«Εκτίμηση του ασθενούς με μη εμμένουσα VT σε φυσιολογική καρδιά και σε δομική καρδιοπάθεια»

Παναγιώτης Ιωαννίδης

Διευθυντής Τμήματος Αρρυθμιών &

Επεμβατικής Ηλεκτροφυσιολογίας Βιοκλινικής Αθηνών

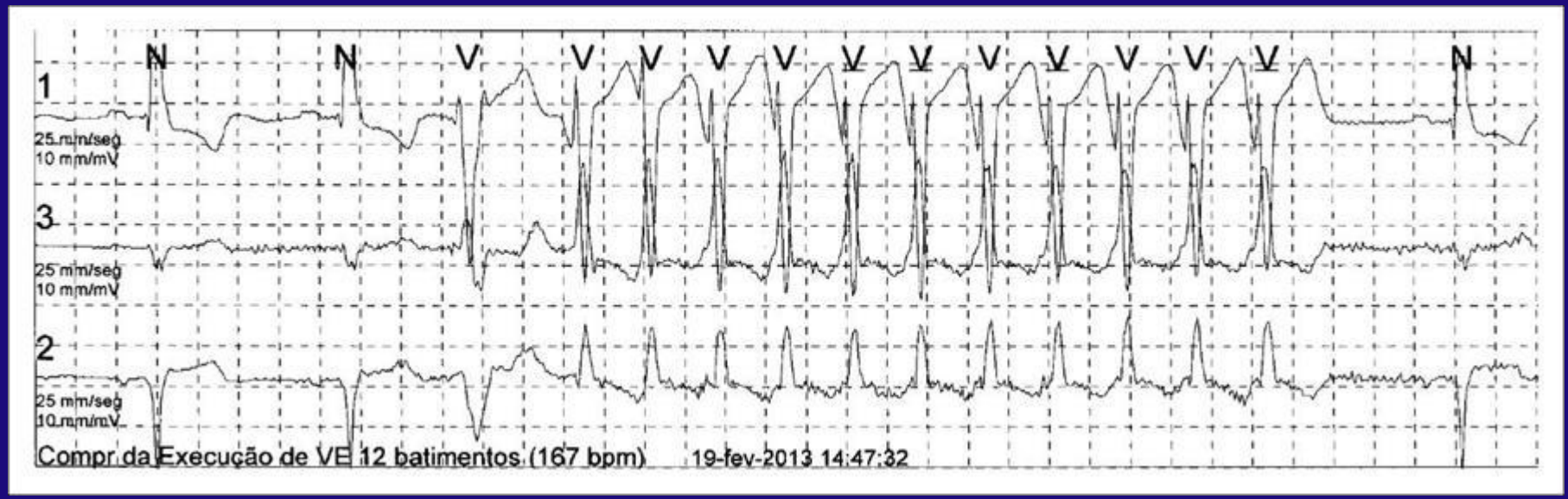
Βιοκλινική Αθηνών

"Λήψη κλινικών αποφάσεων στις Καρδιαγγειακές Παθήσεις"
Αθήνα, 13-11-2015

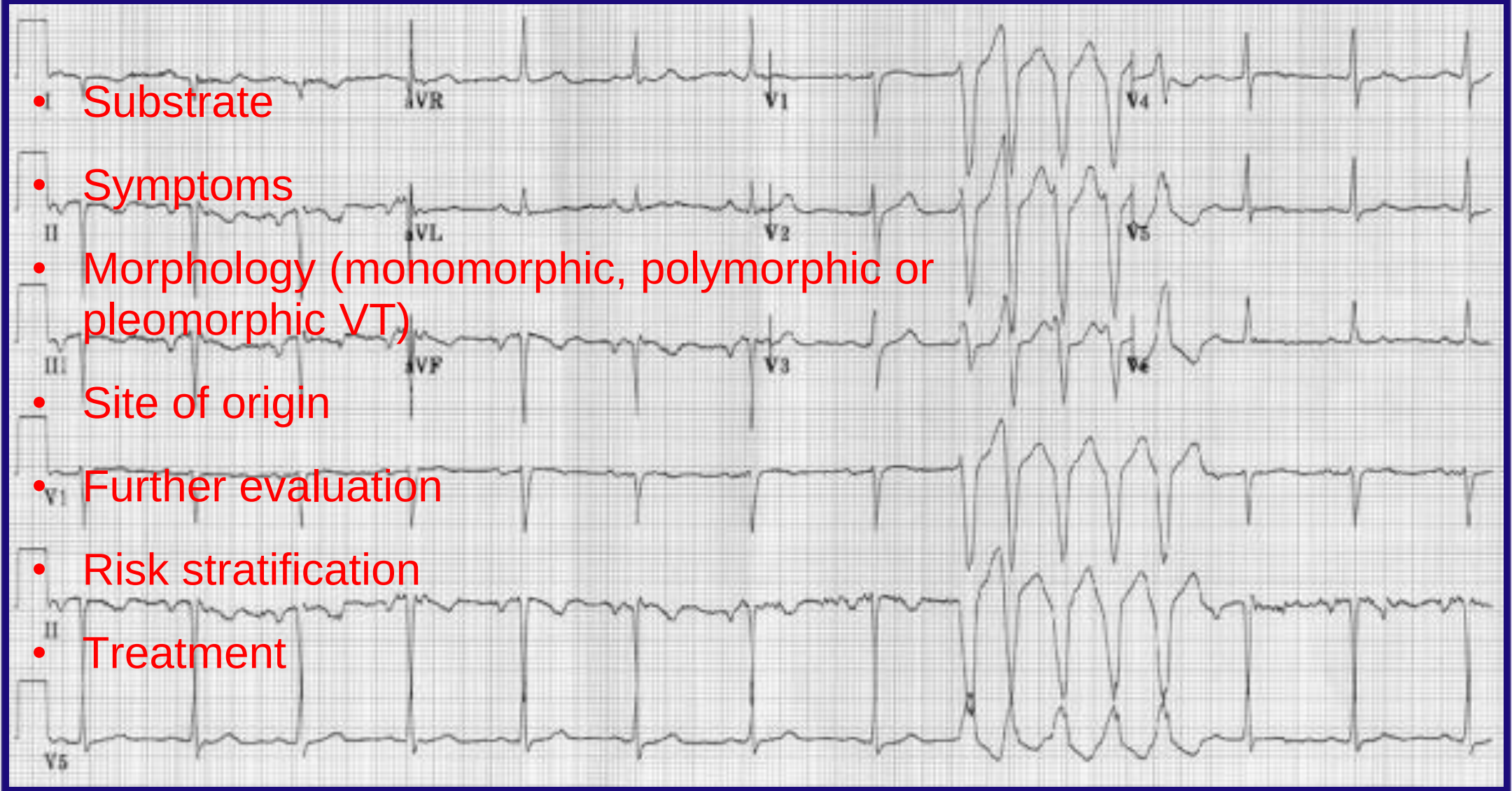
Nonsustained Ventricular Tachycardia (NSVT)

Definition:

NSVT is defined as 3 (sometimes 5) or more consecutive beats arising below the atrioventricular node with an RR interval of 600 - 500ms (100-120 beats/min) and lasting <30 sec

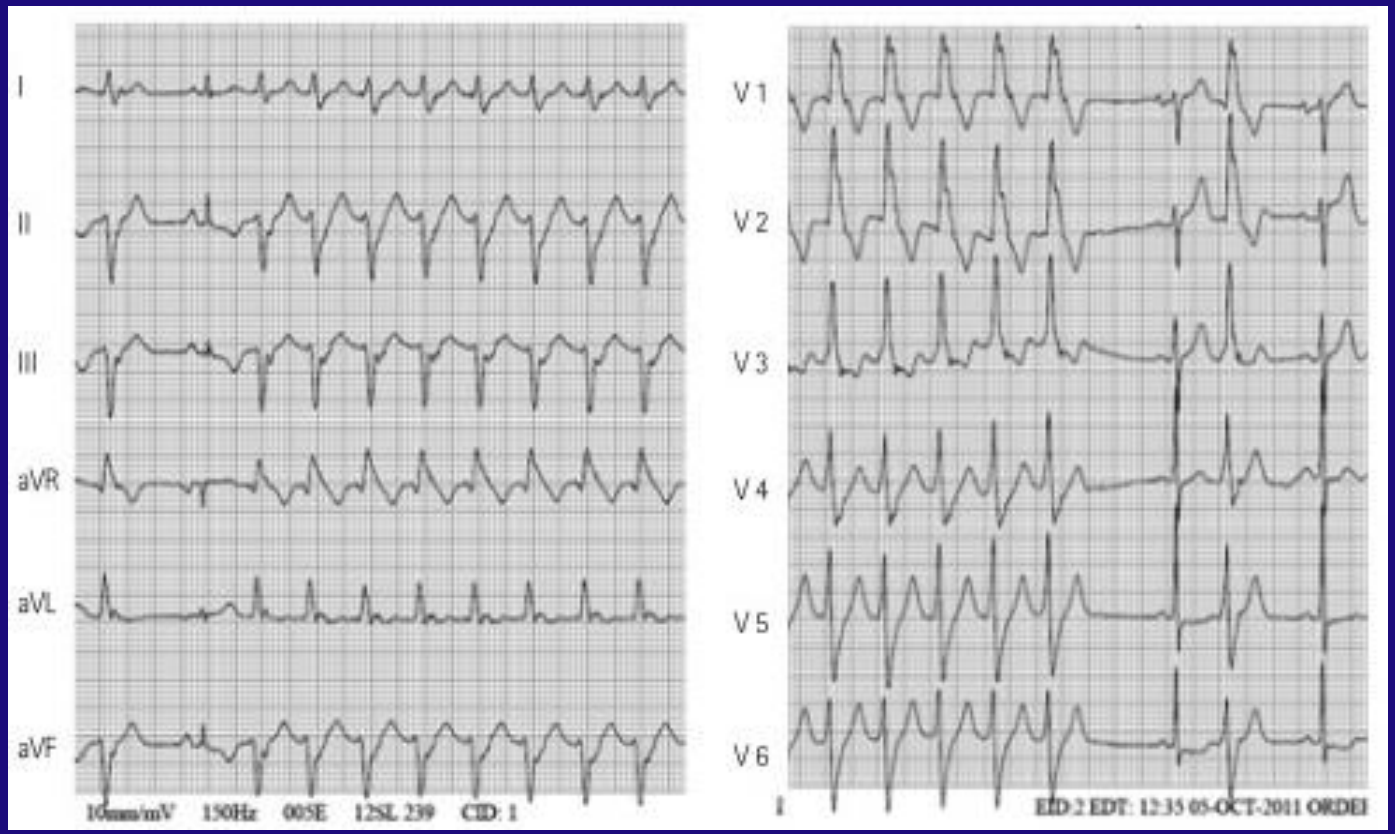


Non-sustained Ventricular Tachycardia (NSVT): Initial Evaluation



- Substrate
- Symptoms
- Morphology (monomorphic, polymorphic or pleomorphic VT)
- Site of origin
- Further evaluation
- Risk stratification
- Treatment

