LA TECNICA DELL'ECG INTRACAVITARIO PER LA TIP LOCATION DURANTE IL POSIZIONAMENTO DEGLI ACCESSI VENOSI

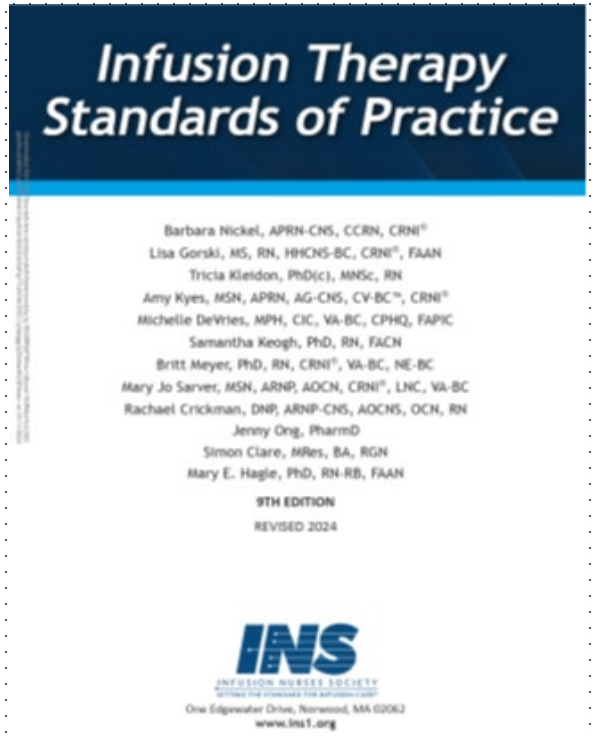
EMANUELE IACOBONE

OSPEDALE DI MACERATA

UO ANESTESIA E RIANIMAZIONE

B. Position the tip of a CVAD in the lower third of the superior vena cava (SVC) or upper third of the right atrium (RA) at or near the CAJ for adults and children.

1. For upper body insertion sites, respiratory variation, arm movement, and changes in body position will cause the CVAD tip to move in a caudal or cephaloid direction. Tip location deeper in the right atrium near the tricuspid valve or in the right ventricle is associated with cardiac arrhythmias (refer to Standard 51, *Central Vascular Access Device Malposition*). Tip location proximal to the SVC is associated with increased risk of thrombosis (refer to Standard 51, *Central Vascular Access Device Malposition;* Standard 50, *Catheter-Associated Thrombosis).*
2. For lower body insertion sites, position the CVAD tip in the inferior vena cava (IVC) above the level of the diaphragm.[4-6] (IV)
3. For hemodialysis CVADs, position the CVAD tip at the mid-right atrium to avoid vessel and right atrial trauma or complications.[7] (IV)

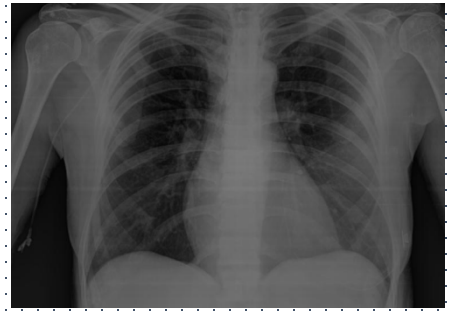


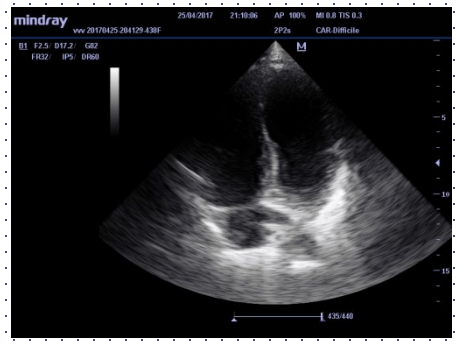
9TH EDITION

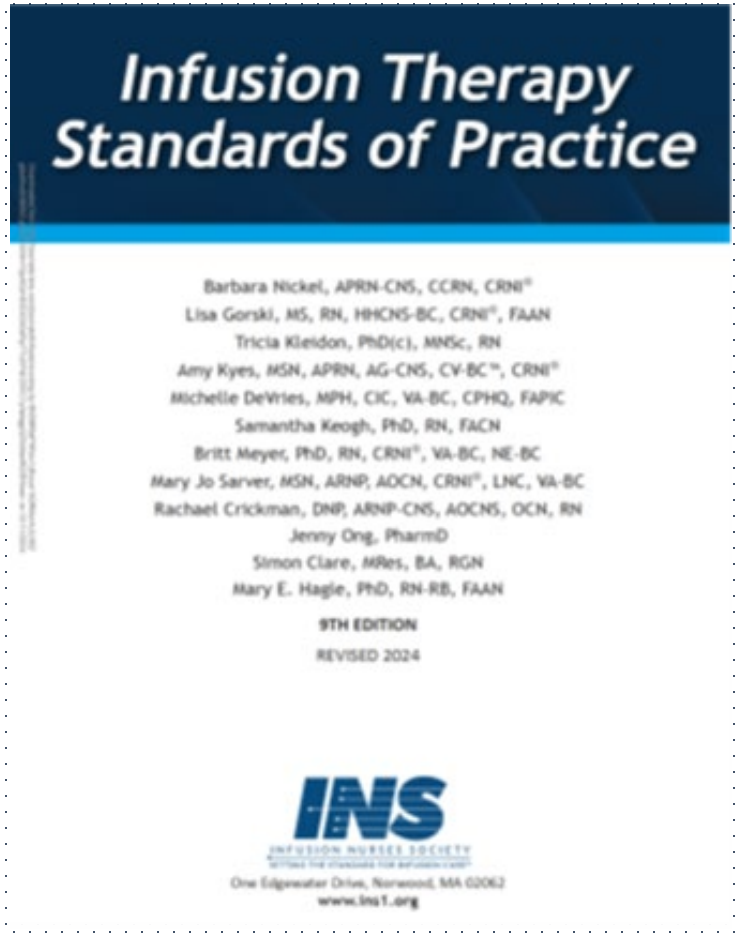
REVISED 2024

TECNICHE DI TIP LOCATION

INTRAPROCEDURALI	POSTPROCEDURALI
ECG intracavitario Fluoroscopia Ecocardiografia transtoracica - transesofagea	Radiografia del torace Ecocardiografia TC, RM, angiografia…..







9TH EDITION

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IC-ECG

E. Use tip locating methods to identify CVAD tip location during the insertion procedure (ie, "real-time") for neonate, pediatric, and adult patients. Studies have demonstrated greater accuracy, more efficient initiation of infusion therapy, and reduced costs.[1,12] (IV)

   1. Use electrocardiogram (ECG) methods with either a metal guidewire or a column of normal saline inside the catheter lumen and observe the ECG tracing to place the CVAD tip at the CAJ. Follow manufacturers' directions for use with other ECG-based technology using a changing light pattern to detect tip location.[1,12-30] (I)

17078. Recording of Intracavity Potentials Through a Single Lumen, Saline Filled Cardiac Catheter.

H. K. HELLERSTEIN,* W. H. PRITCHARD, AND R. L. LEWIS.

Evaluation of the correct position of peripherally inserted central catheters: anatomical landmark vs. electrocardiographic technique

J Vasc Access 2015; 16 (5): 394-398
DOI: 10.5301/jva.5000431

Francesco Baldinelli[1], Giuseppe Capozzoli[1], Roberta Pedrazzoli[1], Natascia Marzano[2]

ORIGINAL ARTICLE

In conclusion, although the use of the ECG has its limits (atrial fibrillation, cardiac pacemaker, dilated cardiomyopathy), patients in sinus rhythm with an absence of changes in shape of the P wave should be an indication that the catheter is in the internal jugular vein, in the brachiocephalic trunk of the left vein or in the internal mammary vein, or that the catheter is in an aberrant position. The tip posi-

PROTOCOLLO SIC	Verifica intra-procedurale della posizione centrale della punta (tip location) **mediante ECG intracavitario** e/o mediante **ecocardioscopia con bubble test** (secondo il protocollo ECHOTIP)
PROTOCOLLO ISP 2	Controllo della posizione centrale della punta (tip location) **mediante il metodo dell'ECG intracavitario**, nella variante modificata nel caso di pazienti in fibrillazione atriale, eventualmente corroborato dalla tip location mediante **ecocardiografia transtoracica con 'bubble test'** (secondo il protocollo ECHOTIP)
PROTOCOLLO ISF	Verifica intra-procedurale della posizione centrale della punta (tip location): se la punta è prevista in atrio destro, utilizzare **il metodo dell'ECG intracavitario e/o la ecocardioscopia con bubble test** (secondo il protocollo ECHOTIP); se la punta deve stare in vena cava inferiore, usare una stima della lunghezza mediante reperi cutanei **con ecocardioscopia intraprocedurale con bubble test** (secondo il protocollo ECHOTIP), ma prendere in considerazione **una lastra dell'addome** post-procedurale in casi selezionati
PROTOCOLLO ISP-Port	Controllo della posizione centrale della punta (tip location) **mediante il metodo dell'ECG intracavitario** - nella variante modificata nel caso di pazienti in fibrillazione atriale – eventualmente corroborato da tip location **mediante ecocardiografia transtoracica con bubble test** (secondo il protocollo ECHOTIP).
Protocollo ISALT-3	Controllo intra-procedurale della posizione della punta (tip location) **mediante ECG intracavitario** (metodo convenzionale oppure metodo modificato, in caso di fibrillazione atriale) e/o **ecocardioscopia con bubble test** (secondo il protocollo ECHOTIP).

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

ESPEN Guidelines on Parenteral Nutrition: Central Venous Catheters (access, care, diagnosis and therapy of complications)

Position of CVC tip	High osmolarity PN requires central venous access and should be delivered through a catheter whose tip is in the lower third of the superior vena cava, at the atrio-caval junction, or in the upper portion of the right atrium (Grade A). The position of the tip should preferably be checked during the procedure, especially when an infraclavicular approach to the subclavian vein has been used. Postoperative X-ray is mandatory (a) when the position of the tip has not been checked during the procedure, and/or (b) when the device has been placed using blind subclavian approach or other techniques which carry the risk of pleuropulmonary damage.	C, B	5

Annals of Internal Medicine SUPPLEMENT

The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC): Results From a Multispecialty Panel Using the RAND/UCLA Appropriateness Method

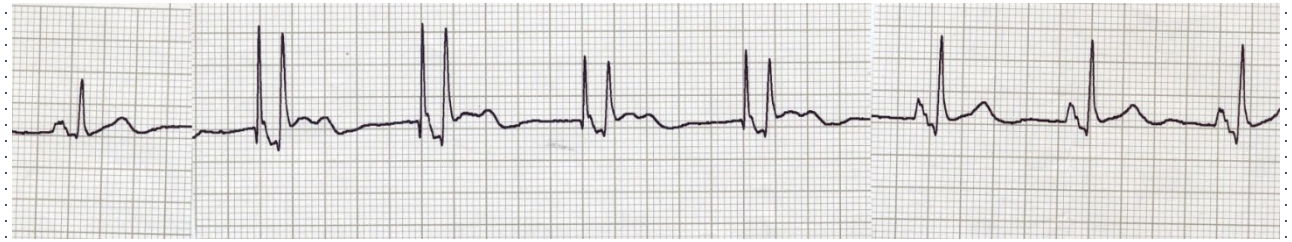
Vineet Chopra, MD, MSc; Scott A. Flanders, MD; Sanjay Saint, MD, MPH; Scott C. Woller, MD; Naomi P. O'Grady, MD; Nasia Safdar, MD, PhD; Scott O. Trerotola, MD; Rajiv Saran, MD, PhD; Nancy Moureau, BSN, RN; Stephen Wiseman, PharmD; Mauro Pittiruti, MD; Elie A. Akl, MD, MPH, PhD; Agnes Y. Lee, MD, MSc; Anthony Courey, MD; Lakshmi Swaminathan, MD; Jack LeDonne, MD; Carol Becker, MHSA; Sarah L. Krein, PhD, RN; and Steven J. Bernstein, MD, MPH

