ULTRASOUND-GUIDED INSERTION of CENTRAL LINES in the NEONATE

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Gavecelt 2019, Veroma

900g Baby



USG

nowadays permits the PERICLAVICULAR INSERTION of RELATIVELY LARGE BORE CENTRAL VENOUS CATHETERS

Even in premies < 1kg

- 540g for IJV

Montes-Tapia; J Pediatr Surg 2016

- 550g for BCV

Breschan; Anesthesiology 2018

ADVANTAGES of CICCs

Relatively large bore i.e. 2 (-3, -4) Fr

– 5-6 weeks in place if non-tunneld

- blood sampling

- haemodynamic monitoring

- high flow infusion

→ reduction of mortality/morbidity?

→ stressreduction

→ improved neurocognitive outcome?

Ahn Y; J Trop Pediatr 2006

Stevens B; Nurs Res 1999

Breschan; Pediatr Anesth 2000

Oulego-Erroz; Am J Perinatol 2018

PECULARITIES in NEONATES

- **Small vessel calibre**

  +

- **Immature thrombolytic system**

  → catheter related thromboembolism↑

- **Catheter size only *1/3* of vein**

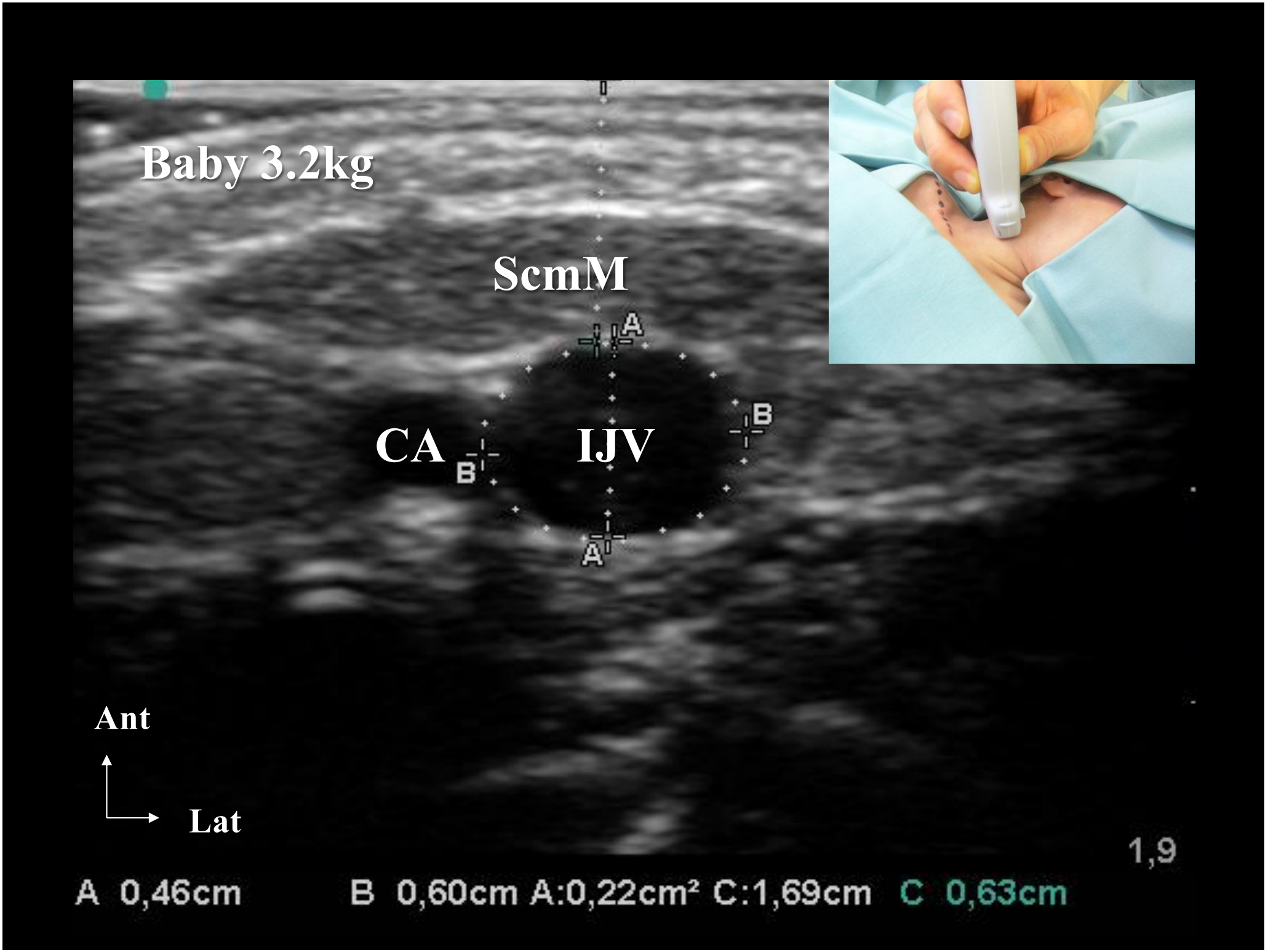
  - RaCeVA

- **Subjective size measurement of veins**

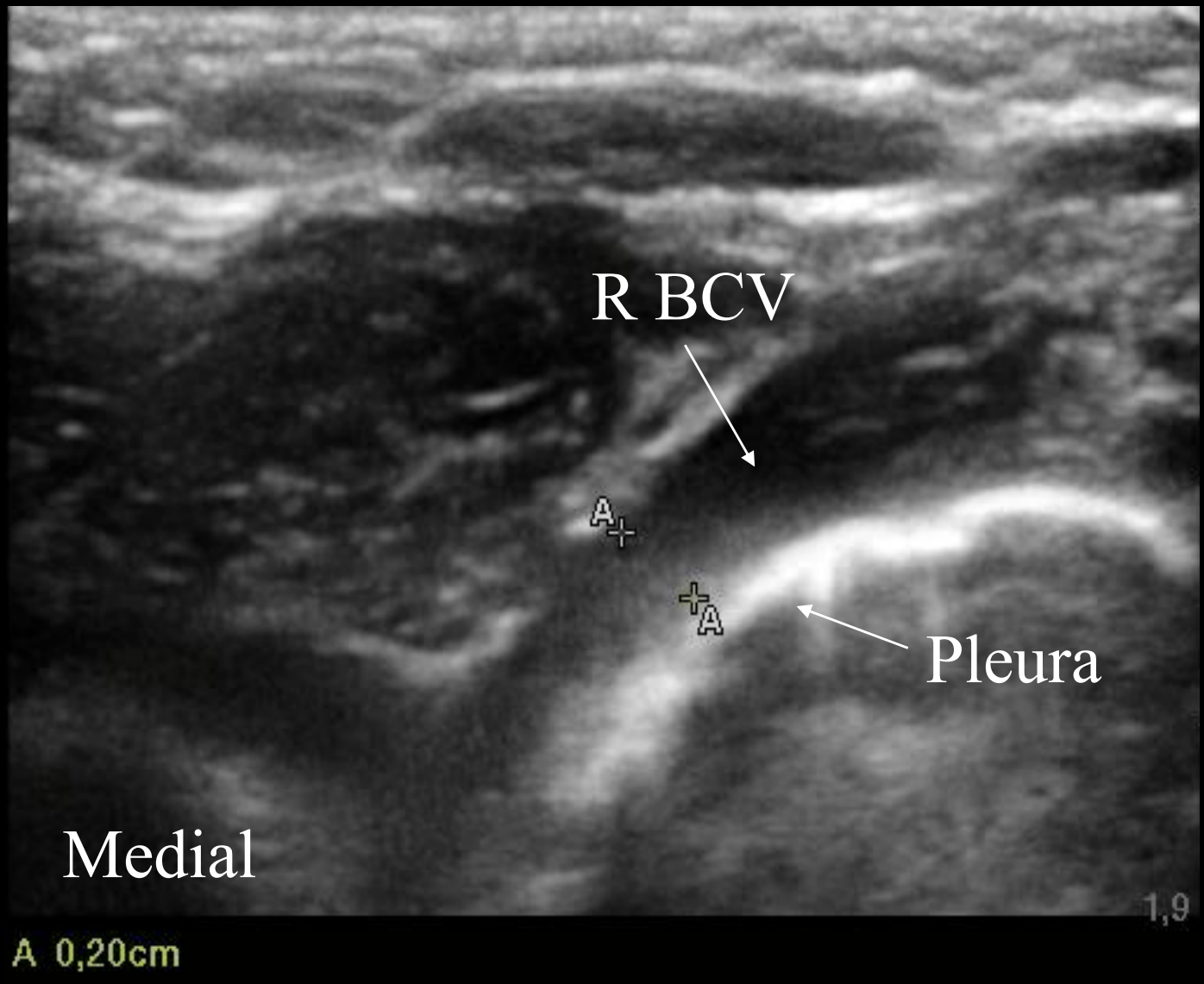
  – veins are ovally shaped

  → cross-sectional area

Barone; Neonatology 2019


Baby 3.2kg
ScmM
CA
IJV
A
B
B
A
Ant
Lat
1,9
A 0,46cm
B 0,60cm A:0,22cm² C:1,69cm
C 0,63cm

LONG AXIS VIEW of BCV in a 3kg BABY



PERICLAVICULAR CANNULATION SUCCESS in NEONATES/PREMIES *increases by using*

- **Deep sedation/GA**
- **Appropriate material**
- **Appropriate positioning**

Araujo; J Pediatr (Rio J) 2007



INTERNAL JUGULAR VEIN

- **Most popular „central“ vein**
- **Relatively large in neonates**

  Cobb; Surg Gynecol Obstetr 1987
  Breschan; Br J Anaesth 2010

- **Easy to scan**

  – sig. anatomical variations

INTERNAL JUGULAR VEIN

However

- **Mobile, collaptic**

  → approach as low as possible

- **Indirect immobilisation**

  – hyperextension of the neck

  – skin traction method

  Goldstein SD; J Laparaendosc Adv Surg Tech A 2015
  Morita M; Anesth Analg 2009
  Breschan; Anesthesiology 2017

