Guideline

Women and Babies: Umbilical Venous Catheter Insertion

Document No: RPAH_GL2015_025
Functional Sub-Group: Clinical Governance
                                    Corporate Governance
Summary: Describes the indications, procedure and complications of umbilical venous catheter insertion in newborn infants.
National Standard: Standard 1: Governance for Safety and Quality in Health Service Organisations
Policy Author: Head of Department
                                    RPA Newborn Care Guideline Development Committee
Approved by: General Manager
Publication (Issue) Date: April 2015
Next Review Date: April 2020
Replaces Existing Policy: Umbilical Venous Catheterisation
Previous Review Dates: January 2011

Note: Sydney Local Health District (LHD) and South Western Sydney LHD were established on 1 July 2011, with the dissolution of the former Sydney South West Area Health Service (SSWAHS) in January 2011. The former SSWAHS was established on 1 January 2005 with the amalgamation of the former Central Sydney Area Health Service (CSAHS) and the former South Western Sydney Area Health Service (SWSAHS).

In the interim period between 1 January 2011 and the release of specific LHN policies (dated after 1 January 2011) and SLHD (dated after July 2011), the former SSWAHS, CSAHS and SWSAHS policies are applicable to the LHDs as follows:

Where there is a relevant SSWAHS policy, that policy will apply

Where there is no relevant SSWAHS policy, relevant CSAHS policies will apply to Sydney LHD; and relevant SWSAHS policies will apply to South Western Sydney LHD.
Umbilical Venous Catheterisation

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Umbilical Venous Catheterisation

1. Introduction

The risks addressed by this policy:

Risk of central venous catheterisation through the umbilical vein.

The aims / expected outcome of this policy

To facilitate appropriate insertion, placement and maintenance of umbilical venous catheters while minimising risk of complications.

2. Policy Statement

The goal of this guideline is to familiarise staff with the indications and procedure for insertion and correct placement of umbilical venous catheters in newborn infants and to minimise the risk of complications.

3. Guidelines: Umbilical venous catheterisation

Background: The umbilical vein offers a technically easy, relatively safe and pain free portal for intravascular catheter access in the newborn. An umbilical vein catheter (UVC) provides a good alternative to a peripheral venous catheter that reduces the need for multiple procedures to maintain venous access while not being associated with greater risks of infection or necrotising enterocolitis. When the catheter tip is in a good position a UVC can be left in place for at least 14 days without increased risk of complications and one study suggests up to 28 days is safe. Butler-O’Hara et al, randomised UVCs inserted at birth to either be replaced with a PIC line at 7 to 10 days or to be left in for 28 days. There was a non-significant trend to a higher infection rate in the longer duration group but no difference in other complications.

Indications:
1. Consider for venous access from early after birth in very preterm babies and any other baby requiring respiratory support.
2. For urgent vascular access in resuscitation for administration of adrenaline or volume expansion. The procedure may not be sterile in these circumstances and emergency UVCs should be replaced under sterile conditions if there is a continuing need.
3. Infusion of hypertonic solutions for example in resistant hypoglycaemia requiring more than 10% dextrose or TPN.
4. Exchange transfusion.
5. Unable to gain peripheral cannula access and clinical need for antibiotics and/or fluids.
## Procedure for insertion of UVC

<table>
<thead>
<tr>
<th>Clean Equipment</th>
<th>Sterile Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clean dressing trolley with mild detergent wipes, leave one minute &amp; wipe dry</td>
<td>• single lumen UVC (Argyle)</td>
</tr>
<tr>
<td>• Blue sterile plastic sheet to place under sterile drape.</td>
<td>• double lumen UVC (Argyle) use for:</td>
</tr>
<tr>
<td>• IV infusion pump (Agilia®))</td>
<td>o infants &lt;1000gms/28 weeks</td>
</tr>
<tr>
<td>• tape measure</td>
<td>o infants likely to require inotropes</td>
</tr>
<tr>
<td>• masks</td>
<td>o meconium aspiration syndrome</td>
</tr>
<tr>
<td>• protective goggles if patient on open care system</td>
<td>o persistent pulmonary hypertension</td>
</tr>
<tr>
<td>• 4 ampoules heparinised saline (50units / 5ml)</td>
<td>• UVCs size 3.5Fg for all infants</td>
</tr>
<tr>
<td>• unopened solutions for skin preparation (aqueous chlorhexidine 0.015%)</td>
<td>• consider 5Fg single lumen for infants needing:</td>
</tr>
<tr>
<td>• Comfeel</td>
<td>o exchange transfusion or</td>
</tr>
<tr>
<td>• New roll - leukoplast (brown tape)</td>
<td>o large volume replacement</td>
</tr>
<tr>
<td></td>
<td>• two sets of sterile gown and sterile gloves, one for operator, one for assistant.</td>
</tr>
<tr>
<td></td>
<td>• sterile green drapes (incl fenestrated)</td>
</tr>
<tr>
<td></td>
<td>• dressing pack</td>
</tr>
<tr>
<td></td>
<td>• umbilical drip insertion set (scalpel blade / sutures included)</td>
</tr>
<tr>
<td></td>
<td>• 3.0 silk suture / Scalpel Blade</td>
</tr>
<tr>
<td></td>
<td>• sterile linen cord tie</td>
</tr>
<tr>
<td></td>
<td>• additional gauze swabs</td>
</tr>
<tr>
<td></td>
<td>• assorted needles / 5 mls syringes</td>
</tr>
<tr>
<td></td>
<td>• 100 ml burette / IV giving set</td>
</tr>
</tbody>
</table>

