GAVeCeLT
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V Convegno Nazionale
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GAVePed
Gruppo Accessi Venosi Pediatrici

Utilizzo dell'ecografo nel posizionamento di cateteri venosi ombelicali nel neonato

Giovanni Barone

Ospedale Infermi di Rimini

GdS Accessi Vascolari Neonatali

UTILIZZO DELL'ECOGRAFO NEL POSIZIONAMENTO DI CATETERI VENOSI OMBELICALI NEL NEONATO

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

AGENDA

Uso dell’ecografia all’impianto

Uso dell’ecografia per la gestione

AGENDA

Uso dell’ecografia all’impianto

Uso dell’ecografia per la gestione

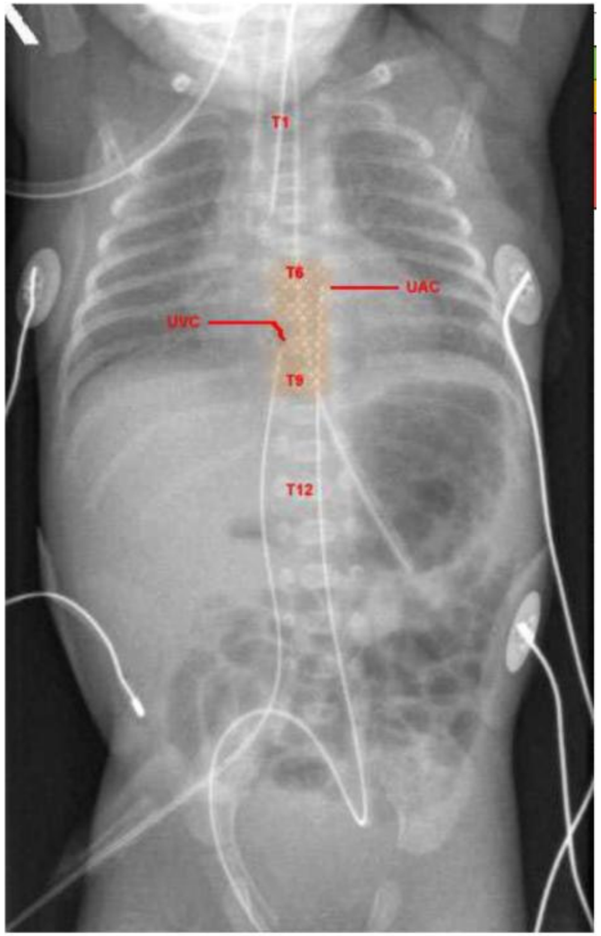
Tip location

Molte delle complicanze da CVO sono legate alla sua malposizione:

- CVO posizionato nel cuore:
    1. Perforazione del cuore
    2. Versamento pericardico con tamponamento cardiaco
    3. Aritme, potenzialmente fatali
    4. Trombosi endocavitarie
    5. Versamento pleurico

- CVO posizionato nel sistema portale:
    1. NEC
    2. Perforazione del colon
    3. Necrosi ed ematomi epatici
    4. Cisti epatiche
    5. Perforazione di vasi del sistema portale
    6. Ipertensione portale

Avery Disease of the Newborn. Neonatology Gomella

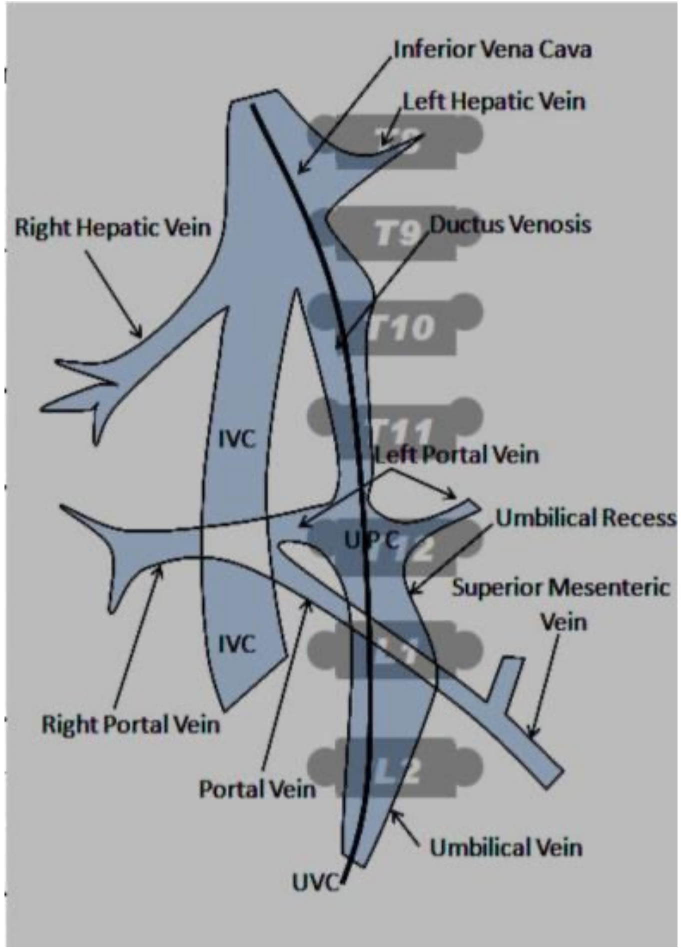


UVC
Optimal above diaphragm T8-10
Acceptable Low position in IVC
Withdraw if in heart or diverted angle into liver, re XRay

UAC
Optimal T6 – T9
Acceptable low position L3 - 4
Withdraw if at T12 -L2 as site of mesenteric and renal arteries

Insertion length:
UAC = 3 x weight + 9cm + stump
or diagonally umbilicus to shoulder length + 1cm + stump

UVC = 1.5 x weight + 5cm+ stump
Emergency UVC access 5cm plus cord length



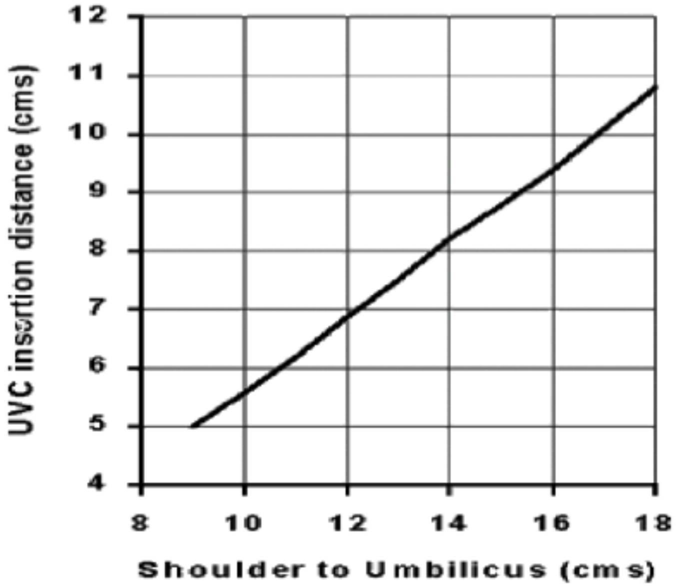
C. Determine the length of catheter to be inserted by anatomical measurement of shoulder to umbilicus length, by equations based on body weight, or with other research-based protocols to achieve successful tip placement.[12-16] (V)

D. Place the catheter tip for:

   1. UVCs in the inferior vena cava near the junction with the right atrium.

- Formula di Shukla = (3 * Peso (kg) + 9)/2 +1
- Lunghezza ombelico spalla
- Lunghezza ombelico-processo xifoideo et c…

La letteratura e i libri sono pieni di formule e nomogrammi!
Quale usare???



Infusion therapy standard of practice. Journal of infusion nursing 2016

ORIGINAL ARTICLE

Simple measurements to place umbilical catheters using surface anatomy

AO Gupta[1], MR Peesay[2] and J Ramasethu[2]

Table 2. Expected position of umbilical venous catheter with different morphometric measurements and Shukla formula

	Over-insertion					Under-insertion				
Neonates	UIM									
Total N = 170	35 (2									
> 1500 g n = 109	24 (2									
⩽ 1500 g n = 61	11 (18%)	0	55 (91%)	2 (3%)	30 (49%)	2 (3%)	61 (100%)	0	2 (3%)	3 (5%)

Abbreviations: UIMD, umbilicus to midpoint of inter-mammary distance; UN, umbilicus to nipple distance; UXp, umbilicus to xiphoid process distance.

There is no universal formula, measurement or nomogram available for placement of umbilical catheters, which is satisfactory for infants of all BWs and gestational ages.[6–9] In our

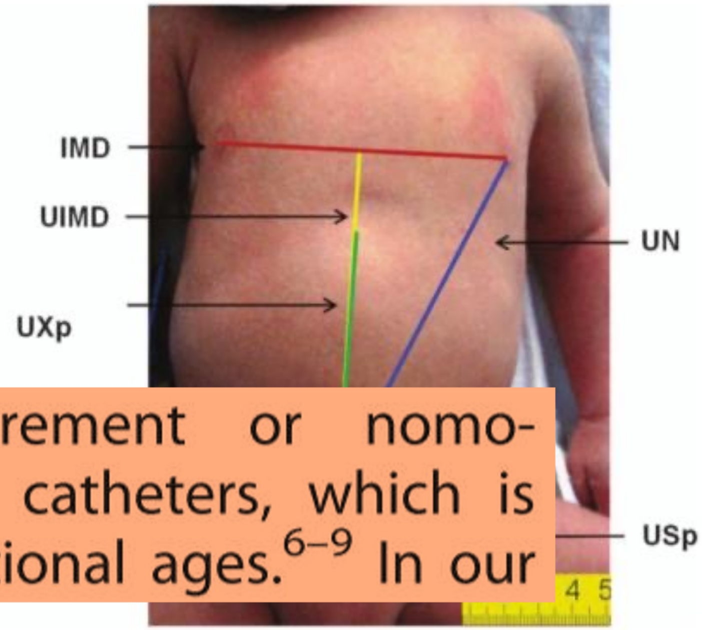
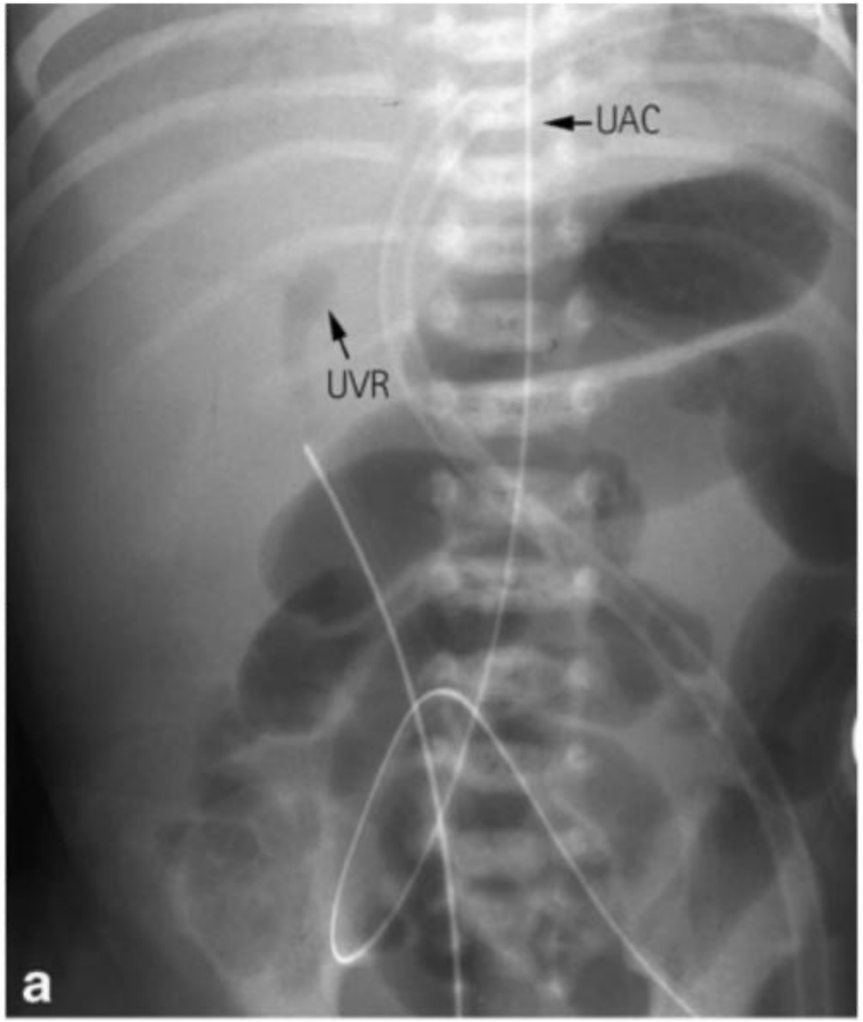
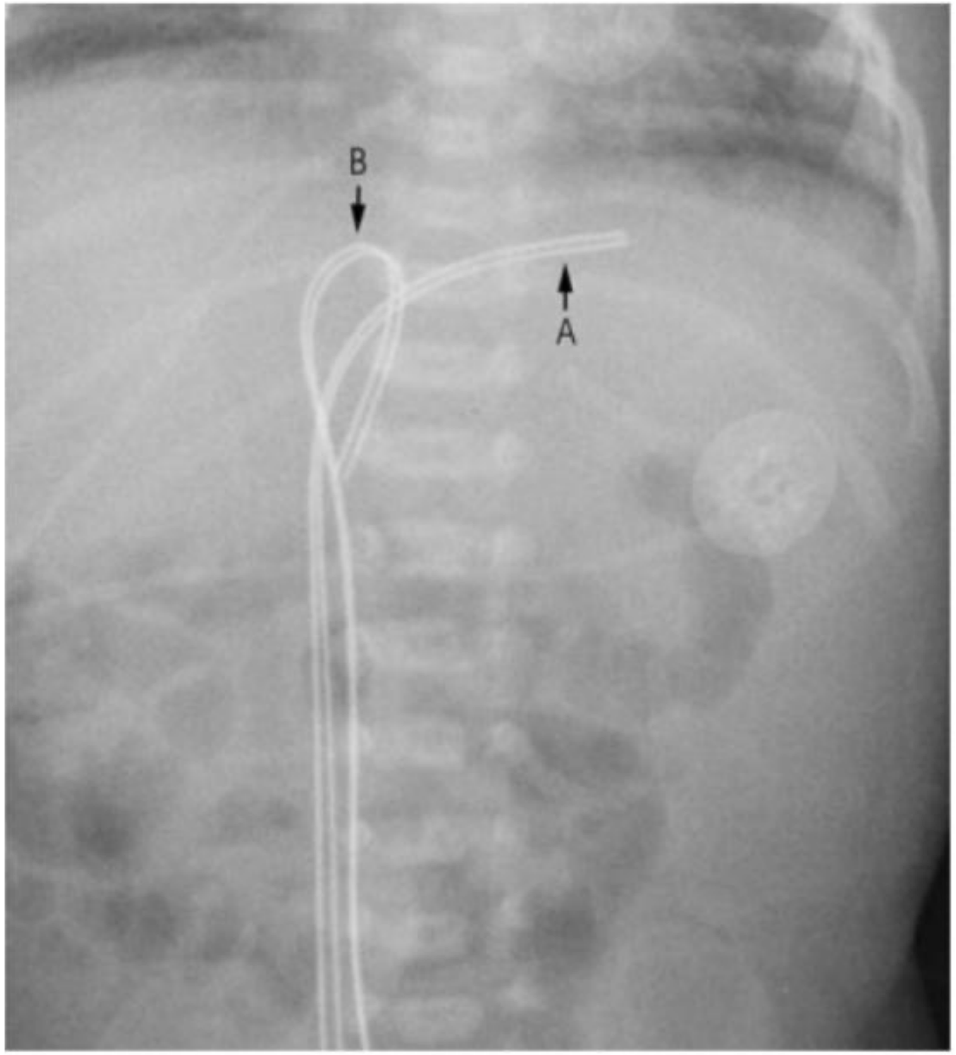


Figure 1. Morphometric measurements. IMD, inter-mammary distance; UIMD, umbilicus to midpoint of IMD; UN, umbilicus to nipple; USp, umbilicus to symphysis pubis; UXp, umbilicus to xiphoid process.

Simple measurements to place umbilical catheters using surface anatomy. JoP 2015



Umbilical vein catheterization—appropriate and inappropriate placement. Pediatric Radiology 2010



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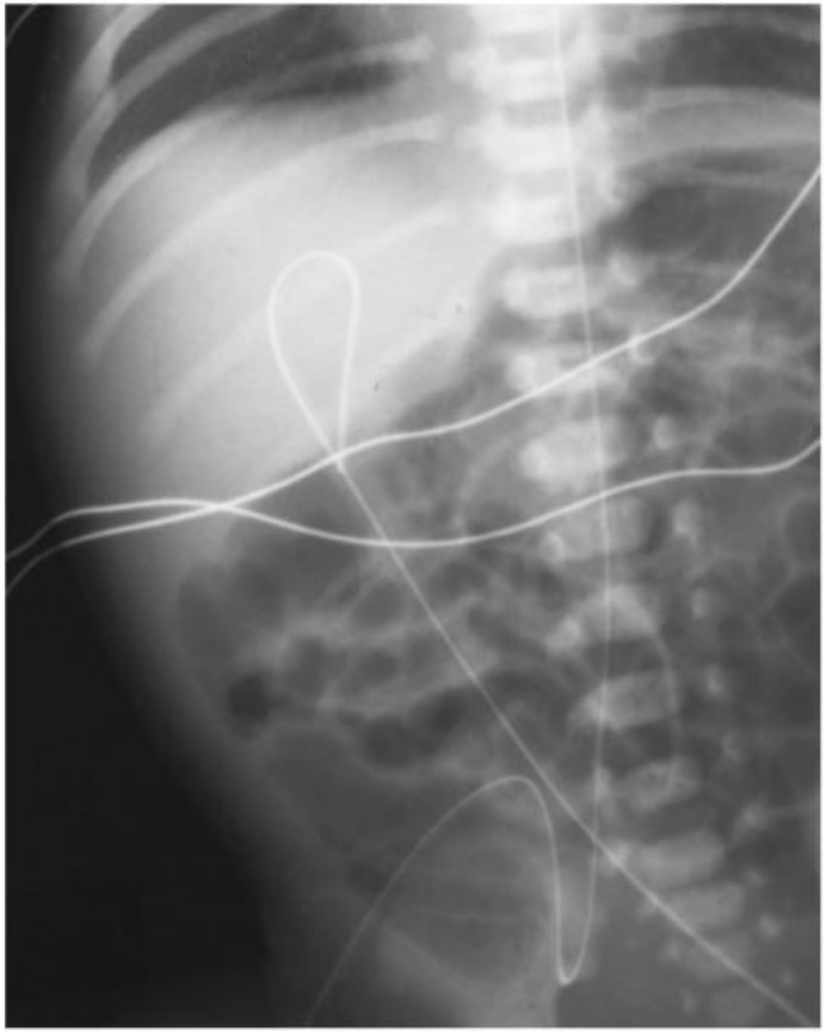

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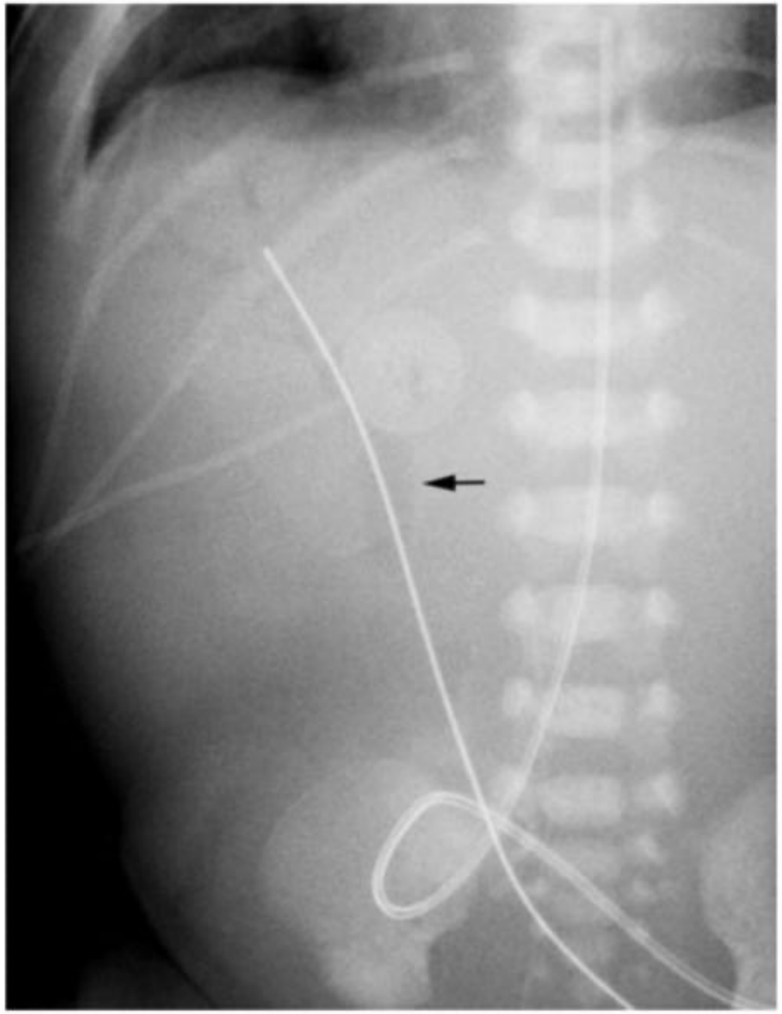

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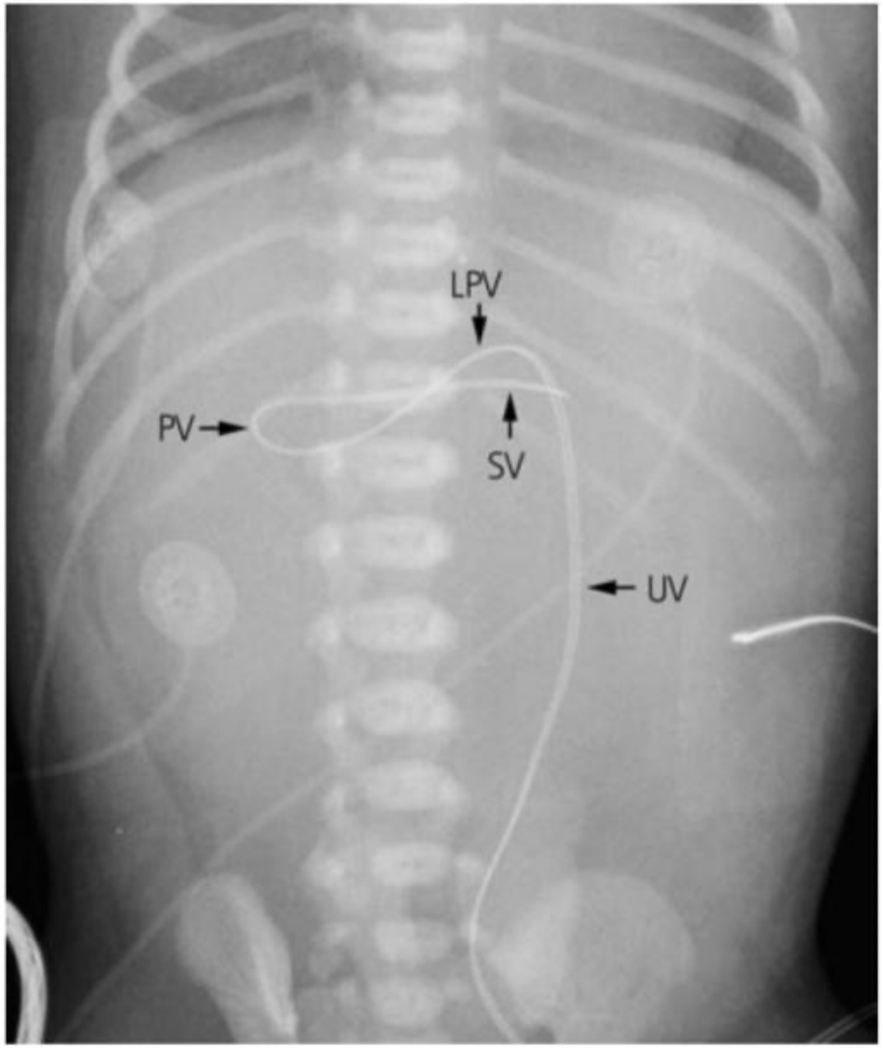

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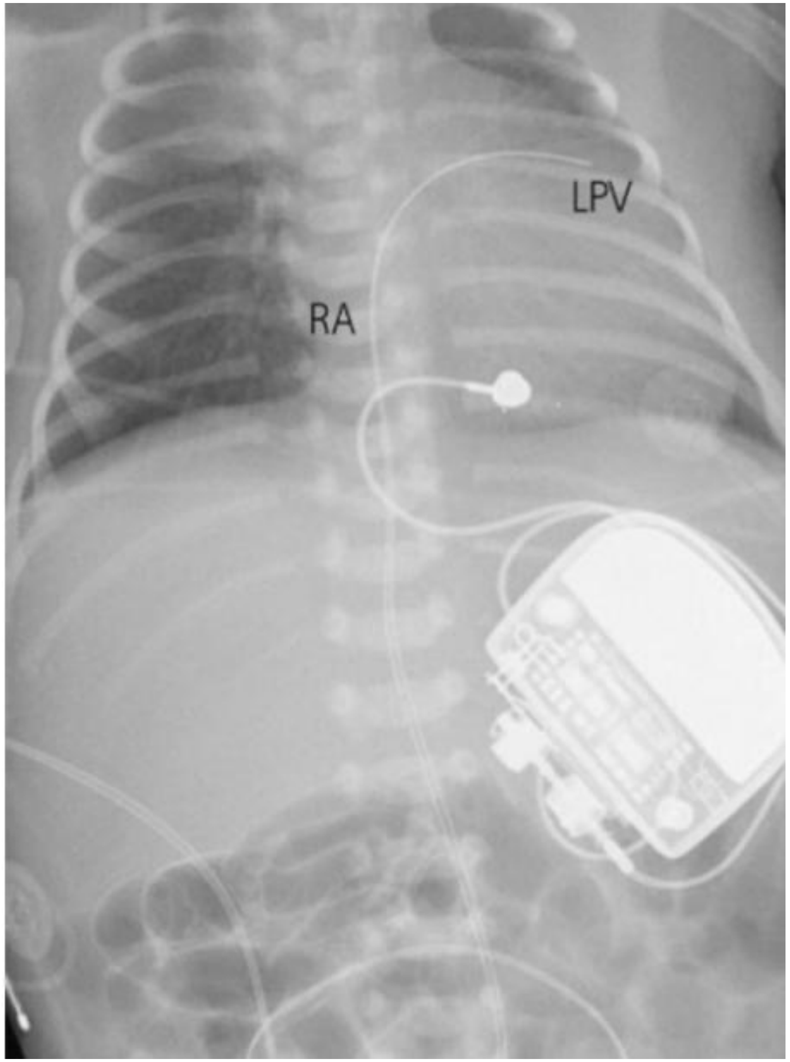
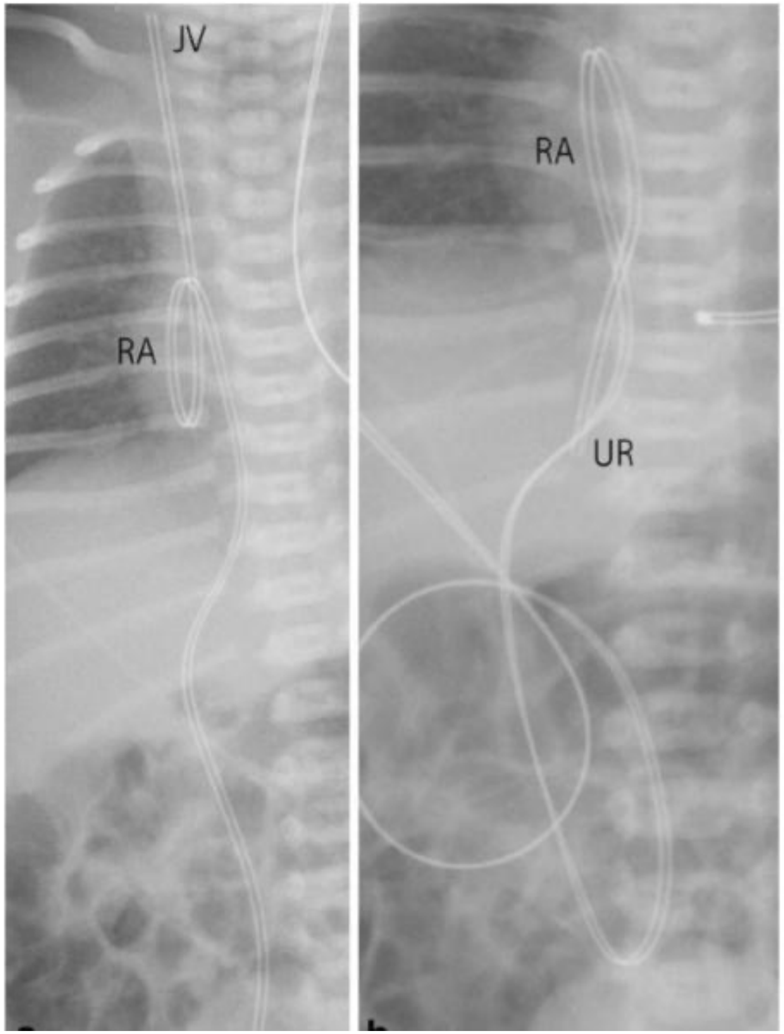


Umbilical vein catheterization—appropriate and inappropriate placement. Pediatric Radiology
2019



Umbilical vein catheterization—appropriate and inappropriate placement. Pediatric Radiology 2010

