Il protocollo ECHOTIP per la tip location dei PICC

Roma 12 dicembre 2023

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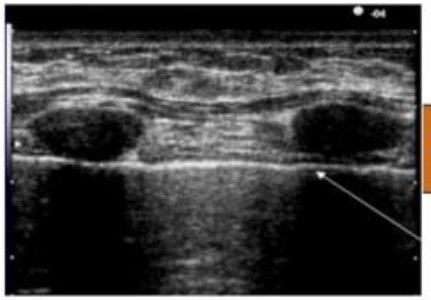
Istituto di Anestesia e Rianimazione
Fondazione Policlinico Universitario Agostino Gemelli-
IRCCS

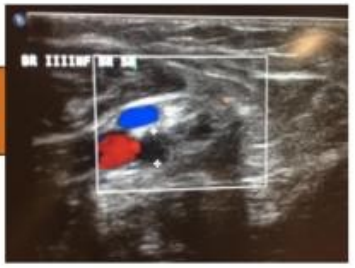
Pre-procedural US evaluation

US guided puncture

Tip navigation and Tip location



Exclusion of early and late complications



Editorial

JVA The Journal of Vascular Access

The Journal of Vascular Access
1–10

DOI: 10.1177/11297298211044325
journals.sagepub.com/home/jva
SAGE

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

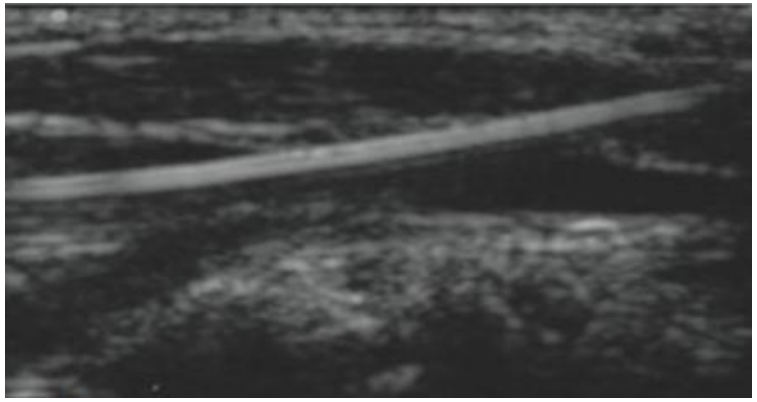
Antonio La Greca[1], Emanuele Iacobone[2], Daniele Elisei[2], Daniele Guerino Biasucci[3], Vito D'Andrea[4], Giovanni Barone[5], Geremia Zito Marinosci[6] and Mauro Pittiruti[1]

2021

1. Tip navigation: ultrasound-based visualization of the guidewire and/or of the catheter to verify the correct direction into the superior vena cava (SVC) or inferior vena cava (IVC).
2. Tip location by direct visualization of the final position of the tip of the catheter, usually at the junction between right atrium and SVC or between right atrium (RA) and IVC.
3. Tip location by indirect visualization of the final position of the tip of the catheter, using the so-called "bubble test" (visualization of micro-bubbles inside the vasculature after injection of saline or saline/air mixture into the catheter).

Tip navigation

Tip navigation: ultrasound-based visualization of the guidewire and/or of the catheter to verify the correct direction into the superior vena cava (SVC) or inferior vena cava (IVC).



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

Table 1. (a) ECHOTIP protocol for CICCs.

	Probe	Technique
Tip navigation	7–12 MHz linear probe	Visualization of the cannulated vessel (wire/catheter inside the vein)
		Visualization of the deep vessels of neck and chest according to RaCeVA
Tip location	2–6 MHz sectorial probe	Immediate visualization (<1 s) of bubbles in RA after flushing
	As alternative option:	First option: subcostal views (four-chamber or bi-caval)
	3–8 MHz convex probe	Second option: four-chamber apical view

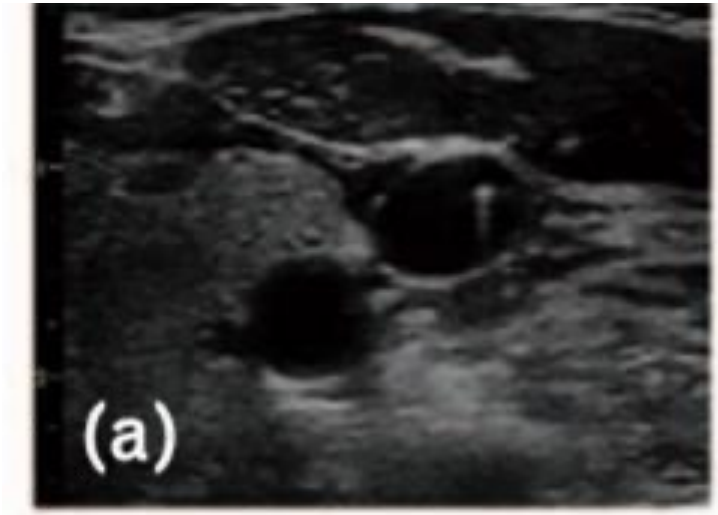
(b) ECHOTIP protocol for PICCs.

	Probe	Technique
Tip navigation	7–12 MHz linear probe	Visualization of the deep veins of the arm and of the infra/supraclavicular area according to RaPeVA and RaCeVA
Tip location	2–6 MHz sectorial probe	Immediate visualization (<2 s) of bubbles in RA after flushing
	As alternative option:	First option: subcostal views (four-chamber or bi-caval)
	3–8 MHz convex probe	Second option: four-chamber apical view

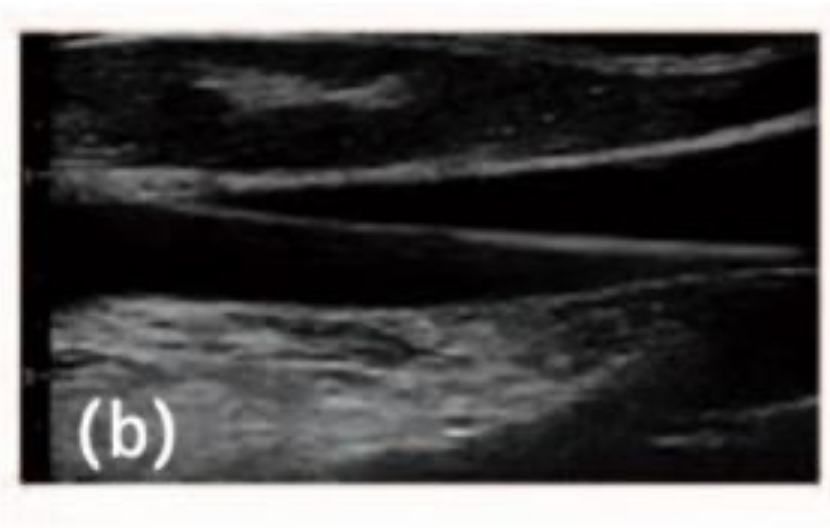
(c) ECHOTIP protocol for FICCs.

	Probe	Technique
Tip navigation	7–12 MHz linear probe (femoral vein and external iliac vein)	Visualization of the deep vessels of the lower limb according to RaFeVA
	3–8 MHz convex probe (common iliac vein and IVC)	Visualization of IVC in short and long axis views
Tip location	2–6 MHz sectorial probe	Visualization of bubbles after flushing
	As alternative option: 3–8 MHz convex probe	Tip in IVC: immediate visualization of bubbles in IVC
		Tip in RA or at the junction RA/IVC: immediate visualization of bubbles in RA

