GAVeCeLT
Gli Accessi Venosi Centrali a Lungo Termine

IV Convegno Nazionale GAVePed

31 maggio

Protocollo Neo-ECHOTIP

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GdS Accessi Vascolari Neonatali

Protocollo NEO-ECHOTIP

I have no actual or potential conflict of interest in relation to this presentation

The Journal of Vascular Access
1–10

DOI: 10.1177/11297298211007703
journals.sagepub.com/home/jva
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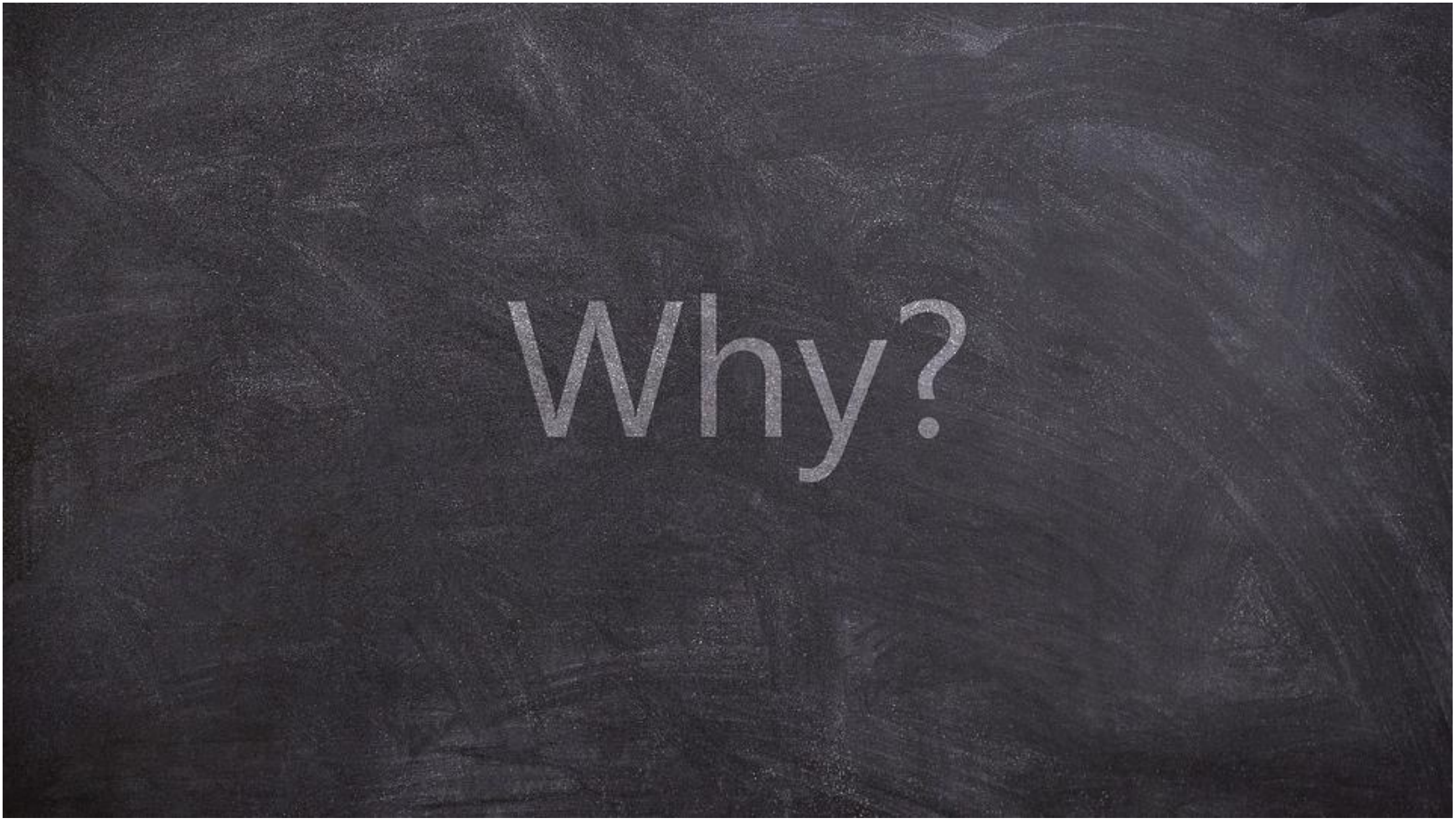
Neo-ECHOTIP: A structured protocol for ultrasound-based tip navigation and tip location during placement of central venous access devices in neonates

Giovanni Barone[1], Mauro Pittiruti[2], Daniele G Biasucci[3], Daniele Elisei[4], Emanuele Iacobone[4], Antonio La Greca[2], Geremia Zito Marinosci[5] and Vito D'Andrea[6]


Why?

Tip location

E. Use methods for identifying CVAD tip location during the insertion procedure (ie, "real-time") due to greater accuracy, more rapid initiation of infusion therapy, and reduced costs.[38-47] (III)
   1. Use electrocardiogram (ECG) methods with either a metal guidewire or a column of normal saline inside the catheter lumen and observe the ECG tracing to place the CVAD tip at the CAJ. Follow manufacturers' directions for use with other ECG-based technology using a changing light pattern to detect tip location.[1,2,4,11,23,24,26,27,43,44,48-61] (II)
   2. Assess patient for known history of cardiac dysrhythmias and the presence of a P wave on ECG (if available) before planning to use ECG technology for placement. Contraindications to the use of ECG technology include patients with an abnormal ECG rhythm with an absence or alteration in the P wave (eg, presence of pacemakers, extreme tachycardia). Recent prospective observational studies have demonstrated safety and efficiency of using ECG to confirm catheter tip position in patients with atrial fibrillation.[1,51,62] (IV)

23. CENTRAL VASCULAR ACCESS DEVICE TIP LOCATION

Infusion Therapy Standards of Practice

Infusion therapy standard of practice. Journal of infusion nursing 2021

Tip location with IC-ECG

CVO
- Only 2 studies
- Compared with Chest X Ray
- NO TIP NAVIGATION

ECC
- Small studies
- Compared with Chest X Ray
- 1 Fr Catheters???

Editorial

Epicutaneo-caval catheters in neonates: New insights and new suggestions from the recent literature

Consider the use of intracavitary ECG for tip location

In adults and in children, intracavitary ECG is nowadays the gold standard for the intra-procedural verification of the central position of the tip during the insertion procedure, due to its great accuracy and feasibility.[26] So far, few studies have investigated ECC placement with intracavitary ECG in neonates.[45–47] The small number of patients enrolled and the poor quality of the signal, probably related to the small diameter of the catheter, make it impossible to draw a definite conclusion about the feasibility of this technique in the neonatal population. Although, this is an interesting field of research and in the next future intracavitary ECG may be an aid in tip location, together with ultrasound.

Tip location

3. Consider the use of ultrasound for CVAD tip location. The clinical applicability of this is currently limited by the small sample sizes used to demonstrate its efficacy as a reliable and safe method to replace chest radiographs in all ages, and its usefulness is limited by the knowledge, skill, and experience of the operator.[36,43,44,46,63-65] (III)
   a. The addition of agitated saline to enhance transthoracic echocardiography has been shown to be effective in detecting catheter tip position in the lower third of the SVC, as well as detecting catheter malposition through delayed opacification and reduced echogenicity.[66-68] (IV)
4. Consider the use of ultrasound to confirm catheter tip position in neonates due to the relative ease of visualizing the catheter tip in this age group, as well as in the emergency department or other critical care environments where immediate confirmation of tip location is time critical.[46,69] (IV)

23. CENTRAL VASCULAR ACCESS DEVICE TIP LOCATION

Infusion Therapy Standards of Practice

ECHO TIP Protocol

Infusion therapy standard of practice. Journal of infusion nursing 2021

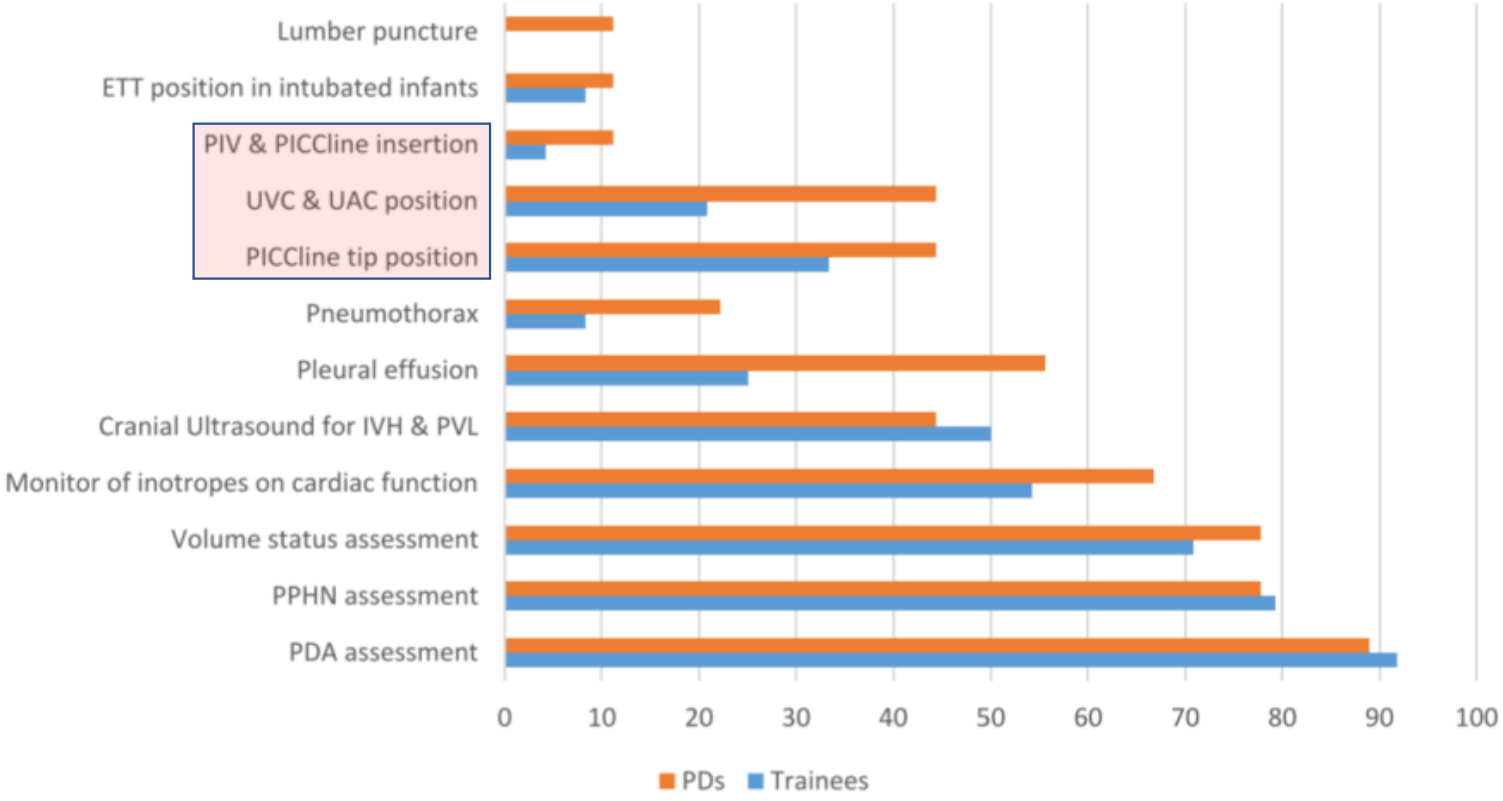
Tip location without X Rays is better

It is relatively inaccurate. As x-rays do not allow the direct visualization of the veins, the location of the catheter tip is assessed indirectly, i.e., using radiological landmarks such as the vertebral bodies, the cardiac silhouette, the diaphragmatic contour, etc.

It is consistently a post-procedural methodology, since fluoroscopy is not considered appropriate in NICU.

It is not harmless, since it exposes the neonate to ionizing radiation, which may ultimately be associated with long term damage

Where are we?



Point of care ultrasound (POCUS) in Canadian neonatal intensive care units (NICUs): where are we?
Journal of Ultrasound.2019

Where are we?