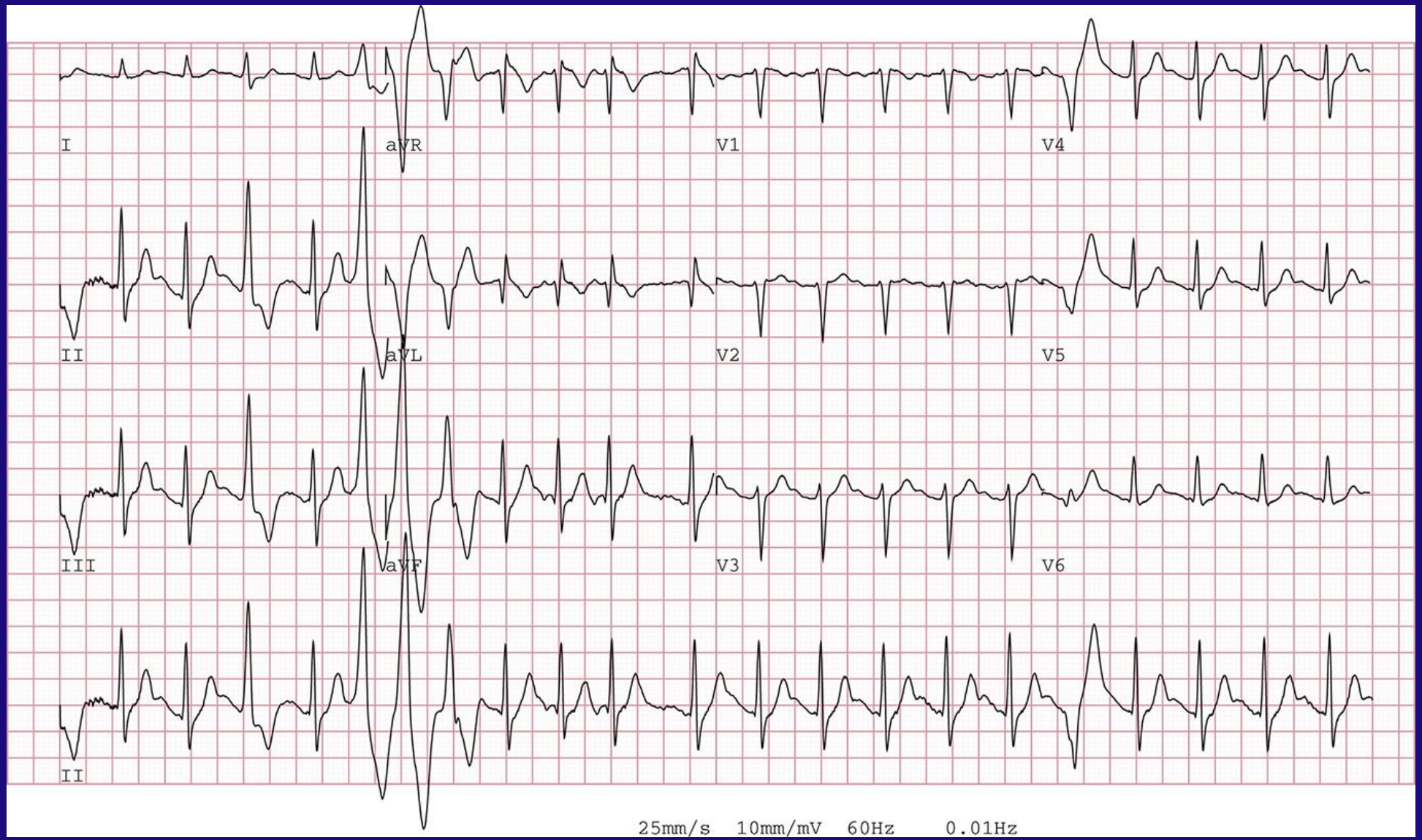
Substrate



- RBBB morphology, superior axis

- Asymptomatic
- Coronary Artery Disease
- Dilated (non-ischemic) Cardiomyopathy
- Hypertrophic Cardiomyopathy
- Athlete's Heart
- No detectable substrate (Idiopathic VAs)

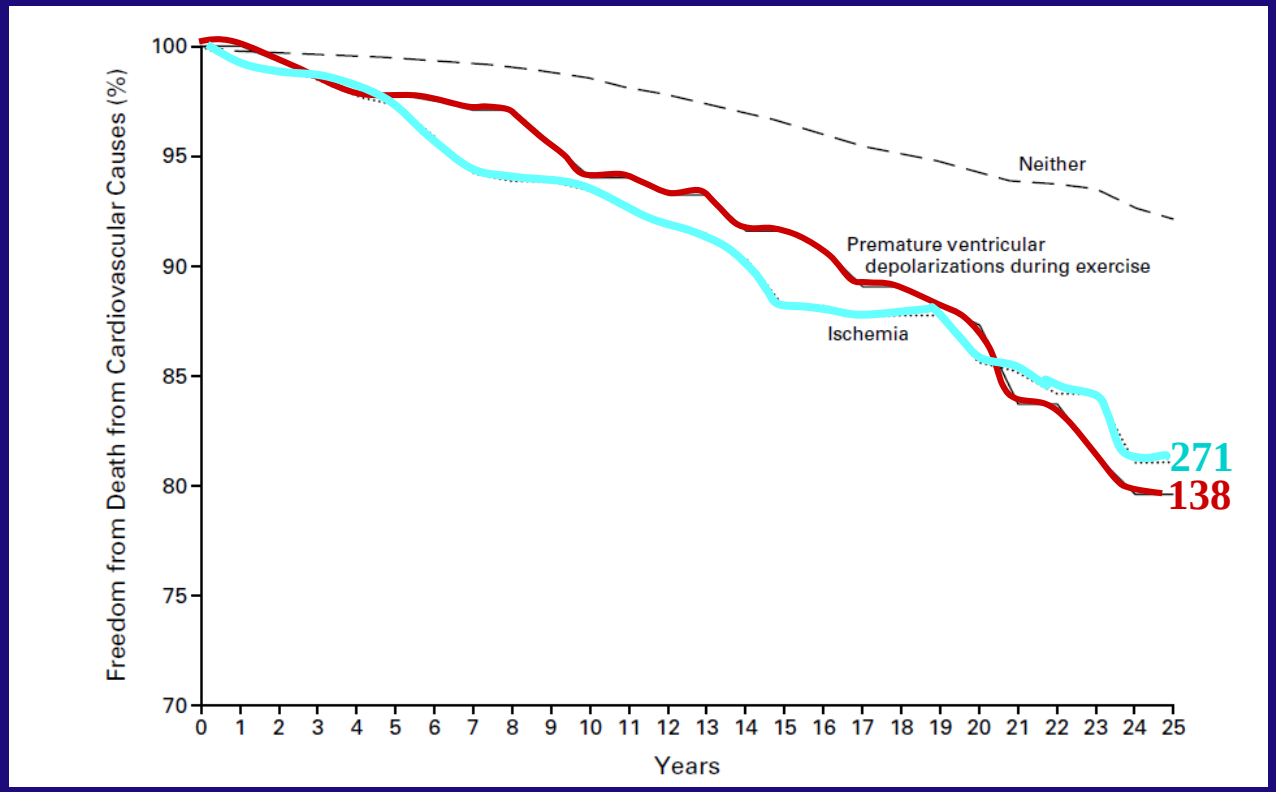
Ventricular Arrhythmias in Exercise Stress Test



Ventricular Ectopy as a risk factor

LONG-TERM OUTCOME IN ASYMPTOMATIC MEN WITH EXERCISE-INDUCED PREMATURE VENTRICULAR DEPOLARIZATIONS

XAVIER JOUVEN, M.D., MAHMOUD ZUREIK, M.D., PH.D., MICHEL DESNOS, M.D., DOMINIQUE COURBON, M.SC., AND PIERRE DUCIMETIÈRE, PH.D.



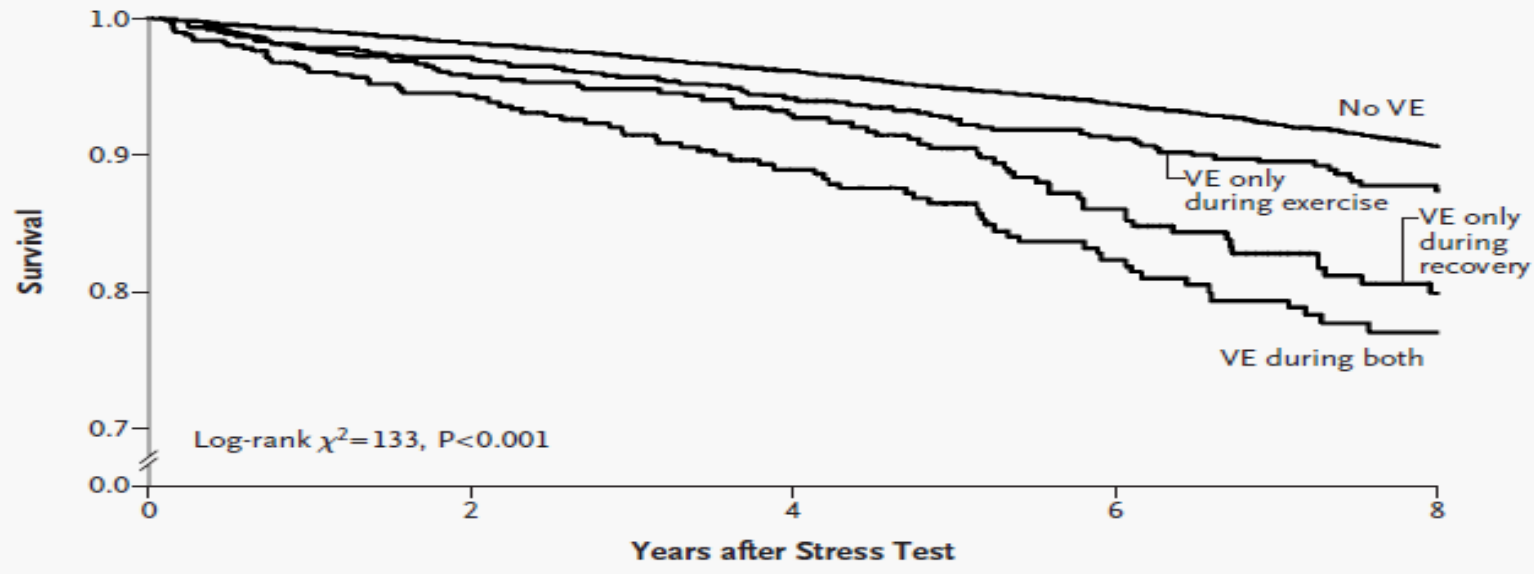
- 6101 asymptomatic men (42 to 53 years of age) who were free of clinically detectable cardiovascular disease underwent a standardized graded exercise test between 1967 and 1972.
- 23 years follow-up
- **271** subjects with a positive exercise test for ischemia → 3% had frequent PVCs during exercise.
- **138** subjects with frequent PVCs during exercise → only 6% had an exercise test that was positive for ischemia

Jouven et al. NEJM 2000;343:826-33

Ventricular Ectopy in Exercise Stress Test

Frequent Ventricular Ectopy after Exercise as a Predictor of Death

Joseph P. Frolkis, M.D., Ph.D., Claire E. Pothier, M.S., Eugene H. Blackstone, M.D., and Michael S. Lauer, M.D.



