GUIDELINE

Central Line Imaging in Neonates: Radiographic Views, and Acceptable Line Positions

Scope (Staff):	Nursing and Medical Staff
Scope (Area):	NICU KEMH, NICU PCH, NETS WA

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Contents

Aim: 2
Background/ risks: 2
Key points: 2
Radiographic Views: 3
Table 1: Views and patient positioning for imaging of central lines in neonatal patients. ... 3
Two views / lateral view 4
Limb positioning 4
Upper limb PICCs: 4
Figure 1: Example of how line tip moves depending upon whether arm is abducted or adducted in upper limb PICCs 4
Table 2: Movement of line tips depending upon the vein of insertion. 5
Lower limb PICCs 5
Line Positioning – Ideal and Acceptable Positions 6
Table 3: Ideal and acceptable central line tip positioning in neonates. 6
Examples of ideal line placements 7
UVC (ideal position): 7
UAC (ideal position): 7
Upper limb/ scalp PICC (ideal position): 7
Lower limb PICC (ideal position): 8

Internal jugular CVC (ideal position): 8
Femoral CVC (ideal position): 8
Examples of malposition lines highlighted by a second radiographic view 9
UVCs 9
Lines which look in UVC on AP but are intraparenchymal within liver (malposition): 9
Diaphragm and RA/IVC junction easier to see on lateral: 9
Lines which are looped/ coiled and not seen in single view: 10
Upper limb PICCs 10
Posterior entrance of erroneous intra-arterial catheters (malpositioned): 10
Difficult to visualise tips (malpositioned): 11
Lower limb PICCs 11
Normal v aberrant course: 11
Lines in spinal veins (malpositioned): 12
Projection (malpositioned): 13
Coiled/ turned lines (malpositioned): 13
Lateral view showing extent of malposition: 14

Aim:

Outline the process of imaging of central lines, correct line tip positions and what to do about malpositioned lines.

Background/ risks:

The use of central venous and arterial lines are essential for the care of critically unwell neonates. However, correct tip positioning is essential to reduce the risk of line complications such as line occlusion, vessel wall irritation and thrombophlebitis, extravasation, thrombosis, liver injury, arrhythmias, pericardial effusion/ cardiac tamponade, renal injury, limb ischaemia.

Key points:

- Never leave a line tip where it won't thread further – it is likely in a smaller vessel. Pull back at least 1cm.
- The most important test of a line being intravascular is that it bleeds back and flushes easily (this may not be possible in 1F Premicaths).
- Never leave a line tip where it won't thread further – it is likely in a smaller vessel. Pull back at least 1cm.
- Two X-ray views is important for most line positioning. The lateral view is especially important for UVC and lower limb PICC positioning.

- Correct patient positioning is crucial for limb PICCs as incorrect positioning can alter the line tip by up to 2-3 vertebral bodies.
- Never leave a UVC in the liver, instead pull back out of the liver to a low-lying position (outside of liver, usually 5-6cm in term neonates and 4cm in preterm neonates). Intrahepatic UVCs increase the risk of liver injury and both intrahepatic and low-lying UVCs increase the risk of thrombosis and CLABSI. Infusions are delivered directly to the liver, potentially causing injury and infusions such as glucose undergo 1st pass metabolism in the liver meaning it can be difficult to get the desired effect. If possible low-lying UVCs should not be used for vasoactive or hyperosmolar fluids. They should only be used as a PIV and preferably replaced. With suitable alternative access within 24hrs.
- Never leave a line tip near a joint (shoulder/ groin/ knee) as the risk of extravasation/ line blockage is higher.
- Never leave a line intracardiac as this increases the risk of arrhythmias and pericardial effusion.
- When measuring X-ray to determine how far to pull back, if there are 2 views, always measure in both views.
- Re-Xray all lines which have been pulled back.

Radiographic Views:

Table 1: Views and patient positioning for imaging of central lines in neonatal patients.

		AP	Dorsal decubitus
UVC/ UAC	**At initial insertion** **Follow-up**	X (CXR/AXR) X	X (CXR/AXR)
	Positioning	Legs straight/ arms above head	Legs straight/ arms above head
Arm PICC	**At initial insertion** **Follow-up**	X X	
	Positioning	Both shoulders abducted to 30°	
Scalp PICC/ internal jugular CVC	**At initial insertion** **Follow-up**	X X	
	Positioning	Chin and head neutral	

Lower limb PICC/ femoral CVC	**At initial insertion** **Follow-up**	X X	X
	Positioning	Frog leg position	Frog leg position
NB. If there is a question of line position on a single view, a further view should be requested.			

Two views / lateral view

There are occasions when 2 radiographic views / an additional lateral view are helpful in determining line position.

This is especially true for lower limb PICCs when a lateral view may more easily reveal an aberrant course e.g. lines in spinal veins.

A lateral view is also useful for UVC placement as it gives a more accurate view of the IVC / RA junction and shows lines which are intrahepatic more clearly.