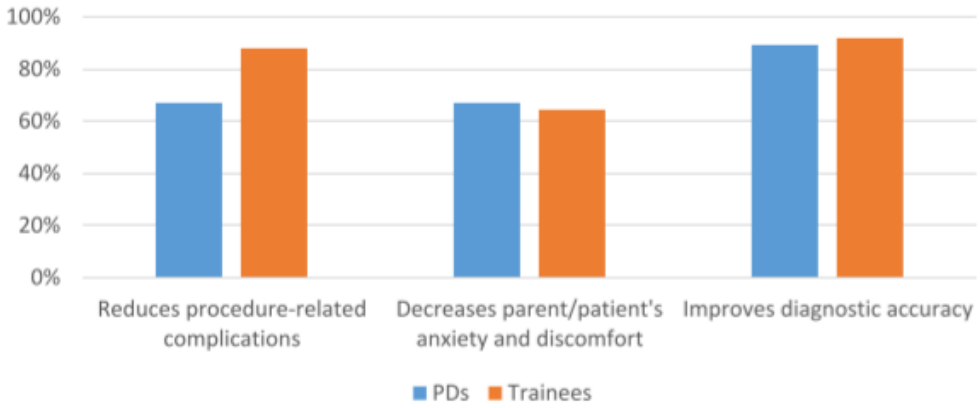
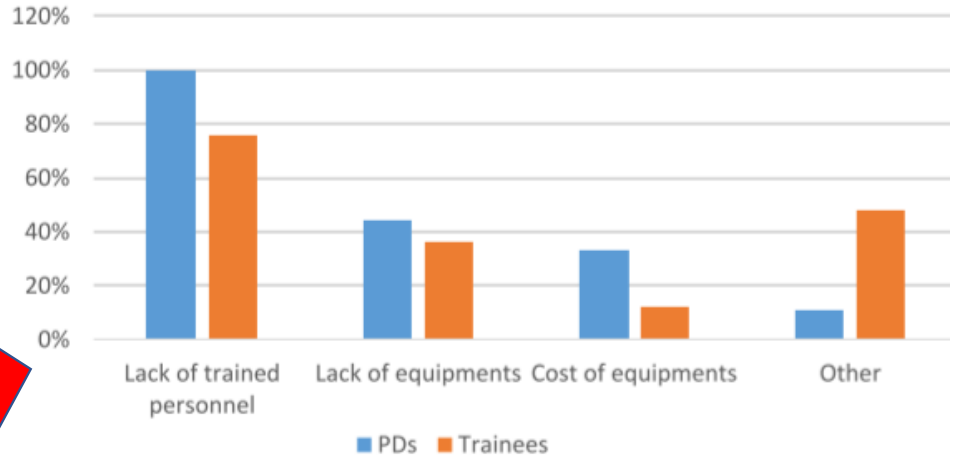


Table 1 Other potential barriers to POCUS training

Lack of dedicated time to get training due to other competing educational priorities Lack of time and resources to develop POCUS curriculum
Lack of teachers who are expert in POCUS
Acquiring full spectrum of POCUS skills including cardiac ultrasound might take longer than what a 2-year fellowship program can accommodate
Resistance from radiology and cardiology



Point of care ultrasound (POCUS) in Canadian neonatal intensive care units (NICUs): where are we?

Journal of Ultrasound.2019

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Infusion Therapy Standards of Practice

PLEASE FILL THE GAP

NEO-ECHOTIP protocol

Pedivan

espnic
European Society of Paediatric and Neonatal Intensive Care


HOW?

Table 1. Summary of Neo-ECHO tip.

Catheter	Protocol	Probe	Windows
UVC	Tip navigation	Small sectorial probe, 7–8 MHz	Low subcostal longitudinal view
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view
ECCs inserted via veins of the scalp or of the upper limbs	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Acoustic windows of RaCeVA and RaPeVA
	Tip location	Small sectorial probe, 7–8 MHz	Bi-caval view; four-chamber apical view; long axis view of SVC
ECCs inserted via veins of the lower limbs	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Short and long axis view of the femoral vein
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view
CICC	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Acoustic windows of RaCeVA
	Tip location	Small sectorial probe, 7–8 MHz	Bi-caval view; four-chamber apical view; long axis view of SVC
FICC	Tip navigation	Linear "hockey stick" probe, 10–14 MHz and small sectorial probe	Short and long axis view of the femoral vein and subcostal longitudinal view
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view

UVC: umbilical venous catheter; ECC: epicutaneo-caval catheter; RaCeVA: rapid central vein assessment; RaPeVA: rapid peripheral vein assessment; CICC: centrally inserted central catheter; FICC: femoral inserted central catheter.

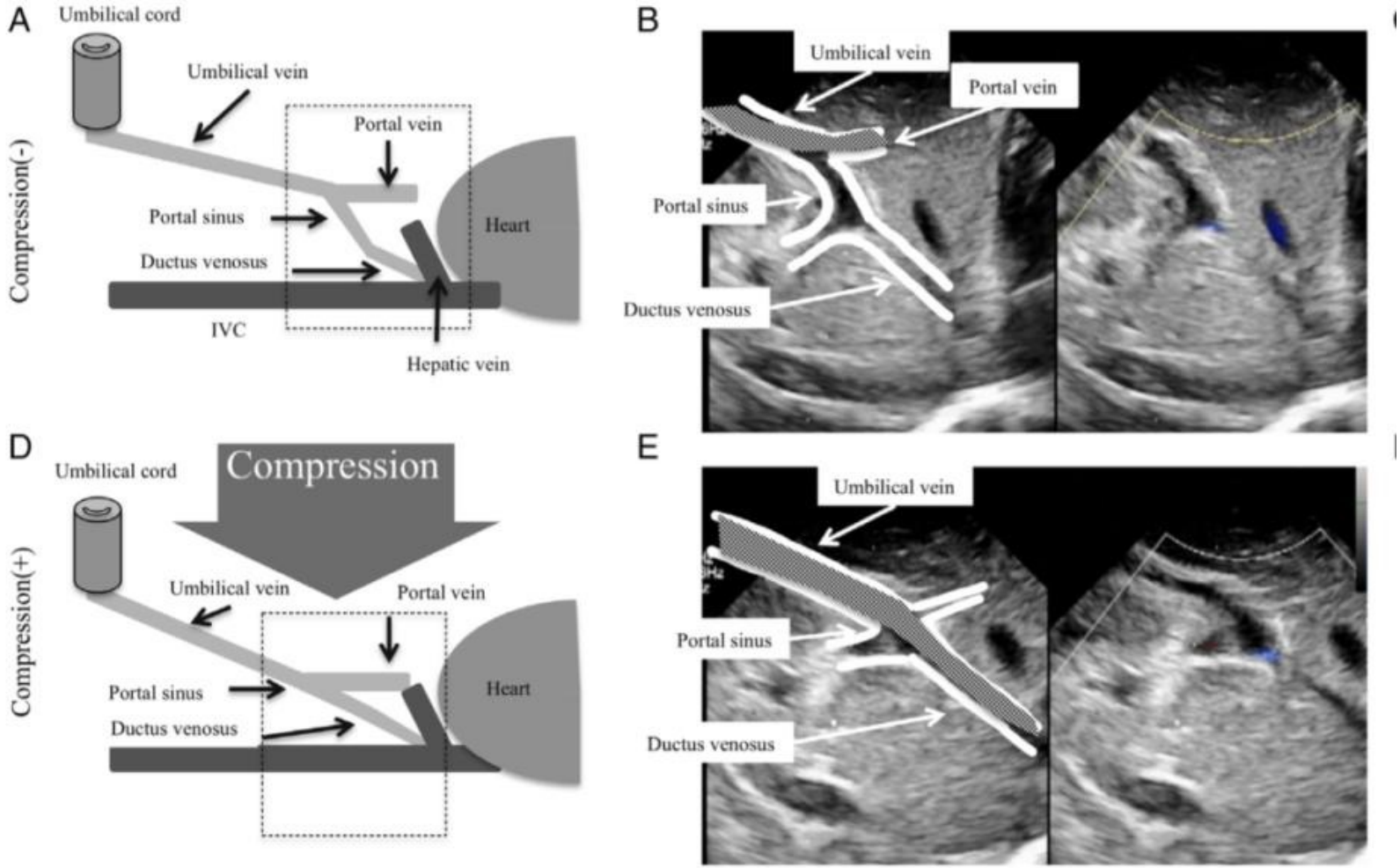
Neo-ECHOTIP for UVC

Tip navigation protocol:

Probe: small sectorial probe, 7-8 MHz.

Acoustic window: subcostal longitudinal view. This view allows to visualize the pathway of fetal umbilical venous flow from the umbilical vein to the ductus venosus, and further on to the junction between IVC and RA.

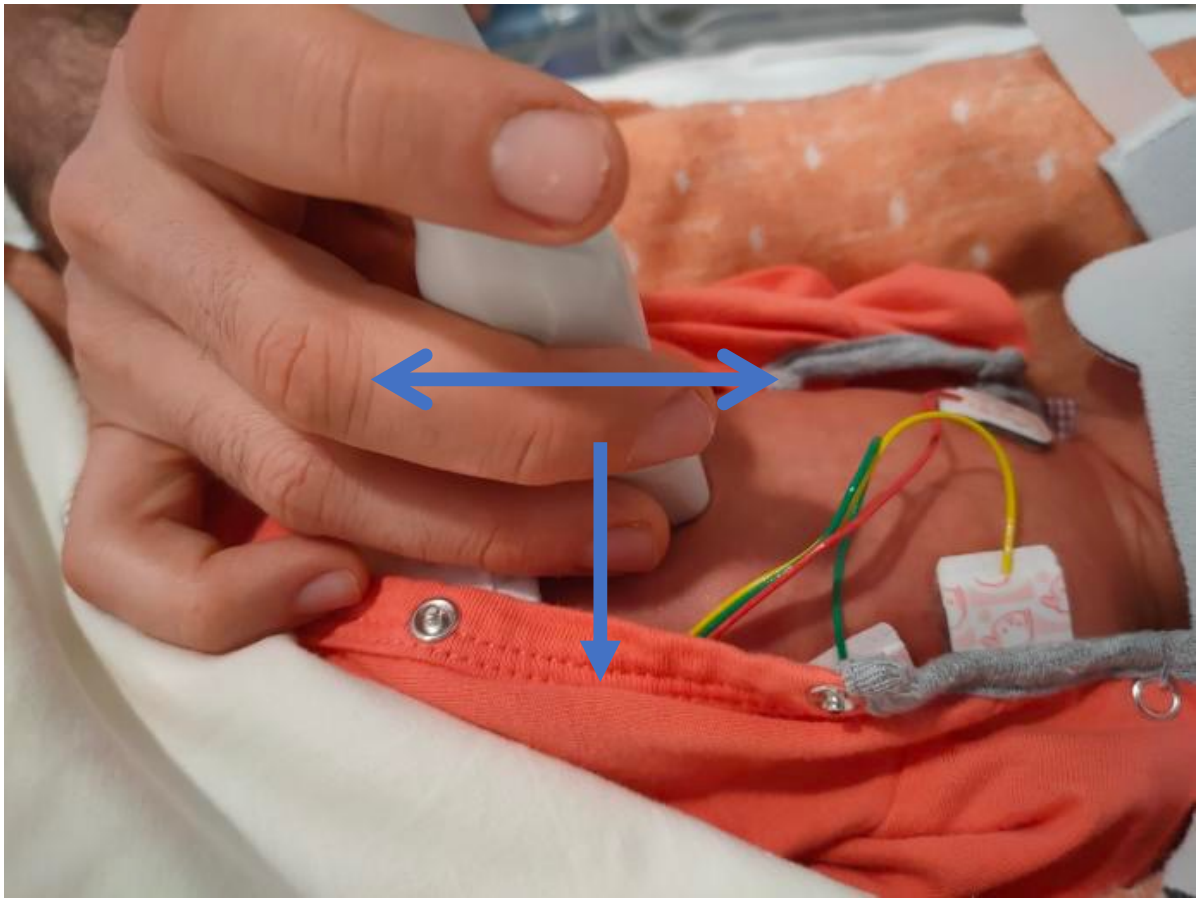
Procedure: During catheter insertion, the tip is visualized as it passes through the umbilical vein, the ductus venosus and the IVC. A small pressure with the probe may facilitate the lineup between the ductus venosus and the IVC, increasing the odds to direct the catheter into the proper position



Kishigami et al. Ultrasound-Guided Umbilical Venous Catheter Insertion With Alignment of the Umbilical Vein and Ductus Venosus. J of ultrasound Medicine 2019

Neo-ECHOTIP for UVC

Probe TIP-Navigation



Neo-ECHOTIP for UVC

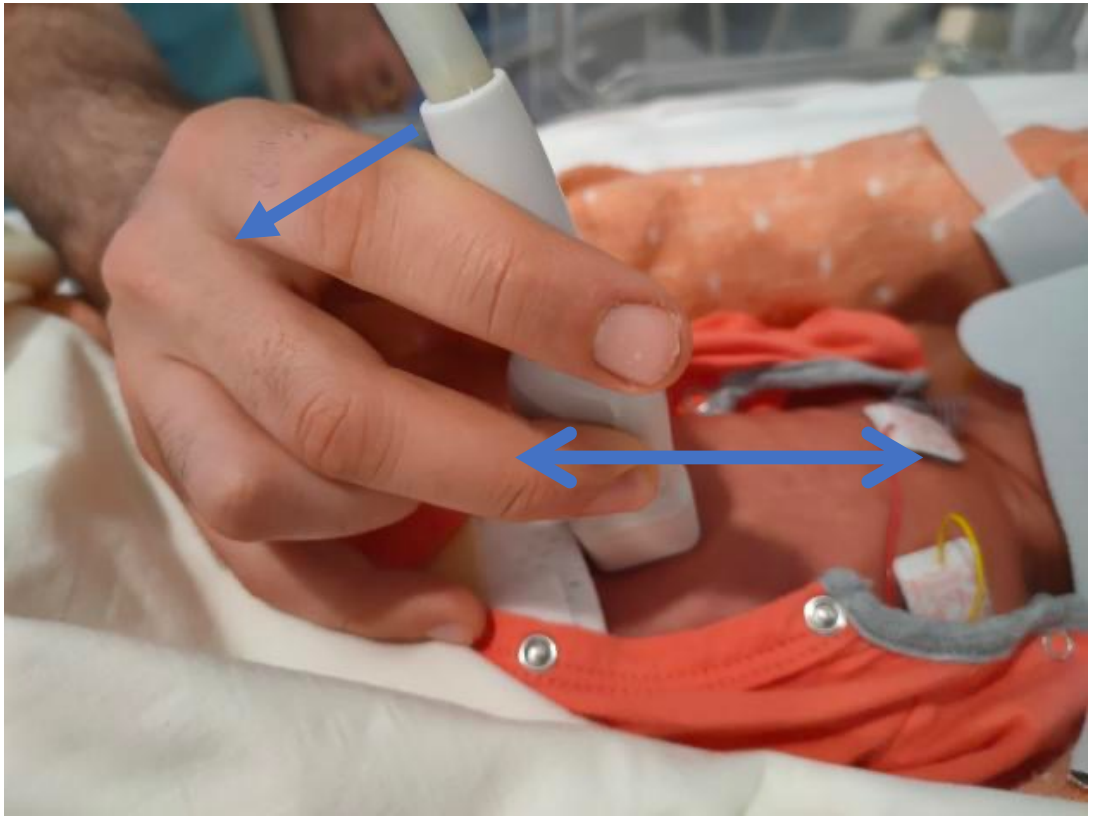
Tip location protocol:

Probe: small sectorial probe, 7-8 MHz.
Acoustic window: subcostal longitudinal view. This view allows to visualize the IVC and the RA.

