



Vantaggi e Limiti della Tecnica dell'ECG Intracavitario nel 2024



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Alcune definizioni....

VAD centrali (CVADs): punta in vena cava superiore, in atrio destro, in vena cava inferiore.

TIP LOCATION: metodica per verificare la posizione «centrale» della punta di un CVAD

The NAVIGATE project: A GloVANet–WoCoVA position statement on the nomenclature for vascular access devices

The Journal of Vascular Access
1–8
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Matheus (Roland) van Rens¹, Robin van der Lee¹, Timothy R Spencer², Ton van Boxtel³, Giovanni Barone⁴, Alessandro Crocoli⁵, Fulvio Pinelli⁶, Mauro Pittiruti⁷, on behalf of the WoCoVA Foundation (World Conference on Vascular Access) and of the Global Vascular Access Network (GloVANet)



Posizione punta CVAD e complicanze

La **corretta posizione della punta** è essenziale per evitare complicanze quali:

- ✓ **trombosi vascolare**
- ✓ **malfunzionamento del catetere**
- ✓ **aritmie**

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

ORIGINAL ARTICLE

Jo Caers
Christel Fontaine
Vincent Vinh-Hung
Johan De Mey
Gerrit Ponnet
Chris Oost
Jan Lamote
Jacques De Greve
Benjamin Van Camp
Patrick Lacor

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

Tip Location Intraprocedurale

STANDARDS OF PRACTICE

Infusion Therapy Standards of Practice, 8th Edition

Gorski, Lisa A. MS, RN, HHCNS-BC, CRNI®, FAAN; Hadaway, Lynn MEd, RN, NPD-BC, CRNI®; Hagle, Mary E. PhD, RN-BC, FAAN; Broadhurst, Daphne MN, RN, CVAA(C); Clare, Simon MRes, BA, RGN; Kleidon, Tricia MNSc (Nurs. Prac), BNSc, RN; Meyer, Britt M. PhD, RN, CRNI®, VA-BC, NE-BC; Nickel, Barb APRN-CNS, CCRN, CRNI®; Rowley, Stephen MSc, BSc (Hons), RGN, RSCN; Sharpe, Elizabeth DNP, APRN-CNP, NNP-BC, VA-BC, FNAP, FAANP, FAAN; Alexander, Mary MA, RN, CRNI®, CAE, FAAN

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

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

Massimo Lamperti^{1,✉}, Fulvio Pinelli²; on behalf of the GAVeCeLT Working Group for Vascular Access in COVID-19

peri-operative use of ultrasound-guided for vascular access (PERSEUS vascular access)

Massimo Lamperti¹, Daniele Guerino Biasucci, Nicola Disma, Mauro Pittiruti, Davide Vailati, Matteo Subert, Vilma Traškaitė, Andrius Macas, Jean Emmanuel Boselli, Philip Hopkins



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

Mauro Pittiruti[✉]

Practice Guidelines for Central Venous Access 2020

*An Updated Report by the American Society of Anesthesiologists Task Force on Central Venous Access**

RACCOMANDAZIONI GAVeCeLT 2024

PER LA INDICAZIONE, L'IMPIANTO E LA GESTIONE DEI DISPOSITIVI PER ACCESSO VENOSO



RACCOMANDAZIONI GAVeCeLT 2024
PER LA INDICAZIONE, L'IMPIANTO E LA GESTIONE
DEI DISPOSITIVI PER ACCESSO VENOSO

a cura di Mauro Pittiruti e Giancarlo Scoppettuolo

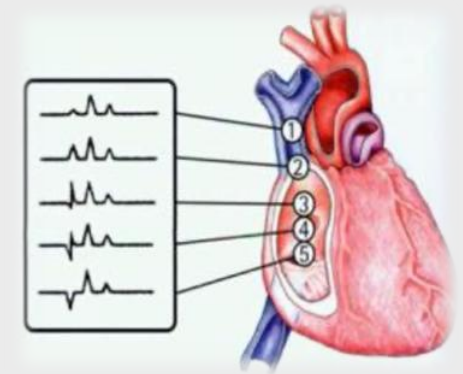
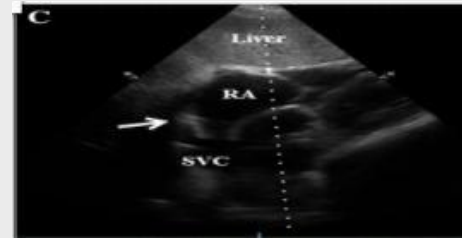
Tip Location Intraprocedurale

