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# Neonatal Guidelines

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## Chapter 12: Clinical Procedures Version 2015.1

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|------------------------|-------------------------------------------|
| Specialty:             | Neonatal Medicine                         |
| Revised by:            | Sujoy Banerjee, Jean Matthes, Jamie Evans |
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## Directorate of Women & Child Health

### Checklist for Clinical Guidelines being submitted for Approval by Quality & Safety Group

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**Amendement: 5<sup>th</sup> June 2014**

- Chloraprep removed for skin preparation in procedure for lumbar puncture
- Chloral hydrate sedation added to MRI procedures

**Amendment / additions: Individually ratified 20<sup>th</sup> November 2013**

Blood culture

Umbilical Cannulation

Percutaneous Long line

Lumbar Puncture

MRI scanning at Singleton site using 3T machine

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## Guidance for use of ChloraPrep for aseptic procedures in premature infants

Due to a couple of recent incidents related to superficial burns in premature infants on our unit related to the use of ChloraPrep (2% Chlorhexidine in 70% alcohol) we have agreed to revise our current guidance on its use for aseptic procedure.

1. **ChlorPrep should not be used for any aseptic procedures in premature infants who are less than 28 weeks gestation at birth AND also less than seven days old.** In these infants, for all aseptic procedures including central lines, please use 0.5% Chlorhexidine in aqueous base as per previous practice (White solution available in glass bottles)
2. For all other infants including infants less than 28 weeks gestation at birth but over 7 days old at the time of the aseptic procedure, ChlorPrep could be used aseptic cleaning. **However, in all cases any residual ChlorPrep must be washed with sterile water after 30 seconds to minimise adverse effects related to prolonged contact.** Any pooling of the solution at the back must be avoided to prevent serious burns. It may be good practice to check for any immediate reaction after dabbing the solution on a test area of the skin.

## **Procedure Guidance: Peripheral Cannulation**

**Indication:** Peripheral intravenous access

### **Equipment list**

- Sucrose
- Silver trolley (wiped with Tuffie wipe)
- Sterile water for injection
- Dressing pack inc. sterile towel, apron and gloves
- Square gauze
- Yellow cannula
- "T" extension set
- Bung
- 0.9% saline flush
- Steristrip
- Splint
- 5 ml syringe
- Green (21G) needle
- Filter
- Sterile scissors

**Cleaning solution:** Chloraprep (2%) lollipop OR Chlorhexidine 0.5% aqueous as appropriate for gestation and age.

***Consider beforehand if baby requires a culture or other bloods with this new cannula; prepare additional equipment as necessary.***

### **Operator procedure**

Wearing apron and non sterile gloves:

Identify suitable site

Bring baby into comfortable position, (give sucrose)

**Assistant (this could be the nurse looking after the baby. Use assistance whenever practically possible)**

Place dressing pack on trolley – open all equipment required onto trolley for operator

Help operator by holding saline for drawing of flush by operator

Open sterile water and squeeze into tray for use following chlorhexidine

Take sterile rubbish bag from operator and attach to side of trolley

Open doors of incubator for operator

Give help to hold baby and fix cannula during procedure whilst wearing apron and non sterile gloves

## Operator

- Wash hands with scrub technique, dry with sterile towel and put on sterile gloves and apron
- Pass sterile rubbish bag to assistant to attach to side of trolley
- Draw up saline with help from assistant
- Flush extensions set and filter and cut steristrips to size if required
- Clean area with 0.5% Chlorhexidine in aqueous base for infants <28 week gestation AND less than a week old. For all other infants use Chloraprep lollipop (2%) (See Chloraprep guideline).
- Wait 30 seconds for chlorhexidine to dry
- Place limb in sterile field
- Insert cannula
- Once cannula in satisfactory position, stabilise with steristrips with help of assistant
- (Take blood if required)
- Attach flushed extension set and filter and flush cannula
- Flush and attach bung to the end of the extension set
- Fix cannula with Tegaderm
- Apply splint
- Clean away sharps at point of care
- Dispose of rubbish and wipe trolley with Tuffie wipe

Please note the insertion site of the cannula should be easily visible



## **Clinical Procedure: Blood culture**

**Indication:** Uncontaminated blood for microbiological culture in suspected sepsis

### **Equipments:**

|                                                                            |                         |
|----------------------------------------------------------------------------|-------------------------|
| Sucrose                                                                    | Sterile gloves          |
| Silver trolley                                                             | Apron                   |
| Tuffie wipe                                                                | Sterile towel for hands |
| Azo wipe                                                                   |                         |
| Sterile water for injection                                                |                         |
| Sterile field + / IV / Dressing pack                                       |                         |
| Yellow cannula                                                             |                         |
| Blood culture bottle                                                       |                         |
| 2 or 5 ml syringe                                                          |                         |
| Green (21G) needle                                                         |                         |
| Steristrip                                                                 |                         |
| Cleaning solution: Chloraprep (2%) lollipop OR Chlorhexidine 0.5% aqueous. |                         |

### **Procedure:**

***Consider beforehand if baby requires further blood sampling after culture or a new cannula; prepare additional equipment as necessary.***

#### **Wearing apron and non sterile gloves:**

- Identify suitable site
- Bring baby into comfortable position.
- Displace cap of blood culture bottle

#### **After removing non-sterile gloves:**

- Clean silver tray with tuffie wipe followed by azo wipe
- Place dressing pack on trolley – place all equipment directly from packets onto tray



**Wash hands again, dry with sterile towel and put on sterile gloves**

- Pass sterile rubbish bag to assistant to attach to side of trolley
- Prepare needle and syringe
- Clean area with 0.5% Chlorhexidine in aqueous base for infants <28 week gestation AND less than a week old. For all other infants use Chloraprep lollipop (2%) (See Chloraprep guideline).
- Wait 30 secs for Chloraprep to dry, assistant can give oral sucrose if indicated.
- Place limb in sterile field
- Insert cannula
- Once cannula in satisfactory position, you can stabilise with steristrip if required
- If possible place sharp directly into sharps bin, if not possible place into dressing pack tray so it can be easily identified for disposal following procedure
- Use needle and syringe to aspirate blood from cannula
- A least 0.5ml of blood is required to achieve effective yield from culture
- Provided no contamination has occurred, needle and syringe can be inserted into prepared blood culture bottle.
- Remove cannula and apply pressure or if keeping this cannula for antibiotics, flush with 0.9% saline and secure with tegaderm.
- Clean away sharps and rubbish and wipe trolley with Tuffie wipe

## **Clinical Procedure – Umbilical Cannulation**

### **Indications for Umbilical vein Cannulation**

- Need for secure venous access
  - BW <800gm
  - Gestation <28 weeks
- Administration of vasoactive drugs
- Infusion of hypertonic solution or Parenteral nutrition
- Emergency procedure for central access
- Exchange transfusion

### **Indications for Umbilical Artery Cannulation**

- Gestation <26/40 or 800gm
  - Frequent blood sampling in very preterm infants or unstable clinical status
  - Direct BP measurement / Labile BP requiring inotropic support
  - Exchange transfusion
- 

### **Contraindication for Umbilical Cannulation:**

- Omphalitis
- Omphalocele
- Evidence of local vascular compromise in lower extremities or buttocks
- Peritonitis
- Necrotizing enterocolitis

**Decide whether a UVC or UAC or both is required for the patient depending on the indications above**

- 1. If possible insert the UAC first**
2. If you have inserted UVC first for clinical reasons or as personal preference and then require to explore the cord further for a difficult UAC insertion
  - a. Consider temporary removal of the UVC and reinsertion back after the cord exploration and UAC insertion is completed
  - b. If this is thought to be risky or the UVC is considered a critical lifesaving vascular access, be fully aware of the above rare complication when further exploring the cord.

## Equipments

Silver Trolley, Tuffie wipes and Azo wipes

Umbilical cannulation set

Sterile gloves

Disposable scalpel x 2

Sterile gown

Sutures

Cap and mask

Saline 0.9%

Cord tie

Double lumen UVC ( 4Fr -20cm length)

Single lumen UAC (Fr 3.5 < 1250g baby/ Fr 4.0 > 1250g baby)

Cleaning solution: Chloraprep (2%) lollipop OR Chlorhexidine 0.5% aqueous as appropriate for gestation and age

## Measurements

### Umbilical vein

- Measure from the base of the stump to the xiphisternum and add the length of the umbilical stump
- Formula
  - $[(\text{weight(Kg)} \times 1.5) + 5]$
  - Remember to add on the length of the umbilical stump

### Umbilical artery

- Direct measurement of the shoulder-umbilical length  
Measure the perpendicular distance from an imaginary line drawn between the shoulders to the level of the umbilicus and calculate the catheter length using the graph
- Formula (use only if graph above not available)  
 $[(\text{Weight (Kg)} \times 3) + 9] + \text{length of the stump in cm}$

## Procedure

Remove all extraneous items prior to commencement of procedure i.e. soft toys, positioning blankets from incubator/cot to prevent accidental contamination of gloves/equipment & to maximise view **AND**

Ensure a nurse is available to assist with the positioning of the baby and provide sucrose if indicated

- Wash hands and put on non sterile gloves
- Complete measurements as above to determine lengths of catheters required
- Position baby for procedure with umbilicus exposed and nappy etc not causing obstruction
- Clean trolley with Tuffie wipe first followed by Azo wipes
- Open pack onto trolley and open equipment as above onto tray
- Put on hat and mask
- Wash hands with scrub technique and put on gown and sterile gloves
- Prepare tray by flushing catheters if required
- Ask the assistant to lift the cord up by the cord clamp and use a sterile artery forceps to re-clamp the cord below the plastic cord clamp. Ask the assistant to cut the cord between the plastic clamp and artery forceps and thereby remove the plastic clamp. Dispose the cord clamp and the scalpel safely. Now clean thoroughly using the artery forceps to anchor the cord. Clean area with 0.5% Chlorhexidine in aqueous base for infants <28 week gestation AND less than a week old. For all other infants use Chloraprep lollipop (2%) (See Chloraprep guideline).
- Allow Chlorhexidine to dry for 30 seconds
- Clean again with sterile water if using Chloraprep (2%) lollipop – **Important**
- Slip in the folded sterile transparent drape over the baby using the free hand (if needed you may briefly get the side lid down) and feed the cord through.
- Place cord tie around the base of the umbilicus
- Now apply gentle traction on the cord and slice the cord with a new scalpel, 1 – 1.5cm from the skin margin in one smooth cut away from yourself.
- Dispose of the forceps and artery forceps.
- Blot the cut surface dry and identify the umbilical vessels:
  - The single thin walled umbilical vein
  - Two smaller thick walled round arteries, generally constricted so that their lumen appear pinpointed. They often protrude from the cut surface of the umbilical cord.

