

**Yorkshire and Humber
Neonatal Operational Delivery Network
Clinical Guideline**

PAN ODN

Umbilical venous and arterial lines – indications, insertion, use and care of

**Author &/Or Working Group
Name**

ODN Central lines working group

Date Written/Reviewed

March 2023

Date Ratified

December 2023

Next Review due Date

June 2028

This clinical guideline has been developed to ensure appropriate evidence-based standards of care throughout the Yorkshire and Humber Neonatal Operational Delivery Network. The appropriate use and interpretation of this guideline in providing clinical care remains the responsibility of the individual clinician. If there is any doubt discuss with a senior colleague.

A. Summary page and best practice points

Umbilical venous lines:

Should be inserted and accessed using aseptic technique.

Tip should lie at the junction of the IVC and right atrium T8-T9, the line should be relatively straight and not kink (this suggests it has taken the wrong path) or be significantly bent near the tip.

Position should be reviewed and documented on all subsequent x-rays.

Life threatening complications include cardiac tamponade which should be considered in infants with circulatory collapse and a central line.

Security of lines should be regularly reviewed.

Umbilical venous catheter (UVC)
a) $1.5 \times \text{weight (kg)} + 5.5 + \text{stump (in cm)}$
OR
b) Distance between xiphisternum and umbilicus +1 (in cm), plus stump length (consider this calculation in hydropic babies or those with growth restriction or oedema)

UVC tip position		
Tip position	Acceptable or unacceptable	Precautions/adjustments
T8-T9	Acceptable	
Below T12, not inside liver shadow	Acceptable in the short term	Acceptable in short term at: Consultant discretion AND Sampling AND Replace at earliest opportunity (within 24 hours) (BAPM Framework 2018)
In cardiac silhouette	Unacceptable	
Above T8	Unacceptable	
Below T10-T12	Unacceptable	

Umbilical arterial lines:

Should be inserted and accessed using aseptic technique.

Tip should lie at T6-T10,

Position should be reviewed and documented on all subsequent x-rays.

Patency should be maintained using infusion of heparin solution.

Common complications are thrombosis and infection.

Security of lines should be regularly reviewed.

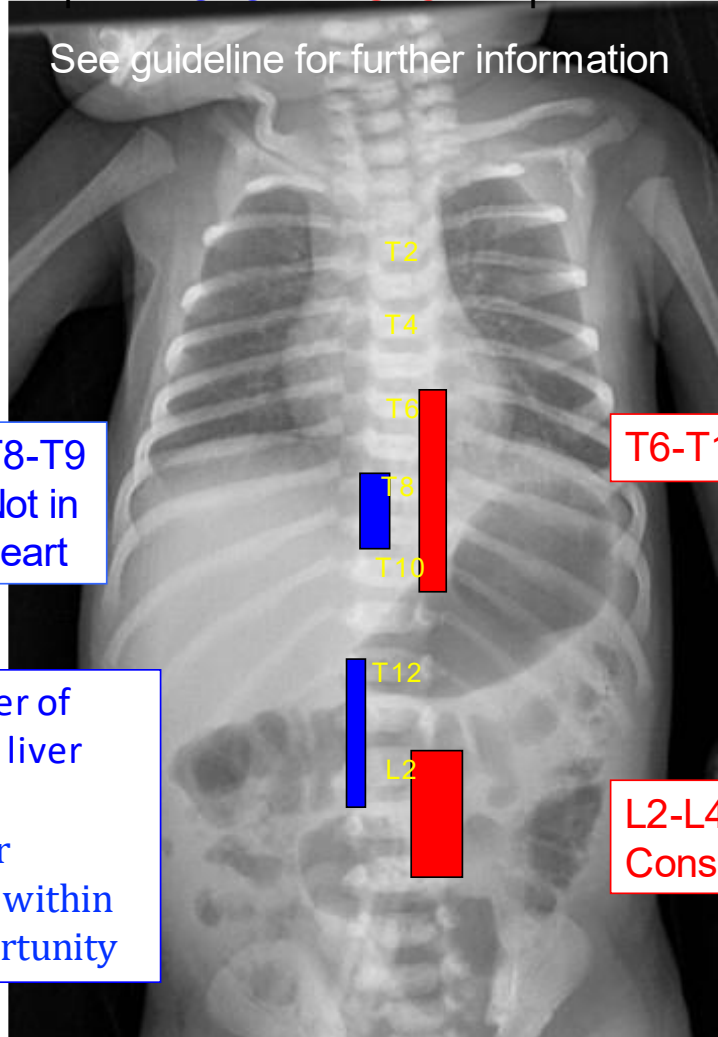
Close monitoring of extremities is required.

Umbilical arterial catheter (UAC)
Use a single lumen catheter 3.5Fr for <1.5kg and 5Fr for >1.5kg
a) $(\text{Weight} \times 3) + 9 = \text{length in cm (+stump)}$
OR
b) Twice distance (in cm) from umbilicus to mid inguinal point, plus distance from umbilicus to xiphisternum- consider using for hydropic babies or those with severe growth restriction or oedema

Acceptable UAC tip positions		
Tip position	Acceptable or unacceptable	Precautions/adjustments
Above T6	Not acceptable	Pull back to T6-T10
T6-T10	Acceptable	Ideal high UAC position
T11-L1	Not acceptable	Pull back to L2-4
L2-L4	Acceptable short-term alternative	Consultant decision-low UAC position
L5 or below	Not acceptable	Remove catheter

Acceptable **UVC** and **UAC** line positions

See guideline for further information



T8-T9
Not in
heart

T6-T10

Low-lying (lower border of
liver and not inside the liver
shadow)
Consultant decision for
PN/inotropes. Replace within
24 hours/earliest opportunity

L2-L4
Consultant decision

A repeat Xray must be performed for all lines
previously within the cardiac silhouette

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1. Background

Umbilical venous and arterial lines are inserted into infants requiring intensive care to aid monitoring, blood sampling and delivery of infusions.

2. Aim

This aim of the guideline is to ensure safe insertion and use of umbilical lines and their common and important complications.

3. Areas outside remit

This guideline only refers to umbilical arterial and venous lines and not peripherally or surgically inserted venous lines.

4. Evidence

Most of the evidence for this guideline is recommended practice from nationally accepted textbooks and frameworks for practice e.g., BAPM (British Association of Perinatal Medicine). There is little research into this field of neonatology.

5. Indications and contraindications

5.1 Umbilical venous catheters (UVC)

5.1.1 Indications:

- Acute emergency resuscitation - should be re-sited once the infant has stabilised with an aseptically inserted catheter.
- Central access e.g., for maintenance fluids, inotropes, hyperosmolar solutions
- Exchange transfusions (administration of blood/fluids)
- Measurement of central venous pressure (note not a true reading but trend can be used, for a true reading the UVC tip needs to be 2cm above the diaphragm but extreme caution as tamponade risk, therefore consultant decision to keep high)
- Central venous access for low-birth-weight infants to avoid multiple peripheral cannulation.
- Delivery of medications with a pH lower than 6 or higher than 8 where access is limited (e.g., vancomycin, phenobarbitone).

5.1.2 Relative Contraindications

- Abnormalities of the abdominal wall/umbilicus

5.2 Umbilical arterial catheters (UAC)

5.2.1 Indications:

- Frequent blood gas monitoring and blood sampling
- Requiring ventilation in the first 5 days of life
- Invasive blood pressure monitoring
- Hypotensive, requiring inotropic support
- Exchange transfusions/hyperbilirubinaemia when exchange transfusion anticipated
- In exceptional circumstances a UAC can be used for infusions of clear fluids when no other access is available.
- Resuscitation (though the umbilical venous route is the first choice)

5.2.2 Relative contraindications

- Local Infections
- Necrotising enterocolitis (balance benefit of BP measurement with potential impairment of intestinal blood flow)
- Abnormalities of the abdominal wall/umbilicus

6. Insertion

6.1 Aseptic technique

Follow local policy for aseptic technique.

6.2 Equipment

Use a large metal trolley (decontaminate before use), and place items below, onto an opened sterile dressing pack using aseptic technique.

- Sterile gloves (2 pairs)
- Sterile gown
- Mask and hat
- Sterile drapes (transparent recommended for continuous assessment of the infant and to help ensure correct straight positioning of baby's body before X-Ray)
- Umbilical catheters as needed
- Needle free connectors (blue for the UVC lumens and red for the UAC)
- Sterile antiseptic solution as local IPC guidance
- Scalpel
- Gauze
- Sutures
- Umbilical cord tie
- Syringes and needles
- Normal saline or water for flush
- Steristrips
- Zinc oxide tape
- Central venous line pack (which will include sterile forceps, scissors, dilator, clamp etc)
- Fixation equipment as per local agreed practice

UVC Double lumen catheters are usually the preferred line for preterm infants, to reduce the need for further peripheral venous lines. Typically, 4Fr gauge.

UAC The catheter should have end holes, since those with side holes have been associated with an increase in thrombosis, possibly related to endothelial damage. Suggest using a single lumen catheter 3.5Fr for <1.5kg and 5Fr for >1.5kg.

6.3 Preparation

6.3.1 Ensure appropriate awareness of procedure and support available

Nursing staff should be informed before the procedure starts as assistance should be sought to maintain sterility. Ideally the nurse looking after the baby should be available throughout the procedure to assist.

6.3.2 Update parents prior to procedure where this does not impact upon patient care

Parents should be informed about the insertion of umbilical lines at the earliest practicable opportunity however prior consent is not always possible. If appropriate, discussion around central line insertion could happen in the antenatal period.

It is good practice to clearly explain to parents the reasons for umbilical lines and their potential complications. Clinicians should check understanding and explore any questions or concerns.

Providing written information in the form of a parent information leaflet is also good practice.

6.3.3 Ensure monitoring is in place before, during and after procedure

Vital signs should be monitored before, during and after the procedure to avoid any physiological instability or worsening of instability which may require immediate intervention. Particular attention should be paid to:

- Temperature: this should be monitored ideally continuously but as a minimum every 15 minutes during the procedure and acted upon as appropriate.
- Continuous oxygen saturations— changes in requirement must be highlighted to the medical team
- Continuous ECG monitoring dependent upon gestational age
- Blood pressure
- If the infant is intubated, check the endotracheal tube is secure before commencing the procedure as baby will be draped

6.3.4 Consider developmental needs of infant

- Unless contraindicated, consider the use of sucrose or breast milk and non-nutritive sucking.
- Shield baby's eyes from bright light
- Consider the use of a second person to provide comfort holding

6.3.5 Position the infant and surrounding equipment so the cord is accessible.

6.3.6 Calculate catheter length:

Umbilical venous catheter (UVC)

b) $1.5 \times \text{weight (kg)} + 5.5 + \text{stump (in cm)}$

OR

b) Distance between xiphisternum and umbilicus +1 (in cm), plus stump length (consider this calculation in hydropic babies or those with growth restriction or oedema)

Umbilical arterial catheter (UAC)

Use a single lumen catheter 3.5Fr for <1.5kg and 5Fr for >1.5kg

b) $(\text{Weight} \times 3) + 9 = \text{length in cm (+stump)}$

OR

b) Twice distance (in cm) from umbilicus to mid inguinal point, plus distance from umbilicus to xiphisternum- consider using this calculation for hydropic babies or those with severe growth restriction or oedema

6.3.7 Create a clean zone

The area around the procedure trolley should be kept as clear from traffic as possible e.g., by using screens. This zone should only be entered by personnel assisting with the procedure. An assistant is required to prepare the equipment and in draping the infant.

6.4 Procedure

The procedure must be performed using an aseptic technique.

It should be performed by those have been trained to insert lines or under their direct supervision.