No. at Risk									
No VE	27,219	26,295	22,900	19,576	16,708	13,971	11,283	9292	6480
VE only during exercise	945	900	840	687	598	504	418	352	255
VE only during recovery	589	564	474	425	331	276	226	162	121
VE during both	491	459	403	329	265	231	190	148	122

Figure 1. Kaplan–Meier Analysis of the Association of Frequent Ventricular Ectopy (VE) Only during Exercise, Only during Recovery from Exercise, or during Both Exercise and Recovery, with Survival.

Frequent ventricular ectopy during recovery after exercise is a better predictor of an increased risk of death than ventricular ectopy occurring only during exercise.

Frolkis et al. NEJM 2003;348:781-90

Prevalence and Prognostic Significance of Exercise-Induced Nonsustained Ventricular Tachycardia in Asymptomatic Volunteers

BLSA (Baltimore Longitudinal Study of Aging)

Joseph E. Marine, MD,* Veena Shetty, MPH,† Grant V. Chow, MD,* Jeanette G. Wright, BA,‡ Gary Gerstenblith, MD,* Samer S. Najjar, MD,‡§ Edward G. Lakatta, MD,‡ Jerome L. Fleg, MD||

- 2,099 subjects (mean age: 52 years; 52.2% male) underwent a mean of 2.7 tests
- 79 (3.7%) developed NSVT during at least 1 exercise test
- Mean follow-up of 13.5 ±7.7 years

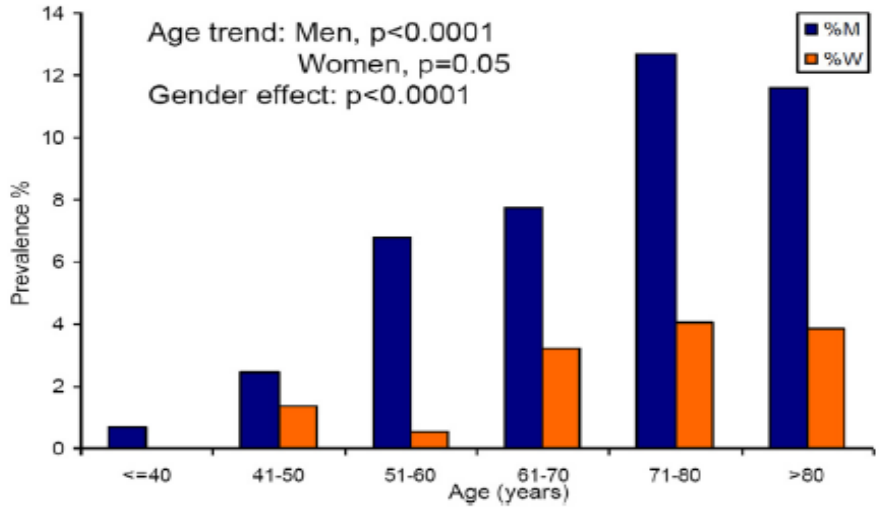


Figure 2 Prevalence of Exercise-Induced NSVT by Age and Sex

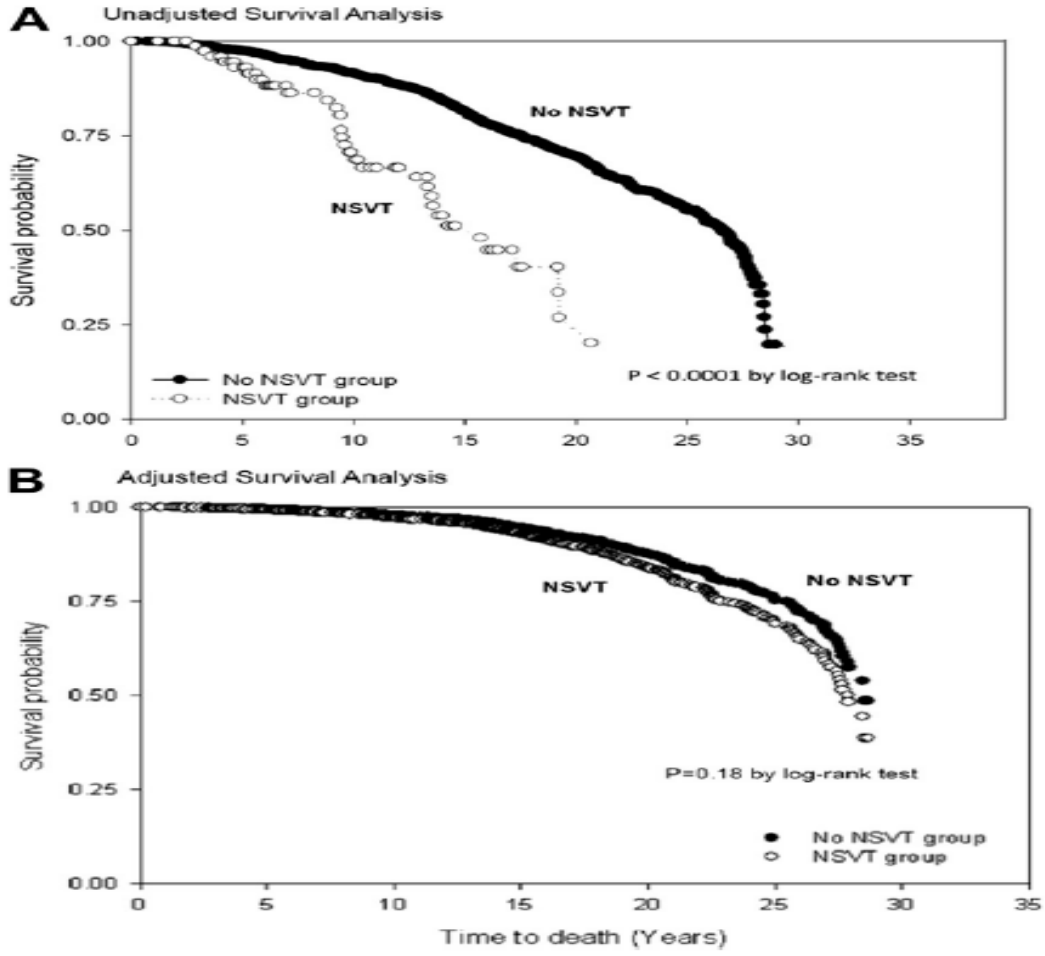
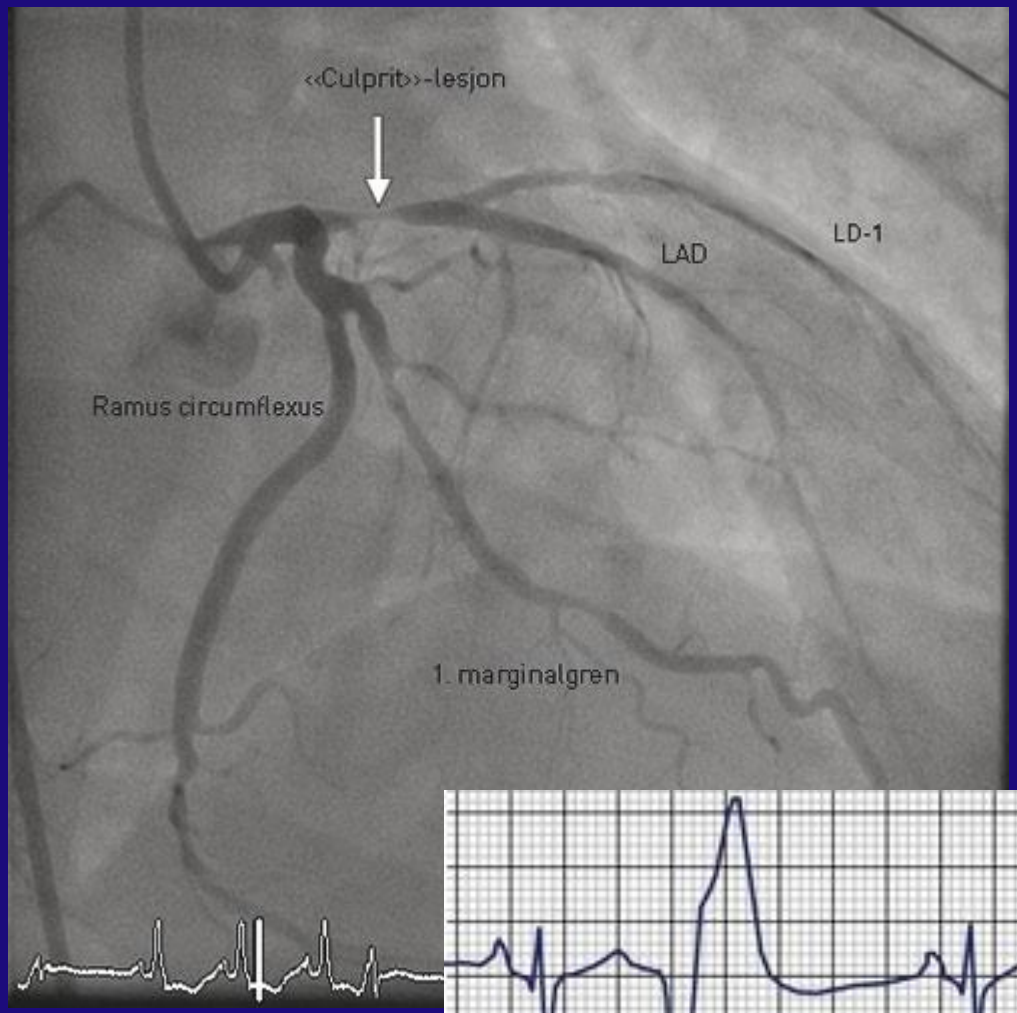
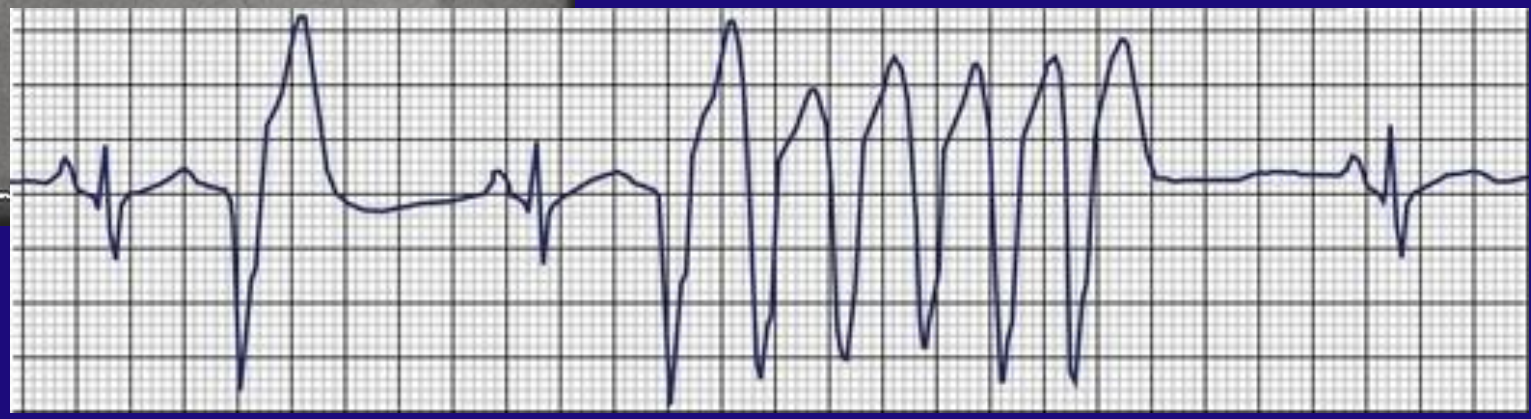


