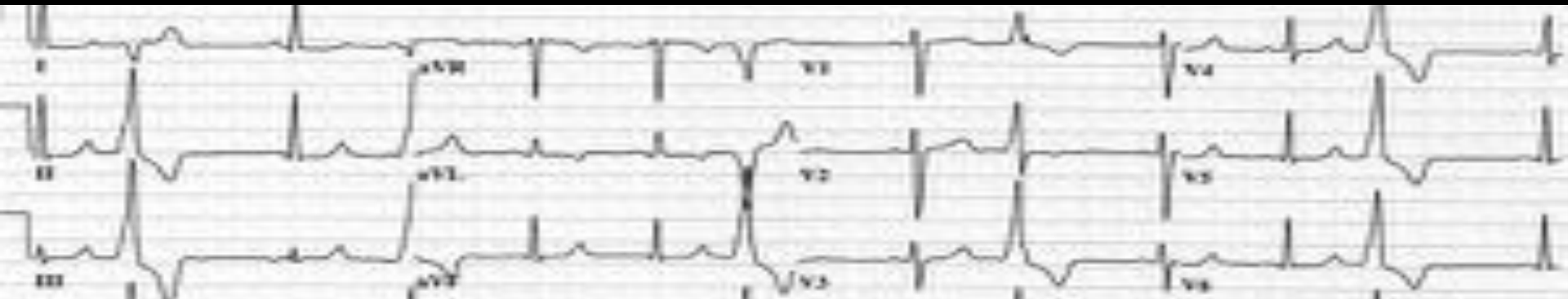
VENICE 2015

"PVC ABLATION. WHEN SHOULD IT BE RECOMMENDED?"

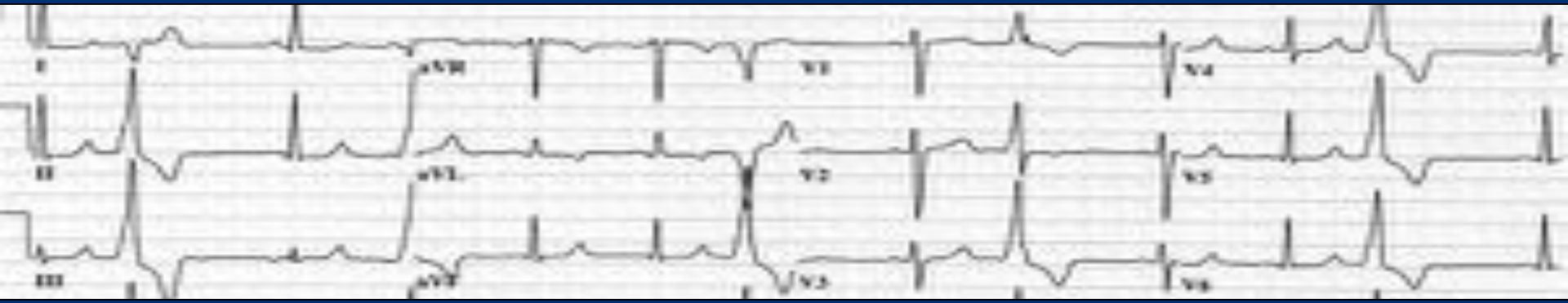
Luis Aguinaga, MD, PhD, FACC, FESC



October 16 - 18
14th EDITION 2015

NO CONFLICT OF INTEREST TO DECLARE

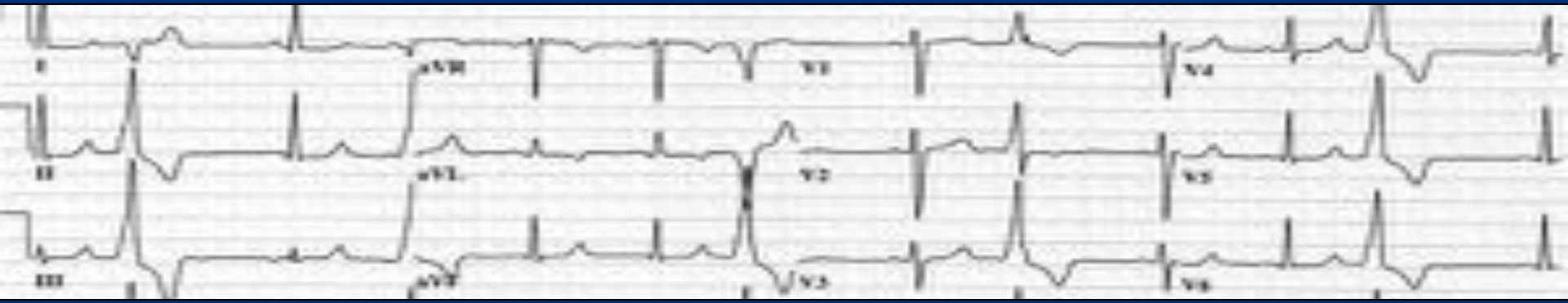
Should we perform ablation in PVCs????



PVC ABLATION

NO…!!

In some patients ???



PVC ABLATION

YES...!!

CATHETER ABLATION
who should it be recommended to ?

PVC ABLATION

1-Symptomatic, refractory to AA drugs, or when AA drugs are not tolerated or not desired….

CASE 1

- 16 y/o. Male
- Highly symptomatic.
- Professional soccer player
- Not authorized.


DI
DII
DIII
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6


DI
DII
DIII
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6
H1
H2

Recommendations	Class[a]	Level[b]	Ref[c]
In patients with frequent symptomatic PVC or NSVT:			
– Amiodarone should be considered.	IIa	B	64
– Catheter ablation should be considered.	IIa	B	341–343
Catheter ablation should be considered in patients with LV dysfunction associated with PVCs.	IIa	B	341–343

ESC GUIDELINES 2015

Why are some patients with PVCs highly symptomatic?

Mechanical Concealed Bradycardia

HR=60bpm

Pulse=30 bpm

Fatigue as Presenting Symptom and a High Burden of Premature Ventricular Contractions Are Independently Associated with Increased Ventricular Wall Stress in Patients with Normal Left Ventricular Function.

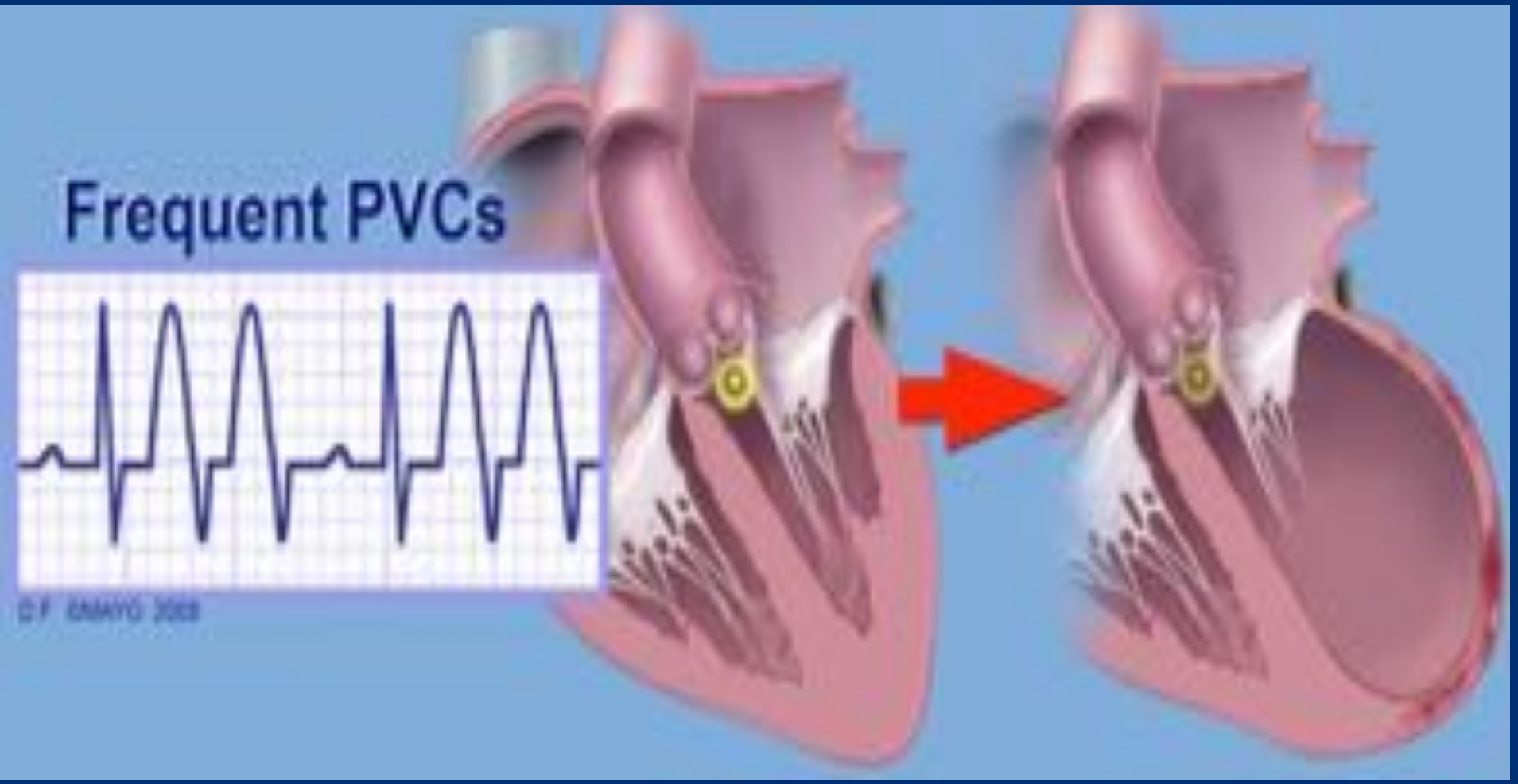
HIGH PVC BURDEN
+
WALL STRESS
-NT-proBNP
-Circumferential end-systolic wall stress (cESS)

Sustained Successful ablation

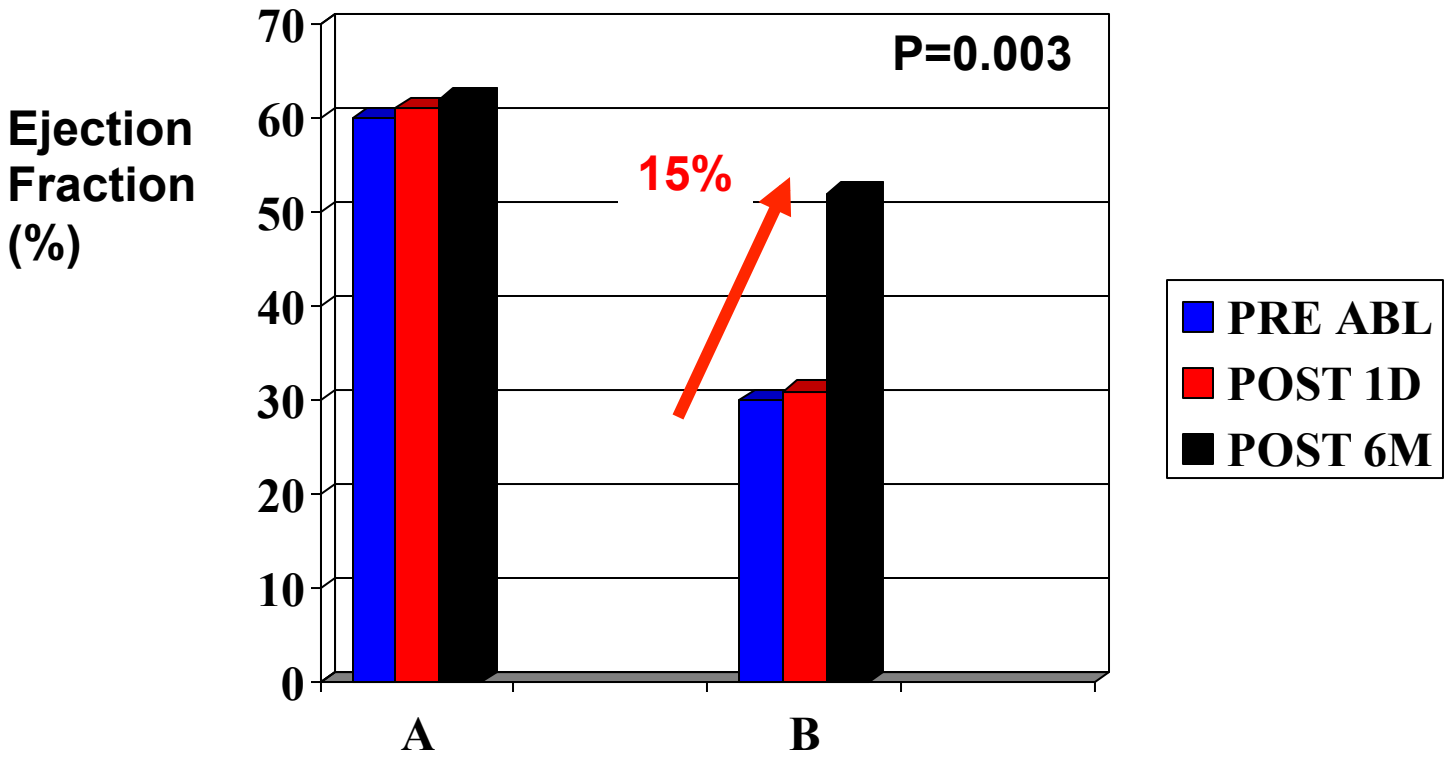
WALL STRESS
(NT-proBNP and cESS) decreased significantly ($p<0.001$)

Circ Arrhythm Electrophysiol. Sept 2015

2-PVC "induced" left ventricular dysfunction


Frequent PVCs

“Clinical impact of catheter ablation in left ventricular cardiomyopathy associated with right ventricular outflow tract premature ventricular complex”



Aguinaga L, et al. European Heart Journal (2008) 29 (Abstract Supplement), 742

Radiofrequency Catheter Ablation for the Treatment of Idiopathic Premature Ventricular Contractions Originating from the Right Ventricular Outflow Tract: A Systematic Review and Meta-Analysis

Table I.

Characteristics of Included Studies

Study	Pre-Post Design	No. of Included Patients	Structural Heart Disease	24-Hour Holter Monitor	Follow-Up (Mean ± SD)
Aguinaga et al.	Yes	N = 6	No	Yes	56 ± 15 months
Ardashev et al.	Yes	N = 30	No	No (echocardiogram)	2 months, 6 months, and 12 months (mean unknown)
Chovancik et al.	Yes	N = 19	No	Yes	14 ± 9 months
Darrieux et al.	Yes	N = 24	No	Yes	14.5 ± months
Kim et al.	Yes	N = 24	No	No (echocardiogram)	10.5 ± 7.1 months
Lauck et al.	Yes	N = 11	n = 1	Yes	Median = 10 months
Lauribe et al.	Yes	N = 5	No	Yes	25 ± 8 months
Raungratanaamporn et al.	Yes	N = 15	Unknown	Yes	10.9 ± 7.5 months
Taieb et al.	Yes	N = 2	No	Yes	6 months
Takemoto et al.	Yes	N = 13	No	Yes	8 ± 1
Wijnmaalen et al.	Yes (w/control group)	N = 23	No	No (echocardiogram)	Median 13 months
Yarlagadda et al.	Yes	N = 7	No	Yes	8 ± 10
Yokokawa et al.	Yes	N = 24	No	Yes	12 ± 9 months
Zhu et al.	Yes	N = 9	No	Yes	10 ± 4

PACE. 2013

Recommendations	Class[a]	Level[b]	Ref[c]
In patients with frequent symptomatic PVC or NSVT:			
– Amiodarone should be considered.	IIa	B	64
– Catheter ablation should be considered.	IIa	B	341–343
Catheter ablation should be considered in patients with LV dysfunction associated with PVCs.	IIa	B	341–343

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3-PVC “worsened” left ventricular dysfunction

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http://dx.doi.org/10.1016/j.jacc.2013.06.012

Neurohormonal, Structural, and Functional Recovery Pattern After Premature Ventricular Complex Ablation Is Independent of Structural Heart Disease Status in Patients With Depressed Left Ventricular Ejection Fraction

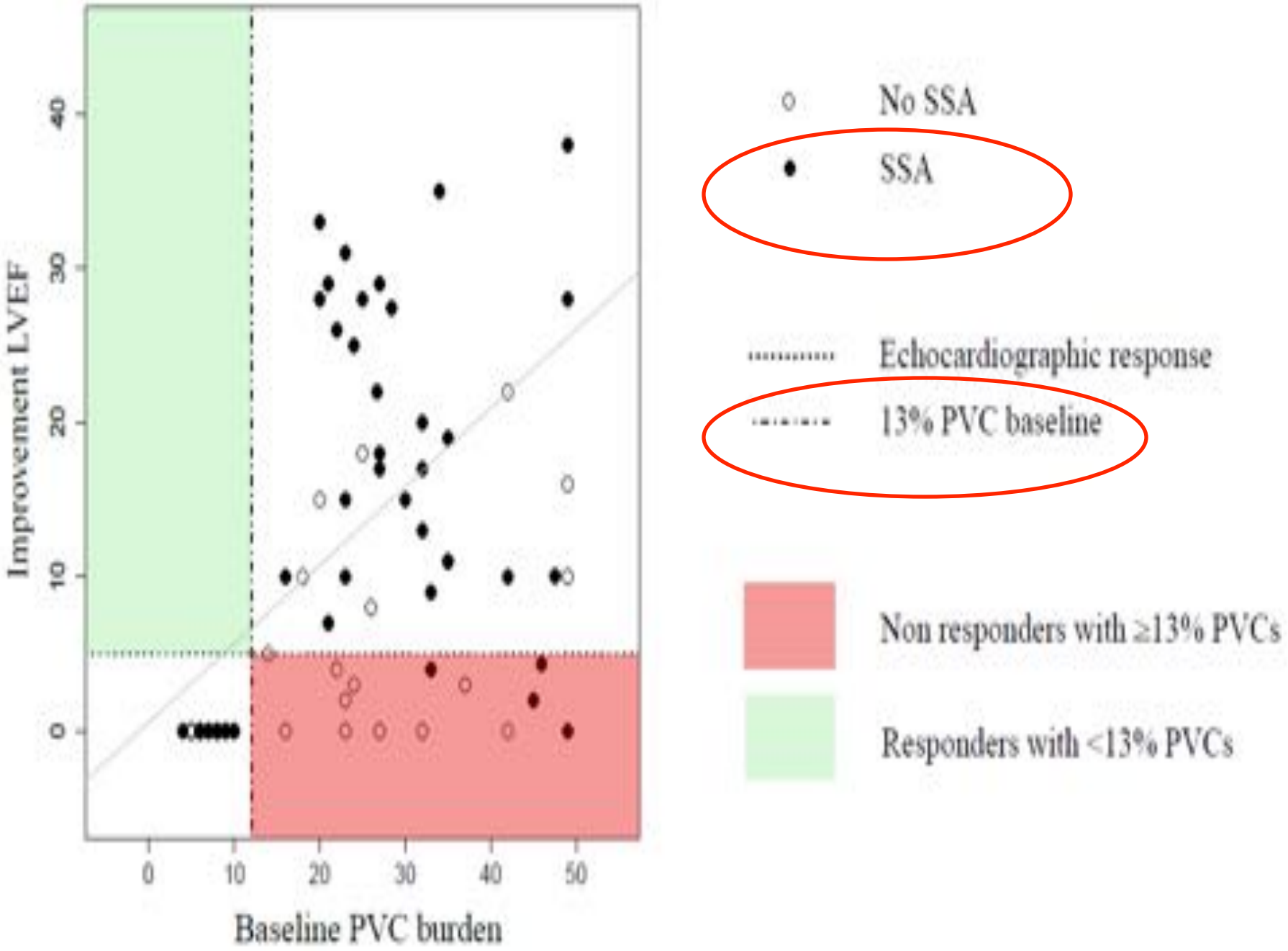
A Prospective Multicenter Study

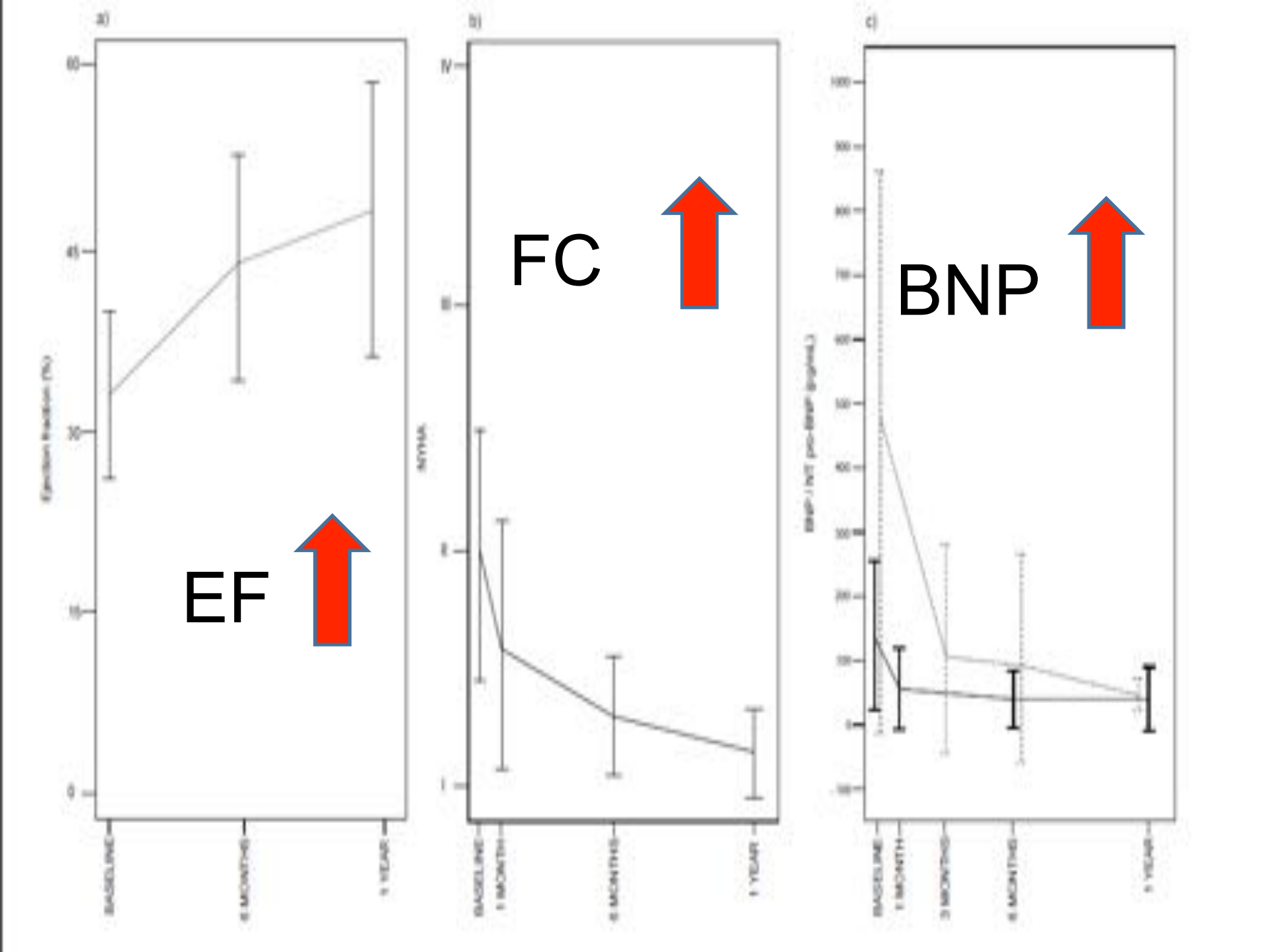
Diego Penela, MD,* Carine Van Huls Vans Taxis, MD,† Luis Aguinaga, MD,‡