Evita interventi correttivi post-procedurali che comportano:

- ✓ Incremento dei costi
- ✓ Ritardo nell'avvio del trattamento
- ✓ Rischio più elevato di infezioni
- ✓ Maggiore disagio per il paziente

Tip Location Intraprocedurale: quali metodiche ?

- ✓ Ecocardiogramma TransEsofageo
- ✓ ECG intracavitario (IC-ECG)
- ✓ Ecocardiogramma TransToracico
- ✓ Fluoroscopia



Ecocardiogramma Transesofageo

- ✓ Gold Standard
- ✓ Invasivo
- ✓ Costoso
- ✓ Non praticabile nella maggior parte dei pazienti
- ✓ Necessario training avanzato



Ricostruzione 3D giunzione cavoatriale destra

ECG Intracavitario

✓ Non invasivo

✓ Economico

✓ Versatile

CARDIOVASCULAR ANESTHESIA: RESEARCH REPORT

Accurate Central Venous Port-A Catheter Placement: Intravenous Electrocardiography and Surface Landmark Techniques Compared by Using Transesophageal Echocardiography

Chu, Koung-Shing MD^{*}; Hsu, Jong-Hau MD[†]; Wang, Shie-Shan MD[‡]; Tang, Chao-Shun PhD[§]; Cheng, Kuang-I MD[§]; Wang, Chien-Kuo MD[‡]; Wu, Jiunn-Ren MD[†]

General Anesthesia

Transesophageal echocardiographic evaluation of ECG-guided central venous catheter placement

[Évaluation échocardiographique transœsophagienne de la mise en place d'un cathéter veineux central guidée par ECG]

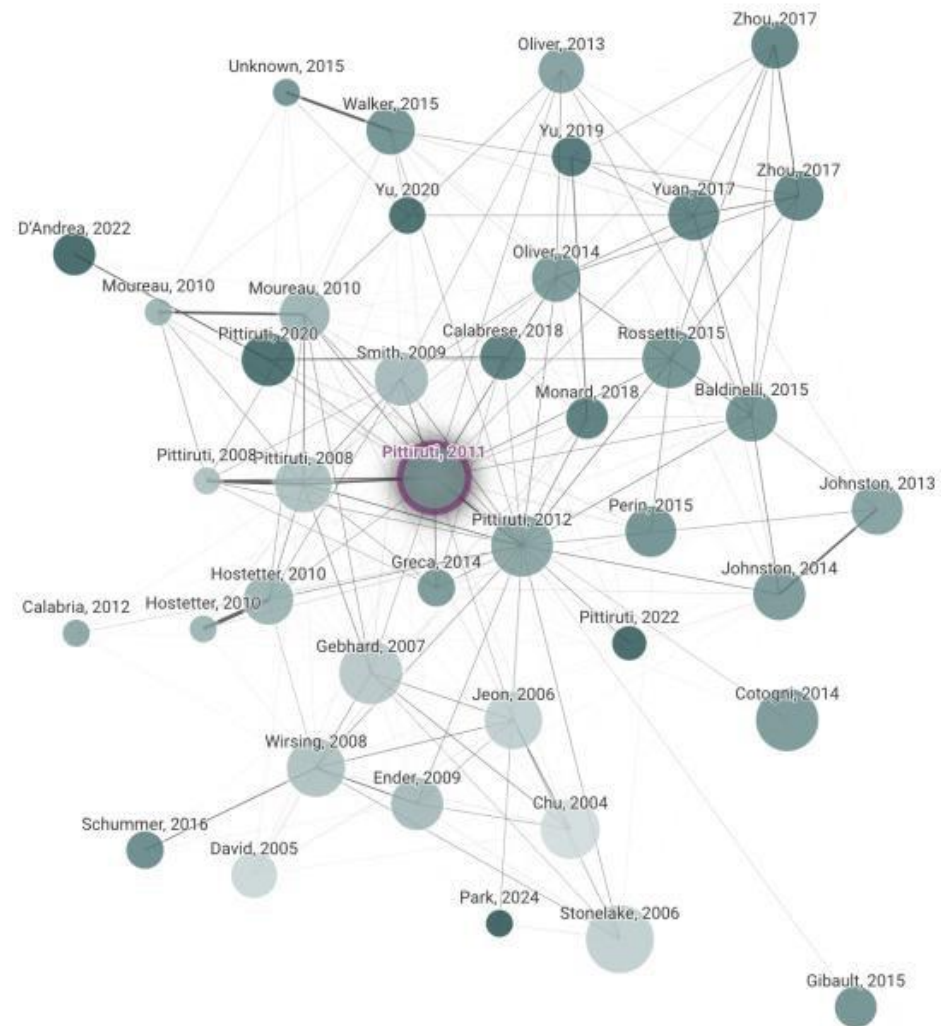
Transesophageal echocardiography for verification of the position of the electrocardiographically-placed central venous catheter