Tip navigation
Guidewire visualization

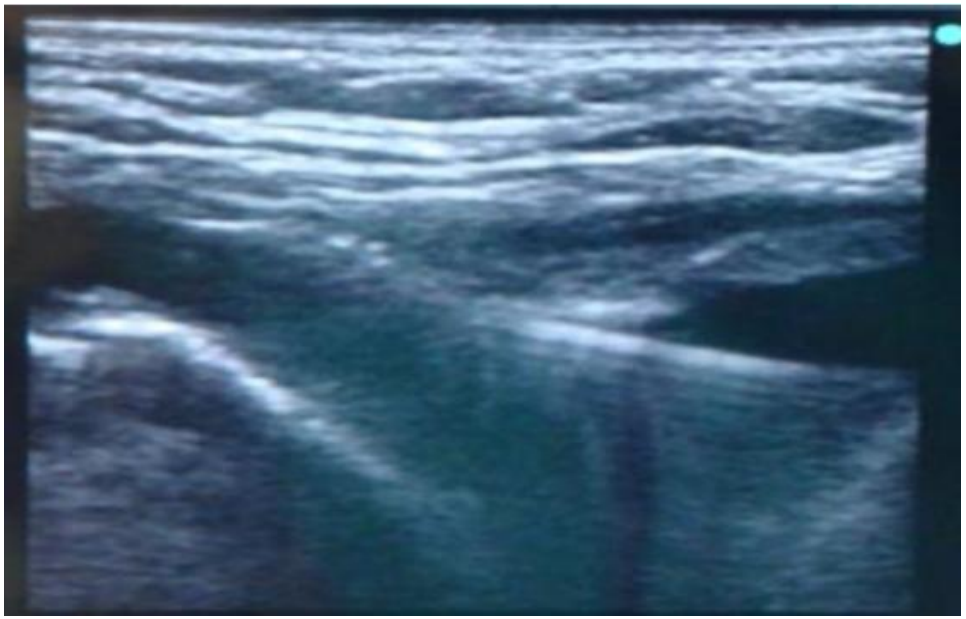


Short axis

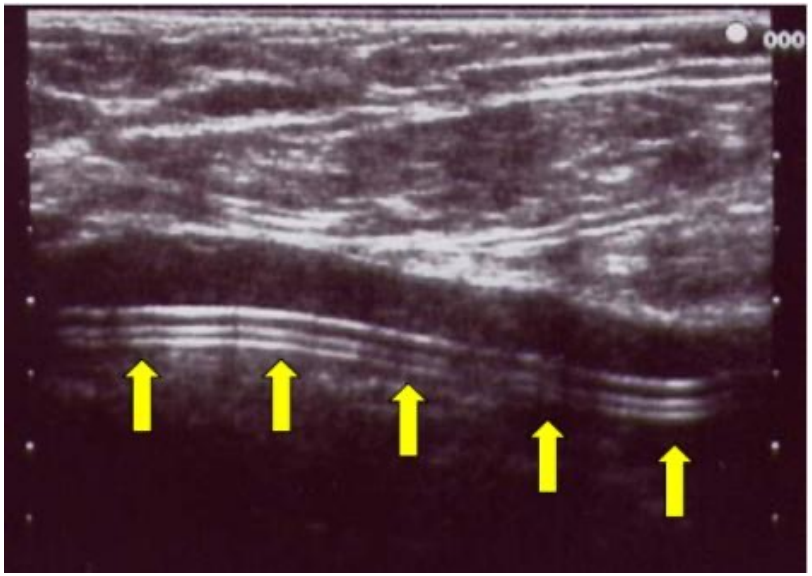


Long axis

Tip navigation



Guidewire

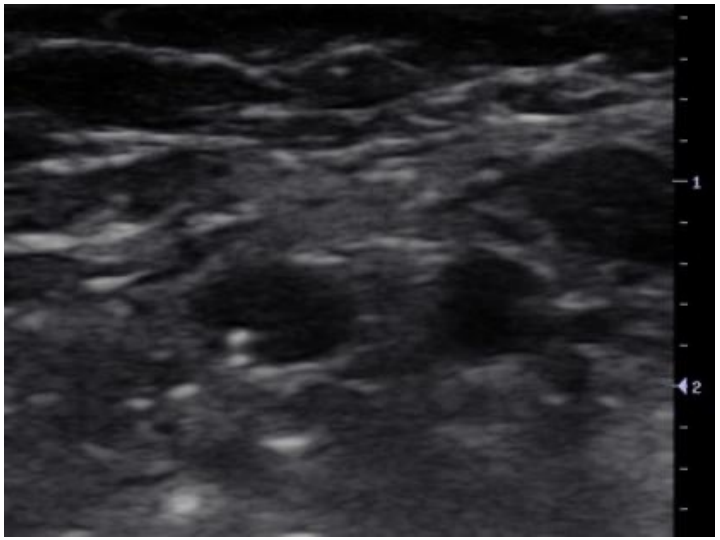


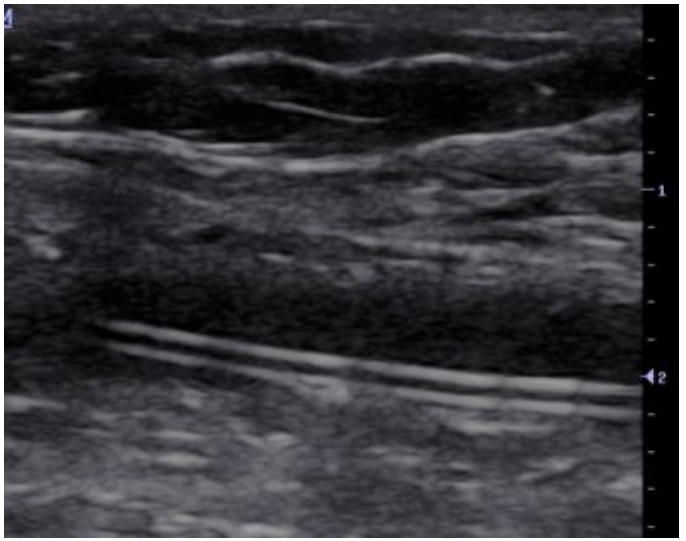
Catheter

… but the final position of the tip can not be properly assessed

Visualization of the guidewire toward brachio-cephalic vein and SVC

Visualization of the catheter in the vein

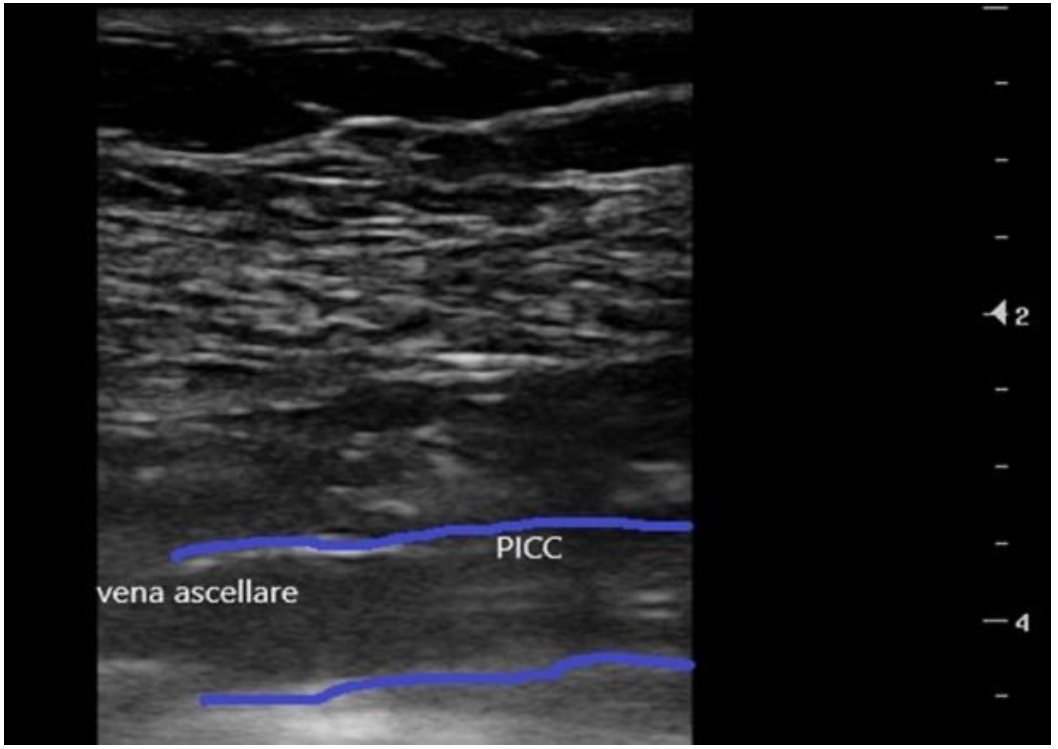




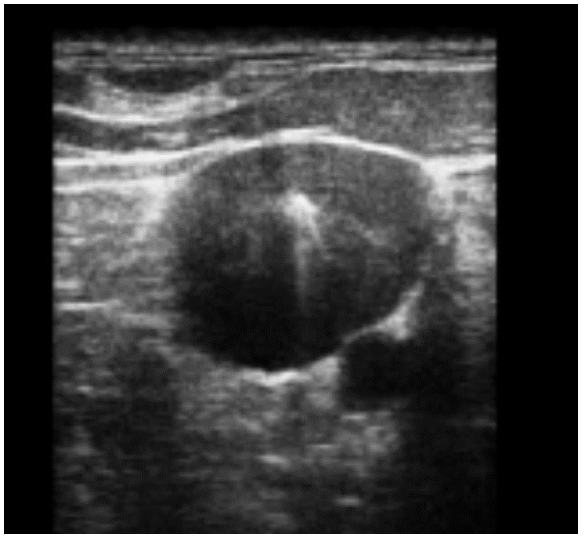
short axis view

long axis view

Visualization of the catheter in the axillary vein



Tip navigation



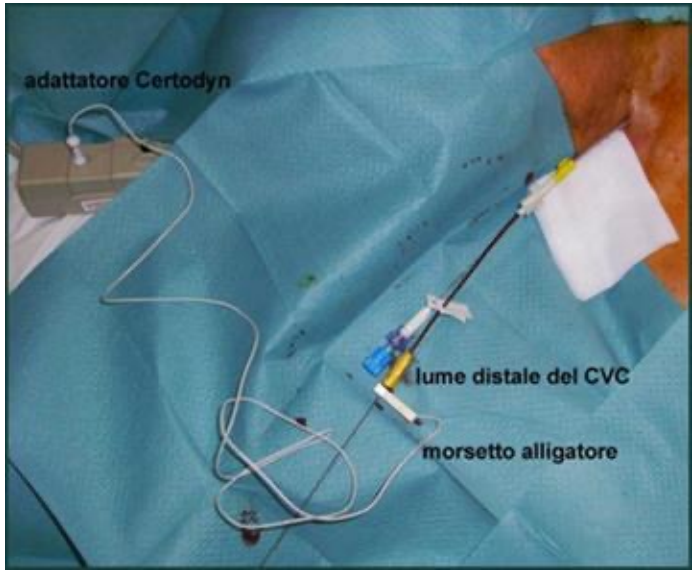
- Overall feasibility 96%

- Specificity 100%
  (no false positives)

LIMITS

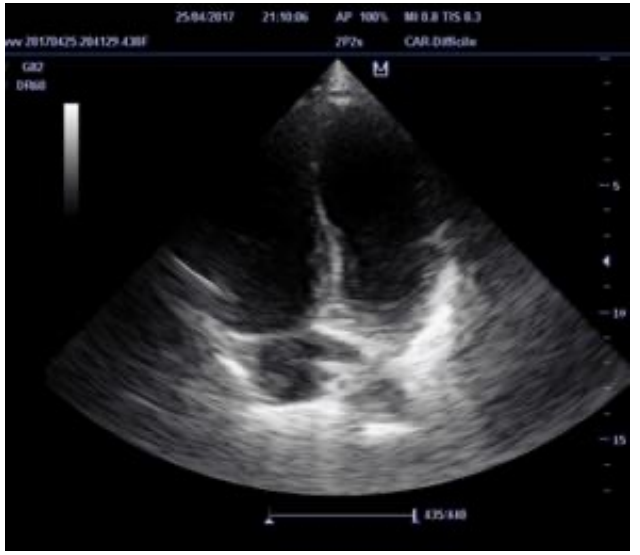
- While the guidewire can be easily visualized in SVC, the catheter is not easily identified, unless it still has the guidewire inside.

