

Elettrofisiologia e dispositivi

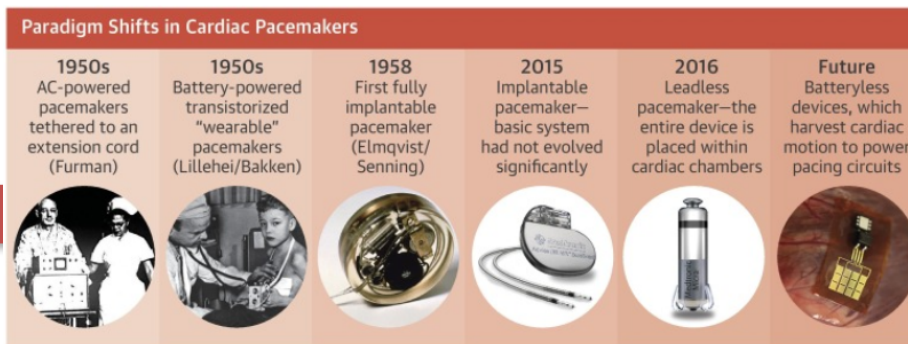
**EARLY VENTRICULAR CAPTURE FAILURE AFTER DUAL-CHAMBER
PACEMAKER IMPLANTATION IN A PATIENT WITH SYSTEMIC
ANGIODYSPLASIA AND PAROXYSMAL HIGH-GRADE
ATRIOVENTRICULAR BLOCK**

Michelearcangelo Moretti

U.O. Cardiologia Universitaria – Policlinico di Bari



Storia passata e problemi attuali



Mulpuru, S.K. et al. J Am Coll Cardiol. 2017;69(2):189-210.

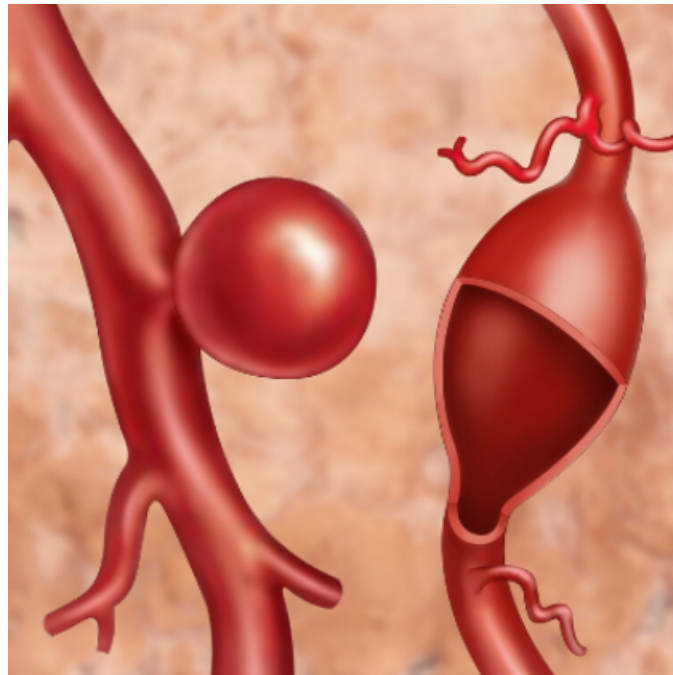
- Negli ultimi 50 anni importanti sviluppi tecnologici hanno interessato l'ambito della cardiostimolazione
- Il sistema è rimasto **sostanzialmente invariato**:
generatore + elettrocateri a contatto con il miocardio

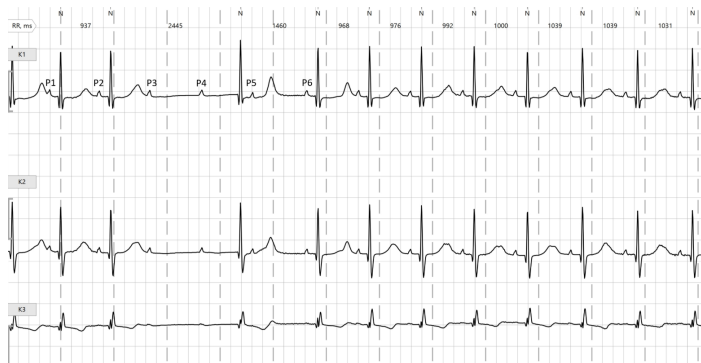
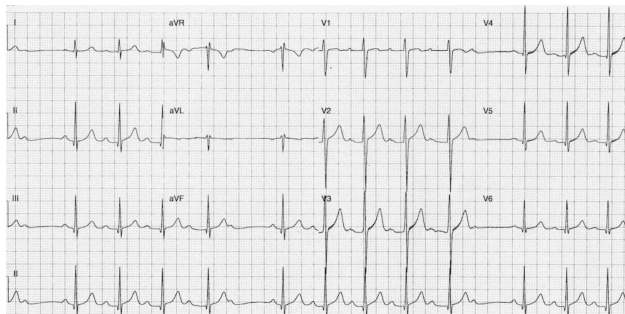
- Il problema delle **complicanze legate ai PM** è ancora rilevante
- Ulteriore complessità conferita da **anomalie anatomiche** e specifiche **comorbidità**