Barcelona and Tarragona, Spain; Leiden, the Netherlands; and Tucuman, Argentina

Table 1 Baseline Characteristics

	No SHD (n = 53)	SHD (n = 27)	All Patients (N = 80)	p Value
Age, yrs	51.5 ± 11.7	56.6 ± 11.4	53 ± 11.8	0.065
Male	25 (47)	22 (82)	47 (59)	0.003
LVEF, %	34.7 ± 7.8	33.5 ± 8.9	34.3 ± 13	0.54

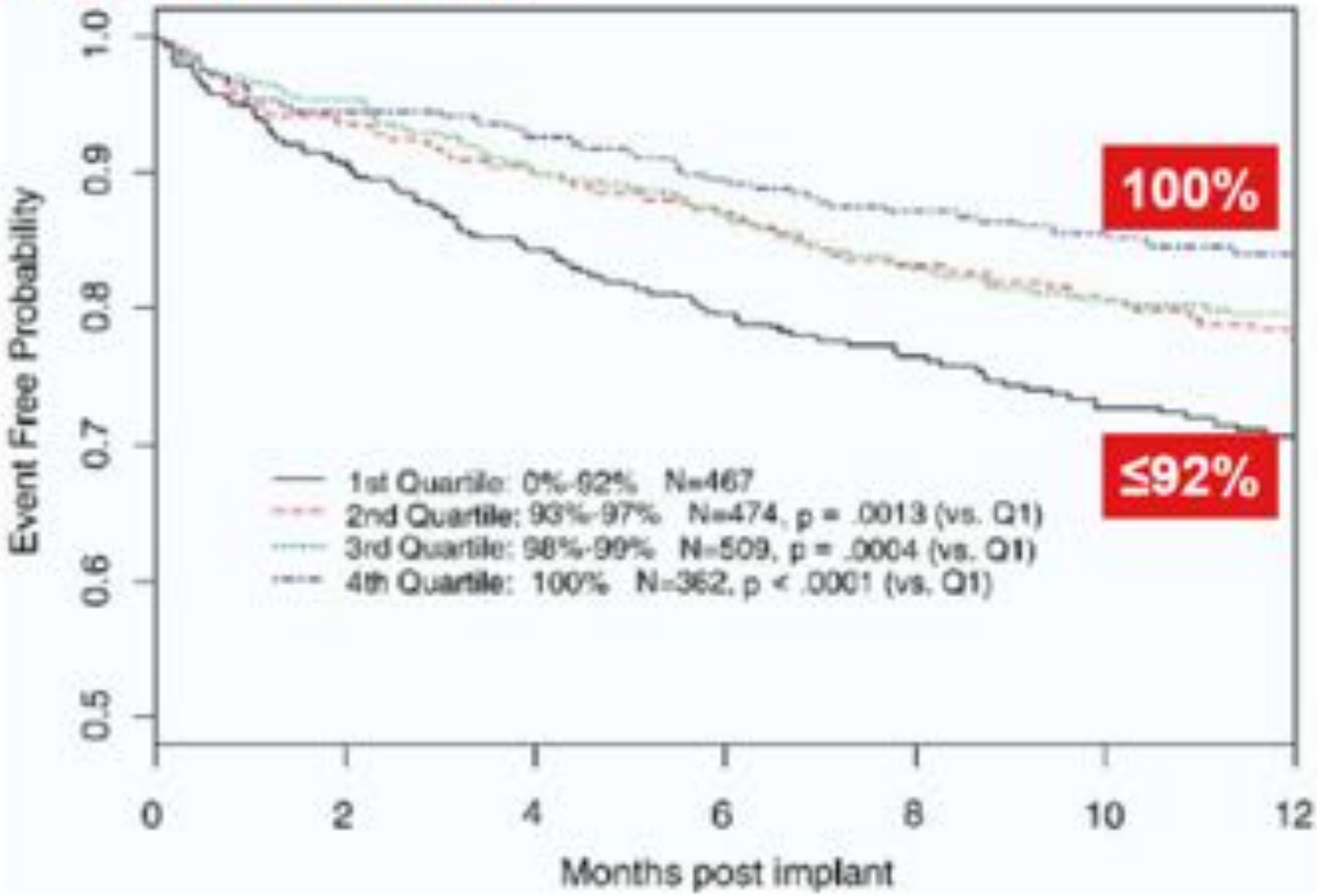

Improvement LVEF
0
10
20
30
40
0
10
20
30
40
50
Baseline PVC burden
No SSA
SSA
Echocardiographic response
13% PVC baseline
Non responders with ≥13% PVCs
Responders with <13% PVCs


a)
b)
c)
EF
FC
BNP
BASELINE
6 MONTHS
1 YEAR
1 MONTH
3 MONTHS

Should we assess the PVC burden in all the patients with left ventricular dysfunction?

4-Improvement of CRT response

Freedom from HF Hospitalization and Death in CRT Patients as a Function of BiV Pacing Percentage



Koplan BA et al. *JACC* 2009; 53: 355-360

Reasons for < 100% Biventricular Pacing

- Loss of left ventricle (LV) pacing due to dislodgment or lack of capture of the LV lead
- Intrinsic AV conduction "faster" than programmed sensed/paced AV interval
- Arrhythmias
  - Atrial fibrillation
    - Paroxysmal / Persistent
    - Long Standing Persistent / Permanent
  - Ventricular ectopy

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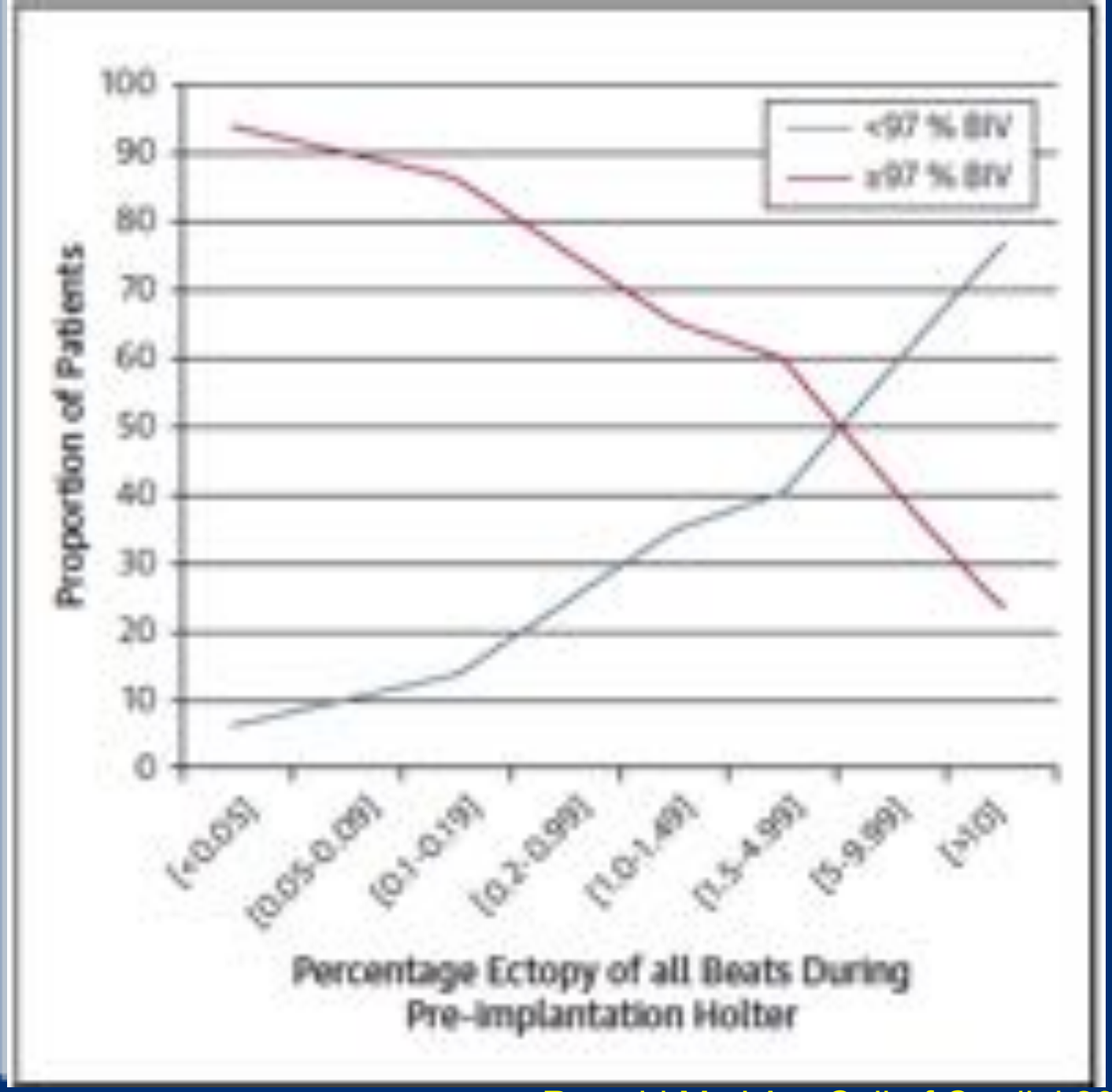
http://dx.doi.org/10.1016/j.jacc.2014.06.1177

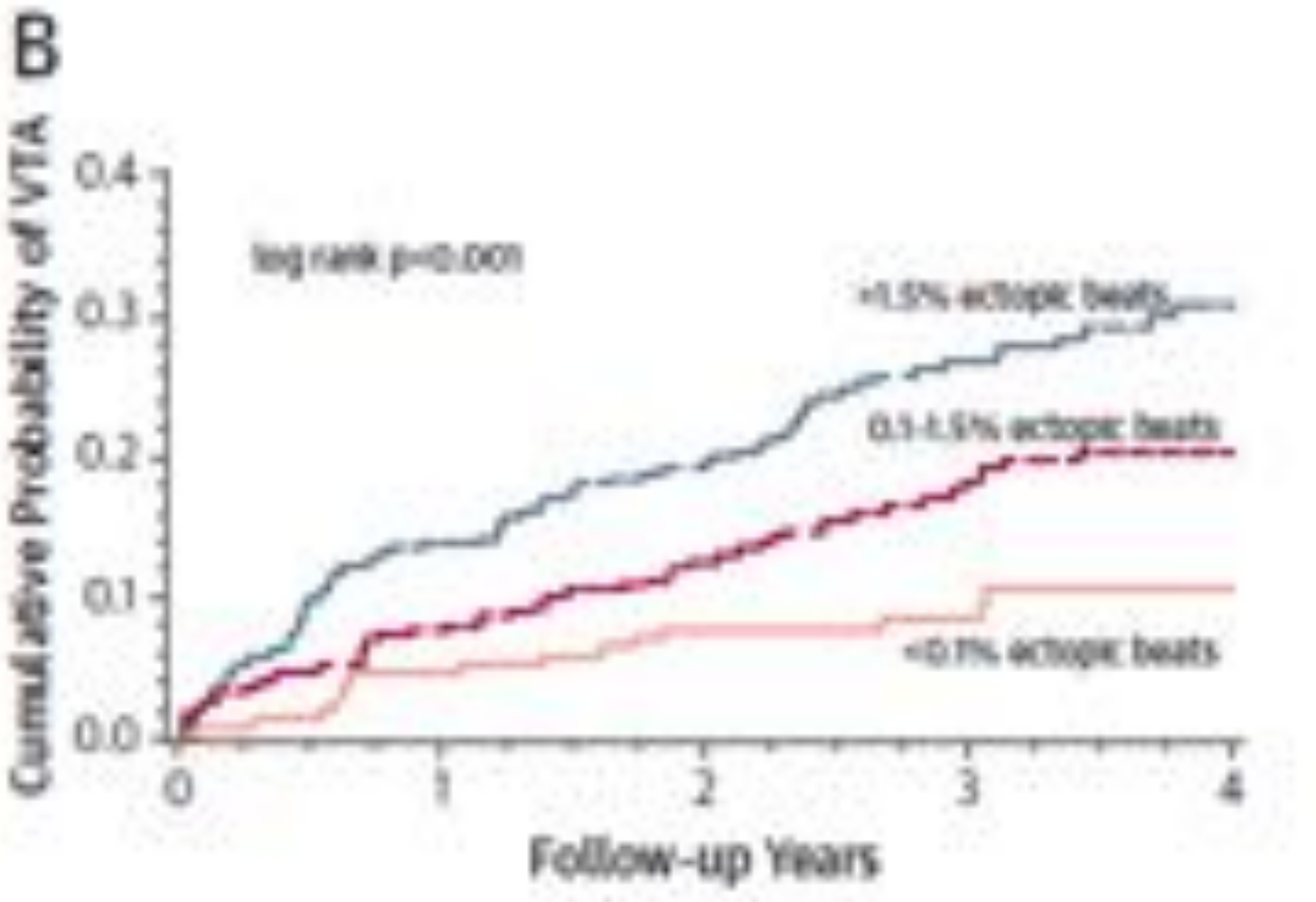
Association Between Frequency of Atrial and Ventricular Ectopic Beats and Biventricular Pacing Percentage and Outcomes in Patients With Cardiac Resynchronization Therapy

Martin H. Ruwald, MD, PhD,*† Suneet Mittal, MD,‡ Anne-Christine Ruwald, MD,*† Mehmet K. Aktas, MD,*
James P. Daubert, MD,§ Scott McNitt, MS,* Amin Al-ahmad, MD,‖ Christian Jons, MD, PhD,†
Valentina Kutyifa, MD, PhD,* Jonathan S. Steinberg, MD,‡ Paul Wang, MD,¶ Arthur J. Moss, MD,*
Wojciech Zareba, MD, PhD*

Ruwald M. J Am Coll of Cardiol 2014



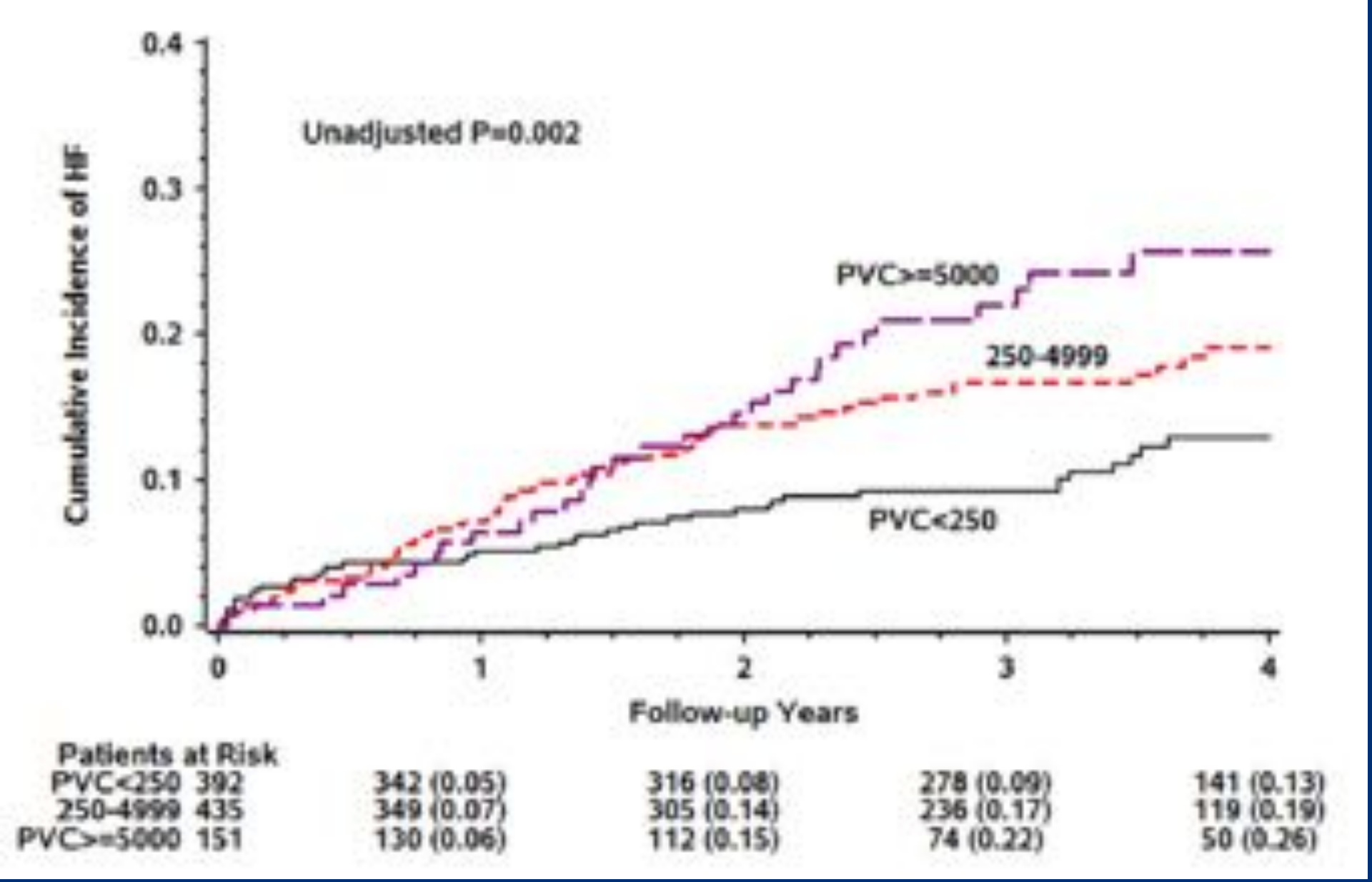
Ruwald M. J Am Coll of Cardiol 2014



Patients at Risk

160	151 (0.04)	140 (0.08)	96 (0.08)	35 (0.10)
321	288 (0.08)	262 (0.12)	178 (0.18)	80 (0.20)
320	273 (0.14)	240 (0.19)	147 (0.27)	60 (0.31)

Ruwald M. J Am Coll of Cardiol 2014



Mittal S. J Cardiovasc Electrophysiol 2014

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Vol. 60, No. 16, 2012

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ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2012.06.035

CME

Radiofrequency Ablation of Premature Ventricular Ectopy Improves the Efficacy of Cardiac Resynchronization Therapy in Nonresponders