Procedure: the tip is followed until it reaches the target zone, i.e., the junction between the IVC and the RA. A small flush of normal saline (0.5-1 ml) can improve the visualization of the tip

Neo-ECHOTIP for UVC

Probe TIP-Location



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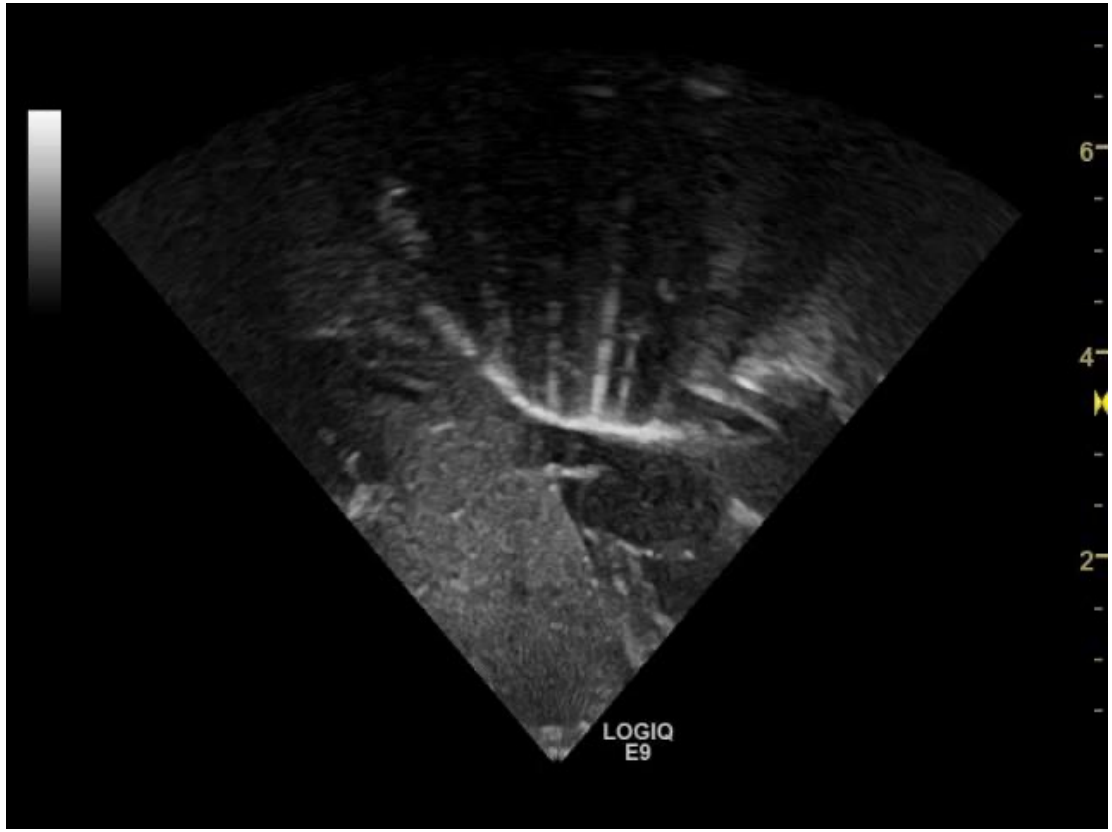
REAL TIME



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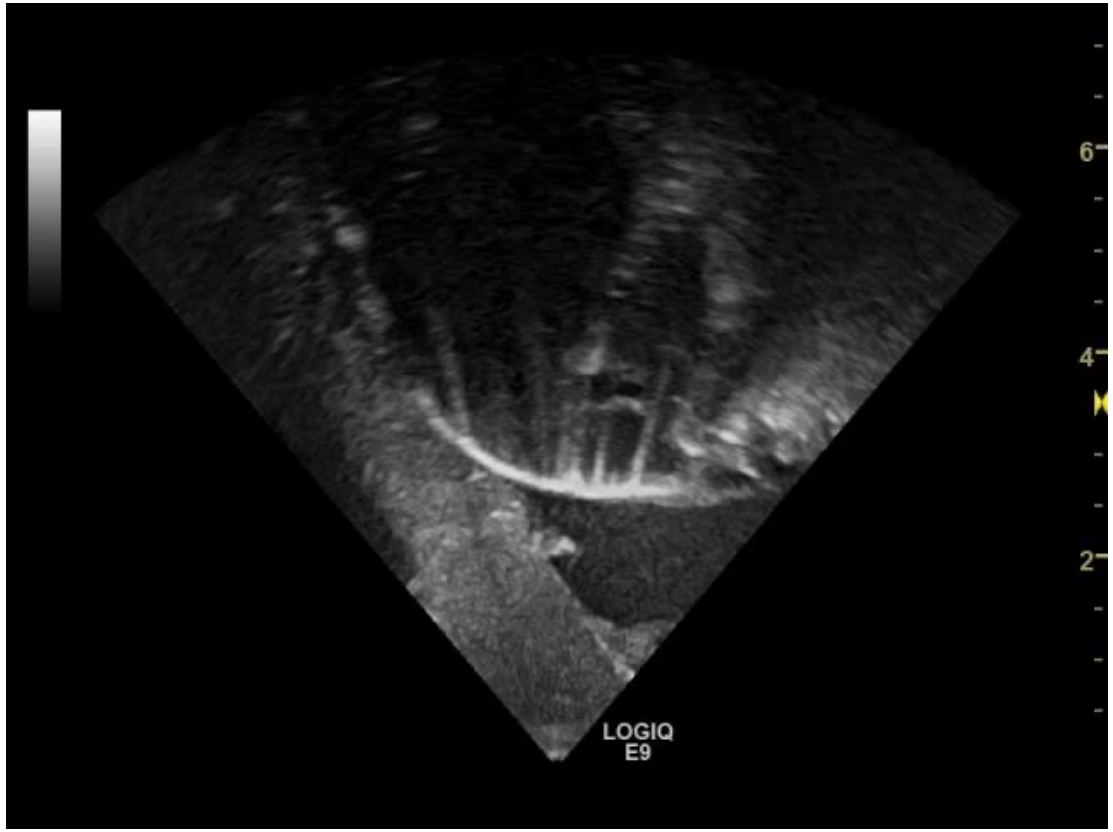

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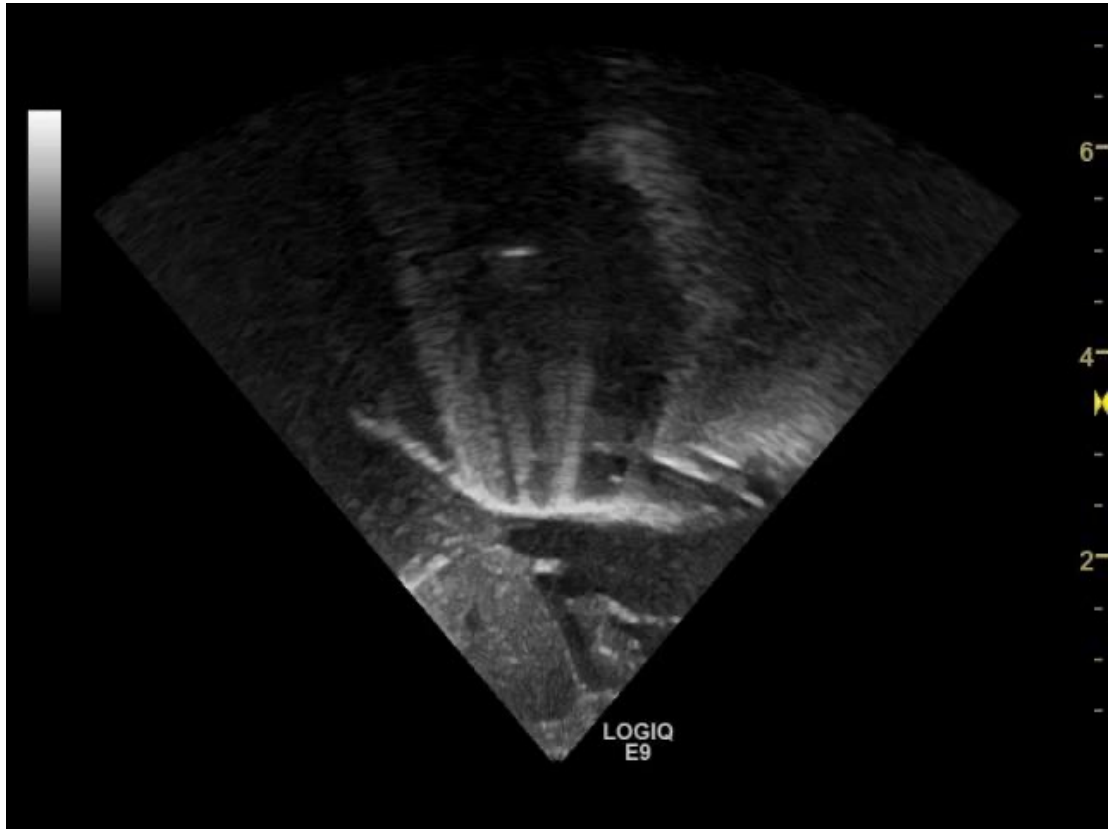

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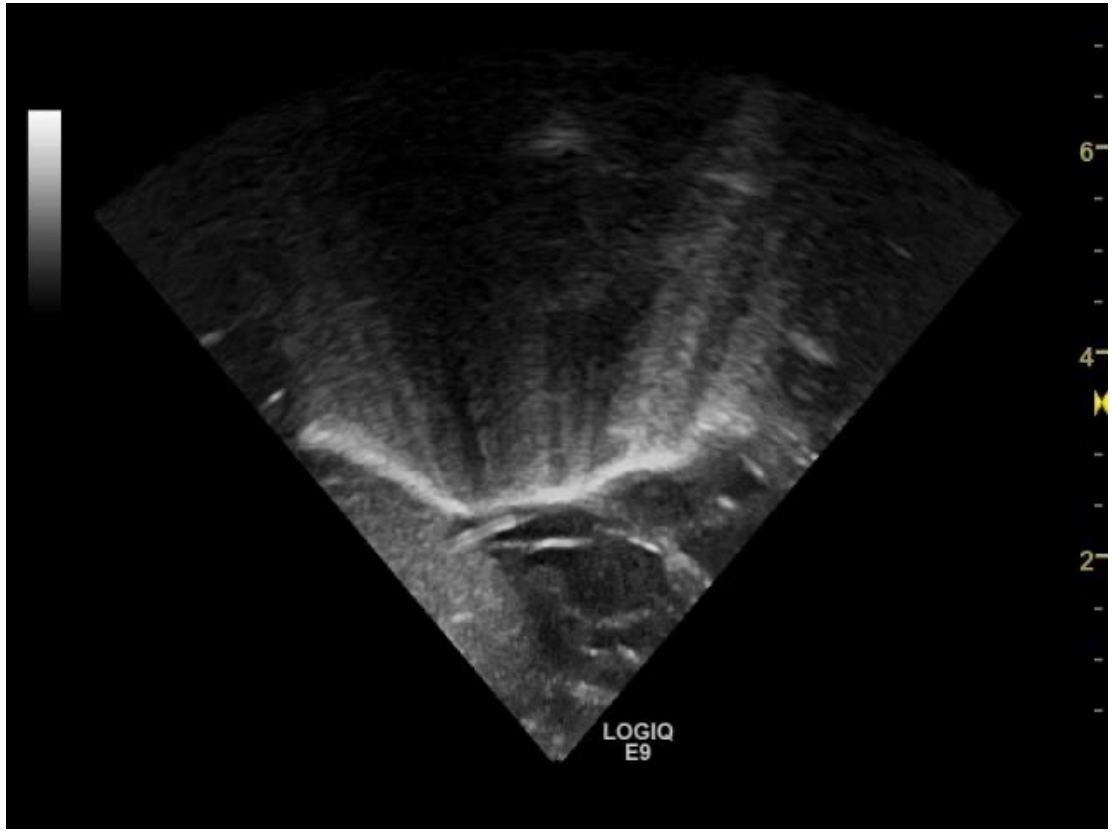

