XII Congresso GAVeCeLT

Il Protocollo ECHOTIP

The ECHOTIP Protocol

Daniele G. Biasucci

GAVeCeLT
Gli Accessi Venosi Centrali a Lungo Termine

TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

EcoTIME
Ecografia in Terapia Intensiva e Medicina dell'Emergenza

UNIVERSITAS CATHOLICA SACRI CORDIS MEDIOLANI

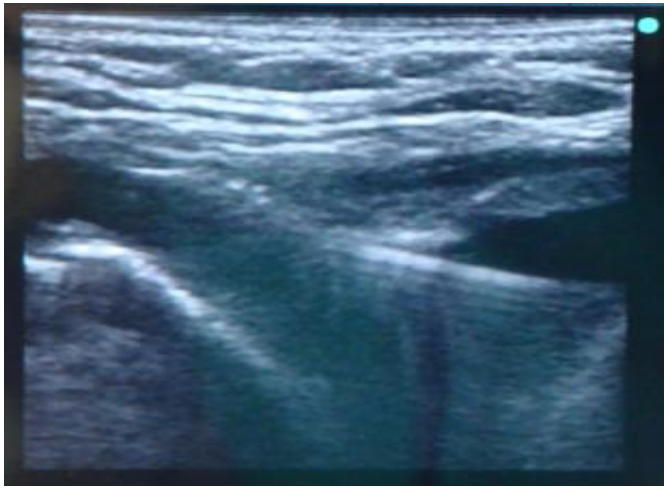
ECHOTIP Protocol: *a picture is worth 1000 words!*

- Rationale
- Published Evidence (EBM)
- Recommendations and Guidelines
- Ultrasound Views
- Bubble Test
- Training

Rationale

- In regard to the prevention of primary malposition US may play two roles:
  - As a „tip navigation“ technique
  - As a „tip location“ technique

- Rule-out a suspected *late* malposition



CLINICALLY-INTEGRATED POCUS in VA placement

- Answer simple clinical questions
- Focused ultrasound view
  - Clinically guided
- Rapid
  - exam time approximately 2 min
- Simple interpretation
  - Which is the safest vein to be punctured?
  - Which is the proper and safe approach?
  - Is the needle inside the vein?
  - ***Is the guidewire and/or the catheter travelling towards the right direction?***
  - ***Where is located the tip?***
  - Is there any complications?
  - …

EBM

REVIEW

Bedside ultrasound to detect central venous catheter misplacement and associated iatrogenic complications: a systematic review and meta-analysis

Jasper M. Smit[1,2*], Reinder Raadsen[1,2], Michiel J. Blans[3], Manfred Petjak[4], Peter M. Van de Ven[5] and Pieter R. Tuinman[1,2]

Author (year)	Study design (period)[1]	Setting (country)	Patients (CVCs), *n*	Ultrasoundprotocol	Reference standard	Primary outcome (secondary outcome)	Performing operators (experienced operators), *n*
Miccini et al. (2016) [46]	Prospective study (Jan 2012–Dec 2014)	Operating theatres (Italy)	302 (302)	Vascular ultrasound and TTE[a]	IF/CXR	Malposition, pneumothorax	2 (2)
Park et al. (2014) [60]	Prospective study	Pediatric ICU (United States)	108 (108)	Vascular ultrasound and TTE[a]	CXR	Malposition (insertion depth CVC)	3 (3)
Arellano et al. (2014) [27]	Prospective study	Operating theatres (Canada)	100 (100)	Vascular ultrasound and TTE[b]	TEE	Malposition	4 (2)
Bedel et al. (2013) [24]	Prospective study (Jan 2010–Nov 2010)	ICU (France)	98 (101)	Vascular ultrasound and TTE[b]	CXR	Malposition (pneumothorax, time until confirmation)	1 (1)
Blans et al. (2016) [18]	Prospective study (Jan 2015–Sep 2015)	ICU (The Netherlands)	53 (53)	Vascular ultrasound, TTE and CEUS[a]	CXR	Malposition, pneumothorax (time until confirmation)	2 (2)
Matsushima and Frankel (2010) [19]	Prospective study (Nov 2004–Sep 2005)	Surgical ICU (United States)	69 (83)	Vascular ultrasound, TTE and CEUS[a]	CXR	Malposition, pneumothorax (time until confirmation)	1 (0)
Meggiolaro et al. (2015) [32]	Prospective study (Jan 2013–Sep 2013)	Operating theatres (Italy)	105 (105)	Vascular ultrasound, TTE and CEUS[a]	CXR	Malposition, pneumothorax (timing bubble test, time until confirmation)	1 (1)
Vezzani et al. (2010) [31]	Prospective study (Apr 2008–Aug 2008)	ICU (Italy)	111 (111)	Vascular ultrasound, TTE and CEUS[a]	CXR	Malposition, pneumothorax (time until confirmation, cost analysis)	1 (1)
Zanobetti et al. (2013) [61]	Prospective study (Jan 2009–Dec 2011)	Emergency department (Italy)	210 (210)	Vascular ultrasound, TTE and CEUS[a]	CXR	Malposition, pneumothorax (time until confirmation)	4 + (4+)[3]

Table 1 Study characteristics

Author (year)	Study design (period)[1]	Setting (country)	Patients (CVCs), *n*	Ultrasoundprotocol	Reference standard	Primary outcome (secondary outcome)	Performing operators (experienced operators), *n*
Killu et al. (2010) [47]	Prospective pilot study	Surgical ICU (United States)	5 (5)	Supraclavicular ultrasound[a]	CXR	Malposition (time advancement guidewire)	1 (1)
Kim et al. (2015) [26]	Prospective pilot study (Jul 2012–Oct 2012)	Operating theatres (Germany)	51 (51)	Supraclavicular ultrasound[b]	CXR/TEE	Malposition (time until confirmation)	2 (2)
Kim et al. (2016) [25]	Prospective pilot study (Jun 2014–Aug 2014)	Operating theatres (Germany)	20 (20)	Supraclavicular ultrasound[b]	CXR	Malposition (time advancement guidewire)	1 (1)
Baviskar et al. (2015) [48]	Prospective study (Apr 2013–Jan 2014)	Surgical ICU (India)	25 (25)	TTE and CEUS[a]	CXR	Time until confirmation (malposition)	1 + (1+)[3] experienced staff
Cortellaro et al. (2014) [49]	Prospective study	Emergency department (Italy)	71 (71)	TTE and CEUS[a]	CXR	Malposition (time until confirmation)	3 (2)
Duran-Gehring et al. (2015) [50]	Prospective study (Dec 2012–Nov 2013)	Emergency department (United States)	50 (50)	TTE and CEUS[a]	CXR	Time until confirmation (malposition, pneumothorax)	2 (2)
Gekle et al. (2015) [51]	Prospective study (Dec 2012–Mar 2014)	Emergency department (United States)	81 (81)	TTE and CEUS[a]	CXR	Malposition, pneumothorax (time until confirmation)	Unclear
Kamalipour et al. (2016) [52]	Prospective study (Aug 2013–Jan 2014)	Operating theatres (Iran)	116 (116)	TTE and CEUS[a]	CXR	Malposition	1 (1)
Lanza et al. (2006) [53]	Prospective study (Nov 2004–Sep 2005)	Pediatric ICU (Italy)	107 (107)	TTE and CEUS[a]	CXR	Malposition, pneumothorax	1 (1)
Salimi et al.[2] (2015) [17]	Prospective study	Nephrology department (Iran)	82 (82)	TTE and CEUS[a]	CXR	Malposition, pneumothorax	1 (1)
Santarsia et al. (2000) [54]	Prospective study	Nephrology department (Italy)	158 (158)	TTE and CEUS[a]	CXR	Malposition	Unclear
Weekes et al. (2014) [55]	Prospective study (Jan 2013–Apr 2013)	Emergency department and ICU	147 (152)	TTE and CEUS[a]	CXR	Malposition	5 (5)
Weekes et al. (2016) [56]	Prospective study (Nov 2013–Mar 2015)	Emergency department and ICU	156 (156)	TTE and CEUS[a]	CXR	Malposition, pneumothorax (time until confirmation)	Unclear, by or under supervision of study investigator
Wen et al. (2014) [57]	Retrospective study (Jun 2011–Jul 2012)	Nephrology department (Germany)	202 (219)	TTE and CEUS[a]	CXR	Malposition (time until confirmation)	2 + (2+)[3]
Alonso-Quintela et al. (2015) [58]	Prospective study (Jan 2012–Jan 2014)	Pediatric ICU (Spain)	40 (51)	Vascular ultrasound and TTE[a]	CXR	Malposition (time until confirmation)	1 (1)
Maury et al. (2001) [59]	Prospective study (Mar 1999–Sep 1999)	ICU (France)	81 (85)	Vascular ultrasound and TTE[a]	CXR	Malposition, pneumothorax (time until confirmation)	3 (0)

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Critical Care

Tip Navigation and Tip location - EBM

AUTHOR	YEAR	Study Design	N of patients	US technique
Maury	2001	observational prospective	81	Vascular US + TTE
Miccini	2016	observational prospective	302	Vascular US + TTE
Bedel	2013	observational prospective	98	Vascular US + TTE
Blans	2016	observational prospective	53	Vascular US + TTE + CEUS
Matsushima	2010	observational prospective	69	Vascular US + TTE + CEUS
Meggiolaro	2015	observational prospective	105	Vascular US + TTE + CEUS
Vezzani	2010	observational prospective	111	Vascular US + TTE + CEUS
Zanobetti	2013	observational prospective	210	Vascular US + TTE + CEUS
Park	2014	prospective (pediatric)	108	Vascular US + TTE
Alonso-Quintela	2015	prospective (pediatric)	40	Vascular US + TTE
Arellano	2014	observational prospective	100	Vascular US + TTE

High specificity but low sensitivity

- The limited sensitivity of US to detect CVC malposition can be explained by the small a priori chance of primary malposition
- Given the small incidence of primary malposition in these studies, they was certainly underpowered
- Therefore, small changes in the number of false negatives could eventually cause dramatic changes in the sensitivity
- Lack of exam standardization

Low sensitivity: why?

- Imperfect reference standard!
  - Excepting for 3 studies in which the reference standard was TEE, in the remaining studies the reference was the CXR which should not be considered always a reliable and accurate diagnostic method for tip location
- There is a large inter-observer variability among radiologists in identifying the cavo-atrial junction on CXRs; therefore, reading of a bedside CXR alone may not be sufficiently accurate to identify tip position

Smit et al. Critical Care (2018) 22:65
https://doi.org/10.1186/s13054-018-1989-x

Critical Care

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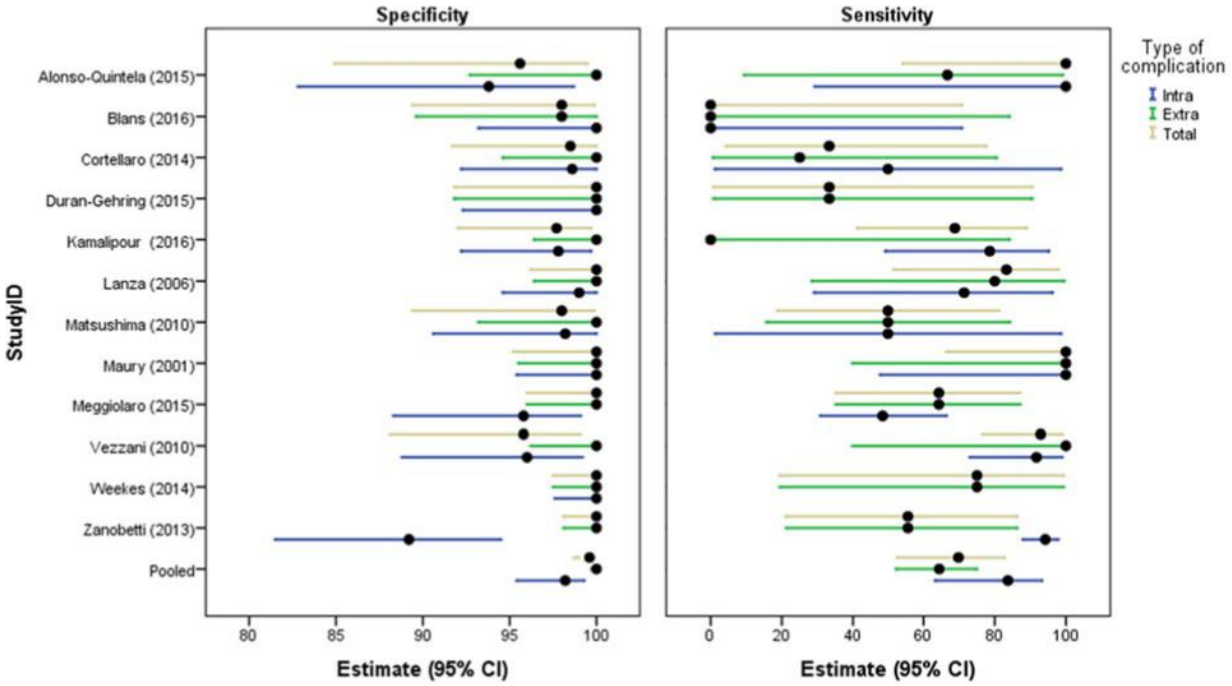


- ***"….CVC position, according to our meta-analysis, is best verified by vascular US combined with TTE…"***
- Theoretically, the best protocol is an US method incorporating a scan of the central vessels bilaterally (if needed) and visualizing the migration of the CVC tip into the heart through CEUS

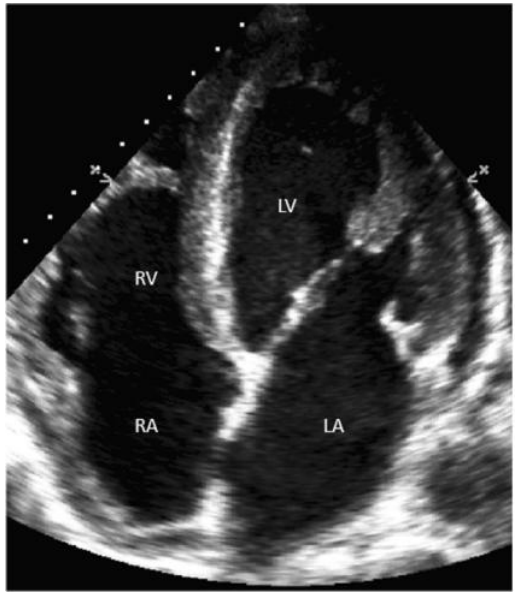
Corradi *et al. Critical Care* (2022) 26:113
https://doi.org/10.1186/s13054-022-03985-3

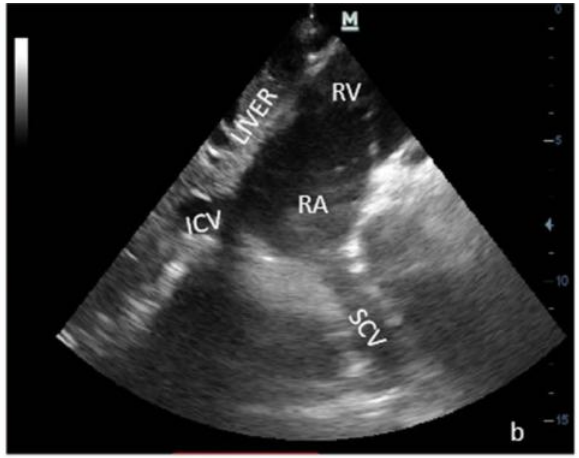
Critical Care

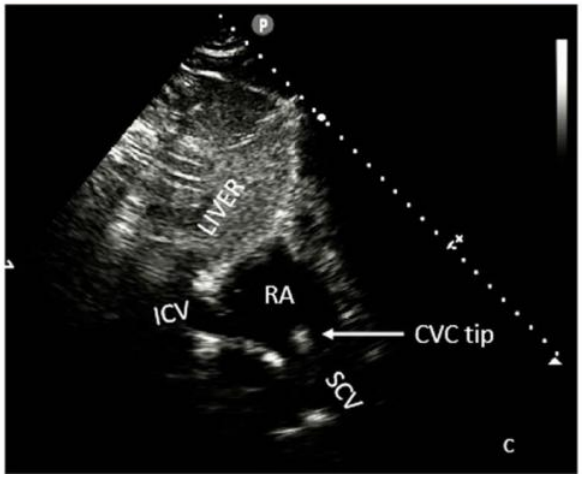
RESEARCH Open Access

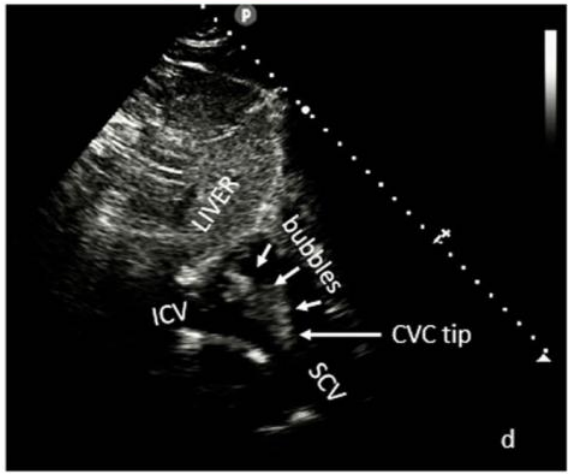
Ultrasound localization of central vein catheter tip by contrast-enhanced transthoracic ultrasonography: a comparison study with trans-esophageal echocardiography

Francesco Corradi[1,10*], Fabio Guarracino[2], Gregorio Santori[3], Claudia Brusasco[4], Guido Tavazzi[5,6], Gabriele Via[7], Silvia Mongodi[6], Francesco Mojoli[5,6], Raffaello Umberto Dario Biagini[1], Alessandro Isirdi[1], Federico Dazzi[1], Chiara Robba[3,8], Luigi Vetrugno[9] and Francesco Forfori[1] on behalf of UCARE research group









TEE

- TEE is the most accurate method for tip location (gold standard), but it is expensive and invasive.

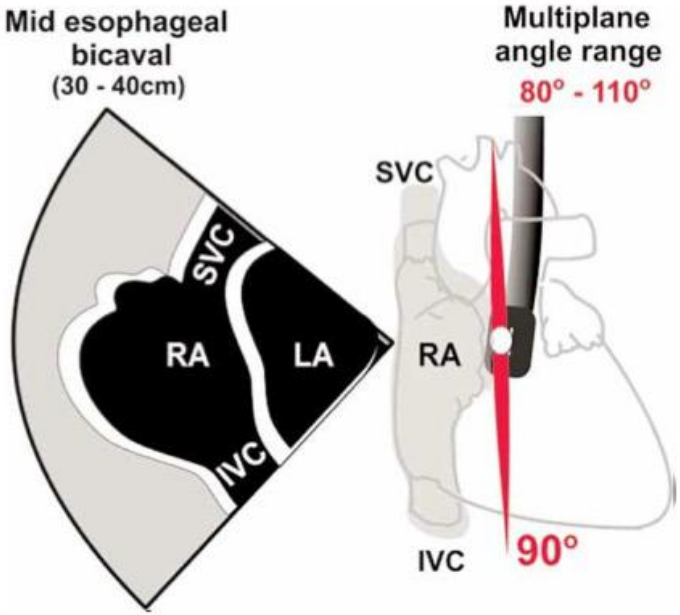
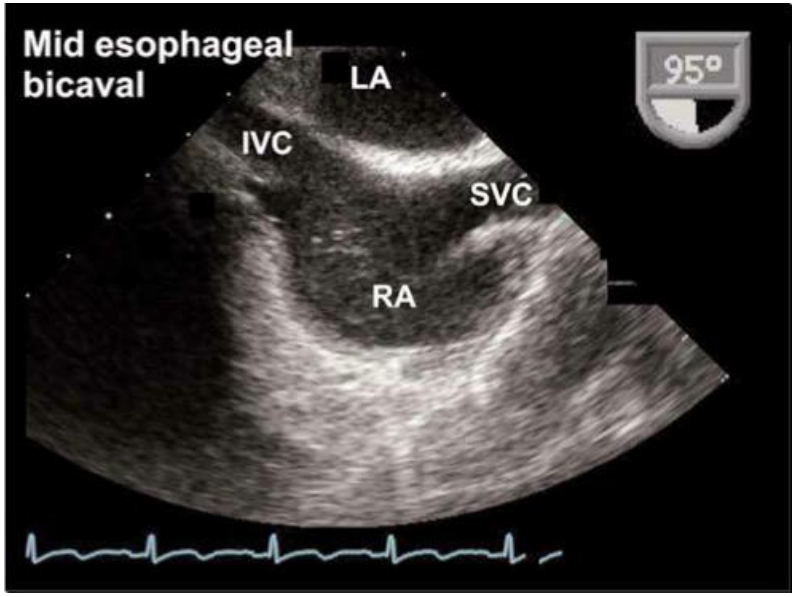
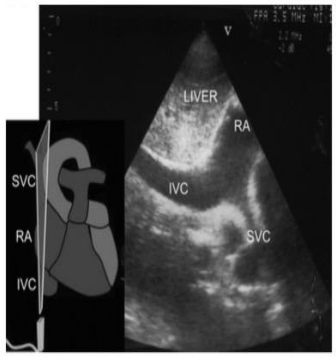


Fig. 19. Midesophageal bicaval (L).