Joerg Ender ¹, Gabor Erdoes, Eugen Krohmer, Derk Olthoff, Chirojit Mukherjee

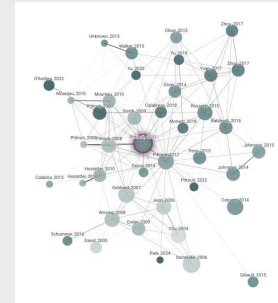
Produzione scientifica Sull' IC-ECG 2004-2024

IC-ECG:

- ✓ Sicuro
- ✓ Fattibile
- ✓ Accurato



ECG Intracavitario: Sicurezza



- ✓ Nessuna complicanza associabile direttamente alla metodica
- ✓ Monitoraggio continuo ECG
- ✓ Con la tecnica della colonna di liquido la punta del catetere e la punta del device coincidono: **massima precisione**

Effectiveness of electrocardiographic guidance in CVAD tip placement

Graham Walker, Raymond J Chan, Evan Alexandrou, Joan Webster and Claire Rickard

DOI: 10.5301/JVA.2012.9020 • Corpus ID: 9027120

The Intracavitary ECG Method for Positioning the Tip of Central Venous Catheters: Results of an Italian Multicenter Study

M. Pittiruti, D. Bertollo, E. Briglia, M. Buononato, Giuseppe Capozzoli, L. De Simone, A. La Greca, C. Pelagatti, Pier Sandro Sette [less](#)

J Vasc Access 2011; 12 (4): 280-291
DOI: 10.5301/JVA.2011.8381

REVIEW

The electrocardiographic method for positioning the tip of central venous catheters

Mauro Pittiruti¹, Antonio La Greca¹, Giancarlo Scoppettuolo²

¹Department of Surgery, Catholic University, Rome - Italy

²Department of Infectious Diseases, Catholic University, Rome - Italy

ECG Intracavitario: Accuratezza

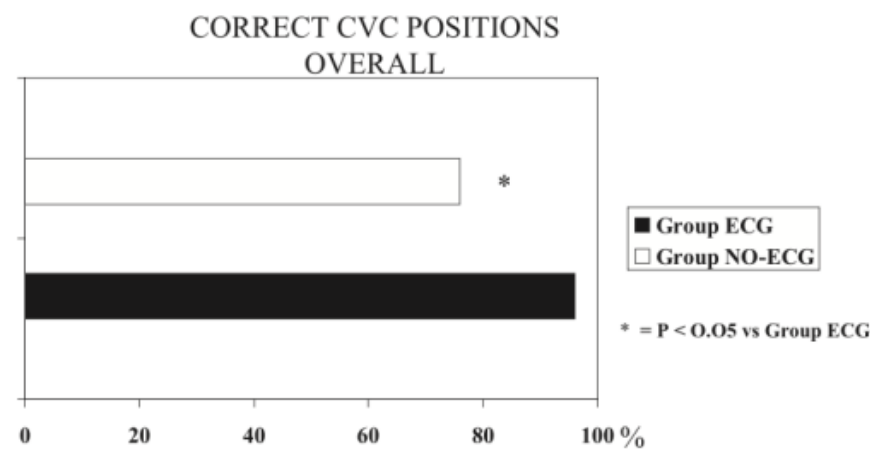
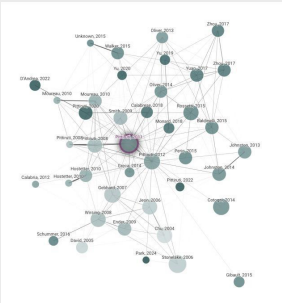


