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EXCHANGE TRANSFUSION

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INTRODUCTION

- Exchange transfusion is a potentially life-saving procedure that is done to counteract the effects of serious jaundice or changes in the blood due to diseases such as sickle cell anemia.
- The procedure involves slowly removing the person's blood and replacing it with fresh donor blood or plasma.

Definition

- An exchange transfusion involves removing aliquots of childs blood and replacing with donor blood in order to remove abnormal blood components and circulating toxins whilst maintaining adequate circulating blood volume.

Indications

- immediate exchange transfusion is recommended in infants showing signs of acute bilirubin encephalopathy or if total serum bilirubin is ≥ 85 micromol/L above these levels (I mg /dl =17.1umol/l)
- Risk factors include alloimmune haemolytic disease,
- G6PD deficiency,
- sepsis and acidosis

Calculation of volume of exchange transfusion

Blood Volumes

- The volume of blood for exchange is calculated using an estimate of the neonate's circulating blood volume:
- Term infants 80ml/kg
- Preterm infants 100ml/kg

Types of exchange transfusion

Single volume exchange transfusion

- 1 x circulating blood volume (for example, for a term infant 80ml/kg)
- Replaces approximately 60% of the blood volume
- Consider when aetiology is not Haemolytic Disease of the Newborn

Double volume exchange transfusion

- most commonly used for removal of bilirubin and antibodies.
- 2 x circulating blood volume (for example, for a term infant 2 x 80ml/kg = 160ml/kg)
- Replaces approximately 85% of the blood volume
- This will cause an approximate reduction of 50% of the pre-exchange bilirubin level
- but can be expected to rebound 4 hours post transfusion to approximately two thirds of pre-exchange level

Partial exchange transfusion for polycythaemia using normal saline

- Where desired haematocrit following exchange transfusion is 0.55, the volume of exchange (mls) can be calculated as follows:
- (actual Hct – desired Hct) x infant's blood volume (mls)
- Newborns: **55%** to **68%.** One (1) week of age: 47% to 65%

Blood Product

- FFP
- Packed red blood cells

- Preparation of the Infant
- Obtain consent
- Exclusively allocate at least one doctor and one nurse to care of the infant throughout the procedure
- When an exchange transfusion is taking place the Consultant Neonatologist on duty should be present
- Registrar can carry out the procedure without interruption

- Cont…

- Ensure resuscitation equipment and medications are easily accessible
- Nurse infant under radiant warmer for accessibility
- Ensure infant is comfortable and settled
- sedation and pain relief are not usually required unless the infant is active and likely to compromise line stability or sterile field

Cont…..

- Document full set of baseline observations
- (temperature, respiratory and heart rate, blood pressure and oxygenation)
- Infant should be nil orally as soon as decision is made to perform exchange transfusion.
- Pass oro/nasogastric tube and aspirate stomach contents.
- Leave tube in-situ and on free drainage for duration of procedure

- Cont..
- Before commencing exchange transfusion collect blood samples such as
- Tests may include blood cultures, blood gas, serum bilirubin, blood glucose, FBC, UEC, LFT, newborn screening test, haematological, chromosome or metabolic studies
- Establish vascular access for procedure if not already in-situ
- depending on whether the procedure will be performed via arterial and venous access or via single venous access
- Check blood as per RCH Procedure “Blood Transfusion

- **Equipment**
- Plastic aprons or protective gowns
- Protective eye wear
- Sterile gloves
- Blood warmer
- Blood administration set
- Urine drainage bag
- Exchange transfusion recording sheet
- Sterile drape 3-way taps
- Syringes assorted sizes as required
- Blood gas syringes
- Drawing up needles
- Sodium chloride 0.9% and Water for Injection ampoules

Emergency resuscitation equipment

- Medications and fluids
- Calcium gluconate 10%
- Sodium bicarbonate 8.4%
- Glucose 10%
- Frusemide (20mg/2ml)
- Pathology collection tubes as required
- Alcohol swabs
- Sterile gauze and
- Packed red blood cells Fresh frozen plasma (ordered but do not collect from Blood Bank until required)

- **Procedure**

- Exchange transfusion involves the sequential withdrawal and injection of aliquots of blood, through arterial and venous lines, either peripheral or central.
- Exchange transfusion should be performed slowly over approximately 2 hours to avoid major fluctuations in blood pressure.
- Anticipate the need for increased oxygen requirement during procedure (administer oxygen via nasal cannula in self ventilating babies if required).
- Set blood warmer at 41oC.
- **Using aseptic technique:**
- Connect the blood administration set to the blood warming coil and clamp off the lines
- Insert the administration set spike into the bag of red cells

- Cont…..

- Release the clamp and prime the line/coil with blood.
- Clamp off the lines and maintain the sterility of the end of the line
- Attach the water feed set to the urine drainage bag. Secure with a strip of sleek.
- **Do not remove pin** from self-closing clamp on the water feed set.
- Fasten the urine drainage bag below the cot
- Strict aseptic technique should be maintained throughout procedure.
- Record baseline observations (infant temperature, heart rate, respiratory rate, blood pressure, oxygen requirement, oxygen saturations, neurological status) prior to commencement of procedure.