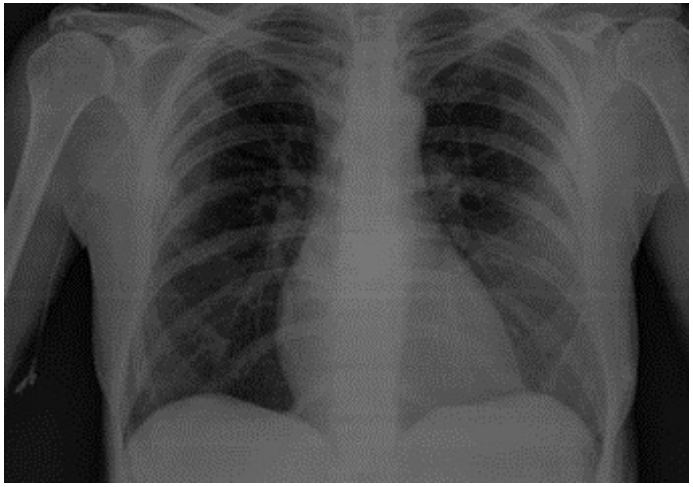
- Some case of false negative has been described



Tip location

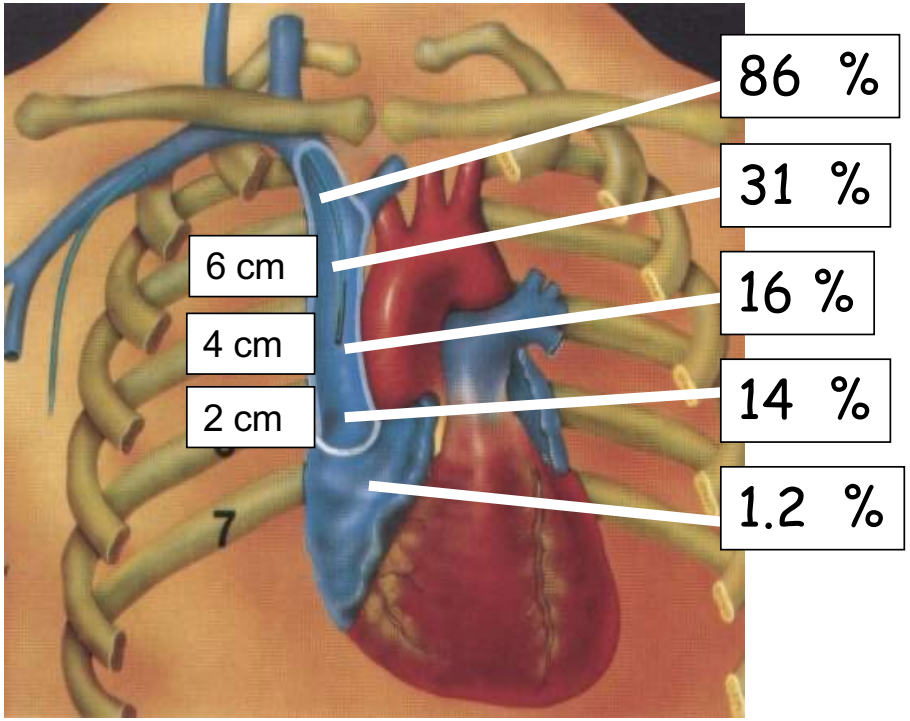
?





MALPOSIZIONE : PROBLEMI CLINICI

The "SHORT" catheter



Silicone Venous Access Devices Positioned with Their Tips High in the Superior Vena Cava Are More Likely to Malfunction

Judy Petersen, RN, MN, AOCN, Joseph H. Delaney, MD, Mark T. Brakstad, MD, Ronald K. Rowbotham, MS, Charles M. Bagley, Jr., MD, *Seattle, Washington*

Am J Surg. 1999;178:38–41.

86 %

31 %

16 %

14 %

1.2 %

Malfunzione

MALPOSIZIONE: PROBLEMI CLINICI

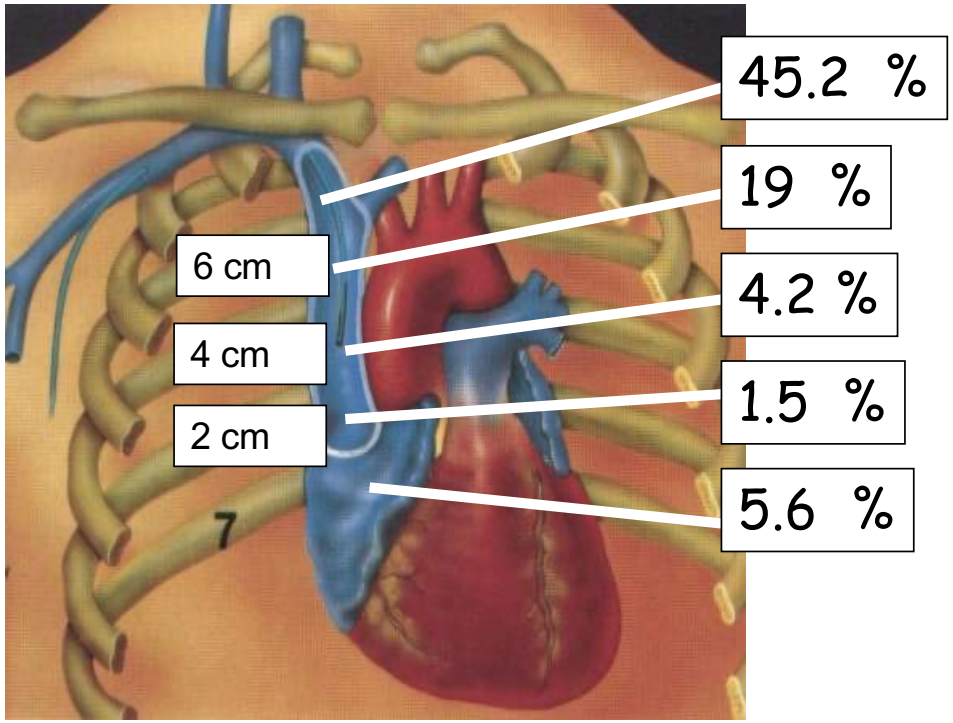
Support Care Cancer (2005) 13:325–331
DOI 10.1007/s00520-004-0723-1

ORIGINAL ARTICLE

The "SHORT" catheter

Jo Caers
Christel Fontaine
Vincent Vinh-Hung
Johan De Mey
Gerrit Ponnet

Catheter tip position as a risk factor for thrombosis associated with the use of subcutaneous infusion ports