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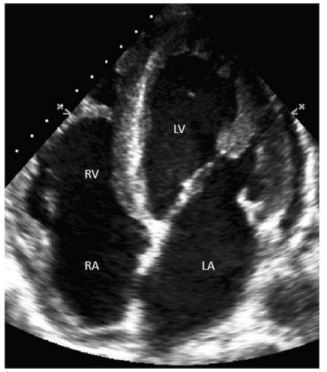

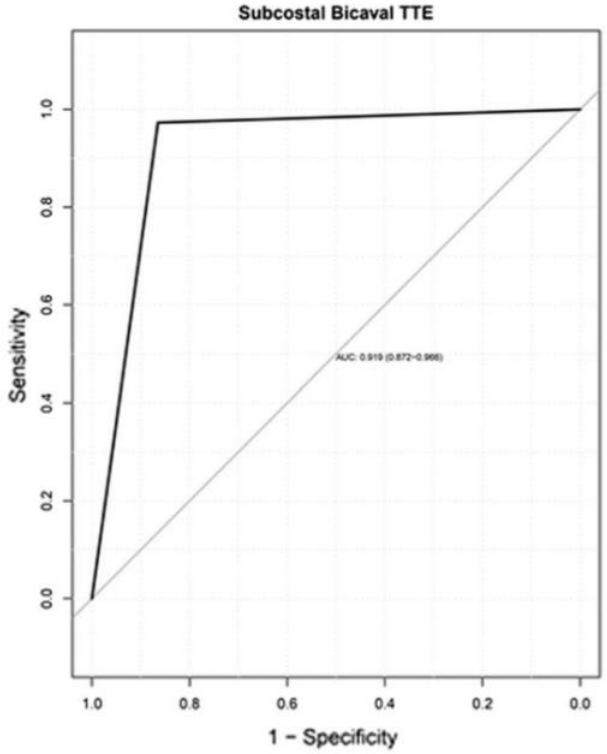

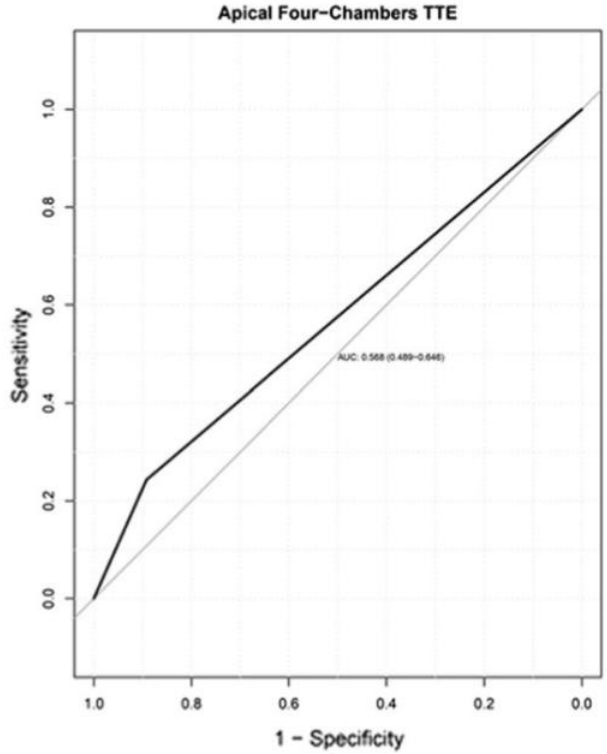

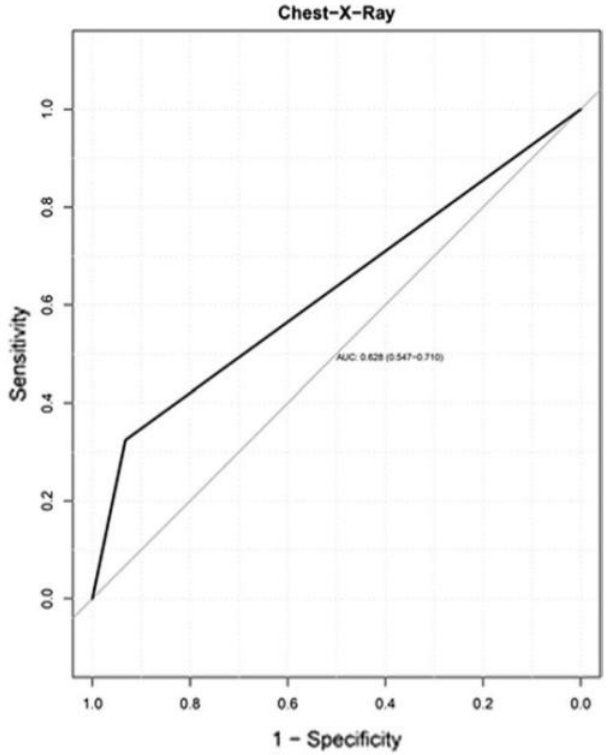

Guidelines & Recommendations

EJA 2020

Eur J Anaesthesiol 2020; 37:344–376

Evidence Based

GUIDELINES

European Society of Anaesthesiology guidelines on peri-operative use of ultrasound-guided for vascular access (PERSEUS vascular access)

Massimo Lamperti, Daniele Guerino Biasucci, Nicola Disma, Mauro Pittiruti, Christian Breschan, Davide Vailati, Matteo Subert, Vilma Traškaitė, Andrius Macas, Jean-Pierre Estebe, Regis Fuzier, Emmanuel Boselli and Philip Hopkins

2019

Guidelines 2016

Association of Anaesthetists of Great Britain and Ireland*

Safe vascular access 2016

A. Bodenham (Chair),[1] S. Babu,[2] J. Bennett,[3] R. Binks,[4] P. Fee,[5] B. Fox,[6] A. J. Johnston,[7] A. A. Klein,[8] J. A. Langton,[9] H. Mclure[10] and S. Q. M. Tighe[11]

JVA ISSN 1129-7298

J Vasc Access 2014; 00 (00): 000-000
DOI: 10.5301/jva.5000314

ORIGINAL ARTICLE

2014

Central venous access devices in pediatric malignancies: a position paper of Italian Association of Pediatric Hematology and Oncology

Alessandro Crocoli[1], Assunta Tornesello[2], Mauro Pittiruti[3], Angelica Barone[4], Paola Muggeo[5], Alessandro Inserra[1], Angelo Claudio Molinari[6], Valeria Grillenzoni[7], Viviana Durante[8], Maria Pia Cicalese[9], Giulio Andrea Zanazzo[10], Simone Cesaro[7]

Intensive Care Med
DOI 10.1007/s00134-012-2597-x

CONFERENCE REPORTS AND EXPERT PANEL

Massimo Lamperti
Andrew R. Bodenham
Mauro Pittiruti
Michael Blaivas
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Mahmoud Elbarbary
Thierry Pirotte
Dimitrios Karakitsos
Jack LeDonne
Stephanie Doniger
Giancarlo Scoppettuolo
David Feller-Kopman
Wolfram Schummer
Roberto Biffi
Eric Desruennes
Lawrence A. Melniker
Susan T. Verghese

International evidence-based recommendations on ultrasound-guided vascular access

Evidence Based

2012

8TH EDITION

REVISED 2021

2016 - 2021

INS
INFUSION NURSES SOCIETY
SETTING THE STANDARD FOR INFUSION CARE®

GRADE-RAND & DELPHI

EJA

Eur J Anaesthesiol 2020; **37**:344–376

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2020

Intensive Care Med
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International evidence-based recommendations on ultrasound-guided vascular access

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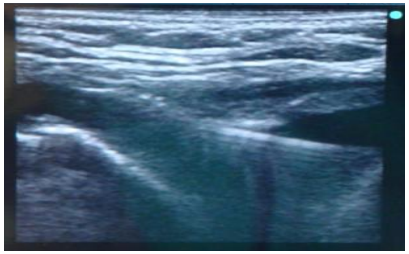
2012



Tip navigation and Tip location

EJA

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Recommendations

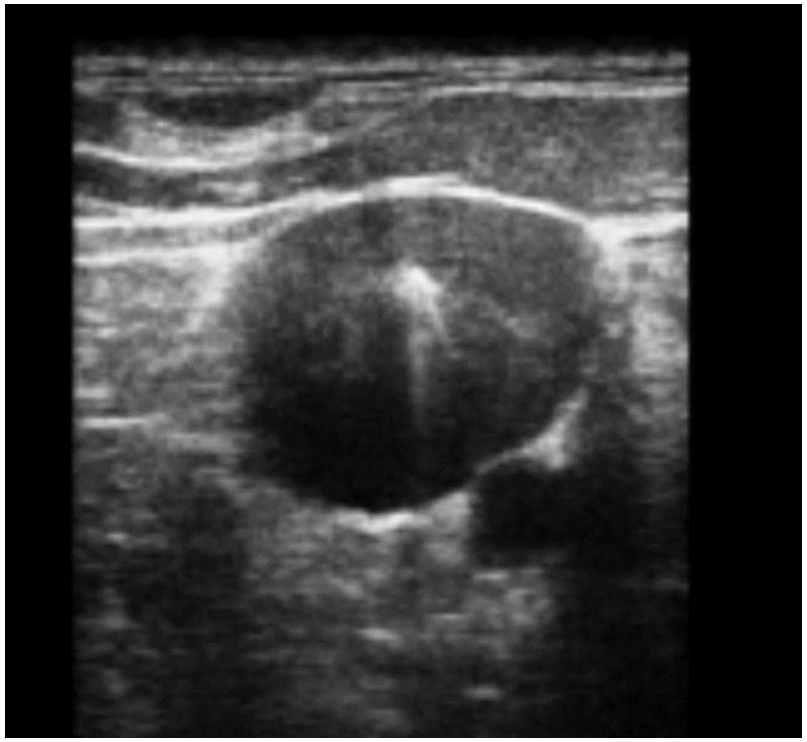
(1) The quality of evidence on which to base recommendations is generally weak, with relatively small RCTs and prospective cohort studies that have a high degree of heterogeneity.

(2) When an intracardiac electrocardiogram is not applicable, we recommend using real-time ultrasound to detect and prevent central venous catheter malposition, as it has been shown to be well tolerated, feasible, quickly performed and interpreted at bedside, and more accurate and faster than a chest radiograph **(1C).**

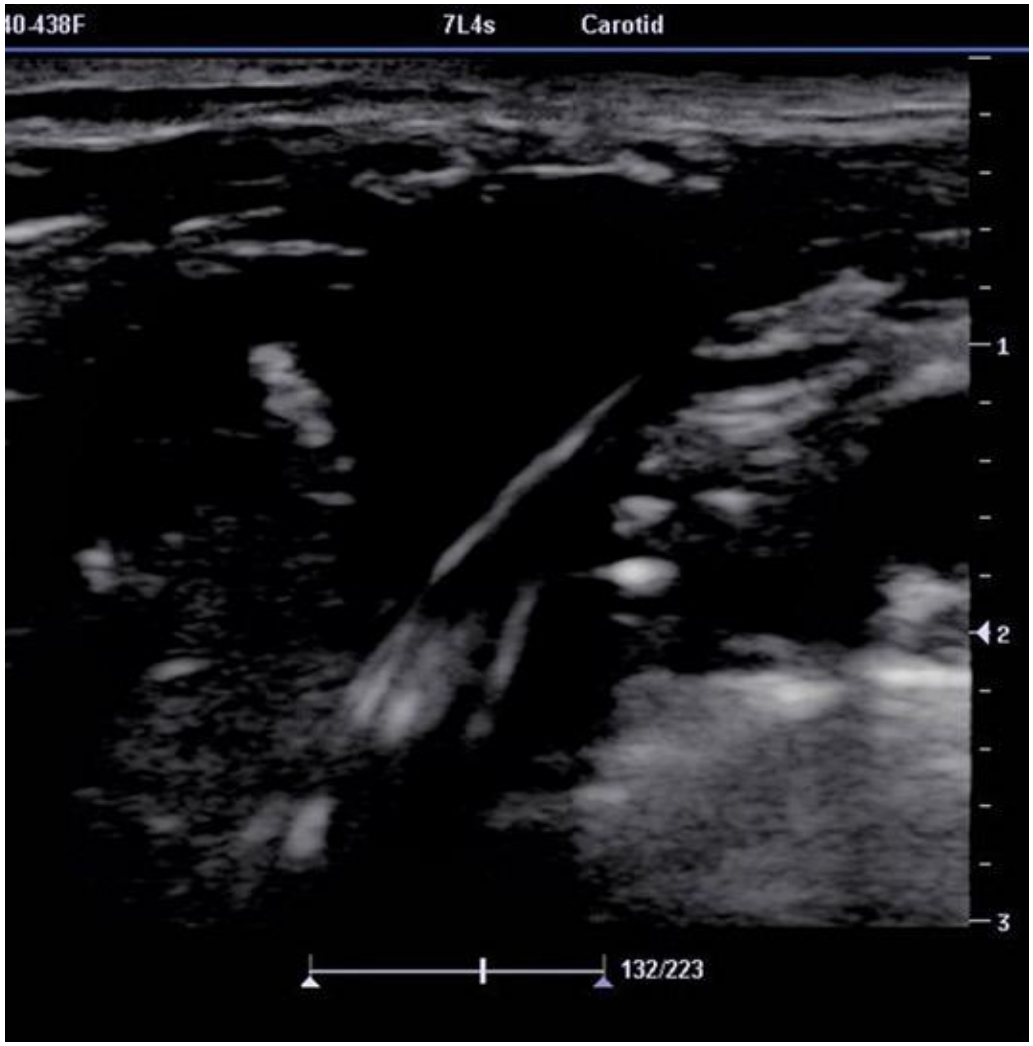
(3) We recommend combining vascular ultrasound for guidewire and central venous line tip navigation with transthoracic echocardiography for tip location **(1C).**

US views - ‘Tip navigation’

- They provide information about the presumed position of the catheter tip during its trajectory
- They help us to identify the ‘wrong’ direction of the tip
  - in the ipsilateral wrong veins
  - in the controlateral tributary caval veins (brachio-cephalic, subclavian, jugular)



Courtesy of E. Iacobone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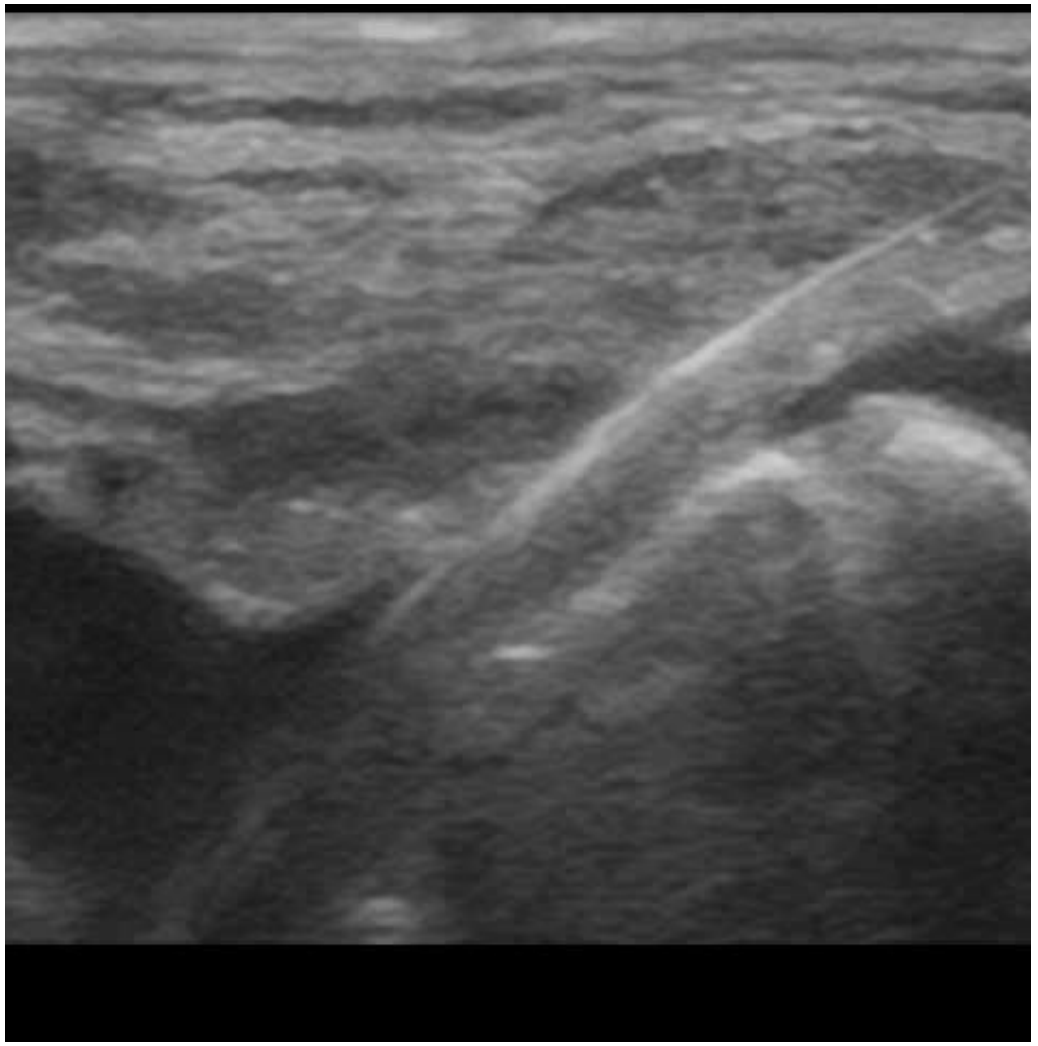

