NUOVE STRATEGIE PER IL POSIZIONAMENTO E DI CATETERI OMBELICALI E DI CATETERI EPICUTANEO CAVALI NEL NEONATO

GAVeCeLT
Gli Accessi Venosi Centrali a Lungo Termine

GAVePed
Gruppo Accessi Venosi Pediatrici

Vito D'Andrea

Primo Convegno Nazionale GAVePed
Sabato 2 marzo 2019

Indicazioni ai CVO

Practice Criteria

A. Establish organizational guidelines for appropriate use of UACs and UVCs based on gestational age, birth weight, and severity of illness in an effort to decrease their unnecessary use and associated complications.[1-3] (IV)

30.2 The clinical need for the umbilical catheter is assessed on a daily basis and promptly removed when no longer indicated.

Infusion therapy standard of practice. Journal of infusion nursing 2016

One + all | we care Royal Cornwall Hospitals NHS
NHS Trust

INSERTION OF UMBILICAL LINES – ARTERIAL (UAC) and VENOUS (UVC) - NEONATAL CLINICAL GUIDELINE

Umbilical Venous Catheterisation (UVC)

- Emergency venous access
- Central venous access for maintenance intravenous fluids, hypertonic fluids/drugs, TPN, blood products
- Exchange transfusion

Our Vision
To provide every patient with the care we want for those we love the most

Norfolk and Norwich University Hospitals NHS
NHS Foundation Trust

Trust Guideline for the Management of: Insertion of Umbilical Venous Catheter (UVC)

Indications[1]

- Venous access for low birth weight infants to avoid multiple peripheral cannulation
- Emergency vascular access for resuscitation of infants at birth
- Exchange transfusion

The Royal Children's Hospital Melbourne

Assessment

Indications: (2, 3, 4, 5)

Central venous access in neonates in the first 14 days of life

- Administration of medication, parenteral nutrition and IV fluids
- Exchange or partial exchange transfusion
- Central venous pressure monitoring
- Frequent blood sampling in unstable patients without arterial access

NTS Clinical Guideline

NTS NEONATAL TRANSFER SERVICE LONDON

Indications for Umbilical Venous Catheter

- During resuscitation for administration of emergency drugs/fluids
- Difficult peripheral IV access
- Extreme prematurity
- Infusion of hypertonic solutions (eg >12.5% dextrose)
- Administration of vaso-active drugs
- Can be used for measurement of central venous pressure

The NEW ENGLAND JOURNAL of MEDICINE

VIDEOS IN CLINICAL MEDICINE

Umbilical Vascular Catheterization

JoDee Anderson, M.D., Douglas Leonard, M.D., Dana A.V. Braner, M.D.,
Susanna Lai, M.P.H., and Ken Tegtmeyer, M.D.

INDICATIONS

Umbilical-vessel catheters are indicated for use in neonates in unstable condition, including those who require frequent monitoring of blood gas, more than 40% oxygen, continuous monitoring of blood pressure, administration of high-osmolality fluids such as parenteral nutrition, or emergency vascular access. Umbilical-vessel catheterization may be indicated when attempts to obtain peripheral access are unsuccessful.

Standardizing Umbilical Catheter Usage in Preterm Infants

abstract

BACKGROUND AND OBJECTIVE: Absence of guidelines on umbilical arterial catheter (UAC) and umbilical venous catheter (UVC) use and inability to predict the hospital course may sway the frontline staff to overuse umbilical catheters in preterm infants. Our objective was to evaluate the feasibility of implementing guidelines standardizing the use of umbilical catheters and its impact on the incidence of sepsis and resource use.

Standardizing umbilical cathether usage in preterm infants. Pediatrics 2015

TABLE 1 Guidelines for Vascular Access in Preterm Infants <33 Weeks' Gestation

Gestation	UVC	UAC	PIV
≤26 wk	Recommended	Recommended	
27–28 wk	Recommended	Recommended for selected cases[a]	
≥29 wk	Avoid except in selected cases[a,b]	Recommended for selected cases[a]	Recommended

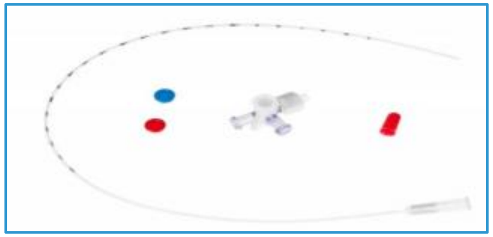
Nurses were to inform the staff neonatologist if PIV could not be established after 4 attempts.

[a] Use only if the patient is intubated and ventilated, or $F_{IO_2} > 40\%$ on continuous positive airway pressure, or the patient is hemodynamically unstable, needing fluid bolus or inotropes.

[b] Difficulty establishing PIV access.

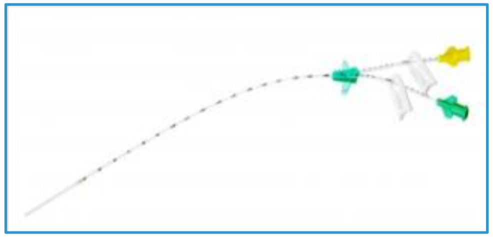
La scelta del CVO

Monolume in PUR



Ø Est. Fr.	2.5	3.5	4	5	8

Bilume in PUR



CATETERE (PUR) O.R.X.				FLUSSO ml/min		CAPACITÀ ml	
Ø Est. mm	Ø Fr	Lungh. cm	Lumi	Distale	Prossimale	Distale	Prossimale
1.4	4	20	2 x 20 G	15	15	0.26	0.26
1.4	4	40	2 x 20 G	6	6	0.28	0.28
1.7	5	40	2 x 19 G	9	9	0.30	0.30

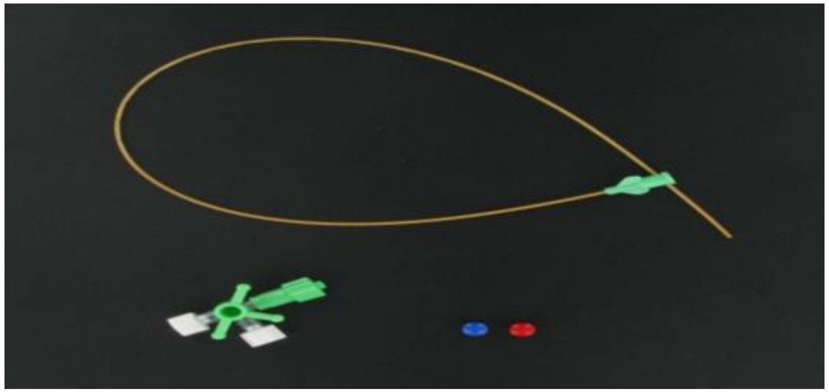
I cateteri in PUR sono da preferire rispetto a quelli in polietilene e polivinile in quanto riducono la colonizzazione

La scelta del CVO

Catetere
Ag ION

expert
umbilical catheters

VYGON
Value Life



Ø est. Fr.	2.5	3.5	4	5	8

Da preferire in neonati con età gestazionale < 30 W

La scelta del CVO

- 13-20% dei neonati con catetere sviluppano CRBSI (1)
- Colonizzazione intraluminale o extraluminale (20%) dei cateteri
- L'impiego di "lock solutions" a base di eparina e/o antibiotici è di grande interesse

Gli ioni d'argento hanno una funzione batteriostatica attraverso 3 meccanismi:

1. Danneggiano la parete cellulare del batterio
2. Danneggiano i mitocontri batterici
3. Inibiscono la riproduzione batterica

Reduction of catheter-related bloodstream infections in preterm infants by the use of catheters with the AgION antimicrobial system. EHD 2013
(1) CDC

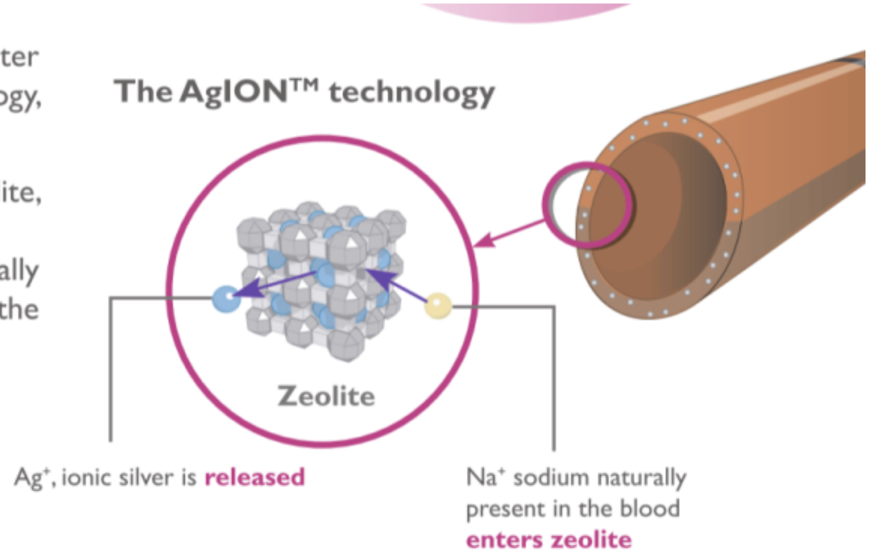
La scelta del CVO

The **expert** umbilical catheter is the only umbilical catheter with an integrated antimicrobial technology, the AgION™ technology, to fight against CRBSI in NICUs.

The AgION™ technology is made of ionic silver bound into zeolite, a bio-inert ceramic integrated in the catheter material[11].
When the catheter comes in contact with blood the zeolite naturally releases the Ag^+ ions and replace them by Na^+ ions present in the blood. It is a pure ionic exchange.

Ionic silver is a highly efficient antimicrobial technology with[11, 12]:

- a broad spectrum of action on gram$^+$, gram$^-$ and fungi
- a low toxicity
- a tri-modal action



Al contrario delle convenzionali strategia di «lock solutions» avrebbe le potenzialità di agire sulla colonizzazione intra ed extraluminale.

Vygon website

La scelta del CVO

- RCT
- Non-cieco
- Catetere impregnato vs Catetere in poliuretano
- EG ≤ 30
- Definite CRBSI: EMO + da v. periferica e catetere + punta del catetere positiva+ segni clinici+ catetere in sede o entro 48 h dalla rimozione
- Probable CRBSI: EMO negativa; punta del catetere positiva; segni clinici; catetere in sede o entro 48 h dalla rimozione
- BSI without source: EMO positiva; punta del catetere negativa; segni clinici; catetere in sede o entro 24 h dalla rimozione

Table 1
Characteristics of study groups. Mean ± (SD) or rate (%).

	Polyurethane catheter group (n = 41)	AgION catheter group (n = 45)	p
Gestational age (weeks)	26.2 ± 1.5	26.2 ± 2.0	0.99
Birth weight (g)	796 ± 203	840 ± 190	0.40
Stay in hospital (days)	85 ± 35	70 ± 33	0.04
Case fatality rate for CRBSI	4 (7)	0	0.04
Mortality	5 (10)	4 (9)	0.73
Duration of UVC (days)	8.5 ± 4.4	10.8 ± 4.7	0.02

Table 2
Occurrence of catheter colonization and catheter-related bloodstream infection (CRBSI), and blood-stream infection (BSI) in study groups. Rate (%).

	Polyurethane catheter group (n = 41)	AgION catheter group (n = 45)	p
Colonization, n (%)	2 (5)	2 (2)	0.66
CRBSI	9 (22)	1 (2)	0.005
• Definite, n (%)	8 (20)	1 (2)	0.01
• Probable, n (%)	1 (2)	0 (0)	NA
BSI without a source	1 (2)	1 (2)	0.48

Reduction of catheter-related bloodstream infections in preterm infants by the use of catheters with the AgION antimicrobial system. EHD 2013

La scelta del CVO

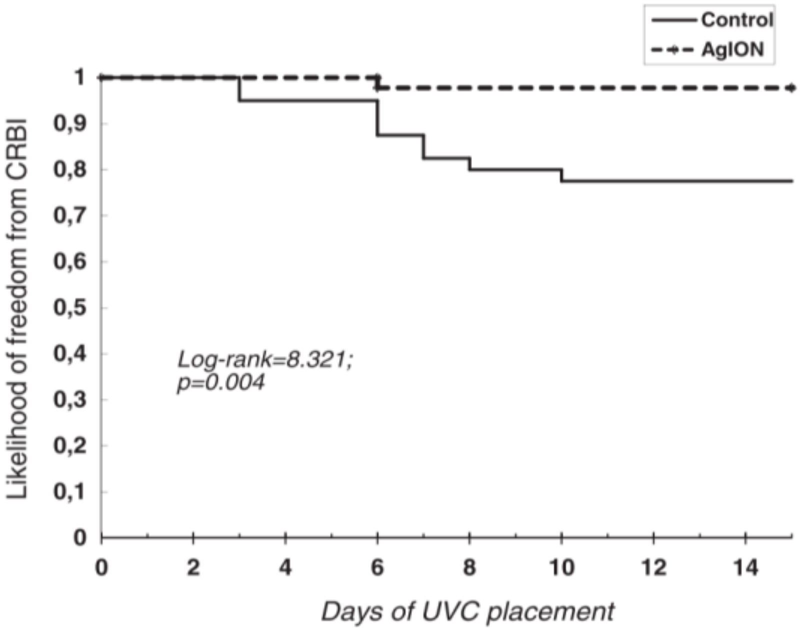


Fig. 2. Kaplan–Meier estimates of the cumulative likelihood of freedom from CRBSI in the 2 study groups.

CRBSIs were caused by *Enterobacter aerogenes* in the patient in the AgION group and CoNS in the control group patients (n = 9); BSI without a source was caused by *P. aeruginosa* in the AgION group (n = 1) and by CoNS in the control group (n = 1).

Multivariate analysis demonstrated that non-impregnated catheter use (OR 12.5, 95% CL 2.06–75.9) and catheter placement for more than 7 days (OR 5.1, 95% CL 1.13–23.6) increased the risk of developing a CRBSI in our population.

There was no case of intolerance to the AgION catheters and none of these catheters had to be removed due to a local skin infection.

Cochrane Library

2015

Cochrane Database of Systematic Reviews

Reduction of catheter-related bloodstream infections in preterm infants by the use of catheters with the AgION antimicrobial system. EHD 2013

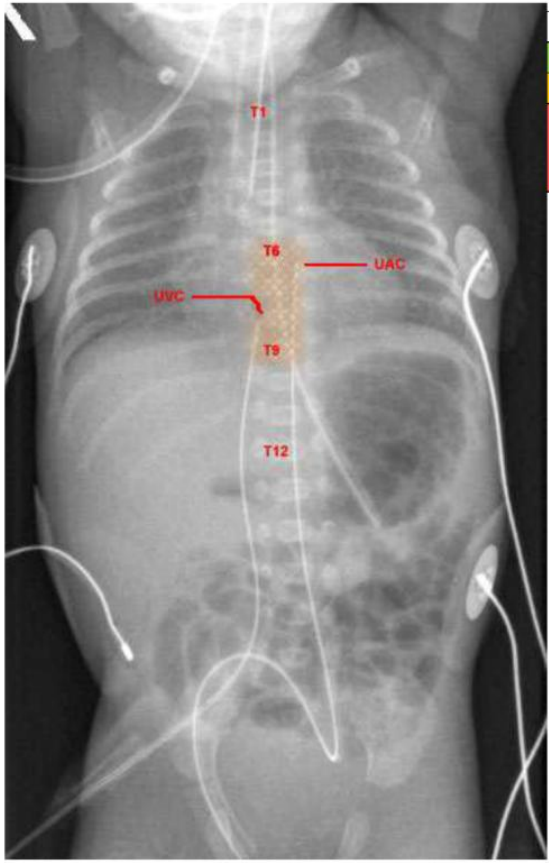
Importanza della tip location

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

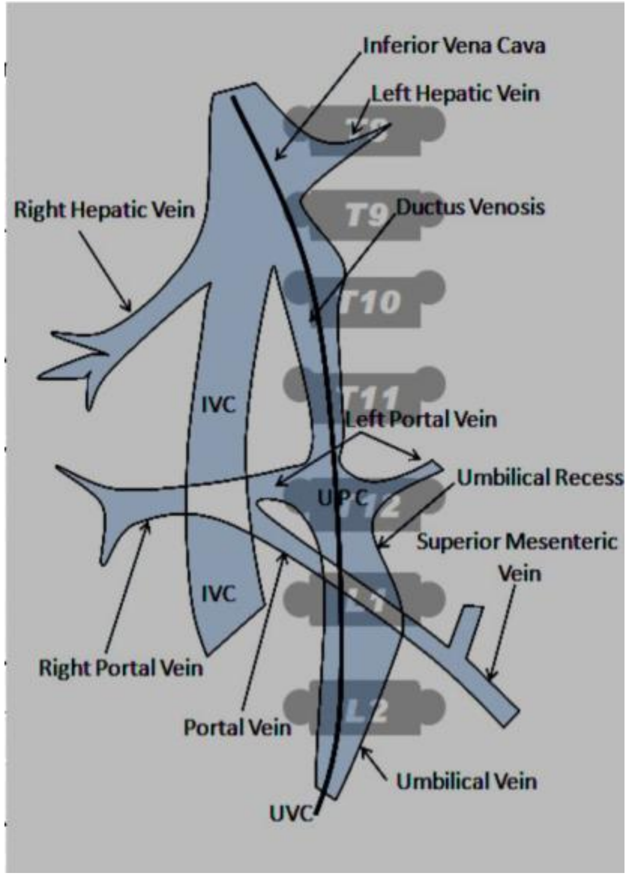


UVC
Optimal above diaphragm T8-10
Acceptable Low position in IVC
Withdraw if in heart or diverted angle into liver, re XRay

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

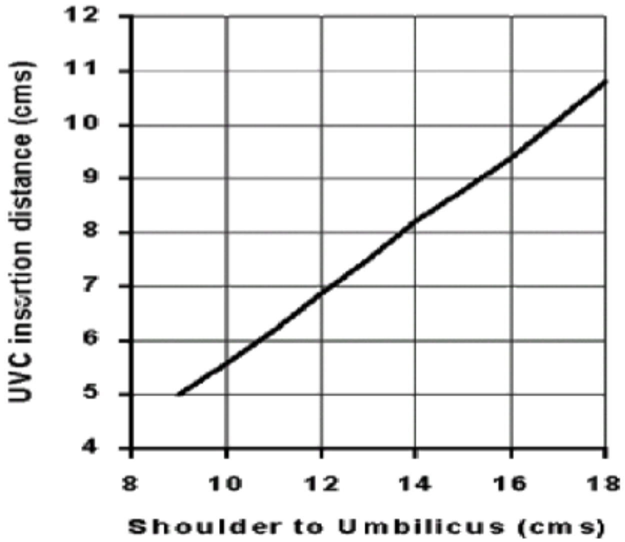


Tip location…metodi convenzionali???

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

Tip location…metodi convenzionali???

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	*UIMD*	*UXP*	*UN*	*UN – 1 cm*	*Shukla*	*UIMD*	*UXP*	*UN*	*UN – 1 cm*	*Shukla*
Total *N* = 170	35 (21%)	0	160 (94%)	7 (4%)	61 (36%)	3 (2%)	170 (100%)	0	4 (2%)	12 (7%)
> 1500 g *n* = 109	24 (22%)	0	105 (96%)	5 (5%)	31 (28%)	1 (1%)	109 (100%)	0	2 (2%)	9 (8%)
⩽ 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.

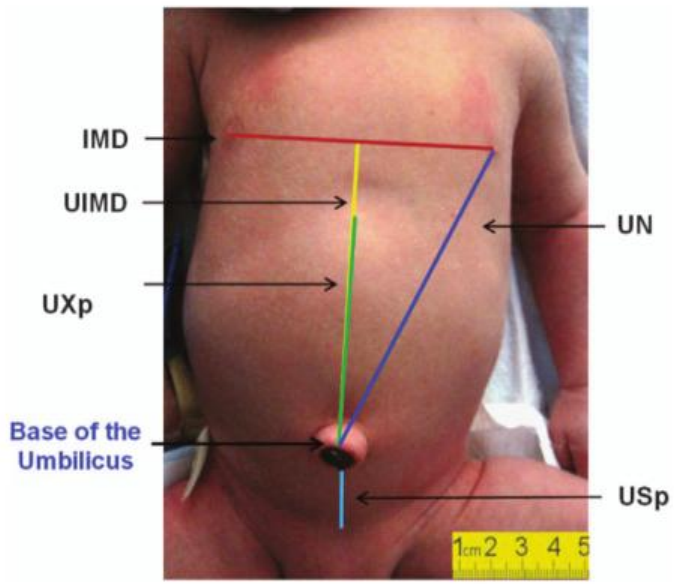


Figure 1. Morphometric measurements. IMD, inter-mammary distance; UIMD, umbilicus to midpoint of IMD; UN, umbilicus to nipple; USp, umbilicus to symphysis pubis; UXp, umbilicus to xiphoid process.

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

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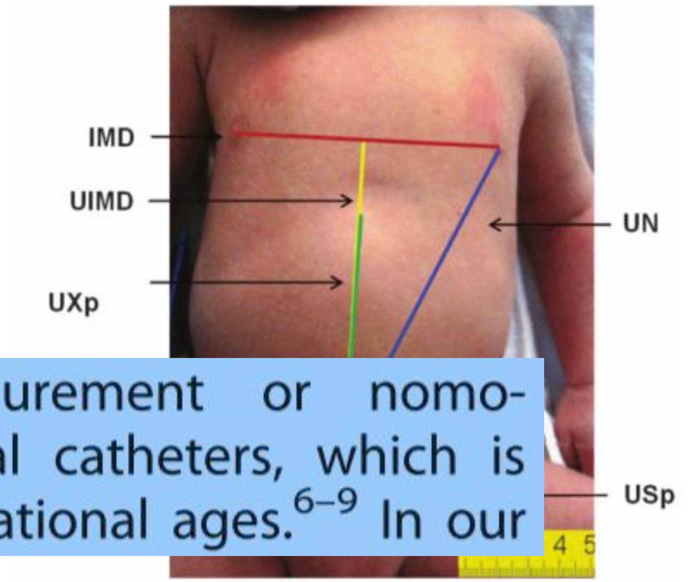
Neonates	UIM[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total N = 170	35 (2[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
> 1500 g n = 109	24 (2[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⩽ 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



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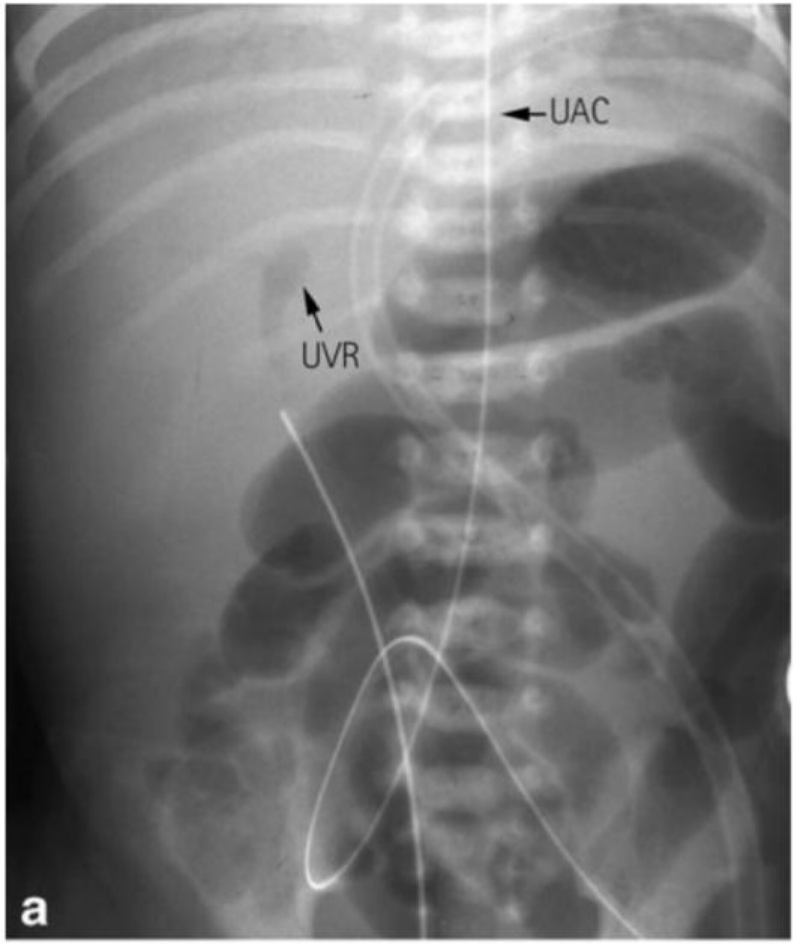
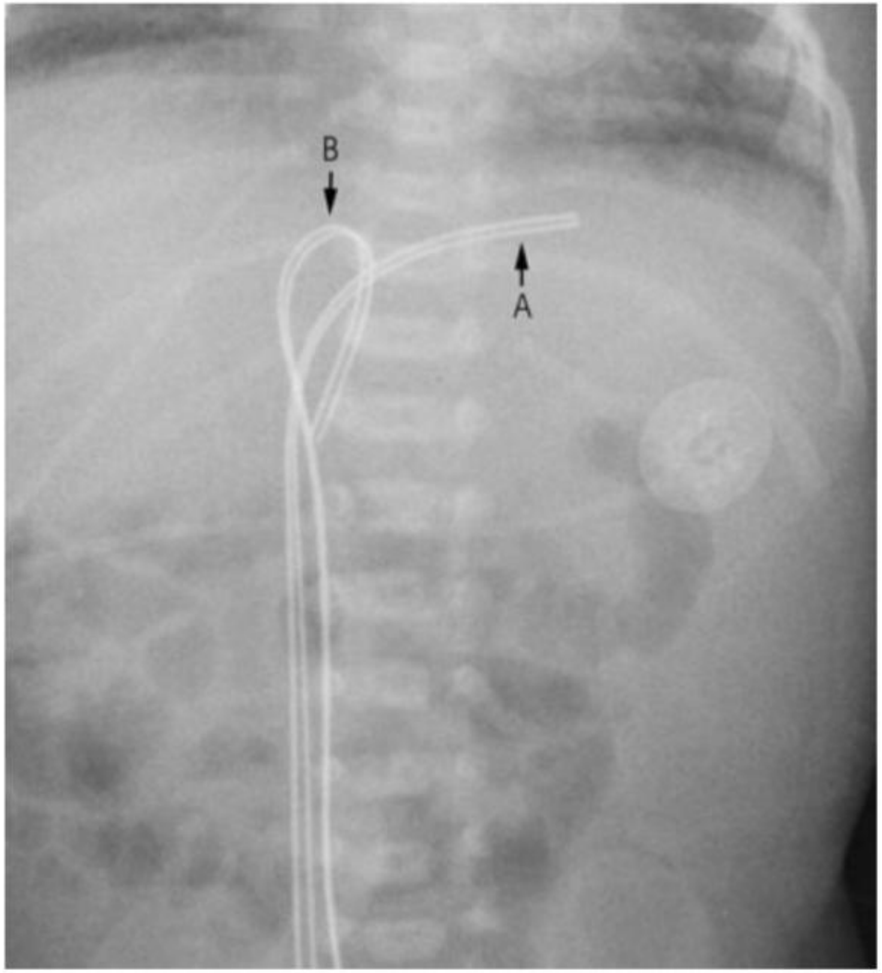


