Multiple premature ventricular contractions favouring heart failure in candidates to CRT: where do we start from?

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Background

Premature ventricular contractions (PVCs) are frequently found in patients both with and without structural disease.

The recommended treatment for PVCs has been evolving over the years.

The level of importance relegated to the presence of PVCs has also been a moving target

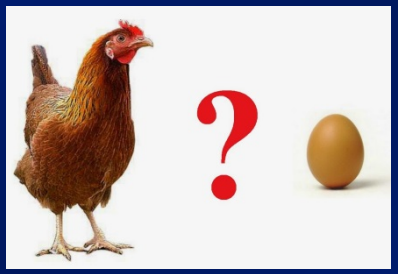
→ In the past, PVC only a negative prognostic factors after MI → moving to PVC-induced CMP

Vicious circle

HF

PVC

PVC and HF: who come first ?



PVCs usually precede cardiomyopathy

In the absence of underlying cardiac disease,

in the absence of coronary artery disease

1) PVCs >20,000 per day;

2) one or two primary PVC morphologies;

3) origin in RVOT, LVOT, or fascicular;

Provided that preserved myocardial thickness and absence of scar on echocardiogram are documented

Cardiomyopathy: how many PVCs are needed?

Impact of ventricular ectopic burden in a premature ventricular contraction–induced cardiomyopathy animal model

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(Heart Rhythm 2016;13:755–761)

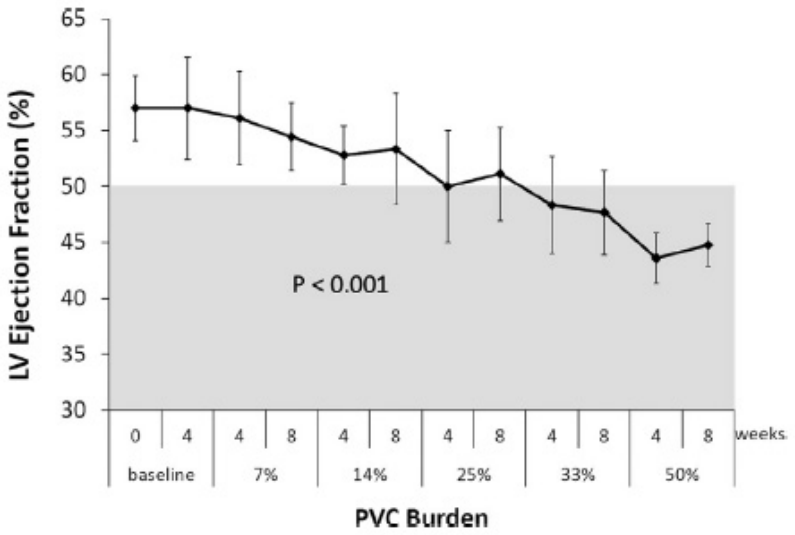

Figure 1 Progression of LV ejection fraction after 4 and 8 weeks of a progressive incremental PVC burden starting from 0% (baseline) to 7%, 14%, 24%, 33%, and 50%. *P* values were calculated using repeated-measures 1-way analysis of variance. LV = left ventricular; PVC = premature ventricular contraction.

Sort of threshold effect

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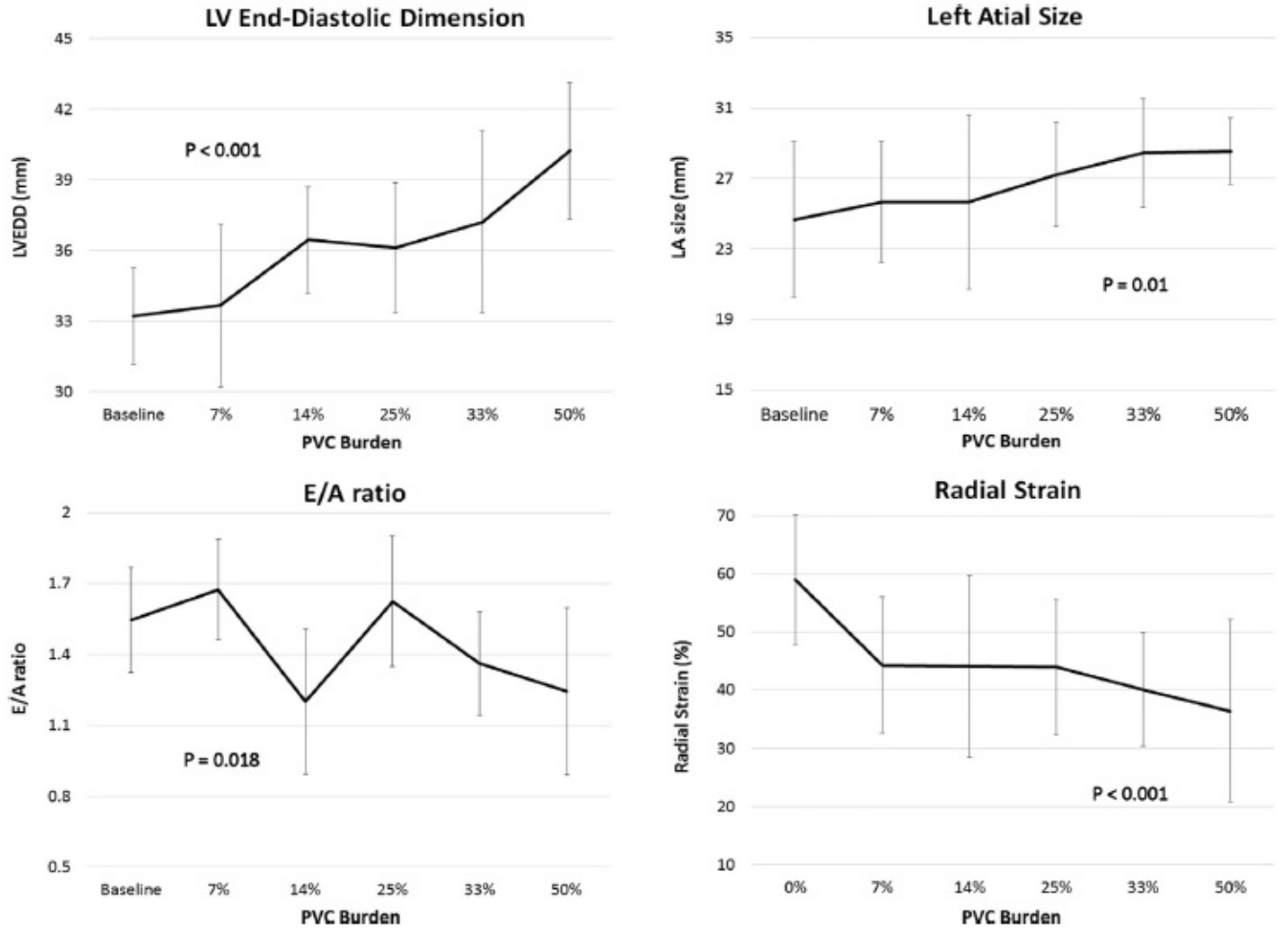

Figure 2 Estimated means of LVEDD, LA size, E/A ratio, and radial strain that showed a significant change between PVC burden levels (0%, 7%, 14%, 25%, 33%, and 50%). *P* values were calculated using repeated-measures 1-way analysis of variance. Details are given in Table 2. LA = left atrial; LV = left ventricular; LVEDD = left ventricular end-diastolic dimension; PVC = premature ventricular contraction.

25% 33% : minimum burden to induce CM

50% burden : 100 % CM

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Yet, a high PVCs burden is not solely sufficinet to induced CM …

Predictors of PVC- induced CM

WIDER PVC QRS duration (epicardial ?)

NON OUTFLOW TRACT site of origin

~~PVC coupling interval~~

Mechanism of PVC- induced CM

→ ~~Tachicardio~~ induced CM ?:
normal average rate !

→ ~~PVCs trigger~~ a remodeling process →
structural abnormalities

no fibrosis on animal studies !

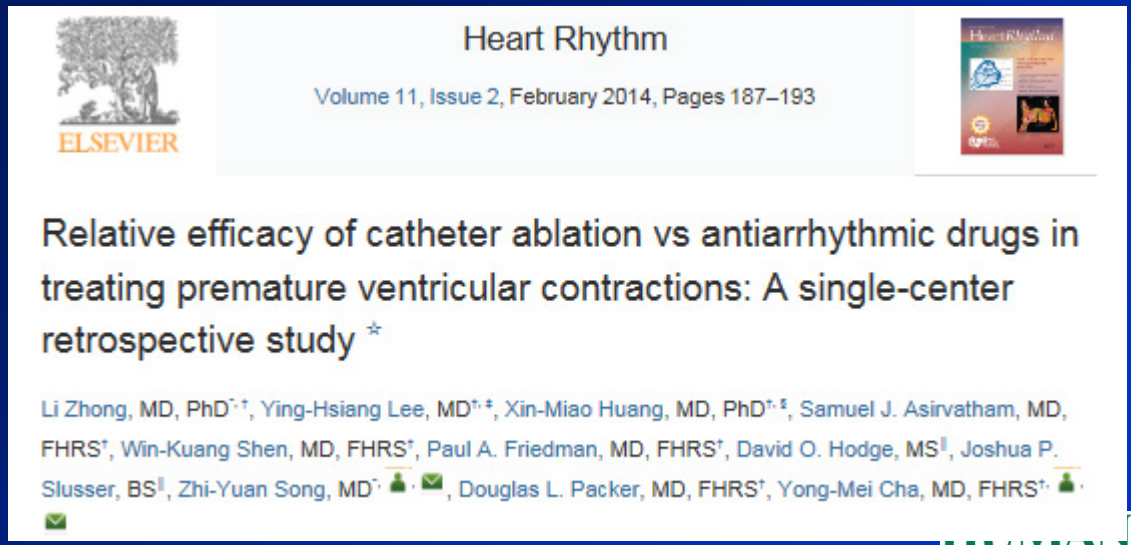
→ Dyssynchronous and ineffective
mechanical ventricular contraction:

Which therapy ?