Figure 3 Kaplan-Meier Analysis of Survival Probability Stratified by the Presence or Absence of NSVT

Marine et al. JACC 2013;62:595–600

NSVT in Acute MI





Volume 324 CAST MARCH 21, 1991 Number 12

MORTALITY AND MORBIDITY IN PATIENTS RECEIVING ENCAINIDE, FLECAINIDE, OR PLACEBO

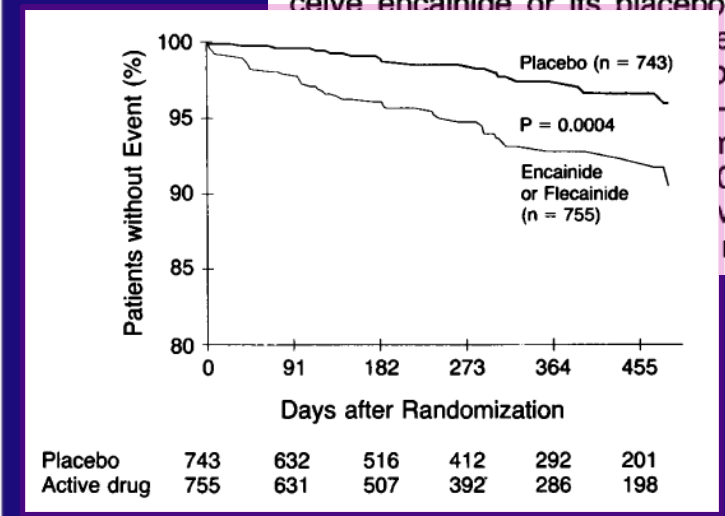
The Cardiac Arrhythmia Suppression Trial

DEBRA S. ECHT, M.D., PHILIP R. LIEBSON, M.D., L. BRENT MITCHELL, M.D., ROBERT W. PETERS, M.D., DULCE OBIAS-MANNO, R.N., ALLAN H. BARKER, M.D., DANIEL ARENSBERG, M.D., ANDREA BAKER, R.N., LAWRENCE FRIEDMAN, M.D., H. LEON GREENE, M.D., MELISSA L. HUTHER, DAVID W. RICHARDSON, M.D., AND THE CAST INVESTIGATORS*

Abstract *Background and Methods.* In the Cardiac Arrhythmia Suppression Trial, designed to test the hypothesis that suppression of ventricular ectopy after a myocardial infarction reduces the incidence of sudden death, patients in whom ventricular ectopy could be suppressed with encainide, flecainide, or moricizine were randomly assigned to receive either active drug or placebo. The use of encainide and flecainide was discontinued because of excess mortality. We examined the mortality and morbidity after randomization to encainide or flecainide or their respective placebo.

Results. Of 1498 patients, 857 were assigned to receive encainide or its placebo (432 to active drug and e assigned to receive fle- active drug and 318 to -up of 10 months, 89 pa- nia (43 receiving drug vs. 0004), 22 of nonarrhyth- ving drug vs. 5 receiving noncardiac causes (3 receiving drug vs. 5 receiving placebo). Almost all cardiac deaths not due to arrhythmia were attributed to acute myocardial infarction with shock (11 patients receiving drug and 3 receiving placebo) or to chronic congestive heart failure (4 receiving drug and 2 receiving placebo). There were no differences between the patients receiving active drug and those receiving placebo in the incidence of nonlethal disqualifying ventricular tachycardia, proarrhythmia, syncope, need for a permanent pacemaker, congestive heart failure, recurrent myocardial infarction, angina, or need for coronary-artery bypass grafting or angioplasty.

Conclusions. There was an excess of deaths due to arrhythmia and deaths due to shock after acute recurrent myocardial infarction in patients treated with encainide or flecainide. Nonlethal events, however, were equally distributed between the active-drug and placebo groups. The mechanisms underlying the excess mortality during treatment with encainide or flecainide remain unknown. (N Engl J Med 1991; 324:781-8.)



Echt et al NEJM 1991;324:781-8

NSVT in the setting of acute non-STEMI

MERLIN – TIMI 36 trial:

- A total of 6560 pts (6345 patients in NSVT sub-analysis) [1,2]
- Ranolazine vs pacebo in acute non-STEMI pts (Ranolazine reduced recurrent ischemia but not major cardiovascular events) [1]

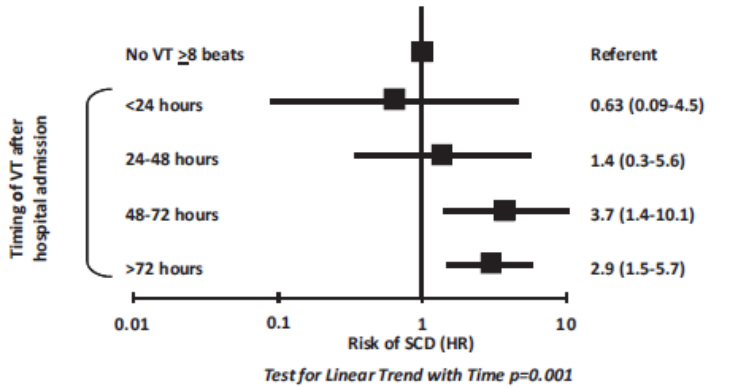
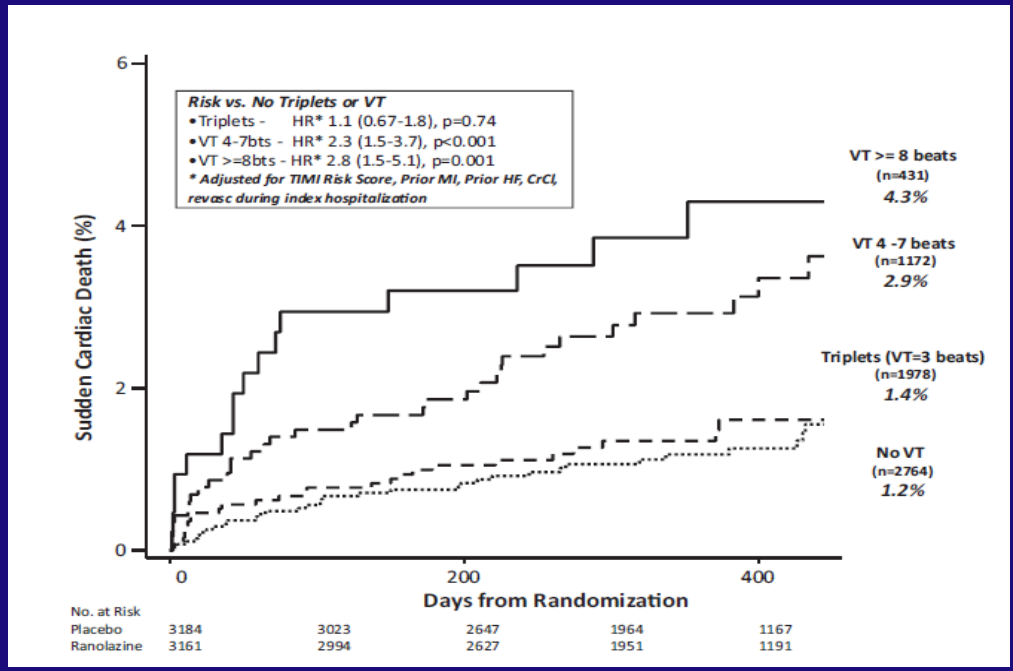


Figure 3. Risk of SCD according to timing of VT lasting at least 8 beats and hospital admission.

VT occurring within the first 48 hours after admission was not associated with SCD [2]



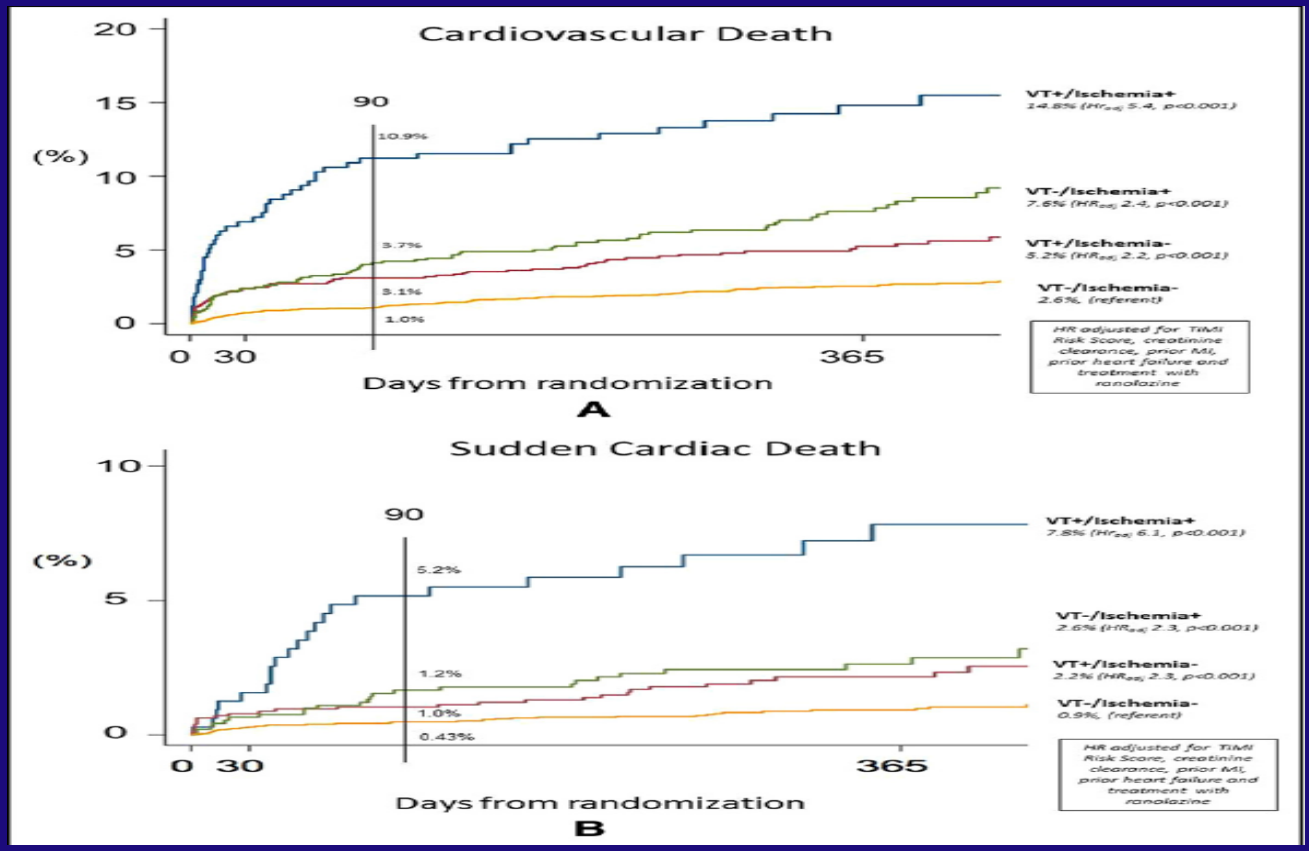
Patients with VT lasting 4-7 beats were at increased risk of SCD compared with patients with triplets only (HR_{adj}, 2.13; 95% CI, 1.30 to 3.57; *P*=0.003), but there was no difference in risk compared with patients with VT lasting ≥8 beats (HR_{adj}, 0.83; 95% CI, 0.45 to 1.56; *P*=0.59) [2]