### Maximal Sterile Precautions

Isolate cot space by using large mobile curtain. Use the dedicated central line trolley. **All resources should be assembled prior to line insertion.**

Both proceduralists don surgical hat, mask and sterile gown. Surgical hand scrub to be performed prior to donning gown and gloves. Large sterile drapes are used to completely cover patient and cot area

**Two people should be scrubbed for each line insertion.**
Preparation

- Perform calculation and/or measurement to estimate insertion distance. An approximation of the insertion distance in centimetres can be derived from the formula: \(3 \times (1.5 \times \text{birth weight in kg}) + 5.5\).
- Select size 3.5FG double or single lumen UVC. Use 5FG single lumen for exchange transfusion.
- Prime the umbilical catheter with 3-way tap attached using heparinised saline (50 units per 5ml) and leave syringe attached. Prime both lumens where appropriate.
- Sterilise the cord and area around the cord with aqueous chlorhexidine. Do not allow topical antiseptic to pool under the infant, allow to dry for 3 minutes and then drape the area around the cord as shown.
- Remove first set of gloves.
- Place sterile cord tie around the base of the cord and tie in a loop with moderate tension (this is to stop back bleeding).
- The assistant to hold the clamp with sterile forceps then use the scalpel to cut the cord between the cord clamp and the skin at the base of the umbilicus. Cut away from you and close to the clamp. Do not cut flush with the skin as this will limit any further attempts.
- Change gloves again if either of you have touched the cord clamp.
- Drape the area, leaving the umbilical stump exposed with as little surrounding skin as possible.

Identify the vessels and probe the vein

- Examine the cut end of the cord and identify the two arteries (small, thicker walled and constricted) and the single vein (more gaping and thin walled).
- Grasp the edge of the cord with the suture forceps and use the lacrimal probe or the fine toothed forceps to tease open the vein. It will usually open up easily.
### Introduce and advance catheter

- Ease the catheter into the open vein and advance slowly to the estimated insertion distance. It will usually need only slight pressure to advance.

- Withdraw on the syringe to test whether you can get free flowing withdrawal of blood. If you can't withdraw blood, it usually means the catheter tip is in the portal veins, so withdraw the catheter slowly until you get free flow of blood.

- If you do have to withdraw the catheter to get blood back then it's probably passed into a smaller branch of the portal vein and it becomes really important to use ultrasound to ensure the catheter tip is in a main branch of the portal vein, see below.

### Secure the catheter
• Anchor catheter to base of the cord with a 3/0 silk suture.
• Connect catheter to infusion at 0.5ml/hr to keep catheter open until tip position confirmed with x-ray.
• (Non-sterile) Prior to X ray secure with ‘goal post’ tapes as shown using Comfeel® first and then brown leucoplast tape.
• The proceduralist completes documentation in the Infant case Notes (MR45) & inserts vascular access sticker in notes – record **Batch Number** of catheter
• Post catheter insertion visualise stump, observe closely for bleeding. **Umbilical tie (if used) should be removed when bleeding controlled to avoid possible skin necrosis.**

**Locating UVC Tip on X-ray.**

• Once the UVC is secured, order an A-P chest and abdo x-ray to locate tip position. The ideal catheter tip position is at the junction of the ductus venosus and the inferior vena cava. On x-ray, this has the appearance shown, with the UVC going straight up with the tip at the level of the diaphragm. This can be confirmed on ultrasound (see below)
• On x-ray, you cannot be certain the UVC is through the DV unless the tip is above the diaphragm. If the catheter tip is in the chambers of the heart, measure the distance for an ideal position, withdraw and re-xray or ultrasound to confirm position.
• About 50% of UVCs will not follow the path into the Ductus Venosus and instead follow the portal vein into one of the lobes of the liver. On x-ray, the catheter deviates off to one side into the liver as shown. In these situations, measure the distance to bring the catheter tip into a central position and withdraw.