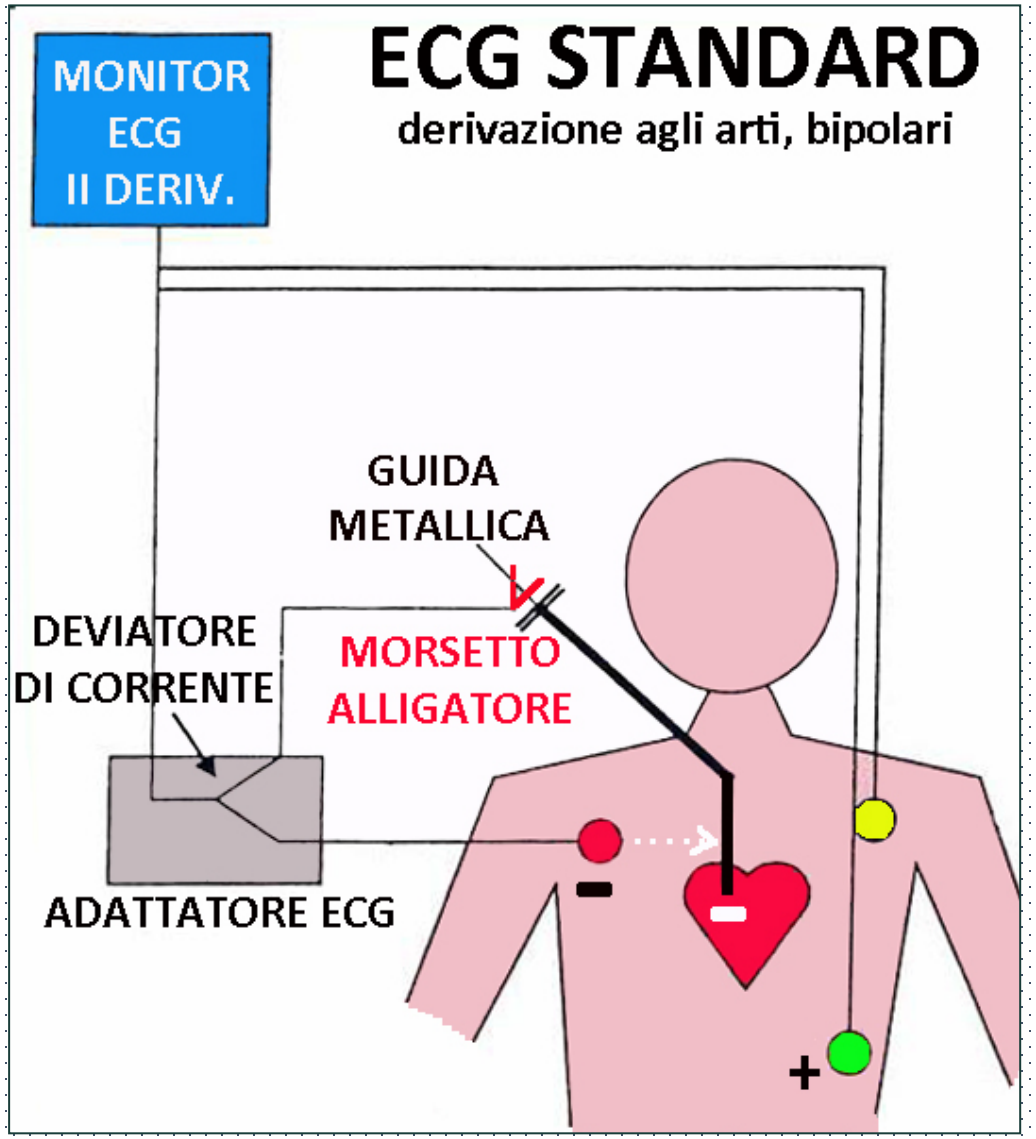
existing PICC. Conversely, panelists rated routine radiographic verification of PICC tip position as inappropriate when PICCs were placed with electrocardiographic guidance, provided that proficiency with this technology had been demonstrated and adequate tracings (such as P-wave deflections) were observed.

TECNICA DELL'ECG INTRACAVITARIO

- **Collegare l'elettrodo negativo dell'arto sup. dx o della spalla all'adattatore**
- **Registrazione ECG e durante la progressione del catetere visualizzare sulla II derivazione di Einthoven la P "max"**

P basale **P max** **P rise**





Grazie a Giuseppe Capozzoli

Review

JVA The Journal of Vascular Access

Intracavitary electrocardiography for tip location during central venous catheterization: A narrative review of 70 years of clinical studies

The Journal of Vascular Access
1–8

DOI: 10.1177/1129729820929835
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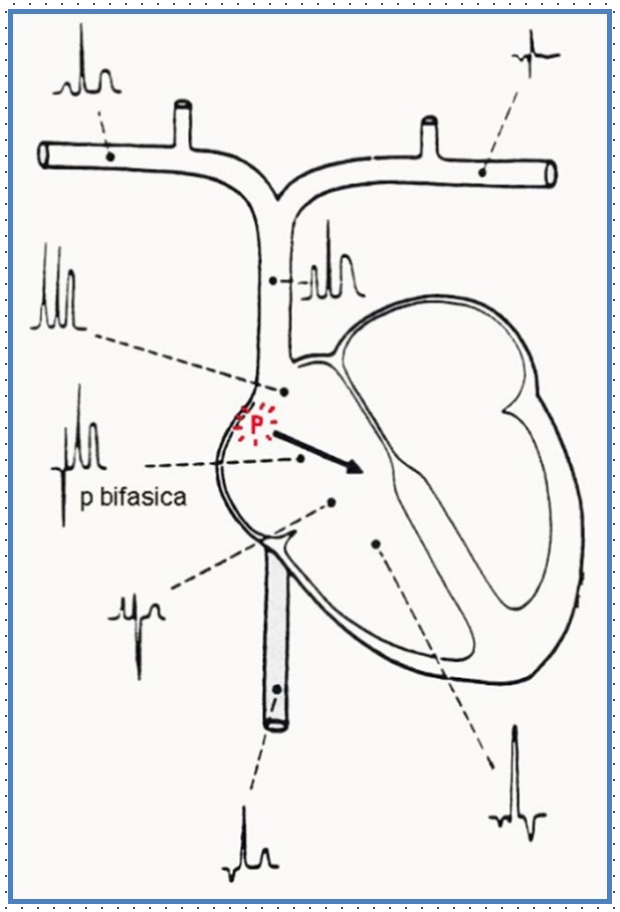
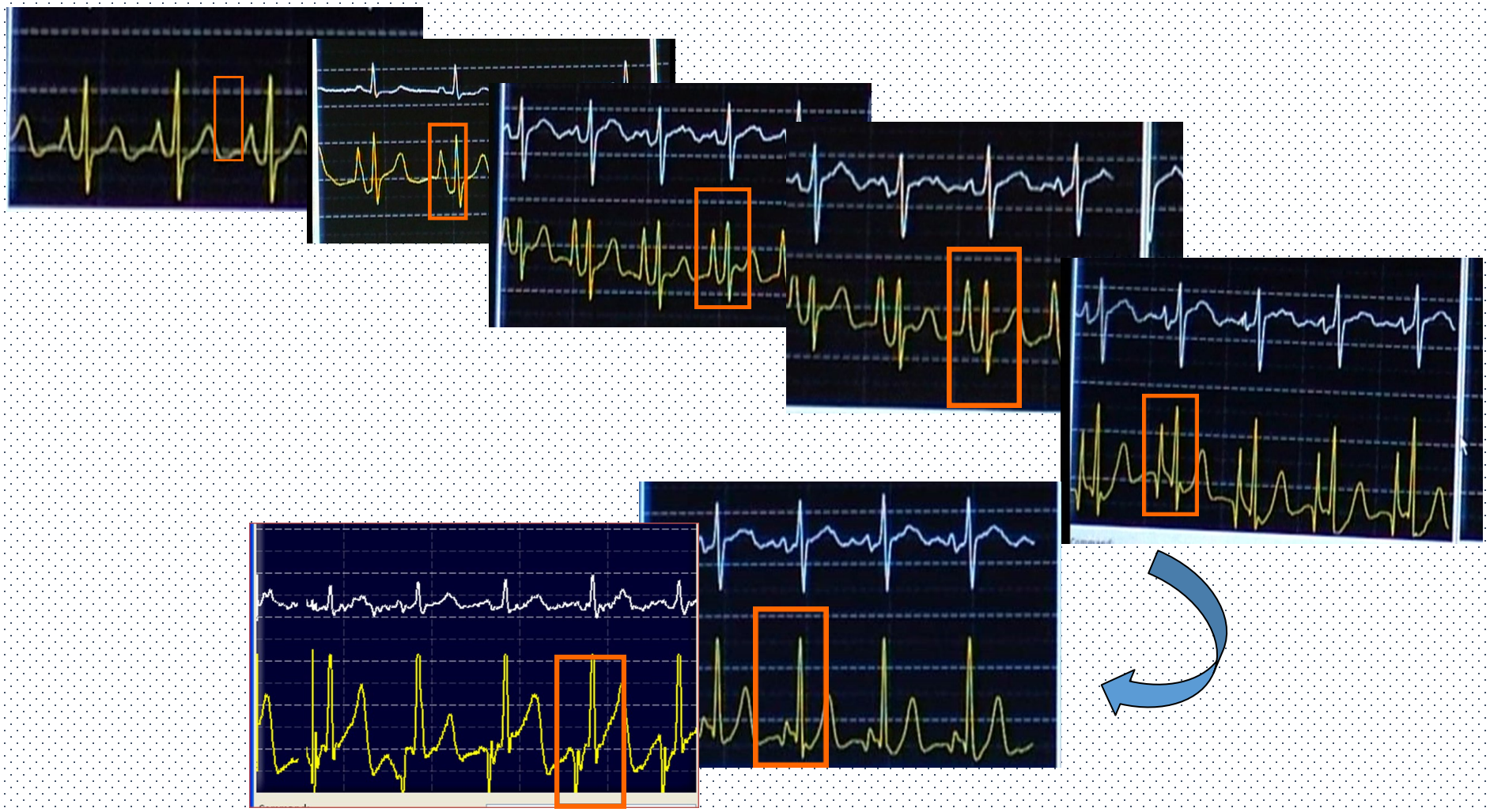
Mauro Pittiruti[1], Filippo Pelagatti[2] and Fulvio Pinelli[3]

catheters. Thanks to this intense publishing activity, many issues has been clarified: (a) the maximal height of the P wave represents faithfully CAJ (i.e. the crista terminalis); (b) the maximal height of the P wave is not related to the location of the sinus node, but to the site of transition between electrically inactive tissue (SVC) and electrically active tissue (RA); and (c) the best way to identify maximal P wave, avoiding false positives, is to look at the "typical" pattern of P wave changes when the catheter is pushed from the SVC into the atrium (rising P–peak–decreasing or biphasic P).

Variazioni dell'onda P in II derivazione

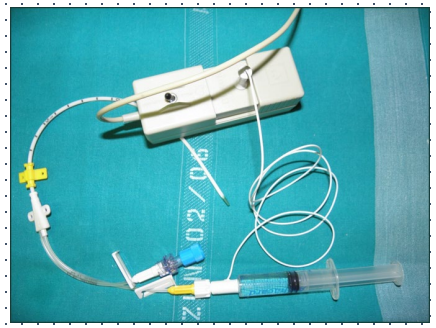


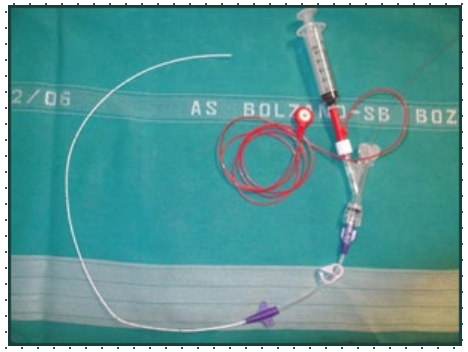


Martin JT et al. Neuroanesthetic adjiuncts for surgery in the sitting position. Intravascular electrocardiography. Anesth Analg 49: 793-805, 1970.

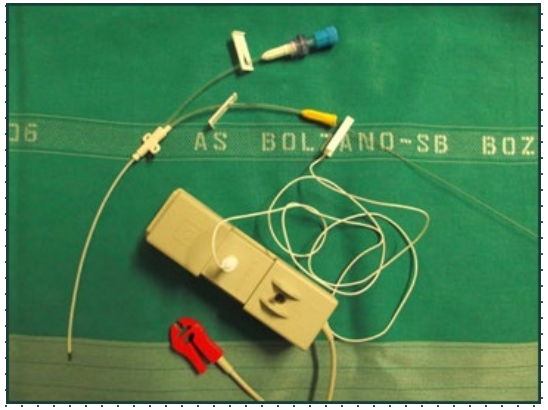
Grazie ad Antonio La Greca

Tecnica della colonna di soluzione salina





Tecnica della guida metallica



Martin JT et al. Neuroanesthetic adjiuncts for surgery in the sitting position. Intravascular electrocardiography. Anesth Analg 49: 793-805, 1970.