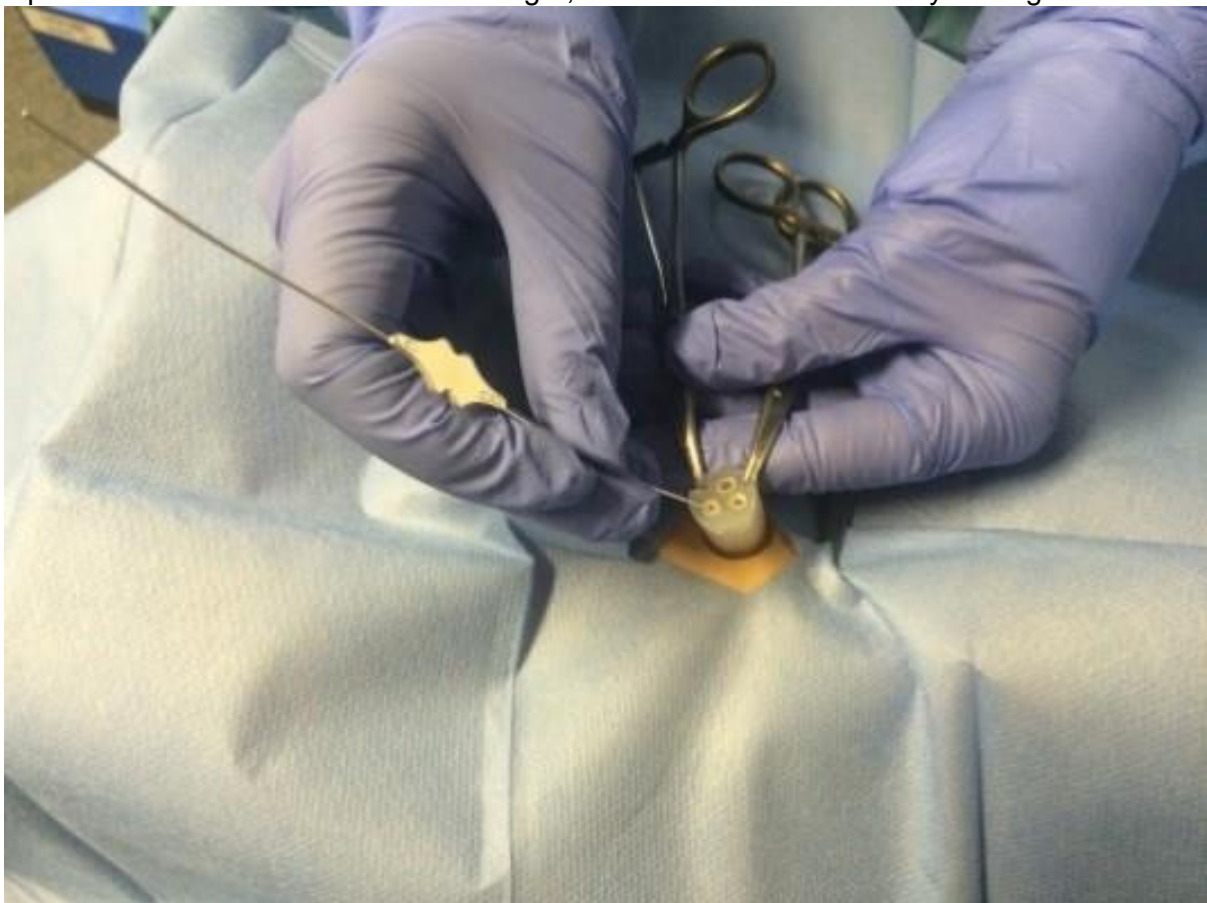
- a. Wash hands and dry with a sterile towel
- b. Gown and glove
- c. Assistant to open equipment onto sterile trolley
- d. Prepare lines:
 - **UVC:** Pre-flush blue needle free connectors and attach to each lumen of the UVC. Flush each lumen of UVC via the connector.
 - **UAC:** Pre-flush, then attach 3-way tap to UAC. Pre-flush red needle free connector, then attach to side-port of 3-way tap. Flush UAC and keep syringe attached. Ensure there is no air in the system. Turn the three-way tap off or clamp the catheter to prevent any entry of air into the catheter to reduce the risk of air embolism whilst the catheter is being inserted.

e. Prepare the site:

- Clean area with cleaning solution and consider washing off (Infants <28 weeks and <7 days wash off cleaning solution after 1 minute)
- Avoid pooling of cleaning solution or water under the baby to prevent burns and hypothermia during the procedure
- When cleaning ensure only cord area is cleaned and avoid skin on abdomen to minimise risk of burns.
- Arrange drapes (**gold standard are transparent drapes**) to achieve sterile field.

f. Loosely tie cord tie at base of cord (ensure ends easily accessible as will need to be tightened if haemorrhage occurs)

g. Transect cord approximately 1- 2cm above abdominal wall using scalpel. Use forceps or artery forceps to hold the cord and aim for a straight, “clean cut” with one steady cutting motion.

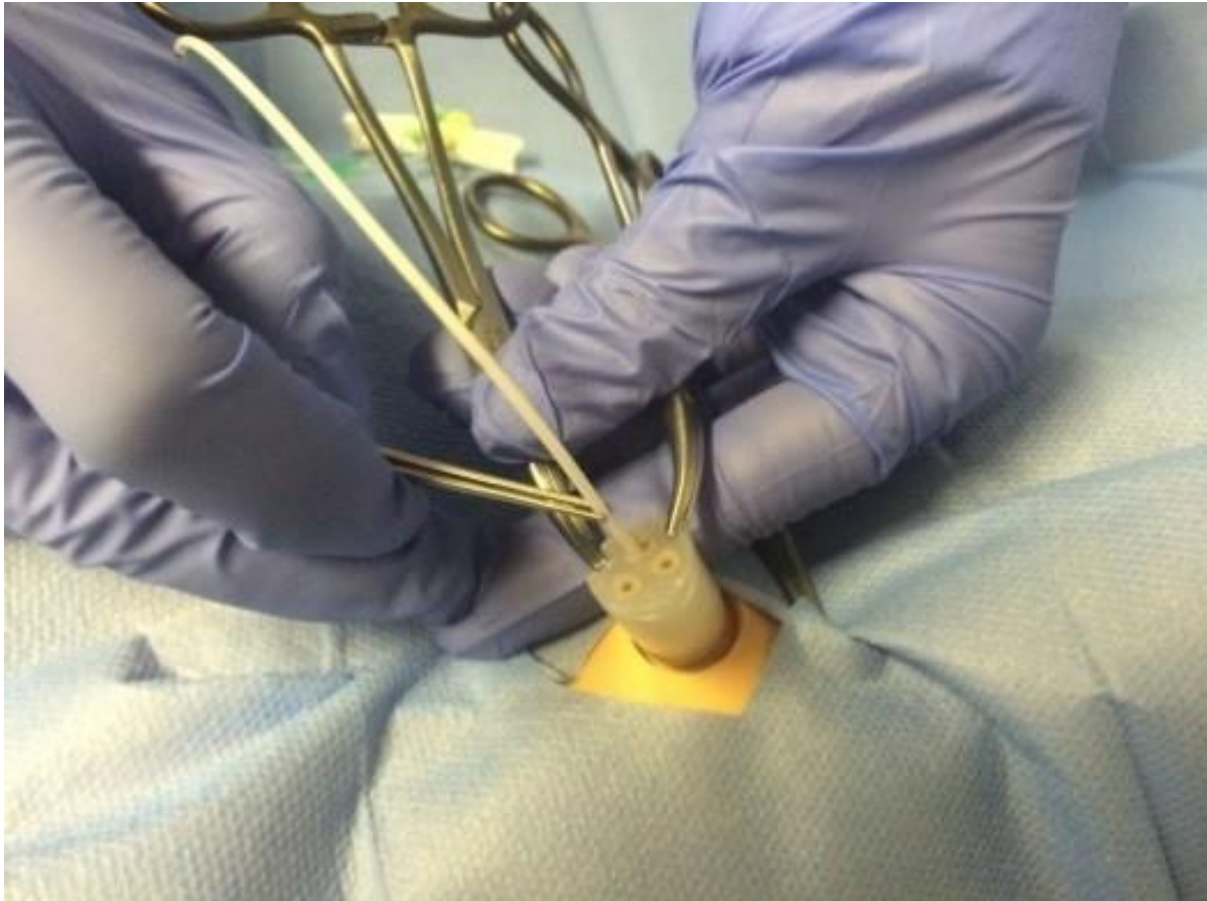


h. Identify the vessels: The umbilical vein typically lies superior to the two arteries and has a thin wall with larger lumen. The arteries have smaller lumens, thicker walls and tend to “stand proud.”



6.5 UVC insertion

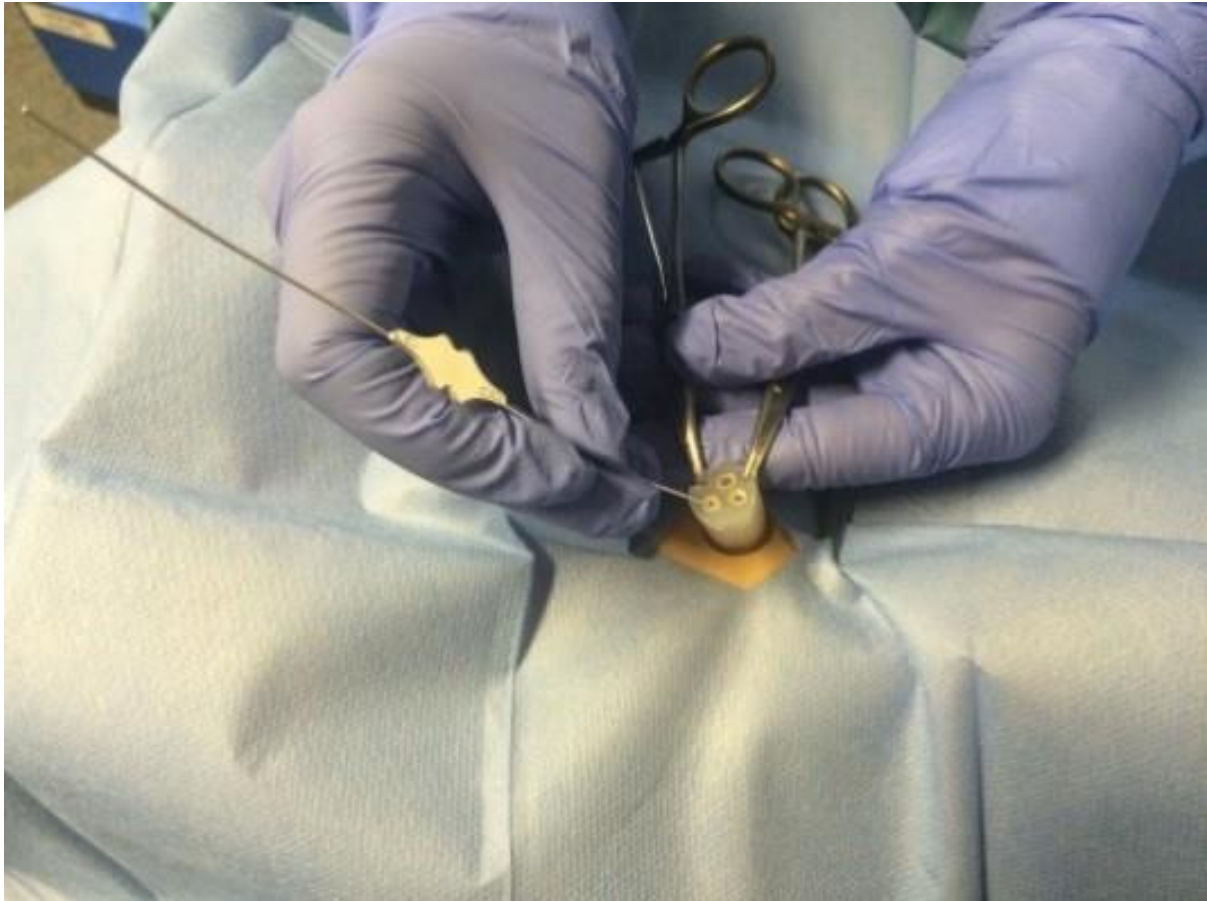
- a. Stabilise the cord using artery forceps and apply gentle upward traction.
- b. If required, use dilator to identify precise location of the umbilical vein lumen. The vessel does not usually require significant dilation.
- c. Place the tip of the catheter, held with non-toothed forceps into the lumen of the vessel and gently advance, in a cephalic direction, to the calculated length. Remember the vein goes up towards the heart therefore, the catheter should be passed upwards.
- d. If there is any resistance and the catheter cannot be advanced to the calculated length or if there is a bobbing motion of the catheter, it may have entered the portal vein or be wedged in the intra-hepatic branch of the umbilical vein. If this happens prior to reaching the calculated length, the catheter can be withdrawn by 1-2cm and re-advanced with a clockwise twisting motion. Avoid 'railroad' technique (do not pass another catheter alongside the first catheter)
- e. Check to ensure the catheter bleeds back (indicating it is in a large vessel) and flushes easily. If not, the catheter must either be retracted or removed and replaced.
- f. Take blood samples and flush the line.
- g. 'Peripheral solutions' (eg. Clear fluids/10% dextrose) and antibiotics can be given at this time, prior to x-ray confirmation of position.
- h. Confirm position on x-ray, secure line, and document.



If an umbilical artery is inadvertently catheterised or is unsuccessfully dilated careful attention must be paid to haemostasis as bleeding may subsequently occur from the artery e.g., if blood pressure improves. Nursing staff must be informed. See 11.1.2 for management of bleeding.

6.6 UAC insertion

- a. Stabilise the cord with artery forceps
- b. Gently dilate the opening to the artery using either a blunt dilator or curved forceps to a maximum depth of 1cm.
 - With a dilator: Do not push the dilator down the vessel as this may create a false passage. Gently rotate the tip in the end of the vessel to open it out.
 - With curved forceps: Allow the points to spring apart and maintain the forceps in this position for a few seconds to dilate the vessel
- c. Keep the vessel open with the forceps or probe and prepare to insert the catheter



- d. Place the tip of the catheter in the lumen of the vessel between the prongs of the forceps (or remove the probe just before inserting) and gently advance.
- e. Pass about 2 cm into the vessel with a firm steady motion until resistance is felt at the point where the umbilical artery turns upwards. Initially the path of the vessel is caudal (towards the feet) into the iliac artery and directing the catheter towards the feet may aid insertion.
- f. Continue to advance catheter to the calculated length.
- g. Aspirate to confirm an intraluminal position. Arterial pulsation should be seen. Flush the catheter through to keep the catheter clear and turn the three-way tap off.
If insertion is easy but blood is not aspirated the catheter is likely to be in a false passage and should be removed.
- h. Infuse heparinised solution as determined by local policy. This can be commenced prior to x-ray confirmation of position.
- i) Once the UAC has been fixed and position confirmed on x-ray, it should be connected to a transducer with a heparinised circuit.

If unsuccessful get help, do not attempt catheterisation of the second artery. A lateral arteriotomy might be helpful. See Appendix 18.6.

6.7 X-ray for position

- Ensure equipment (instruments, ECG leads, transwarmers etc) are removed prior to x-ray
- Arrange x-ray to confirm line position and make any necessary adjustments. Ensure straight position of baby's body.