Umbilical vein catheterization—appropriate and inappropriate placement. Pediatric Radiology 2010



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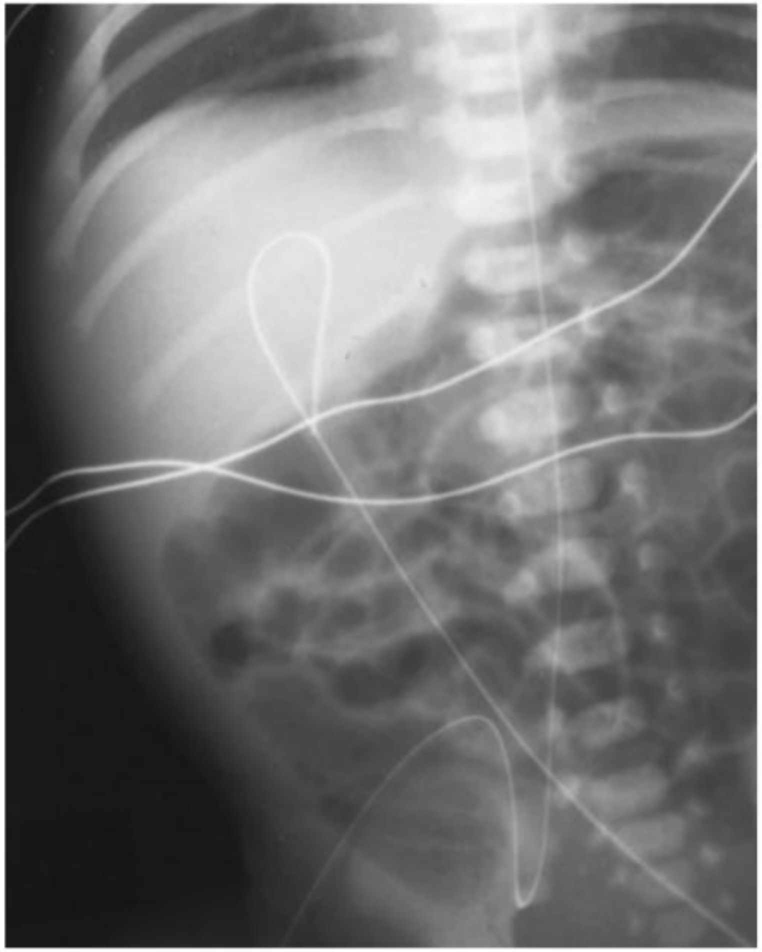

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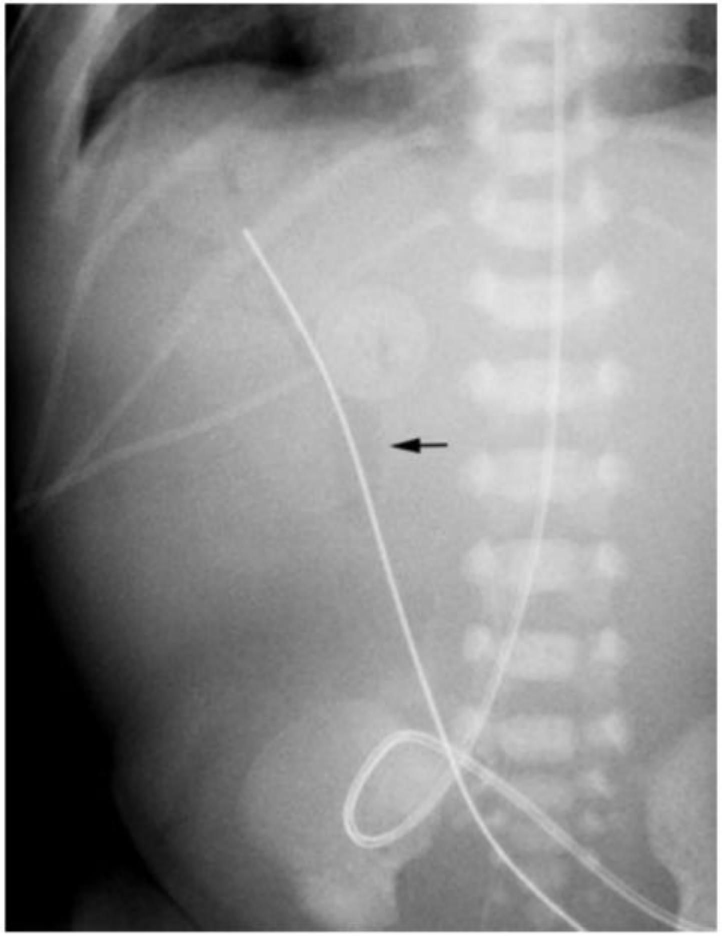

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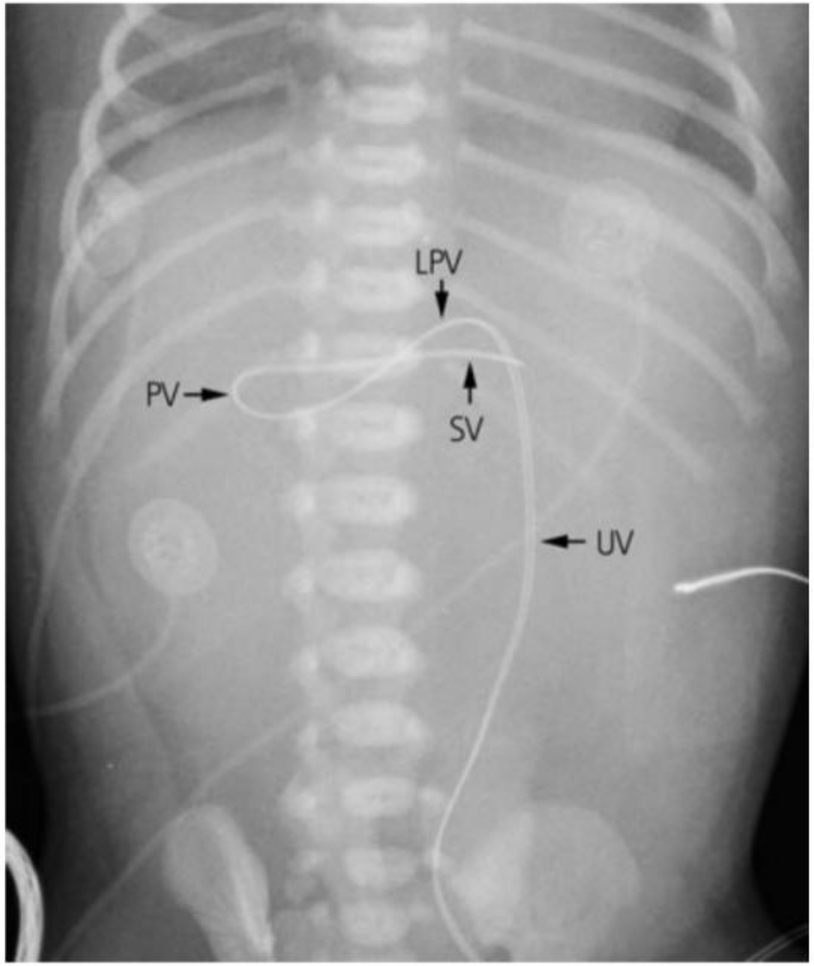

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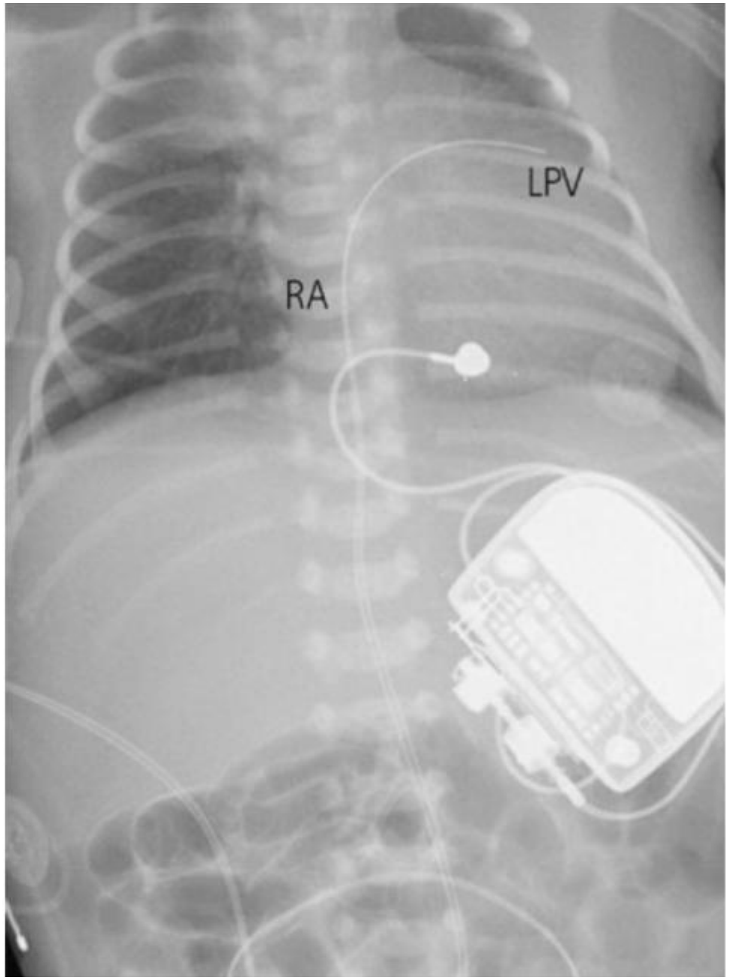

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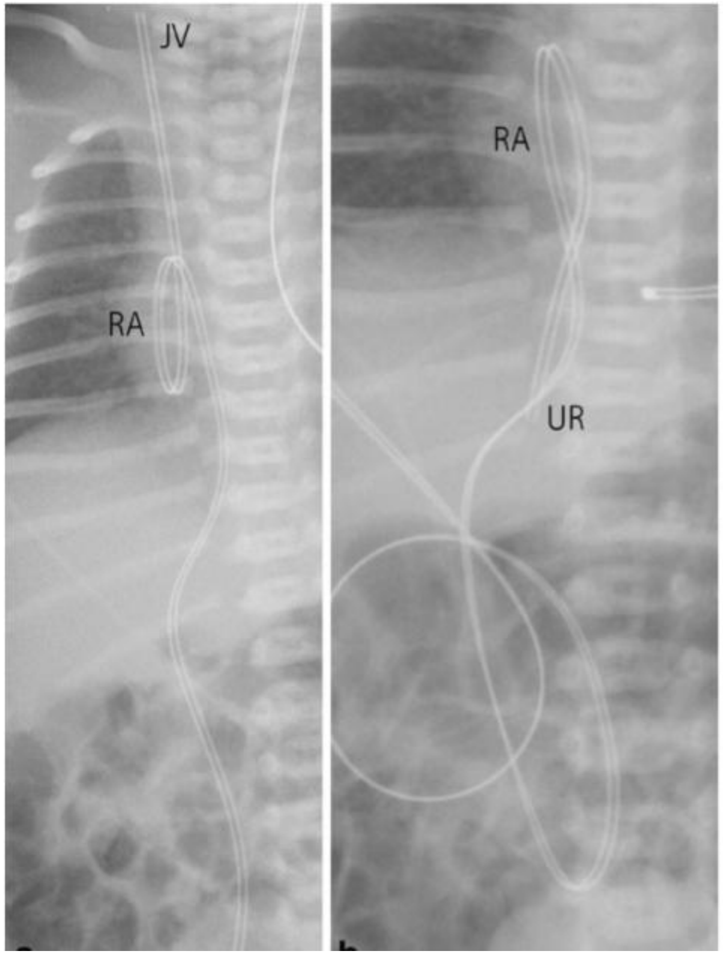
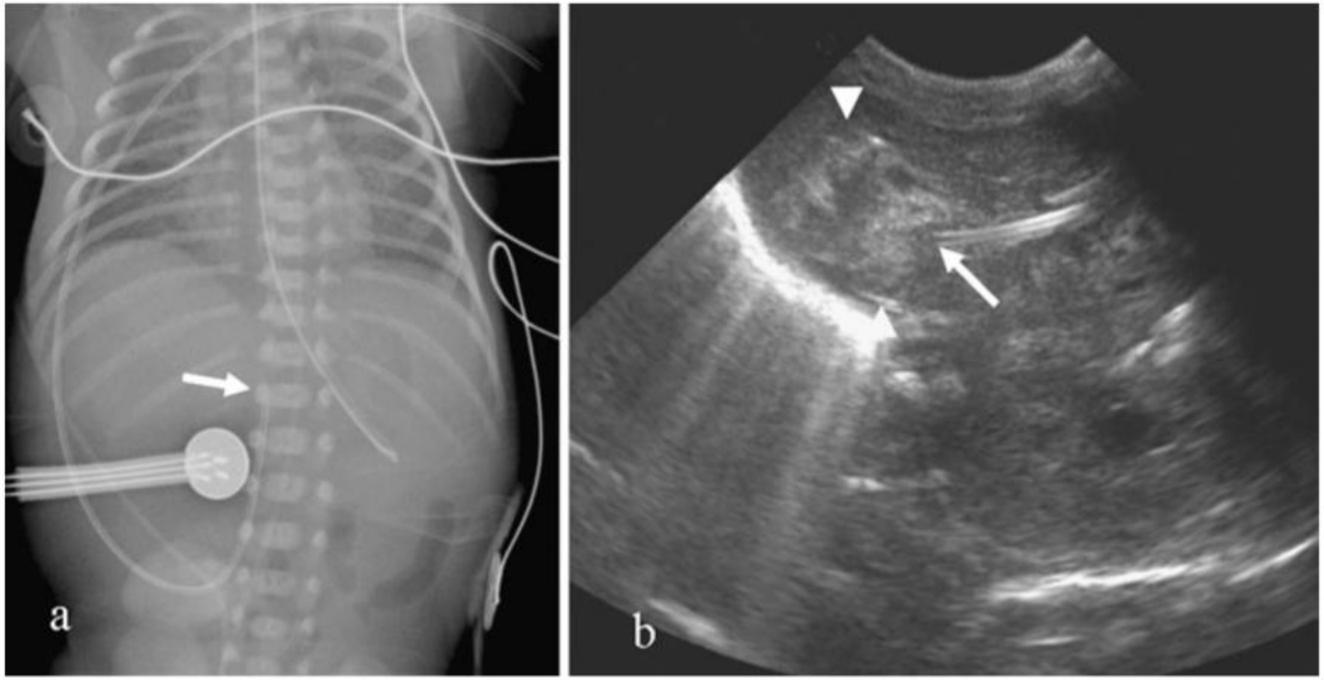


Umbilical vein catheterization—appropriate and inappropriate placement. Pediatric Radiology 2010

Tip location..US

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



Umbilical venous catheter position: evaluation by ultrasound. ER. 2011

Tip location..US

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

"Can we do it better?"…tip location..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

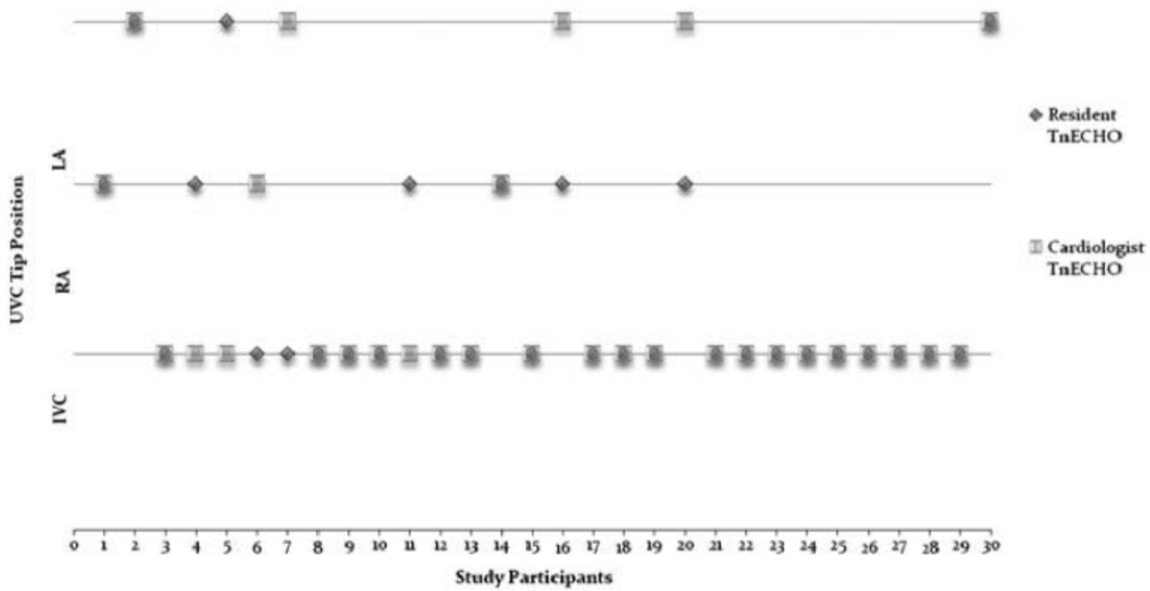
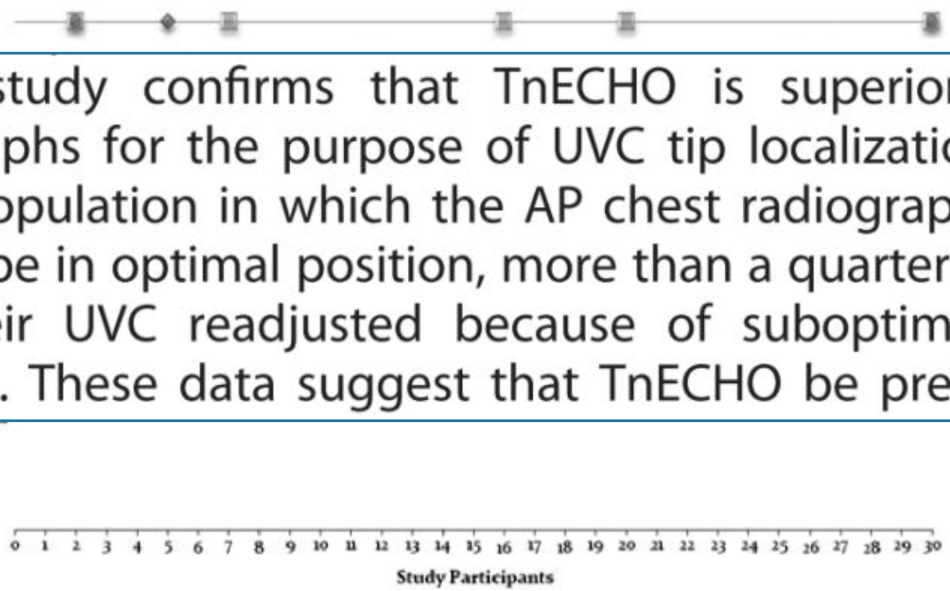


Figure 2. Targeted neonatal echocardiography (TnECHO) reports of pediatric residents and pediatric cardiologist for all participants in the study demonstrating concurrence of umbilical venous catheter (UVC) tip localization in 23 of 30 study cases (77%). In the seven cases with discordant results, there 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.

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



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

"Can we do it better?"…tip location..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

Cardiac Silhouette

Vertebral body

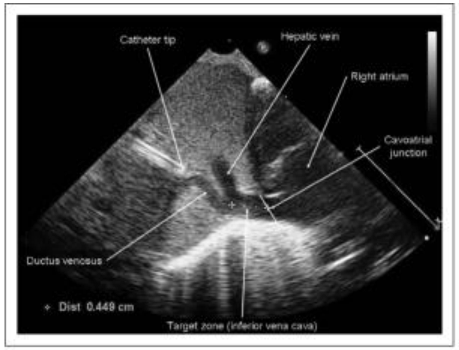


Figure 2. Ultrasound of the target zone (i.e., the length of the inferior vena cava between the insertion of the ductus venosus and the cavoatrial junction) measured as 4.49 mm.

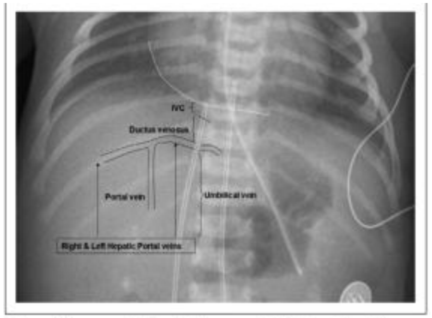


Figure 1. Assessment of umbilical venous catheter tip position by the cardiac silhouette method where the position of the cavoatrial junction is estimated by extrapolating the curve of the right atrial border medially (*dotted white line*) to its intersection with the inferior vena cava (IVC).

Vertebral Body 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

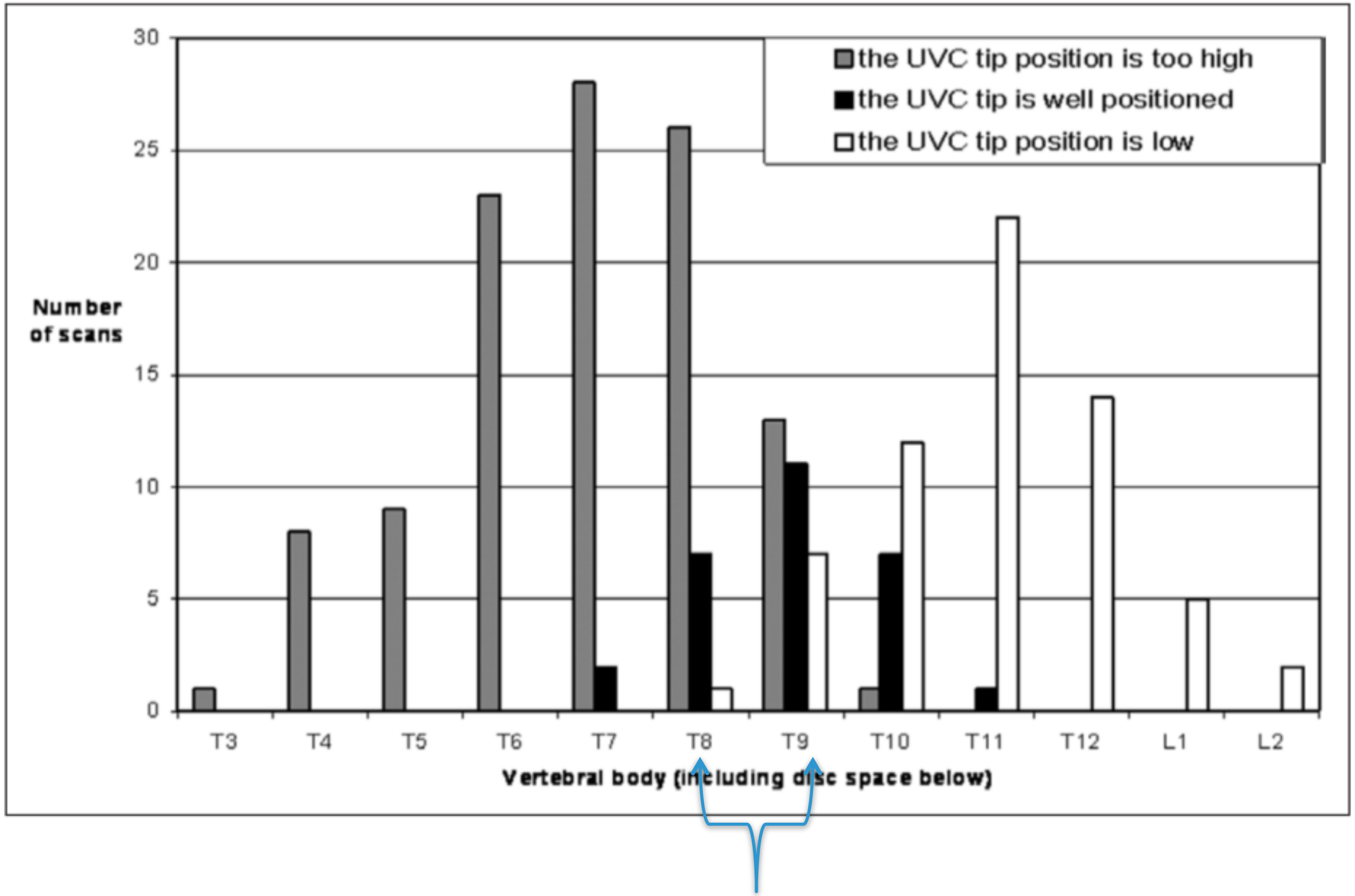
“Can we do it better?”…tip location..US

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

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

"Can we do it better?"…tip location

E. Confirm the catheter tip location by radiography, echocardiography, or ultrasonography before catheter use.

4. Ultrasound imaging using parasternal long- and short-axis views for UVC tip location compares favorably to radiography. Injection of normal saline through the catheter may assist in identifying the exact tip location. However, ultrasound will not rule out loops or curls in the catheter pathway.[18,22,23] (IV)
5. Neonatal echocardiography may be superior to chest and abdominal radiography for identifying malpositioned catheters or in extremely low-birth-weight neonates.[24,25] (V)

Prospettiva futura: Localizzazione intraprocedurale del catetere

Infusion therapy standard of practice. Journal of infusion nursing 2016

"Can we do it better?"…tip location

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

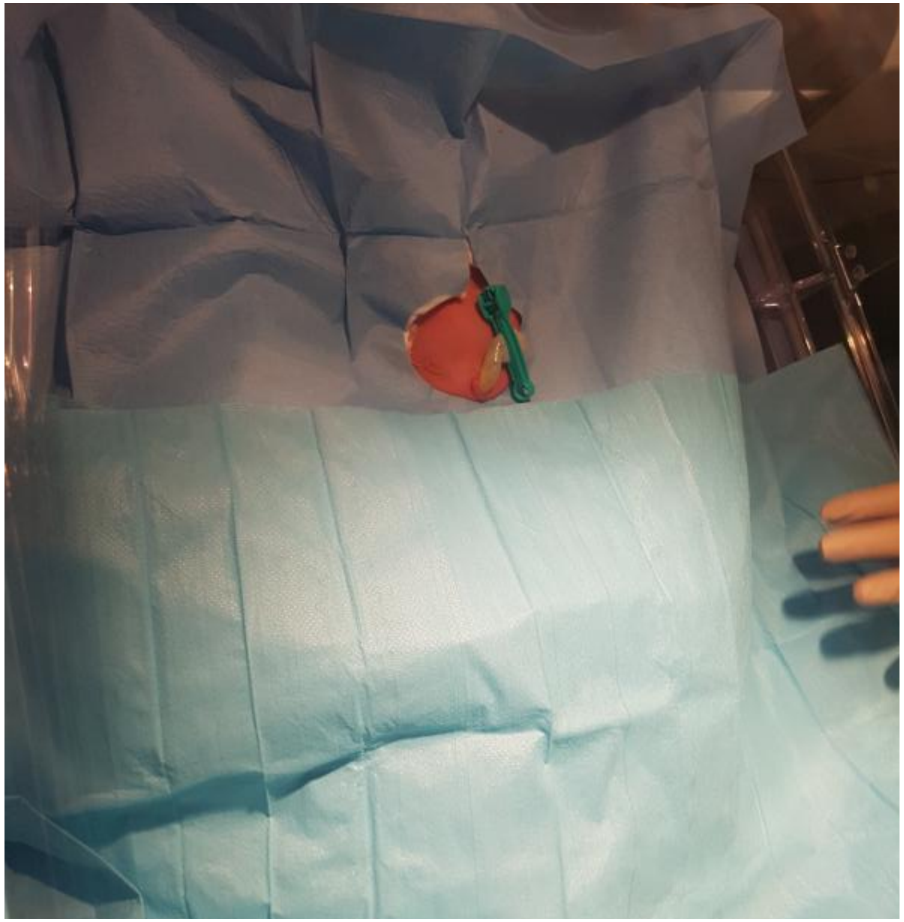
Real-time ultrasonography was used to assess the position of umbilical venous catheters tips in 79 newborn infants (birth weight range, 400 to 4200 gm). The position of the umbilical venous catheters determined by ultrasonography was compared with the projection of the catheter tip on the closest vertebral 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.