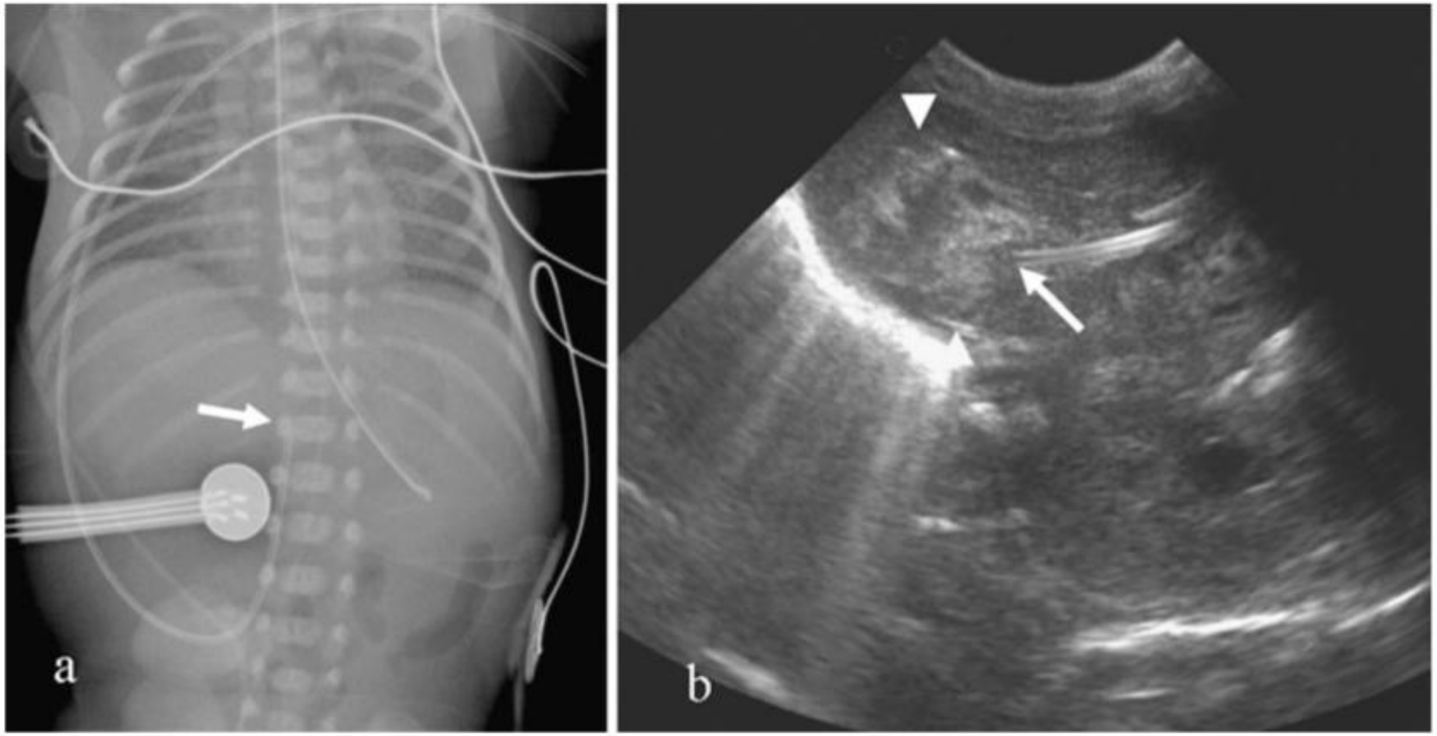


Fig. 5 **a** Abdominal radiograph in a 2-day-old, 1,300 g baby boy. The catheter was judged to be satisfactorily positioned. **b** Ultrasound obtained with a 5–8 MHz transducer reveals the extraluminal position of the catheter (*arrow*) and hyperechoic collection of total parenteral nutrition fluid (*arrowheads*) in the liver parenchyma

Fig. 5 US-guided drainage of a hepatic collection in a 38-week-old, 4.69-kg infant. **a** US on day 9 of life demonstrates a large heterogeneous fluid complex collection measuring 8.9 × 8.4 × 5.4 cm involving the right lobe of the liver. **b** US shows the hepatic collection during an US-guided drainage demonstrates hepatic abscess aspiration of a complex collection in the liver. A total of 8 cc of purulent blood-tinged fluid was removed. **c** Follow-up US shows the hepatic collection after undergoing US-guided drainage. Abdominal US performed 1 month following the US-guided aspiration shows slow evolution of the 7.1-cm complex mass in the right lobe of the liver. The echogenic margins suggested early calcification

Clinical-radiologic features and treatment of hepatic lesions caused by inadvertent infusion of parenteral nutrition in liver parenchyma due to malposition of umbilical vein catheters. Pediatric Rafiology 2013

pediatric reports

MDPI

Brief Report

Predictors of Umbilical Venous Catheter Misalignment

Aimann Surak [1,*], Michael Miller [2] and Henry Roukema [2]

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[2] Department of Pediatrics, London Health Sciences Centre, London, ON N6A 5W9, Canada
* Correspondence: aimannsurak@gmail.com

Abstract: Introduction: The insertion of an umbilical venous catheter (UVC) is a routine procedure. The success rate of this procedure is about 40–50%, with potential complications arising from misaligned UVC placement. Objectives: To explore potential factors that may aid in the prediction of UVC misalignment. We hypothesized that UVC misalignment is proportionally related with increased chronological age. Methods: Retrospective chart review for newborns who had an UVC procedure followed by an x-ray. All analyses were conducted using standard comparative statistical methods and logistic regression modelling with SPSS v.24 (IBM Corp., Armonk, NY, USA), and *p*-values < 0.05 were considered statistically significant. Results: The final sample size was 480 patients. There were significant differences between the two groups in terms of gestational age {OR 1.06, 95% CI (1.02–1.10)}, small for gestation (SGA) status {OR 1.07, 95% CI (0.98–1.15)}, and 5-min APGAR scores {OR 0.48, 95% CI (0.23–1.00)}. There were no other significant group differences. Logistic regression modeling identified that chronologic age positively predicted, and SGA negatively predicted, UVC misalignment. *Conclusion:* A misaligned UVC is more likely to occur in late preterm and term babies, whereas a baby being SGA increases the likelihood of a well-aligned UVC.

Keywords: UVC; ductus venosus; preterm; NICU

Tip location…cosa dicono le LG

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

Clinical Trial > Acta Biomed Ateneo Parmense. 2000;71 Suppl 1:647-50.

[Positioning of umbilical vein catheter with ECG-guided technique: randomized study]

[Article in Italian]

P Biban [1], C Cavalli, P Santuz, M Soffiati, S Rugolotto, T Zangardi

Affiliations + expand

PMID: 11424822

Abstract

Goal: To evaluate the effectiveness of electrocardiography-guided technique to aid in the correct positioning of umbilical vein catheters.

Design: A prospective, randomized controlled study.

Methods: Term and preterm newborns who required an umbilical venous catheter were managed by an ECG-guided technique (group A) or by a conventional method (group B). Correct positioning was defined by a chest-X-ray when the catheter tip was located above the diaphragm and outside the right atrium. For the ECG-guided technique we utilized a conductive device Vygocard (Medival, Padova) inserted in a 3-way stopcock connected with the catheter. The catheter was inserted under ECG observation until the appearance of a tall P-wave in lead III, which indicated the tip was within the right atrium. The catheter was then withdrawn until the P wave size returned to normal.

Results: We enrolled 44 patients (16 F, 28 M). Median gestational age (GA) and birth weight (BW) were 34 weeks (range 26-41) and 2130 g. (590-3870), respectively. Sex distribution, GA, BW and Apgar scores were not different between patients in group A (n = 22) and group B (n = 22). Catheters could not be advanced till the estimated insertion depth in 11 patients (A = 5, B = 6). In the remaining 33 patients, correct tip placement was more frequent in group A (88%) compared with group B (50%) (p = 0.021 by Fisher's exact test). No side effects specific to the ECG-guided method were noted.

Conclusions: The ECG-guided technique seems to be a safe and effective method for the proper placement of umbilical vein catheters in newborns.

Journal of Paediatrics and Child Health

doi:10.1111/jpc.14710

ORIGINAL ARTICLE

Application of a modified electrocardiogram-guided technique for umbilical venous catheterisation in neonates: A retrospective trial

Liyuan Wu,[1,2] Min Peng,[1,2] Tian Cao,[1,2] Yonghui Yang,[1] Qin Wang,[1,2] Kaiju Luo[1] and Pingyang Chen[1]

[1]Division of Neonatology, Department of Pediatrics, and [2]Clinical Nursing Teaching and Research Section, The Second Xiangya Hospital, Central South University, Changsha, China

Fig. 2 (a) The standard baseline electrocardiogram (ECG) (lead II mode). (b) A specific Q wave and a tall and sharp P wave appears when the tip of catheter is in the upper part of the right atrium. (c) Biphasic P waves appear when the catheter tip is withdrawn to the middle of the atrium. (d) Negative P waves appear when the catheter tip is withdrawn to the lower part of the atrium. (e) The catheter continues to be withdrawn until the negative P waves disappear. The tip of the catheter is at the level of the junction between the inferior vena cava and the right atrium. The ECG waveform indicates the optimal position of the catheter.

Table 1 Comparison of general characteristics of the electrocardiogram (ECG) and control groups

Variable	Control group (n = 33)	ECG group (n = 33)	
Gender, n (%)			
Male	17 (51.5)	15 (45.5)	χ^2 = 0.243 ; P = 0.622
Female	16 (48.5)	18 (54.5)	
Gestational week, weeks	28.9 ± 2.21	29.4 ± 2.26	t = 1.211 ; P = 0.230
Birthweight, g	1150 ± 250	1250 ± 260	t = 1.540 ; P = 0.129
Age at catheter placement, h†	7.00 ± 7.52	7.73 ± 5.76	Z = 1.152 ; P = 0.250
Duration of indwelling catheter, days†	5.58 ± 3.71	7.38 ± 1.72	Z = 1.597 ; P = 0.110

†Non-normally distributed data were compared using Wilcoxon's rank-sum test for independent samples.

Table 2 Comparison of the correct tip placement rate on first try between the two groups

Groups	Rate of correct tip placement	χ^2 test	OR and 95% CIs
Control group (n = 33)	57.6%	χ^2 = 14.580; P = 0.000	1
ECG group (n = 33)	97.0%		23.6 (2.87–193.84)

CI, confidence interval; ECG, electrocardiogram; OR, odds ratio.

Table 4 Comparison of the incidence of catheter-related complications between the two groups

Groups	Incidence of catheter related complication†	χ^2 test	OR and 95% CIs
Control group (n = 33)	18.2%	χ^2 = 0.471; P = 0.492	1
ECG group (n = 33)	12.1%		0.62 (0.16–2.44)

†The control group included four cases of abdominal distension and two cases of haemorrhage. The ECG group included one case of abdominal distension and three cases of haemorrhage. CI, confidence interval; ECG, electrocardiogram; OR, odds ratio.

Tip location was confirmed with Chest X- Ray
Retrospective study

2) TIP LOCATION

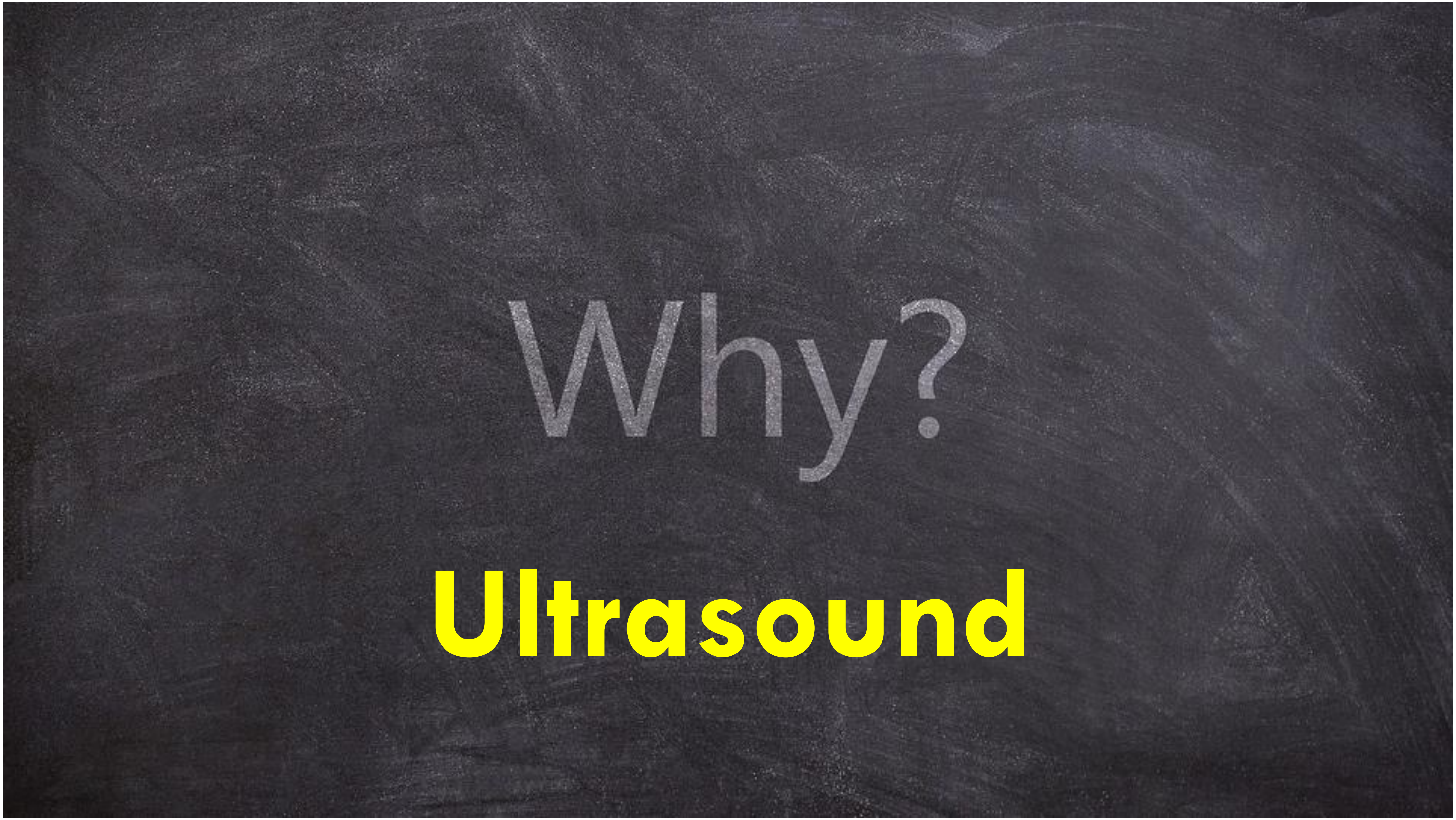
3. Consider the use of ultrasound for CVAD tip location. The clinical applicability of this is currently limited by the small sample sizes used to demonstrate its efficacy as a reliable and safe method to replace chest radiographs in all ages, and its usefulness is limited by the knowledge, skill, and 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)

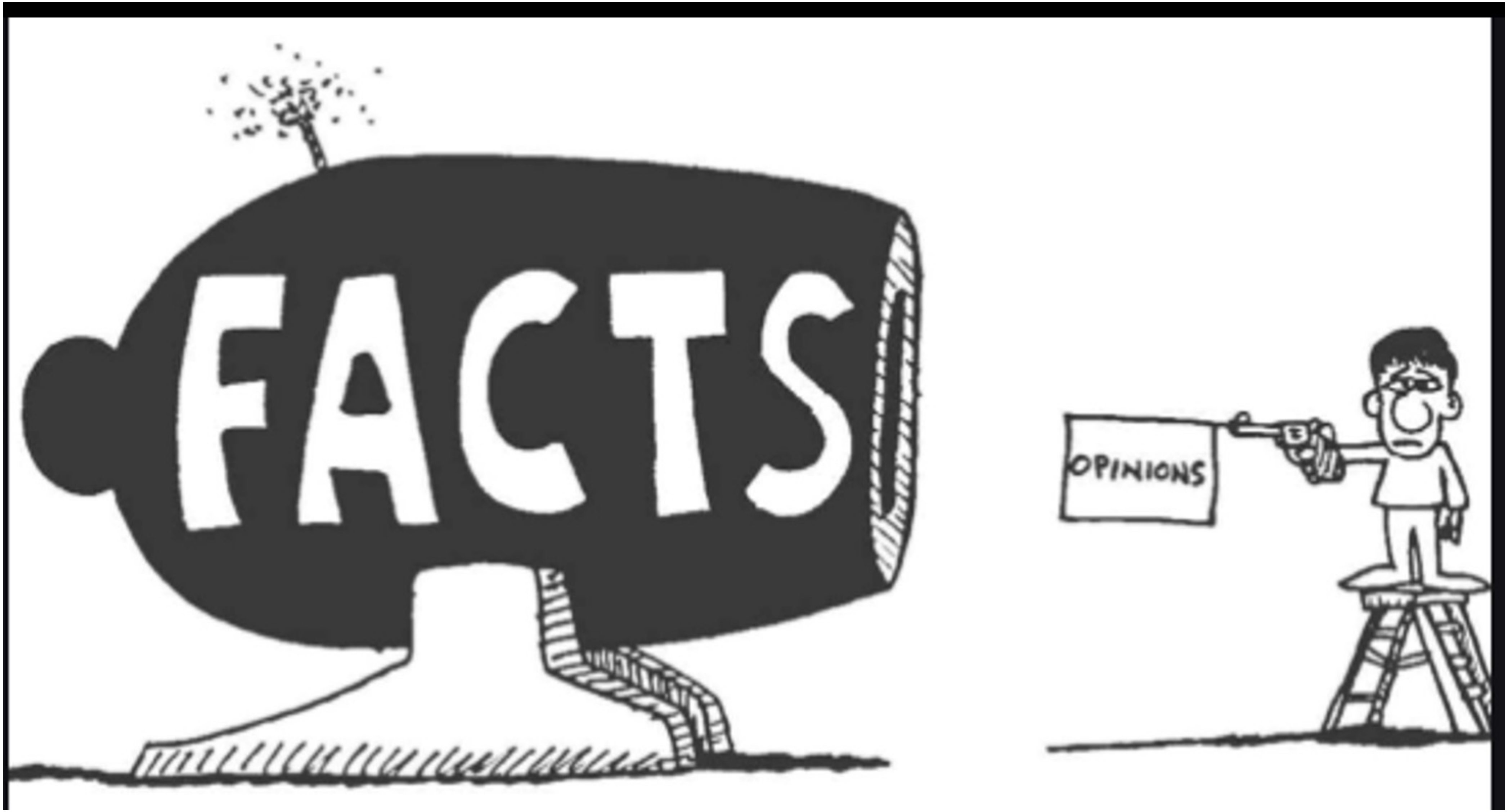
23. CENTRAL VASCULAR ACCESS DEVICE TIP LOCATION

Infusion Therapy Standards of Practice

ECHO TIP Protocol

Infusion therapy standard of practice. Journal of infusion nursing 2021


Why?
Ultrasound


FACTS
OPINIONS

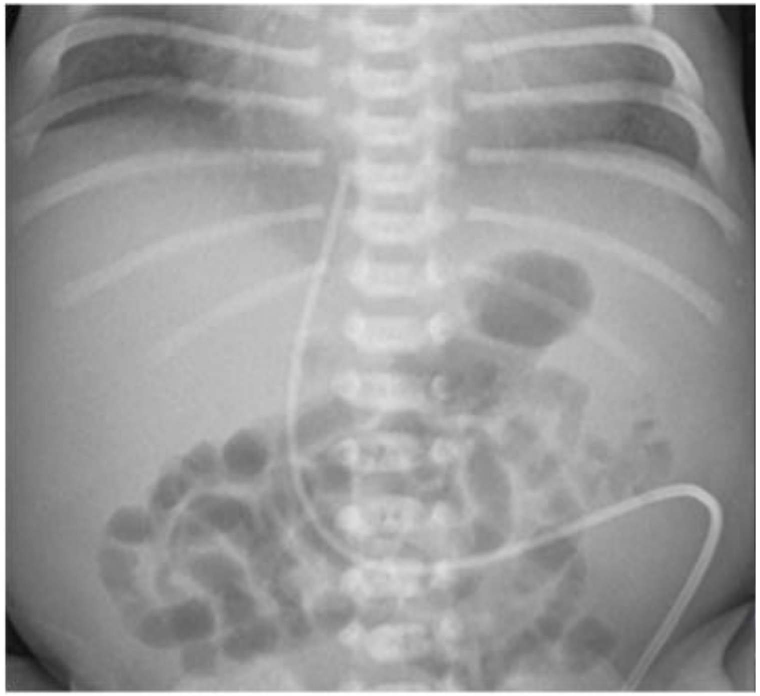
Why not the Chest X Ray?

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

Why not the Chest X Ray?



Why not the Chest X Ray?

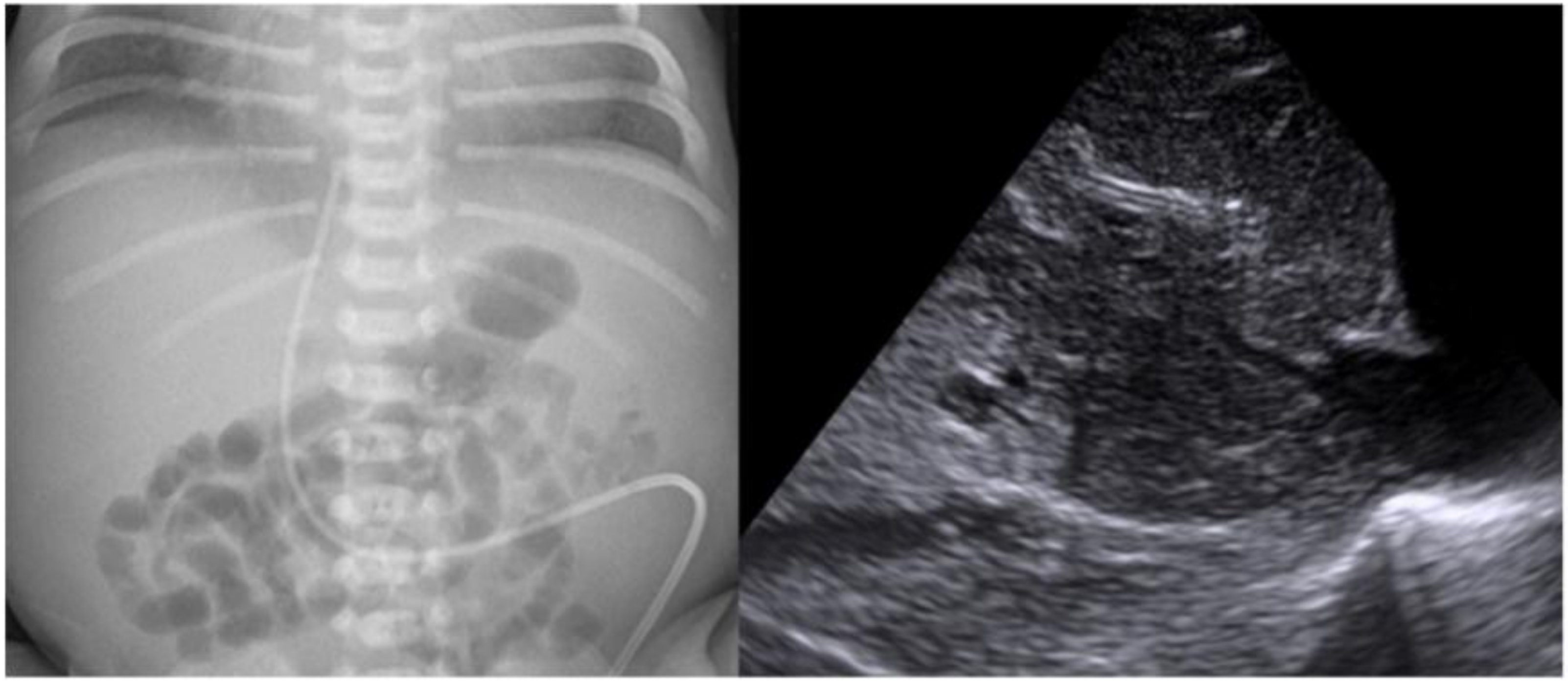


Figure 4 An umbilical venous catheter (UVC) outside the cardiac silhouette, below the level of the diaphragm and pointing towards the base of the right atrium on X-ray (and therefore felt to be in a safe position) which is shown on ultrasound to be penetrating the liver parenchyma.

Why not the Chest X Ray?

Why not the Chest X Ray?

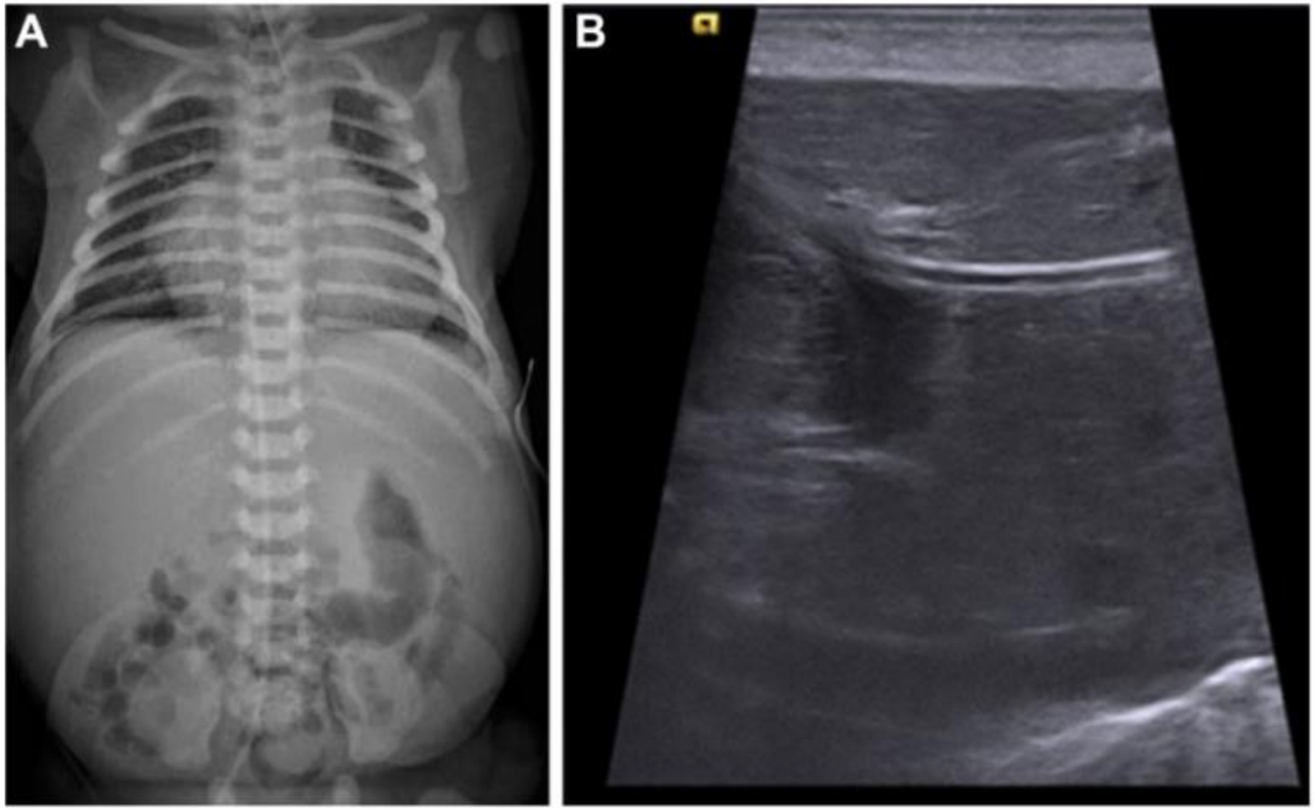


Figure 7 On X-ray the umbilical venous catheter (UVC) lies at T9 but the line curves away from the heart and the tip does not point towards the right atrium (A). On a sagittal ultrasound scan the UVC in this baby has crossed the anterior portal sinus entering a vessel arising from it (B).

Why not the Chest X Ray?

Journal of Paediatrics and Child Health

doi:10.1111/jpc.14

ORIGINAL ARTICLE

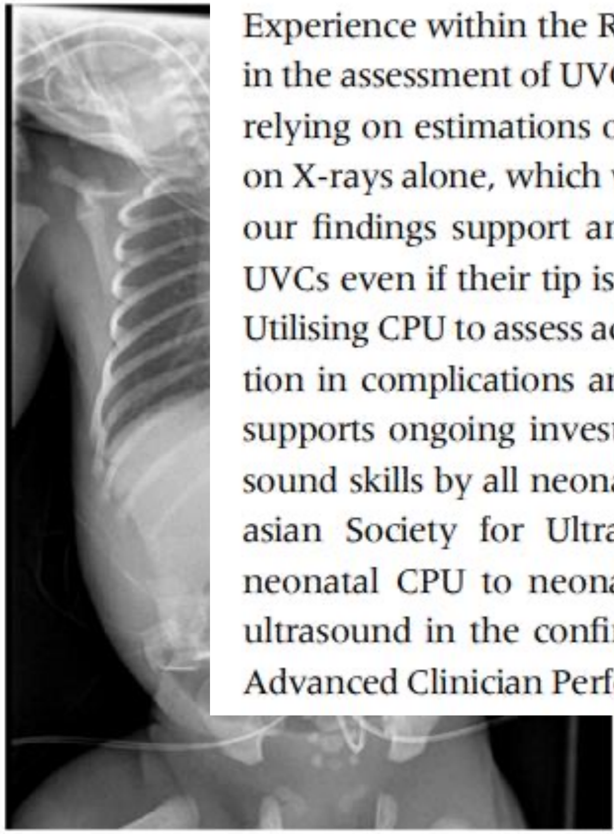
Use of clinician-performed ultrasound in the assessment of safe umbilical venous catheter tip placement

Amber Seigel[1] Nick Evans[1,2] and Tracey Lutz[1,2]

[1]Department of Newborn Care, Royal Prince Alfred Hospital and [2]Department of Obstetrics, Gynaecology and Neonatology, University of Sydney, Sydne
New South Wales, Australia

Why not the Chest X Ray?