Indirect Immobilisation of IJV
Neck Hyperextension



Collapsing Int. Jug. Vein



INFRACLAVICULAR CANNULATION of SUBCLVIAN VEIN

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

However

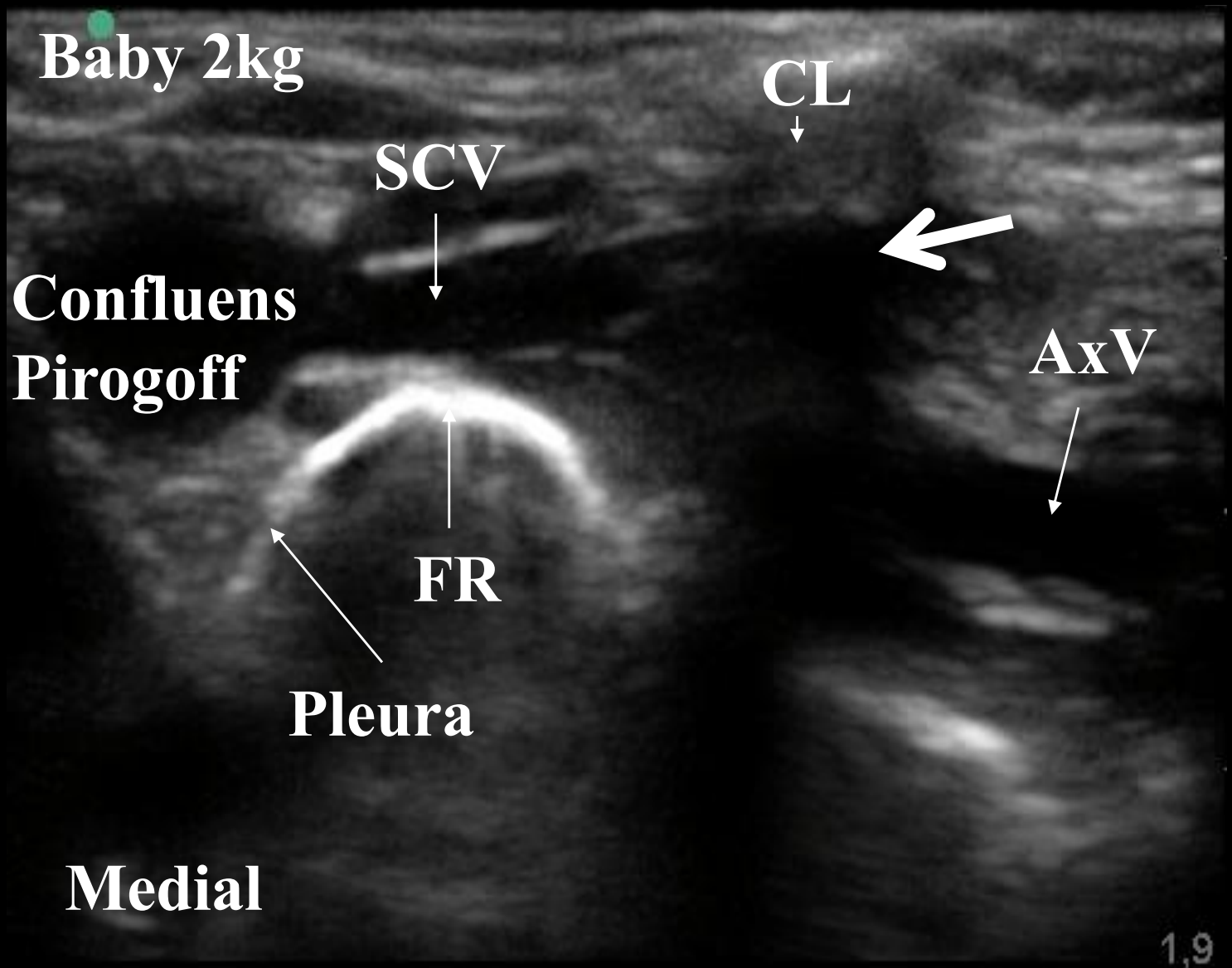
- **Small**

- **US shadow of clavicle**

  → ***difficult approach!***

Pirotte; Br J Anaesth 2007

SONOANATOMY of SCV: 2kg Baby



Pirotte T, Br J Anaesth 2007

SUPRACLAVICULAR CANNULATION of BRACHIOCEPHALIC VEIN

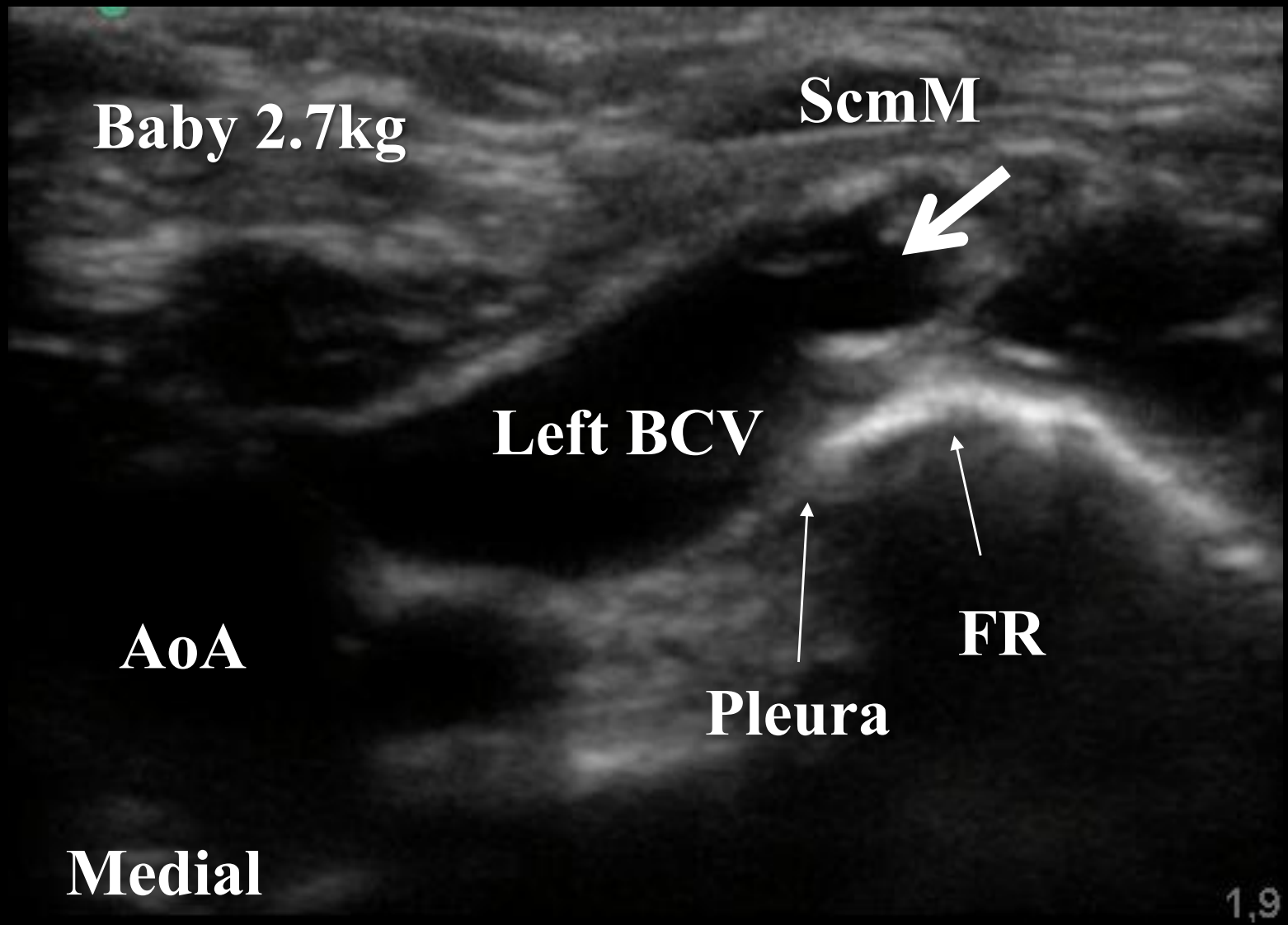
- **BCV: Non-collaptic,** ***cephalad course in neonates***

As opposed to ScV

- **Large** **→ easy to scan**

- **No disturbing US shadow of clavicle!!**
  – needle visibility over entire insertion distance

SONOANATOMY of BCV: 2.7kg Baby



Breschan C; Br J Anaesth 2011

INSPIRATORY STRIDOR



IP cannulation of right BCV: 590g Baby



US-Guided Supraclav.Cannulation of the Brachiocephalic Vein

PREMIES/NEONATES < 3.5kg

Aug 09 – Nov 19

- **n = 475**

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

- ***< 1kg:*** ***n = 17***

US-Guided Supraclav. Cannulation of BCV

NEONATES + PREMIES: 0.55 – 3.5 kg

SUCCESS RATE

n = 475

Aug 09 – Nov 19

Success rate **463 (97.5%)**

- **1. attempt** **345 (72.6%)**

- **Left: 189** **Right: 286**

  - 1.attempt: 138 (73.8%) ***- 1.attempt: 208 (72.7%)***

Complications

- 12 x unsuccessful

- 3 subclavian artery injuries (0.6%)

USG SUPRACLAV. CANNULATION of the INT. JUG. VEIN OOP

NEONATES + PREMIES: 0.7 – 3.5 kg

SUCCESS RATE

n = 9

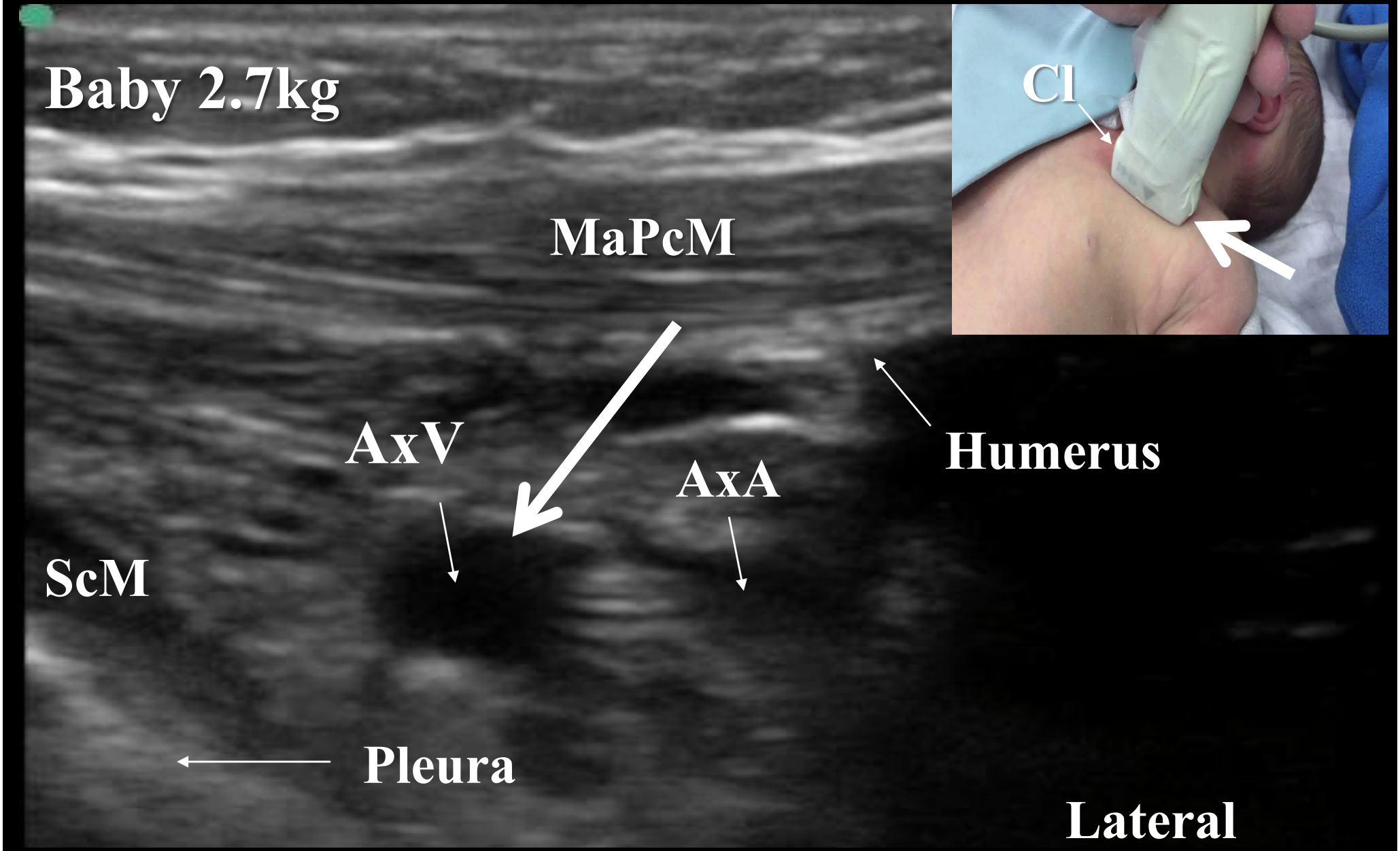
Aug 09 – Nov 19

Success rate	**9 (100%)**
• **1.Attempt**	**7 (78%)**
• 2.Attempt	2 (22%)

