

Umbilical Arterial Catheterisation of the Newborn

Introduction

- Umbilical arterial catheterisation is a common procedure within the NICU
- The umbilical artery can be used for arterial access during the first 5-7 days of life. It is rarely used beyond 7-10 days (1)
- Umbilical arterial catheters provide reliable physiological information for the management of sick newborn babies

Aim

The aim of the guideline is to outline the principles of management of neonates requiring umbilical arterial 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
IU	International Units
IV	Intra venous
UAC	Umbilical Artery Catheter

Assessment

Indications: (2)

- Continuous arterial blood pressure monitoring
- Arterial blood gases to monitor acid-base balance status and oxygenation
- Exchange transfusion
- Frequent blood sampling
- Angiography

Contraindications: (2, 3, 6, 7)

- Infection:
 - Omphalitis
 - Necrotizing Enterocolitis
 - Peritonitis
- Abdominal wall defect:
 - Omphalocele
 - Gastroschisis
 - Umbilical fistula
 - Cord anomalies
- Vascular compromise to the kidneys, buttocks or lower limbs (4)

Complications: (2, 3, 6, 7)

Malpositioned Catheter

- Vessel perforation, haematoma formation and retrograde arterial bleeding
- Refractory hypoglycaemia (if catheter tip near celiac axis)
- Peritoneal perforation
- False aneurysm
- Sciatic nerve damage

Vascular Accident

- Thrombosis (7-9)
 - Femoral artery resulting in limb ischaemia, gangrene
 - Renal artery resulting in hypertension, haematuria and renal failure
 - Mesenteric artery resulting in gut ischaemia, NEC
 - Aortic thrombosis causing heart failure
- Embolism / infarction
- Vasospasm of the femoral artery causing blanching of toes and foot
- False aneurysm
- Loss of extremity
- Air embolism
- Paraplegia (4,7)

Equipment Related

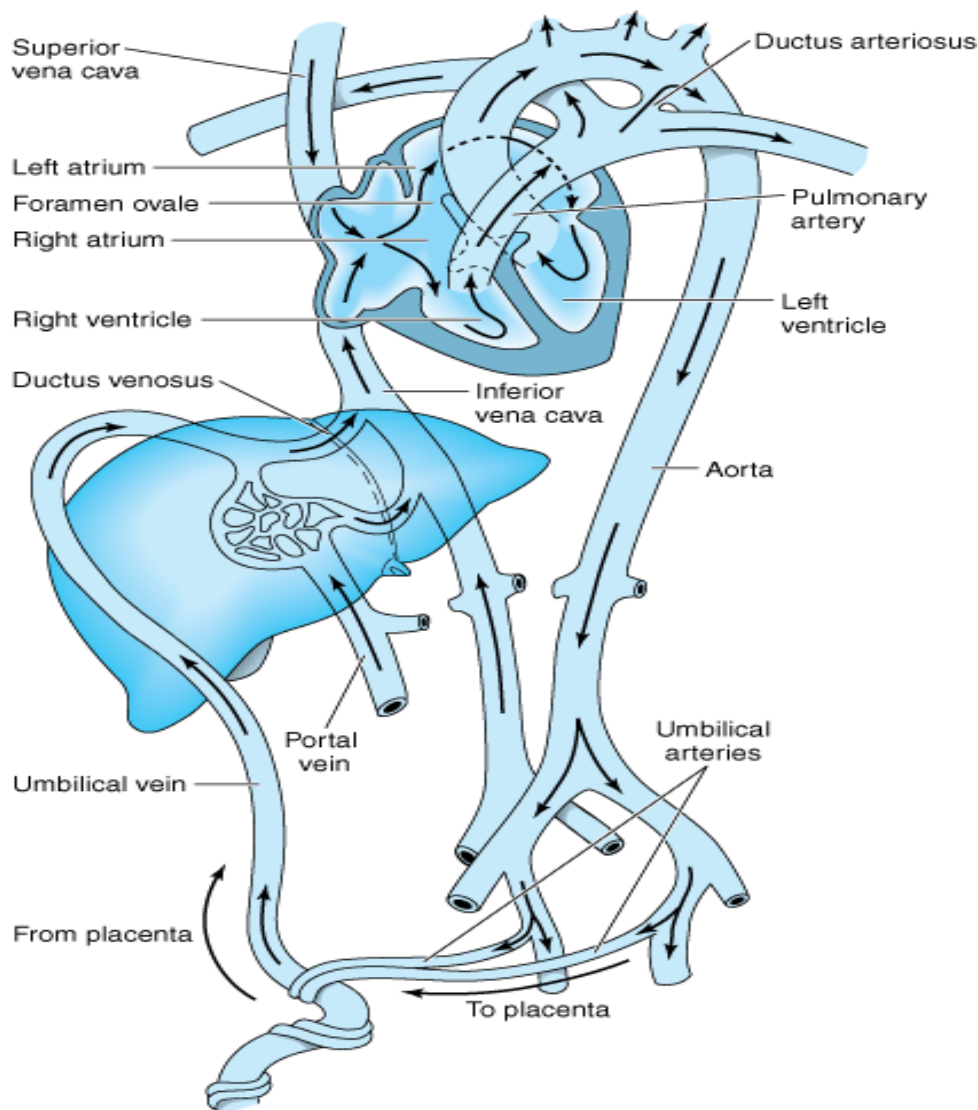
- Broken catheter
- Transection of catheter (10)

