

Ultrasound guided central venipuncture in the newborn



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GAVePed 2023; Rimini***

900g Baby



PECULIARITIES in NEONATES

- Prone to hypothermia
 - Vulnerable skin
 - Prone to apnoea, haemodynamic depression
 - Non-cooperative
- *placement of CICC must be quick*
- *least invasive technique should be used*

PECULIARITIES in NEONATES

- Veins are small
 - *technically challenging cannulation*

Breschan; Anesthesiology 2018

Barone; Neonatology 2019

- Immature thrombolytic system
 - *reducing the risk of thrombosis*
 - *catheter size only $\frac{1}{3}$ of vessel*

However

- Tricky size measurement of the BCV in long axis view
 - *due to the oval shape*

Special REQUIREMENTS for CICC INSERTION in NEONATES

- Warm enviroment
 - *overhead radiant*
 - *heating blanket*
- Careful positioning
 - *hyperextension of neck*
 - *full access to the baby*

POSITIONING of a 1kg BABY in an INCUBATOR



Baby 1kg: cannulation of left BCV



SEDATION/ANALGESIA for CICC INSERTION in NEONATES

- Baby has to lie completely still
→ *deep sedation/analgesia*

- *If intubated*

- 3-5µg/kg fentanyl i.v.

- Oulego-Eroz; Europ J Pediatr 2020*

- *If-non intubated*

- 0.5-1mg/kg *ketamine i.v.*

- ± midazolam 0.05-0.1mg/kg i.v.

- sevoflurane via mask inhalation

- *+ infiltration of LA*

- Oulego-Eroz; Europ J Pediatr 2020*

- Barone; J Vascular Access 2020*

- Breschan; Br J Anaesth 2022; Pediatr Anesth 2020; Anesthesiology 2018*

- Montes Tapia; J Pediatr Surg 2016*

SEDATION/ANALGESIA for CICC INSERTION in NEONATES

- Deep sedation/analgesia *in very small infants*
 - *apnoea*
 - *airway obstruction*
- Non-invasive ventilation via CPAP mask
 - or*
- Mask ventilation by an assistant
 - or*
- Intubation
 - *< 1 kg*

ECC

epicutaneo-cava catheter

- No deep syst. sedation/analgesia needed
 - *EMLA*
 - *oral sucrose*

However

- Small bore lumen

USG nowadays PERMITS the periclavicular INSERTION of rel. large bore **CICCs** i.e. 2-3-4 Fr

- CICCs in neonates

- **350g: BCV**

- Barone; J Vasc Access 2021*

- **550g: BCV**

- Breschan; Anesthesiology 2018*

- Breschan; Pediatr Anesth 2020*

- **540g: IJV**

- Montes-Tapia; J Pediatr Surg 2016*

RELATIVELY LARGE BORE CICC*s* *i.e.* 2-3-4 Fr

Enable

- Blood sampling
- Hemodynamic monitoring
- High flow infusions

→ *reduce morbidity/mortality?*

→ *improved neurocognitive outcome?*

Ahn Y; J Trop Pediatr 2006

Stevens B; Nurs Res 1999

Breschan; Pediatr Anesth 2000

Oulego-Erroz; Am J Perinatol 2018

CHOICE of best VEIN for CVCs in NEONATES?

Ideal insertion site

- RaCeVA
- RaFeVA
 - *if feasible*

Ideal exit site

- Central ZIM
 - *infracalvicular region*
 - *mid-upper thigh region*

INTERNAL JUGULAR VEIN

- **Most popular „central“ vein**
- **Relatively large in neonates, easy to scan**

Cobb; Surg Gynecol Obstetr 1987

Breschan; Br J Anaesth 2010

However

- **Mobile, collapsible**

***OOP cannulation of IJV: 3.4 kg Baby
– initial transfixion of IJV***

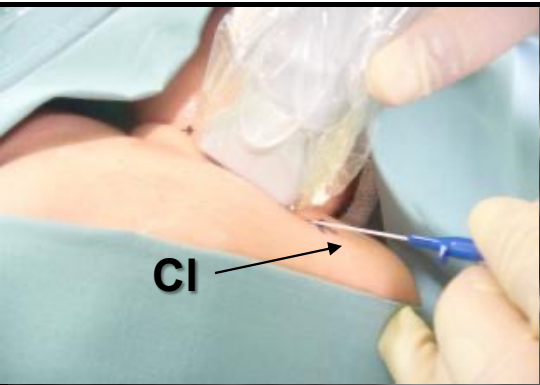


INFRACLAVICULAR CANNULATION of SUBCLAVIAN VEIN

- **ScV: Non-collapsible**, *cephalad course in neonates*

However

- **Small**
- **US shadow of clavicle**
→ ***difficult approach!***
Pirotte; Br J Anaesth 2007