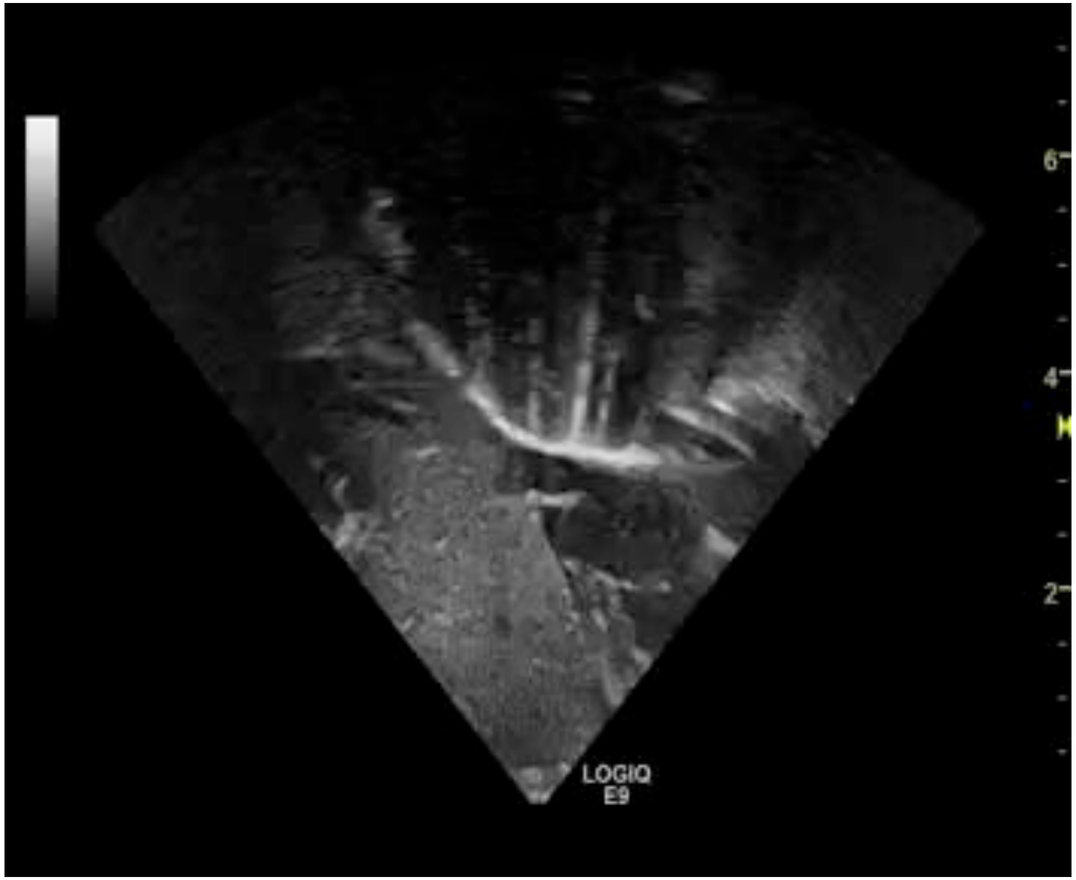
“How we do it better”…

“How we do it better”…

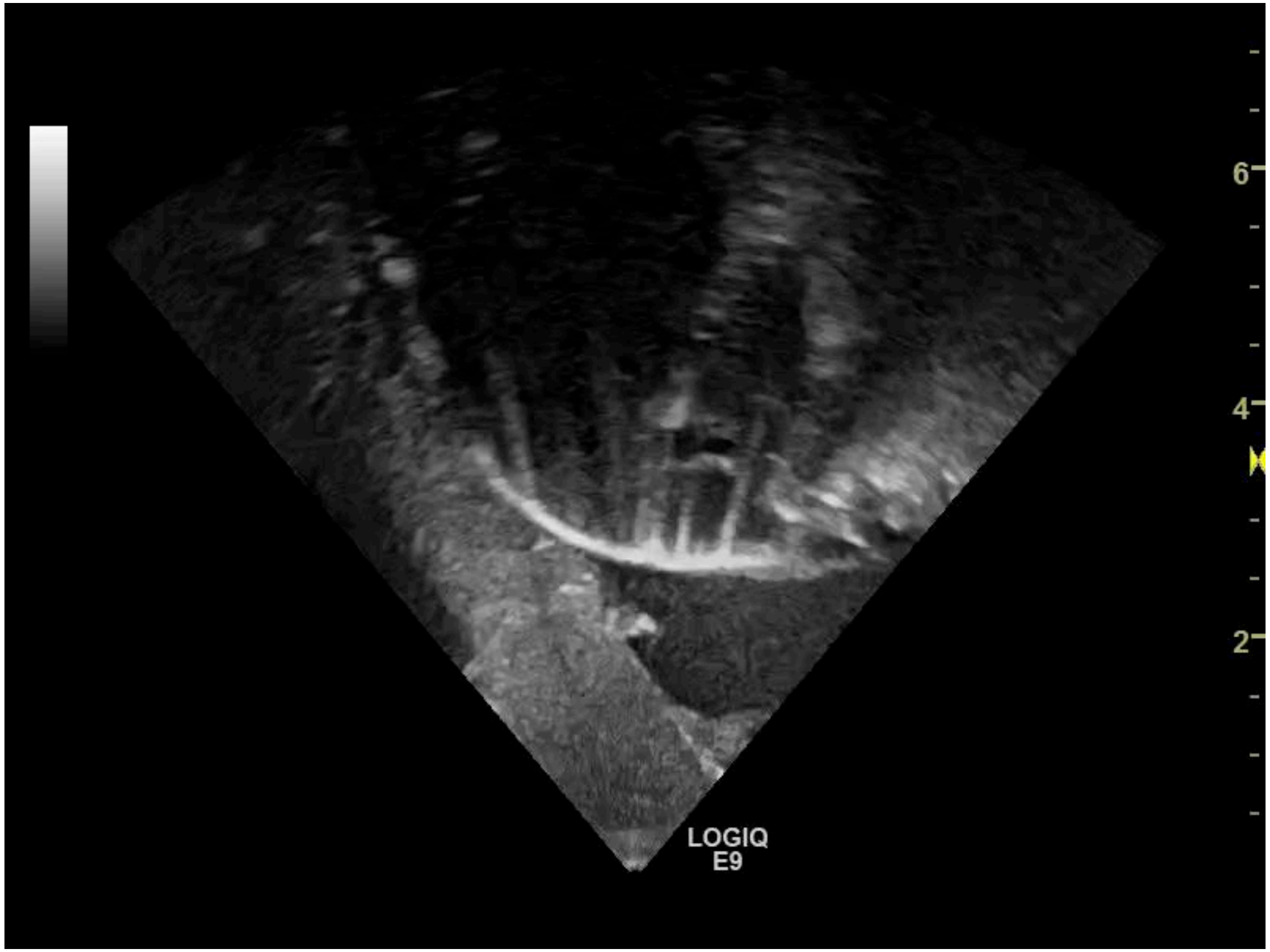


“How we do it better”…

VISUALIZZAZIONE ECOGRAFICA INTRAPROCEDURALE DEL CVO



VISUALIZZAZIONE ECOGRAFICA INTRAPROCEDURALE DEL CVO



VISUALIZZAZIONE ECOGRAFICA INTRAPROCEDURALE DEL CVO

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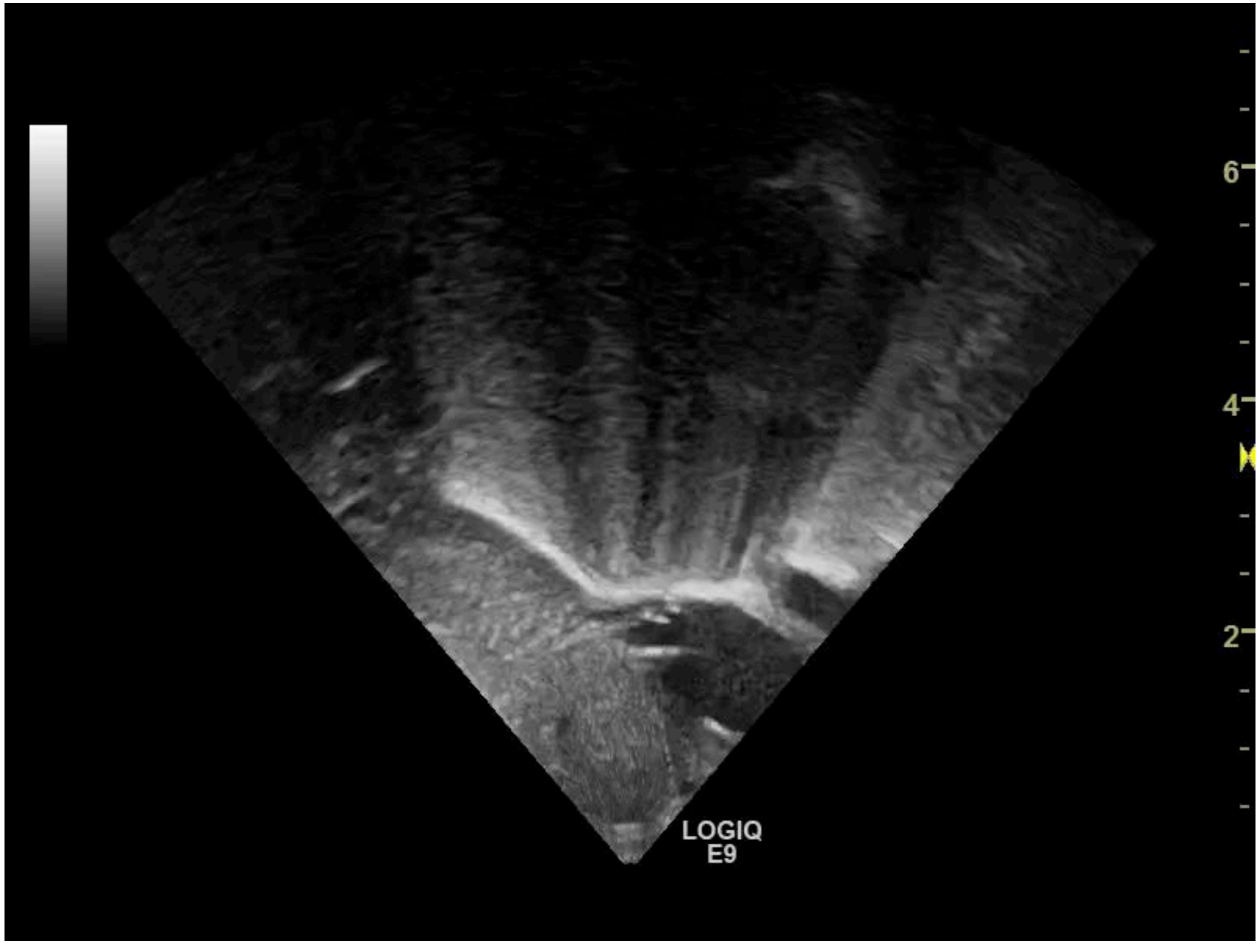

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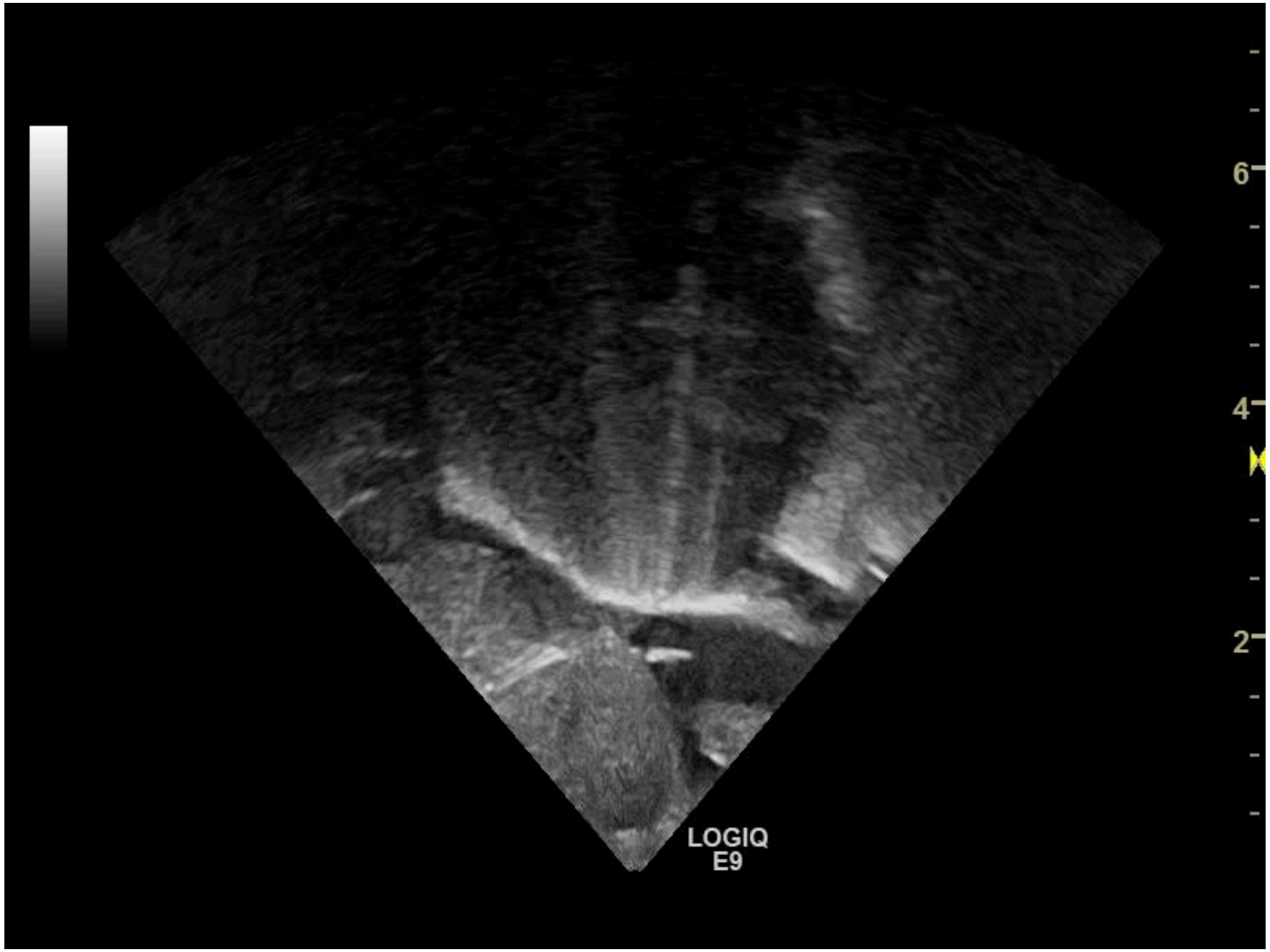

“Ultrasound”

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).

"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

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

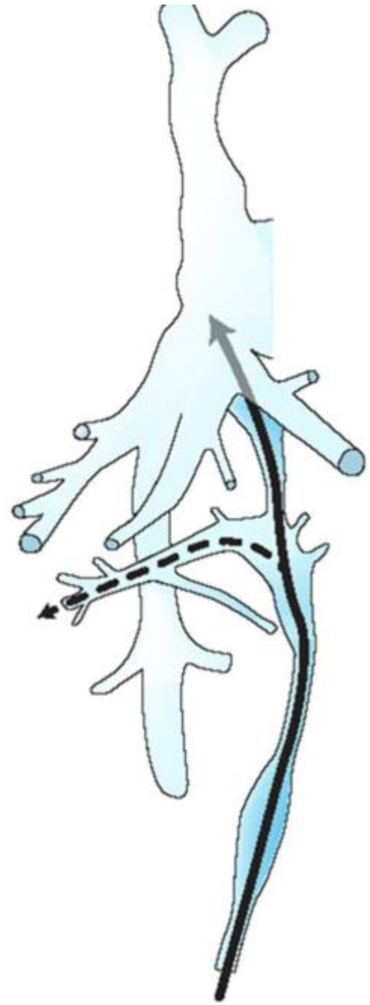

Fig. 7 Incorrect course of the UVC in cases of hepatic collections. The solid line indicates the appropriate pathway of the UVC through the umbilical vein whereas the dotted line shows the UVC entering the portal venous system. (This figure has been modified from Richter and Lierse [1991]. Imaging atlas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

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

Original Paper

Neonatology

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Umbilical Venous Catheter Malposition Is Associated with Necrotizing Enterocolitis in Premature Infants

Mustafa Sulemanji[a, d] Khashayar Vakili[a] David Zurakowski[a, b]
Wayne Tworetzky[c] Steven J. Fishman[a] Heung Bae Kim[a]

Table 1. Descriptive and univariate characteristics of the cohort based on NEC as the outcome

	Prospective cohort (n = 132)		Subset cohort ≤1,500 g (n = 62)	
	no NEC (n = 120)	NEC (n = 12)	no NEC (n = 50)	NEC (n = 12)
Birth weight, g	1,644±533	868±289*	1,168±277	868±289*
Gestational age, weeks	31.5±2.8	28.0±2.1*	29.2±2.6	28.0±2.1
SGA status (<10 percentile)[a]			9 (18)	4 (33)
Gender				
Male	54 (45)	4 (33)	26 (52)	4 (33)
Female	66 (55)	8 (67)	24 (48)	8 (67)
Median Apgar score (25–75 quartile)				
1 min	7.0 (6.0–8.0)	6.5 (5.0–8.0)	7.0 (5.0–8.0)	6.5 (5.0–8.0)
5 min	8.0 (8.0–9.0)	8.0 (7.0–9.0)	8.0 (7.0–8.0)	8.0 (7.0–9.0)
Maternal GBS status (+GBS/total)	20 (17)	3 (25)	7 (16)	3 (25)
Prenatal steroid use (+use/total)	95 (79)	11 (92)	44 (88)	11 (92)
PDA status (+PDA/total)	22 (18)	5 (42)	21 (42)	5 (42)
Respiratory status at 48 h (on ventilator)	38 (32)	10 (83)+	30 (60)	10 (83)
History of blood transfusion	8 (7)	4 (33)+	8 (16)	4 (33)
Time to full feeds, days	8.5±4.0	11.5±5.0*	8.5±4.0	11.5±5.0
UVC discontinuation (n = 69), days	6.6±2.9	3.4±2.5*	6.9±2.7	3.4±2.5*
UVC status at discontinuation				
No UVC (n = 63)	63 (52)	0 (0)		
Routine removal (n = 44/39)[b]	42 (35)	2 (17)	37 (74)	2 (17)
Failure to insert (n = 10/9)[c]	7 (6)	3 (25)+	6 (12)	3 (25)+
Malposition (n = 15/14)[d]	8 (7)	7 (58)+	7 (14)	7 (58)+
NEC grade				
No NEC	120	–	50	–
Medical NEC (>grade II)	–	9 (7)	–	9 (15)
Surgical NEC (necrotic bowel +)	–	3 (3)	–	3 (5)
Time to diagnosis of NEC, days	–	9.5±9.3 (3.0–30.0)	–	9.5±9.3 (3.0–30.0)

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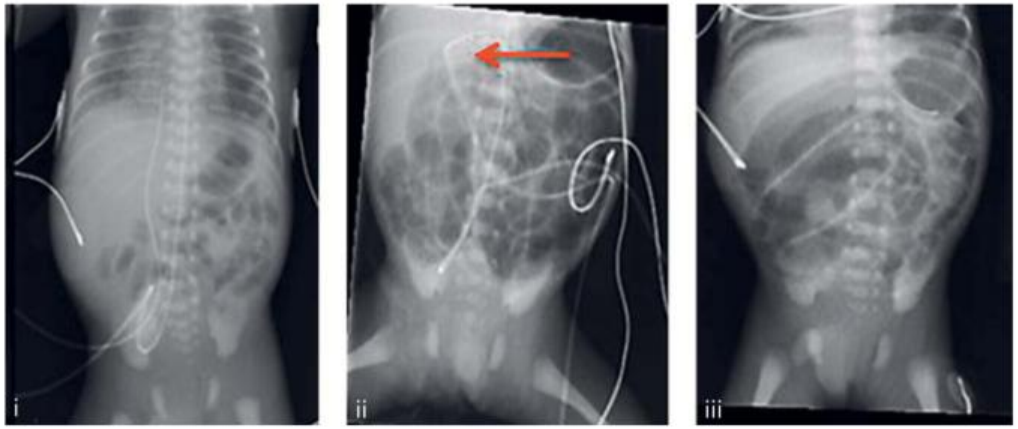
SGA status (<10 percentile)[a]			9 (18)	4 (33)
Gender				
Male	54 (45)	4 (33)	26 (52)	4 (33)
Fe[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Media[illegible]				
1 m[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5 m[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Matern[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Prenat[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PDA s[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Respir[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Histor[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Time t[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UVC c[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UVC s[illegible]				
No UVC (n = [illegible])	[illegible]	[illegible]	[illegible]	[illegible]
Routine removal (n = 44/39)[b]	42 (35)	2 (17)	37 (74)	2 (17)
Failure to insert (n = 10/9)[c]	7 (6)	3 (25)⁺	6 (12)	3 (25)⁺
Malposition (n = 15/14)[d]	8 (7)	7 (58)⁺	7 (14)	7 (58)⁺
NEC grade				
No NEC	120	–	50	–
Medical NEC (>grade II)	–	9 (7)	–	9 (15)
Surgical NEC (necrotic bowel +)	–	3 (3)	–	3 (5)
Time to diagnosis of NEC, days	–	9.5±9.3 (3.0–30.0)	–	9.5±9.3 (3.0–30.0)

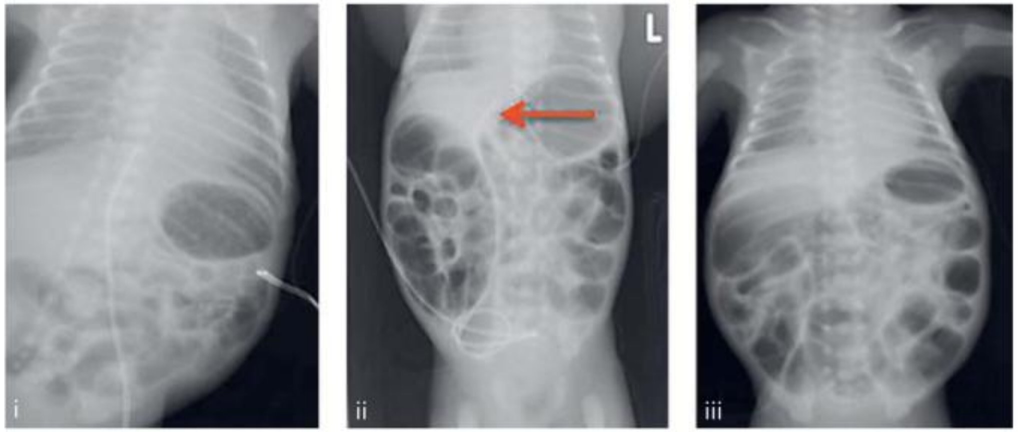
dependent of birth weight and respiratory status. The odds of NEC were over twice as high for each 250-g decrease in birth weight (OR 2.2, 95% CI 1.2–4.7, p = 0.001). In addition, the odds of NEC were estimated to be over 6 times higher given UVC malpositioning (OR 6.9, 95% CI 1.6–35.3, p = 0.007). The predictive accuracy of the

Fig. 2. Timeline of event
course of UVC status and t
of NEC in individual subje
figure represents the time
discontinued and NEC dia
erage time for UVC discor
non-NEC subjects (n = 5(
by the green triangle in sub
1–7, UVC malposition ar
purple); subjects 8–10, U
NEC (n = 3, blue); subjects
routine and NEC (n = 2, re(
only.



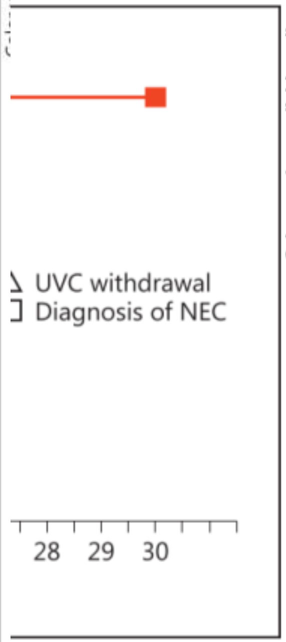
UVC line in place – day 1 | UVC line malpositioned into the left portal vein – day 4 | NEC grade III – day 5

a



UVC line in place – day 1 | UVC line malpositioned into the DV – day 1.5 | NEC grade III – day 3

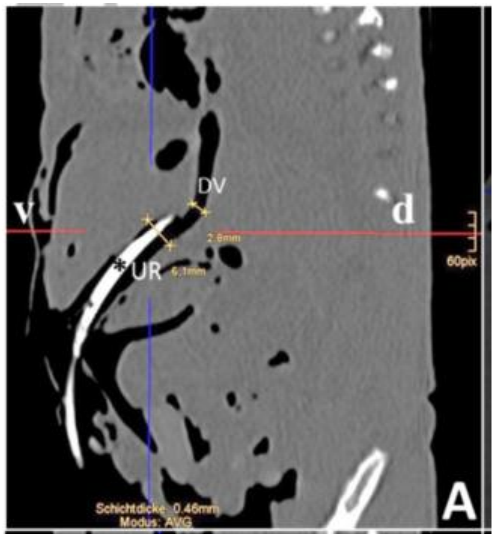
b

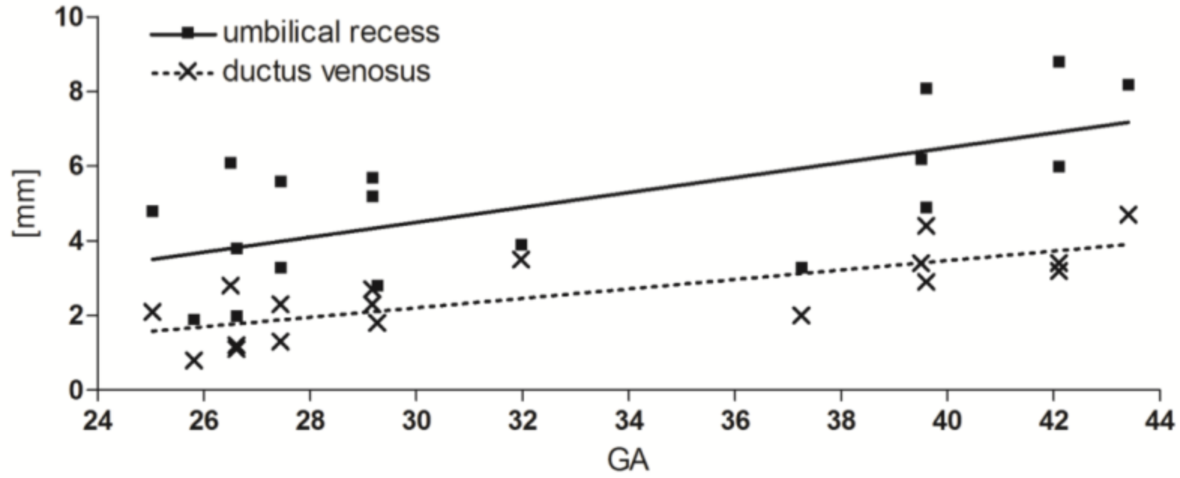


Color version available online

DIMENSIONE DV???