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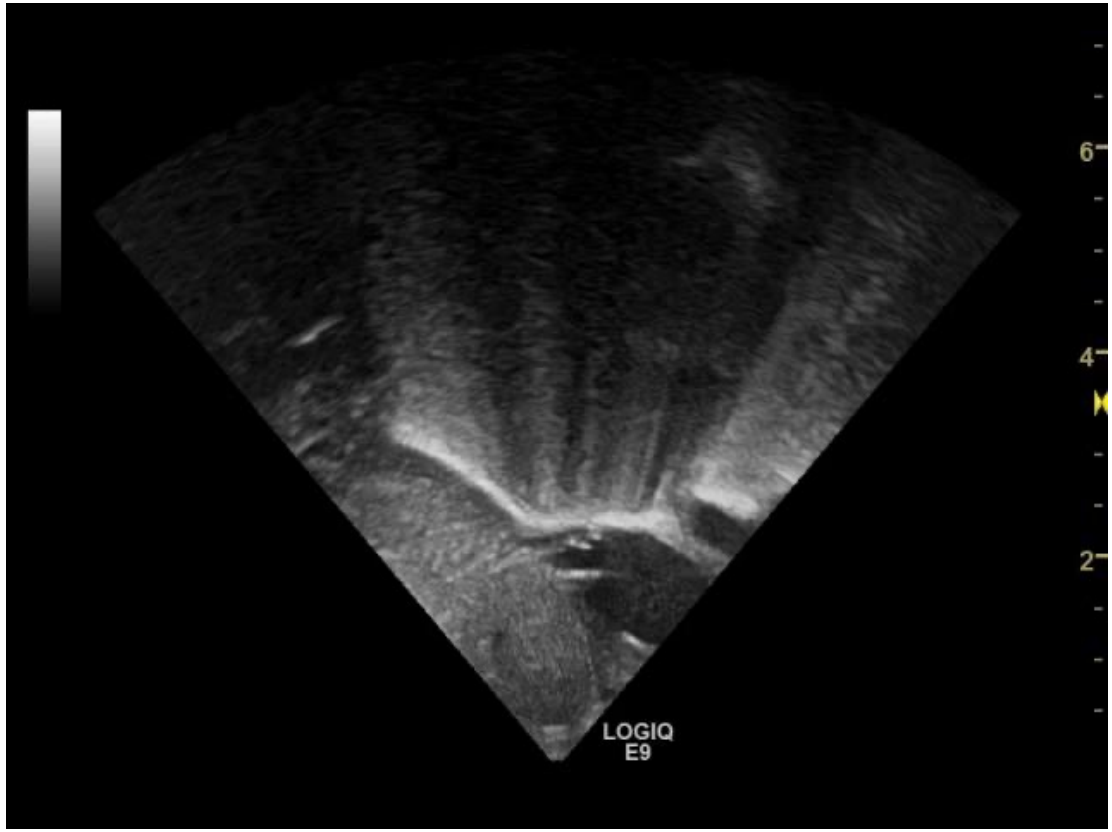
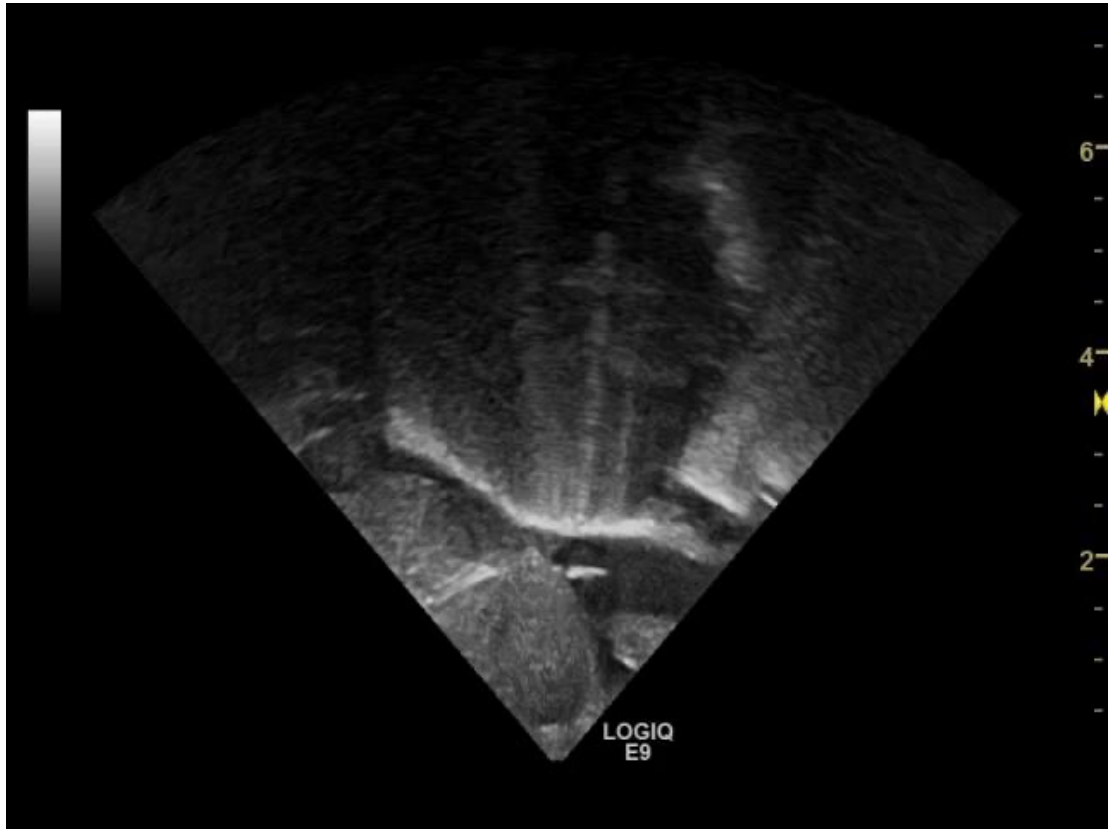


“How we do it better”…



Training issue

The position of the UVC tip should be checked after 24 h, so to exclude secondary malposition due to subsequent migration. *Training issues..* Even though US-based placement of UVC has been proved to be accurate, effective, and safe, many neonatologists still consider the chest X-rays as the gold standard technique for tip location of umbilical vein catheters, probably because the training for RT-US is perceived as long and difficult. This is not true: training for RT-US for UVC has been shown to be simple and feasible.[23,26,28,34]

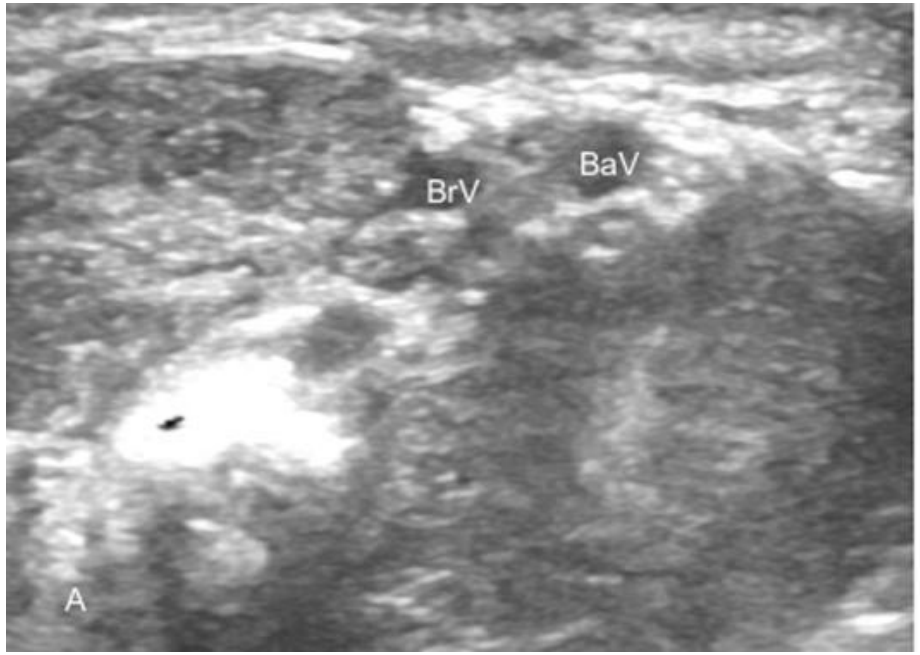
Neo-ECHOTIP for ECC inserted via veins of the upper limbs

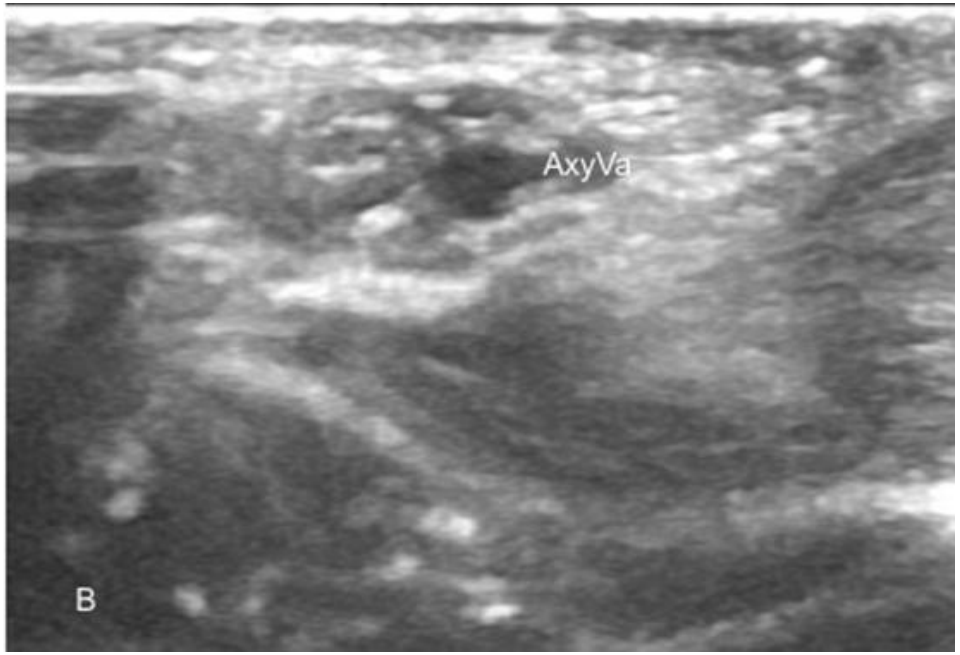
Tip navigation protocol:

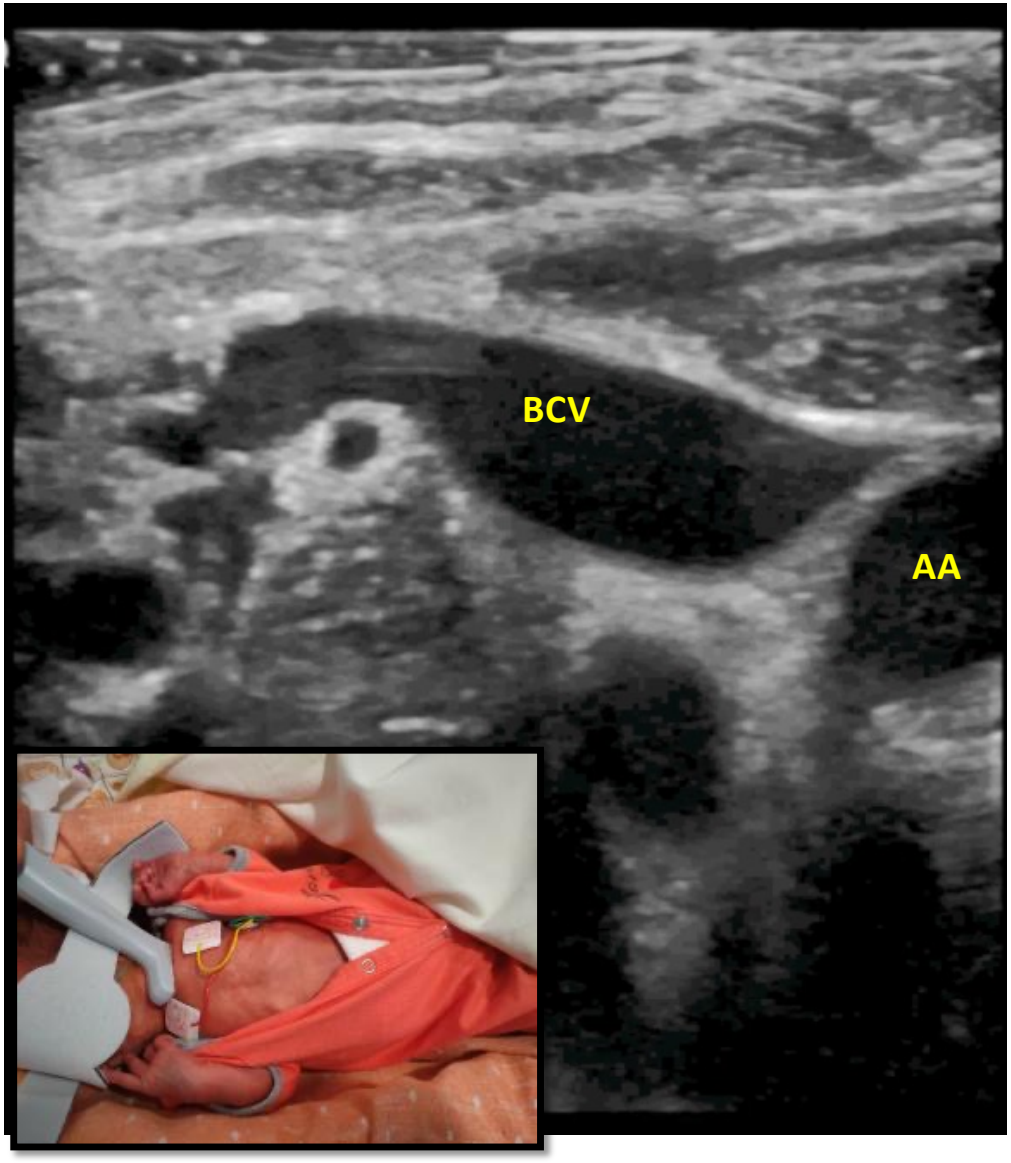
Probe: linear 'hockey stick' probe, 10-14 MHz.
Acoustic windows: the protocol includes the acoustic windows of RaCeVA and RaPeVA .