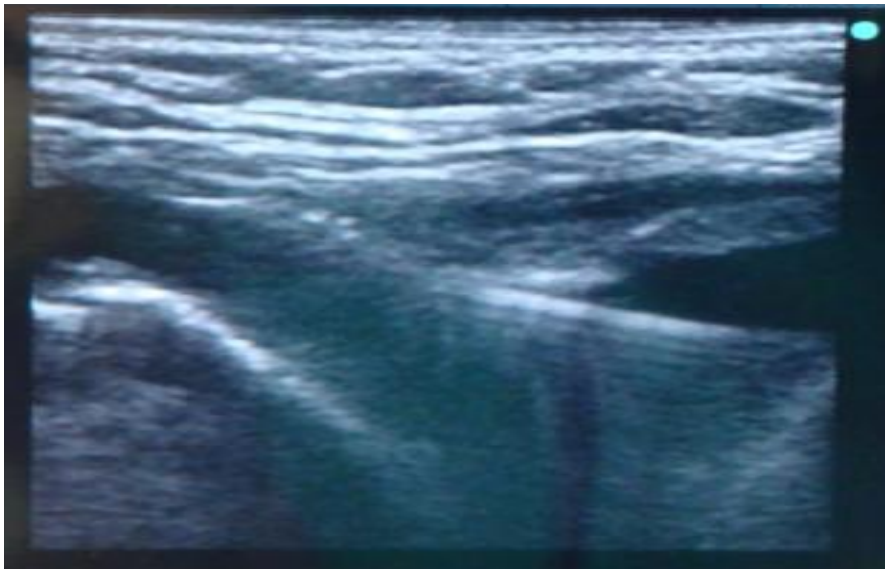

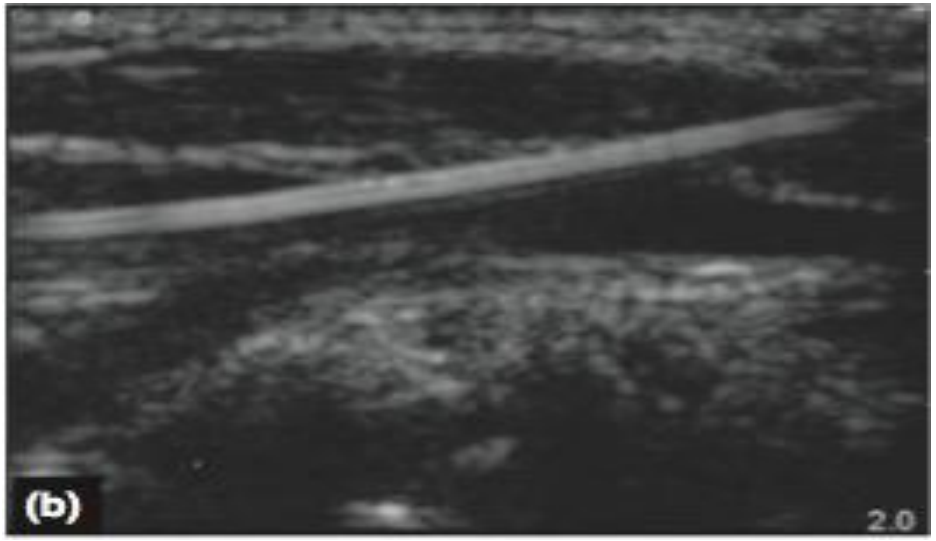
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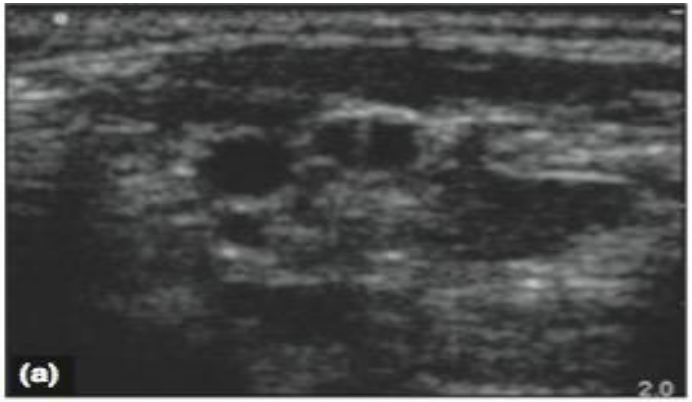
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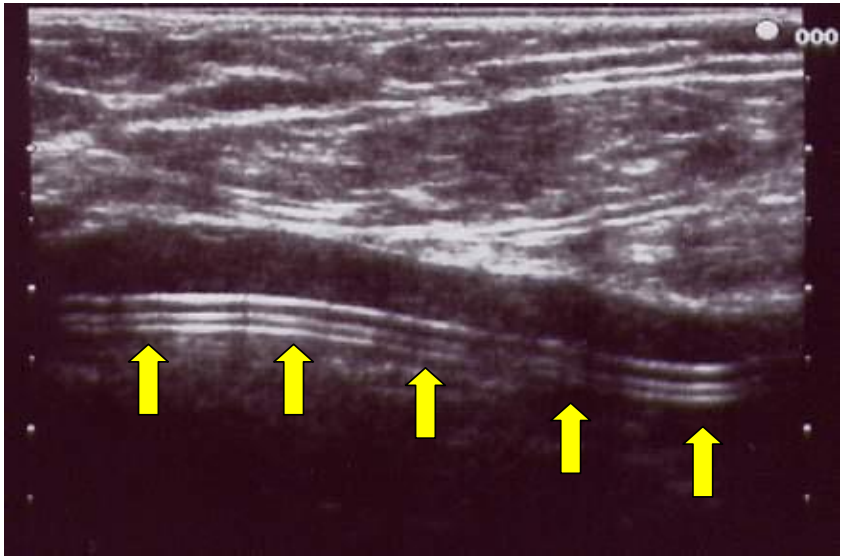
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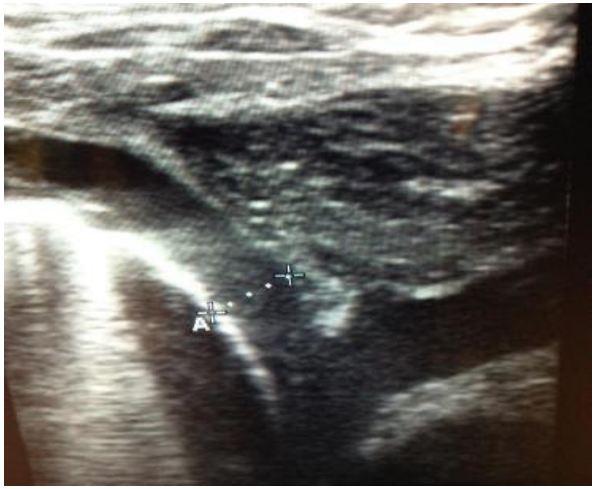
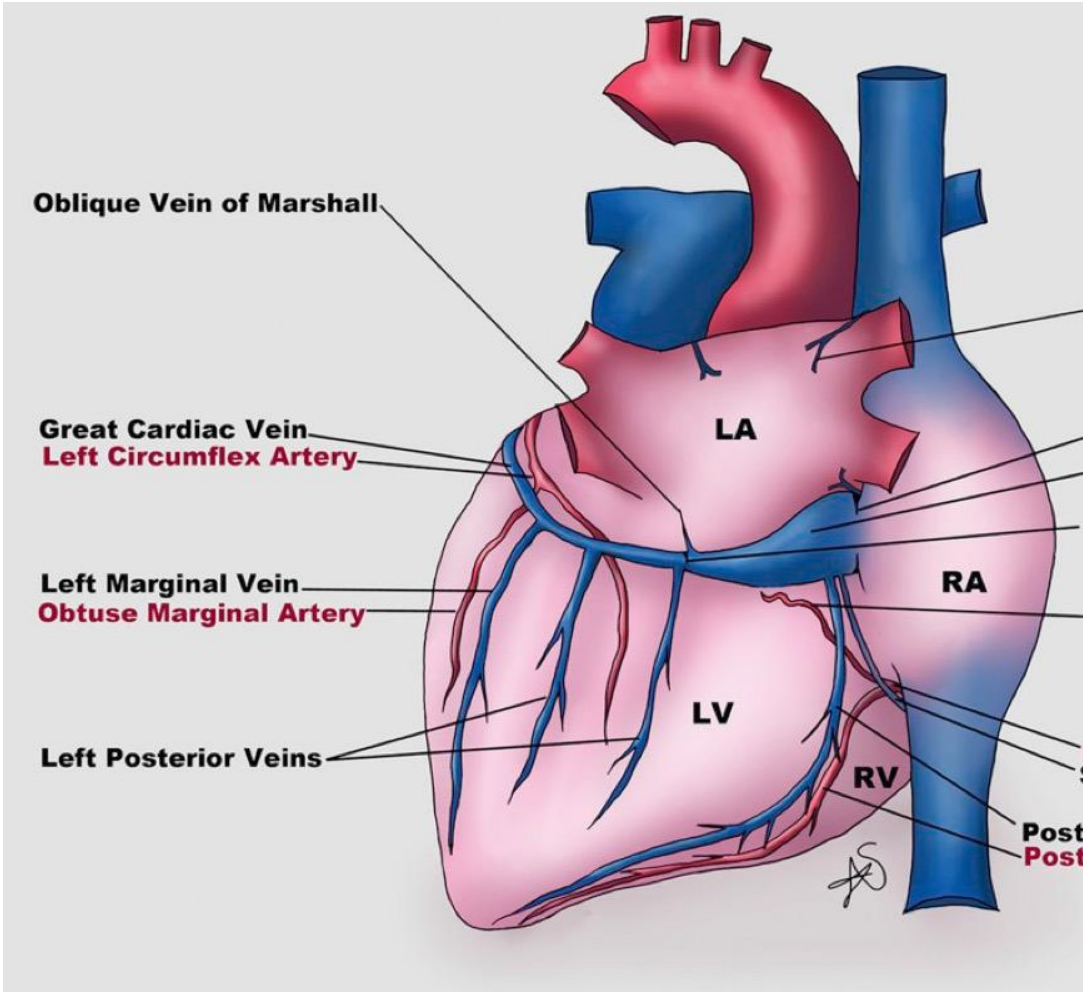
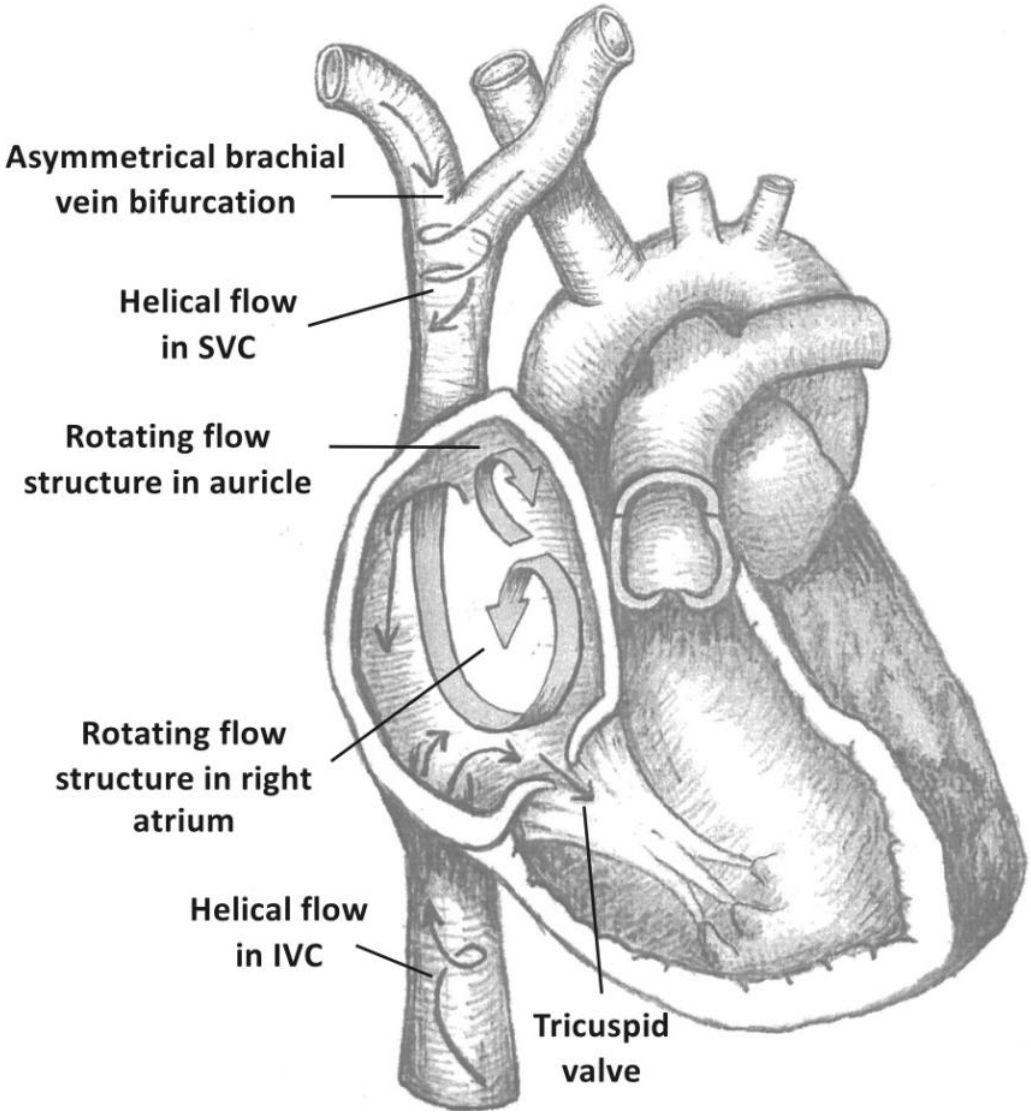
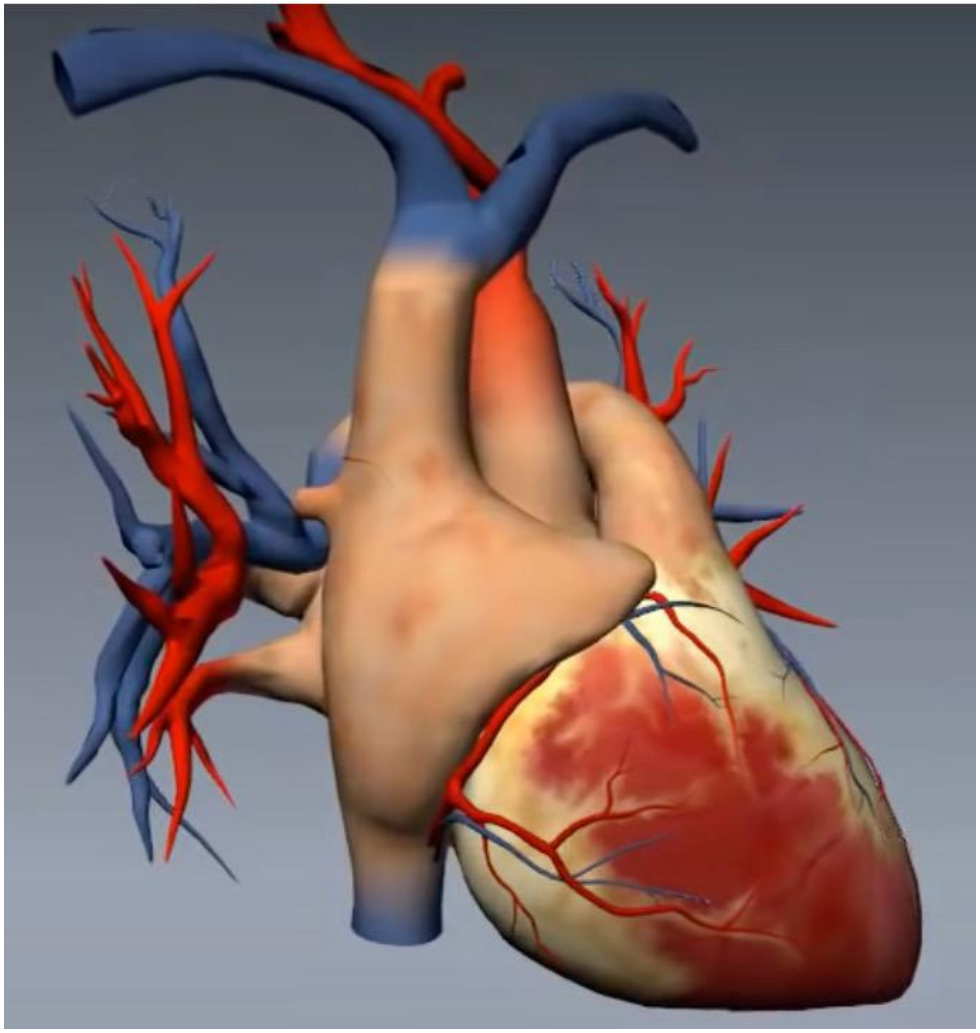