• Catheters in an intermediate or low position should be replaced early (usually by 48 hrs) with a PICC line (see below)

### Locating UVC Tip on Ultrasound

**Anatomy:**

- The umbilical vein enters the liver at the Falciform ligament and enters a branch of the left portal vein called the Pars Umbilicus. The Pars Umbilicus runs in a posterior and slightly superior direction (anterior and inferior in postnatal life).

- The Ductus Venosus is at the base of the Pars Umbilicus and runs more superiorly in a true sagittal plane to join the confluence of the IVC and the right atrium.

- At the base of the Pars Umbilicus, the Pars Transversus section of the left portal vein branches sharply right towards the main and right portal vein and other branches go left deeper into the left lobe of the liver.
Normal Ultrasound

- Use the 8-5C curvilinear or the 15-7L linear transducer. Have the transducer in a midline subcostal position and in a true sagittal orientation with ‘superior’ on the right hand side of the screen. Angle the transducer slightly to the right of the IVC.
- The Pars Umbilicus appears as an echolucent, often quite large vessel, running in a supero-posterior direction.
- The Ductus Venosus is at the base of the Pars Umbilicus and runs very straight in a more superior direction into the right atrium.
- There is often only a weak colour Doppler signal in the Pars Umbilicus but a stronger signal is apparent in the Ductus Venosus, if it is still patent.

UVC through the Ductus Venosus.

- When the UVC is in the correct position, it is easily seen passing down the Pars Umbilicus and through the ductus venosus.
- The tip should ideally be just beyond the exit of the ductus venosus in the venous confluence that enters the right atrium with the IVC.
- If you cannot see the UVC in the ductus venosus, it is not in the correct position and you need to look carefully elsewhere to find it.
UVC not through the Ductus Venosus.

- If the UVC is not in the Ductus Venosus it has gone elsewhere, usually further into the left portal venous system or across to the right portal vein. This is usually apparent on x-ray.
- The goal here should be to withdraw the UVC so the tip can be seen within the body of the Pars Umbilicus.

Danger! UVC looks like it's in the ductus venosus on xray but is actually in the portal vein.

- The Pars Umbilicus is part of the left portal venous system in postnatal life, so it sends branches into the left lobe of the liver as it descends towards the Ductus Venosus.
- Some of these branches are directly anterior to the Ductus Venosus, so an A-P x-ray can mislead as to the location of the tip.

- Consider this x-ray, the direct superior path along the line of the ductus venosus could mislead the clinician where the tip of the UVC actually is.
• In fact, the UVC in this case was in a branch of the Pars Umbilicus directly anterior to the ductus venosus.

When to use x-ray or ultrasound?

• X-ray should be used as the primary investigation for UVC tip localisation.
• Ultrasound may be used as an additional investigation if the UVC tip is above the diaphragm on x-ray, safe localisation of the catheter tip can be confirmed, after withdrawal if necessary.
• Ultrasound performed or supervised by Staff Specialist/Fellow with skills in catheter localisation must be used in any baby where the UVC tip is below the diaphragm on x-ray.
• If an UVC is withdrawn from a position below the diaphragm e.g from the right portal vein, then both x-ray and ultrasound should be used to confirm the tip is in the body of the Pars Umbilicus not in one of the branches.

How long can a UVC be left in place?.

This will be determined by the clinical condition of the baby and availability of alternative venous access but in general terms:

• Evidence would suggest that an UVC within or through the ductus venosus can be used for ongoing intravenous needs for up to 14 days.²
• An UVC with the tip in an intermediate or low position below the diaphragm on x-ray should not usually be left in situ for more than 48 hours unless the clinical situation is critical and there is no alternative secure venous.
• If a decision is made to leave a UVC in the low position for longer than 48 hours, there must be confirmation of a safe catheter tip position with ultrasound performed or supervised by Staff Specialist/Fellow with skills in ultrasound catheter localisation.
Risks of Umbilical Venous Catheters.

Catheter malposition and extravasation:
These are the most serious complications and are potentially life-threatening. The two most serious extravasation sites are into the pericardium and within the liver.