## UAC insertion

1. Pick **one** artery and gently open it using either the fine forceps or fine probe. Gradually dilate the artery, advancing either to the curve of the forceps or to half of the probe length
2. Cannulate the artery and gently advance the catheter. Obstruction may be encountered at the anterior abdominal wall or bladder. This can usually be overcome by 30-60seconds of gentle steady pressure and pulling the umbilical stump up towards the baby's head to straighten out the artery as it turns caudally in the anterior abdominal wall just below the umbilicus. Avoid excessive pressure or repeated probing. If unsuccessful, **ask for help**.
3. The most common error arises after cannulating the layer between the vascular intima and the muscle. This usually occurs if dilatation of the artery in the cord has been inadequate. **Do not attempt the 2<sup>nd</sup> artery unless very experienced.**
4. Ensure patency of catheter by checking for easy withdrawal of blood and "pulsation" of blood/saline in the catheter.
5. Ask assistant to monitor position of UAC until UVC is placed and both are secured

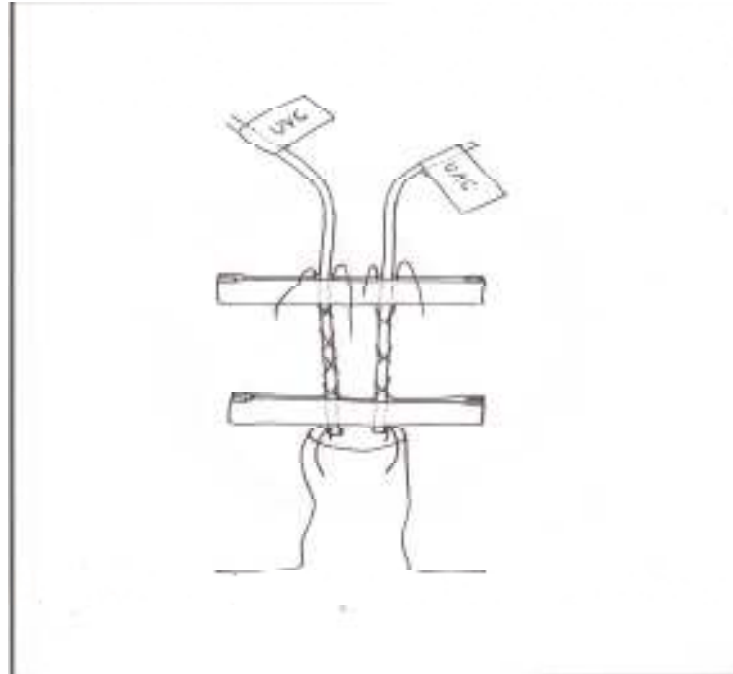
## UVC insertion

1. Immobilise cord using an artery forceps and with the second forceps grasp the wall of the vein.
2. Insert catheter into vein to required length. Some resistance will be felt at the umbilical ring just below the level of the skin; apply gentle pressure until the catheter passes through. If in, catheter will fill with blood. If blood is not drawn back easily insert the catheter a little further or withdraw it back slightly and try again. Flush the catheter with saline to avoid clotting.

## Fixation:

Once happy with the position of the catheter, take some Vicryl sutures and place one suture in either side of the cord with two lengths of suture extending from it around 5cm in length. The suture needs to go through a substantial thickness of cord, tied and wound around the catheter (tying the sutures with each turn around the catheter).

Ties and catheters should then be stuck down fast with two strips of either **elastoplast** or **sleek**. A couple of millimetres at the ends of the strips can be folded inwards to allow the strips to be peeled apart if necessary, as in the diagram. The lower strip should be as close as possible to the end of the cord.



Check position of catheters with X-ray. Until catheter position confirmed:

Connect UAC catheter to heparinised saline infusion (1unit/ml) - 0.3ml/hr (<1kg) or 0.5ml/hr (>1kg)

Connect UVC to infusion of 10% dextrose at 0.5ml/hr

Document procedure in clinical notes

### **UVC catheter position**

- The UVC should ideally be in the IVC just under the diaphragm.
- **Placement of the catheter tip in the portal circulation or liver is not acceptable and catheter should be removed.**
- Under no circumstances should the catheter be advanced, it should be removed and a new catheter inserted under sterile conditions. Only Infusions of 10% dextrose can be commenced until conformation of catheter tip.

## UAC catheter position

There are two **suitable** positions:

### **HIGH POSITION: Between T6 –T9**

- This is in the descending aorta above the origin of the mesenteric and renal arteries and below the ductus arteriosus. The high position is associated with fewer episodes of blanching and cyanosis of the lower extremities. However hypertension may be more common and this position may also be associated with increased incidence of IVH.

### **LOW POSITION: Between L3 – L4**

- This coincides with the aortic bifurcation at the upper end of L4 and is below the major aortic branches.  
Any other position is unsuitable and the catheter should either be removed or pulled back to one of the two suitable positions if possible. **Under no circumstances should the catheter be advanced, it should be removed and a new catheter inserted under sterile conditions.**

### **Emergency UVC insertion:**

- In a real emergency then there is no time for full aseptic technique, however you should work as cleanly as possible and observe universal precaution.
- Fill a 5ml syringe with 0.9% saline and flush through a 3 way tap attached to the umbilical line
- Tie the core ligature or tape loosely around the base of the cord. The arteries are unlikely to bleed at this point though bleeding from the vein is still likely and arterial bleeding may occur following recovery.
- Clean the umbilicus with an alcohol swab.
- Cut the cord about a centimetre from the skin with a clean stroke of the scalpel. A sawing action causes 'teeth' at the vessel edge making cannulation difficult.
- Identify the vein and grasp the cord with the artery forceps near the vein. With a second grip one wall of the vein before gently inserting the catheter into the vein using fingers or forceps. Do not probe the vein without supporting it by its edges with forceps.

- Insert catheter into vein until resistance is felt at the umbilical ring just below the level of the skin; apply gentle pressure until the catheter passes through. If in, catheter will fill with blood. In an emergency it is sufficient to get the end of the cannula in a large vessel, i.e. into a vessel from which it is easy to aspirate blood. If blood is not drawn back easily insert the catheter a little further or withdraw it back slightly and try again. Advancing only by about 3-5cm beyond the muco-cutaneous junction will prevent the catheter reaching as far as the portal circulation. Flush the catheter with saline to avoid clotting.
- During resuscitation, it is best for one dedicated person to keep hold of the catheter and be solely in charge of this. Taping or suturing is often practically impossible and frequently results in the catheter being lost in the process wasting valuable time. Secure this then well at the earliest opportunity once CPR has been discontinued.

#### ONGOING MANAGEMENT:

- Post catheter insertion visualize stump and observe closely for bleeding and/or displacement.
- Observe the umbilical area for local signs of infection

#### COMPLICATIONS OF UMBILICAL CANNULATION :

- Haemorrhage
- Infection
- Thromboembolism : liver, lungs and rarely systemic through foramen ovale
- Malpositioned / Migrated catheter and its complications
  - Cardiopulmonary circulation – pericardial effusion / tamponade, arrhythmias, hydrothorax, haemorrhagic lung infarction, pleural effusion
  - In portal system: Necrotising enterocolitis, hepatic haematoma or necrosis, thrombosis of hepatic veins, perforation of peritoneum or rarely bowel.



## **Procedure - Lumbar Puncture**

### **Indications:**

- Sterile sample of CSF for cytological, biochemical and microbiological analysis
- Drainage of CSF in communicating hydrocephalus associated with IVH

### **Equipment**

Silver Trolley, Tuffie wipe and Azo wipe

Lumbar Puncture set inc. 3 bottles

Gown

Spare sterile sheet

Sterile gloves

Sterile scissors

Cap and mask

Lumbar puncture needle if not included in pack

Cavalon spray

Plaster

Glucose bottle

Cleaning solution: Chlorhexidine 0.5% aqueous. **DO NOT USE** Chloraprep for skin preparation for lumbar puncture

### **Prior to procedure**

Ensure that baby is clinically stable for procedure. Check to ensure normal platelet count

LPs may be performed on intubated babies as long as the correct care is taken to maintain airway patency. Supplemental oxygen may be required.

### **Procedure**

- Clean silver trolley initially with Tuffie wipes followed by Azo wipes
- With non sterile gloves and apron, place baby in the lateral decubitus position with legs flexed.
- Ensure correct alignment of the spine and hips with the spine at 90 degrees to the surface of the cot. An experienced assistant is essential to maintain the correct position
- Check landmarks. Palpate the iliac crest and slide finger down to the L4 vertebral body. The preferred space is L4/5. Allow the assistant to relax the flexed position of the baby until you are ready to clean the area.