Procedure: the RaPeVA protocol is used in case of difficult progression of the catheter through the deep veins of the arm. The RaCeVA protocol is used for tip navigation of the catheter into the subclavian vein, the brachio-cephalic vein and the SVC, so to prevent primary malposition (such as inside the internal jugular vein) during the maneuver of insertion. The RaCeVA protocol can also easily visualize an ECC inserted into scalp veins as it passes through the internal jugular vein, the brachiocephalic vein and the SVC.

RaPeVa



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Neo-ECHOTIP for ECC inserted via veins of the upper limbs

Tip location protocol:

Probe: Small sectorial probe, 7-8 MHz.

Acoustic windows: At least three different windows have been used to locate the catheter tip. The most useful ones are the subcostal longitudinal view ('bi-caval' view); the four-chamber apical view; the parasternal, long axis view of SVC.

Procedure**:** the catheter tip is followed until it reaches the target zone, i.e., the transition between SVC and RA. A small flush of normal saline (0.5-1 ml) may help visualizing the tip.

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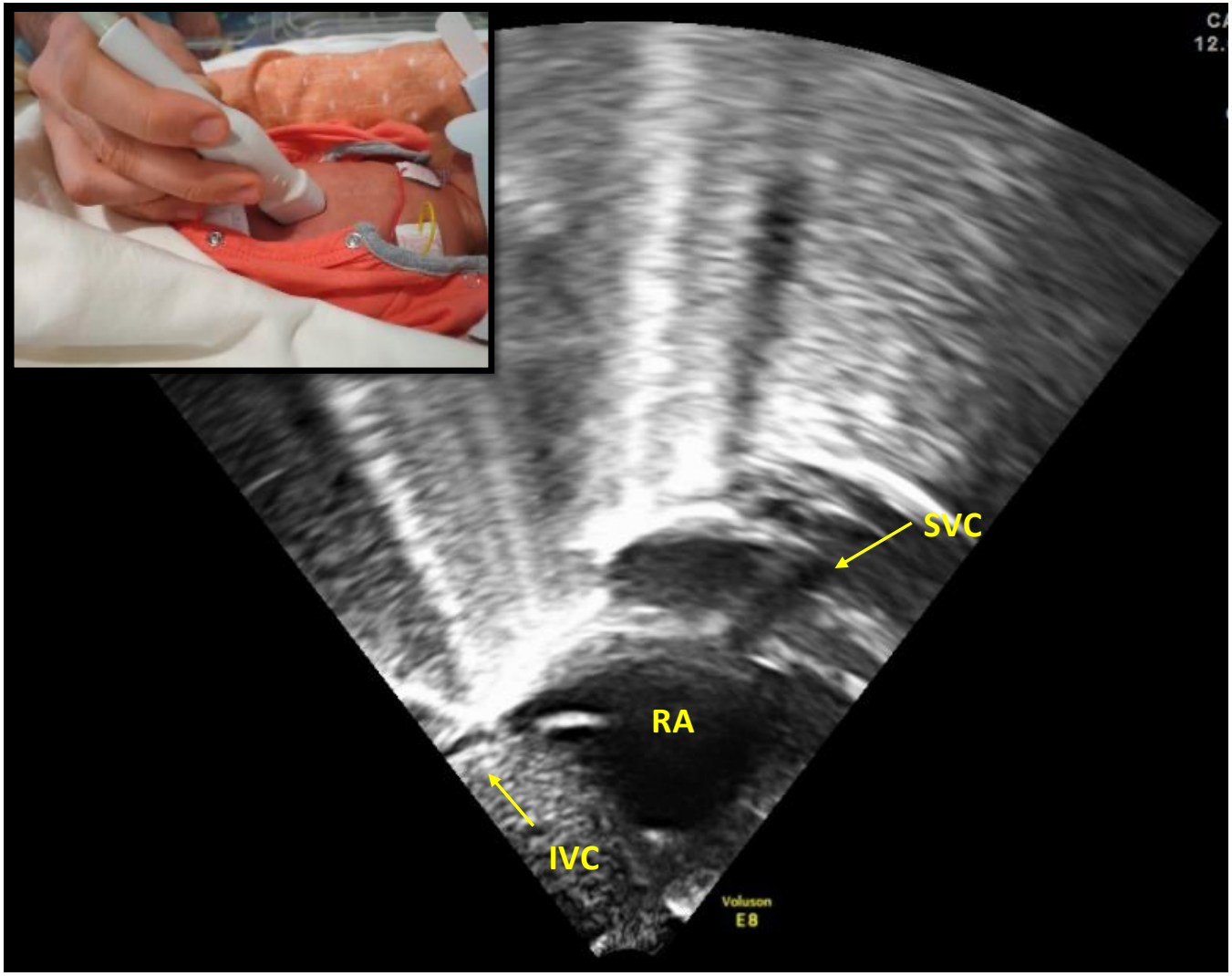

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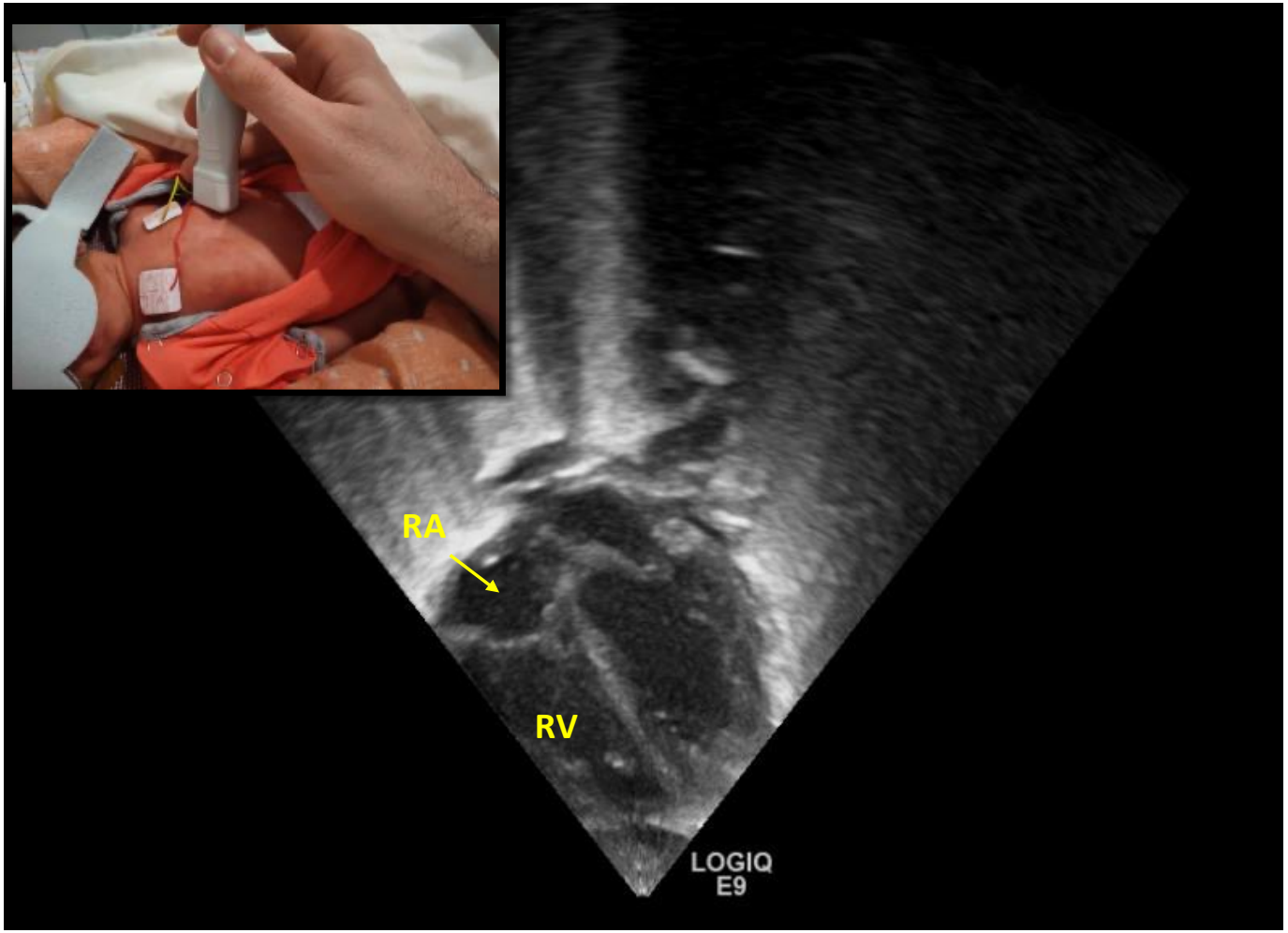

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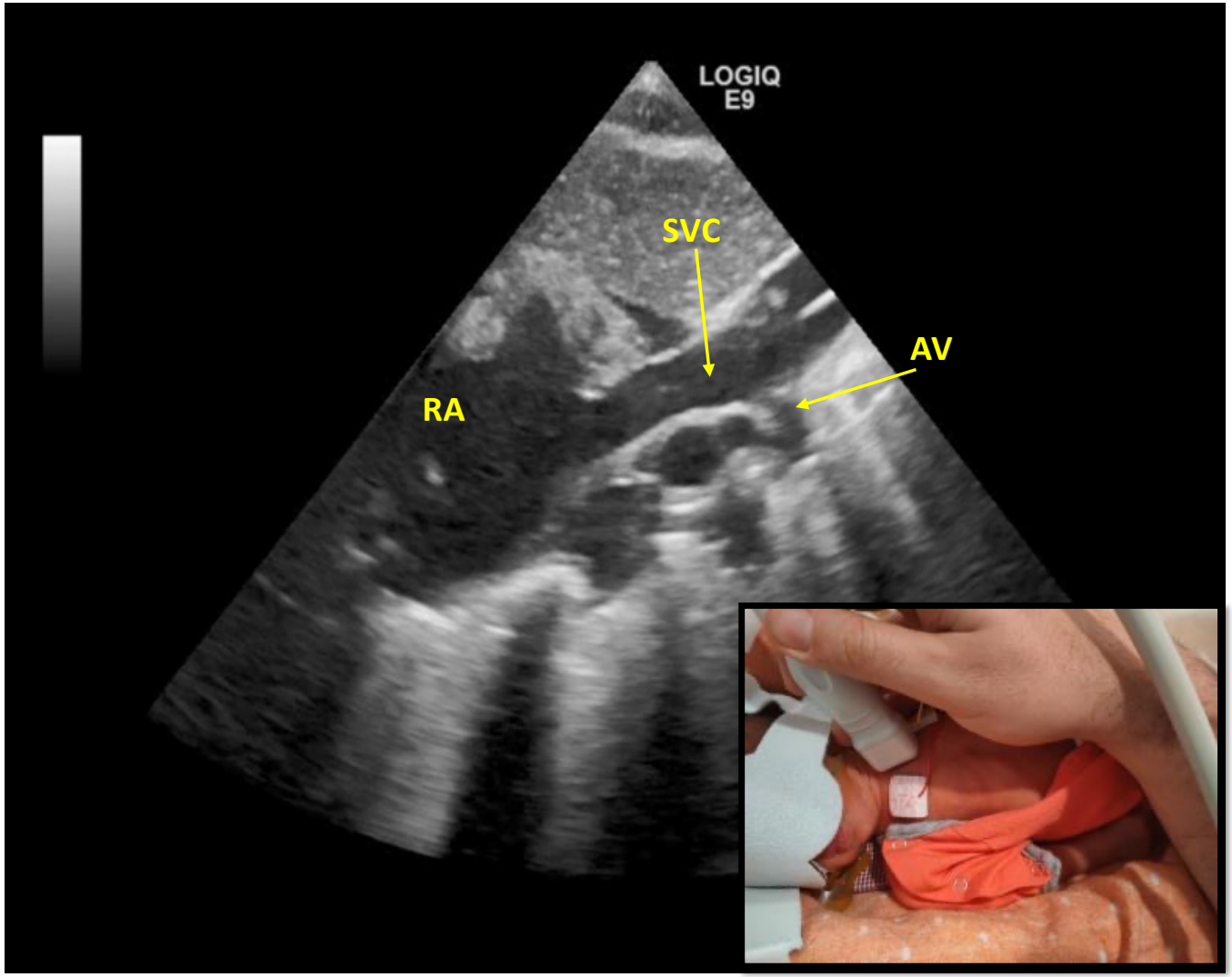

