
    b. Divide the number of mLs by 5 to give your infusion speed
        i. <28wks = 1mL/min
        ii. 28-32wks = 2mL/min

iii. 33-36wks = 3mL/min
iv. >36wks = 4mL/min

c. Divide your calculated total required volume by your mL/min to obtain total transfusion time i.e. 4kg, term baby = 4x90x2 = 720mL @ 4mL/min = 180min

Pre-Procedure

Things you will need:

1. Someone to hold the bleep, as previously stated
2. A 1-1 nurse to monitor and document the procedure and to provide other support
3. A sterile gown and gloves
4. Several 20mL syringes & posiflush syringes

Bloods & Recordings:

At the end of each aliquot the nurse should record:

- BP
- HR
- SpO2
- General Condition
- Temperature
- Volume infused this aliquot, Total Infused Volume,
- Volume withdrawn this aliquot, Total Withdrawn Volume.

The following bloods need to be sent at the start, middle and at the end of the procedure.

- FBC
- U&E
- Bilirubin (Split & Total)
- Blood glucose
- Calcium
- Blood Gas
- Clotting

Warning signs:

Vomiting or crying during infusion	Too rapid? Stop and review
Cyanosis or pallor	Too rapid? Altered circulation? Stop and review Check temp, pH, PaCO2, HR, BP
Aspirated blood becomes dark	UVC in portal vein? Adjust catheter Patient unwell? Stop and review Check temp, pH, PaCO2, HR, BP

Tachycardia and bradycardia	Volume, pH or electrolyte abnormality? Stop and review Check temp, pH, PaCO2, HR, BP, K+, Ca+
ECG abnormalities	Cold blood or altered K+/Ca+? Stop and review Check temp, pH, PaCO2, HR, BP, K+, Ca+ Manage hyperkalaemia, Hypocalcaemia
Cardiac arrest	Air embolism? Cold blood or altered K+? Rapid injection of calcium gluconate? Hypovolaemia?
Convulsions	Stop and manage seizure Check pH, glucose, calcium and magnesium

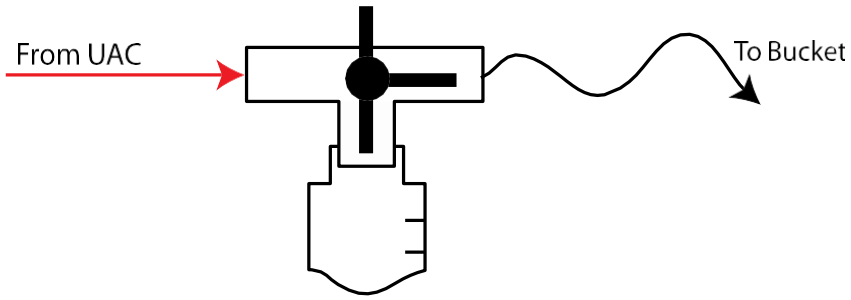
Procedure

Keep the child nil by mouth and aspirate stomach contents prior to starting.

UAC/UVC:

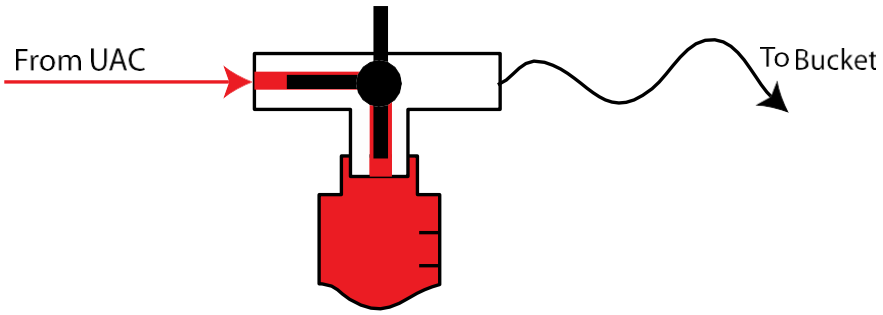
Connect the blood, via blood warmer, to a Baxter pump. Set the pump to adult mode to allow infusion at the correct rate[1] as determined earlier. Connect the tubing to the UVC.

Cut the end off a giving set and put the cut end into a sharps bucket. Connect the other end to the end of the 3-way tap on the UAC that would normally connect to the fluids/transducer.