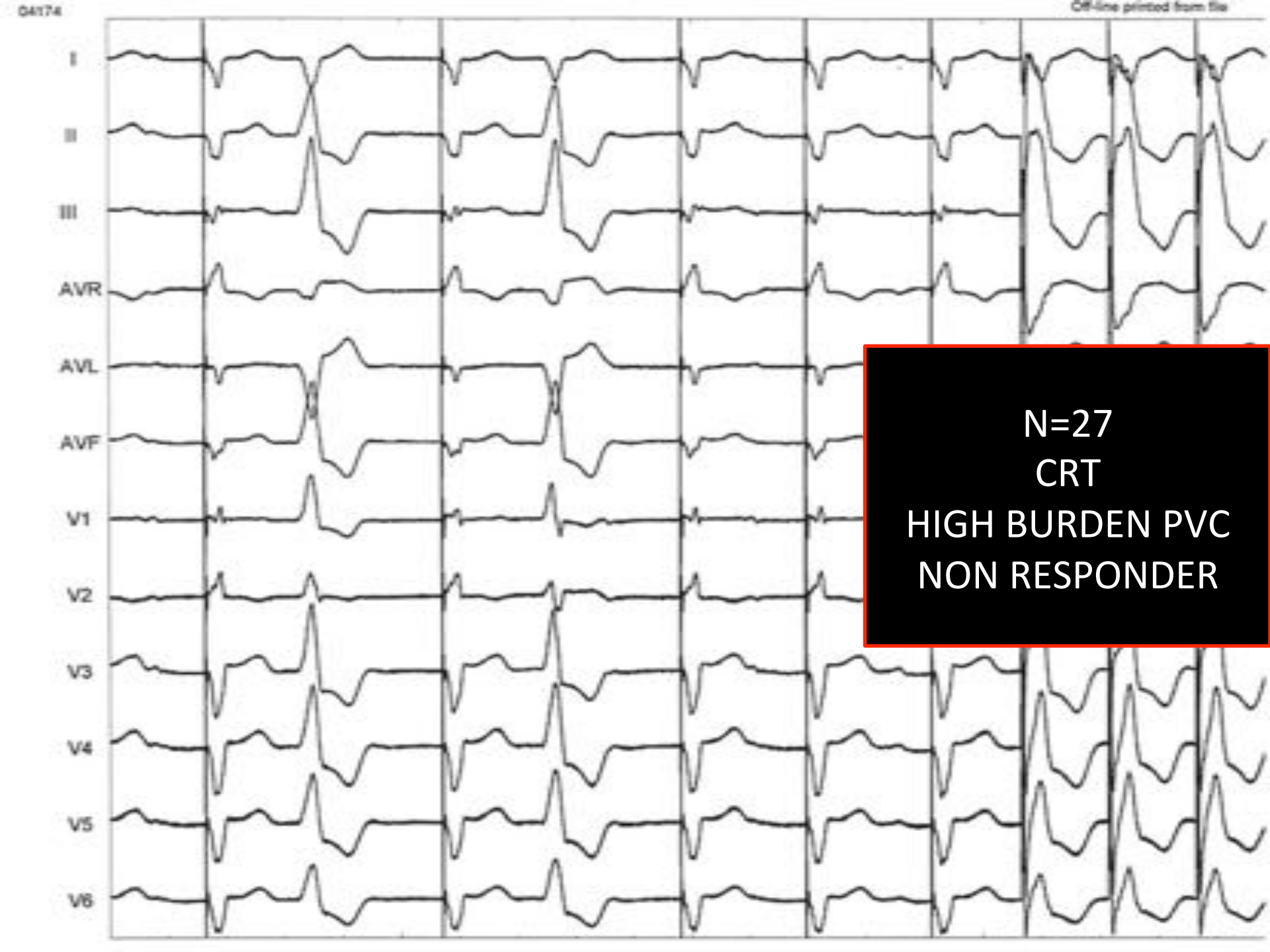
Dhanunjaya Lakkireddy, MD,* Luigi Di Biase, MD, PHD,†‡§ Kay Ryschon, MS,* Mazda Biria, MD,* Vijay Swarup, MD,‖ Yeruva Madhu Reddy, MD,* Atul Verma, MD,¶ Sudharani Bommana, MPHIL,* David Burkhardt, MD,† Raghuveer Dendi, MD,* Antonio Dello Russo, MD, PHD,# Michela Casella, MD, PHD,# Corrado Carbucicchio, MD,# Claudio Tondo, MD, PHD,# Buddhadeb Dawn, MD,* Andrea Natale, MD†‡

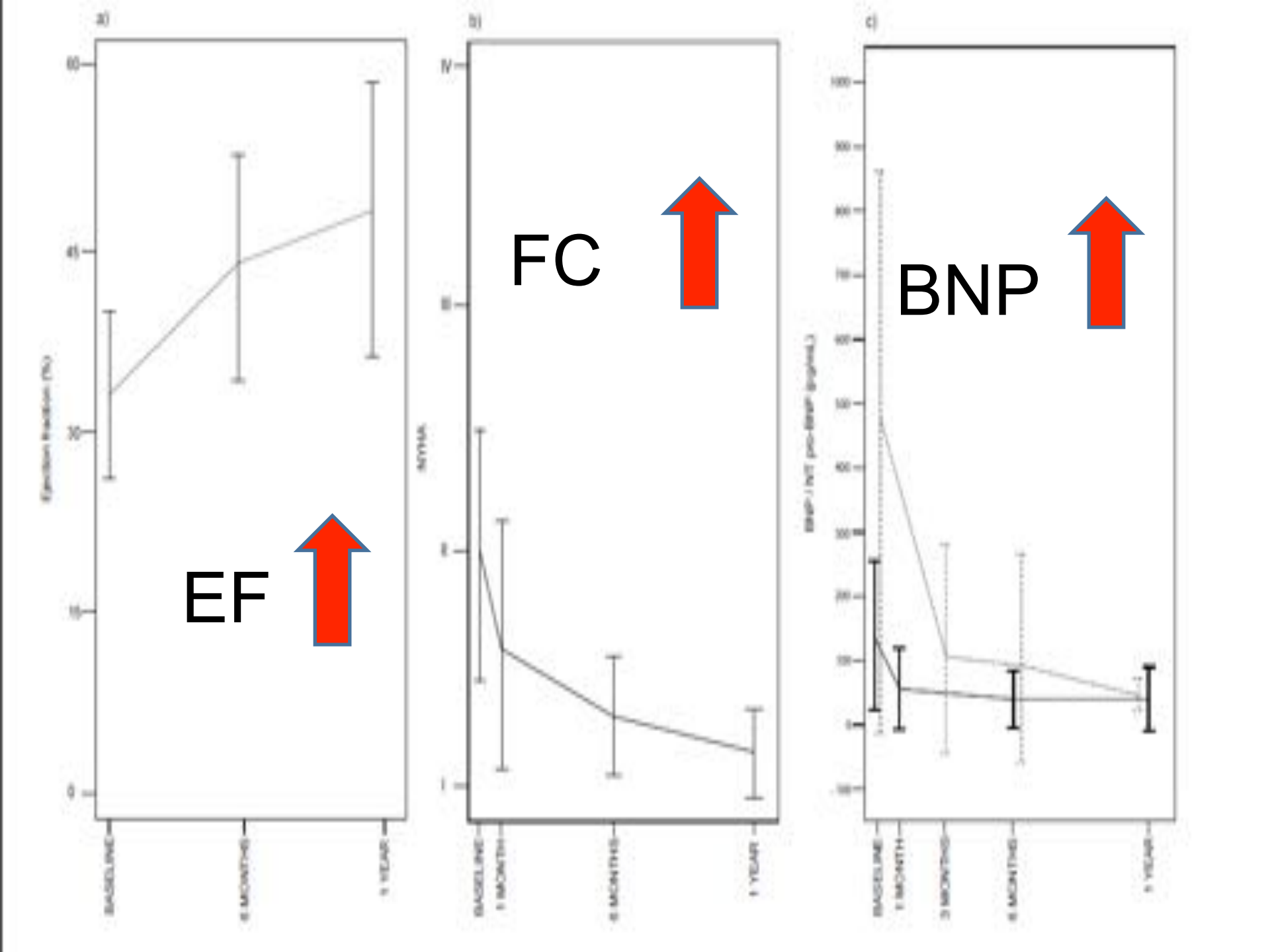
Kansas City, Kansas; Austin, Texas; Phoenix, Arizona; Southlake, Ontario, Canada; and Foggia and Milan, Italy

Neurohormonal, Structural, and Functional Recovery Pattern After PVC Ablation in non Responders to CRT

Luis Aguinaga, Antonio Berruezo, et al.

Rev Fed Arg Cardiol. In Press


04174
Off-line printed from file
I
II
III
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6
N=27
CRT
HIGH BURDEN PVC
NON RESPONDER


a)
b)
c)
EF
FC
BNP
BASELINE
6 MONTHS
1 YEAR
1 MONTH
3 MONTHS

CRT: Conclusions

- Maximal benefit in CRT is dependent on achieving near 100% Biventricular pacing.
- PVCs are common in CRT patients and puts them at risk of heart failure ,ventricular arrhythmias and could be the cause of non-response to CRT.
- Patients with high burden of PVCs may be candidates for catheter ablation

Should we assess the PVC burden in all the patients with CRT?

5-PVC that triggers VF.....

PVC THAT TRIGGERS VF

- Structural Heart Disease
- Haissaguerre ,Circulation 2002

- Myocardial Infarction
- Baensch ,Circulation 2003

- Brugada Sindrome- Long QT
- Haissaguerre, Circulation 2003

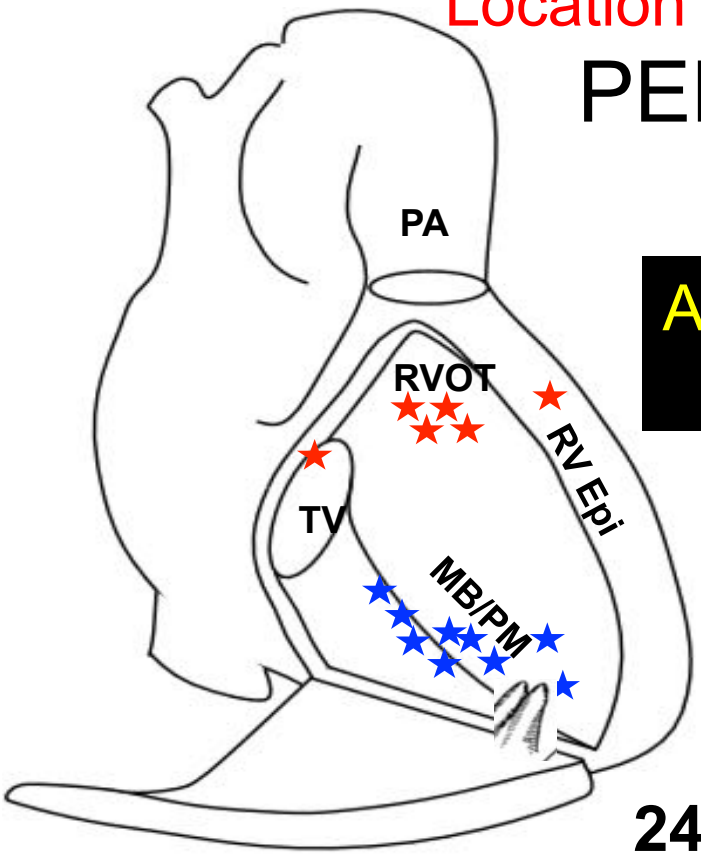
- RVOT
- Noda,J Am Coll Cardiol 2005

AV

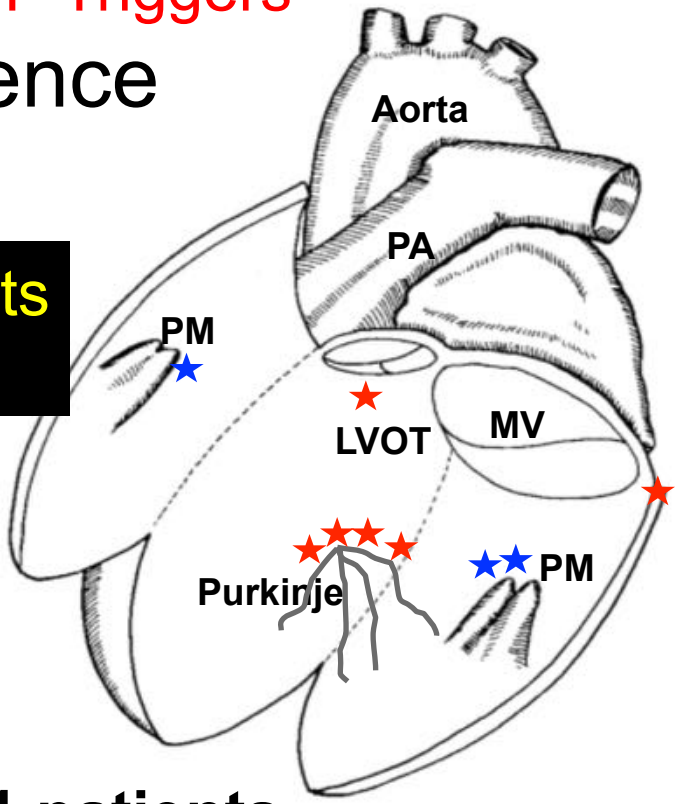
- Idiopathic VF
- Marchlynski, Heart Rhythm Journal 2014

Location of Idiopathic VF Triggers

PENN Experience



Anatomic Targets
More RV



24 triggers in 21 patients

Right Ventricle

Left Ventricle

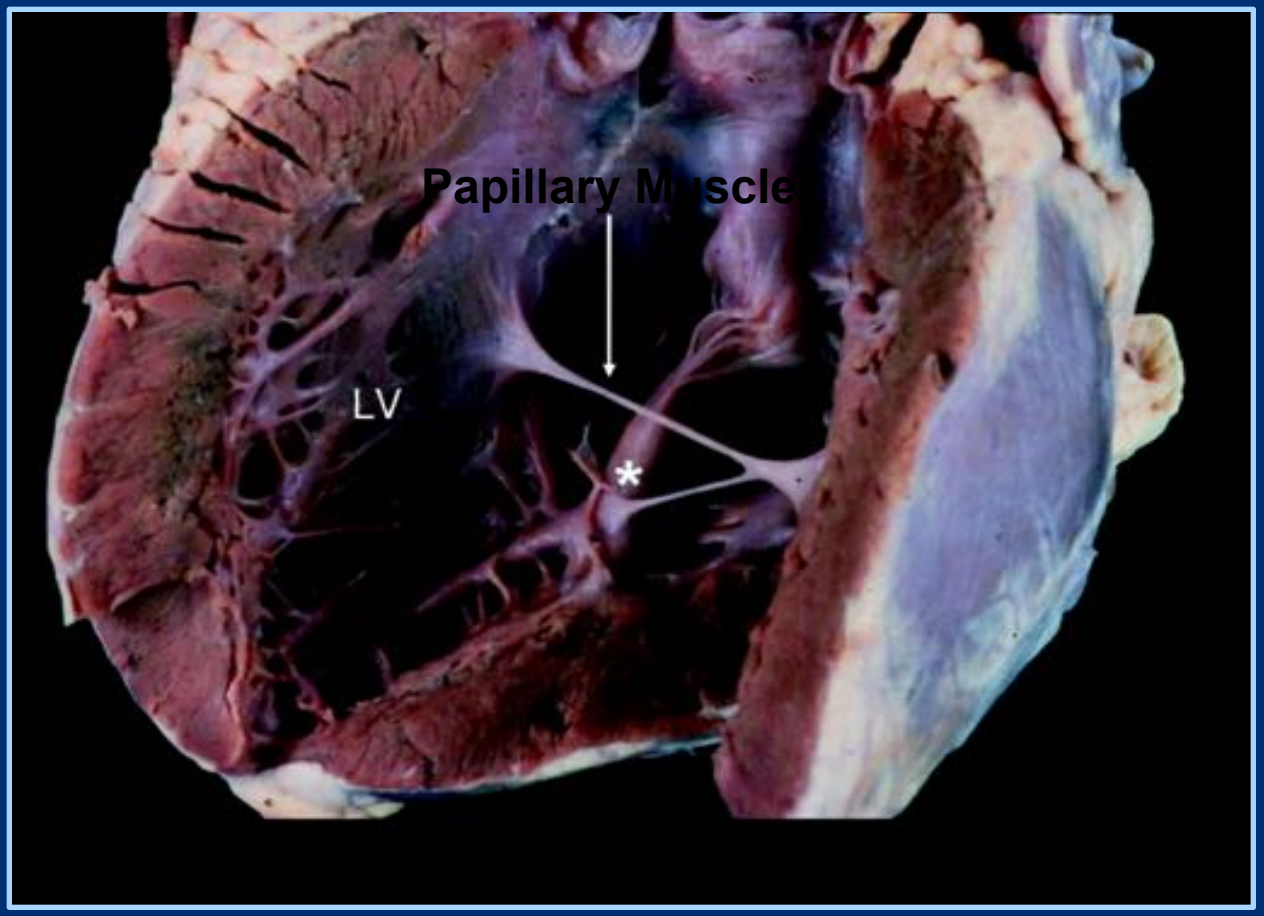
50% of VF triggers from the PM and MB

LVOT = Left ventricular outflow tract (1)
LV PM = Papillary muscle (3)
LV Purkinje (4)
Epi-MV = Mitral valve (1)

RVOT = Right ventricular outflow tract (4)
RV MB/PM = Moderator band (6)/Pap Muscle (3)
Epi RV (1)
TV = Tricuspid valve (1)

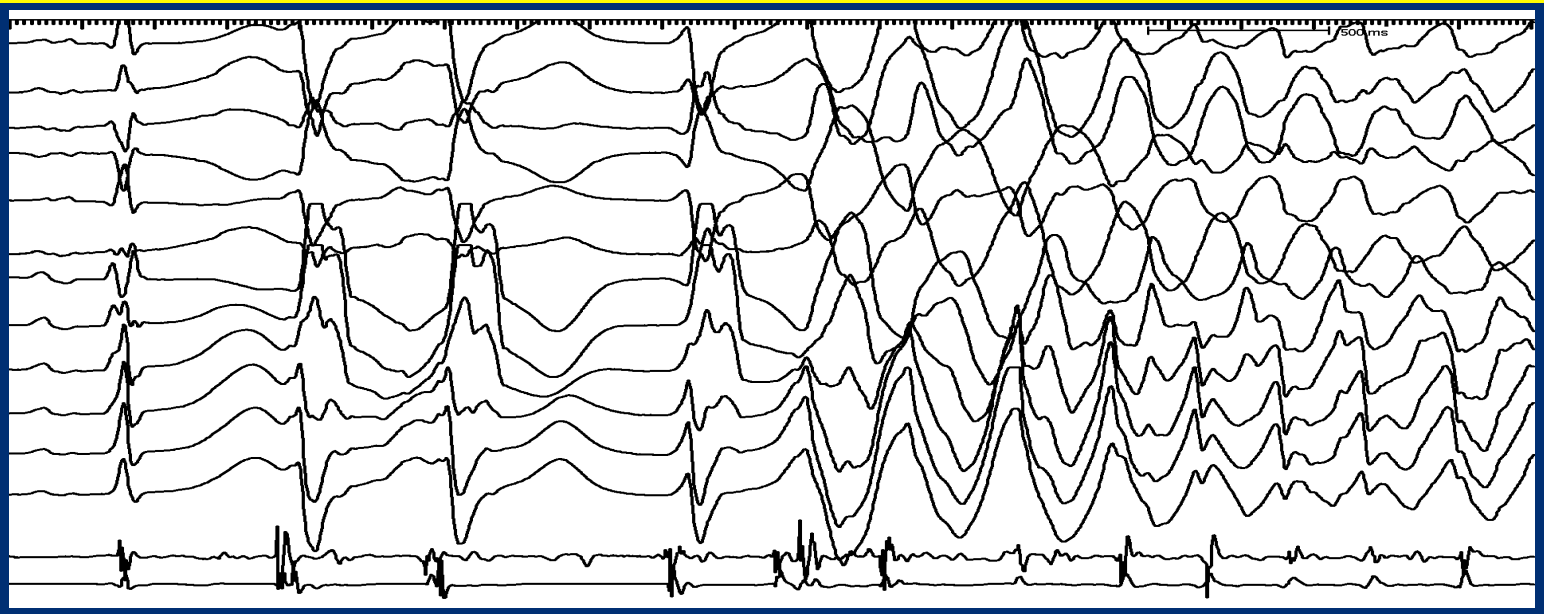
Courtesy of Dr. Marchlynski

Updated Van Herendael H et al Heart Rhthym 2014:11:566-73 and Santangeli P et al Heart Rhythm 2015 (Abst)