Caso clinico

- Donna, 81 anni
- FRCV: Ipertensione arteriosa
- APR:
 - Sgg portatore di mutazione in eterozigosi di **fattore V di Leiden, mutazione in omozigosi di MTHFR II**
 - pregressa (1986) chiusura endovascolare di fistola carotido cavernosa;
 - nota angiodisplasia sistemica con **dilatazione aneurismatica a carico di multipli distretti** vascolari: a. carotide esterna, tripode celiaco, a. splenica, a. renale dx, a. iliache comuni
 - 2013: **emotorace spontaneo** massivo a sx
 - 2022: TC con evidenza di dissezione cronica a. iliaca comune dx e a. ipogastrica sx





Anamnesi patologica prossima:

- febbraio 2026 **sincope** complicata da trauma cranico occipitale
- Successivo Holter ecg delle 24h: episodi di BAV II grado Mobitz 1 ed episodi di **BAV II grado avanzato**
- Indicazione a ricovero per **impianto di PMK**



Come gestire una paziente a rischio per una procedura complessa?

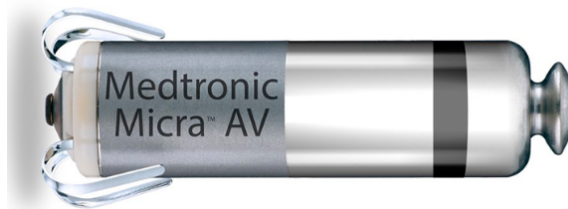


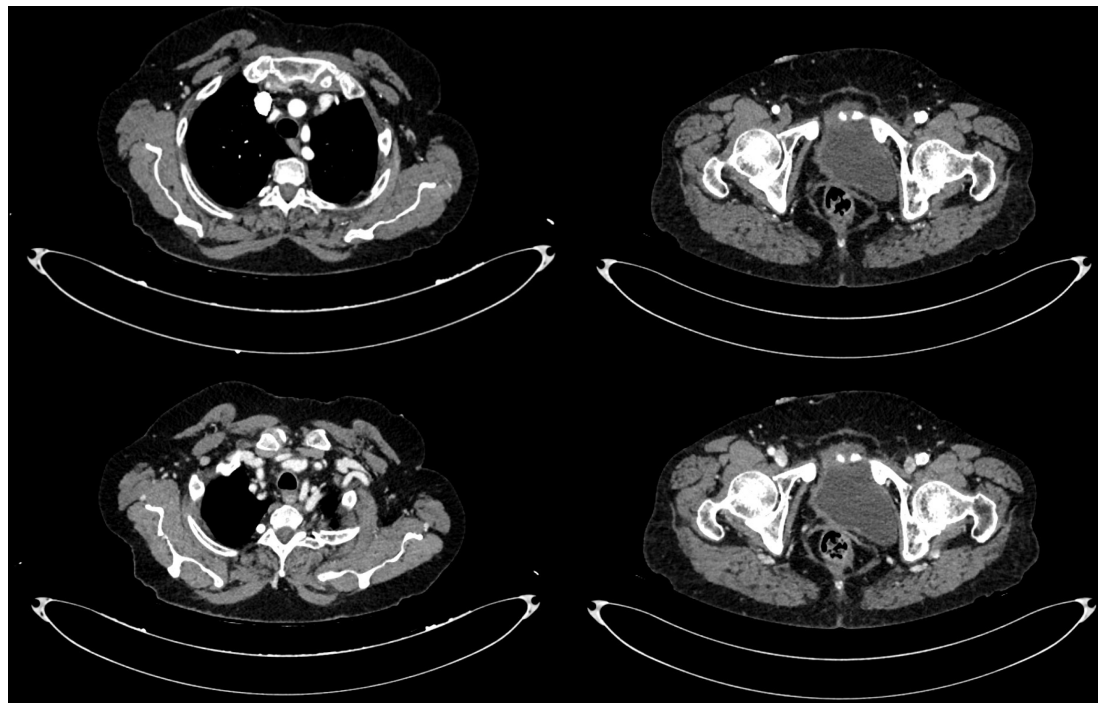
Due possibili scenari

Vene del torace pervie, assenza di significative anomalie a carico delle grosse arterie:



Trombosi/anomalie vascolari del torace, assi femorali pervie:





Le vene femorali e succlavie
bilateralmente non
mostrano segni di trombosi.