Ultrasound Views

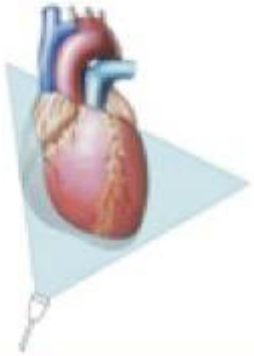


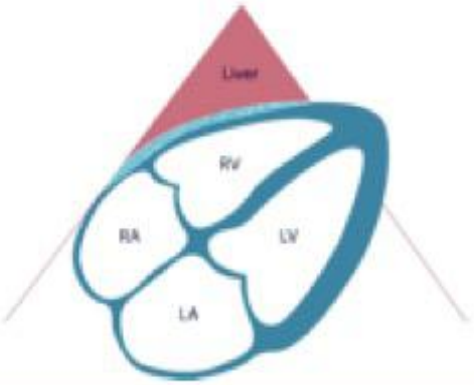




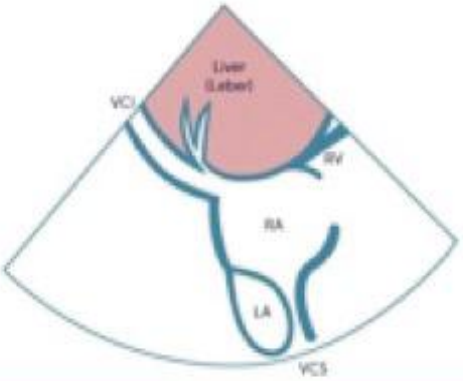

Auricle
Atrium

Subcostal Views



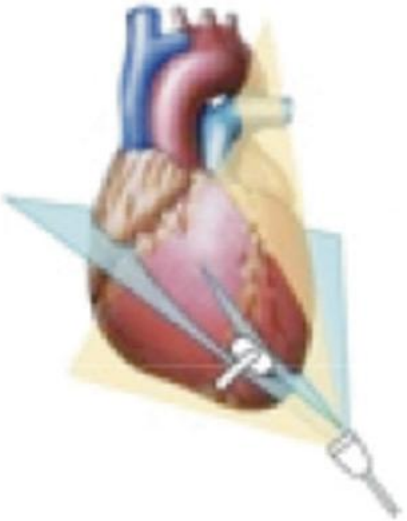


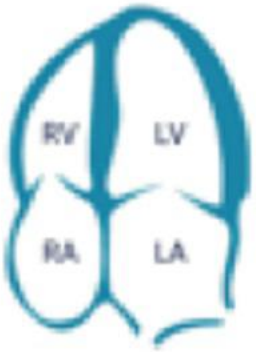
Subcostal 4 chamber view



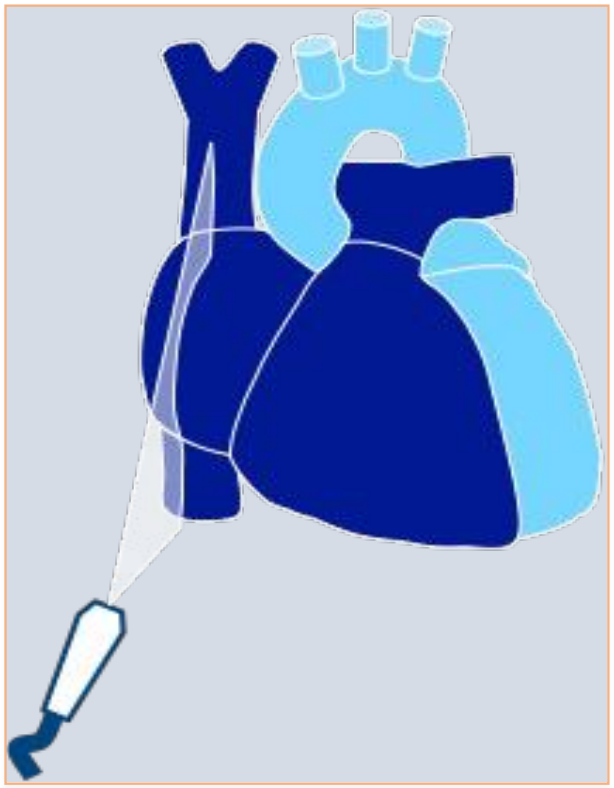
Vena cava inferior view

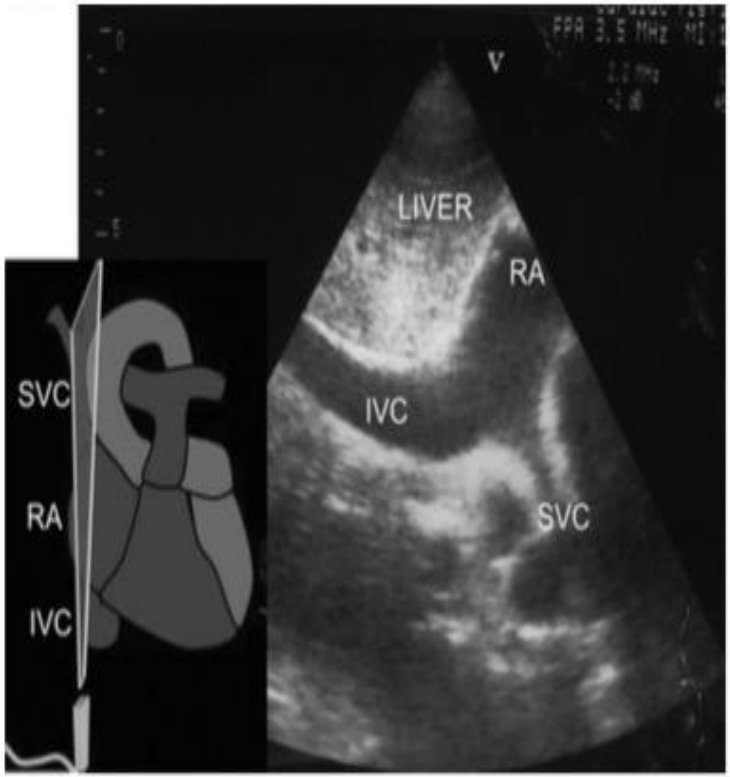
Apical Views





4 chamber view

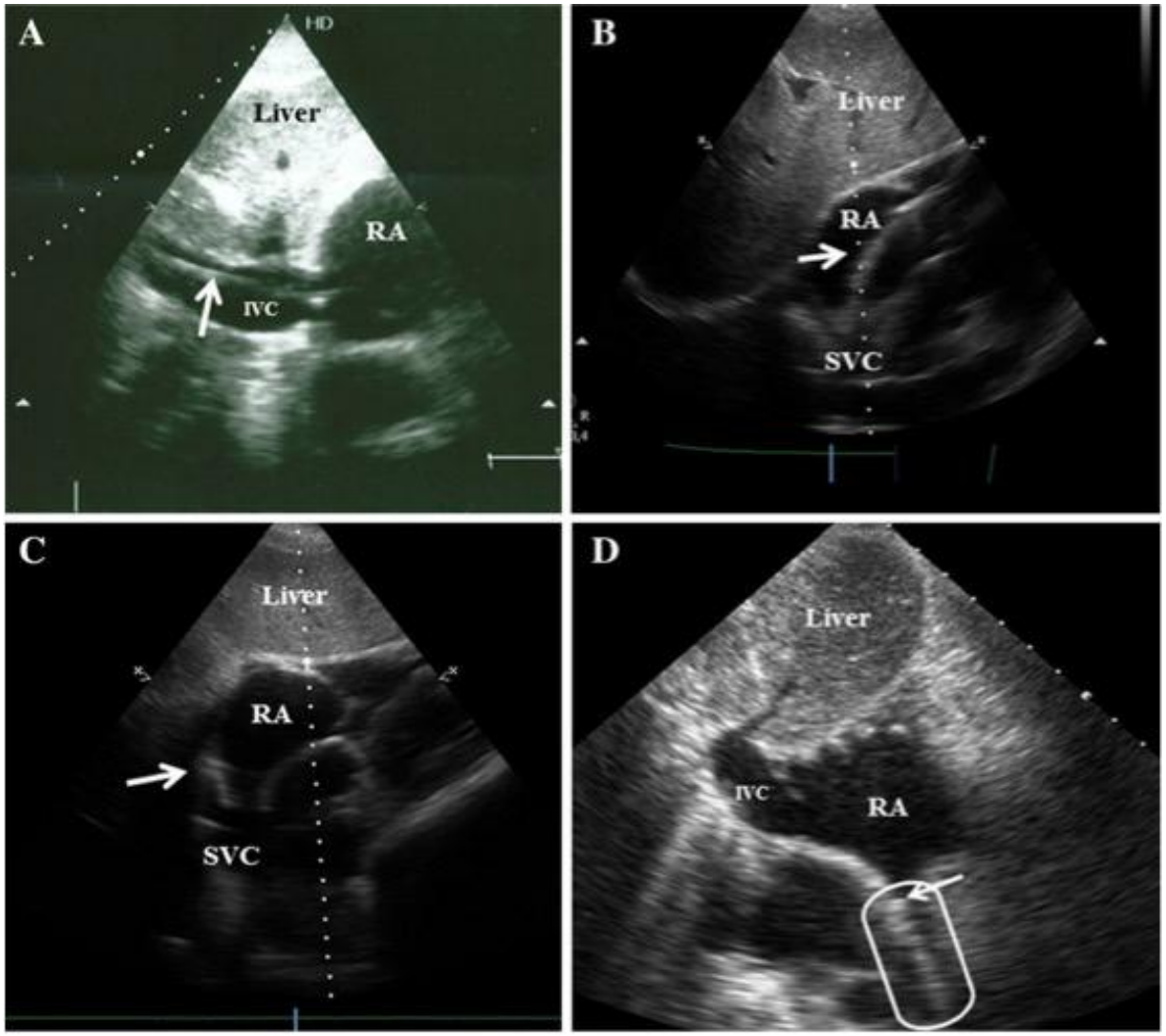


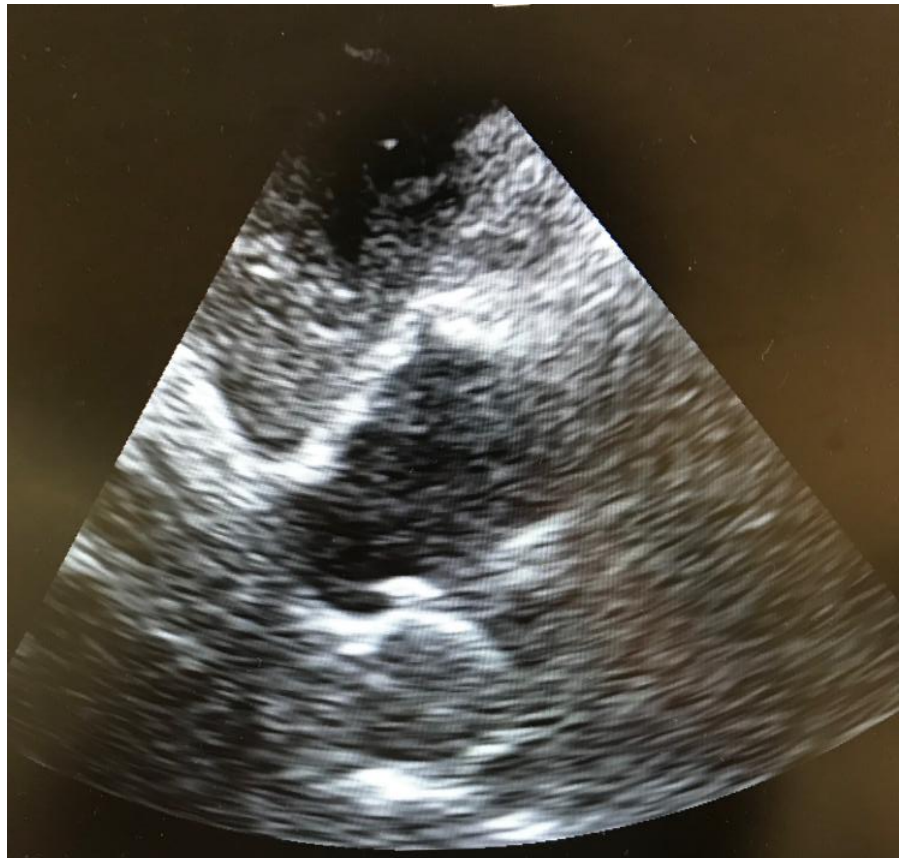


Ultrasound localization of central vein catheter and detection of postprocedural pneumothorax: An alternative to chest radiography*

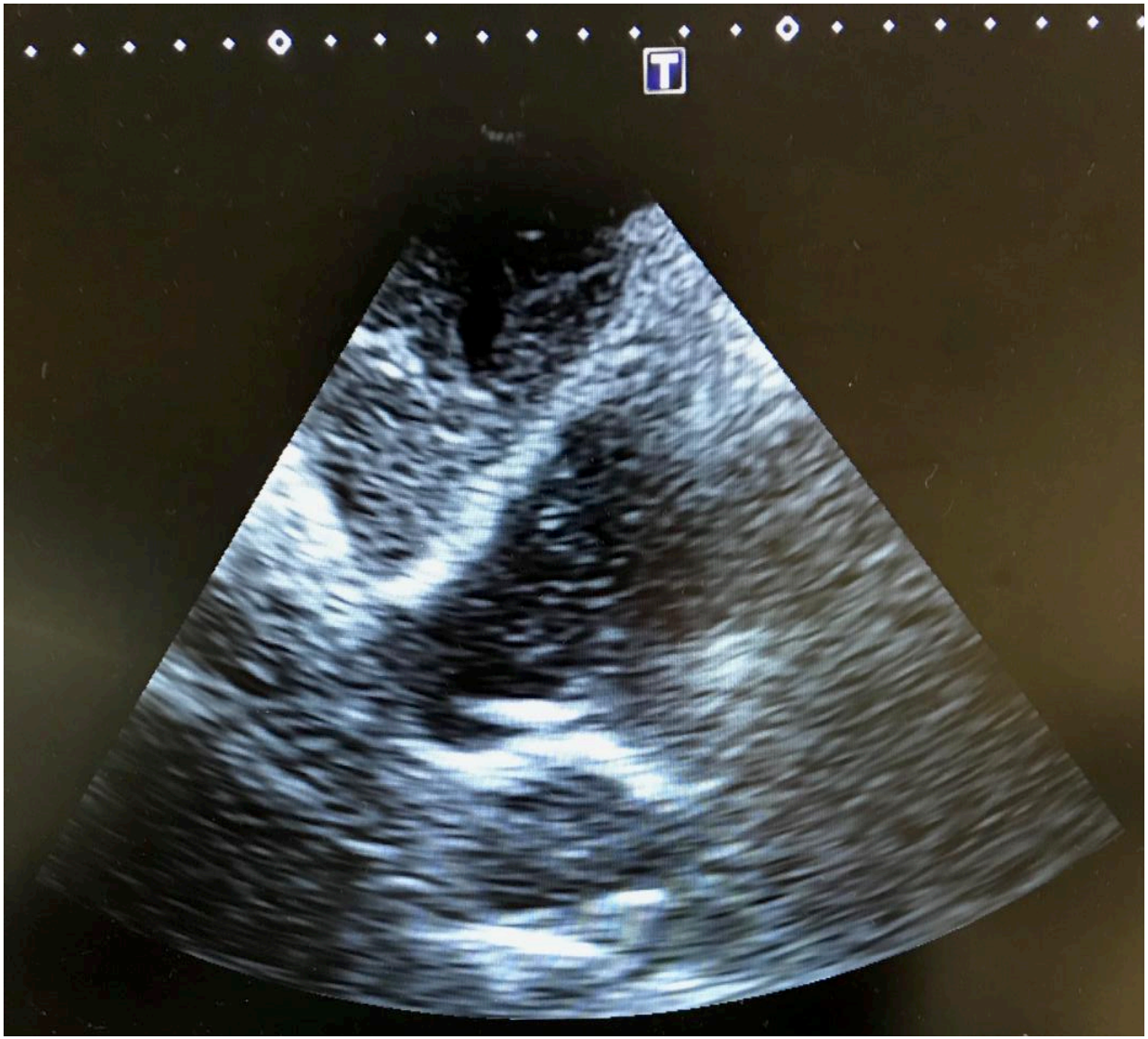
Antonella Vezzani, MD; Claudia Brusasco, MD; Salvatore Palermo, MD; Claudio Launo, MD; Mario Mergoni, MD; Francesco Corradi, MD, PhD

Crit Care Med 2010 Vol. 38, No. 2





Bedel et al. Intensive Care Med (2013) 39:1932–1937

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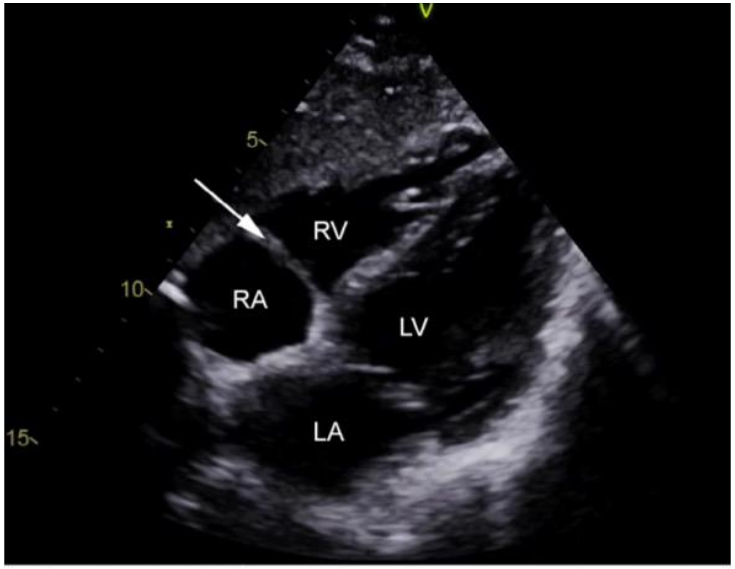
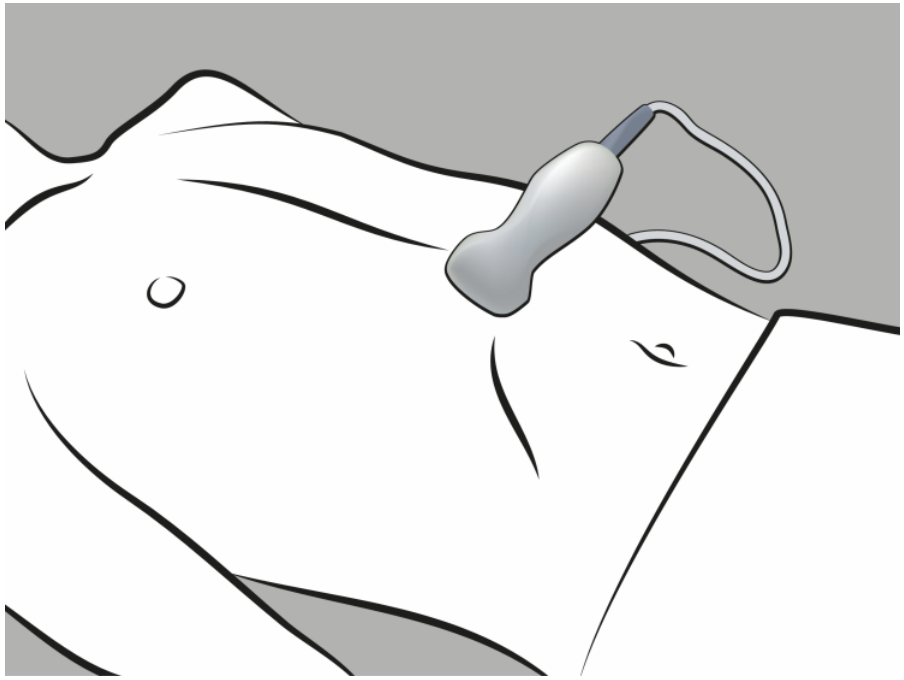
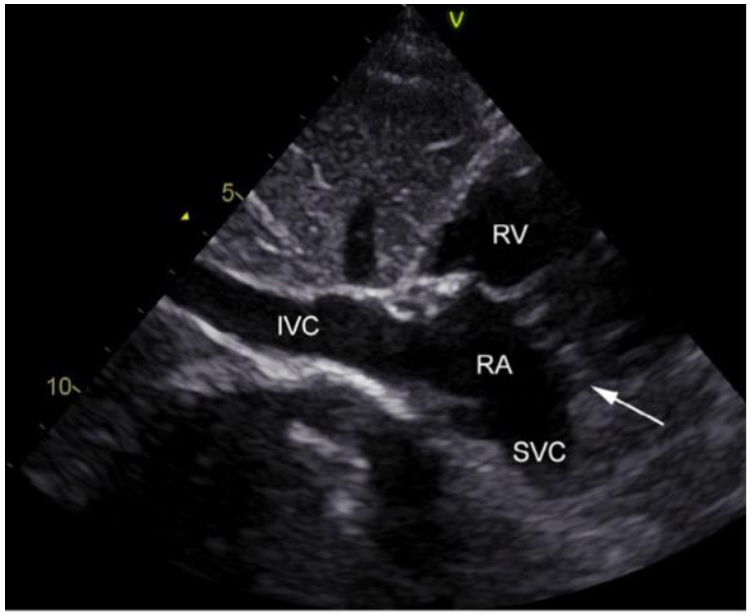
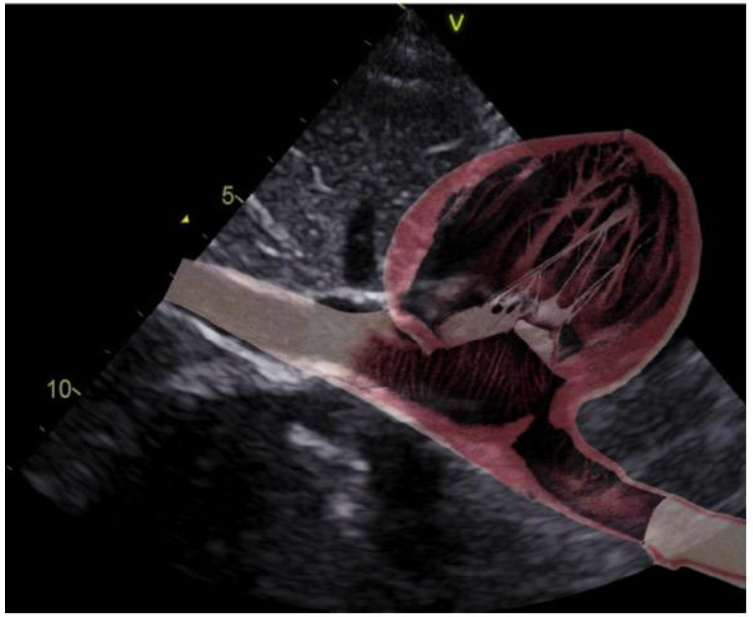