- Clean trolley with Tuffie wipes
- Open lumbar puncture pack and add equipment including needle, cleaning solution, x2 sterile sheet and scissors
- Label your bottles 1, 2 and 3 and the bottle and the lid and leave outside the sterile field. A second assistant will be required to pass the bottles to you so make sure they are now available
- Scrub and put on sterile gown, gloves etc.
- Clean area with 0.5% Chlorhexidine in aqueous base for all infants. Start cleaning at the preferred site of lumbar puncture and clean in circulating movements AWAY from site.
- Wait to dry for 30seconds
- Cover area with sterile towel with area for lumbar puncture only showing.
- Clean the immediate area for lumbar puncture with the appropriate cleaning agent as before for a second time
- Wait for 30 seconds
- Re-check landmarks and alignment of baby
- Insert spinal needle (bevel upwards) with steady force in the midline of the interspace, at a right angle to the skin.
- Advance the needle slowly. It is important to remove the stylet at regular intervals to check for fluid and to avoid passing the needle too far and getting a bloody tap.
- Collect CSF in numbered universal containers taking care to maintain sterility (a helper is essential). 10 drops per tube is adequate. Don't forget glucose, and consider 4th container for Herpes PCR and titres should this be a possible diagnosis.
- Replace stylet, and withdraw needle.
- Maintain pressure over area. Spray insertion point with Cavilon spray and cover with sterile gauze/ plaster.
- Clean away tray taking care to place any sharps directly into the sharps bin
- Wipe down trolley with Tuffie wipes

## **Percutaneous peripheral long line insertion**

### **A. FOR TINY BABIES <1KG**

- DELTEC 20 cms single luer catheter (27G) with guidewire
- VYGON Premicath (28G) 20cm catheter – no guidewire

### **B. FOR BABIES > 1KG**

- Nutriline PIC line. 30 cm length. 2F with a peelable cannula
- DELTEC 20cms single leur catheter (23G) guidewire

### **Catheters with a guidewire do not need to be flushed prior to insertion**

Remove all extraneous items prior to commencement of procedure i.e. soft toys, positioning blankets from incubator/cot to prevent accidental contamination of gloves/equipment & to maximise view plus

Ensure a nurse is available to assist with the positioning of the baby and provide sucrose as required

### **Equipment**

Silver trolley wiped with Tuffie wipe followed by Azo wipes (70% alcohol)

Sterile pack including steristrip/tegaderm/gauze/syringes

Yellow Neoflon

Catheter of choice

Hepsal / 0.9% saline

Chloraprep (Chlorhexidine 2% in 70% isopropyl alcohol) OR Chlorhexidine 0.5% aqueous chlorhexidine as suitable for age and gestation

Sterile water for injection

Sterile scissors

Sterile gown and gloves

Hat and mask

2 assistants

## **Operator**

Wash hands and put on apron and non sterile gloves

Decide on where to place catheter, position baby and measure the length of catheter required with tape measure.

Measure the distance between the site of insertion (e.g. antecubital fossa or ankle) and the desired final position and use this as the approximate length of insertion of the catheter. This should be the sternal angle for lines inserted via upper limb and xiphisternum for lines inserted via the lower limb.

## **Assistant 1**

### **Wash hands and wear apron and non sterile gloves:**

Open sterile pack for operator and add any equipment necessary to pack for operator

Hold saline for operator to draw up

Place sterile rubbish bag on side of silver trolley when passed by operator

Open the incubator doors for operator and assistant 2

Be available to assist operator and assistant 1

## **Assistant 2**

Scrub at the same time as the operator and put on gown, sterile gloves, hat and mask

Ask assistant 1 to open incubator doors for you

Using sterile gauze, hold the hand/foot of the limb required for placement of the catheter whilst operator cleans the limb.

Then, with a second piece of gauze, hold the leg/arm whilst the foot/hand is cleaned

Continue to hold limb whilst the operator drapes the limb

Help to hold the limb in a suitable position for the operator to optimise successful placement of catheter

## **Operator**

Put on mask and hat

Wash hands using aseptic technique and put on gown and sterile gloves

Prepare trolley including flushing catheter if required (i.e if no guidewire) and cutting hole to size in sterile drape.

Cut small hole in the centre of 1 small tegaderm as shown in the fixation guide below

Cut steristrips to size

Clean whole limb with appropriate cleaning solution

Leave to dry for 30 seconds

If using Chloraprep, clean point of entry with sterile water

Using sterile drape with pre cut hole, drape the washed limb

Site the cannula required for the size of long line being used

Thread long line in

Remove guide wire (if required)

Fix the long line with steristrip and tegaderm with help from assistant 2.

( see fixation procedure below)

Cover with sterile gauze

Start infusion of 10% Dextrose at 0.5ml/hour immediately after insertion and prior to x-ray

Request x-ray

**The correct position for the tip of the catheter is in the superior venacava or inferior venacava, about 1 cm or so from the heart.**

Wash the rest of the limb with sterile water

Dispose the waste and clean trolley.

### **LONG LINE FIXATION**

1. Secure the line with a short piece of Steristrip (adherent side facing skin) leaving the point of entry visible



**2.** Place 2nd shorter steristrip under the line (adherent side facing up) as close as possible to the first steristrip



**3.** Place 3rd longer steristrip (adherent side downwards) over 2nd steristrip fixing the line between the 2 steristrips. 3rd steristrip must be longer than 2nd steristrip to adhere to the skin on each side



**4.** Take tegaderm with hole cut in (demonstrated below) and place so that the hole in the tegaderm is over the point of entry of the long line.



4. Place sterile gauze under the butterfly/cannula and then secure the rest of the area with tegaderm leaving just the point of entry visible through the hole in the tegaderm



5. Cover the whole area in sterile gauze and secure with tegaderm. Remove the sterile blue sheet and obtain x-ray to confirm position.

If long line needs to be pulled back, this can be done by sterile procedure via the window in the tegaderm.

When the position is confirmed, using sterile technique, remove the gauze from the limb and place a 2nd tegaderm over the window in the first tegaderm.

**Notes: Do not completely encircle the limb with tegaderm or steristrip as this may affect perfusion. Use only wide steristrips.**

## **Femoral venous lines**

This is a specialised technique which should preferably be done by an experienced member of staff. It uses a modified Seldinger technique.

### **Equipment:**

Blue Abbocath (22g)

VYGON Leaderflex 22 g. 8 cm line

Chlorhexidine antiseptic

Sterile drapes, cotton wool, gauze swabs

2 x 5ml syringes

Hepsal

### **Technique:**

Usually this is done in babies who are ventilated, sedated and paralysed.

- Using strict aseptic technique, clean and drape the area of insertion obtaining a good aseptic field.
- Flush the long line catheter with Hepsal. Attach the blue Abbocath to a 5 ml syringe of Hepsal and flush.
- Insert the blue cannula in the femoral vein and obtain a good flowback of blood. The femoral vein is located just medial to the artery. Remove the Trocar.
- Insert the guidewire very gently and carefully through the cannula into the vein by the flexible end. Never force the guidewire if you encounter resistance.
- Once the guidewire is in the vein about 5 cms, holding it in place, gently withdraw the IV cannula and remove it. (You may need to apply pressure over the site of entry of the guidewire to stop blood loss.)
- Now thread the central venous catheter onto the guidewire. A length of guidewire should be sticking out of the proximal end of the catheter.
- With a twisting motion, insert the C.V. catheter through the skin. If this is difficult, the site of entry may be extended using a small scalpel.
- Once the C.V. catheter is inside the vein, advance it gently whilst holding the distal end of the guidewire so that only the catheter advances and not the guidewire. Again, do not force the catheter through a resistance.



- Once the catheter has advanced to the desired length, remove the guidewire. Connect the catheter to a syringe with hepsal and aspirate gently. With correct placement, there should be a good flowback of blood.
- Secure the catheter using a sterile dressing, e.g. tegaderm and use a luer-lock connector to connect to a syringe. Reflush the catheter so it does not block.

### **Use of contrast to confirm position of percutaneous long line in neonates**

**Aim:** To aid in defining the position of a percutaneous long line in a neonate in situations where a plain X-ray without contrast is not sufficiently informative.

**Contrast used:** Omnipaque 300 (1ml diluted with 1ml of sterile water for injection and then inject 0.5 to 1ml of the solution). Do not use any other contrast medium without discussing it with a Consultant Radiologist.

**Procedure:** Discuss with Consultant Neonatologist prior to use of contrast. Consider discussing the plain X-ray with the Consultant Radiologist before using the contrast. Position the limb for ideal exposure. Keep 1ml of 0.9% saline flush ready. Inject 0.5 to 1 ml of the diluted contrast medium. Take X-ray few seconds after completing the injection. Once X-ray is taken, flush immediately with 1 ml of normal saline. Review X-ray for position of line and discuss with Consultant Neonatologist. DO NOT repeat the contrast medium injection again without discussion with Consultant.

## **Guideline for maintaining patency of Central Venous Access Devices in Neonates (CVADs)**

*(Adapted from guidelines from Great Ormond Street Hospital for Sick Children, UK)*

### **Introduction:**

Central Venous access devices are primarily used in neonates to provide a secure long term vascular access to provide parenteral nutrition where percutaneous long line access has failed. They are also sometimes used to administer intravenous medications that are too caustic to be given through peripheral veins or where reliable peripheral access has proven impossible following prolonged periods of intensive care.

Many of these devices are inserted surgically under general anaesthetic and maintained in-situ until the clinician is sure that the devices are no longer required. Veins suitable for insertion of CVADs are limited and hence it is important to keep these lines patent and free of infection as long as possible.

This guideline covers the flushing of the CVADs using aseptic precautions either on the neonatal unit or in the community.

### **Devices covered:**

The devices that are covered by this guideline include –

1. Skin tunnelled central venous catheters (CVCs) (commonly referred to as Hickman<sup>®</sup> catheters, Broviac<sup>®</sup> catheters). These CVCs may have one, two or three separate lumens.

If the child has a CVAD in situ that is not listed here, contact the manufacturer of the CVAD for further information as regards flush volumes.