[1] Morrow et al JAMA. 2007;297:1775-1783
[2] Scirica et al. Circulation 2010;122:455-462

NSVT in the setting of acute non-STEMI

Myocardial Ischemia and Ventricular Tachycardia on Continuous Electrocardiographic Monitoring and Risk of Cardiovascular Outcomes After Non–ST-Segment Elevation Acute Coronary Syndrome (from the MERLIN-TIMI 36 Trial)

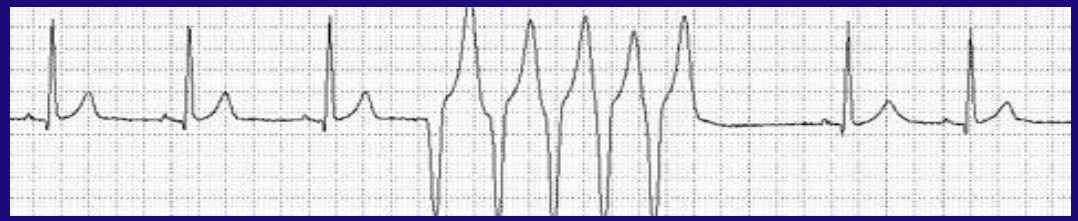
James R. Harkness, MD[a,b], David A. Morrow, MD, MPH[a,c], Eugene Braunwald, MD[a,c], Fang Ren,[a,c], J. Lopez-Sendon, MD[d], Christopher Bode, MD[e], Andrzej Budaj, MD, PhD[f], and Benjamin M. Scirica, MD, MPH[a,c,*]



The presence of myocardial ischemia or VT alone, and particularly in combination, was independently associated with poor cardiovascular outcomes and thus provides incremental improvement in early risk stratification

Harkness et al. Am J Cardiol 2011;108:1373–1381

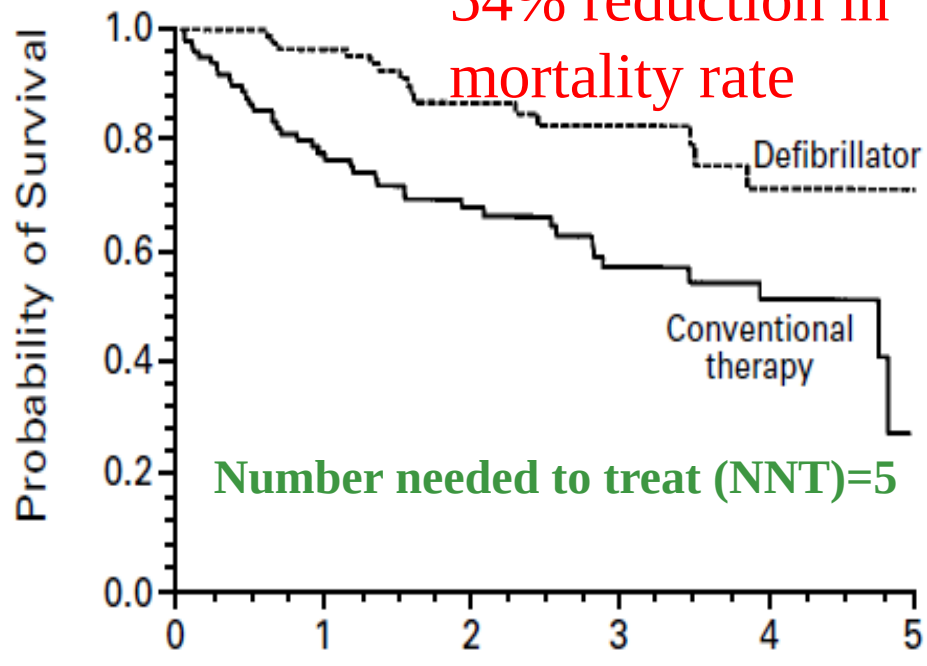
NSVT in patients with Ischemic Cardiomyopathy (MADIT I): The ultimate tool for risk stratification in primary prevention



- 196 pts with previous (≥3 weeks before entry) MI
- LVEF≤ 35%
- Unsustained VT (a run of 3 to 30 ventricular ectopic beats at a rate >120 bpm)
- Inducible, nonsuppressible ventricular tachyarrhythmia on electrophysiologic study
- Randomized to receive an ICD (n=95) or conventional medical therapy (n=101)

Cause of Death	Conventional Therapy (N=101)	Defibrillator (N=95)	Hazard Ratio (95% CI)*	P Value†
	no. of patients			
Cardiac cause‡	27	11		
Primary arrhythmia	13	3		
Nonarrhythmia	13	7		
Uncertain	1	1		
Noncardiac cause	6	4		
Unknown cause	6	0		
Total	39	15	0.46 (0.26–0.82)	0.009

54% reduction in mortality rate

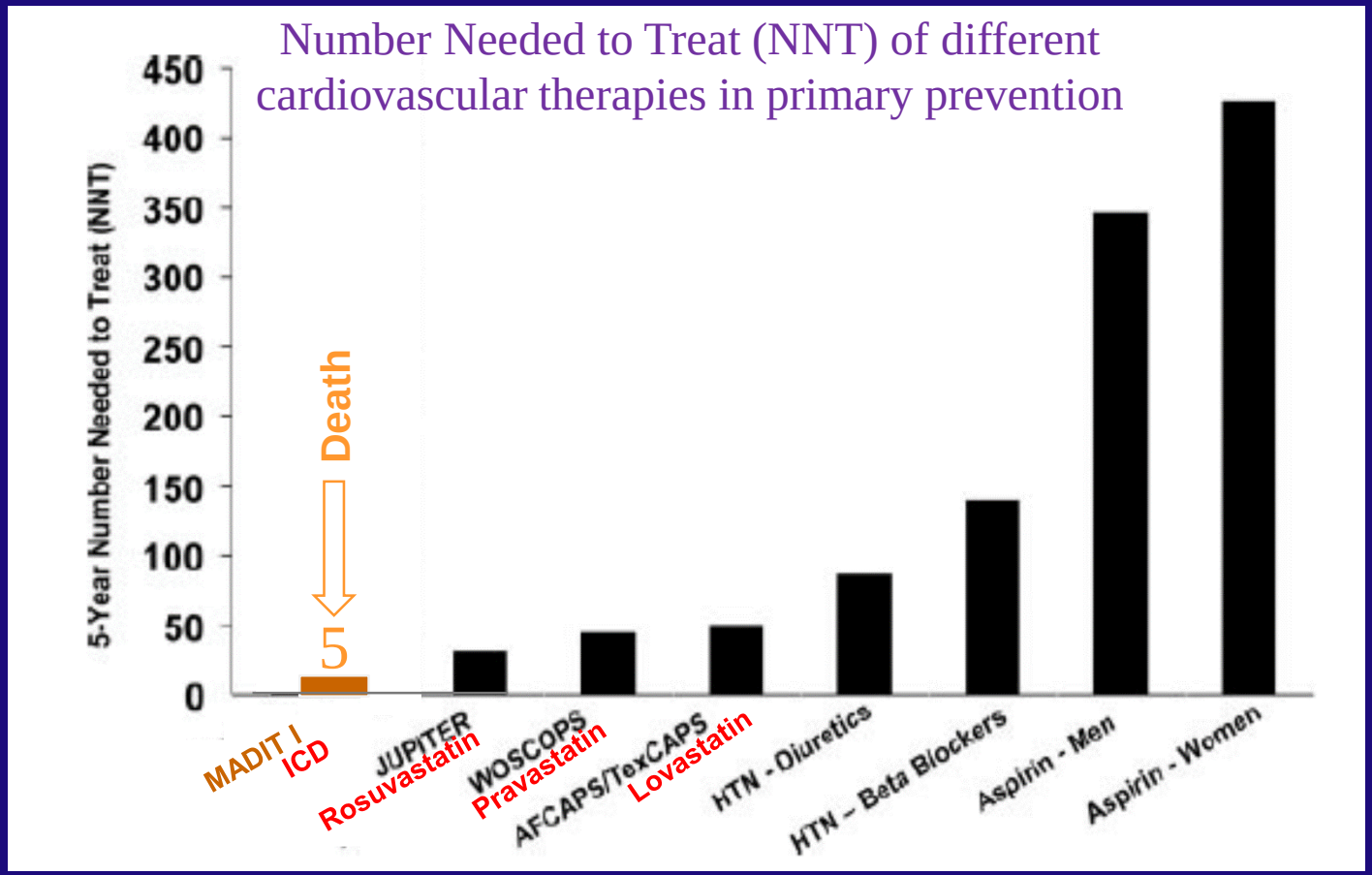


Number needed to treat (NNT)=5

No. of Patients						
Defibrillator	95	80	53	31	17	3
Conventional therapy	101	67	48	29	17	0