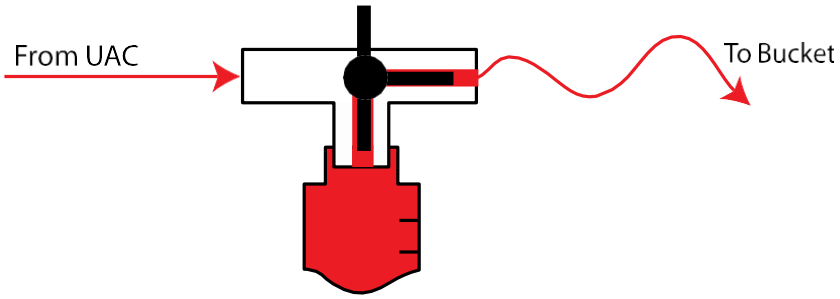


Make sure you are comfortable (i.e. have used the toilet, had a drink etc…) and position yourself at the incubator in sterile gown and gloves. The nurse should also be stationed with a view of both a clock and the baby's vital signs.Start the infusion via the Baxter pump and start a timer. Gradually withdraw blood from the UAV into the syringe by turning the 3 way tap on. This should be performed slowly, at exactly the same rate as the calculated infusion rate.

[1] a pump set to the normal paediatric mode has a safety cut-off to prevent infusion at high rates, this CAN be disabled by setting to adult mode



For **intermediate aliquots** (i.e. those where bloods are not required for analysis) discard the blood by flushing into the waste bucket through the 3 way tap.



It may become necessary during the procedure to replace the 3 way connector due to clot. The art-line may also require flushing with a posiflush syringe.

Peripheral Cannula & UAC:

This procedure is the same as the above procedure but with the blood connected to the peripheral cannula not the UVC. Particular care must be taken to check for tissuing of the cannula.

Peripheral Cannula & Art-Line:

Similar to UAC/UVC procedure but three way tap is connected to art-line.

UVC Only:

This requires withdrawal of aliquots of blood from the UVC, disposal, and then administration of new blood via the UVC. As this method depletes and repletes total volume repeatedly it is not recommended.

After The Procedure

- Phototherapy should continue after the procedure with 4-6hrly checking of bilirubin concentrations. It may be necessary to repeat the exchange transfusion if bilirubin continues to rise.
- Do not remove the lines until no further exchanges are likely.
- Withhold feeds initially, as the risk of NEC is increased by alteration of gut perfusion.
- Monitor blood sugars for 4 hours as exchanged blood may have high dextrose levels and can cause rebound hypoglycaemia following the exchange.

- Calcium and other electrolyte levels should be checked. As transfusion blood contains citrate to prevent clotting it binds free calcium and so levels can fall dangerously low. Prophylactic administration of calcium gluconate is, however, not currently common practice.

The baby must receive irradiated blood for 6 months post transfusion to eliminate the risk of graft vs. host disease.

Follow up

- To go home on Folic Acid 250 microgram/Kg/day for 3 months
- Repeat check Hb at two weeks and six weeks (risk of late onset anaemia)
- Audiology brain stem response testing
- Paediatric outpatient follow up

3. References (including any links to NICE Guidance etc.)

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- NICE Jaundice Guideline
- AAP Subcommittee on neonatal hyperbilirubinaemia. Neonatal jaundice and kernicterus. Paediatrics 2001;108 (3): 763-5
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4. Documentation Controls

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	V4	Dec 2023	Dr B Subramanian	Review and update
Intended Recipients: Paediatric Consultants & Nursing staff at Derby Hospital				
Training and Dissemination: Cascade the information via BU newsletter and address training				
Development of Guideline: Dr B Subramanian Consultant Paediatrician and Neonatologist				
In Consultation with: Consultant Neonatologists at RDH & QHB				
Linked Documents: (Nice guidance/Current national guidelines)				
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Divisional Sign Off			**Group:** Women's and Children's Clinical Governance Group **Date: 1st Feb 2024**	
Date of Upload			05/02/2024	
Review Date			Dec 2026	
Contact for Review			Dr B Subramaniam	

