

British Association of Perinatal Medicine



**Use of Central Venous Catheters in Neonates
A Framework for Practice**

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Organisations and representatives involved in the consultation process

Members of the British Association of Perinatal Medicine (BAPM), the British Society of Paediatric Radiologists (BSPR), the British Association of Paediatric Surgery (BAPS) and Bliss.

The working group wishes to acknowledge the contribution made by clinicians involved in the care of babies where complications of central venous catheters have arisen. Their insights ensured that lessons learned could be shared. These have been instrumental in informing the guidance for improving practice and safety when using central venous catheters.

Executive Summary

The findings of the Working Group recommend that:

- Any clinical deterioration of a baby in whom a central venous catheter is present should raise the question of catheter-related complications, particularly infection, extravasation and tamponade.
- All central catheter tips should be positioned outside the cardiac silhouette.
- An umbilical venous catheter (UVC) tip should ideally be sited at T8-T9 (assuming this lies outside the cardiac silhouette). A UVC tip sited at or below T10 carries a significantly higher risk of extravasation. It may be necessary to use these catheters in the short term, but they should be replaced at the earliest opportunity.

1. Introduction

1.1 Background and Definitions

The use of central venous catheters (CVCs) is an essential part of neonatal care allowing delivery of intravenous fluids and medication. The use of these catheters is associated with a number of complications. Whilst catheter-associated infection is well recognised and subject to scrutiny, extravasation into a body cavity is less common but potentially fatal if tamponade ensues. A recent national survey revealed wide variation in practices around umbilical catheter insertion and management [1]. Following several case reports of fatal CVC-associated extravasation BAPM was contacted by NHS England (Patient Safety Domain) to review the use of CVCs (both umbilical and peripherally-inserted) in neonates with the aim to reduce harm and improve safety. The remit of this Working Group was to develop a framework for practice covering all aspects of CVC use in neonates.

1.2 Target Users

This framework is designed to be used by all healthcare professionals involved in the care of neonates in whom a CVC is used.

1.3 Purpose of framework

This framework seeks to provide practice points to:

- Address aspects of insertion, on-going use and care of CVCs in the neonatal setting
- Improve the uniformity and standard of CVC care nationally
- Reduce the incidence of complications associated with the use of CVCs
- Highlight early recognition of the rare but potentially fatal complication of extravasation into a body cavity
- This guidance does NOT refer to surgically placed tunneled lines.

2. Process

Members of the group were tasked with undertaking a literature search around specified aspects of CVC insertion, use and on-going care. This included searches of MEDLINE and PubMed 1976 to April 2015. A face-to-face meeting was used to discuss each area and

agree practice points based either on published evidence or, when evidence was lacking, professional consensus.

3. Framework

In the following section recommendations are either referenced or are asterisked (*) where based on expert opinion or consensus of the working group. A synopsis of the supporting evidence is given for each practice point where applicable in the subsequent section.

Practice points

1. Units using CVCs in babies should use a care bundle which covers all aspects of insertion, use and on-going management of these catheters.
2. Parents should always be informed about the use of central catheters at the earliest opportunity, although formal prior consent is impractical. (*)
3. Units which use central catheters should have a formal training package for insertion of catheters which should include an assessment of technical competence and awareness of potential complications. (*)
4. Staff who insert central catheters have a responsibility to ensure they maintain their competence and should be familiar with the equipment and procedures used for catheter insertion in that setting. (*)
5. In each situation where a central catheter is required an assessment should be made as to who is the most appropriate person to undertake the procedure. (*)
6. Units which use central catheters should use a standardised method for calculating catheter insertion length. There should be a documented audit trail for accuracy and adjustment.
7. Resistance encountered during the insertion of an umbilical venous catheter (UVC) or a peripherally-inserted central venous catheter (PICC) often indicates malposition

and the catheter should be withdrawn to a point at which it freely aspirates blood. It should then be secured and an X-ray performed to determine tip position. (*)