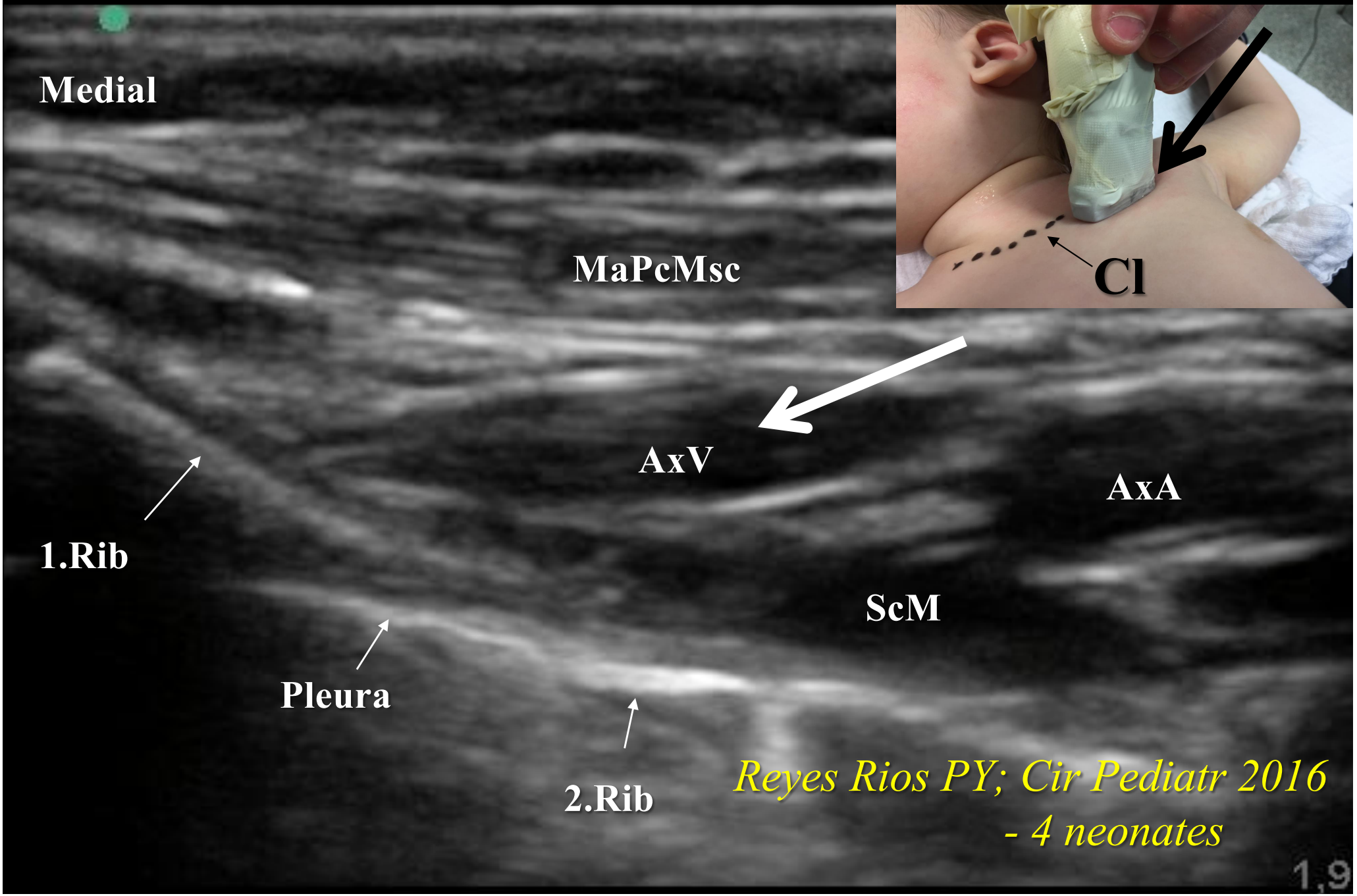
OOP cannulation of IJV: 3.4 kg Baby



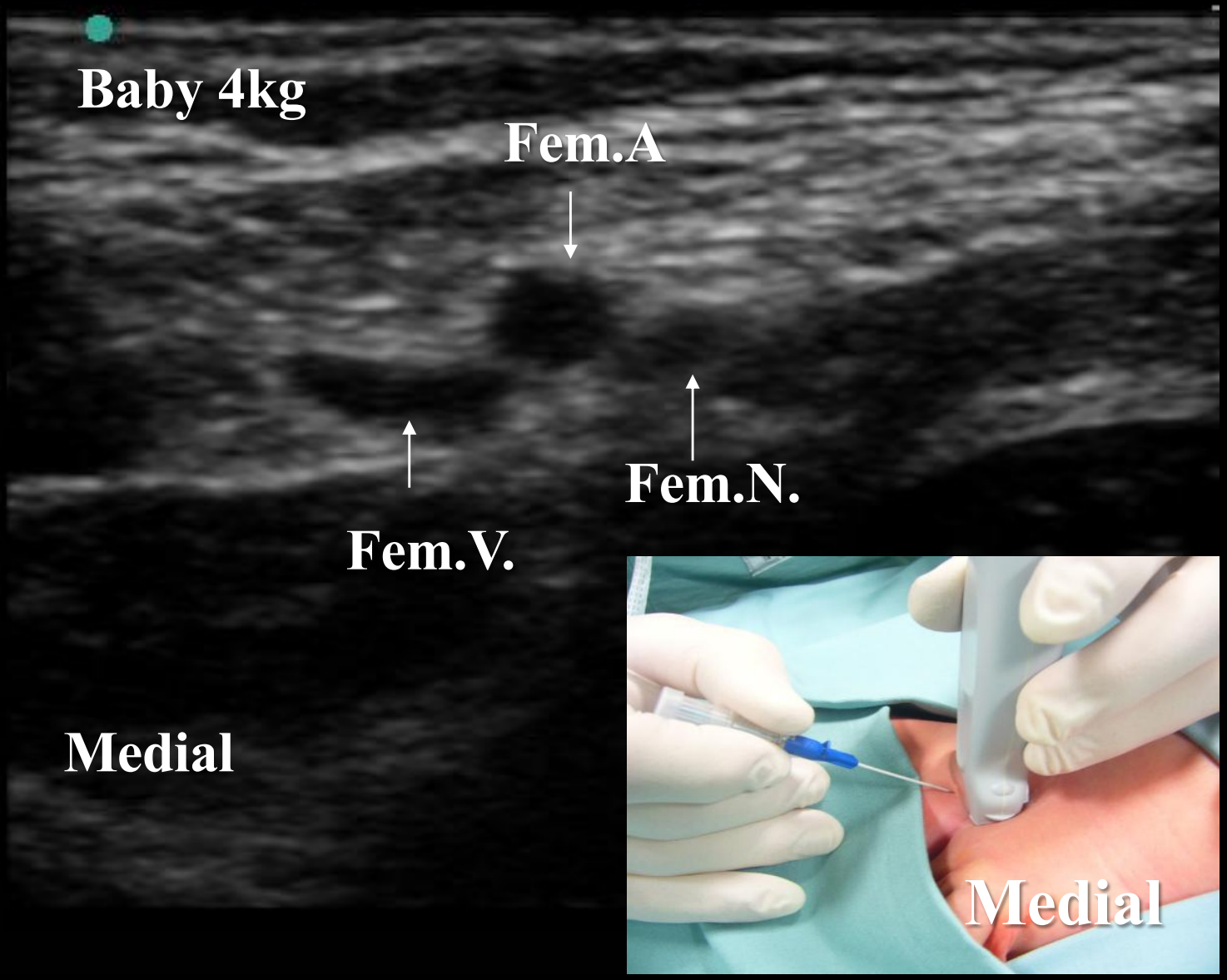
TRANSPECTORAL APPROACH to AXILLRY VEIN



TRANSPECTORAL APPROACH to AXILLRY VEIN



FEMORAL VEIN



OOP CANNULATION of FEMORAL VEIN in a 5kg BABY



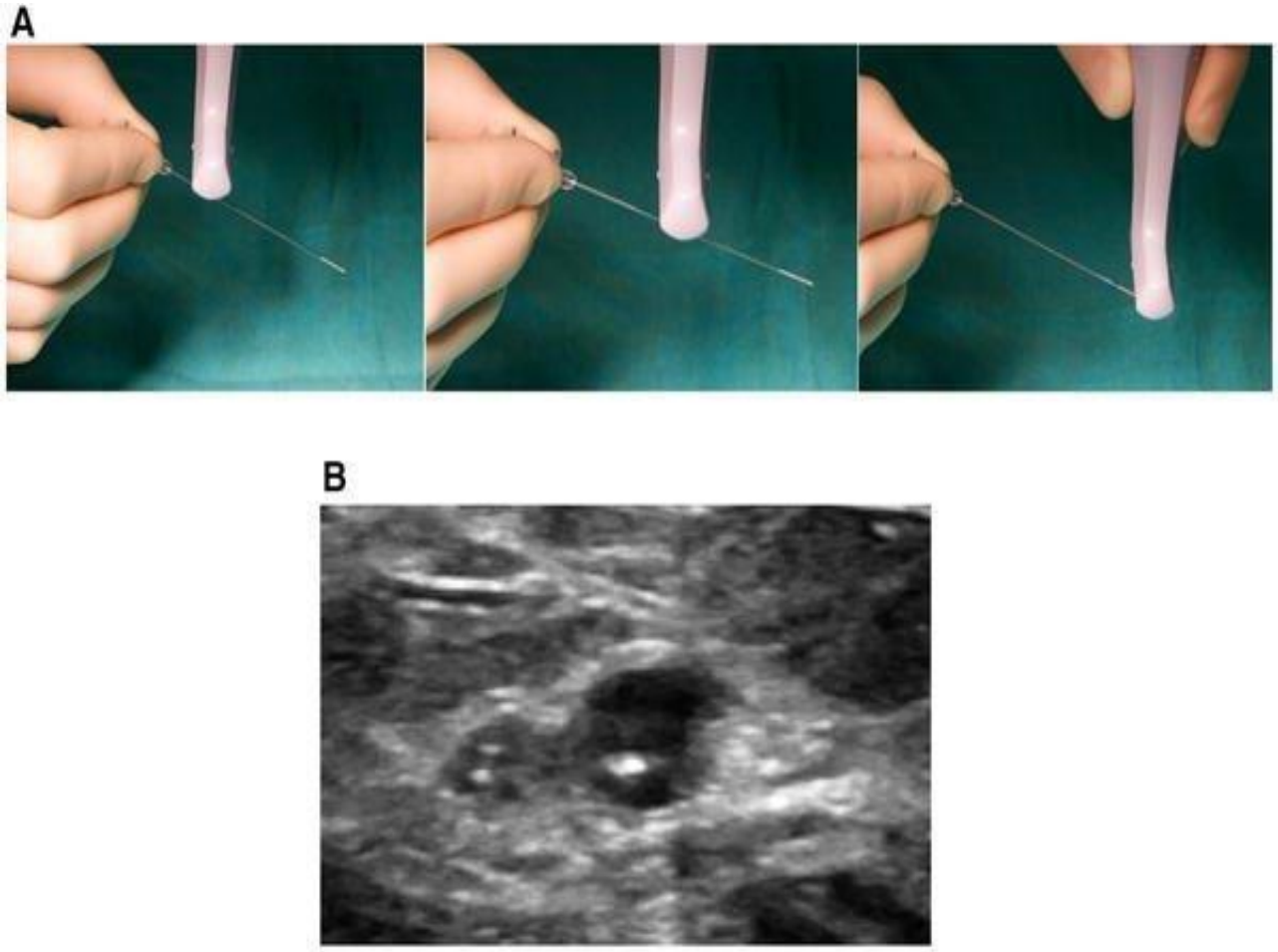
USG
PICCs in PRETERMS

- **Weight range: 485 – 1390g**
  – 10 babies

- **Basilic, - cephalic vein**

- **USG**
  - OOP approach
  - dynamic needle tip positioning
  i.e. dynamic walking down technique

Johnson KN; Pediatr Surg Int 2016



Johnson KN; Pediatr Surg Int 2016

USG
PICCs

- **No sig. puncture related complications**

However

- **Veins**
  - ***small***
  - ***collaptic***
  - ***difficult guidewire insertion***
  - ***catheter tip migration***

Sertic AJ; Pediatr radiol 2018

USG
IJV, BCV in Neonates

- **High puncture success rate:** ***98.4%***
  - 1. attempt > 72%

- **Low puncture complication rate**
  - inadvertent artery injury < 1%

Oulego-Erroz; J Crit Care 2016
Merchaoui; Front Pediatr 2017
Breschan; Anesthesiology 2018
Montes-Tapia; J Pediatr Surg 2016

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

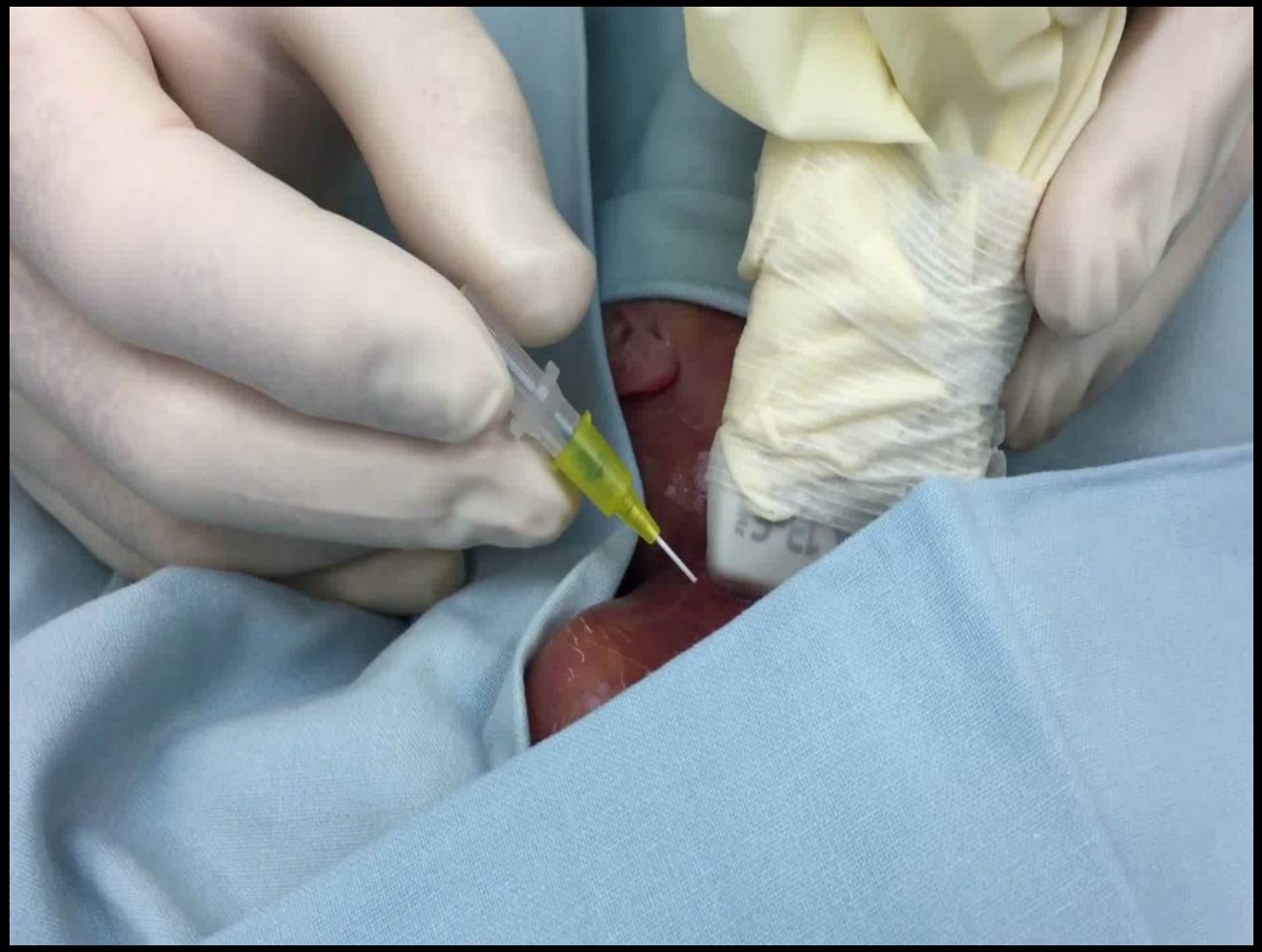
- **Fewer catheter obstructions**

- **Fewer CAIs**
  - ***5 vs. 16%***
- **Fewer symptomatic deep vein thrombosis**
  - ***2.7 vs 10%***

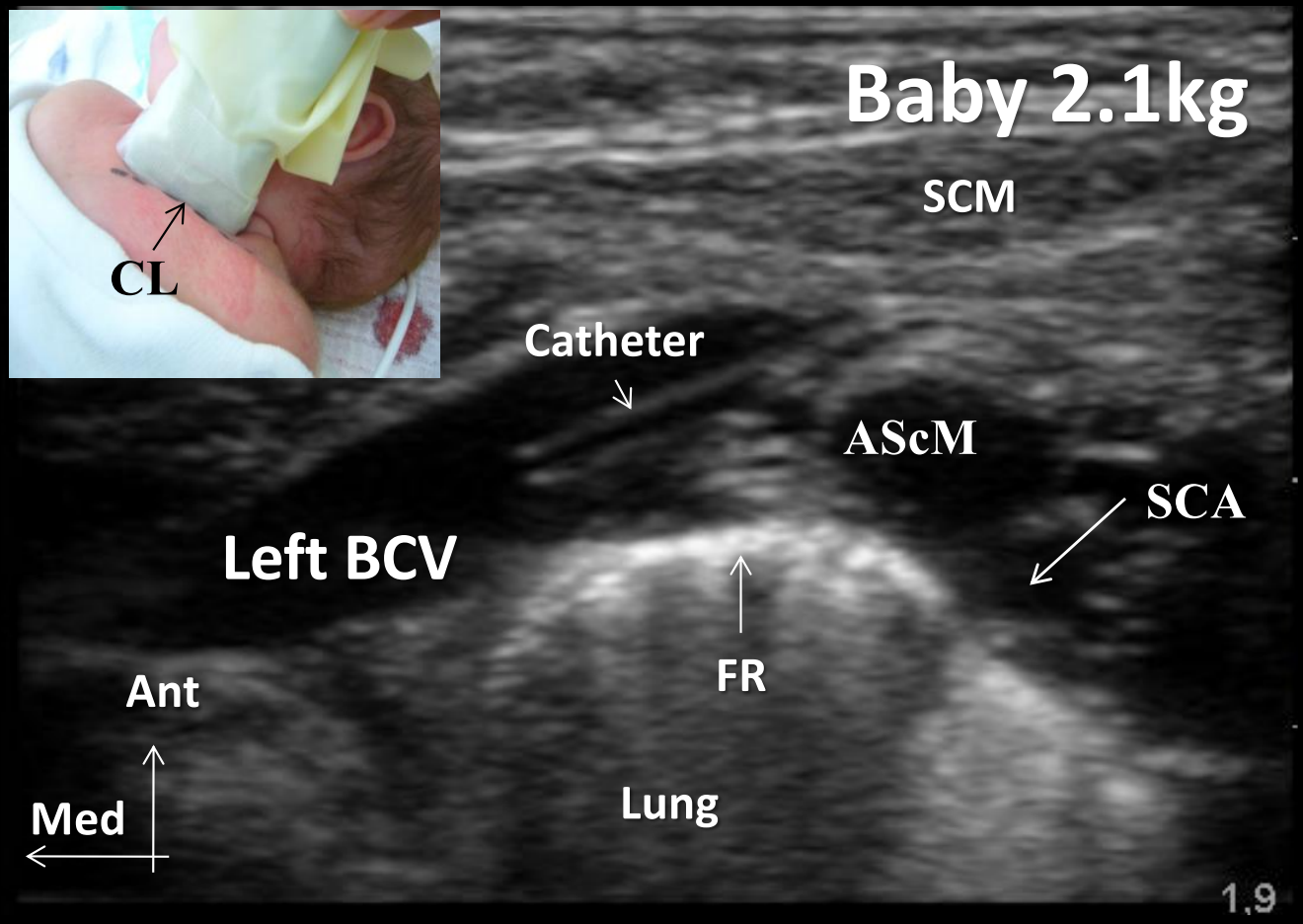
Oulego-Erroz; Am J Perinatol 2017
Habas; Europ J Pediatr 2017

TIPS and TRICKS for BCV CANNULATIONS

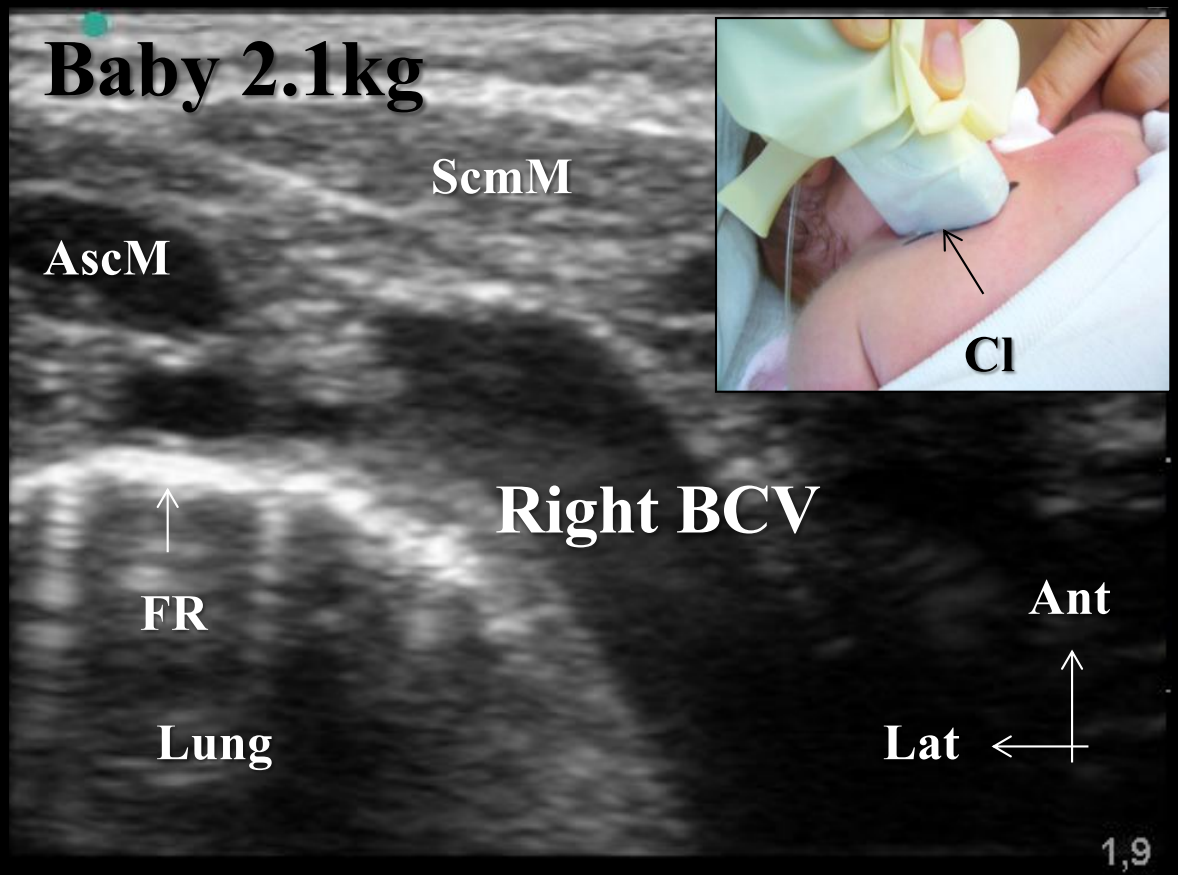
IP cannulation of left BCV: 550g Baby:
cannula tip abutting vessel wall