### **Purpose of flushing CVADs:**

Routine flushing of CVADs is performed at established intervals to promote and maintain patency and prevent the mixing of incompatible medications and solutions.<sup>1</sup> Sodium chloride 0.9% or other compatible solution must be used before, between

and after the administration of incompatible medications and/or solutions.<sup>1,2</sup> Standard flushing solutions used most frequently for CVADs includes sodium chloride 0.9% and/or heparinised sodium chloride (various strengths 10-5,000 units per ml).<sup>3,4,5</sup>

### **Risks Associated with heparin flush Solutions:**

Decreasing unnecessary exposure to heparin is important to minimise adverse effects associated with heparin use, e.g. autoimmune mediated heparin-induced thrombocytopenia, allergic reactions and the potential for bleeding complications following multiple, unmonitored heparin flushes.<sup>6</sup>

Problems known to occur when heparin flush solutions are used include:

- Confusion with other 'look alike' products.<sup>2</sup>
- Using unlabelled heparin syringes.<sup>2</sup>
- Errors in calculating and diluting heparin.<sup>2</sup>
- Incompatibility of heparin with other medicines
- Administration of incorrect strength of heparin i.e. 10,000 units per ml instead of 10 units per ml resulting in the deaths of three infants
- Heparin interfering with blood test results if it is present in the CVAD or cannula
- Administration of heparin without a prescription or patient group direction increases the risks of errors.<sup>2</sup>

### **General Guidance when flushing CVADs:**

Use of an aseptic non touch technique (ANTT) and good standards of hand washing can reduce the risk of infection when using CVADs. ANTT must be used when accessing CVADs, hands must be decontaminated and an effective hand washing technique used before accessing a CVAD.

Clean or sterile gloves should be used when accessing CVADs.<sup>6</sup>

The catheter hub/needless connector should be cleaned with an alcoholic chlorhexidine wipe for 30 seconds using friction and allowed to dry before use.<sup>6</sup>

The concentration of heparin used should be the lowest possible that will maintain patency.<sup>1</sup>

Preferably sterile sodium chloride 0.9% should be used to flush and lock catheter lumens that are in frequent use i.e. accessed more than twice daily.<sup>6</sup>

All flush solutions used for CVADs **must** be administered in accordance with patient specific direction.<sup>2,11</sup>

10 ml syringes should be used to flush CVADs.<sup>7</sup> Excessive force should be avoided when flushing CVADs.

If resistance is felt during flushing and force is applied to the syringe plunger this can result in high pressure within the catheter which may rupture. Before use, the CVAD should be checked for patency using a 10 ml or larger syringe containing 0.9% sodium chloride.<sup>12</sup>

**Flushing Techniques:** There are two main methods of flushing used to maintain patency - the turbulent or pulsatile flush and positive pressure.<sup>3,5,12</sup>

### **Turbulent/ pulsatile flush**

This method is used to clear the catheter of blood or drugs that may adhere to the internal surface of the catheter. This technique utilises a rapid stop-start or push-pause method when injecting the flush solution into the catheter.<sup>3,5,12</sup> This technique is based on the concept of laminar and turbulent fluid flow. Laminar fluid flows in undisturbed layers, with the fastest current in the center of the lumen. Turbulent flow moves in swirls and eddies. Theoretically, turbulent flow removes any blood attached to the catheter wall and thus reduces the risk of catheter lumen occlusion.<sup>3</sup>

### **Positive pressure flushing**

This technique prevents or reduces the risk of blood reflux into the catheter lumen when the syringe is detached from the hub and pressure is released. The technique involves clamping the catheter whilst instilling the last part of the flush, so that 0.5-1ml of solution is left in the syringe immediately after which the pressure is released on the syringe.

## Flushing Volumes:

The volume of the flush solution should be equal to at least twice the volume of the catheter and add-on devices.<sup>1</sup> The internal volume of the catheter will differ depending on the type of catheter and its size.<sup>5</sup> Many of the long term CVADs will have been cut in theatre to fit each individual child, therefore the internal volume of the catheters will be less than the stated catheter priming volume. The following flush volumes are given as a guide. The child's size and clinical condition will also dictate the amount of flush to use, which will rely on the clinician's clinical judgement at the time.

| <b>Table of flushing volumes for skin tunnelled CVC<br/>(Broviac and Hickman's : 2.7Fr, 4.2Fr, 6.6Fr (single lumen))</b> |                                                                                                      |                                   |
|--------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------------------------|
| <b>Action</b>                                                                                                            | <b>Volume</b>                                                                                        | <b>Solution</b>                   |
| To assess patency pre access                                                                                             | 1-2mls                                                                                               | sodium chloride<br>0.9%           |
| In between/after IV medication                                                                                           | 1-2mls                                                                                               | sodium chloride<br>0.9%           |
| Frequently accessed catheters<br>(three times daily or more) after<br>each use as a lock                                 | 1-2mls                                                                                               | sodium chloride<br>0.9%           |
| Infrequently accessed catheters<br>(once or twice daily) after each<br>use as a lock                                     | 1-2mls sodium<br>chloride 0.9%<br>followed by 1.5mls<br>heparinised saline<br><b>10 units per ml</b> | n/a                               |
| To lock the catheter - weekly                                                                                            | 1.5mls                                                                                               | heparin sodium 10<br>units per ml |
| To flush after blood sampling                                                                                            | 2-3mls                                                                                               | sodium chloride<br>0.9%           |

Actual catheter priming volumes: 2.7Fr=0.15ml, 4.2 Fr=0.3ml, 6.6 Fr=0.7ml.

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## **Suprapubic aspirate**

### **Indication:**

Suprapubic aspirate is the gold standard for obtaining urine specimens for culture.

Ideally part of septic screen in any sick baby

### **Interpretation:**

Any growth of pathogenic bacteria in an SPA specimen is felt to be significant.

### **Contraindications:**

- Bleeding diathesis
- Abdominal distension
- Massive organomegaly

### **SPA Procedure:**

- Use oral sucrose if not contraindicated for analgesia
- Ultrasound guidance may improve success rate by reducing attempt on an empty bladder
- Ask assistant to hold **infant supine with legs extended** and be ready to catch urine if the baby voids
- Wipe the skin with chlorhexidine and drape
- Identify insertion point
  - Midline
  - Lower abdominal crease
- Insert needle perpendicular to the skin, aspirating gently as you advance the needle.
- If no success, withdraw the needle to just under the skin, and advance at an angle with the needle aimed more away from the pelvis.
- If urine is obtained, remove needle and squirt urine into sterile urine jar

**Complications:** Uncommon (estimates ~0.2% (i.e. 1 in 500), most of which are benign). They include:

- Macroscopic hematuria (infrequent — not usually clinically significant)
- Bladder haematoma (rare)
- Bladder haemorrhage (very rare)
- Intestinal perforation (rare — not usually clinically significant)
- Anaerobic bacteraemia or abscess formation (very rare)

## **Extravasation Injury - Guidelines for Prevention**

**Clinical circumstances will vary and there will be exceptions to all these guidelines. However, if these guidelines are to be overridden, this decision can ONLY be taken at senior level.**

1. Junior medical staff should have no more than three attempts at peripheral venous cannulation before asking for senior assistance.
2. TPN, High concentration dextrose fluid (15% or more), Calcium infusion, Dopamine containing solutions should only be given via a central venous line, which is a peripherally inserted long line or an umbilical venous line.
3. Antibiotics should preferably not be given through cannula inserted into the small veins on the dorsum of the foot. Acceptable sites in order of preference include:
  - The back of the hand and forearm
  - The saphenous vein (as long as the site of entry is close to the ankle joint and the cannula tip is beyond the ankle joint) \*\*
  - The antecubital fossa \*\*
  - The scalp veins.

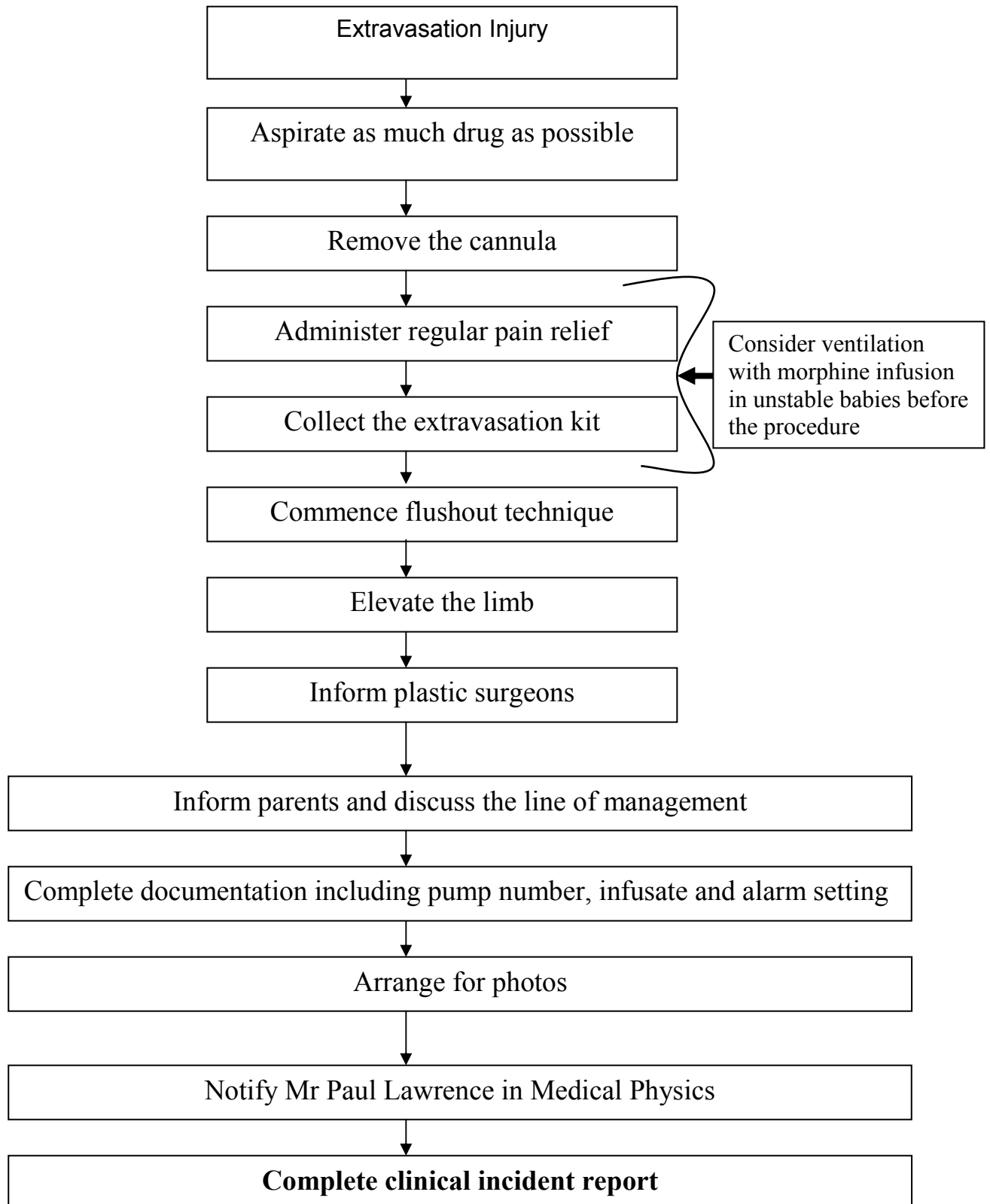
**\*\*Don't use these veins if it is likely that the baby will need a long line in the future.**