TABLE II - OVERALL ACCURACY

P – Perfect match	1199	83.0%
C – Correct match	179	12.4%
S – Mismatch	55	3.8%
NA – Not applicable	11	0.7%



The EKG Method for Positioning the Tip of PICCs: Results from Two Preliminary Studies

Mauro Pittiruti¹, MD, Giancarlo Scoppettuolo², MD, Antonio La Greca³, MD, Alessandro Emoli¹, RN, Alberto Brutti⁴, RN, Ivano Migliorini¹, RN, Laura Dolcetti¹, RN, Cristina Taraschi¹, RN, Gennaro De Pascale¹, MD
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Catholic University Hospital, Rome, Italy

The Accuracy of Electrocardiogram-Controlled Central Line Placement

Ralf E. Gebhard, MD*

Peter Szymuk, MD†

Evan G. Pivalizza, MBChB, FFASA‡

Vladimir Melnikov, MD‡

Christianne Vogt, MD‡

Robert D. Warters, MD‡

BACKGROUND: Electrocardiogram (ECG) guidance to confirm accurate positioning of central venous catheters (CVC), placed before surgery in the operating room, is rarely used in the United States. We designed this randomized, controlled trial to investigate whether the use of this technique impacts the accuracy of CVC placement.

METHODS: Patients in group ECG (n = 147) had a CVC placed using right-atrial ECG to guide catheter tip positioning. CVCs in group NO-ECG (n = 143) were positioned without this technique.

RESULTS: Overall, guidewire-ECG control resulted in more correctly positioned CVCs (96% vs 76%, P = 0.001) without increasing placement time. Significantly more CVCs were placed in the middle of the superior vena cava in group ECG (P = 0.001), although placement into the right atrium or right ventricle and into other vessels occurred significantly more often in group NO-ECG (P = 0.001). Twenty patients in group NO-ECG required repositioning of their CVC after surgery, whereas this maneuver was necessary only in three patients in group ECG (P = 0.001).

CONCLUSIONS: ECG guidance allows for more accurate CVC placement, and should be considered to increase patient safety and reduce costs associated with repositioning procedures.

(J Am Surg Assoc 2007;104:65-70)

DOI: 10.5301/JVA.2012.9020 • Corpus ID: 9027120

The Intracavitary ECG Method for Positioning the Tip of Central Venous Catheters: Results of an Italian Multicenter Study

M. Pittiruti, D. Bertollo, E. Briglia, M. Buononato, Giuseppe Capozzoli, L. De Simone, A. La Greca, C. Pelagatti, Pier Sandro Sette less

ECG Intracavitario: Accuratezza

DOI: 10.5301/JVA.2012.9020 • Corpus ID: 9027120

The Intracavitary ECG Method for Positioning the Tip of Central Venous Catheters: Results of an Italian Multicenter Study

[M. Pittiruti](#), [D. Bertollo](#), [E. Briglia](#), [M. Buononato](#), [Giuseppe Capozzoli](#), [L. De Simone](#), [A. La Greca](#), [C. Pelagatti](#), [Pier Sandro Sette](#) [less](#)

- ✓ Utilizzato in differenti tipi di CVADs
- ✓ La massima altezza dell'onda p è correlata al zona di transizione tra tessuto elettricamente inattivo (VCS) a tessuto elettricamente attivo (atrio destro)
- ✓ Pattern di variazione dell'onda p durante il passaggio del catetere dalla VCS all'atrio destro

ECG Intracavitario: fattori che possono influenzare l'accuratezza

Table 4. Factors influencing changes in P-wave amplitude on intracavitary electrocardiography (n = 1160).