→ AADs Class II (betablockers)

Class III (sotalol, amiodarone)

→ RF ablation



Heart Rhythm

Volume 11, Issue 2, February 2014, Pages 187–193

Relative efficacy of catheter ablation vs antiarrhythmic drugs in treating premature ventricular contractions: A single-center retrospective study ☆

Li Zhong, MD, PhD[*,†], Ying-Hsiang Lee, MD[†,‡], Xin-Miao Huang, MD, PhD[†,§], Samuel J. Asirvatham, MD, FHRS[†], Win-Kuang Shen, MD, FHRS[†], Paul A. Friedman, MD, FHRS[†], David O. Hodge, MS[‖], Joshua P. Slusser, BS[‖], Zhi-Yuan Song, MD[*], Douglas L. Packer, MD, FHRS[†], Yong-Mei Cha, MD, FHRS[†]

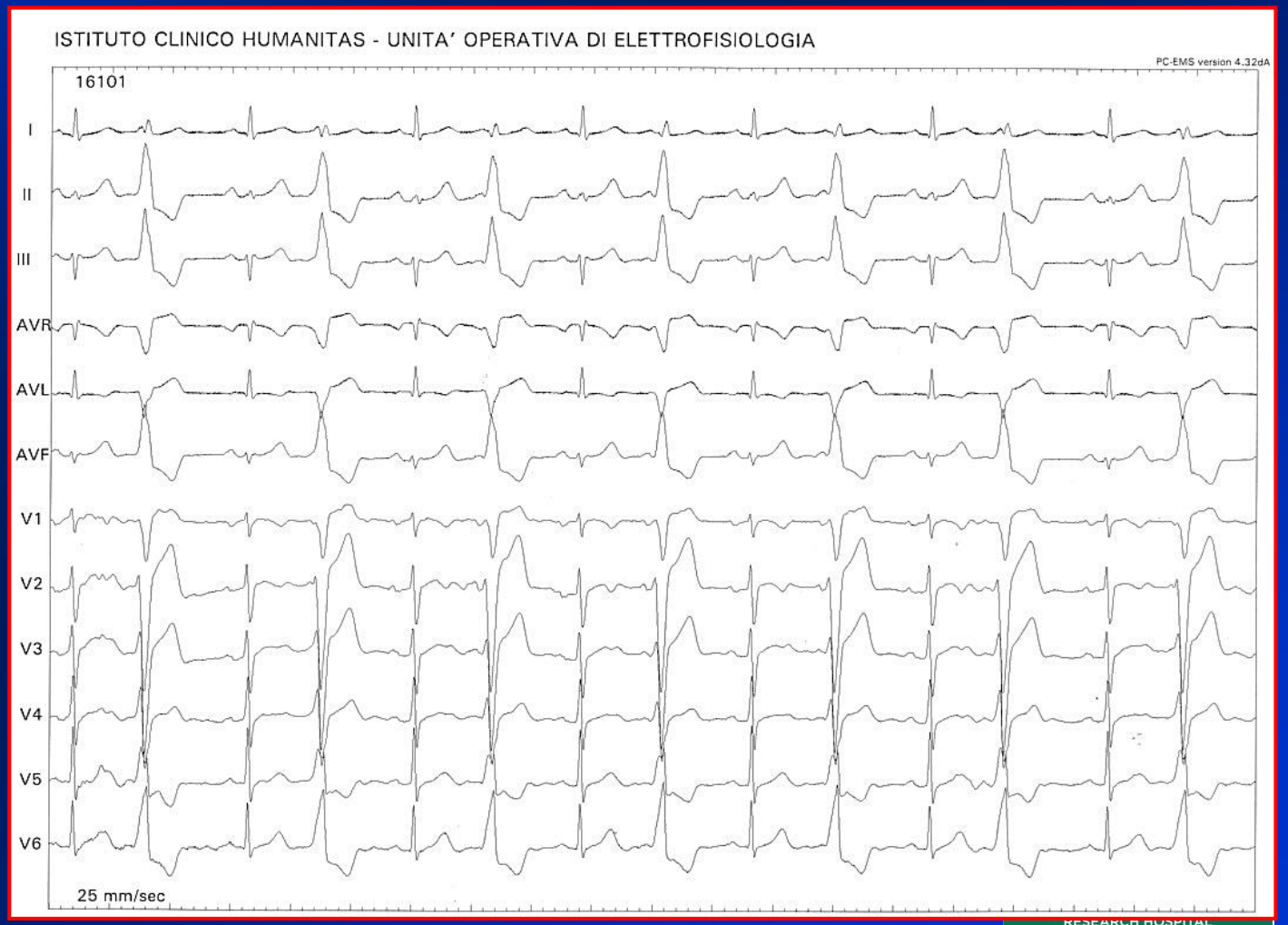
1) No structural heart disease

PVCs from RVOT

Male

47 yrs old

LVEF 45%

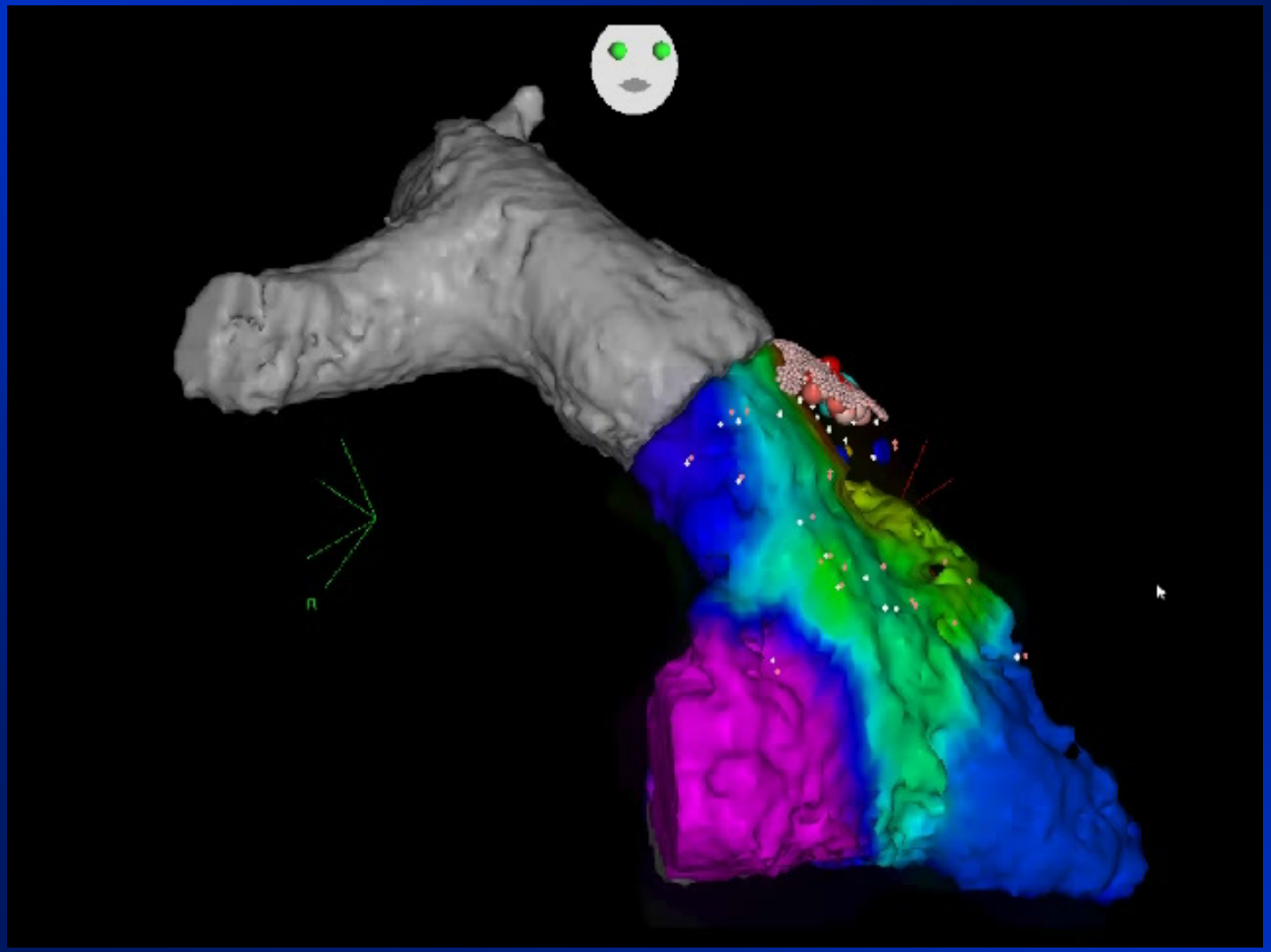


Europace (2015) **17**, 1601–1687
doi:10.1093/europace/euv319

2015 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

Treatment of outflow tract ventricular tachycardia

Recommendations	Class[a]	Level[b]	Ref.
Catheter ablation of RVOT VT/PVC is recommended in symptomatic patients and/or in patients with a failure of anti-arrhythmic drug therapy (e.g. beta-blocker) or in patients with a decline in LV function due to RVOT-PVC burden.	I	B	525-528
Treatment with sodium channel blockers (class IC agents) is recommended in LVOT/aortic cusp/epicardial VT/PVC symptomatic patients.	I	C	529-531