Moss et al NEJM 1996;335:1933-40

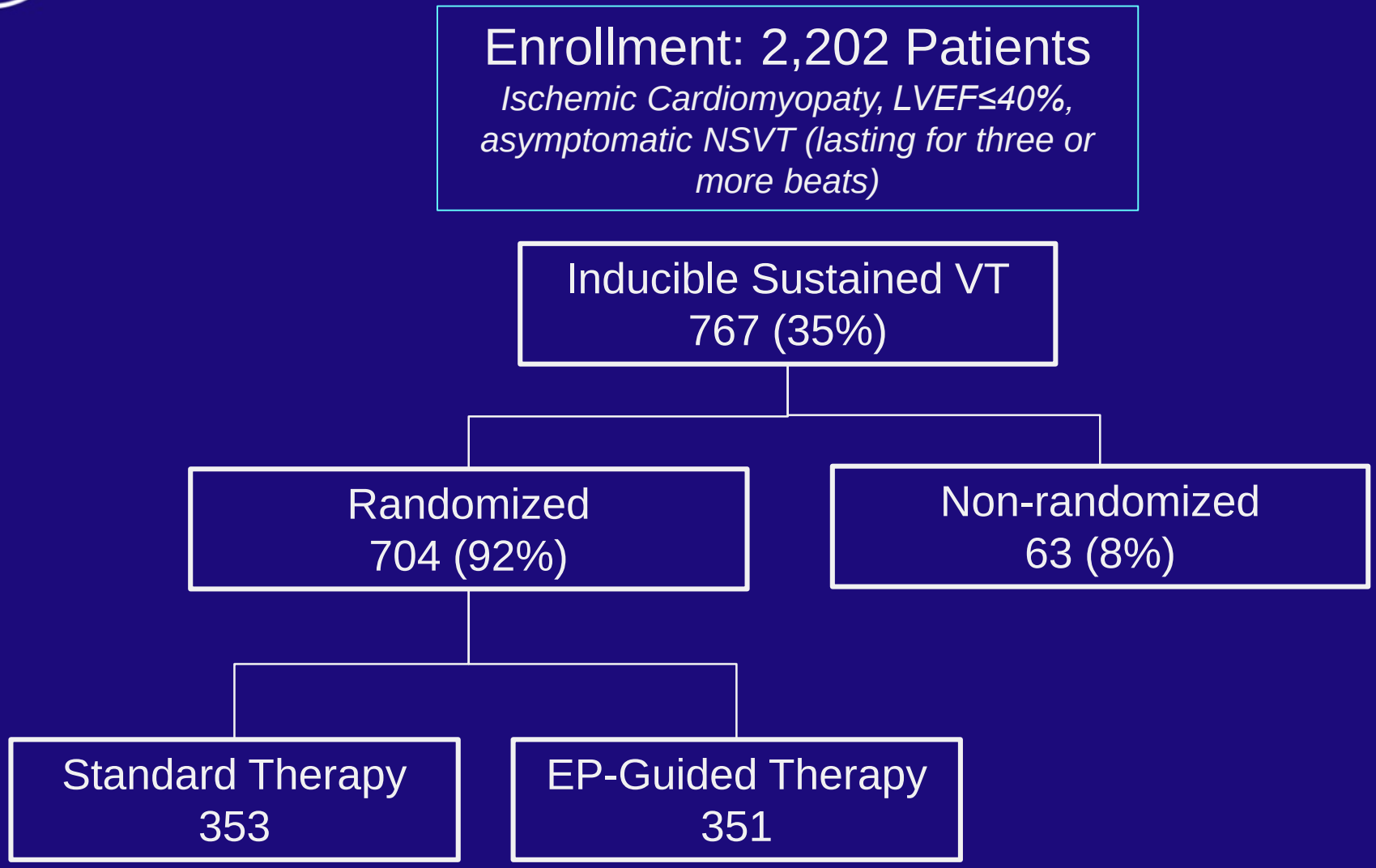
NSVT in patients with Ischemic Cardiomyopathy (MADIT I): The ultimate tool for risk stratification in primary prevention



- Five-year NNT values to prevent 1 major cardiovascular event in comparable primary prevention populations for statin therapy, antihypertensive therapy, and aspirin

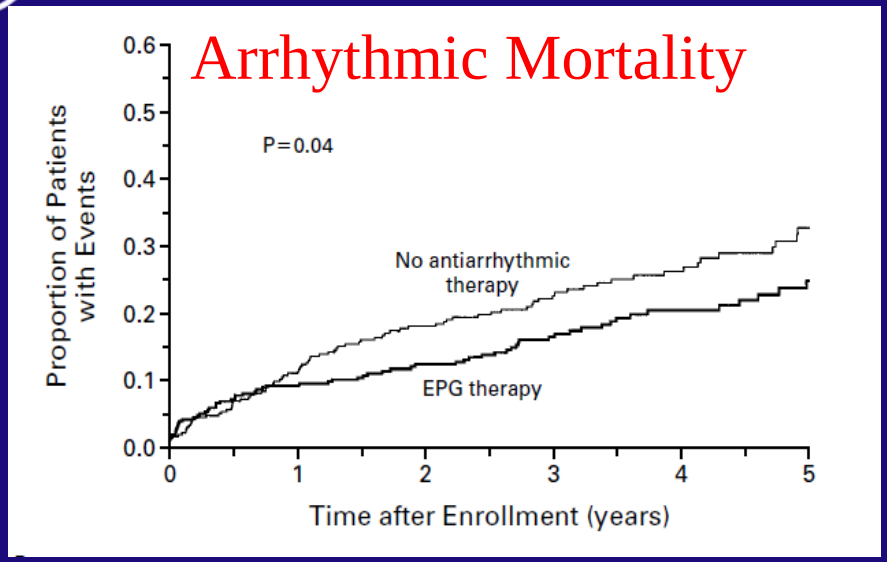
Ridker P. Circ Cardiovasc Qual Outcomes 2009;2:279-285

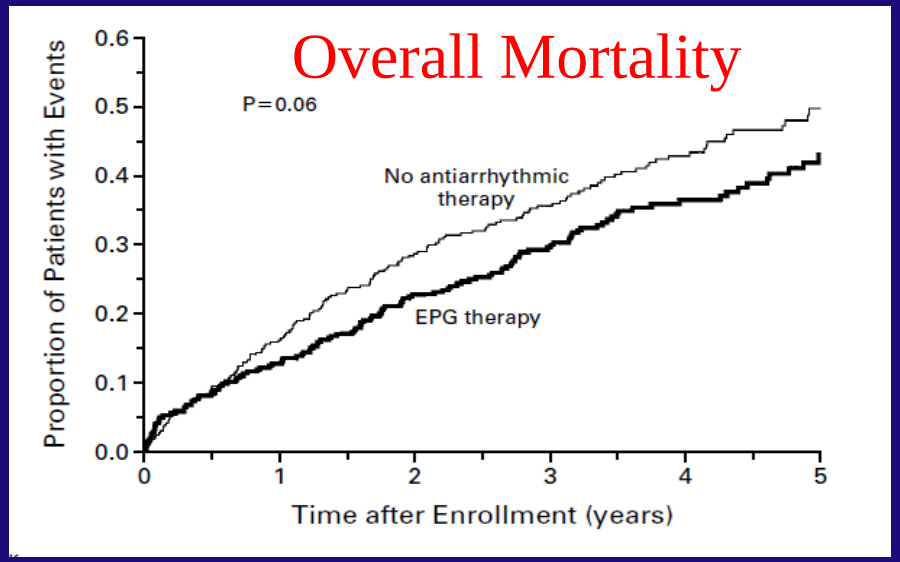
MUSTT: Study Design

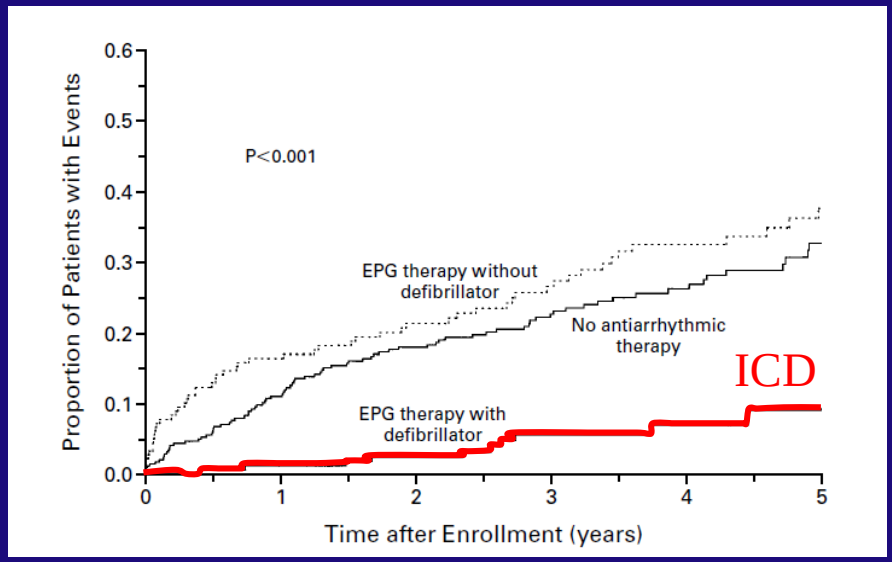


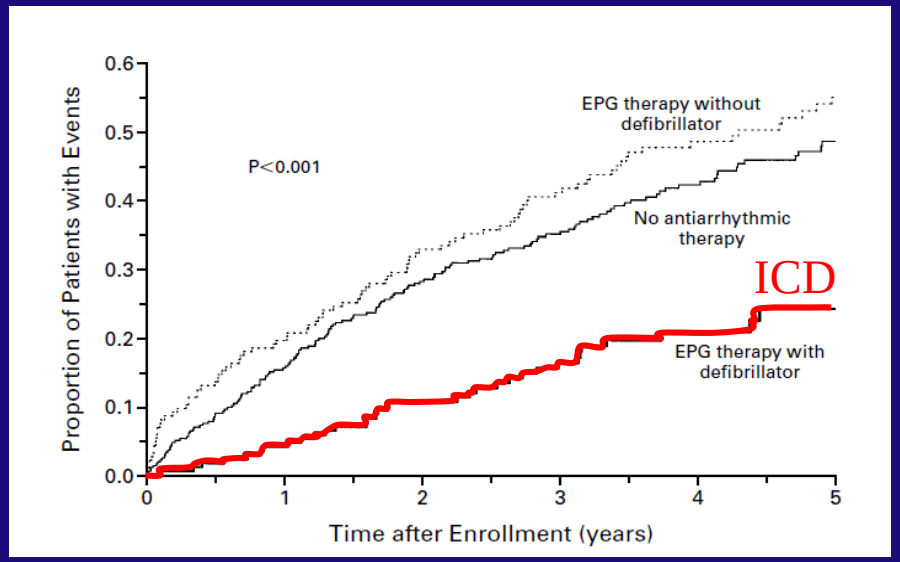
Buxton et al. NEJM 1999;341:1882-90

MUSTT: Arrhythmic and Overall Mortality







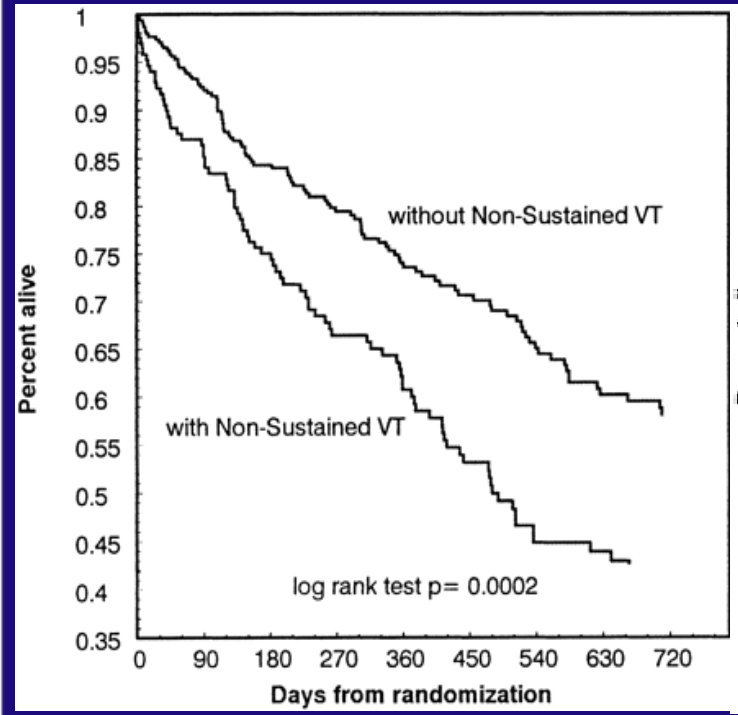


Buxton et al. NEJM 1999;341:1882-90

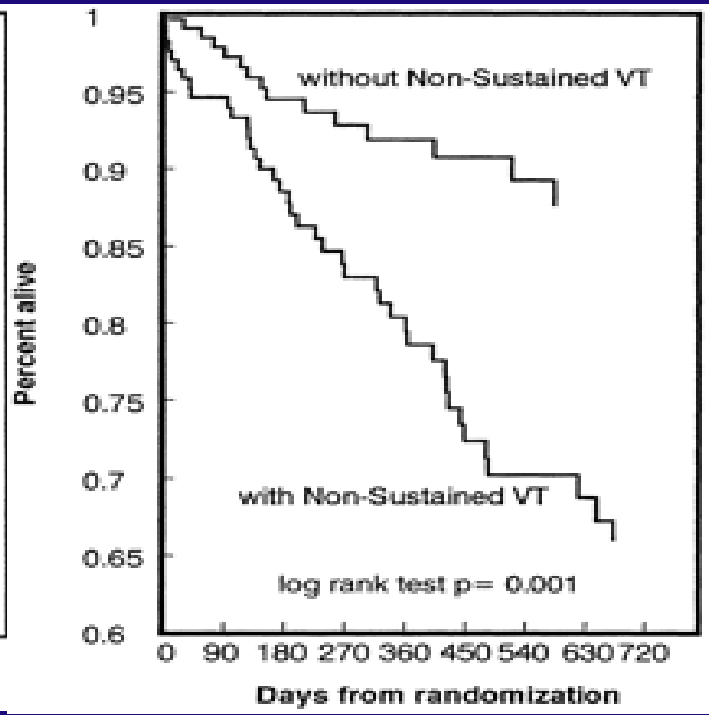
Nonsustained Ventricular Tachycardia in Severe Heart Failure
Independent Marker of Increased Mortality due to Sudden Death