The association between fascicular PVCs and idiopathic VF is now well known

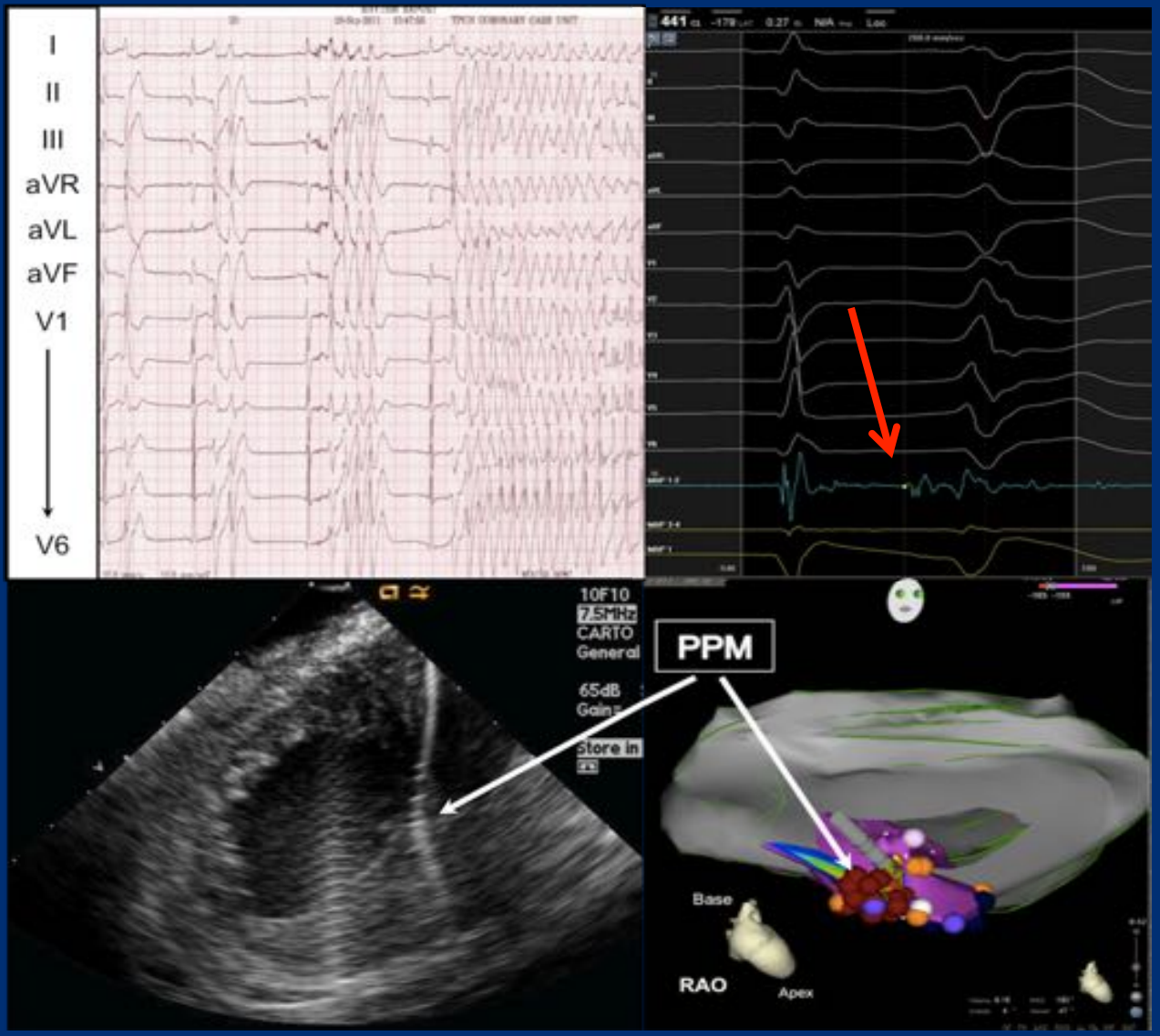
Spontaneous PVC from Pap Triggering VF



Single Extrastimulus from Pap Triggering VF

Imaging LV Papillary Muscle Trigger for Idiopathic VTVF

ECG
LV POST
PAP

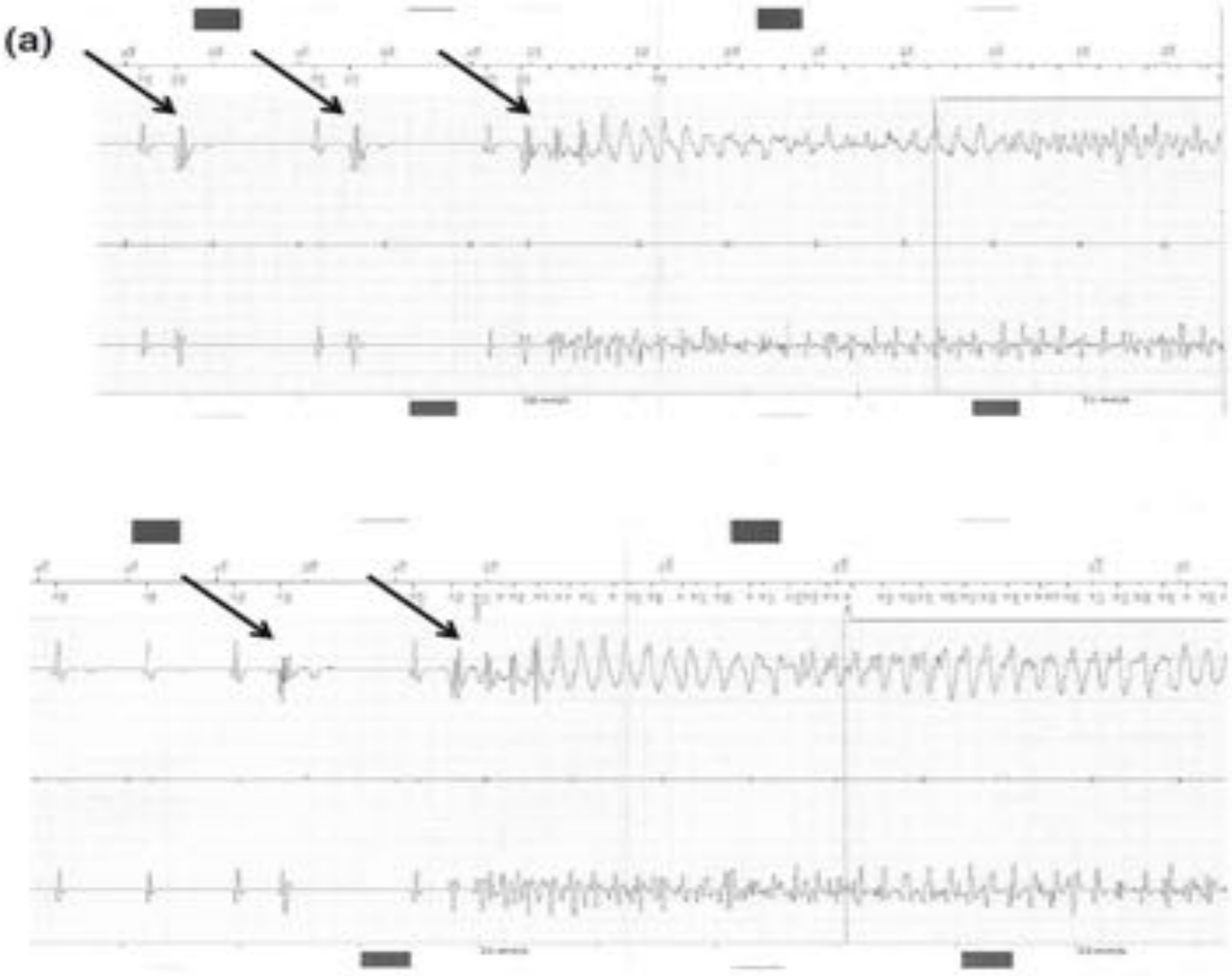


Activation –
late pukinje

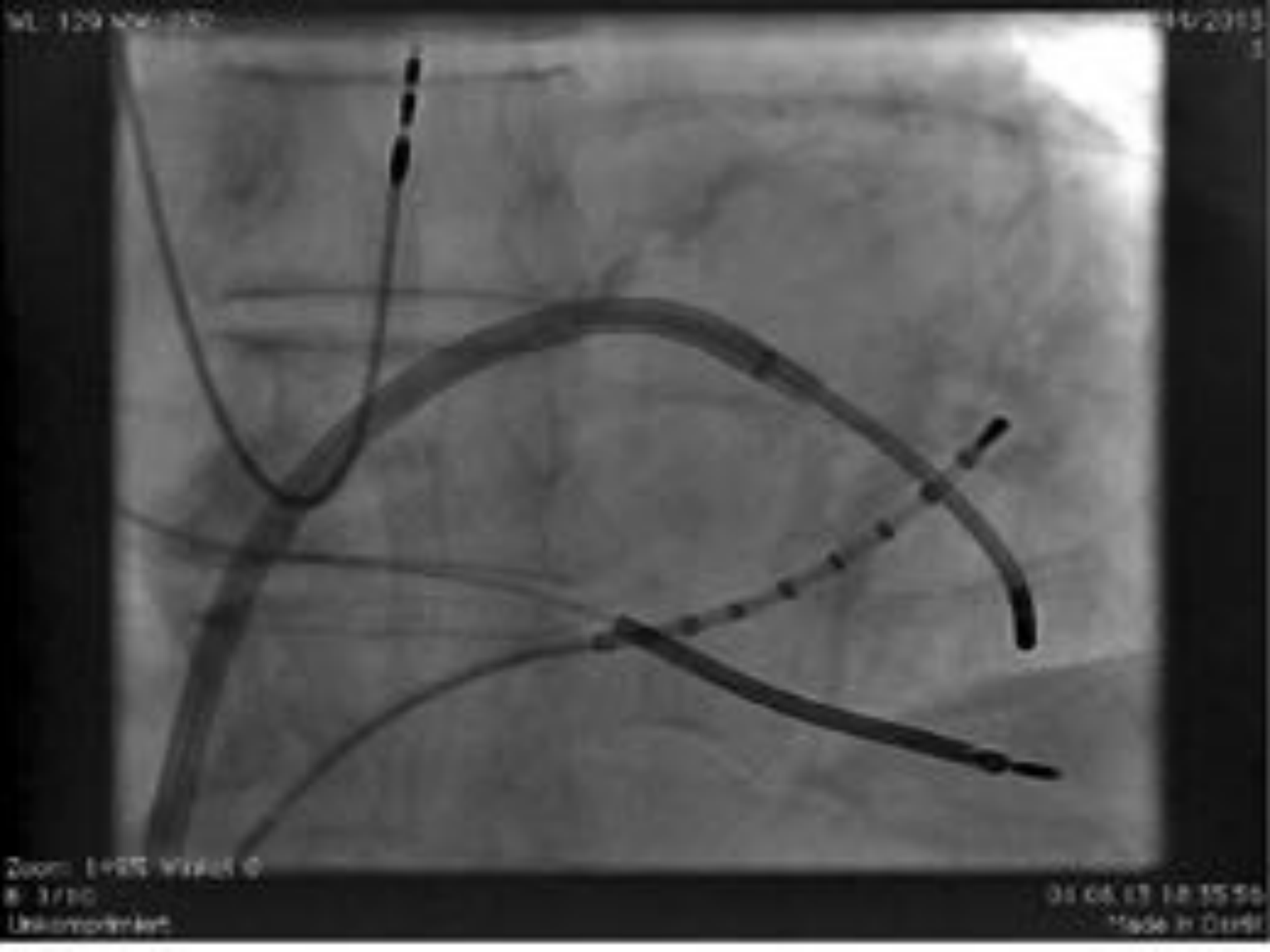
ICE
Imaging
to
localize

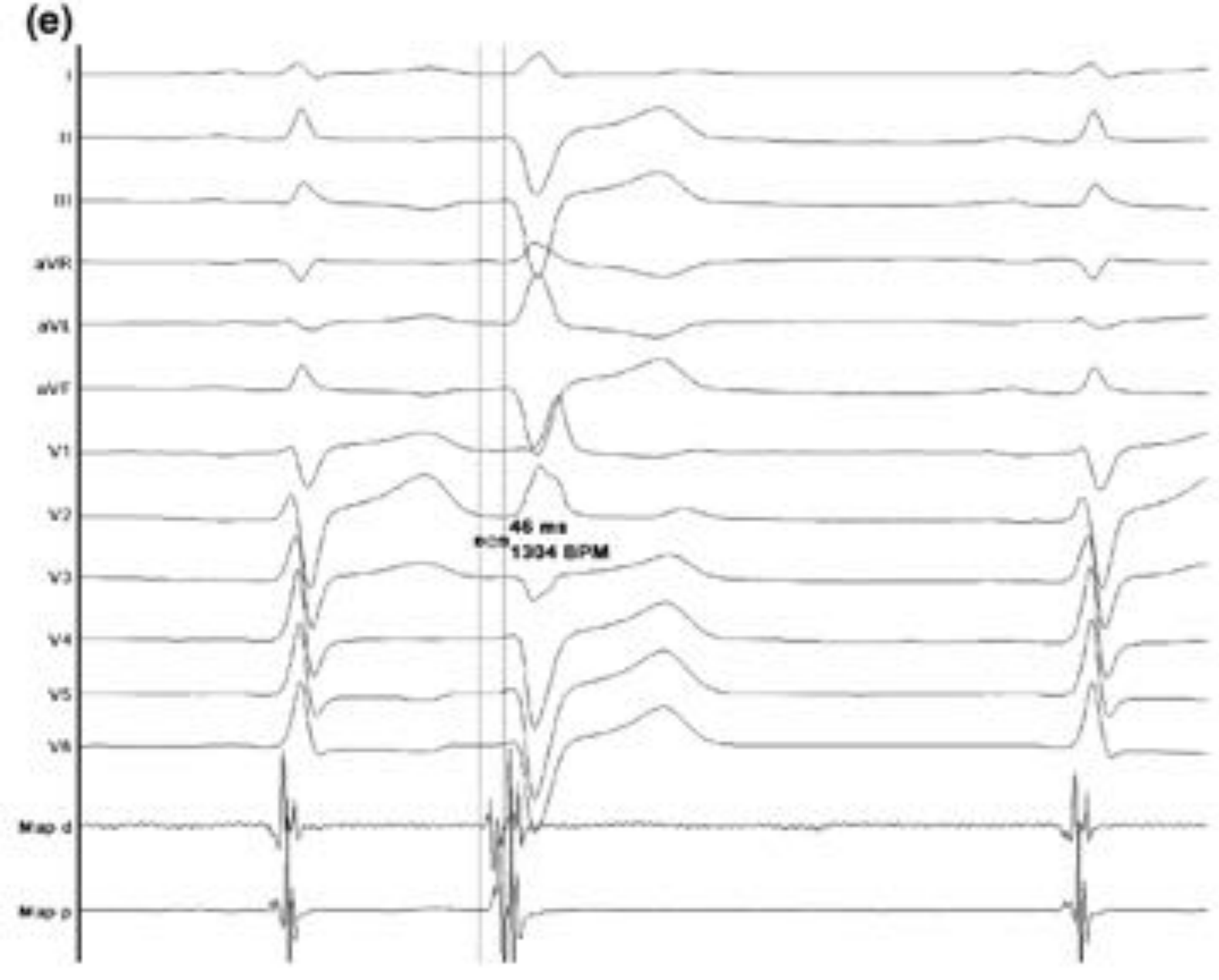
EAM
Imaging

Van Herendael H et al Heart Rhthym 2014:11:566-73


(a)


(b)
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6




(e)
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
Map d
Map p
46 ms
1304 BPM

6- In patients meeting criteria for Primary Prevention ICD implant

+ High PVC burden

Ablation of frequent PVC in patients meeting criteria for primary prevention ICD implant. Safety of withholding the implant

Diego Penela, Juan Acosta, Luis Aguinaga, et al.

Heart Rhythm Journal. September 2015

Should we assess the PVC burden in all the patients with primary prevention ICD implant indication?

Europace Advance Access published January 23, 2015

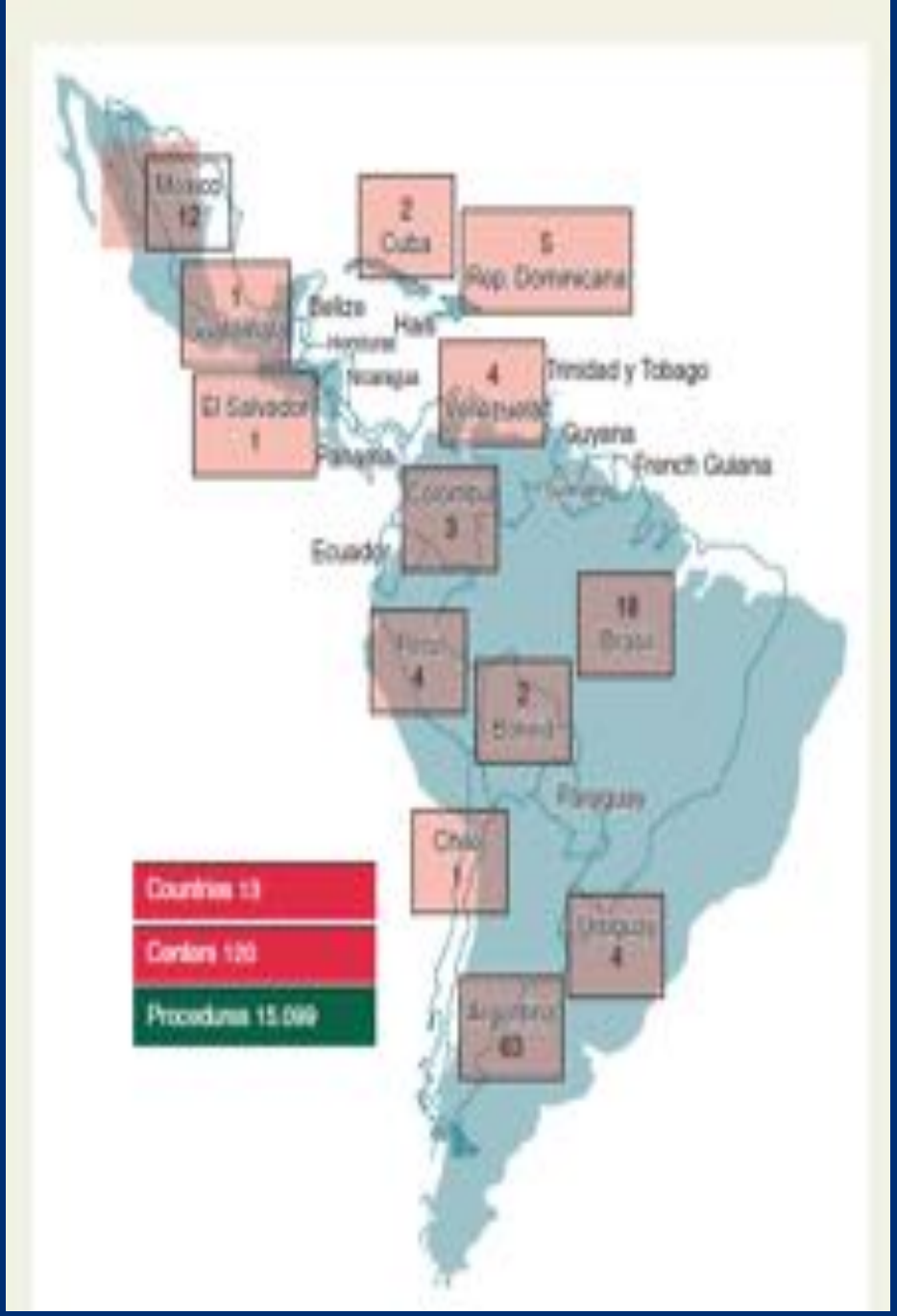
Europace
doi:10.1093/europace/euu322

CLINICAL RESEARCH

The first Latin American Catheter Ablation Registry

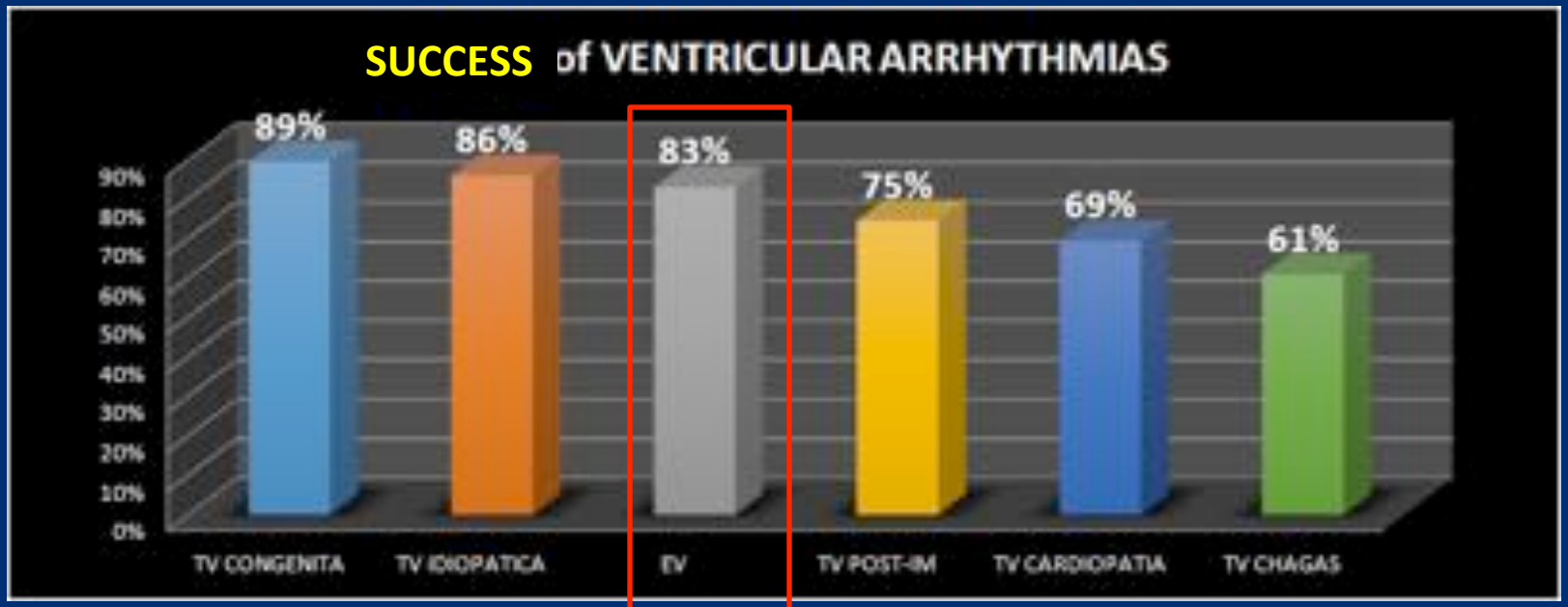
Roberto Keegan[1*], Luis Aguinaga[2], Guilherme Fenelon[3], William Uribe[4], Gerardo Rodriguez Diez[5], Mauricio Scanavacca[6], Manuel Patete[7], Ricardo Zegarra Carhuaz[8], Carlos Labadet[9], Claudio De Zuloaga[10], Domingo Pozzer[11], and Fernando Scazzuso[12] on behalf of the SOLAECE registry investigators[†]

FIRST LATIN AMERICAN CATHETER ABLATION REGISTRY



Keegan R, Aguinaga L, et al. Europace 2015

	PVC	%	IVT	%
Patients	589		264	
Procedures	**628**		**280**	
Right V/Left V	**440/138**	**76/24**	**163/105**	60/40



COMPLICATIONS: 3%

Keegan R, Aguinaga L, et al. Europace 2015

CONCLUSIONS

PVC ABLATION

- Generally the PVCs should not be treated with ablation.
- ……

PVC ABLATION

- Some groups of patients have high potential benefit with catheter ablation…..
  - PVC symptomatic, drug refractory.
  - PVC induced left ventricular dysfunction.
  - PVC worsened left ventricular dysfunction.
  - Improvement of response to CRT.
  - PVC that triggers VF
  - In patients meeting criteria for Primary Prevention indication ICD implantation and frequent PVCs

Thank you!!