4. Wherever the cannula is inserted all the usual precautions to test that the cannula is in the vein should be performed prior to infusing the antibiotics.
5. Hourly inspection of peripheral IV cannula (for venous blood return), sites (for swelling, redness, pain) and regulation of delivery of IV fluids.
6. The infusion pump's occlusion alarm should be set at the lowest possible limit and the GREASEBY pump should not be set above low for peripheral IV cannula.
7. If the pump alarms the infusion site should be carefully examined and tested (if necessary) with normal or heparinised Saline.
8. Both Medical and Nursing staff should have a formal training in infusion pumps and be aware of drugs and infusates likely to cause tissue injury if extravasated.



9. Remove ID bands before cannulation and avoid tight strapping around the cannula site

GUIDELINES FOR TREATMENT:



**Flush-out technique:**

Clean and drape the damaged area of skin as for a sterile procedure

Make sure you give adequate analgesia (Sucrose/ paracetamol / morphine)

Ensure that the baby does not become cold / wet during the procedure

Infiltrate the area of injury immediately with 0.3-0.4 mls/kg of 1% lignocaine. Then inject 500 – 1000 units of Hyaluronidase into the subcutaneous tissue under the area of damaged skin.

Make multiple small thickness skin incisions around the site of injury using scalpel blade

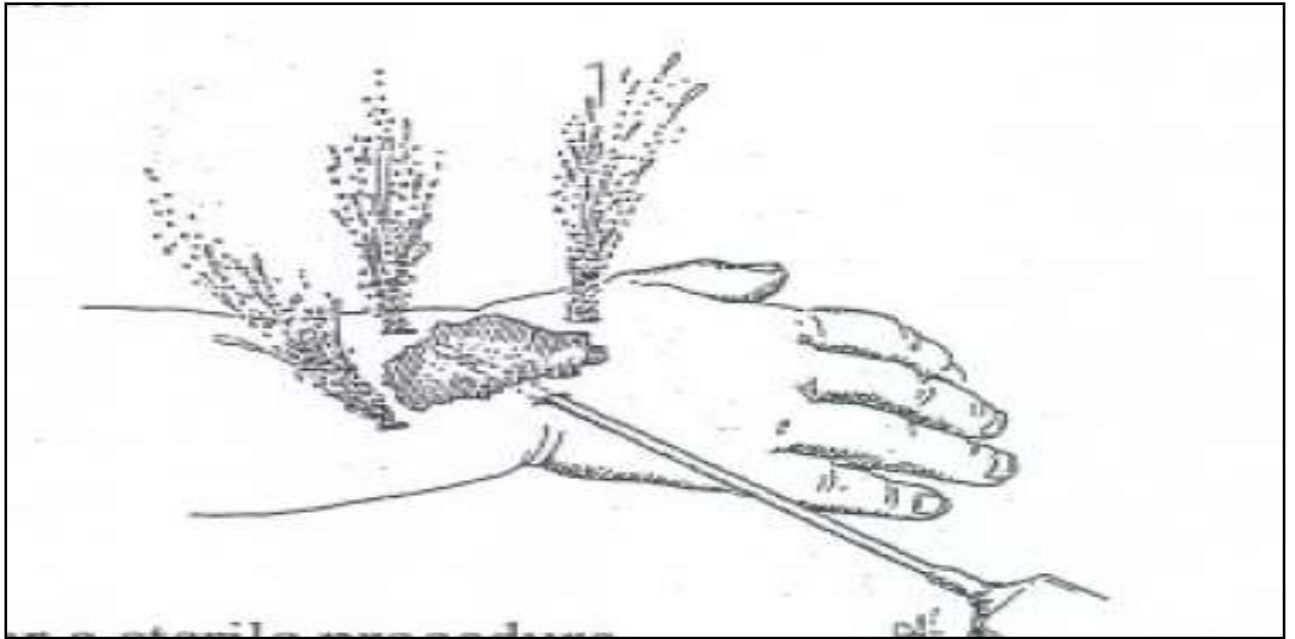
Use the extravasation cannula (stored in the CSSD room in NICU) to make channels beneath the skin that connect the area of extravasation to the small skin incisions

Flush the area with up to 500 mls of Normal Saline with 20 ml syringe connected to the extravasation cannula. Insert the cannula into each separate incision and flush with saline. This should wash out subcutaneous tissue and fluid should leak out of the remaining incisions. If saline collects in the surrounding subcutaneous tissues, it should be milked towards and out of the small skin incisions.

Clean the area and dress with a sterile Jelonet and gauze dressing.

Elevate the limb and change dressing daily.

The multiple small incisions do not require suturing and will close spontaneously.



## **Thoracocentesis**

### **Indication:**

- Tension pneumothorax

### **Technique:**

- Site – 2<sup>nd</sup> or 3<sup>rd</sup> intercostal space, mid-clavicular line anteriorly
- Insert a 19G butterfly needle attached to a 3-way tap (turned off) and a 20ml syringe
- Always do a chest x-ray following insertion and attempted aspiration as this procedure itself may cause a pneumothorax

## **Chest tube insertion**

### **Indication:**

- Pneumothorax
- Pleural effusion

### **Technique – must be done aseptically**

#### **Preparation:**

- increase inspired oxygen to 100%
- ensure adequate working field – clear away leads, toys etc
- cover baby to ensure temperature maintained
- prepare drain
  - put 20mls of water in drainage bottle (not needed for effusion)
  - ensure lid tightened
  - fix bottle to bottom of incubator using tape as necessary

#### **• Site**

- Laterally in the 5<sup>th</sup> or 6<sup>th</sup> intercostal space in the mid axillary line
- Avoid nipple and breast bud for cosmetic reasons

#### **Method:**

- Clean skin with antibacterial solution and if time allows, infiltrate with local anaesthetic e.g. 1% Lignocaine at site of insertion. Increase / commence IV analgesia

- Approach upper edge of rib (intercostal artery lies at lower edge of rib) and make a small incision along the skin line with the scalpel
- Perform blunt dissection of intercostal muscle with forceps until pleural cavity is entered (air may bubble out at this point, or fluid if draining an effusion)
- Insert chest drain **without** the trocar using either an 8FG or 10FG chest tube or a pigtail catheter

### **Alternatively**

- Place an arterial clamp a short distance from the end of the chest drain containing the Trocar so that by applying pressure, the arterial clamp will restrict the ability to insert the chest drain and Trocar to just 1-2mm within the pleural cavity
- Once pleural cavity has been entered, the arterial clamp is removed and the chest drain advanced while the Trocar is retained in its original position so that only the drain and NOT the Trocar is put into the chest, ensuring that the Trocar itself cannot damage the underlying lung

### **Then**

- Connect tube (clamped) to valve or underwater seal, unclamp and observe air bubbles and swinging with respiration
- Fix the tube to chest wall with Tegaderm and steristrips or a suture
- X-Ray to check tube position and lung re-expansion

**The aim is to position the tip of the chest drain just behind the upper sternum, that is, in an anterior position**

### **Removal of chest drain:**

Clamp the chest drain once the drain has stopped bubbling or swinging (usually within 24-48 hrs).

May remove drain after a further 12-24 hours if there is no clinical deterioration, no bubbling on removing the clamp or no reaccumulation of the pneumothorax on chest x-ray. Following removal, apply steristrips to site of chest drain bringing edges together. Purse string sutures can leave unsightly scars and as such are not advised.

## **Guideline for tapping from a ventricular reservoir**

The CSF reservoir is felt subcutaneous in as a small 'button' in the fronto- parietal region. A Reservoir is inserted in babies who are developing hydrocephalus usually secondary to intraventricular bleed. The aim is to control the hydrocephalus i.e. intracranial pressure, ventricular size and cortical thinning till the baby is of a reasonable weight (2.5kg) and the protein content of the CSF is within acceptable limits to carry out a V.P shunt procedure. In some babies (about 50%) the hydrocephalus may resolve over a period of time and may not require a VP shunt at all.