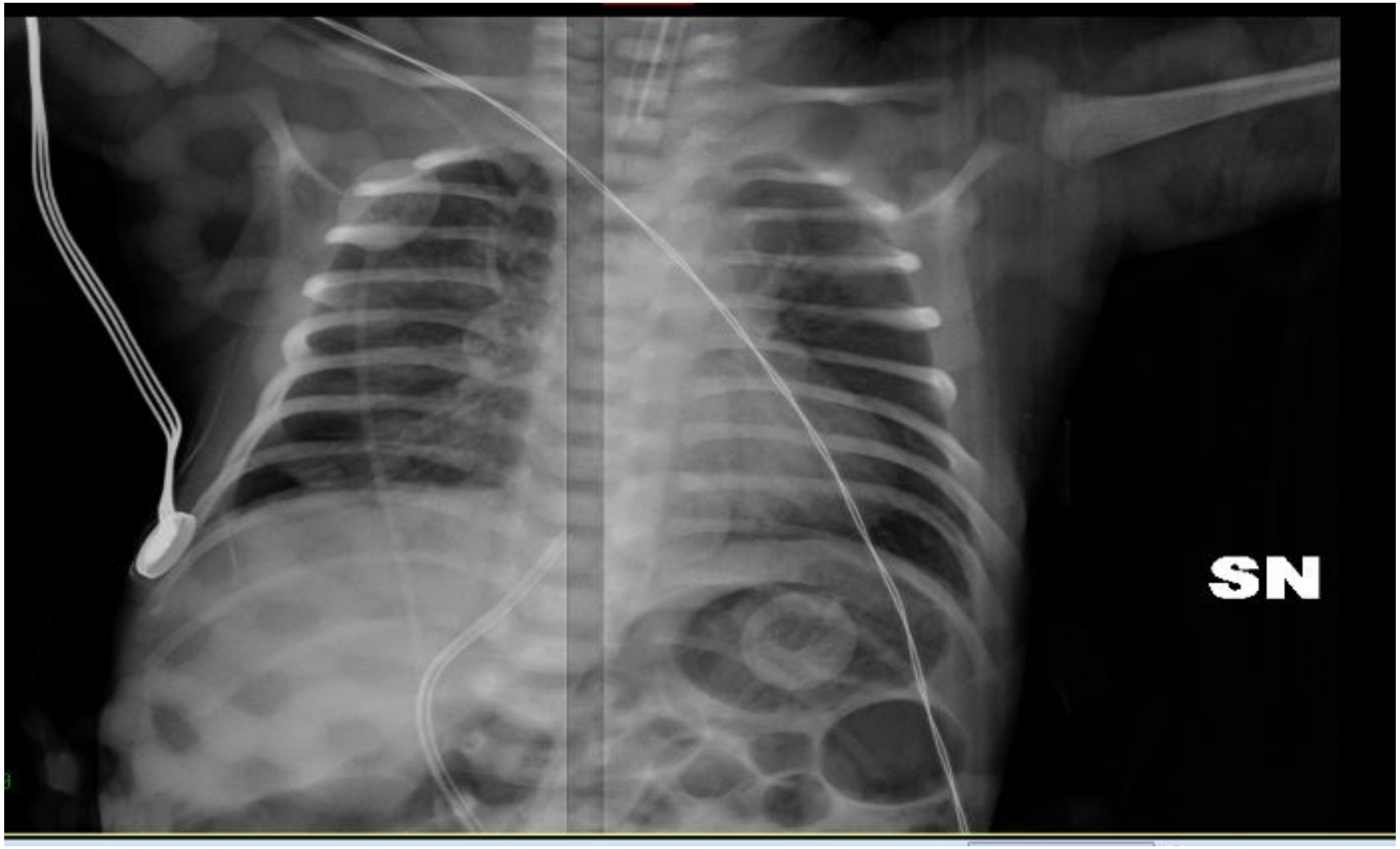
(a) (b)



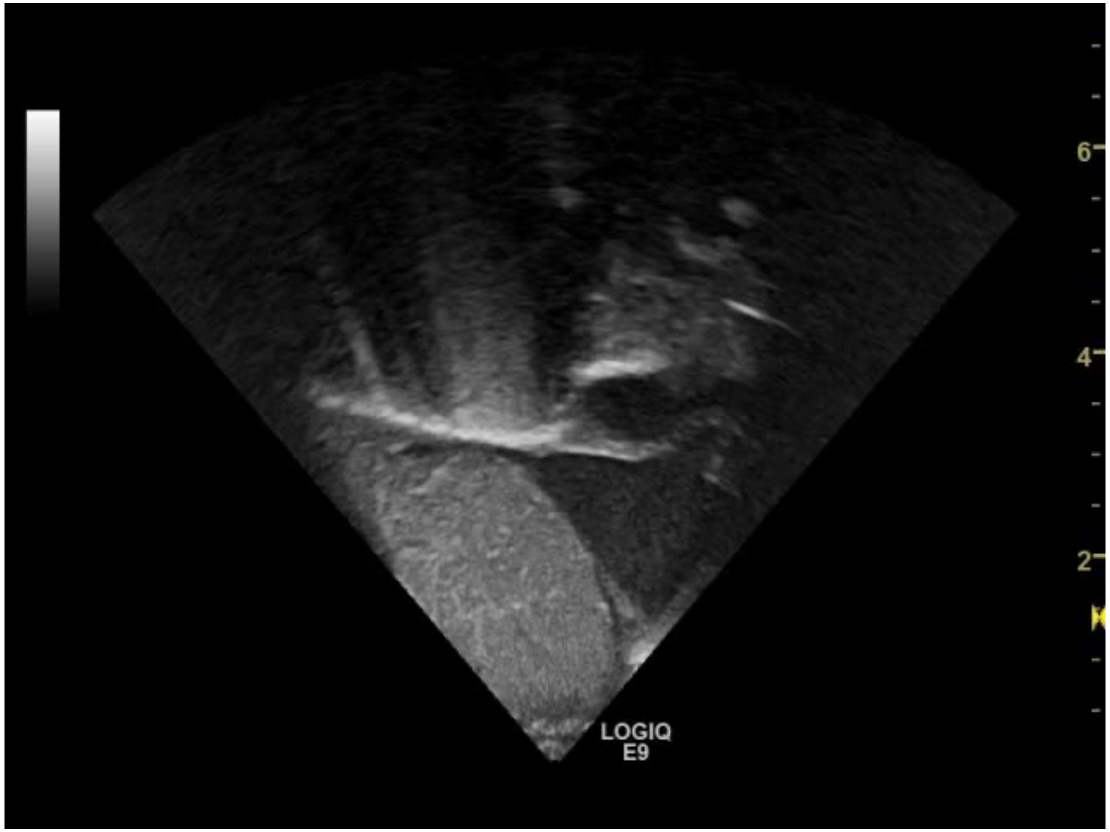
Experience within the RPAH NICU supports the ongoing use of CPU in the assessment of UVC tip position in addition to X-ray rather than relying on estimations of vessel position according to vertebral level on X-rays alone, which we have demonstrated is flawed. In addition, our findings support amending the policy to mandate CPU for all UVCs even if their tip is noted to be above the diaphragm on X-ray. Utilising CPU to assess accurate placement of UVCs results in a reduction in complications and should be standard care. Our experience supports ongoing investment in the development of bedside ultrasound skills by all neonatal fellows and neonatologists. The Australasian Society for Ultrasound in Medicine offers certification in neonatal CPU to neonatologists and neonatal fellows. The use of ultrasound in the confirmation of line placement is covered in the Advanced Clinician Performed Neonatal Ultrasound curriculum.[19]

Fig. 2 Discrepancy between X-ray and clinician-performed ultrasound (CPU) findings of umbilical venous catheter (UVC) tip position below diaphragm. (a) X-ray: UVC tip projects lateral to midline, between T9 and T10 vertebral bodies. (b) CPU: UVC tip in small portal vessel (white crosses), branching from pars umbilicus (—▸), lying anterior to the course of ductus venosus (- - - -).

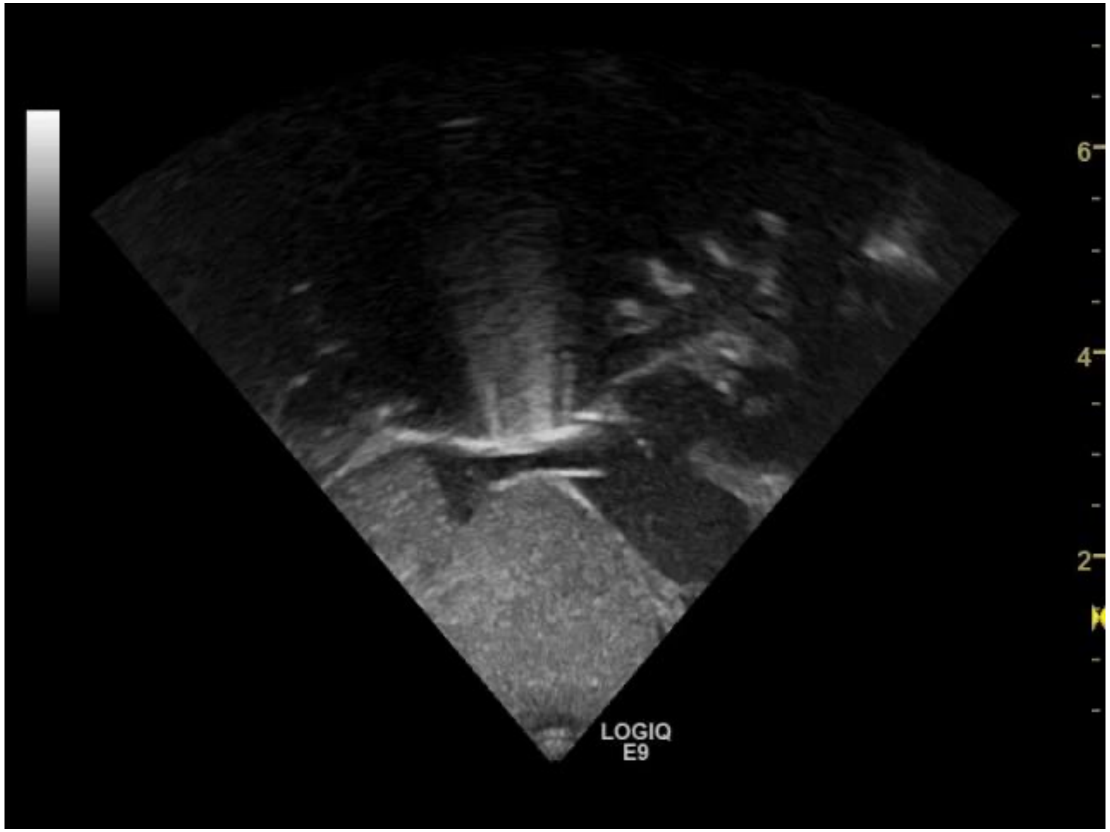
Tip location…Clinical case



Tip location…Clinical case

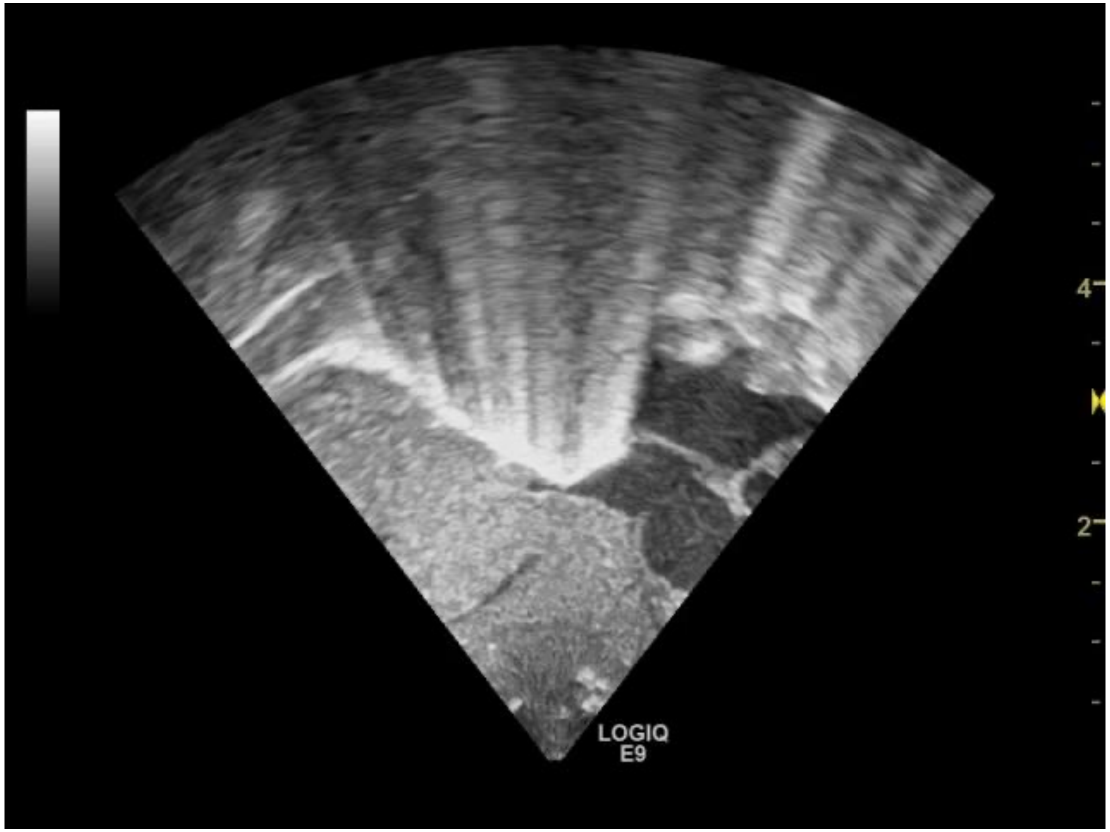


Tip location…Clinical case



Tip location…Clinical case

Tip location…Clinical case



Tip location

5. Avoid fluoroscopy except where CVAD placement is difficult or has failed at the bedside, as it requires exposure to ionizing radiation.[4,53,62,70] (IV)
6. Postprocedure radiograph imaging is not necessary if alternative tip location technology confirms proper tip placement.[46,50,71] (II)

Confirmation of tip location by postprocedure chest radiograph remains acceptable practice and is required in the absence of technology used during the procedure. This method is less accurate because the CAJ cannot be seen on the radiograph, requiring identification of tip location by measurement from the carina, trachea-bronchial angle, or thoracic vertebral bodies. Patient repositioning or movement results in distal or proximal migration of the catheter tip by as much as 2 cm dependent on the movement.[4,12,69,72-75] (II)

Infusion therapy standard of practice. Journal of infusion nursing 2021

POCUS

RESEARCH Open Access

International evidence-based guidelines on Point of Care Ultrasound (POCUS) for critically ill neonates and children issued by the POCUS Working Group of the European Society of Paediatric and Neonatal Intensive Care (ESPNIC)

Yogen Singh[1,2*†], Cecile Tissot[3†], María V. Fraga[4], Nadya Yousef[5], Rafael Gonzalez Cortes[6], Jorge Lopez[6], Joan Sanchez-de-Toledo[7], Joe Brierley[8], Juan Mayordomo Colunga[9], Dusan Raffaj[10], Eduardo Da Cruz[11], Philippe Durand[12], Peter Kenderessy[13], Hans-Joerg Lang[14], Akira Nishisaki[15], Martin C. Kneyber[16], Pierre Tissieres[12], Thomas W. Conlon[15] and Daniele De Luca[5,17]

17.	POCUS is helpful to accurately detect pneumothorax in neonates and children	Strong agreement	B
18.	POCUS is helpful to insert chest tube or perform needle aspiration in neonatal tension pneumothorax	Strong agreement	B
19.	POCUS is helpful to detect pleural effusions in neonates and children	Strong agreement	B
20.	POCUS is helpful to guide thoracentesis in neonates and children	Strong agreement	B
23.	POCUS-guided technique should be used for internal jugular vein (IJV) line placement in neonates and children	Strong agreement	A
24.	POCUS-guided technique is helpful for subclavian vein line placement in neonates and children	Strong agreement	B
25.	POCUS-guided technique is helpful for femoral line placement in neonates and children	Strong agreement	B
26.	POCUS-guided technique is helpful for arterial catheters placement in children	Agreement	B
27.	POCUS-guided technique is helpful for peripherally inserted central catheters in children	Agreement	B
28.	POCUS is helpful to locate catheter tip position in neonates and children	Strong agreement	C

Why US?

ORIGINAL ARTICLE

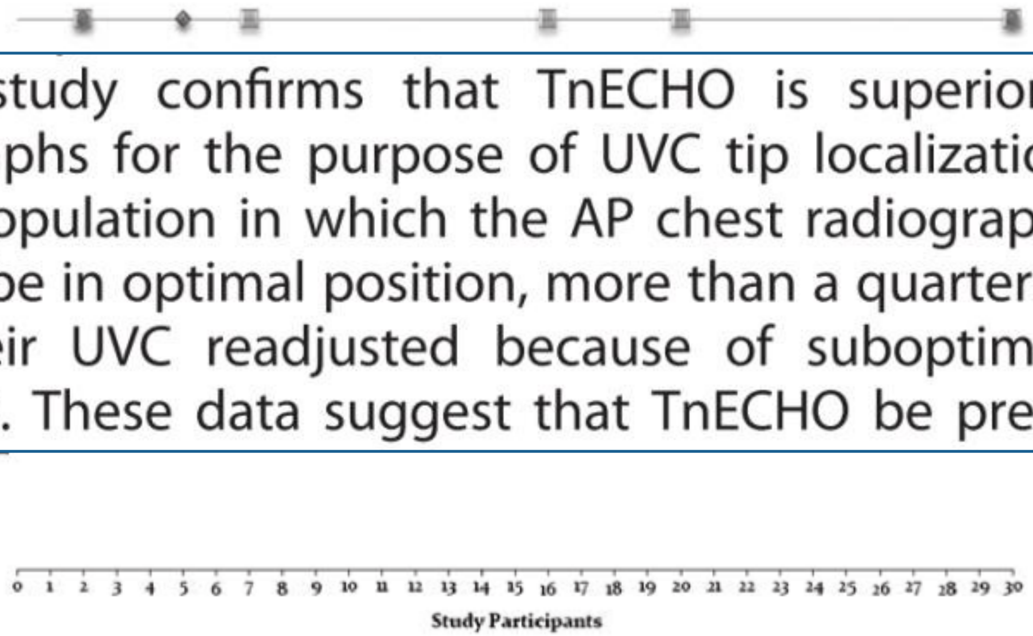
Superiority of targeted neonatal echocardiography for umbilical venous catheter tip localization: accuracy of a clinician performance model

AS Pulickal[1], PK Charlagorla[2], SC Tume[3], M Chhabra[2], P Narula[2] and AM Nadroo[2]

Antero-posterior (AP) chest radiography is the current standard imaging technique used to localize the tip of the UVC; the landmarks being the thoracic vertebral bodies and the diaphragm. However, case reports suggest that complications of UVC insertion could occur even in situations where chest radiographs had confirmed optimal position of the UVC.[11] In view of this phenomenon, attempts have been made to utilize other modalities to confirm UVC tip position. Ades *et al.* showed that

Superiority of targeted neonatal echocardiography for umbilical venous catheter tip localization: accuracy of a clinician performance model. JoP 2013

Why US?



Our study confirms that TnECHO is superior to AP chest radiographs for the purpose of UVC tip localization. Among the study population in which the AP chest radiograph reported the UVC to be in optimal position, more than a quarter of the patients had their UVC readjusted because of suboptimal position on TnECHO. These data suggest that TnECHO be preferred to chest

Figure 2. Targeted neonatal echocardiography (TnECHO) reports of pediatric residents and pediatric cardiologist for all participants in the study demonstrating concurrence of umbilical venous catheter (UVC) tip localization in 23 of 30 study cases (77%). In the seven cases with discordant results, there were only two cases (participants 5 and 7, 6% of study population) wherein there was a large discordance (inferior vena cava (IVC) position vs left atrium (LA)) between the two TnECHO reports. *y* Axis legend: IVC, right atrium (RA), LA.

Superiority of targeted neonatal echocardiography for umbilical venous catheter tip localization: accuracy of a clinician performance model. JoP 2013

Why US?

Determination of Umbilical Venous Catheter Tip Position With Radiograph

Adam B. Hoellering, MBBCh (Hons), FRACP; Pieter J. Koorts, MBChB, FRACP;
David W. Cartwright, MBBS, FRACP; Mark W. Davies, MBBS, PhD, FRACP

US Gold Standard

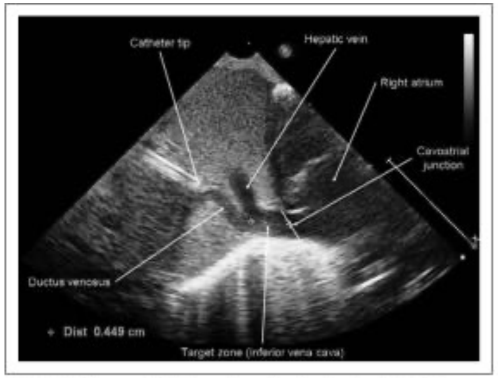


Figure 2. Ultrasound of the target zone (i.e., the length of the inferior vena cava between the insertion of the ductus venosus and the cavoatrial junction) measured as 4.49 mm.

Cardiac Silhouette

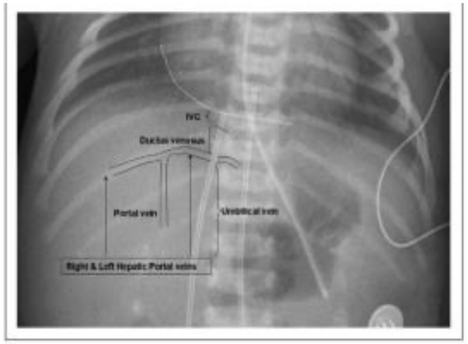


Figure 1. Assessment of umbilical venous catheter tip position by the cardiac silhouette method where the position of the cavoatrial junction is estimated by extrapolating the curve of the right atrial border medially (*dotted white line*) to its intersection with the inferior vena cava (IVC).

Vertebral body

Vertebral Body Method

The UVC tip position was defined as "well positioned" if the tip was at the level of T8–T9, "high" if above the body of T8, and "low" if below the body of T9.

Determination of Umbilical Venous Catheter Tip Position With Radiograp. Pediatric Critical Care Medicine 2014

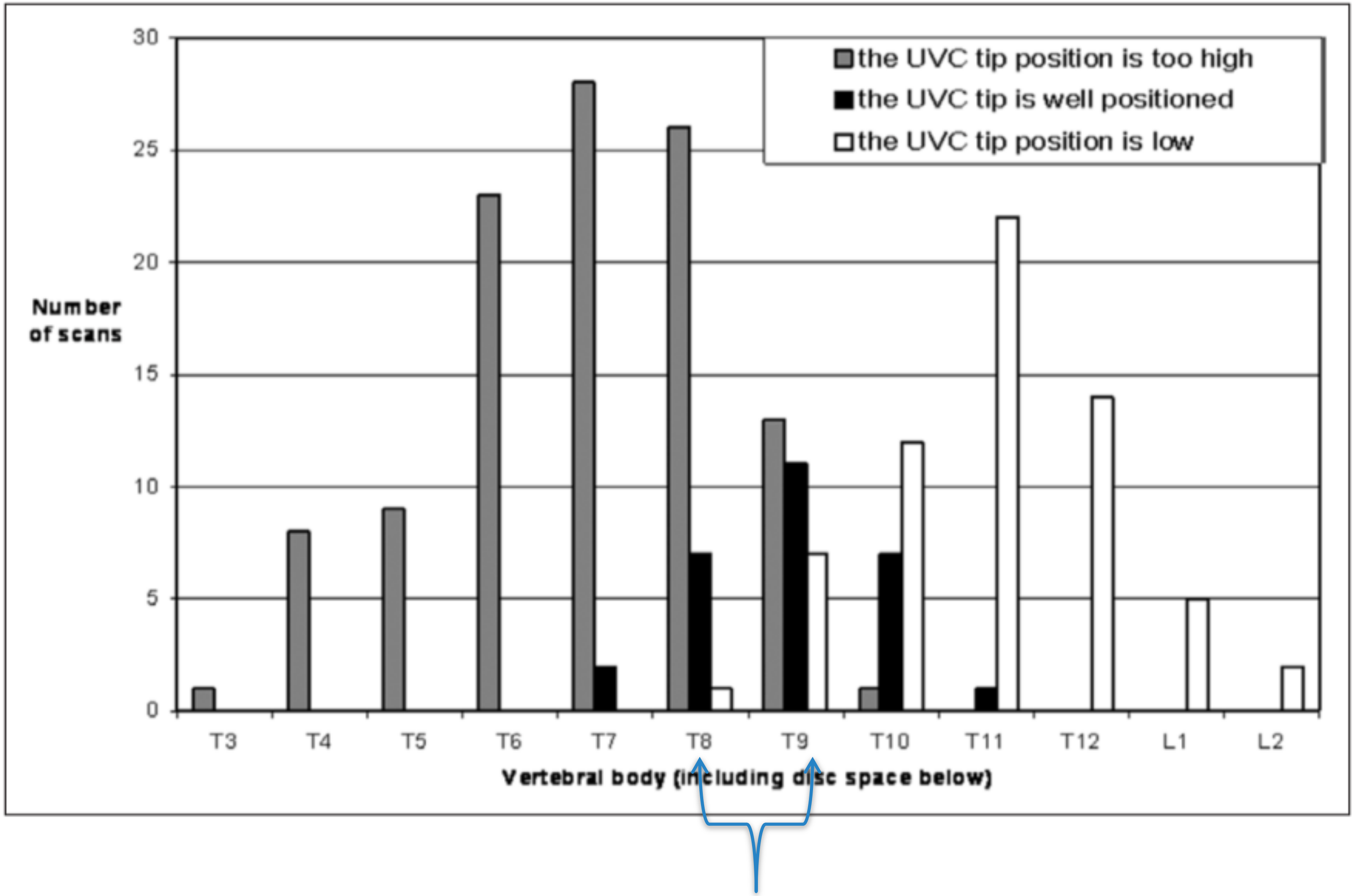
Why US?

TABLE 1. Test Characteristics (95% CI) for Vertebral Body Level and Cardiac Silhouette Method of Radiographic Analysis Compared With Ultrasound

Variable	Vertebral Body Level Method	Cardiac Silhouette Method
Sensitivity	0.61 (0.41–0.79)	0.86 (0.67–0.96)
Specificity	0.74 (0.66–0.82)	0.94 (0.89–0.97)
Positive predictive value	0.27 (0.17–0.40)	0.69 (0.51–0.83)
Negative predictive value	0.92 (0.86–0.96)	0.98 (0.94–0.99)

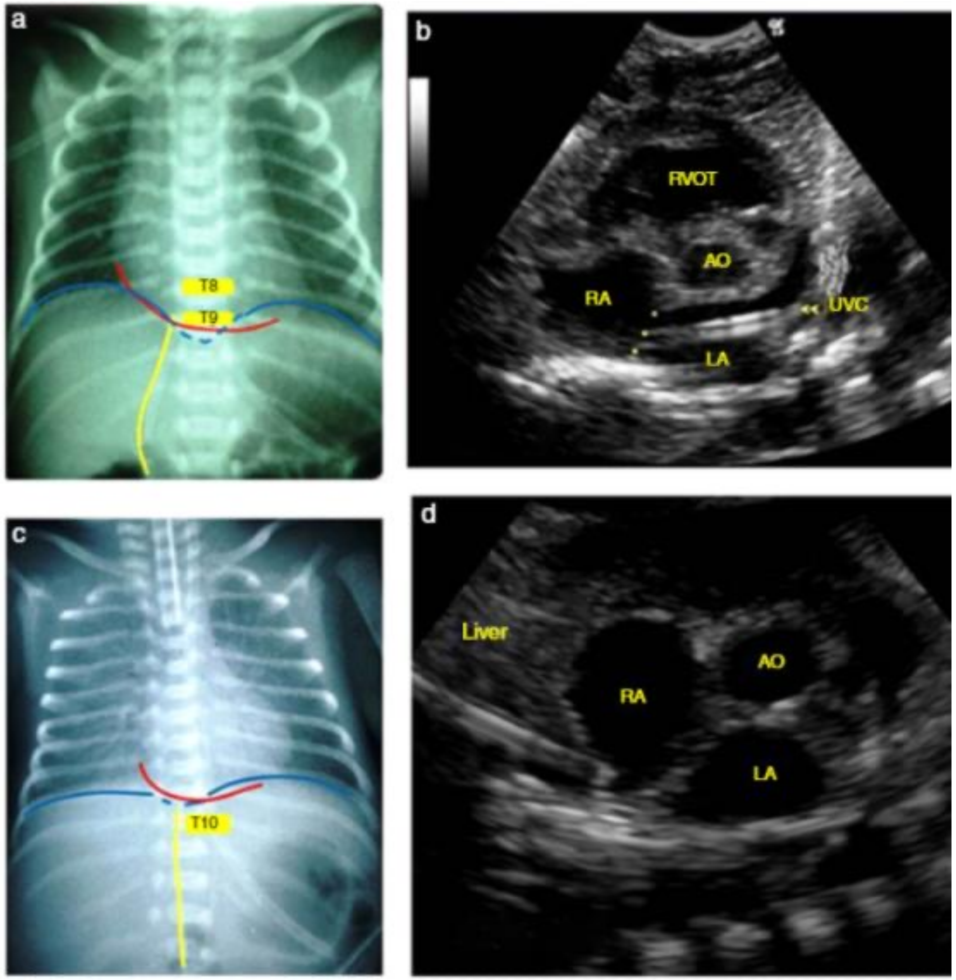
Determination of Umbilical Venous Catheter Tip Position With RadiograpH. Pediatric Critical Care Medicine 2014

“Can we do it better?”...tip location..US



Determination of Umbilical Venous Catheter Tip Position With Radiograph. Pediatric Critical Care Medicine 2014

“Can we do it better?”…tip location..US



Determination of Umbilical Venous Catheter Tip Position With Radiograph. Pediatric Critical Care Medicine 2014

Why US?

In experienced hands, ultrasound is a safe reliable tool for determining the location of UVC tips. Scans were well tolerated and use of saline injection to locate the tip was required in 24% of scans. The average scanning time of 5 minutes is faster than the time required for radiograph acquisition and processing on our unit and compares to an average time of 3 minutes for a radiologist (16). All the scans in this study were performed by neonatologists experienced in the use of ultrasound and inexperienced operators may take longer.

RECOMMENDATIONS

If ultrasound is available, we now use it as the method of first choice for determining UVC tip position. However, ultrasound is not always available. Because of this and based on the results of this study, we recommend the following:

1. Initial assessment of catheter tip position should include an AP chest-abdominal radiograph.
2. If ultrasound evaluation of catheter tip position is not available, the catheter tip position should be determined using the cardiac silhouette method.
3. There should be an appropriately designed prospective studies to assess the reliability of repositioning UVCs with ultrasound guidance and to describe the patterns of umbilical catheter tip migration with time.