5
10
15
RV
RA
LV
LA

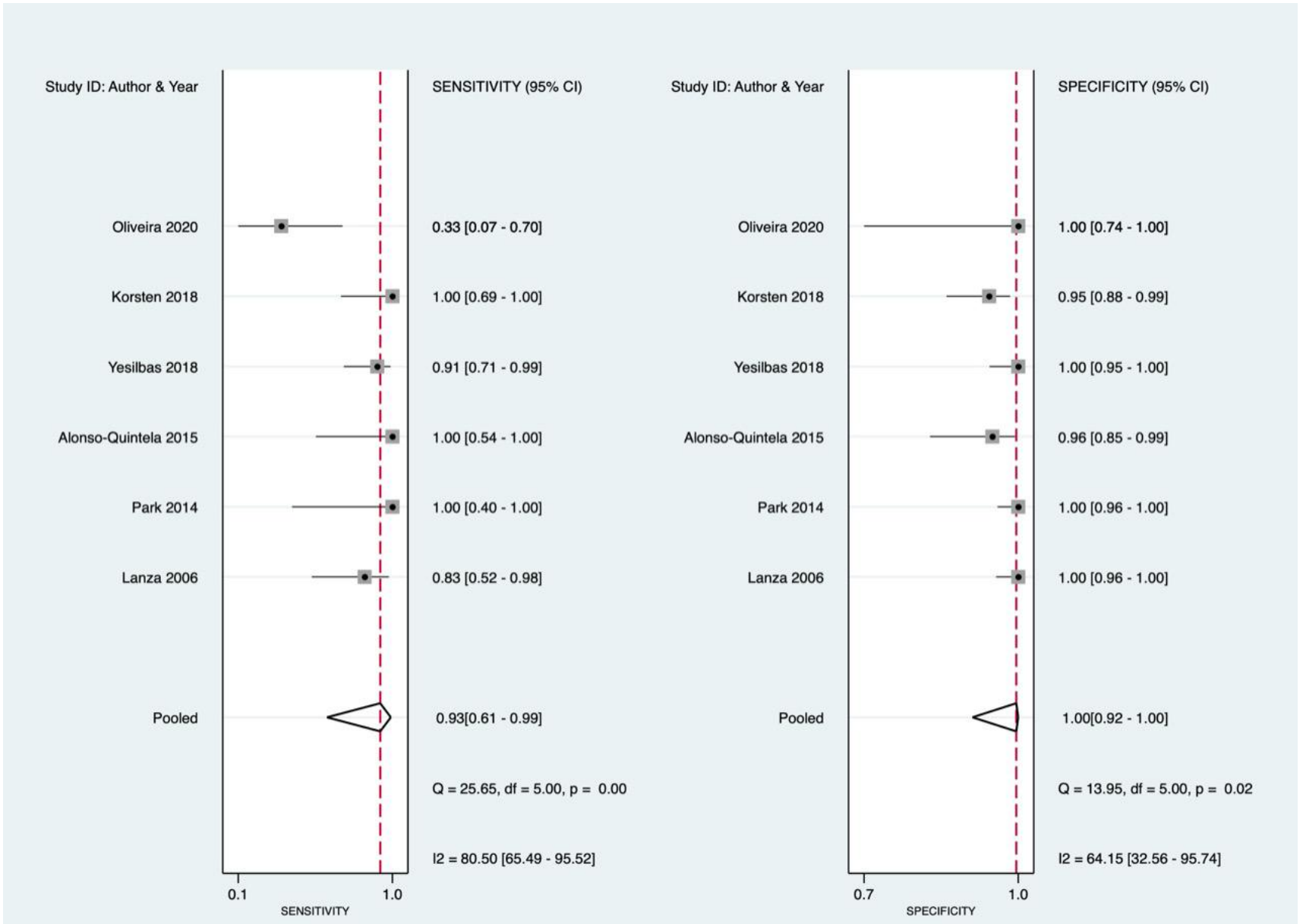

5
10
15




V
5
10
RV
IVC
RA
SVC


V
5
10

STUDY	SAMPLE SIZE	PROTOCOL	PROBE	VIEWS
LANZA 2006	107	Tip navigation Tip location + 'bubble' test	Linear Convex Convex	Short axis of neck veins Coronal view of SVC Subcostal 4-chambers view
PARK 2014	106	Tip location, no 'bubble'	Small Sectorial	Right parasternal in long and short axis
ALONSO-QUINTELA 2015	40	Tip navigation Tip location	Linear Small Sectorial Small Sectorial	Short and long axis view of IJV, SV, BCV and FV Coronal view of SVC (for CICC) Subcostal Longitudinal View of IVC (for FICC) Subcostal bi-caval or right parasternal (as alternative)
YESILBAS 2018	77	Tip location + 'bubble' test	Small Sectorial	Subcostal 4-chambers or apical 4-chambers (as alternative)
KORSTEN 2018	100	Tip location + 'bubble' test	Small Sectorial	Subcostal 4-chambers or apical 4-chambers (as alternative)
OLIVEIRA 2020	21	Tip location + 'bubble' test	Convex	Apical 4-chambers


Study ID: Author & Year
SENSITIVITY (95% CI)
Oliveira 2020
0.33 [0.07 - 0.70]
Korsten 2018
1.00 [0.69 - 1.00]
Yesilbas 2018
0.91 [0.71 - 0.99]
Alonso-Quintela 2015
1.00 [0.54 - 1.00]
Park 2014
1.00 [0.40 - 1.00]
Lanza 2006
0.83 [0.52 - 0.98]
Pooled
0.93[0.61 - 0.99]
Q = 25.65, df = 5.00, p = 0.00
I2 = 80.50 [65.49 - 95.52]
0.1
1.0
SENSITIVITY
Study ID: Author & Year
SPECIFICITY (95% CI)
Oliveira 2020
1.00 [0.74 - 1.00]
Korsten 2018
0.95 [0.88 - 0.99]
Yesilbas 2018
1.00 [0.95 - 1.00]
Alonso-Quintela 2015
0.96 [0.85 - 0.99]
Park 2014
1.00 [0.96 - 1.00]
Lanza 2006
1.00 [0.96 - 1.00]
Pooled
1.00[0.92 - 1.00]
Q = 13.95, df = 5.00, p = 0.02
I2 = 64.15 [32.56 - 95.74]
0.7
1.0
SPECIFICITY

Neo-ECHOTIP: A structured protocol for ultrasound-based tip navigation and tip location during placement of central venous access devices in neonates

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

ECHOTIP: A structured protocol for ultrasound-based tip navigation and tip location during placement of central venous access devices in adult patients

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

ECHOTIP-Ped: A structured protocol for ultrasound-based tip navigation and tip location during placement of central venous access devices in pediatric patients

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

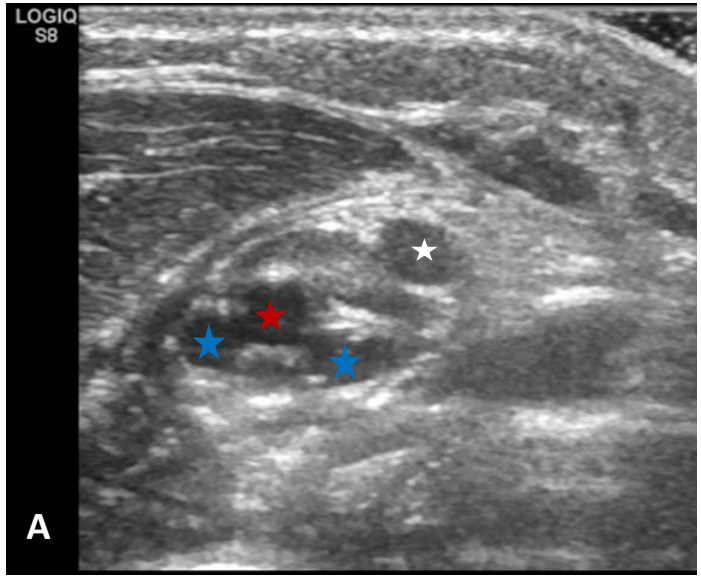
JVA The Journal of Vascular Access

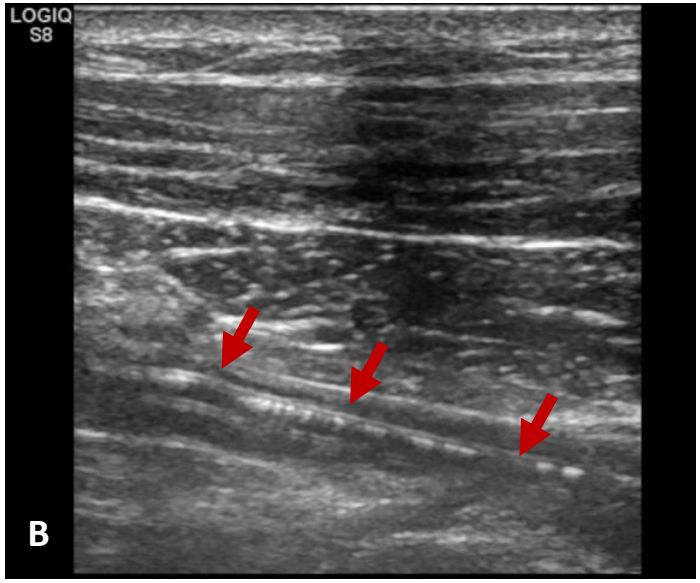
JVA | The Journal of Vascular Access

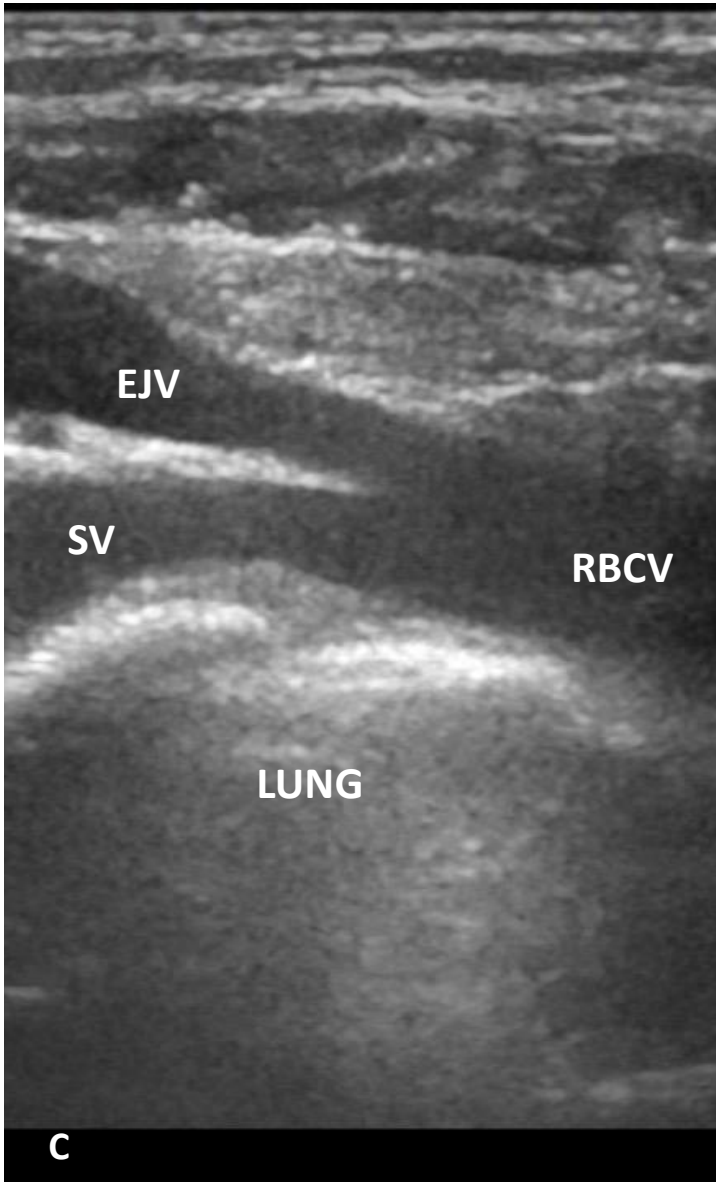
ECHOTIP-Ped: A structured protocol for ultrasound-based tip navigation and tip location during placement of central venous access devices in pediatric patients

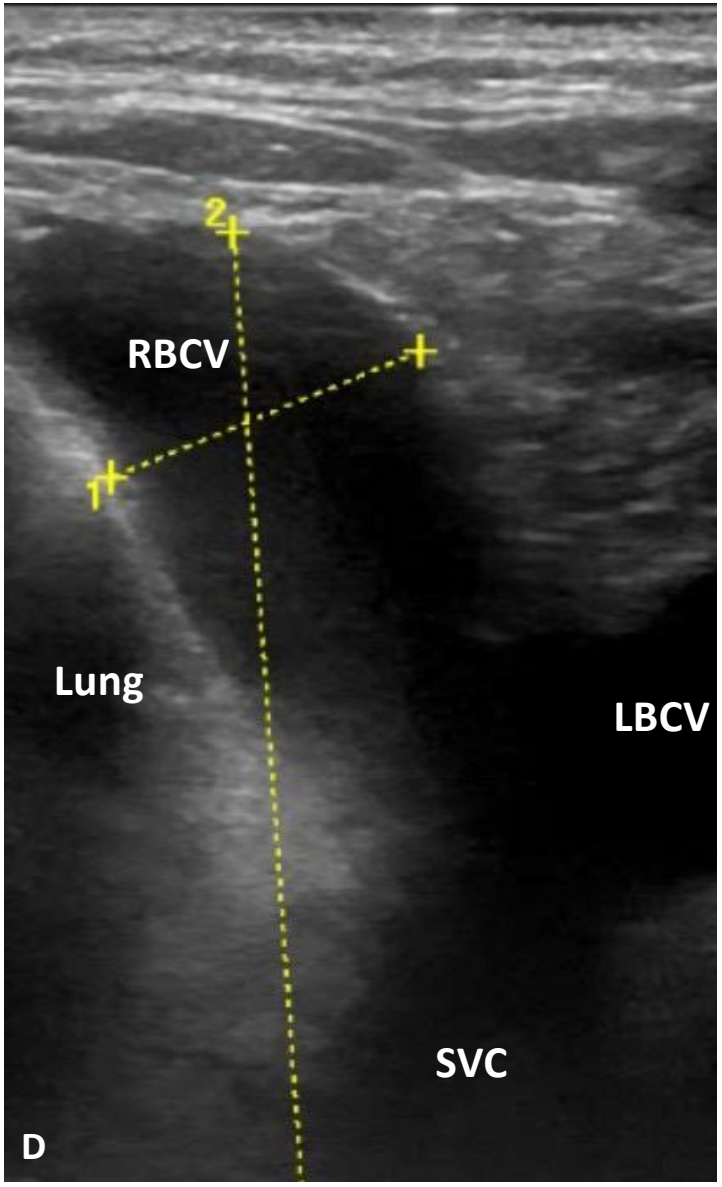
Geremia Zito Marinosci[1*], Daniele Guerino Biasucci[2*], Giovanni Barone[3], Vito D'Andrea[4], Daniele Elisei[5], Emanuele Iacobone[5], Antonio La Greca[6] and Mauro Pittiruti[6]

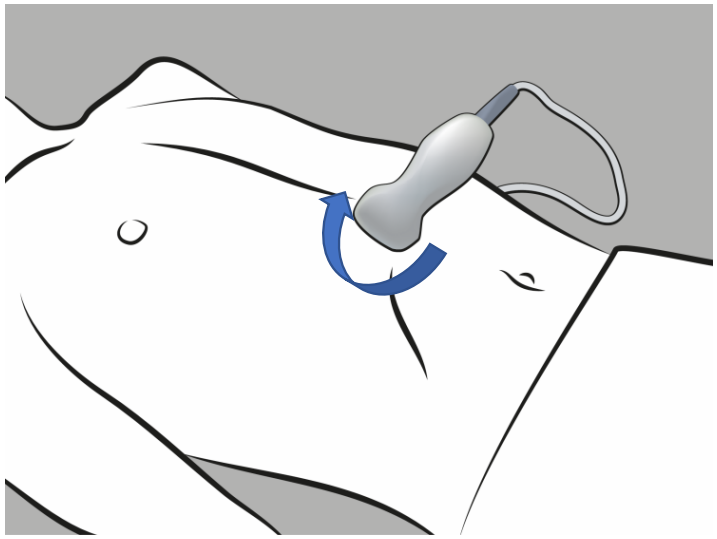
CVC	Protocol	Probe	Windows
CICC	Tip navigation	linear 'hockey stick' probe, 10-14 MHz	Same acoustic windows as RaCeVA
	Tip location	micro-convex probe, 4-8 MHz, or small sectorial probe, 3-7 MHz	Subcostal bi-caval view (recommended) or 4-chambers apical view (as alternative option)
PICC	Tip navigation	linear 'hockey stick' probe, 10-14 MHz	Same acoustic windows as RaPeVA and RaCeVA
	Tip location	micro-convex probe, 4-8 MHz, or small sectorial probe, 3-7 MHz	Subcostal bi-caval view (recommended) or 4-chambers apical view (as alternative option)
FICC	Tip navigation	linear 'hockey stick' probe, 10-14 MHz, or micro-convex probe, 4-8 MHz	Short + long axis views of the femoral vein and external iliac vein; and short + long axis views of IVC
	Tip location	micro-convex probe, 4-8 MHz	Subcostal longitudinal view of the IVC