### **Indications for Reservoir Taps:**

1. Clinical status: The baby may have symptoms of increased intracranial pressure i.e. increased irritability, poor feeding, apnoea or bradycardic episodes or signs such as tense A.F, sutural separation, sun setting sign and cranial nerve palsies.
2. Head circumference: An increase of 1-2mm per day is within normal limits of growth.
3. Centile chart: If the Head circumference is crossing the centile charts upwards then the frequency of taps is not enough.
4. Head scan: If the ventricular index is increasing or crossing the '2<sup>nd</sup> line' (4mm > 97<sup>th</sup> centile) on the ventricular index chart.

It is generally accepted that a tap of **10-20 ml/kg** at a rate not greater than 1ml/kg/min should be done.

### **Equipment:**

1. Chlorhexidine or Povidine-Iodine skin preparation solution as appropriate
2. 25 gauge butterfly needle (may need 23g if CSF tenacious)
3. 5ml syringes
4. Standard infant lumbar puncture set
5. Sterile drapes to allow for maintenance of a sterile field

**Precautions:**

1. Maintain strict asepsis.
2. Monitor and correct serum electrolytes every other day if more than 10ml removed daily.
3. Be prepared to provide rapid fluid replacement should infant not tolerate large volumes removed. Replace fluid removed with intravenous normal saline.
4. If skin breakdown occurs, select insertion site away from broken area.
5. Do not place IVs on same side of scalp.

**Procedure:**

**Serial tapping of the reservoir has a great danger of introducing infection in the CSF causing meningitis or ventriculitis. Strict attention should be paid to complete aseptic technique.**

1. Before you start the procedure, feel for the reservoir
2. Cut any long hair that interferes with the surgical area but do not shave operative area..
3. trolley, Gown, mask, cap, orange butterfly needle, sterile tray, betadine, chlorhexidine, 3 white topped bottles, 1 yellow topped bottle for glucose, sterile gloves, 10-20 ml syringes (3-4), extra drapes.
4. You would need at least one doctor / nurse to assist you. Consider the use of [sucrose for analgesia](#) if the baby meets the criteria
5. Put on hat and mask. Wash your hands thoroughly and dry aseptically. Then put on gown and sterile gloves.
6. Place the infant with head in neutral position in anticipation of a 20 to 25 minute procedure
7. An assistant puts sterile towel under baby's head, holds the head still and gives some sucrose to the baby. Now clean the area around the reservoir thoroughly with chlorhexidine and betadine (apply betadine for 2 minutes and allow to dry before finally cleaning it with chlorhexidine).
8. Now drape the local site, first by a sterile towel with a hole of about ½ inch diameter and then putting the blue drape on the top of it.

9. With the orange butterfly attached to a syringe, insert the needle perpendicularly in the reservoir about 0.5 cm. You will not and you should not be looking for a 'giveaway' feeling. Select an insertion site different from the one most recently used. The base of the reservoir is metal so cannot be punctured. In most instances the CSF can then be aspirated at a rate and volume as mentioned above.
10. Once the procedure is complete and the area dressed, baby should be kept supine for next 1 hour.
11. The CSF samples should be sent for biochemistry and culture after every tap and the results chased. Serum sodium will need to be checked at least once a week.

The chart should be completed (see below). The notes should be completed and signed.

**The centile chart should have head circumference plotted at least three times a week (Monday, Wednesday and Friday)**

#### **Complications:**

1. Local skin breakdown
2. Hypovolaemia
3. Hypoproteinaemia
4. Hyponatraemia (check electrolytes every 2-3 days)
5. Wound or reservoir infection
6. CSF leak from puncture site
7. Obstruction of ventricular catheter
8. Ventriculitis
9. May precipitate further haemorrhage if large amounts of CSF removed



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# VENTRICULAR RESERVOIR TAP CHART

| SERIAL NO. | DATE | VOLUME | BIOCHEM | CULTURE | PRE-TAP H.C | POST-TAP H.C | HEADSCAN V. IND R L |
|------------|------|--------|---------|---------|-------------|--------------|---------------------|
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |
|            |      |        |         |         |             |              |                     |

**CFM:** See Neurology guideline

**Cranial USS:** See Neurology guideline

**Neonatal Guidelines**

Chapter 12: Clinical Procedures v2015.1

Valid until 31<sup>ST</sup> January 2018 42

## **Exchange Transfusion:**

A procedure by which severe anaemia is corrected and toxic metabolites, bilirubin and drugs are removed from the circulation.

### **Indications:**

1. Severe haemolytic anaemia: e.g. rhesus iso-immunisation (**double volume exchange transfusion of plasma reduced or semi-packed RBCs**)
2. Severe hyperbilirubinaemia (**double volume exchange of semi-packed RBCs**)
3. Severe non-haemolytic anaemia e.g. twin to twin transfusion causing chronic anaemia with heart failure (**single volume exchange of packed RBCs**)
4. Polycythaemia: **partial** exchange transfusion may be indicated using **0.9% saline**
5. Rarely severe coagulopathies and DIC (**double volume exchange of whole blood**)
6. Removal of toxic metabolites e.g. Ammonia in amino-acidopathies and drug poisoning (**single volume with semi-packed RBCs**)

**Single volume exchange (ml) = 80 x weight (kg)**

**Double volume exchange (ml) = 2 x 80 x weight (kg)**

### **Donor Blood:**

1. ABO compatible. CMV, HIV, Hepatitis B and rhesus negative, preferably irradiated unless delay in obtaining irradiated blood would cause significant clinical delay.
2. <48 hours old, citrate phosphate dextrose (CPD) is preferred; it has higher PH, more 2,3 diphosphoglycerate and lower potassium
3. Ideally plasma reduced (Hct 0.55 – 0.6). If packed cells are used particularly in non haemolytic conditions, dilution may be required with 0.9% saline in the last few aliquots to avoid iatrogenic polycythaemia. Do not use FFP as diluent as it increases donor exposure
4. Infants with Rh incompatibility: the blood must be O Rh negative crossed matched with the mother's blood.

5. Infants with ABO incompatibility: the blood must be O Rh compatible (with the mother and the infant) or Rh negative and cross-matched with the infant's and the mother's blood.
6. Other blood group incompatibilities: (e.g. anti-Rh-C, anti-Kell, anti-Duffy), blood must be cross-matched with the mother's blood.
7. Babies who had received intrauterine transfusions must receive irradiated blood to prevent GVHD

**Technique: (see diagrams)**

1. Iso-Volumetric: (preferred method) Using umbilical artery and umbilical vein or peripheral artery and peripheral vein.
2. Non-Volumetric: A single umbilical vein is used for withdrawing and infusing

**Equipment:**

1. Radiant warmer (Obtain from Obstetric theatres) and equipment for respiratory support and resuscitation.
2. Monitoring of HR, RR, Temperature, Sat O<sub>2</sub>, BP and if indicated CVP.
3. Umbilical artery and venous catheterisation sets.
4. Exchange transfusion set, connections and blood warmer.
5. NGT to evacuate stomach before the procedure and keep it in-situ.
6. An assistant for iso-volumetric exchange transfusion and a third person to monitor the vital signs, check blood gases and record the exchanged volumes.

Exchange transfusion is an intensive care procedure performed under aseptic conditions.

**Procedure:**

- ❖ Inform parents about the procedure, which may take 60-90 minutes to perform.
- ❖ Complications (see later) may arise especially if the procedure is not strictly adhered to
- ❖ The baby will have an IV dextrose infusion with calcium supplement. Enteral feeds will be stopped and not re-started until 24 hours after the procedure
- ❖ If deemed necessary, the procedure may need to be repeated.

1. Insert a NGT and aspirate the stomach contents.
2. Aseptically cannulate umbilical artery (UAC) and umbilical vein (UVC).
3. Take blood for:
  - ❖ Group & direct Coomb test
  - ❖ FBC, Hct, film, coagulation screen
  - ❖ U&E, LFTs, Ca, bilirubin, glucose
  - ❖ ABG
  - ❖ In haemolytic disease with no obvious cause blood for G6PD and GAL1 PUT levels
4. Check the blood pack information: group, rhesus status, expiry date.
5. Connect 3-way tap and 10ml syringe to the UAC and waste bag. Blood withdrawn from the infant is pushed via a sterile waste pipe into a sterile waste bag.
6. Connect 3-way tap and 10ml syringe to the UVC and transfusion giving set. Withdraw blood from the transfusion bag and give to the baby.
7. The blood pack is connected to a giving set which will coil in a blood warmer to keep temperature at **37°C** before it is given to the baby.

**During** the procedure:

- ❖ Monitor BM and ABG every 30 minutes.
- ❖ Monitor ECG trace, HR, RR, temp continuously and BP every 15 minutes. Observe for any evidence of hypocalcaemia e.g. twitching, prolonged Q-T interval. Start again when stable. Look for any cyanosis, pallor, abdominal distension, and vomiting or bloody diarrhoea. If any of these develop, stop the procedure, do a blood gas, sugar, Ca, K and treat accordingly.