Determination of Umbilical Venous Catheter Tip Position With Radiograhp. Pediatric Critical Care Medicine 2014

US…time to change

Placement of umbilical venous catheters with use of bedside real-time ultrasonography

Mark Greenberg, MD, Hamid Movahed, MD, Beverly Peterson, and Raul Bejar, MD

From the Departments of Neonatology and Pediatrics, University of California–San Diego, San Diego, California

Real-time ultrasonography was used to assess the position of umbilical venous catheters tips in 79 newborn infants (birth weight range, 400 to 4200 gm). The position of the umbilical venous catheters determined by ultrasonography was compared with the projection of the catheter tip on the closest vertebral body shown on a standard chest radiograph. Of the catheters initially placed with radiographic guidance, 56% were repositioned because of unsatisfactory location. Ultrasonography is more precise than radiography because it allows direct visualization of the catheter tips in relation to internal vascular structures. When ultrasonography is unavailable, placement at the ninth thoracic vertebral body ensures safe positioning. (J Pediatr 1995;126:633-5)

DISCUSSION

Our data indicate that real-time ultrasonography at the bedside can be used to determine the position of UVCs in critically ill term and preterm infants. Although the catheters were visualized in all patients, fluid injection was helpful to image the exact position of the tip. Real-time ultrasonography was more effective than radiography because the location of the UVC in the body could be determined, and the catheters could be positioned at the RA-IVC junction during the initial insertion procedure. Furthermore, real-time ultrasound scanning during insertion avoids false passage to the portal sinus or advancement to the left atrium, reducing the risk of complications.

Neonatology

Ca

Neo
DOI:

Use of Wireless Ult
Isolated Infants: A
SARS-CoV-2-Positi

Giorgia Prontera Alessandro Perri

Division of Neonatology, Department of Woman anc
Fondazione Policlinico Gemelli IRCCS, Rome, Italy

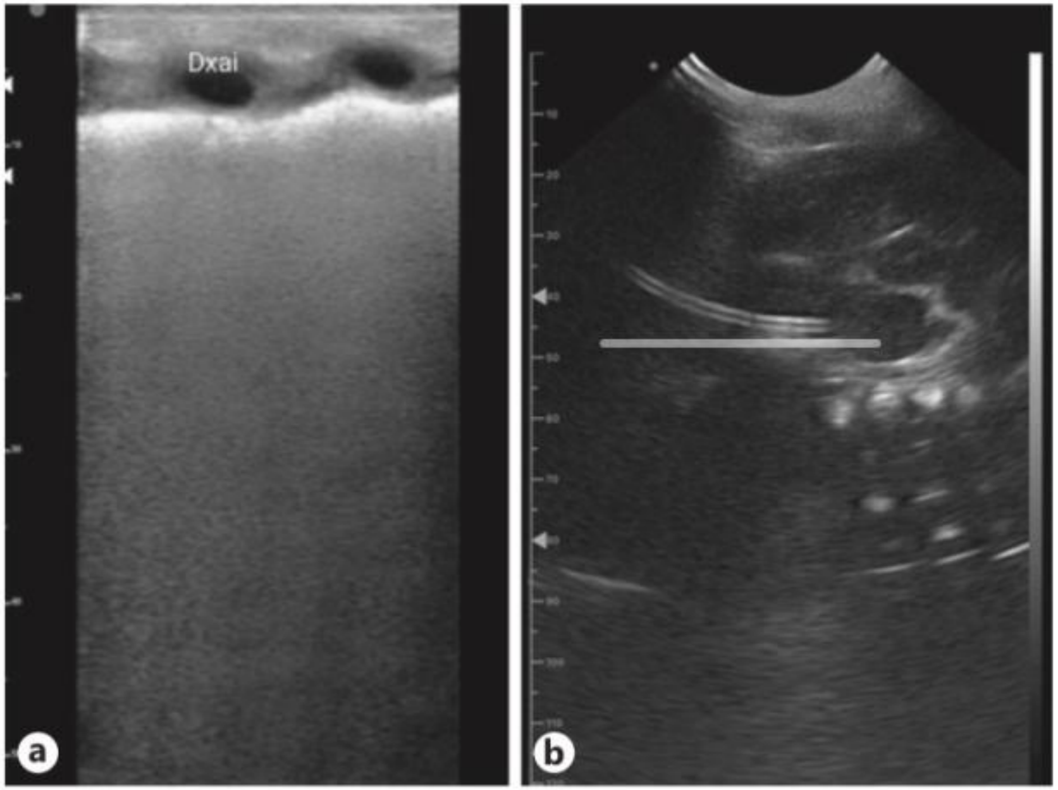


Fig. 1. a Image of white lung in the isolated preterm infant. **b** Ultrasound scan of the correct UVC tip position at the junction of the IVC-RA. IVC, inferior vena cava; RA, right atrium.

ɔcation of the UVC
atheter.

Journal of Perinatology
https://doi.org/10.1038/s41372-020-00836-3

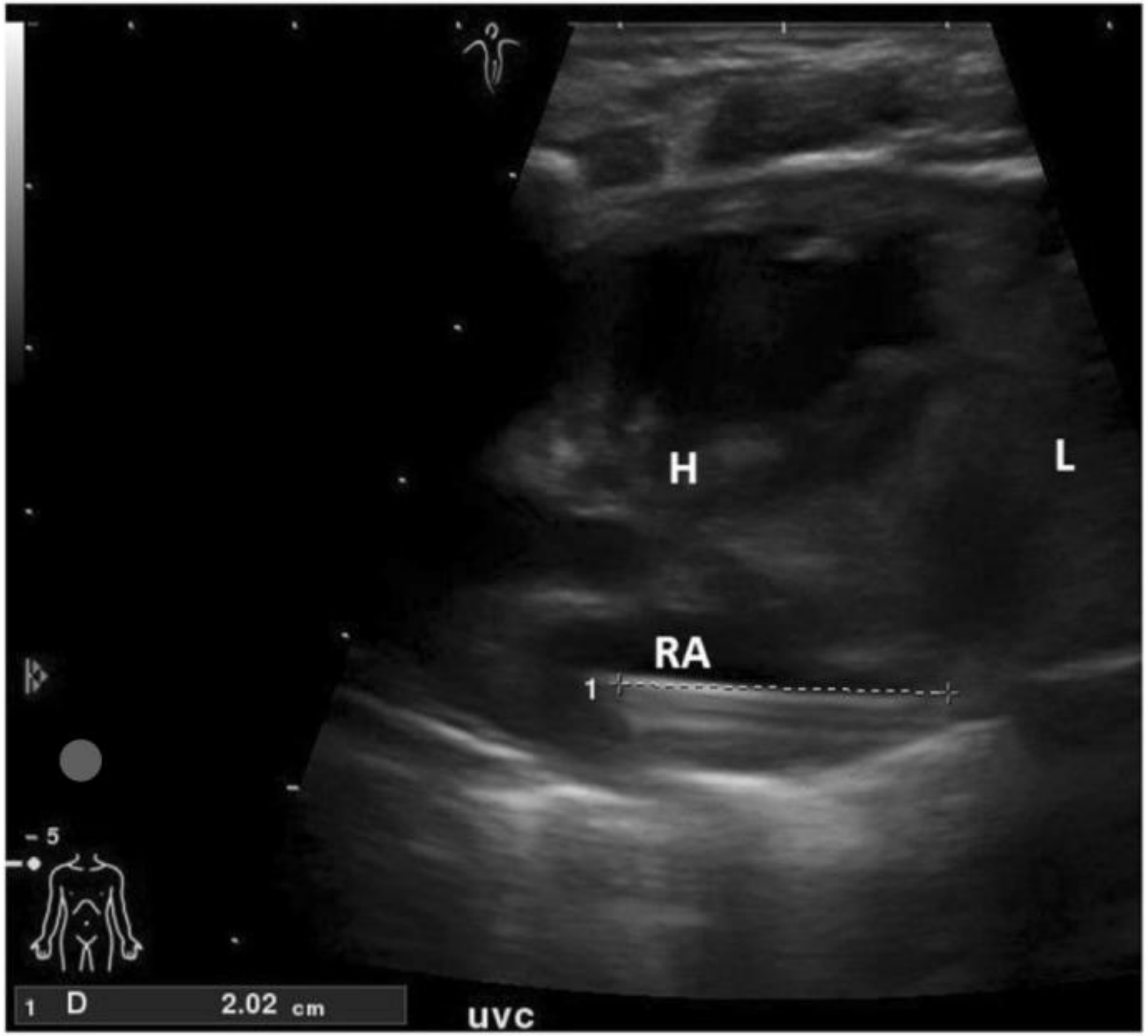
ARTICLE

Fingertip ultrasound evaluation of umbilical catheter position in the neonatal intensive care unit compared to conventional ultrasound radiography: a preliminary investigation

Jonathan R. Wood[1] · Neil R. Halonen[1] · Kelly A. Bear[2] · Carmen E. Campbell[3] · Patricia A. Wilhelm[4] · Emmanuel R. E. Kling[5] · Veronica J. Rooks[1]

Received: 16 April 2020 / Revised: 28 August 2020 / Accepted: 18 September 2020

ʼig. 1 **Sonivate SonicEye® finge**
ʼound transducer. The fingertip l
ʼlides onto a finger.



Linear transducer
93% (25/27)
[75.5%, 99.1%]
100% (14/14)
[76.8%, 100%]

nfidence intervals.

"Ultrasound"

Table 1 Ultrasonography during catheter insertion

	Population	*n* RTUS-guided insertions	US operator	Probe	Technique	Tips visualized by US	Average time savings with US	Average manipulations per patient prevented with US	Average XRs per patient saved with US
Garg et al (1983)[12]	BW: 725–3,540 g GA: 26 wk to term	22 UACs	Not specified	5 MHz	Posterior axillary line between rib cage and iliac crest	100%	Not reported	Not reported	Not reported
Greenberg et al (1995)[13]	BW: 1,600 (480–4,200) g	35 UVCs	Not specified	7 MHz	Parasternal SAX, subcostal sagittal, and apical views. Saline contrast used	100%	Not reported	Not reported	Not reported
Fleming and Kim (2011)[14]	BW: 1,728 ± 1,133 g GA: 31 ± 4 wk	15 UACs/ UVCs	Neonatologist and neonatal fellow	13 MHz linear	UAC: mid-chest in the sagittal plane. UVC: subcostal sagittal view. Saline contrast used	100%	64 min	1.2 (UVC)	1.8

Abbreviations: BW, birth weight; CGA, corrected gestational age; GA, gestational age; LE, lower extremity; PICC, peripherally inserted central catheter; RTUS, real-time ultrasound; SAX, short axis; UAC, umbilical artery catheter; UE, upper extremity; US, ultrasound; UVC, umbilical venous catheter; XR, radiograph.
Note: Population expressed as ranges, means ± standard deviation, and median (range).

Ultrasonography for Central Catheter Placement in the Neonatal Intensive Care Unit—A Review of Utility and Practicality. Am J Per 2015

Table 2 Ultrasonography after catheter insertion

	Population	*n*	US operator	Probe	Technique	Tips visualized by US	Clinical utility
Madar and Deshpande (1996)[17]	BW: 1,210 (640–3,530) g GA: 28 (23–40) wk	18 UACs, 3 UVCs, 19 PICCs	Not specified	7.5 MHz	Suprasternal, subcostal, and parasternal SAX views	95%	US detected two venous catheters passed through the foramen ovale which was not evident on XR
Ades et al (2003)[5]	BW: 550–4,320 g GA: 24–42 wk	53 UVCs	Pediatric sonographer or cardiologist	Not specified	Parasternal SAX and LAX, apical, and subcostal coronal and sagittal views. Saline contrast used	100%	US revealed that UVCs were located in ideal position in only 23% after XR guidance, with 28% in RA and 45% in LA
Simanovsky et al (2011)[18]	GA: 30 (24–40) wk. Weight: 1,580 (450–3,600) g	75 UVCs	Pediatric radiologist	7 MHz convex and 12 MHz linear	Subcostal sagittal views	97%	US prevented two potential complications from UVC tip being in the liver
Michel et al (2012)[19]	BW: 2,496 ± 1,081 g GA: 34.7 ± 4.2 weeks.	61 UVCs	Pediatric radiologist	12.5 MHz linear and 8.5 MHz convex	High subcostal views	95%	Among 12 lines needing withdrawal, US allowed withdrawal of two UVCs with thrombus, one tip positioned in the heart, and two tips positioned in the portal system

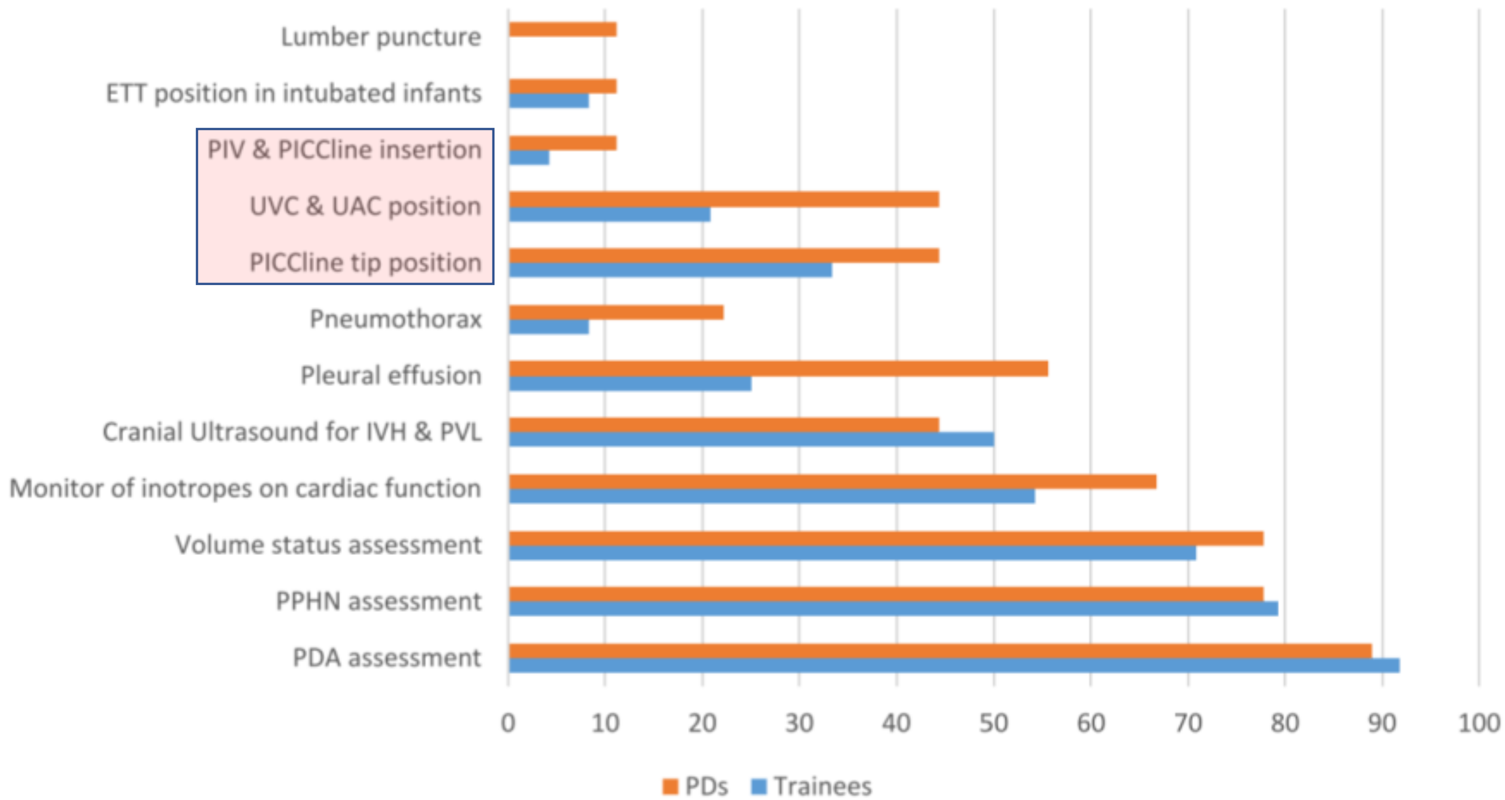
Abbreviations: BW, birth weight; CGA, corrected gestational age; GA, gestational age; LAX, long axis; LE, lower extremity; PICC, peripherally inserted central catheter; SAX, short axis; UAC, umbilical artery catheter; UE, upper extremity; US, ultrasound; UVC, umbilical venous catheter; XR, radiograph.

Note: Population expressed as ranges, means ± standard deviation, and median (range).

TIP location. RT US. Riassumendo…

1. Gli studi che hanno valutato l'affidabilità della metodica ecografica per la valutazione della posizione della punta sono riusciti a visualizzare la punta del CVO in una percentuale estremamente elevata (tra il 95 e il 100%).
2. Le sonde impiegate sono state:
    - Sonda lineare da 12-13 Mhz
    - Sonda microconvex da 7-8.5 Mhz
    - Sonda microsettoriale
3. La proiezione più utizzata è stata una sottocostale longitudinale sagittale, alcuni autori hanno completato la medodica ecografica con finestre acustiche supplementari quali una apicale o una parasternale in asse corto.
4. In quasi tutti gli studi la visualizzazione della punta è stata accompagnata da un flush di soluzione fisiologica.
5. Esistono pochi dati in letteratura relativamente alla tip navigation durante il posizionamento del CVO

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?

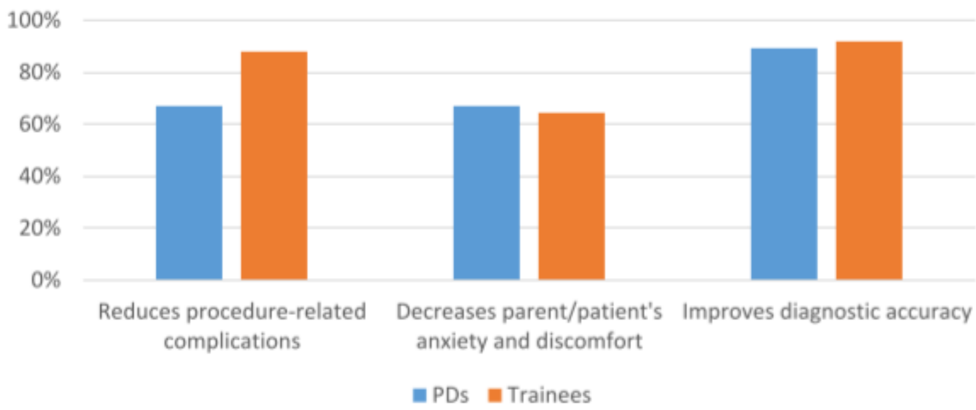
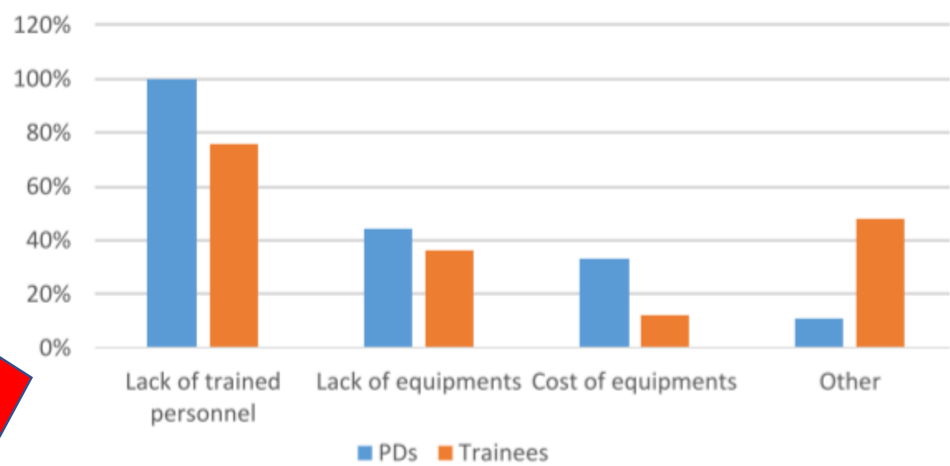


Table 1 Other potential barriers to POCUS training

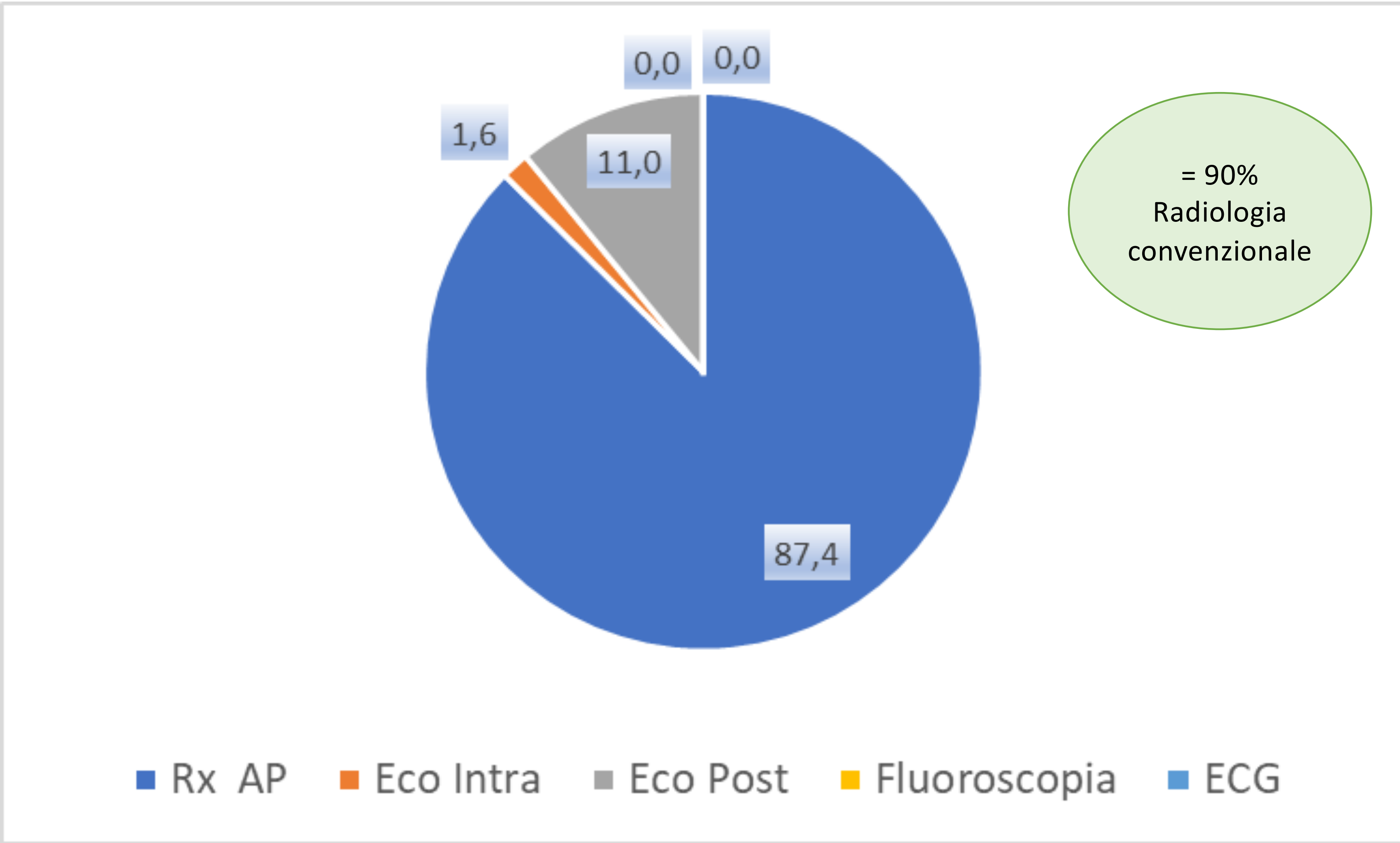
Lack of dedicated time to get training due to other competing educational priorities Lack of time and resources to develop POCUS curriculum
Lack of teachers who are expert in POCUS
Acquiring full spectrum of POCUS skills including cardiac ultrasound might take longer than what a 2-year fellowship program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

Tip location CVO….Survey ER


0,0
0,0
1,6
11,0
87,4
= 90%
Radiologia
convenzionale
Rx AP
Eco Intra
Eco Post
Fluoroscopia
ECG

Pediatric Vascular Access Practice: Time for Evolution or Revolution?

By Amanda J Ullman RN, MAppSci, PhD, Centaur Fellow, Director-at-Large;
Association for Vascular Access Pediatric Special Interest Group, Senior Lecturer;
Alliance for Vascular Access Teaching and Research (AVATAR) Group, Griffith University

1. **We need to <u>improve central venous access in the neonates</u>, the main issues being:**
   - Define the role of ultrasound (US) -guided central venous catheters (3Fr, PUR, power injectable, high performance) in premature newborns if compared to the use of epicutaneo-caval catheters (ECC) (1-2.7Fr, silicone or PUR, non-power, low performance)
   - Verify the cost-effectiveness and the indication of Near Infra Red Technology in visualizing and cannulating the superficial veins for insertion of ECC
   - Improve the training of health care specialists so to implement the use of new technology for insertion (US, NIR) and for tip location (echocardio, intracavitary EKG) of central access in neonates

GAVePed
Gruppo Accessi Venosi Pediatrici

Infusion Therapy Standards of Practice

Pedivan

espnic
European Society of Paediatric and Neonatal Intensive Care

PLEASE FILL THE GAP

NEO-ECHOTIP protocol

Editorial

JVA | Vascular Access

The Journal of Vascular Access
1–10

DOI: 10.1177/11297298211007703
journals.sagepub.com/home/jva
SAGE

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]

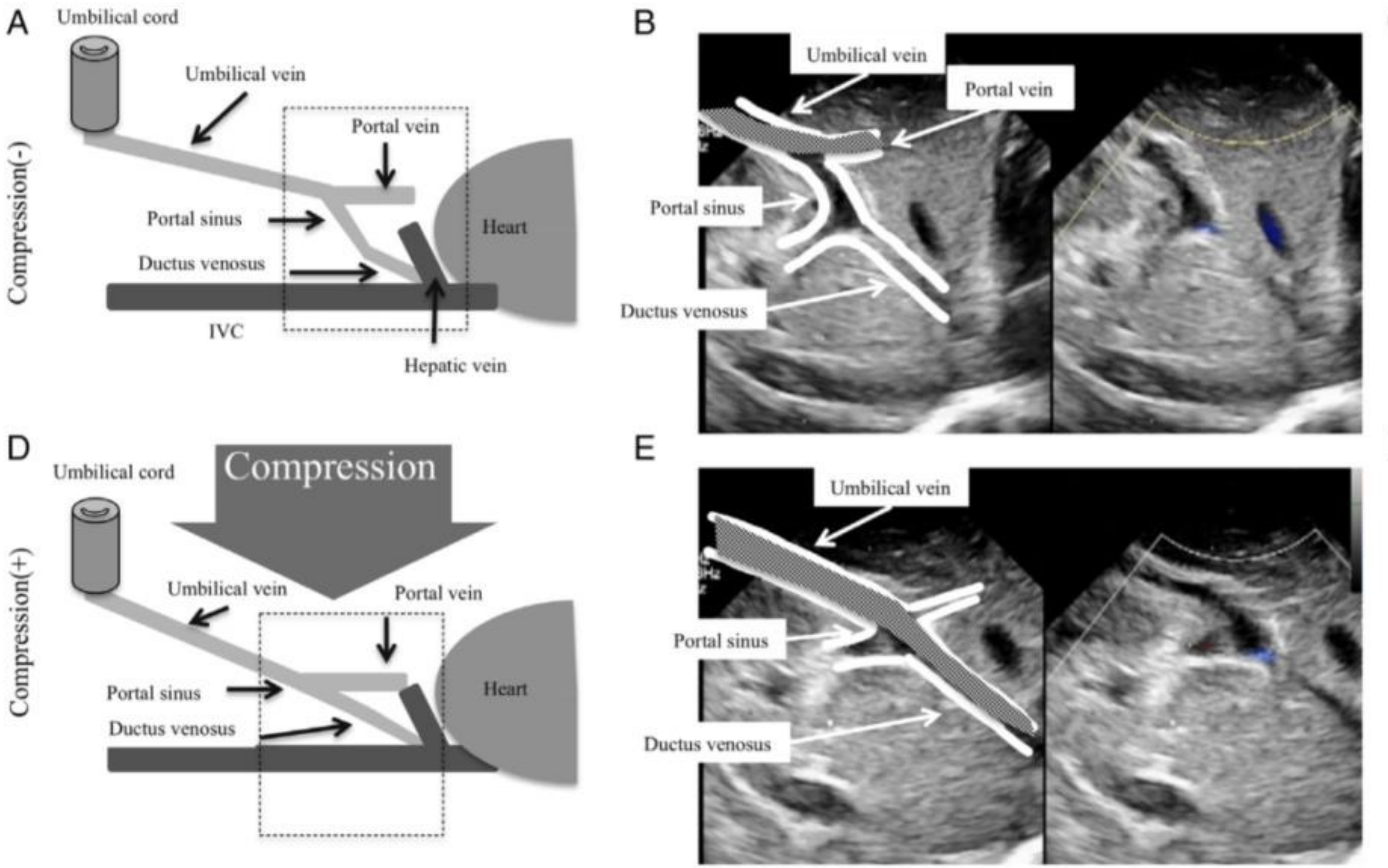
Neo-ECHOTIP for UVC

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

Real-Time Ultrasound Guidance for Umbilical Venous Cannulation in Neonates With Congenital Heart Disease

Benjamin W. Kozyak, MD[1]