Cardiac tamponade from extravasation into the pericardium: While more commonly reported from PIC lines this can occur with UVCs. Reported mortality from this complication is 50% and the mortality results from lack of clinical recognition. It can result when catheter tips are left too far into the heart, particularly if the tip abuts against the myocardium. With the repeated movement of the heart beat, the tip works its way through the myocardium and fluid is infused into the pericardium with resulting tamponade if not recognised. Prevention comes from careful location of the catheter tip, as above, and withdrawing catheters that have been inserted too far and reconfirmation of safe tip position with x-ray and/or ultrasound, after withdrawal.

Recognition comes from a high level of clinical suspicion and immediate access to point of care ultrasound. Typically these babies present with a relatively quick cardio-respiratory deterioration that cannot be explained. They are often misdiagnosed as suspected sepsis. The chest x-ray may show a large heart shadow but ultrasound gives the diagnosis immediately with the characteristic echolucent fluid collection around the heart as shown.

Management includes immediate cessation of the infusion and removal of the UVC. If there is significant compromise, perform pericardocentesis from the sub-xiphisternal position. Ultrasound can be used to guide the needle during the procedure.

Extravasation in the Liver with Ascites: This occurs when the UVC tip is in the lower position on x-ray and usually when the tip has been left in one of the smaller branch portal veins deeper into the liver parenchyma. The extravasation will initially develop in the parenchyma of the liver forming a fluid filled cyst. This fluid will eventually track through the liver parenchyma into the peritoneal cavity resulting in ascites.

Prevention is based on trying to locate the UVC tip through the ductus venosus and, when that is not successful, ensuring safe catheter tip position within the portal vein on ultrasound. UVCs sited in the lower positions should usually be removed within 48 hours of insertion.

The presentation of this is more insidious than tamponade and will often present with mild abdominal distension in an otherwise well baby. The ascites may be apparent on x-ray but the problem is usually quite advanced by the time this becomes obvious. Early recognition depends again on a high index of suspicion and
point of care ultrasound. Subcostal views of the liver show the typical echolucent fluid filled cyst, often with brightly echo dense edges as shown in the figure above.

Management is immediate cessation of the infusion and withdrawal of the UVC. Consider draining any ascites, particularly if there is a significant collection. If the infusate is hypertonic, then potentially this may draw fluid into the peritoneum from the vascular space, resulting in hypovolaemia.

**Sepsis:** This is an ever present risk for any indwelling long line or catheter. The risk management of this is the same as for all intravascular access e.g. strict aseptic insertion technique, minimising line interruptions and strict aseptic technique for any line handling. Studies would suggest that use of well placed UVCs for up to 14 days is not associated with an increased rate of infection.¹

**Thrombosis:** Clinically significant thrombosis is uncommon but well recognised risk of UVC. Thrombosis of the inferior vena cava or the portal vein would create the greatest longer term risks. For this reason platelets or clotting factors should not usually be given through a UVC unless the situation is critical.

Using data from an RCT of duration of UVC placement,⁸ univariate risk factors for thrombosis included haematocrit above 55%, small for dates and maternal pre-eclampsia. Of these, only haematocrit greater than 55% remained a significant risk factor on multivariate analysis.

**Key Points:**

<table>
<thead>
<tr>
<th>Key Point</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>The umbilical vein offers an easy, safe and pain free portal for intravascular access.</td>
<td>Level 4¹</td>
</tr>
<tr>
<td>With an appropriately sited catheter tip, UVCs can be left in situ for at least 14 days without increased risk of complications.</td>
<td>Level 2, Grade of Recommendation C²</td>
</tr>
<tr>
<td>The catheter tip should be located at the level of the diaphragms on x-ray and confirmed to be through the Ductus Venosus with ultrasound.</td>
<td>Level 4</td>
</tr>
<tr>
<td>UVC inserted beyond this into the heart should be withdrawn and tip position re-checked with x-ray and ultrasound.</td>
<td>Level 4</td>
</tr>
<tr>
<td>Catheters deviating into the liver should be withdrawn to a position in the main portal veins and the tip position reconfirmed with x-ray and ultrasound. These should usually be removed within 48 hrs.</td>
<td>Level 4</td>
</tr>
<tr>
<td>Extravasation into the liver and pericardium from tip malposition are the most serious complications from UVCs.</td>
<td>Level 4⁵,⁶,⁷</td>
</tr>
</tbody>
</table>
References and links


Minimum list (nothing to do with UVC insertion).

- Legislative Compliance: Organisation, Management and Staff Obligations – Governing Body and Management manual, Policy Number 2.7.1
- Code of Conduct – Governing Body and Management Manual, Policy Number 1.1

Nick Evans; April 2015