8. There is no evidence to support the practice of 'railroading' a second UVC beside one which is thought to be malpositioned. This practice is to be avoided since it may increase the risk of vessel trauma and consequent extravasation. (*)
9. All central catheter tips should be positioned outside the cardiac silhouette.
10. A UVC tip should ideally be sited at T8-T9 (assuming this lies outside the cardiac silhouette). A UVC tip sited at T10 or below carries a significantly higher risk of extravasation. It may be necessary to use these catheters in the short term, but they should be replaced at the earliest opportunity.
11. The tip of upper limb PICCs should ideally lie in the superior vena cava, with the relevant arm positioned perpendicular to the chest wall when the check radiograph is taken. For lower limb-inserted PICCs, the tip should ideally be in the inferior vena cava above L4-L5 level, and the possibility of malposition in an ascending lumbar vein requires specific consideration.
12. All central catheters should allow aspiration of blood in their final position, and this aspiration should be documented. Where aspiration is not possible, operators should be aware that this may indicate a malpositioned catheter. (*)
13. A repeat X-ray should be performed following catheter adjustment to confirm tip position and opportunistically on any x-rays undertaken for other clinical indications. (*)
14. The final fixation method for a central catheter should minimise skin injury and potential for catheter migration or loss.
15. Umbilical catheters should be clearly labelled to distinguish arterial and venous catheters. (*)

16. There should be thorough contemporaneous documentation of each central catheter insertion including indication, description of the catheter itself, number of attempts, length inserted, position on X-ray, and any adjustments subsequently made. The accepted position should be verified in writing within 24 hours of insertion by a consultant neonatologist/paediatrician or from a radiologist's report. (*)
17. The need for continued retention/use of a central catheter should be reviewed daily.
18. On-going care of central catheters should include regular review of catheter fixation and position, strict asepsis and minimising catheter access, and for PICCs regular documentation of the integrity of the dressing and insertion site and should also include the region of the catheter tip location, particularly for shorter-than-ideal-catheter insertion lengths.
19. Any clinical deterioration of a baby in whom a central venous catheter is present should raise the question of catheter-related complications, particularly infection, extravasation and tamponade.
20. Following removal of UVCs or UACs ensure that the catheters are complete, haemostasis has been achieved and an adequate period of observation of the umbilicus is undertaken before placing the infant prone. (*)

Synopsis of Supporting Evidence

Care bundle (Practice Point 1)

The American Institute for Health Improvement (IHI) has developed the concept of “care bundles” to help deliver the best possible care to patients undergoing particular treatments with inherent risks [2]. Their key strength is ensuring uniformity in process which mitigates the potential for inefficiency or harm through individual variability or preference. Bundling of best practices has been shown to result in better outcomes than implementing them individually, and the NHS is adopting this practice in a number of different areas.

Much of the evidence base for care bundles relating to central venous access is found in adult practice, where implementation has led to a reduction in the incidence of Catheter Related Bloodstream Infections (CRBSIs) [3, 4]. However, there is now growing literature of neonatal studies demonstrating improved outcomes with implementation of care bundles for central venous access [5, 6].

For central venous access in neonates, the bundle should address all aspects from preparation and insertion to ongoing management (as per **Practice Points 6-19**). An insertion checklist (see example in **Appendix 2**) and training package should be integral components.

Parental consent (Practice point 2)

Umbilical catheterisation is often used as part of neonatal resuscitation or initial stabilisation. For this reason seeking formal consent is impractical but parents should be informed as to the reasons for this procedure as soon as possible. Elective insertion of a CVC out with the above situations should be discussed in advance wherever possible and these discussions documented. Provision of written information sheets can be helpful and there are on-line resources available specifically for families which provide relevant information to augment discussions [7].

Personnel and Training (Practice points 3-5)

Central catheter insertion, be it central or peripherally-inserted, is performed by a range of professionals with varying skills, experience and training requirements. There should be mechanisms to ensure operators have appropriate experience and competence, and awareness that the clinical condition of some babies requires more experienced personnel to undertake the procedure in a timely manner.

Every unit where central catheter insertion is undertaken should have a robust training package. There is an emerging evidence base for the use of simulation in neonatal care, and this could form the basis for familiarisation with both the equipment and procedure before clinical exposure. There is currently no validated training package available for CVC insertion, but it is reasonable to expect that training should include both didactic and clinical components delivered by skilled and experienced operators. These training packages would be best co-ordinated at network level utilising the expertise of units where procedures are more regularly undertaken. This should both encourage procedural consistency for staff members rotating around units, and facilitate consistency in management for babies moved between these units.

