East of England Neonatal ODN
(Hosted by Cambridge University Hospitals)

Clinical Guideline:

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For use in: EoE Neonatal Units
Guidance specific to the care of neonatal patients.

Used by: EoE Neonatal Units

Key Words: Exchange Transfusion, Jaundice, Neonatal Jaundice

Date of Ratification: **June 2022**

Review due: **June 2025**

Registration No: **NEO-ODN-2022-9**

Approved by:

Neonatal Clinical Oversight Group	
Clinical Lead Matthew James	**Matthew James**

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Exchange Transfusion in Neonates

1. INTRODUCTION

1.1 Jaundice is common in the first few days of life, but significant hyperbilirubinaemia is associated with risks of brain damage, kernicterus and long-term disability. It is usually successfully managed with phototherapy and feeding support.

1.2 Exchange transfusion may be indicated in significant hyperbilirubinaemia secondary to acute haemolysis, by removing the affected red blood cells and circulating maternal antibodies to reduce red cell destruction. This involves the removal of patient blood in aliquots and replacement with donor blood.

2. PURPOSE

2.1 To help staff manage significant hyperbilirubinaemia safely and prevent complications of brain damage and kernicterus.

3. SCOPE

3.1 All health-care professionals (permanent and temporary) working on NICU/SCBU within North West Anglia Foundation Trust.

4. INDICATIONS

4.1 Measured serum bilirubin is on or above exchange transfusion line (https://www.nice.org.uk/guidance/cg98/resources) and not responding to intensive phototherapy

4.2 Risk factors that increase the risk of kernicterus:

- Rate of rise of bilirubin >8.5micromol/litre/hour
- Clinical features of acute bilirubin encephalopathy
- Evidence of acute haemolysis
- Acute anaemia at birth (Hb <100g/l)
- Cord bilirubin >80micromol/litre

5. PRENATAL MANAGEMENT

5.1 The need for exchange transfusion may be predicted antenatally, particularly if atypical antibodies are detected or there is known rhesus disease. In this instance, it is helpful to organise blood in advance, as it may be difficult to source for rare maternal antibodies.

5.2 These patients should be highlighted during the perinatal meeting and a joint plan made for each patient.

6. PREPARATION

6.1 Total serum bilirubin above exchange transfusion threshold is a medical emergency and it is essential that the consultant on-call is informed. The infant should be admitted to NICU/SBCU for the procedure.

6.2 Start intensive phototherapy and IV fluids (at one day ahead) as soon as possible. Consider the use of 360 phototherapy if available.

6.3 Consider the administration of IVIG.

Use should be considered when managing a baby with haemolytic disease of the newborn if there is delay in commencing an exchange transfusion due to the availability of blood. It can also be used as an adjunct to phototherapy to try and reduce the need for exchange transfusion.

Use IVIG 500mg/kg over 4 hours.

Parents and carers should be offered information on the following:

- Why IVIG is being considered
- Why IVIG may be needed to treat significant hyperbilirubinemia
- The possible adverse effects of IVIG
- When it will be possible for parents/carers to see the baby

The adverse effects are fever, allergic reaction (including anaphylaxis), hypoglycaemia, hypotension and fluid overload.

6.4 Inform parents of the procedure, gain consent and document the conversation.

Parents should be made aware of the following:

- The need to admit the baby to NICU/SCBU
- Why an exchange transfusion is being considered and how it will treat significant hyperbilirubinaemia
- The duration of the procedure
- The risks of the procedure
- When it will be possible for parents to see the baby

The risks are air embolus, thrombosis, haemorrhage, hypotension, IVH (preterm infants), electrolyte derangement, arrhythmias, dilutional coagulopathy, necrotising enterocolitis, sepsis, hypothermia.

There is a 3 in 1000 risk of death.

Follow the trust policy if parents refuse to give consent for the transfusion. A child should be given such treatment as is immediately necessary for the preservation of life or prevention of serious harm or deterioration.

6.5 Calculate the required transfusion volume and contact Blood Bank to order the blood (CMV negative, irradiated, less than 5 days old). A group and save sample from the infant and mother will be required to cross-match blood.

Unless otherwise indicated, a **double-volume exchange of 170ml/kg** should be used.

6.6 A minimum of 3 staff are required for the procedure. A 1:1 nurse and doctor will be required throughout the procedure (2-3 hours), plus one other healthcare professional. Staff should be bleep-free. Consider delegation and reallocation of the workload.