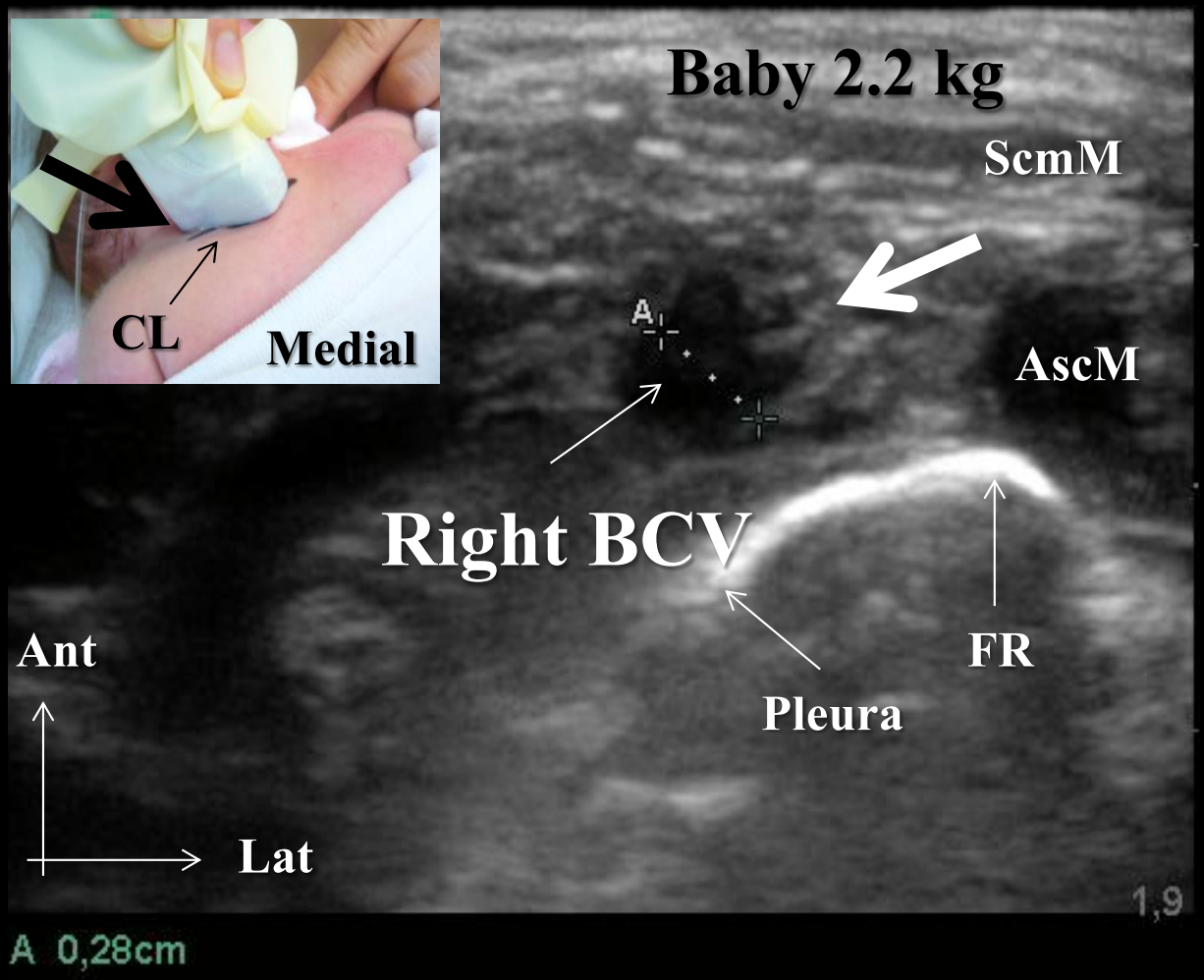
Left BCV



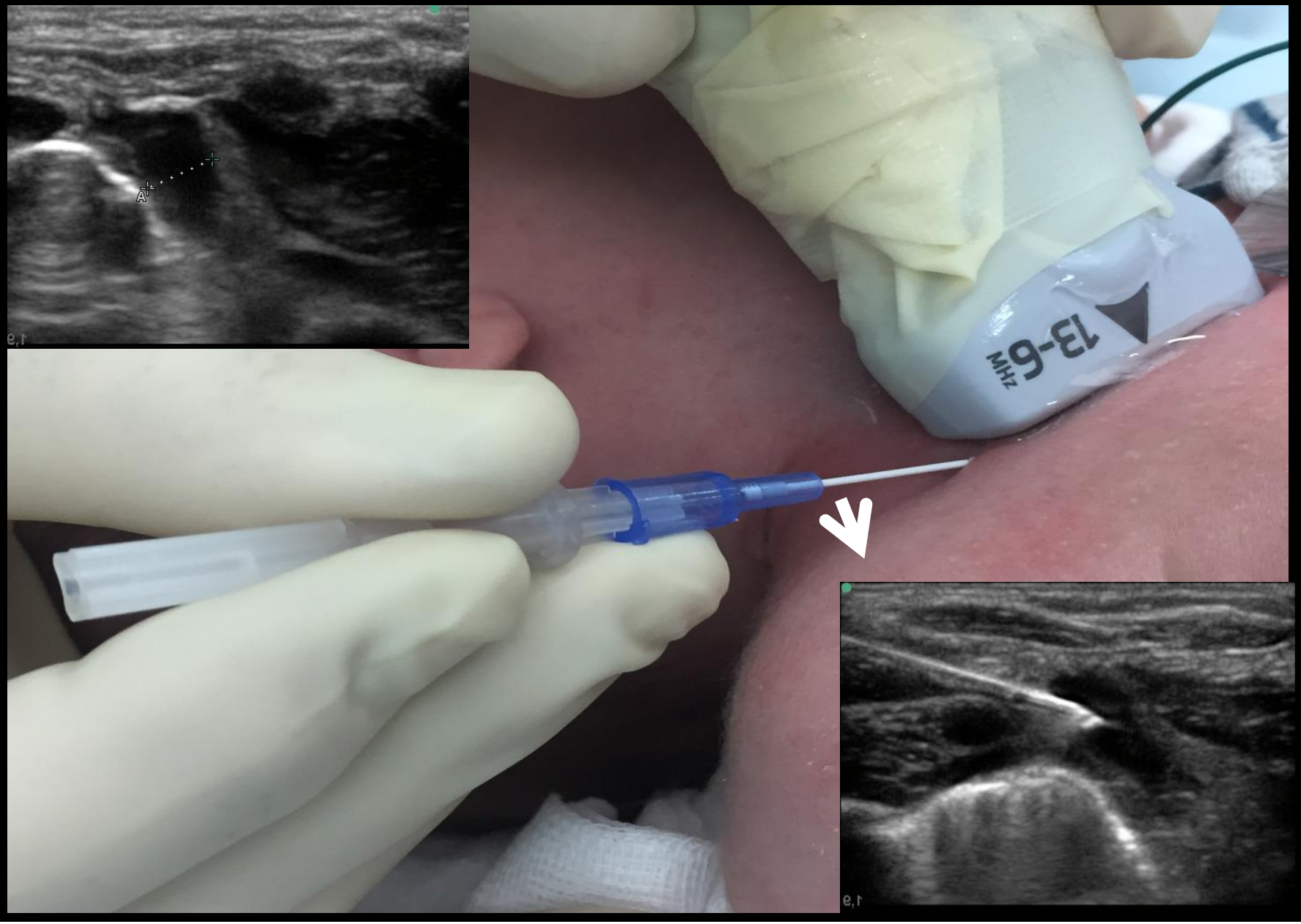
Right BCV



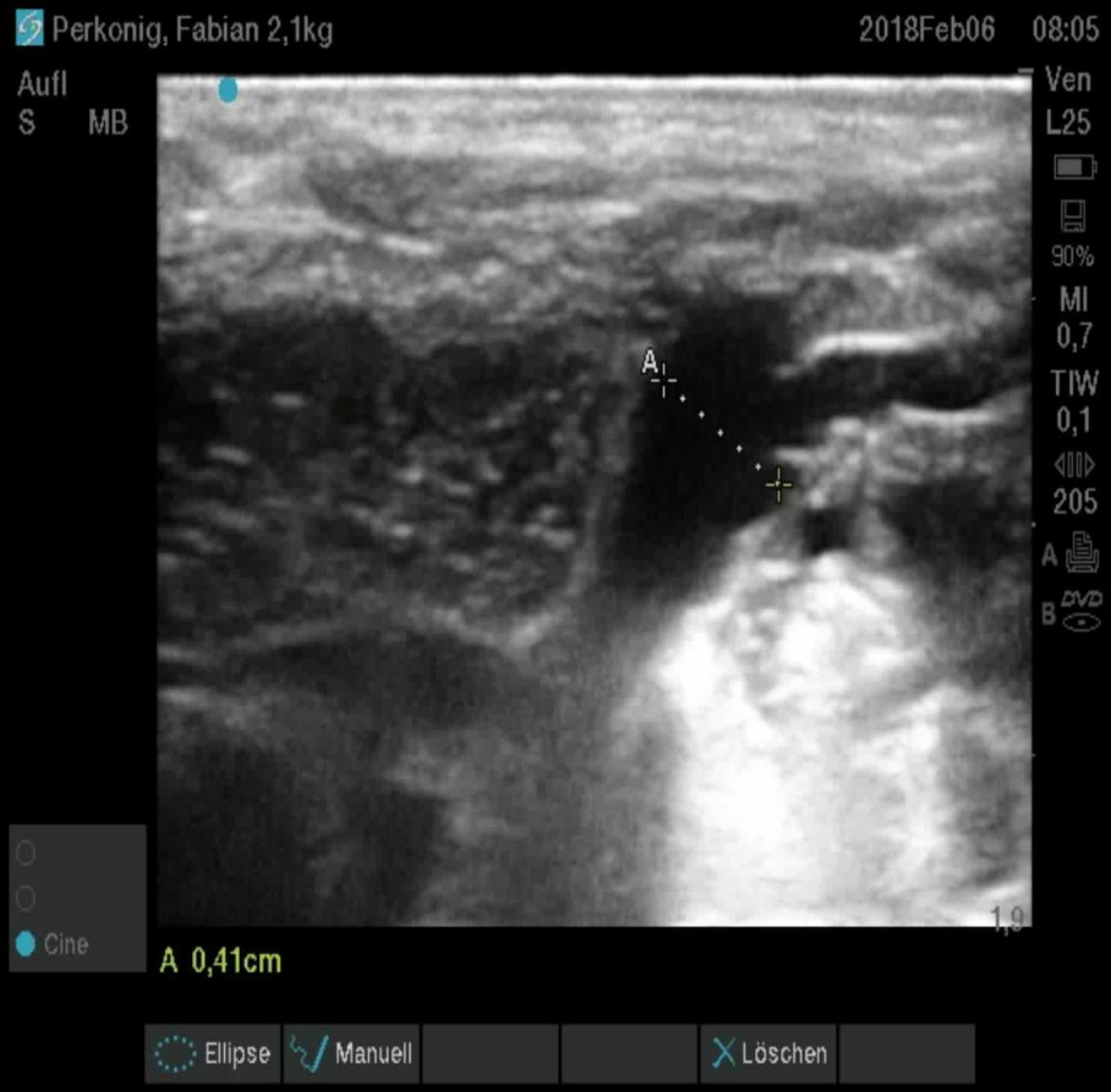
Right BCV


Baby 2.2 kg
ScmM
AscM
CL
Medial
Right BCV
Ant
Lat
Pleura
FR
1,9
A 0,28cm

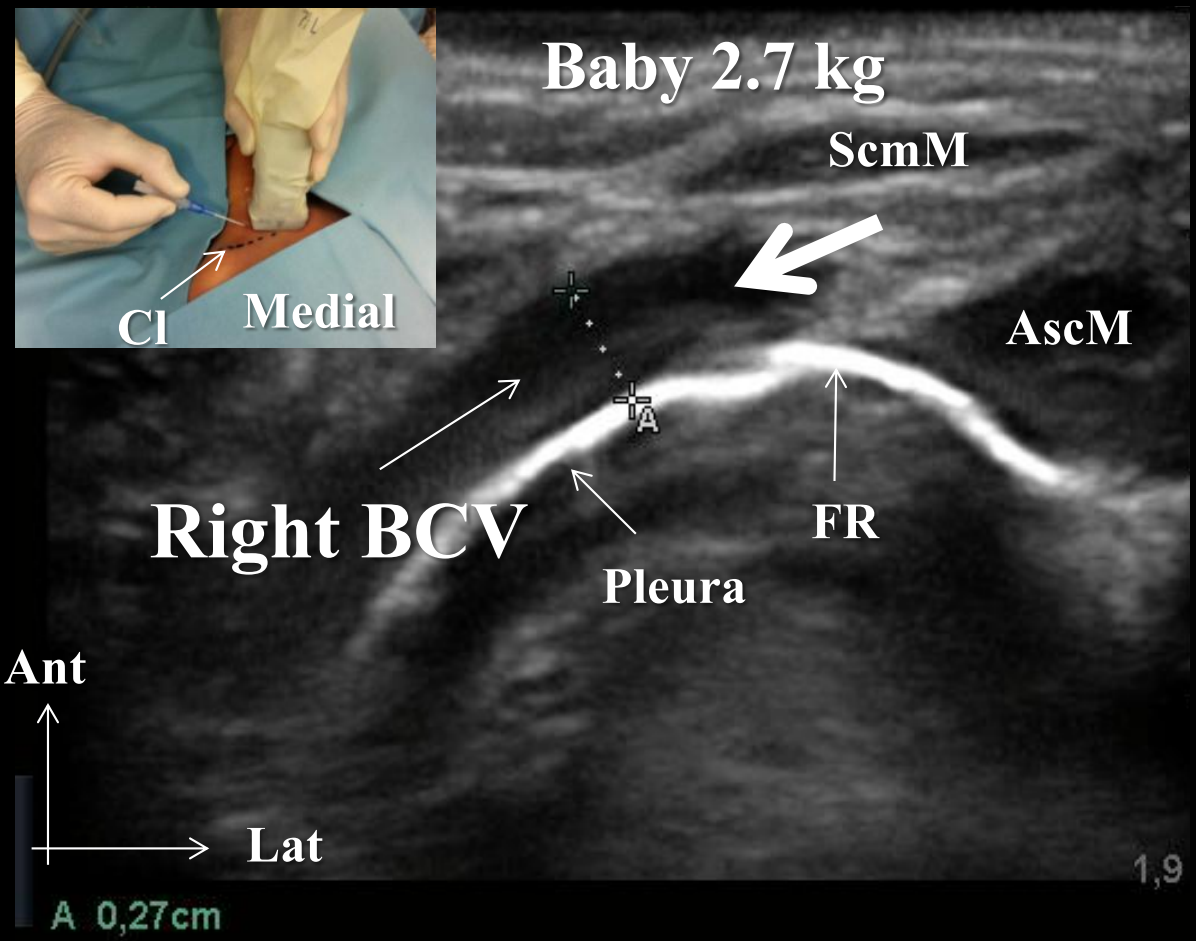
Difficult IP aligment of US probe, vessel and needle → lateral needle movement