Directly Observed Procedural Skills (DOPS) assessments are one method of assessment of competence utilised by the Royal College of Paediatrics and Child Health (RCPCH). Professionals undertaking CVC insertion include personnel with a nursing background and non-training grade medical staff and there should be an additional unit-recognised assessment of initial and continued competence that can be applied to all groups of staff. This assessment should not be limited to practical competence, but should include knowledge of indications, the ability to assess satisfactory placement and an awareness of all potential complications.

Preparation and Insertion Length (Practice point 6-8)

There are different methods used to predict the position of umbilical catheters. Two of the more commonly used methods are described by Dunn [8] and Shukla and Ferrara [9]. The Dunn method uses a nomogram based on shoulder-umbilical distance; a formula using birth weight is the basis of Shukla and Ferrara's method. Neither has been validated on large

groups of neonates. It should be noted that both of these methods originally aimed for a UVC position in the right atrium, which is now considered potentially unsafe [10]. In the absence of high-level evidence to promote the superiority of any method, we recommend each unit adopts a single method of calculation, includes it in their training package and audits the accuracy of calculated insertion to length at the radiologically-verified final fixed position.

For upper limb PICC insertion, an external measurement is traditionally made from the point of insertion to the sternal notch. It should be noted that tip position is influenced by arm placement; catheters placed in the basilic (medial) vein move towards the heart on adduction whilst those placed in the cephalic (lateral) vein move away from the heart [11]. For lower limb PICC insertion, an external measurement is made from the planned point of insertion to the xiphisternum.

If resistance is encountered during catheter insertion this is likely to indicate catheter malposition; the application of additional force must be avoided and the catheter should be withdrawn.

Positioning (Practice points 9-13)

Easy aspiration of blood from catheters should be seen and indicates that the tip of the catheter lies within a large vessel.

Central catheters should be sited so as to minimise the risk of tamponade in the event of extravasation. For this reason central catheter tips should lie outwith the cardiac silhouette on X-ray [10]. Where a catheter tip lies within the cardiac silhouette, it should be withdrawn and a repeat X-ray performed. When a UVC fails to pass into the IVC, it should not be used if it has entered one of the hepatic or portal vessels because of the increased risk of extravasation into the hepatic parenchyma [12] and abdomen [13]. There is a higher risk of hepatic injury and abdominal extravasation if an umbilical catheter is used in a low-lying position, especially if infusing hypertonic solutions or vasoactive drugs. [12]. The use of

umbilical catheters in low positions especially in the context of hypertonic solutions and vasoactive drugs has to be risk assessed carefully. Outside of emergency use replacing the UVC or alternative access through a percutaneous catheter need to be considered carefully as alternative options.

Ascending lumbar vein (ALV) malposition is a relatively common complication of lower-limb placed PICCs but may often go unrecognised [14]. Practitioners inserting CVCs should be familiar with the specific features of ALV malposition. Routine use of radiopaque contrast or a horizontal beam technique may improve recognition of this specific malposition. [14, 15]

Many neonatal units use radiopaque contrast either routinely or occasionally for checking PICC positions [14]. Contrast use helps determine location of nominally radio-opaque catheters in many instances where a tip is unclear on plain film [16], and routine use may help facilitate recognition of some malpositions [14], but its use cannot guarantee detection of a malposition by a practitioner. In the absence of any randomised-controlled trial to show that routine contrast use reduces catheter-associated morbidity, there is presently insufficient evidence to recommend that contrast use should always be routine at PICC insertion.

Fixation (Practice points 14-15)

Umbilical catheters should be fixed in a way that minimises the chance of catheter migration, allows ongoing assessment of position and permits straightforward catheter adjustment and removal. One of the more commonly used methods is that which is advocated by the Resuscitation Council UK [17]. This method has the advantage of avoiding adherence to the skin. It requires taping close to the cord with the sutures taut (see example in **Appendix 1**).

While there are various methods of fixation that can be used, we consider that individual units should adopt a single method used by all operators, regardless of individual preference.

Umbilical venous catheters should be clearly labelled to distinguish them from arterial catheters, the latter being additionally identifiable by an arterial waveform when transduced.

Peripherally-inserted central catheters (PICCs) should be secured with a transparent dressing that allows visualisation of the site of entry. The dressing should be non-circumferential and should cover the entire catheter and any additional securing aids such as sterile adherent strips or gauze to protect the skin under the hub.