A second view for any type of line may also reveal coiled / turned lines, clues that the line is erroneously arterial and may show difficult to visualise lines better.

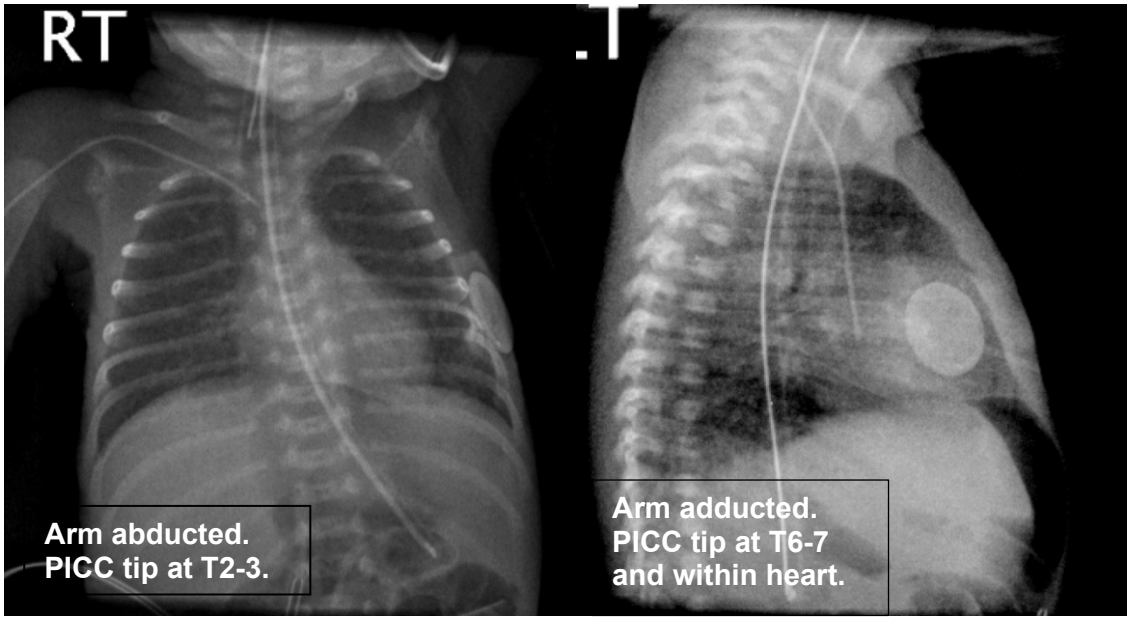
If there is ever any doubt of line tip positioning, a further view should be taken.

Limb positioning

Upper limb PICCs:

It has been shown that upper limb PICC line tips can move up to 2-3 vertebral bodies on abduction/ adduction of the arm (see figure 1).

Figure 1: Example of how line tip moves depending upon whether arm is abducted or adducted in upper limb PICCs.



The direction of tip movement depends upon which arm vein of the line has been inserted into (see table 2).

Table 2: Movement of line tips depending upon the vein of insertion.

	Basilic	Cephalic	Axillary
Shoulder adduction	Toward heart	Away from heart	Toward heart
Shoulder abduction	Away from heart	Toward heart	Away from heart
Elbow flexion	Toward heart	Toward heart	No effect
Elbow extension	Away from heart	Away from heart	No effect

Lower limb PICCs

The tips of lower limb PICCs move deeper upon hip flexion.

For the above reasons, radiographs for PICC line placement should be taken with the infant's limbs in the position that they will be in for most of the day (see table 1).

Line Positioning – Ideal and Acceptable Positions

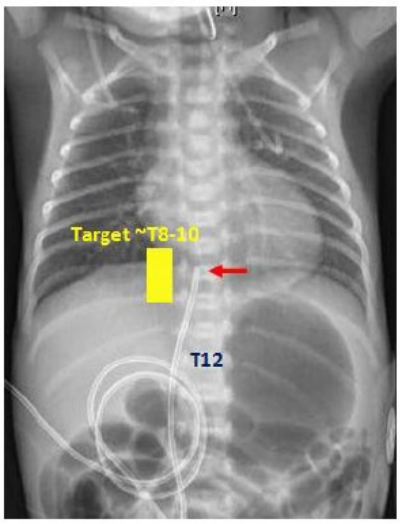
Table 3: Ideal and acceptable central line tip positioning in neonates.

