

# EXCHANGE TRANSFUSION

Exchange transfusion replaces withdrawn baby blood with an equal volume of donor blood

**Discuss all cases with local consultant and consider urgent transfer to tertiary unit**

## INDICATIONS

### Haemolytic anaemia

- A newborn who has **not** had an in-utero transfusion (IUT) with a cord Hb <120 g/L and is haemolysing, may require urgent exchange transfusion to remove antibodies and correct anaemia:
- if Hb <100 g/L: discuss **urgently** with consultant and proceed to exchange transfusion; avoid simple packed cell transfusions
- if Hb 100–120 g/L: obtain 6-hrly bilirubin values and, if rapidly rising or close to exchange transfusion level (see **Jaundice** guideline), use intravenous immunoglobulin (IVIG)
- A newborn who has had IUTs and whose Kleihauer test (may not be available in every hospital) demonstrates a predominance of adult Hb, anaemia can be managed using a top-up transfusion of irradiated, CMV-negative blood

### Hyperbilirubinaemia

- Discuss promptly with consultant. If bilirubin values approaching guidance below; senior decision required:
- guidance as determined by exchange transfusion line on gestation-specific NICE jaundice chart (see **Jaundice** guideline)
- if bilirubin rises faster than 8.5 micromol/L/hr despite phototherapy, anticipate need for exchange transfusion

### Other indications

- Chronic feto-maternal transfusion (chronic anaemia with normovolaemia)
- Disseminated intravascular coagulation (DIC)
- Severe non-haemolytic anaemia with normovolaemia

## COMPLICATIONS

- Cardiac arrhythmias
- Air embolism
- Necrotising enterocolitis
- Coagulopathy
- Apnoeas and bradycardia
- Sepsis
- Electrolyte disturbances: hyperkalaemia, hypocalcaemia
- Hypoglycaemia
- Acidosis owing to non-fresh blood
- Thrombocytopenia
- Late hyporegenerative anaemia

## PROCEDURE

### Prepare

- Ensure full intensive care space and equipment available and ready
- Allocate 1 doctor/practitioner and 1 member of nursing staff, both experienced in exchange transfusion, to care for baby during procedure. Document their names in baby's notes
- Obtain written consent and document in baby's notes
- Use **Proforma** (at end of guideline) to document exchanged volumes

- Calculate volume of blood to be exchanged: double volume exchange removes 90% of baby's red cells and 50% of available intravascular bilirubin. Use:
  - term babies: 160 mL/kg
  - preterm babies: 200 mL/kg
- For anaemia without antibodies or hyperbilirubinaemia use single volume exchange. For term baby use 80 mL/kg, for preterm baby use 100 mL/kg
- Order appropriate volume (usually 2 units) of blood from blood bank, stipulating that it must be:
  - crossmatched against mother's blood group and antibody status, and (if requested by your blood bank) baby's blood group
  - CMV-negative
  - irradiated (shelf-life 24 hr) for any baby who has had an in-utero blood transfusion
  - ≤4 days old and as fresh as possible
  - plasma reduced red cells for 'exchange transfusion' (haematocrit 0.5–0.6), not SAG-M blood and not packed cells

#### **Prepare baby**

- Empty stomach using nasogastric tube (see **Nasogastric tube insertion** guideline) and keep baby nil-by-mouth
- Pay attention to thermoregulation, particularly if procedure to be performed under radiant heater
- Commence continuous cardiac, temperature and saturation monitoring
- If exchange for hyperbilirubinaemia, continue phototherapy during exchange transfusion

#### **Document**

- Blood pressure, respiratory rate, temperature, SpO<sub>2</sub> and heart rate every 15 min throughout exchange
- Volume of blood in and out with each cycle, and keep a running total (see **Proforma** at end of guideline)

#### **Prepare blood**

- Set up blood warmer early (aim for 37°C)
- do not use if:
  - intermittent bolus infusion i.e. single catheter exchange
  - blood is exposed to a radiant heater (risk of haemolysis)
- Check blood units as per hospital policy
- Connect donor blood to filter and prime blood giving set
- Connect to 4-way (if using UVC) or 3-way tap (outside the warmer) as indicated
- Gently squeeze donor blood bag before transfusion and every 15 min during transfusion, to prevent settling of red blood cells

#### **During procedure**

- Take arterial blood gas every 30 min during procedure (including pH, lactate, glucose, calcium and potassium readings)
- Ensure continued clinical monitoring for cyanosis, distress, pallor, vomiting or abdominal distension

***If any change in baby's cardiorespiratory status, pause exchange by priming catheter with donor blood that will not clot. Discuss with consultant***

#### **Technique**

- Ensure working area sterile

#### **Either**

- Isovolumetric or continuous technique

- continuous infusion of donor blood via a venous line with intermittent removal of baby’s blood via an arterial line
- use umbilical venous or peripheral venous line for infusion and umbilical arterial or peripheral arterial line for removal of blood (see **Umbilical arterial catheterisation and removal**, **Umbilical venous catheterisation and removal** and **Arterial line insertion** guidelines)

**Or**

- Single catheter push-pull technique
- sequential withdrawal of baby’s blood and infusion of donor blood via a UVC (see **Umbilical venous catheter: insertion and removal** guideline)

**Isovolumetric or continuous technique**

- Connect catheter bag, using Vygon connector, to 3-way tap attached to arterial line extension