Baby 3.2kg

CL

SCV



FR



AxV



Medial

Pirotte T. Br J Anaesth 2007

3.8kg Baby with Tracheostomy



FEMORAL VEIN

- Small, collapsible, mobile, narrow angle
– *difficult guide-wire insertion*

- Higher risk of infection and thrombosis

Iwashima; Pediatr Cardiol 2003

However

- *USG tunneled femoral venous catheters*
 - *82 neonates: 0.6-3.5kg*
 - *dwell time: 18 (5-72) days*

Ostroff M; J Vasc Acc 2020

SUPRACLAVICULAR CANNULATION of BRACHIOCEPHALIC VEIN

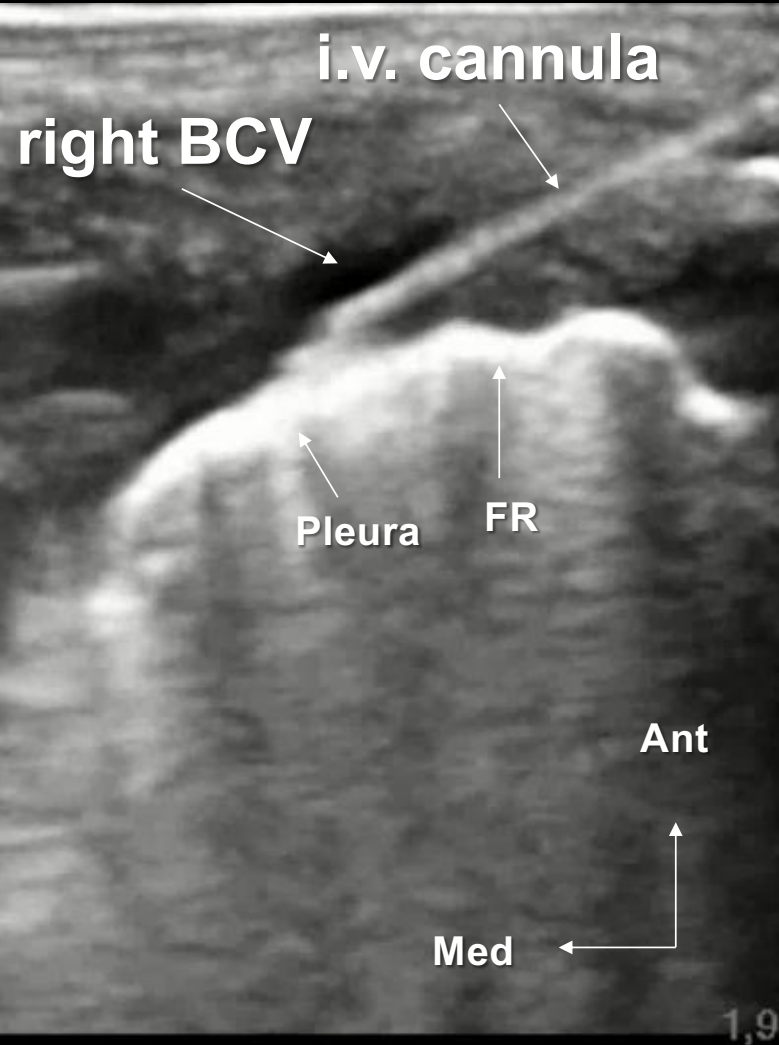
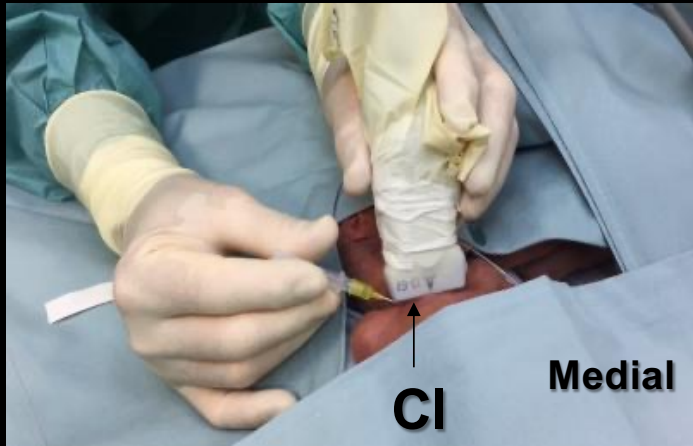
- **BCV: Non-collapsible**, *cephalad course in neonates*