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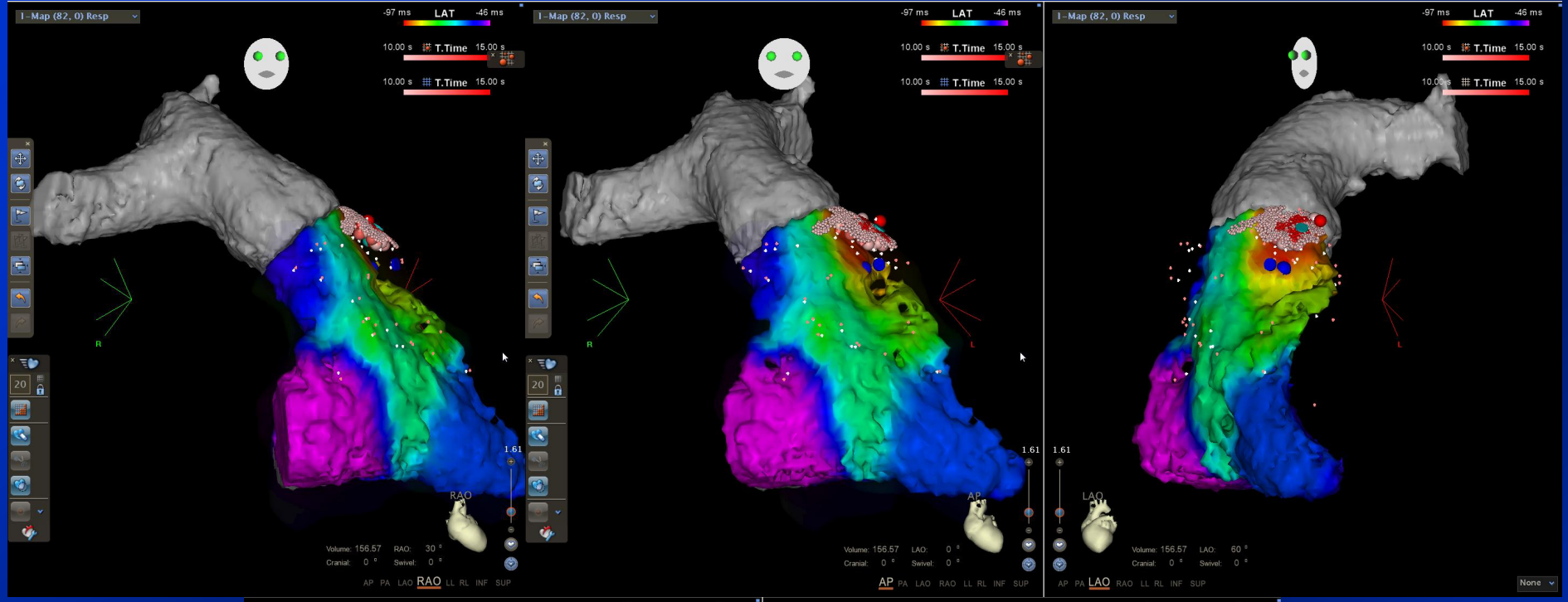