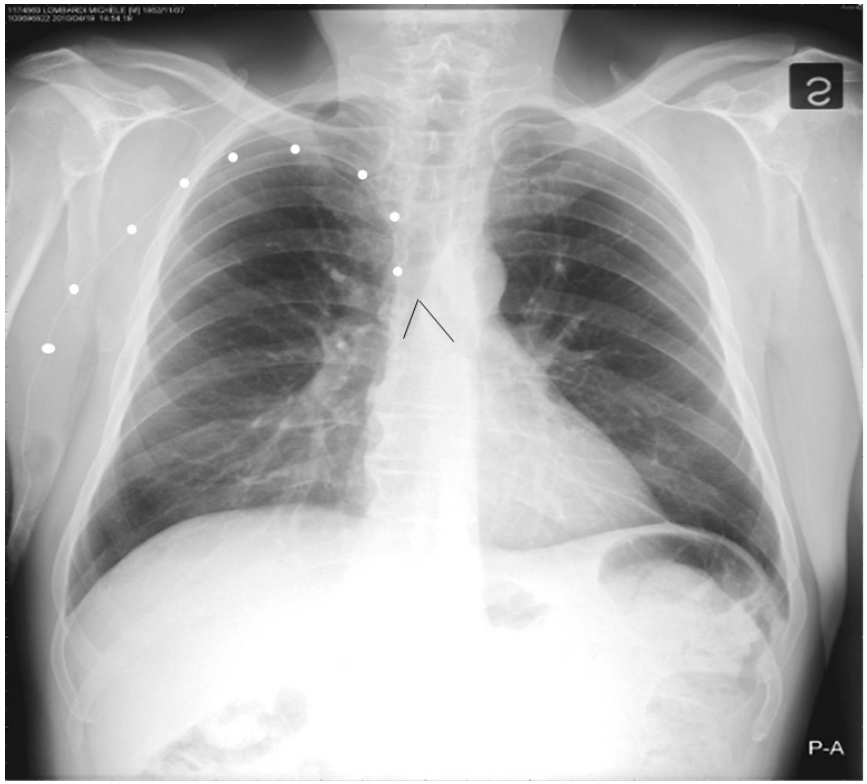


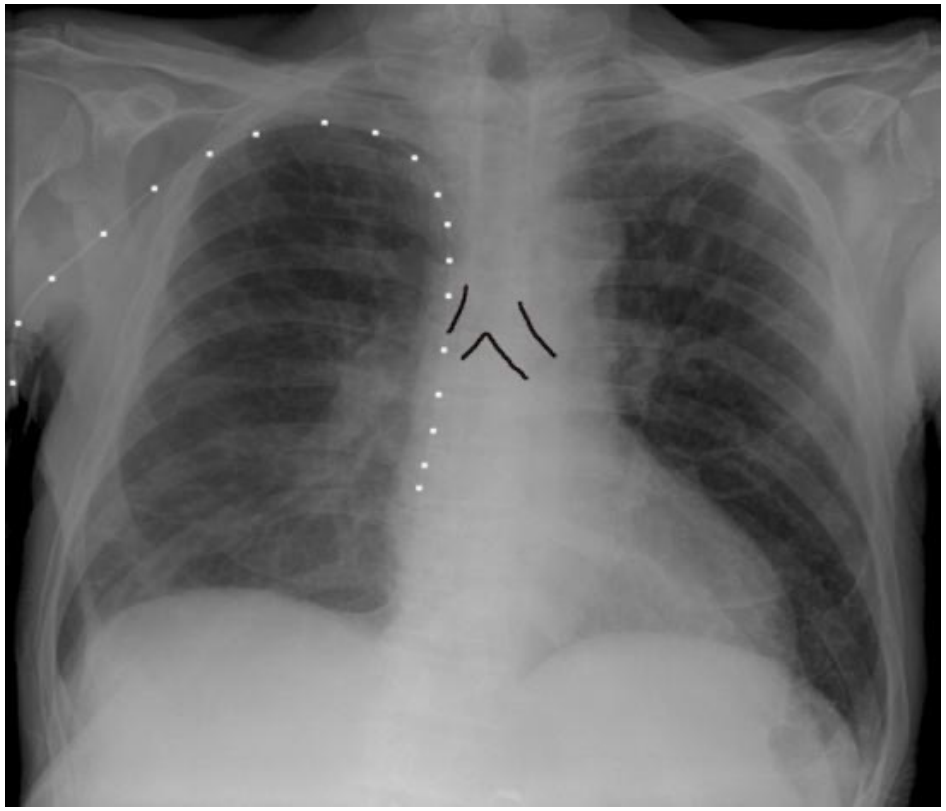
TROMBOSI

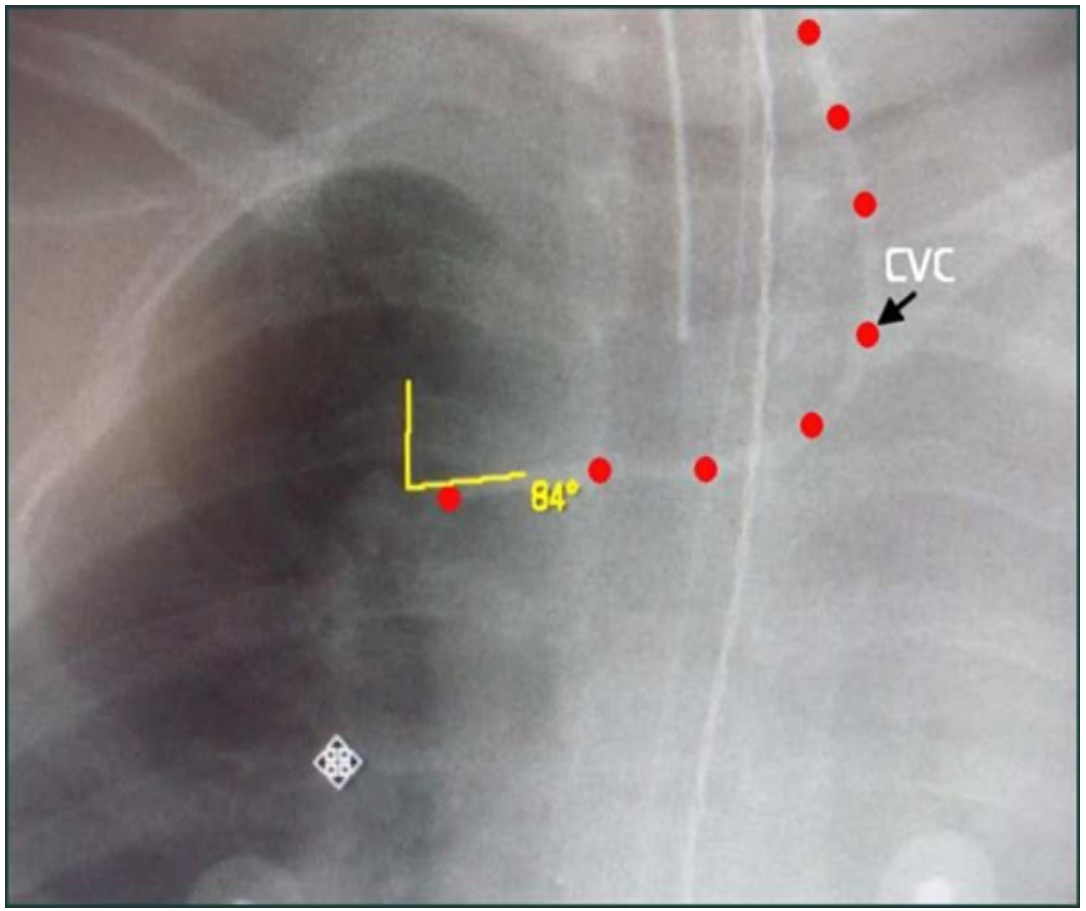
MALPOSIZIONE:PROBLEMI CLINICI

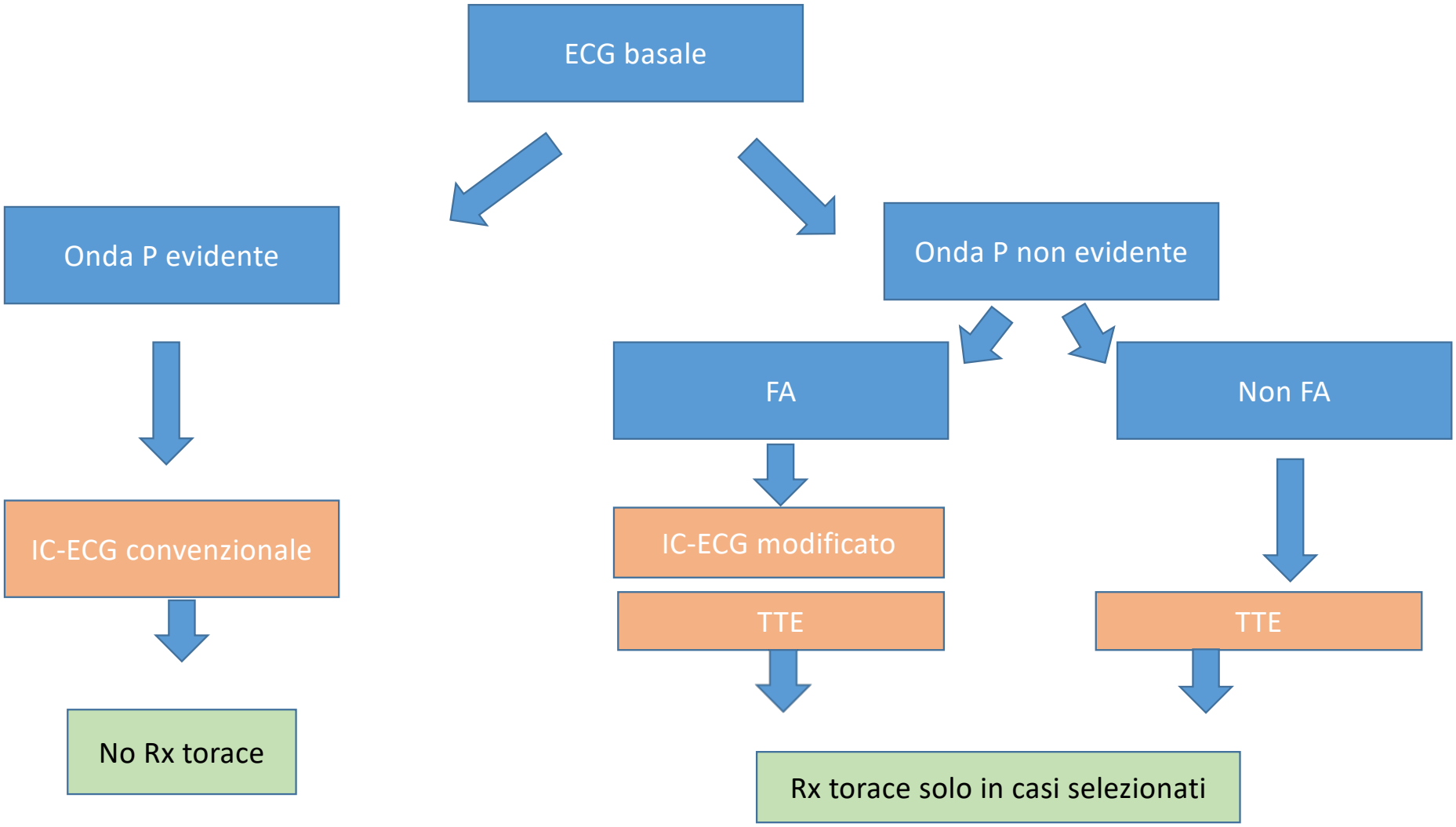
The “LONG” catheter

- Aritmie
- Lesioni valvolari
- Trombosi atriale


P-A




CVC
84°


ECG basale
Onda P evidente
Onda P non evidente
IC-ECG convenzionale
FA
Non FA
IC-ECG modificato
TTE
TTE
No Rx torace
Rx torace solo in casi selezionati

Ecografo e sonde

Lineare

Settoriale

Convex

Sonda wireless

- Portable
- 240 g
- Pocket-sized
- Wireless
- Multiple transducers
- Interface with tablet or smartphone
- Compatible with iOS, Android and Windows operating systems


Wireless ULTRASOUND


CERBERO

Table 1. (a) ECHOTIP protocol for CICCs.

	Probe	Technique
Tip navigation	7–12 MHz linear probe	Visualization of the cannulated vessel (wire/catheter inside the vein) Visualization of the deep vessels of neck and chest according to RaCeVA
Tip location	2–6 MHz sectorial probe As alternative option: 3–8 MHz convex probe	Immediate visualization (<1 s) of bubbles in RA after flushing First option: subcostal views (four-chamber or bi-caval) Second option: four-chamber apical view

(b) ECHOTIP protocol for PICCs.

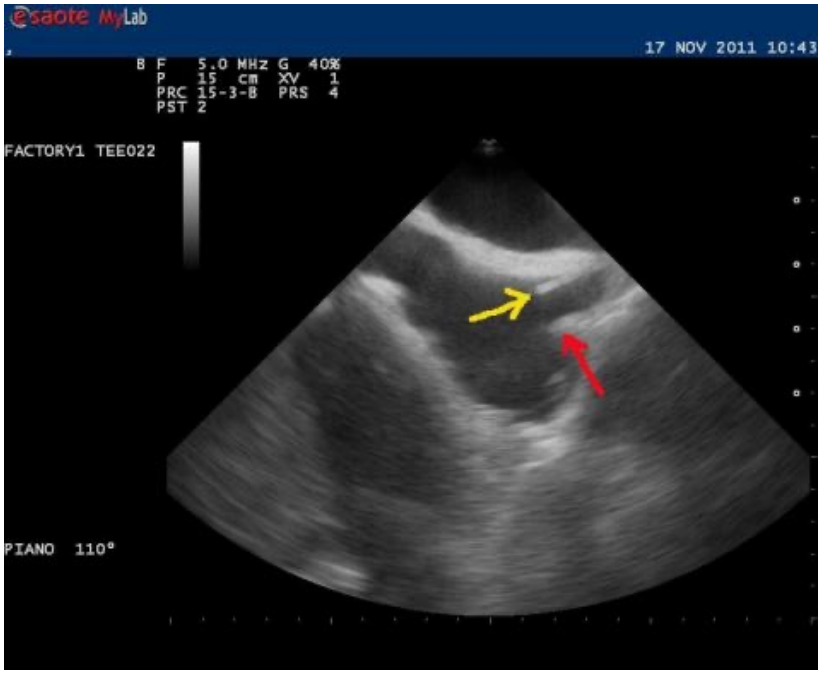
	Probe	Technique
Tip navigation	7–12 MHz linear probe	Visualization of the deep veins of the arm and of the infra/supraclavicular area according to RaPeVA and RaCeVA
Tip location	2–6 MHz sectorial probe As alternative option: 3–8 MHz convex probe	Immediate visualization (<2 s) of bubbles in RA after flushing First option: subcostal views (four-chamber or bi-caval) Second option: four-chamber apical view

(c) ECHOTIP protocol for FICCs.