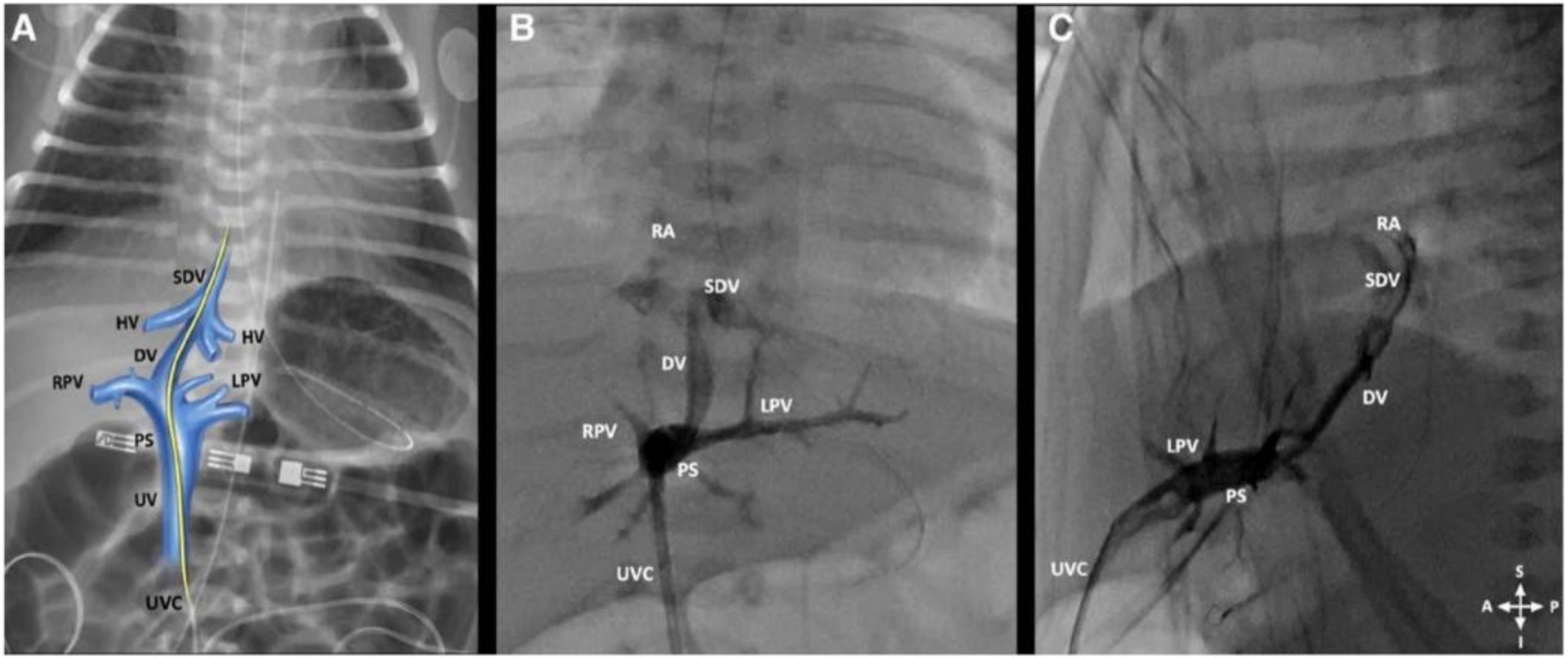
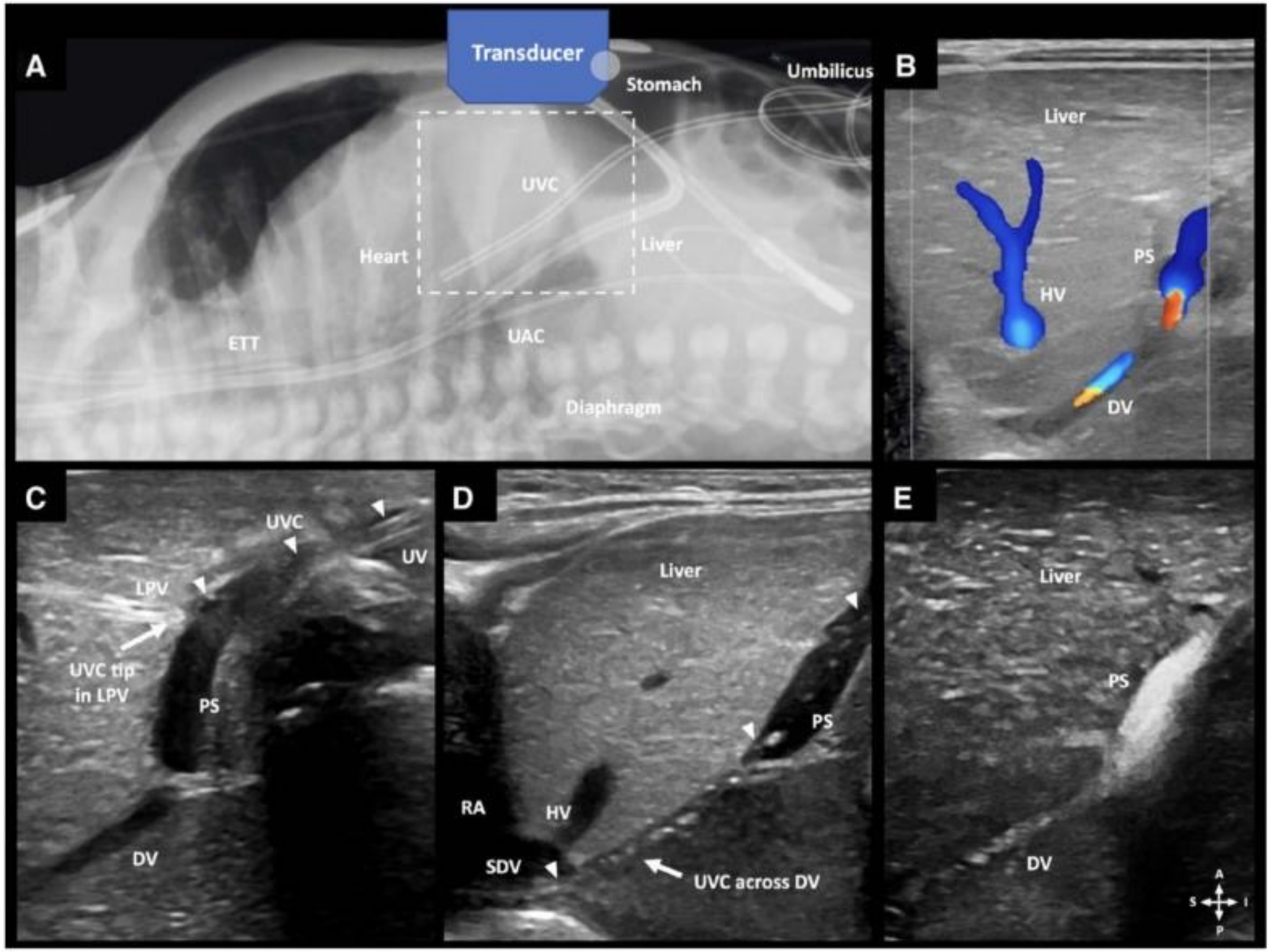


Figure 1. Anatomy of the umbilical vein (UV), portal sinus (PS) (umbilical recess), ductus venosus (DV), and portal veins. **A**, Illustration highlighting the vascular structures and proper course of an umbilical venous catheter (UVC) (*yellow*); **B** and **C**, Posteroanterior and lateral angiograms. Contrast is injected through an UVC with its tip in the proximal umbilical vein. The lateral projection profiles the "S-turn" that must be taken by the UVC from UV to DV. *Directional arrows* apply to **C** and indicate anterior (A), posterior (P), superior



A
Transducer
Stomach
Umbilicus
UVC
Heart
Liver
ETT
UAC
Diaphragm
B
Liver
HV
PS
DV
C
UVC
UV
LPV
UVC tip
in LPV
PS
DV
D
Liver
PS
RA
HV
SDV
UVC across DV
E
Liver
PS
DV
A
S
I
P

Figure 4. Effect of liver pressure. Ultrasound assists in navigating the path through the portal sinus to the ductus venosus (*), avoiding the left (*small arrows*) and right (#) portal veins that readily accept the umbilical venous catheter and result in malposition. **A** and **B**, *Red lines* accentuate the potential, incorrect courses taken by the catheter into the portal veins. The *green line* represents the optimal catheter course. **C**, With titrated liver pressure, the left portal veins are compressed (*large arrows*), the caudal turn into the right portal veins (#) becomes more acute, and the "S-turn" (seen in **B**) through the portal sinus to the ductus venosus becomes flatter and more favorable.

Overall, use of POCUS facilitated the rescue of malpositioned UVCs in 23 of 32 patients (72%), 20 of 25 (80%) performed in the first 48 hours of life and three of seven (43%) performed later. UVC rescue was successful in 18 of 24 patients (75%) on prostaglandin E1 at the time of the procedure, versus three of eight patients (38%) not on prostaglandin E1. Reasons for failure included small DV aperture, DV spasm following catheter instrumentation, and unfavorable angle of DV takeoff despite liver manipulation. In eight of 23 patients (35%), the UVC was somewhat deep once manipulated through the DV, based a combination of x-ray and ultrasound assessment; no catheter was too shallow. At the time of UVC placement, the mean weight was 3.05 kg (range, 2.04–3.80 kg).

DISCUSSION

In this study, we demonstrate that real-time POCUS may be used to achieve optimal UVC positioned with a high rate of success, even after unsuccessful attempts by experienced providers using traditional techniques. Using ultrasound, the provider can make adjustments that are impossible without continuous visual feedback, correcting the catheter course and manipulating the intrahepatic vascular anatomy to achieve the desired trajectory.

Reported rates of successful UVC placement using traditional "blind" techniques range from 50% to 75% (13, 14), which is consistent with a recent internal review of our Special Delivery Unit experience at the Children's Hospital of Philadelphia. We have demonstrated that it is possible to salvage malpositioned UVCs and achieve central venous access in most patients using real-time ultrasound guidance. This technique has the potential to greatly improve the overall success of umbilical venous cannulation, from 50% to 75% to approximately 90–95%. This is similar to the improvement imparted by POCUS to other types of central venous access in children (20). Our experience supports an emphasis on attempting UVC placement early after birth to maximize the chances of DV patency. The additional manipulation does not appear to be associated with increased risk of procedural or catheter-related complications.

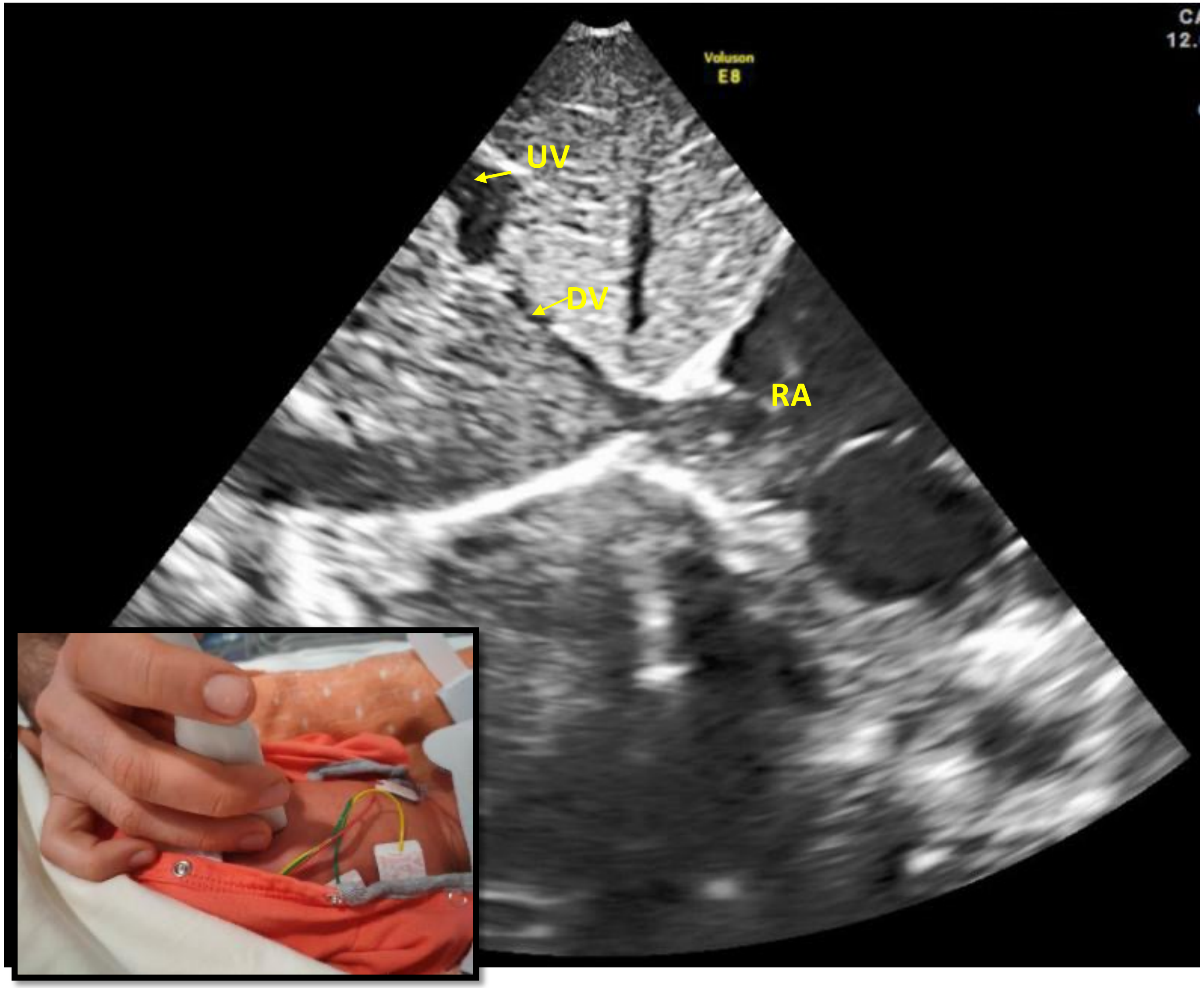
Neo-ECHOTIP for UVC

Tip location protocol:

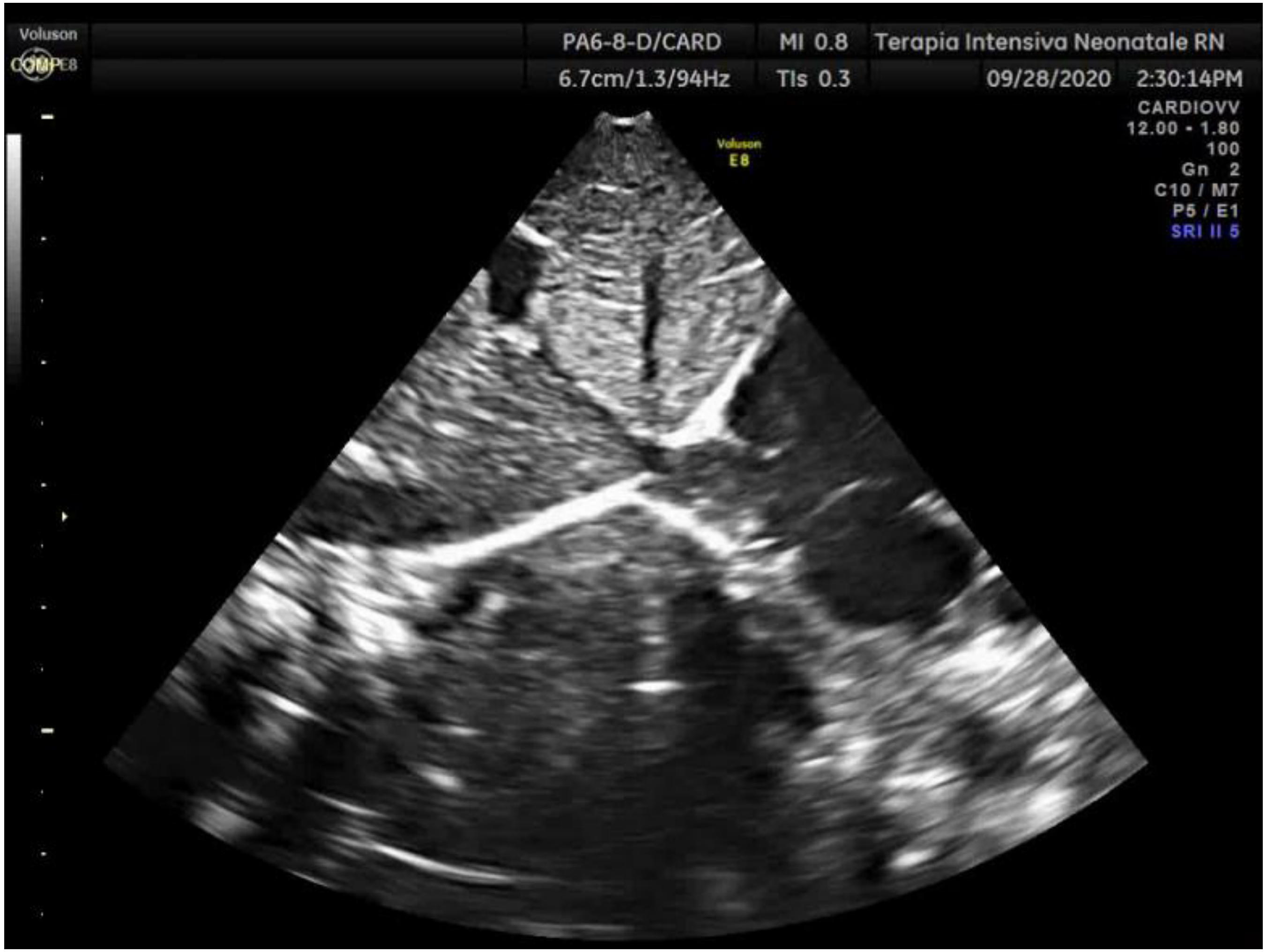
Probe: small sectorial probe, 7-8 MHz.

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



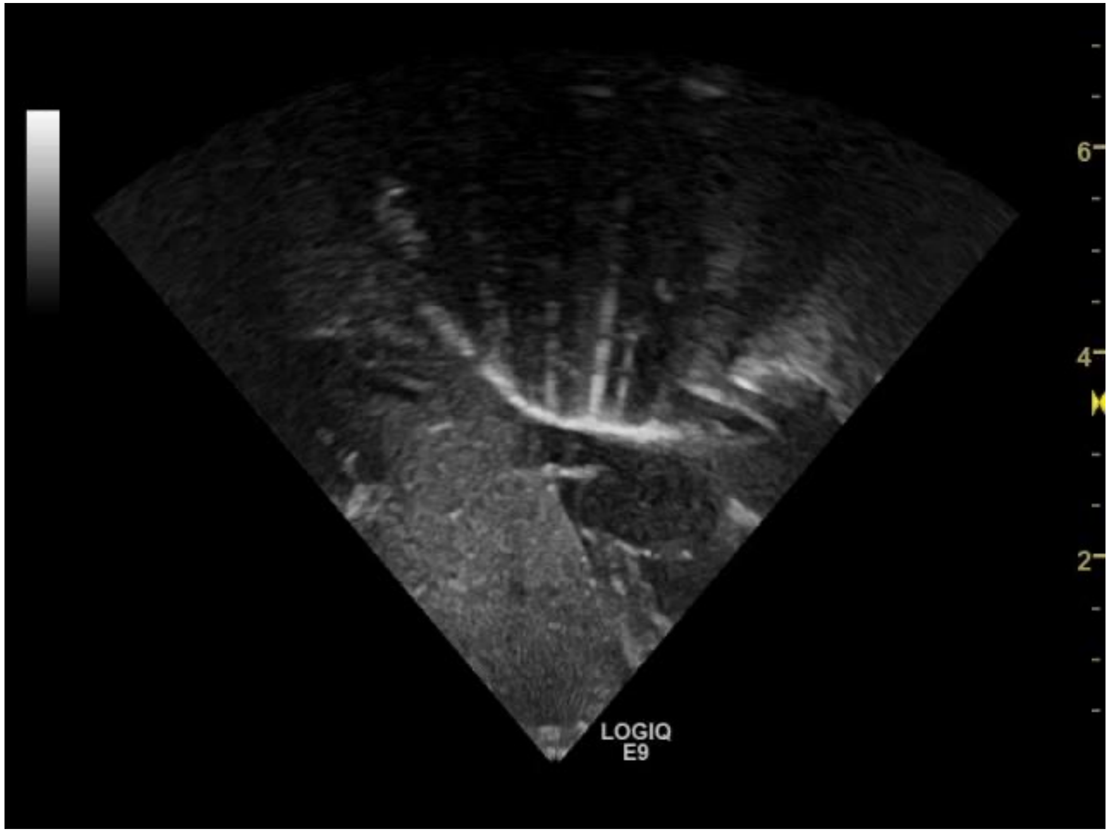
Voluson
E8
UV
DV
RA


Voluson
PA6-8-D/CARD
MI 0.8
Terapia Intensiva Neonatale RN
6.7cm/1.3/94Hz
TIs 0.3
09/28/2020
2:30:14PM
CARDIOVV
12.00 - 1.80
100
Gn 2
C10 / M7
P5 / E1
SRI II 5
Voluson
E8