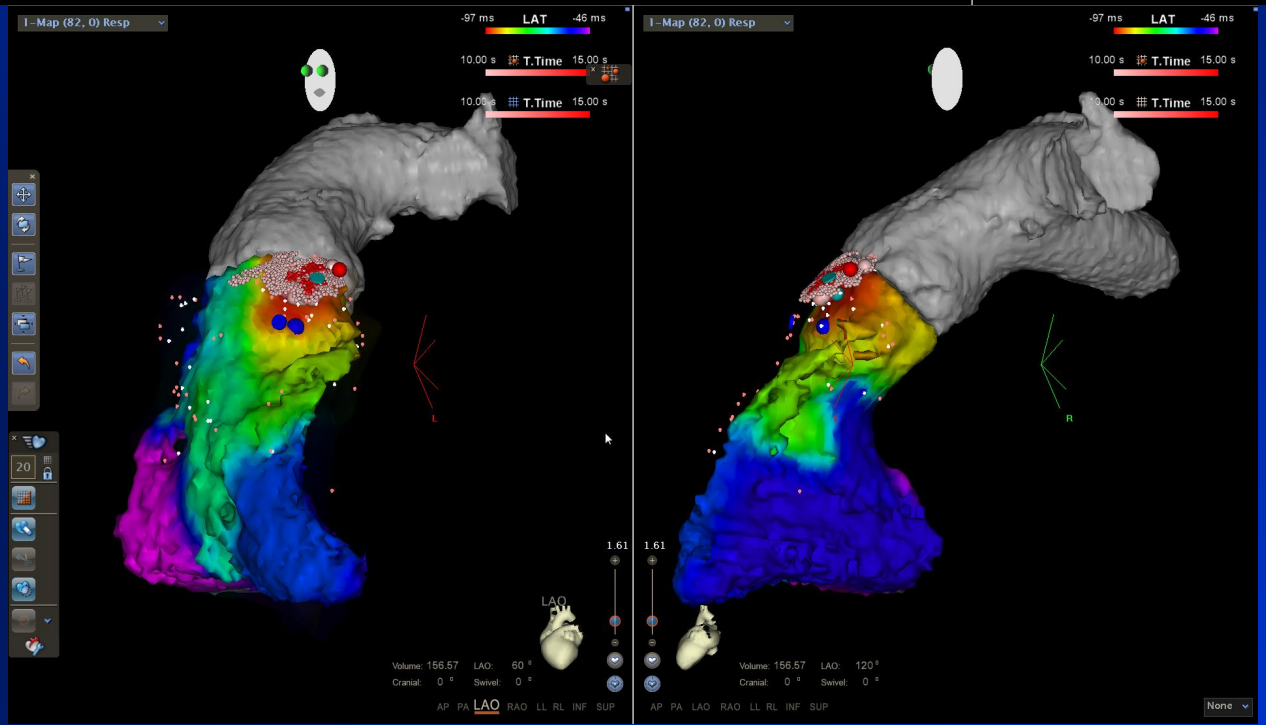

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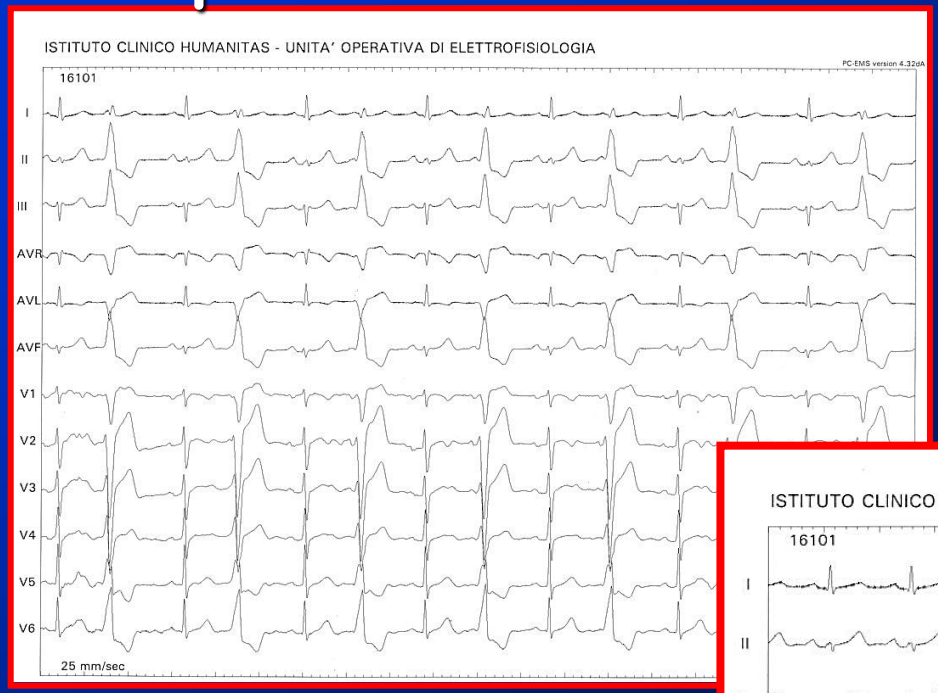
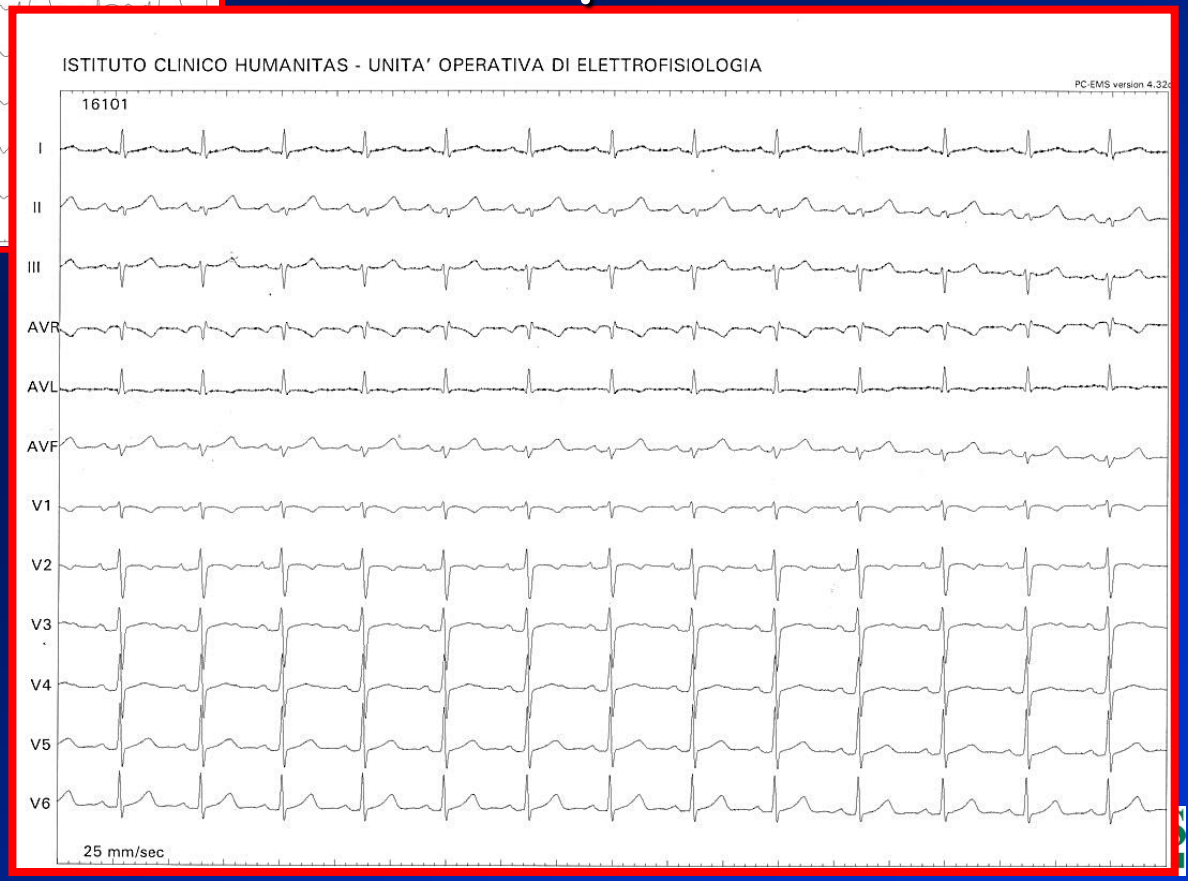
Pre procedure



Post procedure



3 months later

LVEF 55%

Heart Rhythm

Volume 11, Issue 2, February 2014, Pages 187–193

Relative efficacy of catheter ablation vs antiarrhythmic drugs in treating premature ventricular contractions: A single-center retrospective study *

Li Zhong, MD, PhD[·,†], Ying-Hsiang Lee, MD[†,‡], Xin-Miao Huang, MD, PhD[†,‡], Samuel J. Asirvatham, MD, FHRS[†], Win-Kuang Shen, MD, FHRS[†], Paul A. Friedman, MD, FHRS[†], David O. Hodge, MS[‖], Joshua P. Slusser, BS[‖], Zhi-Yuan Song, MD[·], Douglas L. Packer, MD, FHRS[†], Yong-Mei Cha, MD, FHRS[†·]

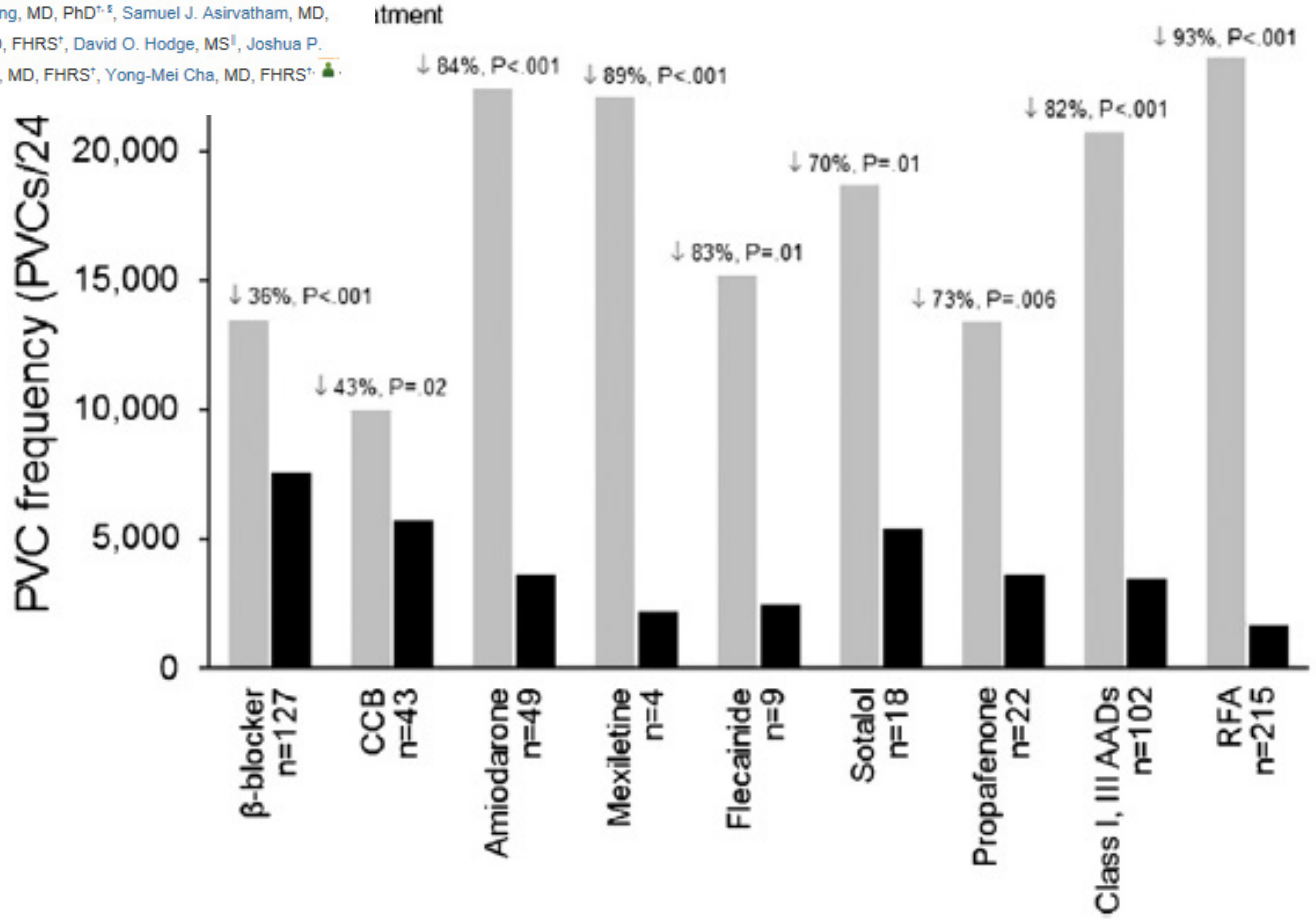


Figure 2 Reduction in the frequency of premature ventricular contractions (PVCs) after treatment with antiarrhythmic drugs (AADs) and radiofrequency ablation (RFA). CCB = calcium channel blocker.