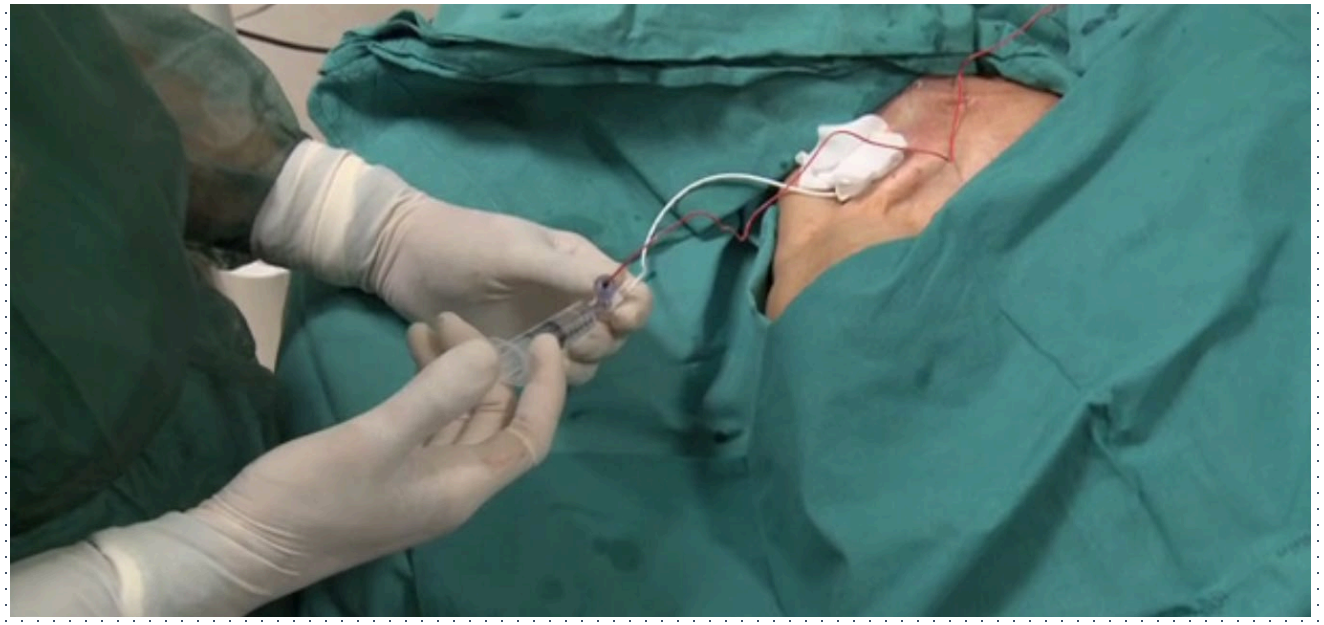
Conclusioni Tecnica Standard

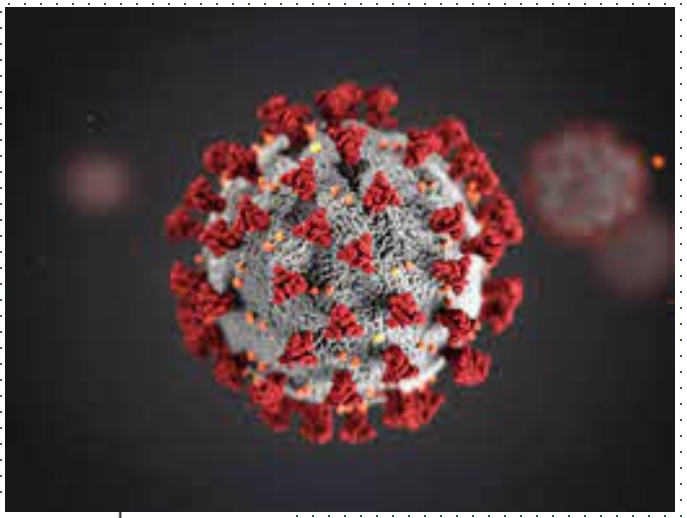
Un monitor standard

Un cavo universale

Controlla la variazione dell’onda P

Visualizza l'intero pattern delle variazioni dell'onda P





Pittiruti and Pinelli *Critical Care* (2020) 24:269
https://doi.org/10.1186/s13054-020-02997-1

Critical Care

COMMENTARY Open Access

Recommendations for the use of vascular access in the COVID-19 patients: an Italian perspective

Mauro Pittiruti[1*], Fulvio Pinelli[2] on behalf of the GAVeCeLT Working Group for Vascular Access in COVID-19

- Elevata affidabilità del metodo
- Facilità di esecuzione
- Scarso dispendio temporale
- Immediata possibilità di correzione
- Esposizione radiologica assente
- Bassi costi

JVA The Journal of Vascular Access

Editorial

Vascular access in COVID-19 patients: Smart decisions for maximal safety

The Journal of Vascular Access
2020, Vol. 21(4) 408–410

DOI: 10.1177/1129729820923935
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Giancarlo Scoppettuolo[1], Daniele Guerino Biasucci[2] and Mauro Pittiruti[3]

JVA The Journal of Vascular Access

Editorial

Choice and management of vascular access in the context of COVID-19 outbreak in Italy: Recommendations from clinical practice

The Journal of Vascular Access
1–6

DOI: 10.1177/1129729820968415
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Davide Vailati[1], Giorgia Montrucchio[2], Vittorio Cerotto[3], Giuseppe Capozzoli[4], Fabio Gori[5], Flavia Petrini[6,7] and Luca Brazzi[2,8]; on behalf of the Italian Society of Anesthesia and Intensive Care (Società Italiana di Anestesia, Analgesia, Rianimazione e Terapia Intensiva, SIAARTI)

RESEARCH ARTICLE

Factors Influencing Intracavitary Electrocardiographic P-Wave Changes during Central Venous Catheter Placement

PLOS ONE | DOI:10.1371/journal.pone.0124846 April 27, 2015

1) Letti di degenza o tavoli operatori a comando elettrico (motorizzati), pompe infusionali
2) Sonda ecografica
3) Deviatore di corrente collegato al monitor ed alla guida metallica

CLASSIFICAZIONE
delle apparecchiature elettromedicali

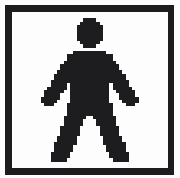
- B apparecchi elettromedicali in genere
- BF apparecchi elettromedicali con uscite o ingressi isolati da terra (flottanti)
- CF apparecchi elettromedicali con uscite o ingressi isolati da terra per applicazione diretta cardiaca

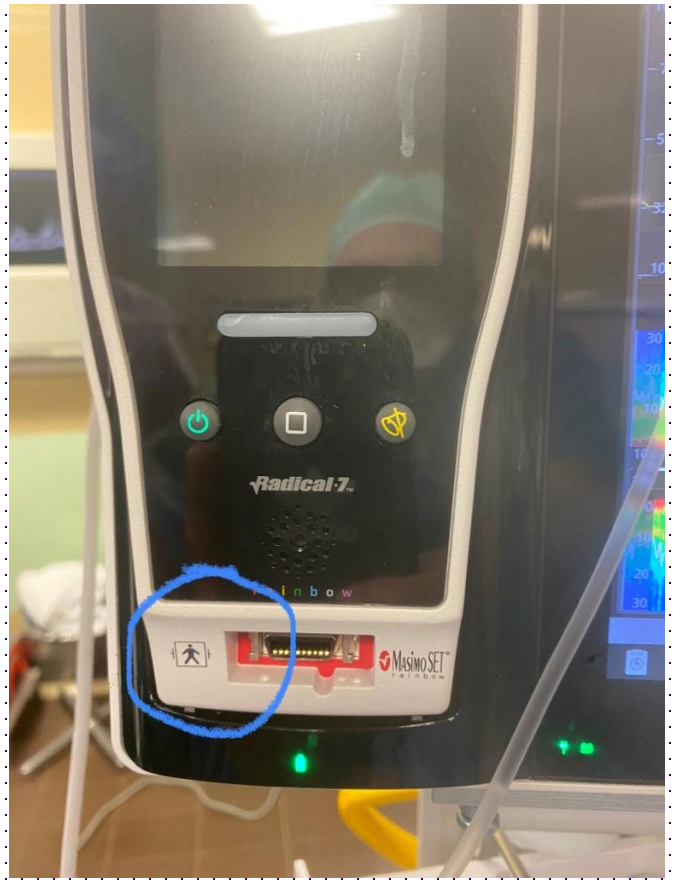
TIPO	SIMBOLO	Corrente di dispersione nell'involucro	Corrente di dispersione nel paziente	Corrente di dispersione verso terra
B		100 µA	100	500
BF		100	100	500
CF		100	**10**	500

Swerdlow CD, Circulation 99: 2559-2564,1999

Grazie a Giuseppe Capozzoli


DEFIBRILLATORE
REGISTRATORE
MONITOR
HEWLETT-PACKARD
Carica
Registra
Derivazioni
Sinc
Marker
Dimens. ECG
Allarme FC
Revisione
Analisi
CodeMaster

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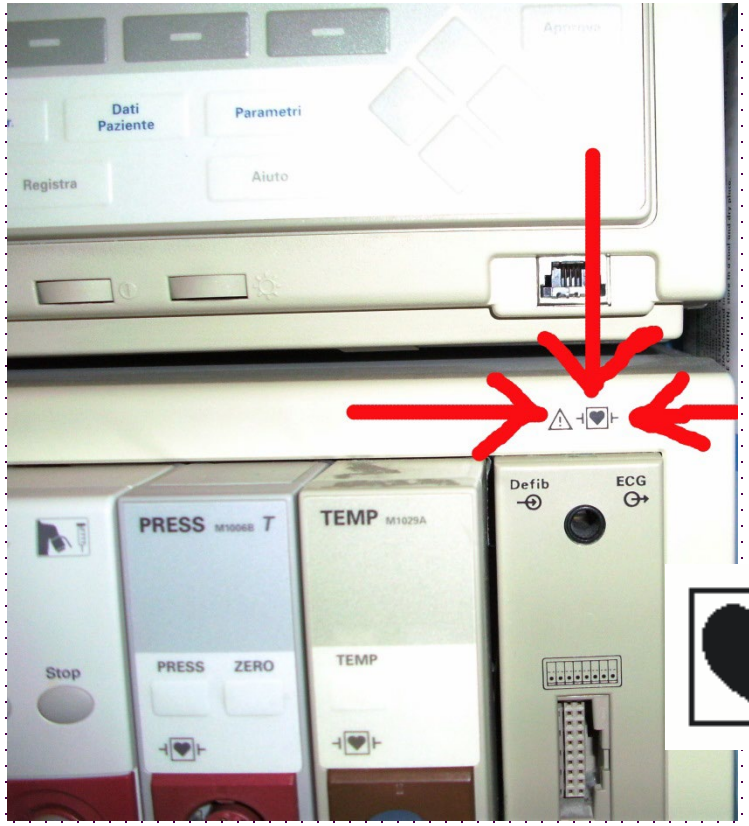
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Original research article

JVA | The Journal of Vascular Access

Effects of indwelling centrally inserted central catheter on tip location of peripherally inserted central catheter with intracavitary electrocardiogram guidance: A retrospective case-control study

The Journal of Vascular Access
1–6

DOI: 10.1177/11297298211015088
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Table 2. Stability of the ECG waveform.

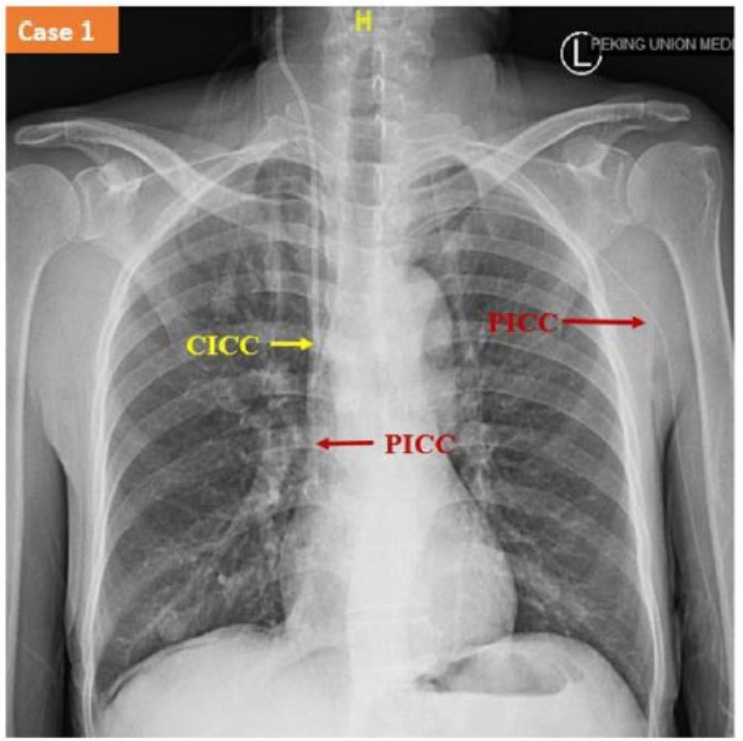
Group	Unstable waves (*N*, %)	Stable waves (*N*, %)	χ^2	*p* Value
Cases	3 (10.00)	27 (90.00)	0.22	0.64
Controls	2 (6.67)	28 (96.67)		

Table 3. Amplitude of the *P*-waves.