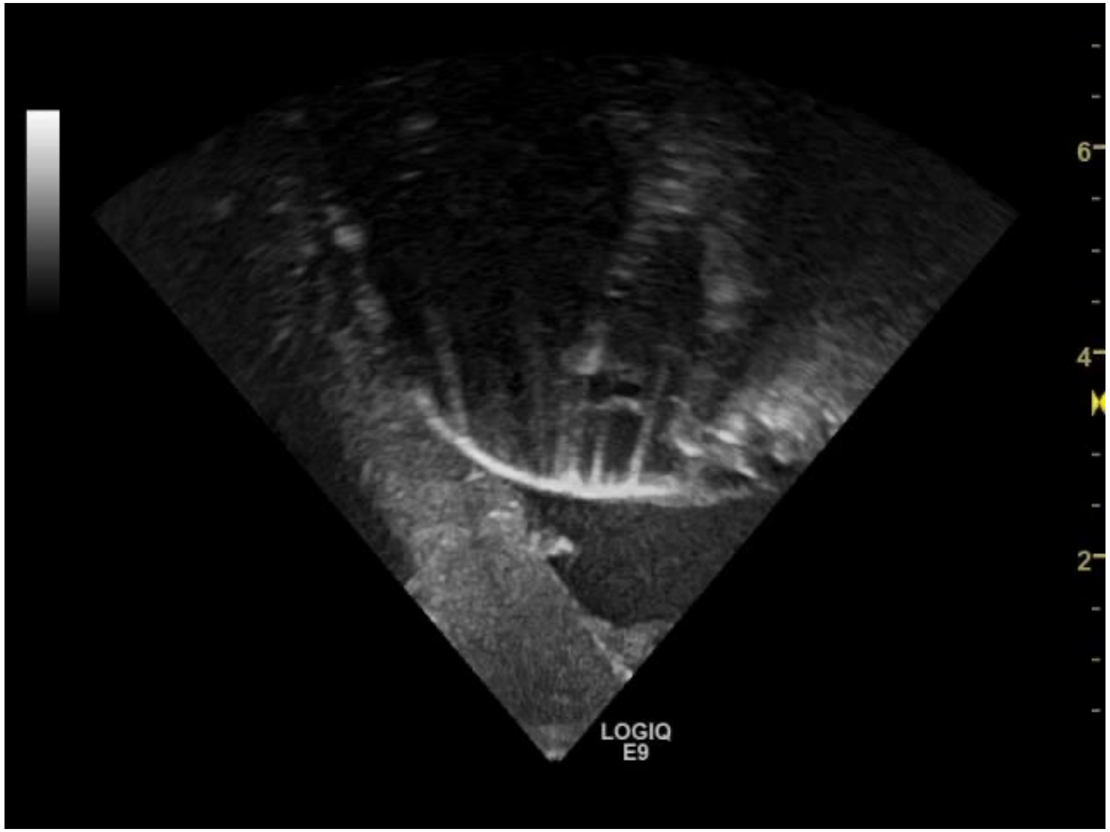
“How we do it better”…

“How we do it better”…

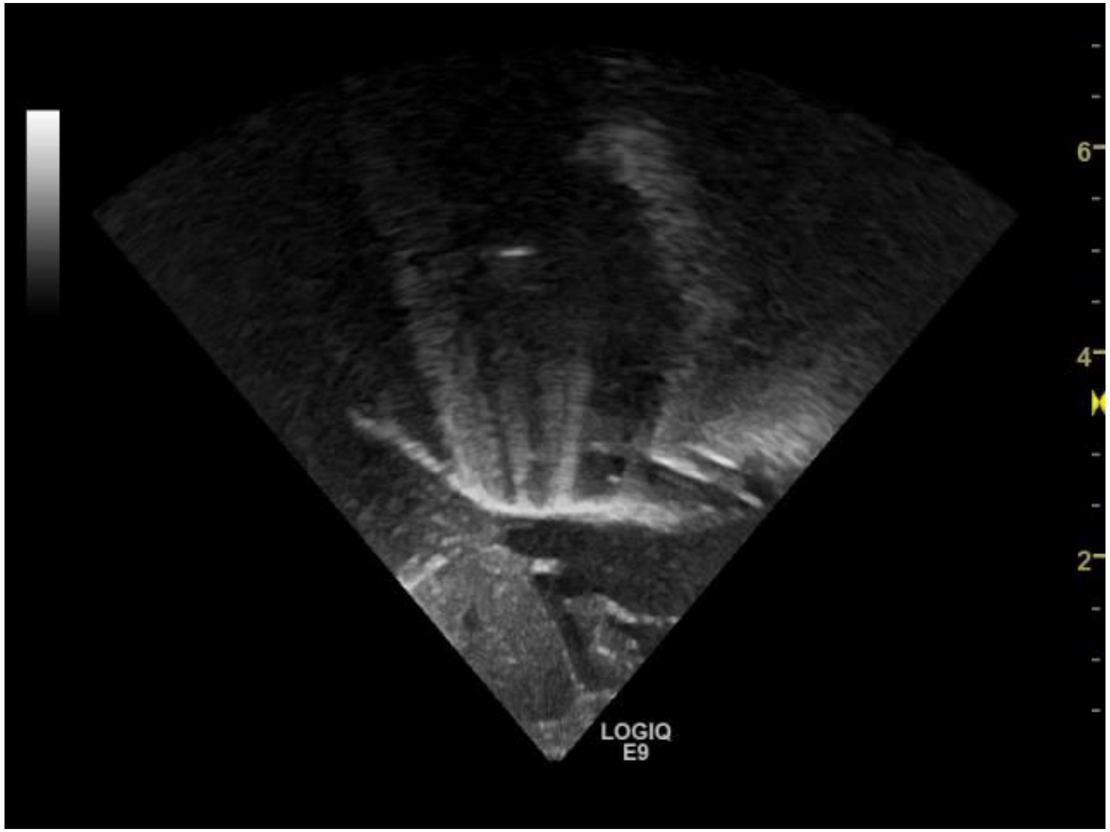
“How we do it better”…



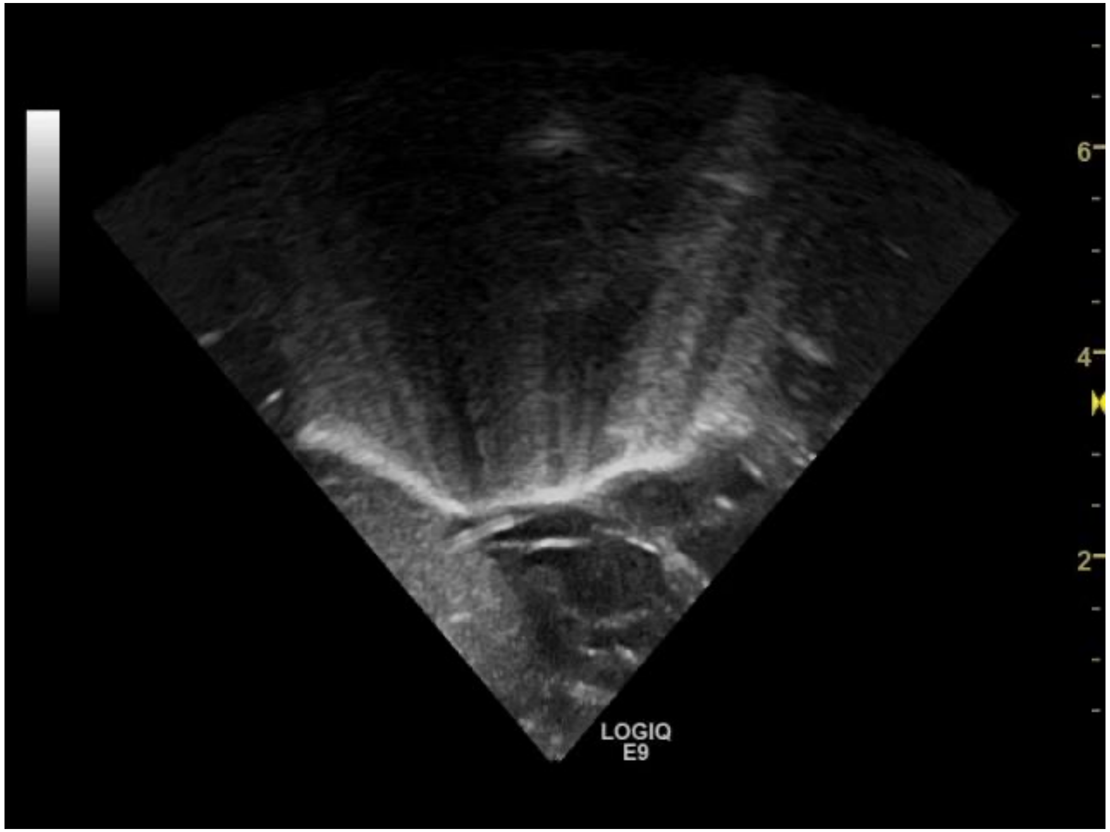
“How we do it better”…



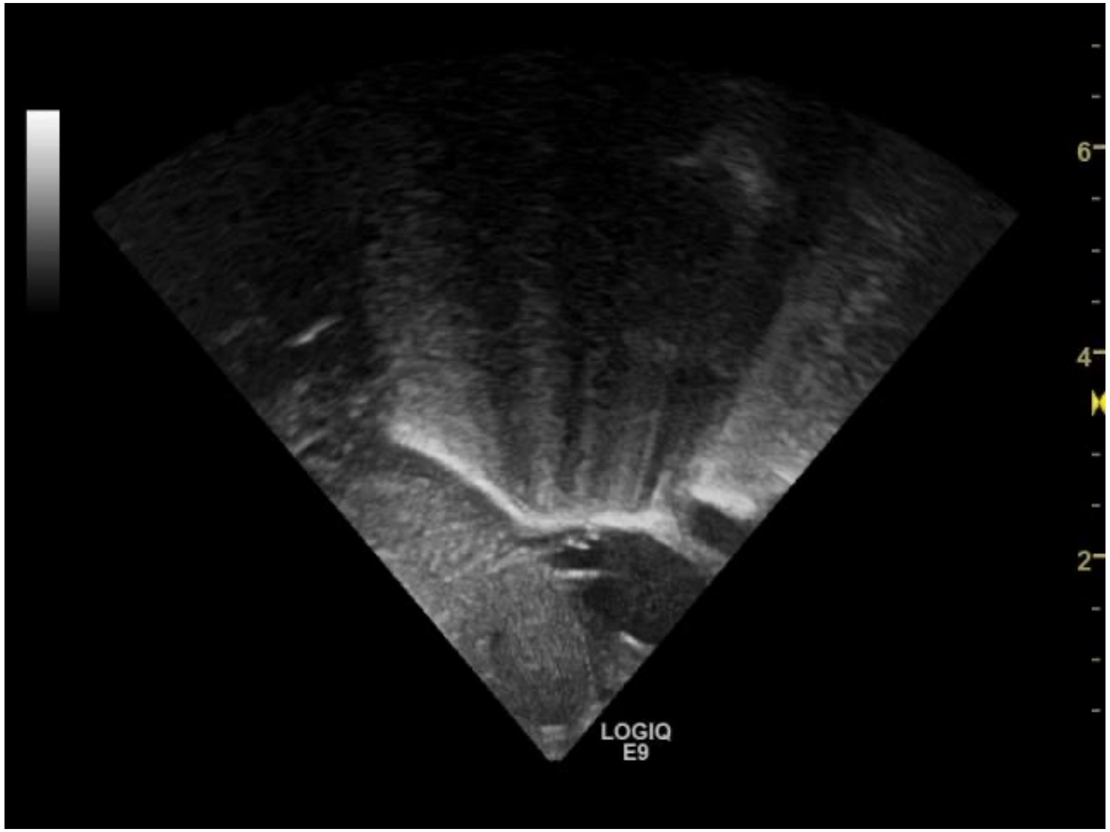
"How we do it better"…



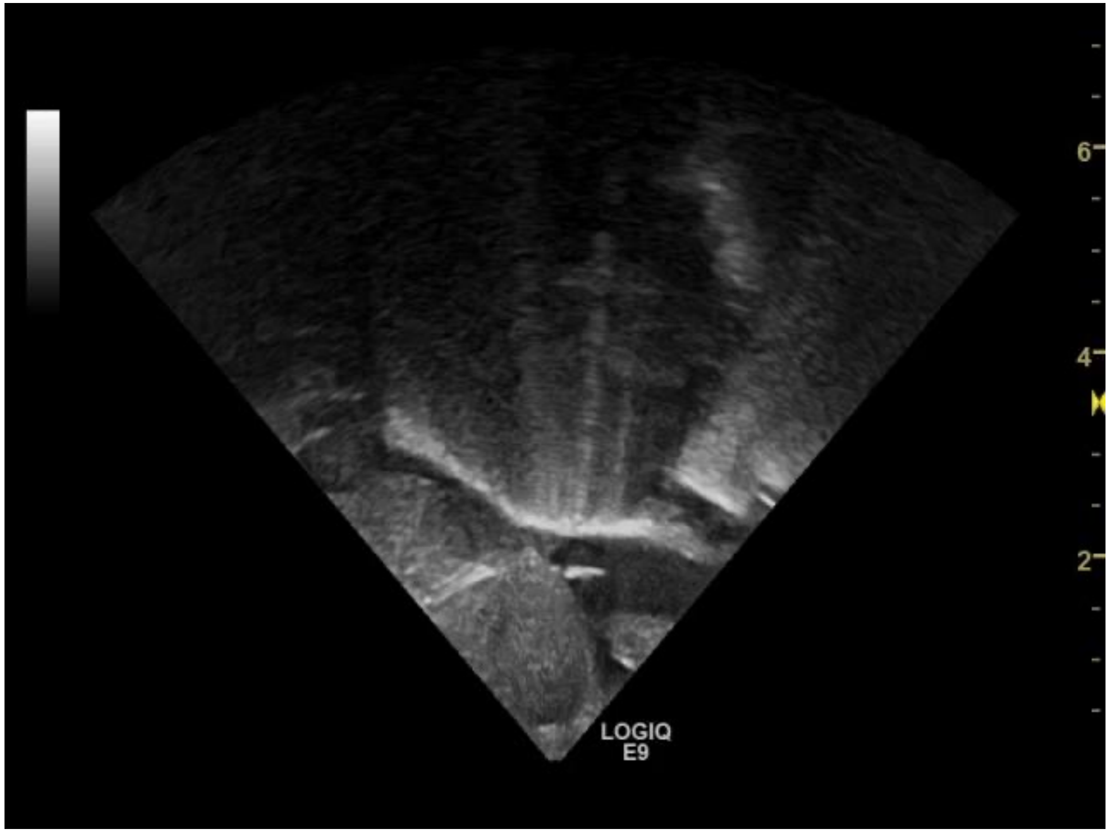
“How we do it better”…



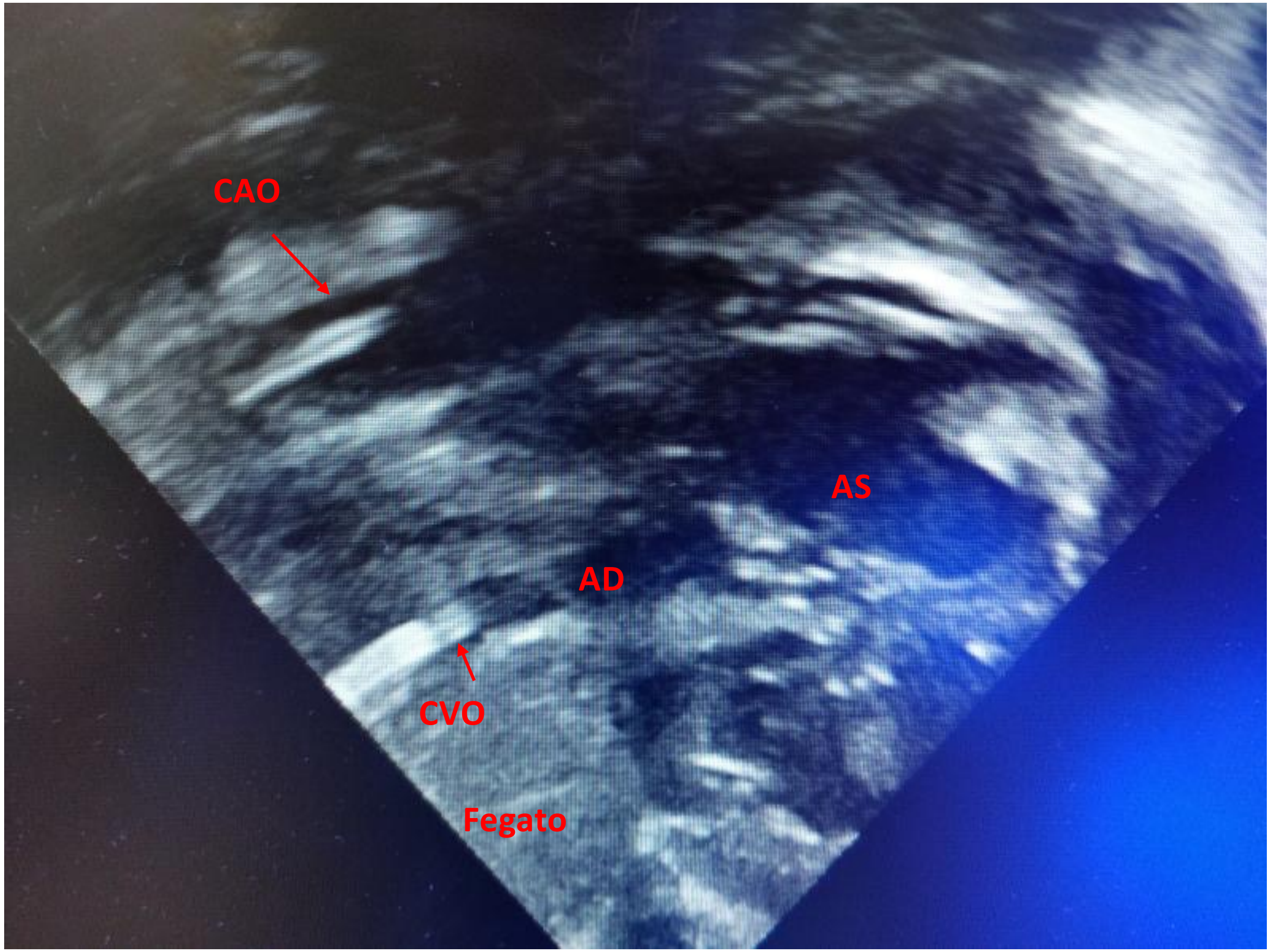
“How we do it better”…



“How we do it better”…



“How we do it better”…CVO e CAO



Protocollo Echo Tip: il training per il CVO

- Nonostante le prove di efficacia disponibili l’ecografia non è ancora di ampio utilizzo all’interno delle TIN
- Tale fenomeno è verosimilmente legato all’errata percezione del problema del training.
- Diversi studi hanno dimostrato che il traning per l’ecografia real time nella valutazione della punta del CVO è semplice e fattibile

VISUALIZZAZIONE ECOGRAFICA INTRAPROCEDURALE DEL CVO

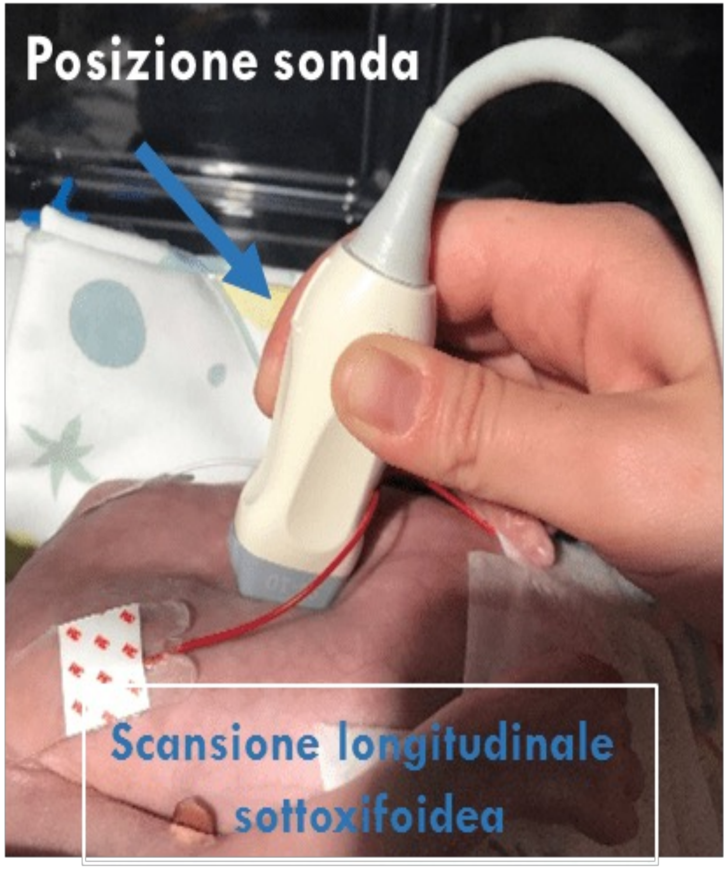
Calcolo della lunghezza da inserire (UN – 1 cm)

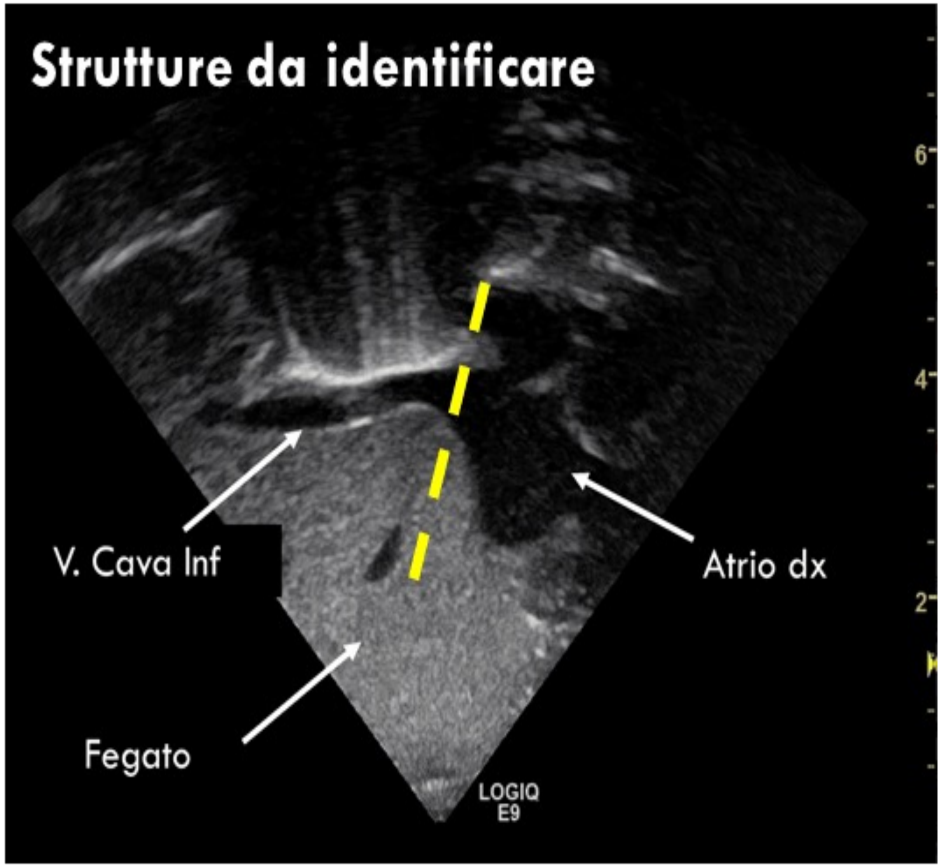
Cosa serve

- Neonatal Pack
- CVO
- Ecografo
- Kit copri-sonda sterile

- **1° operatore** inserisce il CVO fino **-1 cm** della lunghezza calcolata
- **1° o 2° operatore** posiziona la sonda ed evidenzia le strutture ecografiche di riferimento (scansione longitudinale sottoxifoidea)
- **1° operatore** inserisce lentamente il catetere fino alla visualizzazione della punta in posizione ottimale
- **1° operatore** infonde un bolo da 0.5-1 ml di soluzione fisiologica per confermare la posizione della punta
- Fissaggio del catetere

VISUALIZZAZIONE ECOGRAFICA INTRAPROCEDURALE DEL CVO





Training Gemelli

Formal classroom lesson	**Duration** 40 minutes **Timing** Repeated weekly (4 times in a month) to allow all the trainees to attend at least once. **Aims** Showing and highlighting the advantages of using RUS vs traditional chest radiography for UVC insertion and localization, according to literature. Teaching how to perform an US-guided UVC placement. **Materials and Methods** Case reports and images from literature and clinical practice on correct and incorrect UVC positions. Images and descriptions of all the potential complication of a malpositioned UVC. Images and US scans of anatomic and vascular structures to be identified for the procedure. US scans (images and videos) of UVC in correct or incorrect positions. Description, images and videos of how to perform the complete US-guided UVC positioning procedure.
Bedside US practise	**Timing** After each frontal lesson and anytime trainees were interested in practising US on babies with an UVC in the correct position and in stable conditions (parental consent was previously obtained) **Aims** Showing how to set the bedside US and the correct probe. Teaching how to identify anatomic and vascular structures and the catheter tip position in babies with an UVC in a good position (parental consent was previously obtained). **Methods** The QI team member assisted as a direct supervisor a trainee while performing the scans.

Training Gemelli

Bedside teaching	**Timing** Every time (daytime) an UVC was placed during the training period **Aim** **T**eaching how to perform a complete US-guided UVC placement **Methods** The QI team member performed the RUS or assisted as a supervisor a trainee in the US-guided UVC placement.
Informative teaching material	**Aim** Improving access to the training program and contents and support the learning. **Materials and Methods** Posters containing description and illustrations of the entire procedure were posted on walls in each ward and pocket cards were available for all the trainees. They explained how to set the US machine, which probe to use, where to find all the materials, how to set the sterile field with the probe. The complete sequence of the US-guided UVC placement was described and explanatory images showed.
Weekly surveys	**Aim** Improving or changing some aspects of the training. **Materials and Methods** Written questionnaires or talk with a QI team member through which the trainees were frequently encouraged to express their approval or concerns.

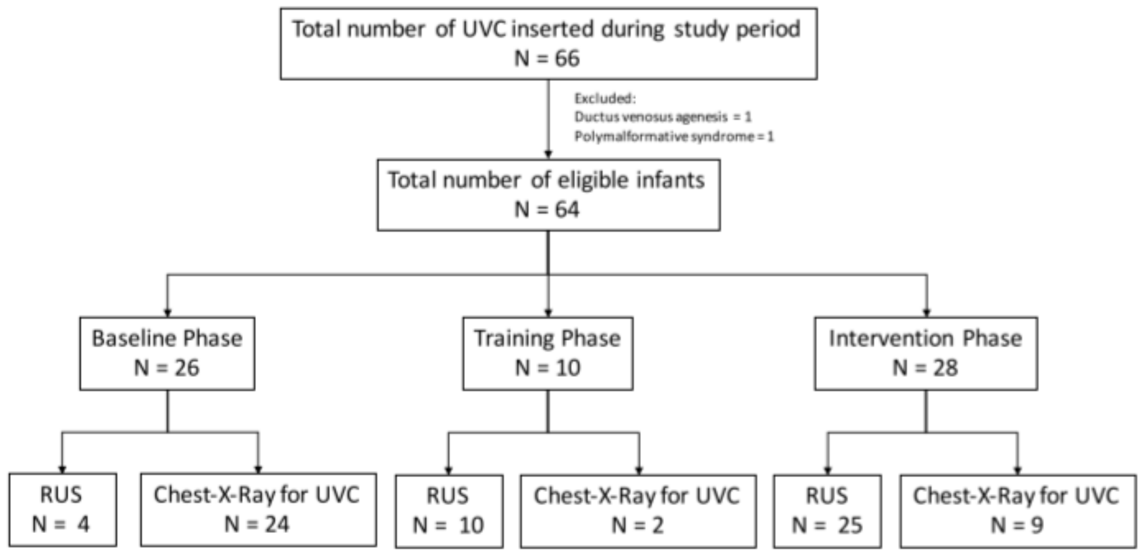
Rubortone et al. Italian Journal of Pediatrics (2021) 47:68
https://doi.org/10.1186/s13052-021-01014-7

Italian Journal of Pediatrics

RESEARCH Open Access

Real-time ultrasound for tip location of umbilical venous catheter in neonates: a pre/post intervention study

Serena Antonia Rubortone[1*], Simonetta Costa[1], Alessandro Perri[1], Vito D'Andrea[1], Giovanni Vento[1] and Giovanni Barone[2]



UVC, umbilical venous catheter
RUS, real time ultrasound

Fig. 3 Flow diagram of the study population

Table 3 Primary and secondary outcomes. Data are shown as number (%) or median (interquartile range), mean (standard deviation)

	Pre-Intervention Phase ***N* = 26**	**Post-Intervention Phase** ***N* = 28**	***P***
Real-time US	4 (15.3)	25 (89.2)	< 0.0001
Chest X-Ray	24 (92.3)	9 (32.1)	< 0.0001
Time to visualize UVC tip (h)	2 [1–3]	0 [0–1]	0.0012
N of manipulations first 24 h	11 (42.3)	5 (17.8)	0.0740
UVC in a good position	8 (30.7)	21 (75.0)	0.0023
Double lumen UVC	21 (80.7)	21 (75.0)	0.7471
Size 3.5–4 Fr	18 (69.2)	16 (57.1)	0.4082
Size 5 Fr	8 (30.8)	12 (42.9)	0.4082
UVC dwell time (days)	4.7 (2.7)	5.4 (2.5)	0.3306
Sepsis	2 (7.7)	0	0.2271
Elective UVC removal	19 (73.1)	24 (85.7)	0.3198
Catheter-related complications	2 (7.7)	0	0.2271
Antibiotic therapy	20 (76.9)	20 (71.4)	0.3187

Table 3 Primary and secondary outcomes. Data are shown as number (%) or median (interquartile range), mean (standard deviation)

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THE JOURNAL OF MATERNAL-FETAL & NEONATAL MEDICINE
https://doi.org/10.1080/14767058.2021.1946508

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SHORT REPORT

Implementation of point of care ultrasound to assess umbilical venous catheter position in the neonatal intensive care unit

Patrick Louis Polonio[a], Dmitry Tumin[b], Yingying Zheng[c], Anita Gandhi[d] and Kelly Bear[a]

[a]Department of Neonatology, Vidant Medical Center, Greenville, NC, USA; [b]Department of Pediatrics, Brody School of Medicine at East Carolina University, Greenville, NC, USA; [c]Department of Pediatrics, East Carolina University and Vidant Medical Center, Greenville, NC, USA; [d]Brody School of Medicine, East Carolina University, Greenville, NC, USA

The training consisted of three phases. First, trainees received lectures on the introduction and the physiology behind POCUS. Next, trainees participated in 3–5 hands-on assisted scans and bedside teaching with the POCUS champions to ensure proper technique. Finally, trainees performed POCUS independently to locate UVC placement. To assure quality, every trainee was supervised by a champion or cardiologist when they were performing the scan. The champion or cardiologist would provide immediate feedback about the accuracy of the image before trainees reached proficiency, defined as completing at least 20 scans where the trainees were able to visualize the catheter tip in at least one view of the four views they were trained to obtain [6]. Time to

Results

A total of 27 providers were included in the education curriculum, of whom three were champions and twenty-four were considered trainees for this project. All three champions, and six of twenty-four trainees, achieved proficiency within a median of 5 months (interquartile range: 3–14 months) of project initiation. Counting both champions and trainees, the rate of proficiency increased from 0% at the outset to 33% (9/27). The providers achieving proficiency included four fellows, three attendings, and two nurse practitioners.

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ARTICLE

Agitated saline contrast to delineate central venous catheter position in neonates

Jaya Upadhyay[1] · Sriparna Basu[1] · Yash Srivastava[2] · Kanhu Charan Digal[1] · Shantanu Shubham[1] · Rajat Grover[1] · Poonam Singh[1]

Received: 15 April 2020 / Revised: 11 July 2020 / Accepted: 22 July 2020

Table 2 Combined umbilical venous catheter (UVC) and peripherally inserted central catheter (PICC) delineation by targeted neonatal echocardiography.

Parameter	AS group ($n = 55$)	NS group ($n = 55$)	p value
Visibility, n (%)	48 (87.2)	28 (50.9)	<0.001[a]
Time taken to visualize catheter tip (s), Mean (SD)	12.6 (4.9)	40.7 (13.9)	<0.001[b]
Volume of saline push (mL) Median (IQR)	1.5 (1–2)	1.5 (1–2)	0.161[c]

Table 3 Umbilical venous catheter (UVC) delineation by targeted neonatal echocardiography.

Parameter	AS group ($n = 35$)	NS group ($n = 35$)	p value
Birth weight (g), mean (SD)	1449 (393)	1565 (426)	0.241[a]
Size of the infant			
<1000 g, n (%)	4 (11.4)	3 (8.6)	0.863[b]
1000–1499 g, n (%)	16 (45.7)	14 (40.0)	
1500–2499 g, n (%)	14 (40.0)	16 (45.7)	
>2500 g, n (%)	1 (2.8)	2 (5.7)	
Clearly visible UVC, n (%)	33 (94.3)	22 (62.8)	<0.001[b,c]
X-ray position of UVC tips non visualized on TNE, n (%)	2 (5.7)	13 (37.1)	<0.001[b]
Appropriately placed	–	7	
Short lying in IVC	–	3	
Right branch of portal vein	–	1	
Left branch of portal vein	–	2	
Coiled within ductus venosus	1	–	
Inadvertent placement in umbilical artery	1	–	
Time taken to visualize UVC tip (s), Mean (SD)	12.5 (5.2)	35.7 (10.7)	<0.001[a]
Inter-observer agreement, κ (SE)	0.938 (0.034)	0.813 (0.103)	0.120[d]

There is a word of caution. The process of agitation should be done carefully. No air should be present in the empty syringe and both the syringes should be tightly fitted into the three-way stopcock to prevent the introduction of air while creating agitation. Besides, we have used AS to delineate CVCs only. This modality may not be appropriate for arterial lines including umbilical arterial catheters

AGENDA

Uso dell'ecografia all'impianto

Uso dell'ecografia per la gestione

AGENDA

Uso dell’ecografia all’impianto

Uso dell’ecografia per la gestione

"Can we do it better?"...tip check and re-check

- La migrazione del catetere è descritta soprattutto nelle prime 24-48 ore
- La gelatina di Wharton si essicca e il moncone ombelicale si accorcia
- 65 Neonati con cateteri fissati con punto + NeoBridge

Table 1 Ultrasound findings of catheter tip position

	First ultrasound, n=65	Second ultrasound, n=52	Third ultrasound, n=42	Fourth ultrasound, n=24
Good position, n (%)	25 (38.5)	40 (77)	24 (57)	13 (54.2)
Malposition, n (%)	40 (61.5)	12 (23)	18 (43)	11 (45.8)
Right atrium, n (%)	17 (26.2)	6 (11.5)	9 (21)	1 (4.2)
Foramen ovale, n (%)	6 (9.2)	1 (2)	2 (5)	2 (8.3)
Left atrium, n (%)	15 (23.1)	3 (5.7)	–	1 (4.2)
Hepatic vessels, n (%)	2 (3)	2 (3.8)	7 (17)	7 (29.1)
Migration rate, n (%)	–	9 (17)	13 (31)	7 (29.1)

- 29/58 (50%) dei neonati hanno nel complesso avuto fenomeni di migrazione
- Solo il 50% dei neonate avevano un CVO normoposizionato alla fine dello studio

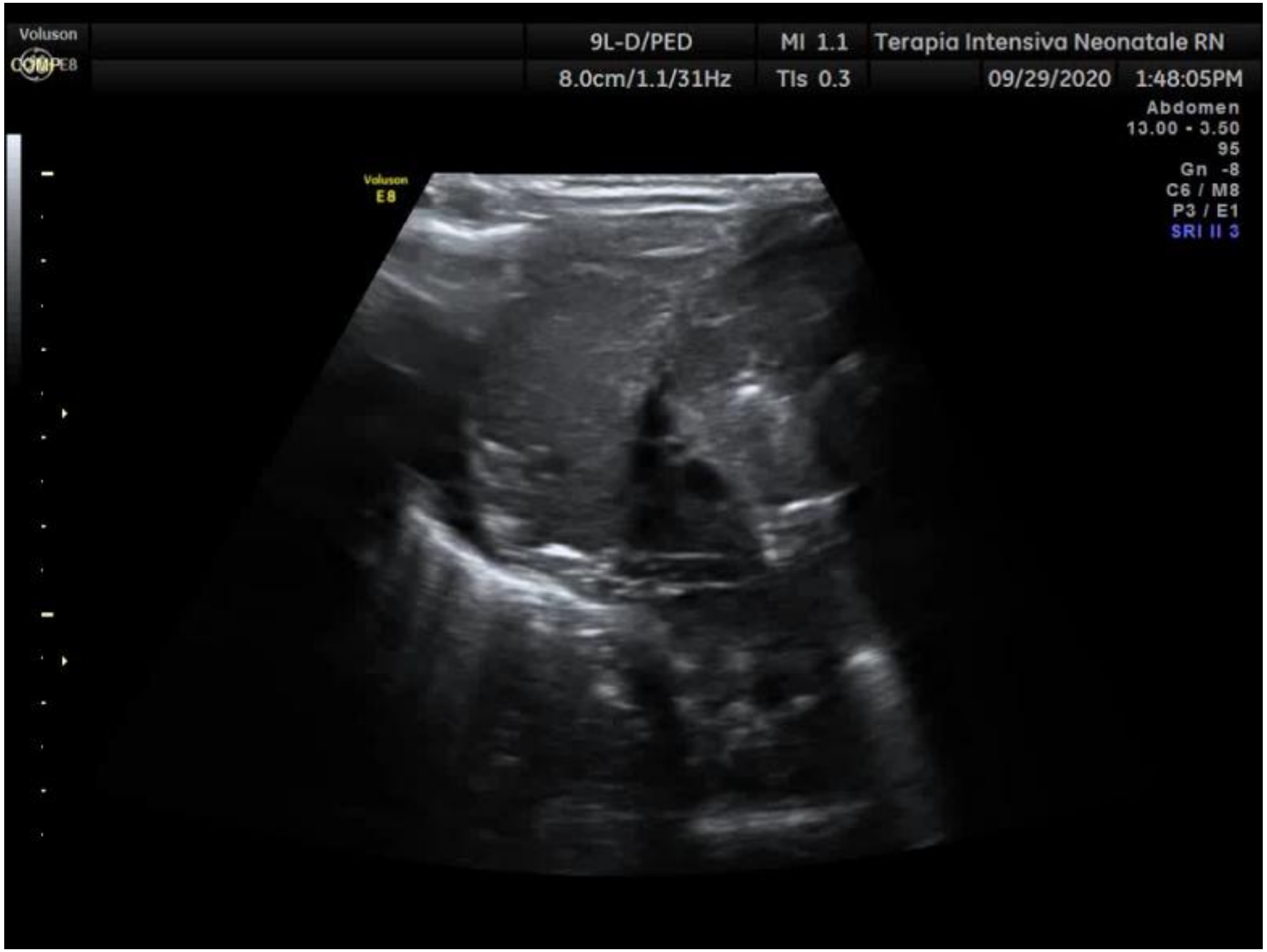
Ultrasound assessment of umbilical venous catheter migration in preterm infants: a prospective study. ADC 2016

Can UVCs migrate from a safe position over time?

In neonates with a UVC in situ [patient] which was felt to be in a safe position following insertion [test], can we assume it will remain in a safe position [outcome]?