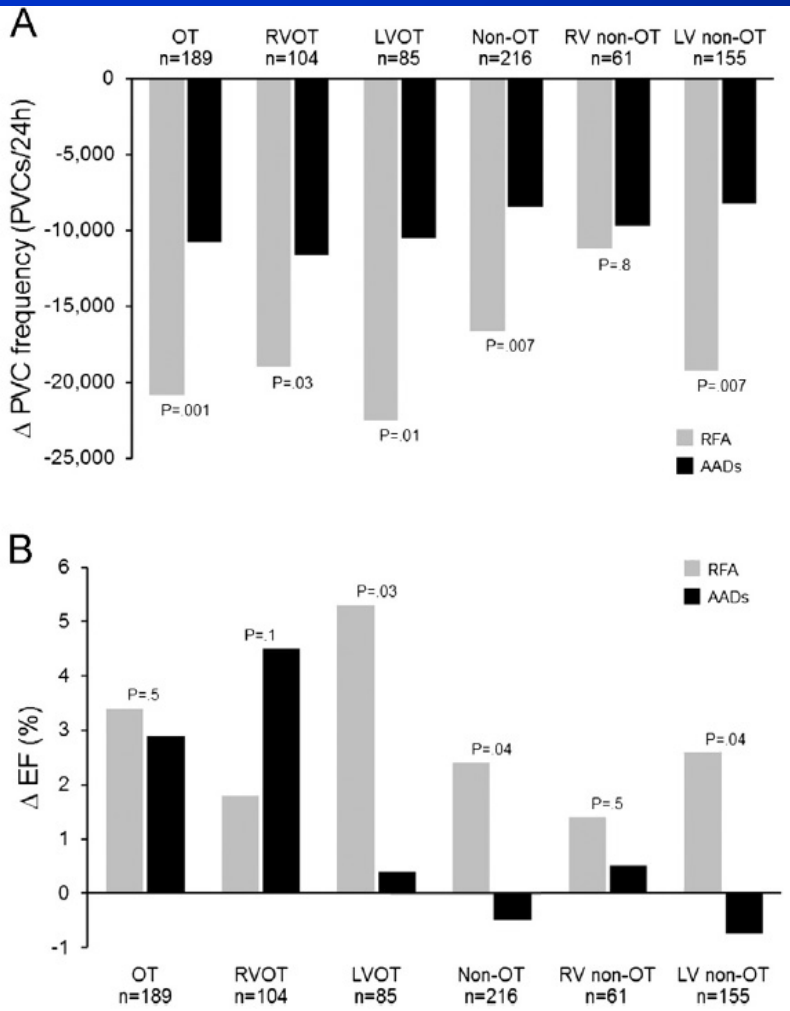


Figure 3 Changes in premature ventricular contraction (PVC) frequency and left ventricular ejection fraction (LVEF) after treatment by PVC origin groups. **A:** Comparison of PVC reduction after antiarrhythmic drug (AAD) and radiofrequency ablation (RFA) treatment. **B:** Comparison of changes in LVEF after RFA and AAD treatment. LV non-OT = left ventricular non–outflow tract; LVOT = left ventricular outflow tract; RV non-OT = right ventricular non–outflow tract; RVOT = right ventricular outflow tract.

x 273,0 mm

The PVC frequency and burden significantly reduced by both RFA and AADs

In pts with lower PVC frequency, only RFA, not AADs, effectively reduced PVCs frequency

RFA more effective than AADs ($p < 0.001$)

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Table 1 Comparison of baseline clinical characteristics between RFA and AAD treatment groups*

Characteristic	RFA (n = 215)	AADs (n = 295)	P†
Age (y)	47.2 ± 16.3	61.6 ± 17.8	<.001
No. of women/men	115/110	110/185	<.001
Comorbid conditions			
Hypertension	23 (11)	106 (36)	<.001
Diabetes	12 (6)	28 (9)	.121
CAD	13 (6)	38 (13)	.010
AF	12 (5)	45 (15)	.002
DCM	68 (32)	85 (29)	<.001
Sleep apnea	1 (0.4)	14 (5)	.074
History of syncope	15 (7)	13 (4)	.223
Symptoms			
Shortness of breath	32 (15)	43 (15)	.903
Dizziness	19 (9)	22 (7)	.645
Palpitations	58 (27)	59 (20)	.100
Chest discomfort	27 (13)	17 (6)	.010
PVC frequency (n/24 h)	23,554 ± 18,448	17,259 ± 14,512	<.001
PVC burden (%)	18.4 ± 15.2	12.1 ± 12.8	<.001
NSVT (runs/24 h)	275 ± 51	112 ± 43	.014
PVC origins			
RVOT	74 (34)	33 (11)	<.001
RV non-OT	22 (10)	39 (13)	.109
LVOT	47 (22)	39 (13)	.143
LV non-OT	51 (24)	106 (36)	<.001
Multiform PVC	9 (4)	18 (6)	.202
PVC QRS duration (ms)	148 ± 21	150 ± 19	.311
PVC coupling interval (ms)	488 ± 95	494 ± 104	.545
LVEF (%)	53.0 ± 11.9	52.1 ± 8.5	.210
LVESD (mm)	37.5 ± 8.7	37.2 ± 9.5	.723
LVEDD (mm)	53.9 ± 7.0	52.4 ± 6.7	.301
AADs			
β-Blocker	34 (16)	135 (46)	
CCB	6 (3)	21 (7)	
Mexiletine	2 (1)	13 (4)	
Flecainide	3 (1)	26 (9)	
Sotalol	2 (1)	12 (4)	
Amiodarone	5 (2)	41 (14)	
Propafenone	5 (2)	16 (5)	
Digoxin	3 (1)	25 (8)	<.001
ACEI/ARB	25 (12)	95 (32)	<.001

2) Structural heart disease

PVCs & structural heart disease (EF < 30%)

First step: OPT → CRT

If after CRT + OPT, PVC persist

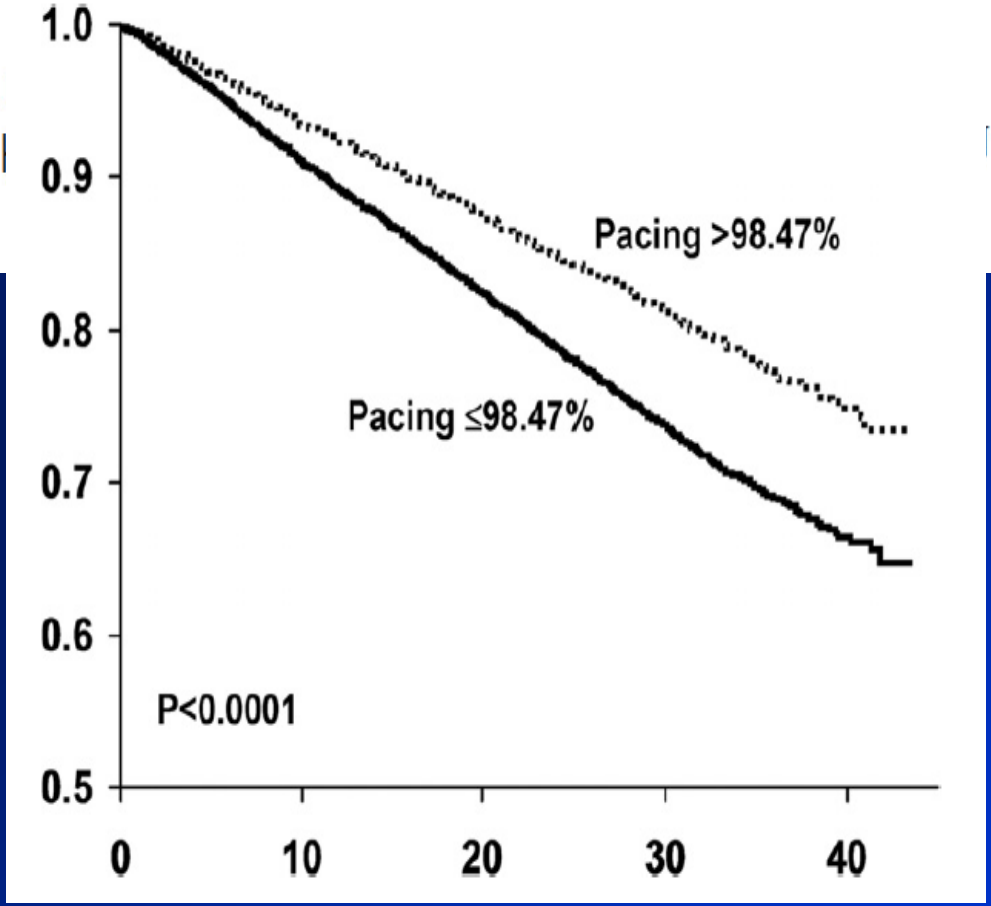
Suboptimal BIV pacing→
absence or limited response to CRT

Biventricular Pacing < 90%

Cardiac resynchronization therapy and the relationship of percent biventricular pacing to symptoms and survival

David L. Hayes, MD, FHRS,* John P.
F.R. Gilliam III, MD, FHRS,§ Paul A. I
Leslie A. Saxon, MD, FHRS#

36000 pts
2 yrs f.u.