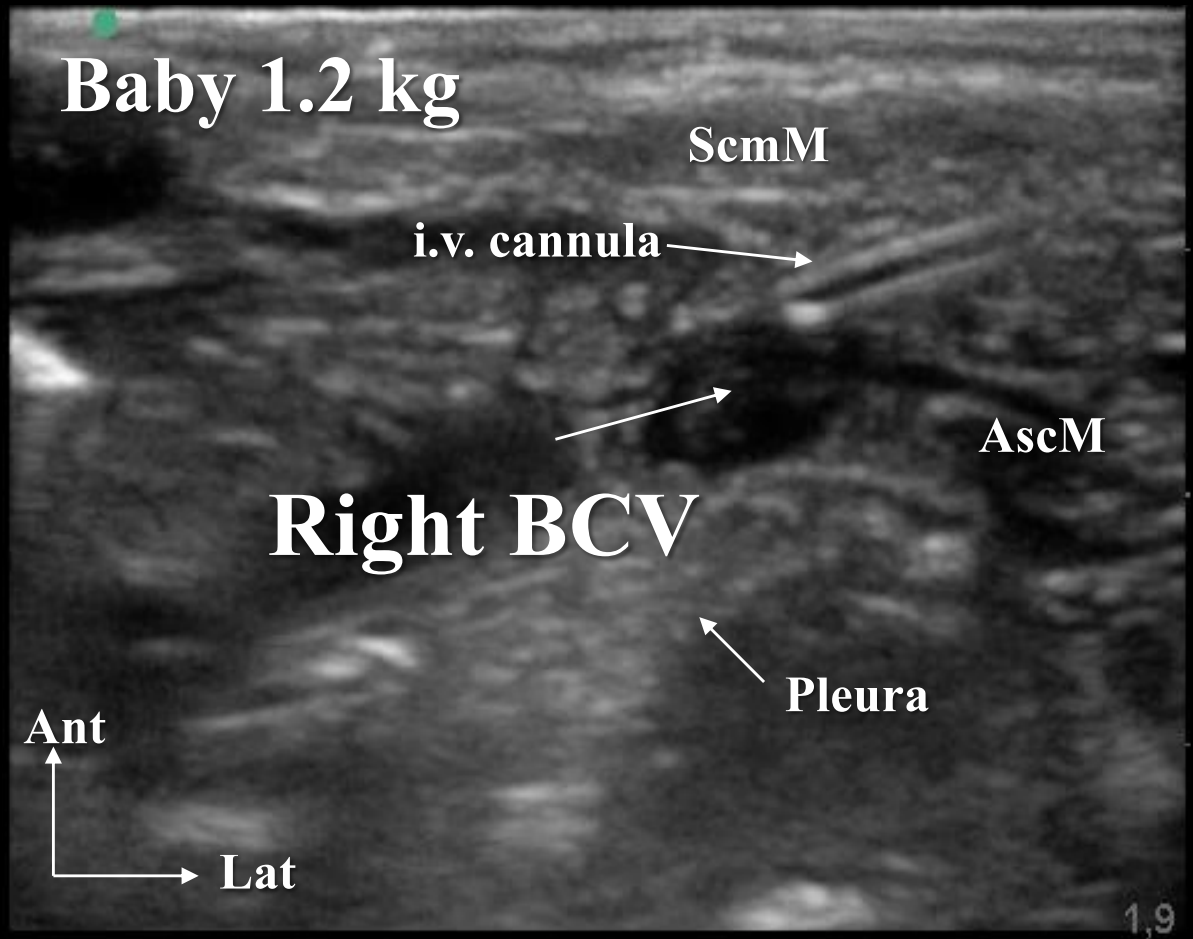
IP cannulation of the right BCV: 2kg baby