As opposed to ScV

- Large → *easy to scan*
- No disturbing US shadow of clavicle!!
 - *needle visibility over entire insertion distance*

Breschan; Br J Anaesth 2011

Cannulation of the right BCV: 680g



Baby 680g

Baby 680g: cannulation of right BCV



Vena cava superior: *subcostal* view

Rud, Elias 2,6kg

2022 Sep 12 08:29

Allq THI
S MB

Abd

C60



90%

MI

0,9

TIW

0,4

A

B



4,7

USG supraclav. cannulation of the BCV
PREMIES/NEONATES < 3.5kg

Aug 09 – Apr 23

- **n = 659**

- **Weight: Median: 2.6 ± 0.59 kg**
Range: 0.55 – 3.5 kg

- **< 1kg: n = 27**

Klinikum Klagenfurt 2023

USG Guided supraclav. cannulation of BCV
NEONATES + PREMIES: 0.55 – 3.5 kg

SUCCESS RATE

n = 659

Aug 09 – Apr 23

Success rate

647 (98.2%)

- **1. attempt**

504 (76.5%)

- **Left: 230**

Right: 429

- 1.attempt: 170 (74%)

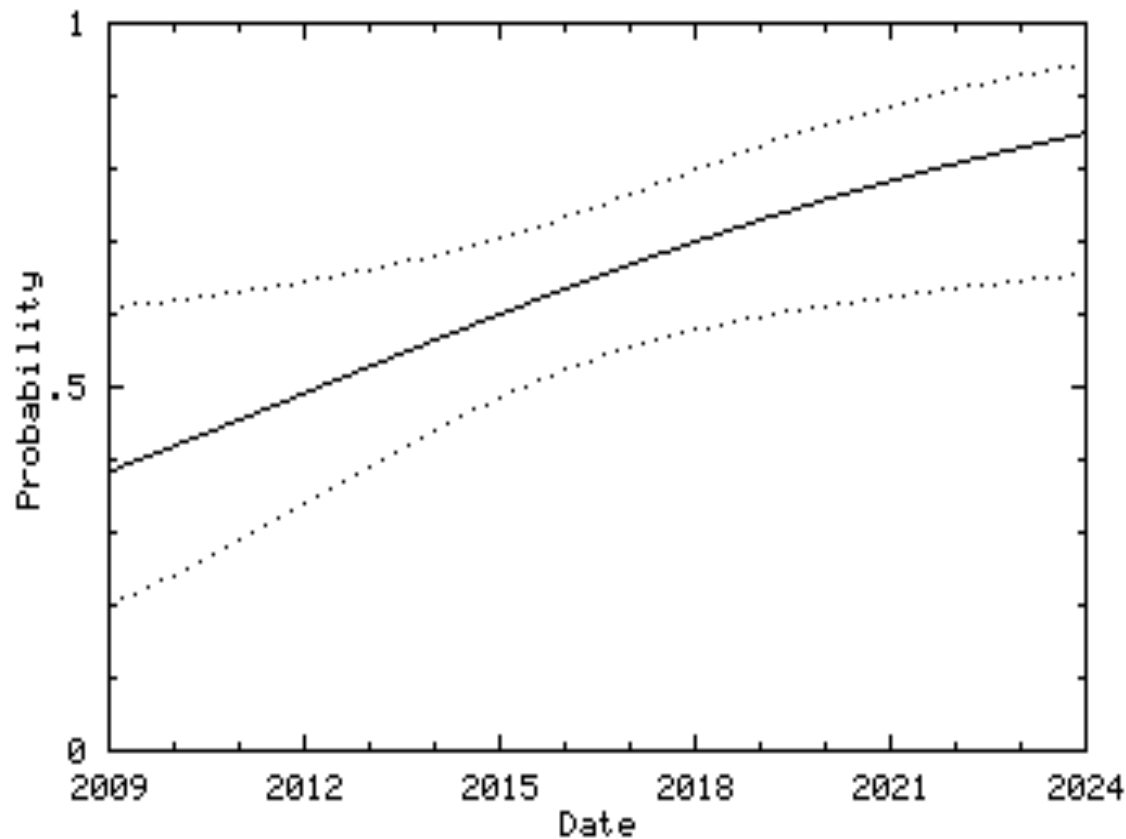
- 1.attempt: 334 (77.8%)