**After** you finish, take blood for:

- ❖ FBC, Hct and coagulation screen
- ❖ U&E, Ca, glucose, bilirubin
- ❖ Blood culture
- ❖ ABG

- Aliquots of 5 mls in preterm and 10-15 mls in full term babies are withdrawn and infused over no faster than 3-minute cycles.
- Iso-volumetric exchange transfusion needs two operators; one for withdrawing and the other for infusing blood at the same time at the same rate (**diagram 1**).
- If a single vein is used, one operator is needed using two 3-way taps (**diagram 2**).
- If a further exchange transfusion is likely, leave the lines in otherwise remove.
- Commence phototherapy.
- For a partial exchange, follow the same principles only the volume of exchange will be less and with a 0.9% saline. It usually comes to 20mls/kg

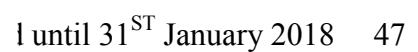
#### **Volume for partial exchange (ml)**

$$= \frac{80 \times \text{weight (kg)} \times (\text{Observed Hct} - \text{Desired Hct})}{\text{Observed Hct}}$$

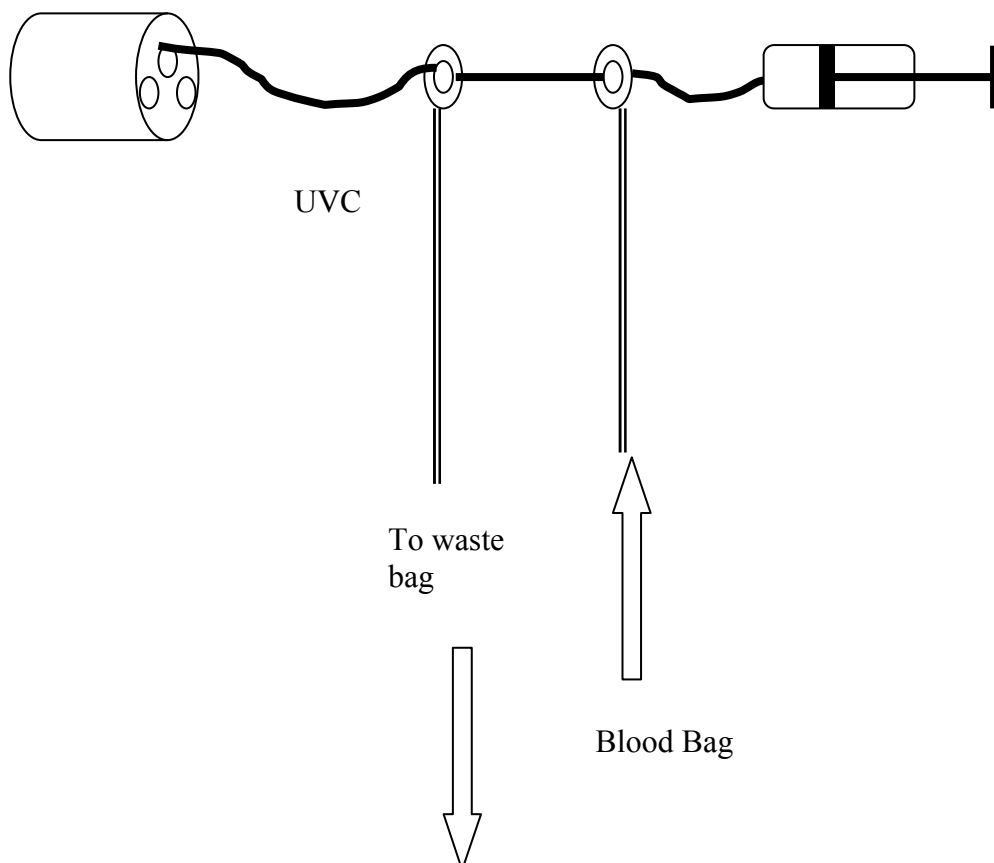
#### **Complications of exchange transfusion:**

1. Metabolic acidosis
2. Hypoglycaemia
3. Hypocalcaemia
4. Hyperkalaemia
5. Thrombocytopenia
6. Coagulopathy
7. Circulatory overload
8. Cardiac arrhythmias
9. Air embolism
10. Acute dilatation of stomach
11. Ischemia of intestine, perforation and necrotising enterocolitis
12. Infection: Usually staphylococcal, hepatitis, CMV, HIV reported but rare nowadays.

**Neonatal Guidelines**  
Chapter 12: Clinical Procedures v2015.1



**Neonatal Guidelines**  
Chapter 12: Clinical Procedures v2015.1



**References:**

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2. Neonatology Management, procedures, on-call, problems, diseases and drugs.  
TL Gomella, MD Cunningham, FG Eyal, KE Zenk. Apple & Lange, 3<sup>rd</sup> ed. 1994
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3<sup>rd</sup> ed ,1989
4. Handbook of transfusion medicine: United Kingdom Blood services 4<sup>th</sup> Edition



## **I-Gel Supraglottic Airway Use in Neonates** **(Section author – Kate Richards and Pinki Surana)**

I-gel is a single use supraglottic airway device from Intersurgical. It consists of a mask with a soft non-inflatable cuff attached to an airway tube. Once inserted, the anterior tip enters the upper oesophagus while the non-inflatable cuff made of thermoplastic elastomer gel conforms to the anatomical contours of the perilaryngeal structures with its lumen facing the laryngeal opening. On successful insertion, it can then be connected via an adaptor to a positive pressure inflation device i.e. Ambu bag/ neopuff.

### **Indications of i-gel use:**

It can be used to ventilate the lungs of **babies weighing over 2000g and greater than 33 weeks gestation**

- 1) When bag and mask ventilation (BMV) has proven ineffective or problematic and endotracheal intubation (ETT) is unsuccessful or not feasible
- 2) With facial and/or airway deformities
- 3) It may provide a more stable airway when a sick neonate (non-intubated and needing positive pressure ventilation by mask) is transported by paramedics / midwifery staff from home or Midwifery-led Units to neonatal units.

### **I-gel should not be used:**

- 1) In newborns weighing < 2000 g or delivered < 34 weeks gestation
- 2) In the settings of meconium-stained amniotic fluid
- 3) When chest compressions are required
- 4) For the delivery of drugs into the trachea

### **Advantages of i-gel use in neonates:**

- 1) Use of i-gel in neonatal resuscitation is not reported however the ease of insertion without the need of inflation and monitoring of cuff pressure makes it more attractive as a resuscitation airway device for those inexperienced in tracheal intubation.

- 2) Minimal risk of tissue compression and instability after insertion that can occur with inflatable supraglottic airway devices or traditional laryngeal mask airways.
- 3) Easily learned skill & easily replicated
- 4) Less invasive than endotracheal intubation
- 5) Insertion does not require neuromuscular blockers and sedation
- 6) Potential to be life saving

### **Which size to choose?**

We have only one size suitable for use in babies over 2Kg. **Size 1 is suitable for babies weighing 2-5kg.** There lies a central port within i-gel through which an endotracheal tube can be passed (ETT size 3 in size 1 i-gel).

### **I-gel insertion technique in Neonates:**

- 1) If airway management is considered necessary and cannot be adequately managed using BMV/ neopuff or tracheal intubation, then prepare I-gel
- 2) Place head centrally in “air sniffing position”
- 3) Remove i-gel from sterile protective cage.
- 4) Grasp the i-gel close to the connector and lubricate the back, sides and front of the cuff with thin layer of K-Y jelly ensuring no lubricant remains in the bowl of the cuff (Oral secretions alone may be sufficient to aid movement)
- 5) Depress infant's chin, thereby enlarging oral cavity
- 6) Grasp the i-gel close to cuff, holding it like a pen
- 7) Point the i-gel tip cranially against hard palate
- 8) Glide the device downwards and backwards along the hard palate with a continuous but gentle push until a definitive resistance is felt.
- 9) I-gel will advance along the posterior pharyngeal wall, with tip locating itself in the upper oesophagus
- 10) Grasp the i-gel firmly and attach to neopuff / bag & mask ventilation @ preset pressures (remember that cuff is non-inflatable and hence inflation is not needed in i-gel)
- 11) Observe for signs of clinical improvement, confirmed by chest movement, increasing heart rate, improving colour and saturations
- 12) Listen for air leaks (may not be in correct position)

- 13) Ensure device remains centrally (confirmed by black i-gel logo remaining visible in central position)
- 14) Once position confirmed and considered to be clinically effective, please tape from maxilla to maxilla to avoid loss of the airway.



Fixing of **i-gel** using adhesive tape



Correct placement of the **i-gel**

### **Points to remember:**

- 1) Do not allow peak pressure of ventilation to exceed 40cm H<sub>2</sub>O
- 2) Do not use excessive force to insert the device
- 3) Excessive air leak during manual ventilation is due to suboptimal depth of i-gel insertion, malposition or excessive peak pressure use
- 4) Do not leave the device in situ for more than 4 hours
- 5) Do not reuse or attempt to reprocess the i-gel
- 6) No more than three attempts in one patient should be attempted

### **Complications/ Side-effects**

- 1) Malposition
- 2) Vagal response leading to bradycardia
- 3) Gastric ventilation, distension & aspiration (theoretically possible as airway not entirely secure). The risk is higher if higher inspiratory pressures are used or if i-gel is malpositioned
- 4) Laryngospasm or trauma to the pharyngo-laryngeal framework

## References

1. Grein AJ, et al. Laryngeal mask airway versus bag-mask ventilation or endotracheal intubation for neonatal resuscitation. *Cochrane Database Syst Rev* 2005;18;(2):CD003314
2. Zhu XY, et al. A prospective evaluation of the efficacy of the laryngeal mask airway during neonatal resuscitation. *Resuscitation*. 2011; Jul 16
3. Trevisanuto D, et al. LMA for the inter hospital transfer of Neonates. *Pediatrics* 2005;115: (1) pp 109 – 11
4. Beylacq L, Bordes M, Semjen F, AM Cros. The i-gel, a single use supraglottic airway device with a noninflatable cuff and an esophageal vent: an observational study in children: *Acta Anaesthesiol Scand* 2009;53: 376–379
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**Guideline for Scanning Neonates on the 3 Tesla MRI Scanner  
(This is for use on Singleton site only)**