**Never leave arterial line open to catheter bag**

- Connect donor blood to venous catheter
- Prior to the exchange transfusion, send pre-exchange bloods from the arterial line including; serum bilirubin, full blood count, blood culture, blood glucose, calcium, electrolytes, coagulation, liver function tests and bloodspot screening (if not already done)
- when exchange performed for reasons other than known blood group antibodies, send blood for G6PD screening and viral serology
- Determine transfusion rate and total transfusion time (aliquot = volume of blood to be removed)

**Table 1**

<b>Weight</b>	<b>Aliquot size</b>	<b>Infusion speed</b>
<1500 g	5 mL	1 mL/min (60 mL/hr)
1500–2499 g	10 mL	2 mL/min (120 mL/hr)
2500–3499 g	15 mL	3 mL/min (180 mL/hr)
≥3500 g	20 mL	4 mL/min (240 mL/hr)

- Take aliquots from arterial line at 5 min intervals
- Divide calculated total required volume (160ml x birth weight) by infusion speed (ml/min) to obtain total transfusion time

**Example:**

For a 3.5 kg term baby undergoing double volume exchange transfusion:

$3.5 \times 160 = 560 \text{ mL}$  (**Total required volume**)

$560 \text{ mL} \div 4 \text{ mL/min} = 140 \text{ min}$  (**Total transfusion time**)

$560 \text{ mL} \div 20 \text{ mL aliquots} = 28$  separate aliquots

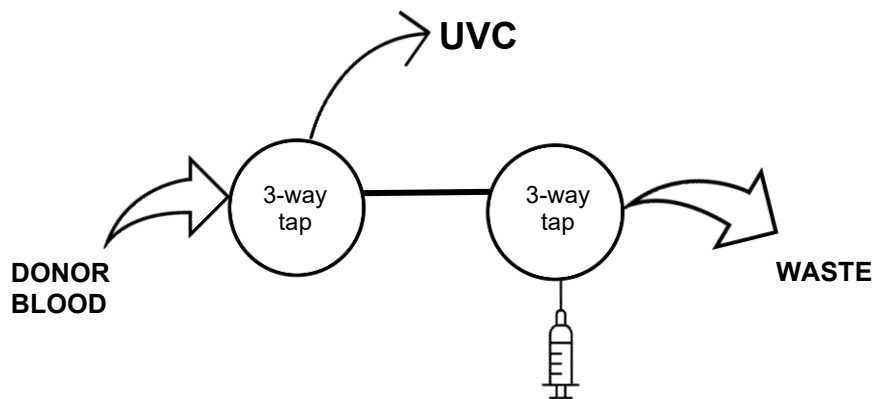
- Observe limb distal to arterial line at all times and document appearance. **If concerned, pause exchange and discuss with consultant**
- If exchange stopped for >2–3 min, discontinue procedure and ensure all lines are flushed with sodium chloride 0.9%
- Send last 'out' baby blood sample for post-exchange bloods including; serum bilirubin, full blood count, blood culture, blood glucose, calcium and electrolytes

**Single catheter or 'push-pull' technique**

- Connect catheter bag (using Vygon connector) and donor blood to 4-way tap and 4-way tap to UVC
- Do not use blood warmer with this method

- Remove blood from UVC using syringe and send for pre-exchange bloods as above in **Isovolumetric or continuous technique**
- Replace precise volume removed with donor blood, slowly using a syringe
- Each out-in cycle should replace  $\leq 8.5$  mL/kg and take  $\geq 5$  min; start with smaller aliquots (10 mL) and increase to 20 mL (if baby stable and weight allows) only after 30 min
- Discard 'out' baby blood into catheter bag
- Continue out-in cycles every 5 min (maximum aliquot with each cycle) until complete
- Send last 'out' baby blood sample for post-exchange bloods as above

**Figure 1: Set-up for single catheter push-pull technique**



## POST PROCEDURE

### Immediate

- When Hb and bilirubin in final 'out' sample known, check with consultant before removing all lines
- Complete documentation (volumes in/out, and all observations) (see proforma at end of guideline) and add to baby's clinical notes
- Recommence feeds 4–6 hr after completion
- Monitor blood sugar 4-hrly until acceptable on 2 consecutive occasions (see **Hypoglycaemia** guideline)
- Update parents

### Intermediate

- In babies receiving antibiotics, a repeat dose may be required – discuss with consultant
- Bloodspot screening to be taken at appropriate time (see **Bloodspot screening** guideline)

### Follow-up

- Neurodevelopmental follow-up in all babies who have undergone exchange transfusion
  - Repeat full blood count at intervals (likely 1–2 weekly but to be determined individually) for  $\geq 6$  weeks, to detect anaemia secondary to ongoing haemolysis

**Proforma**

**NAME:**

**HOSPITAL ID:**

**DATE OF BIRTH:**

**DATE OF EXCHANGE TRANSFUSION:**

Once number of needed aliquots has been calculated, draw clear lines on proforma to block out additional aliquot lines

Weight					kg	
Transfusion (160 mL/kg term or 200 mL/kg preterm)					mL/kg	
Volume to be exchanged					mL	
Aliquot size					mL	
Aliquot number						
Aliquot number	Time	In		Out		Total Balance In – Out =
		Vol aliquot mL	Total mL	Vol aliquot mL	Total mL	
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