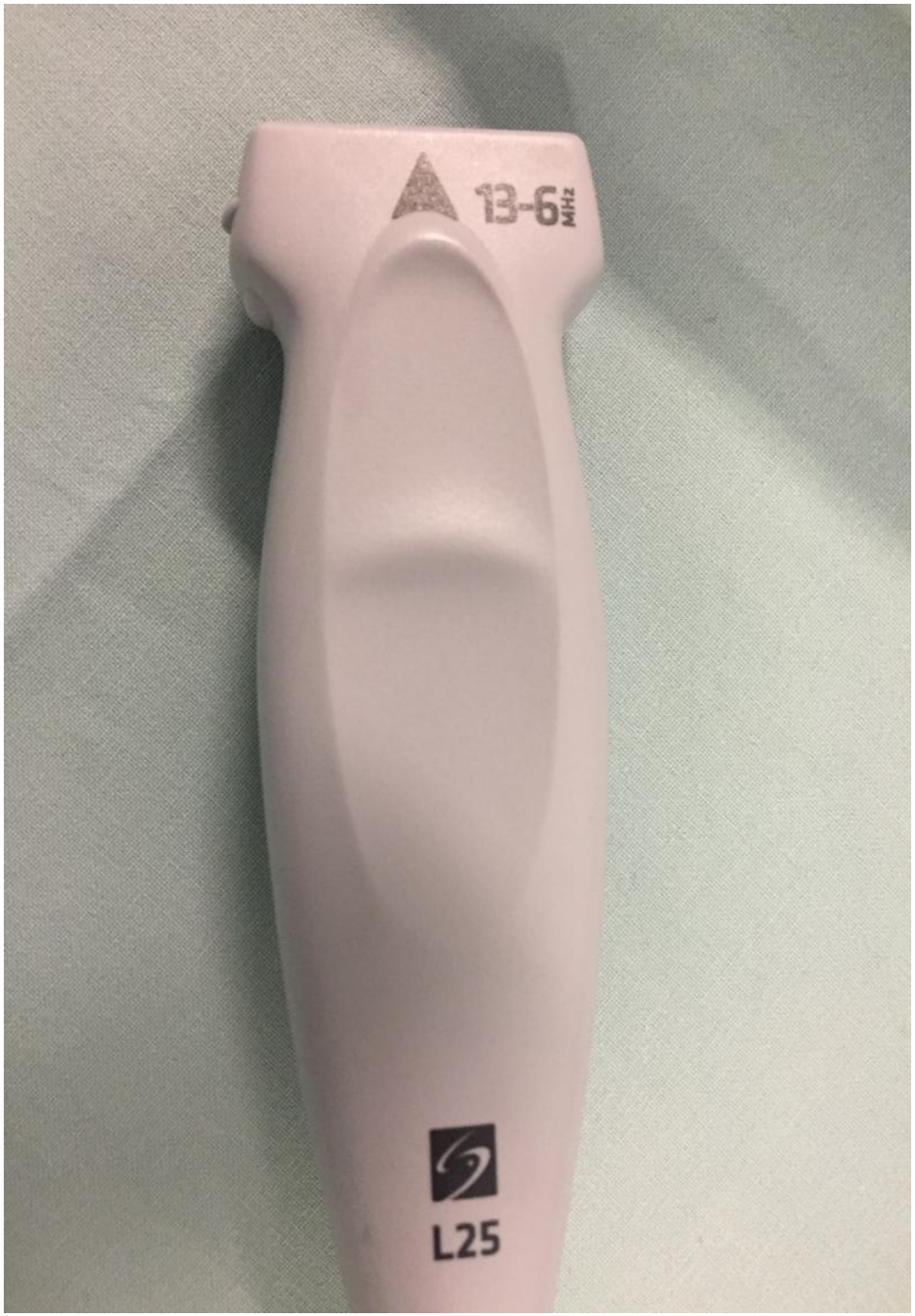
Right BCV


Baby 2.7 kg
ScmM
AscM
Cl
Medial
Right BCV
Pleura
FR
Ant
Lat
A 0,27cm
1,9

Right BCV



13–6 MHz
25 mm
1.9 cm depth

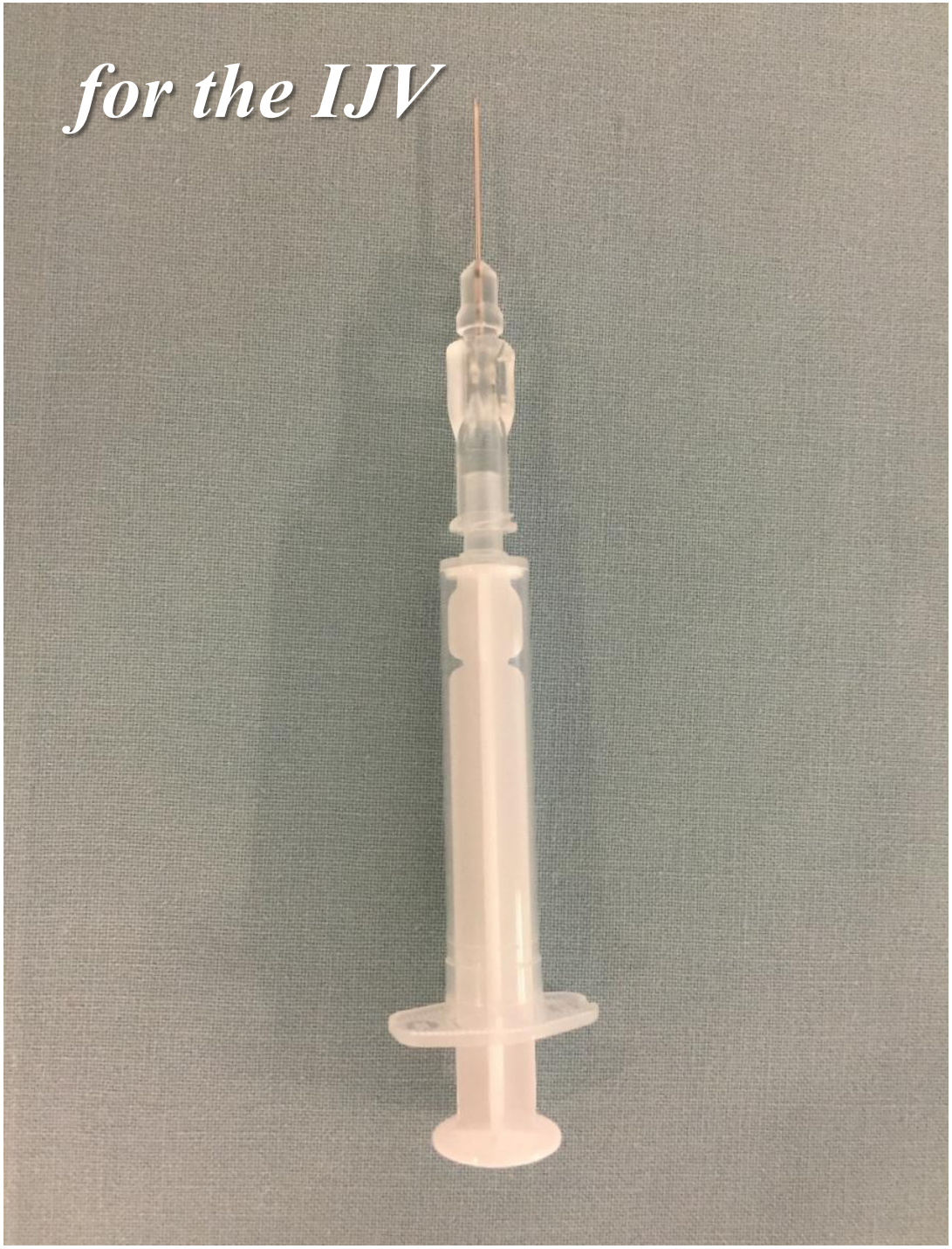


< 1.5kg:
24 G Jelco

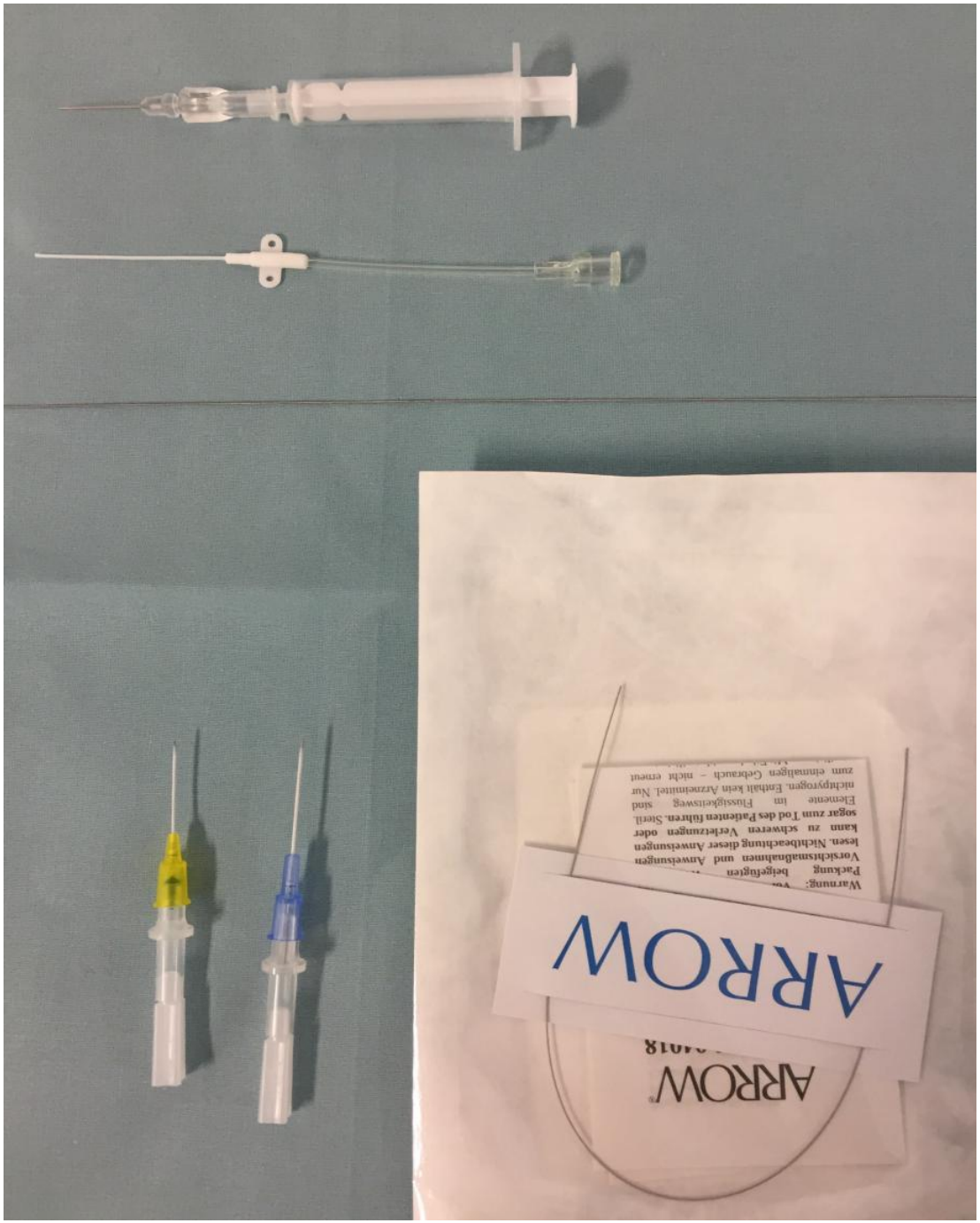
> 2.5kg:
22 G Jelco

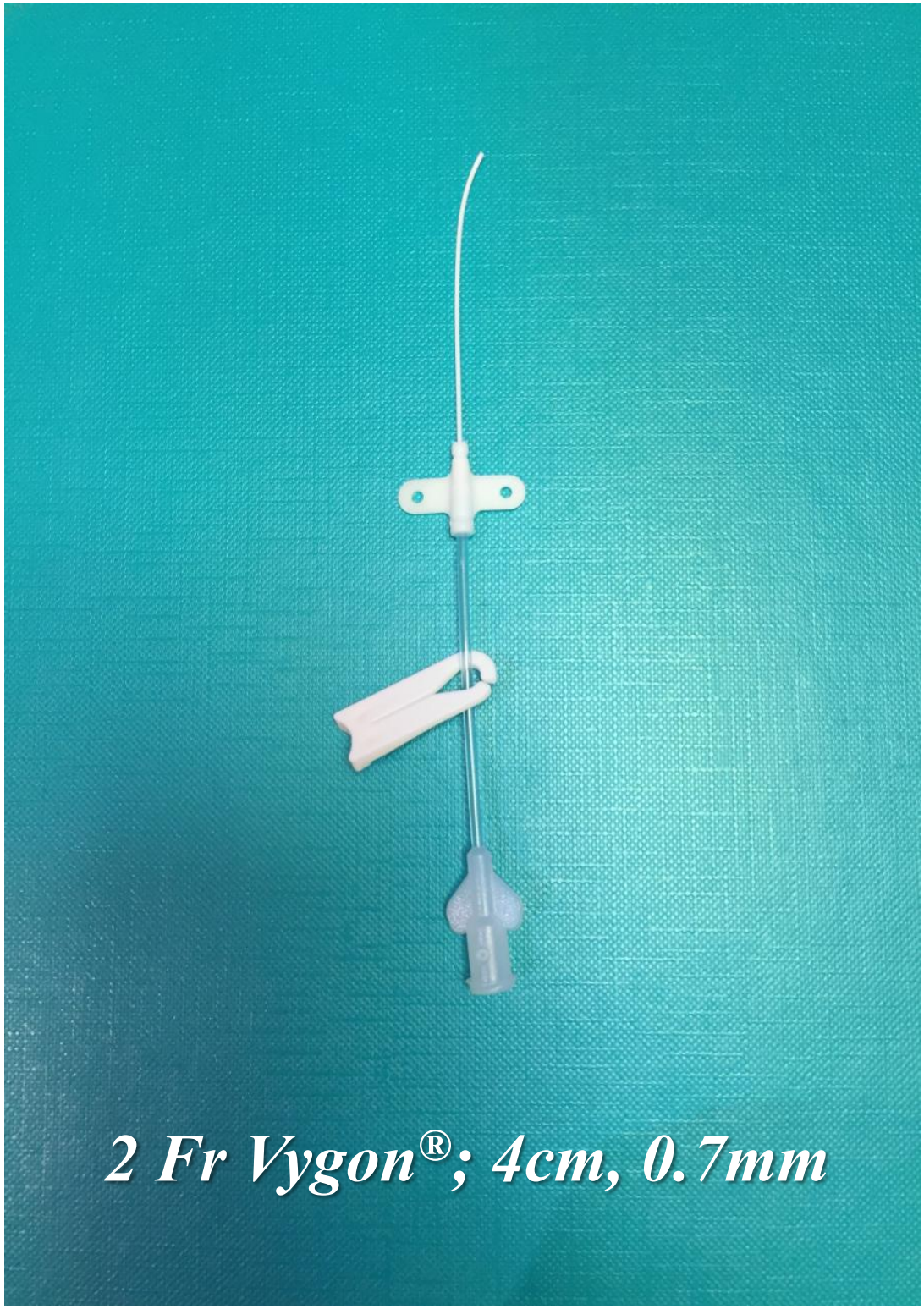


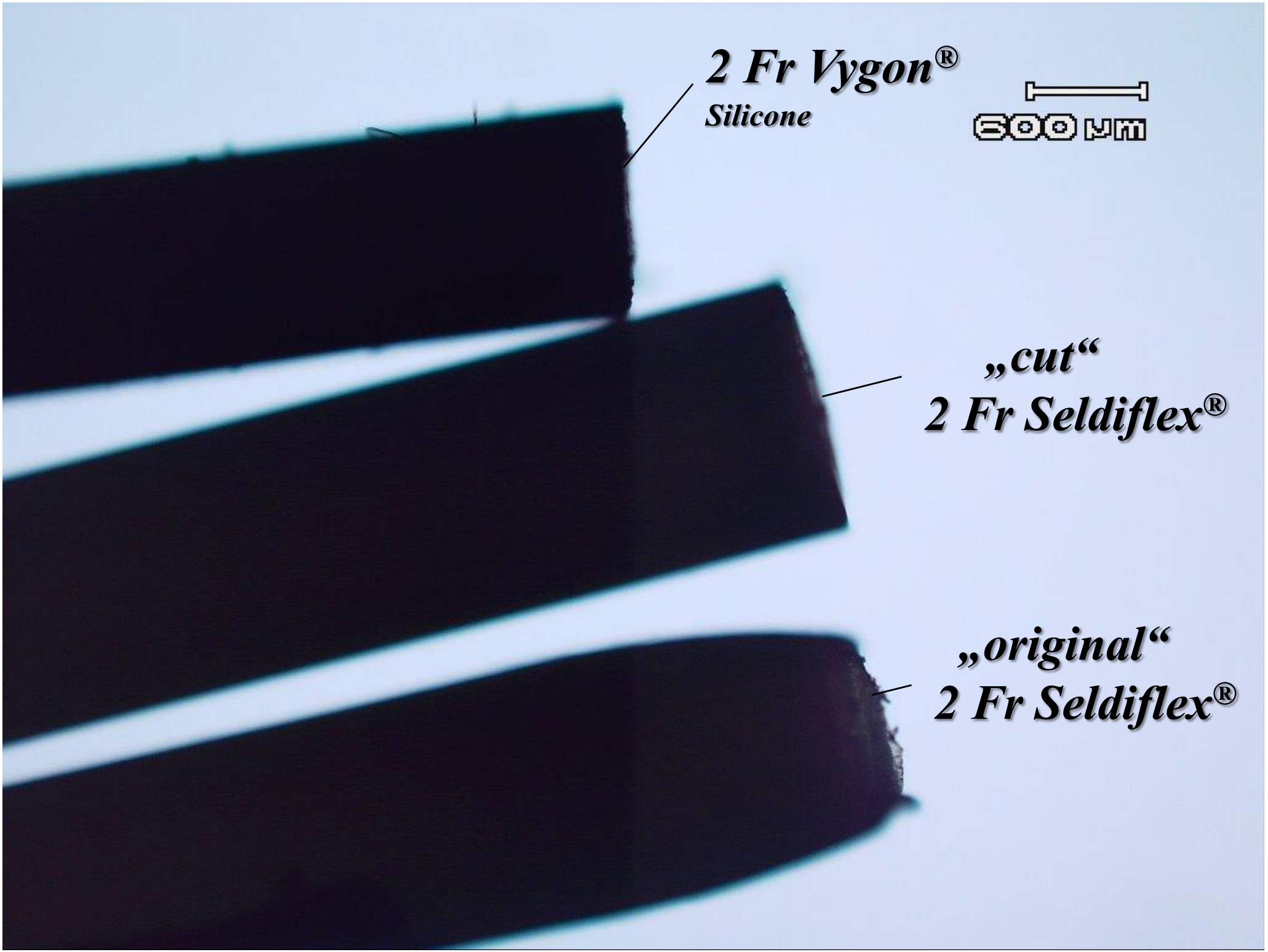
22 G needle
2 ml syringe



Straight Nitinol 0.018inch Guidewire




2 Fr Vygon®; 4cm, 0.7mm


2 Fr Vygon®
Silicone
500 µm
„cut“
2 Fr Seldiflex®
„original“
2 Fr Seldiflex®

SUMMARISING

- **Real-time USG is mandatory for all central venous lines in neonates**

  except for ECC *i.e. small bore*

- **Surgical cutdown techniques are obsolete!**

Blum LV; J Pediatr Surg 2017
HSU CC; Cochrane Database 2016
Pandit PB; J Perinatol 1999
Lamperti; Int Care Med 2012
WoCoVa, Lissabon 2017
www.gavecelt.it

SUMMARISING

- **Periclavicular insertion of 2(-3) Fr catheters is possible in extremely small premies**

  – reduction of mortality/morbidity?

- **USG**

  – 2.choice: IJV OOP
  – 1.choice: BCV IP

Breschan; Anesthesiology 2017
Montes-Tapia; J Pediatr Surg 2016

IP cannulation of left BCV: 1.1kg Baby



IP cannulation of right BCV: 790g Baby



CONCLUSION

USG SUPRACLAVICULAR BCV ACCESS

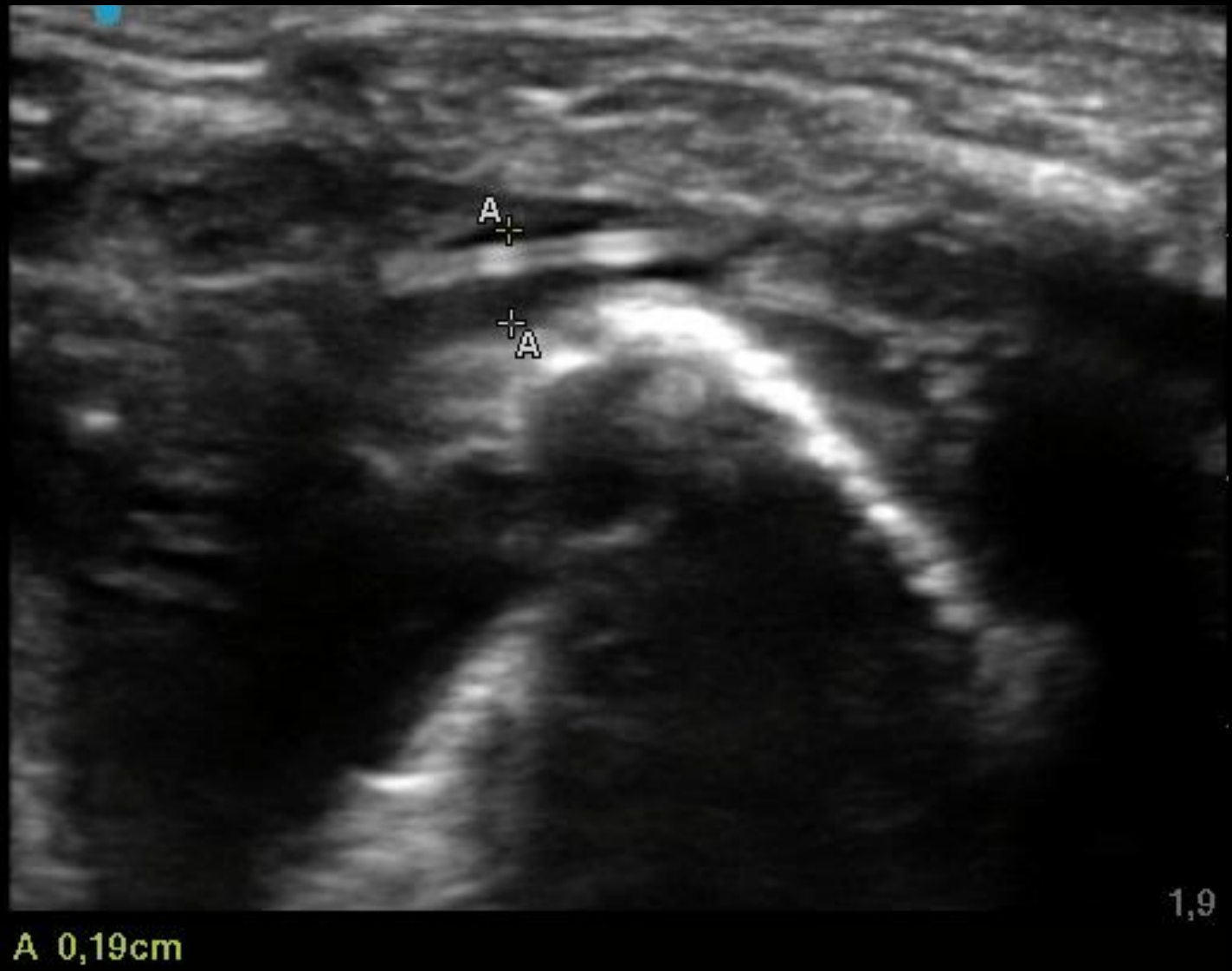
- **Safe approach!**
- **Easier for the left BCV** *in neonates*
- **Prescanning of the right BCV**
  – ***difficult: yes/no***
- **Learning curve**


550g Baby
Never ever lose the
RESPECT!!