Hernan C. Doval, MD; Daniel R. Nul, MD; Hugo O. Grancelli, MD; Sergio D. Varini, MD; Saul Soifer, MD; Gianni Corrado, MD; Sergio Dubner, MD; Omar Scapin, MD; Sergio V. Perrone, MD; for the GESICA–GEMA Investigators*
Correspondence to Dr Hernan C. Doval, Malvinas Argentinas 740, Capital Federal, Argentina, CP 1406.

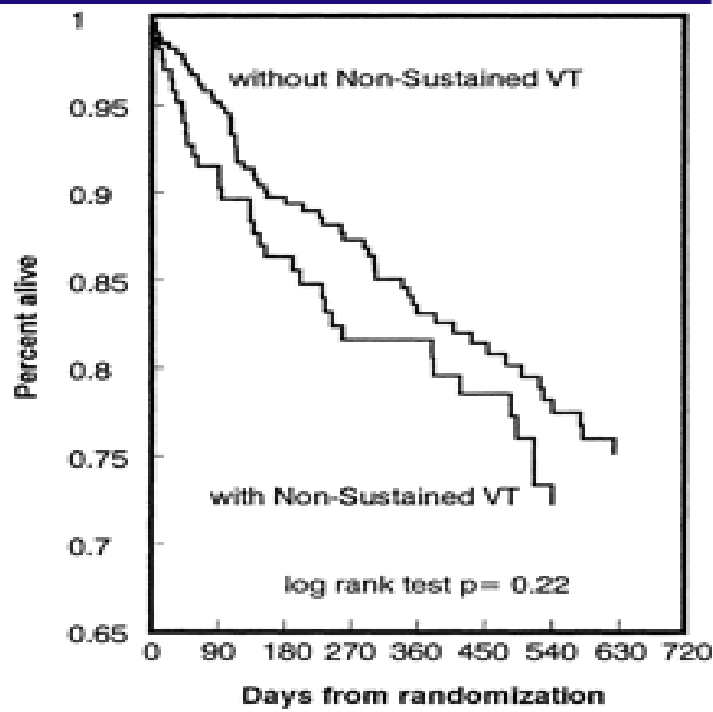
total mortality



sudden death



progressive heart failure death



The presence of NSVT correlates with total mortality, with a persistent increased risk of 1.63 after adjustment with other variables.

Doval et al. Circulation 1996;94:3198-3203

Amiodarone Versus Implantable Cardioverter-Defibrillator: Randomized Trial in Patients With Nonischemic Dilated Cardiomyopathy and Asymptomatic Nonsustained Ventricular Tachycardia—AMIOVIRT

S. Adam Strickberger, MD, FACC,* John D. Hummel, MD, FACC,† Thomas G. Bartlett, MD, FACC,‡ Howard I. Frumin, MD, FACC,§ Claudio D. Schuger, MD, FACC,‖ Scott L. Beau, MD, FACC,¶ Cynthia Bitar, RN,# Fred Morady, MD, FACC,# for the AMIOVIRT Investigators

Washington, DC; Columbus and Toledo, Ohio; Berkley, Detroit, Ann Arbor, Michigan; and Little Rock, Arkansas

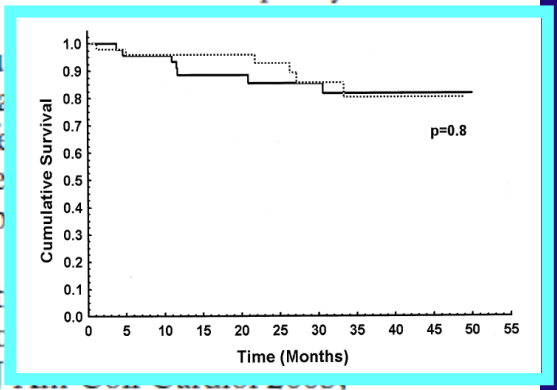
OBJECTIVES The purpose of this multicenter randomized trial was to compare total mortality during therapy with amiodarone or an implantable cardioverter-defibrillator (ICD) in patients with nonischemic dilated cardiomyopathy (NIDCM) and nonsustained ventricular tachycardia (NSVT).

BACKGROUND Whether an ICD reduces mortality more than amiodarone in patients with NIDCM and NSVT is unknown.

METHODS One hundred three patients with NIDCM, left ventricular ejection fraction ≤0.35, and asymptomatic NSVT were randomized to receive either amiodarone or an ICD. The primary end point was total mortality. Secondary end points included arrhythmia-free survival, quality of life, and costs.

RESULTS The study was stopped when the prospective stopping rule for fu
percent of patients surviving at one year (90% vs. 96%) and three yea
amiodarone and ICD groups, respectively, were not statistically diffe
of life was also similar with each therapy (p = NS). There was a tre
compared to the ICD, towards improved arrhythmia-free survival (p
during the first year of therapy ($8,879 vs. $22,039, p = 0.1).

CONCLUSIONS Mortality and quality of life in patients with NIDCM and NSVT t
or an ICD are not statistically different. There is a trend towards a mo
and improved arrhythmia-free survival with amiodarone therapy. (J
41:1707–12) © 2003 by the American College of Cardiology Foundation



Strickberger et al. JACC 2003;41:1707–12

Noninvasive Arrhythmia Risk Stratification in Idiopathic Dilated Cardiomyopathy

Results of the Marburg Cardiomyopathy Study

Wolfram Grimm, MD; Michael Christ, MD; Jennifer Bach, MD;
Hans-Helge Müller, PhD; Bernhard Maisch, MD

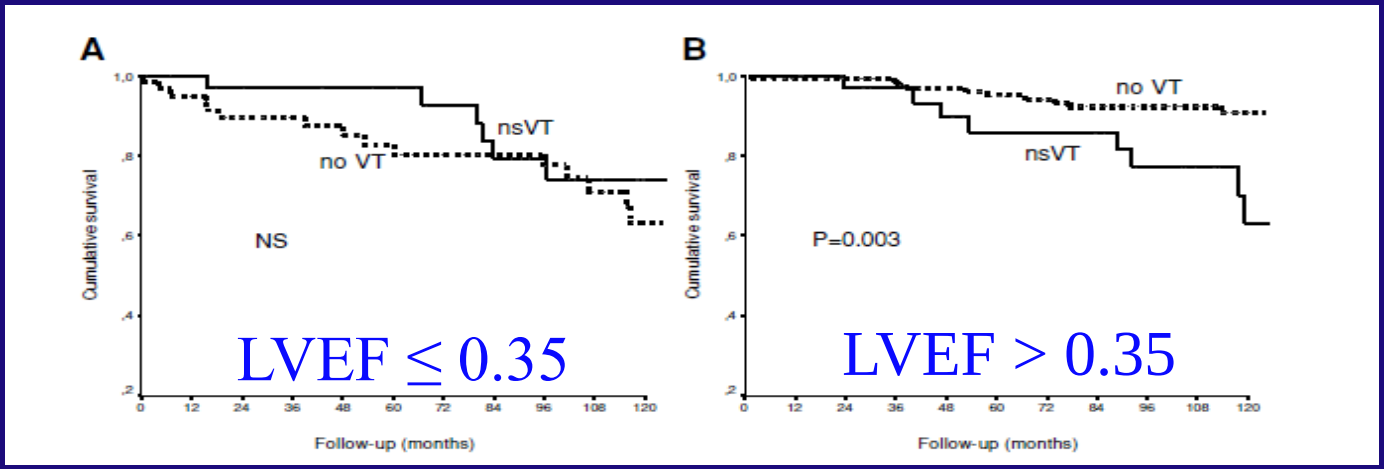
TABLE 3. Predictors of Transplantation-Free Survival in 263 Patients With IDC and Sinus Rhythm

	Transplantation-Free Survival		Univariate and Multivariate Cox Analysis		
	Yes (n=220)	No (n=43)	*P*, Univariate	*P*, Multivariate	RR (95% CI)
Medication at enrollment, n (%)					
Digitalis	149 (68)	40 (93)	0.006	NS	
Diuretics	166 (75)	38 (88)	0.06	NS	
ACE inhibitors	194 (88)	39 (91)	0.59	NS	
Spironolactone	28 (13)	6 (14)	0.21	NS	
β-Blockers	116 (53)	16 (37)	0.46	0.085	0.51 (0.24–1.11)
Echocardiographic study					
LV end-diastolic diameter, mm	66±7	70±8	0.003	NS	
LVEF, %	31±10	23±8	0.0001	0.0001	2.51 (1.65–3.85)*
Arrhythmias on 24-h Holter ECG, n (%)					
Nonsustained VT (≥3 beats)	69 (31)	19 (44)	0.09	NS	
Frequent VPDs (>10/h)	68 (31)	21 (49)	0.02	NS	