Franta *et al* found that 50% of UVCs in infants born <32 weeks' gestation had migrated during the first week after insertion.[16] All neonates with a UVC in situ, whether or not it is initially in an optimal position, need to be monitored closely for all complications, not just those associated with a line in an ideal position. Some centres advocate regular proactive reassessment of UVC position, which, in light of Franta's data, seems prudent.[14]

Ultrasound assessment of umbilical venous catheter migration in preterm infants: a prospective study. ADC 2016


Voluson
E8
9L-D/PED
MI 1.1
Terapia Intensiva Neonatale RN
8.0cm/1.1/31Hz
TIs 0.3
09/29/2020
1:48:05PM
Abdomen
13.00 - 3.50
95
Gn -8
C6 / M8
P3 / E1
SRI II 3
Voluson
E8

Journal of Paediatrics and Child Health

doi:10.1111/jpc.14073

ORIGINAL ARTICLE

Study of movement of umbilical venous catheters over time

Adam Hoellering,[1] Didier Tshamala[1,2] and Mark W Davies[1,3]

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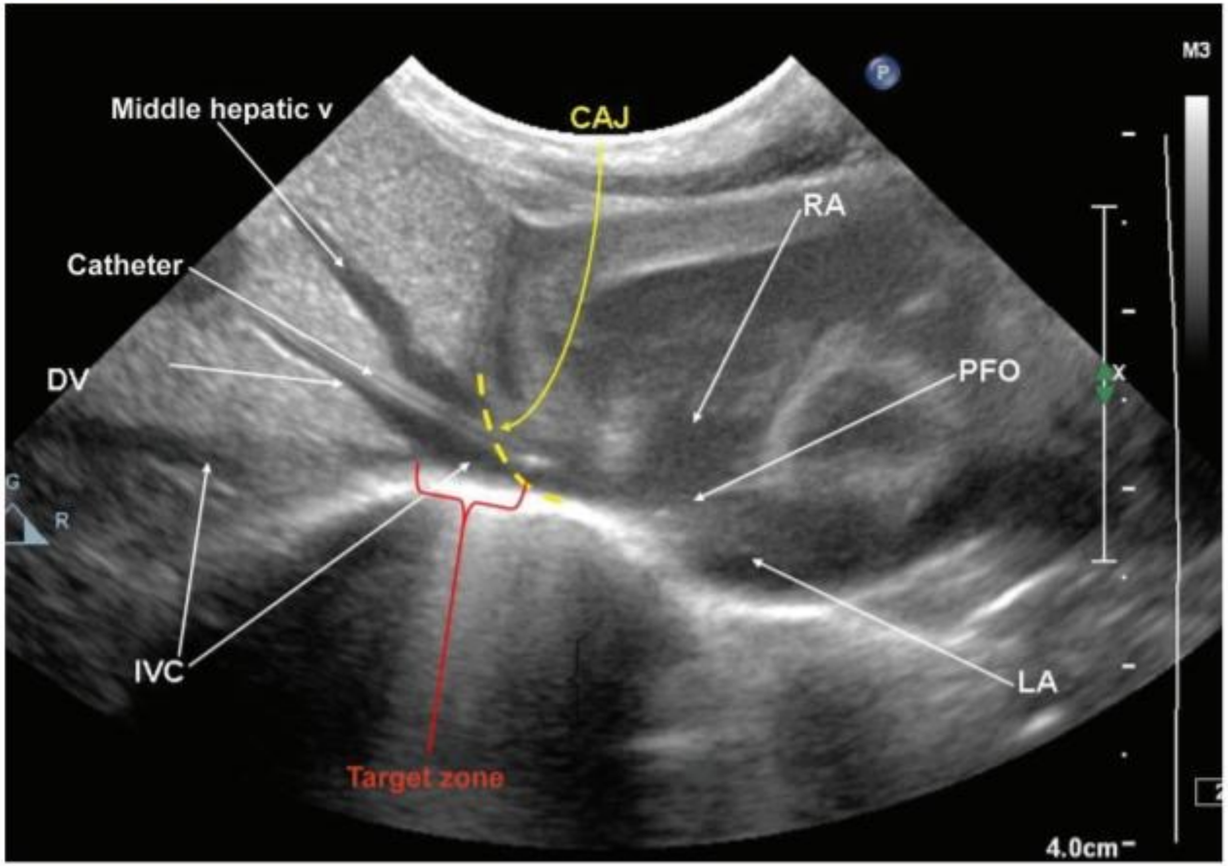
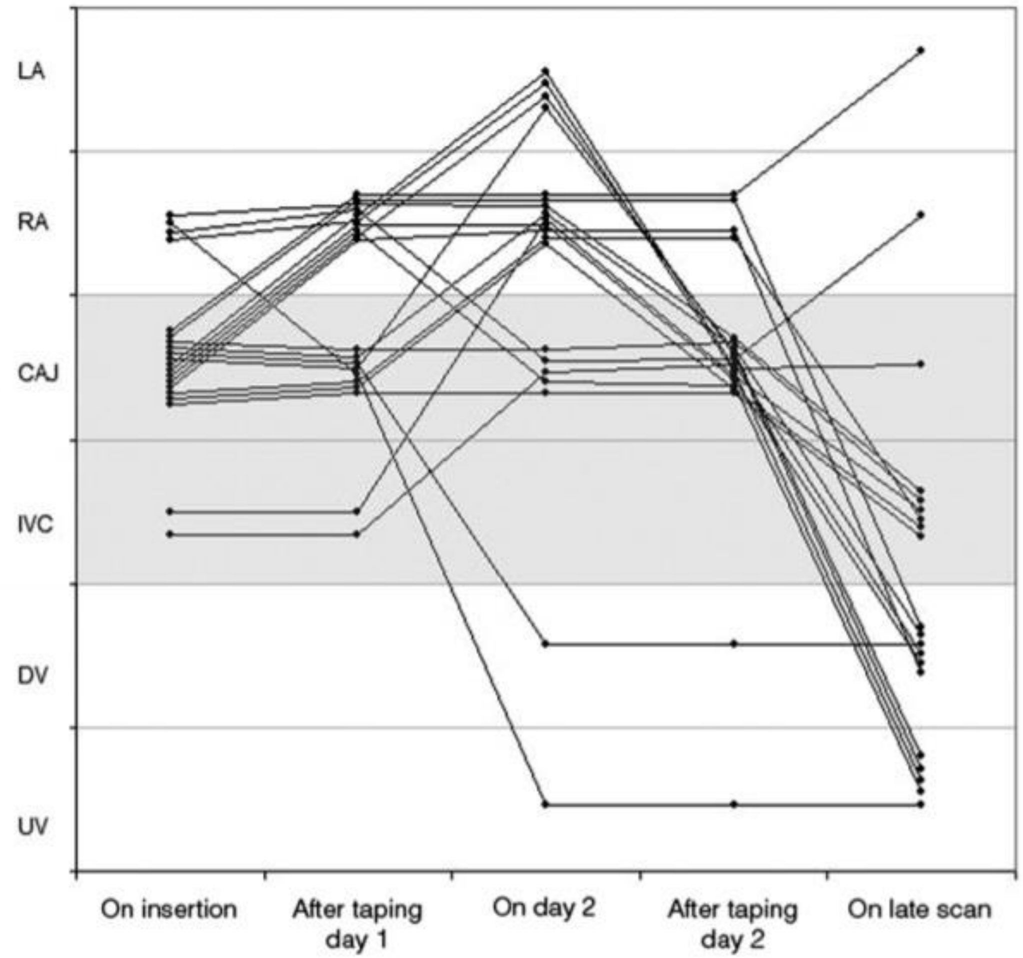
[3]Department of Paediatrics and Child Health, University of Queensland, Brisbane, Queensland, Au





an adjustment in catheter position.[20] Despite this, in our study, 65% of catheters were positioned outside of the target zone on the late scan. It would seem prudent, therefore, to regularly assess catheter tip position, with ultrasound if possible. We now recommend that a daily assessment of UVC tip position is made with either an X-tray or an ultrasound scan until it is removed.

Neonatology

Neonatology 2019;115:205–210
DOI: 10.1159/000494369

Inadvertent Migration of Umbilical Venous Catheters Often Leads to Malposition

Gerdina H. Dubbink-Verheij[a] Remco Visser[a] Ratna N.G.B. Tan[a]

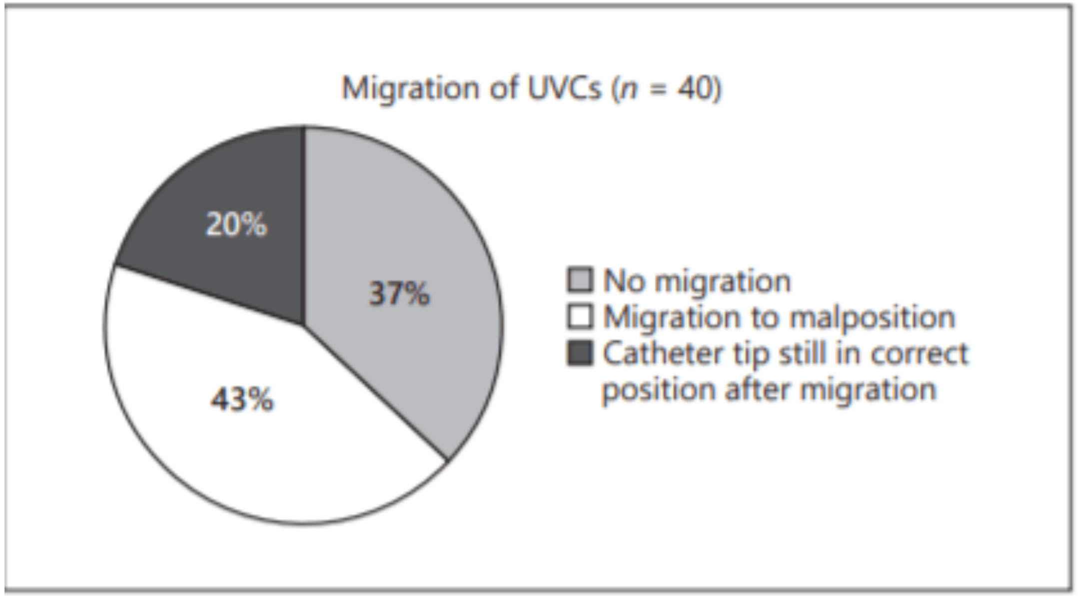


Table 1. Migration of umbilical venous catheters

	Day 3 (n = 37)	Day 7 (n = 24)	Day 8 (n = 11)
No migration	16 (43)	15 (63)	9 (82)
Migration	21 (57)	9 (38)	2 (18)
Inward, too high	11	5	1
Inward, still correct	1	–	–
Outward, too low	2	–	–
Outward, still correct	7	4	1

Data are represented as number (percentage). Time expressed in days of umbilical venous catheterization. Day 1: insertion day, Day 3 (IQR 3–3), Day 7 (IQR 6–7), Day 8 (IQR 8–10).

Ultrasound Monitoring of Umbilical Catheters in the Neonatal Intensive Care Unit—A Prospective Observational Study

*Alina Sobczak, Aleksandra Dudzik, Piotr Kruczek and Przemko Kwinta**

Neonatal Intens

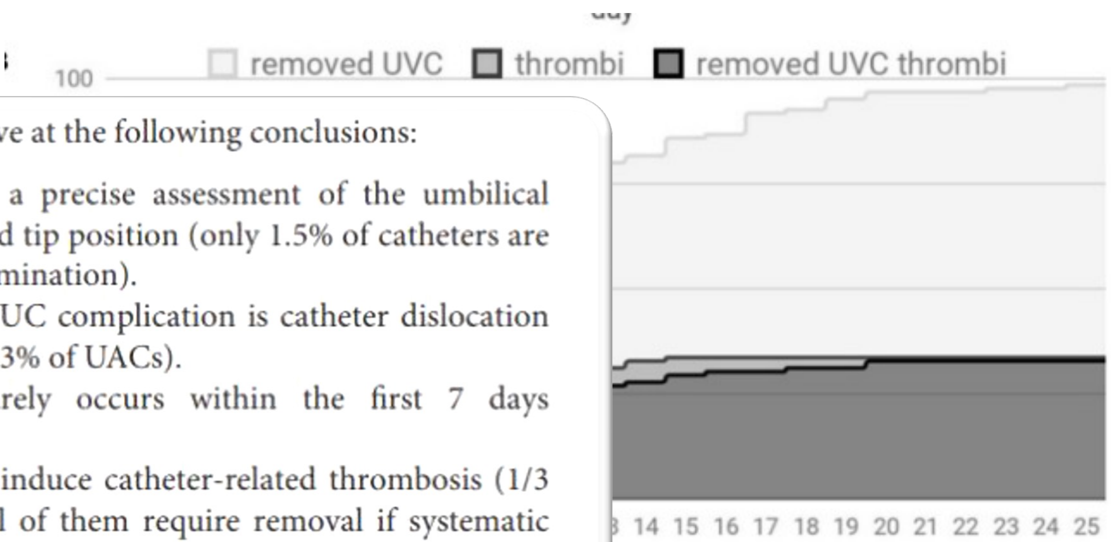
FIGURE 1 | Proper UVC **(A)** and UAC **(B)** imaging and positioning. The UVC leaving the ductus venosus **(C)**; the UAC, crossing the celiac trunk and superior mesenteric artery **(D)**.

Ultrasound Imaging

Ultrasound imaging was performed directly after insertion, within the first 24 h and then every 1–2 days or more often if the patient was unstable. Bedside examin

TABLE 1 | Comparison of catheterization complicatio

Outcome	UAC (n
DISLOCATION	17 (23% To a cru place: (
Clinical decision: intervention	0
THROMBI during catheterization	6 (8%)
Clinical decision: catheter removal	6 (100%
THROMBI visible only post catheterization	3 (4%)



With this paper, we arrive at the following conclusions:

1) US imaging allows a precise assessment of the umbilical catheters' surface and tip position (only 1.5% of catheters are not visible upon examination).
2) The most common UC complication is catheter dislocation (68% of UVCs and 23% of UACs).
3) UC thrombosis rarely occurs within the first 7 days of catheterization.
4) UVCs are prone to induce catheter-related thrombosis (1/3 of cases), yet not all of them require removal if systematic monitoring is implemented.
5) UAC thrombi, although rare, leave a thrombotic sheath in the aorta; some of them can be detected only after catheter removal.
6) Bedside ultrasound imaging of catheters supports the decision-making process related to the catheterization duration, shortening the time if abnormalities are detected and allowing a safer prolonged UVC stay when an alternative central line cannot be assessed.

n Insertion and Within

Data based on radiographs in NIC a relative risk of lifetime cancer r that of baseline controls (18). Rece Radiology together with the Ame Technologists raised a campaign called "Image Gently," whose role is to raise awareness of radiation risks in children and to

had a final location of the UVC hout any complications, which in y of the described location while a proper monitoring protocol is implemented. However, recently, there has been a lot of controversy in the medical literature, regarding the accurate location of both UVC and UAC, despite the imaging technique.

Lesioni da CVO

Hepatic Complications of Umbilical Venous Catheters in the Neonatal Period

The Ultrasound Spectrum

Betul Emine Derinkuyu, MD, Oznur Leman Boyunaga, MD, Cagri Damar, MD, Sezin Unal, MD, Ebru Ergenekon, MD, Ayse Gul Alimli, MD, Cigdem Oztunali, MD, Canan Turkyilmaz, MD

Technique

The umbilical venous catheters were inserted by a pediatric neonatologist without imaging guidance. After the procedure, in every neonate, the catheter tip was controlled with an anteroposterior thoracoabdominal radiograph to reposition the catheter tip if necessary. The correct position of the catheter tip was at the level of the right hemidiaphragm or between T8 and T10. Double-lumen 3F to 5F umbilical venous catheters were used to allow simultaneous administration of fluids, drugs, and total parenteral nutrition (TPN) as needed.

- 244 neonati; 88.5% pretermine, 11,5% a termine
- ECO a D0, D1, D3, D7; post rimozione D3, D7, M1, M3

Journal Ultrasound Medicine 2017

Lesioni da CVO

Table 1. Hepatic Complications of Umbilical Venous Catheter in 244 Neonates

	%
Air in the portal vein	20.1% (n=49/244)
Left portal vein thrombosis	6.1% (n=15/244)
Liver parenchymal lesions	7.4% (n=18/244)
Single echogenic lesion	4.1% (n=10/244)
Multiple small branching echogenic lesions	2.1% (n=5/244)
Large heterogeneous lesion with laceration and effusion	1.2% (n=3/244)

- 60% delle trombosi con CVO in sede; 40% post rimozione
- 8 Casi di trombosi si sono risolti, 7
- 70% delle trombosi ipotrofia del lobo sinistro al FU

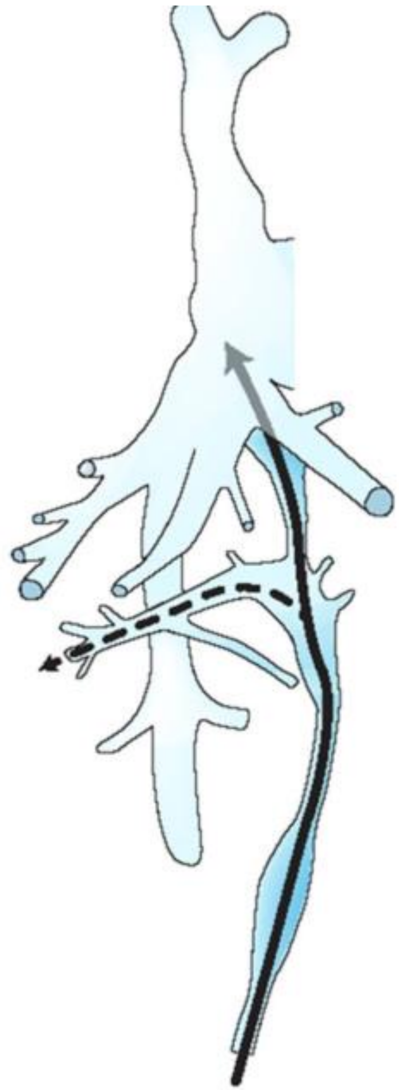
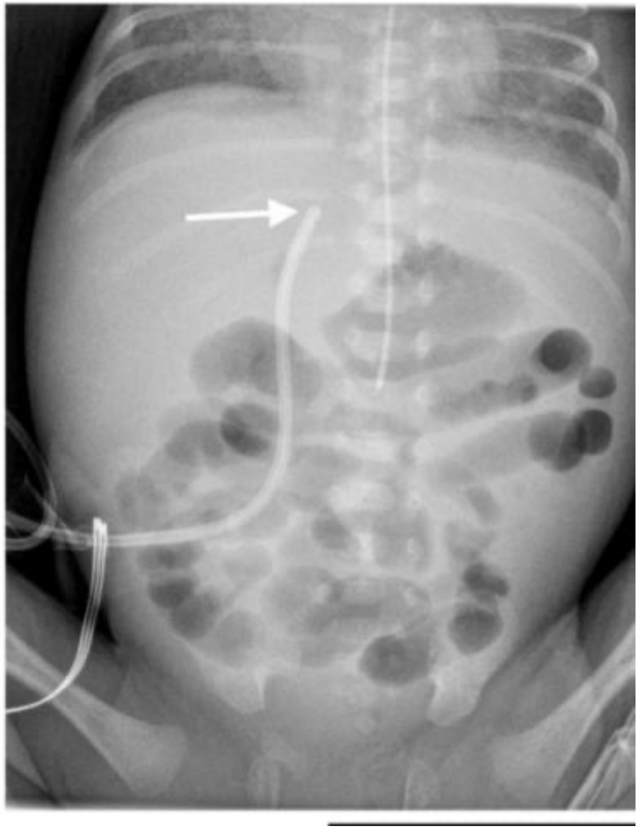
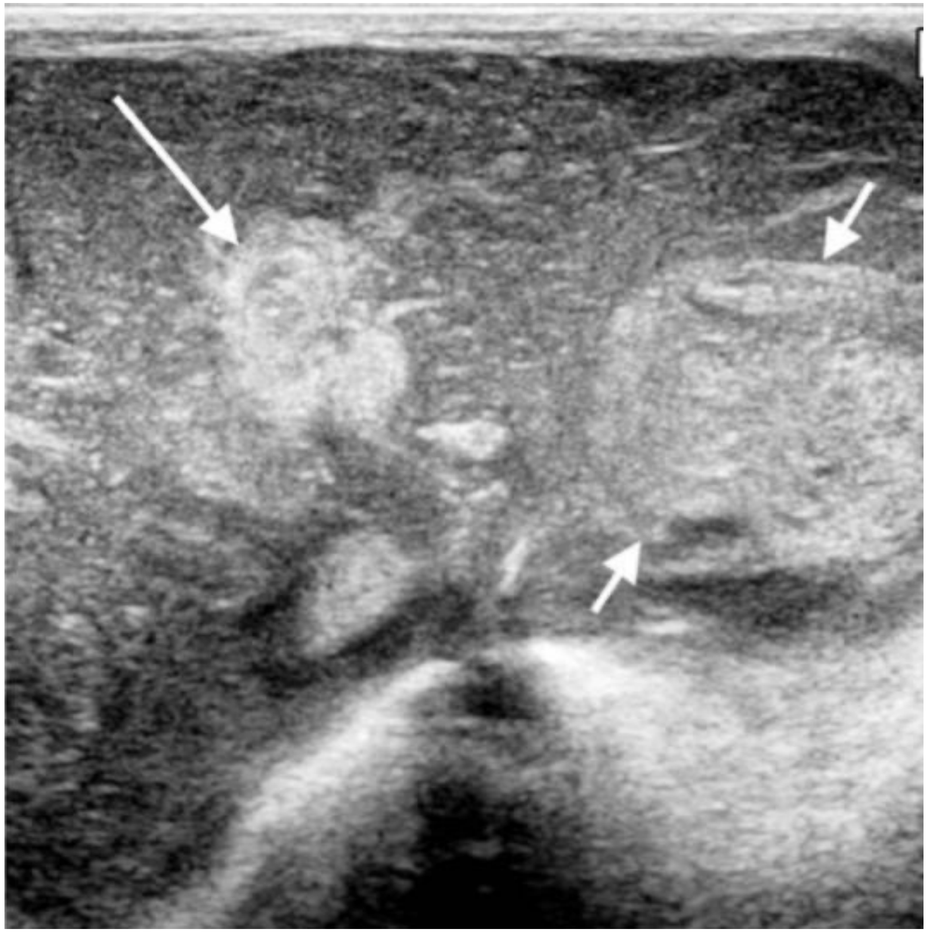


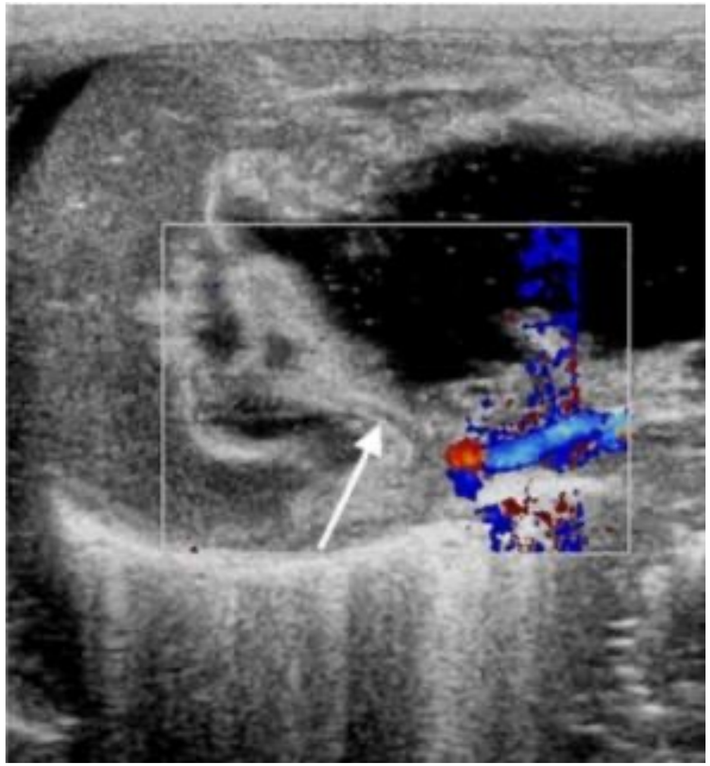
Fig. 7 Incorrect course of the UVC in cases of hepatic collections. The solid line indicates the appropriate pathway of the UVC through the umbilical vein whereas the dotted line shows the UVC entering the portal venous system. (This figure has been modified from Richter and Lierse [1991]. Imaging atlas of the newborn) [13]

Lesioni da CVO





Lesioni da CVO



Lesioni da CVO

Lesioni da CVO

Hepatic extravasation complicated by umbilical venous catheterization in neonates: A 5-year, single-center experience

Pediatrics and Neonatology (2020) 61, 16–24

Table 2 Factors related to HE in 1327 neonates with UVC placement.

Variables/groups	Non-HE (n = 1294)	HE (n = 33)	Student-t (95% CI)[a]/Chi-square[b]	*P*-value
Gestational age (weeks)	30.4 ± 3.1	30.5 ± 4.7	−0.074, 0.274[a]	0.259
Gestational age < 30 weeks	652 (50.4%)	17 (51.5%)	0.002[b]	0.962
Male (n, %)	630 (48.7%)	17 (51.5%)	0.021[b]	0.885
Birth weight	1531.2 ± 406.9	1443.3 ± 807.7	64.94, 111.5[a]	<0.0001*
Birth weight < 1500 g (n, %)	852 (65.8%)	22 (66.7%)	0.008[b]	0.930
Improper UVC location (n, %)	606 (46.8%)	30 (90.9%)	23.316[b]	<0.0001*
Duration of UVC				
>5 days (n, %)	559 (43.2%)	18 (54.5%)	1.256[b]	0.262
>7 days (n, %)	74 (5.7%)	3 (9.1%)	0.159[b]	0.659

[a]Data of continuous variables were expressed as mean ± SD, and analyzed by student *t* test; mean values were significantly different between variables ($p < 0.05$*).
[b]Descriptive data were analyzed by Chi-square test; number (percentage) was significantly different between variables ($p < 0.05$*).
HE = hepatic extravasation; CI = confidence interval; UVC = umbilical venous catheterization.

Lesioni da CVO

Severe Liver Injury while Using Umbilical Venous Catheter: Case Series and Literature Review

Ruza Grizelj, MD, PhD[1] Jurica Vukovic, MD, PhD[1] Katarina Bojanic, MD[2] Damir Loncarevic, MD[1]
Ranka Stern-Padovan, MD, PhD[3] Boris Filipovic-Grcic, MD, PhD[1] Toby N. Weingarten, MD[4]
Juraj Sprung, MD, PhD[4]

Results Of 1,081 neonates, 9 (0.8% [95% exact binomial confidence interval, 0.4–1.6%]) with UVC developed severe hepatic injury. All had the UVC malpositioned within the liver circulation. All presentations were life threatening, with acute abdominal distension (hepatomegaly) being the most consistent sign. Two neonates died from complications which were unrelated to catheter-associated liver injury.

Conclusions: In all neonates with liver injury, UVC was malpositioned within the portal circulation. Despite the fact that our report provides only circumstantial evidence for the mechanism of injury, it supports reports which suggest that "low" UVC position increases potential for this type of complication. Acute onset of abdominal distension in a neonate with UVC should prompt ultrasonographic evaluation of position of the catheter tip.

our neonates. Most frequently, the presenting sign is abdominal distension due to hepatomegaly or ascites.[2–9,24] Most typically, the intraperitoneal fluid represents extravasated TPN, which may be hemorrhagic.[2] Other presentations include hypotension,[2–6,8,24,26] worsening respiratory distress,[2–5,8–10,14,26,33,34] anemia,[3,8,24,26,27] fatal hemorrhagic shock,[3,24,27] anuria,[11] sepsis or hepatic abscess,[4,5,13,33] acute liver hematoma,[24,35] and portal thrombosis with chronic portal hypertension.[13,22,36] In six of our nine neonates, hemorrhagic shock or severe anemia developed secondary to bleeding into the cystic liver lesion. Finally, bleeding within the liver can compromise local blood flow and may result in development of acute portal hypertension (melena and caput medusae) as was present in one of our neonates (► **Fig. 2B**).

confluence of the portal circulation. When a neonate with UVC develops, unexplained clinical deterioration associated with acute abdominal distension suspicion for catheter-associated liver injury should be ruled out. Since evidence exits that the prolonged UVC use may be associated with life-threatening complications, it should be replaced with an alternative peripherally inserted intravenous access as soon as possible.

Quello che non ti aspetti....

Original article

Thrombosis after umbilical venous catheterisation: prospective study with serial ultrasound

Table 1 Patient characteristics of infants with UVC (study group) and infants without UVC (control group)

Variable	Study group (n=40)	Control group (n=20)	P value
Gestational age at birth (weeks)	27 (24–41)	29 (27–41)	0.06
Birth weight (grams)	1052 (600–3925)	1464 (1020–3300)	0.07
SGA, n (%)	6 (15)	0 (0)	0.07
Duration of hospital admission (days)	18 (3–102)	13 (3–44)	**0.04**
PICC received after UVC, n (%)	12 (30)	3 (15)	0.21
NEC, n (%)	5 (12.5)	1 (5)	0.36
Culture-proven sepsis, n (%)	11 (27.5)	2 (10)	0.12
Mortality, n (%)	4 (10)	1 (5)	0.51

In this study, thrombosis in the UVC route was detected with screening by ultrasonography in 75% of infants after umbilical catheterisation, whereas no thrombi were demonstrated in the investigated location in infants without UVCs. This result

UVCs is not advised. However, given the high risk of thrombus formation in UVCs, these catheters should be used with caution and removed promptly if the clinical indication is no longer present.