	Probe	Technique
Tip navigation	7–12 MHz linear probe (femoral vein and external iliac vein) 3–8 MHz convex probe (common iliac vein and IVC)	Visualization of the deep vessels of the lower limb according to RaFeVA Visualization of IVC in short and long axis views
Tip location	2–6 MHz sectorial probe As alternative option: 3–8 MHz convex probe	Visualization of bubbles after flushing Tip in IVC: immediate visualization of bubbles in IVC Tip in RA or at the junction RA/IVC: immediate visualization of bubbles in RA

CRITICAL CARE

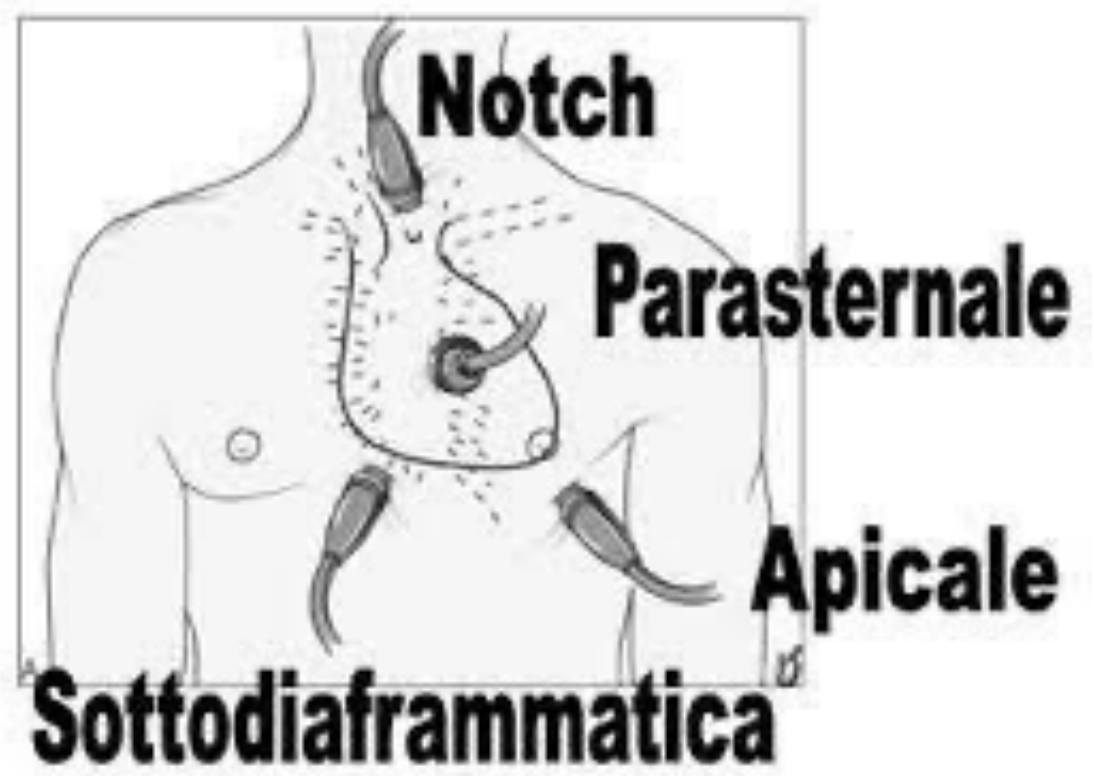
Transoesophageal echocardiographic evaluation of central venous catheter positioning using Peres' formula or a radiological landmark-based approach: a prospective randomized single-centre study†



- The most accurate method for tip location
- Invasive
- Logistically impossible in the vast majority of patients
- Feasible for CICCs before/during cardiac surgery
- Not feasible for PICCs
- It requires a hard training for operators.

British Journal of Anaesthesia, 118 (2): 215–22 (2017)

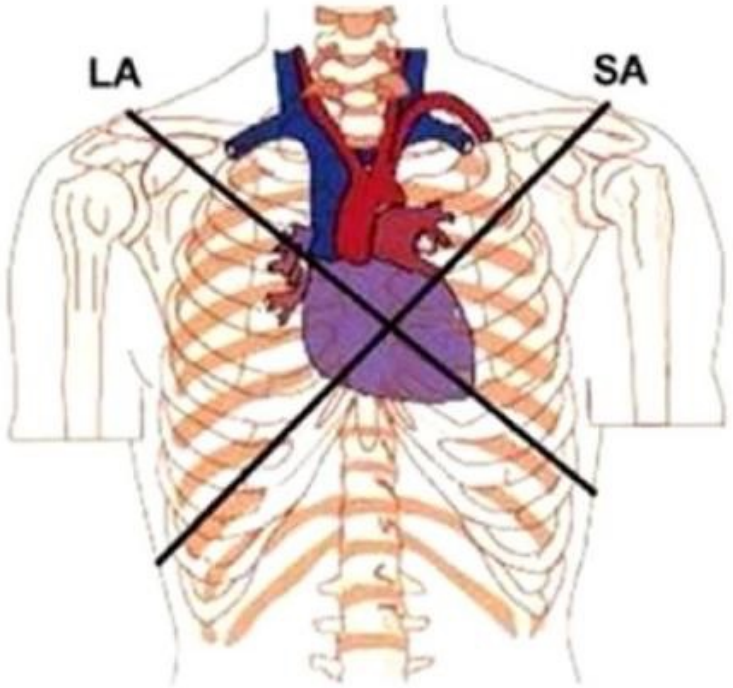
Finestre ecocardiografiche

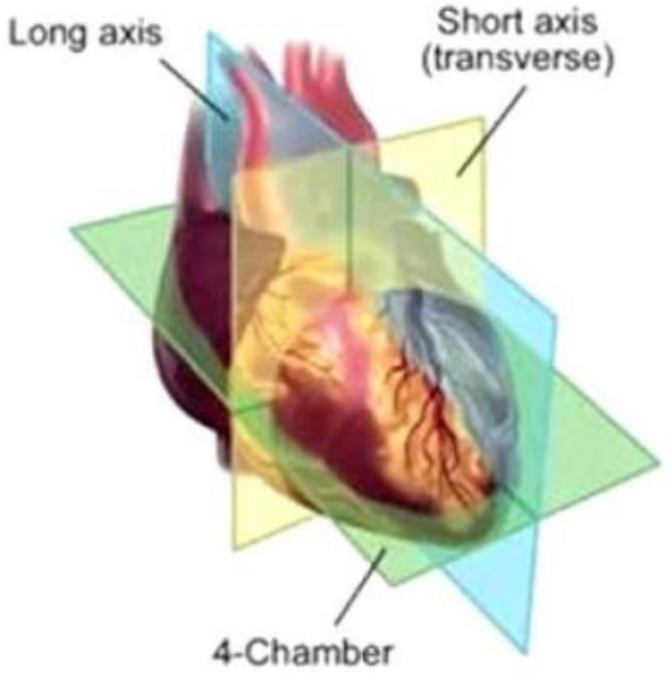


4 camere

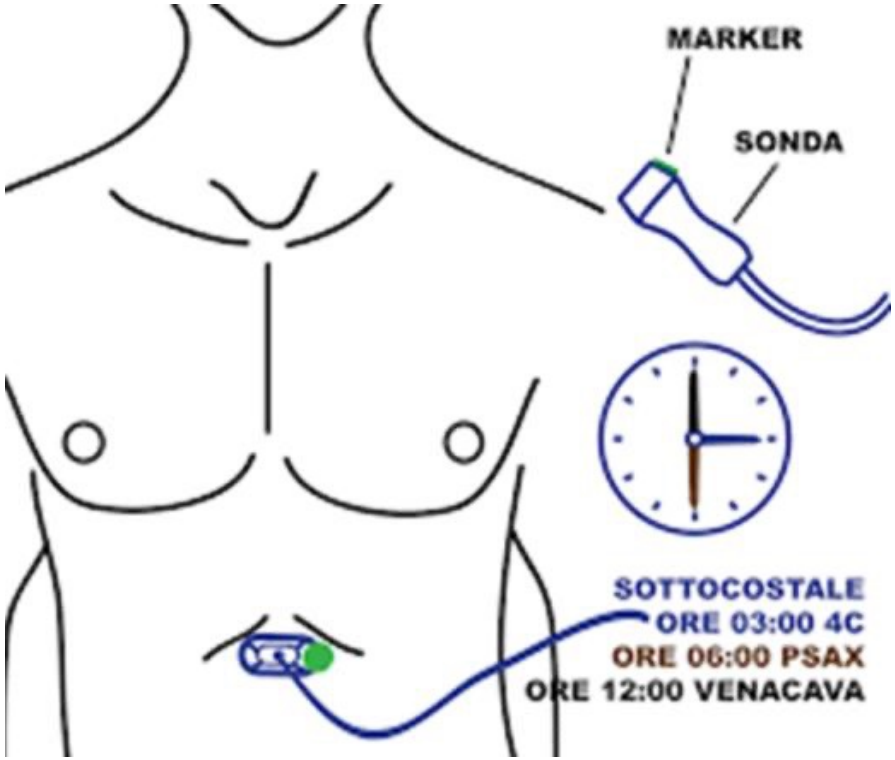
Longitudinale (4 camere)
Obliqua (bicavale)