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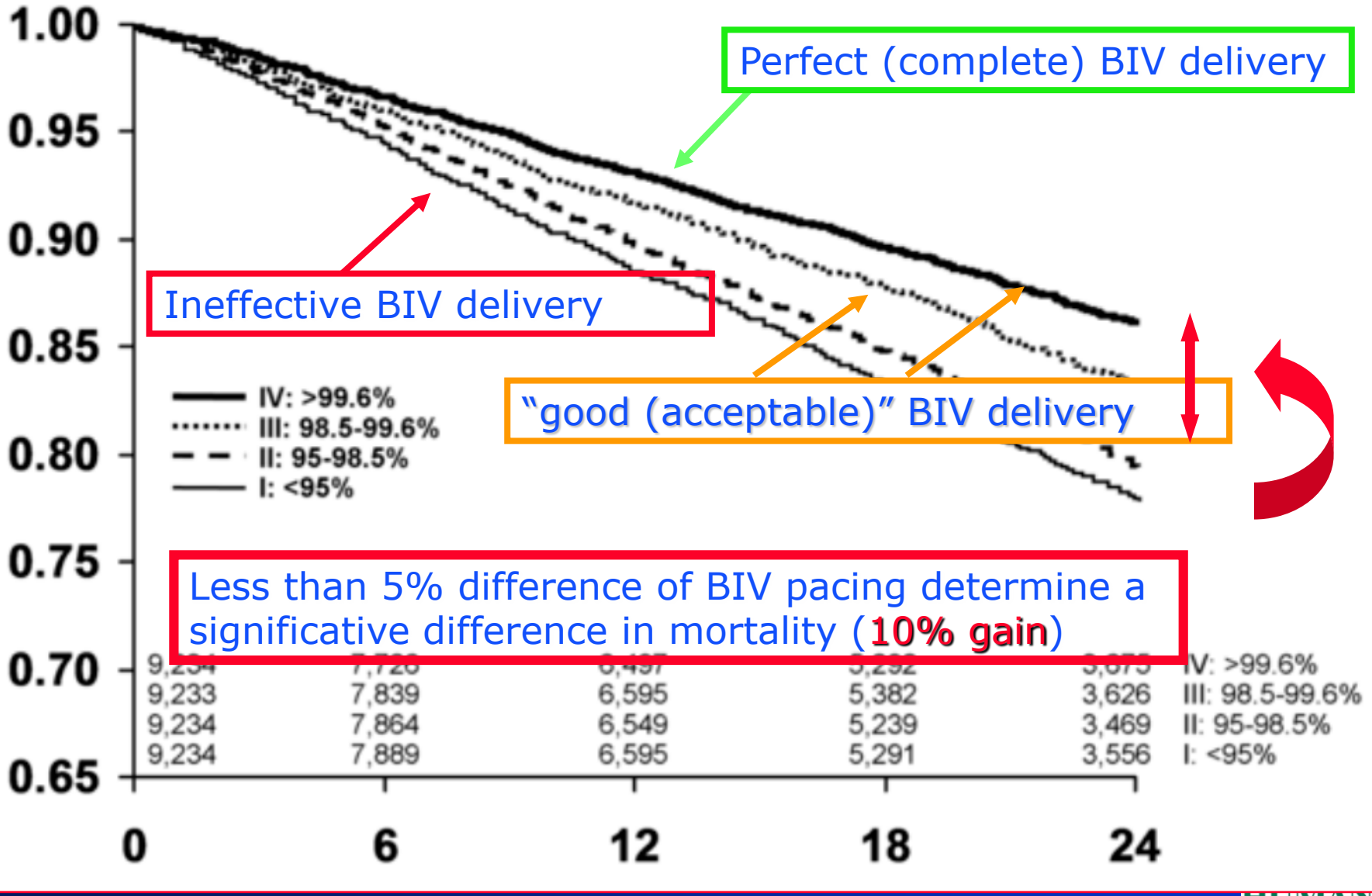
(Heart Rhythm 2011;8:1469–1475)

Figure 2 When assessed by quartiles, patients with biventricular pacing percentage above 99.6% experienced a 24% reduction in mortality compared with the other quartile groups (hazard ratio = 0.76, P <.001). Patients with <94.8% biventricular pacing had a 19% increase in mortality (hazard ratio = 1.19, P < .001).



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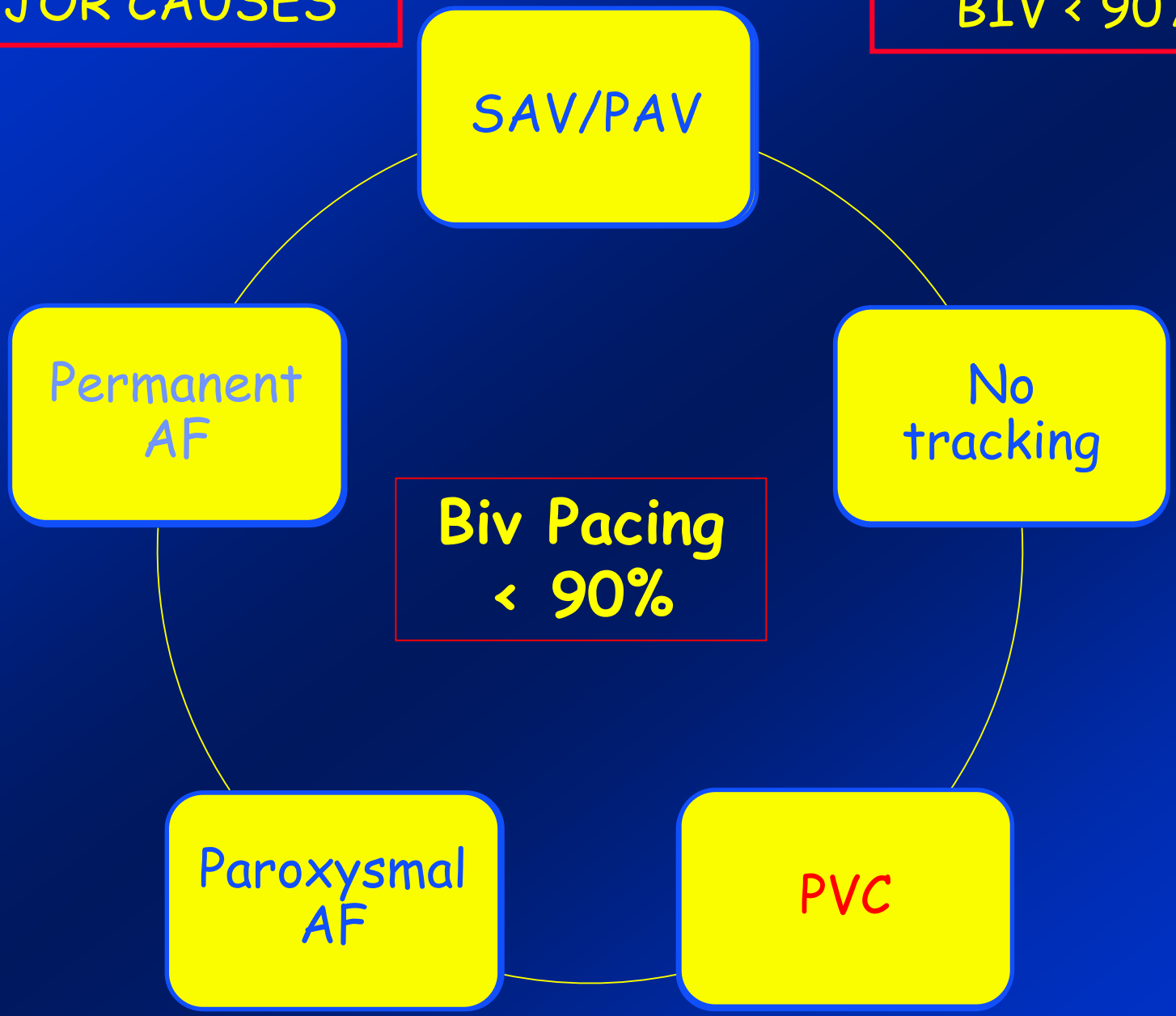
5 MAJOR CAUSES

BIV < 90%



Vicious circle

Interaction of PVC & HF in CRT.

→ Loss of CRT

→ Heart failure → worsening

→ More frequent hospitalizations

→ Inappropriate ICD shocks (?)

→ Increased sympathetic tone

→ Haemodynamic compromise

↑ PVCs

↑ Permanent AF

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From
MADIT CRT

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

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James P. Daubert, MD,§ Scott McNitt, MS,* Amin Al-ahmad, MD,‖ C
Valentina Kutyifa, MD, PhD,* Jonathan S. Steinberg, MD,‡ Paul War
Wojciech Zareba, MD, PhD*

TABLE 2 Association Between Number of Ectopic Beats (Ectopic Burden) and Likelihood of Low BIV Pacing (<97%) Versus High Percentage (≥97%)

	Odds Ratio: BIV Pacing <97% vs. BIV Pacing ≥97%	95% CI	p Value
Per percent increase in ectopic beats	1.18	1.14-1.23	<0.001
Per 0.1% increase in ectopic beats*	1.02	1.01-1.02	<0.001
<0.1% ectopic beats (<85 total APCs or PVCs)	1.00 = ref	NA	NA
0.1%-1.5% ectopic beats (85-1,347 total APCs or PVCs)	3.37	1.74-6.50	<0.001
>1.5% ectopic beats (>1,347 total APCs or PVCs)	13.42	7.02-25.66	<0.001
Separate analysis of APCs and PVCs			
Per percent increase in APCs/total beats	1.09	1.02-1.16	0.015
Per percent increase in PVCs/total beats	1.22	1.16-1.28	<0.001

Multivariate logistic regression model. Adjusted for age, left bundle branch block QRS configuration, prior ventricular arrhythmias, prior myocardial infarction, and creatinine level. *If estimated by use of an ordinal scale in the range from 0% to 1.5% by 0.1% increase and pooling patients with more than 1.5% ectopy: odds ratio 1.16; 95% CI: 1.13 to 1.19; p < 0.001 per 0.1% increase in ectopic beats.

CI = confidence interval; NA = not applicable; ref = reference; other abbreviations as in Table 1.