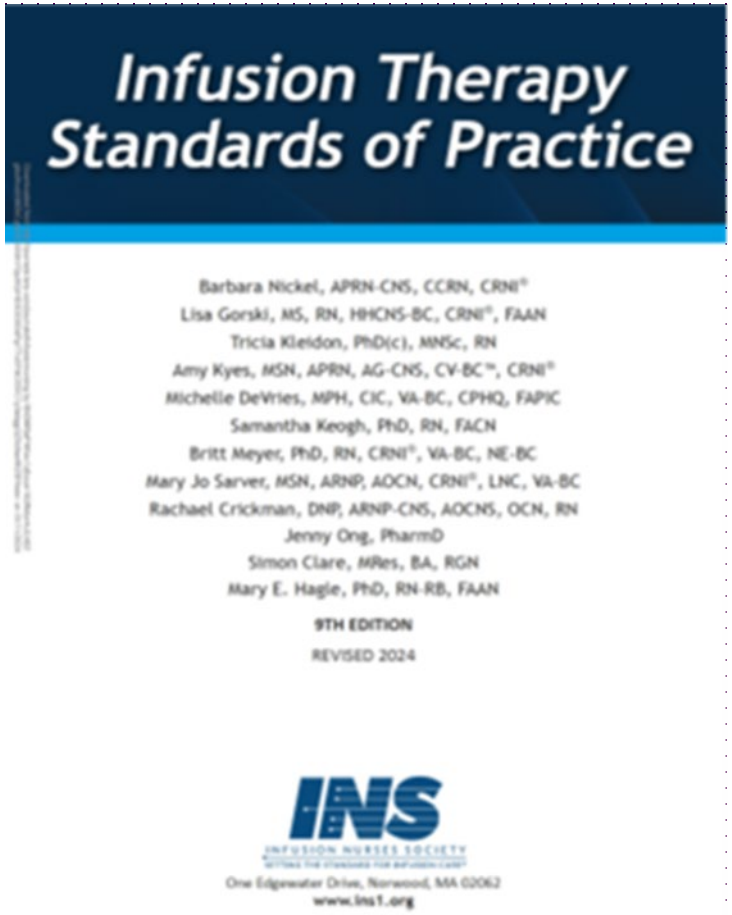
Amplitude (mV)	Cases	Controls	*t*	*p* Value
Baseline P-wave	0.14 ± 0.14	0.14 ± 0.11	0.06	0.96
Ideal P-wave	0.72 ± 0.47	0.64 ± 0.20	0.80	0.43

Table 4. Accuracy of the PICC tip location.

Group	PICC tip location (*N*, %)			Distance (cm)
	Accuracy	Shallow	Deep	
Cases	28 (93.33)	1 (3.33)	1 (3.33)	2.43 ± 1.51
Controls	29 (96.67)	1 (3.33)	0	2.47 ± 1.20
χ^2/t	1.40			−0.03
p Value	0.50			0.98



a. Assess patient for known history of cardiac dysrhythmias and the presence of a P wave on ECG (if available) before planning to use ECG technology for tip confirmation. Contraindications to the use of ECG technology include patients with an abnormal ECG rhythm with an absence or alteration in the P wave (eg, presence of pacemakers, extreme tachycardia). Prospective observational studies have demonstrated safety and efficiency of using ECG to confirm catheter tip position in patients with atrial fibrillation.[20,29,31,32] (III)



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Limiti della tecnica ECG

Onda P assente (Fibrillazione atriale o altre aritmie sopraventricolari)

Onda P anormale (ritmi ectopici)

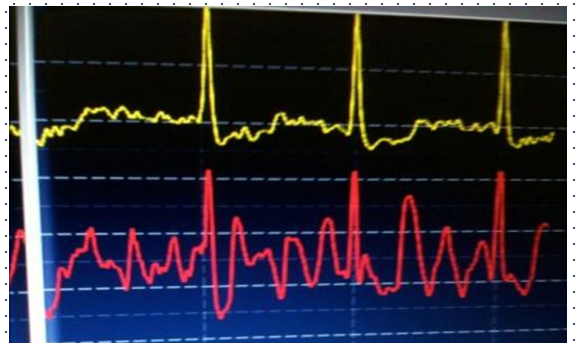
Onda P non visibile (PMK)

Applicabilità

Onda P difficile da identificare/valutare (tachicardia, paziente con tremori, problemi tecnici, malposizionamenti)

Fattibilità

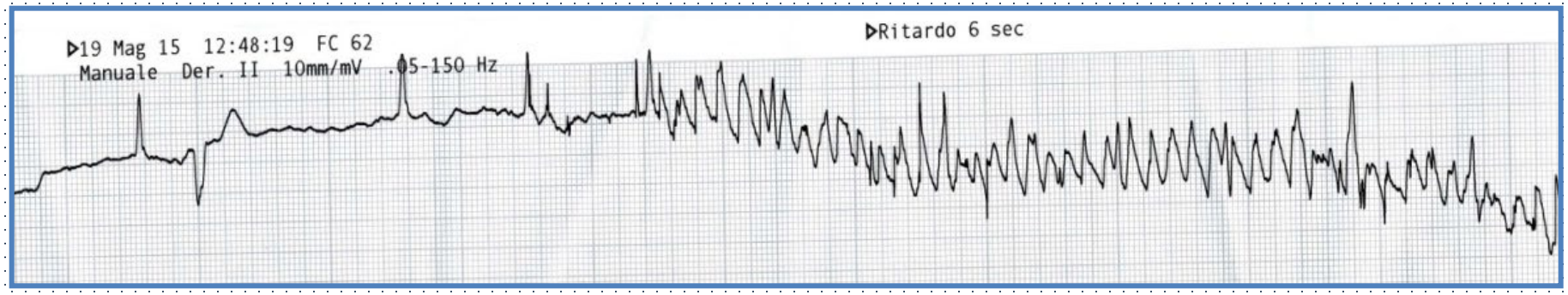
Applicabilità: 91-93%

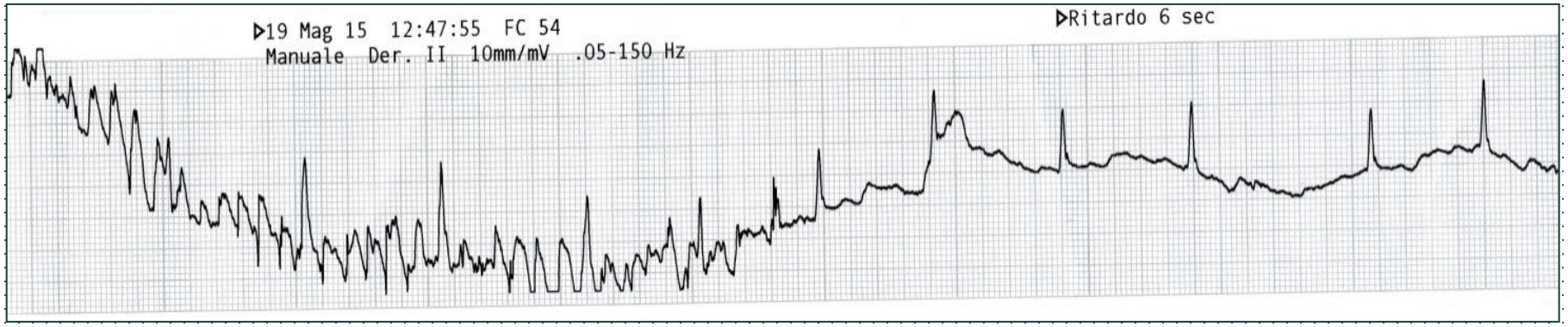


Fattibilità 98.5-99.3%

Limiti della tecnica elettrocardiografica

fibrillazioni, flutter e tachicardia atriale parossistica





Schummer W. Modified ECG-guidance for optimal central venous catheter tip positioning. A transesophageal echocardiography controlled study Anaesthesist. 2005.

Original research article

JVA The Journal of Vascular Access

A modified intracavitary electrocardiographic method for detecting the location of the tip of central venous catheters in atrial fibrillation patients

The Journal of Vascular Access
1–8

DOI: 10.1177/1129729818819422
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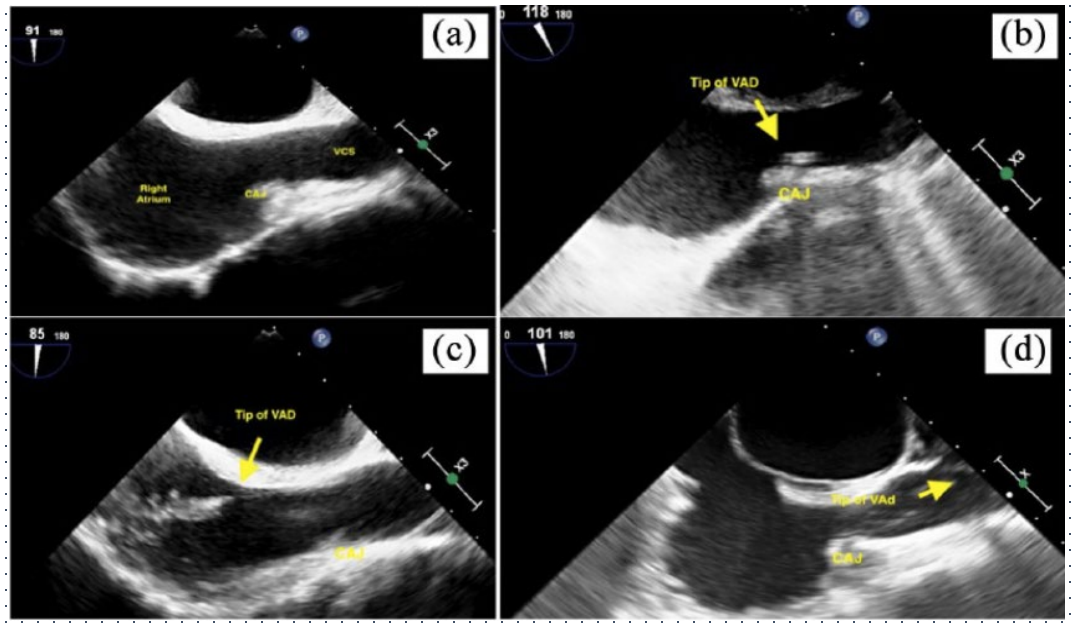
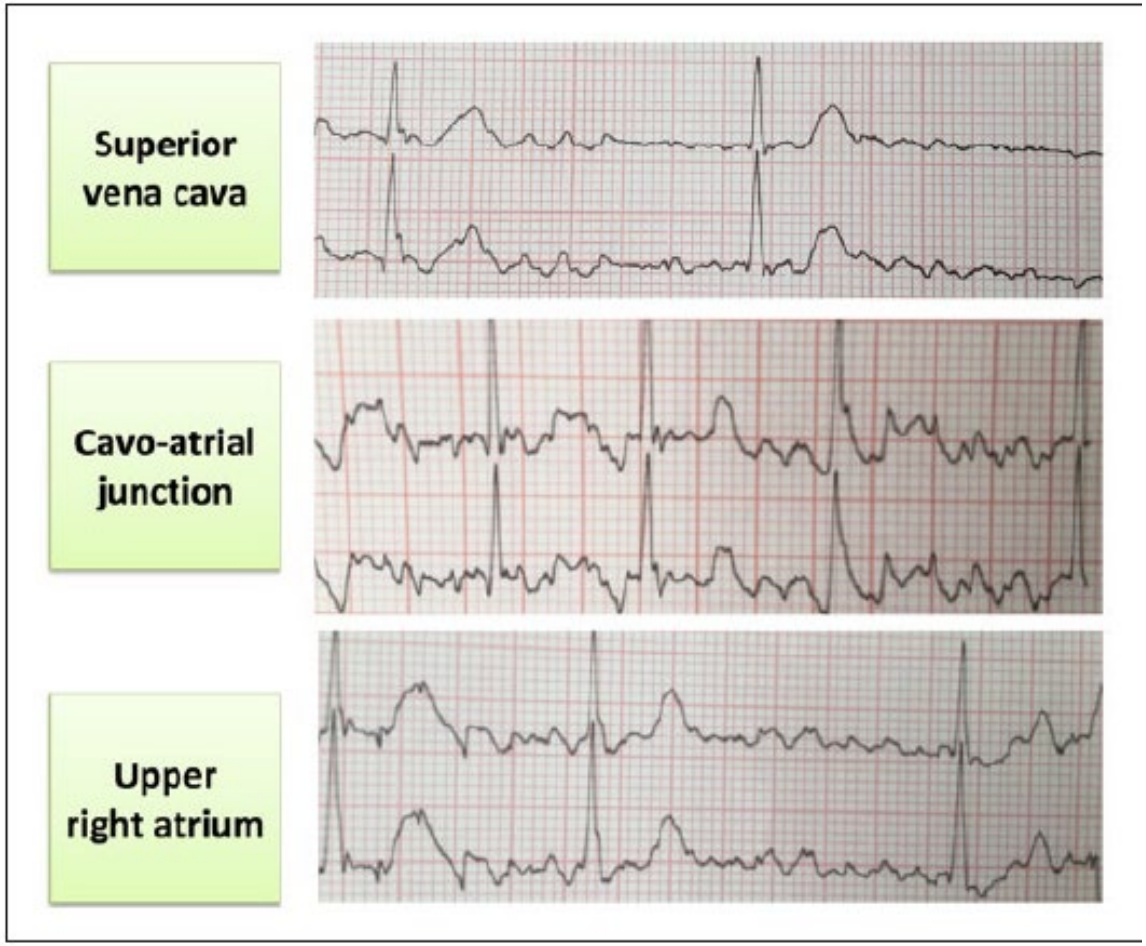
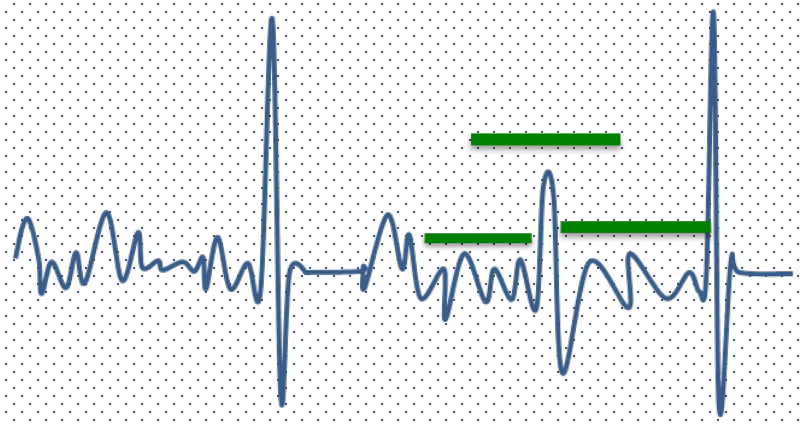
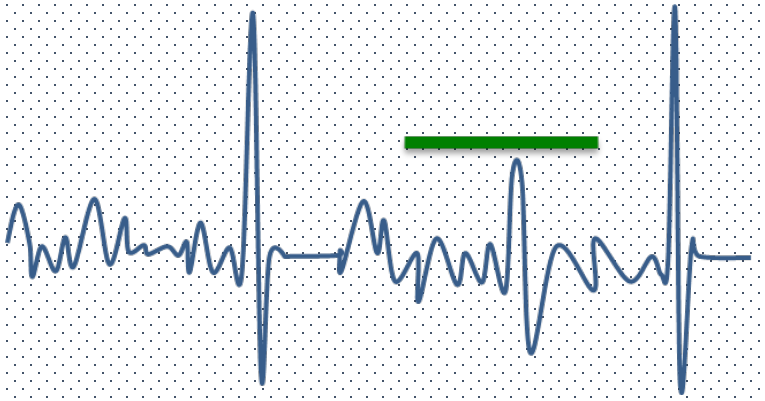
Maria Calabrese[1], Luca Montini[2], Gabriella Arlotta[1], Antonio La Greca[3], Daniele G Biasucci[2], Francesca Bevilacqua[1], Enrica Antoniucci[1], Andrea Scapigliati[1], Franco Cavaliere[1] and Mauro Pittiruti[3]