Factors	P-wave amplitude changes		Statistics	P value
	Yes	No		
Age	54.03 ± 11.60	53.02 ± 11.38	t = 0.546	0.585
Height	160.29 ± 7.31	159.24 ± 7.46	t = -0.898	0.370
Body weight	57.48 ± 9.72	59.63 ± 8.79	t = 1.399	0.162
Gender				
Male	572 (94.4)	20 (5.6)	$\chi^2 = 0.086$	0.769
Female	547 (92.0)	21 (8.0)		
Heart rate	81.46 ± 14.56	81.44 ± 12.36	t = -0.010	0.992
P-wave amplitude	0.92 ± 0.67	1.32 ± 1.01	t = 3.673	0.016*
Catheter insertion site				
Left	170 (90.2)	12 (9.8)	$\chi^2 = 5.924$	0.015
Right	949 (93.8)	29 (6.2)		
Catheter types				
CICC	851 (94.1)	22 (5.9)	$\chi^2 = 10.650$	0.001
PICC	268 (90.8)	19 (9.2)		

* Heterogeneity of variance

doi:10.1371/journal.pone.0124846.t004

RESEARCH ARTICLE

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

Guorong Wang¹, Ling Guo², Bin Jiang³, Min Huang¹, Jian Zhang⁴, Ying Qin⁵*

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Non hanno alcun influenza ($p > 0.05$):

- ✓ Età
- ✓ Sesso
- ✓ Altezza
- ✓ Peso Corporeo
- ✓ Frequenza Cardiaca

ECG Intracavitario: fattibilità

TABLE VI - EFFECT OF ECG TECHNIQUE

	Guidewire	Saline
P	83.3%	82.7%
C	11.2%	13.6%
S	4.1%	3.5%
NA	1.4%*	0.1%*

C, correct match; NA, not applicable; P, perfect match; S, mismatch; P<.03

From the point of view of common clinical practice, our study may raise a few considerations:

- the intracavitary ECG method is safe and feasible in almost 100% of those patients whose P-wave is identifiable at the basal surface ECG;

if compared with the most common standard method

The EKG Method for Positioning the Tip of PICCs: Results from Two Preliminary Studies

Mauro Pittiruti¹, MD, Giancarlo Scoppettuolo², MD, Antonio La Greca¹, MD, Alessandro Emoli³, RN, Alberto Brutti⁴, RN, Ivano Migliorini¹, RN, Laura Dolcetti², RN, Cristina Taraschi², RN, Gennaro De Pascale², MD
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Electrocardiogram (EKG) Guided Peripherally Inserted Central Catheter Placement and Tip Position: Results of a Trial to Replace Radiological Confirmation

Nancy L. Moureau, RN, BSN, CRNI, CPUI, Glenda L. Dennis, RN, CCRN, Elizabeth Ames, RN, CCRN, Robyn Severe, RN, BSN

JVasc Access 2011; 12 (4): 280-291
DOI: 10.5301/JVA.2011.8381

REVIEW

The electrocardiographic method for positioning the tip of central venous catheters

Mauro Pittiruti¹, Antonio La Greca¹, Giancarlo Scoppettuolo²

¹Department of Surgery, Catholic University, Rome - Italy
²Department of Infectious Diseases, Catholic University, Rome - Italy

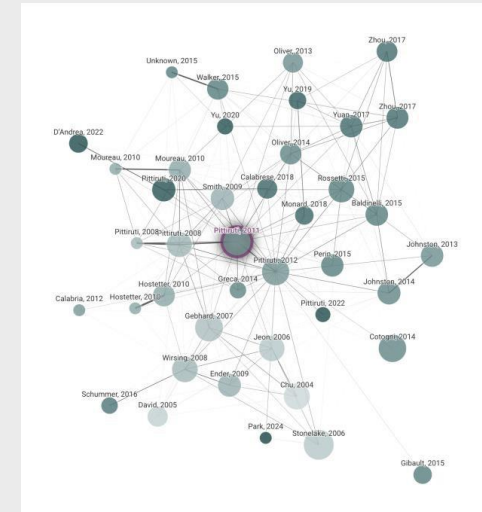
DOI: 10.5301/JVA.2012.9020 • Corpus ID: 9027120