18 neonati sottoposti a TAC 29 W EG

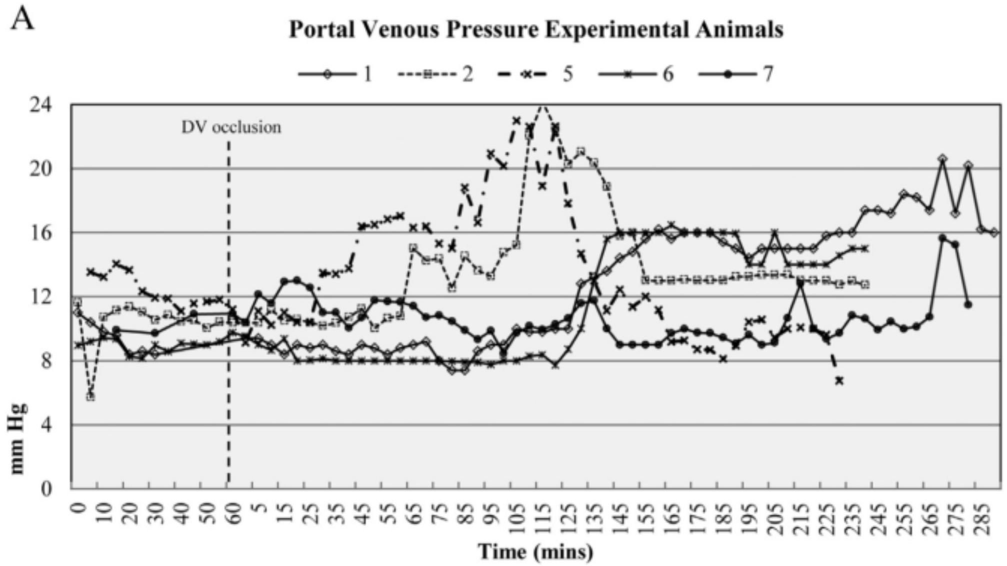


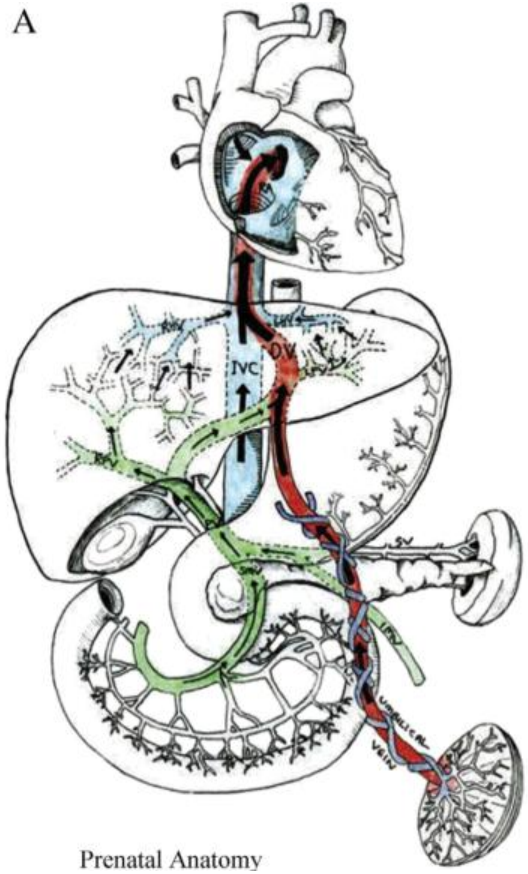


Investigation of umbilical venous vessels anatomy and diameters as a guideline for catheter placement in newborn. Eifinger. Clin Anat 2018

Ductus venosus closure results in transient portal hypertension—Is this the silent trigger for necrotizin enterocolitis?

Mustafa N. Sulemanji [a], Humberto Azpurua [b], Matthew Suh [c], Kristina Potanos Ryan Cauley [a], Shaun M. Kunisaki [d], Biren Modi [a], David Zurakowski [a], Steven J. Fishman [a], Heung Bae Kim [a,*]





Journal of Pediatric Surgery 2013

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Mustafa N. Sulemanji[a], Humberto Azpurua[b], Matthew Suh[c], Kristina Potanos[a], Ryan Cauley[a], Shaun M. Kunisaki[d], Biren Modi[a], David Zurakowski[a], Steven J. Fishman[a], Heung Bae Kim[a,*]

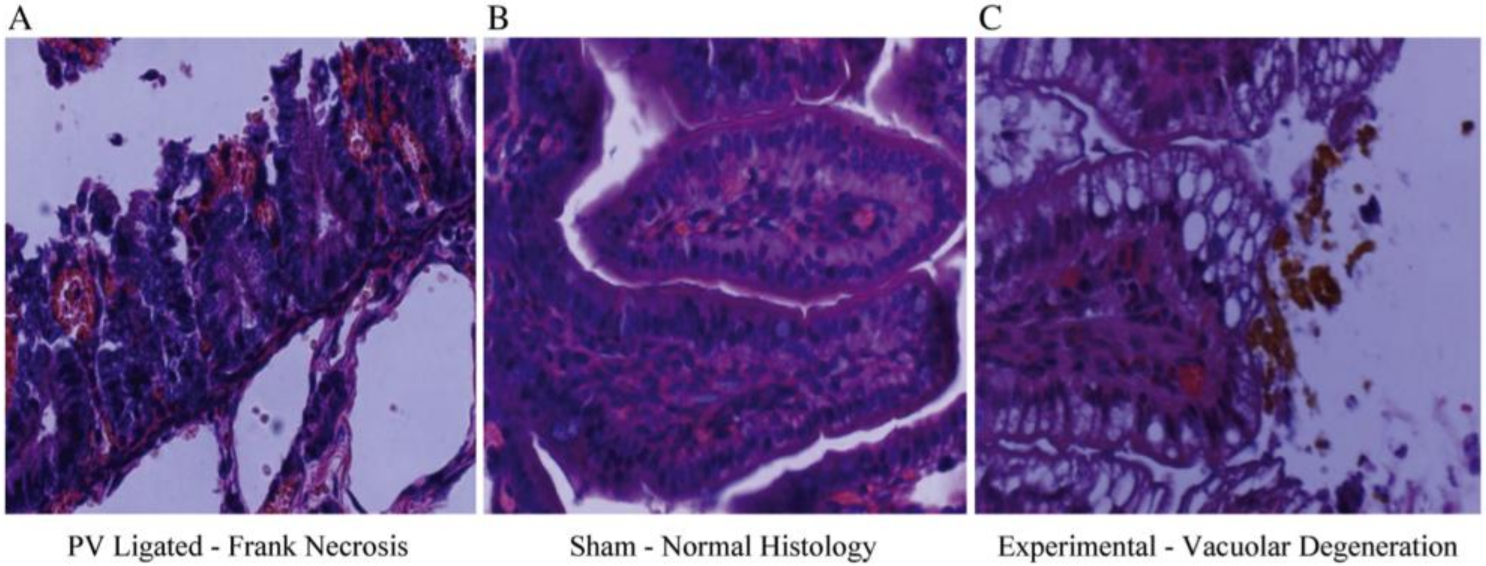


Fig. 6 Histologic analysis of intestinal tissue (terminal ileum) after staining with Hematoxylin and Eosin (H&E) stain.

Journal of Pediatric Surgery 2013

La durata del CVO

Clinical Bottom Lines

1 Dedicated teams should be used to maintain central lines within the neonatal intensive care unit as part of an overall CLABSI prevention strategy (Level 4 evidence).
2 If longer term (>5–7 days) central venous access is required, replacement of a UVC with a PICC may be beneficial, if combined with a PICC maintenance team (Level 4 evidence).
3 A large multi-centre randomised trial is needed to clearly answer the question of whether routine replacement of UVCs and PICCs at days 5–7 or earlier will result in lower rates of CLABSIs in neonates that require longer term central access.
4 The most effective way to minimise CLABSIs in neonates is not to have a central line in situ. Need for central lines should be assessed on a daily basis and removed as soon as no longer required.

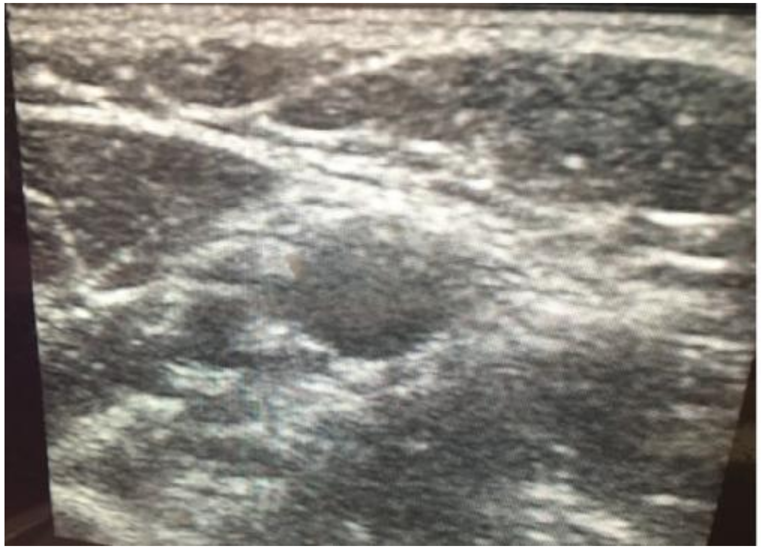
Remove umbilical catheters promptly when no longer needed or if a complication occurs.

1. Consider limiting UVC dwell time to 7 to 14 days; risks of infection are increased with longer dwell times. UVC removal at 7 days followed by insertion of a peripherally inserted central catheter (PICC) for continued infusion therapy is one strategy to reduce central line-associated bloodstream infection.[4,30,32,33] (III)

How long should umbilical venous catheters remain in place in neonates who require long-term (≥5–7 days) central venous access JPCH 2014
Infusion therapy standard of practice. Journal of infusion nursing 2016

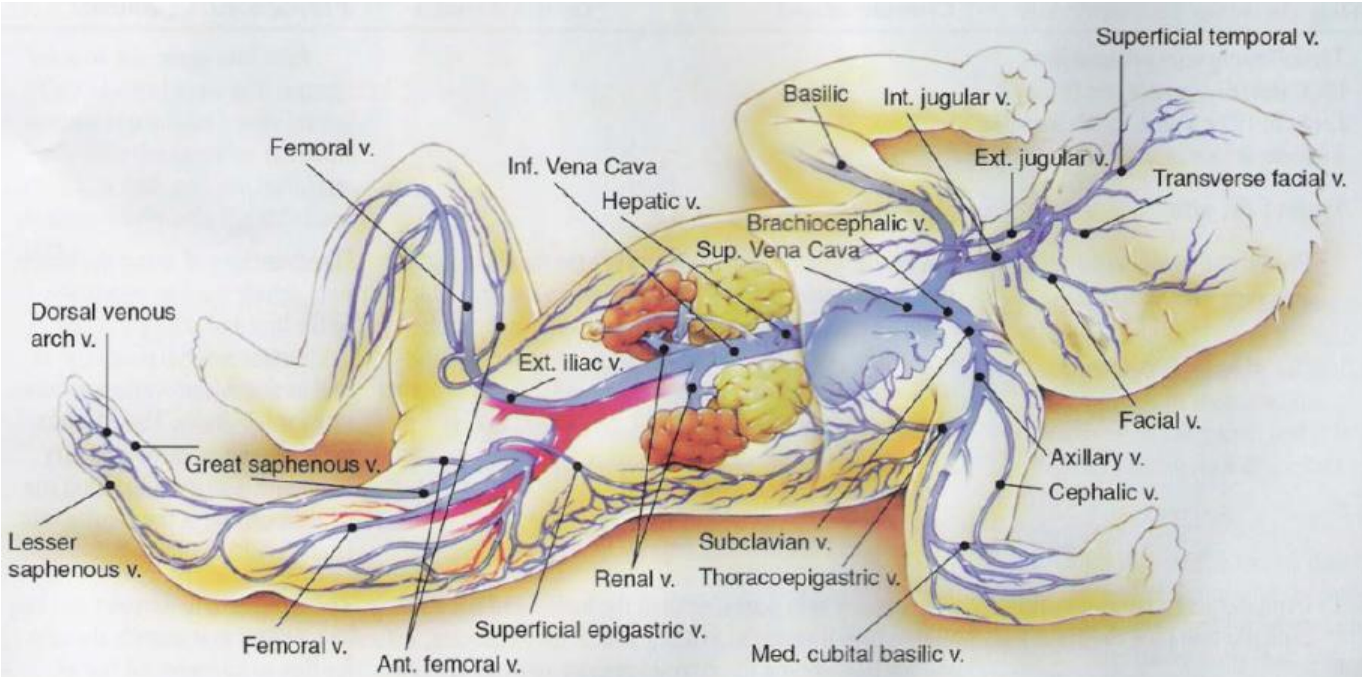
DEFINIZIONE

- PICC

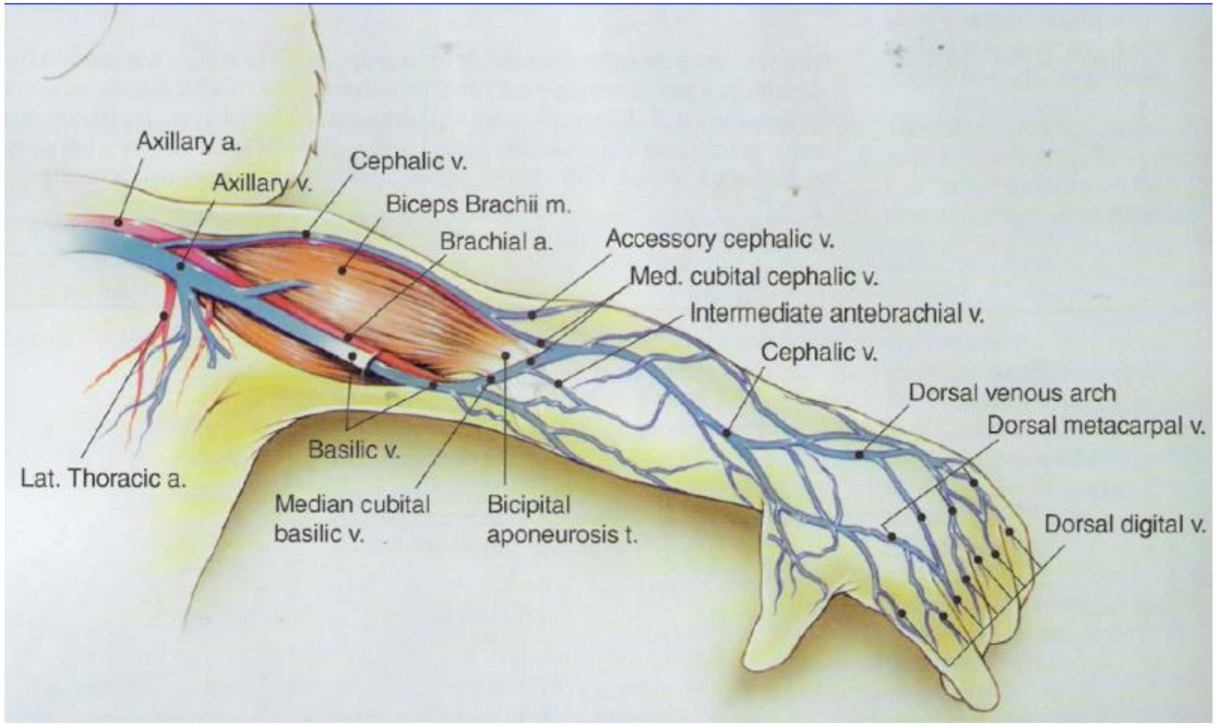


- ECC

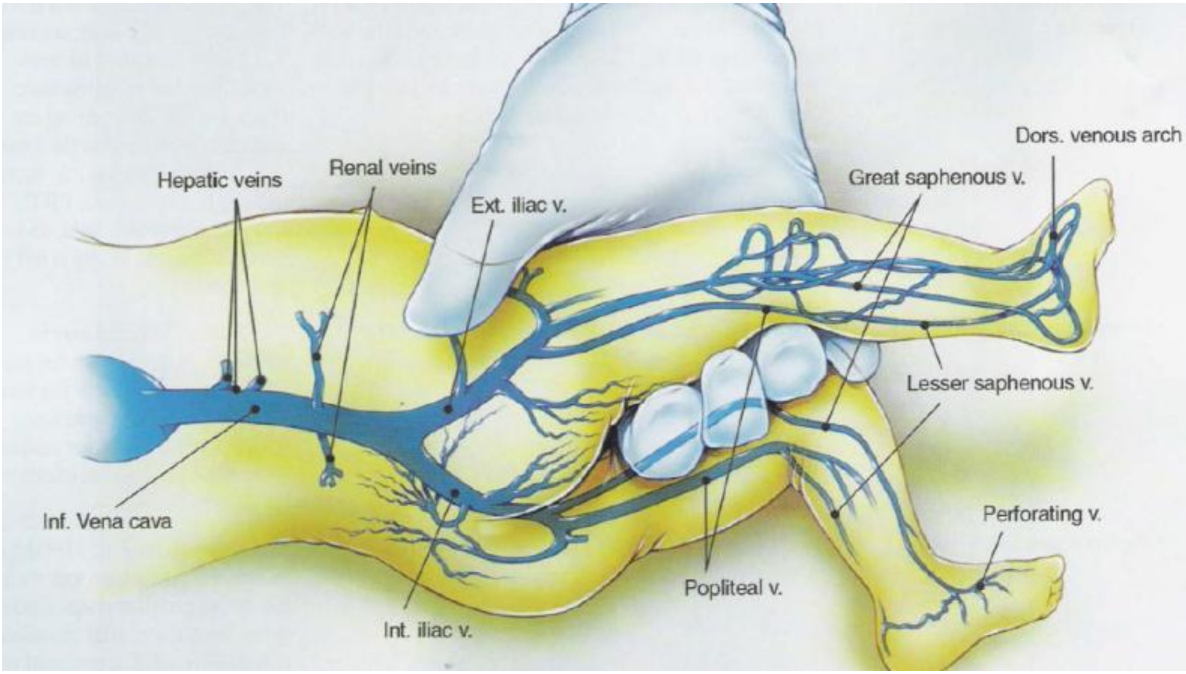
VENE


Superficial temporal v.
Basilic
Int. jugular v.
Ext. jugular v.
Transverse facial v.
Femoral v.
Inf. Vena Cava
Hepatic v.
Brachiocephalic v.
Sup. Vena Cava
Dorsal venous arch v.
Ext. iliac v.
Facial v.
Axillary v.
Great saphenous v.
Cephalic v.
Lesser saphenous v.
Subclavian v.
Renal v.
Thoracoepigastric v.
Superficial epigastric v.
Femoral v.
Ant. femoral v.
Med. cubital basilic v.

VENE


Axillary a.
Axillary v.
Cephalic v.
Biceps Brachii m.
Brachial a.
Accessory cephalic v.
Med. cubital cephalic v.
Intermediate antebrachial v.
Cephalic v.
Dorsal venous arch
Dorsal metacarpal v.
Dorsal digital v.
Basilic v.
Lat. Thoracic a.
Median cubital basilic v.
Bicipital aponeurosis t.

VENE

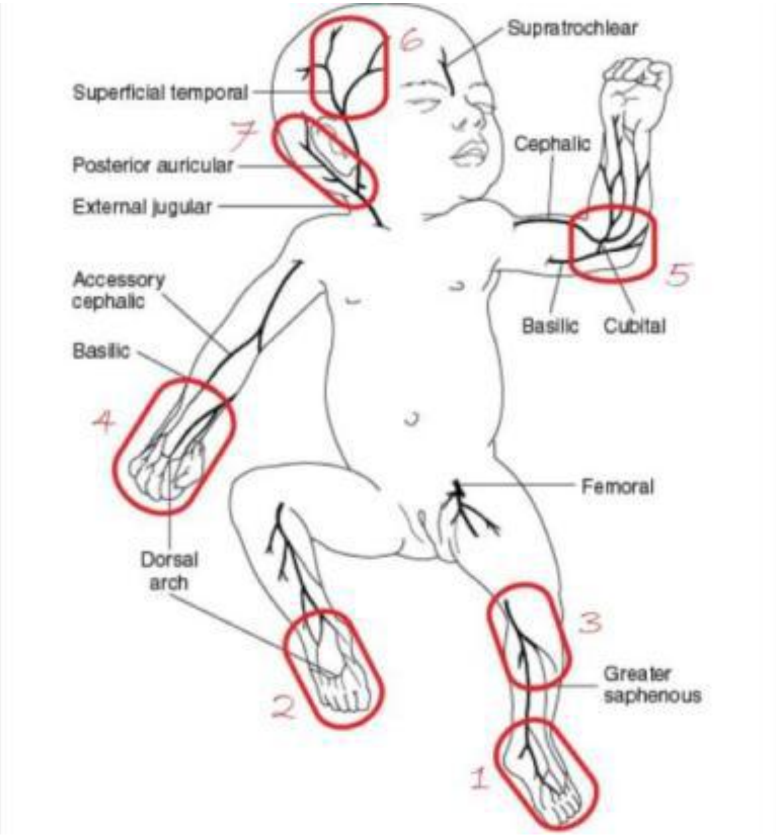

Dors. venous arch
Great saphenous v.
Hepatic veins
Renal veins
Ext. iliac v.
Lesser saphenous v.
Inf. Vena cava
Perforating v.
Popliteal v.
Int. iliac v.

RASUVA: UNO STRUMENTO AMBIZIOSO

- Mappatura delle vene del neonato
- Scelta delle vena più idonea (AVP vs ECC)
- Aumentare la probabilità di successo della prima venipuntura
- Preservare le vene del neonato

RASUVA: RAPID SUPERFICIAL VEIN ASSESSMENT

Necessità di un protocollo sistematico per la scelta della vena superficiale per la inserzione di una agocannula o di un ECC



RASUVA: «from foot to head»

Esame sistematico delle vene superficiali del neonato (con e senza tecnologia NIR, con e senza laccio)

Malleolo mediale (MM)	Vd
	Fd
	Vs
	Fs
Malleolo laterale (ML)	Vd
	Fd
	Vs
	Fs
Retropoplitea (RP)	Vd
	Fd
	Vs
	Fs
Mano e polso (MP)	Vd
	Fd
	Vs
	Fs
Antecubitale (AC)	Vd
	Fd
	Vs
	Fs
Preauricolare (PR)	Vd
	Fd
	Vs
	Fs
Postauricolare (PO)	Vd
	Fd
	Vs
	Fs

MALLEOLO
MEDIALE

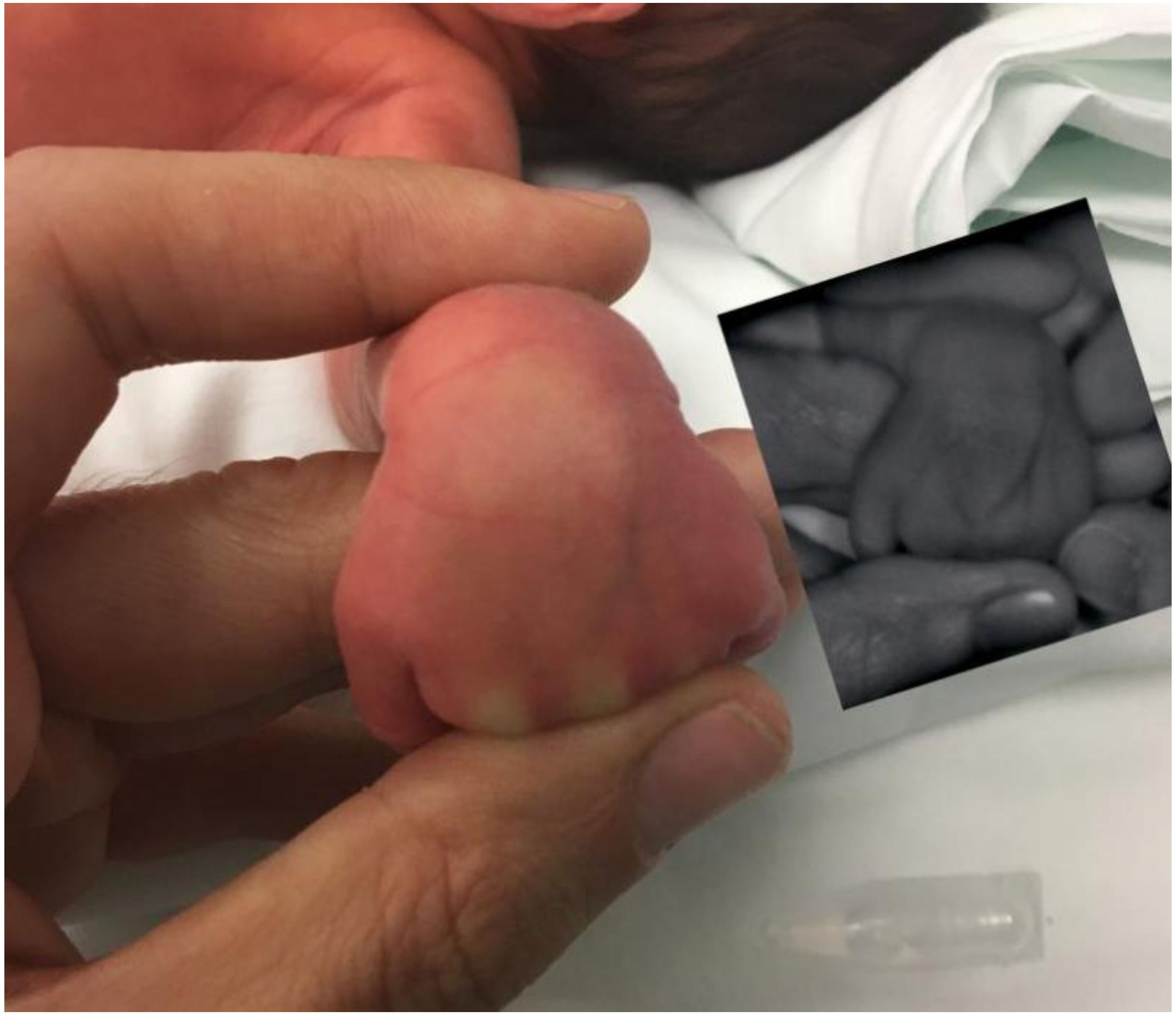
MALLEOLO MEDIALE (CON LACCIO)