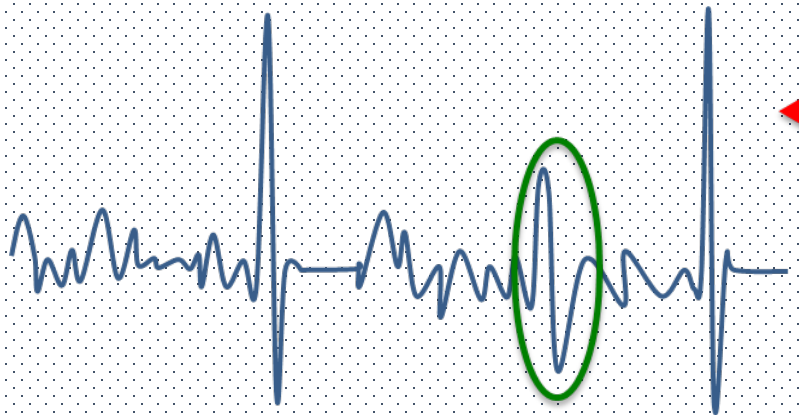




Method A



Method B



Method C

Conclusion

Our study describes a new "modified" IC-ECG method based on the maximal electrical activity of the TQ tract and not on the maximal height of the *P* wave and demonstrates that such method can be safely used for detecting the location of the tip of central VADs in AF patients. Our data also suggest that this method should replace other tip location methods currently used in AF patients, such as fluoroscopy or post-procedural chest X-ray, since such radiological techniques are less accurate, more expensive, and less safe than IC-ECG.

Original research article

JVA | The Journal of Vascular Access

Electrocardiography-controlled central venous catheter tip positioning in patients with atrial fibrillation

The Journal of Vascular Access
1–7

DOI: 10.1177/1129729818757976
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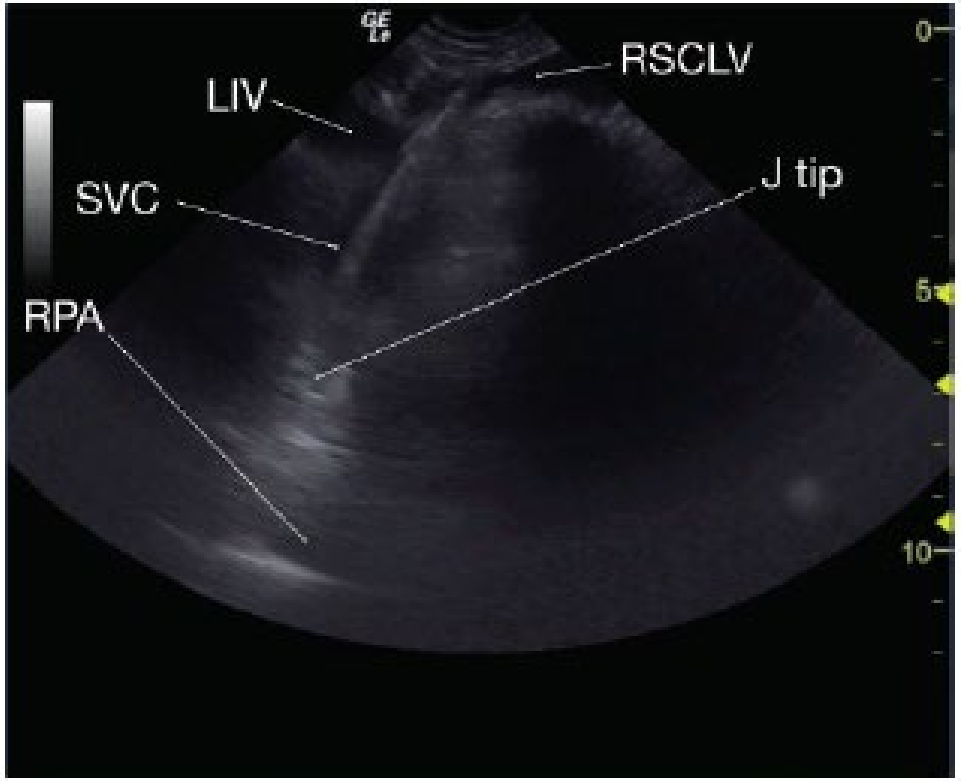
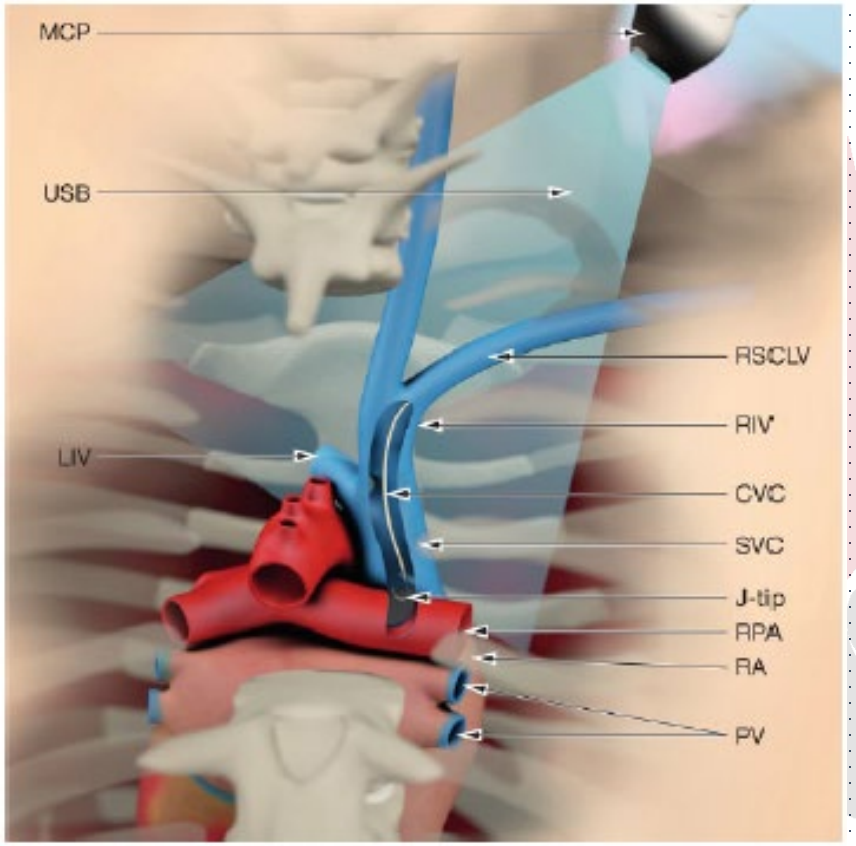
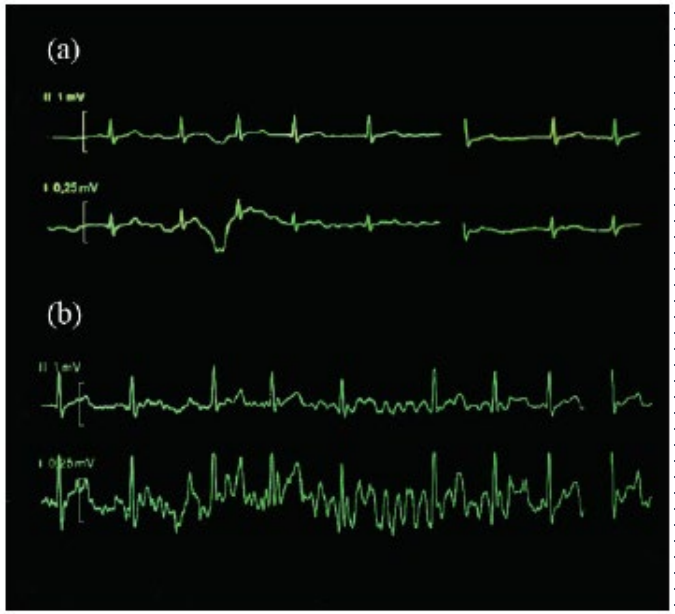
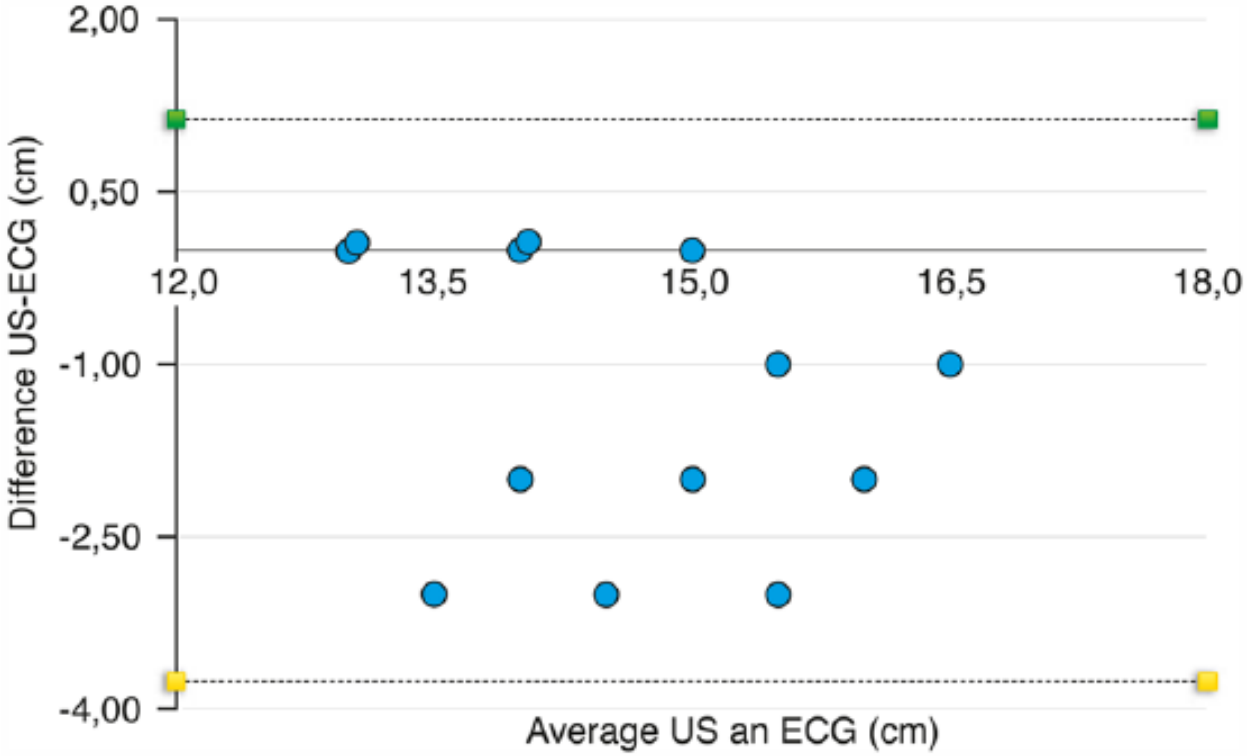
Folkert Steinhagen[1], Maximilian Kanthak[1], Guido Kukuk[2], Christian Bode[1], Andreas Hoeft[1], Stefan Weber[3] and Se-Chan Kim[1,4]



