

# L'ECG intracavitario oggi: il punto di riferimento per la tip location dei PICC

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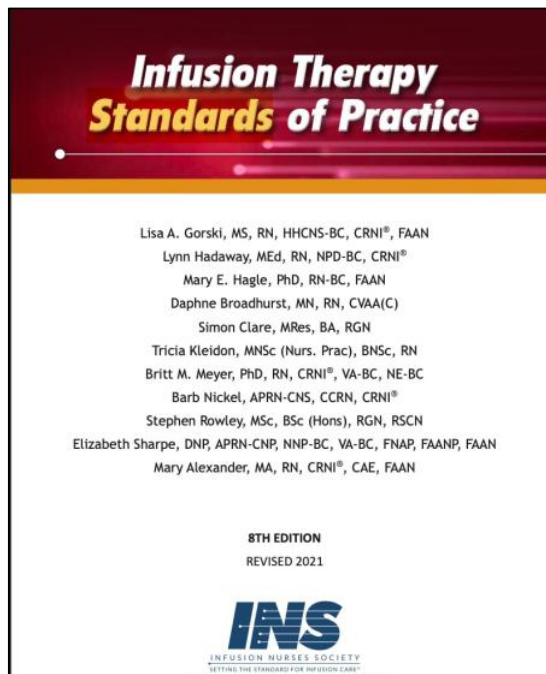
Fulvio Pinelli  
Firenze

# Perché è importante la TIP location?

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- La corretta posizione della punta dei dispositivi di accesso venoso centrale (CVAD) è essenziale per evitare complicanze legate al catetere:
  - malfunzionamento
  - malposizionamento secondario
  - trombosi
  - erosioni vascolari e valvolari
  - aritmie

# Quale posizione?



2021

## 23. CENTRAL VASCULAR ACCESS DEVICE TIP LOCATION

### Standard

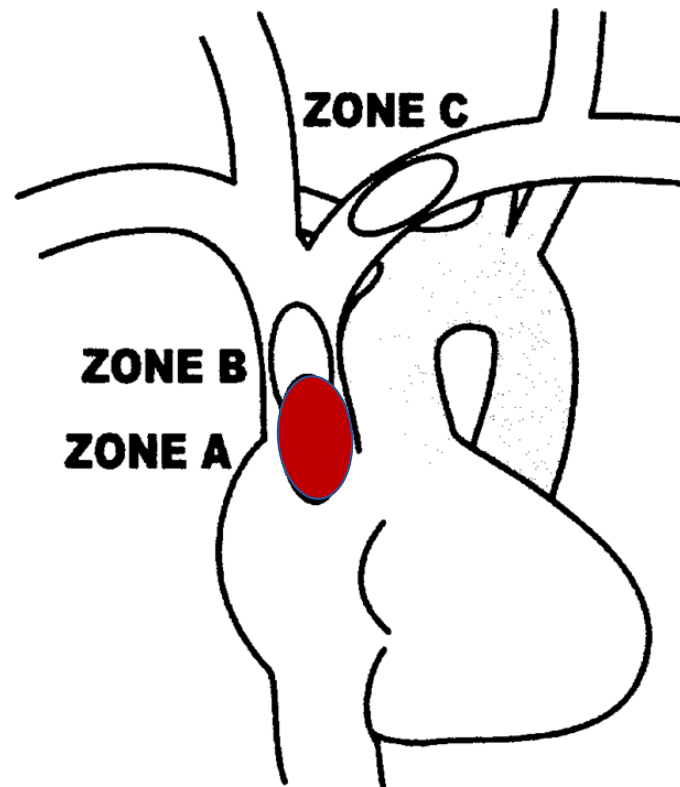
23.1 Tip location of a CVAD is determined radiographically or by other imaging technologies prior to initiation of infusion therapy or when clinical signs and symptoms suggest tip malposition.

23.2 The original tip location is documented in the patient's health record and made available to other organizations involved with the patient's care.

23.3 The CVAD tip location with the greatest safety profile in adults and children is the cavoatrial junction (CAJ).

# CORRECT POSITION

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Fletcher SA et al. BJA 2000

# Metodi per tip location

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## ***INTRAPROCEDURALI***

- FLUOROSCOPIA
- ECOCARDIOSCOPIA (TTE, TEE)
- ECG INTRACAVITARIO

## ***POSTPROCEDURALI***

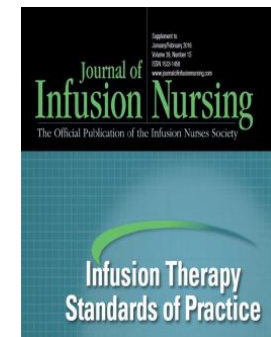
- RX TORACE
- CT, MRI

# IL METODO DI SCELTA E' INTRAPROCEDURALE

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- «**Use methods** for identifying CVAD tip location **during** the insertion procedure (ie, «**real time**») due to **greater accuracy, more rapid initiation** of infusion therapy, and **reduced costs.**»
- «Postprocedural radiograph imaging remains acceptable practice (...) **only in absence** of technology used during the procedure»