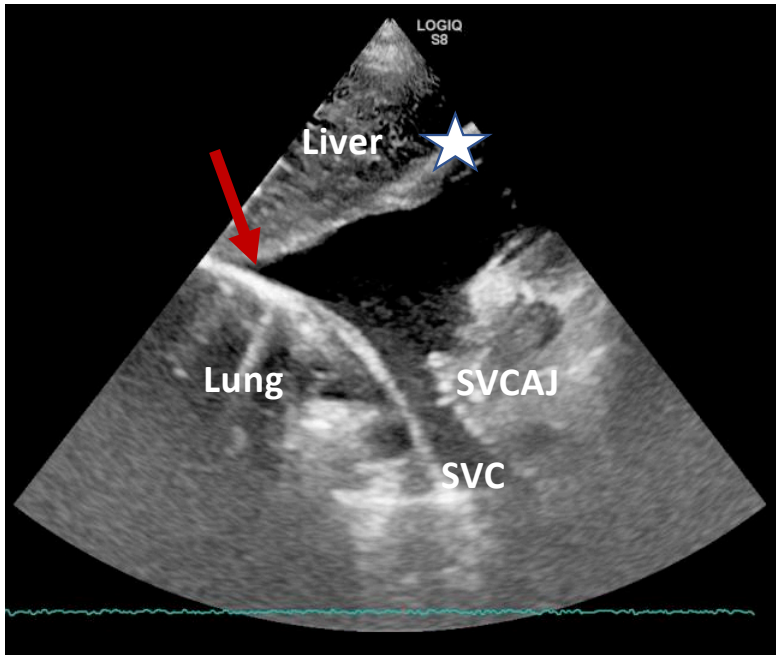

LOGIQ
S8
A

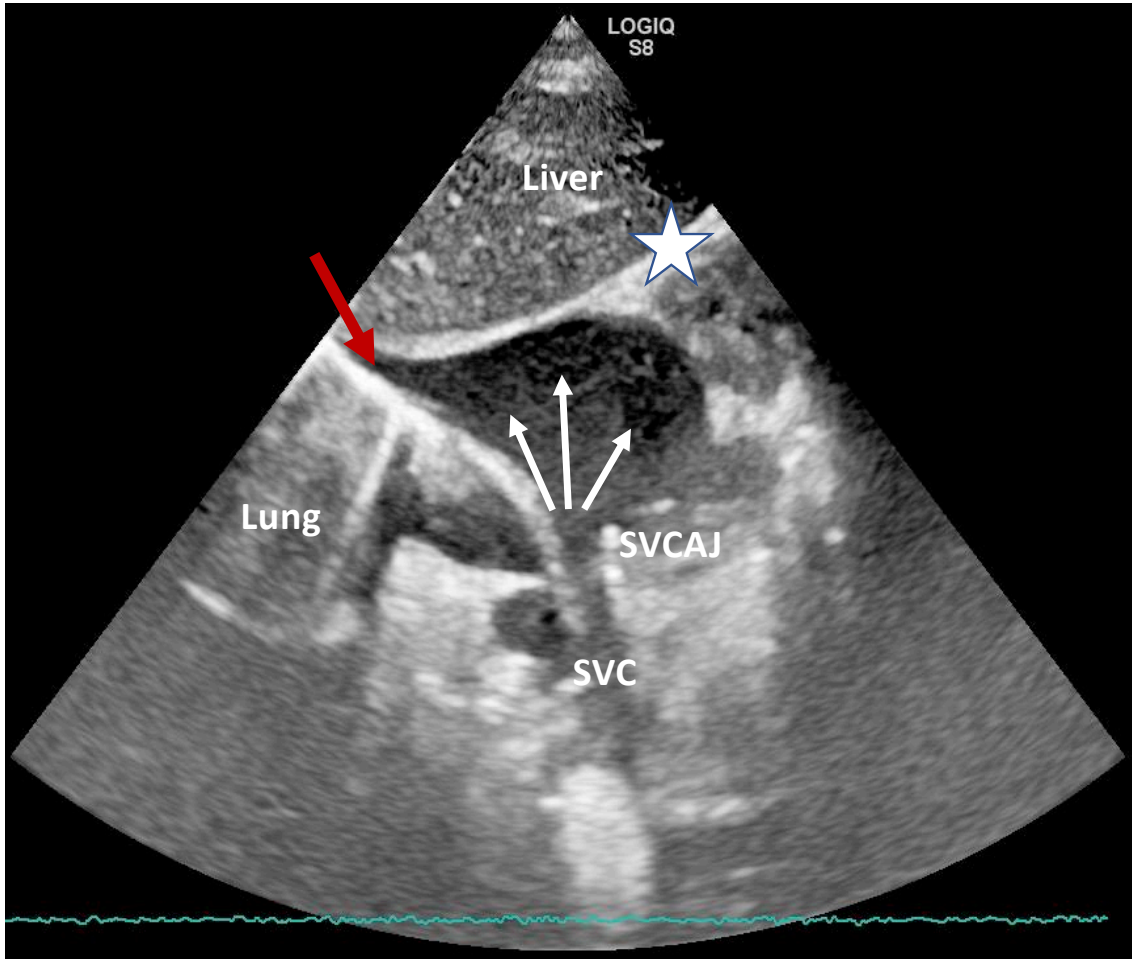

LOGIQ
S8
B

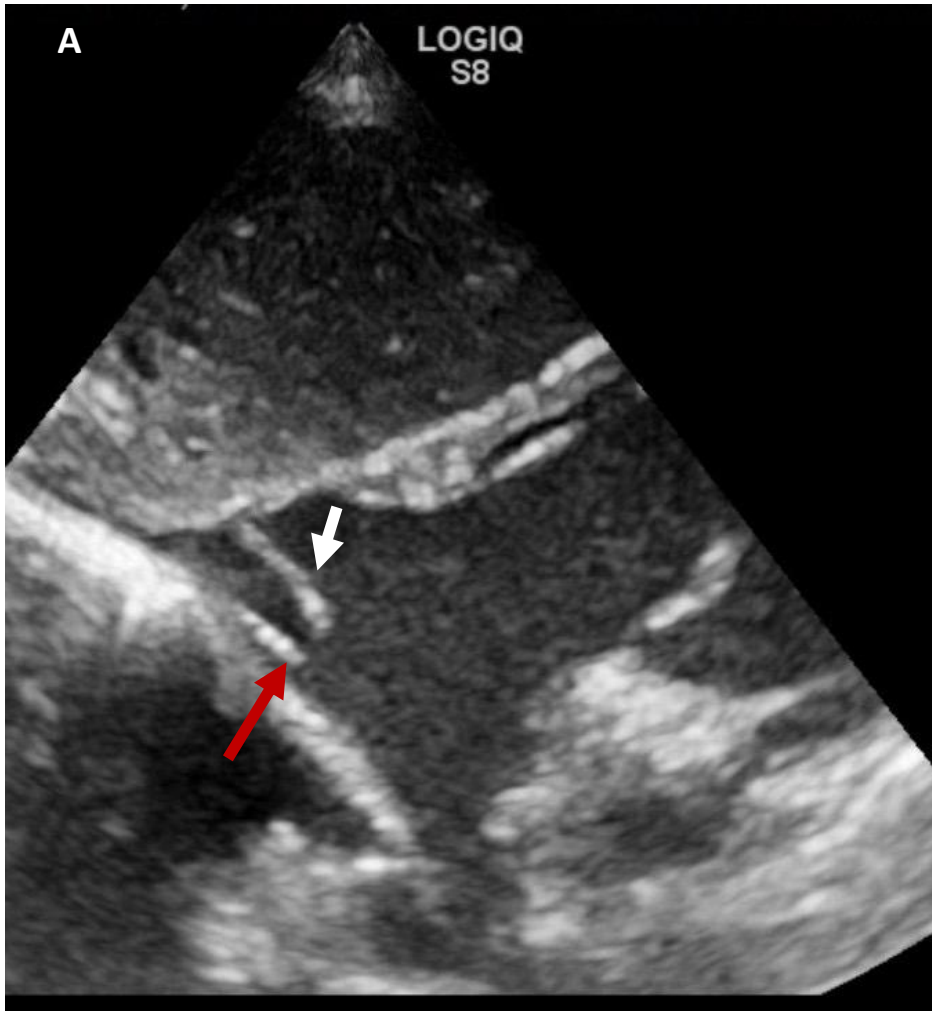

EJV
SV
RBCV
LUNG
C


2
RBCV
1
Lung
LBCV
SVC
D




LOGIQ
S8
Liver
Lung
SVCAJ
SVC


LOGIQ
S8
Liver
Lung
SVCAJ
SVC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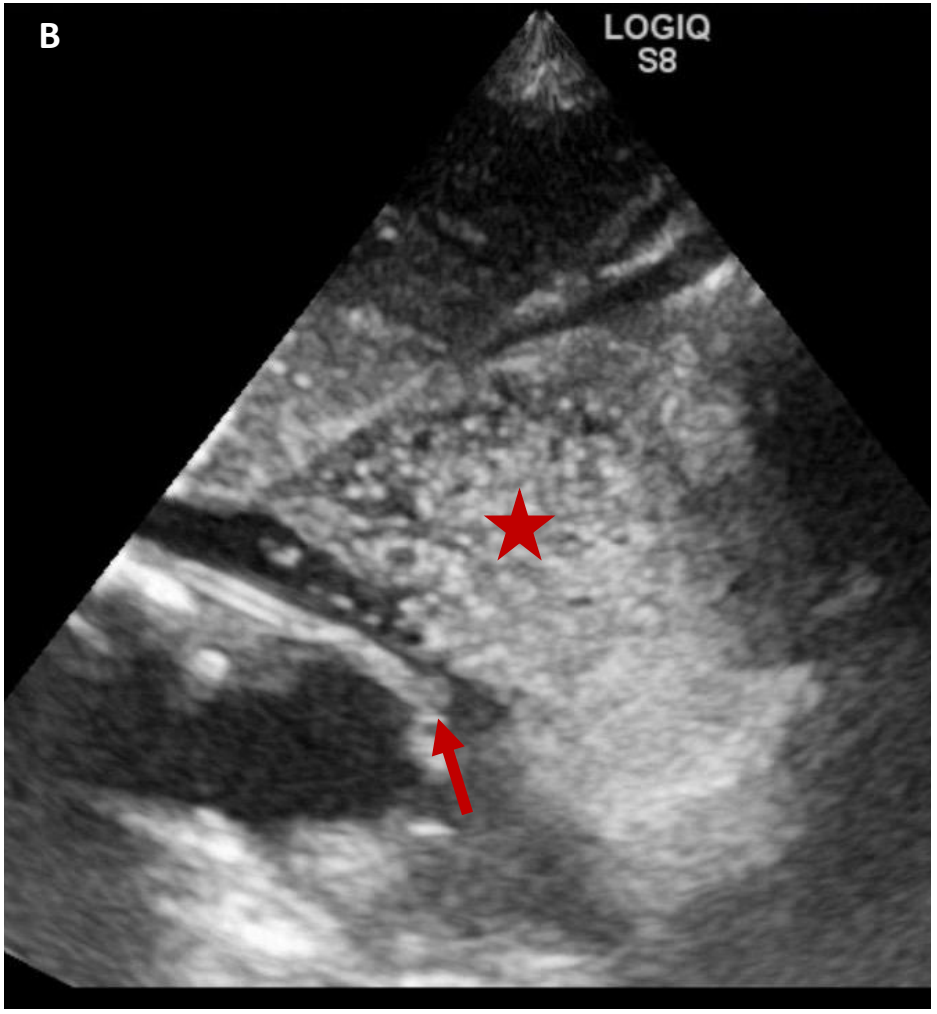

B
LOGIQ
S8

BUBBLE TEST…

Ultrasound localization of central vein catheter and detection of postprocedural pneumothorax: An alternative to chest radiography*

Antonella Vezzani, MD; Claudia Brusasco, MD; Salvatore Palermo, MD; Claudio Launo, MD;
Mario Mergoni, MD; Francesco Corradi, MD, PhD

Crit Care Med 2010; 38:533–538

Characteristics	Interpretation
No bubbles	Negative test: an aberrant or too distal tip position must be considered.
Few bubbles or appearance time >2 secs	Test to be repeated: if confirmed, possible misplacement (probably in the SV or IJV).
Numerous bubbles indistinguishable separately turbulent flow coming from atrium within 2 secs	Negative test; intra-atrial positioning.
Numerous bubbles indistinguishable separately linear flow coming from superior vena cava within 2 secs	Positive test: CVC tip correctly placed in the SVC.

Academic Emergency Medicine
Official Journal of the Society for Academic Emergency Medicine

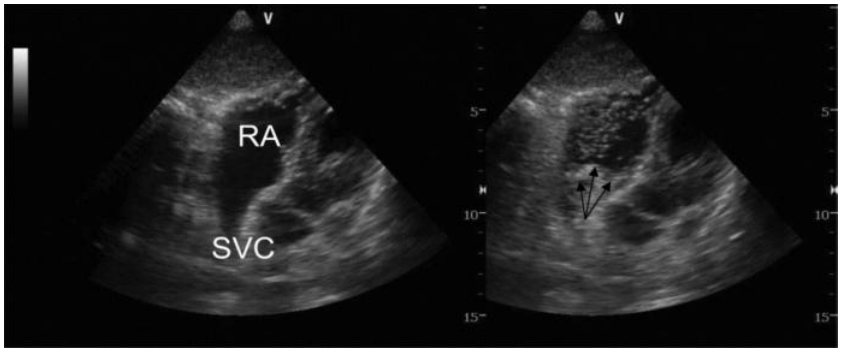
ORIGINAL RESEARCH CONTRIBUTION

Central Vascular Catheter Placement Evaluation Using Saline Flush and Bedside Echocardiography

Anthony J. Weekes, MD, David A. Johnson, MD, Stephen M. Keller, MD, Bradley Efune, MD, Christopher Carey, MD, Nigel L. Rozario, MS, and H. James Norton, PHD

The mean (±SD) times of onset of turbulence for CVC tips in proximal and distal SVC zones were 1.12 (±0.33) and 1.10 (±0.30) seconds, respectively.

2014



2015

Confirmation of correct central venous catheter position in the preoperative setting by echocardiographic "bubble-test"

M. MEGGIOLARO [1], A. SCATTO [1], A. ZORZI [2], E. ROMAN-POGNUZ [1]
A. LAURO [3], C. PASSARELLA [1], G. BONACCORSO [1]

sis, a cut off value of 500 ms had the highest diagnostic accuracy with a sensitivity of 100% (95% C.I. lower limit=60%) and a specificity of 99% (95% C.I. lower limit=84%) for CVC mal-position. The inter-observer agreement on a cut

Transthoracic echocardiography as bedside technique to verify tip location of central venous catheters in patients with atrial arrhythmia

Emanuele Iacobone[1], Daniele Elisei[1], Diego Gattari[1], Luigi Carbone[1] and Giuseppe Capozzoli[2]

When the tip was well positioned, the mean (±SD) time for onset of the bubble effect was 0.89 ± 0.33 s in patients with CICC and 1.1 ± 0.20 s in those with PICC; this time difference was not statistically significant ($p > 0.05$).

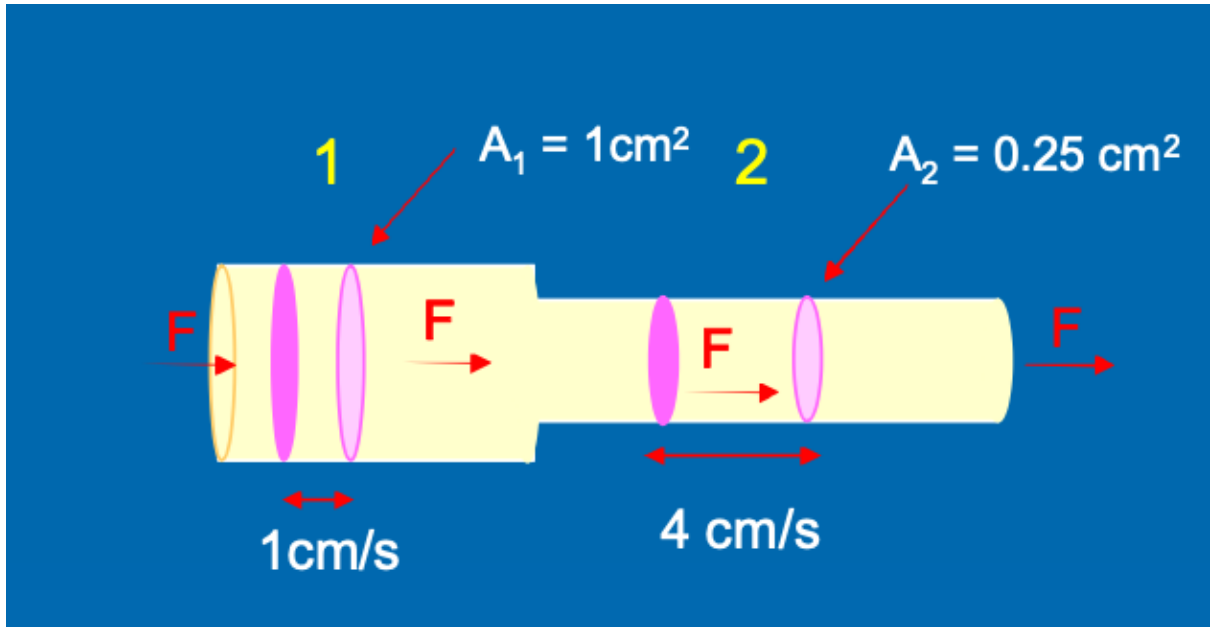
Conclusion

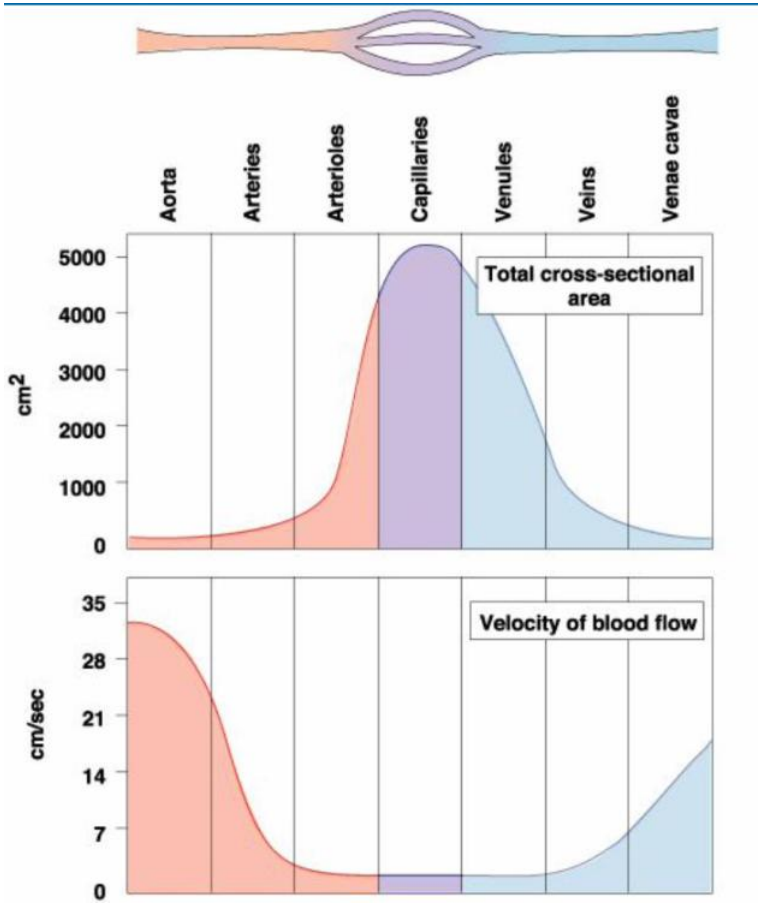
In conclusion, TTE with bubble test is feasible, safe, and accurate in verifying bedside correct tip location at the CAJ in patients with atrial arrhythmia. When the tip is in the correct position, the appearance of bubbles in the right atrium is immediate, and the time from the injection is much fewer than 2 s. Tip location by TTE can also be applied in PICC, but further studies may be needed to confirm its use in this type of catheter.

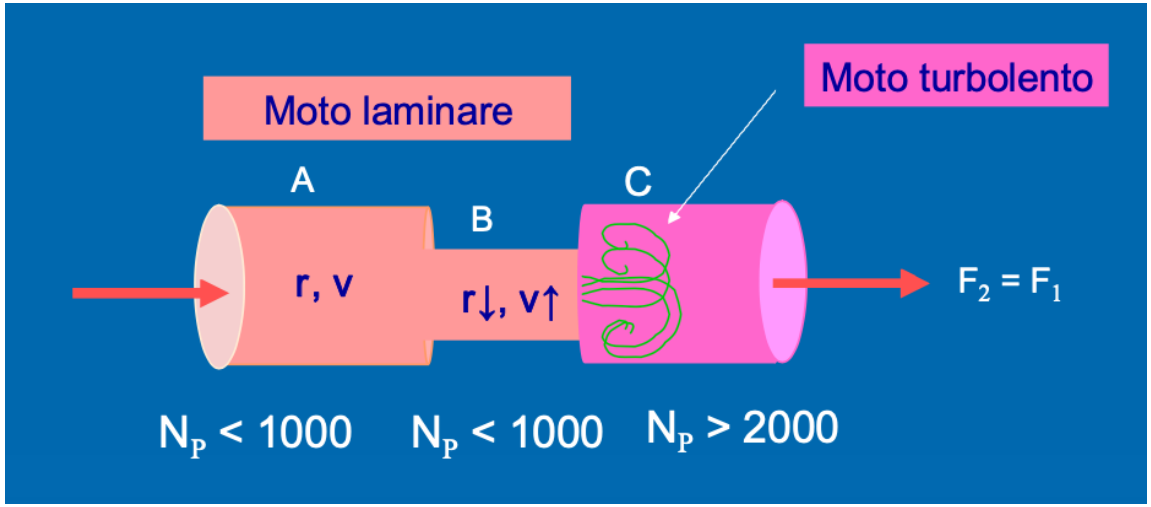
JVA The Journal of Vascular Access


Che confusione
nella mia testa!