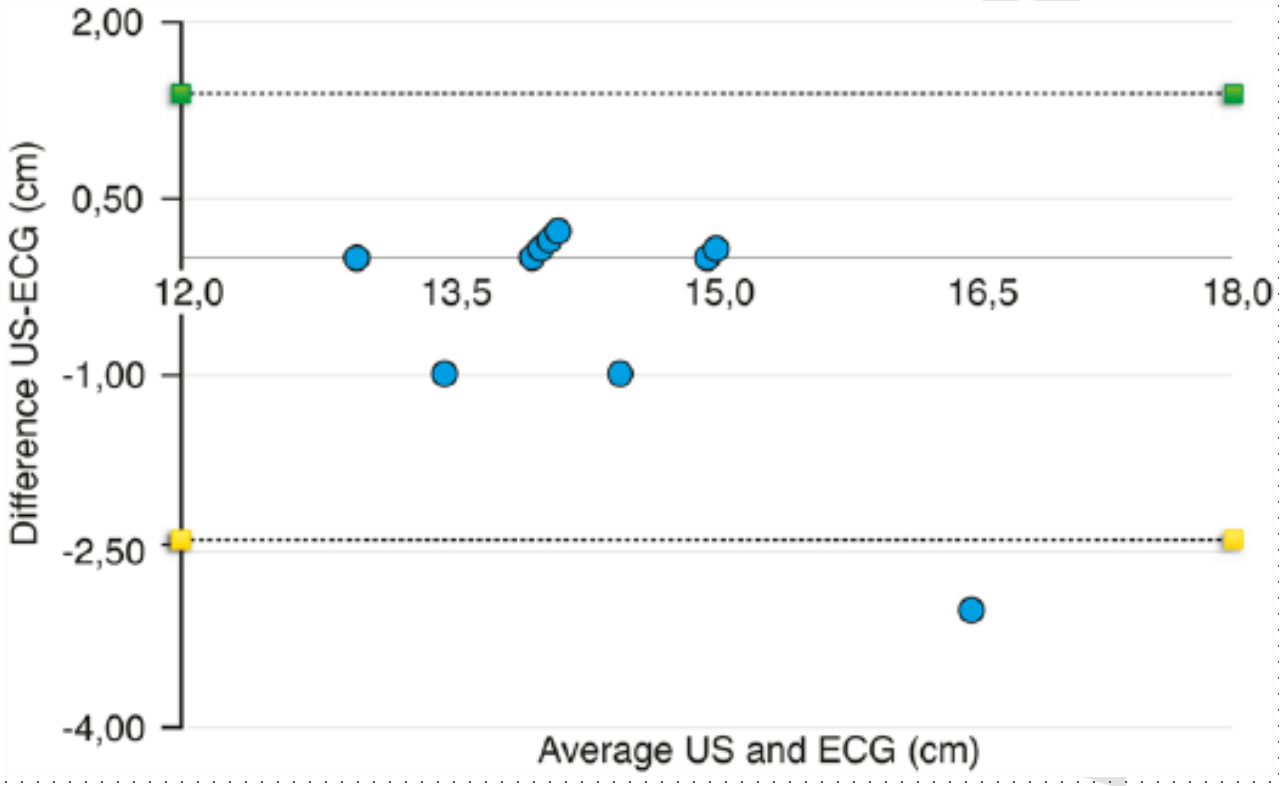




Pazienti in FA



Pazienti in ritmo sinusale



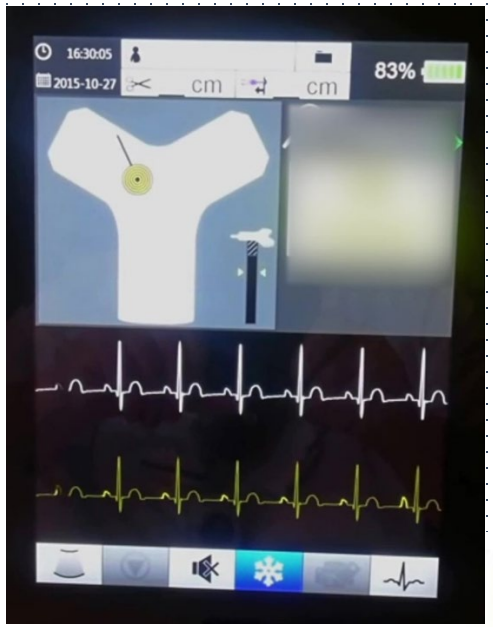

100 %
VYGON
F 99
HR 99
2091
cm
0:0:8
ECG from file

A new wireless device for bedside assessment of tip location of central venous access devices using intracavitary ECG: A retrospective study

JVA | The Journal of Vascular Access

Un monitor "digitale" dedicato può garantire una buona rilevazione e interpretazione del segnale (filtraggio, amplificazione, ecc.).

Migliora la fattibilità



Review

JVA The Journal of Vascular Access

A GAVeCeLT consensus on the indication, insertion, and management of central venous access devices in the critically ill

The Journal of Vascular Access
1–19

DOI: 10.1177/11297298241262932
journals.sagepub.com/home/jva
Sage

Question 11: Which should be the preferred methods for assessment of tip location?

Panel recommendation. The position of the tip of any central VAD must be assessed by intra-procedural, non-invasive methods such as intracavitary ECG or ultra-sound-based tip location (preferably, according to the ECHOTIP protocol). *(Strong agreement: 26 agree, 0 uncertain, 0 disagree)*

The combined use of intracavitary ECG and ultrasound based tip location may completely avoid the need for intraprocedural fluoroscopy and/or post-procedural chest X-ray in adult patients requiring central venous catheterization…….

JVA | The Journal of Vascular Access

A feasible and safe standardized protocol for ultrasound and intracavitary electrocardiogram-based tip navigation and tip location during placement of peripherally inserted central catheters

The Journal of Vascular Access
2024, Vol. 25(3) 935–942

DOI: 10.1177/11297298221095039
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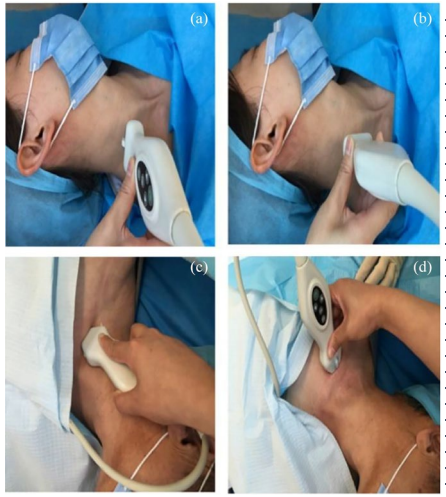

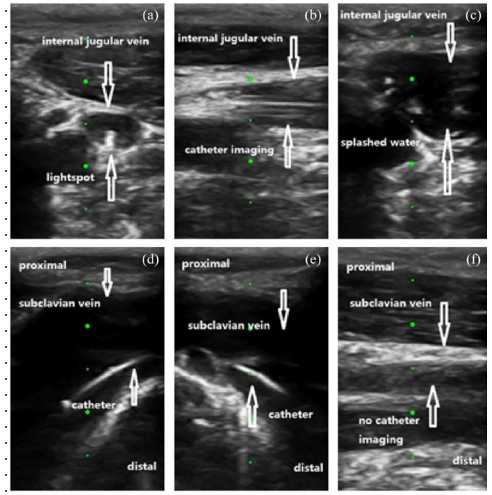

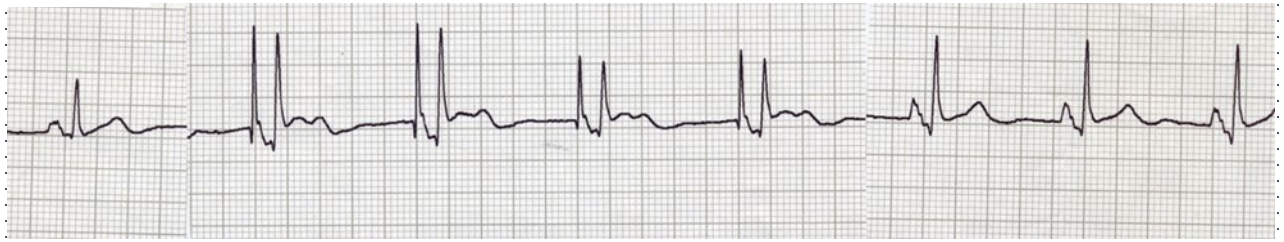

Table 3. Compared malposition of the tip location between two groups ($n = 3454$).

	ECG ($n = 1727$)	ECG + US ($n = 1727$)	Total ($n = 3454$)	p
Distance from tracheal carina (cm), *n* (%)				**<0.001**
<1.6	22 (1.3)	5 (0.3)	27 (0.8)	
1.6–4	1681 (97.3)	1720 (99.6)	3401 (98.5)	
>4	24 (1.4)	2 (0.1)	26 (0.8)	
Whether malposition or not, *n* (%)				**<0.001**
Y	46 (2.7)	7 (0.4)	53 (1.5)	
N	1681 (97.3)	1720 (99.6)	3401 (98.5)	

International Journal of Surgery Case Reports 12 (2015) 84–86

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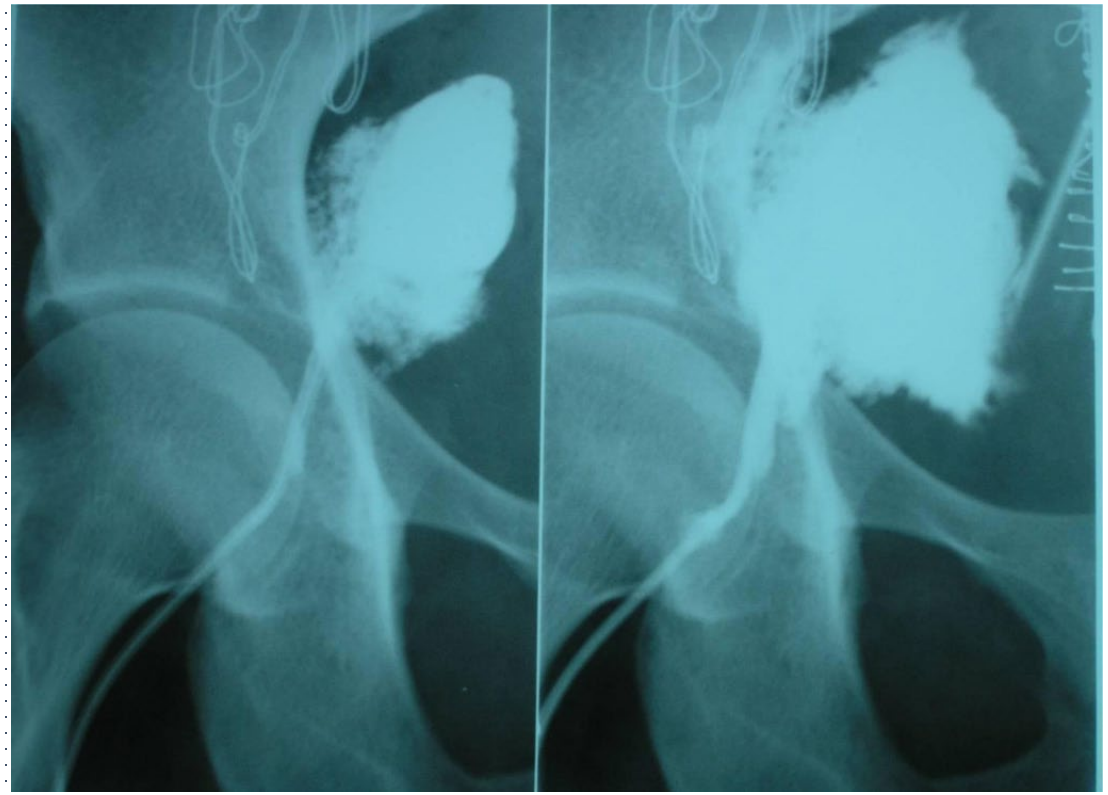
journal homepage: www.casereports.com