Dubbink-Verheij GH. ADC 2019

Thrombosis after umbilical venous catheterisation: prospective study with serial ultrasound

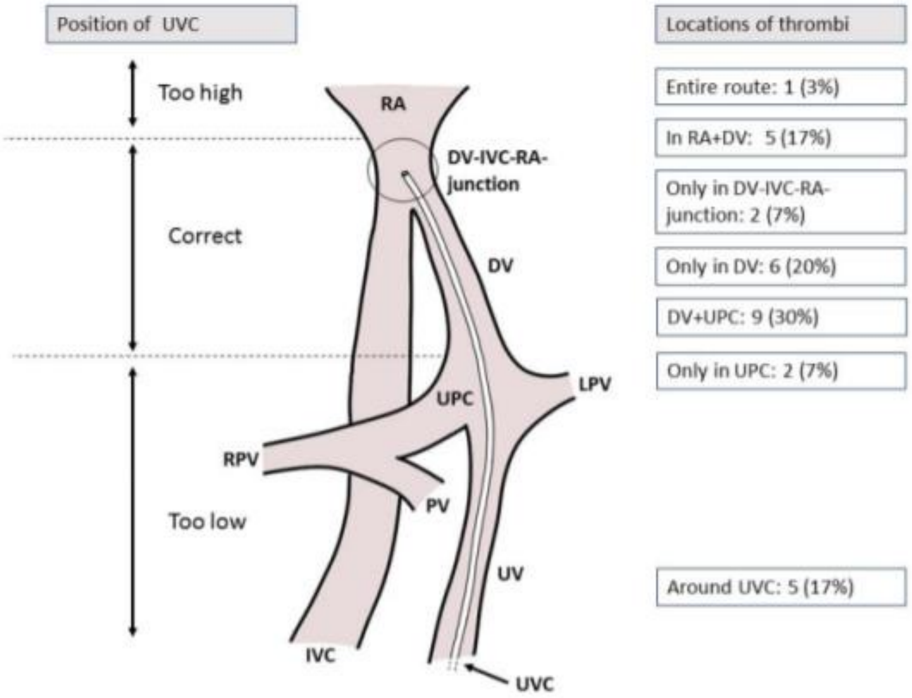
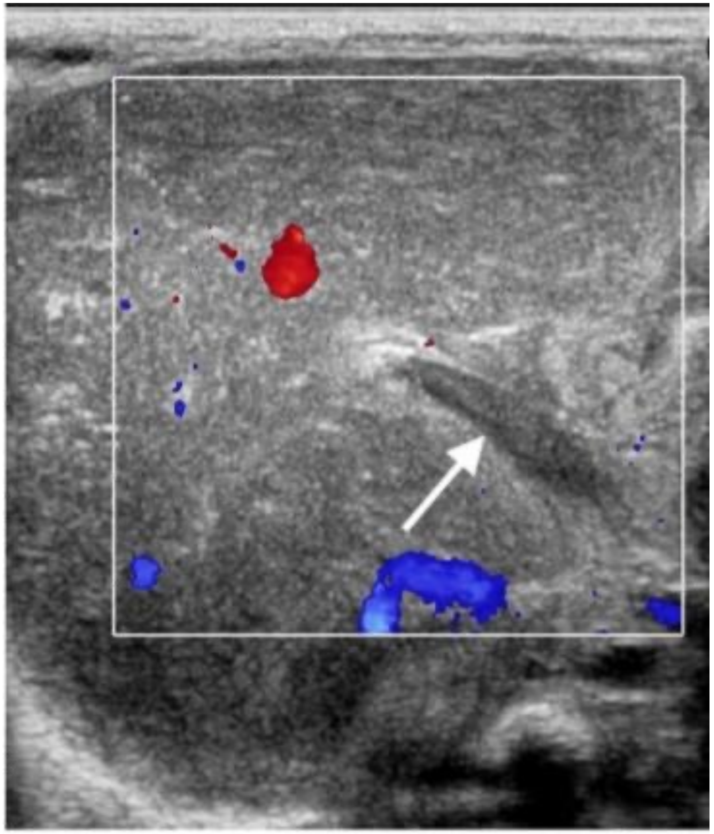
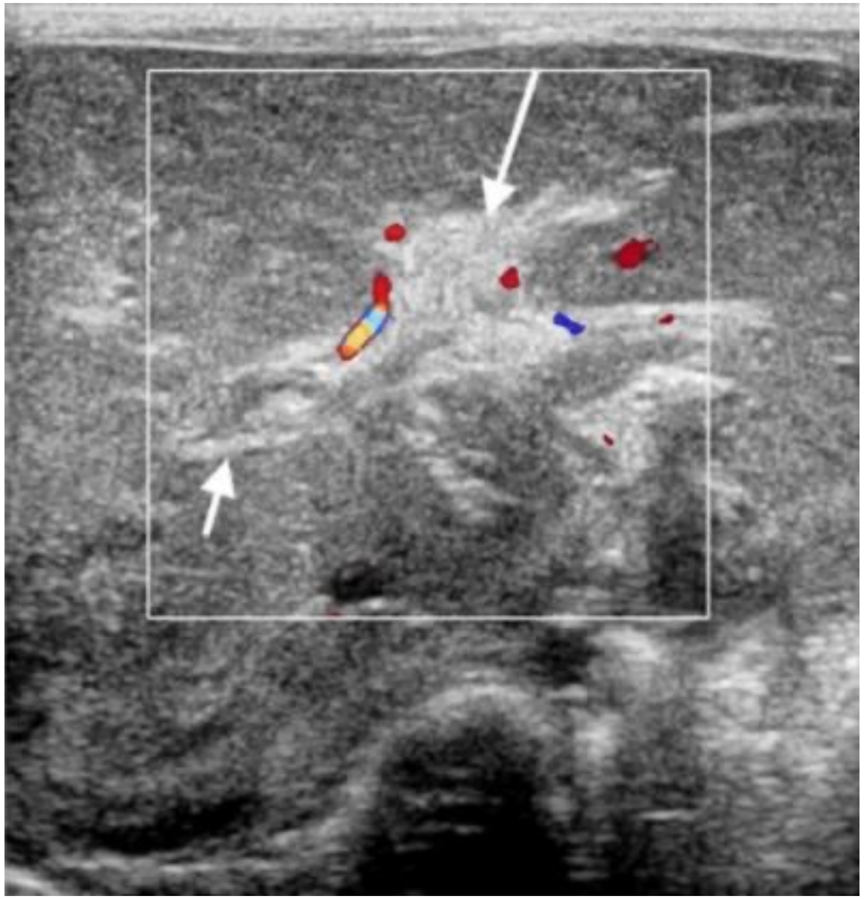


Figure 1 Locations of the 30 detected thrombi, n (%). DV, ductus venosus; IVC, inferior vena cava; LPV, left portal vein; PV, portal vein; RA, right atrium; RPV, right portal vein; UPC, umbilico-portal confluence; UV, umbilical vein; UVC, umbilical venous catheter.

Dubbink-Verheij GH. ADC 2019

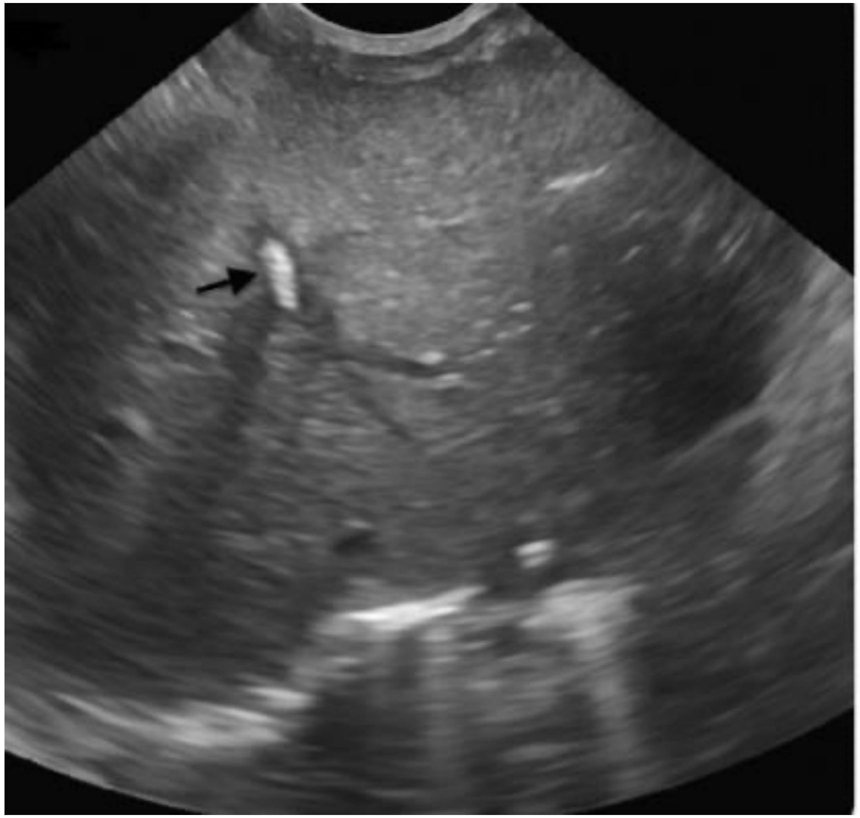
Quello che non ti aspetti....





Dubbink-Verheij GH. ADC 2019

Quello che non ti aspetti....



World Journal of
Hepatology

Submit a Manuscript: https://www.f6publishing.com World J Hepatol 2021 November 27; 13(11): 1802-1815

DOI: 10.4254/wjh.v13.i11.1802 ISSN 1948-5182 (online)

SYSTEMATIC REVIEWS

Incidence of umbilical vein catheter-associated thrombosis of the portal system: A systematic review and meta-analysis

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Incidenza cumulativa del 12%. Con un ampio range di variabilità da 0 al 49%

Table 2 Characteristics of included studies

Ref.	Study design	UVC with PVT	UVC without PVT	Dwel time UVC with PVT	Dwel time UVC without PVT	Indication to UVC control	Type of imaging	Country/territory
Levit *et al*[42], 2020	Prospective	1	2016	N/A	N/A	Clinical Suspicion	X-ray + US	United States
Dubbink-Verheij *et al*[31], 2020	Prospective	13	27	N/A	N/A	Screening	X-ray + US	The Netherlands
Chen *et al*[15], 2020	Retrospective	7	1320	N/A	N/A	Screening	X-ray + US	Taiwan
Hwang *et al*[46], [illegible]	Retrospective	15	54	N/A	N/A	Screening	X-ray + US	South Korea
Boo *et al*[44], 1999	Prospective	6	57	N/A	N/A	Screening	X-ray + US	Malaysia
Schwartz *et al*[40], 1997	Prospective	1	99	3	4 (0-12)[2]	Screening	X-ray + US	United States
Yadav *et al*[43], 1993	Prospective	7	15	N/A	N/A	Screening	X-ray + US	India

[1]Results are expressed as mean ± SD, if reported.

[2]Results are expressed as median (range), if reported.

UVC: umbilical venous catheter; PVT: portal vein thrombosis; N/A: Not applicable; US: Ultrasound (abdominal).

Our systematic review has multiple limitations, mostly attributable to the heterogeneity across studies. First, the intrinsic limitation of having included either retrospective studies or "old" studies (from 1980 onwards), *i.e.*, performed at time-points during which clinical approach to patients and awareness about PVT was presumably different compared to more recent studies. Second, the lack of correlation between PVT and UVC tip position in most studies. Third, the different study designs regarding the indication and time schedule for imaging assessment. Fourth, the different approach of clinicians about the use of prophylactic/therapeutic treatment in neonates with indwelling UVCs.

TVP

- Studio retrospettivo su TVP nel primo anno di vita
- SK Toronto
- 133 casi di trombosi (95 CVO (71%), 36 NO CVO, 2 non noto)
- TVP è associata al CVO, alla sua malposizione e alla sua durata

TABLE 3.—Outcome in Relation to UVC (n = 133)

	UVC (n = 95)	No UVC (n = 36)	Unknonw UVC Placement (n = 2)
PVT grade 1	41	18	1
PVT grade 2	33	10	1
PVT grade 3	21	8	–
Lobar atrophy	24	6	–
PHTN	2	4	–

(Courtesy of Morag I, Epelman M, Daneman A, et al. Portal vein thrombosis in the neonate: risk factors, course, and outcome. *J Pediatr*. 148:735-739. Copyright 2006 by Elsevier.)

TABLE 4.—Outcome in Relation to Grade of Thrombus

	Grade 1 (n = 60)	Grade II (n = 44)	Grade III (n = 29)	*P*
Complete or partial resolution	46 (77%)	25 (56%)	10 (34%)	.0005
No change	8	7	1	.2571
Progression to lobar atrophy or PHTN	6 (10%)	12 (27%)	18 (62%)	.0001

(Courtesy of Morag I, Epelman M, Daneman A, et al. Portal vein thrombosis in the neonate: risk factors, course, and outcome. *J Pediatr*. 148:735-739. Copyright 2006 by Elsevier.)

Portal vein thrombosis in the neonate: risk factors, course, and outcome. J Pediatr 2006

TVP

that sets the stage for complications. Portal hypertension is the most serious long-term complication but presents 5 to 6 years later and thus may not be apparent at the time of the original PVT diagnosis. Long-term follow-up is therefore indicated. Another clinical clue associated with poor outcome is atrophy of the left hepatic lobe, which also presents later. All neonatologists should consider the risks of inserting a UVC and reserve this intervention for those infants who are most likely to require it or, better yet, for those who actually do require it in order to ensure the safest transition after birth and, in particular, ensure that the risk that a baby faces with a UVC is not greater than the risk without it.

D. K. Stevenson, MD

Portal vein thrombosis in the neonate: risk factors, course, and outcome. J Pediatr 2006

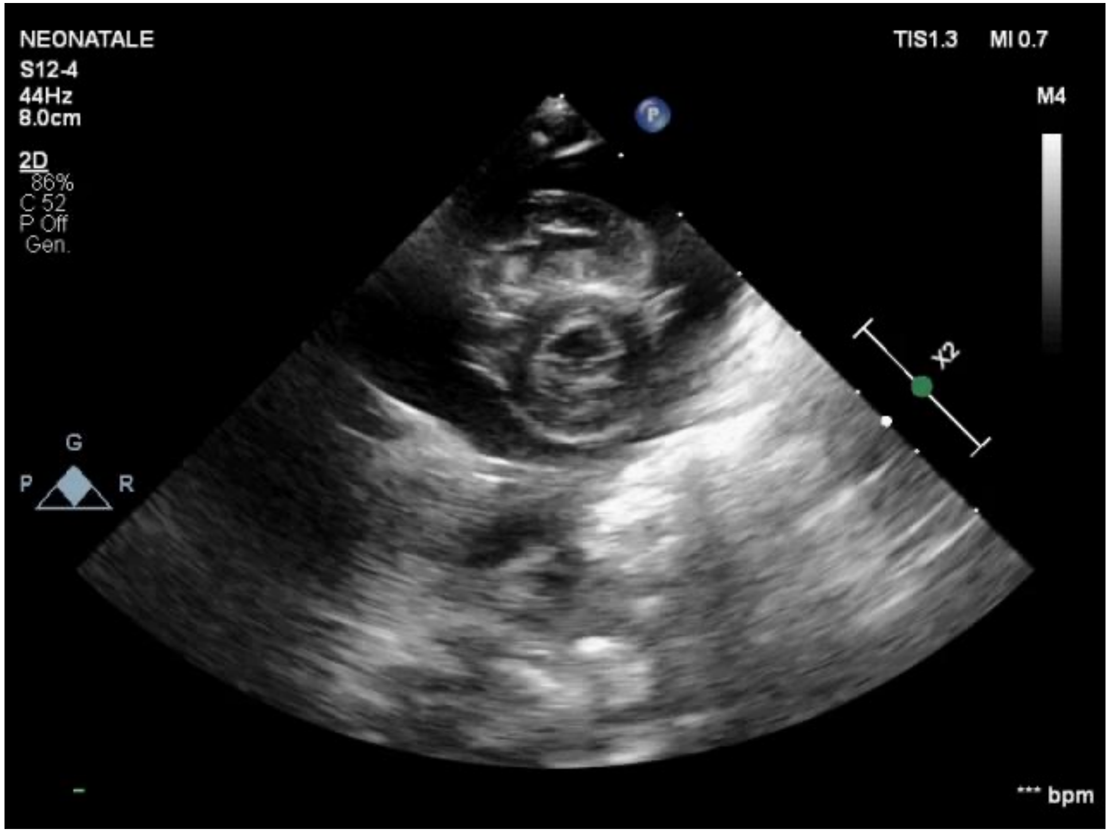
Thrombosis in the Neonatal Intensive Care Unit

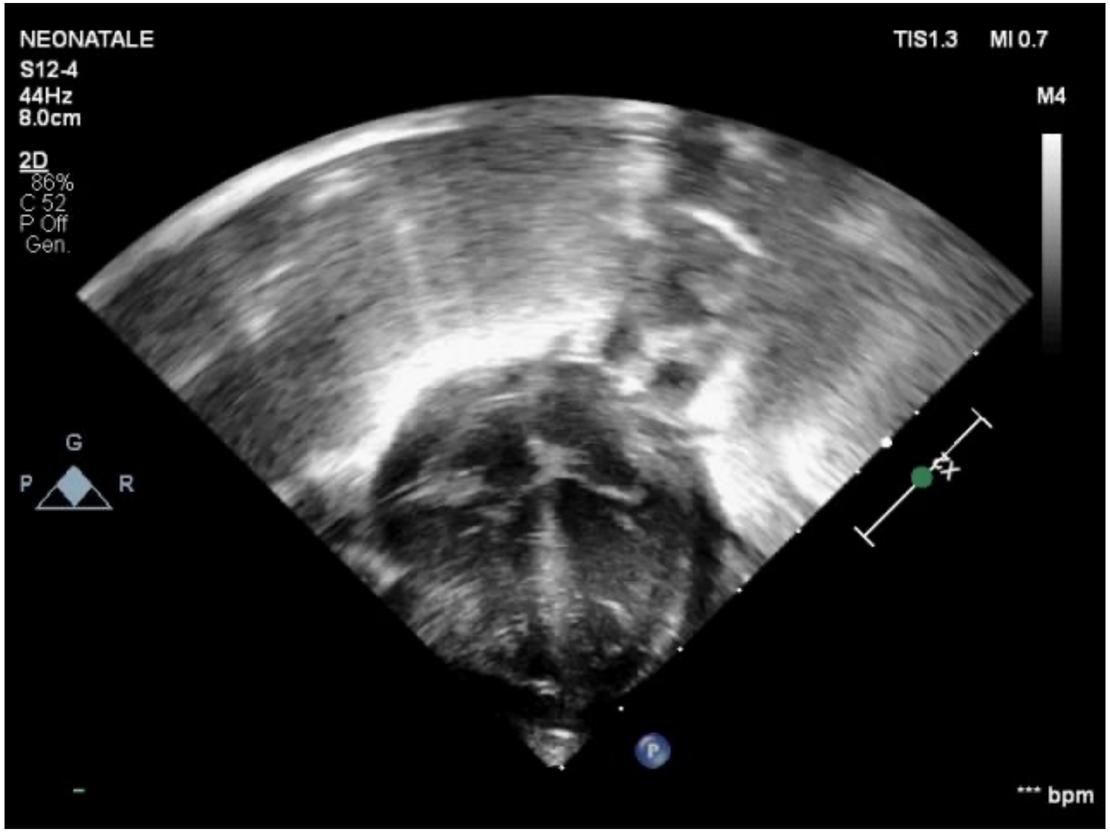
Matthew A. Saxonhouse, MD

Table 5
Management options for neonates with portal venous thrombosis

Treatment Plan	Description of PVT	Recommended Ultrasound (US) Follow-Up
Observation	No extension observed and infant clinically stable	7–10 d
Anticoagulation	Extension into the IVC, RA, or RV but no end-organ compromise	10 d If thrombus resolved, may stop therapy. If still present, treat for 6 wk to 3 mo depending on US follow-up
Thrombolytic therapy	End-organ compromise with extension of the thrombosis into the IVC, RA, or RV	Daily May stop thrombolysis when symptoms improve but would transition to anticoagulation

Last but not least

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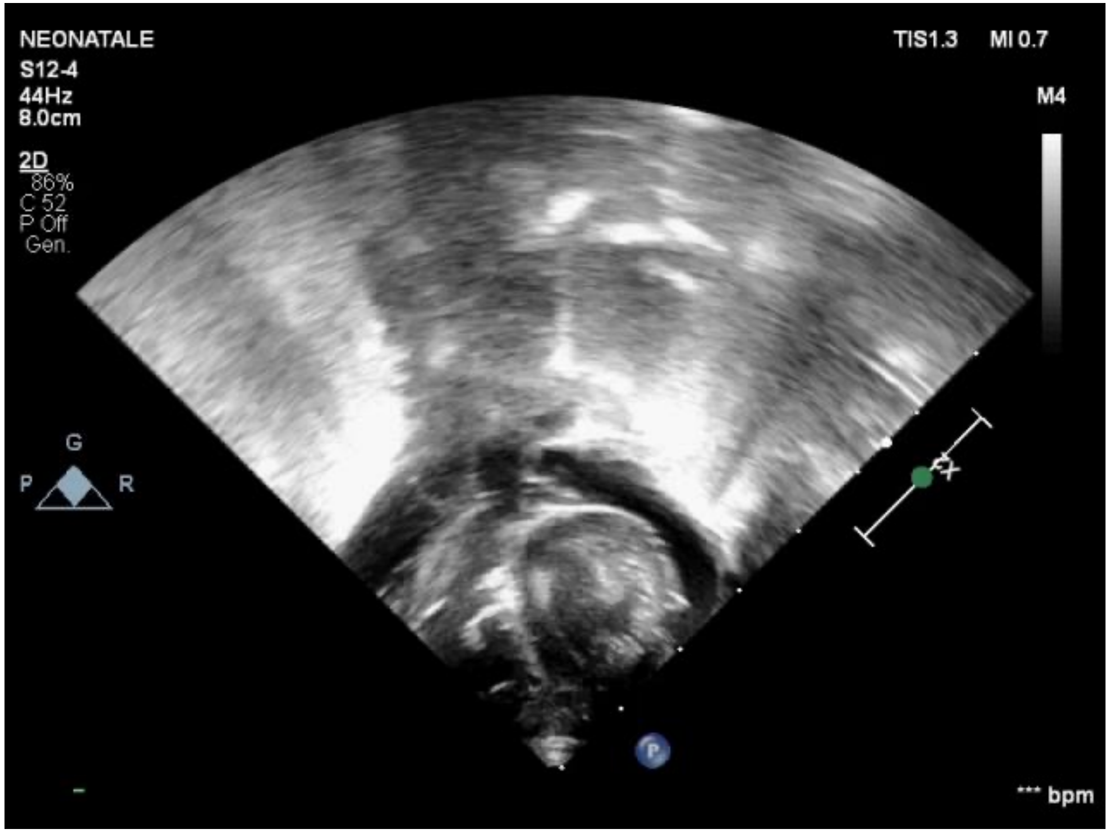
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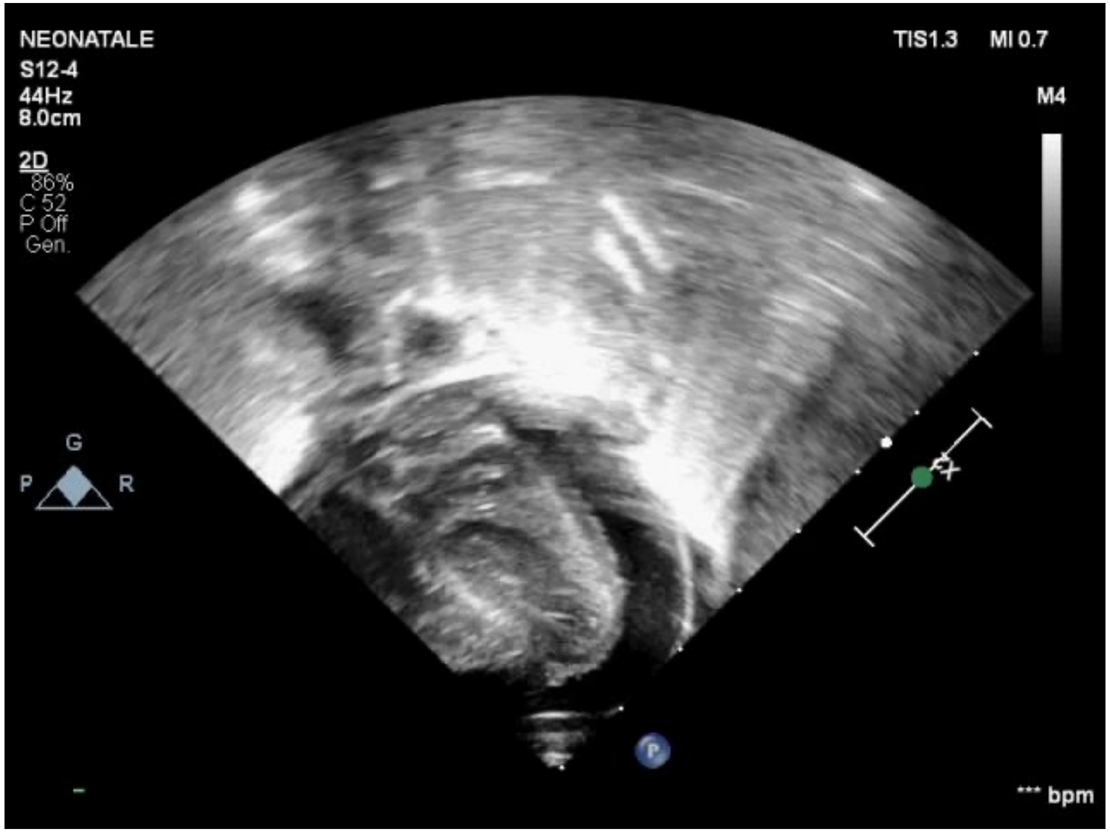
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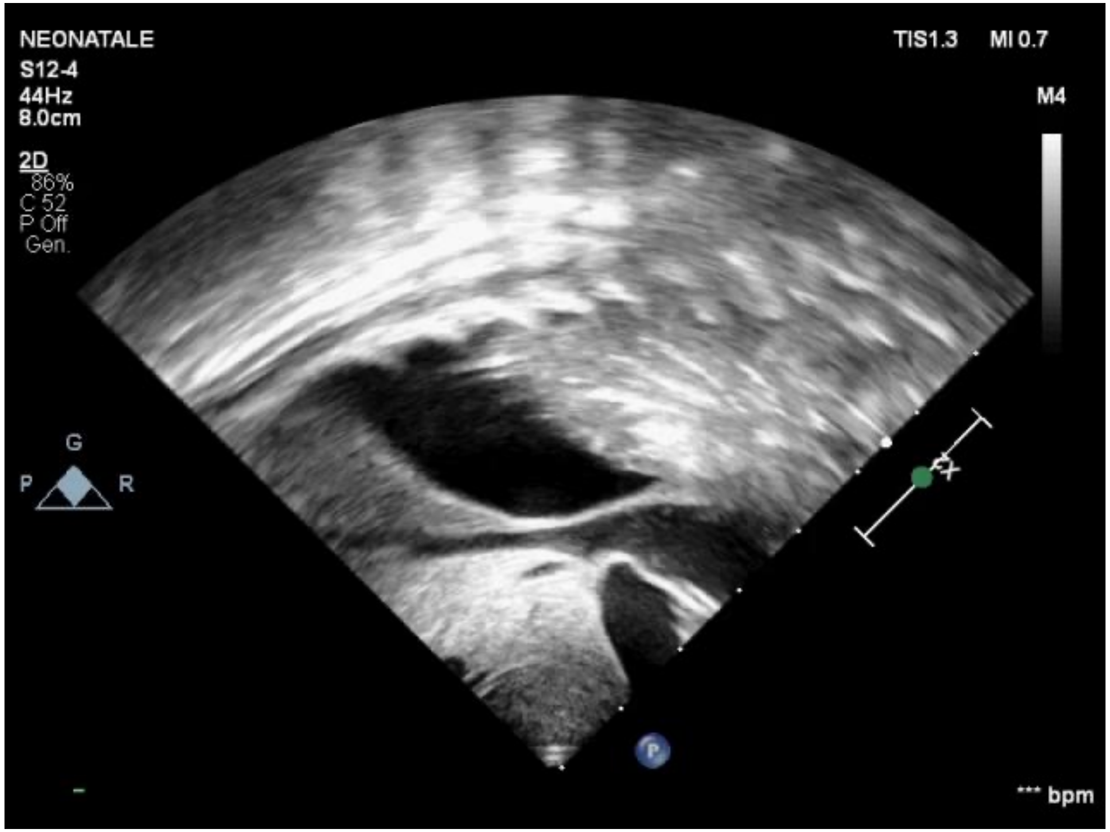
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Echocardiographic Signs Of Cardiac Tamponade

Echocardiographic feature	Sensitivity	Specificity
Large pericardial effusion with swinging heart	n.a.	n.a.
Diastolic collapse of the right atrium (RA)	50–100 %	33–100 %
Duration of diastolic collapse of the RA as ratio on the cardiac cycle length >0.34	>90 %	100 %
Diastolic collapse of the right ventricle	48–100 %	72–100 %
Respiratory changes of the mitral E velocity >25 %, tricuspid E velocity >40 %	n.a.	n.a.
Inferior vena cava plethora (dilatation >20 mm and <50 % reduction of diameter with respiratory phases)	97 %	40 %

n.a. not available

ARTICLE

Check for updates

The incidence of pericardial effusion requiring intervention in infants with a history of umbilical catheter placement: the US national database

Marwa M. Elgendy[1]✉, Hany Aly[1] and Mohamed A. Mohamed[1]

- Popolazione 22,751,313
- Incidenza di versamento pericardico
- Nei neonati a termine 0.29%
- Nei neonati con CHD 0.78%
- Nei prematuri < 1500 gr 0.18%

The mechanism to explain UVC to cause pericardial effusion may be related to TPN infusion. Infusion of TPN with hyperosmolar fluids might play a role in the pathogenesis of pericardial effusion as it causes osmotic damage of the pericardium endothelium, then the fluids diffuse into the pericardial space forming an effusion. Another speculation for the association between UVC placement and occurrence of PCE in VLBW infants is the inaccurate position of the tip of UVC in the heart [20]. The recommended position for the tip of an UVC is the junction of inferior vena cava (IVC) and right atrium [21]. The verification of catheter tip is important both at placement and during follow-up. The tip of UVC is routinely determined by radiography to ensure that the tip has not migrated and is in optimal position. Monitoring of line position, especially when were kept indwelling for long duration, may mitigate this complication. Repeated contact of the UVC tip with the cardiac wall might result in endothelial injury and formation of thrombus, which can promote further adherence of the UVC tip to the cardiac wall and eventually lead to diffusion of fluid into the pericardial space [22]. Unfortunately, this dataset does not include the tip position of umbilical catheters. Accordingly, prospective studies are in need to assess this association.

THANK YOU

GRACIAS
ARIGATO
SHUKURIA
DANKSCHEEN
TASHAKKUR ATU
YAQHANYELAY
SUKSAMA
EKHMET
GRAZIE
MEHRBANI
KOMAPSUMNIDA
MAAKE
PALDIES
BOLZÏN
MERCI
BÏYAN
SHUKRIA
TINGKI
GOZAIMASHITA
EFCHARISTO
JUSPAXAR
SPASSIBO
SNACHALHUYA
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