We did not identify evidence to promote routine re-dressing of PICCs, but consider it prudent that this should occur if the integrity of the dressing is disrupted.

Documentation (Practice Point 16)

The indications for catheter insertion should be clearly documented in the patient notes to reflect a thought process where the balance of risk and benefit has been considered.

Thereafter, the procedure should be documented including reference to any unexpected difficulties encountered. There should be a specific record of an ability to both aspirate from and flush the catheter when located in its final fixed position.

A review of positioning should be undertaken as soon as possible and recorded in the notes, including any adjustments that have been made. If the final accepted position of the catheter is not aligned with this guidance, there should be clear documentation as to the clinical rationale for accepting this deviation. Regardless of the experience of the operator, we consider it a point of best practice that there is a documented review of the catheter position by a consultant within 24 hours of catheter placement.

A sticker – such as that pictured in **Appendix 2** – placed in the patient notes serves the purposes of an aide-memoire and is identifiable in patient notes.

On-going care of CVCs (Practice Point 17-20)

As with all treatments, the continued need for a CVC should be reviewed by the multidisciplinary team at least daily with appropriate documentation. There is relatively little evidence around the optimum dwell duration of CVCs in the neonatal population. Two single-centre studies [18, 19] suggested that UVC replacement at between 7-10 days may reduce catheter-associated infection. As with UVCs there is similarly little clear evidence on optimum dwell durations for PICCs. In a retrospective multicentre study, Milstone et al. reported the incidence of catheter-associated infection rose during the first 2 weeks after insertion and remained elevated thereafter [20].

Catheter access frequency should be minimised. All staff caring for babies with CVCs in situ should be aware of potential complications and seek to exclude these in the event of a change in the baby's clinical condition.

Care should be taken when removing catheters to avoid transection or breakage. Sufficient time should be allowed for haemostasis following removal of umbilical catheters before placing the baby prone to avoid the potential for concealed haemorrhage.

Appendix 1

Umbilical Catheter Fixation

1



- The ends of the tape should be folded over so that they are easy to pull apart.
- The catheter should be taped as close to the cord as possible.

3



- The catheter should then be looped so that any force applied is not transmitted directly to the point of catheter insertion.

Two-person
technique

2



- Both sutures should be placed next to the catheter and held taut.

4



- The tape should be closed over the catheter and sutures.
- During removal it should be possible to peel the tape apart without the use of cutting implements.

Each catheter
requires
separate
fixation

Appendix 2
Documentation

1. Example of insertion record sticker

Parental discussion by (print name and position):				Date:	
Type:	UVC	UAC	Long line	Entry site: Date and time of insertion:	Length inserted:
Size:					
Inserted by:					
<u>Operator</u> review of line Name				Anatomical position of tip Date and time of review:	Line adjusted?:
<u>Consultant</u> review of line Name				Anatomical position of tip Date and time of review:	Line adjusted?:
Line tip position as stated on radiology report: Date radiology report reviewed:					Line adjusted?:
Date line removed:				Reason for removal:	

2. Example of insertion checklist

NEONATAL CVC INSERTION CHECKLIST

This checklist should be completed by an observer. **The procedure must be stopped if any of the elements of the checklist are not followed.**

YES

NO

Before the procedure

1	Gather required equipment.		
2	Clean designated work surface.		
3	Operator and assistant should perform a surgical hand wash.		
4	Operator and assistant should don sterile gowns and two pairs of sterile gloves each.		

During the procedure

6	Clean limb/umbilical area with 0.05% Chlorhexidine. Allow to dry.		
7	Clean area of insertion with 2% Chlorhexidine/ 70% isopropyl alcohol and allow to dry for 30 seconds.		
8	Cover baby and surrounding area with sterile drape.		
9	Remove outer gloves prior to catheter insertion.		
10	Maintain sterile field.		

After the procedure

11	Secure catheter with umbilical fixation (UAC/UVC) or sterile transparent dressing (PICC).		
12	Decontaminate hands after removal of gloves.		
13	Complete documentation in the patient notes including insertion record sticker.		

Comments:

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Signed:	Name:	Date:
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Appendix 3

References used in Recommendations

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