Piani di scansione





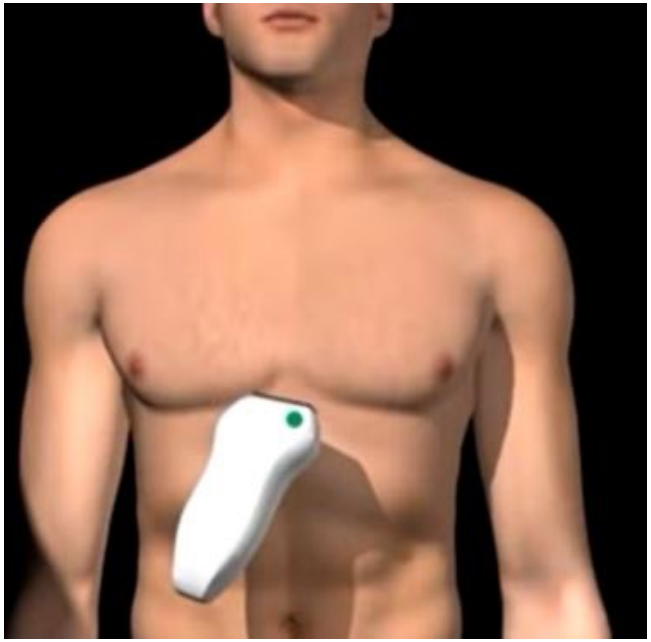
Sottocostale o sottoxifoidea



Longitudinale (4 camere)

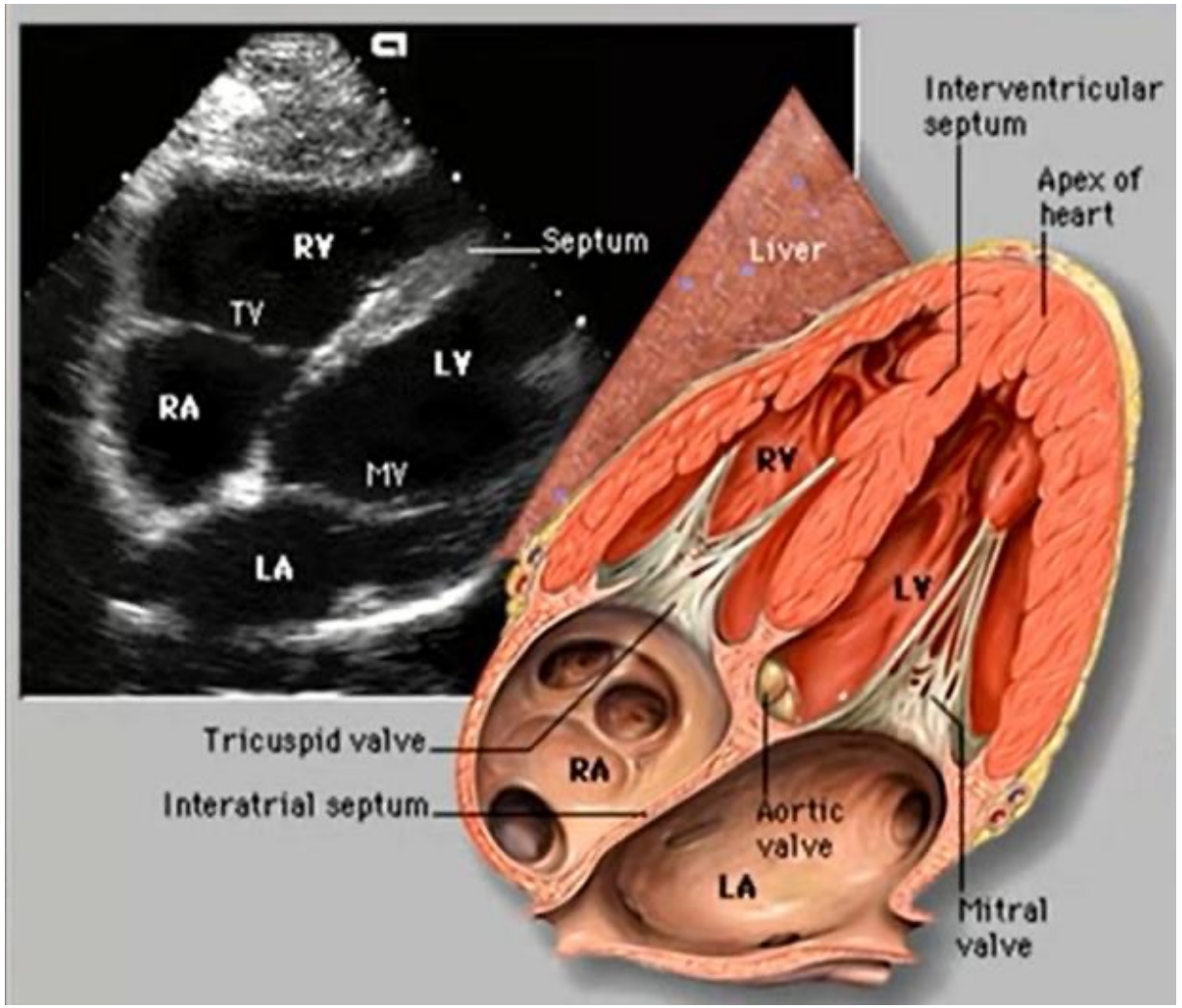
Obliqua (bicavale)

Sottocostale longitudinale 4 camere

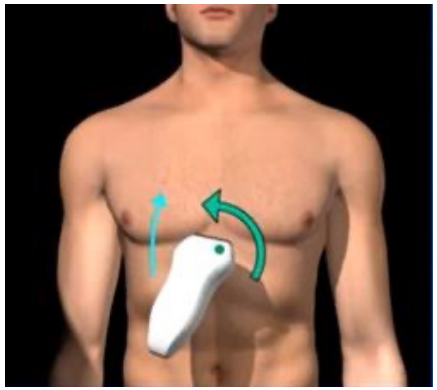


Marker ore 3

Coda della sonda abbassata

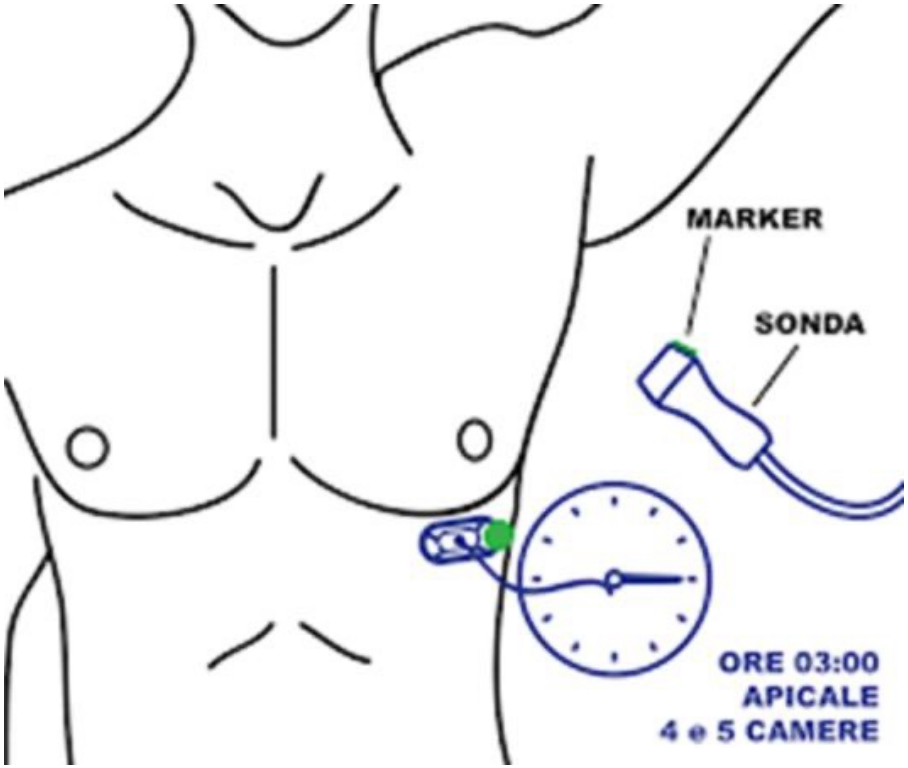


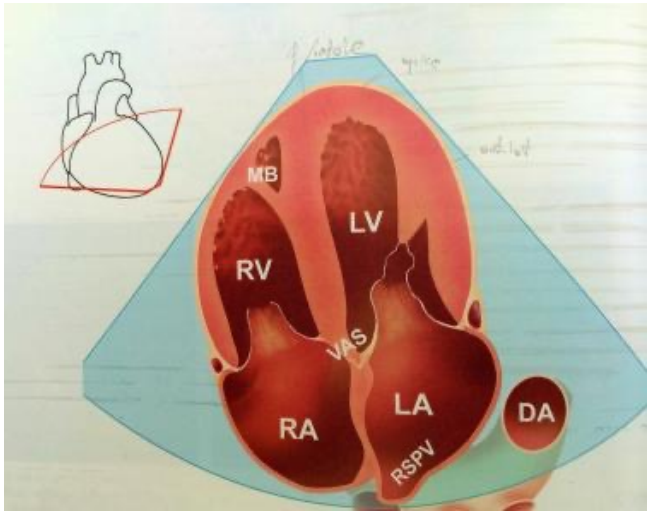
Sottocostale obliqua (bicavale)



