

Introduction

- Umbilical vessels are relatively accessible in newborn infants
- The umbilical vein is large and easy to cannulate. It can be used as a secure venous access for delivery of glucose concentrations >10%, parenteral nutrition, inotropic support and calcium and sodium bicarbonate infusions. (1)
- Double and triple lumen umbilical venous catheters should be considered if the infant is likely to require multiple infusions which may be incompatible e.g. those with congenital diaphragmatic hernias, severe hypoxic ischemic encephalopathy. Infants with hypoplastic left heart should have a triple lumen UVC inserted.
- Note that while the use of multi lumen umbilical venous catheters in neonates is associated with a decrease need for peripheral IV's in the first week of life, there is an increase risk of catheter malfunctions in comparison to single lumen devices. (2)

Aim

The aim of the guideline is to outline the principles of management for neonates requiring umbilical venous catheterisation for clinicians on the neonatal intensive care unit (Butterfly Ward) at the Royal Children's Hospital.

Abbreviations

| | |
|-------|------------------------------|
| BW: | Birth weight |
| CVAD: | Central Venous Access Device |
| ETT: | Endotracheal Tube |
| IV: | Intravenous |
| UVC: | Umbilical Venous Catheter |

Assessment

Indications: (2, 3, 4, 5)

Central venous access in neonates in the first 14 days of life

- Administration of medication, parenteral nutrition and IV fluids
- Exchange or partial exchange transfusion
- Central venous pressure monitoring
- Frequent blood sampling in unstable patients without arterial access

Contraindications: (6)

- Abdominal surgery requiring an incision above the umbilicus
- Infection:
 - Omphalitis
 - Necrotizing Enterocolitis
 - Peritonitis
- Abdominal wall defect:
 - Omphalocele
 - Gastroschisis
 - Umbilical fistula

Complications: (4, 5, 7-10)

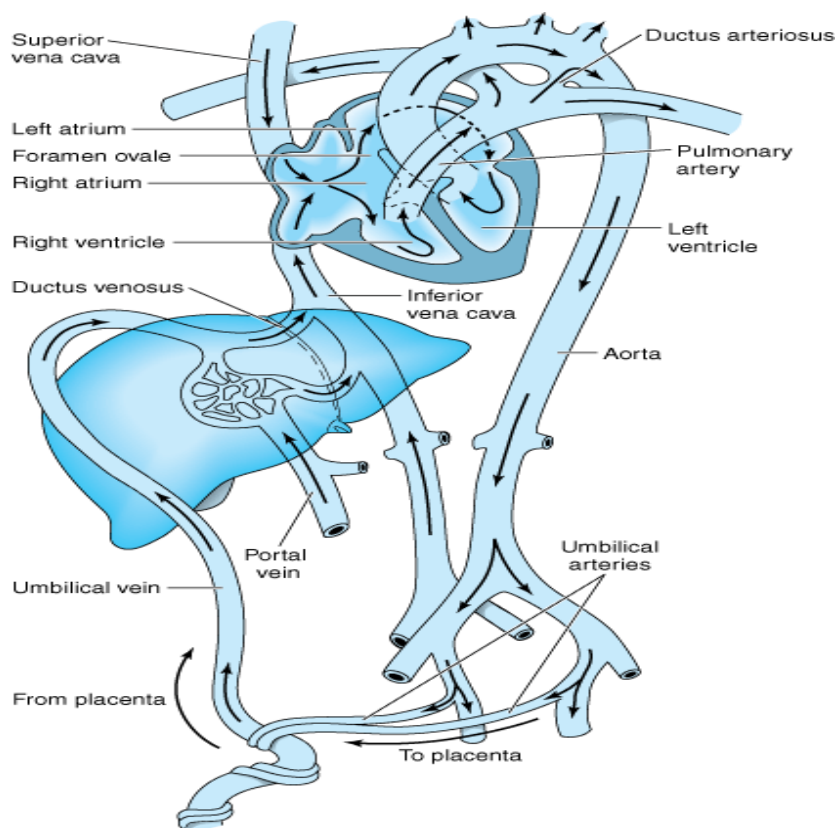
- Infection
- Thromboembolism
- Thrombophlebitis
- Blood loss:
 - From umbilical stump
 - Accidental disconnection of UVC

- UVC malposition in heart and great vessels:
 - Perforation through heart muscle
 - Pericardial effusion/cardiac tamponade
 - Cardiac arrhythmia
 - Thrombotic endocarditis
 - Haemorrhagic infarction of lung
 - Hydrothorax
- UVC malposition in portal system:
 - Necrotising enterocolitis
 - Perforation of colon
 - Hepatic necrosis
 - Hepatic cysts
 - Portal hypertension
 - Vascular perforation
- UVC rupture, transection or fragmentation
- Migration of fragmented UVC

Anatomy

- The umbilical vein is 2-3cm long and 4-5mm in diameter
- From the umbilicus it passes cephalad through the falciform ligament and to the right. After giving off several large intra-hepatic branches it joins the left branch of the portal vein
- The ductus venosus arises from the point where the umbilical vein joins the left portal vein

See diagram below illustrating ductus venosus and left portal vein.