Other

- Haemorrhage +/- due to accidental disconnection
- Infection (5,6,8,9)
- Necrotising Enterocolitis
- Intestinal necrosis perforation or necrosis
- Wharton jelly embolus

Anatomy: (11-13)

- The umbilical arteries are the direct continuation of the internal iliac arteries.
- A catheter passed into an umbilical artery will usually enter the aorta via the internal iliac artery
- Occasionally the UAC will pass into the femoral artery via the external iliac artery or into the gluteal arteries. The femoral artery or gluteal artery, are unsuitable sites for sampling, infusion or blood pressure. The UAC must be removed.



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Diagram above illustrates anatomy of foetal circulation showing the umbilical arteries and veins

Position:

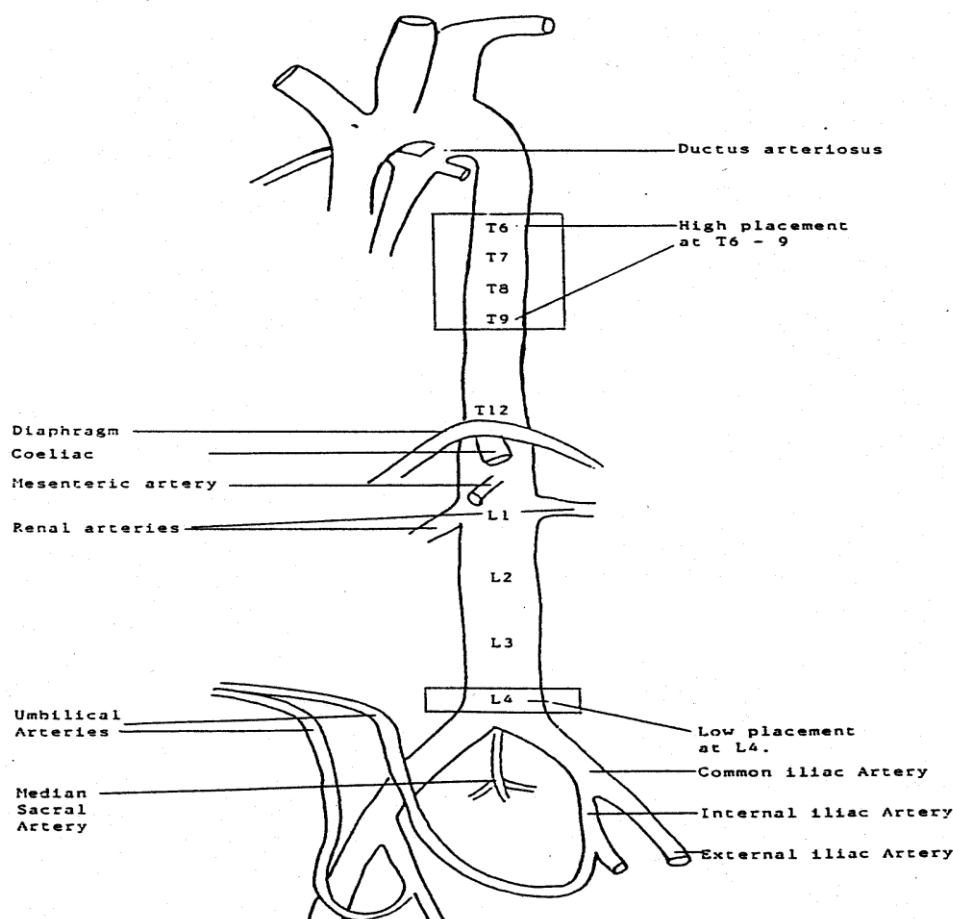


Diagram above illustrates aorta showing large artery branches with tip placement for high and low UAC placement

UAC can be sited either in the high position or the low position though the higher position is associated with lower complication rates. (5, 6, 13) Use of a high UAC is recommended. (2)

In the high position the catheter tip lies above the diaphragm between thoracic vertebrae T6 –T9. This position is above the coeliac artery T12, the superior mesenteric artery T12 - L1 and the renal arteries L1. See diagram above.