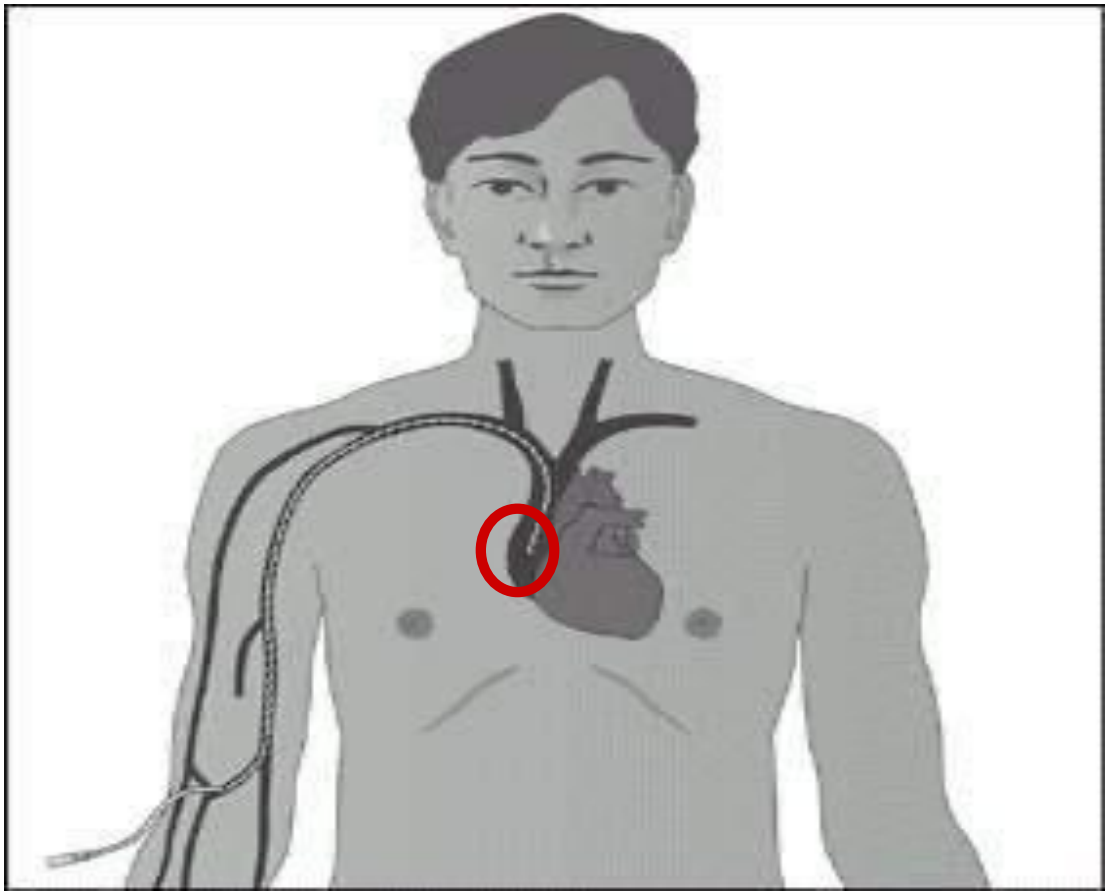
Blood is a NON-COMPRESSIBLE & NON-NEWTONIAN fluid

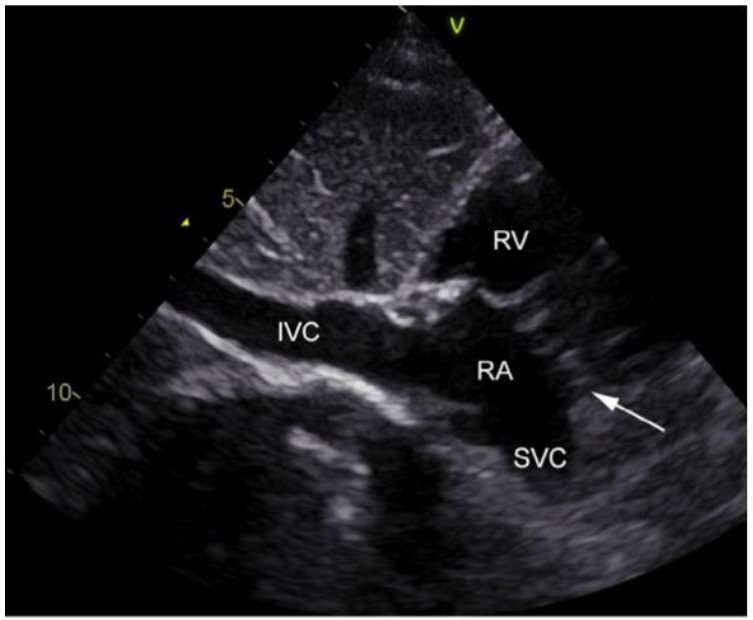


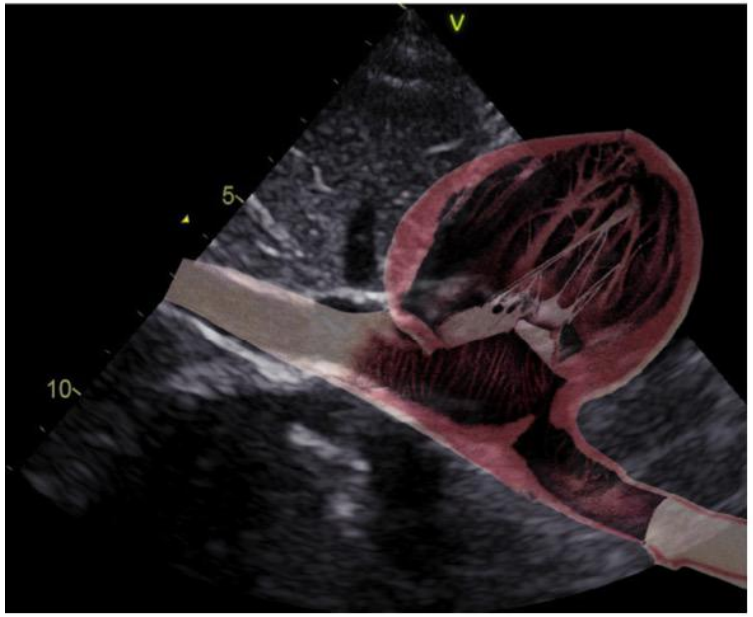



Moto laminare
Moto turbolento
A
B
C
r, v
r↓, v↑
F2 = F1
NP < 1000
NP < 1000
NP > 2000

Tip location







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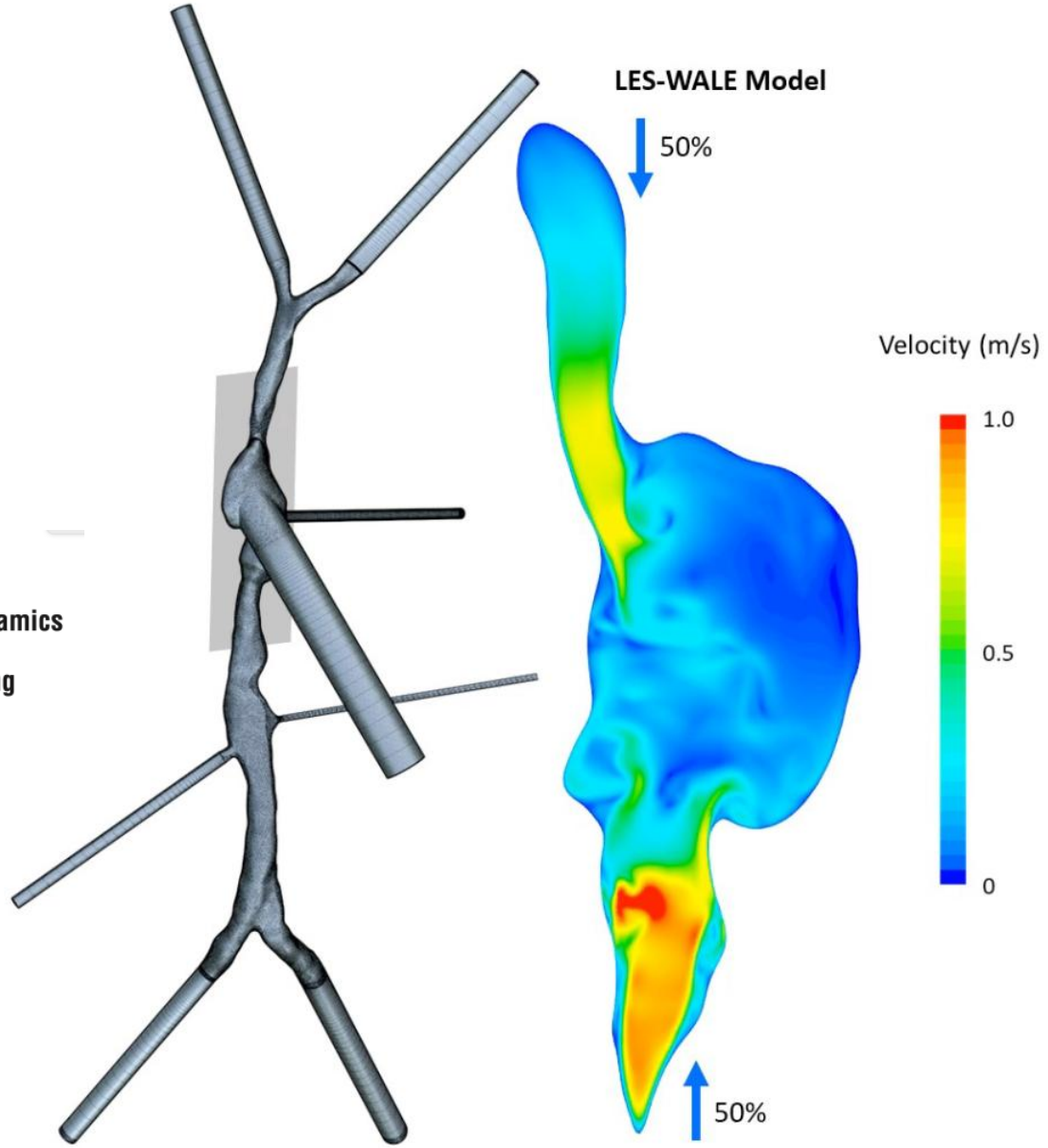
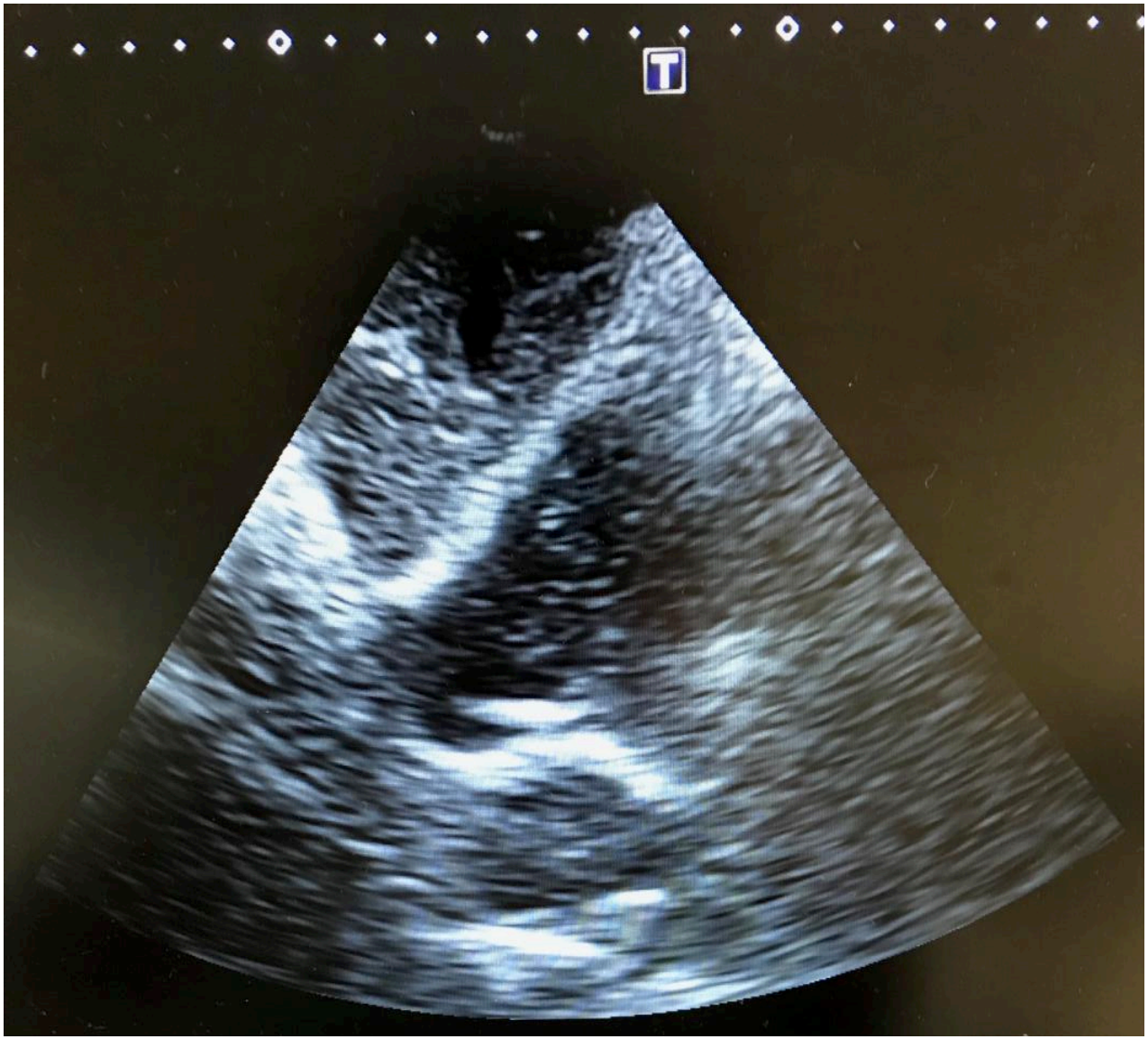
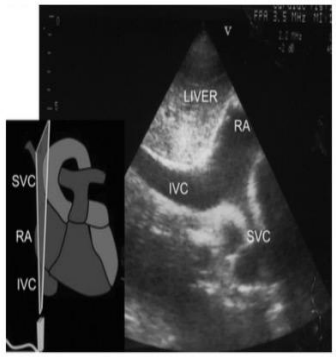
Stockholm 141 57, Sweden

Torkel B. Brismar

Computational Fluid Dynamics of the Right Atrium: A Comparison of Modeling Approaches in a Range of Flow Conditions







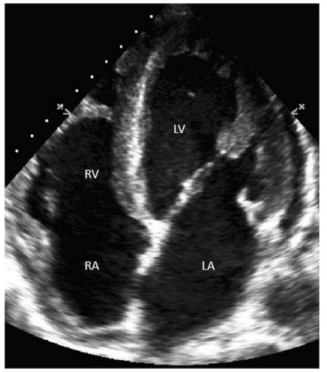
Corradi *et al. Critical Care* (2022) 26:113
https://doi.org/10.1186/s13054-022-03985-3

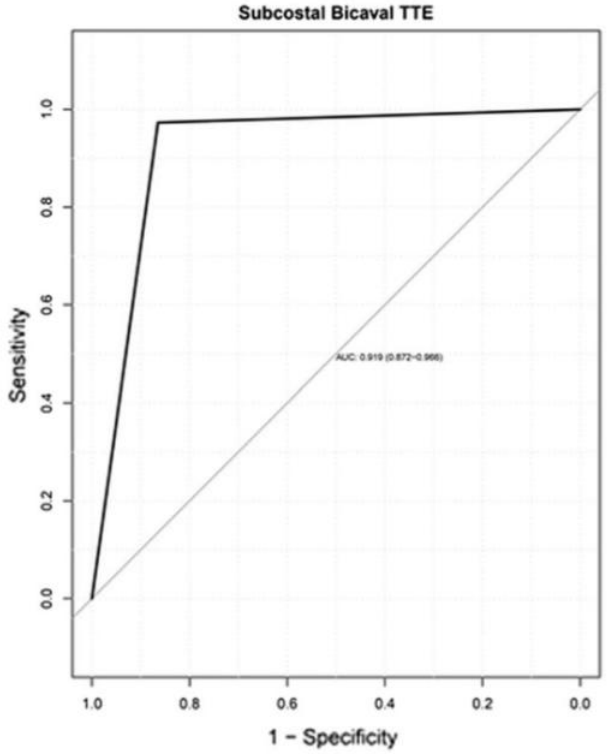
Critical Care

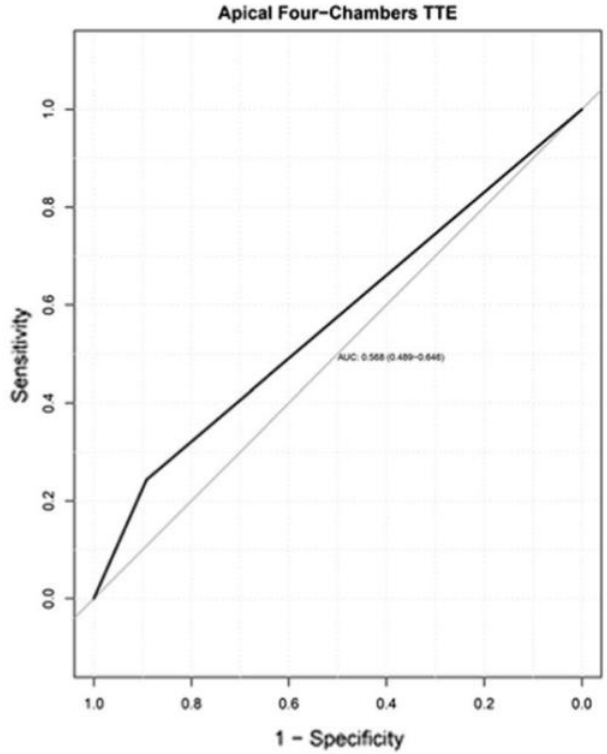
RESEARCH Open Access

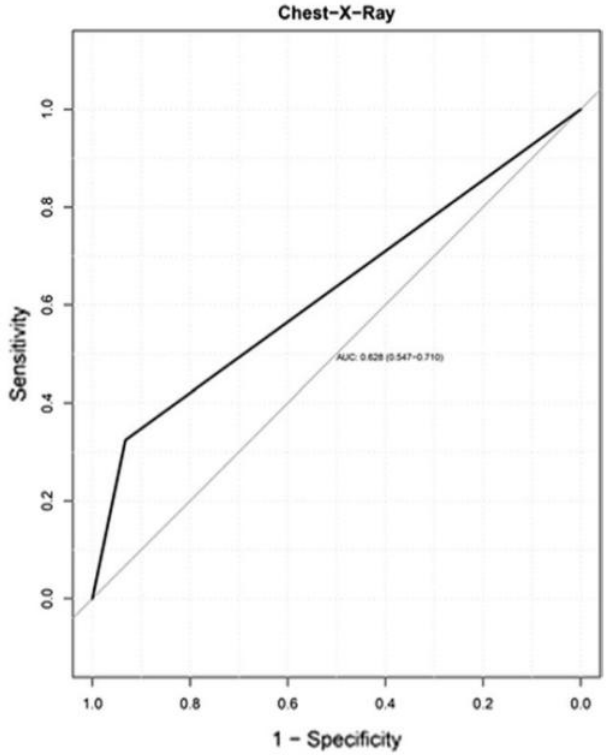
Ultrasound localization of central vein catheter tip by contrast-enhanced transthoracic ultrasonography: a comparison study with trans-esophageal echocardiography

Francesco Corradi[1,10*], Fabio Guarracino[2], Gregorio Santori[3], Claudia Brusasco[4], Guido Tavazzi[5,6], Gabriele Via[7], Silvia Mongodi[6], Francesco Mojoli[5,6], Raffaello Umberto Dario Biagini[1], Alessandro Isirdi[1], Federico Dazzi[1], Chiara Robba[3,8], Luigi Vetrugno[9] and Francesco Forfori[1] on behalf of UCARE research group





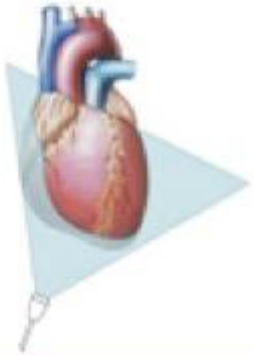


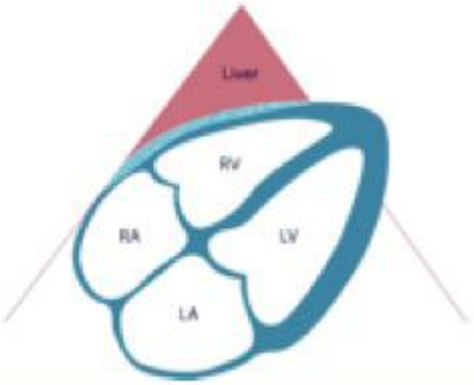


Bubble test?