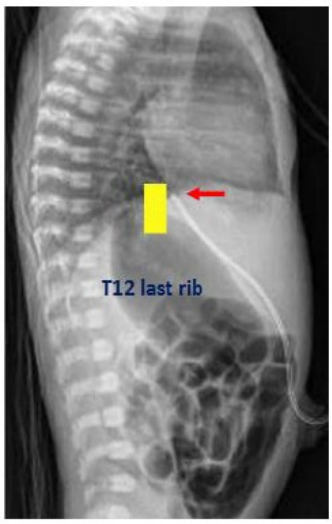
	Ideal position	Notes
UVC	T8-T9, at level of diaphragm on lateral view, outside of the cardiac silhouette	Lines with tips in the ductus venosus can be used (~T10). Intracardiac (higher than ~T7) lines should be pulled back. Lines with tips in the liver should not be used. Lines may be pulled back 1-2cm to a low lying level and used until alternative access is gained within 24hrs. The line tip should be outside of the liver shadow, (usually at a length of 5-6cm for term neonates and 4cm for preterm neonates). In order to use, it is essential that the line bleeds back and flushes easily.
UAC	T6-T9 (preferable) L3-L4 (acceptable)	Low lying lines more likely to cause vascular compromise. Monitor lower limbs and buttocks closely.
Upper limb PICC	T4-T5, at level/ 1 vertebral body below carina, outside of the cardiac silhouette	Lines with tips in brachiocephalic/ subclavian veins can be used. Lines with tips at axilla/ shoulder should not be used. These lines may be pulled back to the level of the mid-humerus and used as a peripheral line for 4-5 days until alternative access is available. Watch carefully for signs of infiltration.
Scalp PICC	T4-T5, outside of the cardiac silhouette	Line tips within the neck should not be used.
Lower limb PICC	T9-T11, at level of diaphragm on lateral view, outside of the cardiac silhouette	Lower positions may be used but avoid renal veins at L1-L2. Lines with tips at groin should not be used. These lines may be pulled back to the level of mid-femur and used as a peripheral line for 4-5 days until alternative access is gained. Watch carefully for signs of infiltration.
Internal jugular CVC	T4-T5, outside of the cardiac silhouette	
Femoral CVC	Tip in lower IVC/ iliac vein acceptable	Line must bleed back and flush easily.

- Best check for line being intravascular is that it bleeds back and flushes easily. However, 1F (28G) PICC lines do not always bleed back and are stiff to flush.
- Any line which has come to a stop and would not advance further should not be used. Pull back to a position where bleeds back prior to imaging.
- Lines being used as ‘peripheral lines’ should not have hyperosmolar fluids/ vasoconstricting vasopressors through.

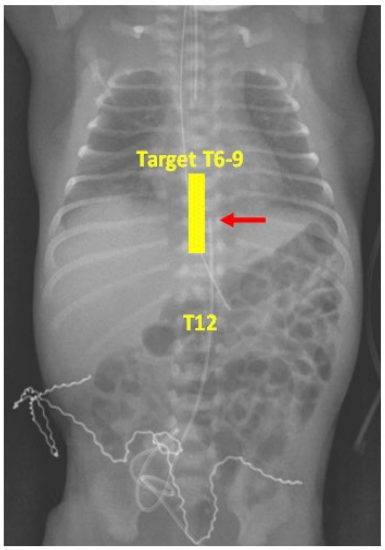
Examples of ideal line placements

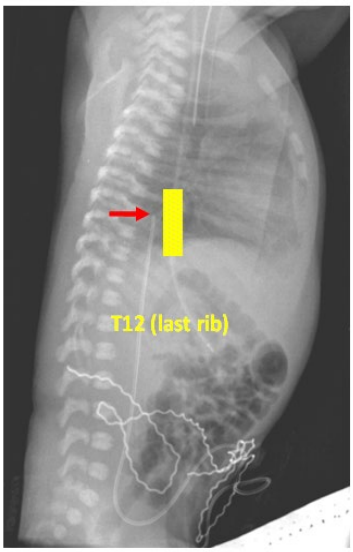
UVC (ideal position):



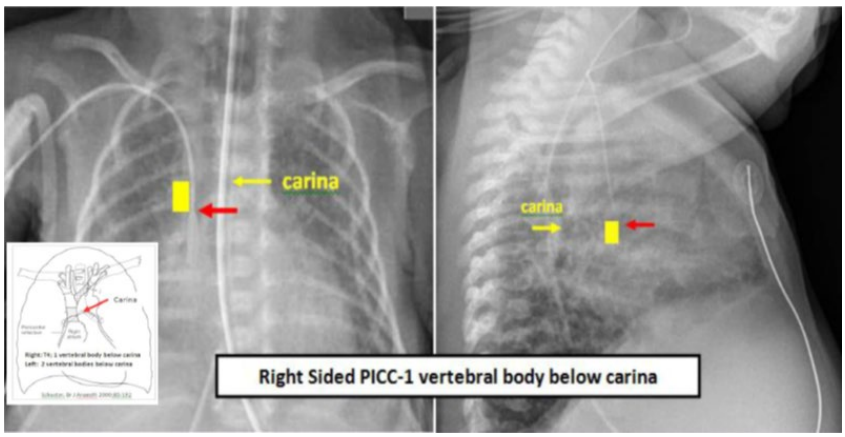


UAC (ideal position):