- Identify externally which line is the UAC and which is the UVC. Placing one line on either side of the infant can aid identification on x-ray, e.g., arterial line to the left, venous line to the right. (There are reported cases where the anticipated UVC has been in the umbilical artery and vice versa).
- Check line positions carefully (see Section 7 Line Position) and re-position as required.
- Document line tip position in medical record.

If following x-ray, there is doubt around which line is in which vessel the following may give helpful additional information:

- Transduce the lines – arterial line should have arterial waveform
- Take a blood gas from both lines and review the pO₂

If the line can be visualised during insertion by a practitioner competent in point of care ultrasound this can reduce the need for x-rays. The sterile field must be maintained at all times. Ultrasound may also be useful subsequently for re-checking line tip position.

6.8 Securing and labelling of lines

After correct position is confirmed (see section 7) ensure umbilical lines are adequately secured as per local policy. Commonly used methods of securing lines can be found in Section 8.

This should minimise risk to skin and potential for catheter migration.

If lines are not adequately secured there is a risk they become misplaced, slip out or increase the risk of developing infection.

Aim to label catheters to be able to clearly distinguish between arterial and venous lines.

Also consider for x-rays placing the arterial line to the left of the baby and venous line to the right.

6.9 Position and monitoring of baby with umbilical lines in situ

The baby should be placed in a supine position for a minimum of 12 hours post umbilical line insertion. Ensure that the lines are visible and not covered by a nappy and incubator covers are not used (substantial amounts of blood may be absorbed in a nappy which may lead to delays in the recognition of bleeding).

- i. Ensure that haemostasis complete before inserting practitioner leaves the baby, including tightening the cord tie
- ii. Following insertion, ensure line and umbilical cord are visible and not covered by nappy (Nappies are intentionally absorbent and will soak up a large volume of blood)
- iii. Do not cover incubator during this 12 hour observation period.
- iv. Umbilical lines must be observed every 30mins for 2 hours to ensure no active bleeding
- v. Baby should ideally be nursed supine for 12 hours after insertion
- vi. Following removal of umbilical catheter, ensure that the catheters are complete, haemostasis has been achieved and an adequate period of observation (at least 4 hours) of the umbilicus is undertaken before placing the infant prone. During this time the incubator should not be covered.

After 12 hours it may be considered that prone positioning may be advantageous, for example to optimise respiratory status.

Umbilical lines must be well secured before moving to prone positioning. Ideally with bridging in place. See Section 8.2.

7. Line tip position

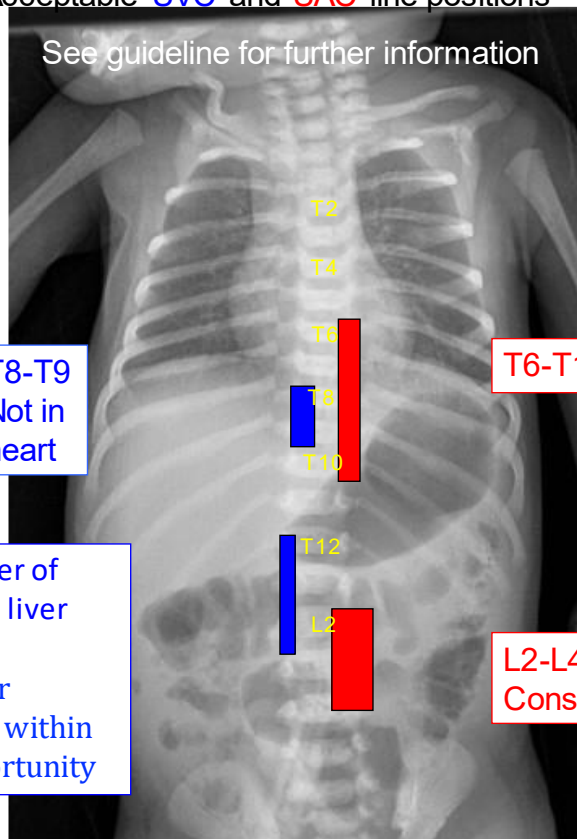
Their location should be reviewed and documented by a consultant Paediatrician/ Neonatologist or Radiologist within 24 hours of insertion.

Line position should be reviewed frequently as catheters are known to migrate after insertion .

For educational purposes, further images of incorrectly sited lines are available in Appendix 18.

Acceptable **UVC** and **UAC** line positions

See guideline for further information



A repeat Xray must be performed for all lines previously within the cardiac silhouette

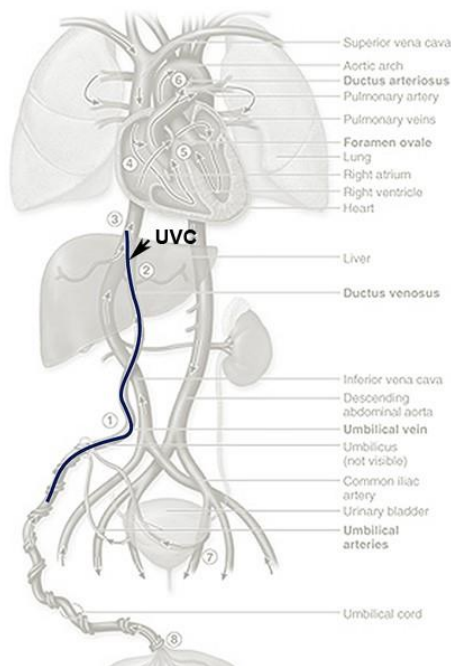
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7.1 UVC position

Location/position

UVC tip position

Tip position	Acceptable or unacceptable	Precautions/adjustments
T8-T9	Acceptable	
Below T12, not inside liver shadow	Acceptable in the short term	Acceptable in short term at: Consultant discretions AND Sampling AND Replace at earliest opportunity (within 24 hours) (BAPM Framework 2018)
In cardiac silhouette	Unacceptable	
Above T8	Unacceptable	
Below T10-T12	Unacceptable	



The catheter takes a course through the umbilical vein, the central part of left portal vein and the ductus venosus to reach the IVC.

It should take a straight path and not kink (this suggests it has taken the wrong path) or be significantly bent near the tip.

The tip should lie at the junction of the inferior vena cava (IVC) and right atrium.

All central catheter tips should be positioned outside the cardiac silhouette.

On radiograph the tip should be seen at the level of the diaphragm or slightly above, usually corresponding to vertebral bodies T8-T9.

A low lying UVC (defined as at the lower border of liver and not inside the liver shadow) can be used assuming all the criteria below are met:

- at the discretion of the consultant
AND
- If the catheter is sampling
AND
- Only for a short period of time, to be replaced at the earliest opportunity (within 24 hours)

There is no evidence of significantly increased complication rates for low-lying UVCs as compared to centrally placed catheters in the short term.

Lines in suboptimal positions should be discussed with the families (and documented). This should be listed within the baby's problem list in the medical notes.

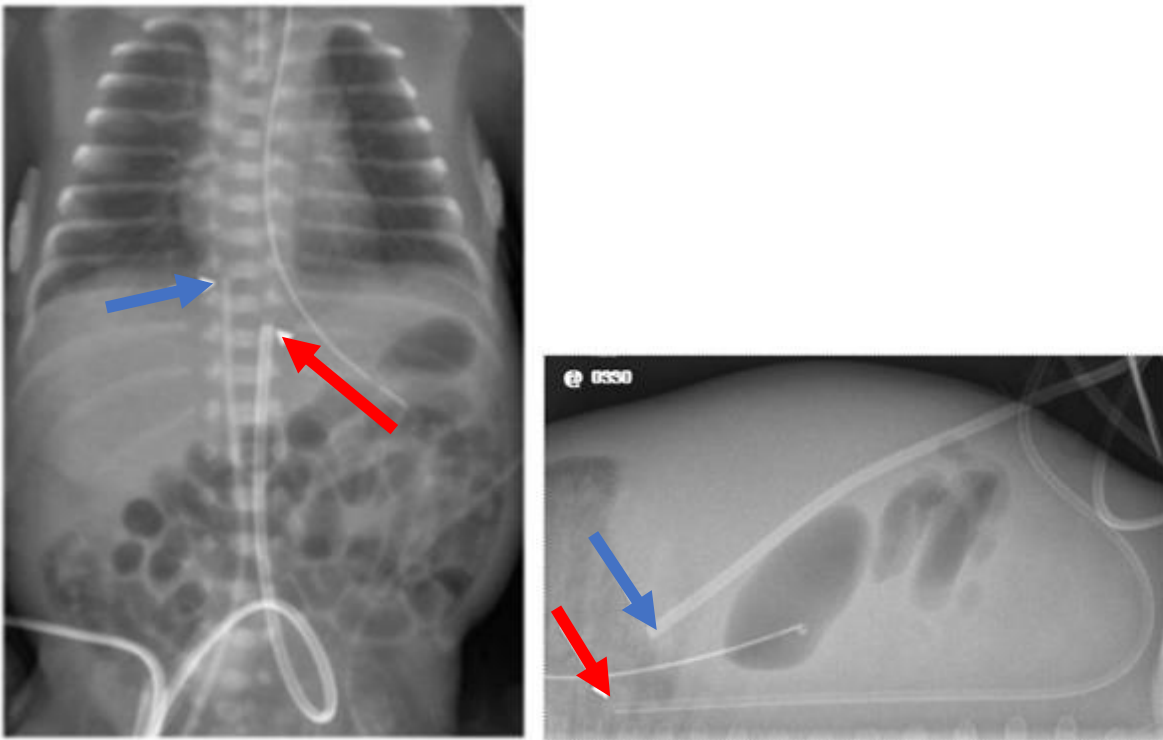
Following any new manual adjustment of UVC position, irrespective of how small the adjustment, a further radiograph must be obtained to verify the new position although in some cases, it may be possible to review/confirm line position using ultrasound.

The UVC position should also be noted on any subsequent x-ray performed on the baby.

The accepted position should be verified in writing within 24 hours of insertion by a consultant neonatologist/consultant paediatrician or from a consultant radiologist's report.

A UVC should not:

Lie over the heart or liver (to minimise the risk of cardiac tamponade or extravasation injury to the liver)



Ideal umbilical line positions

Supine x-ray

Short (blue) arrow- UVC- passing through the ductus venosus to sit in the inferior vena cava with the tip positioned at the diaphragm at level T8/9

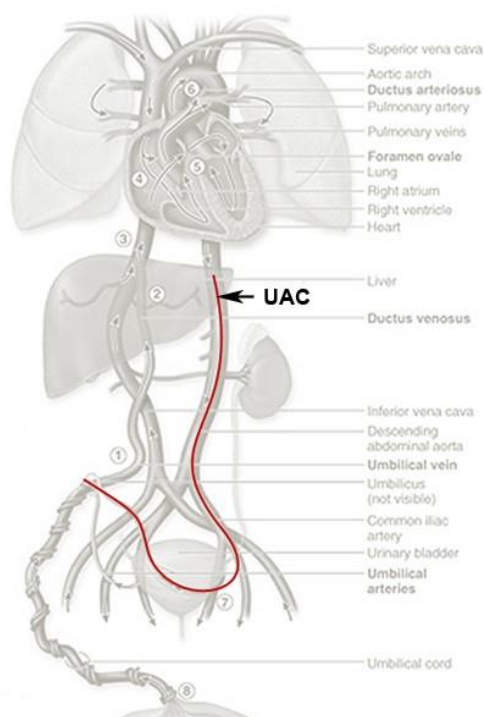
Long (red) arrow -UAC- can be seen dipping down from the umbilical artery to the common iliac artery then the aorta with the tip sitting above the renal and intestinal arteries at T10

Lateral x-ray

The UVC (short blue arrow) can be seen traversing the abdomen from the umbilicus at the anterior abdominal wall superiorly and posteriorly.

The UAC (long red arrow) is coursing from the anterior abdominal wall inferiorly before reaching a posterior position overlying the aorta with the tip above the level of the diaphragm.

7.2 UAC position



Follows one of the umbilical arteries to either the right or left iliac artery to the aorta

A UAC will always go down towards the pelvis before turning up in the iliac vessels

The ideal position on radiograph is between vertebral bodies T6 –T10 (high position- this has been proven to last the longest and be safest)

Avoid the coeliac artery (T12), superior mesenteric artery (T12-L1) and renal arteries (L1).

Low lying (L2-L4) can be accepted as a short-term alternative in exceptional circumstances after discussion with a consultant.

A UAC should not lie below the level of the aortic bifurcation (due to the risk of thrombosis to the lower limbs).

Acceptable UAC tip positions

Tip position	Acceptable or unacceptable	Precautions/adjustments
Above T6	Not acceptable	Pull back to T6-T10
T6-T10	Acceptable	Ideal high UAC position
T11-L1	Not acceptable	Pull back to L2-4
L2-L4	Acceptable short-term alternative	Consultant decision-low UAC position
L5 or below	Not acceptable	Remove catheter

8. Securing lines

8.1 Fixation





There is limited evidence to support any individual method for securing umbilical lines.

BAPM recommend each unit should identify a preferred method of fixation and use this standardised approach.

Units should identify a single method for use within their service.

The method most commonly used within the ODN is detailed below and would be the preference for infants requiring transfer. If using the second method, there should be caution at removal as there have been cases of the line being severed.

8.1.2 Method 1

	<p>Step 1: - Fold over ends of tape so they are easy to pull apart - Tape as close to cord as possible.</p>		<p>Step 2: - Both sutures placed next to the catheter and held taut.</p>
	<p>Step 3: - Loop back catheter (so any force applied is not transmitted directly to insertion point) - Aim for small loop.</p>		<p>Step 4: - Close tape over catheter and sutures - During adjustment/removal it is possible to peel tape apart without the use of cutting implements.</p>
<p>NB the tape used in these images is not zinc oxide. An assistant wearing sterile gloves can be helpful at this stage.</p>			

8.1.3 Method 2 (alternative)

There is an increased risk of severing the line at removal. This method should be used with caution.