6.7 Gather your equipment – please see section 7.1

Ensure appropriate continuous monitoring in place – including ECG, temperature probe, blood pressure and oxygen saturation monitoring.

Document baseline observations on the Neonatal Exchange Blood Transfusion Record

6.8 Keep the infant nil by mouth throughout the procedure

6.9 Obtain access – you will need either:

- UAC and UVC (optimum)
- Peripheral cannula and UAC
- Peripheral cannula and 2 x peripheral arterial line
- UVC only

- **Note: arterial lines should only be used for the withdrawal of blood, NOT the infusion of donor blood**

6.10 Baseline bloods (including group and save, full blood count, clotting, urea & electrolytes, bone profile and split bilirubin), blood glucose and blood gas should be taken prior to the procedure.

Obtain a pre-transfusion blood spot for neonatal screening and consider the need to take diagnostic samples for storage.

6.11 **Phototherapy should continue throughout the procedure.**

6.12 Determine the transfusion rate and total transfusion time. You will be taking aliquots of a set size over 5-minute intervals. (Aliquot = volume of blood to be removed)

WEIGHT	ALIQUOT SIZE	INFUSION SPEED
<1500g	5ml	1ml/min (60ml/hr)
1500g-2499g	10ml	2ml/min (120ml/hr)
2500g-3499g	15ml	3ml/min (180ml/hr)
>3500g	20ml	4ml/min (240ml/hr)

Divide your calculated total required volume (170ml x birth weight) by your ml/min to obtain total transfusion time.

Example: For a 3.5kg term infant undergoing double volume exchange transfusion.

3.5 x 170 = 595ml (TOTAL REQUIRED VOLUME)

595ml divided by 4ml/min = 148.75 minutes (TOTAL TRANSFUSION TIME)

595ml divided by 20ml aliquots = 29.75 separate aliquots

6.13 Please see Appendix 2 for reference flow chart

6.14 During an exchange transfusion DO NOT:

- Stop continuous phototherapy
- Perform a single volume exchange
- Use albumin priming
- Routinely administer IV calcium

7. THE PROCEDURE

7.1 Equipment required:

- Appropriate means of thermoregulation for the infant
- Observation monitoring equipment, including ECG, temperature probe, blood pressure and oxygen saturation monitoring
- Blood sugar monitoring
- Sterile plastic sheet to place under sterile drape
- IV infusion pump (Allaris Signature)
- 10% dextrose
- Selection of disposable sterile Luer lock syringes and needles
- 3-way tap x 2
- Chlorhexidine
- Red cell infusion set with appropriate filters
- Blood warmer (if infusion is given continuously, not suitable for “push-pull” method
- Drainage bag and extension sets
- Urine bag or cotton balls to monitor urine output
- Oral sucrose/pacifier
- Personal protective equipment for sterile procedure
- Sharps bin
- Blood bottles, including clotting (green), EDTA (red) , serum gel (brown) and fluoride (yellow) - as per section 6.10 and 8.4
- Neonatal resuscitation equipment
- Timing device for infusion and withdrawal of aliquots

7.2 Ensure that equipment is set-up using aseptic technique and all lines are primed appropriately. Albumin priming is not recommended.

7.3 <u>Infusion of donor red cells at a constant rate, with simultaneous withdrawal of aliquots of blood from the infant</u>

Donor blood is infused at a constant rate through a venous line – see section 6.12 for calculation of infusion rate.

Simultaneously, aliquots of blood are withdrawn from the infant through an arterial line over 5 minutes – as calculated in section 6.12.

Safety Point: The volume limit should be set on the pump for each quantity of blood being given. This limit should only be increased after verbal confirmation between nurses and doctor that the corresponding aliquot volume has been successfully removed.

If the procedure is halted for any reason or the arterial line stops sampling, it is **essential** that the infusion of donor blood is stopped immediately to prevent hypervolaemia.

Please see diagram in Appendix 1.

7.4 One person push-pull technique via single vascular access

The UVC is connected to the red cell giving set via 2 separate 3-way taps (to ensure a closed system). On the 3-way tap nearest the infant, a 50ml syringe is attached. On the 3-way tap furthest from the infant, a drainage bag is attached.

Standard cycle over 5 minutes:

- A aliquot of blood is withdrawn from the infant (as calculated in section 6.12)
- The 3 way tap is turned off to the infant, and on to the waste
- Blood is pushed into the waste bag
- The 3-way tap is turned off to the waste, and on to the donor blood
- The same size aliquot of blood is withdrawn from the bag
- The 3-way tap is turned off the donor blood, and on to the infant
- The aliquot of blood is delivered to the infant

The procedure always starts with the withdrawal of blood to ensure the infant's circulation is not overloaded.