IP cannulation of right BCV: 790g Baby



Left BCV: 660g Baby



IP cannulation of left BCV: 850g Baby



IP cannulation of left BCV: 900g Baby



OOP cannulation of the right IJV: 1.4 Baby



IP cannulation of right BCV: 550g Baby



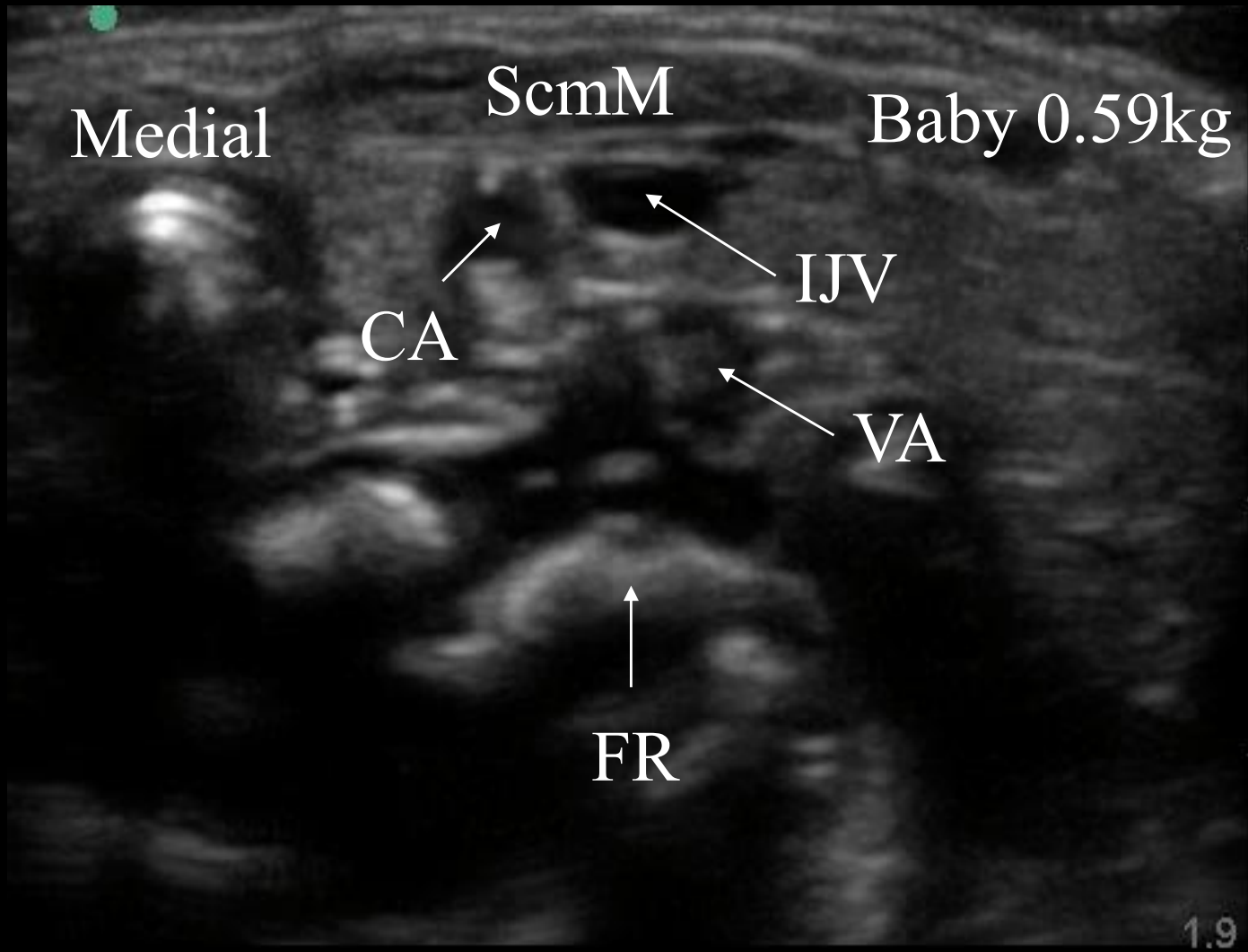
IP cannulation of right BCV: 550g Baby



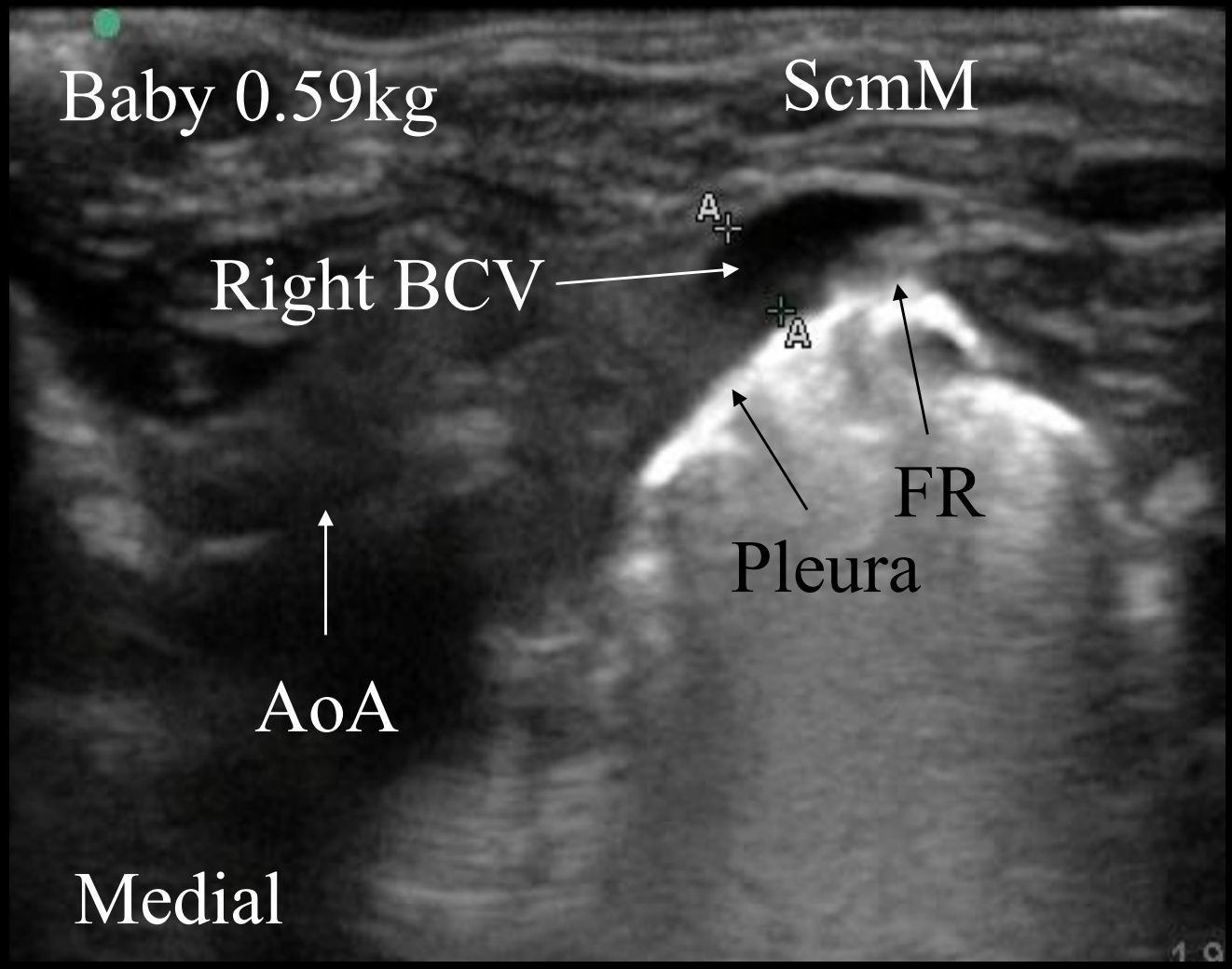
OOP cannulation of IJV: 3.4 kg Baby



Low approach: 0.59kg INFANT



INFANT 0.59kg



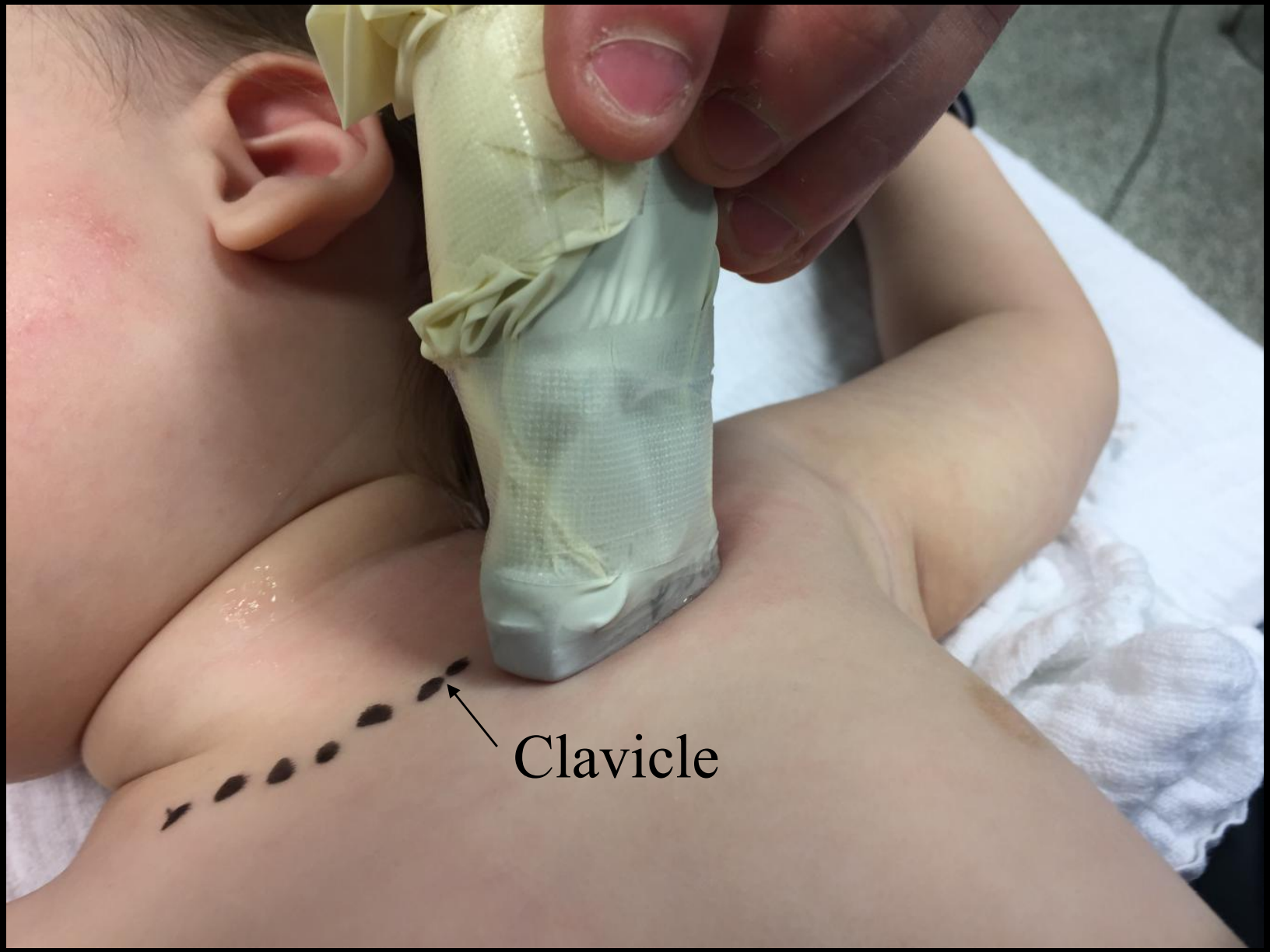
IP cannulation of BCV: 2kg Baby
difficult peripheral venous access
- inguinal herniotomy -



IP cannulation of BCV: 1.9kg Baby
difficult peripheral venous access



SONOANATOMY of AxV



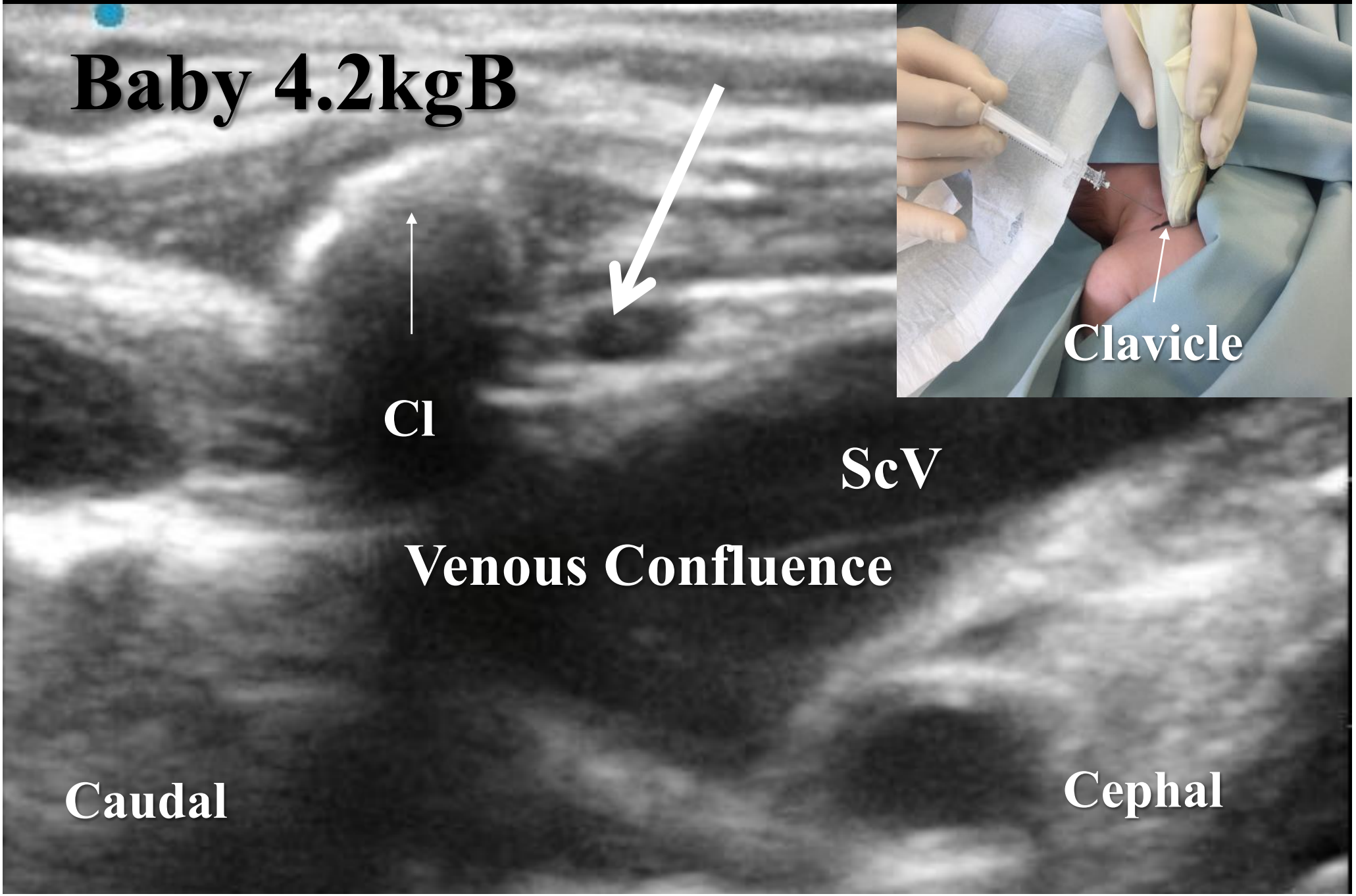
IP cannulation of left BCV: 630g Baby



IP cannulation of left BCV: 1.6kg Baby



OOP APPROACH to BRACHIOCEPHALIC VEIN



OOP APROACH to BRACHIOCEPHALIC VEIN

- **Advantageous for right BCV?**

  Kumar; Indian J Anaesth 2019

- **Disadvantages of OOP technique**
  - ***poor needle visibility***
  - ***poor visibility of surrounding structures***