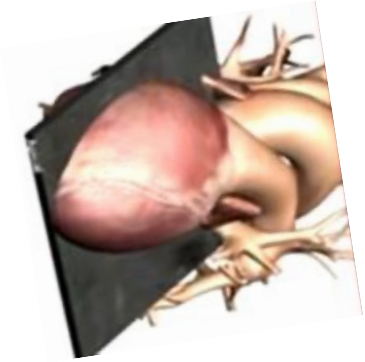
Marker ore 12

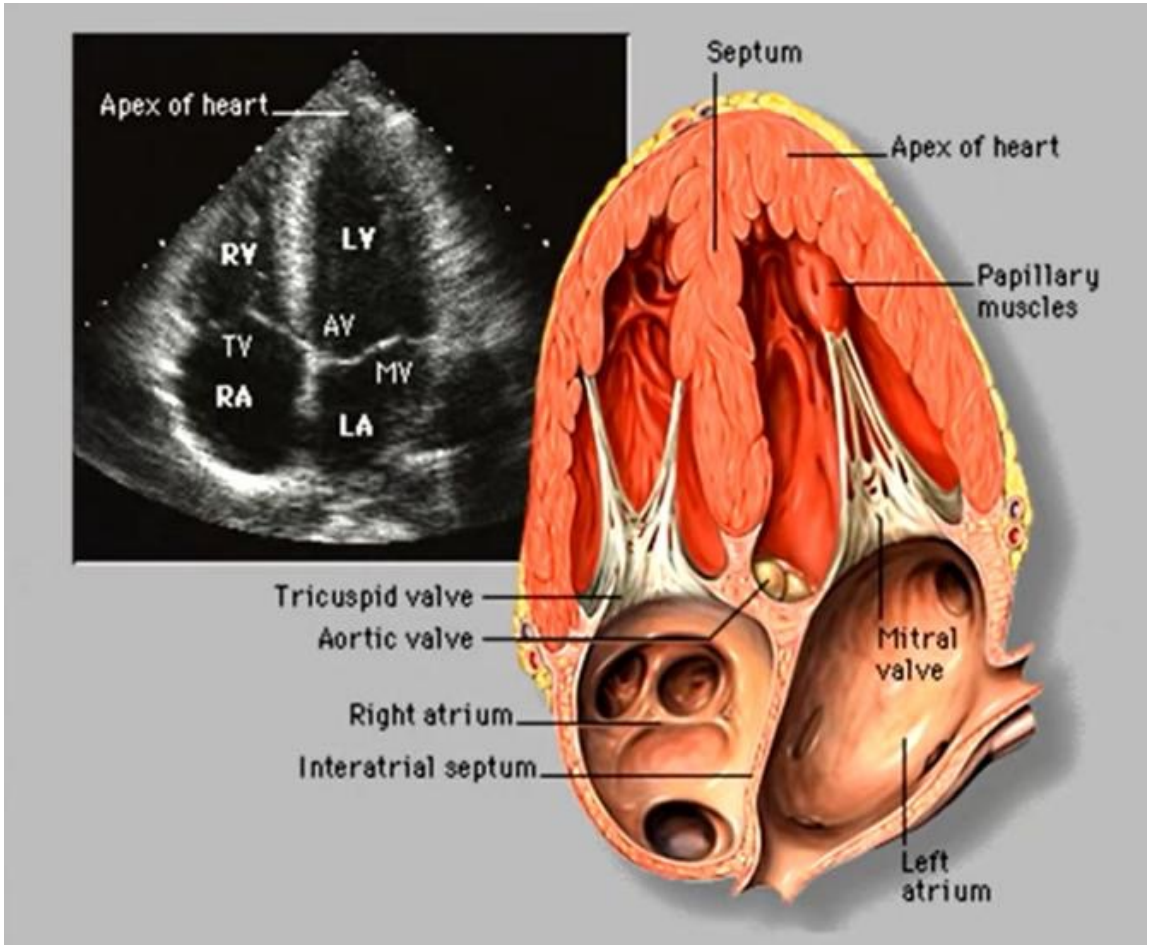
2 Apicale quattro camere





Apicale quattro camere





Editorial

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

The Journal of Vascular Access
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DOI: 10.1177/11297298211044325
journals.sagepub.com/home/jva
SAGE

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]

3. Tip location by indirect visualization of the final position of the tip of the catheter, using the so-called "bubble test" (visualization of micro-bubbles inside the vasculature after injection of saline or saline/air mixture into the catheter).

Infusion Therapy Standards of Practice

Tip location by indirect visualization *of the final position of the tip of the catheter*

Bubble test

a. The addition of agitated saline to enhance transthoracic echocardiography has been shown to be effective in detecting catheter tip position in the lower third of the SVC, as well as detecting catheter malposition through delayed opacification and reduced echogenicity.[66-68] (IV)

J Ultrasound (2013) 16:161–170
DOI 10.1007/s40477-013-0046-5

REVIEW

Ultrasonography as a guide during vascular access procedures and in the diagnosis of complications

A. Vezzani · T. Manca · A. Vercelli · A. Braghieri · A. Magnacavallo

Cut-off < 2 seconds

the other filled with 1 ml air [65]. TTE with the micro-bubble test identifies CVC misplacement with a sensitivity of 96 % and specificity of 93 %; findings are concordant with those of chest X-ray in 95 % of cases [66]. This makes it a valid alternative to chest X-ray for verifying the position of a CVC.

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

ORIGINAL RESEARCH CONTRIBUTION

2014

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

There were 131 subclavian and internal jugular CVCs with their tips in the SVC region by CXR (see Table 5). 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.

ORIGINAL ARTICLE

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]

Results. CXR identified 14 (13%) CVC malpositions. Vascular US showed a sensitivity of 64% and a specificity of 100% while visualization of "no or few bubbles" at bubble test yielded a sensitivity of 50% and a specificity of 100%. "Push-to-bubbles" times were ≈9 times longer in patients with compared to those without CVC malposition (1400 [702-2160] ms *versus* 167 [123-228] ms, P<0.001). A cut off value of 500 ms had a sensitivity of 100% and a specificity of 99% for CVC malposition with an inter-observer agreement of 99% (kappa 0.96, P<0.001).
Conclusion. CVC malposition was observed in a sizeable proportion of patients undergoing preoperative central venous cannulation. Measurement of "push-to-bubbles" time is a fast, accurate and highly reproducible tool for verifying the correct CVC position. *(Minerva Anestesiol 2015;81:989-1000)*

Original research article

JVA | The Journal of Vascular Access

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

The Journal of Vascular Access
1–7

DOI: 10.1177/1129729820905200
journals.sagepub.com/home/jva
SAGE

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 ($p > 0.05$).

Techniques in vascular access

JVA The Journal of Vascular Access

An ultrasound-based technique in the management of totally implantable venous access devices with persistent withdrawal occlusion

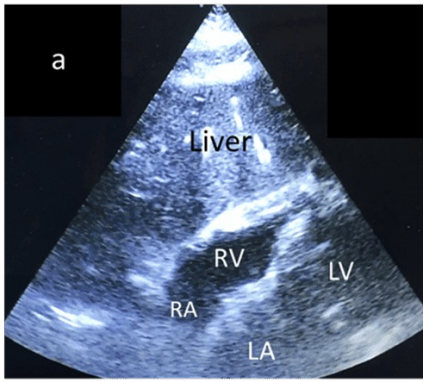
The Journal of Vascular Access
1–5

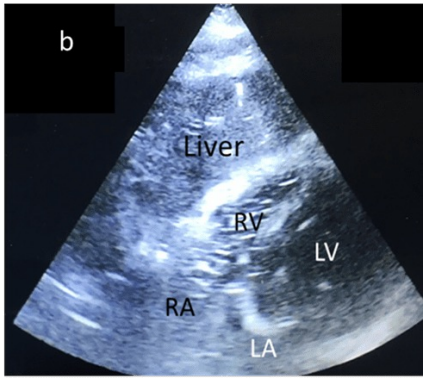
DOI: 10.1177/11297298211023275
journals.sagepub.com/home/jva
SAGE

Sonia D'Arrigo[1], Maria Giuseppina Annetta[1] and Mauro Pittiruti[2]

Table 1. Patients characteristics

Patients (n°)	Age (years)	Gender	Site of TIVAD	Oncological disease	Problem	Mean time for BT (sec)	X-ray confirmation
1	49	F	Right basilic vein	Ovaric cancer in neoadjuvant chemotherapy	PWO	45	Yes
2	51	F	Right axillary vein	Ovaric cancer post surgery, in chemotherapy	PWO	50	Yes
3	65	M	Left basilic vein	Intestinal cancer post surgery, in chemotherapy	PWO	60	Yes
4	34	F	Left basilic vein	Breast cancer post surgery, in chemotherapy	PWO	40	Yes
5	37	F	Right basilic vein	Breast cancer in neoadjuvant chemotherapy	PWO	30	Yes
6	25	F	Right basilic vein	Ovaric cancer post surgery, in chemotherapy	PWO	45	Yes
7	68	F	Right axillary vein	Uterus cancer post surgery, in chemotherapy	PWO	40	Yes
8	69	M	Right axillary vein	Liver cancer in neoadjuvant chemotherapy	PWO	50	Yes
9	56	F	Right brachial vein	Ovaric cancer post surgery, in chemotherapy	PWO	55	Yes



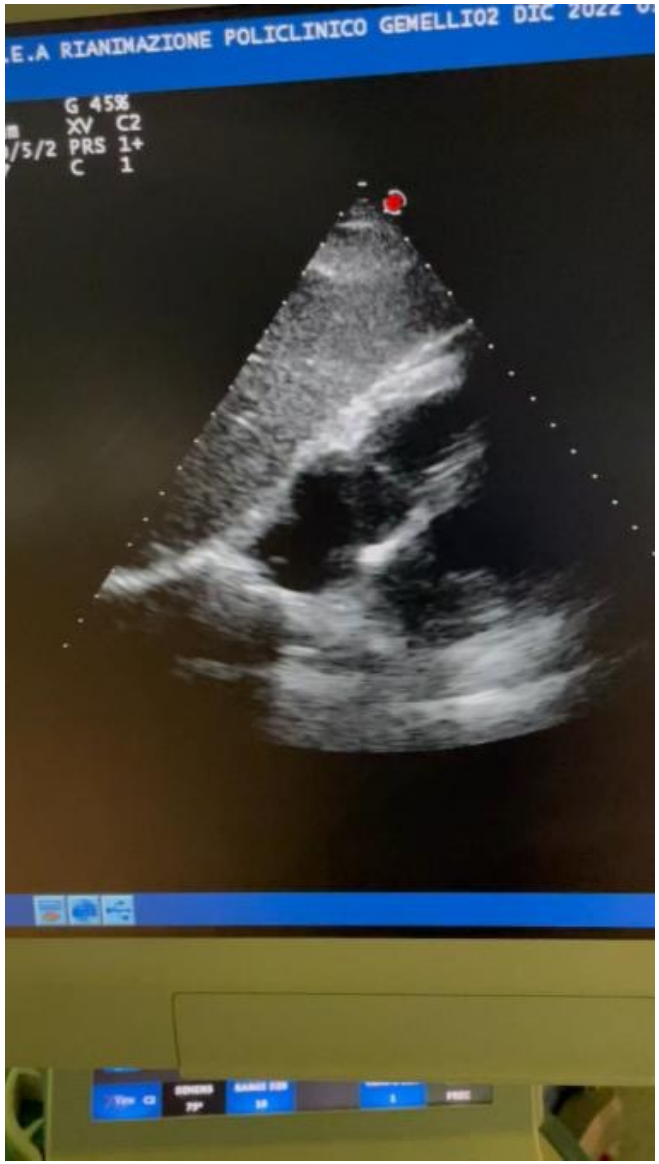


Tempo richiesto

- Il tempo necessario per eseguire il test delle bolle variava da 30 a 60 secondi (in media 45 secondi).