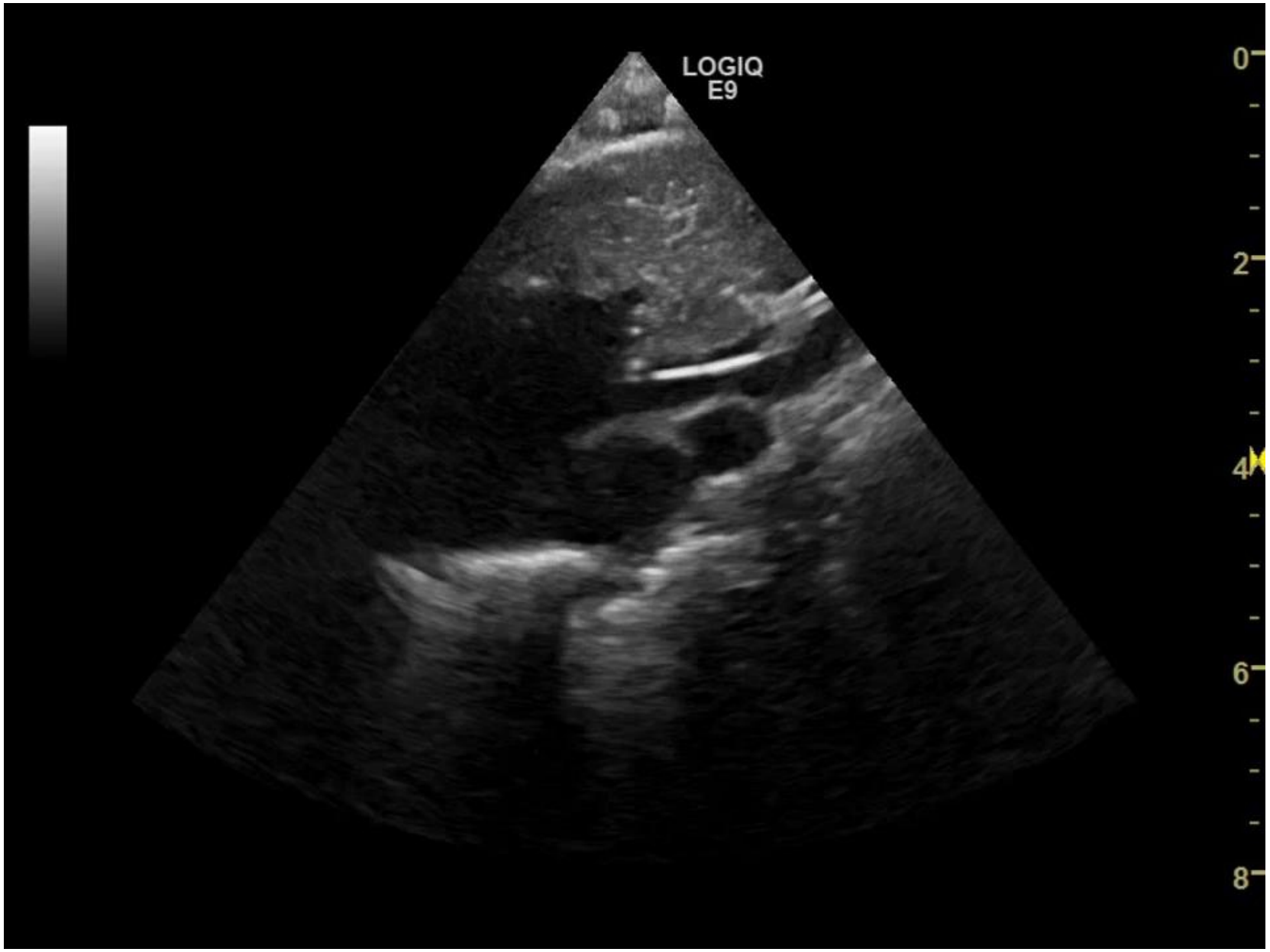
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Protocol for ECCs inserted via veins of the lower limbs

Tip navigation protocol:

Probe: linear 'hockey stick' probe, 10-14 MHz.
Acoustic window: short and long axis view of the femoral vein.
Procedure: During ECC insertion, the catheter tip is visualized into the femoral vein and into the iliac vein.

Tip location protocol:

Probe: Small sectorial probe, 7-8 MHz
Acoustic window: subcostal longitudinal view. This view allows visualization of IVC and RA.
Procedure: the tip is followed until it reaches the target zone, i.e. the transition between IVC and RA. A small flush of normal saline (0.5-1 ml) may help visualizing the tip.

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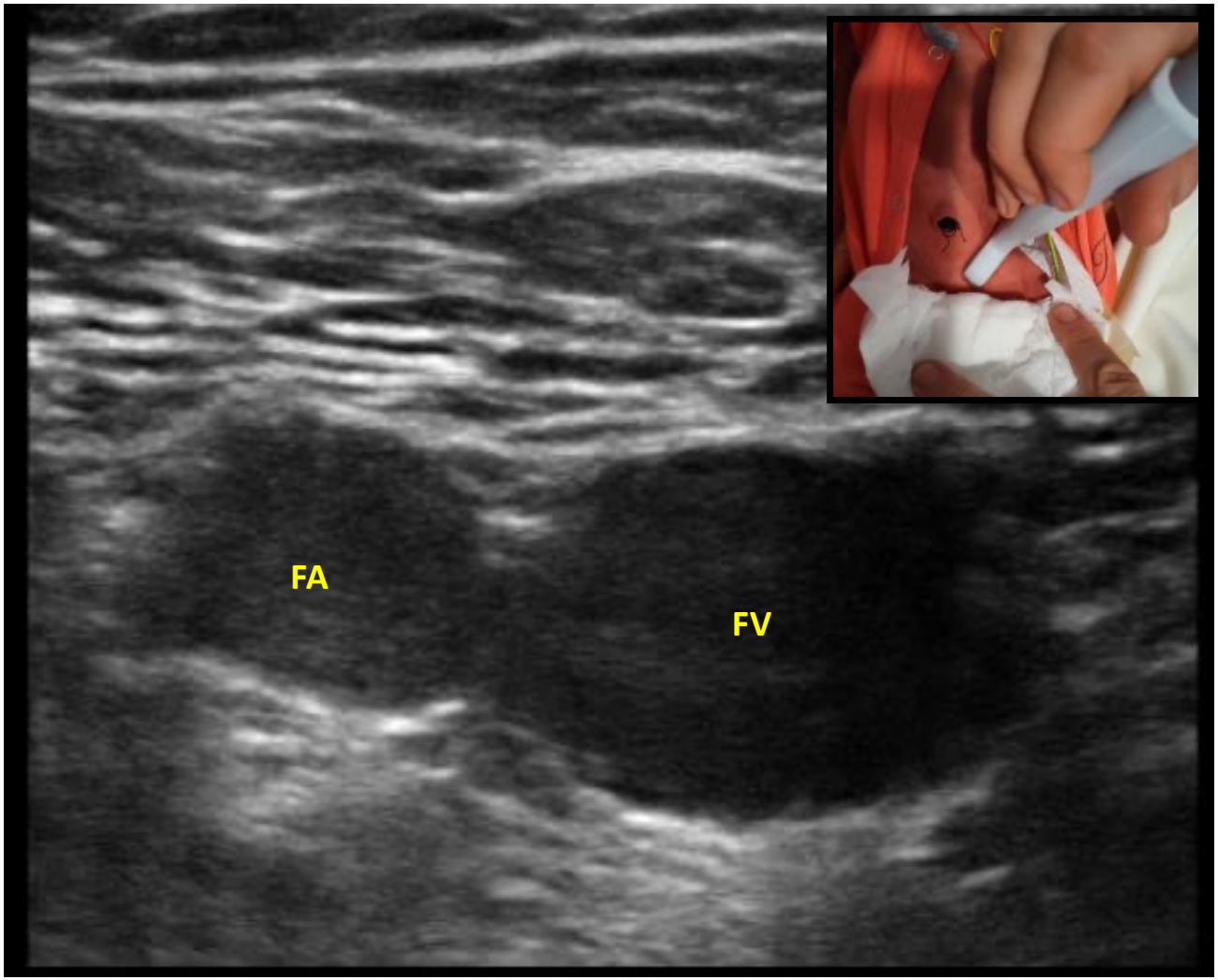

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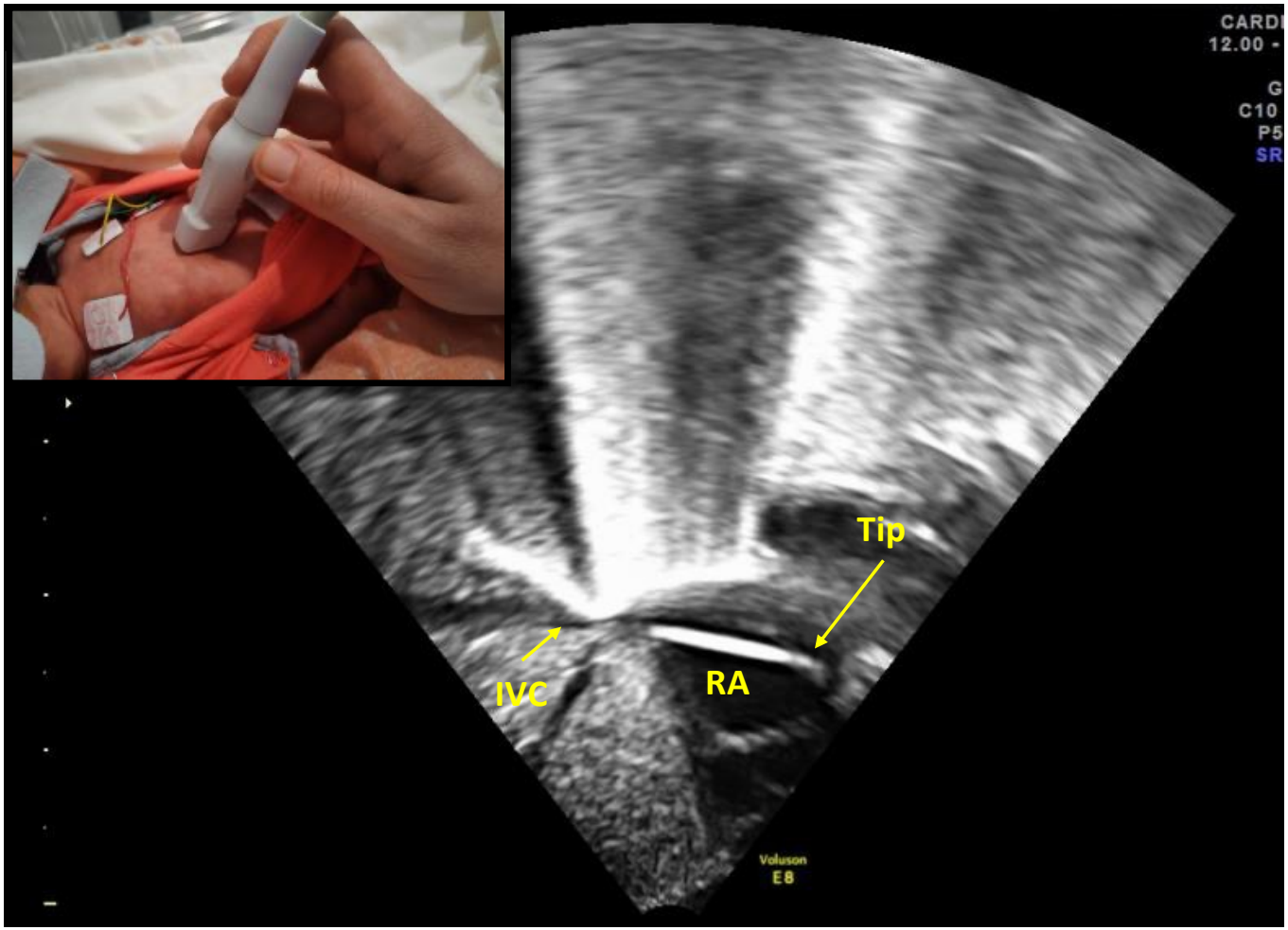