Hot water
Discovery …

PVCs detection

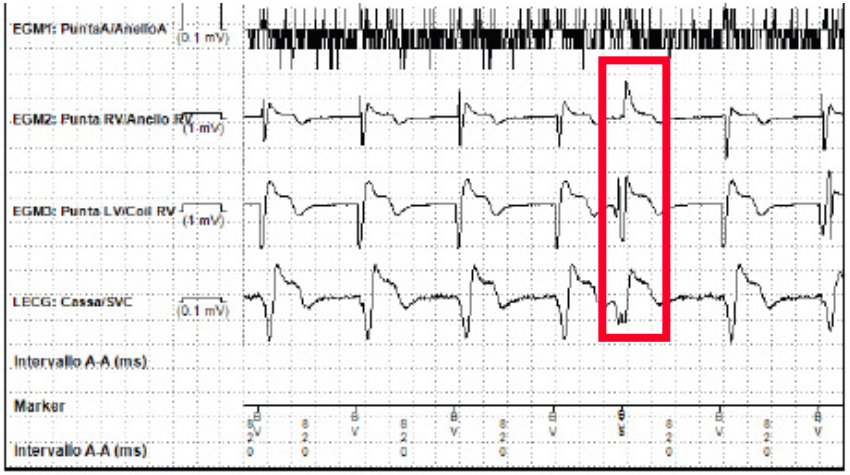
Quick Look II

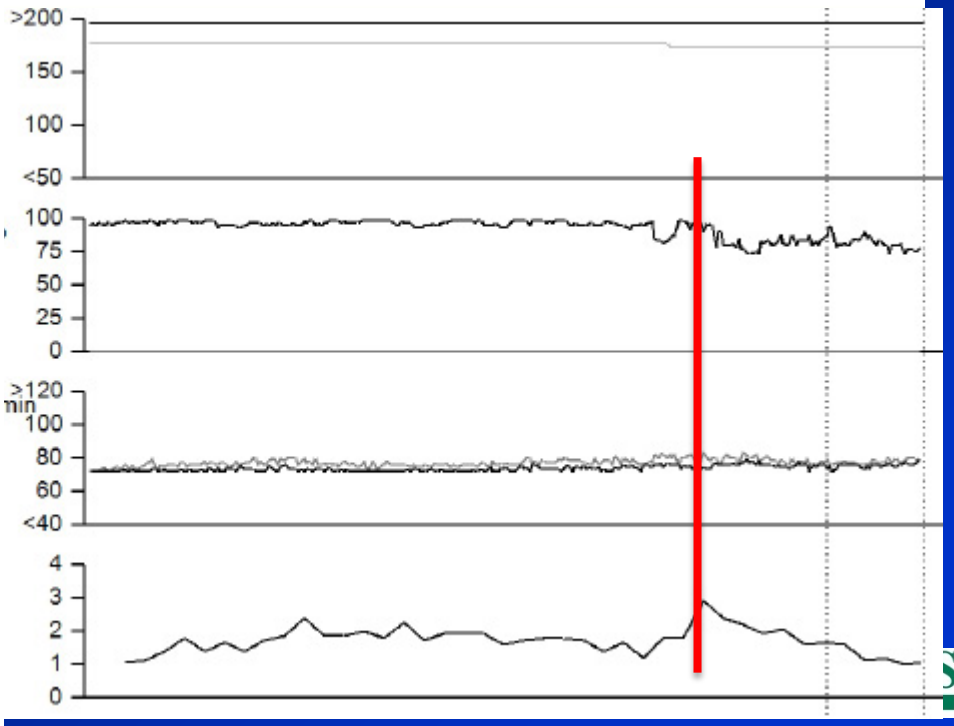
Dispositivo: Maximo™ II CRT-D D284TRK Numero di serie: PZP610776S Data interrogazione: 18-Dec-2012 10:28:40

Medico: drGasparini Maurizio
0282244401

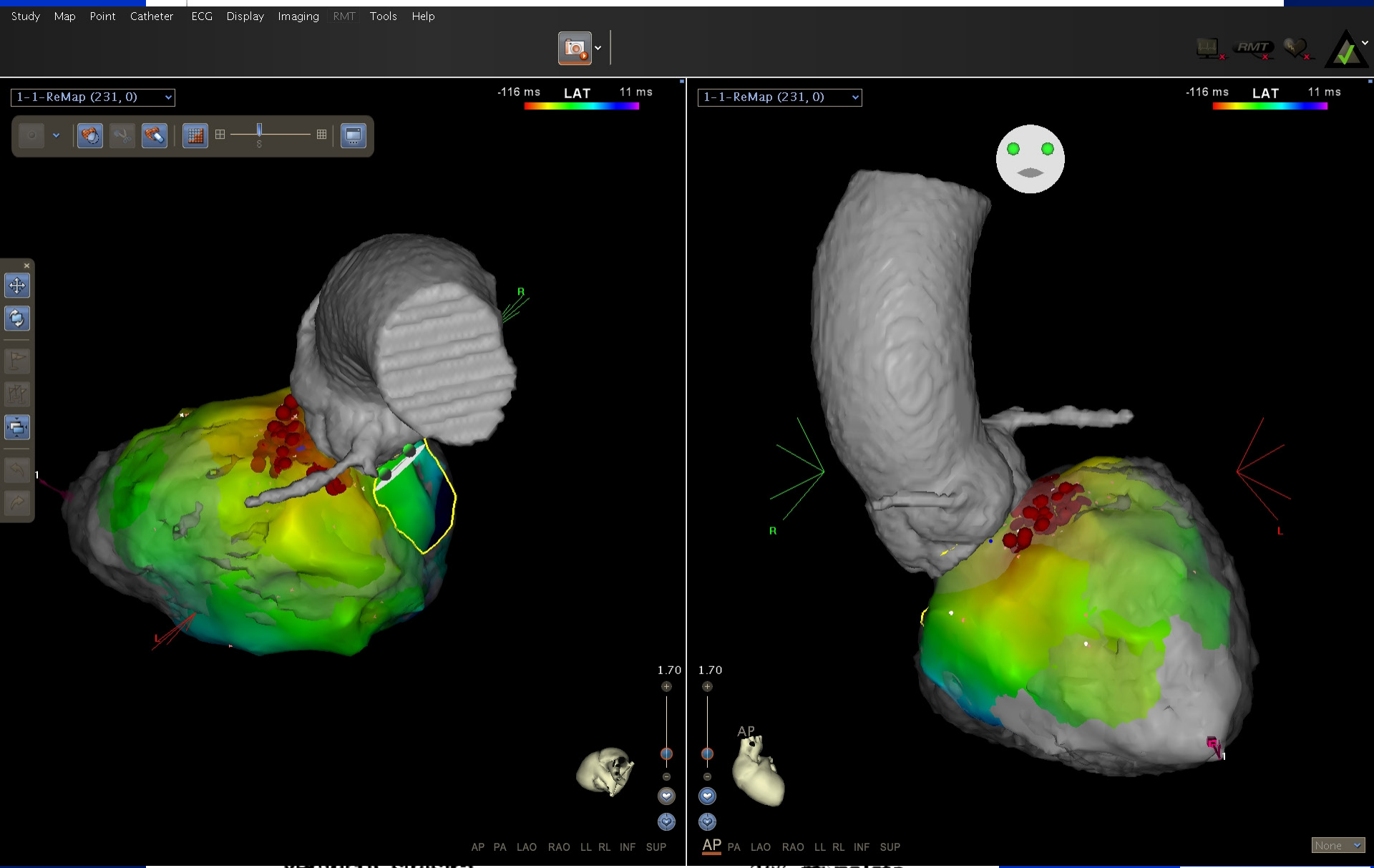
OSSERVAZIONI (1)

· Stimolazione V. (battiti V.) inferiore al 90%.