MALLEOLO
LATERALE

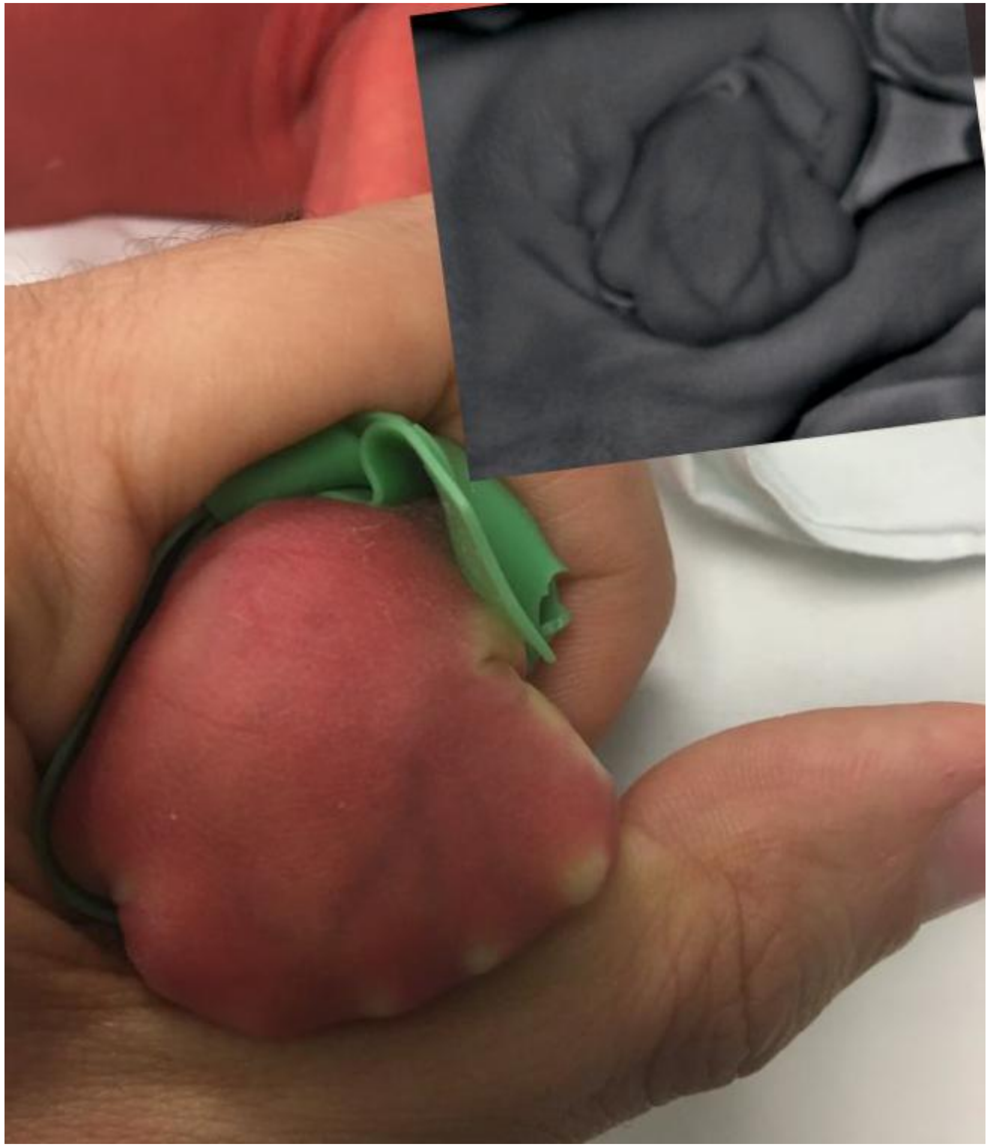
MALLEOLO
LATERALE
(CON
LACCIO)

RETROPOPLITEA

RETROPOPLITEA
(CON LACCIO)

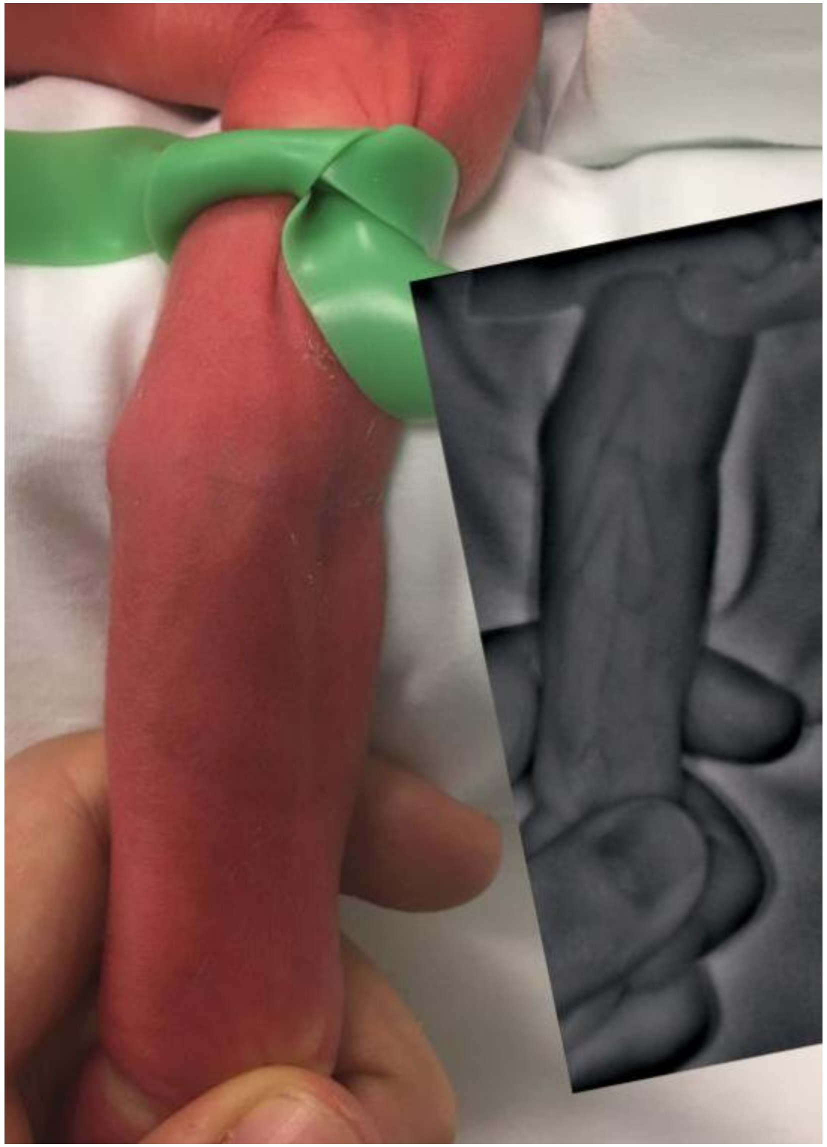


MANO
E
POLSO

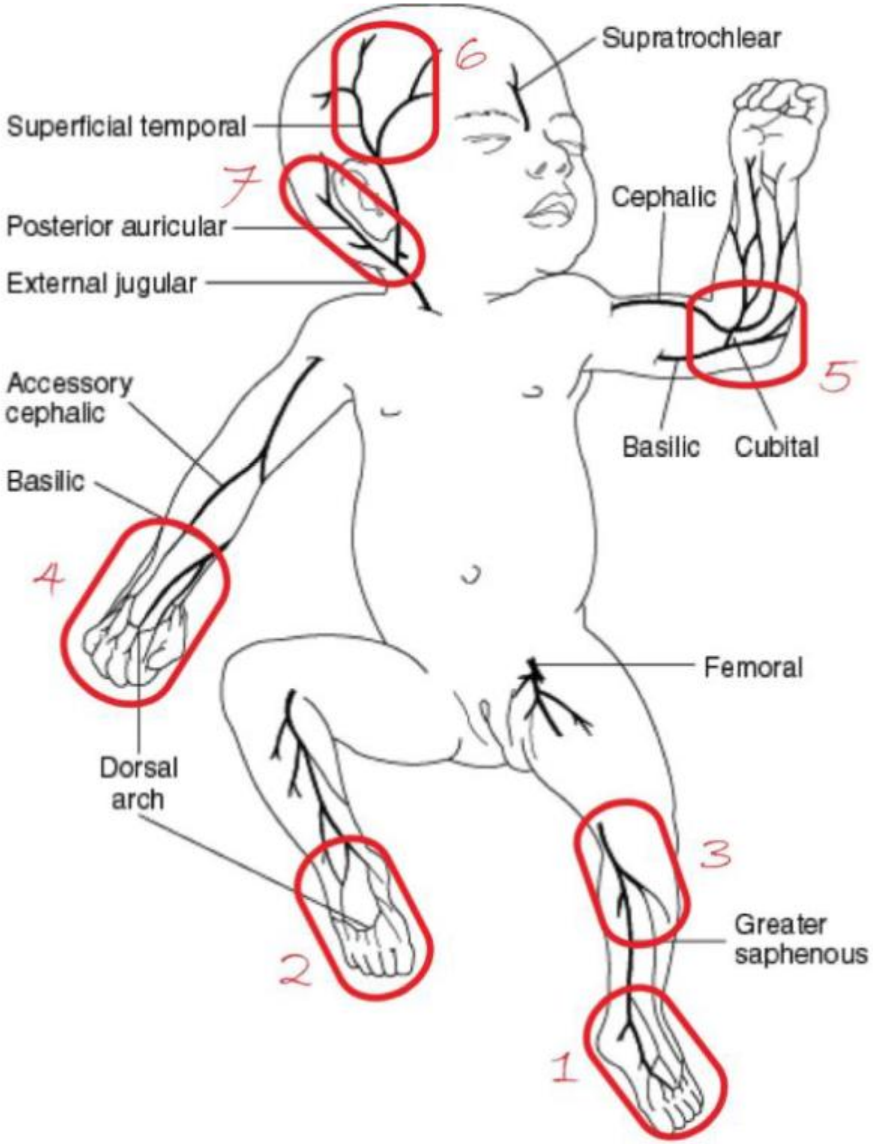


MANO E POLSO (CON LACCIO)

ANTECUBITALE



ANTECUBITALE
(CON LACCIO)



1 – malleolo mediale
2 – malleolo laterale
3 – retropoplitea
4 – mano e polso
5 - antecubitale
6 – preauricolare
7 - retroauricolare

RASUVA

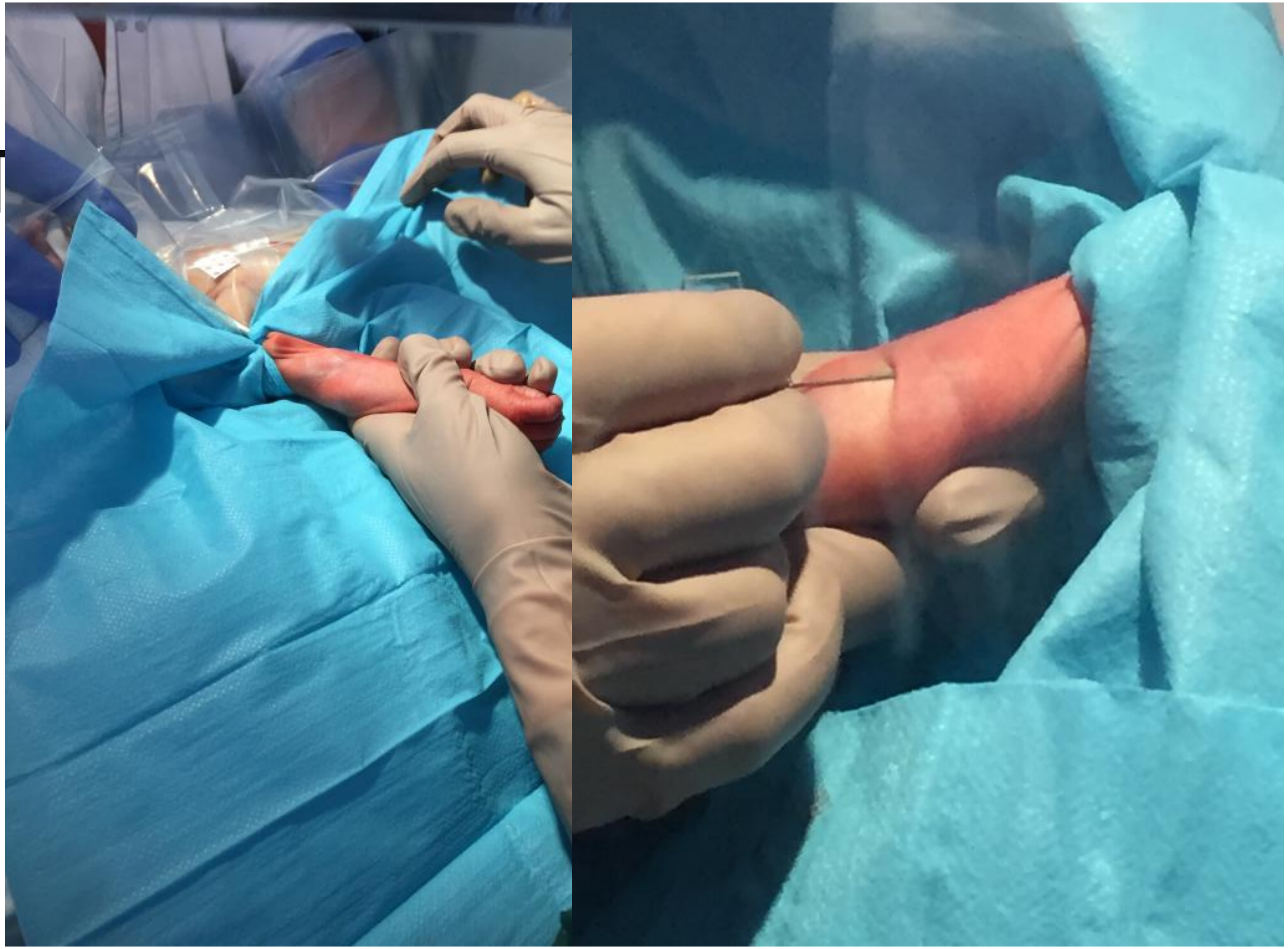
Ordine di preferenza:

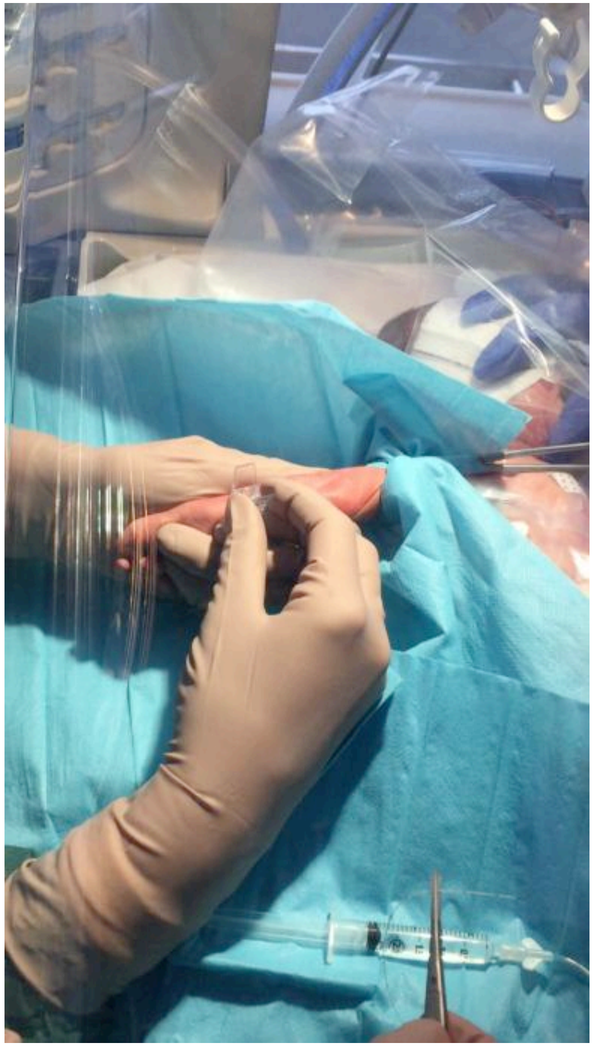
Per agocannula

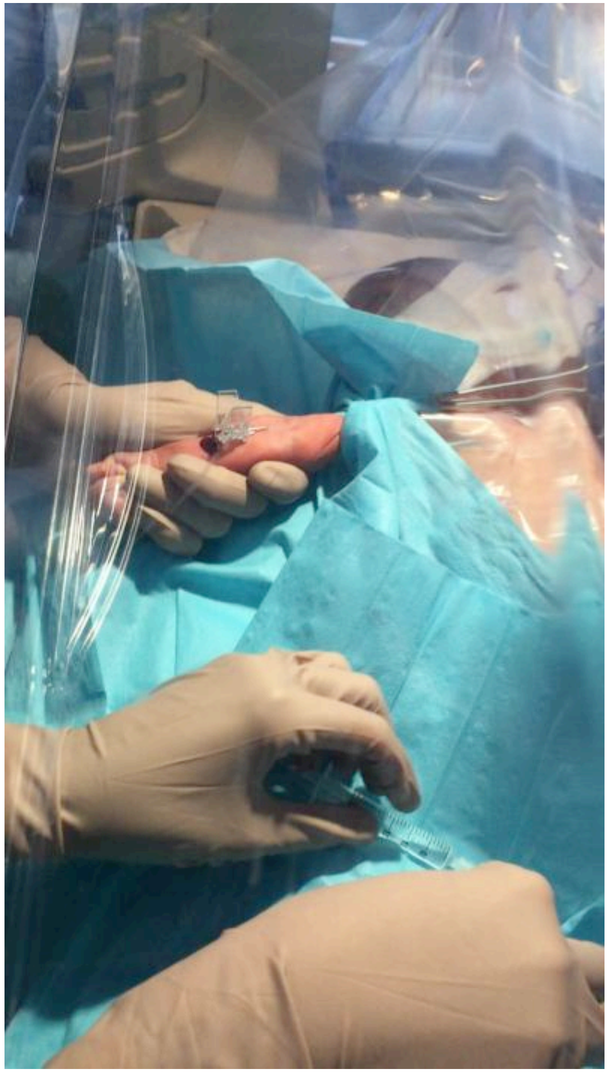
1) *Arti inferiori (safena esclusa)*
2) *Mani e polso*
3) *scalpo*

Per posizionamento ECC

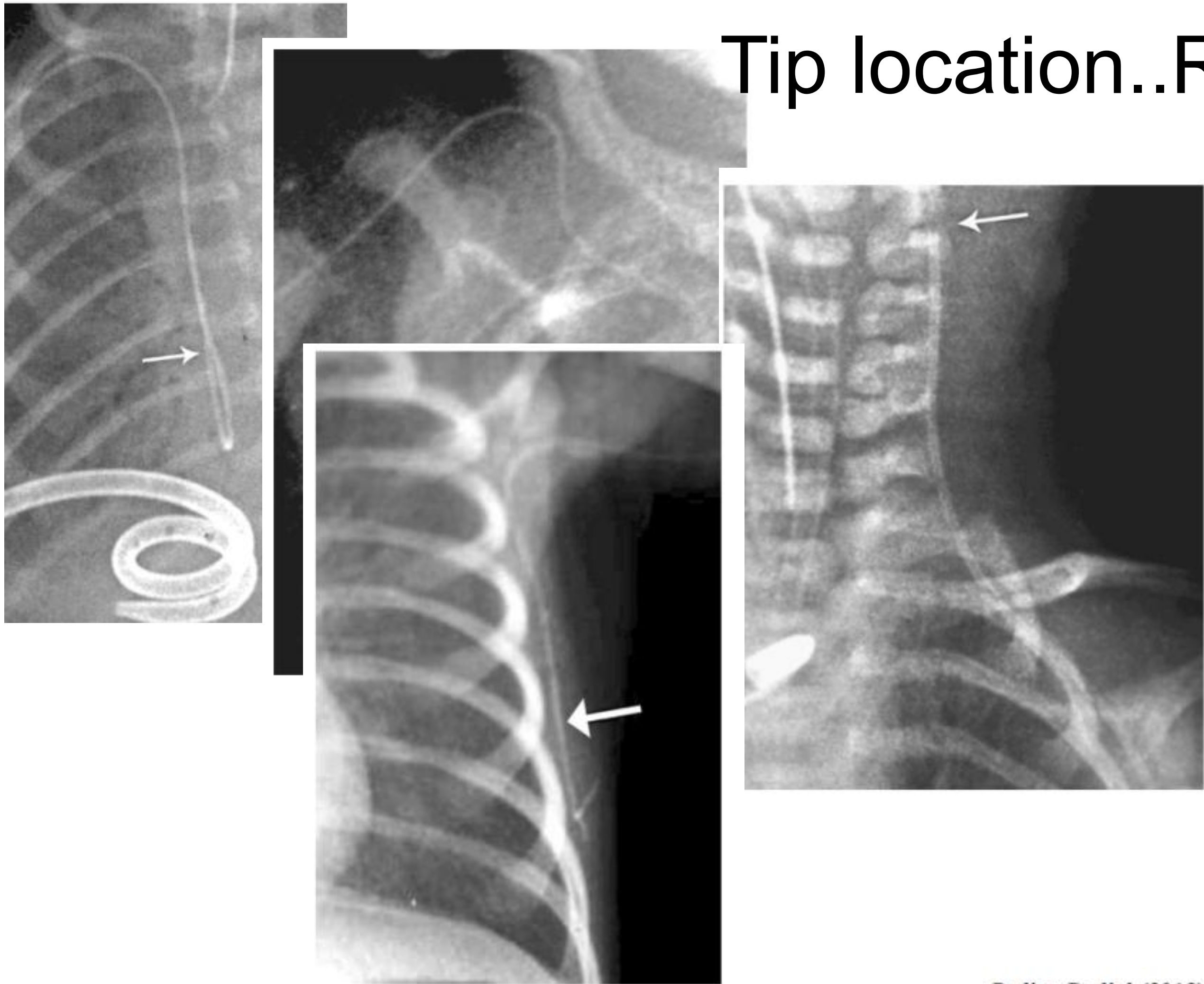
1) *Antecubitale*
2) *Safena al malleolo mediale*
3) *Scalpo*





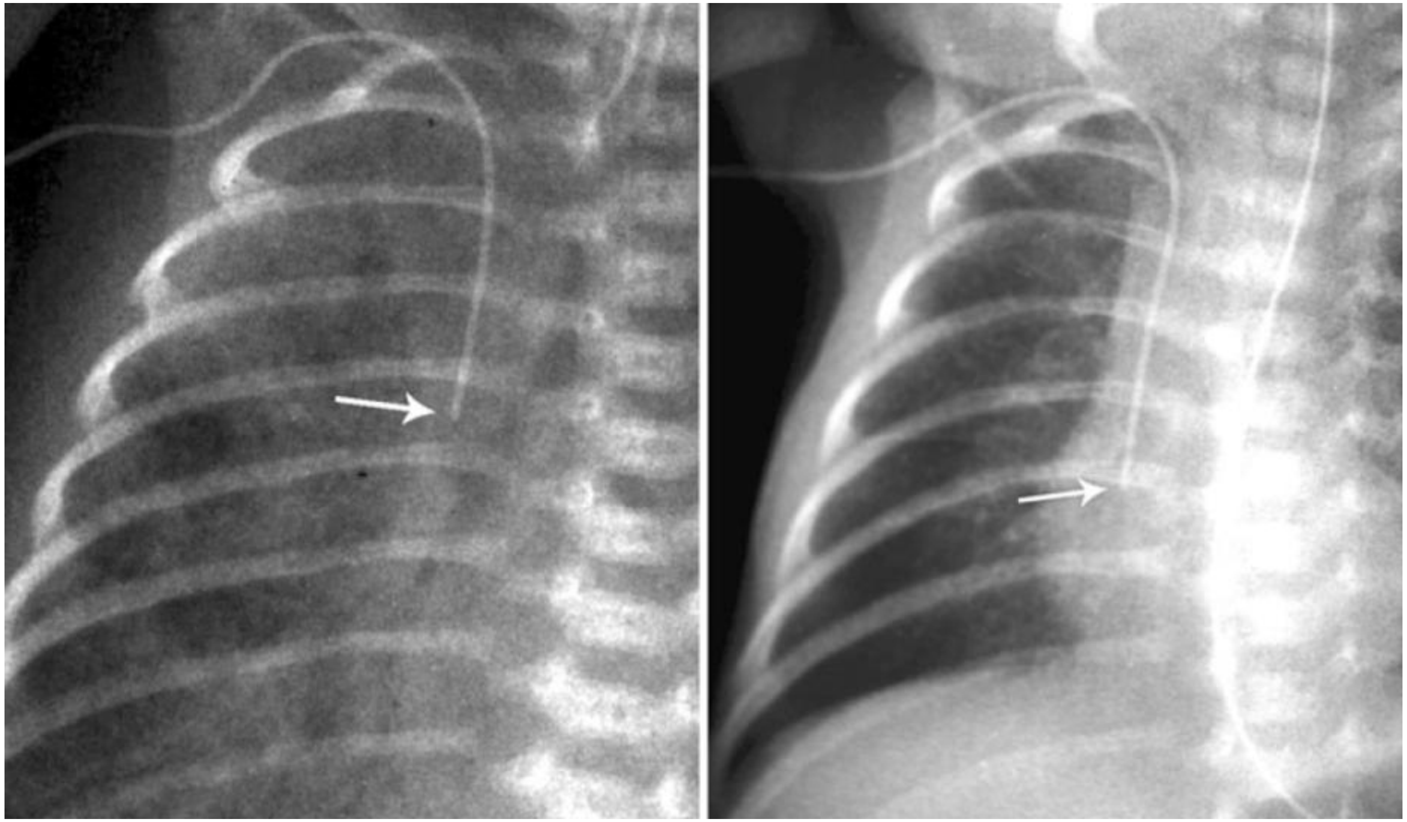


Tip location..Rx????



Pediatr Radiol (2012) 42:1000–1008

Tip location..Rx????