How to fix umbilical lines



1. Place the first suture close to the line and tie a knot



2. Tie the suture around the line- could create a loop (eg around an instrument)



3. Tie the suture around the line, ascending with further knots (like a "ballet shoe")



Close up view- ensure knots are tight but not restricting flow through line (these are a bit loose)



4. Place further suture in cord and tie a knot



5. Place zinc oxide tape on line

- Place close to umbilical line entry site
- ensure all sutures are stuck to tape

6. Pinch tape closed, ensuring it is well stuck to sutures and line. Note you are now not sterile (as Zn tape is not sterile)

7. Lines should now be secured- check with "push pull" test

Each line should be independently secured
If the line needs adjusting (OUT only)

- Carefully remove the tape (use Appeel)
- either cut the sutures/loop and repeat or pull through "ballet shoe" ties
- Re apply zinc oxide tape



8.2 Bridging lines in addition to fixation

UAC and UVC lines should be bridged to ensure they are secure and reduce the risk of dislodgement. Ideally lines should be bridged prior to babies being placed prone or coming out of the incubator for kangaroo care, although this may not always be possible.

In larger (>1.5kg) / more mature babies, this should be done at the time of insertion.

In smaller (<1,5kg) / and extreme preterm babies, this should be delayed until skin integrity improves, usually from 2 days onwards.

Duoderm, or similar, should be used as a base to the bridge to protect the skin. Zinc oxide tape should be used to form the legs and crosspiece. The legs are best constructed prior to entering the incubator and should be of roughly equal length. The UAC and UVC should be taped separately within the bridge to allow easy access for repositioning or removal at different times. The bridging will also include the sutures used to secure the line. Both the legs and cross piece should be close to the umbilical stump, with each umbilical line being either S-shaped or curled to reduce the risk of dislodgement.

Procedure

- a. Attach duoderm to the skin immediately adjacent to the stump
- b. Create a leg by folding a piece of zinc oxide tape so that it is just longer than the umbilical stump, with 2 sticky ends exposed at one end. Attach the sticky ends to the duoderm on the abdominal wall. Repeat on the other side.
- c. Cut a piece of zinc oxide that is twice the length between the 2 legs of your bridge.
- d. Place this on one side of the lines and sutures. Ensure the crosspiece is as close to the stump as possible to prevent lines looping and being dislodged at this site. The umbilical lines should be looped within the 'sandwich' of zinc oxide as you fold it over.
- e. Squeeze around umbilical lines and sutures to ensure zinc oxide is well affixed.

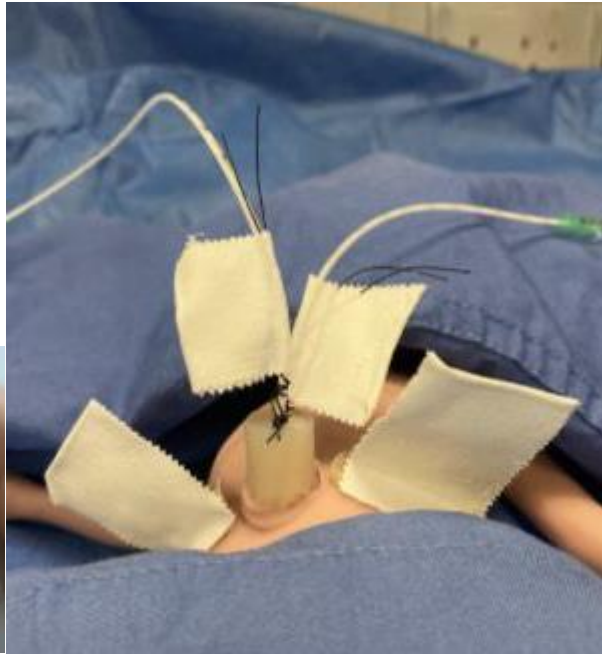


IMAGE AWAITED

9. Accessing umbilical lines

All lines should be accessed using an aseptic technique. This is to minimise the risk of infection.

9.1 UVC:

- A UVC can be used as a peripheral line as soon as it bleeds back i.e., antibiotics and “peripheral” solutions can be commenced (e.g., clear fluids or 10% dextrose) before an x-ray.
- The distal lumen should be used for maintenance infusions and proximal lumen for bolus drugs or low volume drug infusions.
- To reduce potential fluctuations in blood pressure, potentially affecting cerebral perfusion, bolus infusions should be given slowly (over 30 minutes by pump where possible).
- iv fluids such as PN or inotropes should be connected as soon as the x-ray is reviewed, and the line is found to be in acceptable position, or a consultant led management plan for use has been made.
- Hyperosmolar solutions should not be infused into the portal veins. This can lead to hepatic necrosis, laceration, haemorrhage, TPN ascites.

9.2 UAC:

- A heparinised solution should be infused to maintain patency. This can be commenced prior to x-ray confirmation of position.
- Antibiotics can be given by the UAC if blood has been aspirated. X-ray is not required.
- Ideally UAC is used only for blood pressure monitoring and blood sampling.
- In exceptional circumstances iv fluids, blood products and some drugs such as emergency sedation or muscle relaxants can be given through the UAC. This should always be discussed with consultant on call.
- Hyperosmolar and vasoconstricting solutions should be avoided (e.g., 15% dextrose, inotropes).
- Sampling and replacement via arterial lines should also be done slowly to reduce fluctuation in blood pressure (over 1-2mins) and no faster than 1ml/30 seconds.

10. Line maintenance and ongoing infant care

On-going care of central catheters should include regular review of catheter fixation and position, strict asepsis and minimising catheter access.

10.1 Observation of line site and dressing review

Dressing should be intact and lines should be adequately secured. If not secure, immediate action should be taken to rectify this.

Observations:

- Continue hourly observations of heart rate, respiratory rate, blood pressure, oxygen requirement and oxygen saturation.
- Undertake and document hourly observation of line site for bleeding, inflammation and signs of infection (this may be difficult when prone but site should be examined during cares and turns minimum 6 hourly, lines should have been secured as discussed in section 8 prior to baby being position prone)

- UAC: Toes, legs and buttocks should be easily accessible to enable easy and continuous observation of colour and perfusion. Record hourly on nursing observation chart.
- UAC: Ensure appropriate alarms limits are set including mean blood pressure alarm.

Maintenance of line:

- Document type of line and fluid infusing on nursing observation chart and ensure fluid is prescribed as per local guidance.
- Hourly observations of infusion rate, hourly volume infused, total volume infused, and line pressure must be documented on the nursing observation chart.
- Line pressures should be set as per local and manufacturers guidance depending on type of pump but as a rule pressure alarms should be set 25-30mmHg above base line
- UAC: Heparin 1 unit/ml solution (in sodium chloride/sodium bicarbonate dependent upon local guidance) should be infused at rate of between 0.25-0.5 units/hour to maintain line patency (ODN formulary). A rate of 0.5units/hour is commonly used. In infants < 1.5kg heparin solution can be infused at a rate of 0.3ml/hr with good effect.
- UAC: The transducer should be positioned level with the baby's heart and should be zeroed when the line is first inserted, at the start of every shift, whenever the transducer set is changed and whenever the patient is moved.

10.2 Observation and monitoring for complications

Specific attention should be paid to the following:

- Haemostasis should be maintained before the practitioner who has inserted the lines leaves the baby. Consider tightening the ligature around the cord before leaving the baby.
- Lower limb perfusion should be closely monitored for any baby with umbilical lines in situ
- For UACs, a waveform trace should be seen when transduced and this should be ongoing.
- CRP should be performed with routine bloods for parenteral nutrition as per local policy for example 2-3 times/week.

10.3 Documentation and review

- Document the line tip position on the initial x-ray and each subsequent x-ray.
- Document line position on each ward round.
- As with all treatments, the continued need for a UVC or UAC should be reviewed by the multidisciplinary team at least daily with appropriate documentation.
- Consider checking line position at 7 days to reassess the tip position if there have been no x-rays in the meantime.
- There is relatively little evidence around the optimum dwell duration of UVCs in the neonatal population. Two single-centre studies suggested that UVC replacement at between 7-10 days may reduce catheter-associated infection. There is no evidence for how long UACs should remain in situ. Remove once the line is no longer needed once ventilation and blood pressure have stabilised, and the need for frequent blood testing and invasive blood pressure monitoring is reduced. In extreme preterm infants the line may be left for longer to limit skin damage from peripheral blood tests.

- Any sign of compromise potentially related to an umbilical catheter should be discussed with registrar/consultant and removal of line should be considered.

11. Complications of umbilical lines

11.1 Umbilical Venous Catheters

- 11.1.1 Hepatic/abdominal extravasation
- 11.1.2 Bleeding (also applicable for UAC)
- 11.1.3 Infection (also applicable for UAC)
- 11.1.4 Malposition/migration
- 11.1.5 Pericardial effusion and/or tamponade
- 11.1.6 Snapped/severed line (also applicable for UAC)
- 11.1.7 Arrhythmias
- 11.1.8 Venous Thrombosis
- 11.1.9 Subcapsular liver haematoma
- 11.1.10 Urachal cannulation (applicable for UAC too)
- 11.1.11 Air Embolism

11.1.1 Hepatic/abdominal extravasation

Common complication of low lying/malposed UVCs. Severity ranges from asymptomatic liver collection to haemodynamic collapse/metabolic acidosis/renal impairment.

Avoid by:

- i. On X-ray, the UVC should take a straight path and not kink, with the tip lying between T8/T9, not below T10, and not within the cardiac silhouette or liver (Please ensure non-rotated X-ray image).
- ii. UVC sited below T10 should be only used for short term and replaced as soon as possible (ideally within 24 hours)
- iii. UVC should not be used if in the hepatic or portal vessels
- iv. All lines should be freely aspirating at their final position and this documented
- v. If resistance felt, pull back to position where blood freely aspirating
- vi. There is a higher risk of extravasation if UVC in a “low-lying” position and hypertonic or vasoactive drugs are being infused

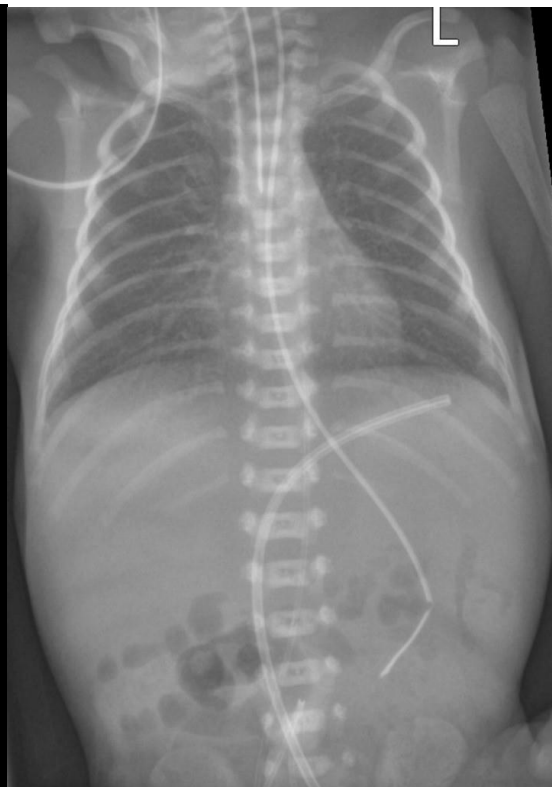


Figure 1 – UVC tip within the right portal vein

Jones J, UVC in right portal vein. Case study, Radiopaedia.org (Accessed on 03 Jan 2023) <https://doi.org/10.53347/rID-27465>

Figure 2 – Jones J. UVC in left portal vein: Radiology case, Radiopaedia Radiopaedia.org.

Available at: <https://radiopaedia.org/cases/uvc-in-left-portal-vein-1?lang=gb> (Accessed: 03 Jan 2023).

Suspect if:

- i. Abdominal distension, ascites or tenderness in a neonate with indwelling UVC
- ii. Abnormal gas pattern associated with UVC tip overlying liver or presence of ascites may raise suspicion of liver extravasation
- iii. Abdominal wall or perineal/genital swelling may represent extravasation
- iv. An unexplained rising lactate.

Action:

- i. Depending on level of concern, consider stopping infusions and removing UVC
- ii. Repeat X-ray may demonstrate malposition or abnormal air (consider injecting contrast into UVC) but ultrasound will be able to better identify tip position as well as any liver parenchymal injury.

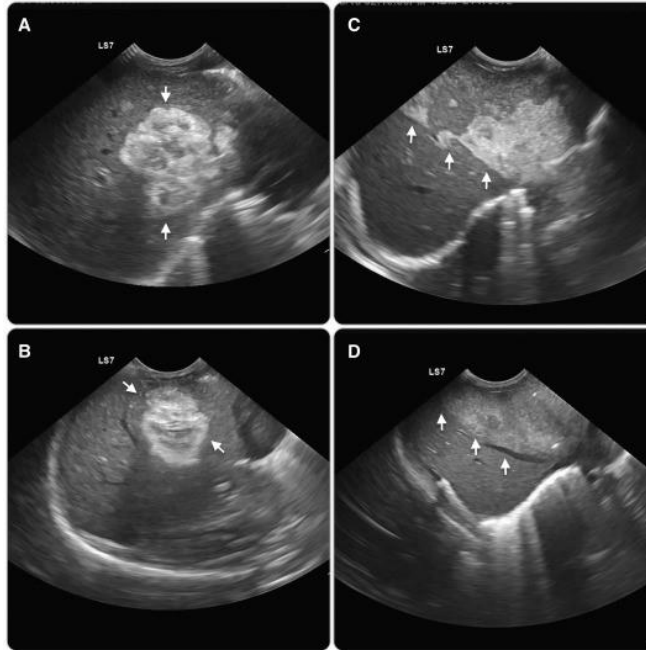


Figure 3 - Hepatic extravasation in 4 different patients secondary to malposed UVCs.