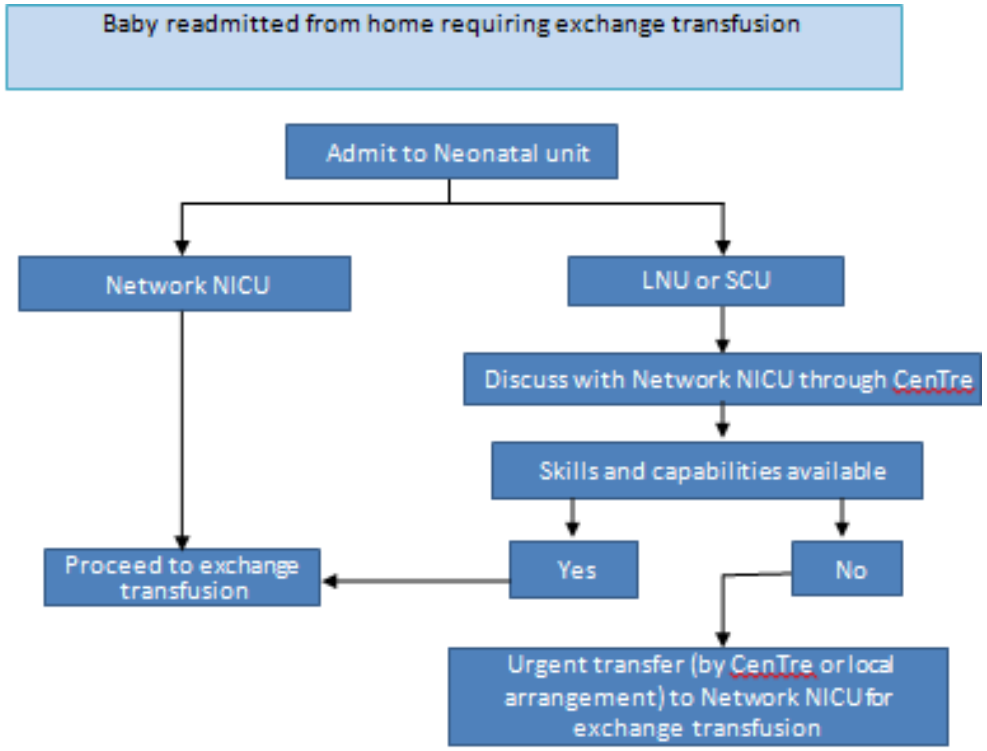
Appendices – see next page

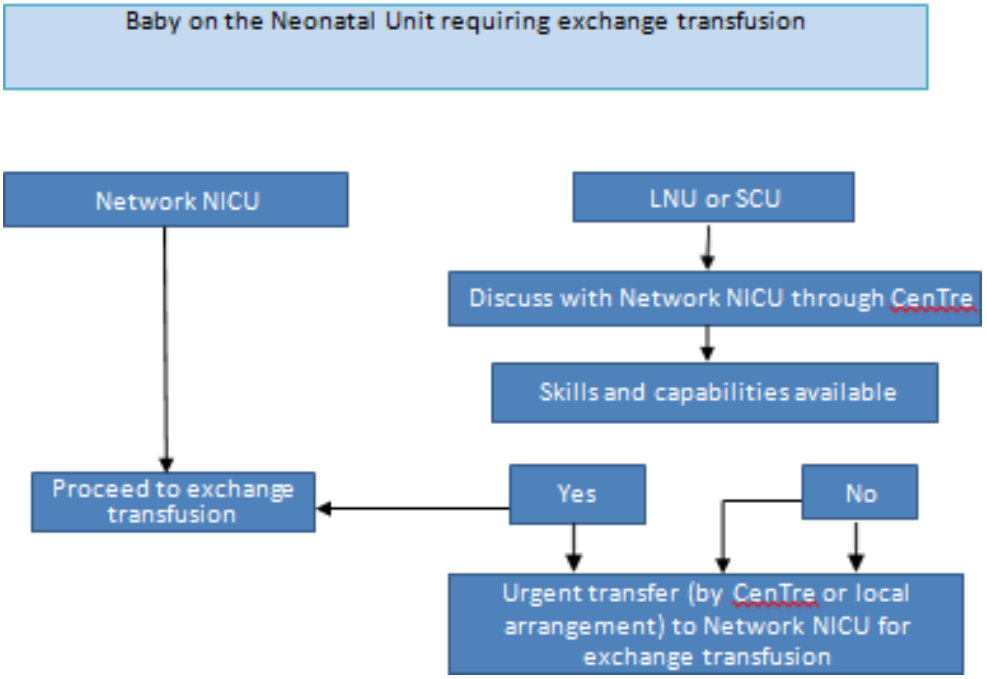
Appendix 1 Exchange Transfusion Monitoring Chart

Patient Name:
Hospital No:
Transfusion Volume:
Aliquot Size: Rate:

Time	BP	HR	SpO_2	Condition	Temp	Volume In		Volume Out	
						Aliquot	Total	Aliquot	Total

Appendix 2


Baby readmitted from home requiring exchange transfusion
Admit to Neonatal unit
Network NICU
LNU or SCU
Discuss with Network NICU through CenTre
Skills and capabilities available
Proceed to exchange transfusion
Yes
No
Urgent transfer (by CenTre or local arrangement) to Network NICU for exchange transfusion


Baby on the Neonatal Unit requiring exchange transfusion
Network NICU
LNU or SCU
Discuss with Network NICU through CenTre
Skills and capabilities available
Proceed to exchange transfusion
Yes
No
Urgent transfer (by CenTre or local arrangement) to Network NICU for exchange transfusion