Origin of Idiopathic VT/PVCs Vs. Idiopathic VF Trigger

Idiopathic VT/PVC Origin

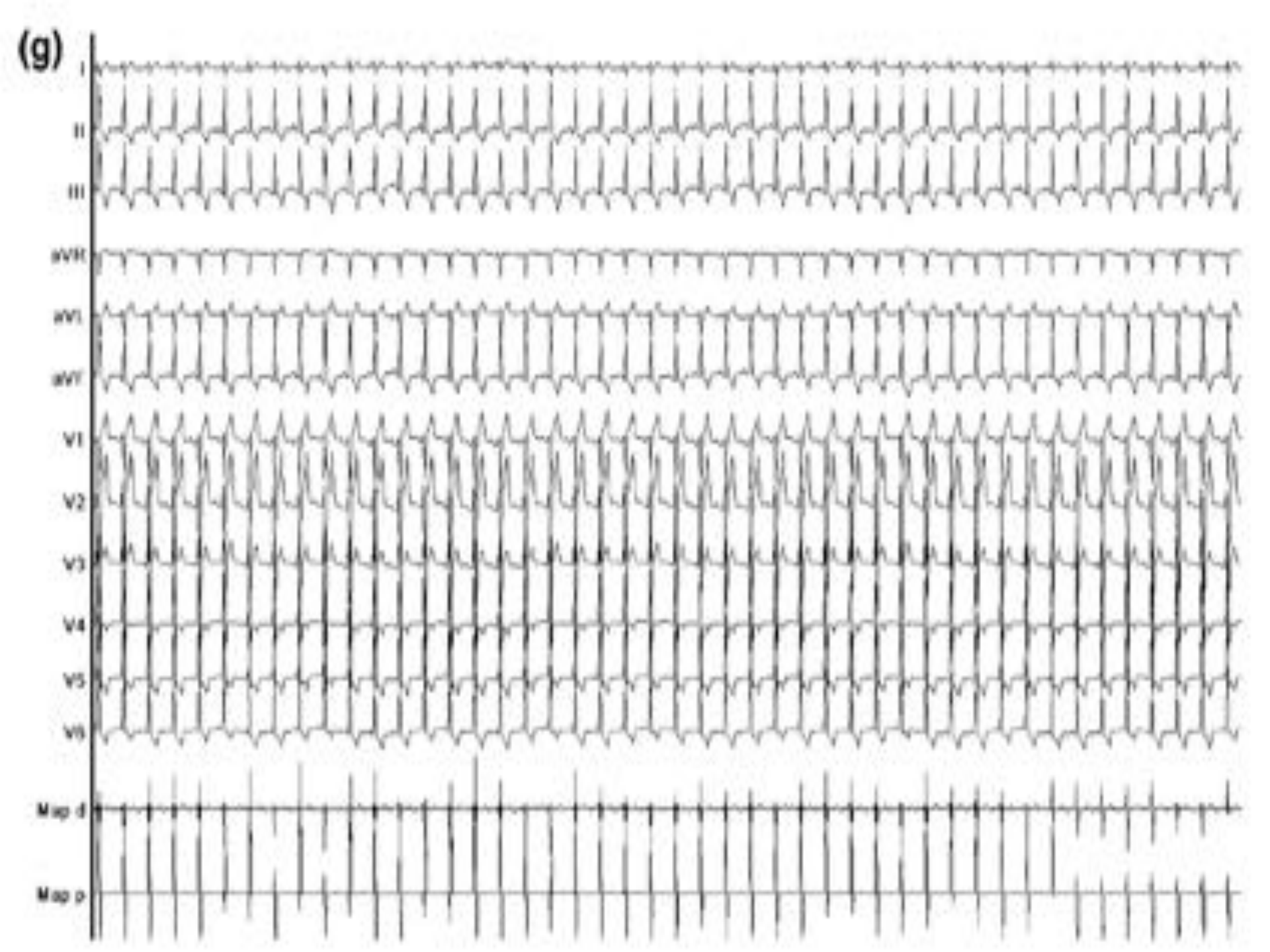
- RVOT - 296
- LVOT - 231
- LV Purkinje - 62
- **RV Pap Muscle/Mod Band -3**
- **LV Pap Muscle -51**
- Mitral Annulus - 49
- Tricuspid Annulus - 28

MB/Pap Muscle 7.5%

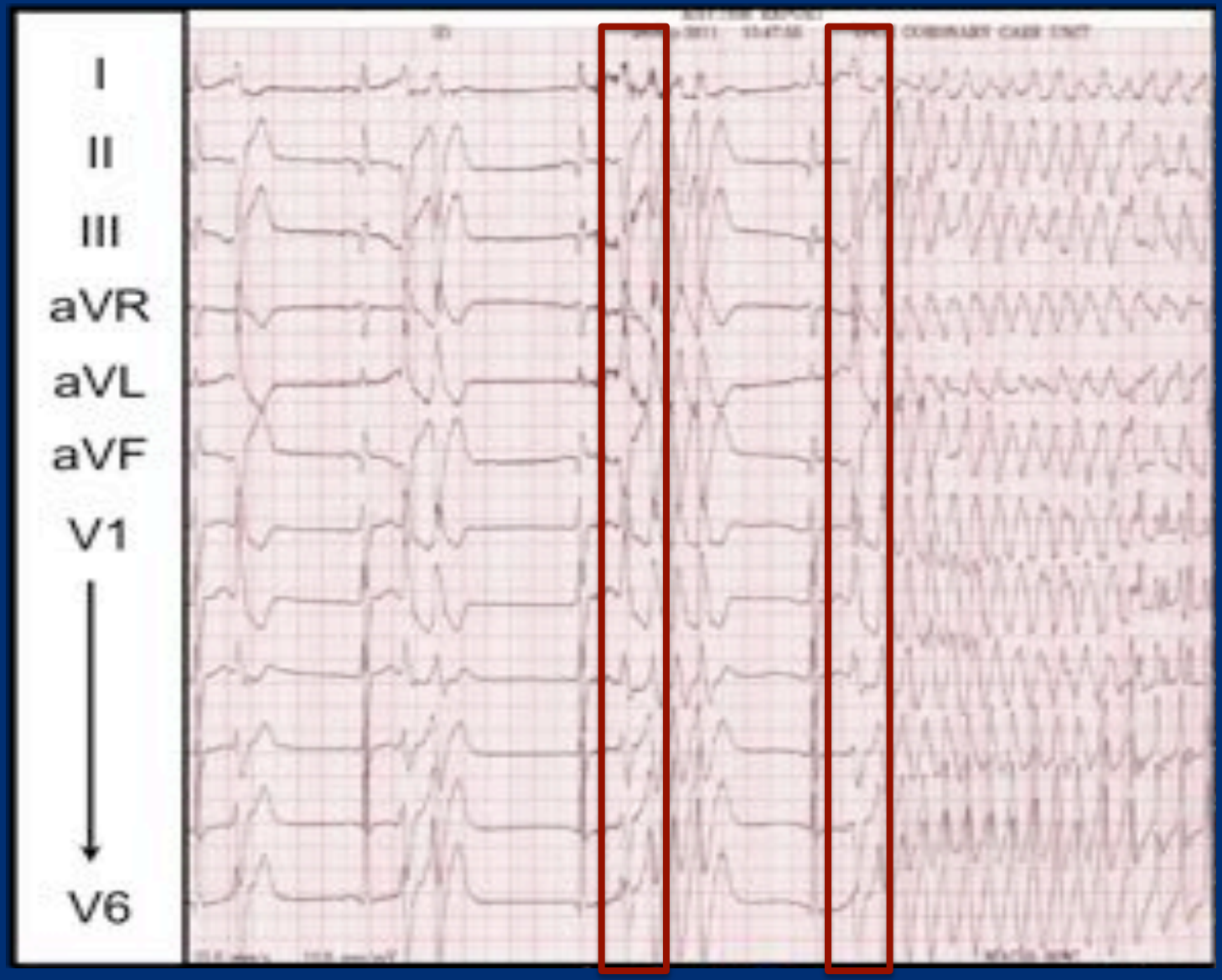
Idiopathic VF Triggers - 24

- RVOT - 4
- LVOT - 1
- LV Purkinje - 4
- **RV Pap Muscle/Mod Band - 9**
- **LV Pap Muscle - 3**
- Mitral Annulus - 1
- Tricuspid Annulus – 1
- RV Epi - 1

50%


(g)
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
Map d
Map p

LV Papillary Muscle Trigger for Idiopathic VTVF



GET - 12 Lead ECG

PVC morphology

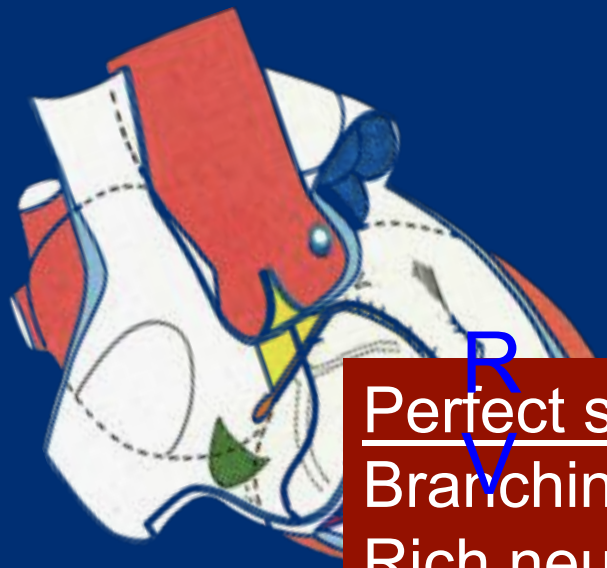
- RBBB – precordial transition V3-5
- qR in V1
- QRS >140ms

Van Herendael H et al Heart Rhthym 2014:11:566-73

Papillary Muscle /Moderator Band VF Triggers

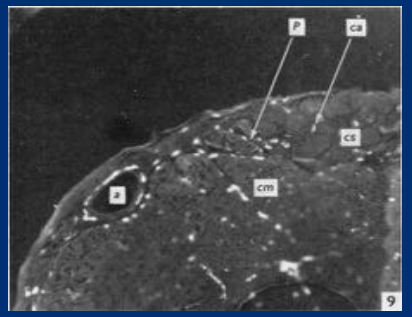
Anatomy

RBB and LBB- Purkinje system (traverses the moderator band on R) ends distally in RV Pap and LV Ant and Post Pap



LBB Tawara, 1906

Neural-Purkinje Association



Perfect storm:
Branching anatomy/Purkinje rich
Rich neural innervation

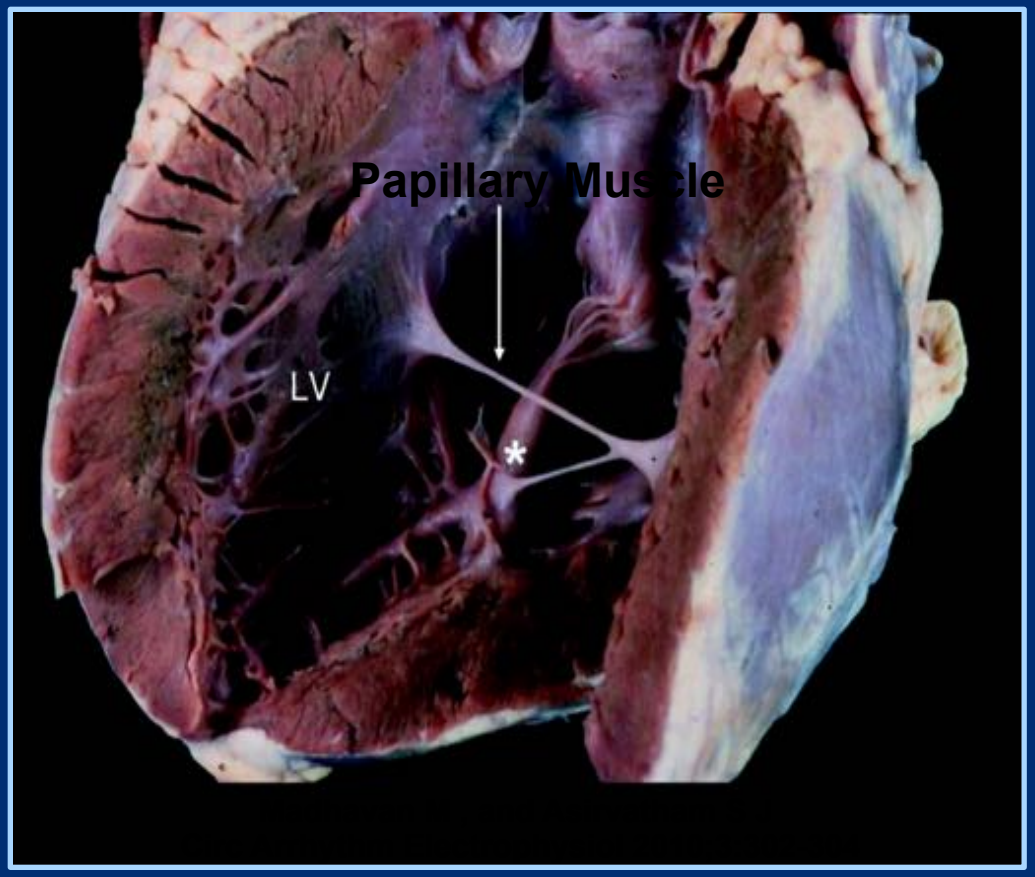
↓

Triggered activity - (EADs)
Inhomogeneity in refractoriness

J Cardiovasc Electrophysiol, Vol. 2

Modified from: The Heart and Coronary Arteries. McAlpine. 1972

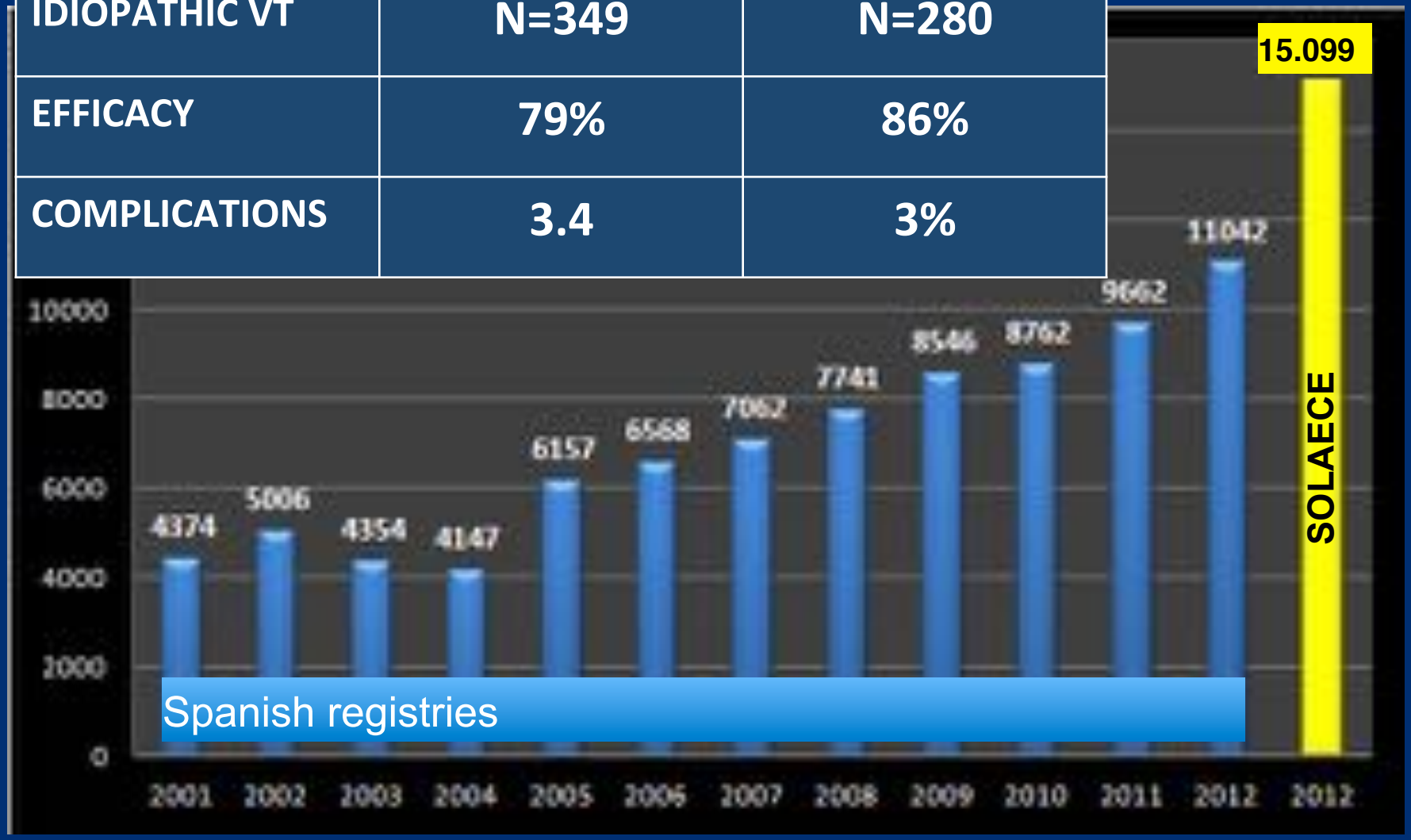
Why Papillary Muscle/Fascicular PVC?



- Mechanical irritation from MVP
  - Traction related
  - Endocardial friction lesions
- Likely focal in origin
- Papillary muscle PVC may originate from:
  - Myocardium
  - Adjacent conduction system

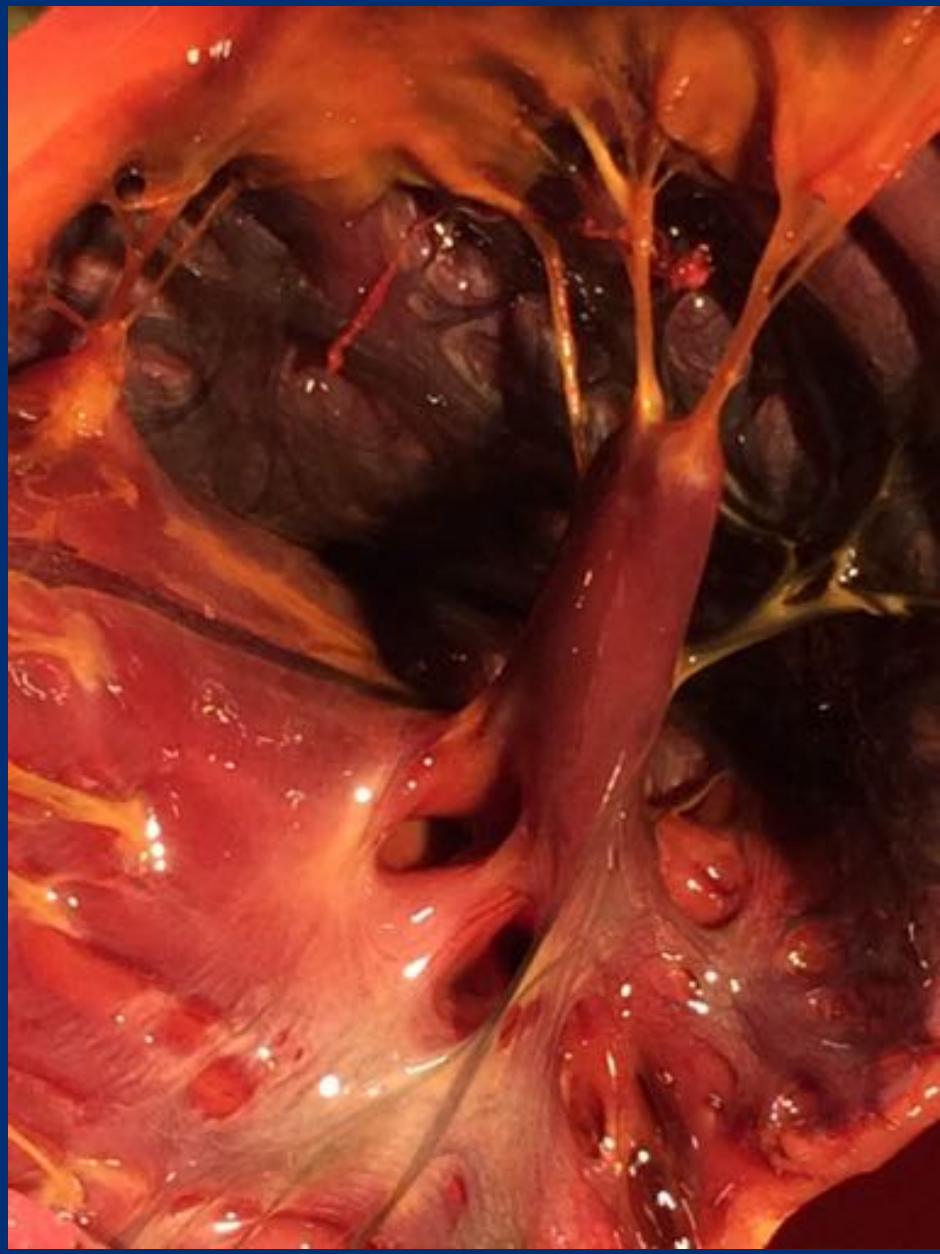
The association between fascicular PVCs and idiopathic VF is now well known