Please see diagram in Appendix 1.

8. MONITORING & COMPLICATIONS

8.1 During the procedure:

- Continuous monitoring of HR and rhythm, oxygen saturations, respiratory rate and temperature. Note: any deviation from baseline may indicate an adverse reaction.
- A staff member should be responsible for accurate recording of blood input and withdrawal, and record observations with each cycle of the procedure.
- Blood gas and blood glucose (including ionised calcium, potassium and lactate) should be measured half hourly during the procedure.
- Bloods, including full blood count, clotting, urea & electrolytes, bone profile and split bilirubin, should be taken halfway through the procedure.

8.2 Closely observe the infant, watching for cyanosis, distress, pallor, vomiting or abdominal distension

8.3 Complications

Cardiac arrest – Consider air embolism, cold blood, hypovolaemia or hypo/hyperkalaemia. Manage according to NLS algorithm and correct above issues if present.

Convulsions – Stop exchange transfusion. Manage seizure. Check pH, glucose, calcium and magnesium.

Hypothermia – Confirm placement of temperature probe. Confirm blood warmer is at 37c. Slow the exchange.

Hyperglycaemia – Donor blood is preserved in dextrose. Blood glucose levels can be elevated during the procedure and generally resolve without intervention.

Hypoglycaemia – May occur during, or shortly after, the exchange. Follow local hypoglycaemia guidelines. Repeat blood glucose within 15 minutes and continue to monitor closely.

Hyperkalaemia – Lower risk with red cells less than 5 days old. Stop exchange if potassium >7.0. Peaked T waves, wide QRS or ventricular ectopics may be seen on ECG monitoring. Manage as per local hyperkalaemia guidelines. The exchange can be restarted if potassium is <6.0.

Hypocalcaemia – Rare with new preservative anticoagulants. If ionised calcium <0.8, then flush catheter dead space with normal saline and give urgent IV correction (1-2ml/kg calcium gluconate 10% via central line over 10 minutes). Prolonged QT may be seen on ECG monitoring.

Metabolic Acidosis – Mild metabolic acidosis is common and may not require treatment. If base excess drops below -10, then flush catheter dead space with normal saline and give a half bicarbonate correction ([body weight x base excess x 0.3]/2 = mmol of sodium bicarbonate 4.2%). If acidosis persists or worsens, consider stopped exchange.

Thrombocytopenia – Donor blood is platelet depleted, so the platelet count will tend to fall. This rarely needs intervention. If platelets are <50, consider stopping exchange and arranging platelet transfusion via a peripheral line.

Air Embolus – Preventable by careful set-up and priming of lines. Observe lines for presence of air during the exchange and ensure 3-way taps are closed with filling or expelling contents of the syringe.

Anaemia/Polycythaemia – Gently agitate donor blood at frequent intervals to prevent separation of red cells and plasma.

8.4 After the procedure:

- Measure the serum split bilirubin, electrolytes, bone profile, full blood count and clotting profile within 2 hours

- Monitor blood glucose hourly for 4 hours, and closely thereafter
- Keep nil by mouth for 24 hours after the procedure
- Continue intensive phototherapy initially, and then manage according to bilirubin result and NICE treatment threshold graphs
- Maintain central access until confident that no further exchanges are required