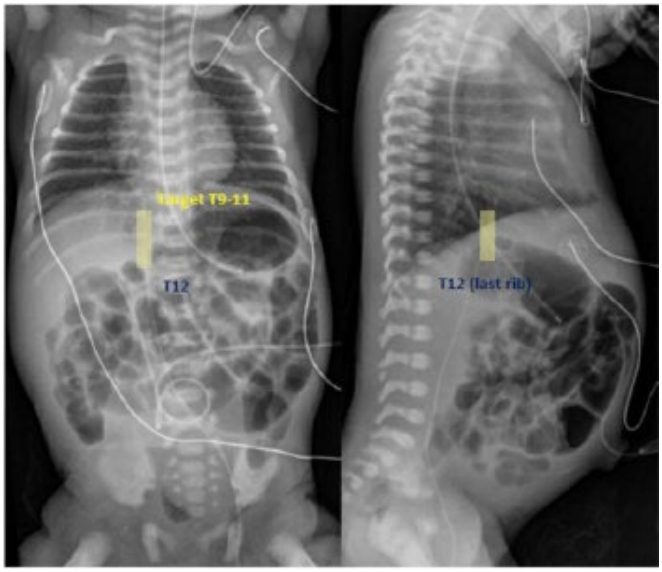




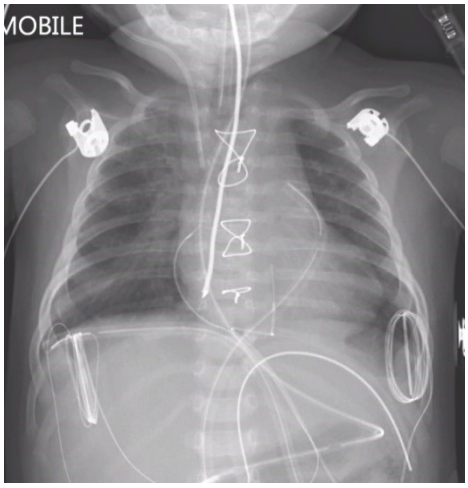
Upper limb/ scalp PICC (ideal position):



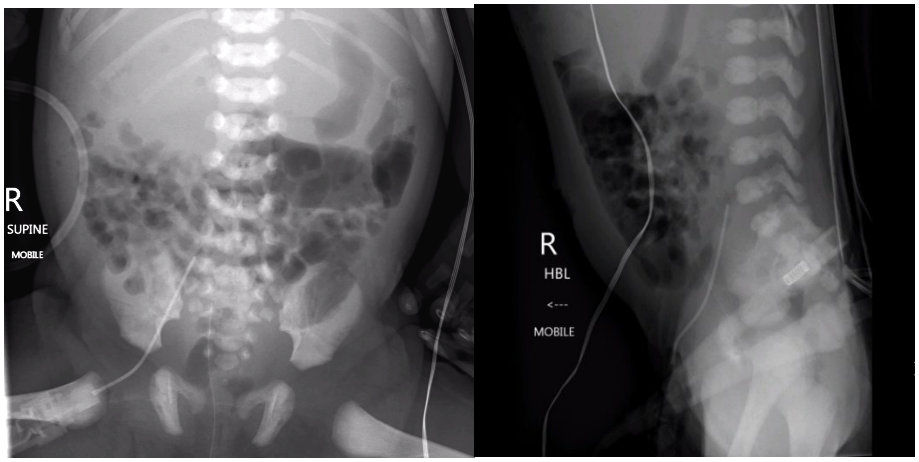
Lower limb PICC (ideal position):



Internal jugular CVC (ideal position):



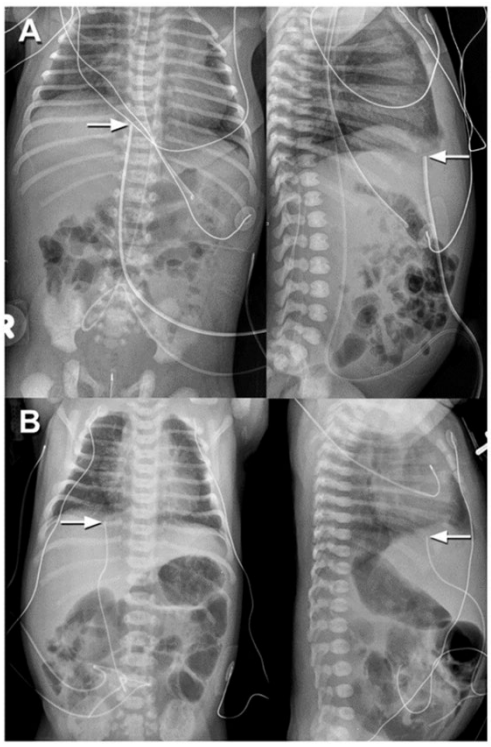
Femoral CVC (ideal position):