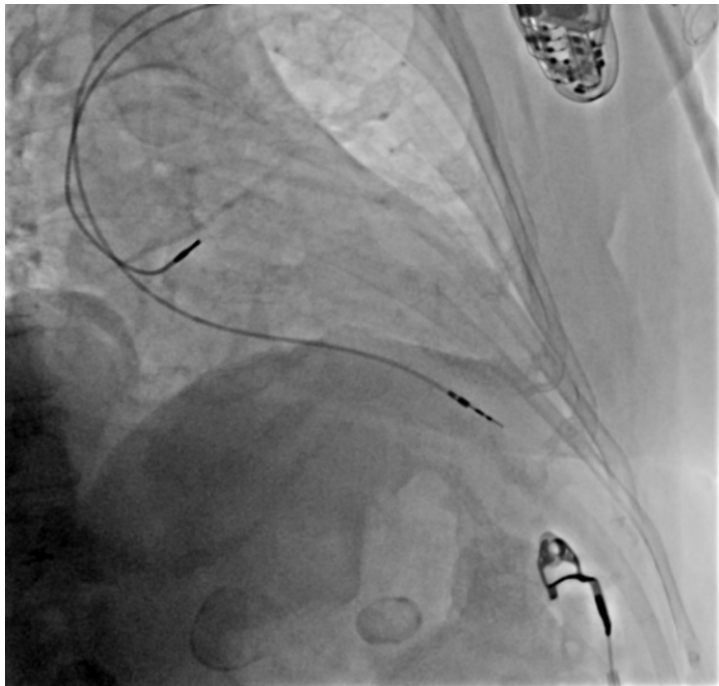
Si è optato per un approccio
con un sistema bicamerale
tradizionale



Prima della procedura, la venografia con contrasto ha confermato la pervietà della v. succlavia sx



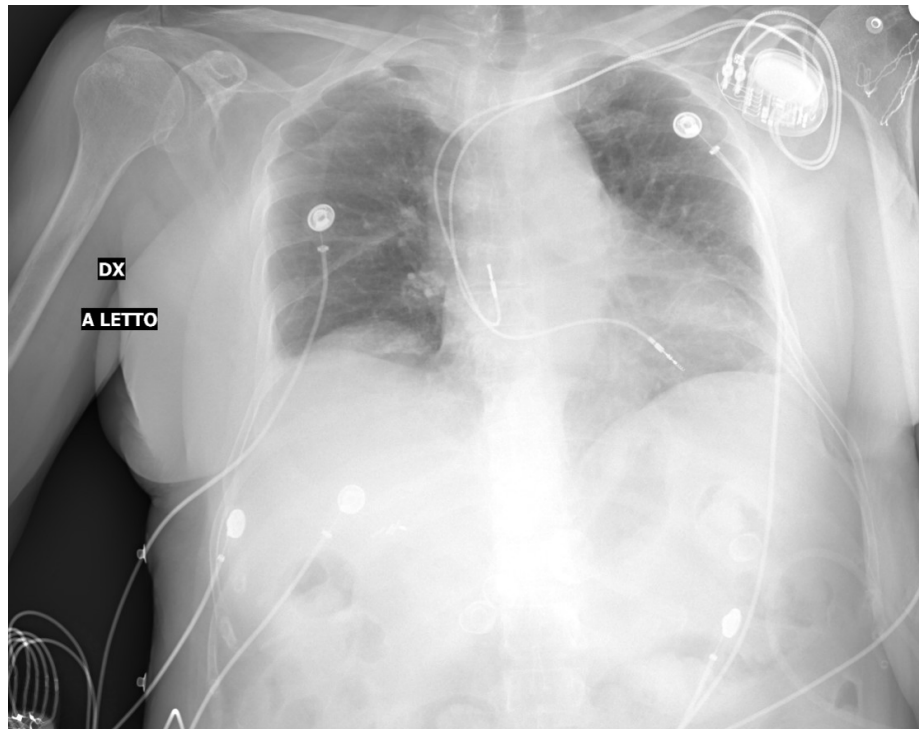
Procedura



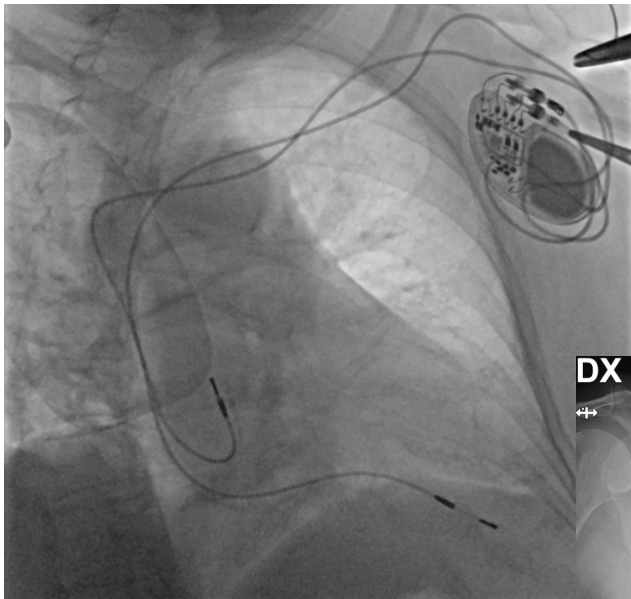
- Accesso venoso cefalico sinistro
- **Impianto in auricola destra di elettrocatetere atriale a barbe:**
precedenti tentativi di posizionamento di sistema a vite infruttuosi per instabilità dell'elc/parametri elettrici subottimali
- **Impianto in setto apicale di elettrocatetere ventricolare a vite**
(insatbilità dell'elc in posizioni più basali)
- Al termine **manovre di stabilità**
dimostrano buon risultato