For a high UAC the length is calculated by the following formula: (12)

$$(\text{Weight in kg} \times 3) + 9$$

e.g. 2.5kg baby = $(2.5 \times 3) + 9 = 16.5\text{cm}$

In the low position the catheter tip lies above the aortic bifurcation L4-L5 between lumbar vertebral bodies L3 and L4. The tip of the catheter lies near the origin of the inferior mesenteric artery L3-L4. A recent Cochrane review (7) showed no evidence to support the use of low lying UAC's

Equipment:

UAC 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: 50i.u. heparin in 50mls 0.9% saline for infants <2.5kg 250i.u. heparin in 50mls 0.9% saline for infants >2.5kg Infusion set Syringe pump	Gown, gloves and cap Drapes as per CVAD guidelines Special procedure tray X1 gauze swabs Fine instruments Dilator Tourniquet (e.g. trachea tape or gauze) Scalpel blade 3.0 black silk suture UAC catheter single lumen 1 luer lock 3-way taps 1 x 10 ml syringes Drawing up needle 1 x 10 ml 0.9% NaCl Heparin (50 units/5ml) Slick (>30/40) or Comfeel (<30/40) to secure UVC

Analgesia/Sedation:

No specific analgesia needed as the umbilical cord is devoid of nerve fibres; however oral sucrose can be given if no other contraindications apply. Avoid placing clamps or sutures on the skin. Soft arm and leg restraints can be used to avoid movement during the procedure

Management

Preparation and Procedure:

Nursing:

1. Heparinised saline may be prepared prior to the procedure under sterile conditions.
 - a. Neonates >2500g prescription is for heparin 250units in 50mls 0.9% saline
 - b. Neonates <2500g prescription is for heparin 50 units in 50mls 0.9% saline
2. Assist in setting up equipment for the procedure
3. Position infant supine under a heat source and wrap their lower limbs to immobilize
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:

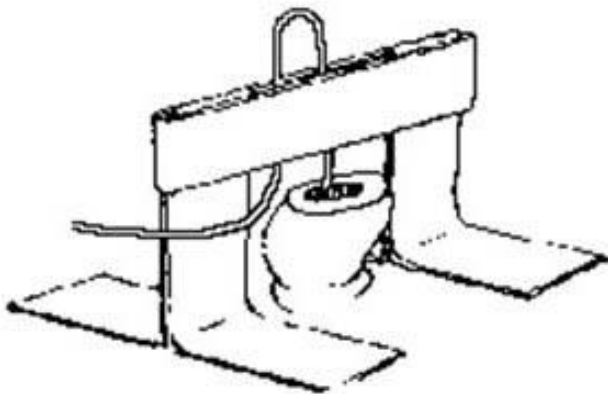
- Refer to CVAD insertion procedure re: sterile field/scrub etc (14)
- Check and assemble all sterile equipment on the trolley
- Don mask, cap
- Perform hand hygiene (sterile)
- Don gloves and gown
- Attach 3 way tap to end of UAC lumen; prime tap and lumen with heparinised saline (1 unit/ml). Exclude any air bubbles and do not clamp the UAC at any time
- With an assistant holding the umbilical stump clear of the abdomen sterilize the abdomen with chlorhexidine and drape as per CVAD guideline (14) (the face and ETT should be visible at all times – use clear drapes where possible).
- Tie a sterile tourniquet around the base of the umbilical stump (not too tight or else the UAC may not pass)
- With the assistant applying gentle upward traction, cut the cord straight across at about 1.0-1.5 cm from the skin margin with the scalpel.
- 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 UAC:

- Stabilize 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 artery starting with the umbilical artery dilator. Perform gentle twists of the dilator to open up the artery. Perform this slowly to prevent the artery going into spasm. Should the artery go into spasm wait a few minutes and start again.
- Once the artery is dilated insert the tip of curved iris forceps into the lumen as deeply as possible. Allow the forceps to spread open over 15-30 seconds whilst holding the tips in the vessel lumen. Repeat this procedure until the artery appears dilated enough to accept the catheter
- Grasp the catheter approximately 1.0cm above the tip with straight forceps and gently insert the tip into the artery which is being held open by the iris forceps. Move the straight forceps back up the catheter in 0.5cm increments and gently advance the catheter into the dilated umbilical artery. Once the catheter is in approximately 2cm remove the curved iris forceps
- Continue to cannulate the artery to the measured distance and regularly aspirate the UAC to ensure blood can be easily aspirated. Once in position the catheter should draw and flush easily
- The catheter tip should be lying above the level of the diaphragm between thoracic vertebrae T6 – T9
- If a "popping" sensation is encountered whilst advancing the UAC the catheter has likely exited the lumen and created a false passage. If this occurs remove the catheter and use the second artery for catheterisation (6)
- If resistance is encountered in the first 5cm during advancement, apply gentle steady pressure for 30-60 seconds to allow the artery to relax

Secure the UAC: (2, 5, 6)

- With the suture take one bite through the umbilical cord and tie a knot
- Place one end of the suture parallel to the UAC. Pass the other end around the UAC and first suture end and return through the loop created.
- Repeat this action placing the "second" end parallel to the UAC and pass the "first" end around the UAC 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 UAC is radiologically confirmed to be in the correct position, Comfeel flags (<30 weeks) or Slek "goalposts" (>30 weeks) can be used to secure the silk to the UAC

***Diagram above illustrates UAC secured using the Slek "goalposts" method***

Confirm that the position of the UAC is correct with an x-ray. (radio-opaque dye injection is not required). This must be done prior to using the UAC. The UAC can be withdrawn but never advanced to the correct position. If there is a delay in the x-ray, intermittently flush the UAC with 0.9% saline to keep the UAC patent. Remove the tourniquet on completion of the procedure. Once position is confirmed intra arterial monitoring can commence.

Document the procedure and UAC 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 UAC at any time
- Assess and document umbilical stump for bleeding or signs of infection hourly.
- Continued use beyond 5 days needs approval by the attending Consultant
- Observe for and report signs of complications
- Document required information every shift on CVAD Observation Chart
- Level and zero arterial line prior to commencing infusion and at commencement of every shift

On Going Management of UAC: (8)

- Observe skin colour
 - Note any skin blanching, bruising of limbs, toes or buttocks prior to, during and after the procedure and at any time the catheter is in situ – report immediately
 - If one limb is involved, warm opposite limb to induce reflex vasodilatation of affected limb
 - If above fails catheter should be withdrawn 0.5 – 1.0cm and observe. Remove catheter if blanching persist for >30 minutes
- Remain nil by mouth whilst UAC remains in situ
- Keep catheter and infusion line clear of blood. Prevent and/or remove all air bubbles and clots in the infusion line and catheter
- Level and zero arterial line at commencement of every shift and if patient is turned / moved
- Change infusion syringe daily and change infusion line 3rd daily

Removal of UAC:

The UAC is removed when:

- It is no longer required
- If a complication develops
- If UAC remains in situ after 10 days remove and site peripheral arterial line if required unless specified by Neonatal Consultant

If the umbilical cord has become very dry and appears to stick to the catheter place sterile gauze soaked in 0.9% saline around the umbilical stump to moisten it for easier removal of catheter. Leave cord to soak for about 20 minutes.

- Removal of the UAC is performed under aseptic conditions
- Prior to commencing the procedure ensure infusion of heparinised saline has been discontinued for 30 minutes
- Clean and prep the area as per CVAD guidelines (14)
- Cut the suture from around the catheter
- Very slowly pull back the catheter about 0.5cm at a time ensuring that the artery is not pulsating. Wait for a minimum of 1 minute after withdrawing each 0.5cm
- If the artery is pulsating wait a few minutes and start removing catheter again
- Continue until the catheter is removed
- If bleeding occurs apply pressure to the umbilical stump by pinching the base with a sterile gauze
- Following the procedure leave the neonate in a supine position for a minimum of 4 hours observing for bleeding (2, 8)
- Document the removal of UAC in the notes

Companion Documents

- Sucrose (oral) for procedural pain management in infants (Hospital Clinical Guideline)
- CVAD Insertion and Management (Hospital Procedure)
- Arterial & Umbilical Lines (Neonates) (RCH Speciality Competency)

References

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