Waikato District Health Board

Procedure

Exchange and Reduction Transfusions in Neonates

Procedure Responsibilities and Authorisation

Department Responsible for Procedure	NICU
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Document Owner Title	Clinical Director
Target Audience	Consultants, Registrars, NNPs, CNSs, RNs
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Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
3	Kathryn Thorn	2019	New format
4	Lee Carpenter	2020	Combining Exchange and Reduction Transfusion in one document
4.1	Jutta van den Boom	2021	Correction of calculations

Exchange and Reduction Transfusions in Neonates

1 Overview

1.1 Purpose

Exchange and Reduction Transfusion is a procedure performed for the treatment and correction of anaemia, hyperbilirubinaemia, removal of antibodies associated with red blood cell haemolysis and polycythaemia.

To maintain the safety of neonates receiving exchange transfusions.

1.2 Scope

Waikato DHB staff working in NICU: Consultants, Registrars, NNPs & CNSs, RNs

1.3 Patient / client group

- Neonates diagnosed with hyperbilirubinaemia, severe anaemia or severe polycythaemia

1.4 Definitions

Anaemia	Anaemia is defined as a low number of red blood cells.
CNS	Clinical Nurse Specialist
Haemolysis	Destruction of red blood cells
Hct	Haematocrit
Hyperbilirubinaemia	An elevated level of the pigment bilirubin in the blood.
Consultant	Senior Medical Officer, Paediatrician or Neonatologist
NNP	Neonatal Nurse Practitioner
Reduction Exchange	A reduction exchange transfusion is a procedure performed to correct polycythaemia.
PAL	Peripheral Arterial Line
Polycythaemia	Polycythaemia is used as a crude measure for hyperviscosity and is defined by a venous haematocrit of greater than 65% (0.6-0.65)
RN	Registered Nurse
UAC	Umbilical Arterial Catheter
UVC	Umbilical Venous Catheter

2 Clinical Management

This procedure is to be performed by an experienced medical staff member (SMO, NNP or registrar) with a registered nurse. Calculations of exchange/reduction volumes are to be double checked.

2.1 Procedure for Exchange Transfusion

- Obtain parental consent.
- Cross-match fresh whole blood.
- Establish vascular access (UVC or UAC or PAL (for removal of blood) plus peripheral IV line (for replacement of blood).
- Place infant on cardiorespiratory monitor and pulse oximeter.
- Calculate volume of blood to be exchanged
  - **two-volume exchang**e: infant blood volume (90ml/kg) x 2
- Calculate rate of exchange.
  - Calculate **volume per cycle**:
    - 5% of infant blood volume (90ml/kg x 0.05), round up to the nearest ml
  - Calculate **number of cycles** by dividing two volume exchange by 5% blood volume
  - Aim to complete the procedure in 90 minutes (or longer if infant unstable) calculate **time of one cycle**:
    - Divide 90 min by number of cycles

For example

- **1000g** infant has blood volume of 90 mL
- **Two volume exchange**: 180ml (1kg x 90ml x2)
- **Volume per cycle**: 5 mL (90ml x 0.05)
- **Number of cycles**: 36 (180ml/5ml)
- **Time of one cycle (blood in and out)**: 2.5 min (90/36)

- **4000g** infant has blood volume of 360 mL (4kg x 90ml)
- **Two volume exchange**: 720ml (4kg x 90ml x2)
- **Volume per cycle**: 18 mL (360ml x 0.05)
- **Number of cycles**: 40 (720ml/18ml)
- **Time of one cycle (blood in and out)**: 2.25 min (90/40)

- Check serum electrolytes and glucose (no more than 4 hours before starting exchange). Set up blood warmer and exchange transfusion tubing (Refer to Nursing Procedure Exchange Transfusion and Partial Exchange transfusion– Nursing management in Neonatal Intensive Care Unit (NICU) Ref:2616).
- Note time of start and record all volume exchanged as per exchange transfusion record sheet (a second person is required to do this). See Appendix A.
- Blood volume per cycle is removed first, then replaced with blood volume for cycle by medical staff, and documented by registered nurse. Repeat until all cycles/volume complete.
- Treat as sterile procedure - use gloves and gown.
- At completion of procedure, send blood for:
    - sodium (Na)
    - potassium (K)
    - calcium (Ca)
    - glucose
    - serum bilirubin (SBR)
    - haemoglobin (Hb)
    - platelets
    - Re-check electrolytes and SBR 4 hours after completion of procedure.