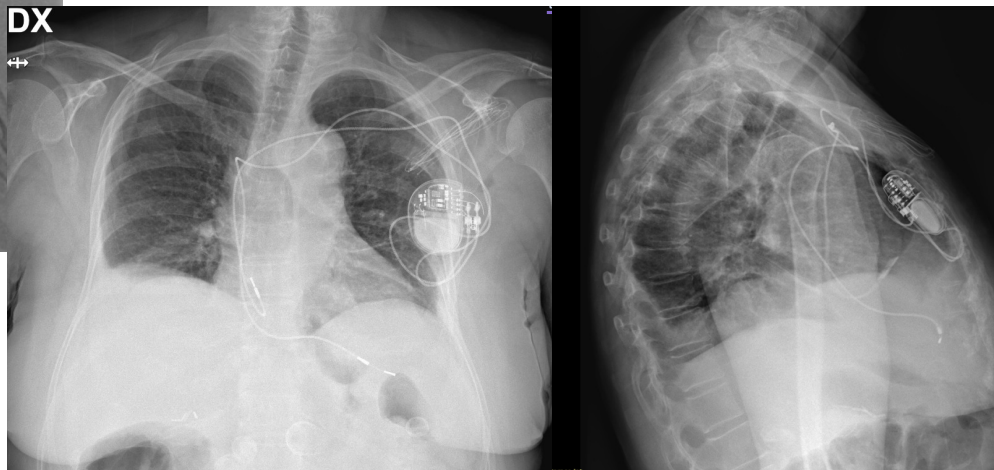
- Subito dopo la procedura la paziente ha lamentato improvvisa comparsa di nausea seguita da vomito
- Eseguito al letto della pz controllo elettronico del PM: riscontro di **difetti di cattura ventricolare**
- Eseguito Rx torace di controllo: **microdislocazione** dell'ellettrocatetere ventricolare destro



Il giorno successivo: revisione



- Espianto dell'elc VD a vite
- Impianto per via venosa succlavia sx di nuovo **elettrocatteter a barbe** in posizione apicale
- Ecoscopia di controllo dimostra assenza di versamento pericardico
- Rx torace in due proiezioni dimostra normoposizionamento degli elc



Controllo presso il nostro ambulatorio di cardiostimolazione a 3 mesi dalla dimissione

- Buon compenso clinico
- Ferita in ordine
- Dispositivo normofunzionante con parametri elettrici accettabili



Dispositivo: Azure XT DR MRI W2DR01 Num. di serie: RNF133353G		Data della visita: 05-Giu-2026 21:19:25 SW030 Versione software 8.2 (8.1) Copyright © Medtronic, Inc. 2020	
Rapporto Quick Look II		Rapporto Quick Look II	
Stato del dispositivo (Impiantato: 25-Mar-2026)		Riepilogo parametri	
Durata residua	14.6 anni (05-Giu-2026)	Modo	AAI<->DDD
RRT	> 5 anni (in base all'interrogazione iniziale)	Freq. min.	60 min ⁻¹
Impedenza elettrocateteri	551 ohm	Trascin. max	130 min ⁻¹
Soglia di cattura	0.375 V a 0.40 ms	Sensore max	130 min ⁻¹
Data misurazione	05-Giu-2026	Riconoscimento	
Ampiezza/durata impulso programmata	3.50 V / 0.40 ms	AT/AF	Monitor
Onda P/R misurata	1.6 mV	VT	Monitor
Sensibilità programmata	0.30 mV	Frequenze	>171 min ⁻¹
		Terapie	Tutte le Rx Off



Cosa ci può insegnare questo caso?