The Intracavitary ECG Method for Positioning the Tip of Central Venous Catheters: Results of an Italian Multicenter Study

M. Pittiruti, D. Bertollo, E. Briglia, M. Buononato, Giuseppe Capozzoli, L. De Simone, A. La Greca, C. Pelagatti, Pier Sandro Sette less

ECG Intracavitario: altri vantaggi

- ✓ Veloce
- ✓ Semplice da insegnare e da apprendere
- ✓ Verifica in tempo reale
- ✓ Riproducibile
- ✓ Economico



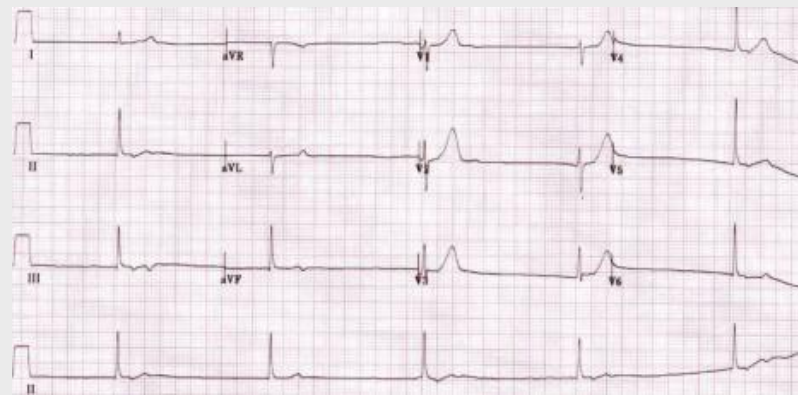
Limiti.....

IC-ECG si basa sulla interpretazione quantitativa dei cambiamenti in ampiezza dell'onda p fino all'identificazione della p massimale che corrisponde alla CAJ.

Limiti.....

NON APPLICABILE se all'ECG di superficie la p è:

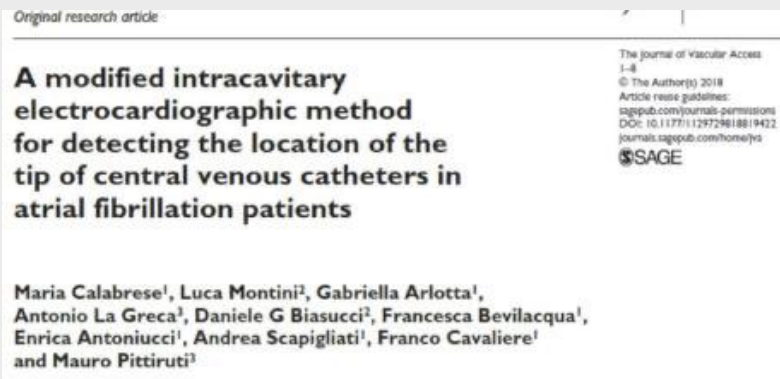
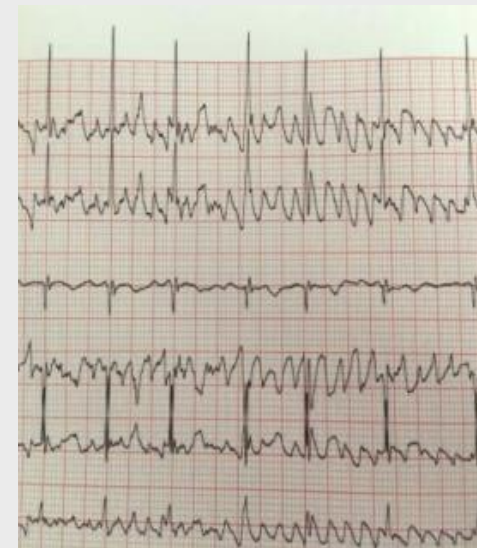
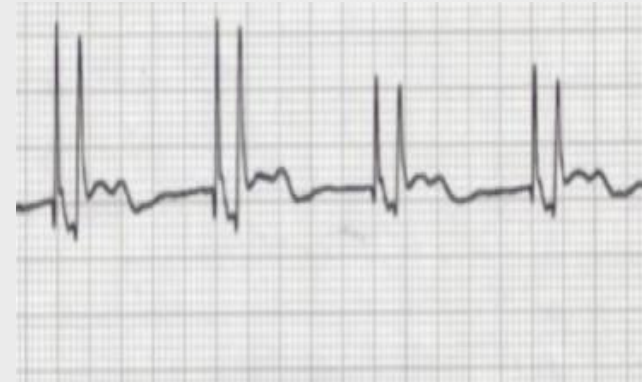
- ✓ Assente (fibrillazione atriale)
- ✓ Anormale (ritmi ectopici)
- ✓ Nascosta (stimolazione da pacemaker)