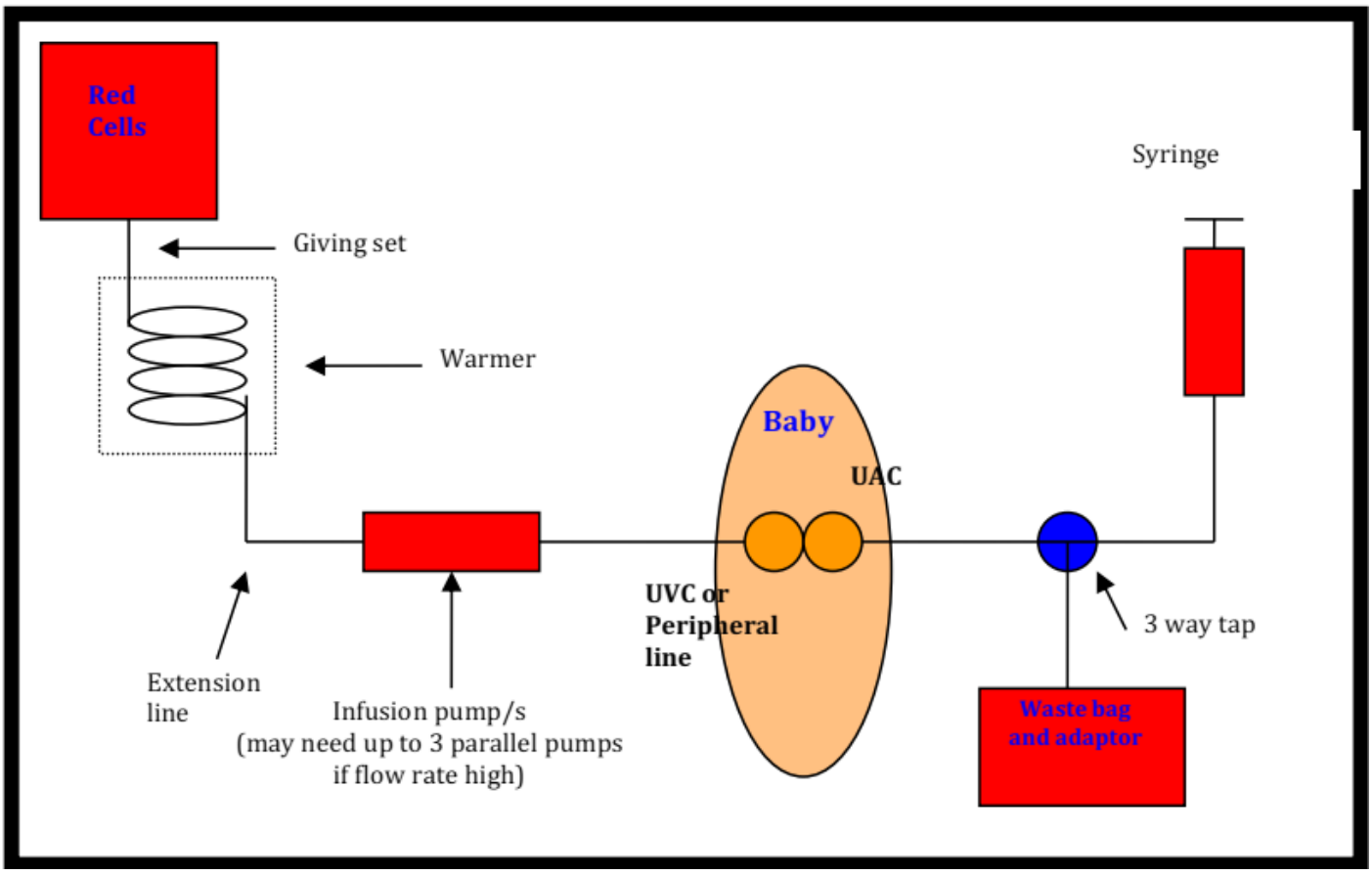
8.5 The infant should receive irradiated blood for any transfusions 6 months post-exchange to eliminate the risk of graft vs host disease