Right SCV THROMBUS





590g Baby









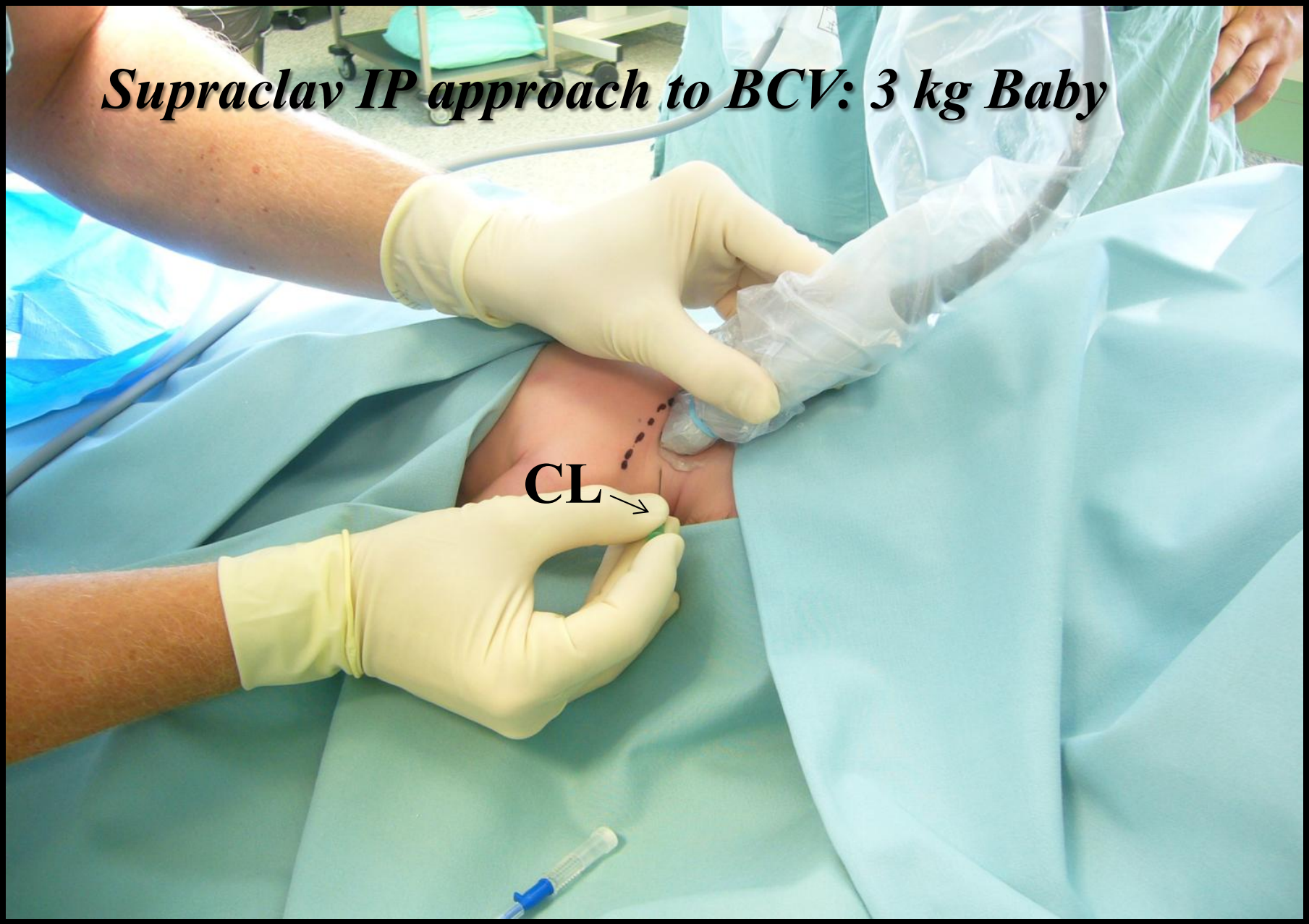

PHILIPS



Infraclavicular in-plane approach to ScV



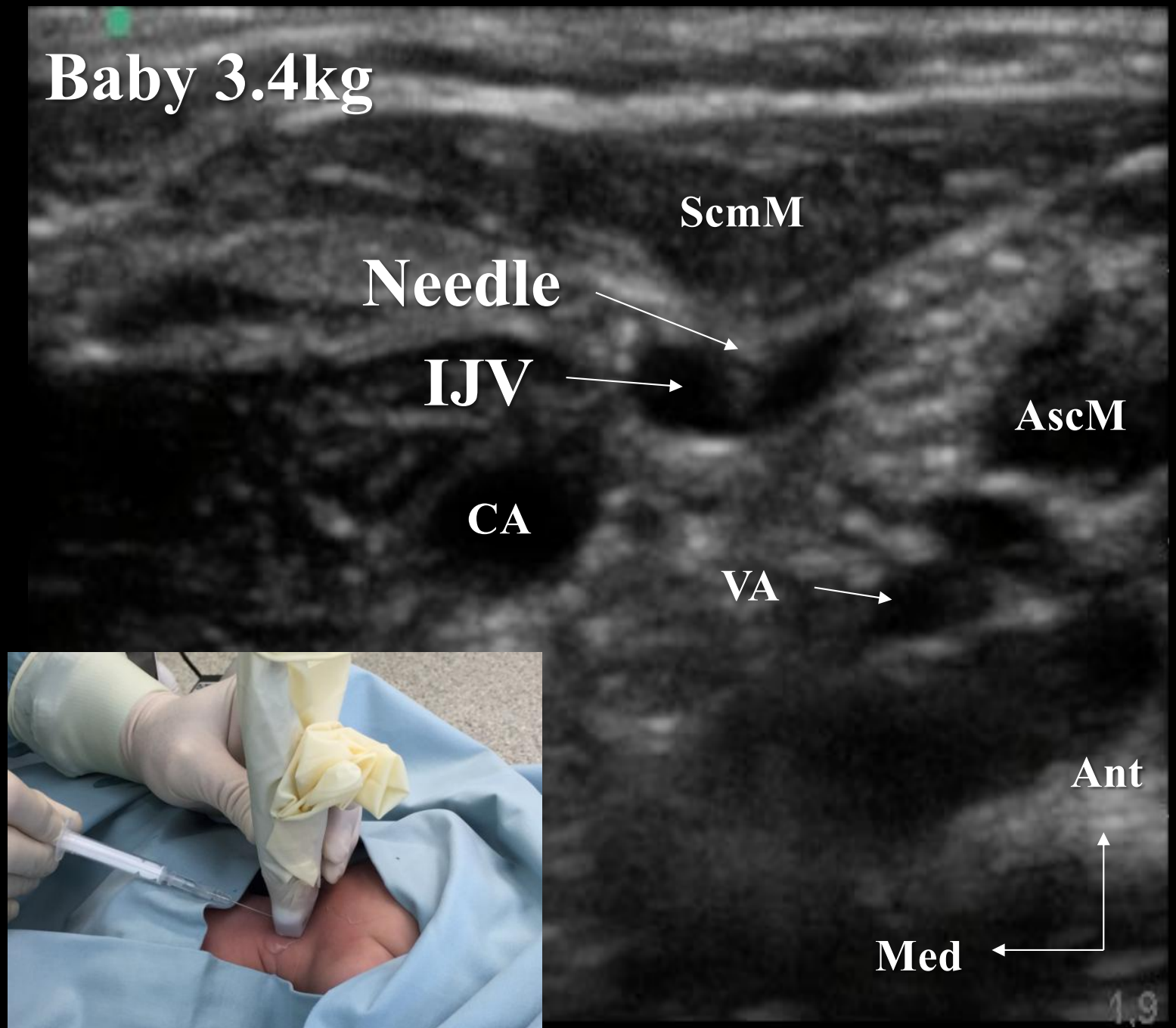
Pirotte T, Br J Anaesth 2007



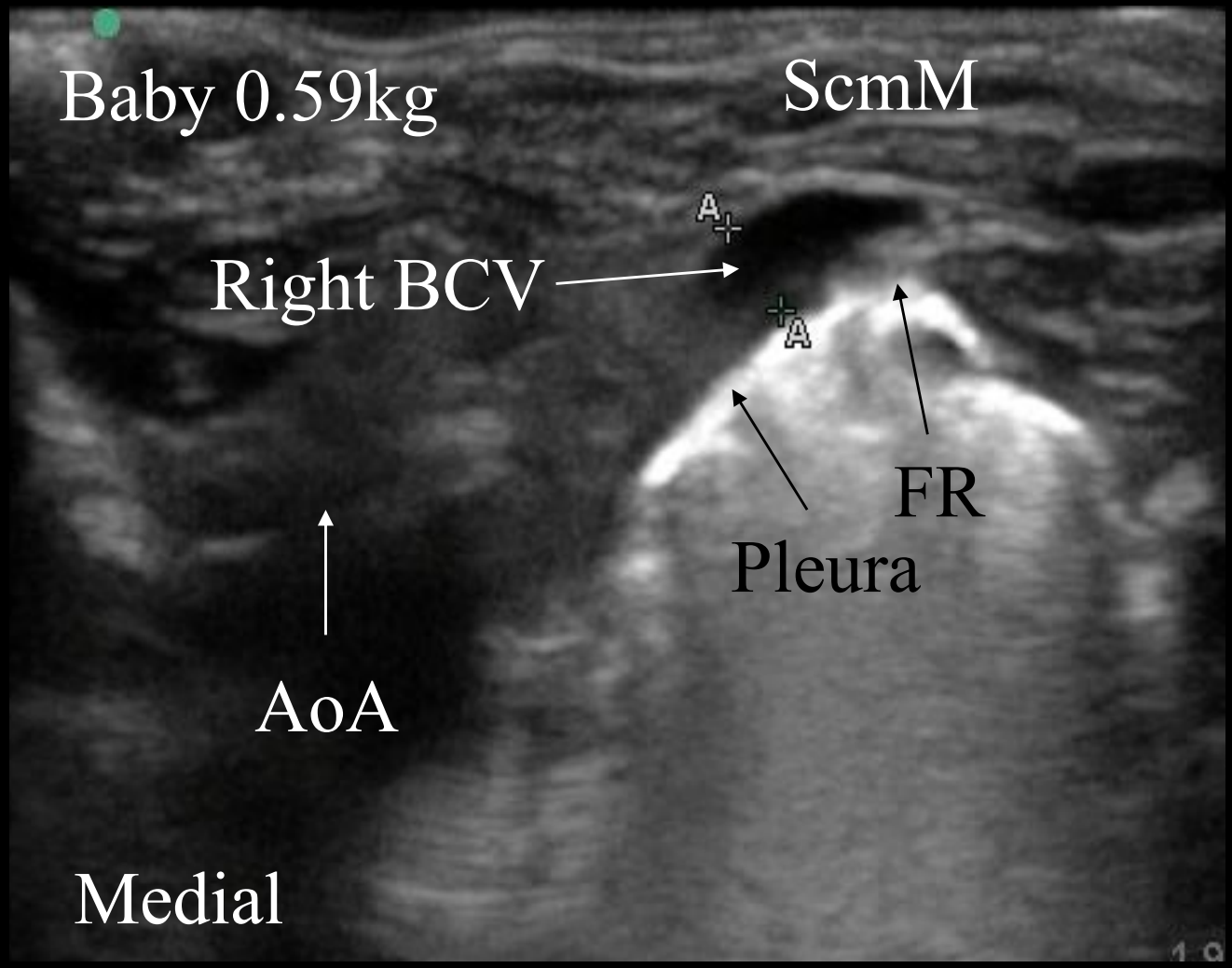
Breschan C; Br J Anaesth 2011

IJV running into BCV




Baby 3.4kg
ScmM
Needle
IJV
AscM
CA
VA
Ant
Med

INFANT 0.59kg



Breschan C; Br J Anaesth 2011

USG
PICCs

- **Fewer CAIs?**

  Yamaguchi RS; Intensive Care Med. 2017

- **Increased risk of thrombosis?**

  Noailly Charny PA; J Pediatr Surg 2018
  Gnannt; Pediatr Radiol 2018
  Johnson KN; Pediatr Surg Int 2016

PITFALL: 630g Baby

Unintentional AscM Cannulation



PITFALL: 630g Baby

Untentional AscM Cannulation



PITFALL: 630g Baby

Unintentional AscM Cannulation



PITFALL: 630g Baby

Untentional AscM Cannulation



Ultrasound-guided supraclavicular cannulation of the right brachiocephalic vein in small infants: a consecutive, prospective case series

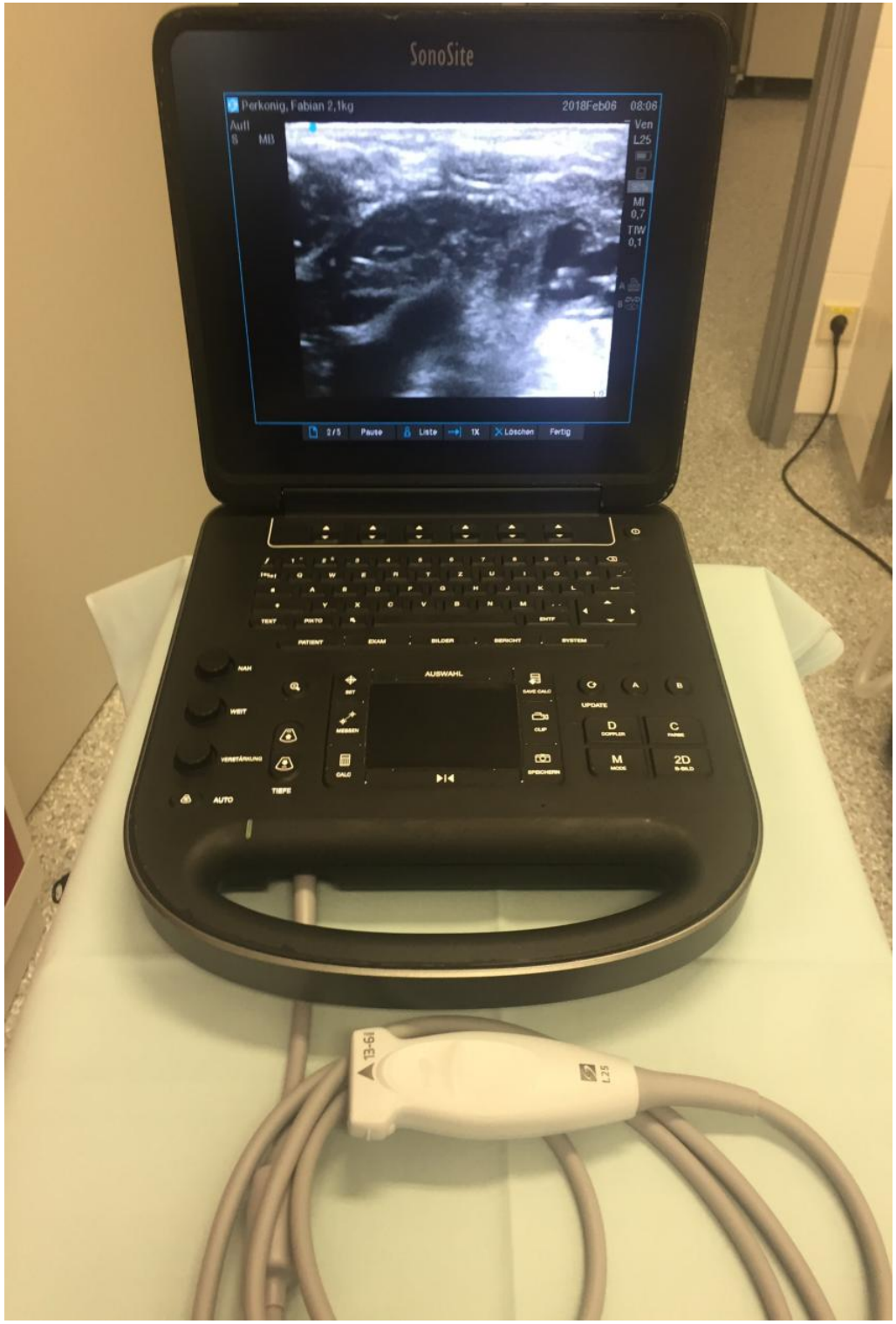
Hypothesis

- in ~ 1/3 of neonates the right BCV quickly disappears behind the sternoclavicular joint

→ invisible via a linear US probe

→ *circular sonograhic appearance*

EDGE II
Sonosite®




590g Baby

OOP cannulation of the right IJV: 3.6 Baby



COMPARING STUDIES

inluding also neonates

- **USG vs landmark**
  - **– femoral, internal jugular veins**
  - **– axillary > subclavian vein**

Kim EH; Anaesthesia 2017

- **USG: BCV > IJV**
  - **– 1.attempt: 73% vs 37%**

Oulego-Erroz; J Crit Care 2016

IP cannulation of the right BCV: 2kg baby