Chen HJ, Chao HC, Chiang MC, Chu SM. Hepatic extravasation complicated by umbilical venous catheterization in neonates: A 5-year, single-center experience. *Pediatr Neonatol.* 2020 Feb;61(1):16-24. doi: 10.1016/j.pedneo.2019.05.004. Epub 2019 May 18.

11.1.2 Bleeding (also applicable for UAC insertion)

Common complication, severity ranges from slight oozing to catastrophic haemorrhage and death (especially if unrecognised).

Avoid by:

- i. Ensure that haemostasis complete before inserting practitioner leaves the baby, including tightening the cord tie
- ii. Following insertion, ensure line and umbilical cord are visible and not covered by nappy (Nappies are intentionally absorbent and will soak up a large volume of blood)
- iii. Do not cover incubator during the 12-hour observation period.
- iv. Umbilical lines must be observed every 30mins for 2 hours to ensure no active bleeding
- v. Baby should ideally be nursed supine for 12 hours after insertion
- vi. Following removal of umbilical catheter, ensure that the catheters are complete, haemostasis has been achieved and an adequate period of observation (at least 4 hours) of the umbilicus is undertaken before placing the infant prone. Do not cover the incubator during this time period.

Suspect if:

- i. Active bleeding from cord following line insertion or removal
- ii. Cardiovascular collapse or instability following line insertion, drop in haemoglobin and/or platelets

Action:

- i. Inspect the catheter and ensure not damaged/leaking
- ii. Consider additional cord tie, a suture around the cord or topical haemostatic dressing e.g. Kaltostat, Surgicel
- iii. Consider correcting hypovolaemia and/or anaemia/coagulopathy if significant bleed – depending on severity consider major haemorrhage protocol.

11.1.3 Infection (also applicable for UAC insertion)

Uncommon complication. Sepsis known to increase risk of long-term morbidity, especially in extreme preterm infants.

Avoid by:

- i. CVC insertion checklist should be used on insertion, adhering to strict asepsis
- ii. On-going care of central catheters should include regular review of catheter fixation and position, strict asepsis and minimising catheter access
- iii. The need for ongoing UVC placement should be reviewed and considered daily
- iv. Consider replacing UVC after 7-10 days with PICC line if central access still needed
- v. Frequency of catheter access should be minimised and infusions should be made up aseptically
- vi. Avoid advancing a UVC if low lying due to risk of infection, once no longer sterile.

Suspect if:

- i. Evidence of infection in infant with indwelling UVC
- ii. Progressive umbilical flare, redness or tracking.

Action:

- i. Screen for infection
- ii. Commence broad spectrum antibiotics as per local policy, take into account any known bacterial colonisation
- iii. Consider removal of line and replace with PICC line depending on level of concern.

11.1.4 Malposition/Migration

Avoid by:

- i. UVCs should be secured as per local agreed procedure – avoiding damaging skin integrity
- ii. The final UVC tip position should be documented as acceptable by consultant neonatologist/radiologist within 24 hours of insertion
- iii. The position of the line tip should be reviewed on every x-ray that is performed regardless of the indication
- iv. The most recent imaging should be reviewed daily on ward round

- v. Consider repeating X-ray after 5-7 days of insertion (if no recent imaging) to ensure not migrated
- vi. The need for ongoing central venous access should be reviewed daily along with the integrity of method of securing.

Suspect if:

- i. See pericardial effusion, arrhythmia and liver extravasation sections above

Action:

Dependent upon x-ray/clinical findings:

- i. It may be possible to re-position the line if it can be moved to an acceptable lower position. Lines cannot be advanced following the initial sterile insertion procedure.
- ii. If there are complications or not possible to move to a lower, acceptable position then the line should be removed. It is at consultant discretion and dependent upon clinical condition of the patient as to whether this occurs prior or after placement of an alternative central line.

11.1.5 Pericardial effusion and/or tamponade

Rare complication, however, potentially catastrophic causing cardiac arrest.

Avoid by:

- i. All central line catheters should be sited outside the cardiac silhouette.

Suspect if:

- i. A deteriorating baby in whom a central venous catheter is present should raise the question of tamponade (please note, this can occur even in if the UVC appears to be in a good position on most recent X-ray)
- ii. Features may include : Tachycardia, poor perfusion, soft heart sounds, cardiomegaly, decreasing oxygen saturations, arrhythmia.

Action:

- i. Consider CXR and/or Echocardiogram. CXR may demonstrate cardiomegaly (see figure 4)
- ii. Stop the infusion and consider pericardiocentesis
- iii. If pericardiocentesis is performed, fluid obtained should be sent for laboratory analysis

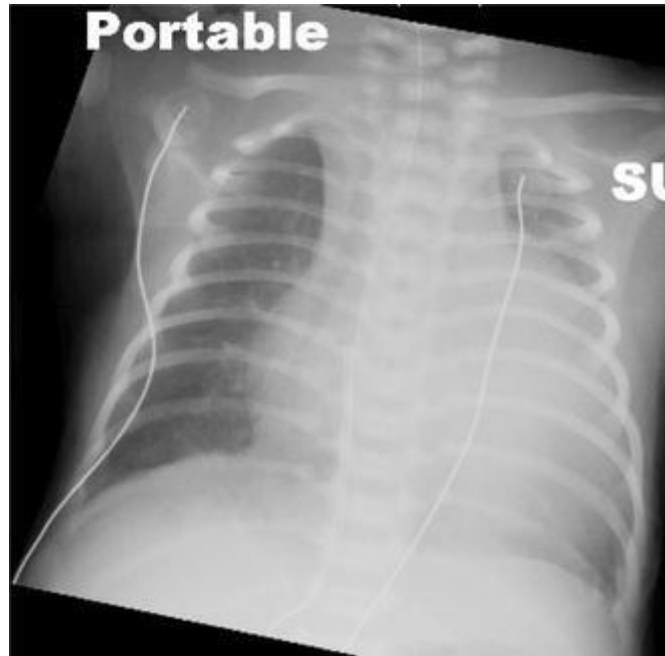


Figure 4 – CXR showing cardiomegaly from pericardial effusion, with a UVC within the cardiac silhouette.

Thomson, T.L., Levine, M., Muraskas, J.K. et al. Pericardial Effusion in a Preterm Infant Resulting from Umbilical Venous Catheter Placement. *Pediatr Cardiol* 31, 287–290 (2010). <https://doi.org/10.1007/s00246-009-9587-y>

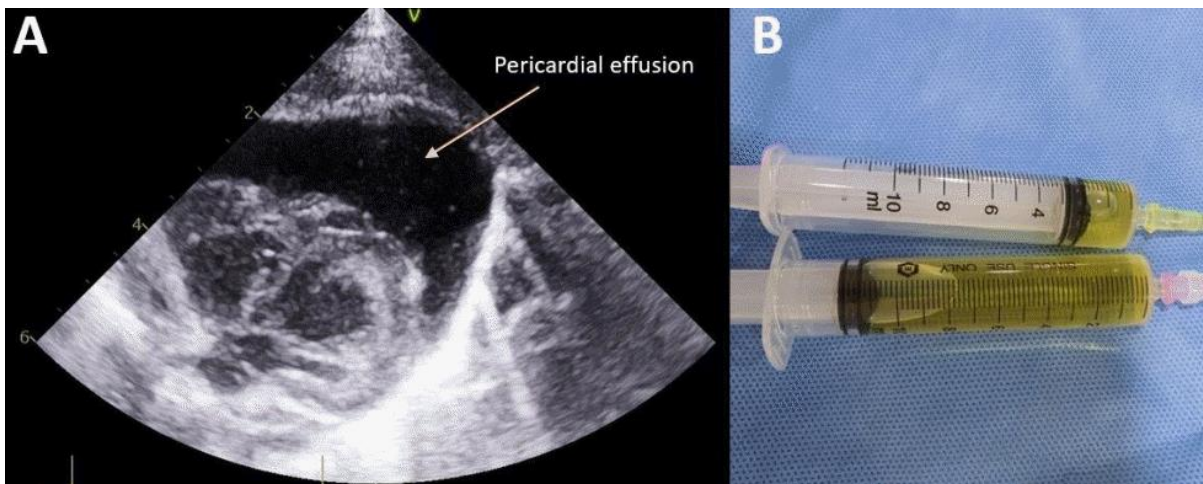


Figure 5. A. Echo image of large pericardial effusion B. Pale yellow fluid aspirated. Park et al. Rapidly Progressive Pericardial Effusion and Cardiac Tamponade in a Term Infant with an Umbilical Venous Catheter: A Case Report Neonatal Medicine (online) Neonatal Medicine (neo-med.org) <https://www.neo-med.org/upload/thumbnails/nm-2022-29-4-135f3.jpg>

11.1.6 Snapped/severed line

Avoid by:

- i. Extreme caution at line removal and when re-positioning babies/moving for kangaroo care to avoid tension on lines
- ii. Use of stitch cutters NOT scalpels
- iii. Ensure line is complete at time of removal

Action:

- i. Aim to secure the distal end of the snapped/severed lines with forceps to prevent this being 'lost' in the vascular system
- ii. Remove the distal end as soon as possible
- iii. Manage haemostasis
- iv. If the line cannot be secured with forceps, contact Embrace and discuss the case with the vascular surgery team at LGI

11.1.7 Arrhythmias

Rare complication. Usually presents as supraventricular tachyarrhythmias due to irritation of the sinoatrial node. Can be asymptomatic, but if unrecognised and/or presents in already haemodynamically compromised baby can result in cardiac failure and haemodynamic compromise.

Avoid by:

- i. All central venous catheters should be sited outside the cardiac silhouette.

Suspect if:

- i. Haemodynamic compromise, abnormal tachycardia or other arrhythmias in a child with indwelling UVC/Long line.

Action:

- i. CXR or Ultrasound to confirm UVC tip position in right atrium
- ii. Withdraw UVC to safe position
- iii. Consider other causes if persistent (e.g. structural cardiac disease, thyroid dysfunction, electrolytes abnormalities) and treat accordingly.

11.1.8 Venous Thrombosis

Very rare complication. Usually asymptomatic but can cause venous congestion if occlusive. Embolic events are exceptionally rare, but very serious.

Avoid by:

- i. Minimise the duration of UVC insertion by reviewing need daily

Suspect if:

- i. Usually picked up incidentally on ultrasound/echocardiogram
- ii. Could present with venous congestion if occlusive, or embolic event
- iii. Renal vein thrombosis can present as isolated haematuria

Action:

- i. If incidental/asymptomatic, consider expectant management
- ii. If large or symptomatic, liaise with local haematology team to guide ongoing management

11.1.9 Subcapsular Liver Haematoma

Very rare complication, however, can result in massive haemorrhage, coagulopathy and death.

Avoid by:

- i. Only use gentle pressure when inserting UVC
- ii. Once UVC inserted past umbilical ring, never use force, or push past resistance.

Suspect if:

- i. Haemodynamic collapse
- ii. Drop in haemoglobin and/or platelets
- iii. Abdominal distension/hepatomegaly.

Action:

- iv. Rule out sepsis and IVH
- v. Diagnose with ultrasound
- vi. Consider correcting hypovolaemia, anaemia and coagulopathy (consider major haemorrhage protocol given clinical scenario).

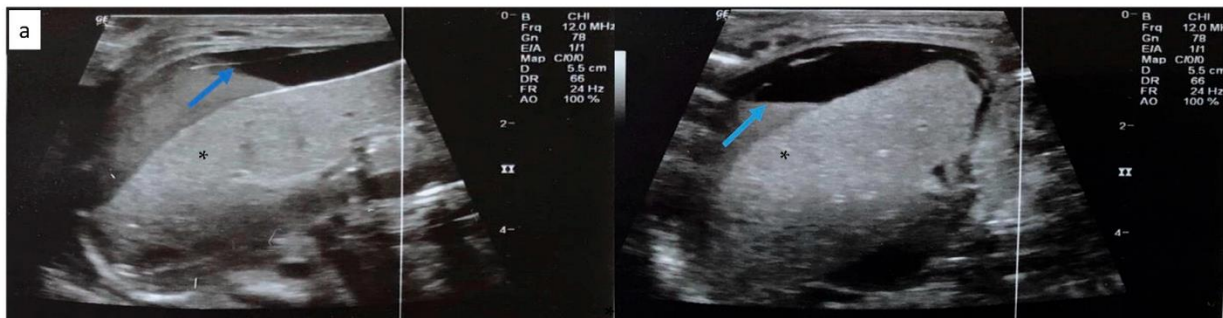


Figure 5 – Ultrasound showing subcapsular fluid.

Liakou P, Batsiou A, Konstantinidi A, Theodoraki M, Taliaka Kopanou P, Tavoulari EF, Tsantes AG, Piovani D, Bonovas S, Tsantes AE, Iacovidou N, Sokou R. Subcapsular Liver Hematoma-A Life-Threatening Condition in Preterm Neonates-A Case Series and Systematic Review of the Literature. *J Clin Med.* 2022 Sep 26;11(19):5684. doi: 10.3390/jcm11195684.