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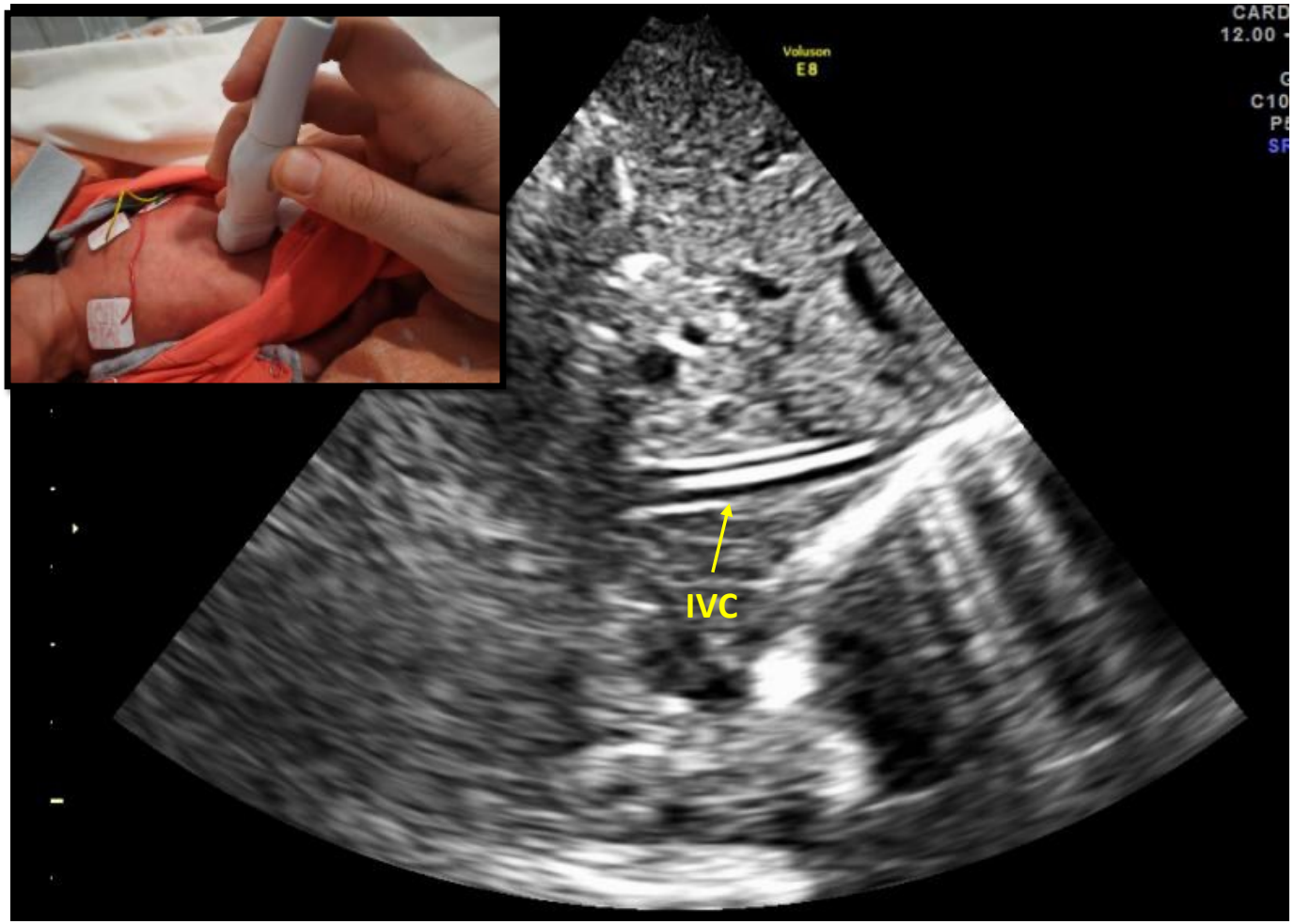
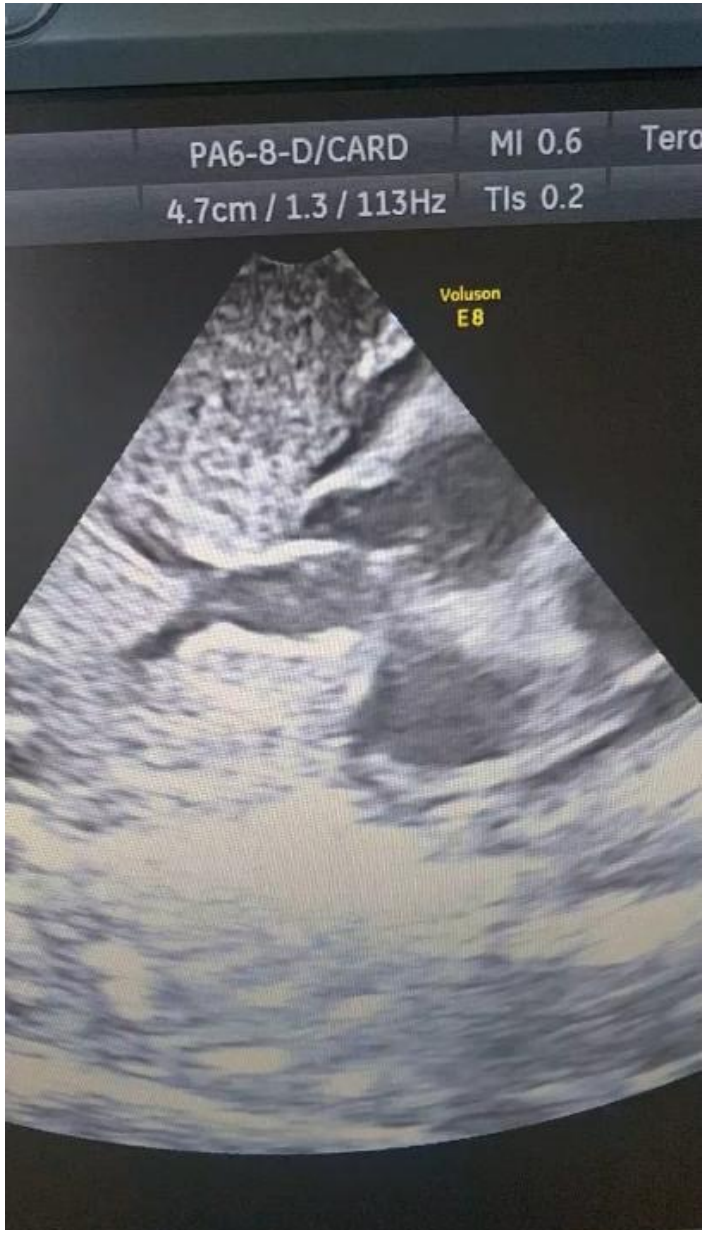


Tip location



Training issue

Training issues. Even though US-based tip location of ECC has been proved to be effective and safe, many neonatologists still consider chest X-rays as the gold standard for this purpose. This is partly explained by the advanced training necessary to complete this maneuver with RT-US.

To the best of our knowledge, few data are available about the training needed for performing ultrasound-based tip location of ECCs. Clinical studies on RT-US for tip location of ECCs show a direct correlation between the level of expertise of the clinician and the percentage of successful tip visualization.[45]

In our experience, the minimum training requirements for ultrasound-based tip navigation and tip location of ECCs should include:

1. Basic knowledge of targeted neonatal echocardiography and advanced vascular ultrasound assessment (in particular, the RaCeVA, RaPeVA, and RaFeVA protocols).
2. Advanced theoretical training, including the evaluation of several clinical case scenarios (at least 12 h).
3. Practical training supervised by a neonatologist with expertise in ultrasound-based tip location of ECCs (at least 50 cases).

Neo-ECHOTIP for CICC and FICC

Reasons for using RT-US during CICC and FICC placement in newborns:

1. RT-US allows both tip navigation and tip location.
2. RT-US can easily rule-out primary malposition, such as the accidental direction of the catheter into the opposite brachio-cephalic vein.
3. RT-US is an effective rescue strategy when the intracavitary ECG is not applicable (for instance in newborns with atrial flutter).
4. RT US is the only way to evaluate the tip location of a FICC when the tip is scheduled to be inside the IVC.

Table 1. Summary of Neo-ECHO tip.

Catheter	Protocol	Probe	Windows
UVC	Tip navigation	Small sectorial probe, 7–8 MHz	Low subcostal longitudinal view
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view
ECCs inserted via veins of the scalp or of the upper limbs	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Acoustic windows of RaCeVA and RaPeVA
	Tip location	Small sectorial probe, 7–8 MHz	Bi-caval view; four-chamber apical view; long axis view of SVC
ECCs inserted via veins of the lower limbs	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Short and long axis view of the femoral vein
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view
CICC	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Acoustic windows of RaCeVA
	Tip location	Small sectorial probe, 7–8 MHz	Bi-caval view; four-chamber apical view; long axis view of SVC
FICC	Tip navigation	Linear "hockey stick" probe, 10–14 MHz and small sectorial probe	Short and long axis view of the femoral vein and subcostal longitudinal view
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view

UVC: umbilical venous catheter; ECC: epicutaneo-caval catheter; RaCeVA: rapid central vein assessment; RaPeVA: rapid peripheral vein assessment; CICC: centrally inserted central catheter; FICC: femoral inserted central catheter.

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Table 1. Summary of Neo-ECHO tip.

Catheter	Protocol	Probe	Windows
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ECCs inserted via veins of the lower limbs	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Short and long axis view of the femoral vein
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view
CICC	Tip navigation	Linear "hockey stick" probe, 10–14 MHz	Acoustic windows of RaCeVA
	Tip location	Small sectorial probe, 7–8 MHz	Bi-caval view; four-chamber apical view; long axis view of SVC
FICC	Tip navigation	Linear "hockey stick" probe, 10–14 MHz and small sectorial probe	Short and long axis view of the femoral vein and subcostal longitudinal view
	Tip location	Small sectorial probe, 7–8 MHz	Subcostal longitudinal view

UVC: umbilical venous catheter; ECC: epicutaneo-caval catheter; RaCeVA: rapid central vein assessment; RaPeVA: rapid peripheral vein assessment; CICC: centrally inserted central catheter; FICC: femoral inserted central catheter.

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Neo-ECHOTIP for CICC

Tip navigation protocol:

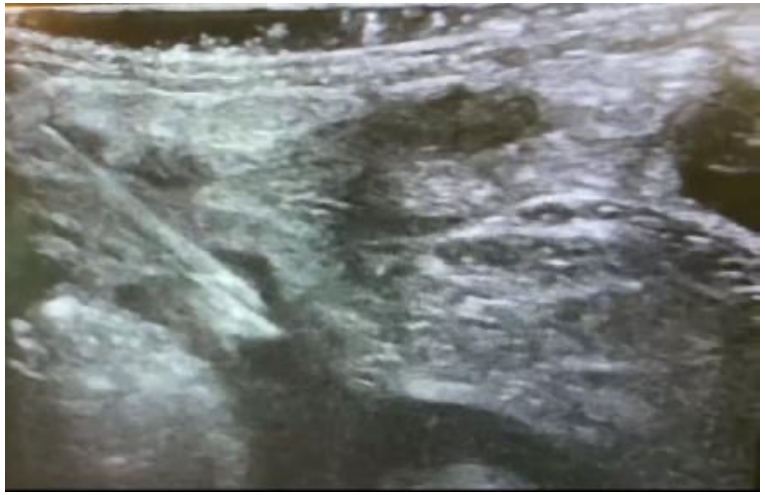
Probe: linear 'hockey stick' probe, 10-14 MHz.

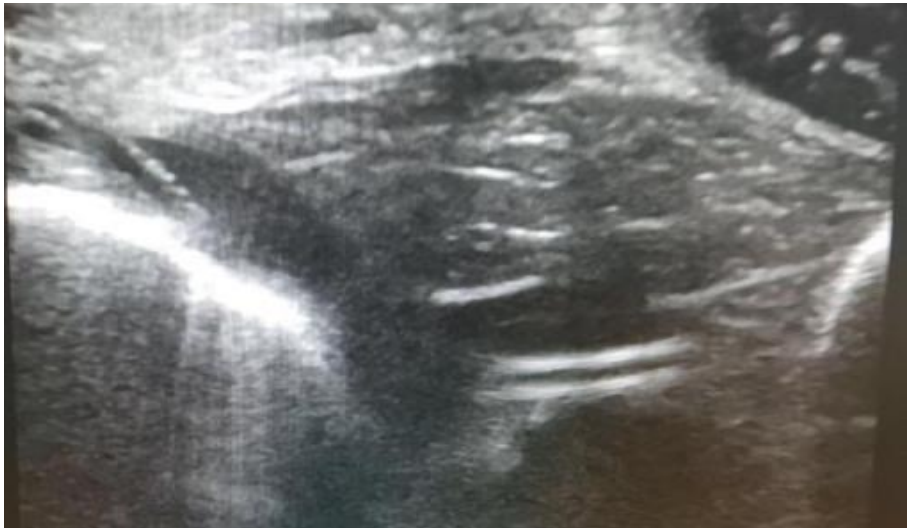
Acoustic windows: same acoustic windows of the RaCeVA protocol, including proper visualization of the brachio-cephalic veins in long axis on both sides.