- **Complications: 3 ScA injuries (0.4%)**

Klinikum Klagenfurt 2023

PREMIES: 0.55 – 1.5: 1.attempt cannulation success rate
Logistic regression analysis: $p=0.021$

n = 60 Aug 09 – Apr 22



Dept of Anaesthesia; Klinikum Klagenfurt, 2022

USG Guided supraclav. cannulation of BCV
NEONATES + PREMIES: 0.55 – 3.5 kg

SUCCESS RATE

n = 647

Aug 09 – Apr 23

Median dwell time **15 days (CI: 9-20)**

Long term complications **15 (2.1%)**

- **CAI** **6 (0.9%)**
- **Cath rel thrombosis** *clin symptomatic* **1 (0.15%)**
- **Catheter obstruction** **8 (1.3%)**

Klinikum Klagenfurt 2023

**USG SUPRACLAV. CANNULATION of IJV: OOP
NEONATES + PREMIES: 0.7 – 3.5 kg**

SUCCESS RATE

n = 9

Aug 09 – Apr 23

Success rate

9 (100%)

• **1.attempt**

7 (78%)

Klinikum Klagenfurt, 2023

CANNULA TIP ABBUTTING the VESSEL (BCV)

WALL < 1kg

- Cannot aspirate blood after full/too deep insertion of cannula/needle
 - *cannula tip abutting the vessel*
 - *preventing guide-wire insertion*

Merchaoui Z et al. J Vasc Access 2021

Breschan et al. Pediatr Anesth 2020

Recommendation

- Incompletely insert the cannula/needle,
→ **aspirate blood, and insert guide-wire**