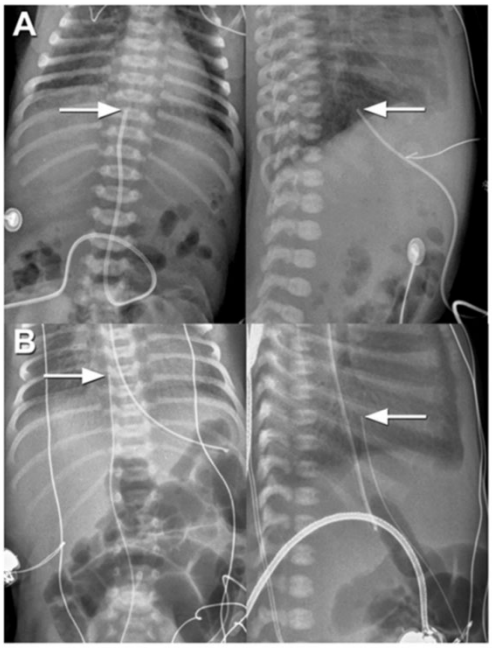
Examples of malposition lines highlighted by a second radiographic view

UVCs

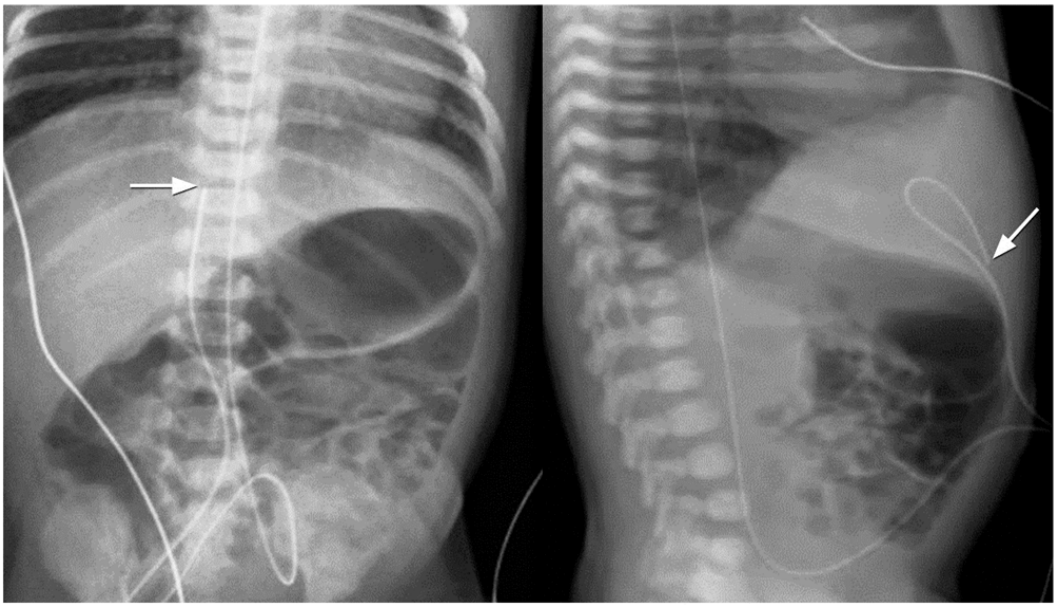
Lines which look in UVC on AP but are intraparenchymal within liver (malposition):



Diaphragm and RA/IVC junction easier to see on lateral:

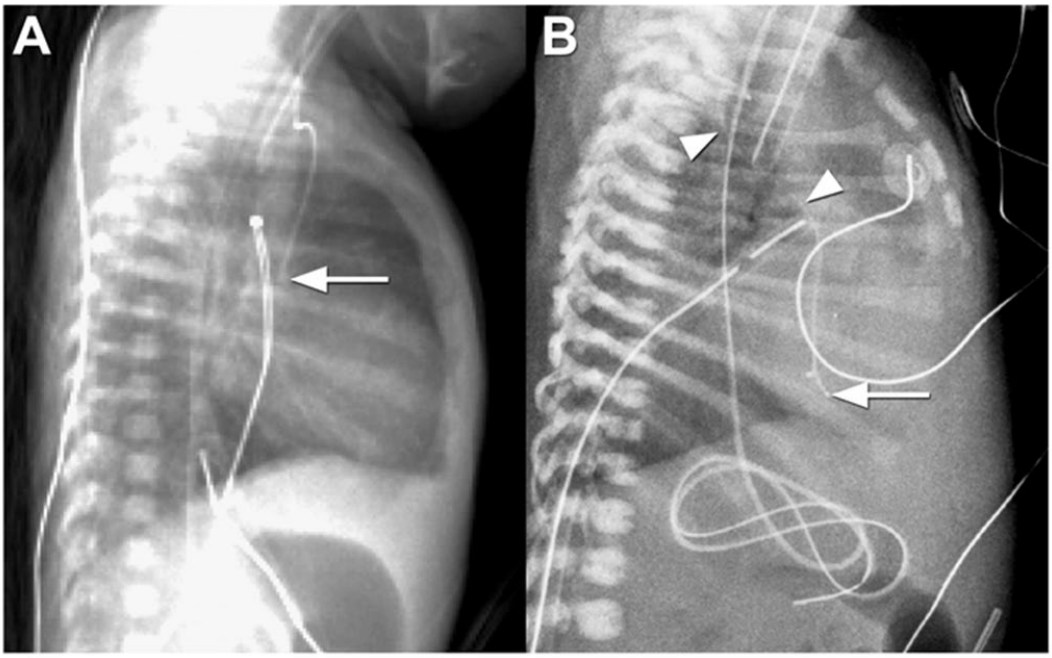


Lines which are looped/ coiled and not seen in single view:

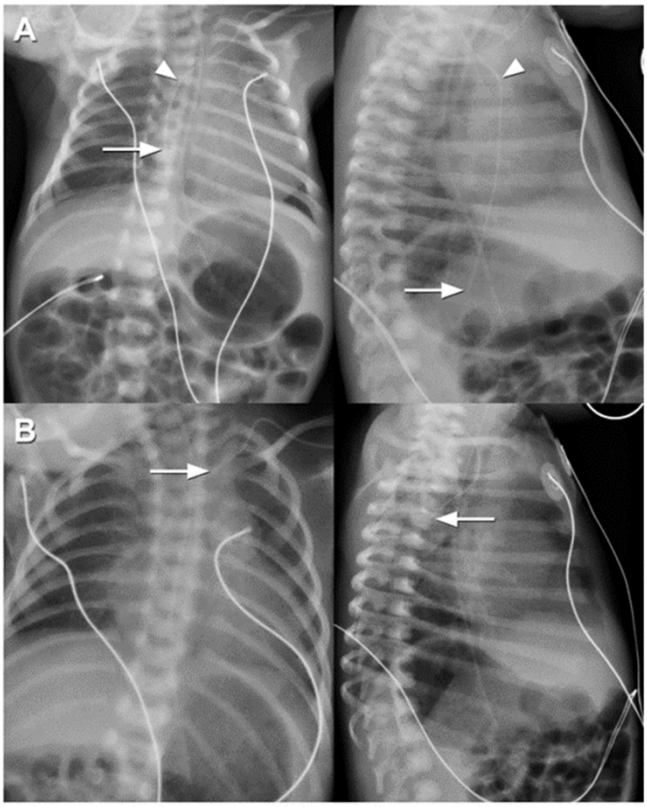


Upper limb PICCs

Posterior entrance of erroneous intra-arterial catheters (malpositioned):

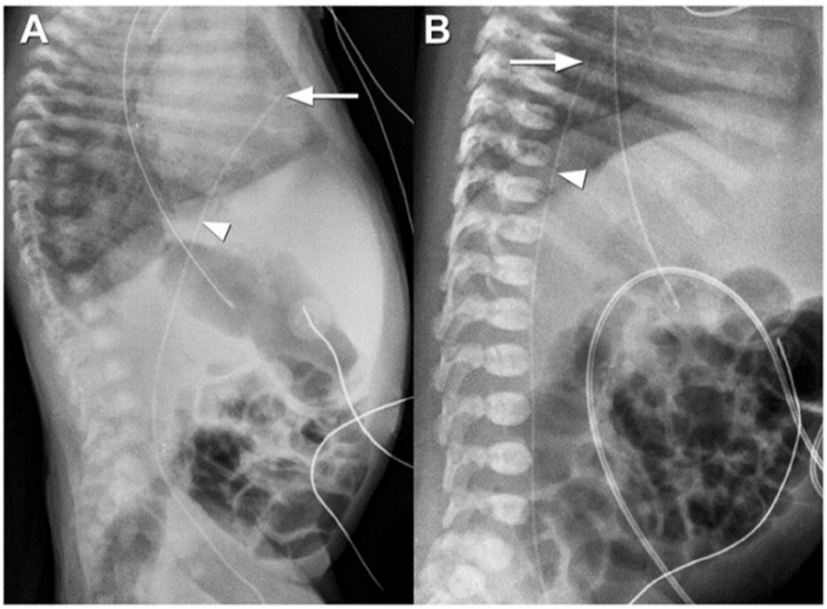


Difficult to visualise tips (malpositioned):