Tip location..US


Tip location..US

E. Confirm the catheter tip location by radiography, echocardiography, or ultrasonography before catheter use.

5. Neonatal echocardiography may be superior to chest and abdominal radiography for identifying malpositioned catheters or in extremely low-birth-weight neonates.[24,25] (V)

Supplement to
January/February 2016
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ISSN 1533-1458
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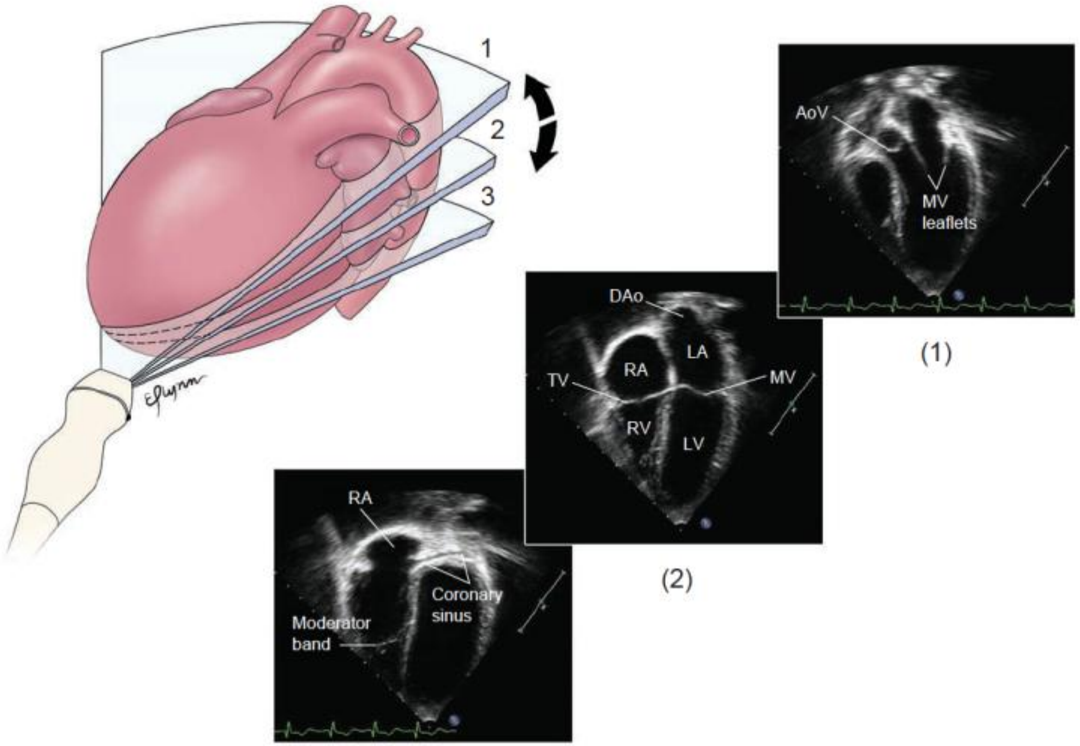
IMPIANTO: TnECHO

Targeted Neonatal Echocardiography in the Neonatal Intensive Care Unit: Practice Guidelines and Recommendations for Training

Writing group of the American Society of Echocardiography (ASE) in collaboration with the European Association of Echocardiography (EAE) and the Association for European Pediatric Cardiologists (AEPC)

Recommendations: Focused TNE can be used for identifying catheter tip position after line placement and potential complications such as line thrombosis or infection. Echocardiography to rule out vegetations should be performed or interpreted by a pediatric cardiologist.

TNECHO



1
2
3
AoV
MV
leaflets
DAo
LA
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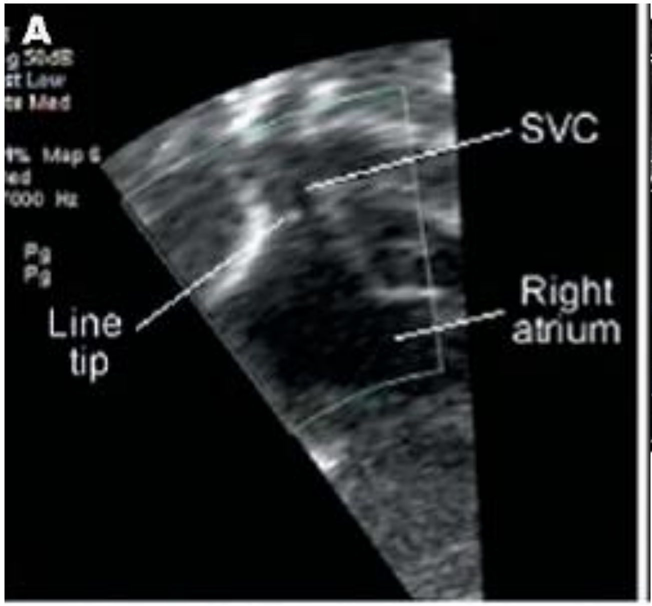
TV
MV
RV
LV
RA
Coronary
sinus
Moderator
band

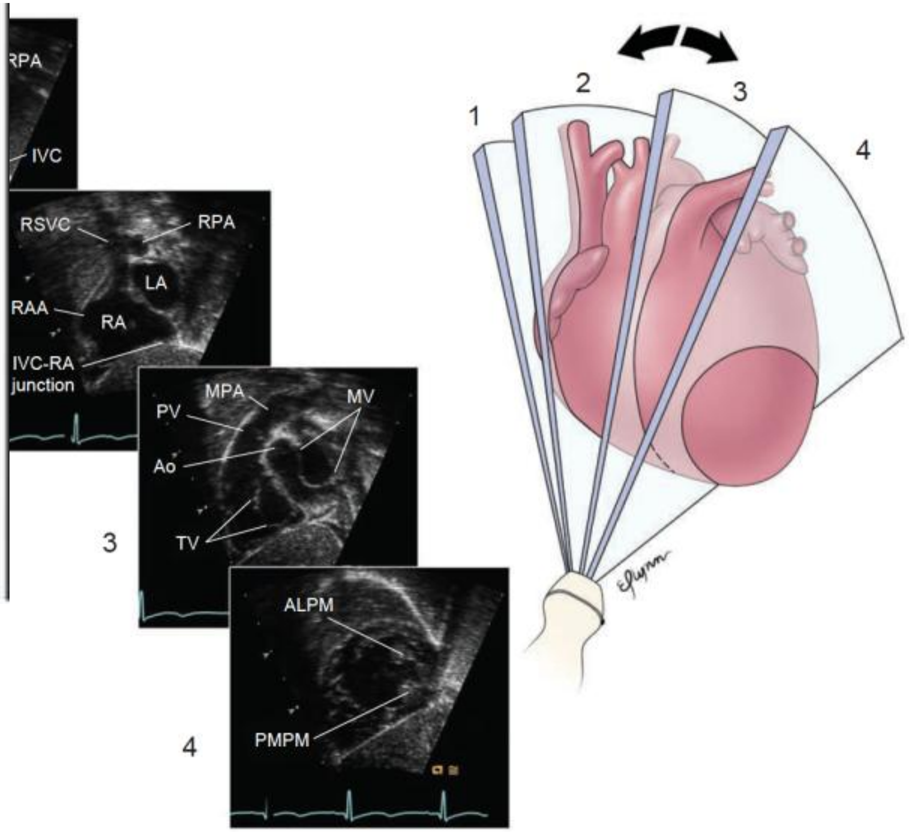
(1)

(2)

(3)

TNECHO


A
SVC
Right atrium
Line tip


RPA
IVC
RSVC
RPA
LA
RAA
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IVC-RA junction
MPA
PV
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3
ALPM
PMPM
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1
2
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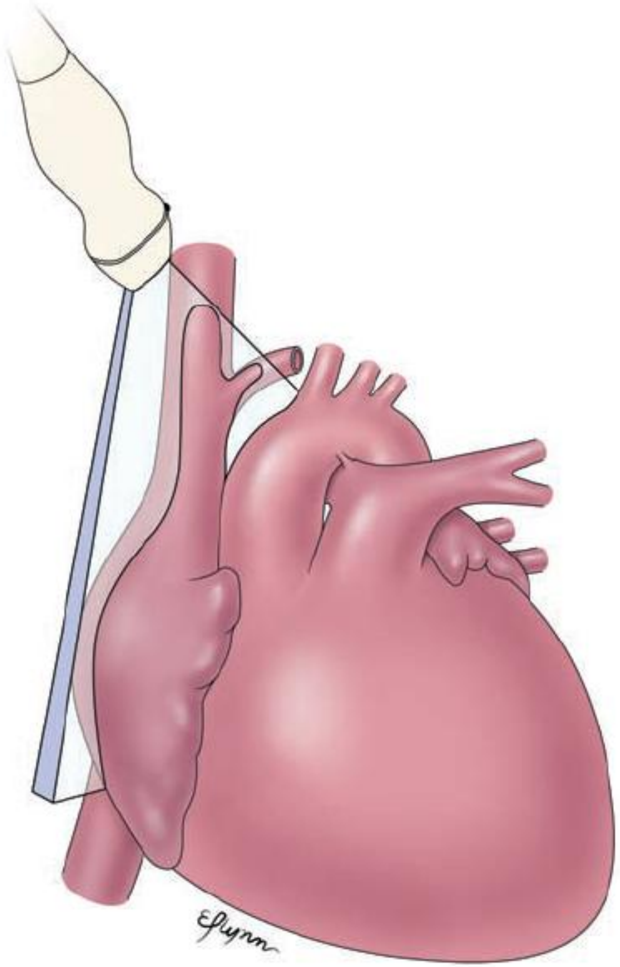
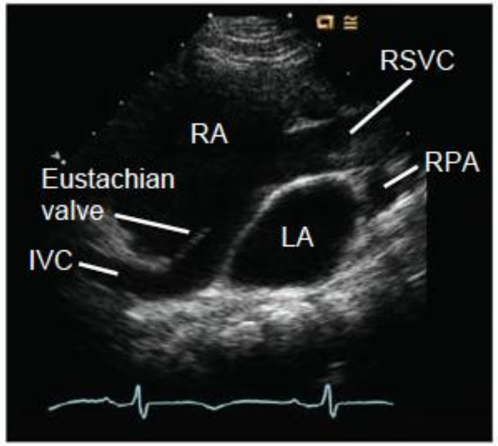
4

TNECHO



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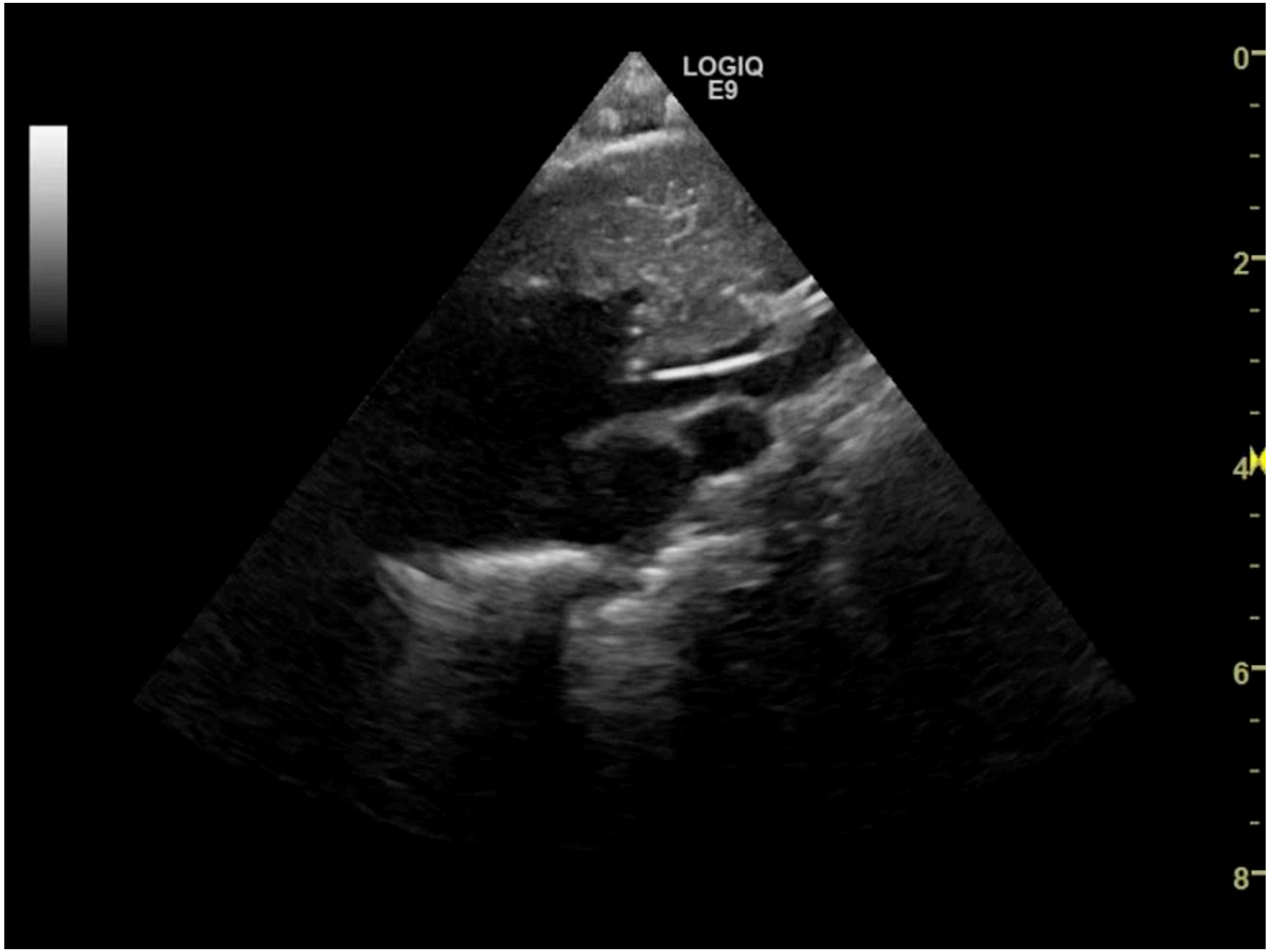

LOGIQ
E9
0
2
4
6
8

IMPIANTO: TnECHO

- Studio prospettico
- EG 26 PN 800 gr
- 22 ECC

- Concordanza in 12 ECC (59%)

Table 1 A 2 × 2 Table Comparing PICC Line Positioning Determination by Radiographs Compared with TnECHO

	TnECHO Poor Position	TnECHO Good Position	Total
XR poor position	7	5	12
XR good position	4	6	10
Total	11	11	

PICC, peripherally inserted central catheter; TnECHO, targeted neonatal echocardiography; XR, plain radiography.

The Use of Targeted Neonatal Echocardiography to Confirm Placement of Peripherally Inserted Central Catheters in Neonates. Am J Perin 2012

IMPIANTO ECC: TnECHO

- Rx vs RT-US + Rx
- Outcome primario: tempo tra inserzione e ECC in posizione ottimale
- EG 31 PN 1200 gr
- Tempo medio per esecuzione rx 38 min

Table 2. Results of PICC placement using ultrasound guidance compared with standard placement in 49 neonates

	Ultrasound group	*Standard group*	P-*value*
Total time for PICC placement with radiograph (minutes)	69 ± 49	99 ± 49	0.034
Time from PICC securement to radiograph read	41 ± 20	34 ± 16	0.219
Number of radiograph (interquartile range)	1 (1–1)	2 (1–2)	<0.001
Infants with additional radiograph (%)	4 (2) two not done after manipulation	16 (68)	<0.001
Number of manipulations (interquartile range)	0 (0–1)	1 (1–2)	0.032
Infants with additional manipulation (%)	6 (30)	19 (68)	0.01
Number of attempts (interquartile range)	2 (1–3)	2 (1–3)	0.676

Abbreviation: PICC, peripherally inserted central catheter.

A randomized controlled trial of ultrasound-guided peripherally inserted central catheters compared with standard radiograph in neonate. JoP 2013

IMPIANTO ECC: TnECHO

- Rx vs RT-US + Rx
- Outcome primario: tempo tra inserzione e ECC in posizione ottimale
- EG 31 PN 1200 gr
- Tempo medio per esecuzione rx 38 min

Table 2. Results of P

	up	*P-value*
Total time for PICC p		0.034
Time from PICC secu		0.219
Number of radiogra		$<$0.001
Infants with additior		$<$0.001
Number of manipula		0.032
Infants with additior		0.01
Number of attempts		0.676

Abbreviation: PICC, pe

The challenge with placement of upper PICCs is that ideal position of the PICC line is in the lower one-third of the superior vena cava to the superior vena cava/right atrial junction, which on the smallest infants can be as little as 0.5 cm. Furthermore, in our experience we have seen PICC lines 'relax' after placement with migration toward the heart on subsequent days. Finally, our unofficial observations of PICC movement with limb manipulation during this study revealed PICC tip movements, with upper limb movement and lower movement of 2 and 3 cm, respectively.

A randomized controlled trial of ultrasound-guided peripherally inserted central catheters compared with standard radiograph in neonate. JoP 2013

IMPIANTO: TIP location ECC

“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
Brissaud et al (2010)[16]	BW: 1,305 (620–3,550) g GA: 30 (26–40) wk	36 PICCs	Pediatric intensivist	Not specified	Not specified	89%	15 min	Not reported	Not reported
Katheria et al (2013)[15]	Weight at procedure: 1,185 ± 538 g. CGA 31 ± 4 wk	20 PICCs	Neonatologists	13 MHz linear	UE: right parasternal sagittal view. LE: subcostal sagittal view. Saline or nonionic, isotonic contrast used	90%	30 min	1	1

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
Ohki et al (2000)[7]	"Neonates"	57 PICCs	Not specified	10 and 12 MHz	Not specified	95%	US could detect 78% of cases of catheter tip dislodgement by changes in extremity position
Jain et al (2012)[6]	BW: 833 (710–1,930) g GA: 26.5 (25.4–28.8) weeks.	22 PICCs	Neonatologists	10 MHz	UE: Subcostal, parasternal LAX, high parasternal, and apical views. LE: subcostal sagittal view. Saline contrast used	100%	XR incorrectly deemed 4 of 11 malpositioned tips in good position, and 5 of 11 well-positioned tips in bad position. In nine infants, a second XR was avoided with US-guided manipulation
Tauzin et al (2013)[8]	BW: < 1,800 g Weight: ~1,130 (828–1,452) g CGA: 27–33 weeks.	109 PICCs	"US specialist"	12 MHz	Subcostal, apical, parasternal LAX, high parasternal, and abdominal parastermal views	100%	US evaluation determined 25% of PICCs extended into the heart even though deemed to be in good position by XR. 21% PICCs repositioned after US evaluation without complications

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).

AHRQ Recommendations

(Agency for Healthcare Research and Quality)

2013

Annals of Internal Medicine | SUPPLEMENT

The Top Patient Safety Strategies That Can Be Encouraged for Adoption Now

Paul G. Shekelle, MD, PhD; Peter J. Pronovost, MD, PhD; Robert M. Wachter, MD; Kathryn M. McDonald, MM; Karen Schoelles, MD, SM; Sydney M. Dy, MD, MSc; Kaveh Shojania, MD; James T. Reston, PhD, MPH; Alyce S. Adams, PhD; Peter B. Angood, MD; David W. Bates, MD, MSc; Leonard Bickman, PhD; Pascale Carayon, PhD; Sir Liam Donaldson, MBChB, MSc, MD; Naihua Duan, PhD; Donna O. Farley, PhD, MPH; Trisha Greenhalgh, BM BCH; John L. Haughom, MD; Eileen Lake, PhD, RN; Richard Lilford, PhD; Kathleen N. Lohr, PhD, MA, MPhil; Gregg S. Meyer, MD, MSc; Marlene R. Miller, MD, MSc; Duncan V. Neuhauser, PhD, MBA, MHA; Gery Ryan, PhD; Sanjay Saint, MD, MPH; Stephen M. Shortell, PhD, MPH, MBA; David P. Stevens, MD; and Kieran Walshe, PhD

Encouraged

- Multicomponent interventions to reduce falls
- Use of clinical pharmacists to reduce adverse drug events
- Documentation of patient preferences for life-sustaining treatment
- Obtaining informed consent to improve patients' understanding of the potential risks of procedures
- Team training
- Medication reconciliation
- Practices to reduce radiation exposure from fluoroscopy and CT
- The use of surgical outcome measurements and report cards, such as those from ACS NSQIP
- Rapid-response systems
- Use of complementary methods for detecting adverse events or medical errors to monitor for patient safety problems
- Computerized provider order entry
- Use of simulation exercises in patient safety efforts

Hall EJ, Brenner DJ. Cancer risks from diagnostic radiology. Br J Radiol. 2008; 81(965):362–378 doi: 10.1259/bjr/01948454 PMID: 18440940

Berrington DE, González A, Darby S. Risk of cancer from diagnostic X-rays: estimates for the UK and 14 other countries. Lancet. 2004; 363(9406):345–351. doi: 10.1016/S0140-6736(04)15433-0 PMID: 15070562

Nguyen KN, Patel AM, Weng FL. Ionizing radiation exposure among kidney transplant recipients due to medical imaging during the pretransplant evaluation. Clin J Am Soc Nephrol. 2013; 8(5):833–839. doi: 10.2215/CJN.03990412 PMID: 23393106

Huda W, Vance A. Patient radiation doses from adult and pediatric CT. AJR Am J Roentgenol. 2007; 188(2):540–546. doi: 10.2214/AJR.06.0101 PMID: 17242266

- 1% delle patologie neoplastiche è attribuito a radiazioni in Canada e USA
- Il max permesso è 50 mSv/aa o 100 mSv/5aa
- Il rischio di morte per cancro è aumentato di 0,4% ogni 100 mSv di dose cumulativa di radiazioni

RESEARCH ARTICLE

Radiation Exposure from Diagnostic Imaging in a Cohort of Pediatric Transplant Recipients

Alexandra Seal, Michael Hawkes, Ravi Bhargava, Michelle Noga, Jutta Preiksaitis, Curtis Mabilangan, Joan Robinson*

University of Alberta and Stollery Children's Hospital, Edmonton, Alberta, Canada

Journal of Clinical Densitometry: Assessment & Management of Musculoskeletal Health, vol. ■, no. ■, 1–7, 2017

1094-6950/■:1–7/$36.00
https://doi.org/10.1016/j.jocd.2017.09.005

Cumulative Effective Dose and Cancer Risk of Pediatric Population in Repetitive Whole-Body Scan Using Dual-Energy X-Ray Absorptiometry

Martin Law,* Wang-Kei Ma, Eva Chan, Candy Mui, Vivian Ma, Wai-Yin Ho, Lawrance Yip, and Wendy Lam

Department of Radiology, Queen Mary Hospital, Hong Kong

ACTA PÆDIATRICA
NURTURING THE CHILD

Acta Pædiatrica ISSN 0803-5253

SHORT COMMUNICATION

Lung ultrasound decreased radiation exposure in preterm infants in a neonatal intensive care unit

Guillaume Escourrou (Guillaume.escourrou@gmail.com), Daniele De Luca
Division of Pediatrics and Neonatal Critical Care, APHP, South Paris University Hospitals, Medical Center « A.Béclère », Paris, France

Radiation exposure in extremely low birth weight infants during their neonatal intensive care unit stay

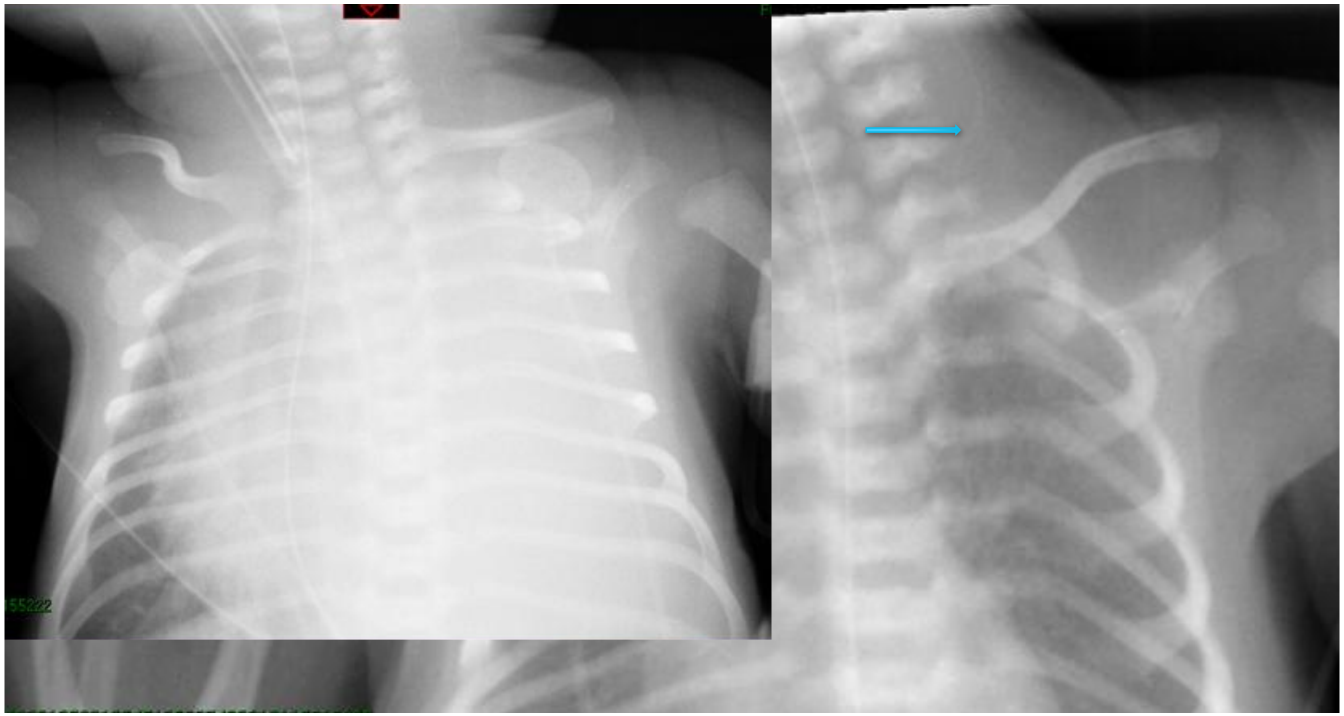
Narayan Prabhu Iyer, Amy Baumann, Mark Stephen Rzeszotarski, Robert Donald Ferguson, Maroun Jean Mhanna
Cleveland, Ohio, USA