Merchaoui Z; J Vasc Access 2021

OR

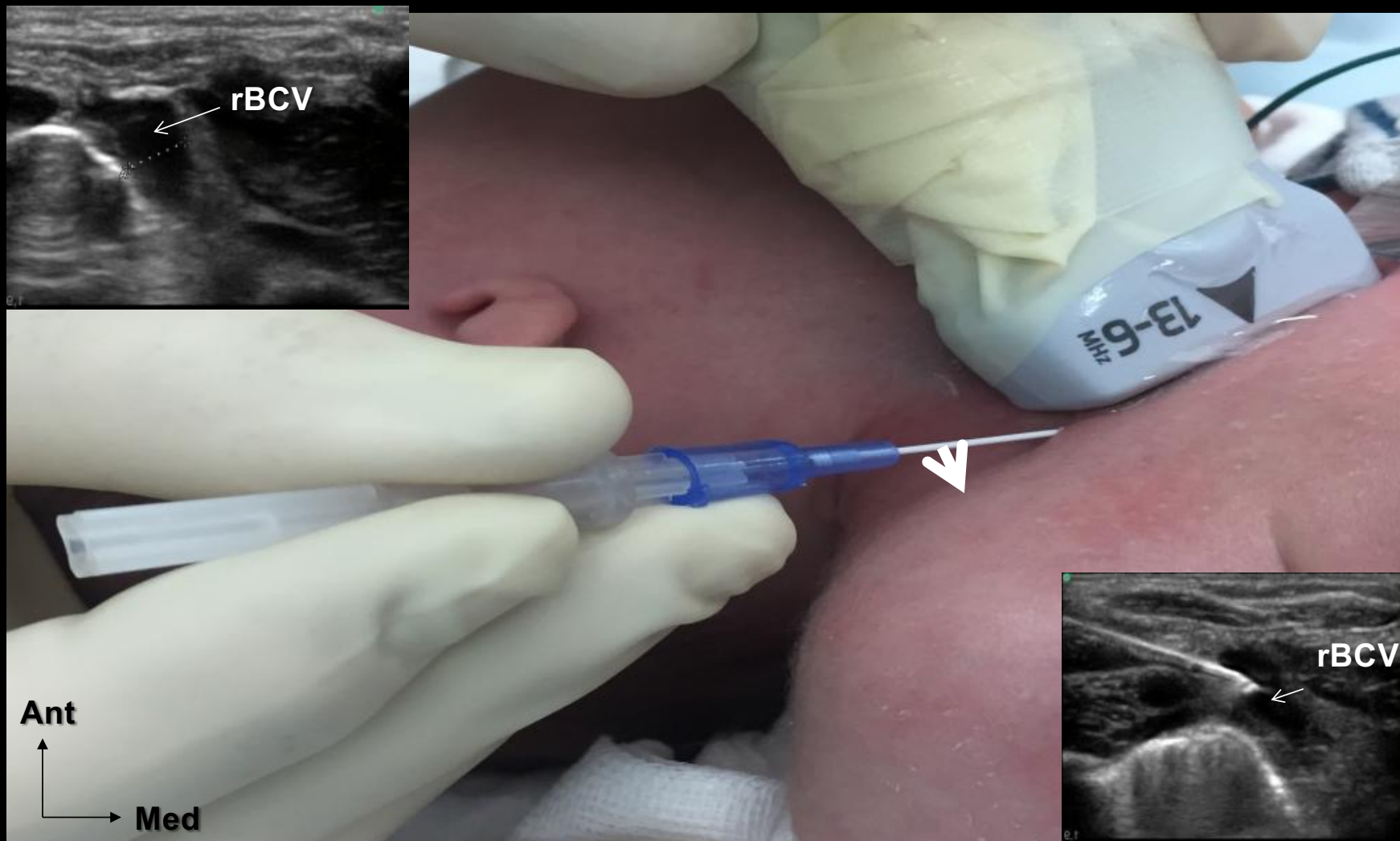
IP can. of right BCV: 550g baby: cannula tip abutting vessel wall

→ ***cannula withdrawal until blood aspiration***

→ ***full insertion of cannula while injecting aspirated blood***



***Difficult IP alignment of US probe, vessel and needle
→ lateral cannula movement i.e. towards clavicle***



***IP cannulation of the right BCV: 2kg baby:
→ IP movement of cannula towards clavicle***

Perkonig, Fabian 2,1kg

2018Feb06 08:05

Aufl
S MB



Ven

L25



90%

MI

0,7

TIW

0,1



205

A

B

☐
☐
☒ Cine

A 0,41cm

1,9

Ellipse

Manuell

Löschen

EDGE II Sonosite®

**Linear Probe 13-6MHz
„bulky“ probe**

Better alternatives?