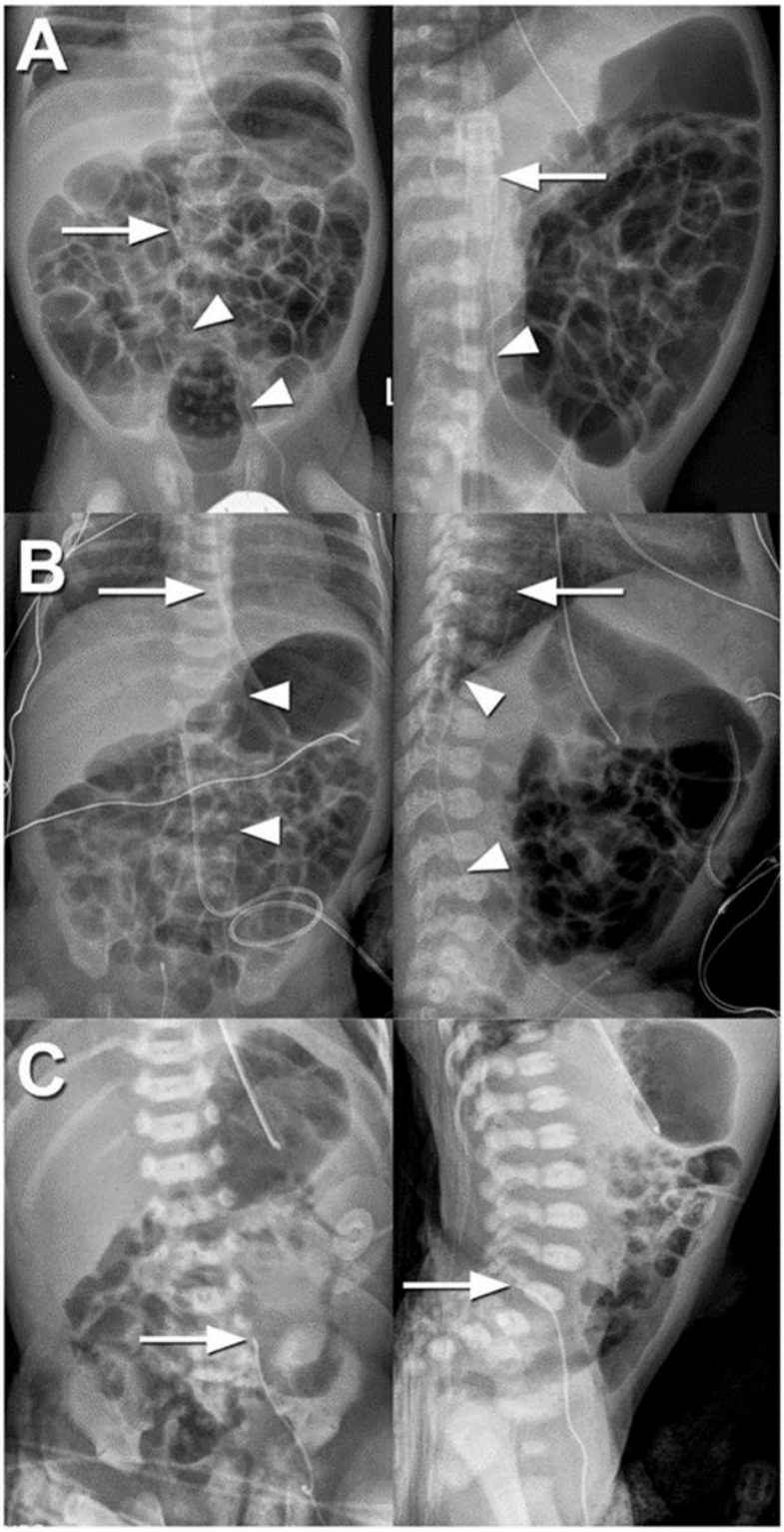


Lower limb PICCs

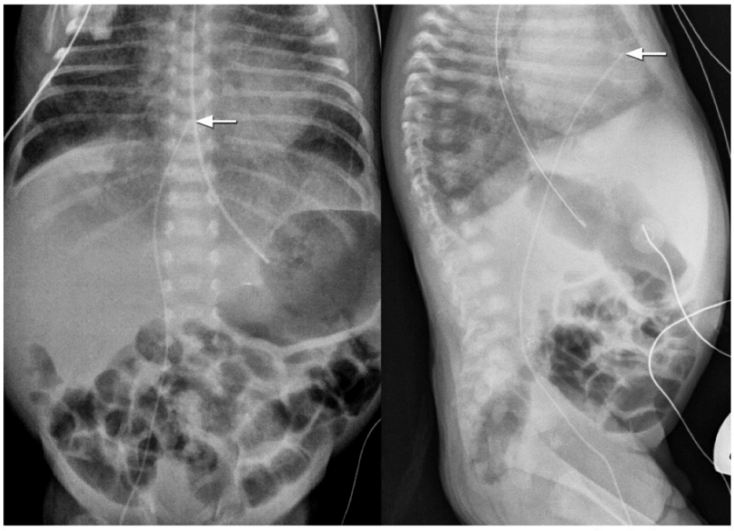
Normal v aberrant course:



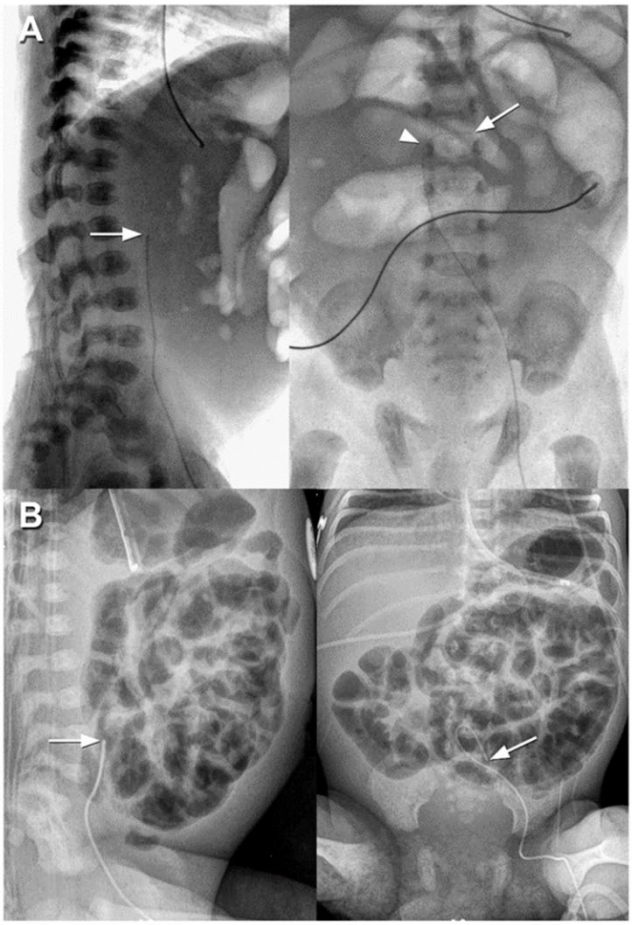
Lines in spinal veins (malpositioned):



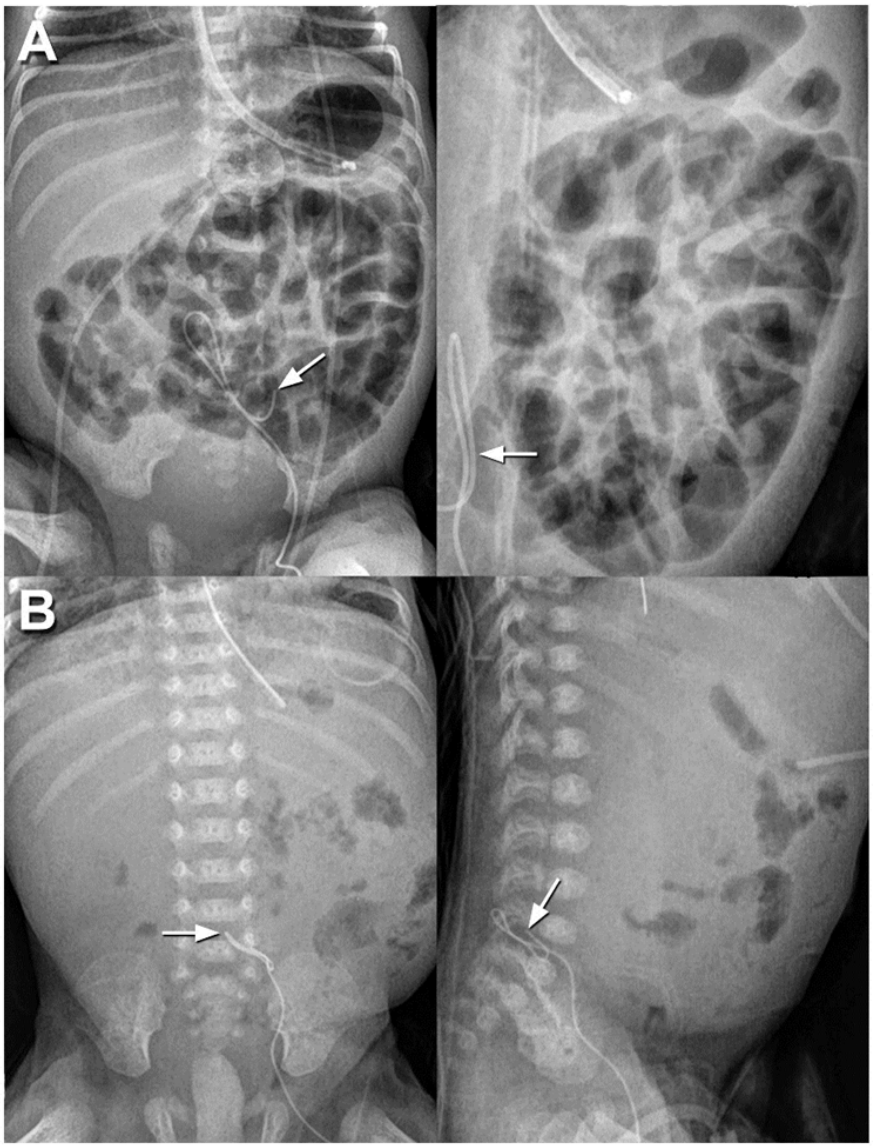
Projection (malpositioned):



Coiled/ turned lines (malpositioned):



Lateral view showing extent of malposition:



Related CAHS internal policies, procedures and guidelines

Neonatology Guidelines

- Central Venous Access Devices (Longlines, PICC Lines)
- Umbilical Arterial and Venous Catheters (UAC/UVC) Insertion, Management and Removal

References and related external legislation, policies, and guidelines

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