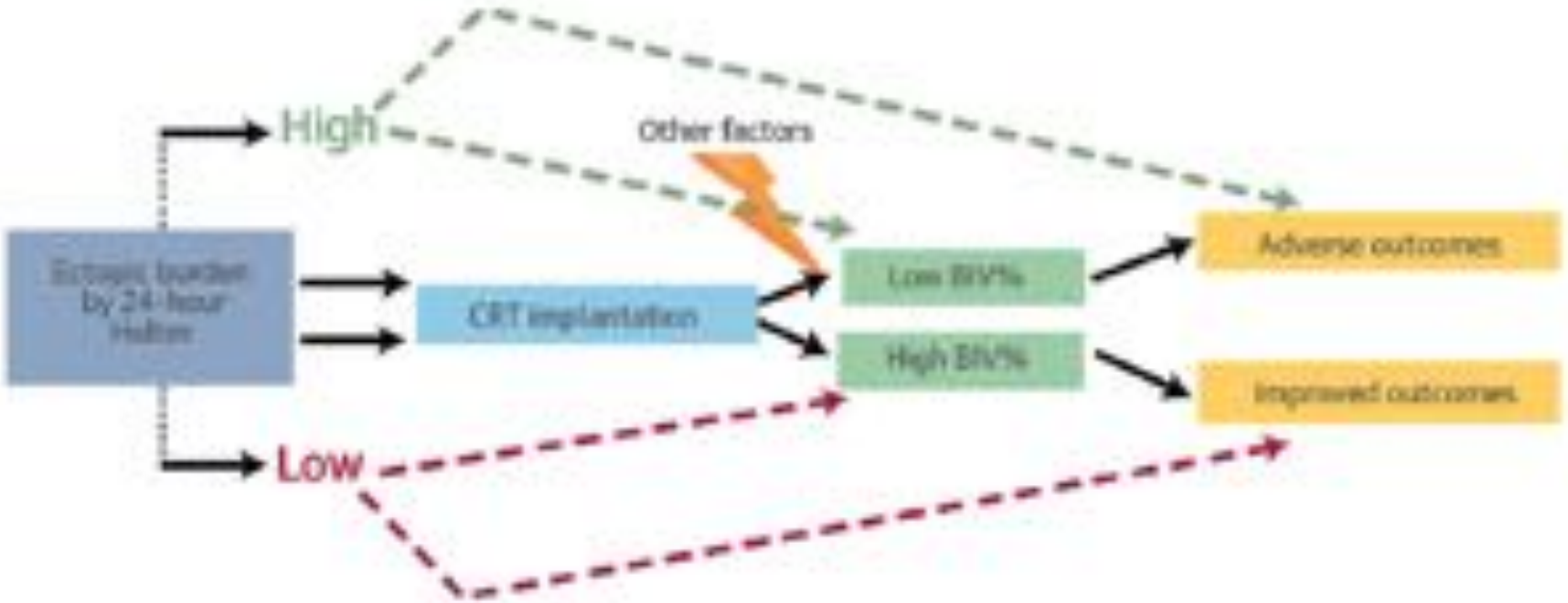
	XI SPANISH REGISTRY	I SOLAECE REGISTRY
IDIOPATHIC VT	N=349	N=280
EFFICACY	79%	86%
COMPLICATIONS	3.4	3%



- N= 27 pacientes con TRC
- TRC <97%
- Carga de EV > 5%
- No respondedores
- Refractarios a FAA
- Ablaciòn de EV

Rev Fed Arg Cardiol. In Press




High
Other factors
Ectopic burden by 24-hour Holter
CRT implantation
Low BiV%
High BiV%
Adverse outcomes
Improved outcomes
Low

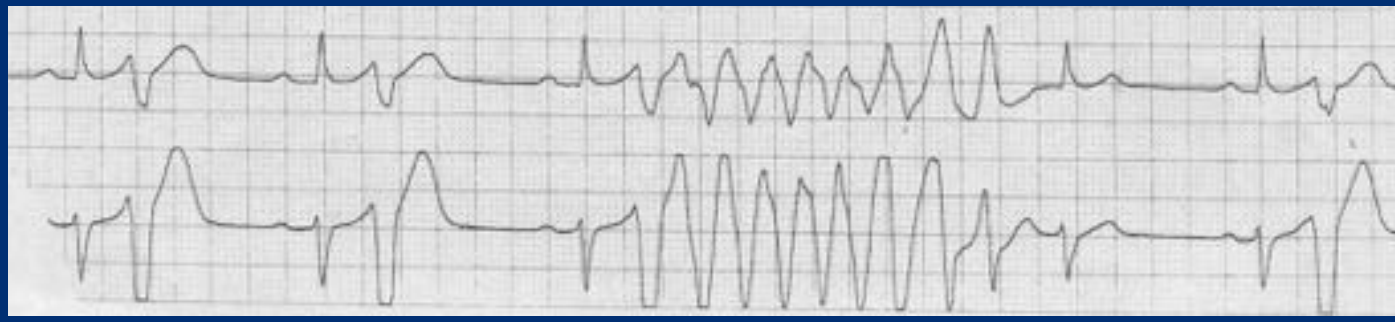
- Futuros estudios confirmarán estos datos y posiblemente ayuden a modificar las Guías.

- Alta carga de EV es una potencial causa de no respuesta a TRC
- Ablaciòn de EV en pacientes No-R a TRC mejora FEY, CF y biomarcadores.
- Una carga mayor al 11% està asociada con una mejor respuesta a TRC, FEY, CF y PNA.
- Los beneficios de ablacion de EV estàn directamente relacionados a un incremento del % de estimulaciòn biventricular

Variability in Triggering Event

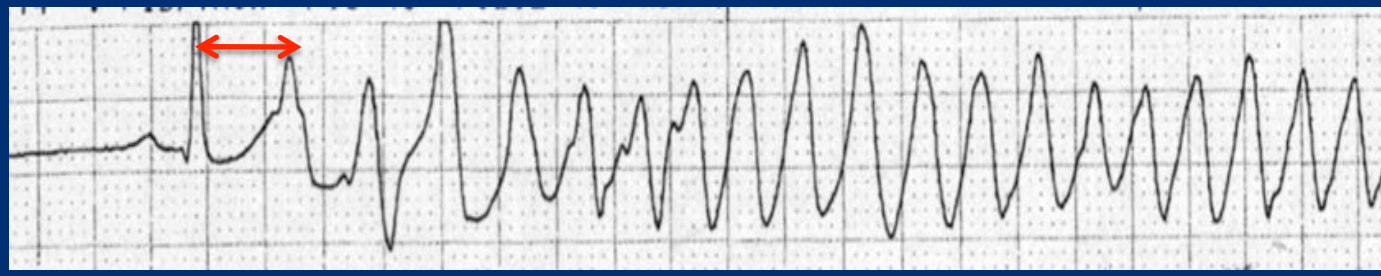
Isolated VF trigger

PVC VF trigger during bigeminy



Short coupling Interval= No VF

Shorter coupling Interval= VF



7-Qué nos dicen las Guías ?

Table 2 Indications for catheter ablation of ventricular tachycardia

Patients with structural heart disease (including prior MI, dilated cardiomyopathy, ARVC/D)

Catheter ablation of VT is recommended

1. for symptomatic sustained monomorphic VT (SMVT), including VT terminated by an ICD, that recurs despite antiarrhythmic drug therapy or when antiarrhythmic drugs are not tolerated or not desired;*
2. for control of incessant SMVT or VT storm that is not due to a transient reversible cause;
3. for patients with frequent PVCs, NSVTs, or VT that is presumed to cause ventricular dysfunction;
4. for bundle branch reentrant or interfascicular VTs;
5. for recurrent sustained polymorphic VT and VF that is refractory to antiarrhythmic therapy when there is a suspected trigger that can be targeted for ablation.

Catheter ablation should be considered

1. in patients who have one or more episodes of SMVT despite therapy with one of more Class I or III antiarrhythmic drugs;*
2. in patients with recurrent SMVT due to prior MI who have LV ejection fraction >0.30 and expectation for 1 year of survival, and is an acceptable alternative to amiodarone therapy;*
3. in patients with haemodynamically tolerated SMVT due to prior MI who have reasonably preserved LV ejection fraction (>0.35) even if they have not failed antiarrhythmic drug therapy.*

Patients without structural heart disease

Catheter ablation of VT is recommended for patients with idiopathic VT

1. for monomorphic VT that is causing severe symptoms.
2. for monomorphic VT when antiarrhythmic drugs are not effective, not tolerated, or not desired.
3. for recurrent sustained polymorphic VT and VF (electrical storm) that is refractory to antiarrhythmic therapy when there is a suspected trigger that can be targeted for ablation.

VT catheter ablation is contra-indicated

1. in the presence of a mobile ventricular thrombus (epicardial ablation may be considered);
2. for asymptomatic PVCs and/or NSVT that are not suspected of causing or contributing to ventricular dysfunction;
3. for VT due to transient, reversible causes, such as acute ischaemia, hyperkalaemia, or drug-induced torsade de pointes.

TRAINING

TECHNOLOGY

TEAM

TIME

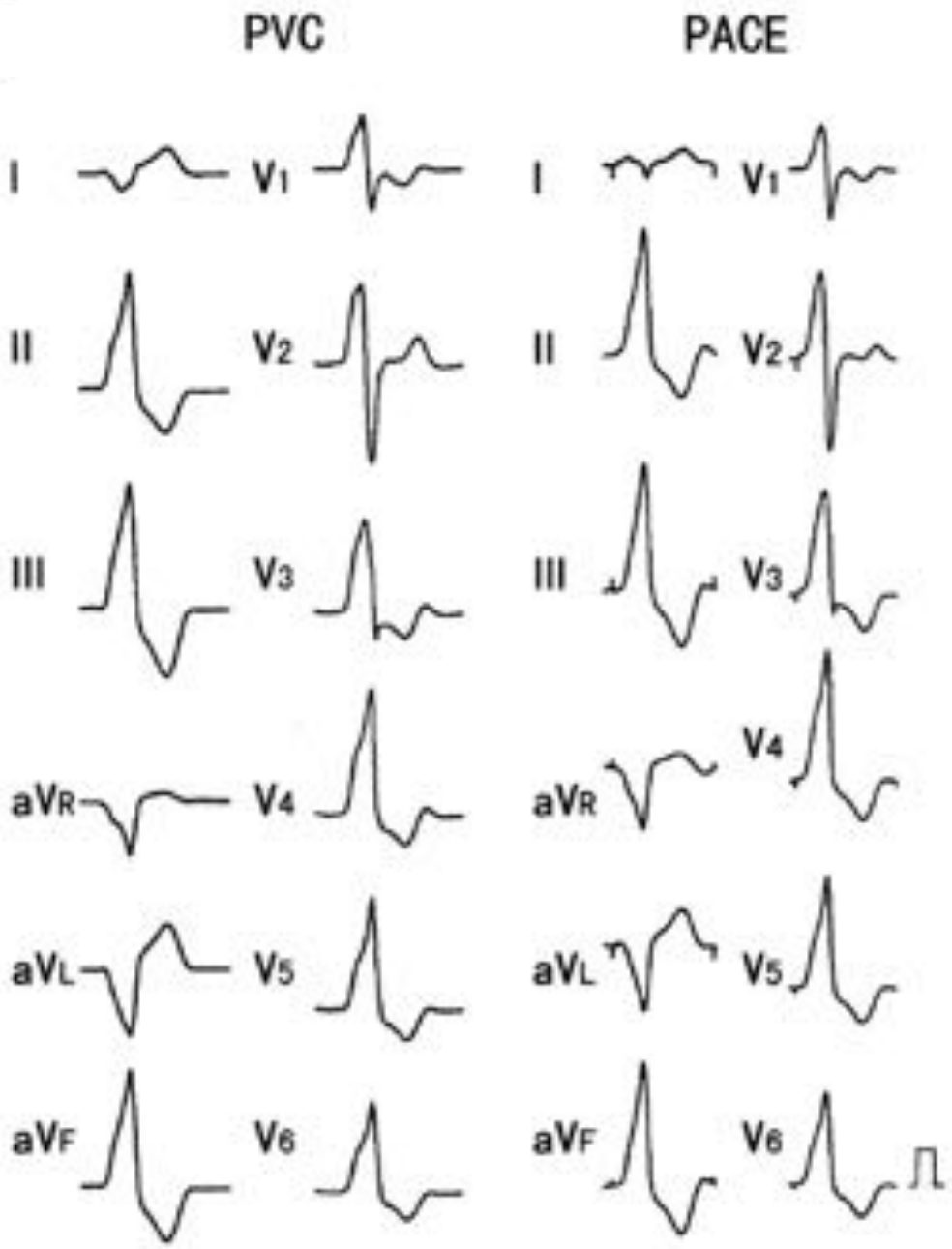
Catheter ablationofventricular fibrillation: Importance of leftventricularoutflow tract and papillary muscle triggers

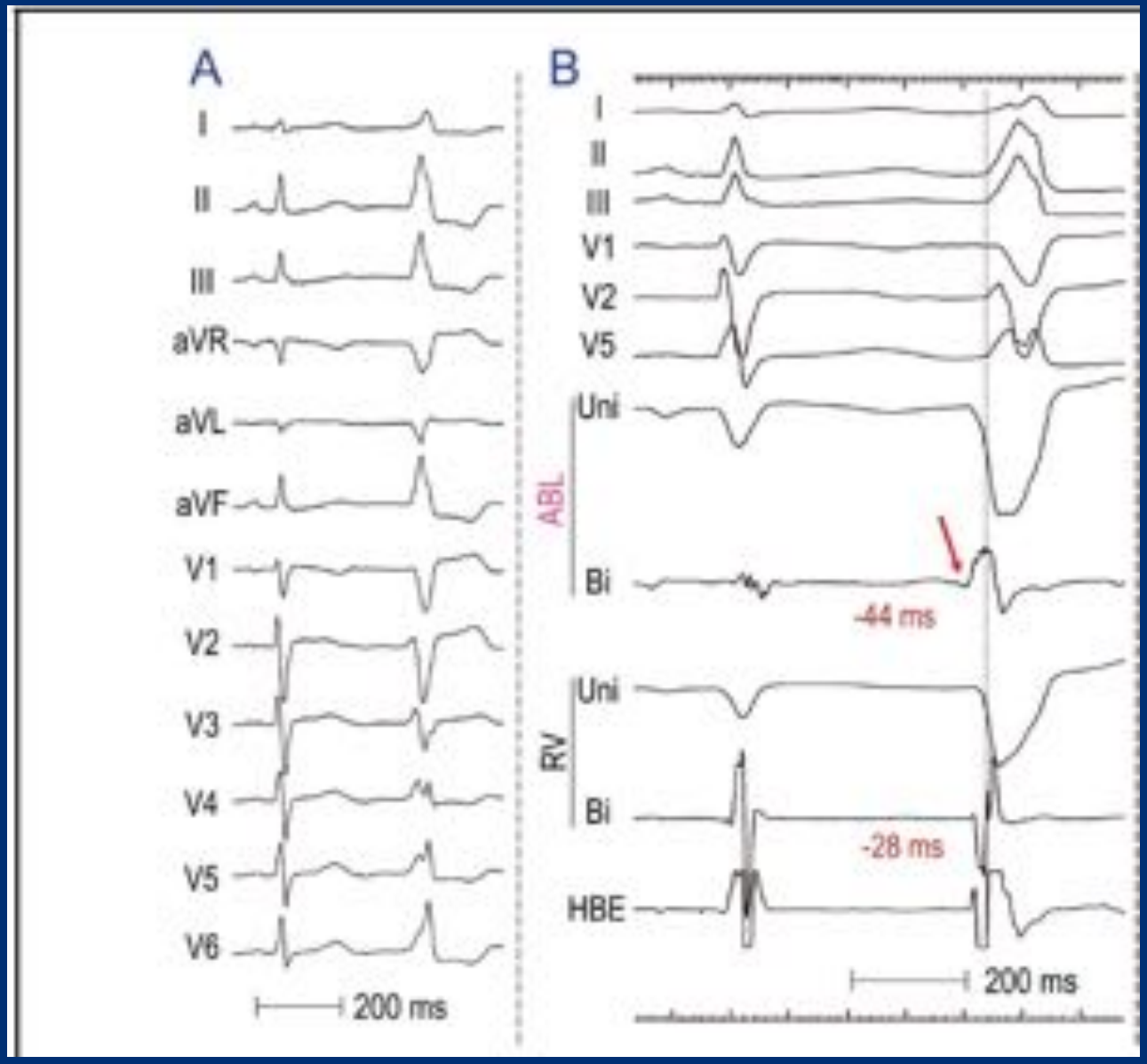
- CONCLUSION Catheter ablation of VPD-triggered VF/PMVT
- Left ventricular outflow tract and papillary muscles are common and are previously unrecognized sites of origin of these triggers in patients with and without structural heart disease.

Marchlinsky F. Heart Rhythm Journal 2014

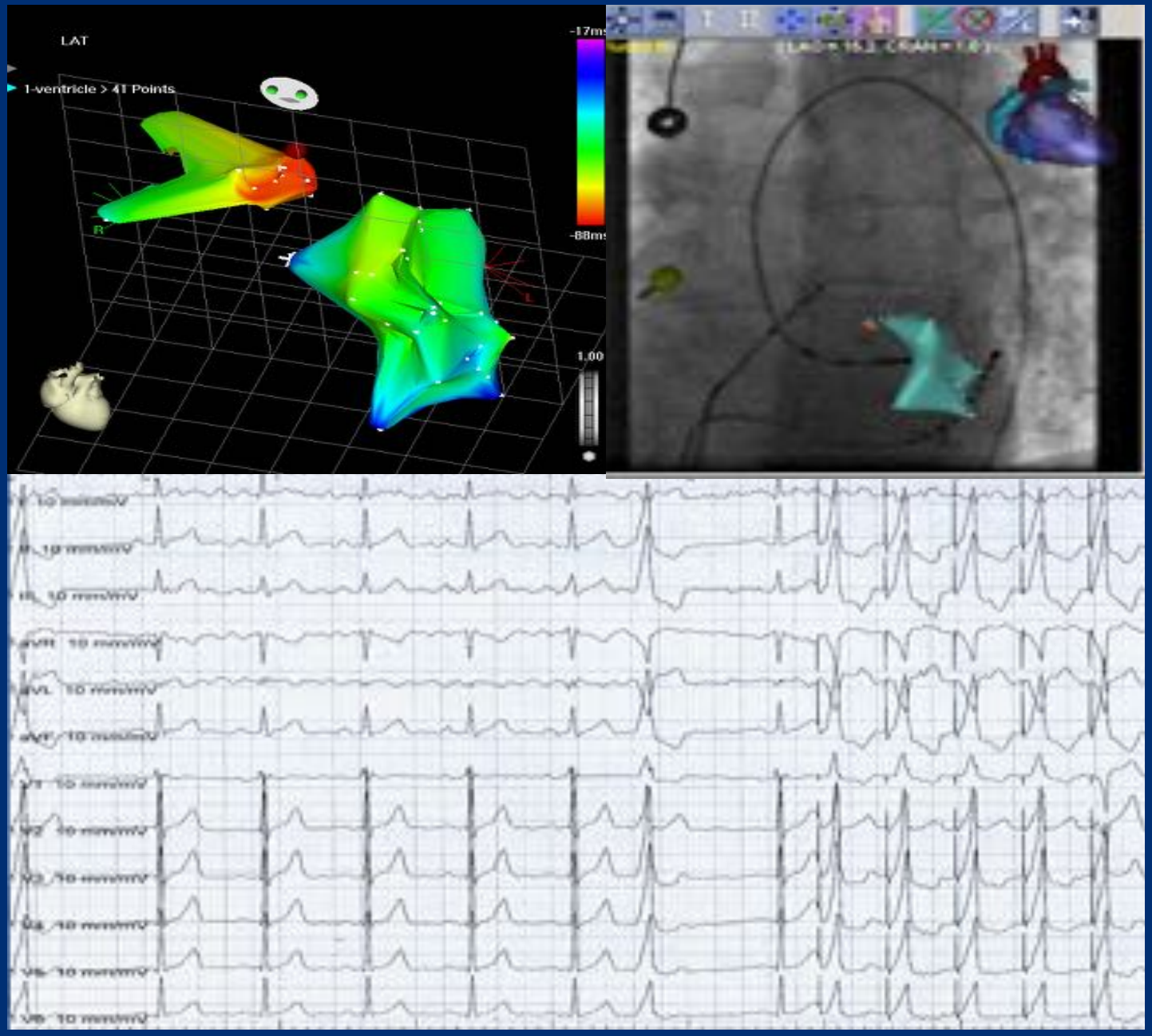
- EV EMPEORA DISF VENT
- EV CAUSA DISF VENTR
- SOLAECE REGISTRO
- DEBEN ABLACION : NO
- ALGUNAS: SI
- EN QUE CASOS…..
- GUIAS…
- TABLA CARDIOP DEL ARTICULO JACC

5-Còmo las ablacionamos??