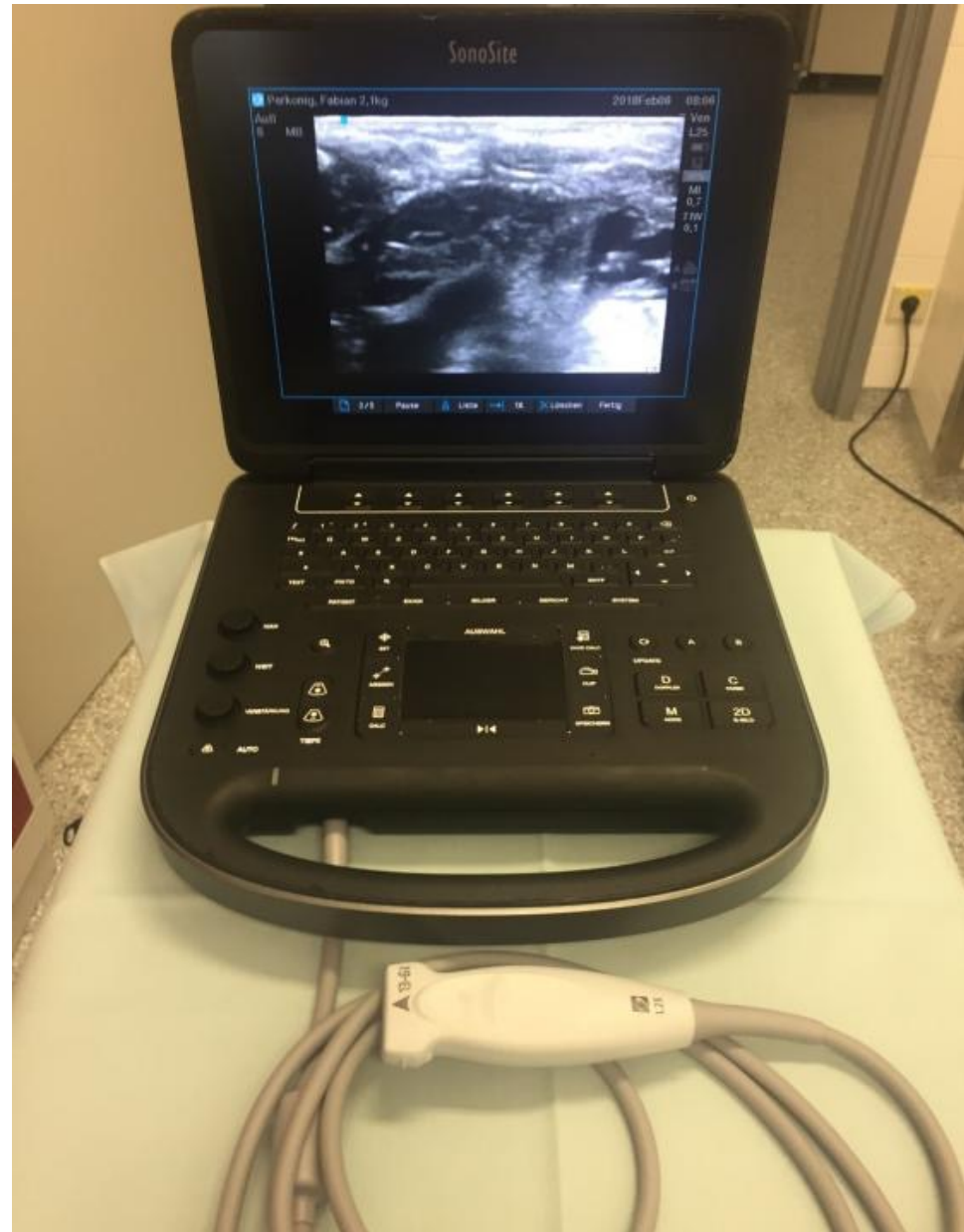
- 19 MHz: **PX Sonosite®**

- 18 MHz: *GE Logiq®*

depth of BCV < 1cm

Ideal an insertion angle < 30°

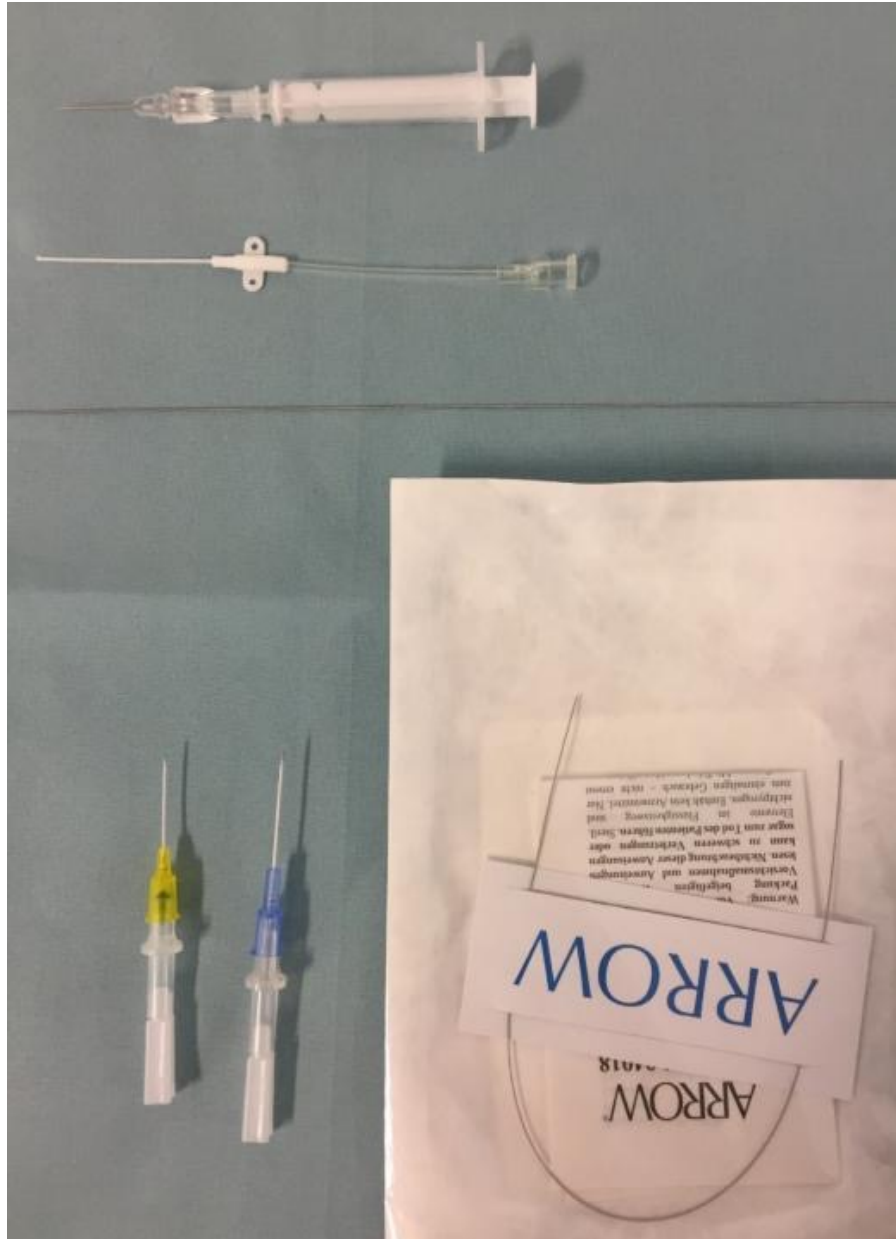
Uzumcugil; J Vasc Access 2021





**< 1.5kg:
24 G Jelco**

**> 1.5kg:
22 G Jelco**



***Straight
Nitinol
0.018 inch guidewire***



2 Fr Vygon®; 4cm, 0.7mm

SUMMARISING Studies

USG BCV CANNULATIONS in NEONATES

n = 1,250

- **Cannulation success rate: 91-100%**
- **1.attempt cannulation success: ~ 75%**
- **Inadvertent arterial puncture: 0-1.3%**

Merchaoui; Frontiers Pediatr 2017

Acosta; Rev Espan Anesthesiol Reanim 2021

Long term complications

BCV lines *superior to* IJV, FV lines, ECCs in Neonates

- No catheter obstruction due to kinking
- Fewer CLABSIs
 - **5 vs. 16%**
- Fewer symptomat. deep vein thrombosis
 - **2.7 vs 10%**

*Oulego-Erroz; Am J Perinatol 2018; Europ J Pediatr 2020
Habas; Europ J Pediatr 2017*

CENTRAL ACCESS in NEONATES

SUMMARIZING

Neonates are different

- Small and fragile
- Non-cooperative
 - *deep systemic sedation/analgesia*
 - *sig. apnea, airway obstruction*

However

- *No ideal sedoanalgesic drugs for non-intubated babies*

CENTRAL ACCESS in NEONATES

SUMMARIZING

BCV

- High cannulation success rate
- Low short and long term complication rate
- BCV seems superior to ECC, IJV, and FV

Oulego-Erroz; Europ J Pediatr 2020

However

- ***Most popular vein: IJV***

CENTRAL ACCESS in NEONATES

CONCLUSION

- 1.choice: BCV
 - *easy to scan*
 - *large*
 - *non-collapsible*
 - *safe*
- Use RaCeVA
 - *if feasible*
 - *right or left BCV*