11.1.10 Urachal Cannulation (also applicable for UAC insertion)

Extremely rare, may cause damage to bladder if unrecognized.

Avoid by:

- i. Careful identification of the umbilical vessels
- ii. Be more suspicious of patent urachus in abnormally thick cord (>5cm in diameter) or cord that has polyps
- iii. The presence of sinus tracts or palpable masses posterior to umbilicus should also alert you to patent urachus
- iv. Gentle palpation of the bladder may lead to serous fluid exuding from the cord.



Figure 6 – Giant umbilical cord that should prompt suspicion of patent urachus. Young S, McGeechan A, Davidson P, et al

Management of the giant umbilical cord: challenging the need for investigations in the newborn Archives of Disease in Childhood - Fetal and Neonatal Edition 2016;101:F538-F539

Suspect if:

- i. UVC insertion challenging or leaking of serous fluid from umbilicus.

Action:

- i. Remove UVC and discuss with paediatric surgeons.

11.1.11 Air embolism – (also applicable for UAC insertion)

Extremely rare but can result in cardiac arrest.

Avoid by:

l) Ensure all central lines are flushed well prior to insertion. Use needle free connectors/three-way tap to ensure no air entrained/entrapped within the neonatal circulation

Suspect if:

- i. Sudden cardiovascular collapse related to line insertion or commencing infusion
- ii. May see intracardiac air on Chest X-ray/Echocardiogram

Action:

- i. Stop infusions/flushes that may be infusing air into circulation
- ii. Cardiorespiratory support – manage ABC

11.2 Umbilical Arterial Catheters

11.2.1 Bleeding (see UVC section, add hyperlink)

11.2.2 Infection (see UVC section, add hyperlink)

11.2.3 Impairment of flow to coeliac, mesenteric and renal arteries

11.2.4 Perineal/lower limb ischaemia

11.2.5 Aortic thrombus

11.2.6 Snapped/severed line (see UVC section above, add hyperlink)

11.2.7 Urachal cannulation (see UVC section, above)

11.2.8 Air Embolism (see UVC section, above)

11.2.3 Impairment of flow to coeliac, mesenteric and renal arteries

Very rare complication with severity ranging from mild feed intolerance or renal impairment, to necrotising enterocolitis (NEC) or renal failure.

Avoid by:

- i. Ensure UAC tip lies between T6-10 ideally, or between L3-4 at consultant discretion. The UAC tip should not lie between L1-3 vertebral levels on X-ray.

Suspect if:

- i. Impairment to flow in the celiac/mesenteric arteries may present as feed intolerance or NEC.
- ii. Impairment to flow in the renal arteries may present as renal failure, haematuria or hypertension
- iii. If suspected, recheck UAC tip position with X-ray and/or ultrasound

Action:

- i. Manage feed intolerance, NEC or renal impairment
- ii. Reposition UAC to acceptable position or remove it.

11.2.4 Perineal/lower limb ischaemia

Very rare complication. If unrecognised, can result in the loss of digits/limbs.

Avoid by:

- i. Nurse baby in a way that lower limbs and perineum/buttocks can be easily seen
- ii. Actively observe for reduced lower limb, perineal and buttock perfusion

Suspect if:

- i. Impaired lower limb or perineal perfusion – prolonged capillary refill, cool to touch, mottling, poor peripheral pulses

Action:

- i. Simple vasospasm may respond to a fluid bolus
- ii. However, if perfusion does not improve or there is worsening lactic acidosis the UAC should be removed.

11.2.5 Aortic Thrombus

Very rare complication. Usually asymptomatic but can present with severe hypertension or distal ischaemia.

Avoid by:

- i. Infuse heparinised fluids to maintain UAC patency
- ii. Remove UAC when no longer required

Suspect if:

- i. May present with poor peripheral perfusion, HYPERTension or heart failure if large/occlusive
- ii. Often asymptomatic and picked up incidentally on ultrasound.

Action:

- i. Manage hypertension symptomatically
- ii. Perform ultrasound to assess size and extent of thrombus
- iii. Liaise with haematology to discuss anticoagulation if large, occlusive or symptomatic.
- iv. Consider thrombolysis if life, organ or limb threatening (discuss with haematology).

12. Removal of line

Extreme care should be taken to ensure lines are not severed at removal, particularly when method 2 of securing has been used. Management of severed line see complications section.

Stitch cutters should be used and NOT scalpels.

Follow local policy for routine microbiology culture of line tip.

UVC – can be removed as required. Infusions can be stopped immediately prior to line removal.

UAC – stop heparin infusion prior to removal.

Following removal of umbilical catheter, ensure that the catheters are complete, haemostasis has been achieved and an adequate period of observation (at least 4 hours) of the umbilicus is undertaken before placing the infant prone. Do not cover the incubator during this time period.

Sufficient time should be allowed for haemostasis following removal of umbilical catheters before placing the baby prone to avoid the potential for concealed haemorrhage.

If there is difficulty in maintaining haemostasis, consider the use of haemostatic dressings (see section 11.1.2 for further details).

BP should be monitored for 24hrs following UAC removal. See charts in appendix 18.7.

13. Parents

Parents should be informed about the insertion of umbilical lines at the earliest practicable opportunity however prior consent is not always possible. It is good practice to clearly explain to parents the reasons for umbilical lines and their potential complications.

If complications occur, parents should be kept informed in as timely a way as the urgency of the situation allows. The next steps should be discussed, understanding checked and questions addressed.

Providing written information in the form of a parent information leaflet is also good practice.

14. Education

Trusts should ensure appropriate training and supervision of medical and nursing staff to ensure safe practice with umbilical catheters.

15. Audit

There are many relevant audits that could be performed. It may be worthwhile for Trusts to consider around data for umbilical lines.

Examples include:

Temperature at line insertion

Complication rates including dislodgement of lines

Documentation of line position and subsequent actions

16. References

1. Use of Central Venous Catheters in Neonates (Revised 2018) A BAPM Framework for Practice 31 Aug 2018 [Use of Central Venous Catheters in Neonates \(Revised 2018\) | British Association of Perinatal Medicine \(bapm.org\)](#)
2. Robertson's textbook of Neonatology. 4th Edition 2005 Published Elsevier
3. Patient safety first- matching Michigan
<http://www.patientsafetyfirst.nhs.uk/Content.aspx?path=/interventions/relatedprogrammes/matchingmichigan/>
4. Barrington KJ. Umbilical artery catheters in the newborn: effects of position of the catheter tip. Cochrane Database of Systematic Reviews 1999, Issue 1. Art. No.: CD000505. DOI:10.1002/14651858.CD000505.
5. Kabra NS, Kumar M, Shah SS. Multiple versus single lumen umbilical venous catheters for newborn infants. Cochrane Database of Systematic Reviews 2005, Issue 3. Art. No.: CD004498. DOI: 10.1002/14651858.CD004498.pub2

6. National survey of umbilical venous catheterisation practices in the wake of two deaths. Clare Hollingsworth, Paul Clarke, Alok Sharma, Michele Upton. Arch Dis Child Fetal neonatal Ed 2015 100 (4), p371
7. Migration of Central Venous Catheters in Neonates: A Radiographic Assessment. Gupta R¹, Drendel AL², Hoffmann RG³, Quijano CV⁴ Uhing MR¹. Am J Perinatol. 2016
8. Ultrasound-guided umbilical catheter insertion in neonates. Fleming SE¹, Kim JH. J Perinatol. 2011 May;31(5):344-9.
9. Early planned removal of umbilical venous catheters to prevent infection in newborn infants. Gordon A¹, Greenhalgh M, McGuire W. Cochrane Database Syst Rev. 2017 Oct
10. Catheters: A Multicenter Study of Practices and Complications. Am J Perinatol 2019; Central versus Low-Lying Umbilical Venous 36(11): 1198-1204

17. Acknowledgements

Guidelines

Y&H South ODN
 EoE
 BAPM
 Leeds "survival guide"
 Bradford
 W Midlands ODN (19-21)
 Leeds SOP
 Embrace
 Hull

Working Group Members:

Anne Bean, Nia Evans, Yousef Gargarni, Marie-Anne Kelly, Umapathee Majuran, Ourania Pappa, Kathy Parke, Elizabeth Pilling, Catherine Smith, Hazel Talbot, Helen Yates, Penny Young,

18. Appendices

- 18.1 Checklist for line insertion (Hull, LGI, Sheffield)
- 18.2 Images for position (printable)
- 18.3 Education: Identifying misplaced umbilical lines
- 18.4 Images for fixation including bridging (printable)
- 18.5 Example Parent Information leaflet
- 18.6 Lateral arteriotomy
- 18.7 BP centiles

Appendix 18.1 Four examples of umbilical line insertion checklists

Umbilical/Central Line Insertion - Medical



Patient Sticker

Umbilical/ central line Insertion					
Date	Aseptic Technique used				
Time	Assistant	Yes	No		
Parental verbal consent	Final line position	Yes	No		
Distal limb circulation checked	Flushes easily	Yes	No		
Indication for insertion	Aspirates blood	Yes	No		
UAC	3.5 FR	5FR		Procedure performed by	
UVC	Single lumen	Name, designation and sign			
	Nutriline/VYGON	Premicath			
Longline					
Procedure checklist completed?	Comments				



Line lot sticker-

Date & Time	Operator	Observer
	Metal trolley cleaned prior to use	<input type="checkbox"/>
	Sterile instrument pack	<input type="checkbox"/>
	Operator (+ supervisor) wash hands with soap and water	<input type="checkbox"/>
	Skin Prep with 2 % chlorhexidine & 70% isopropyl Alcohol. Allow to dry for 30 seconds (washed off skin of babies under 26 weeks with sterile 0.9% saline)	<input type="checkbox"/>
	Sterile Gloves & Gown worn by operator/ supervisor	<input type="checkbox"/>
	Surgical Hat and Mask worn by operator/ supervisor	<input type="checkbox"/>
	Large Sterile Drapes used to cover baby	<input type="checkbox"/>
	Smart site applied	<input type="checkbox"/>
	Maintain sterile field through-out Xray.	<input type="checkbox"/>
	Long line: Sterile dressing, not circumferential, no protruding steristrips	<input type="checkbox"/>
	Umbilical Lines: secured with 2 sutures and Elastoplast (as per guideline)	<input type="checkbox"/>
	Safe disposal of sharps	<input type="checkbox"/>
	Wash hands after	<input type="checkbox"/>

**Remarkable people.
Extraordinary place.**

THERMOREGULATION - Remember to use transwarmer/blankets or bubble wrap to ensure patient remains normothermic

Please use continuation sheet if needed

Insert patient sticker here

Neonatal CVC Insertion Checklist

This checklist should be completed by an observer. The procedure must be stopped if any of these elements of this CVC care bundle checklist are not followed

Baby's Name:	Baby's Unit No:	
Procedure:	Date:	Time:
Operator/s:	Nurse observer:	

Before the procedure

Yes No

1	Required equipment gathered	<input type="checkbox"/>	<input type="checkbox"/>
2	Designated trolley cleaned	<input type="checkbox"/>	<input type="checkbox"/>
3	Hat & mask worn by operator (& supervisor where applicable)	<input type="checkbox"/>	<input type="checkbox"/>
4	Hands decontaminated with soap and water	<input type="checkbox"/>	<input type="checkbox"/>
5	Sterile gown and gloves worn by operator (& supervisor where applicable)	<input type="checkbox"/>	<input type="checkbox"/>

During the procedure

6	2% Chlorhexidine/70% isopropyl alcohol (Chloraprep) used for skin prep and allowed to dry for 30 seconds	<input type="checkbox"/>	<input type="checkbox"/>
7	Large sterile drape used to cover infant	<input type="checkbox"/>	<input type="checkbox"/>
8	Sterile field maintained	<input type="checkbox"/>	<input type="checkbox"/>
9	Sterile field covered with sterile towel while awaiting X Ray	<input type="checkbox"/>	<input type="checkbox"/>

After the procedure

10	Sterile dressing used (Tegaderm)	<input type="checkbox"/>	<input type="checkbox"/>
11	Attach 'closed' needle-free system (Smart site)	<input type="checkbox"/>	<input type="checkbox"/>
12	Decontaminate hands after removal of gloves (Wash/Gel)	<input type="checkbox"/>	<input type="checkbox"/>

Procedure stopped* - Comments:

Completed checklist to be placed in baby's notes.

*If procedure has been stopped please inform PIC line team.

STH UMBILICAL line insertion checklist

NAME
DOB
Hospital number

If one of the criteria is not achieved please either
Correct the error OR Stop the procedure

NB THIS LIST NEEDS TO BE COMPLETED DURING THE PROCEDURE

Time procedure started (ie incubator entered)

		:		
--	--	---	--	--

Temperature monitoring (see page 2 interventions) to record

Time (min)	Pre	0:15	0:30	0:45	1:00	1:15	1:30	1:45
Temp								

Criteria	Achieved?	Comments
Assistant available for whole procedure to complete list, ensure all steps completed and assist with securing		
Xray notified of procedure and requested		
Antibiotics (if required) prescribed and given once blood aspirated		
Clean trolley and allow to dry		
"Sterile zone" created with screens around trolley, consideration of thermal control		
Theatre hat worn		
Wash hands and forearms with CHLORHEXIDINE WASH for 2 minutes. Dry with sterile towel. Gown and 2 pairs sterile gloves put on without contamination		
Equipment (correct size UAC) and incubator port holes opened by assistant		
Area DABBED with chloraprep sponge and allowed to dry.		
Abdomen NOT cleaned (risk of burns)		
Drapes applied without contamination of sterile field/gloves NOTE this requires the incubator door to be opened. Drape must NOT be inserted through port holes. Observer is necessary to check contamination does not occur		
For infants both <28 weeks AND <7 days, cleaning fluid washed off after 1 minute		
Top layer of gloves removed		
Appropriately completed procedure without contamination of the sterile field, equipment and gloves. Hands must NOT touch body at any point- this is no longer sterile after leaning against incubator		
De-scrubs and rescrubs if leaves sterile "zone", eg while waiting/reviewing xray. Changes equipment, gloves or gown if contamination occurs		
Lines fixed individually with zinc oxide tape and sutures		
Fluids attached to central line (by inserter or assistant) within 15 mins of line insertion (to prevent occlusion)		
Antibiotics given via line if indicated (STERILE)		

Time procedure completed (awaiting xray)

		:		
--	--	---	--	--

Time all complete (adjustments following xray)

		:		
--	--	---	--	--

Date of insertion

.....