Aliquots usually tolerated for exchange transfusion:

- Less than 1500g – 5ml
- 1500g – 2500g – 10ml
- 2500g – 3500g – 15ml
- Greater than 3500g – 20ml

OBSERVATION BY THE NURSE

Registered nurse should observe the infant throughout the exchange transfusion and record the following on the Exchange Transfusion Record Sheet:

- volume of blood withdrawn and injected at the end of each cycle (aliquot)
- infant temperature, heart rate, respiratory rate, blood pressure, oxygen requirement, oxygen saturations, blood warmer temperature, general condition of infant – **every 15 minutes**

- If phototherapy lights remain on during procedure they should be turned off frequently to assess infant colour and general condition.
- Observe infant for clinical signs of complications of exchange transfusion (i.e. agitation due to hypocalcaemia, signs of hypoglycaemia)
- Administration of medications as required
- Routine observations should continue to be recorded on the ICU/NNU observation chart (MR100) each hour as per standard procedure.

OBSERVATION CON…

- Blood glucose and blood gas should be monitored at least pre, mid and post exchange and more frequently as indicated to manage metabolic and electrolyte derangements.
- After each 100ml of blood exchanged, flush line with 0.9% sodium chloride, administer 1ml of 10% calcium gluconate (diluted with 1ml of Water for Injection) by slow push followed by a 0.9% sodium chloride flush.
- The calcium gluconate should not come into direct contact with donor red cells or clotting may occur.
- Monitor for changes in heart rate and rhythm during calcium gluconate administration

OBSERVATION CON…

- The last withdrawal volume should be saved for post exchange blood tests.
- **Cease exchange transfusion if infant's condition suddenly deteriorates.** If the exchange transfusion is ceased for any reason, always leave the infant's blood volume in balance.
- Sudden deterioration in infant's condition may be related to the procedure, underlying condition or an adverse reaction to transfusion. A transfusion adverse reaction report should be made

POST PROCEDURE CARE OF THE INFANT

- Continuously monitor vital signs and record 30 minutely for first 4 hours post procedure.
- If stable after this time routine observations as per ICU/NNU observation chart should be continued
- Perform blood glucose levels immediately post procedure and then hourly until stable

- Measure serum bilirubin levels one hour post exchange transfusion and repeat 6 hourly

POST PROCEDURE CARE OF THE INFANT CON…

- Continue phototherapy until bilirubin levels are within acceptable range.
- Anticipate rebound increase in serum bilirubin (up to 60% of pre-exchange level) 2-4 hours post procedure
- Observe catheter sites for signs of bleeding
- Keep infant NBM for at least 4 hours post exchange transfusion, or longer at the direction of the medical officer.

POST PROCEDURE CARE OF THE INFANT CONT…

- As exchange transfusion carries a potential risk of necrotizing enterocolitis (especially in the preterm infant) monitor the appearance of the abdomen and the presence of bowel sounds. Observe for signs of feed intolerance when feeding is recommenced
- Measure urea and electrolytes, full blood examination, haematocrit and blood gas on a regular basis until infant stable (as directed by medical officer)
- The medical officer performing the exchange transfusion should document the procedure in the progress notes

Parameters for exchange transfusion in Rh HDN

parameter	observe	Consider exchange	Do exchange
At birth Cord blood Hb	>14g/dl	12-14g/dl	<12g/dl
Br	<4mg/dl	4-5mg/dl	>5mg/dl
After birth Capillary blood Hb	>12g/dl	<12g/dl	<12g/dl and falling in 48 hrs
Serum bilirubin	<18mg/dl	18-20mg/dl	20mg/dl in first 48 hrs

SELECTION OF BLOOD FOR EXCHAGE TRANSFUSION IN Rh-hdn

- Should be as fresh as possible(<5 days)
- Rh(D) Neg blood of the same ABO gp as that of baby is used(ABO GP of baby & mother same/compatible)
- **If baby's ABO gp is not compatible with mother,it should be O Rh(D) Neg blood free from hemolysin Anti-A &Anti B**
- If more than 1 exchange transfusion is required ,ABO & Rh type same as that of the first time is used.

If mothers antibody is reactive against a high frequency Ag and no compatible blood is available:

- siblings can be tested
- Unit of blood can be collected from the mother, if the obstetricians agree that it is safe.

mothers redcells are constitued in AB plasma

BLOOD GROUP OF MOTHER	BLOOD GROUP OF BABY	CHOICE OF BLOOD
A	A	A,O
	B	O
	O	O
	AB	A,O
B	B	B,O
	A	O
	O	O
	AB	B,O
AB	A	A,O
	B	B,O
	O	O
	AB	AB,A,B,O
O	A	O
	B	O
	O	O
	AB	O

PROCEDURE

- Accomplished throug a single vascular access.
- A 3 way stop clock joins the unit of blood, baby,and the extension tube leads to the container
- A maximum 5ml/kg is used for each draw infused.
- The donar blood should be properly mixed.
- Exchange should be completed within 90 min.

Complications

- Catheter related complications
- air emboli , thrombosis
- hypo or hypertension
- intraventricular haemorrhage (preterm)
- Hypo or hyperglycaemia
- Hypocalcaemia,
- hyperkalaemia

Potential complications related to exchange transfusion:

- Arrhythmias
- Bradycardia
- Neutropenia,
- Feed intolerance,
- necrotizing enterocolitis
- Septicaemia,
- blood born infection
- Hypo or hyperthermia

CONCLUSION

- An **exchange transfusion** is a medical procedure in which patients **blood** is removed and replaced with plasma or donor **blood**.
- This is done via a catheter.
- The procedure is used to save the life of an adult or **child** with life-threatening **blood** abnormalities.
- **Exchange transfusion** involves the sequential withdrawal and injection of aliquots of **blood**, through arterial and venous lines, either peripheral or central.
- Note: arterial lines (umbilical or peripheral) should only be used for withdrawal of infant **blood**, not for injection of donor **blood**.

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