ESC

European Society of Cardiology

European Heart Journal - Cardiovascular Imaging (2024) 25, e1–e32
<https://doi.org/10.1093/ehjci/ead272>

EACVI DOCUMENT

Imaging in patients with cardiovascular implantable electronic devices: part 1—imaging before and during device implantation.
A clinical consensus statement of the European Association of Cardiovascular Imaging (EACVI) and the European Heart Rhythm Association (EHRA) of the ESC

Ivan Stankovic^{1,8}, Jens-Uwe Voigt², Haran Burri³, Denisa Muraru^{4,5}, Leyla Elif Sade^{6,7}, Kristina Hermann Haugaa^{8,9}, Joost Lumens¹⁰, Mauro Biffi¹¹, Jean-Nicolas Dacher¹², Nina Ajmone Marsan¹³, Elise Bakelants³, Charlotte Manisty^{14,15}, Marc R. Dweck¹⁶, Otto A. Smiseth¹⁷, and Erwan Donal¹⁸

Pre-implant
imaging

Diagnosi della patologia sottostante

Valutazione della FEVS

Avvio di terapie specifiche

Scelta del tipo di dispositivo

Identificazione di scar miocardiche

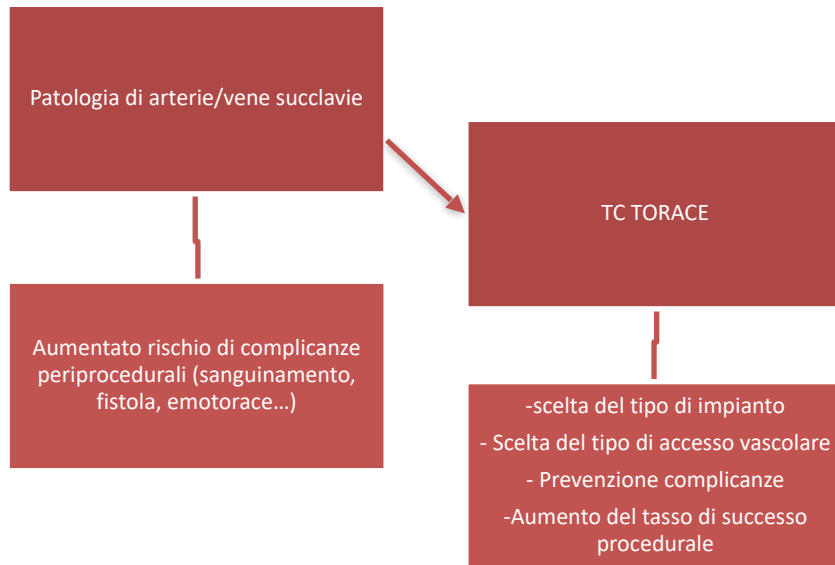
Identificazione di fattori anatomici che possono rendere la procedura «challenging»



Imaging «non usuale» prima dell'impianto

Table 2 Imaging findings associated with potentially challenging CIED implantation

	Preferred imaging modalities	Relevance for CIED implantation
Atrial and ventricular septal defects	TTE/TOE, CMR/CT (sinus venosus defects)	• Misplacement of the lead in the left heart during implantation • Risk of paradoxical embolization during lead extraction for CIED-related infection • Difficult endocardial pacing at the site of repair (fibrosis or prosthetic material)
Persistent left superior vena cava*	TTE with agitated saline injection from the left antecubital vein, CT/CMR	• Left-sided approach frequently challenging • Right-sided approach preferred (if the presence of a right SVC is confirmed by venography or CT/CMR)
Central vein obstruction	Direct and CT venography	• Planning appropriate (technically demanding and riskier) procedures when central veins are actually occluded
Dextrocardia	CXR, fluoroscopy	• Difficult fluoroscopic orientation • The possibility of associated cardiac defects
Severe tricuspid regurgitation	TTE, TOE, CMR	• Difficult lead placement (TR jet, dilated RV)
Mechanical tricuspid valve prosthesis	TTE, TOE	• LV pacing through the coronary sinus or epicardial ventricular pacing is required
Anatomic variants, congenital, or acquired anomalies of the coronary sinus	CT, CMR	• Pre-procedural planning in cases with previously failed coronary sinus cannulation
Prominent embryonic remnants	TTE, TOE, CT, CMR	• Possible entrapment of the pacemaker lead within the right atrium