9. REFERENCES

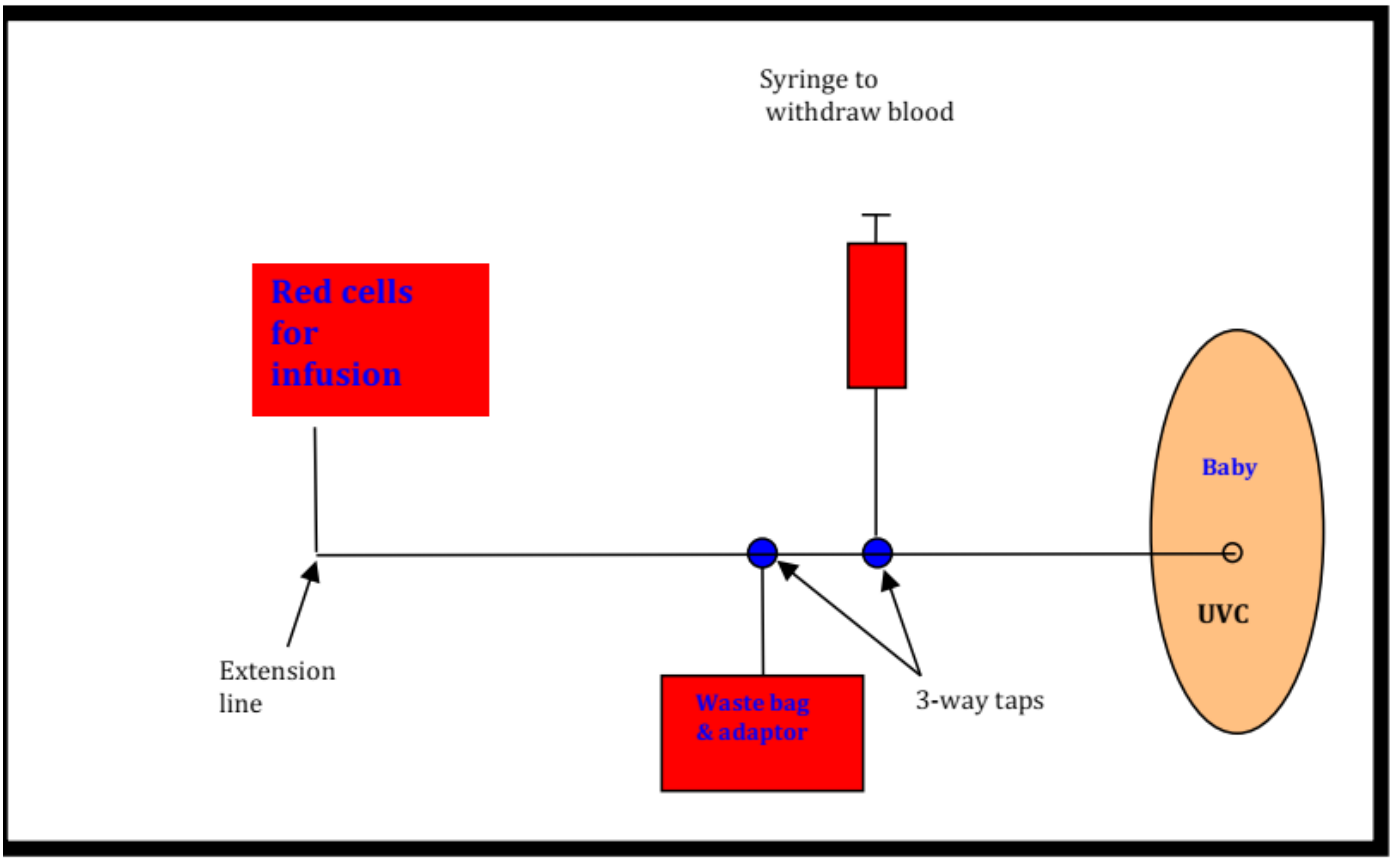
9.1
- National Institute for Health Care and Excellence *Jaundice in newborn babies under 28 days* June 2020
- Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee *Handbook of Transfusion Medicine* 5th Edition, January 2014

APPENDIX A: EQUIPMENT AND SET-UP

Infusion of donor red cells at a constant rate, with simultaneous withdrawal of aliquots of blood from the infant



One person push-pull technique via single vascular access


Syringe to
withdraw blood
Red cells
for
infusion
Baby
UVC
Extension
line
Waste bag
& adaptor
3-way taps

APPENDIX B: SUMMARY FLOW CHART

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APPENDIX C: NEONATAL EXCHANGE TRANSFUSION RECORD

Name			
Date of Birth			
DIS Number			
Gestation		**Total Volume of Transfusion (ml/kg)**	
Blood Group		**Total Required Volume (ml)**	
DAT		**Aliquot Size / Infusion Speed**	
Mothers Name		**Aliquot Frequency**	
Mothers DIS Number		**Time for Transfusion (min)**	

Aliquot Number	Time	IN		OUT		Total Balance (In-Out)	Blood Taken?	HR	RR	Temp	BP	SpO2
		Aliquot ml	Total ml	Aliquot ml	Total ml							
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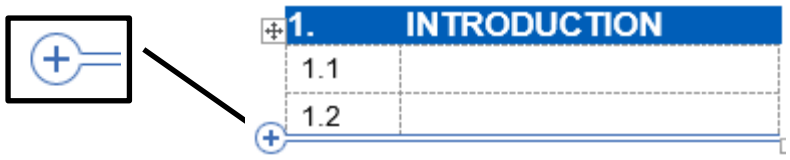

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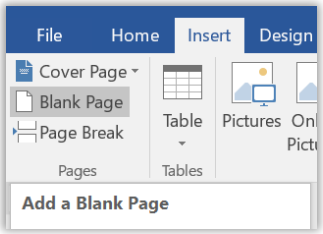

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