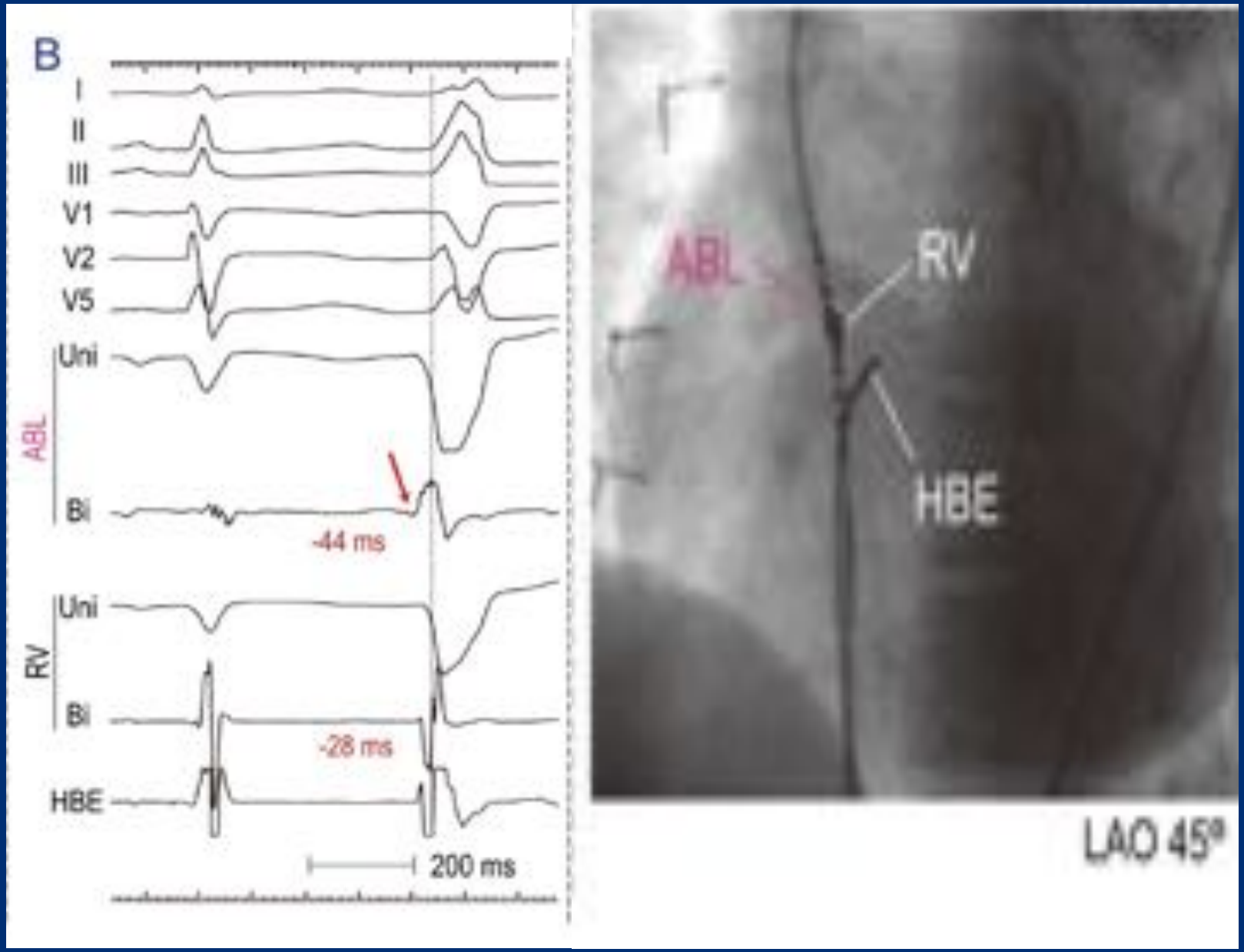

PVC
PACE
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

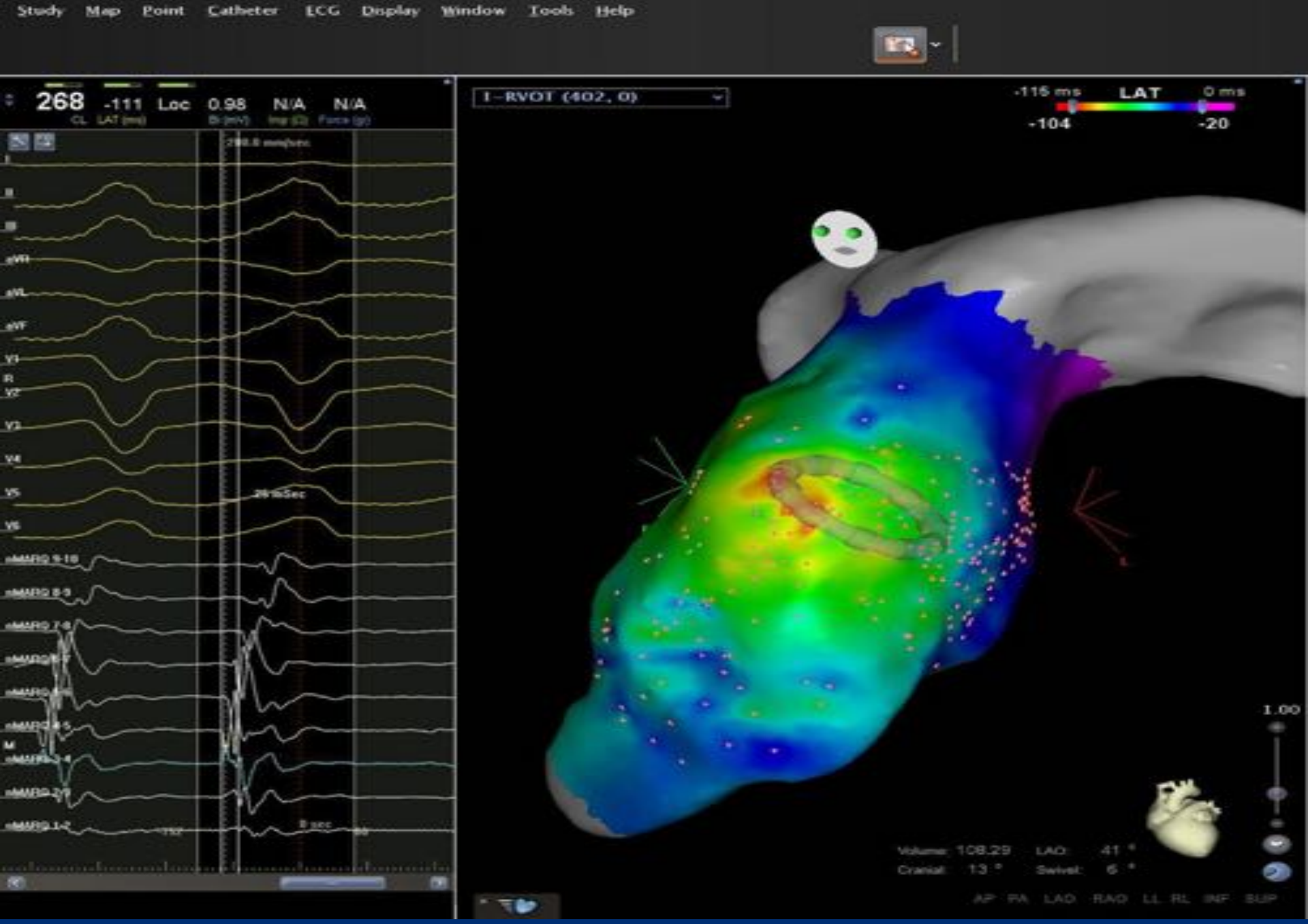

A
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
200 ms
B
I
II
III
V1
V2
V5
ABL
Uni
Bi
-44 ms
RV
Uni
Bi
-28 ms
HBE
200 ms

LEFT CORONARY SINUS



Brugada J, Aguinaga L. Ablación de Arritmias. I Edicion. Buenos Aires 2010


B
I
II
III
V1
V2
V5
Uni
ABL
Bi
-44 ms
Uni
RV
Bi
-28 ms
HBE
200 ms
ABL
RV
HBE
LAO 45°



Tuan J. Heart Rhythm 2014

4-Què es importante conocer para indicar ablaciòn a un paciente con EV…..?

A-CLÌNICO

EV

Presentaciòn Clìnica

-Asymptomatic
-Palpitations

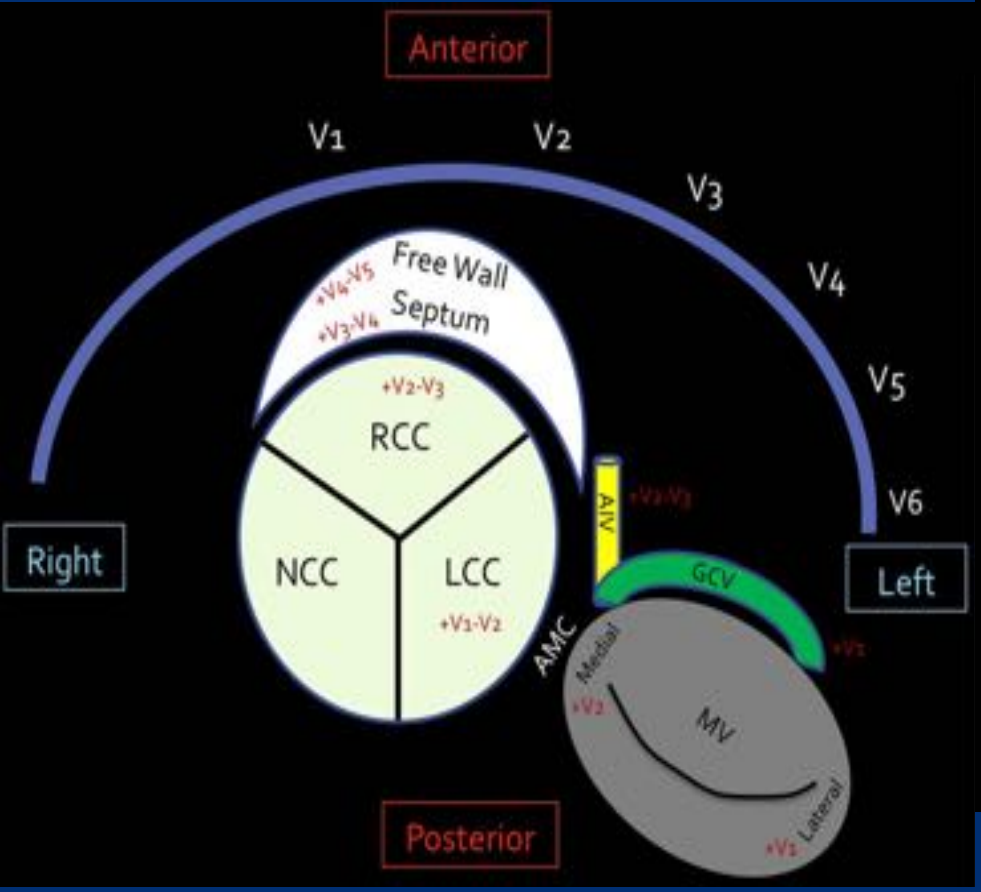
-PVC

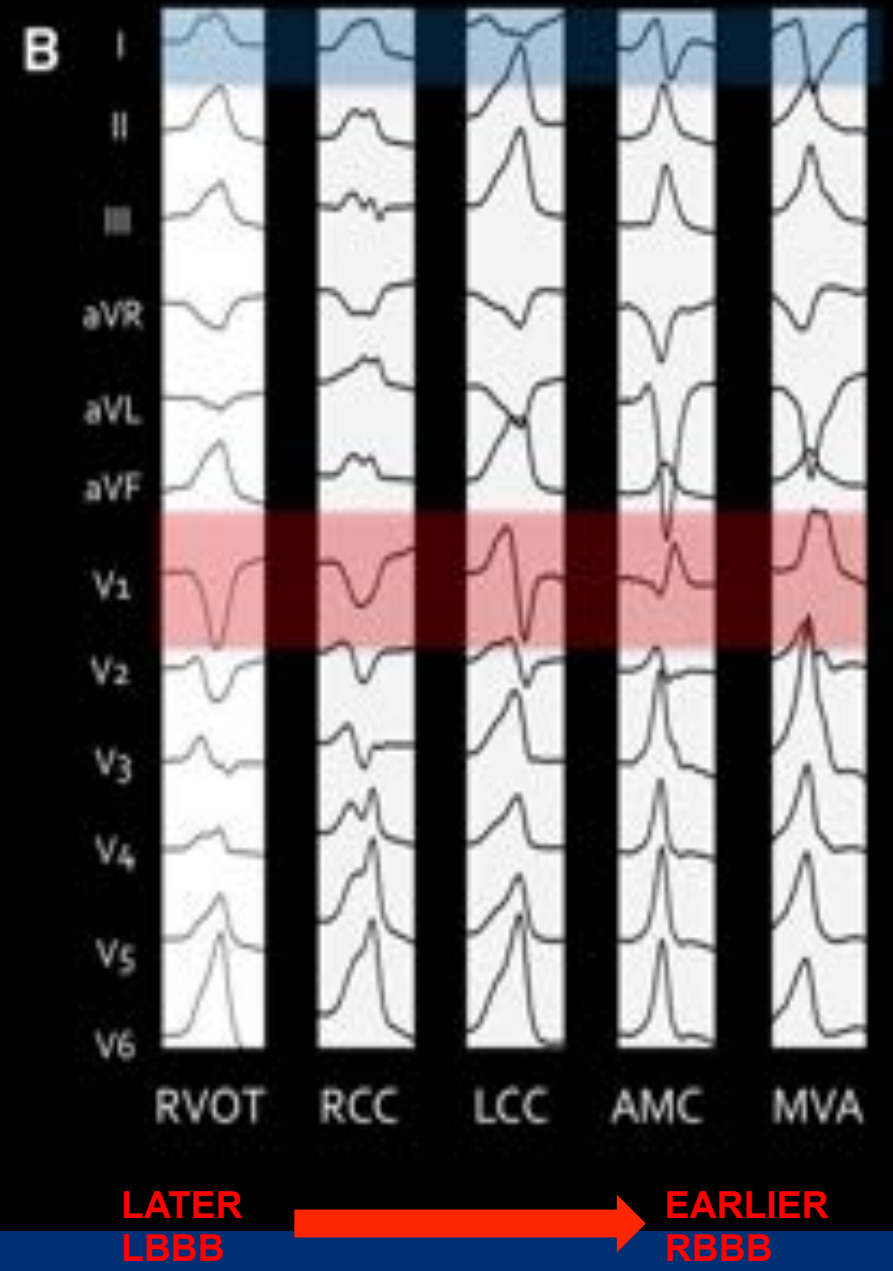
-TVNS

-ECO
-RMN
-TAC

Disfunciòn ventricular inducida por arritmia

B-ECG





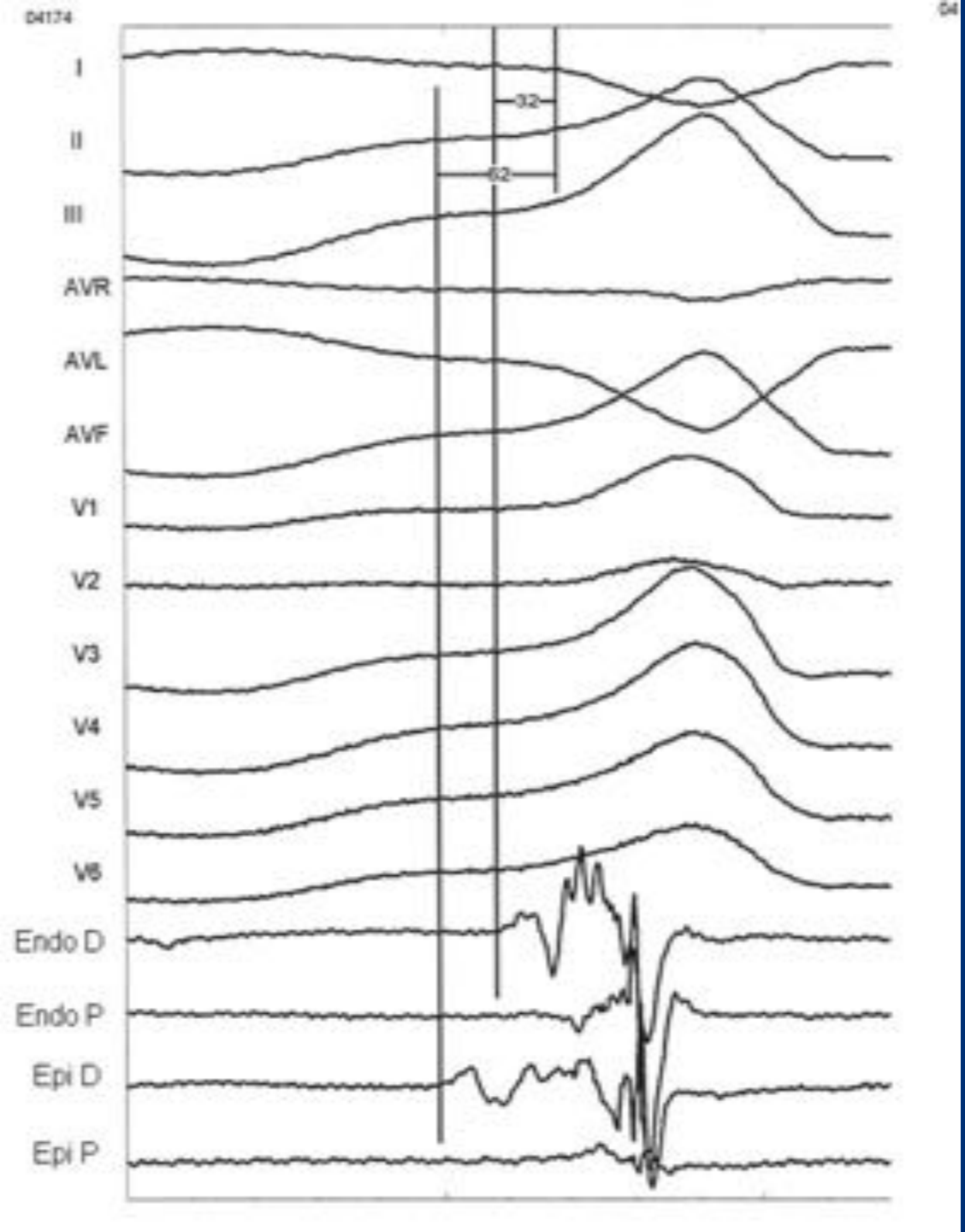
Adapted from.Hutchinson M, Garcìa F. J Cardiovasc Electrofisiol 2013

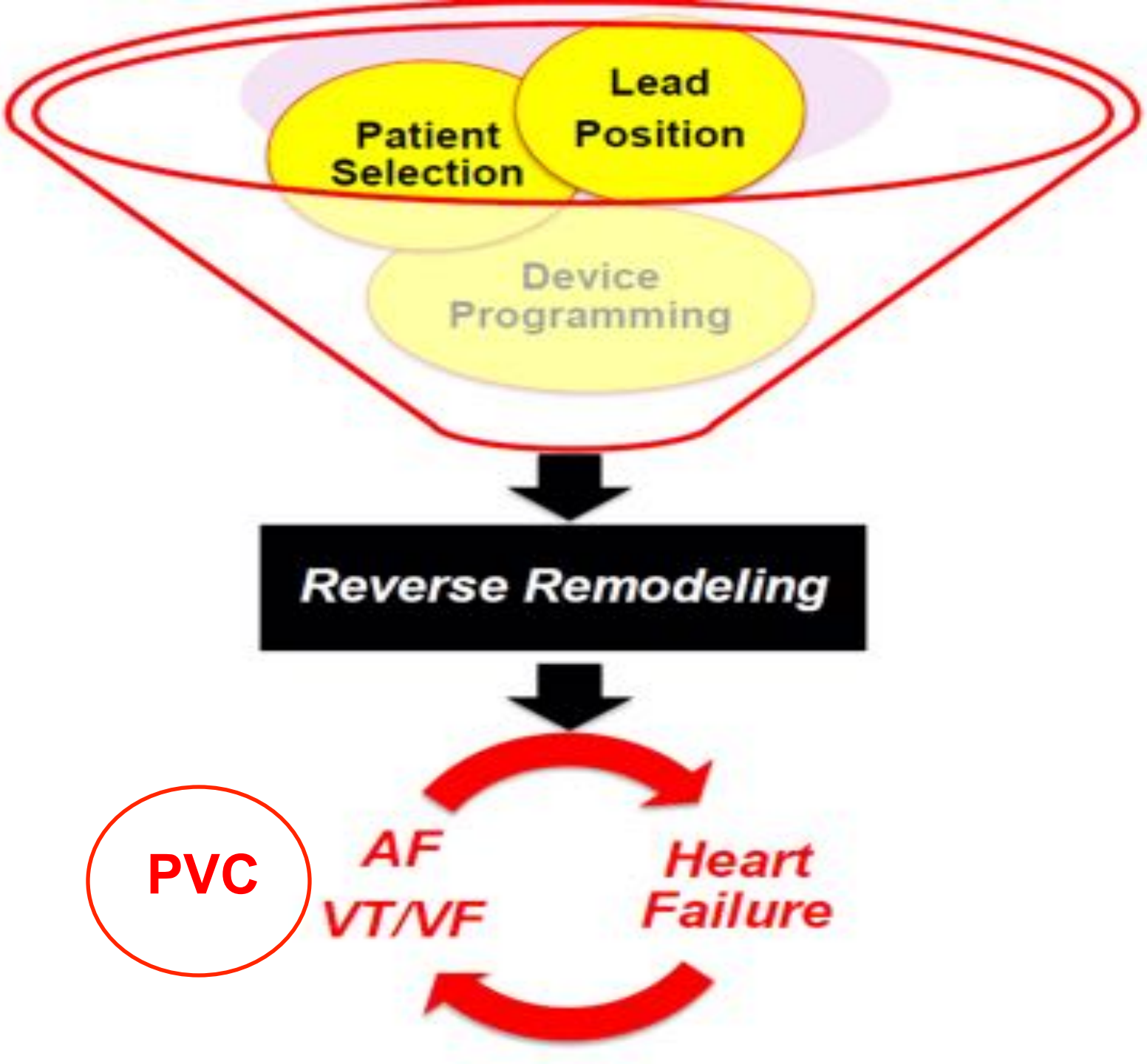
Pacientes con Cardiopatía

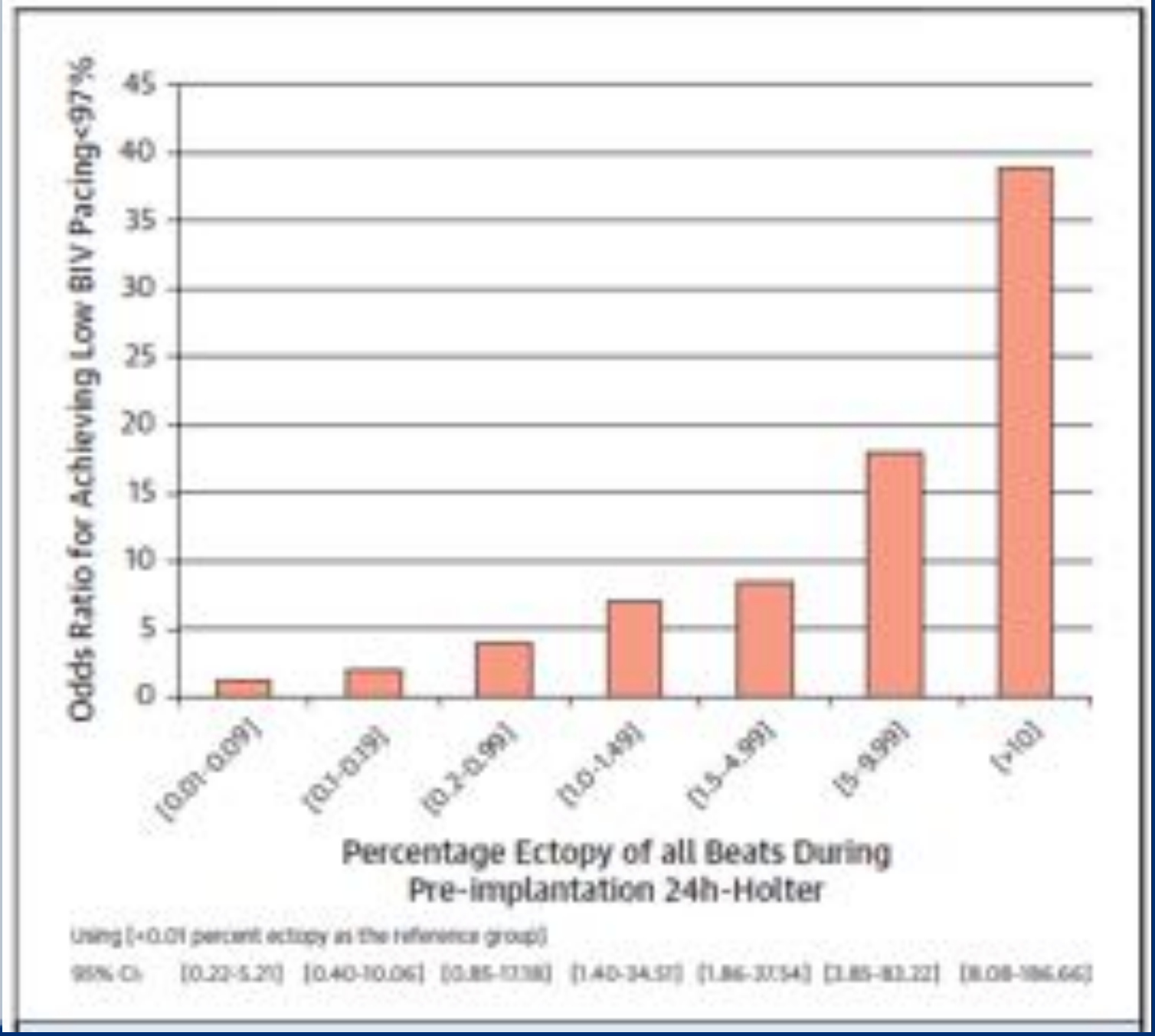
- 27 pacientes (34%) tenían cardiopatía estructural.
- 17 enf. Coronaria
- 4 miocardio no compactado
- 2 valvular
- 1 hipertensiva
- 1 periparto
- 2 displasia