2.2 Potential complications

- Hypotension/shock - too much blood being removed too fast.
- Arrhythmia - hypocalcaemia or hyperkalaemia
- Infection
- Air embolus

If complications occur during exchange transfusion - stop procedure, check circuit for leaks, send blood for Na/K/Ca/glucose and arterial blood gases (ABG).

2.3 Procedure for Reduction Exchange Transfusion

- Obtain parental consent
- Establish vascular access (Umbilical Venous Catheterisation (UVC) or Umbilical Arterial Catherisation (UAC))
- Use sodium chloride 0.9% (room temperature) as exchange fluid.
- Place infant on cardiorespiratory monitor and pulse oximeter
- Calculate **volume of blood** to be exchanged

$$\frac{\text{(actual Hct - desired Hct) x blood volume of infant in mls. (90mL/kg)}}{\text{actual Hct}}$$

- Calculate volume of blood for reduction on each cycle.
  - Calculate **volume per cycle**:
    - 5% of infant blood volume (90ml/kg x 0.05), round up to the nearest ml
  - Calculate **number of cycles** by dividing reduction volume by 5% blood volume
  - Aim to complete the procedure in 20 minutes (or longer if infant unstable) calculate **time of one cycle**:
    - Divide 20 min by number of cycles

  For example
  - **1000g** infant has blood volume of 90 mL
  - **Reduction volume**:
  - (0.7-0.5) x 90ml / 0.7 = 26ml
  - **Volume per cycle**: 5 mL (90ml x 0.05)
  - **Number of cycles**: 5 (26ml/5ml)
  - **Time of one cycle (blood in and out)**: 4 min (20/5)

  - **4000g** infant has blood volume of 360 mL (4kg x 90 ml)
  - **Reduction volume**:
  - (0.7-0.5) x 360ml / 0.7 = 103ml
  - **Volume per cycle**: 18 mL (360ml x 0.05)
  - **Number of cycles**: 6 (103ml/18ml)
  - **Time of one cycle (blood in and out)**: 3.3 min (20/6)

- Note time of starting reduction exchange and record all volumes exchanged as per exchange transfusion record sheet (a second person is required to do this). See Appendix A.
- Blood volume per cycle is removed first, then replaced with normal saline volume for cycle by medical staff, and documented by registered nurse. Repeat until all cycles/volume complete.
- Treat as sterile procedure – use gloves and gown.
- Remove blood in desired aliquots and discard. Infuse equal volume of normal saline on each cycle.
- At completion of procedure send blood for Na/K/Ca /Haemoglobin/platelets

2.4 Potential complications

- Hypotension – shock – too much blood being removed too fast.
- Arrhythmia – hypocalcaemia, hypokalaemia.
- Infection.
- Air embolus.

If complications occur during procedure – stop procedure, check circuit for leaks, send blood for sodium/potassium/calcium (Na/K/Ca) and blood gases.

3 Audit

3.1 Indicators

- There is documented evidence:
  - of parental consent.
  - a recent serum electrolytes and glucose (no more than 4 hours before starting exchange).
  - electrolytes and serum bilirubin 4 hours post procedure
  - Blood volumes are calculated using the recommended formulary

3.2 Associated Waikato DHB Documents

- Nursing Procedure Exchange Transfusion and Partial Exchange transfusion– Nursing management in Neonatal Intensive Care Unit (NICU) Ref:2616

Appendix A

Transfusion Date: _____ **Time started:** _____

Exchange or Reduction: _____ **Time finished:**_____

Total volume for Exchange/Reduction: _____ **Birth Weight:**_____

Volume per cycle _____ **Number of Cycles** _____

Date	In	Out	Temp	MAP	Resps	HR	SaO2	Comments