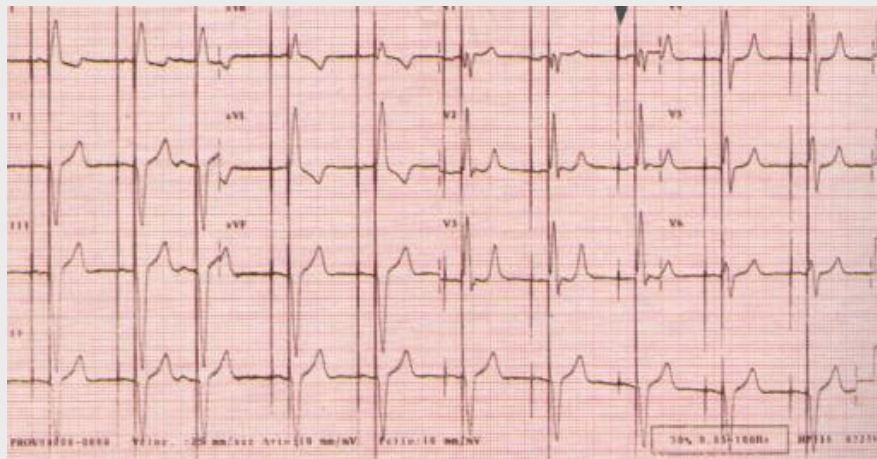
Migliorare la applicabilità...ECG intracavitario modificato

Nei pazienti con la fibrillazione atriale si valuta l'attività elettrica presente nel tratto TQ

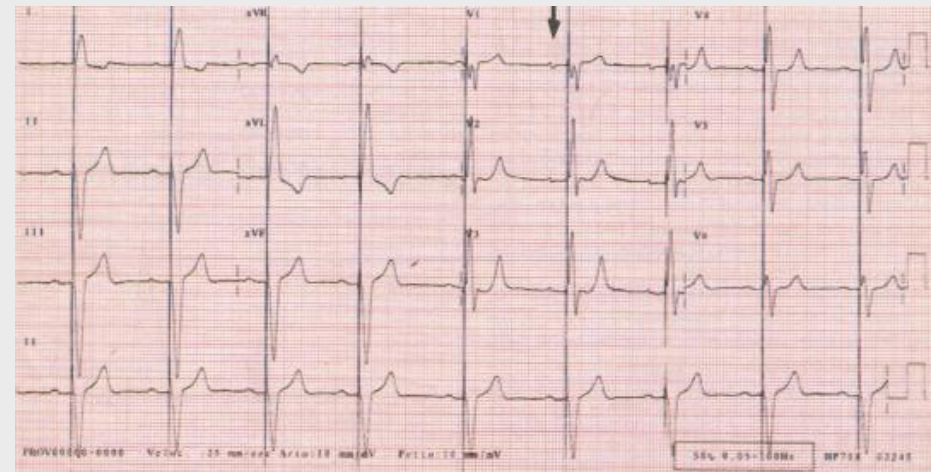
- ✓ Ritmo sinusale: CAJ = onda P massimale
- ✓ Fibrillazione atriale: CAJ = massima attività elettrica del tratto TQ



Migliorare la applicabilità...nei pazienti con pacemaker



DDD 60/min



VDD 30/min

Limiti.....