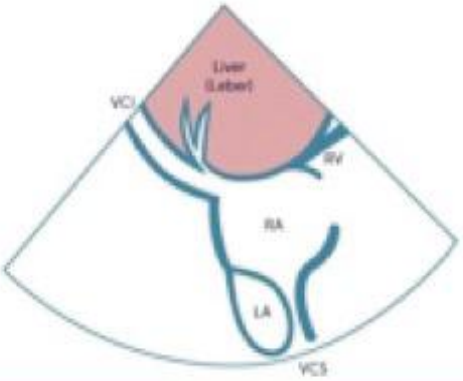
- Which is the optimal cut-off time?
- Should we deal still with a ‘cut-off’ time or better with the optimal view associated with a specific range of cut-off time?
  - Which cut-off time for subcostal 4 Ch view?
  - Which one for apical 4 Ch view?
- Which kind of diagnostic accuracy?
  - Positive or Negative Predictive Value?

Subcostal Views



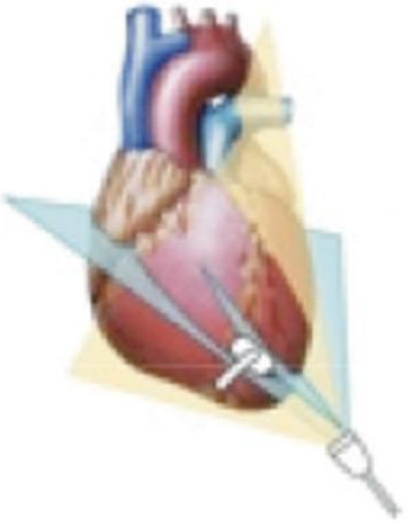


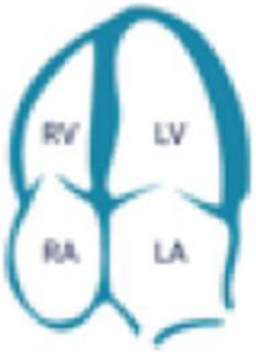
Subcostal 4 chamber view



Vena cava inferior view

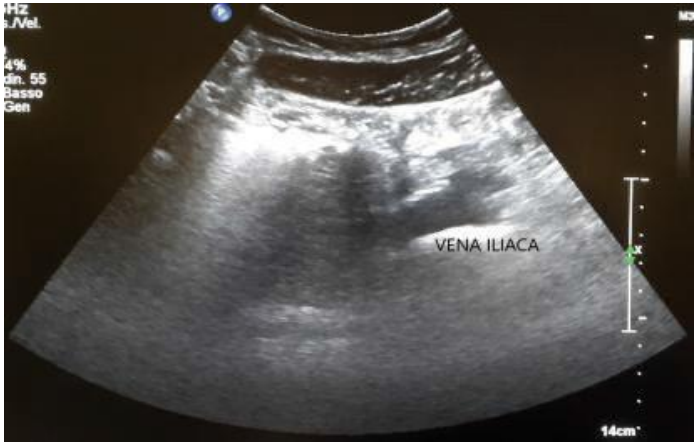
Apical Views





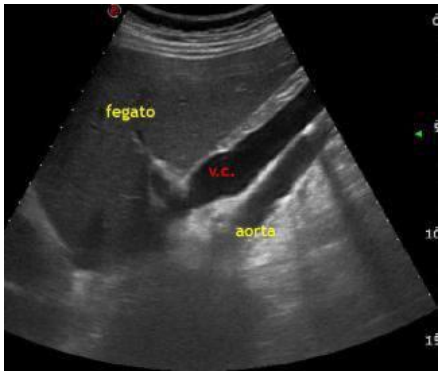
4 chamber view


VENA ILIACA


VENA ILIACA
14cm


VCI
IVC


IVC


fegato
v.c.
aorta

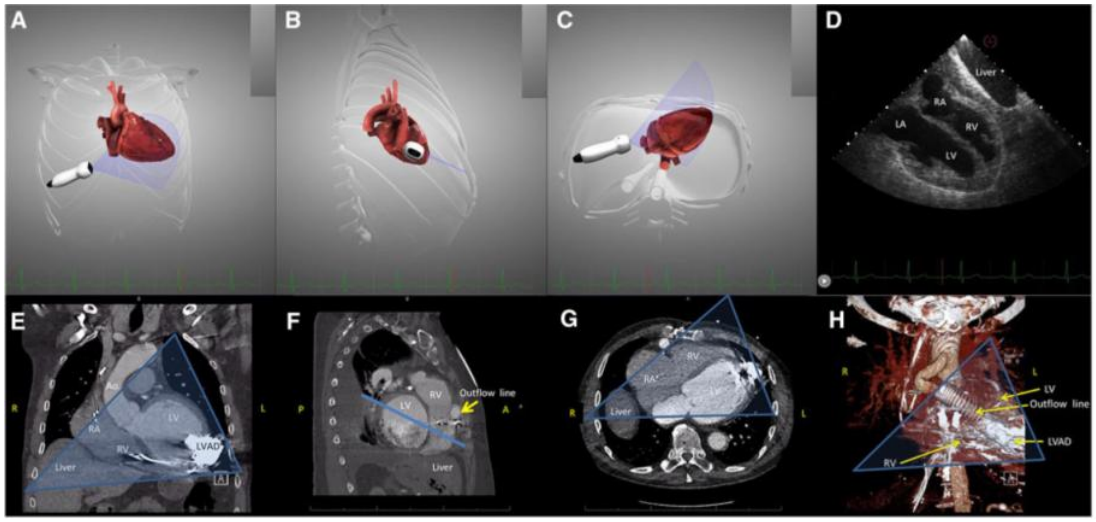

FEGATO
VCI
ATRIO DX

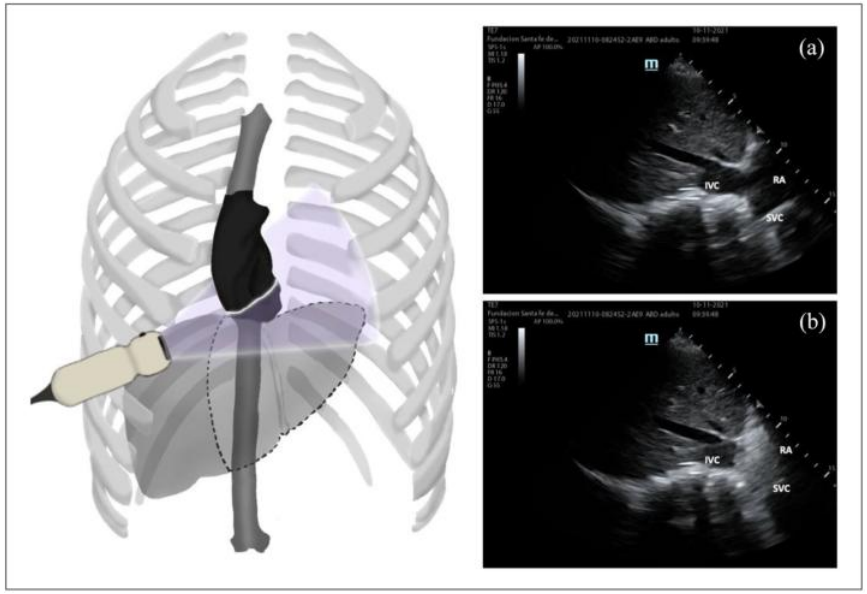

VCI

ESC European Society of Cardiology
European Heart Journal - Cardiovascular Imaging (2020) **21**, 491–497
doi:10.1093/ehjci/jeaa002

Transhepatic echocardiography: a novel approach for imaging in left ventricle assist device patients with difficult acoustic windows

Mihai Strachinaru *, Daniel J. Bowen, Alina Constatinescu, Olivier C. Manintveld, Jasper J. Brugts, Marcel L. Geleijnse, and Kadir Caliskan





Letter to the Editor

JVA The Journal of Vascular Access

Transhepatic right heart ultrasound for central venous catheter tip location in patients with difficult acoustic windows

The Journal of Vascular Access
1–3

DOI: 10.1177/11297298221122116
journals.sagepub.com/home/jva
SAGE

William F Amaya-Zúñiga[1], Viviana Mojica-Manrique[2], Ricardo Vergara-Escudero[3] and Sebastian Amaya[4]

Can J Anesth/J Can Anesth (2018) 65:427–436
https://doi.org/10.1007/s12630-018-1049-7

REVIEW ARTICLE/BRIEF REVIEW

How to Train?

Acquiring and maintaining point-of-care ultrasound (POCUS) competence for anesthesiologists

L'acquisition et le maintien des compétences en échographie au chevet (POCUS) pour les anesthésiologistes

T. Jared McCormick, MD · Elizabeth Clarke Miller, MD · Robert Chen, MD · Viren N. Naik, MD, MEd, MBA

Examination	Views
Basic critical care echocardiography	Parasternal long axis
	Parasternal short axis
	Apical four-chamber view
	Sub-xiphoid four-chamber view
	Inferior vena cava-long axis
Lung and pleura	Anterior chest wall
	Anterolateral chest wall
	Posterosuperior chest wall
	Posteroinferior chest wall
Abdominal free fluid	Right upper quadrant view
	Left upper quadrant view
	Suprapubic view
Guidance for vascular access	Short axis of vessel and surrounding structures
	Long axis of vessel with guidewire *in situ*

Point-of-Care Ultrasound in General Practice: A Systematic Review

Camilla Aakjær Andersen, MD[1]
Sinead Holden, PhD[1,2,3]
Jonathan Vela, MD[4]
Michael Skovdal Rathleff, PhD[1]
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[2]Center for Neuroplasticity and Pain (CNAP), Aalborg East, Denmark

[3]Center for Sensory-Motor Interaction (SMI), Department of Health Science and Technology, Faculty of Medicine, Aalborg University, Aalborg, Denmark

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ABSTRACT

PURPOSE Ultrasound examinations are currently being implemented in general practice. This study aimed to systematically review the literature on the training in and use of point-of-care ultrasound (POCUS) by general practitioners.

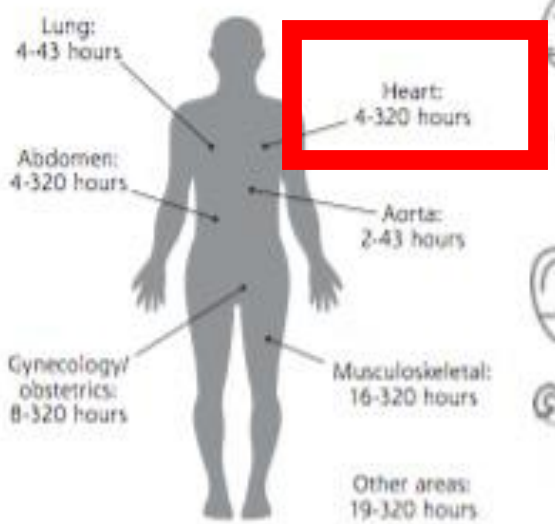
METHODS We followed the Cochrane guidelines for conduct and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for reporting. We searched the databases MEDLINE (via PubMed), EMBASE, CINAHL, Web of Science, and Cochrane Central Register of Controlled Trials using the key words *ultrasonography* and *general practice* in combination and using thesaurus terms. Two reviewers independently screened articles for inclusion, extracted data, and assessed the quality of included studies using an established checklist.

RESULTS We included in our review a total of 51 full-text articles. POCUS was applied for a variety of purposes, with the majority of scans focused on abdominal and obstetric indications. The length of training programs varied from 2 to 320 hours. Competence in some types of focused ultrasound scans could be attained with only few hours of training. Focused POCUS scans were reported to have a higher diagnostic accuracy and be associated with less harm than more comprehensive scans or screening scans. The included studies were of a low quality, however, mainly because of issues with design and reporting.

CONCLUSIONS POCUS has the potential to be an important tool for the general practitioner and may possibly reduce health care costs. Future research should aim to assess the quality of ultrasound scans in broader groups of general practitioners, further explore how these clinicians should be trained, and evaluate the clinical course of patients who undergo scanning by general practitioners.

Ann Fam Med 2019;17:61-69. https://doi.org/10.1370/afm.2330.

Figure 3. Training in ultrasound examinations by anatomic area.

Training Time	Elements of Training	References
	 **Heart** Elements of training: lectures: 5 studies; hands-on: 6 studies; e-learning: 2 studies; case review: 2 studies; supervised scans: 2 studies; training in hospital: 2 studies	20-22, 27, 32, 39, 52, 58, 65, 67
	 **Lung** Elements of training: lectures: 2 studies; hands-on: 2 studies; e-learning: 1 study; case review: 1 study; supervised scans: 1 study; training in hospital: 1 study	22, 30, 32
	 **Aorta** Elements of training: lectures: 7 studies; hands-on: 6 studies; e-learning: 3 studies; case review: 3 studies; supervised scans: 6 studies; training in hospital: 3 studies	17, 19, 20, 22, 32, 37, 51, 57, 58, 62, 63, 65
	 **Abdomen** Elements of training: lectures: 6 studies; hands-on: 6 studies; e-learning: 1 study; case review: 2 studies; supervised scans: 4 studies; training in hospital: 4 studies	20, 25, 28, 31-33, 37, 51, 57, 62, 63, 65
	 **Gynecology/obstetrics** Elements of training: lectures: 9 studies; hands-on: 9 studies; e-learning: 2 studies; case review: 3 studies; supervised scans: 7 studies; training in hospital: 8 studies	20, 23, 24, 35, 36, 40, 45, 46, 49-51, 55-57, 60-62, 64
	 **Musculosketal** Elements of training: lectures: 1 study; hands-on: 2 studies; e-learning: 1 study; case review: 1 study; training in hospital: 1 study	20, 24, 62
	 **Other areas** Elements of training: e-learning: 1 study; case review: 2 studies; supervised scans: 1 study; training in hospital: 1 study	22, 24, 62

Note: Icons made by Freepik from www.flaticon.com.

Emergency Medicine Australasia (2008) **20**, 32–37 doi: 10.1111/j.1742-6723.2007.01039.x

ORIGINAL RESEARCH

EMA

How fast is the focused assessment with sonography for trauma examination learning curve?

O John Ma,[1] Gary Gaddis,[2] Jeffrey G Norvell[3] and Srikala Subramanian[2]
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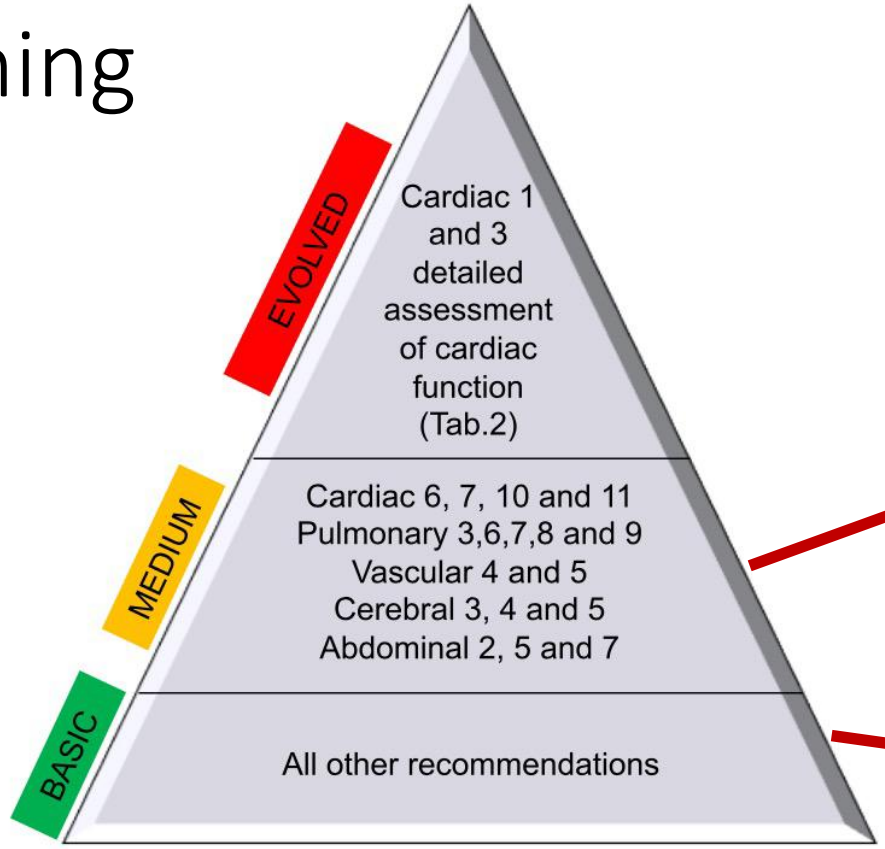
[2]Department of Emergency Medicine, University of Missouri–Kansas City School of Medicine,
[3]Division of Emergency Medicine, University of Kansas School of Medicine, Kansas City, Kansas, USA

Table 1. Accuracy of FAST examination interpretation at baseline, 6 months, 12 months and 18 months for examinations with varying sizes of AS

	Accuracy percentage (95% CI)			
	Baseline	6 months	12 months	18 months
No AS	79.8 (70.3–86.9)	85.9 (77.1–91.8)	91.9 (84.2–96.2)	92.9 (85.5–96.9)
Small AS	27.8 (10.7–53.6)	50.0 (26.8–73.2)	66.7 (41.2–85.7)	72.2 (46.4–89.3)
Medium AS	63.0 (42.5–79.9)	80.6 (63.4–91.2)	86.1 (69.7–94.8)	91.7 (76.4–97.8)
Large AS	77.8 (57.3–90.6)	92.6 (74.2–98.7)	85.2 (65.4–95.2)	100.0 (84.5–100)
Cardiac view	80.0 (64.9–89.9)	86.7 (72.5–94.5)	91.1 (77.9–97.1)	91.1 (77.9–97.1)
RUQ view	77.8 (62.5–88.3)	91.1 (77.9–97.1)	95.6 (83.6–99.2)	95.6 (83.6–99.2)
LUQ view	64.4 (48.7–77.7)	77.8 (62.5–88.3)	80.0 (64.9–89.9)	82.2 (67.4–91.5)
Pelvic view	66.7 (50.9–79.6)	73.3 (57.8–84.9)	82.2 (67.4–91.5)	97.8 (86.8–99.9)
Mean number FAST per EM resident	0	13	35	73

ESPNIC Guidelines Training



Posizionamento PICC
Tip location ecografica
Diagnosi PNX
Incannulamento arterie

Puntura ecoguidata vasi venosi cervico-toracici e vena femorale

Singh *et al. Critical Care* (2020) 24:65
https://doi.org/10.1186/s13054-020-2787-9

Singh *et al. Critical Care* (2020) 24:65
https://doi.org/10.1186/s13054-020-2787-9

Critical Care

RESEARCH Open Access

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

Critical Care

Training & assessment methods

EJA

Eur J Anaesthesiol 2020; **37:**344–376

GUIDELINES

European Society of Anaesthesiology guidelines on peri-operative use of ultrasound-guided for vascular access (PERSEUS vascular access)

Massimo Lamperti, Daniele Guerino Biasucci, Nicola Disma, Mauro Pittiruti, Christian Breschan, Davide Vailati, Matteo Subert, Vilma Traškaitė, Andrius Macas, Jean-Pierre Estebe, Regis Fuzier, Emmanuel Boselli and Philip Hopkins

- **Observe 5** ultrasound guided procedures
- **Perform 5** ultrasound scans on patients
- Logbook that documents every procedure
- **5 supervised** ultrasound guided procedures of each type
- For each ultrasound guided vascular access procedure the practitioner should be signed off as competent for that procedure by an expert trainer using a **global rating scale** before they perform the procedure unsupervised.
- To be eligible for completion of competency-based training in both adult and pediatric US guided vascular access the practitioner should have performed **30 US guided vascular access procedures of any type in a 12 months period**

ECHOTIP… what's next?

- Large multicenter trials aimed at
  - Confirming ***diagnostic accuracy*** of each ultrasound view
  - Clarifying role and optimal cut-off time of the ***'bubble test'*** by assessing positive and negative predictive value for both extra- and intra-cardiac malposition
- Assessing ***inter- and intra- rater variability*** of each ultrasound view associated or not to the 'bubble test'
- ***Consensus on the appropriate training*** on ultrasound based tip-location

Thanks a lot