Controllo della posizione della punta: post-impianto

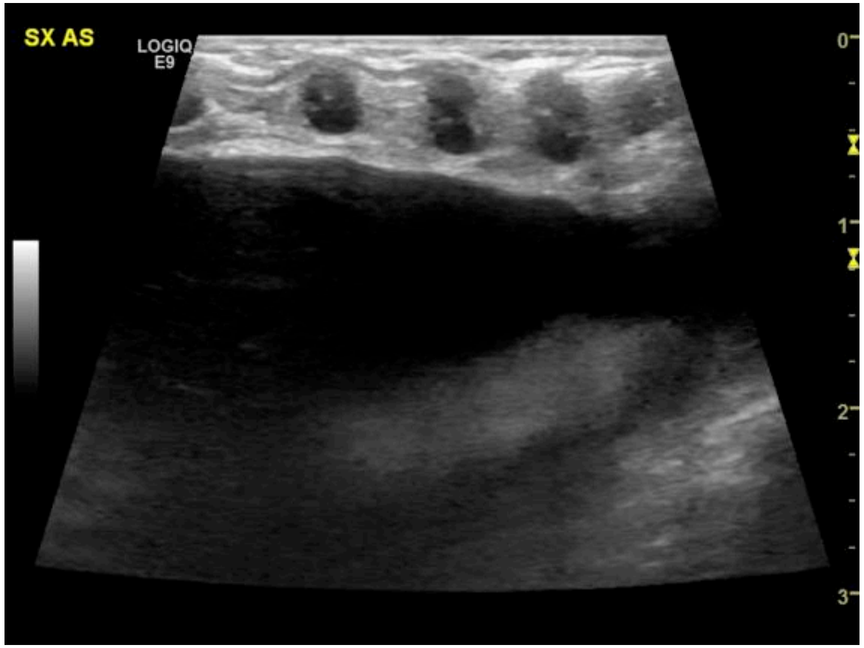
Line type	*N*	Migration 1 h	Migration 24 h
		% (*n*) (95% CI)	% (*n*) (95% CI)
UVC	41	36% (15) (21–51%)	23% (9) (9–36%)
PICC (total)	63	23% (15) (12–33%)	11% (7) (3–18%)
UE PICC	25	28% (7) (10–46%)	28% (7) (10–46%)
LE PICC	38	21% (8) (7–38%)	0

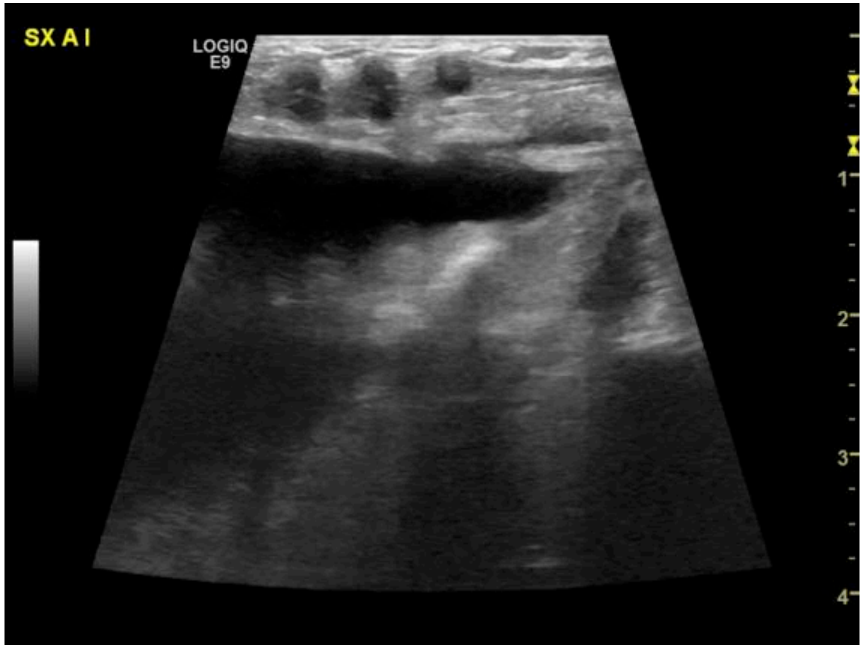
Migration of Central Venous Catheters in Neonates Gupta et al. American Journal of Perinatology

US e complicanze…caso 1

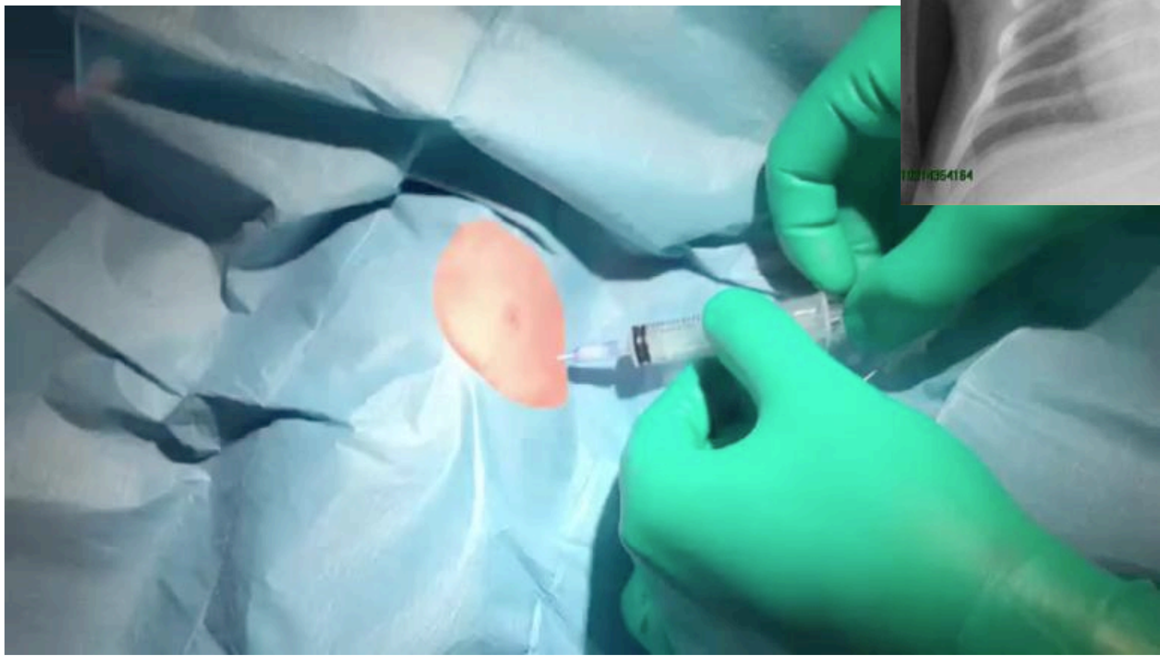


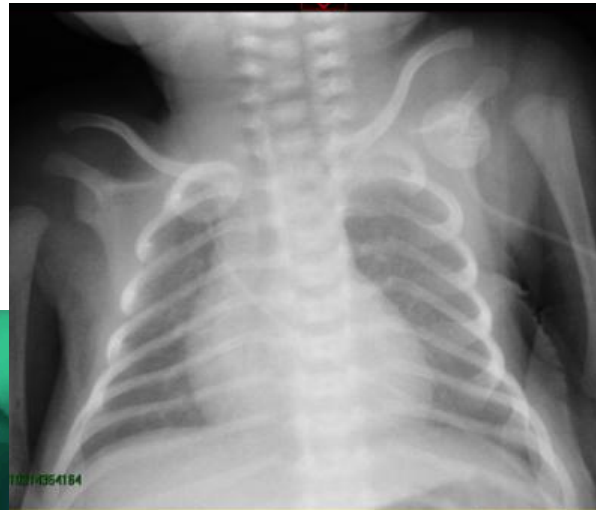
US e complicanze…caso 1



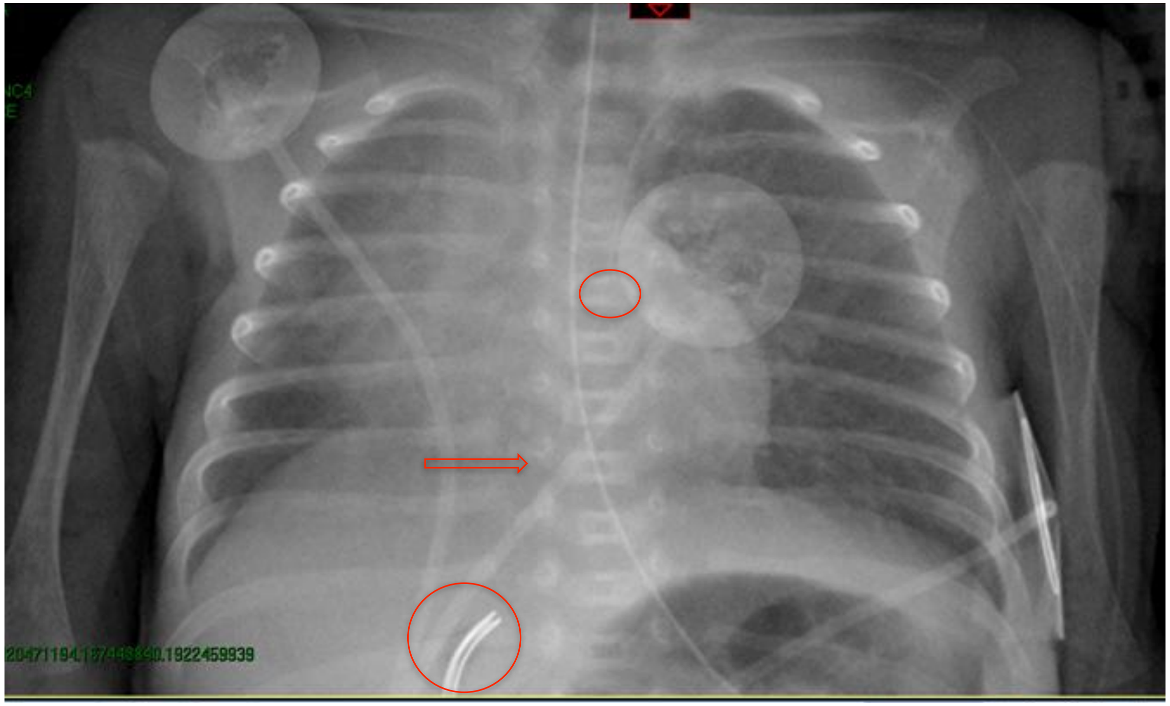


US e complicanze…caso 1





US e complicanze…caso 2

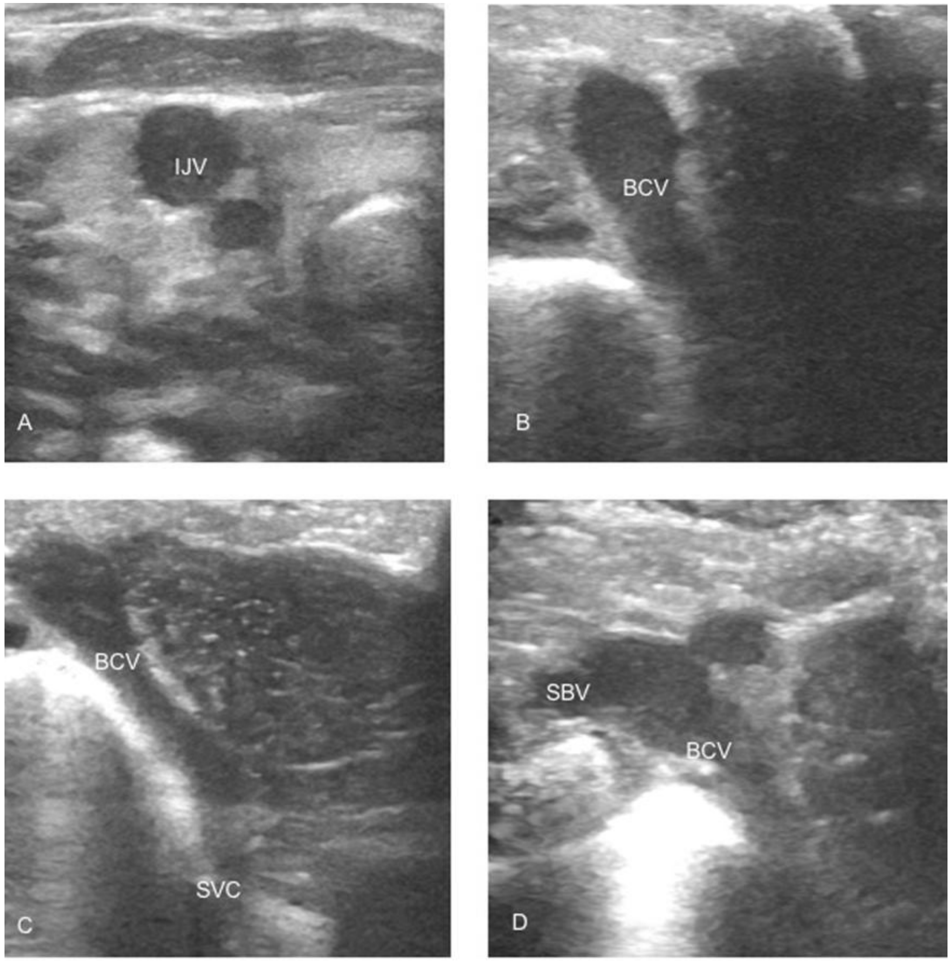



55:05
LOGIQ
E9


LOGIQ
E9

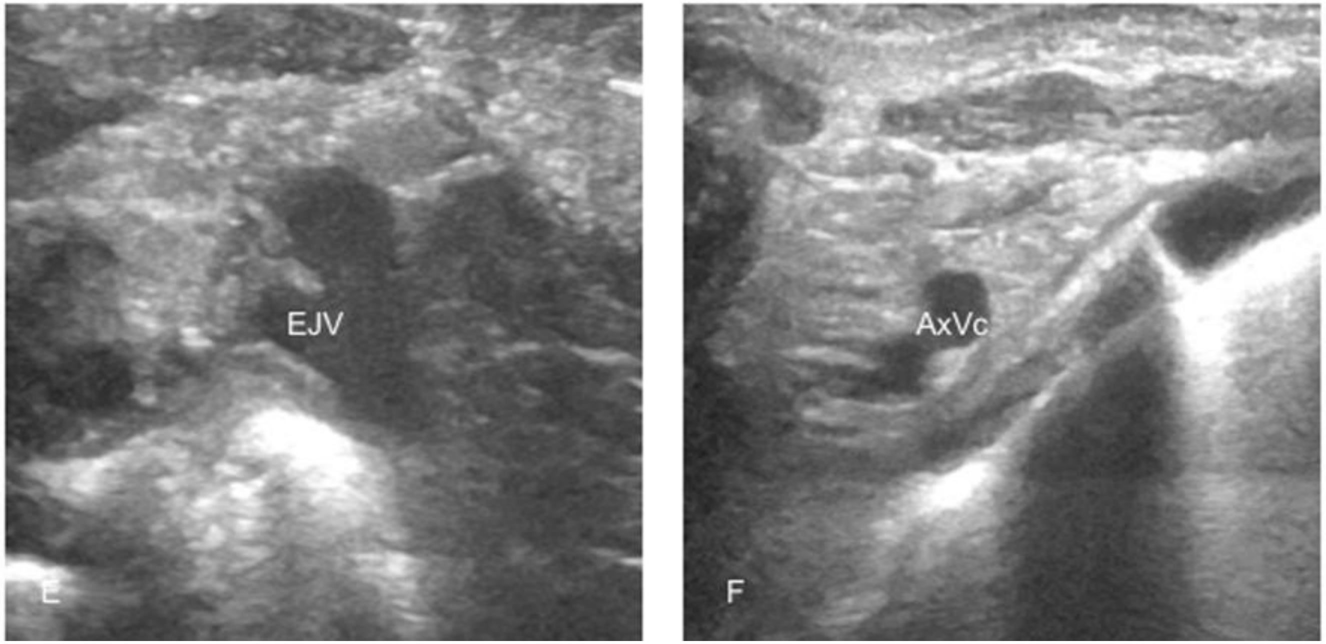
In press Neonatology 2019

Lo studio VEIN



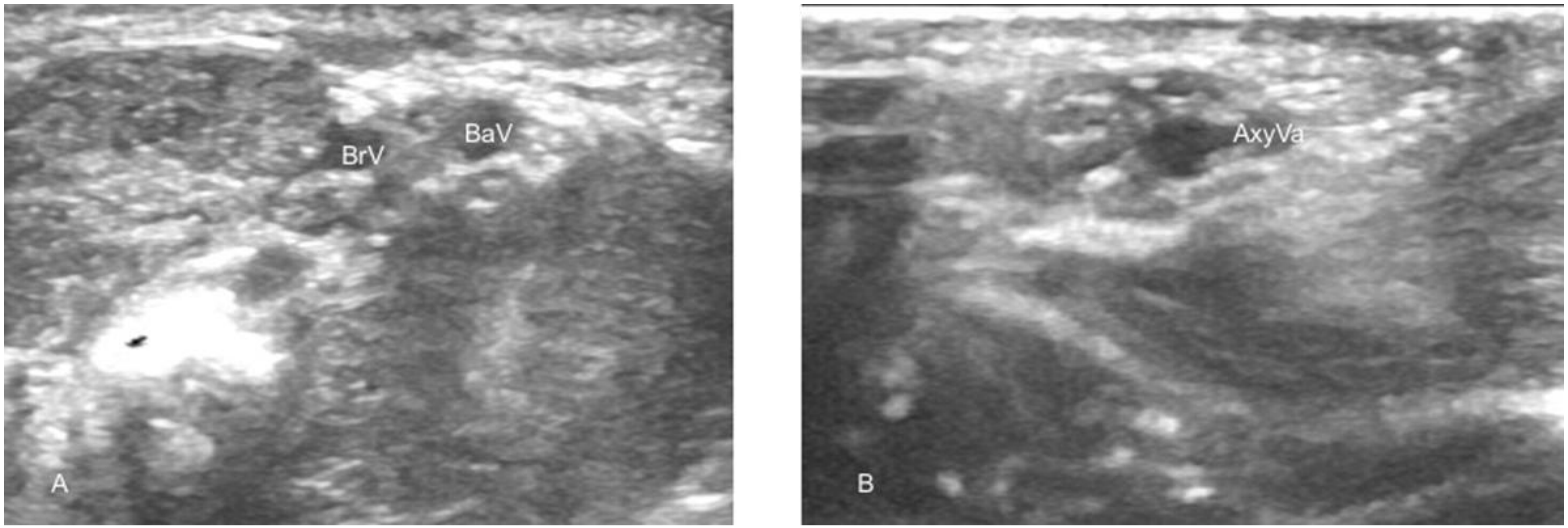
In press Neonatology 2019

Lo studio VEIN



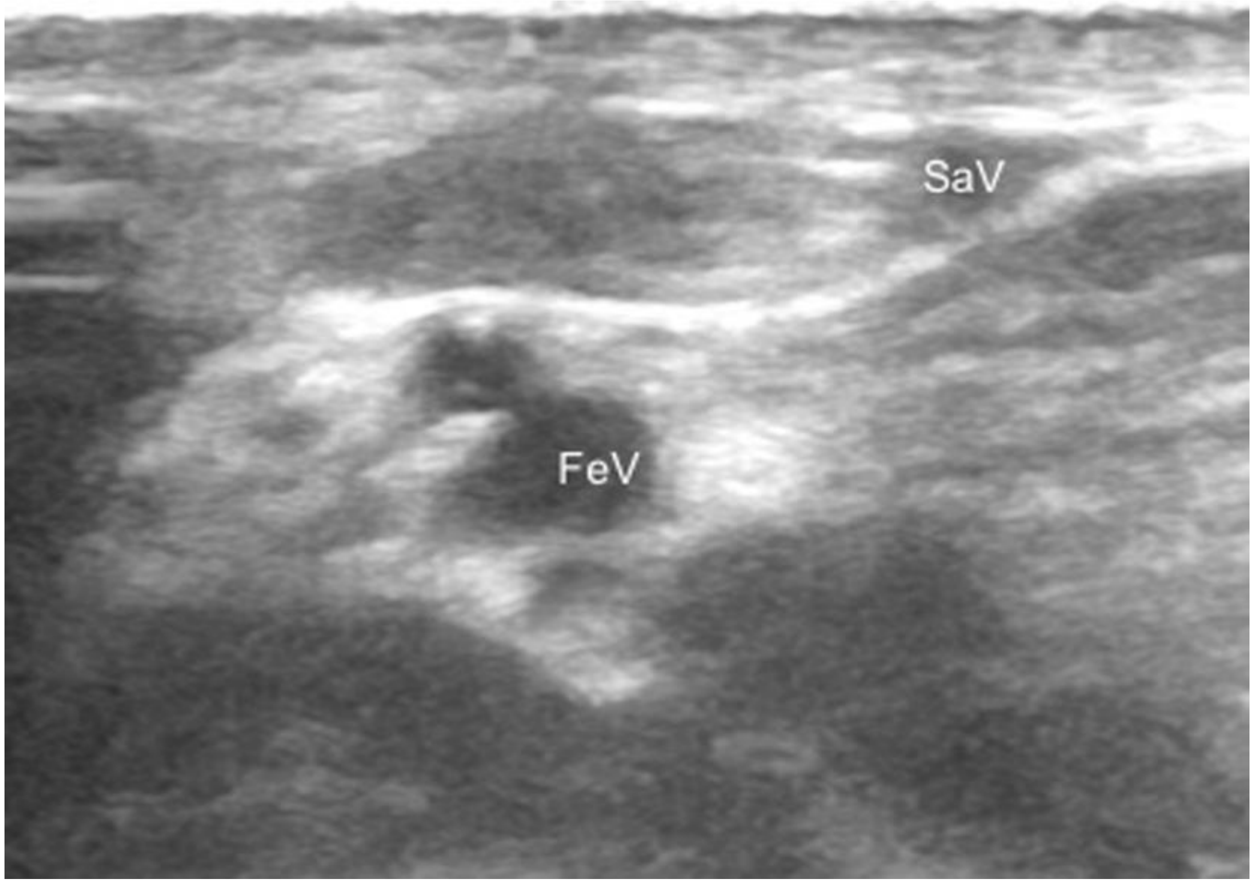
In press Neonatology 2019

Lo studio VEIN



In press Neonatology 2019

Lo studio VEIN



In press Neonatology 2019

Lo studio VEIN

Vein	All (n = 100)	500-1000g (n = 20)	1001-1500g (n = 20)	1501-2000g (n = 20)	2001-2500g (n = 20)	2501-3000g (n = 20)	ICC*
R IJV	3.1 ± 0.8 (1.8-6.0)	2.4 ± 0.5 (1.8-3.1)	2.8 ± 0.5 (2.0-3.3)	3.0 ± 0.6 (2.1-4.2)	3.2 ± 0.3 (2.8-3.6)	4.2 ± 0.7 (3.2-6.0)	0.85
L IJV	3.2 ± 0.8 (1.9-7.0)	2.5 ± 0.4 (1.9-3.1)	2.7 ± 0.5 (2.0-3.4)	3.2 ± 0.6 (2.2-4.4)	3.2 ± 0.2 (2.8-3.6)	4.4 ± 0.9 (3.3-7.0)	0.87
R BCV	3.6 ± 0.6 (2.6-5.7)	3.0 ± 0.3 (2.6-3.6)	3.3 ± 0.3 (2.7-3.7)	3.4 ± 0.3 (2.7-3.6)	3.8 ± 0.4 (3.1-4.2)	4.5 ± 0.6 (3.7-5.7)	0.96
L BCV	3.5 ± 0.8 (2.0-7.5)	3.0 ± 0.3 (2.2-3.3)	2.9 ± 0.4 (2.0-3.6)	3.4 ± 0.5 (2.4-4.2)	3.5 ± 0.3 (2.9-4.1)	4.6 ± 0.9 (3.5-6.5)	0.97
R SBV	1.8 ± 0.6 (0.8-3.0)	1.1 ± 0.3 (0.8-1.7)	1.5 ± 0.3 (1.2-2.2)	1.8 ± 0.3 (1.3-2.3)	2.0 ± 0.3 (1.5-2.4)	2.5 ± 0.4 (2.0-3.0)	0.91
L SBV	1.8 ± 0.6 (0.8-3.2)	1.1 ± 0.3 (0.8-1.6)	1.4 ± 0.3 (0.8-1.7)	1.8 ± 0.3 (1.3-2.2)	2.0 ± 0.3 (1.5-2.3)	2.5 ± 0.3 (1.9-3.2)	0.92
R EJV	1.3 ± 0.3 (0.8-2.2)	1.0 ± 0.2 (0.8-1.3)	1.3 ± 0.2 (0.9-1.5)	1.2 ± 0.2 (0.9-1.5)	1.3 ± 0.2 (1.0-1.5)	1.7 ± 0.3 (1.1-2.2)	0.89
L EJV	1.4 ± 0.4 (0.6-2.4)	0.9 ± 0.2 (0.6-1.2)	1.2 ± 0.3 (0.8-1.5)	1.4 ± 0.2 (1.1-1.7)	1.5 ± 0.2 (1.2-1.7)	1.8 ± 0.2 (1.5-2.4)	0.90
R AxVc	1.9 ± 0.5 (1.2-3.5)	1.5 ± 0.1 (1.2-2.0)	1.7 ± 0.4 (1.3-2.3)	1.8 ± 0.3 (1.3-2.2)	2.0 ± 0.3 (1.5-2.3)	2.5 ± 0.5 (1.9-3.5)	0.91
L AxVc	2.0 ± 0.4 (1.3-3.2)	1.6 ± 0.2 (1.3-1.9)	1.9 ± 0.5 (1.3-2.8)	2.0 ± 0.3 (1.4-2.2)	2.2 ± 0.2 (1.9-2.5)	2.5 ± 0.4 (2.0-3.2)	0.93
R AxVa	1.6 ± 0.4 (0.8-2.4)	1.2 ± 0.3 (0.8-1.5)	1.5 ± 0.3 (1.0-1.9)	1.5 ± 0.3 (1.1-2.1)	1.8 ± 0.3 (1.3-2.2)	2.1 ± 0.2 (1.5-2.4)	0.92
L AxVa	1.6 ± 0.4 (0.8-2.6)	1.2± 0.2 (0.8-1.7)	1.5 ± 0.4 (1.0-2.1)	1.7 ± 0.3 (1.0-2.1)	1.8 ± 0.2 (1.4-2.1)	2.0 ± 0.3 (1.6-2.6)	0.91
R BrV	1.0 ± 0.3 (0.5-2.1)	0.9 ± 0.2 (0.7-1.2)	0.8 ± 0.2 (0.5-1.0)	0.8 ± 0.2 (0.6-1.1)	1.1 ± 0.1 (0.9-1.3)	1.5 ± 0.2 (1.2-2.1)	0.89
L BrV	1.1 ± 0.4 (0.6-1.9)	0.9 ± 0.2 (0.7-1.3)	0.8 ± 0.2 (0.6-1.0)	1.0 ± 0.2 (0.7-1.3)	1.2 ± 0.1 (1.0-1.4)	1.6 ± 0.2 (1.3-1.9)	0.90
R BaV	1.0 ± 0.3 (0.5-1.5)	0.7 ± 0.2 (0.5-1.1)	1.0 ± 0.2 (0.7-1.2)	0.9 ± 0.2 (0.6-1.2)	1.2 ± 0.2 (0.7-1.4)	1.3 ± 0.1 (1.1-1.5)	0.91
L BaV	1.0 ± 0.3 (0.5-1.5)	0.7 ± 0.1 (0.5-1.0)	0.9 ± 0.1 (0.7-1.1)	0.9 ± 0.1 (0.6-1.1)	1.3 ± 0.2 (0.8-1.5)	1.3 ± 0.1 (1.1-1.5)	0.92
R FeV	2.3 ± 0.7 (1.1-3.5)	1.4 ± 0.2 (1.1-1.8)	2.1 ± 0.4 (1.3-2.7)	2.2 ± 0.3 (1.8-2.6)	2.8 ± 0.4 (2.1-3.4)	3.2 ± 0.2 (2.9-3.5)	0.89
L FeV	2.3 ± 0.7 (1.1-3.5)	1.4 ± 0.3 (1.1-1.9)	2.1 ± 0.5 (1.6-2.9)	2.0 ± 0.4 (1.4-2.6)	2.9 ± 0.2 (2.5-3.3)	3.1 ± 0.2 (2.9-3.5)	0.91
R SaV	1.3 ± 0.5 (0.5-2.3)	0.8 ± 0.2 (0.5-1.2)	1.0 ± 0.3 (0.7-1.8)	1.3 ± 0.2 (0.9-1.5)	1.7 ± 0.4 (1.2-2.3)	1.8 ± 0.3 (1.3-2.3)	0.88
L SaV	1.3 ± 0.5 (0.4-2.3)	0.8 ± 0.2 (0.4-1.1)	1.1 ± 0.2 (0.7-1.5)	1.2 ± 0.2 (0.8-1.4)	1.8 ± 0.3 (1.4-2.3)	1.8 ± 0.3 (1..4-2.3)	0.89