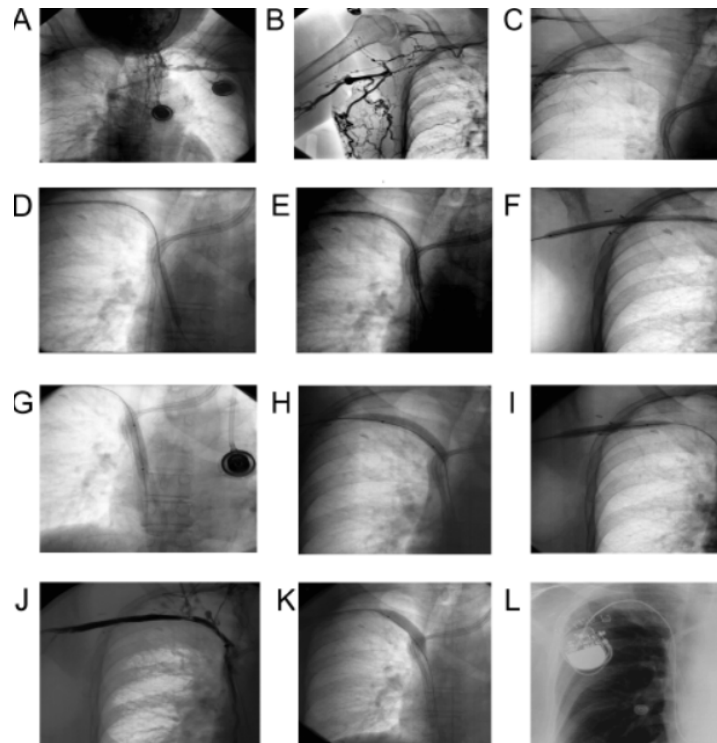




Placement of Transvenous Pacemaker and ICD Leads Across Total Chronic Occlusions

[CRAIG J. MCCOTTER](#), [J. FRITZ ANGLE](#), [LIZA A. PRUDENTE](#), [J. PAUL MOUNSEY](#), [JOHN D. FERGUSON](#),
[JOHN P. DiMARCO](#), [JAMES P. HUMMEL](#), [J. MICHAEL MANGRUM](#)

- Some degree of obstruction can be **seen in up to 13% of patients before device implantation** and 50% after transvenous device implantation.
- The most common predisposing factors are trauma, central lines, particularly those for long-term infusion therapy, hemodialysis, previously infected central lines, and cardiac pacemaker leads
- **Percutaneous transluminal angioplasty (PTA)** of an occluded subclavian vein or superior vena cava, followed by lead implantation, is a technique that offers a minimally invasive and low-risk solution in selected cases
- **Evidence remains limited**

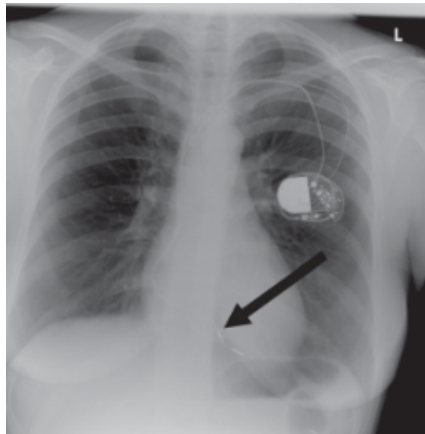


Dislocazione degli elettrocatteteri

- 1,2-2,4% VD; 1,3% A
- Complicanza più comune nell'iniziale periodo post impianto (in genere prima della dimissione)
- Aumenta il rischio di successive complicanze: PNx, tamponamento, mortalità intra-ospedaliera
- Due tipologie:

Microdislocazione:
posizione
apparentemente
corretta all'RX torace

Macrodislocazione:
Evidente al CRX
(talvolta nella camera
cardiaca sbagliata)



- Perdita di cattura/innalzamento delle soglie
- Failure to sense
- Oversensing
- Cattura della camera cardiaca errata



Incidence and predictors of short- and long-term complications in pacemaker therapy: The FOLLOWPACE study

Erik O. Udo, MD, PhD^{1,2} · Nicolaas P.A. Zuithoff¹ · Norbert M. van Hemel, MD, PhD¹ · ... · Thijs Hendriks¹ · Pieter A. Doevendans, MD, PhD¹ · Karel G.M. Moons, PhD¹ ... Show more