NON FATTIBILE se è difficile da identificare un'onda p intracavitaria potenzialmente rilevabile :

- ✓ Tremore o scarsa collaborazione del paziente
- ✓ Tachicardia estrema
- ✓ Problemi tecnici (interferenze elettriche, qualità del cavo o del monitor, posizione degli elettrodi)

Migliorare la fattibilità

Utilizzare **monitor dedicati** che mediante filtri ed amplificatori possano assicurare una buona ricezione del segnale

ECG intracavitario in pediatria

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-

In pediatric patients, intracavitary ECG (IC-ECG) should be considered the gold standard for tip location, as it has been shown to be completely safe, applicable in 99% of patients, and accurate in 98.8% of cases, in particular if performed with a dedicated ECG monitor.⁴ Widespread

J Vasc Access 2014; 00 (00): 000-000
DOI: 10.5301/jva.5000281

ORIGINAL ARTICLE

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

Francesca Rossetti¹, Mauro Pittiruti², Massimo Lamperti³, Ugo Graziano⁴, Davide Celentano⁵, Giuseppe Capozzoli⁶

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⁵ Pediatric Intensive Care Unit, Catholic University Hospital, Roma - Italy

⁶ Department of Anesthesia and Intensive Care, Ospedale Civile di Bolzano, Bolzano - Italy

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 Barone³, Vito D'Andrea⁴ , Daniele Elisei⁵, Emanuele Iacobone⁵ , Antonio La Greca⁶ and Mauro Pittiruti⁶ 

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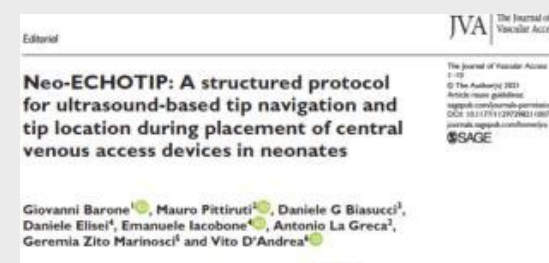

ECG intracavitario in neonatologia



Table I. Tip location by intracavitary ECG.

Vascular Access Device	Applicability	Feasibility	Accuracy
UVC	Applicable, but not recommended	Yes	Low
ECC – upper limbs	Applicable, but not recommended	Not always feasible	High
ECC – lower limbs	Not always applicable	Not always feasible	Low
CICC	Applicable and highly recommended	Yes	High
FICC	Not always applicable	Not always feasible	Low

IC-ECG = never applicable for tip navigation.



ECG intracavitaro e FICC

Tip location of FICCs still remains a matter of debate. If the tip of the catheter is planned to be in the RA or at the junction between IVC/RA, both IC-ECG and TTE can be used. The presence of the tip in the middle of RA is associated with a diphasic wave at IC-ECG. Also, if TTE is adopted, the subxiphoid views allow to easily visualize the last portion of the IVC, the IVC/RA junction, and the RA. On the other hand, if the catheter tip is planned to be in the subdiaphragmatic IVC, other ultrasound views must be considered. In this regard, the right lateral transhepatic

Original research article

JVA The Journal of Vascular Access

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

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2021, Vol. 22(4) 413-422
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DOI: 10.1177/1129729820958324
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Mengdan Ma^{1,2}, Jinghui Zhang^{1,2}, Jianmei Hou²,
Zhihong Gong², Zixin Hu¹, Shujie Chen¹, Xiaoya Kong¹
and Zhengkun Shi³

Case report

JVA The Journal of Vascular Access

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

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Mark D Weber, Adam S Himebauch and Thomas Conlon

Techniques in vascular access

JVA The Journal of Vascular Access

Applicability and feasibility of intraprocedural tip location of femorally inserted central catheters by transhepatic ultrasound visualization of the inferior vena cava in adult patients

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Maria Giuseppina Annetta, Bruno Marche, Igor Giarretta
and Mauro Pittiruti

In conclusione....

ECG intracavitario ha numerosi vantaggi:

- ✓ Accurato
- ✓ Sicuro
- ✓ Semplice
- ✓ Facile da imparare e da insegnare
- ✓ Economico
- ✓ Riproducibile
- ✓ ECG intracavitario modificato per i pazienti in fibrillazione atriale

In conclusione....

L'ecocardiografia transtoracica è l'altra metodica di **tip location** **intraprocedurale** fattibile, accurata e sicura da adottare nei casi in cui l'ECG intracavitario standard e quello modificato non possono essere applicati.

Grazie per l'attenzione



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