Procedure**:** During CICC placement, the brachio-cephalic vein and the SVC should be clearly visualized.

- the needle is visualized during the venipuncture.
- the guidewire is visualized as it passes into the brachio-cephalic vein and into the SVC. It is recommended at this stage also to rule out pneumothorax.
- the micro-introducer is visualized inside the brachio-cephalic vein.
- the catheter is visualized inside the brachio-cephalic vein and then inside the SVC.

Tip navigation





Neo-ECHOTIP for CICC

Tip location protocol:

Probe: Small sectorial probe, 7-8 MHz

Acoustic windows: three different windows are recommended to locate accurately the tip of the catheter. The most useful ones are the subcostal longitudinal view ('bi-caval' view), the four-chamber apical view, and the long axis view of SVC.

Procedure**:** follow the catheter tip until it reaches the target zone, i.e., the transition between SVC and RA. A small flush of normal saline (0.5-1 ml) may help confirming the tip position.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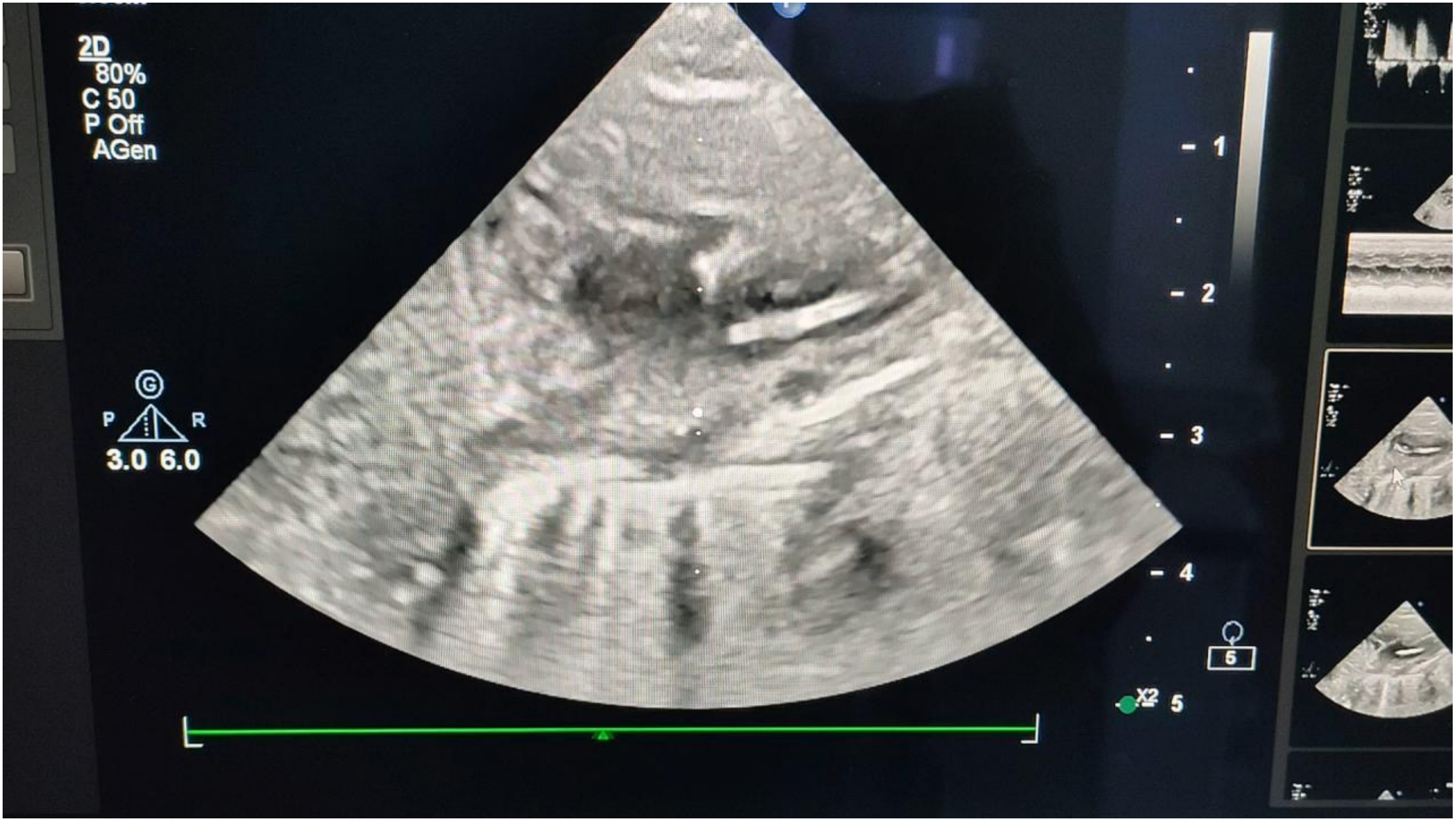
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Neo-ECHOTIP for FICC

1. Tip navigation protocol:
   Probe: linear 'hockey stick' probe, 10-14 MHz
   Acoustic window: **RaFeVa**
   Procedure: During FICC placement, the femoral vein should be clearly visualized.
- the needle is visualized during the venipuncture
- the guidewire is visualized as it passes through the femoral vein (long axis).
- the micro-introducer is visualized inside the femoral vein
- the catheter is visualized inside the femoral vein and then inside the iliac vein.

Neo-ECHOTIP for FICC

Tip location protocol - A:

Probe: Small sectorial probe, 7-8 MHz

Acoustic window: subcostal longitudinal view. It's mandatory to visualize properly the IVC.

Procedure: the catheter tip is visualized as it passes through the IVC.

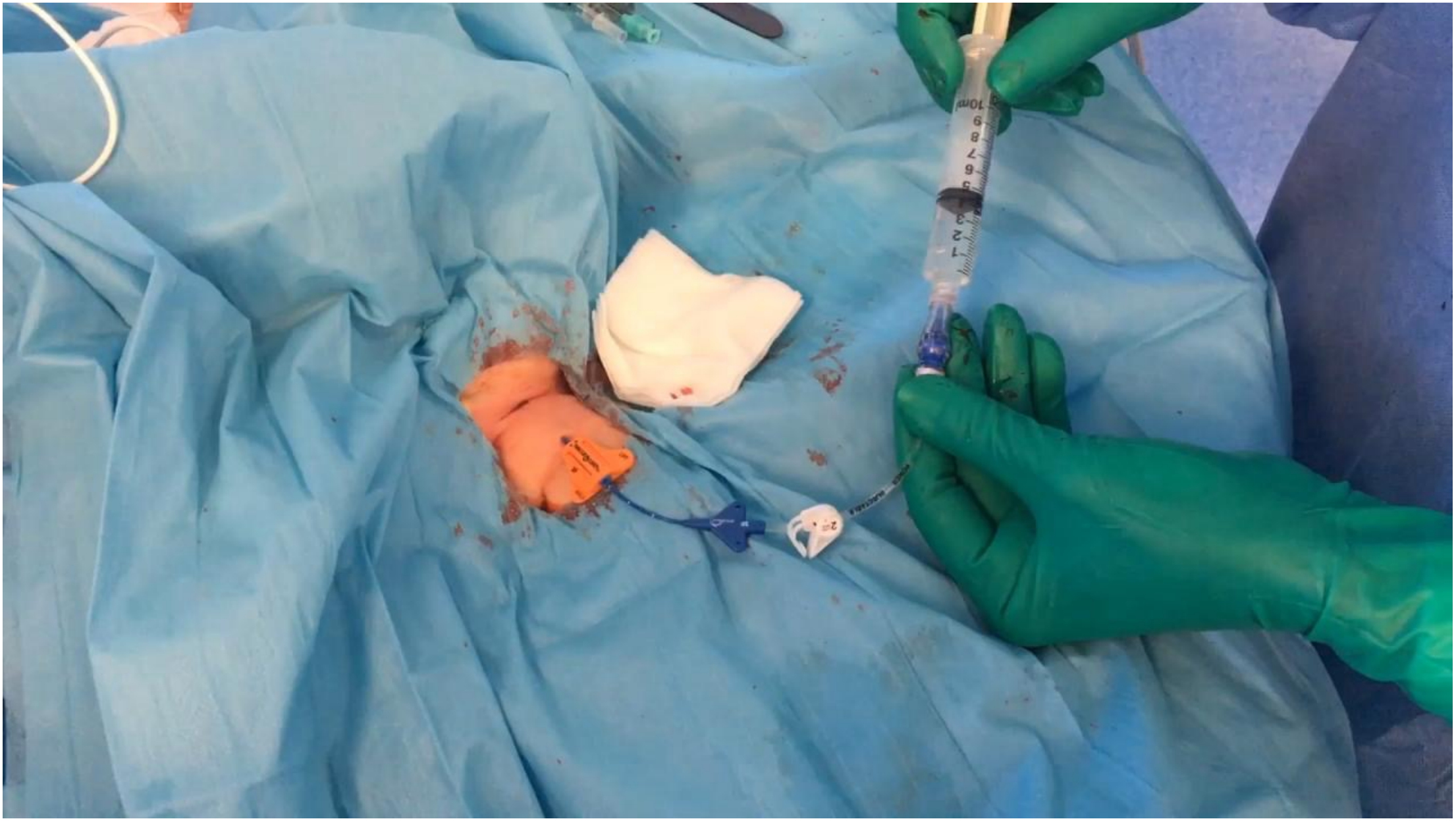
If hemodynamic monitoring is not required, the catheter tip of the FICC is placed below the renal veins

Tip location protocol B:

Probe: Small sectorial probe, 7-8 MHz

Acoustic window: subcostal longitudinal view, so to visualize IVC and RA.

Procedure: the catheter tip is visualized as it reaches the target zone, i.e., the transition between IVC and RA. A small flush of normal saline (0.5-1 ml) may help visualizing the tip



Conclusions

- Neo-ECHOTIP protocol is **stepwise and standardized procedure**, potentially useful to perform both ultrasound based **tip navigation and tip location**, in all central venous access devices currently used in NICU
- **It's based on evidences from many published clinical studies**.
- Some of these maneuvers are easy and require only a minimal training, while some others imply a well trained operator.
- Thus, **training is the main open question**, and we suggest that more evidence should be published about the proper training required for achieving appropriate skills of real-time ultrasound for CVAD insertion in neonates.
- Current evidence and common sense suggest that ultrasound-based tip location will have an **increasingly important role for CVAD in NICU**, considering its many advantages in terms of accuracy, cost-effectiveness and safety

Ultrasound guided Catheter Tip Location in Neonates: A Prospective Cohort Study

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Objective To assess point-of-care-ultrasound (POCUS) guided catheter tip location in a neonatal cohort after insertion of percutaneously inserted central catheters (PICCs) from the upper part of the body.

Study design This was a prospective, observational study on PICC tip location. Tip site was assessed by radiological landmarks or direct ultrasound (US) visualization of the cardiovascular structures.

Results One hundred eighteen PICCs (28Gauge/1French) were studied in 102 neonates (mean postmenstrual age 31 weeks, range 25-43 weeks; mean weight at positioning 1365 g, range 420-4180 g). Feasibility of POCUS guided tip location was 92.3% in our population. Failures were significantly associated with mechanical ventilation (aOR 5.33; 95% CI 1.13-29.5; $P = .038$). Agreement between US and radiographic methods was found in 88 of 109 cases (80.7%). Fifteen of 21 discordant cases led to a change in clinical management.

Conclusions POCUS guided localization of small bore PICC is a non-invasive and effective alternative to the conventional radiogram. The latter should be recommended when US examination fails to locate the catheter tip. *(J Pediatr 2022; ■:1-5).*

The Journal of Vascular Access
1–6

DOI: 10.1177/11297298211068302
journals.sagepub.com/home/jva
SAGE

The intracavitary ECG method for tip location of ultrasound-guided centrally inserted central catheter in neonates

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Abstract

Background: The correct position of the tip of a central venous access device is important in all patients, and especially in neonates. The traditional method of tip location (approximated intra-procedural length estimation + post procedural chest X-ray) is currently considered inaccurate and not cost-effective by most recent guidelines, which recommend the adoption of tip location by intracavitary electrocardiography (IC-ECG) whenever possible.

Methods: This study prospectively investigated the applicability, the feasibility, the accuracy, and the safety IC-ECG for tip location in neonates requiring insertion of ultrasound-guided centrally inserted central venous catheters (CICCs) with caliber 3Fr or more. All catheter tip locations were verified using simultaneously both IC-ECG and ultrasound-based tip location, using the Neo-ECHOTIP protocol.

Results: A total of 105 neonates were enrolled. The applicability of IC-ECG was 100% since a P wave was evident on the surface ECG of all neonates recruited for the study. The feasibility was also 100% since an increase of the P-wave was detected in all cases. The accuracy was also 100%, since a perfect match between IC-ECG based tip location and ultrasound-based tip location was found. There were no adverse events directly or indirectly related to the IC-ECG technique; no arrhythmias occurred.

Conclusions: When applied to ultrasound guided CICCs, tip location by IC-ECG is applicable and feasible in neonates, and it is safe and accurate.

Keywords


THANK
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