Patient or implantation characteristic	Within 2 months				During follow-up			
	Univariable analysis		Multivariable analysis		Univariable analysis		Multivariable analysis	
	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P	HR (95% CI)	P
Male gender	0.81 (0.61-1.08)	.16	0.72 (0.53-0.97)	.03	1.01 (0.73-1.42)	.94	0.91 (0.64-1.29)	.59
Age at implantation*	0.99 (0.97-1.00)	.02	0.98 (0.97-1.00)	.01	0.97 (0.96-0.99)	<.01	0.97 (0.96-0.99)	<.01
Body mass index†	0.59 (0.57-0.62)	.01	0.94 (0.90-0.98)	.01	0.97 (0.93-1.02)	.25	0.96 (0.92-1.01)	.09
Diabetes	1.11 (0.76-1.64)	.58	1.14 (0.76-1.69)	.53	1.18 (0.76-1.83)	.46	1.21 (0.76-1.90)	.42
Hypertension	1.00 (0.74-1.34)	.99	1.01 (0.72-1.41)	.96	1.12 (0.79-1.58)	.53	1.29 (0.87-1.90)	.20
History of atrial tachyarrhythmias	0.99 (0.73-1.33)	.94	1.00 (0.69-1.44)	.98	0.89 (0.63-1.26)	.50	0.87 (0.57-1.33)	.52
Prior cerebrovascular accident	1.60 (0.50-5.04)	.10	0.65 (0.37-1.14)	.13	1.13 (0.64-2.00)	.67	0.96 (0.54-1.71)	.89
Congestive heart failure	0.66 (0.45-0.99)	.04	1.36 (0.85-2.17)	.20	0.68 (0.43-1.09)	.11	1.24 (0.72-2.12)	.44
Cardiac valve disease	1.08 (0.77-1.52)	.65	1.03 (0.70-1.50)	.90	1.01 (0.67-1.51)	.98	1.06 (0.67-1.66)	.81
Coronary artery disease	1.06 (0.75-1.51)	.74	1.05 (0.71-1.55)	.80	1.13 (0.75-1.69)	.56	1.15 (0.74-1.79)	.52
Cardiac surgery	1.05 (0.73-1.51)	.80	1.06 (0.70-1.60)	.78	0.90 (0.58-1.41)	.64	0.84 (0.52-1.37)	.49
Main indication for implantation		.39		.80		.64		.27
Atrioventricular conduction disturbances	Reference		Reference		Reference		Reference	
Atrial fibrillation with slow ventricular response	0.95 (0.62-1.44)		1.22 (0.71-2.10)		1.05 (0.66-1.66)		1.57 (0.87-2.86)	
Sick sinus syndrome and bradytachycardias	0.98 (0.71-1.36)		0.96 (0.68-1.36)		0.87 (0.59-1.28)		0.89 (0.59-1.32)	
Other indications	1.56 (0.89-2.71)		1.13 (0.61-2.10)		1.32 (0.67-2.58)		0.91 (0.43-1.90)	
Dual-chamber device	1.51 (1.05-2.16)	.03	3.09 (0.38-24.97)	.29	1.60 (1.05-2.45)	.03	1.67 (1.01-2.78)	.05
Subclavian vein used for venous access	0.92 (0.60-1.43)	.71	0.83 (0.53-1.29)	.40	—		—	
Use of aspirin or coumarin	1.13 (0.84-1.53)	.41	1.23 (0.87-1.74)	.24	—		—	
Passive atrial lead fixation	1.31 (0.93-1.85)	.13	1.36 (0.94-1.96)	.10	—		—	
Passive right ventricular lead fixation	0.99 (0.71-1.39)	.96	1.04 (0.73-1.50)	.82	—		—	
Annual hospital implanting volume‡	1.00 (1.00-1.00)	.94	1.00 (1.00-1.00)	.78	—		—	
Implantation-related complication	—		—		1.42 (0.83-2.43)	.20	1.28 (0.75-2.21)	.36

- Independent predictors for a short-term PM complication (ie, occurring within 2 months) were male gender*, age at implantation, BMI, a history of cerebrovascular accident, congestive heart failure, use of anticoagulant drugs, and **passive atrial lead fixation**

*Altri studi: sesso femminile associato a dislocazione

Cause specifiche di dislocazione

Posizionamento non ottimale dell'elettrocatteter (insufficiente «slack»)

Twiddler's syndrome, reel's syndrome

Trauma diretto sul sistema

Eccessiva attività del paziente nell'immediato post-impianto



Movimenti energetici del diaframma durante il riflesso del vomito



Come prevenirlo

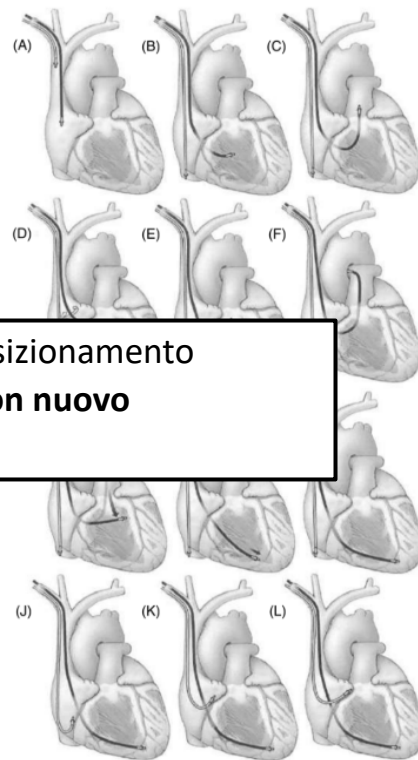
Monitoring fluoroscopic stability while exerting forward pressure

Assessing lead redundancy

Valuating loss of capture, capture threshold, pacemaker negative intrathoracic pressure, such as deep inspiration

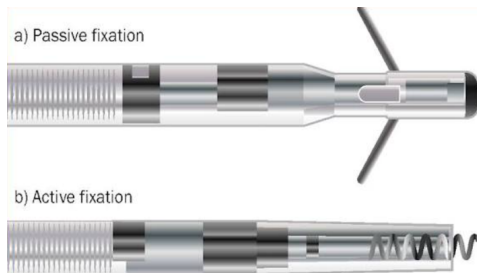
Meticulous closure techniques, including precise suturing of the device and lead sleeves to the fascia

Maggiore rischio di ricorrenza in caso di riposizionamento dell'elettrocatteter rispetto a **sostituzione con nuovo elettrocatteter!**



Vite o barbe?