1. The request for an MRI scan must come from a Consultant Neonatologist and the request must be reviewed and agreed by a Consultant Radiologist before booking.
2. At present we can only scan stable babies who are spontaneously breathing
3. Preparation is key to having good quality images. All preparation for scanning should be completed on the neonatal unit as far as possible to minimise handling and waking the baby up before scanning. The baby should be fed about 30-45 minutes prior to the agreed time of the scan, swaddled thereafter and given 50mg/Kg of oral Chloral hydrate 30 minutes prior to the procedure.
4. The baby will be transported from the Neonatal unit in a suitable incubator or cot. You can use the brains from a Phillips monitor during transfer if required. This will fit inside an incubator. Do not use the CHANTS equipment as it is very heavy and might cause problems in the MRI suite.
5. The incubator or cot must NOT be taken into the MRI scanner room.
6. The infant will be accompanied at all times by an experienced clinician and a qualified neonatal nurse who are competent in Neonatal resuscitation AND have received training on MRI safety and MR compatible 'Precess' monitoring system.
7. The baby needs appropriate monitoring during transfer according to his/her general condition. On arrival in the anteroom, all these ECG leads, sats probes etc which are attached to the baby will be removed and replaced by MR compatible leads and probes.
8. A resuscitation kit bag containing all essential neonatal resuscitation equipment will accompany the baby, but left outside the scan room. In the

event of a change in the baby's condition which requires resuscitation, the scan will be discontinued and the baby moved outside of the MRI scan room for the resuscitation to be given. **No crash team should be called into the MRI scan room under any circumstances.**

9. If the baby requires oxygen during transport to and from the MRI Department the oxygen cylinder must NOT be taken into the MRI scan room.
10. If the baby requires oxygen during the scan the radiographers must be informed of this in advance.
11. Any medical or nursing staff or parents who accompany the baby into the MRI scan room must fill in an MRI safety questionnaire in advance. In the case of staff members these could be filled in prospectively and filed for reference in the MRI Department for when they are required.
12. In the MRI scanner, the baby will be positioned by the radiographic staff. However the responsibility for positioning the monitor leads lies with the accompanying neonatal staff. The monitoring of the baby during the scan is also the responsibility of the neonatal staff.
13. All the **INVIVO equipment** required for monitoring the baby during the MRI scan are **MR specific**. These are at present stored in a cupboard in a room in the MRI suite. This equipment is not to be used for any other patient group, only for neonatal inpatients. You will need a minimum of an ECG quatrode, a saturation probe and a temperature probe. The temperature probe is to be reused and must be cleaned between patient use by wiping with CLINELL wipes. **DO NOT THROW THIS AWAY. WE ONLY HAVE THE ONE.**
14. A standard proforma will be filled out for each investigation. This will include identifying details, the time and duration of the scan and also it will be the

responsibility of the neonatal staff to fill in the measurements of body temperature and oxygen saturation and other vital signs at the start of and during the procedure.

15. An increase of 0.5°C in body temperature to 37.5°C or above will require that the MRI scan is stopped for a Radiologist to be consulted and to review the images that have already been acquired. If the sequence currently running has only a short time to go, upon the discretion of the accompanying medical staff the sequence may be allowed to run to completion.
16. The baby should not be removed from the MRI scanner while the Radiologist is contacted as the decision may be made for the scan to continue. In the rare circumstance that a Radiologist cannot be contacted then a rise of 0.5°C should result in the scan being terminated and the parents informed that the baby may need to be recalled.
17. At the end of the scan further details should be filled in on the proforma sheet including the oxygen saturation and the baby's temperature, also the time of terminating the scan, until the temperature is considered normal
18. The accompanying medical staff should also check the baby for any erythema or other rashes and this should also be entered on the proforma sheet before the baby leaves the department. If required, the baby's own ECG and other monitoring attachments are to be reconnected to the baby once the MRI has been completed, **OUTSIDE** the MRI room
19. The responsibility for ongoing training of the neonatal staff accompanying the babies lies with the neonatal Department. This will include training regarding MRI safety as well as the correct use of the MRI monitor.
20. The MRI monitor will be kept in the MRI suite.

All Radiographers to scan neonates at 'normal' operating mode (as opposed to 'First' level operating mode which is used for adults).

## **APPLICATION OF THE PRECESS LIFE SIGNS MONITOR TO THE INFANT**

**The application of the relevant monitoring probes to the baby for use with the PRECESS life signs monitor should only be undertaken by staff who have been trained specifically in this technique**

The application of the leads must be done prior to moving the baby into the MRI scanning room. The monitoring is done wirelessly with the exception of the temperature.

The monitor should be kept plugged in so that it is on full charge when stored, but will run on battery for the scan

The charge on the machine may last several hours, but if for example, frequent BP readings are undertaken the charge will be used more rapidly. The saturation and ECG probe each require insertion of one of the four batteries (MRI compatible) kept in the Precess module battery charger. The battery module charger is **NOT MRI compatible**. Therefore the charger should **NOT** be taken into the scanning room. It should NOT be kept on the Precess monitor. It is at present on the work station above the cupboard storing the disposables and temperature probe for the PRECESS monitor. It should be kept plugged in at all times, so that the batteries are fully charged.

In the MRI scanner room the monitor must be NO CLOSER than 1 meter to the scanner and preferably as far away from it as possible

### **Initial set up**

Switch the monitor on

'Normal screen'



Go to 'monitor set up' button

Then click on 'recall a set up'

Click on 'A'

This will give a system for monitoring of Temperature, saturation and ECG. We can switch off the end tidal CO2 recordings and, in most cases the blood pressure recordings.

### **Application of ECG**

The ECG electrodes to be used are the quatrobe (9327A) which are specially made for the MRI compatible monitor. **NO other ECG electrodes** are to be used because they may cause burns on the patient

If the baby is post mature and has peeling skin, the skin must be prepped with NU – PREP gel prior to the application of the ECG. Apply a little of the gel (9009) to a sterile gauze and abrade gently over the area where the electrodes are to be applied. Wipe off the gel.

The electrodes are placed in the centre of the baby's chest. It should be ensured that they adhere well to the chest wall. If the electrodes are poorly attached, burns can occur. The position of the clips to attach to the electrodes is marked on each.

|            |            |
|------------|------------|
| White (RA) | Black (LA) |
| Green (RL) | Red (LL)   |

The cable is attached and care should be taken to ensure that the lead is straight and **does not kink**. **Kinking/coiling or looping of leads may lead to serious burns and must be avoided**. For head scans the lead should be placed vertically reaching down to the baby's feet

Utilize a scale of 10 mm/ mv. Select lead 2. The QRS complex should be about 4 bars peak to peak for optimum performance during the scan as MRI dampens ECG waveform output.

Select ECG filter mode 3.0 T

Go to 'monitor set ups'

Press recall set ups and select A

As the ECG is transmitted wirelessly to the monitor there is no physical connection to the monitor

### **Apply temperature probe**

Only the MR compatible blue In vivo temperature probe is to be used. Ensure the probe is clean – clean with CLINELL wipes and ensure that it is dry prior to use.

Insert the probe into the patient's axilla and apply some micropore tape to keep it in place

Insert the temperature probe into the temperature probe connection on the PRECESS monitor until a click is heard

As before, ensure that the cable does not kink, coil or loop. Keep as straight as possible and keep separate from other leads in use.

When the procedure is complete, remove the probe and clean. KEEP it for the next patient. **DO NOT THROW IT AWAY.**

### **Apply Saturation probe**

#### **Use only the MR compatible sats probe**

Use the infant /Neo disposable grip attached to a finger or a toe.

Keep the Saturation lead straight down, ensuring it does not come into contact with any other lead.

It is wirelessly connected and so there is no physical connection to the monitor

### **Alarm settings**

Go to 'normal screen'

Scroll around

Click on alarm set up – change alarms

Go to monitor set up - store alarms

Do not use the machine on standby during scanning as it will not give you alarms or auto BP during scanning

Before, during and after the scan, record the patients pulse, resps, temperature, saturation at least every 5 mins

**If Non invasive BP monitoring is required**

Use the MR compatible equipment - the quick connect single (colourless) lumen hose with a disposable neonatal cuff

Attach the hose to the monitor (attaches by 2 screws)

Go to 'normal screen'

Press NIBP interval and select the interval

Scroll to 'auto mode' then press the control knob

Select 'on' then press the control knob

Press start or stop

**After the scanning is complete** remember to remove the batteries for the ECG and Saturation leads and replace in the charger which is kept OUTSIDE the MRI scanning room. Remember to remove the monitor and plug in to the mains for re-charging.

Remove the quatrode, sats probe and temperature probe from the baby **outside the MRI scanning room** and then resite the original monitors prior to moving the baby back to the neonatal unit.

**Singleton Hospital Neonatal Unit**  
Record of observations during MRI Scanning

Addressograph

Name

Grade

Neonatal Nurse:

Neonatal doctor

Time and date scan completed or discontinued:

Observations (Record every 5 minutes)

| Time | Heart Rate | Sats | Resp rate | Temperature | Blood Pressure | Air or oxygen? |
|------|------------|------|-----------|-------------|----------------|----------------|
|      |            |      |           |             |                |                |
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|      |            |      |           |             |                |                |

Any other notes?

Check for red skin or rashes and record if present

## **Withdrawing care**

It is important to document the infant's neurological status throughout the course. There are charts on the Unit used to document conscious level (i.e. hyper-alert, stuporose or comatose), pupil reflexes, gag reflex, tendon reflexes etc. These observations may be used to categorise the infant into Sarnat stage 1, 2 or 3. Stage 3 infants will die whatever the treatment. Stage 1 babies usually recover completely, where as Stage 2 have intermediate prognoses.

If it is apparent that the baby has sustained very severe cerebral damage; it may be appropriate to withdraw intensive care, but this should only be done after discussion with all members of the team and with the parents. It is important that the parents understand and agree with the management plan. Withdrawal of care is not an admission of failure. It is a part of management and must be done properly, giving the parents time with the baby and enabling them to come to terms with events. Always encourage the parents to hold the baby. Offer to arrange to have the baby Christened if this is what they wish. Try to give them as much time and support as possible.

Sometimes it may take a few days for the parents to accept the inevitable or sometimes they cannot accept withdrawal of intensive care, in which case it may be better to await events as long as it is documented in the notes that everything including the prognosis has been explained.

**For full guidance refer to RCPCH document - Withholding or Withdrawing Life Sustaining Treatment in Children: A Framework for Practice.2<sup>nd</sup> Ed. May 2004**

### **Other references:**

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