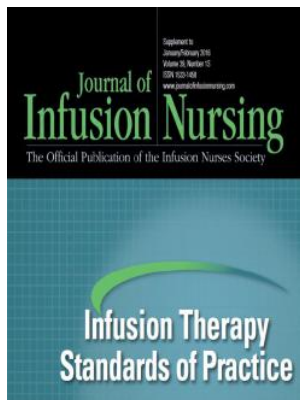
Gorsky L et al. *J Inf Nursing* 2016



# FLUOROSCOPIA?



- Inaccuratezza landmark radiologici
- Costosa
- Non facilmente ed immediatamente disponibile
- Non appropriata per VAD bedside (PICC, CVC a breve termine)
- Esposizione a RX



Avoid fluoroscopy except in the case of difficult CVAD insertions, as it requires exposure to ionizing radiation.

Gorsky L et al. *J Inf Nursing* 2016

# ECG Intracavitario (IC) Oggi: Lo Stato dell'Arte della Tip Location

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# Perché ECG-IC? E perché in particolare per i PICC?

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- IC-ECG:

- Intraprocedurale
- Accurata
- Sicura
- Costo-efficace (semplice; low cost training)
- Portatile, applicabile *bedside*
  - intraospedaliero
  - domicilio



# Una vecchia tecnologia, con una storia recente

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Review

**JVA** | The Journal of  
Vascular Access

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## **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

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**Mauro Pittiruti<sup>1</sup> , Filippo Pelagatti<sup>2</sup> and Fulvio Pinelli<sup>3</sup> **

# (Breve) storia dell'ECG-IC

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- **2019:** 70° anniversario del primo studio su ECG-IC
- **1949:** descritto per la prima volta da Hellerstein (elettrofisiologia)
- **1961:** Primo utilizzo come metodo per la tip location (neuro-anestesia)
- **1961-1999:** ...
- **Ultimi 20 anni:** sviluppo esponenziale

# Gli ultimi 20 anni: la «*golden age*» dell'ECG-IC

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ACCURATEZZA DELLA METODICA: IN QUALE % DEI PAZIENTI ONDA P MASSIMALE CORRISPONDE A CAJ?

- Gebhard R. Anesth Analg 2007: 96%
- Pelagatti C. JVA 2011: 91%
- Capozzoli G. JVA 2012: 99%
- Pittiruti M. JVA 2012: 99%
- Rossetti F. JVA 2014: 99%
- ...

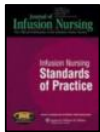
# Gli ultimi 20 anni: la «*golden age*» dell'ECG-IC

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- 3 studi con **TEE** (Chu; Jeon; Ender) dimostrano l'**accuratezza** (100% circa), molto maggiore di RX; meno invasivo, meno costoso e più applicabile di *TEE*
- 2008-2010: primi studi su **PICC con ECG-IC** (Pittiruti; Moureau), dimostrano l'accuratezza e suggeriscono la **non necessità di eseguire RX post-procedurale**
- 2009: **LG ESPEN** per prime **raccomandano ECG-IC vs RX post-procedurale** (metodica «**real time**»)

# 2009: Lo «sbarco» nelle Linee Guida

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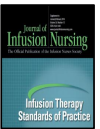
**INS 2006:** «CVAD tip location shall be determined **radiographically**»



**ESPEN 2009:** «Ideally, the position of the tip should be checked **during the procedure**, either by fluoroscopy or by the ECG method.



**INS 2011:** «Tip location of a CVAD shall be determined radiographically or by **other approved technologies** prior to initiation of infusions».



**INS 2016:** «Use **Electrocardiogram methods** (...) to place CVAD tip..».



**INS 2021:** «Use **Electrocardiogram methods** (...) to place CVAD tip..».

# COVID-19 RECOMMENDATIONS

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<sup>1\*</sup>, Fulvio Pinelli<sup>2</sup> on behalf of the GAVeCeLT Working Group for Vascular Access in COVID-19

- Intraprocedural
- Bedside
- No-X-ray
- IC-ECG or US

Editorial

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

Giancarlo Scoppettuolo<sup>1</sup>, Daniele Guerino Biasucci<sup>2</sup> and Mauro Pittiruti<sup>3</sup>