In press Neonatology 2019

Lo studio VEIN

Vein	All (n = 100)	500-1000g (n = 20)	1001-1500g (n = 20)	1501-2000g (n = 20)	2001-2500g (n = 20)	2501-3000g (n = 20)	ICC*
R IJV	3.1 ± 0.8 (1.8-6.0)	2.4 ± 0.5 (1.8-3.1)	2.8 ± 0.5 (2.0-3.3)	3.0 ± 0.6 (2.1-4.2)	3.2 ± 0.3 (2.8-3.6)	4.2 ± 0.7 (3.2-6.0)	0.85
L IJV	3.2 ± 0.8 (1.9-7.0)	2.5 ± 0.4 (1.9-3.1)	2.7 ± 0.5 (2.0-3.4)	3.2 ± 0.6 (2.2-4.4)	3.2 [illegible] (2.8-3.6)	4.4 ± 0.9 (3.3-7.0)	0.87
R BCV	3.6 ± 0.6 (2.6-5.7)	3.0 ± 0.3 (2.6-3.6)	3.3 ± 0.3 (2.7-3.7)	3.4 ± 0.3 (2.7-3.6)	[illegible].1-4.2)	4.5 ± 0.6 (3.7-5.7)	0.96
L BCV	3.5 ± 0.8 (2.0-7.5)	3.0 ± 0.3 (2.2-3.3)	2.9 ± 0.4 (2.0-3.6)	3.4 ± 0.5 (2[illegible]	[illegible]9-4.1)	4.6 ± 0.9 (3.5-6.5)	0.97
R SBV	1.8 ± 0.6 (0.8-3.0)	1.1 ± 0.3 (0.8-1.7)	1.5 ± 0.3 (1.2-2.2)	1.8 ± [illegible]	[illegible]2.4)	2.5 ± 0.4 (2.0-3.0)	0.91
L SBV	1.8 ± 0.6 (0.8-3.2)	1.1 ± 0.3 (0.8-1.6)	1.4 ± 0.3 (0.8-1.7)	[illegible]	[illegible]-2.3)	2.5 ± 0.3 (1.9-3.2)	0.92
R EJV	1.3 ± 0.3 (0.8-2.2)	1.0 ± 0.2 (0.8-1.3)	1.3 ± 0.2 (0.9-1[illegible]	[illegible]	[illegible]0.2 (1.0-1.5)	1.7 ± 0.3 (1.1-2.2)	0.89
L EJV	1.4 ± 0.4 (0.6-2.4)	0.9 ± 0.2 (0.6-1.2)	1.2 ± 0[illegible]	[illegible]	1.5 ± 0.2 (1.2-1.7)	1.8 ± 0.2 (1.5-2.4)	0.90
R AxVc	1.9 ± 0.5 (1.2-3.5)	1.5 ± 0.1 (1.2-2.0)	1[illegible]	[illegible]2.2)	2.0 ± 0.3 (1.5-2.3)	2.5 ± 0.5 (1.9-3.5)	0.91
L AxVc	2.0 ± 0.4 (1.3-3.2)	1.6 ± 0.2 (1.3-1[illegible]	[illegible]	[illegible] (1.4-2.2)	2.2 ± 0.2 (1.9-2.5)	2.5 ± 0.4 (2.0-3.2)	0.93
R AxVa	1.6 ± 0.4 (0.8-2.4)	1.2 ± 0.3 ([illegible]	[illegible]	[illegible]5 ± 0.3 (1.1-2.1)	1.8 ± 0.3 (1.3-2.2)	2.1 ± 0.2 (1.5-2.4)	0.92
L AxVa	1.6 ± 0.4 (0.8-2.6)	1.2[illegible]	[illegible]1)	1.7 ± 0.3 (1.0-2.1)	1.8 ± 0.2 (1.4-2.1)	2.0 ± 0.3 (1.6-2.6)	0.91
R BrV	1.0 ± 0.3 (0.5-2.1)	[illegible]	[illegible] (0.5-1.0)	0.8 ± 0.2 (0.6-1.1)	1.1 ± 0.1 (0.9-1.3)	1.5 ± 0.2 (1.2-2.1)	0.89
L BrV	1.1 ± 0.4 (0.6[illegible]	[illegible]	[illegible] ± 0.2 (0.6-1.0)	1.0 ± 0.2 (0.7-1.3)	1.2 ± 0.1 (1.0-1.4)	1.6 ± 0.2 (1.3-1.9)	0.90
R BaV	1.0 ± 0.3 (0.5-1[illegible]	[illegible])	1.0 ± 0.2 (0.7-1.2)	0.9 ± 0.2 (0.6-1.2)	1.2 ± 0.2 (0.7-1.4)	1.3 ± 0.1 (1.1-1.5)	0.91
L BaV	1.0 ± 0.3 (0.5-1.5[illegible]	[illegible]5-1.0)	0.9 ± 0.1 (0.7-1.1)	0.9 ± 0.1 (0.6-1.1)	1.3 ± 0.2 (0.8-1.5)	1.3 ± 0.1 (1.1-1.5)	0.92
R FeV	2.3 ± 0.7 (1.1-3.5)	[illegible]0.2 (1.1-1.8)	2.1 ± 0.4 (1.3-2.7)	2.2 ± 0.3 (1.8-2.6)	2.8 ± 0.4 (2.1-3.4)	3.2 ± 0.2 (2.9-3.5)	0.89
L FeV	2.3 ± 0.7 (1.1-3.5)	1.4 ± 0.3 (1.1-1.9)	2.1 ± 0.5 (1.6-2.9)	2.0 ± 0.4 (1.4-2.6)	2.9 ± 0.2 (2.5-3.3)	3.1 ± 0.2 (2.9-3.5)	0.91
R SaV	1.3 ± 0.5 (0.5-2.3)	0.8 ± 0.2 (0.5-1.2)	1.0 ± 0.3 (0.7-1.8)	1.3 ± 0.2 (0.9-1.5)	1.7 ± 0.4 (1.2-2.3)	1.8 ± 0.3 (1.3-2.3)	0.88
L SaV	1.3 ± 0.5 (0.4-2.3)	0.8 ± 0.2 (0.4-1.1)	1.1 ± 0.2 (0.7-1.5)	1.2 ± 0.2 (0.8-1.4)	1.8 ± 0.3 (1.4-2.3)	1.8 ± 0.3 (1..4-2.3)	0.89

USE ULTRASOUND

NOVITA’

- RaSuVA per la scelta razionale della vena
- Uso globale dell’ecografo per la tip location e la prevenzione e gestione delle complicanze catetere correlate
- Uso del seldinger indiretto per il posizionamento degli ECC 2 Fr
- Uso di cateteri medicati???
- Uso del cianoacrilato come metodo di fissaggio

NOVITA'

- RaSuVA per la scelta razionale della vena
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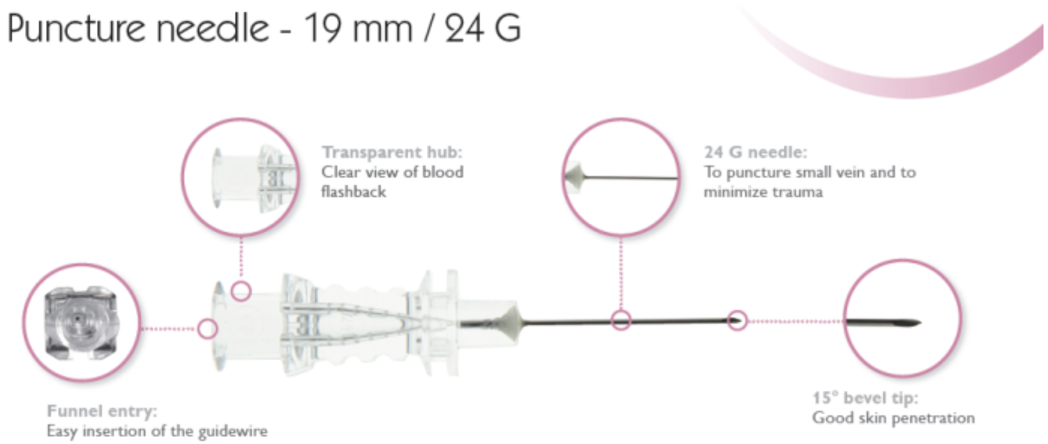
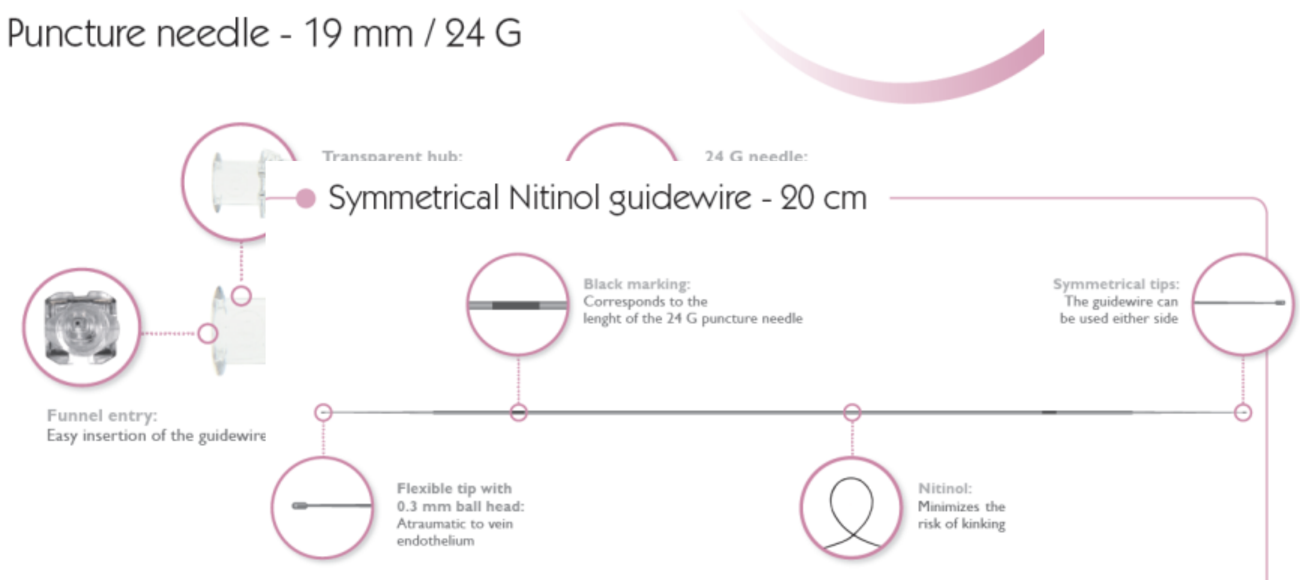
- Uso di cateteri medicati???
- Uso del cianoacrilato come metodo di fissaggio

SELDINGER

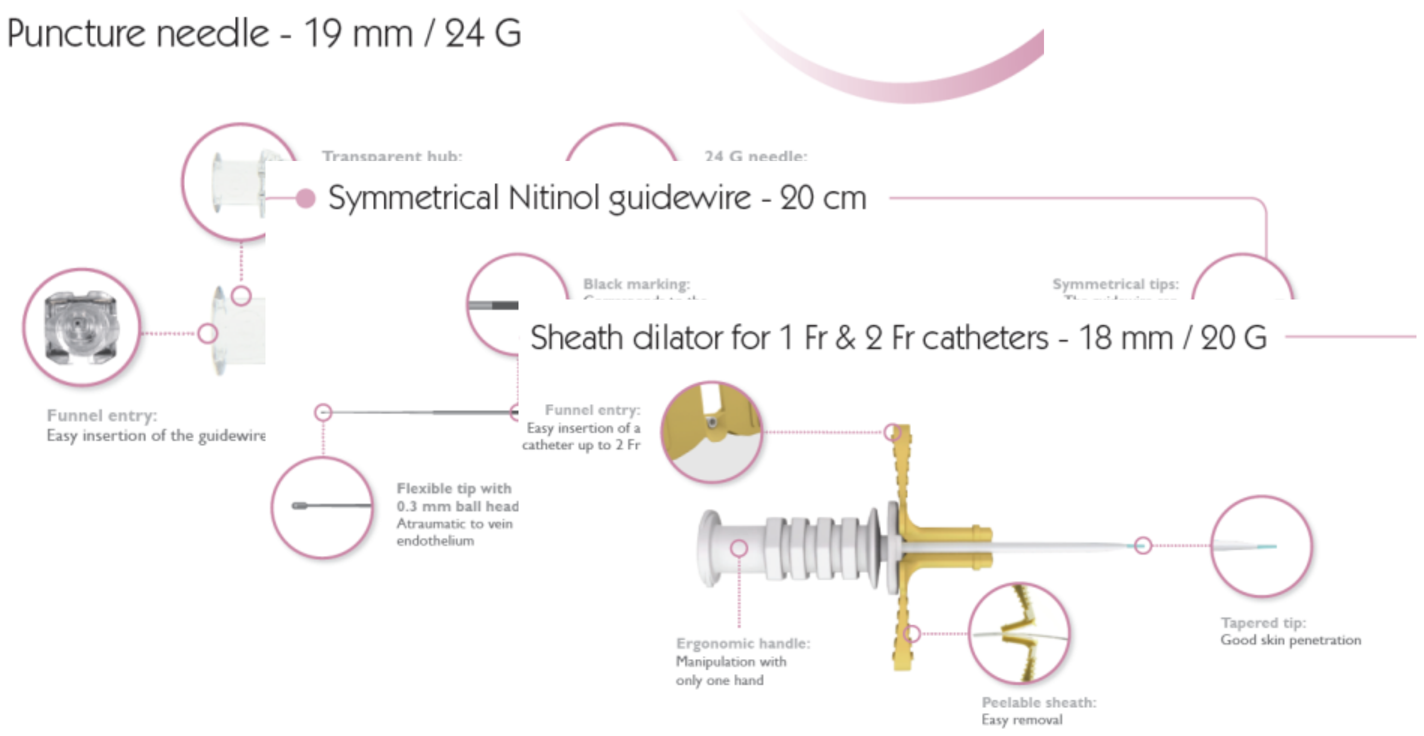

Puncture needle - 19 mm / 24 G
Transparent hub:
Clear view of blood flashback
24 G needle:
To puncture small vein and to minimize trauma
Funnel entry:
Easy insertion of the guidewire
15° bevel tip:
Good skin penetration

SELDINGER



Puncture needle - 19 mm / 24 G
Transparent hub:
24 G needle:
Symmetrical Nitinol guidewire - 20 cm
Black marking:
Corresponds to the
lenght of the 24 G puncture needle
Symmetrical tips:
The guidewire can
be used either side
Funnel entry:
Easy insertion of the guidewire
Flexible tip with
0.3 mm ball head:
Atraumatic to vein
endothelium
Nitinol:
Minimizes the
risk of kinking

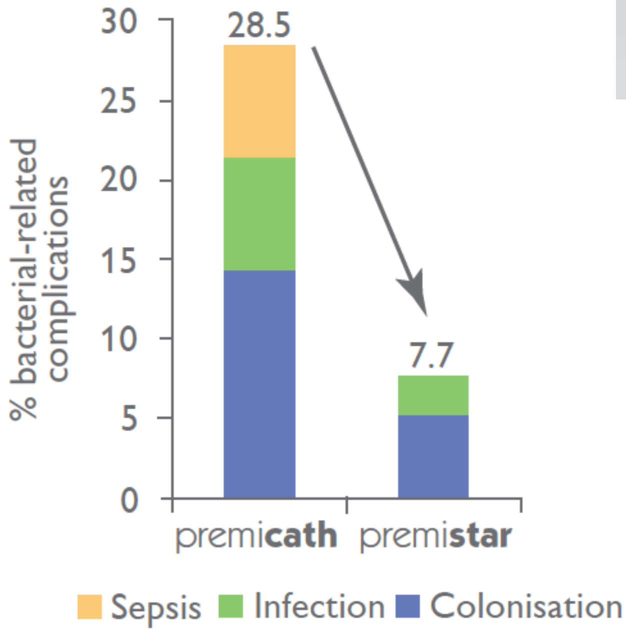
SELDINGER

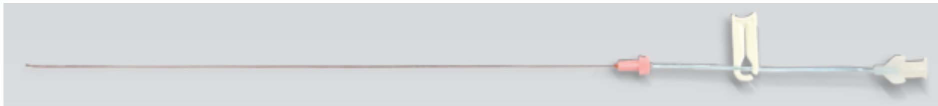

Puncture needle - 19 mm / 24 G
Transparent hub:
24 G needle:
Funnel entry:
Easy insertion of the guidewire
Symmetrical Nitinol guidewire - 20 cm
Black marking:
Symmetrical tips:
Flexible tip with
0.3 mm ball head
Atraumatic to vein
endothelium
Sheath dilator for 1 Fr & 2 Fr catheters - 18 mm / 20 G
Funnel entry:
Easy insertion of a
catheter up to 2 Fr
Ergonomic handle:
Manipulation with
only one hand
Peelable sheath:
Easy removal
Tapered tip:
Good skin penetration

NOVITA’

- RaSuVA per la scelta razionale della vena
- Uso globale dell’ecografo per la tip location e la prevenzione e gestione delle complicanze catetere correlate
- Uso del seldinger indiretto per il posizionamento degli ECC 2 Fr
- Uso di cateteri medicati???
- Uso del cianoacrilato come metodo di fissaggio

Results





Miconazolo + Rifampicina

NOVITA'

- RaSuVA per la scelta razionale della vena
- Uso globale dell'ecografo per la tip location e la prevenzione e gestione delle complicanze catetere correlate
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- Uso di cateteri medicati???
- Uso del cianoacrilato come metodo di fissaggio

USO DELLA COLLA SUGLI ECC: DATI PARZIALI

	ECC (glue+TSD)	ECC (SteriStrip+TSD)
N of babies	92	80
N of catheters	134	124
Mean PMA	29 ± 2.2	29 ± 2.5
Line Migration	20%*	35%*

* P value 0.007

PUNTI APERTI????

- Training per la tip location con RT-US
- Durata del catetere ECC
- Uso dell'ECG-IC per i cateteri ECC

Original research article

JVA The Journal of Vascular Access

The Journal of Vascular Access
1–6

DOI: 10.1177/1129729818761292
journals.sagepub.com/home/jva
SAGE

The intracavitary electrocardiography method for positioning the tip of epicutaneous cava catheter in neonates: Pilot study

Antonella Capasso[1], Rossella Mastroianni[1], Annalisa Passariello[2,3], Marta Palma[2], Francesco Messina[4], Antonella Ansalone[1], Italo Bernardo[1], Daniela Brescia[1], Francesco Crispino[1], Carolina Grassia[1], Attilio Romano[1] and Gaetano Ausanio[1]

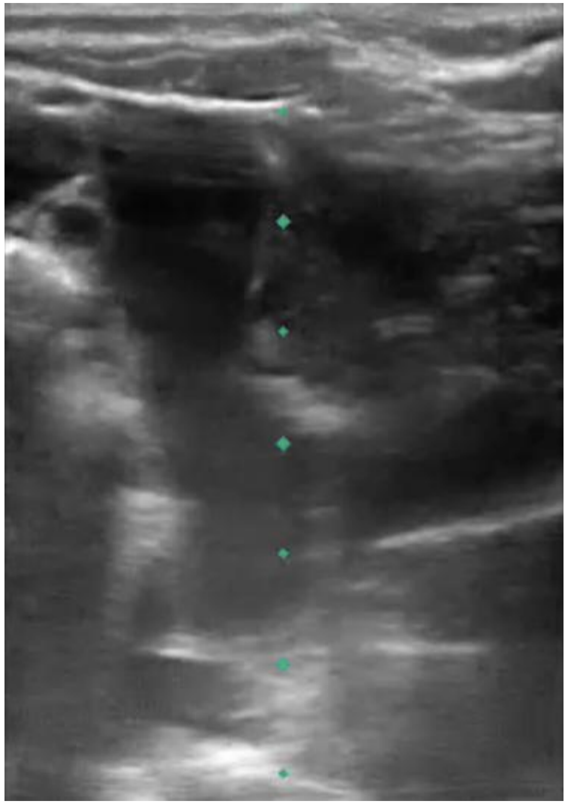
In 1 of 39 neonates, the P wave was too high on the surface ECG (due to pulmonary hypertension) so that IC-ECG could not be performed. This corresponded to an applicability of 97%.

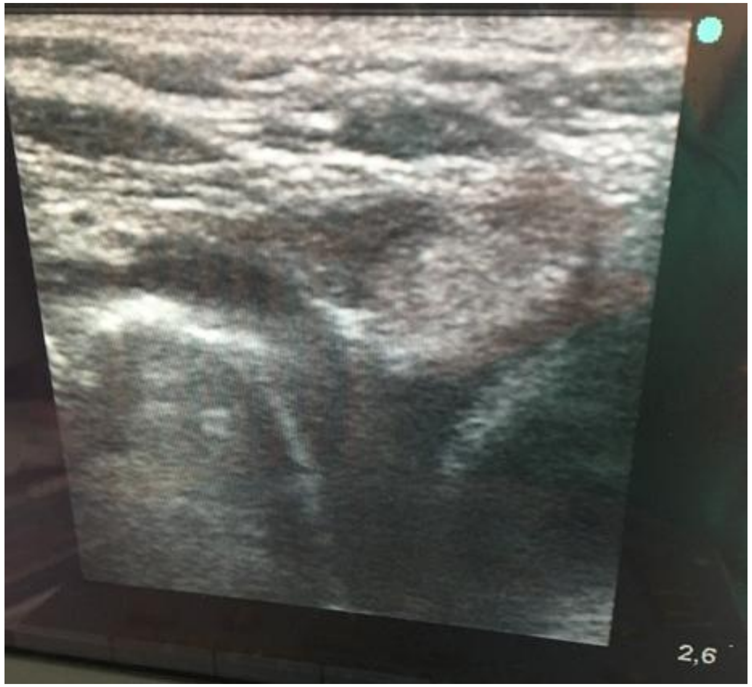
IC-ECG was performed in 38 patients. In eight cases, no elevation of the P wave could be detected on the IC-ECG (so overall feasibility was 79%).

The concordance between the tip verification by the IC-ECG method and by the radiological methods was mildly high: the overall match, that is, tip correctly located both according to IC-ECG and according to x-ray, was observed in 29 of 38 cases (76%) but it rises to 97% (29/30 cases) if peak P wave is detected.

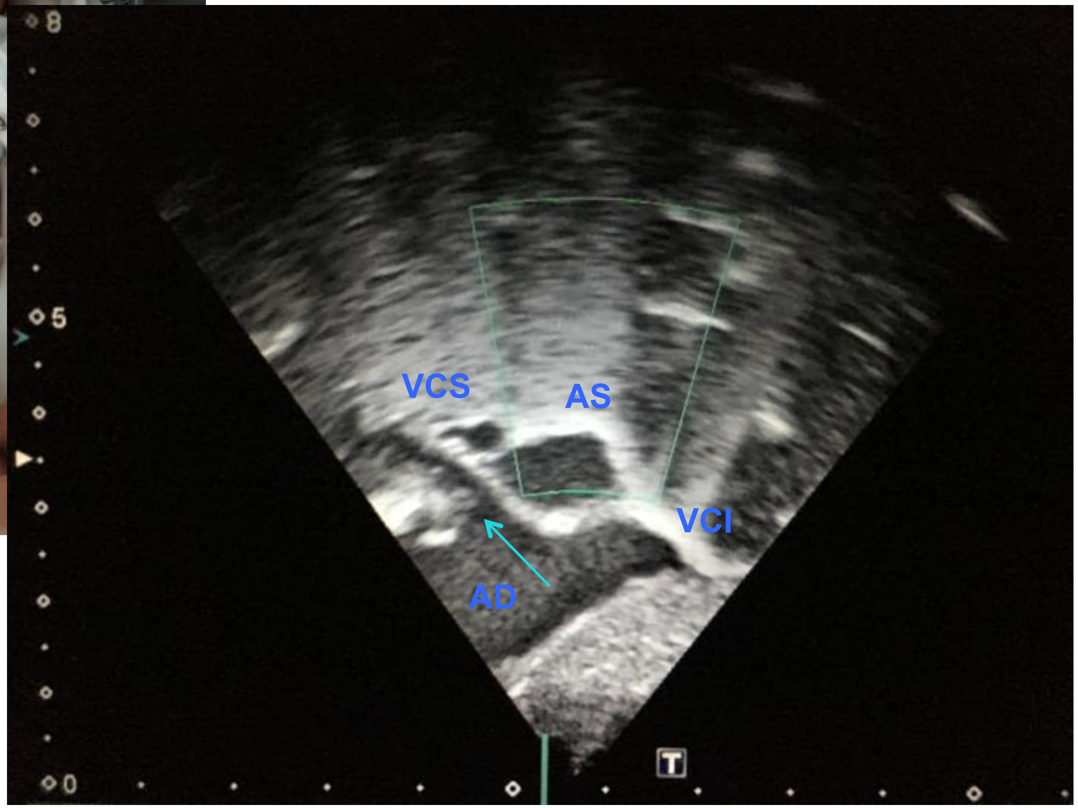
The percentage of concordance between IC-ECG and echocardiography was the same as IC-ECG and x-ray.

NEONATO É ECOGENICO!





USATE L'ECOGRAFO!




thank you
danke
рахмат
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
bedankt
спасибо
Баярлалаа
faafetai lava
dziękuję
mauruuru
hvala
go raibh maith agat
mochchakkeram
sukriya
kop khun krap
terima kasih
감사합니다
ありがとう
arigatô
dakujem
мерси
tapadh leat
хвала
asante
manana
obrigada
murakoze
tenki
chokrane
mamnun
дякую
djiere dieuf
tau
paldies
grazzi
mahalo
matondo
misaotra
dank je
welalin
tack
barka
kia ora
mersi
spas
vinaka
спасибі
blagodaram
kiitos
dankie
nanni
nandri
dhanyavad
bayarlalaa
gràçie
köszönöm
enkosi
sobodi
dêkuji
mèsi
didi madloba
sagolun
najis tuke
kam sah hamnida
rahmat
chnorakaloutioun
gratias ago
gràcies
sulpáy
akun
dankon
aciú
taiku
tanemirt
rahmet
grazie
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xièxie
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shukriya
mercê
trugarez