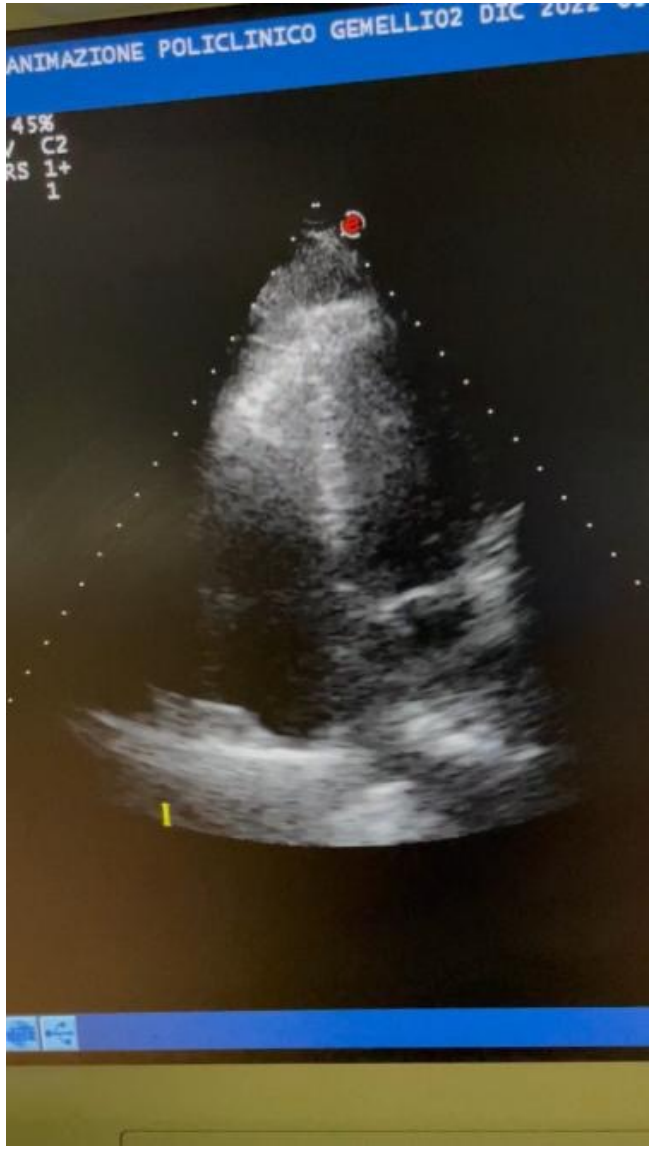
- La conferma in tempo reale e veloce della corretta posizione della punta del dispositivo ci ha permesso di iniziare immediatamente la somministrazione della terapia.

Finestra sottocostale 4 camere



Bubble test


RIANIMAZIONE POLICLINICO GEMELLI02 DIC 2022
G 45%
XV C2
PRS 1+
C 1


ANIMAZIONE POLICLINICO GEMELLI02 DIC
45%
C2
RS 1+
1

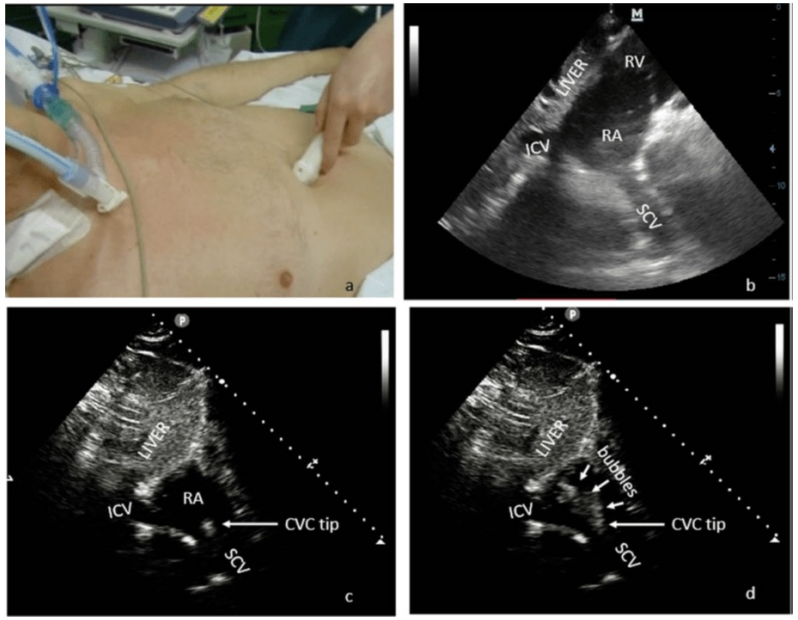
Corradi *et al. Critical Care* (2022) 26:113
https://doi.org/10.1186/s13054-022-03985-3

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



Feasibility:

CE-TTE 4 chambers: 95%
CE-TTE subcostal view: 97.3%

Accuracy:

CE-TTE 4 chambers: 70%
CE-TTE subcostal view: 92%
CXR: 73%

TEE vs. TTE vs. CXR

Original research article

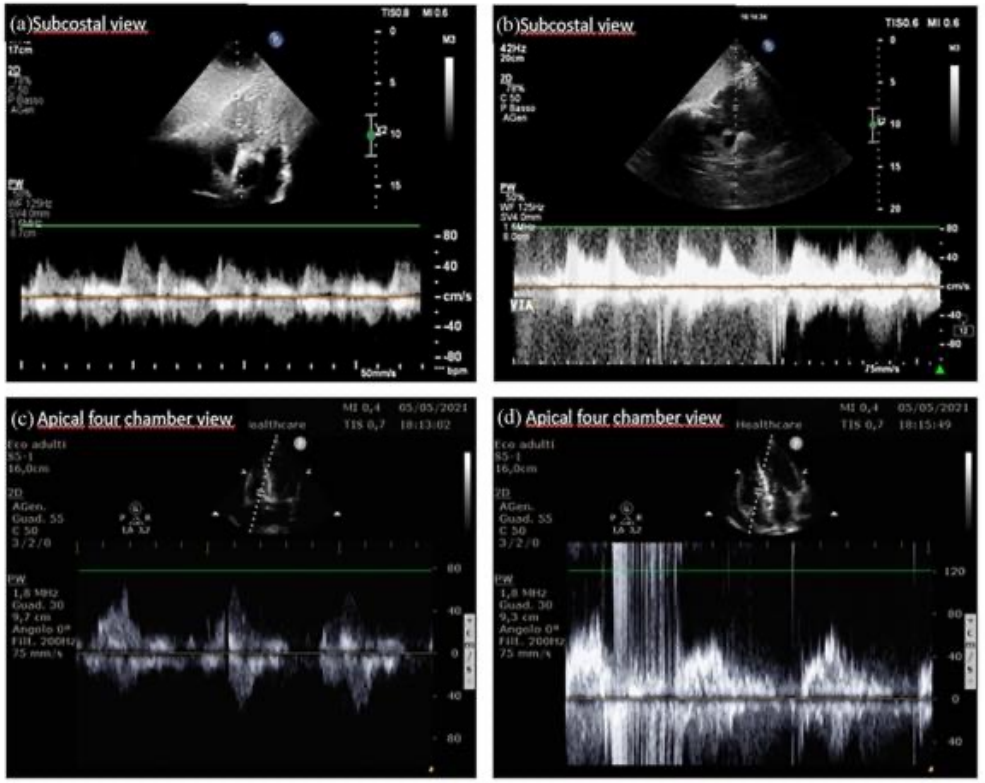
JVA The Journal of Vascular Access

Pulsed-wave Doppler for ultrasound-based tip location using bubble test: A pilot study

The Journal of Vascular Access
1–7

DOI: 10.1177/11297298221109662
journals.sagepub.com/home/jva
SAGE

Antonio Gidaro[1], Francesco Casella[1], Chiara Cogliati[1], Antonio La Greca[2], Francesca Lugli[1], Chiara Trione[1], Maria Calloni[1], Chiara Melchionda[1], Federica Samartin[1], Emanuele Salvi[1] and Elisa Ceriani[1]



Advantages:
Visual signal of MES (microembolic signals)
Production of a typical sound due to the alternation of PW wave
It is synchronous with cardiac flow and heart rate

Limitations:
Single center
Small sample size (n=9)

> J Vasc Access. 2023 Nov 29:11297298231199505. doi: 10.1177/11297298231199505.
Online ahead of print.

Can the length of a catheter change the time to bubble at the tip performing the "Bubble Test"? A bench study

Davide Giustivi [1], Stefano Antonio Gidaro [6], Alberto

Methods: A bench study was conducted using an extracorporeal circuit. For each catheter length (60, 40, and 20 cm), three injections were obtained by each of the five operators with different levels of experience for a total of 45 measurements. Differences among operators were evaluated using ANOVA, and the impact of catheter length and operator expertise on times was assessed using repeated measurement models.

Results: Hub-to-tip times of 247.33 ms (SD 168.82), 166 ms (SD 95.46), 138 ms (SD 54.48), and injection duration of 1620 ms (SD 748.58), 1614 ms (SD 570.95), 1566 ms (SD 302.83) were observed for 60, 40, 20 cm catheter length, respectively. A significant time variability between operators was observed. Moreover, moving from 60 to 20 cm, hub-to-tip time was significantly longer for 60 cm devices ($p = 0.0124$), while little differences were observed for injection duration.

Conclusions: Catheter length can change both the time between the injection of the contrast media and its appearance at the catheter tip and the injection duration. Hub-to-tip times obtained with 20 and 40 cm and overall injection duration did not differ significantly; skilled personnel could substantially reduce both values analyzed in this study.

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