JVA | The Journal of Vascular Access

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Editorial

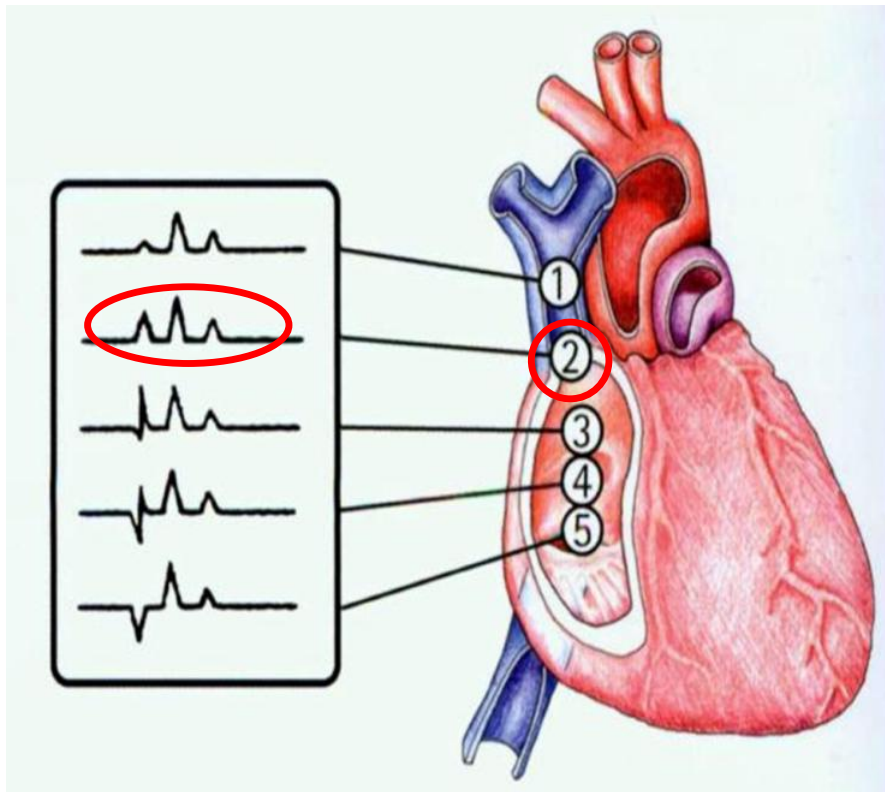
**Choice and management of vascular access in the context of COVID-19 outbreak in Italy: Recommendations from clinical practice**

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

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# ECG-IC: la tecnica



- Punta del catetere come elettrodo intracavitario «viaggiante»
- Vettore II derivazione è coassiale al vettore atriale
- Progressivo aumento dell'altezza dell'onda P, con massima positività alla giunzione cavoatriale (CAJ)
- Avanzando il catetere in atrio dx, l'onda P diventa bifasica (negativa/positiva)



# Problema...



- ✓ IC-ECG si basa sull'interpretazione dei cambiamenti QUANTITATIVI nell'ampiezza dell'onda P durante il rilevamento intracavitario dell'ECG:
  - ✓ maximal p-wave = CAJ

- ✓ L'IC-ECG convenzionale non può essere effettuato quando l'onda P è:

- assente (fibrillazione atriale)
- anormale (ritmi ectopici)
- nascosta (pacemaker attivi)
- difficile da identificare/valutare

Non applicabile  
(7-11%)

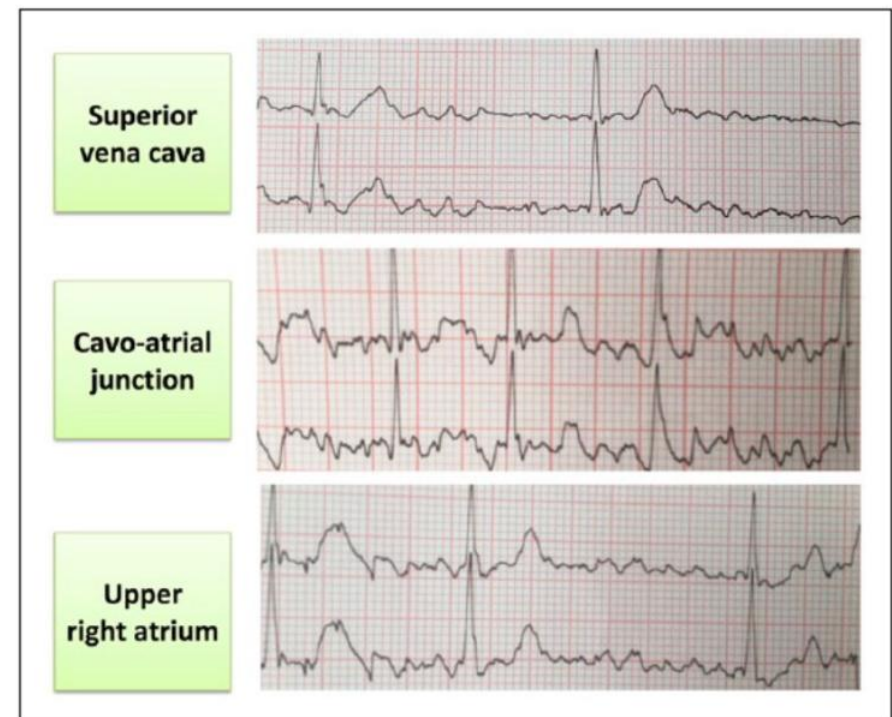
- (tachicardia, pazienti tremanti, problemi tecnici, malposizione)