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Position

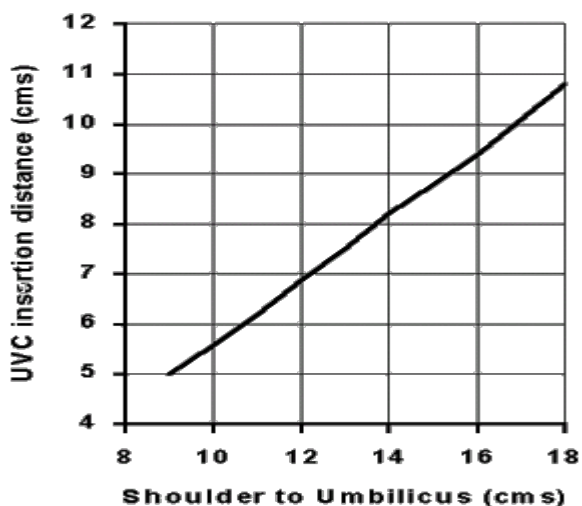
The ideal catheter tip position is at the junction of the ductus venosus and the inferior vena cava just above or at the level of the diaphragm and outside the heart approximately T9 – T10. This may be determined in three ways (14-16)

a. by formula

desired UVC length in cm = $(1.5 \times \text{BW in kg})$

b. by shoulder-umbilical length

measure the distance between the umbilicus and an imaginary line passing through the shoulders. Apply this length to the chart below to obtain the UVC insertion distance



c. by umbilical stump-xiphisternum length

Note: These formulae may overestimate the required length and the line may need to be re-positioned afterwards

Equipment

UVC size:

| Weight | Catheter size |
|------------|---------------|
| <1500g | 3.5 Fr |
| 1500-3500g | 5.0 Fr |
| >3500g | 8.0 Fr |

| Clean | Sterile |
|--|--|
| Procedure trolley Mask Tape measure Chlorhexidine 0.1% solution (<1 kg) Chlorhexidine 0.5% in alcohol 70% (>1 kg) IV solution as ordered by medical/NNP staff Infusion set Syringe pump | Mask, gown and gloves Drapes as per CVAD guidelines (insert hyperlink) Special procedure tray X 1 gauze swabs Umbilical dilator Tourniquet (e.g. sterile trachea tape or gauze) Size 15 scalpel blade 3.0 black silk suture UVC 1 luer lock 3-way tap per lumen 2 x 10 ml syringes Drawing up needle 2 x 10 ml 0.9% NaCl Heparin (50 units/5ml) Silex (>30/40) or Comfeel (<30/40) |

Analgesia/Sedation

No specific analgesia needed, as the umbilical cord has no pain sensation, however oral sucrose can be given if no other contraindications apply. Swaddling the lower limbs may help to pacify the baby. Avoid placing clamps or sutures on the skin.

Management

Preparation and Procedure

Nursing

1. IV fluids to be used may be prepared prior to the procedure under sterile technique
2. Each lumen will require an infusion rate of a minimum of 0.5mls per hour.
3. Assist in setting up equipment for the procedure
4. Position infant supine under a heat source and wrap their lower limbs to immobilise
4. Establish cardio respiratory monitoring with leads positioned away from abdomen
5. Nurse is to remain with the infant during the procedure unless otherwise discussed with medical staff

Medical

- Refer to CVAD management procedure (3)
- Check and assemble all sterile equipment on the trolley
- Don mask and cap
- Perform hand hygiene (sterile)
- Don gown and gloves
- Attach 3 way taps to end of each UVC lumen; prime taps and lumens with heparinised saline (1 unit/ml) and turn taps off. Exclude any air bubbles and do not clamp the UVC at any time
- With an assistant holding the umbilical stump clear of the abdomen sterilize the abdomen with chlorhexidine and drape as per CVAD management procedure (the face and ETT should be visible at all times – use clear drapes where possible).
- Loosely tie the tourniquet around the base of the umbilical stump
- Hold the umbilical cord with forceps about 1.0-1.5 cm from the skin margin. Place the edge of the scalpel against the patient side of the forceps and cut away from yourself in one action. Try not to make a sawing action as this makes the insertion harder.
- Identify the vessels:
 - a single thin walled, often gaping open umbilical vein
 - two smaller thick walled round arteries, often protruding from the cut surface of the cord