Paciente index

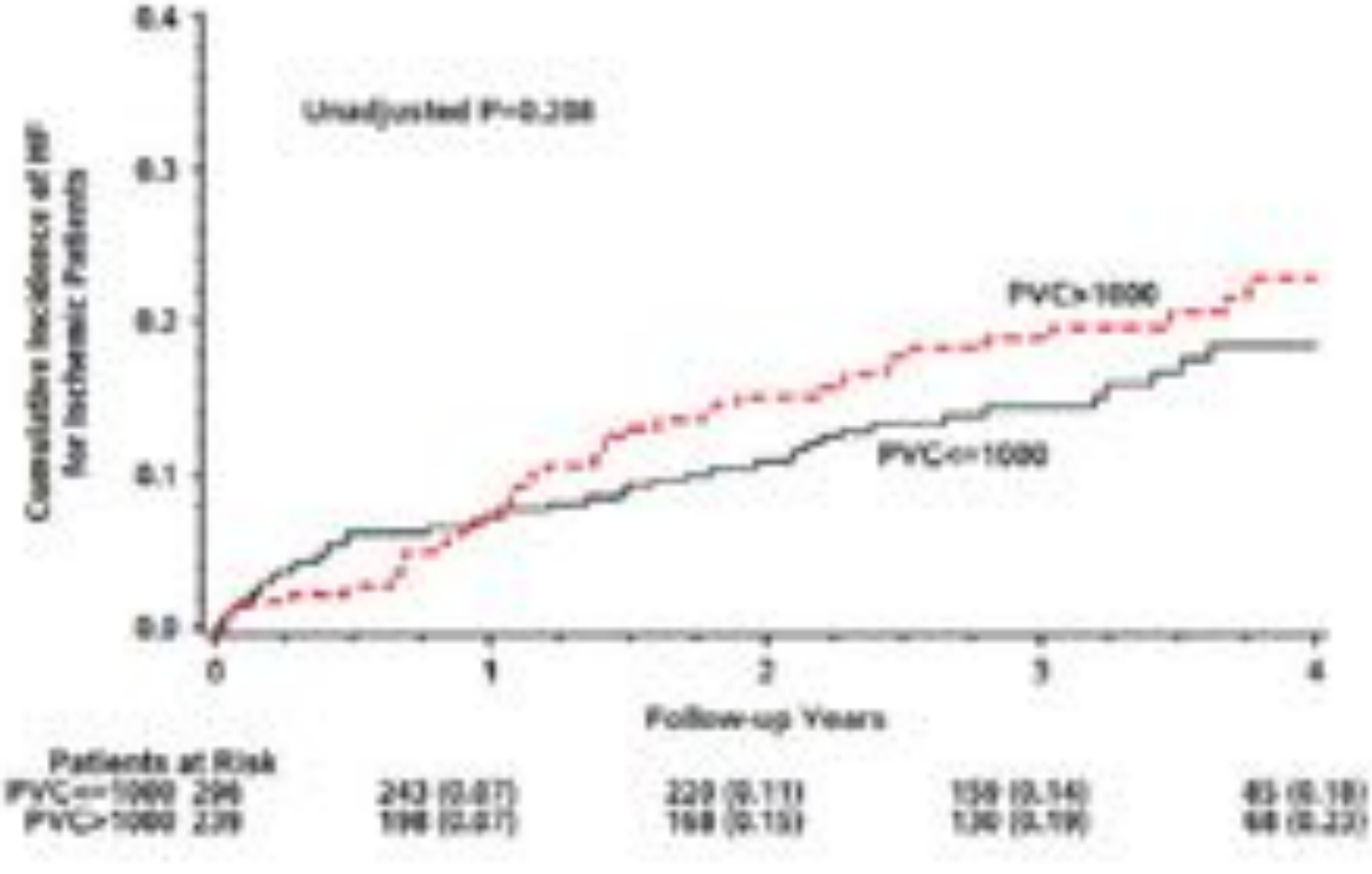
- Mujer
- 64años
- MCDI
- FEY 27%
- IC CFIII
- BCRI
- 2009 TRC-CDI
- No respondedora
- EV Holter: 22,321……..FAA (-) ARF


04174
I
II
III
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6
Endo D
Endo P
Epi D
Epi P
32
62

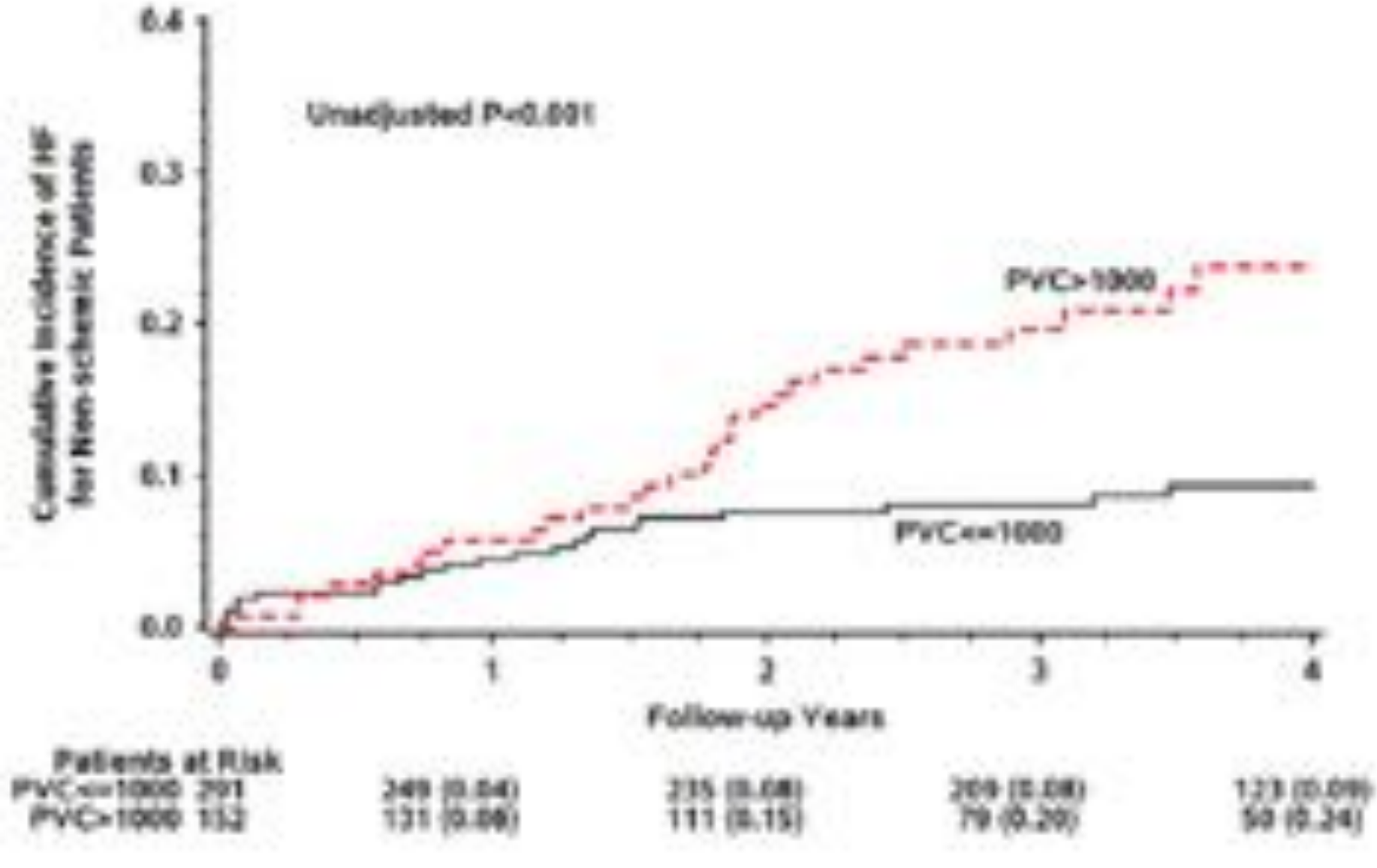

Lead Position
Patient Selection
Device Programming
Reverse Remodeling
PVC
AF
VT/VF
Heart Failure



Ruwald M. J Am Coll of Cardiol 2014



Mittal S. J Cardiovasc Electrophysiol 2014



Mittal S. J Cardiovasc Electrophysiol 2014

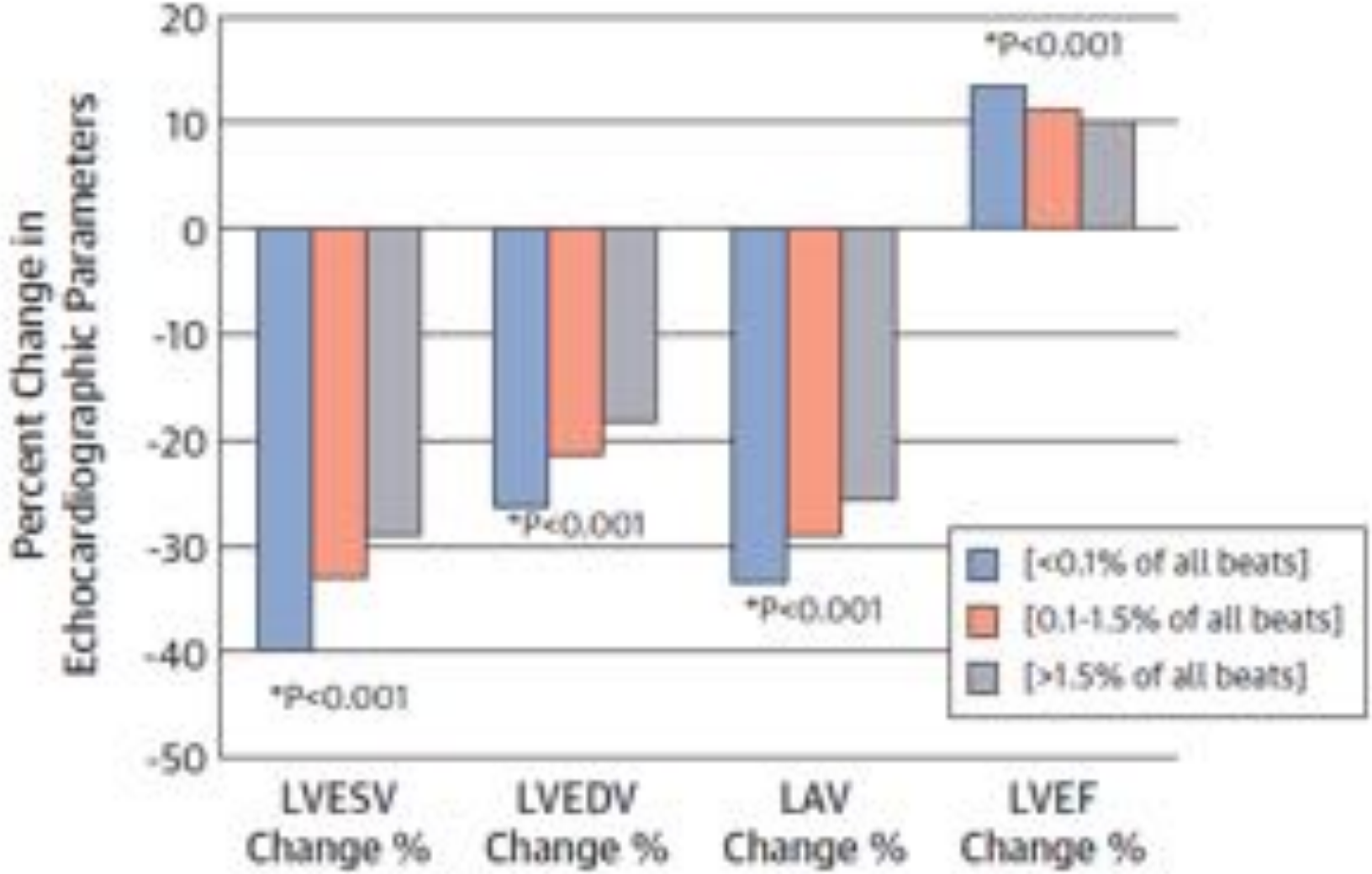
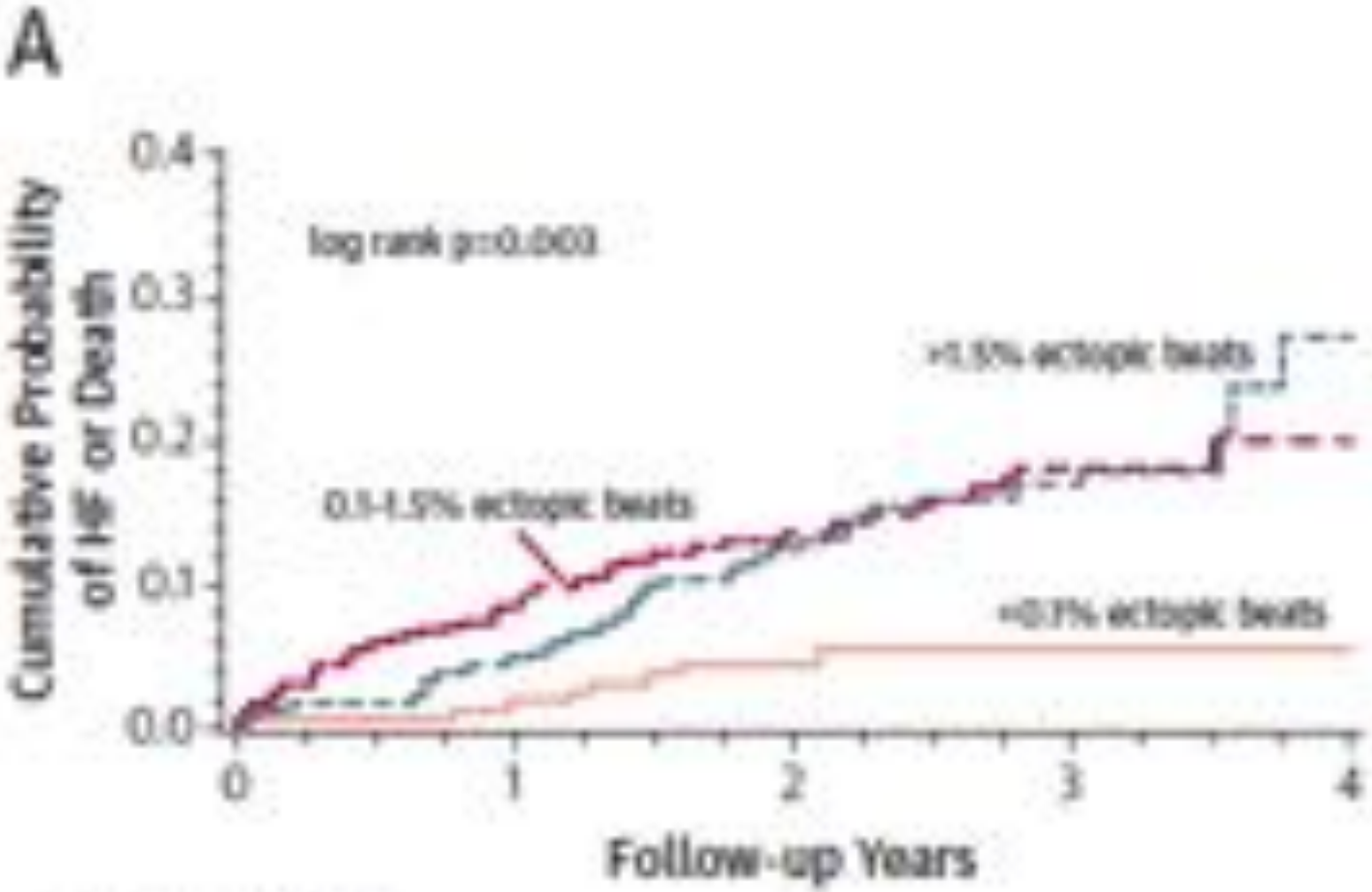


FIGURE 4 Echocardiography-Measured Changes at 1-Year Follow-Up by Ectopic Burden During Pre-Implantation 24-h Holter Monitoring in Cardiac Resynchronization Therapy Patients

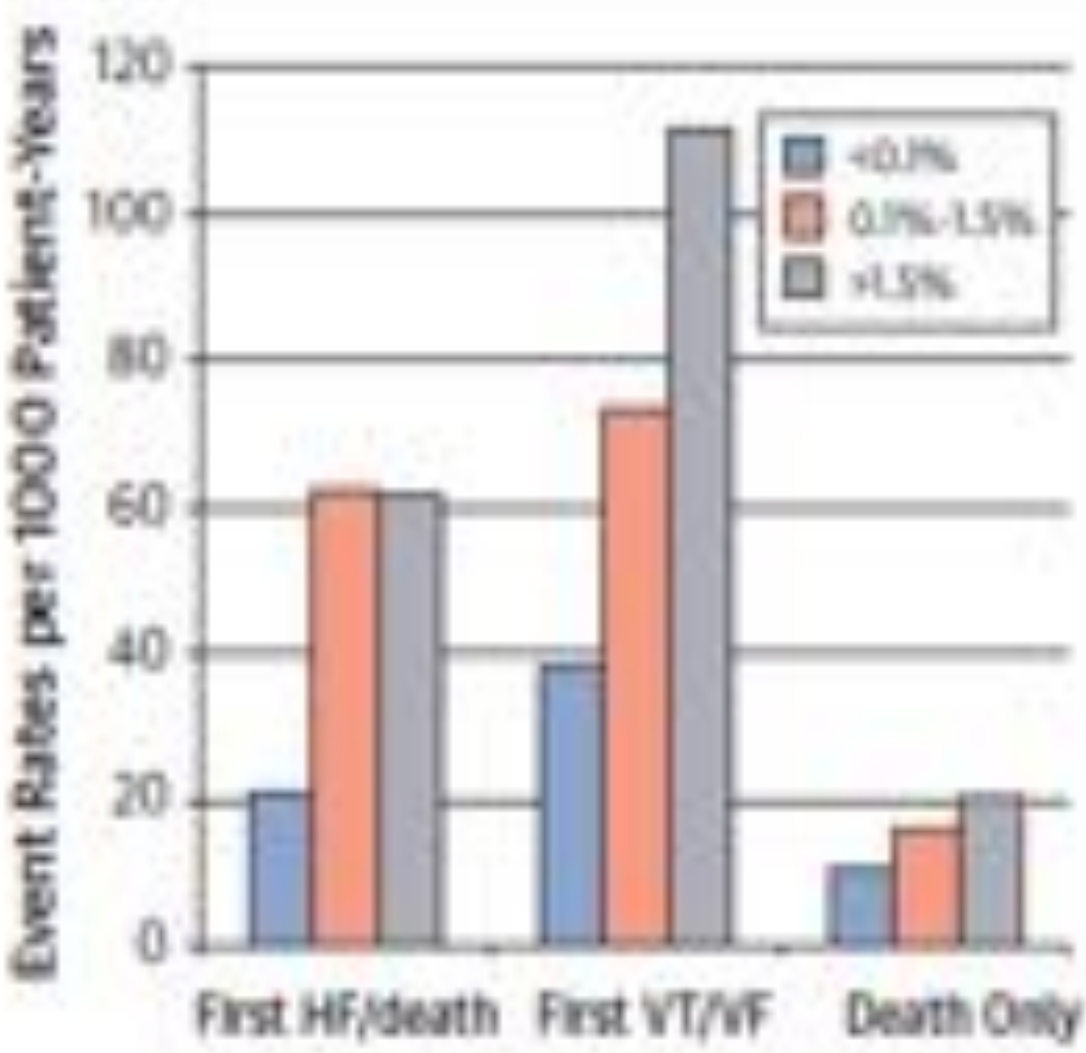


Patients at Risk

160	156 (0.02)	106 (0.05)	41 (0.05)	12 (0.05)
321	291 (0.08)	202 (0.14)	93 (0.18)	24 (0.20)
320	302 (0.05)	192 (0.12)	93 (0.17)	16 (0.27)

Ruwald M. J Am Coll of Cardiol 2014

C



Ruwald M. J Am Coll of Cardiol 2014

12 leads overview