A case report of abdominal compartment syndrome caused by malposition of a femoral venous catheter

Georgios Pafitanis*, Koulas Spyridon, Evgenia Theodorakopoulou, Katrina Mason, Olga Ygropoulou, Ourania Mousafiri

Blizard Institute, 4 Newark Street, London E1 2AT, United Kingdom



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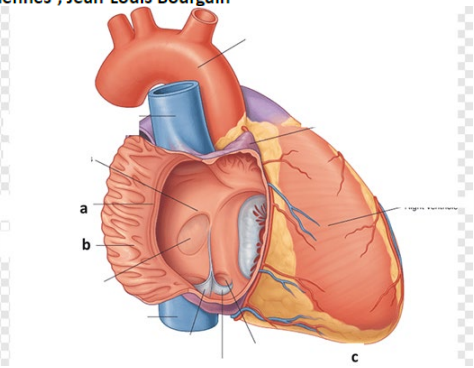
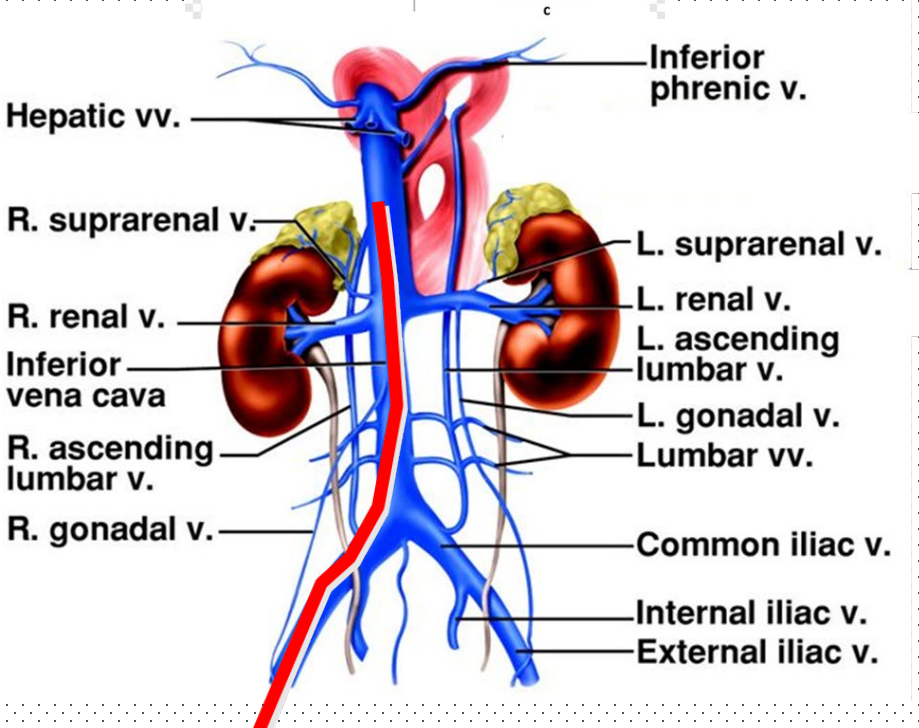
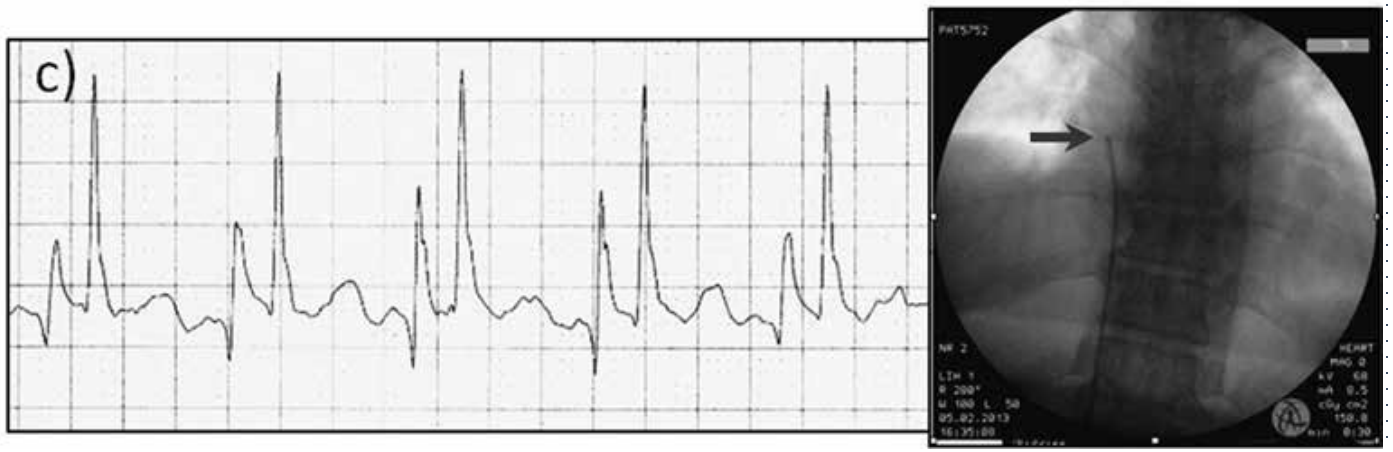
ORIGINAL ARTICLE

Peroperative electrocardiographic control of catheter tip position during implantation of femoral venous ports

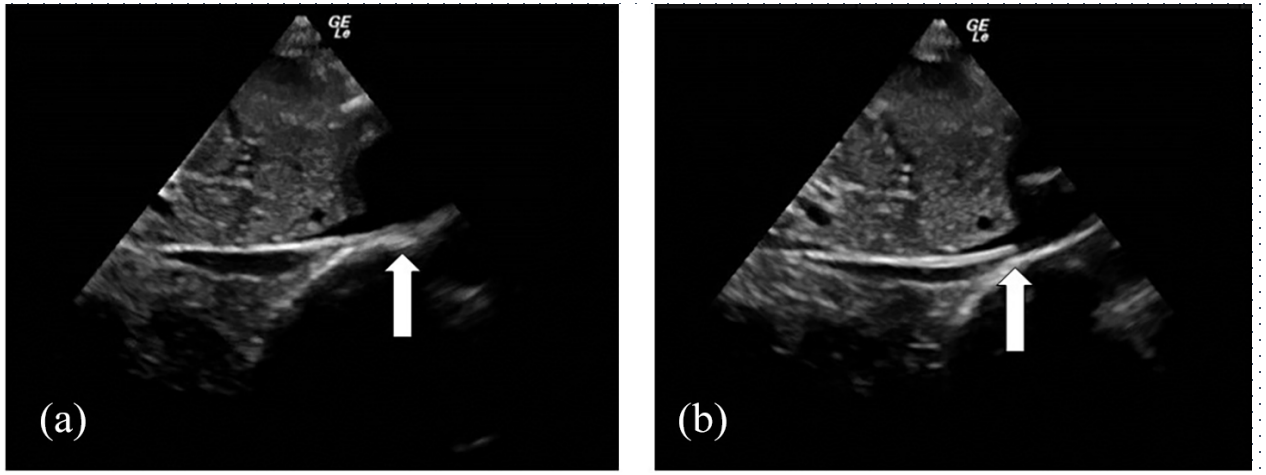
Pierre Gibault[1,2], Eric Desruennes[2], Jean-Louis Bourgain[2]







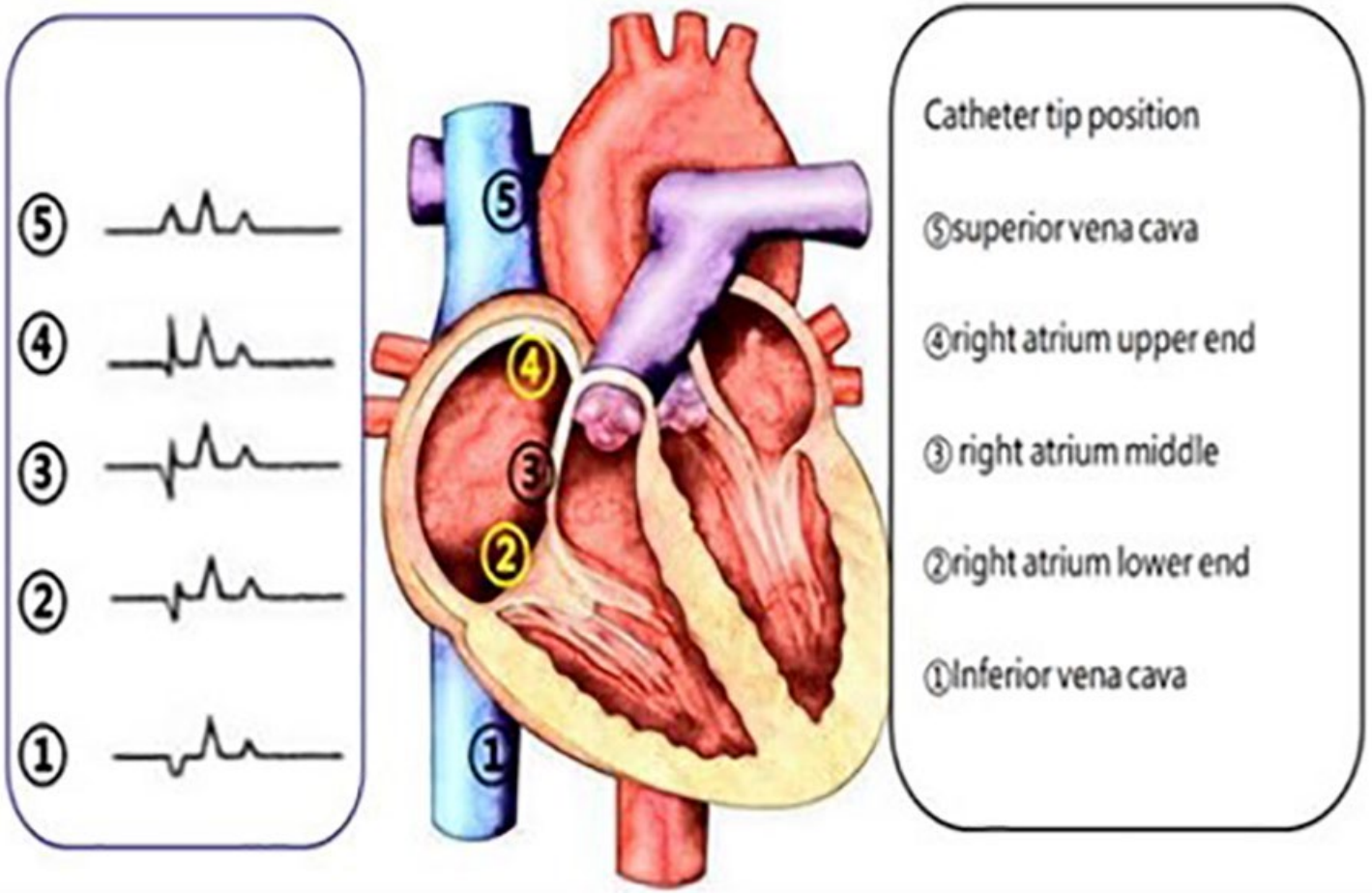
The application of intracavitary electrocardiogram for tip location of femoral vein catheters in chemotherapy patients with superior vena cava obstruction



Use of intracavitary-ECG for tip location of femorally inserted central catheters