Insertion of the UVC

- Stabilise the umbilical stump by holding the Wharton's jelly with two artery forceps with gentle upward traction at 3 and 9 o'clock, grasping the edge of the cord
- Dilate the vein start with the umbilical dilator.
- Grasp the catheter approximately 0.5cm above the tip with straight forceps and gently insert the tip into the vessel lumen. Move the forceps back up the catheter in 1cm increments and gently advance the catheter into the umbilical vein
- Cannulate the vein to the measured distance. If obstruction is met at the level of the abdominal wall, apply 30 seconds of steady, gentle pressure. Avoid excessive pressure or repeated probing.
- It can be difficult to pass the catheter through the ductus venosus. There are some manoeuvres that can assist in placement. These include:
 - Pulling the catheter back to about 4-5cm, then advancing the catheter whilst rotating the catheter clockwise
 - Passing another catheter down beside the already mal-placed catheter. The path of the second catheter may be through the ductus venosus (11-13)
 - Do **not** force a catheter if there is resistance.

NB:

- The most common error is to cannulate the layer between the vascular intima and the muscle.
- If you can't insert the UVC to the estimated distance, do not force it as you may cause damage.
- If you think you may have created a false passage, check the position using radiopaque contrast.

Secure the UVC (6, 14)

- With the suture take one bite through the umbilical cord and tie a knot
- Place one end of the suture parallel to the UVC. Pass the other end around the UVC and first suture end and return through the loop created.
- Repeat this action placing the "second" end parallel to the UVC and pass the "first" end around the UVC and return through the loop created.
- Repeat this action 1cm above the first set of ties.
- Do not use the ballet slipper/roman sandal tie as this will spontaneously unravel with time causing catheter malposition.
- If haemostasis is not achieved place a purse-string suture (using 3 small bites) around the cord without piercing the skin and secure with a knot.
- Once the UVC is radiologically confirmed to be in the correct position, Comfeel flags (<30 weeks) or Sleek "goalposts" (>30 weeks) can be used to secure the silk to the UVC



UVC secured using the Sleek "goalposts" method.

Confirm that the position of the UVC is correct with an antero-posterior and lateral x-ray. (radio-opaque dye injection is not required unless the insertion was difficult or traumatic). This must be done prior to using the UVC unless the UVC is used for acute resuscitation. If there is a delay obtaining the x-ray intermittently flush the line with 0.9% saline to keep the UVC patent. The tip of the UVC should be at T9 – T10. The UVC may be withdrawn but **never advanced** to correct the position

Remove the tourniquet

Document the procedure and UVC tip position by completing an adhesive CVAD form and place it in the patient progress notes.

Post-Procedure Care

- Nurse infant supine or in a lateral position for 24 hours post procedure. When clinically indicated the infant may be positioned prone after this time (with Consultant approval)
- Do not cover the umbilical stump
- Ensure that no traction is applied to the UVC at any time
- Assess and document umbilical stump for bleeding or signs of infection hourly. Continued use beyond 7 days needs approval by the attending Consultant
- Observe for and report signs of complications
- Document required information every shift on CVAD Observation Chart

Removal of Umbilical Venous Catheter

- Turn off infusion pump
- Position the infant supine
- It may be necessary to apply gauze soaked with 0.9% NaCl to the umbilical stump to soften it - apply for 15 min
- Clean the stump with 0.1% Chlorhexidine
- Remove the suture from stump
- Apply a loose tourniquet around the stump in case of ooze upon UVC removal
- Withdraw the UVC with continual traction slowly
- Send the UVC tip for culture only if infection is suspected
- Observe site carefully for bleeding over the next hour: if bleeding does occur, press firmly just above the umbilicus or pinch remainder of stump between thumb and forefinger
- Do not nurse prone or place the infant in a nappy for 4 hrs after removal of the UVC

Companion Documents

- Sucrose (oral) for procedural pain management in infants (Hospital Clinical Guideline)
- CVAD Management procedure (Hospital Procedure)
- Arterial and Umbilical Lines (Neonates) (Hospital Specialty Competency)

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