Non fattibile  
(0.7-1.5%)

# ECG-IC MODIFICATO: ANALISI DEL TRATTO T-Q (ONDE *f*)

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- Engelhardt W et al. *Anaesthetist* 1989
- Calabrese M et al. *JVA* 2018
- Gao Y et al. *Therap Clin Risk Man* 2018
- Steinhagen F et al. *JVA* 2018
- Albertini F et al. *Minerva Cardioangiol* 2019
- Zhao C et al. *Ann Noninvasive Elect* 2021



# ECG-IC MODIFICATO: ANALISI DEL TRATTO T-Q (ONDE *f*)

Original research article

**JVA** The Journal of Vascular Access

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DOI: 10.1177/1724302518819422  
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**A modified intracavitary electrocardiographic method for detecting the location of the tip of central venous catheters in atrial fibrillation patients**

Maria Calabrese<sup>1</sup>, Luca Montini<sup>2</sup>, Gabriella Arlotta<sup>1</sup>, Antonio La Greca<sup>3</sup>, Daniele G Biasucci<sup>2</sup>, Francesca Bevilacqua<sup>1</sup>, Enrica Antonucci<sup>1</sup>, Andrea Scapigliati<sup>1</sup>, Franco Cavaliere<sup>1</sup> and Mauro Pittiruti<sup>2</sup>

**Abstract**  
**Introduction:** The intracavitary electrocardiographic method is recommended for assessing the location of the tip of central venous catheter when there is an identifiable P wave. Previous reports suggested that intracavitary electrocardiographic method might also be applied to patients with atrial fibrillation, considering the so-called *f* waves as a surrogate of the P wave.  
**Methods:** We studied 18 atrial fibrillation patients requiring simultaneously a central venous catheter and a trans-esophageal echocardiography. An intracavitary electrocardiographic trace was recorded with the catheter tip in three different positions defined by trans-esophageal echocardiography imaging: in the superior vena cava, 2 cm above the cavo-atrial junction; at the cavo-atrial junction; and in the right atrium, 2 cm below the cavo-atrial junction. Three different criteria of measurement of the *f* wave pattern in the TQ tract were used: the mean height of *f* waves (method A); the height of the highest *f* wave (method B); the difference between the highest positive peak and the lowest negative peak (method C).  
**Results:** There were no complications. With the tip placed at the cavo-atrial junction, the mean value of the *f* waves was significantly higher than in the other two positions. All three methods were effective in discriminating the tip position at the cavo-atrial junction, though method B proved to be the most accurate.  
**Conclusion:** A modified intracavitary electrocardiographic technique can be safely used for detecting the location of the tip of central venous catheters in atrial fibrillation patients: the highest activity of the *f* waves is an accurate indicator of the location of the tip at the cavo-atrial junction.

**Keywords**  
Atrial fibrillation, intracavitary electrocardiographic method, trans-esophageal echocardiography, cavo-atrial junction, tip location, central venous catheter

Date received: 30 May 2018; accepted: 24 November 2018

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Email: mauro.pittiruti@me.com

- Verifica accuratezza IC ECG modificato usando TEE come *reference*
- La traccia è stata registrata con la punta del catetere in tre diverse posizioni identificate da TEE: SVC (2 cm sopra CAJ); alla CAJ; in RA (2 cm sotto CAJ)
- IC-ECG "modificato" basato sulla massima attività elettrica del tratto TQ (altezza onde "*f*") è accurato per tip location in AF
- Problema: misura delle onde F (necessità di monitor con algoritmi di calcolo automatico)

# CONCLUSIONI

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- Importanza della corretta posizione della punta
- Tip location deve essere intraprocedurale
- ECG-IC rappresenta lo stato dell'arte della tip location dei CVADs:
  - più accurato, sicuro, semplice, costo-efficace e più accessibile della fluoroscopia
  - più semplice e richiede meno training del TTE
  - perfetto per bedside (PICC)
- Studi recenti ne suggeriscono l'utilizzo anche in paziente con FA (monitor con software dedicati sono necessari)
- Rimane non fattibile in una piccola percentuale di pazienti (ruolo di TTE)

# GRAZIE PER L'ATTENZIONE

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