PTO

Line type; UAC UVC

Thermoregulation interventions

Intervention	Hat	Change incubator temperature	Increase room temp	Transwarmer	Suspend procedure
Used?					

Note: humidity will not change core temperature while plastic drape is in situ

	Name	Signature	Date	Time
Line inserted by				
Assistant check list				

Attach cut down set sticker here:

Line type/size (and sticker):

Length inserted to:

Xray position:

Readjusted?. Y/N Please document final length if moved.

Repeat xray (if needed)- result:

<p>ACCEPTABLE;</p> <p>UAC- T6-T10 (ideal)</p> <p>below L3 (acceptable)</p> <p>UVC T8-T10 (ideal T8-9)</p> <p>L2/3 acceptable for central use for short time (replace within 24 hours)</p>

Consultant line position check
Location (vertebral body); UAC

UVC

ACCEPTABLE- Yes/No

Yes/No

Additional notes eg reason for suboptimal position acceptance and plan for use (eg can be used as central line (for up to 24 hours) or only peripheral line (longer term)) and repositioning/timings *(ensure also documented on patient problem list)*

Parents aware of suboptimal position Yes/No
Consultant Signature/Name

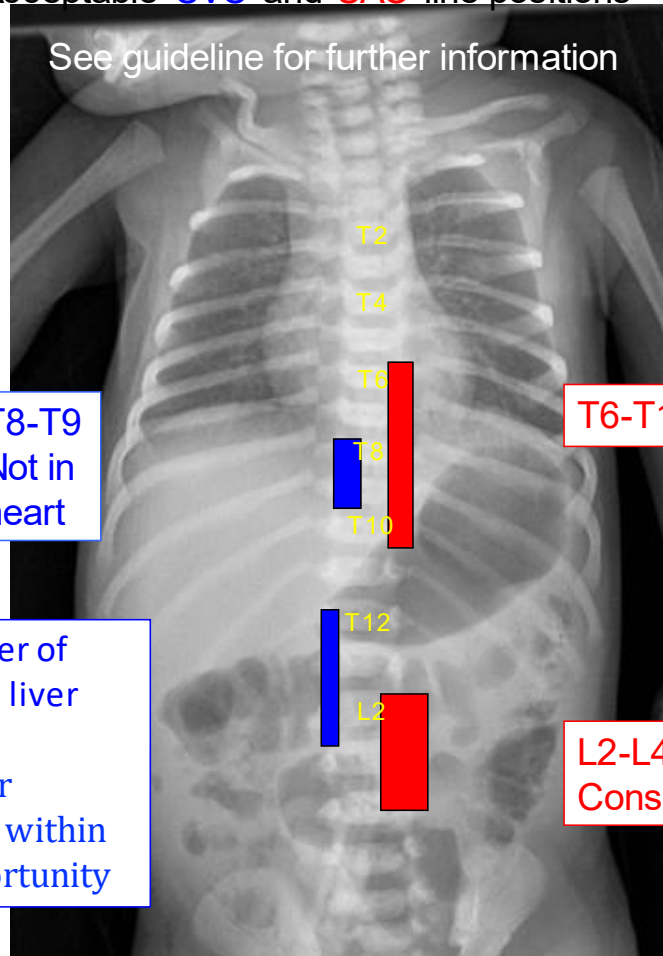
Date/time

IT IS THE RESPONSIBILITY OF THE LINE INSERTOR TO FILE THIS DOCUMENTATION IN THE MEDICAL NOTES WITHIN THE CONTEMPORARY SECTION (LEFT) SIDE

Appendix 18.2. Acceptable UVC and UAC line positions

Acceptable **UVC** and **UAC** line positions

See guideline for further information



T8-T9
Not in
heart

T6-T10

Low-lying (lower border of
liver and not inside the liver
shadow)
Consultant decision for
PN/inotropes. Replace within
24 hours/earliest opportunity

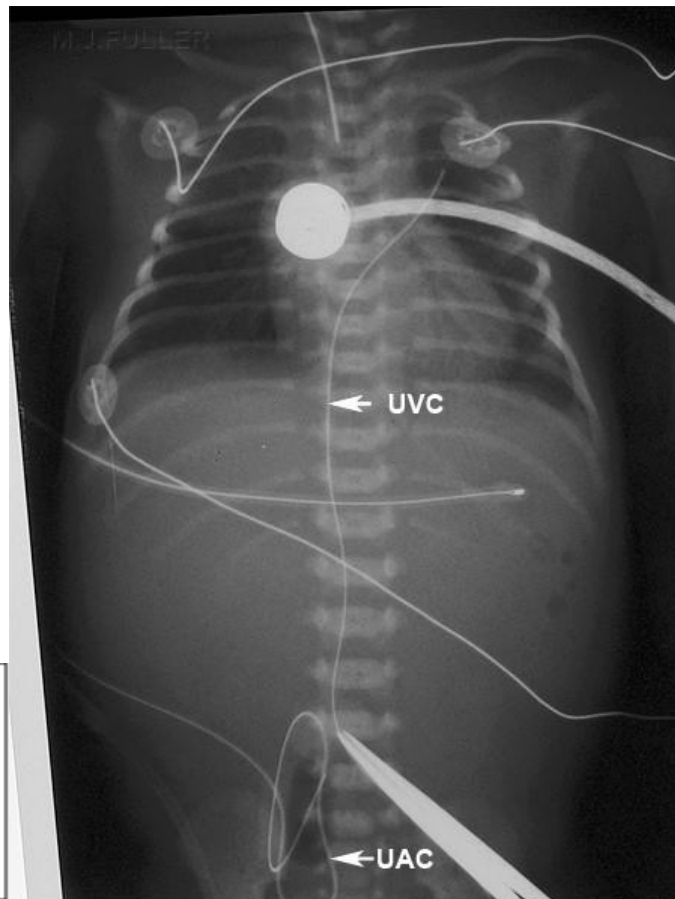
L2-L4
Consultant decision

A repeat Xray must be performed for all lines
previously within the cardiac silhouette

November 2023

Appendix 18.3: Education- Identifying misplaced umbilical lines

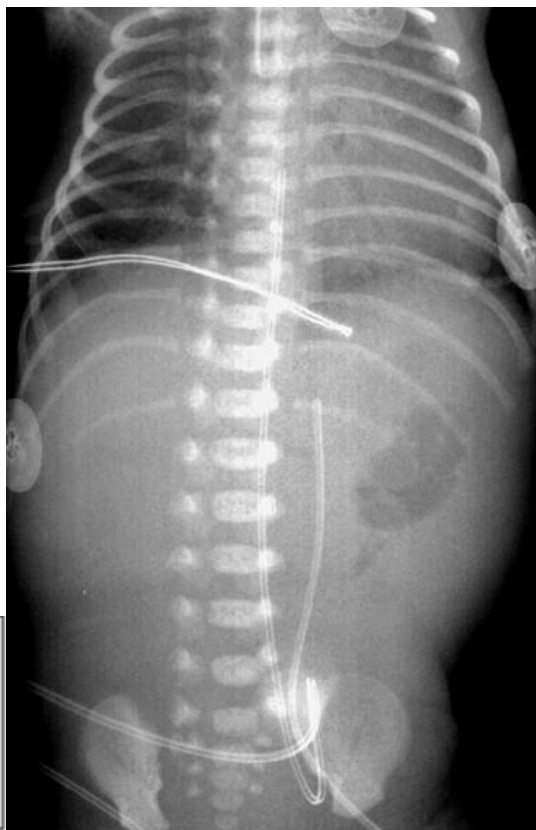
Wrongly positioned umbilical lines (from [Neonatal Lines, Tubes and Catheters - wikiRadiography](#))



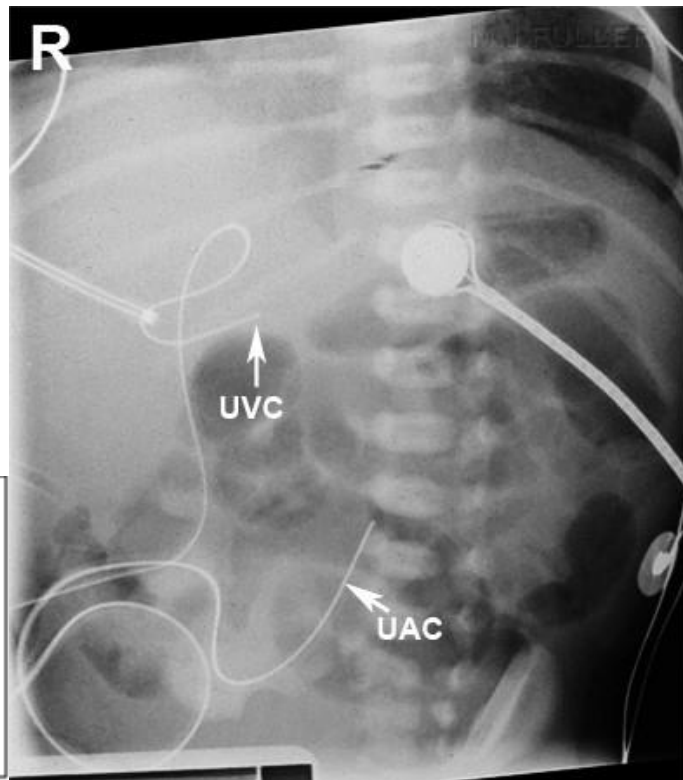
This UAC appears to have taken a course along the right iliac artery or gluteal artery
The UVC tip is in the pulmonary circulation



UAC in left subclavian artery

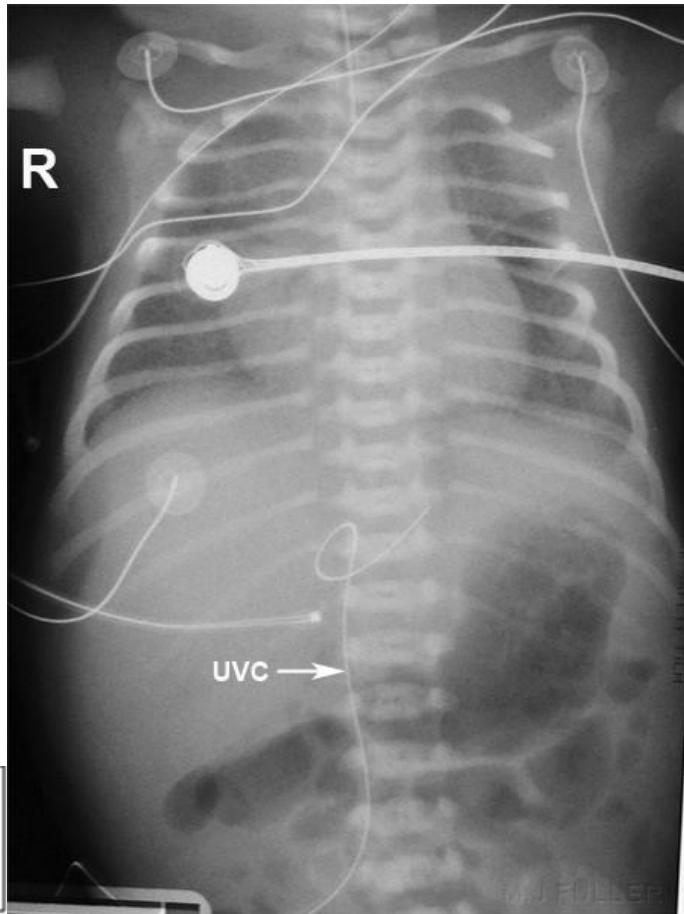


In this image the UAC is on the baby's right and the UVC is on the baby's left. This is the reverse of the usual configuration.- this is due to a rotated film (look at ribs/pelvis)

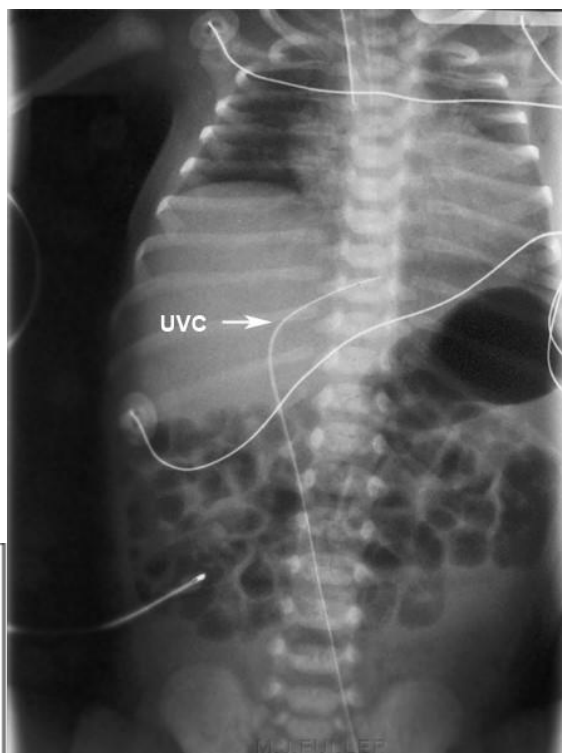


The baby is rotated. The UVC has deviated medially at the level of the left portal vein. It may also have looped in the capacious space at the junction of the umbilical vein and left portal vein