Cateteri a vite: tendenza ad andare incontro **meno frequentemente** a dislocazione



- The most frequent lead-related complication was dislodgement of a lead
- Within 2 months, dislocation of an atrial lead occurred in 27 patients: in 16 **(1.9%) patients with active atrial lead fixation** and in 11 **(3.9%) patients with passive atrial lead fixation** (P .059).
- Dislocation of a right ventricular lead occurred in 20 **(1.8%) passive fixation leads** and in 4 **(1.1%) active fixation leads** (P .368).

Table 3 Complications within 2 months and during long-term follow-up occurring in 1517 patients with a first pacemaker

	Within 2 months		During follow-up	
	n	%	n	%
Traumatic complications—total	42	2.77	1	0.07
Perforation of cardiac structure	6	0.40	1	0.07
Pneumo(hemo)thorax	34	2.24	0	0
Pericardial effusion	2	0.13	0	0
Lead related complications—total	84	5.54	84	5.54
Lead fracture	0	0.00	0	0.00
Lead dislocation or disconnection*	50	3.30	24	1.58
Insulation problem*	4	0.26	11	0.73
Infection (ie, lead endocarditis)*	0	0	3	0.20
Stimulation threshold problem	12	0.79	26	1.71
Diaphragm or pocket stimulation	11	0.73	10	0.66
Diaphragm or pocket stimulation*	0	0	1	0.07
Other†	5	0.33	3	0.20
Pocket complications—total	72	4.75	49	3.23
Hematoma	44	2.90	1	0.07
Difficult to control bleeding*	4	0.26	2	0.13
Infection	10	0.66	4	0.26
Infection*	4	0.26	8	0.53
Discomfort due to pocket or pacemaker	1	0.07	17	1.12
Discomfort due to pocket or pacemaker*	2	0.13	9	0.59
Skin erosion	7	0.46	8	0.53
Pulse generator problem—total	5	0.33	23	1.52
Problem with connection screw	5	0.33	0	0
Manufacturer recall	0	0	5	0.33
Manufacturer recall*	0	0	6	0.40
Reset to default settings	0	0	4	0.26
Device cannot be programmed	0	0	2	0.13
Pacemaker tachycardia	0	0	2	0.13
Malfunction of software algorithm	0	0	4	0.26
Total number of complications in need of reoperation	64	4.22	61	4.02
Number of patients experiencing a complication	188	12.4	140	9.20

*Complication is managed with reoperation. Numbers do not add up, because patients can experience multiple complications.

†See text for details.



Vite o barbe?

Pochi dati sul confronto di cateteri a fissazione attiva rispetto a fissazione passiva in posizione apicale/settale apicale in termini di complicitanze lead-related

A long-term, prospective, cohort study on the performance of right ventricular pacing leads: comparison of active-fixation with passive-fixation leads



Lie Liu¹, Jiaojiao Tang¹, Hu Peng², Shulin Wu¹, Chunying Lin¹, Dongli Chen¹, Qianhuan Zhang¹, Yuanhong Liang¹, Silin Chen¹, Yan Chen³ & Huiqiang Wei¹

Fissazione passiva non peggiore di quella attiva

Coerente con il nostro caso



Declino del pacing tradizionale in favore della stimolazione fisiologica

One patient in the active group, diagnosed with dilated cardiomyopathy, experienced left ventricular lead dislodgement nine months after pacemaker implantation and consequently received lead replacement. Another patient in the passive group was found with a left subclavian lead insulation fracture during the fourth year follow up, and underwent RV lead implantation via the left subclavian vein. No lead perforation or other lead related acute or chronic adverse events were recorded in either group.



Take-home message

Metodiche di imaging non routinariamente utilizzate come la **tomografia computerizzata** possono svolgere un ruolo chiave in pazienti con specifiche comorbidità permettendo di selezionare la tipologia di impianto più adatta e offrendo uno strumento per favorire il successo procedurale e minimizzare le complicanze

Complicanze acute legate agli elettrocaterteri come la **dislocazione** sono ancora possibili con i sistemi tradizionali: un riconoscimento precoce è fondamentale per l'outcome del paziente

La fase acuta post-impianto è un periodo vulnerabile: **un'eccessiva attività del paziente** può avere implicazioni gravi

Gli elettrocaterteri con sistemi di **fissazione passiva** possono trovare ancora spazio nell'epoca contemporanea della cardiostimolazione, potendo garantire maggiore stabilità in alcune categorie di pazienti



Grazie per l'attenzione!