Ventricular extrabeats



ventricol. sinistra

78% stimolato

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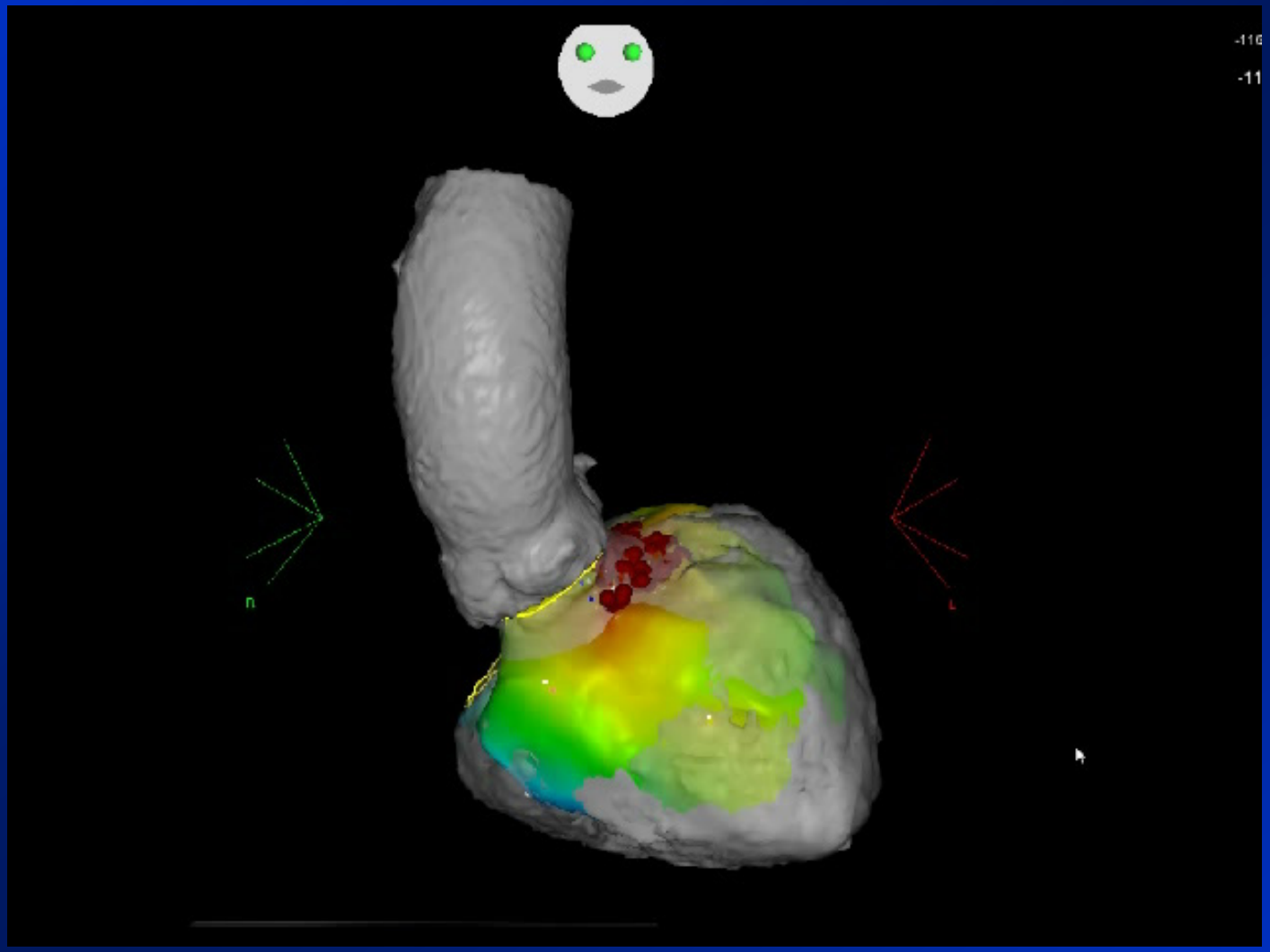
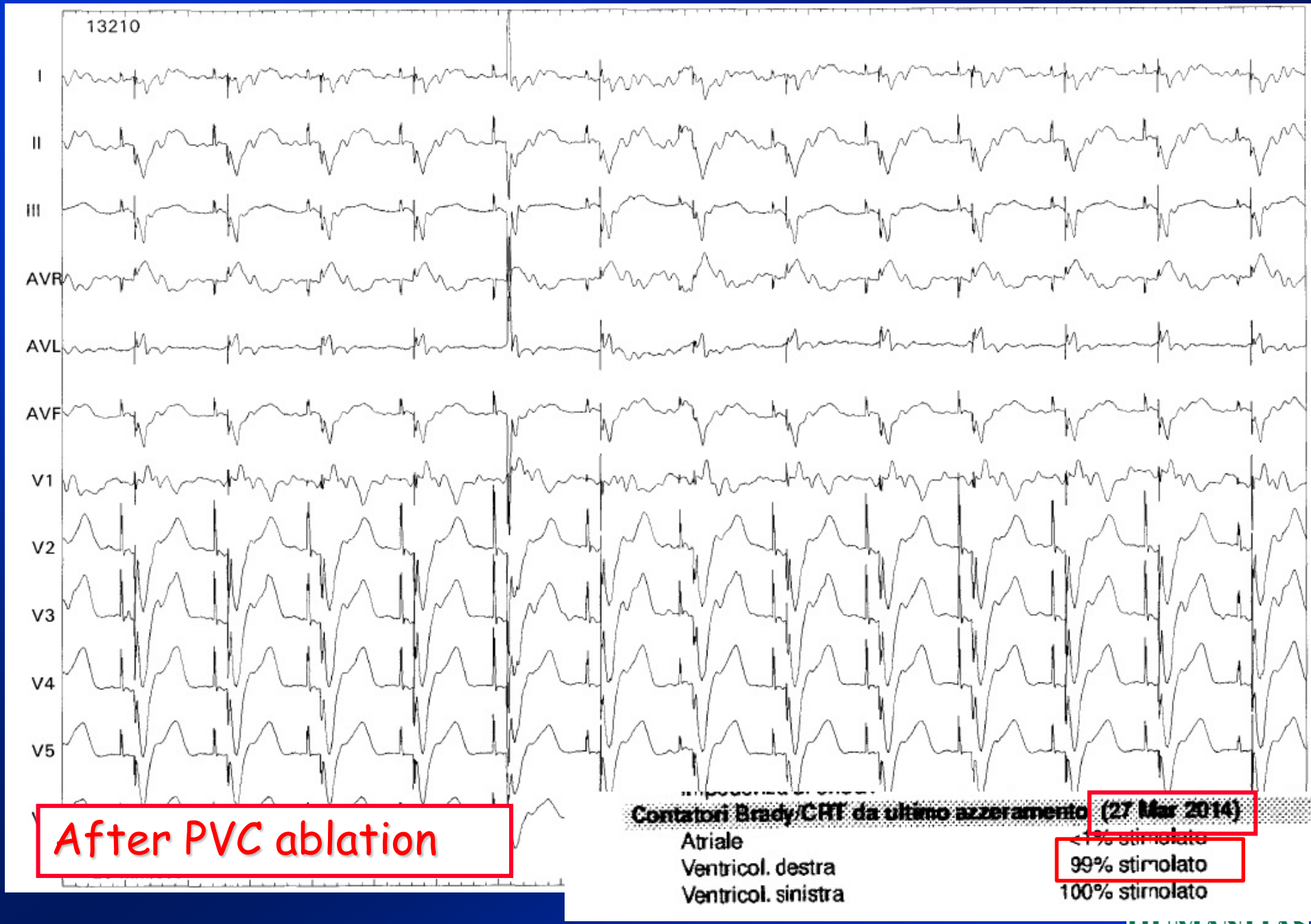




After PVC ablation

Clinical message

→ CRT effective *only* when BIV pacing > 98%

→ Consider arrythmic substrate ablation
(PVC ablation) if necessary.

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†‡

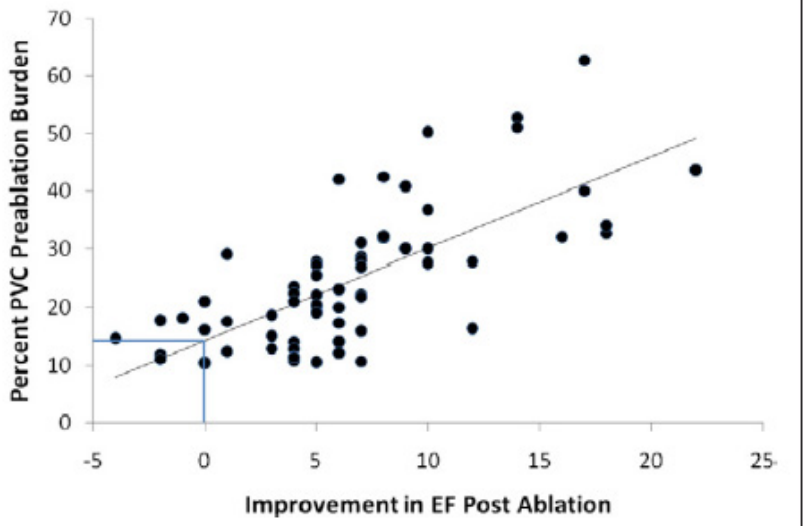


Figure 2 Correlation Between PVC Burden and EF Change Following Ablation

Percentage of pre-ablation premature ventricular contraction (PVC) burden and correlation with change in post-ablation ejection fraction (EF). The figure shows a Pearson correlation coefficient of 0.699, which is statistically significant at $p < 0.001$ (2-tailed). BiV = biventricular.

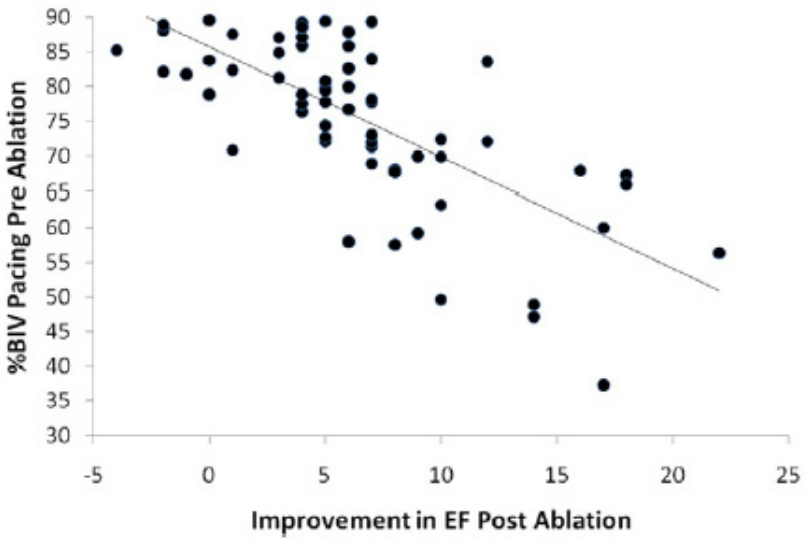


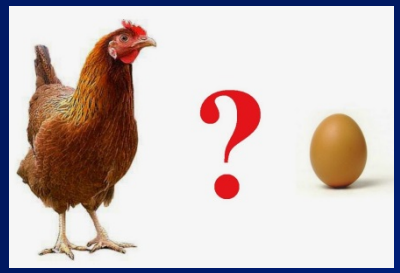
Figure 3 Correlation Between Pre-Ablation BIV Pacing % and Post-Ablation Improvement in EF

The figure shows a Pearson's correlation coefficient of 0.699 which is statistically significant at $p < 0.001$ (2-tailed). BIV = biventricular pacinig; EF = ejection fraction.

Conclusions

Mandatory primum movens identification

PVC and HF: who comes first ?



PVC

No heart disease

First

PVC RF ablation

(Class IA indication for RVOT)

HF Low EF

Structural heart disease

First

CRT

(no different indication in GL)