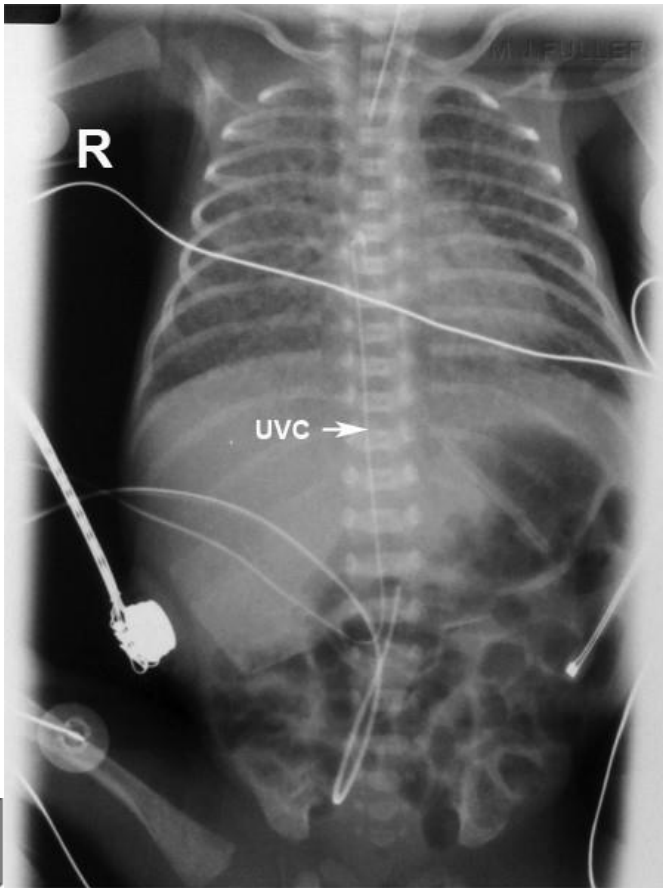
The UAC is low lying



The UVC may have looped at the junction of the left portal vein and then travelled up the left portal vein

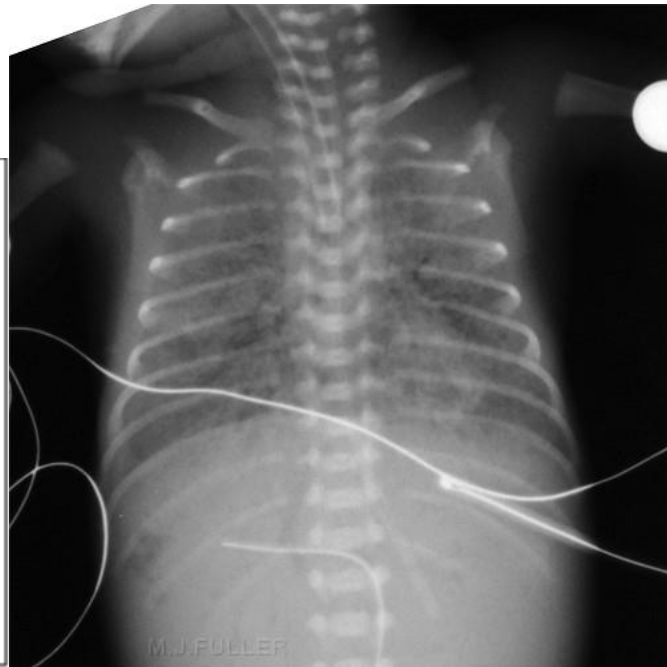


The UVC has deviated to the left at T8 which is the level of the left hepatic vein. The UVC tip is most likely to lie within the left hepatic vein



UVC tip in right atrium

The UVC tip has tracked into the liver and there appears to be portal venous gas. Air in portal venous branches can be associated with umbilical venous catheter insertion. Inconsequential transient portal venous air can be seen immediately after umbilical venous catheter insertion and should not necessarily be attributed to necrotizing enterocolitis



Appendix 18.4: Fixation and bridging (printable)

Method 1



Step 1:
- Fold over ends of tape so they are easy to pull apart
- Tape as close to cord as possible.



Step 2:
- Both sutures placed next to the catheter and held taut.



Step 3:
- Loop back catheter (so any force applied is not transmitted directly to insertion point)
- Aim for small loop.



Step 4:
- Close tape over catheter and sutures
- During adjustment/re moval it is possible to peel tape apart without the use of cutting implements.

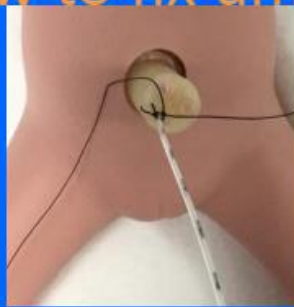
NB the tape used in these images is not zinc oxide. An assistant wearing sterile gloves can be helpful at this stage.

Method 2 – Alternative. There is an increased risk of severing the line at removal. This method should be used with caution.

How to fix umbilical lines



1. Place the first suture close to the line and tie a knot



2. Tie the suture around the line- could create a loop (eg around an instrument)



3. Tie the suture around the line, ascending with further knots (like a "ballet shoe")



Close up view- ensure knots are tight but not restricting flow through line (these are a bit loose)



4. Place further suture in cord and tie a knot



5. Place zinc oxide tape on line

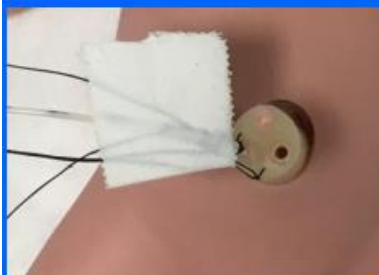
- Place close to umbilical line entry site
- ensure all sutures are stuck to tape

6. Pinch tape closed, ensuring it is well stuck to sutures and line. Note you are now not sterile (as Zn tape is not sterile)

7. Lines should now be secured- check with "push pull" test

Each line should be independently secured
If the line needs adjusting (OUT only)

- Carefully remove the tape (use Apheel)
- either cut the sutures/loop and repeat or pull through "ballet shoe" ties
- Re apply zinc oxide tape



Bridging

UAC and UVC lines should be bridged to ensure they are secure and reduce the risk of dislodgement. Ideally lines should be bridged prior to babies being placed prone or coming out of the incubator for kangaroo care, although this may not always be possible.

In larger (>1.5kg) / more mature babies, this should be done at the time of insertion.

In smaller (<1,5kg) / and extreme preterm babies, this should be delayed until skin integrity improves, usually from 2 days onwards.

Duoderm, or similar, should be used as a base to the bridge to protect the skin. Zinc oxide tape should be used to form the legs and crosspiece. The legs are best constructed prior to entering the incubator and should be of roughly equal length. The UAC and UVC should be taped separately within the bridge to allow easy access for repositioning or removal at different times. The bridging will also include the sutures used to secure the line. Both the legs and cross piece should be close to the umbilical stump, with each umbilical line being either S-shaped or curled to reduce the risk of dislodgement.

Procedure

- Attach duoderm to the skin immediately adjacent to the stump
- Create a leg by folding a piece of zinc oxide tape so that it is just longer than the umbilical stump, with 2 sticky ends exposed at one end. Attach the sticky ends to the duoderm on the abdominal wall. Repeat on the other side.
- Cut a piece of zinc oxide that is twice the length between the 2 legs of your bridge.
- Place this on one side of the lines and sutures. Ensure the crosspiece is as close to the stump as possible to prevent lines looping and being dislodged at this site. The umbilical lines should be looped within the 'sandwich' of zinc oxide as you fold it over.
- Squeeze around umbilical lines and sutures to ensure zinc oxide is well affixed.

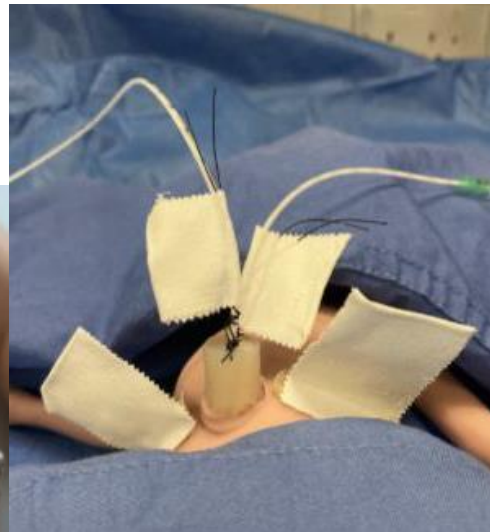


IMAGE AWAITED

Appendix 18.5 Example parent information leaflet

Umbilical Arterial Catheter/Umbilical Venous Catheter/Peripheral Longlines – Information for parents/carers

(courtesy of North Lincolnshire and Goole Hospitals NHS Foundation Trust)

This leaflet has been designed to give you some important information about your Baby's condition, and to answer some common questions you may have.

What is an Umbilical Arterial Catheter (UAC)?

A UAC is a special line which is sited through an artery in your baby's umbilical cord. A UAC is very useful for taking blood samples and monitoring your baby's blood pressure.

What is an Umbilical Venous Catheter (UVC)?

A UVC is a special line which is sited through a vein in your baby's umbilical cord. A UVC is useful for giving your baby fluids or medication.

What is a long line?

A long line is a thin catheter which either goes into a vein in your baby's arm, leg, or neck. Long lines are helpful to administer parenteral nutrition (PN). PN is intravenous feeding and is usually used when babies are unable to tolerate feeding into the stomach. Medication can also be given through a long line.

How are these lines inserted?

All the above lines are inserted under sterile conditions on the Neonatal Unit. It is extremely important to ensure they are in the correct place. Your baby will therefore have an x-ray to check their position after they have been inserted. To reduce the risk of clots forming a drug called Heparin, which helps keep the blood thin, may also be passed through the lines.

How long do the lines remain in for?

The insertion of lines into your baby can carry risks, to reduce these risks and the chances of complications the lines will be taken out as soon as they are no longer needed. Nursing or medical staff will keep you updated.

What are the benefits?

All the lines are invaluable in the management of sick babies. The UAC/UVC lines reduce the need to handle babies. They also reduce the need for repeated pricking of your baby with needles so that blood samples can be taken, or medication given.

If your baby is receiving PN via this will help your baby receive the nutrition, they need to grow.

What are the risks?

There is a risk of complications; however medical/nursing staff will discuss these risks with you explaining the complications against the need for ensuring your baby receives the appropriate care and treatment.

Below are some of the known complications:

- Infection
- Clot formation with the possibility of the clot being carried to other areas in the body.
- Migration – the line extending to beyond where it was thought to be
- Reduced blood supply to the intestines
- Artery spasm with discoloration of the skin of toes.
- Cardiac tamponade (perforation of the heart muscle with fluid in the sac around the heart).

Staff will carry out regular inspections of the site of the lines and if necessary, the lines will be removed.

Are there any alternatives?

There are currently no alternatives. If you are concerned about lines being inserted, please discuss your concerns with medical or nursing staff.

Additional Information

If you require any additional information, please do not hesitate to speak to a member of the medical or nursing staff on the Neonatal Unit.

Concerns and Queries

If you have any concerns/queries about any of the services offered by the Trust, in the first instance, please speak to the person providing your care.

Review Period: Author: Consultant Paediatric Lead Neonatal Unit

Appendix 18.6 Lateral arteriotomy

From Atlas of Procedures in Neonatology

Bloom et al. (33) have described an alternative approach to the artery with lateral arteriotomy. To perform this method, 3 to 4 cm of cord must be preserved because the cord must be rolled over a Kelly clamp 180 degrees (33,34).

1. Clamp across end of cord with a mosquito hemostat in the nondominant hand and pull firmly toward the infant's head.
2. Roll cord 180 degrees over hemostat toward abdominal wall.
3. Identify arteries in superior right and left lateral aspects of cord.
4. Approximately 1 cm from abdominal wall, incise Wharton jelly down to arterial wall, using no. 11 scalpel blade.
5. Incise artery through half of circumference. If necessary, dilate lumen with iris forceps.
6. Insert catheter into lumen of artery, directed in a caudad direction, for predetermined distance.
7. Control bleeding by gentle tension on umbilical tape.

Blot surface of cord stump with gauze swab. Avoid rubbing, because this damages tissue and obscures anatomy

Appendix 18.7 BP Centiles for hypertension

Systolic blood pressure centiles (97th) for infants <12 days of life

Gestational Age	Age in days					
	0	2	4	6	8	10
24	56	59	62	63	68	69
25	57	60	63	67	71	71
26	58	62	66	70	73	75
27	59	63	68	72	77	78
28	60	66	71	75	80	84
29	61	68	74	78	84	86
30	62	71	76	83	86	89
31	63	73	78	86	90	92

Adapted from

Northern Neonatal Nursing Initiative Systolic blood pressure in babies of less than 32 weeks gestation in the first year of life. Arch Dis Child Fetal Neonatal Ed 1999;80:F38–F42

19. Version control

Version Control Table - Document History			
Date (of amendment/ review)	Issue No. (e.g V1)	Author (Person/s making the amendment or reviewing the Guideline)	Detail (of amendment/misc notes)
November 2023	V1	ODN working group	New Pan-ODN guideline