Mark D Weber, Adam S Himebauch and Thomas Conlon

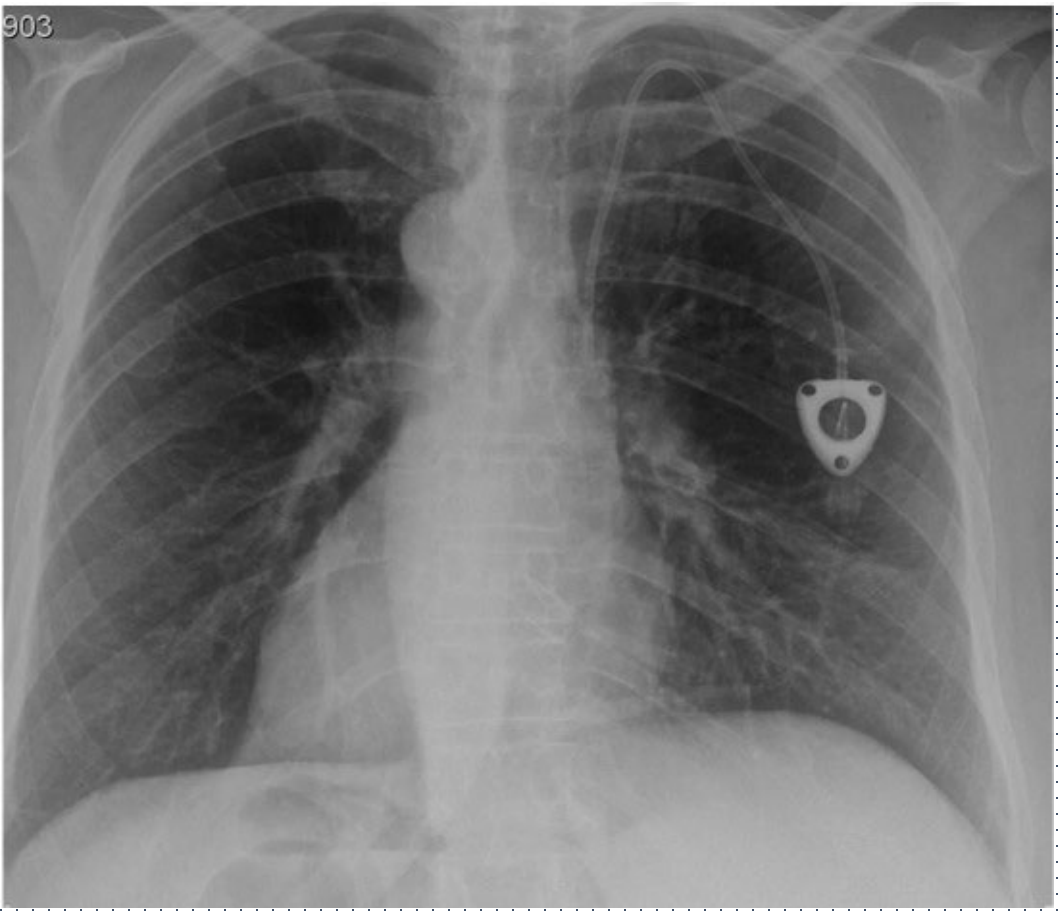
JVA The Journal of Vascular Access



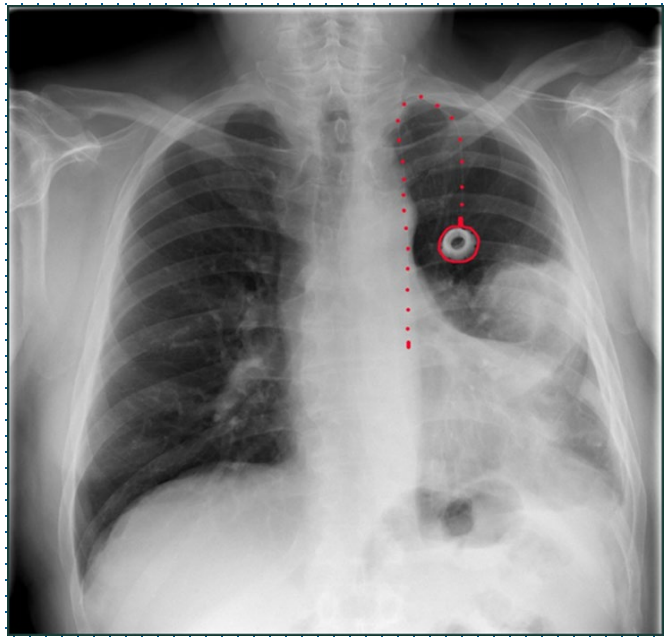
Caso clinico

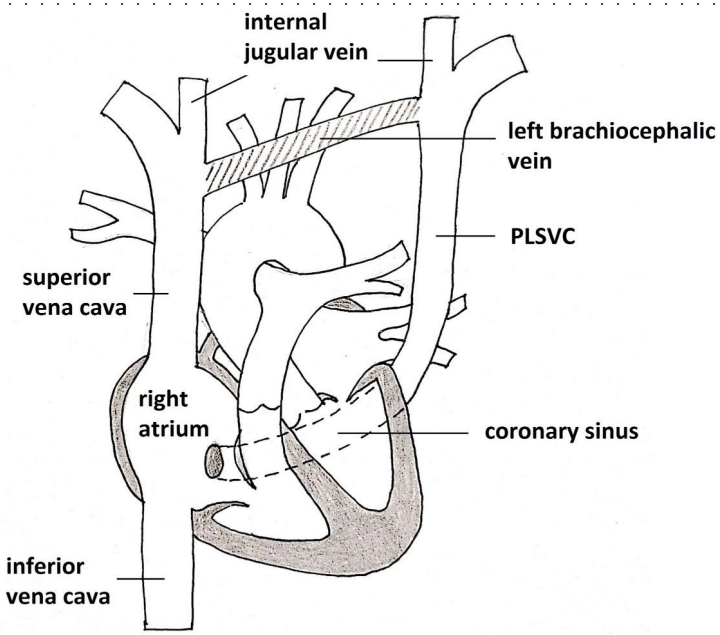
- Donna 30 anni al III mese di gravidanza affetta da stipsi cronica severa tipo *“slow transit”*.
- Indicazione per NP come supporto nutrizionale
- PICC 4 Fr,
- Periodicamente sono stati eseguiti controlli con tecnica ECG endocavitaria per confermare la corretta posizione della punta del PICC

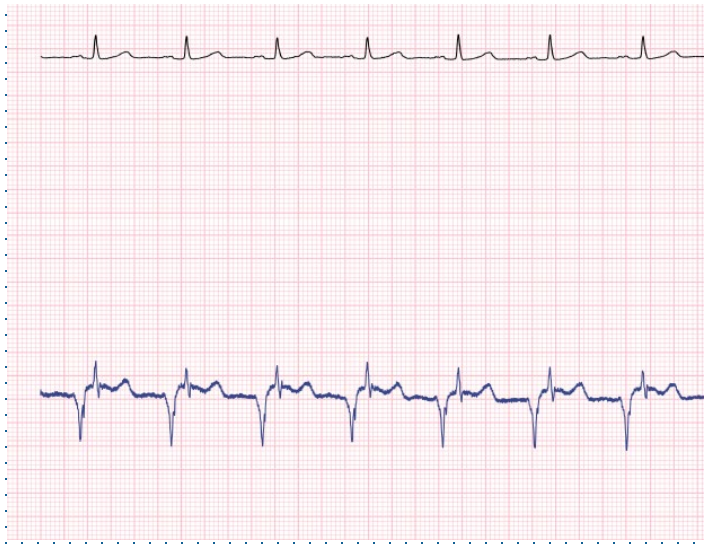
SITUS VISCERUM INVERSUS

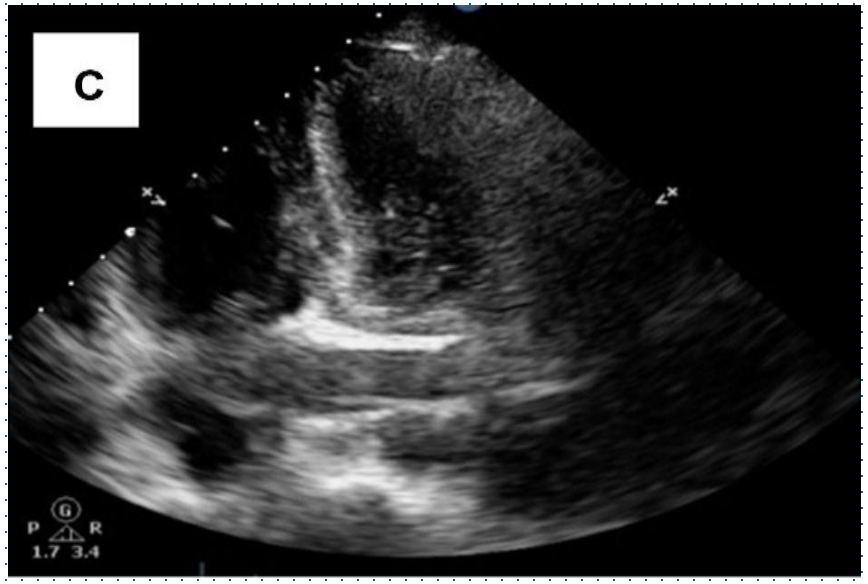


PERSISTENT LEFT SUPERIOR VENA CAVA









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DOI: 10.5301/jva.5000378

ORIGINAL ARTICLE

The intracavitary ECG method for insertion of a tunneled dialysis catheter without using fluoroscopy

Seong Cho, Yu-Ji Lee, Sung-Rok Kim

Division of Nephrology, Department of Internal Medicine, College of Medicine, The Sungkyunkwan Universit Hospital, Changwon - Korea

The feasibility of this method was 94.4%

TABLE II - Tunneled catheter insertion characteristics

	***N* = 142**
Risk of catheter placement failure, *N* (%)	0/142
Arterial puncture, *N* (%)	2/142
Hematoma, *N* (%)	2/142
Pneumo- or hemothorax, *N* (%)	0/142
Malfunction	3/142
P wave morphology at intracardiac EKG monitoring	
Zone 1: same as surface EKG P waves	8
Zone 2: P wave rising to maximal height	134
Zone 3: P wave decreasing with initial negative	0
Position of tip at the chest PA	
Zone 1: above carina	6
Zone 2: carina to 5 cm under the tracheal carina	136
Zone 3: below 5 cm under carina	0
Matching between intracardiac EKG and chest PA zone	134/136

The intracavitary ECG method for positioning the tip of central venous access devices in pediatric patients: results of an Italian multicenter studv

Francesca Rossetti[1], Mauro Pittiruti[2], Massimo Lamperti[3], Ugo Graziano[4], Davide Celentano[5], Giuseppe Capozzoli[6]

J Vasc Access 2014;

TABLE VI - MISMATCH BETWEEN IC-ECG AND X-RAY

	OB	BM	SN	MF	GR	
Mismatch Gr. A N=157	-	-	3	1	2	6 (3.8%)
Mismatch Gr. B N=119	-	-	1	2	3	6 (5%)
Mismatch Gr. C N=31	1	-	-	-	-	1 (3.2%)

The IC-ECG method is safe and accurate in the pediatric patient as much as in adults. Its applicability and feasibility are more than 99%. The concordance with the radiological methods is high (95.8%) and even higher (98.8%) when using a dedicated ECG monitor. If com-

The intracavitary ECG method for tip location of ultrasound-guided centrally inserted central catheter in neonates

Vito D'Andrea[1], Lucilla Pezza[1], Giorgia Prontera[1], Gina Ancora[2], Mauro Pittiruti[3], Giovanni Vento[1] and Giovanni Barone[2]

The Journal of Vascular Access
2023, Vol. 24(5) 1134–1139

DOI: 10.1177/11297298211068302
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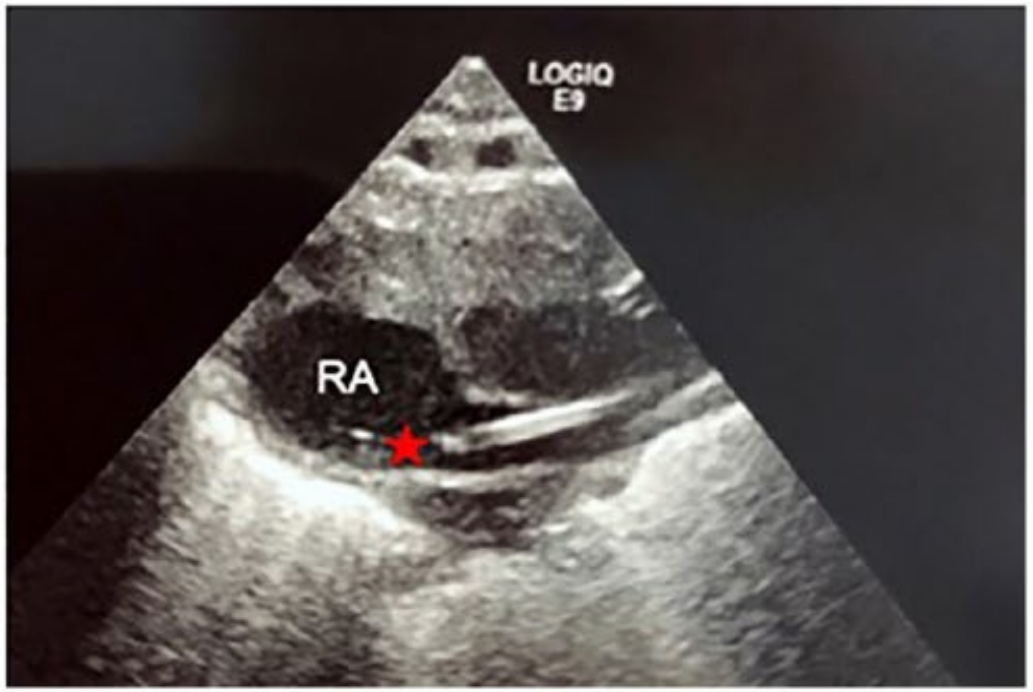

In this field a lot has been done, but there is still a lot that we can do……