Grimm et al. Circulation. 2003;108:2883-2891

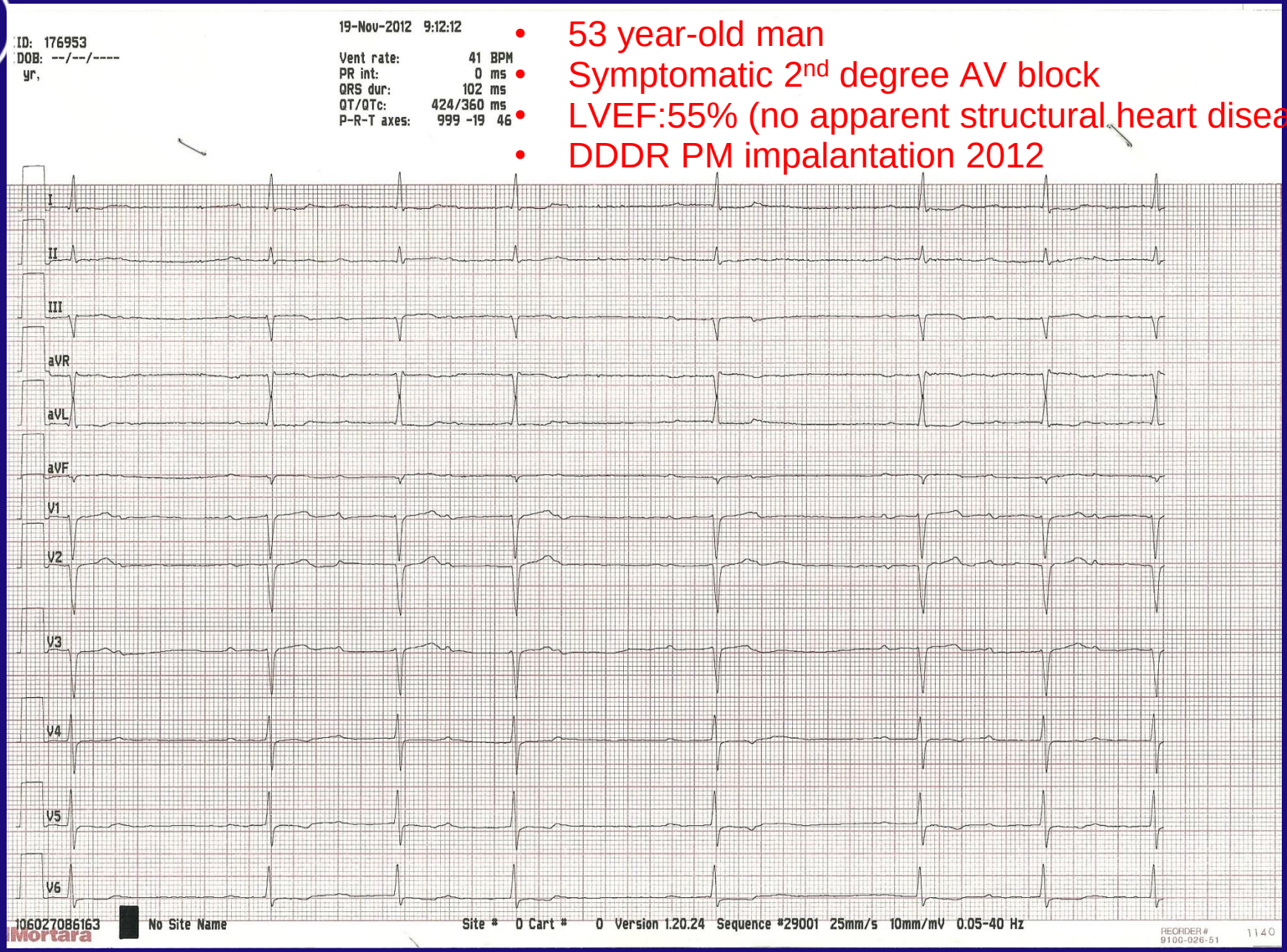
Are NSVTs predictive of major arrhythmias in patients with DCM on optimal medical treatment?

- 319 DCM patients were evaluated after adequate stabilization on optimal ACE inhibitor (88%) and beta-blocker (82%) therapy.
- 96 months follow-up
- Tested if NSVT is a prognostic factor for major arrhythmic events (unexpected SD, Sustain VT, VF, and appropriate ICD interventions)



- A significant reduction in NSVT incidence after optimization of medical treatment was evident.
- In patients with LVEF≤ 35%, event rate was similar regardless of NSVT (3.6 and 4.1 patient-years, respectively, in those with and without NSVT, P = NS), while in patients with LVEF > 0.35, event rate (3.1 per 100 patient-years vs 0.9 per 100 patient-years, P = 0.003) was significantly higher when NSVT were present.

Zecchin et al. PACE 2008;31:290-9



- 53 year-old man
- Symptomatic 2nd degree AV block
- LVEF:55% (no apparent structural heart disease)
- DDDR PM impalantation 2012

ST. JUDE MEDICAL
MORE CONTROL. LESS RISK.

Emmanouil Aleksandros
Accent™ DR 2112 Pacemaker 4308517
Implanting Physician: Dr P. Ioannidis

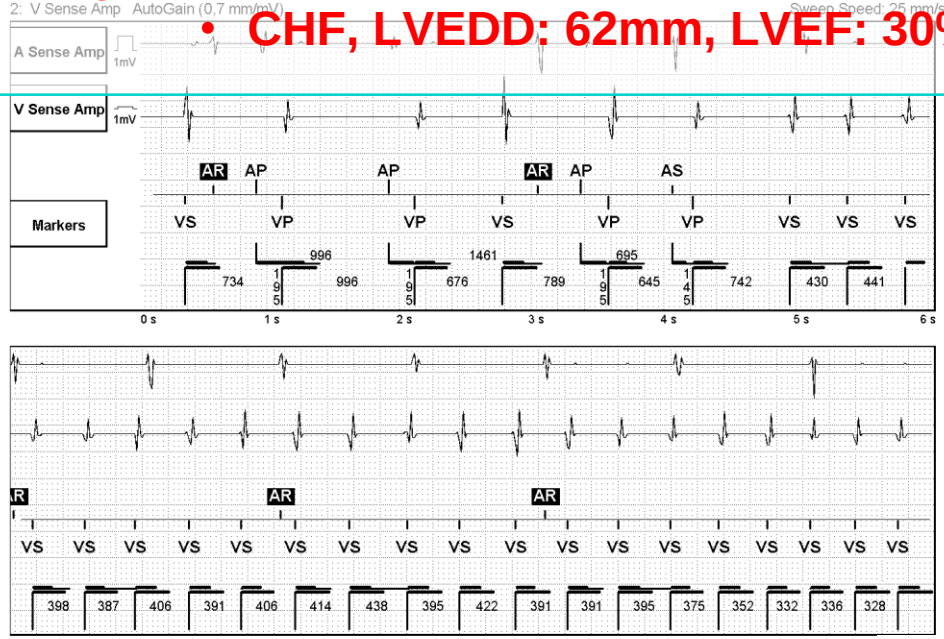
30 Dec 2014
17:54
In-Clinic

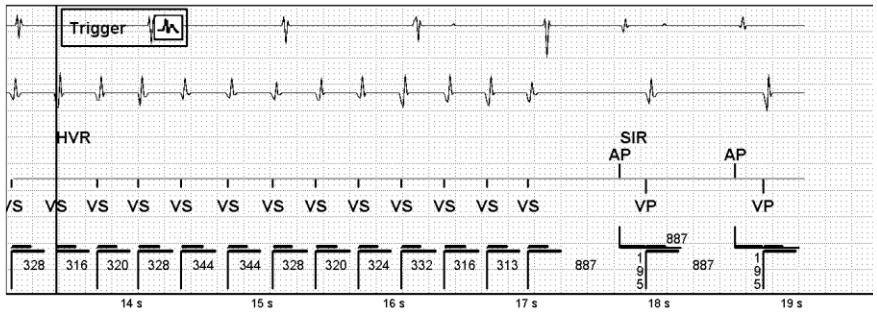
Episode: High Ventricular Rate

Episode 23 of 23
Page 1 of 2

25 Dec 2014 10:09

- **NSVT in routine PM interrogation**
- **Coro: (-)**
- **3 years later →**
  - **CHF, LVEDD: 62mm, LVEF: 30%**

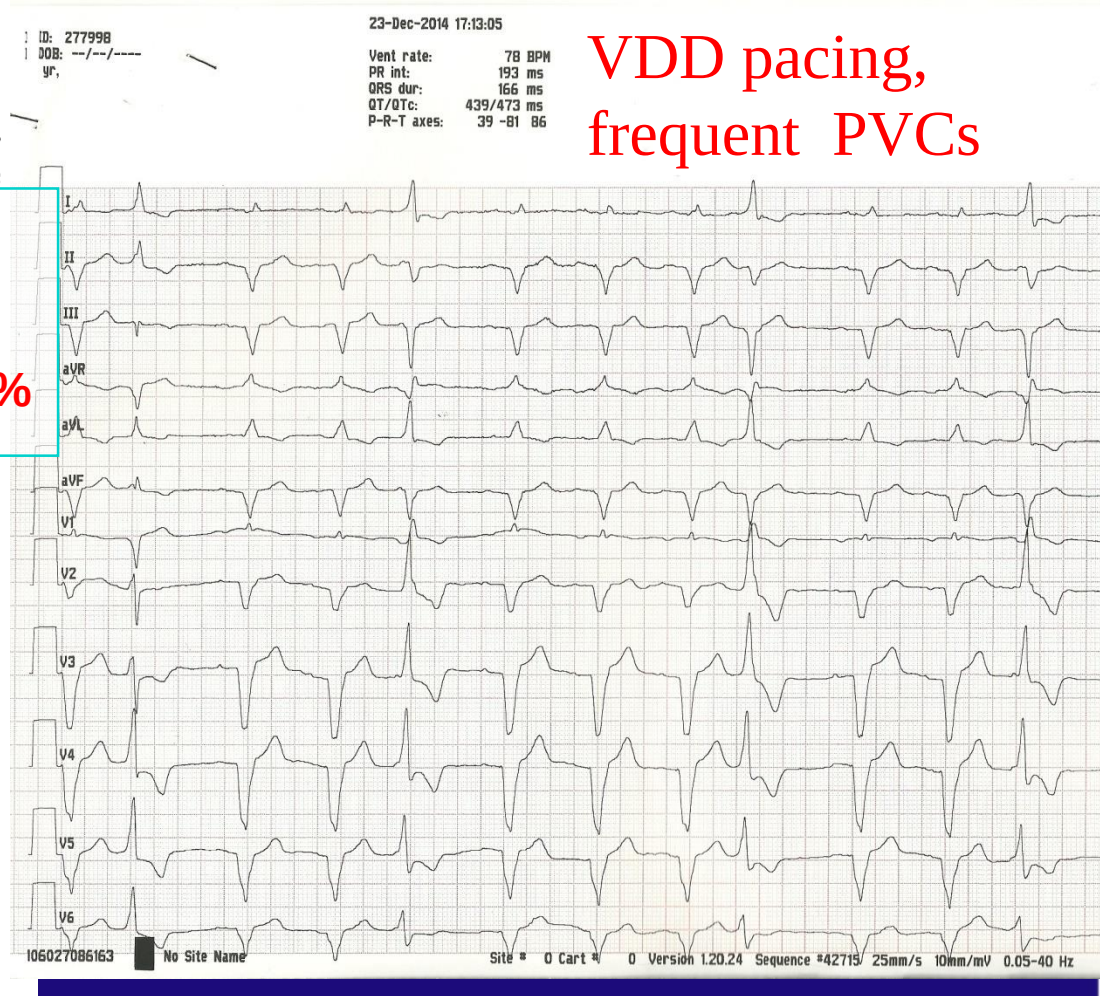




Accent™ DR 2112 Pacemaker (4308517 prB.E.76)
Merlin™ PCS (#12047285 3330 v18.2 rev 1)

Episode 23 of 23 F
30 Dec 2014 17:54

VDD pacing, frequent PVCs



ST. JUDE MEDICAL
MORE CONTROL. LESS RISK.

Emmanouil Aleksandros
Accent™ DR 2112 Pacemaker 4308517
Implanting Physician: Dr P. Ioannidis

30 Dec 2014
17:56
In-Clinic

Diagnostics Summary

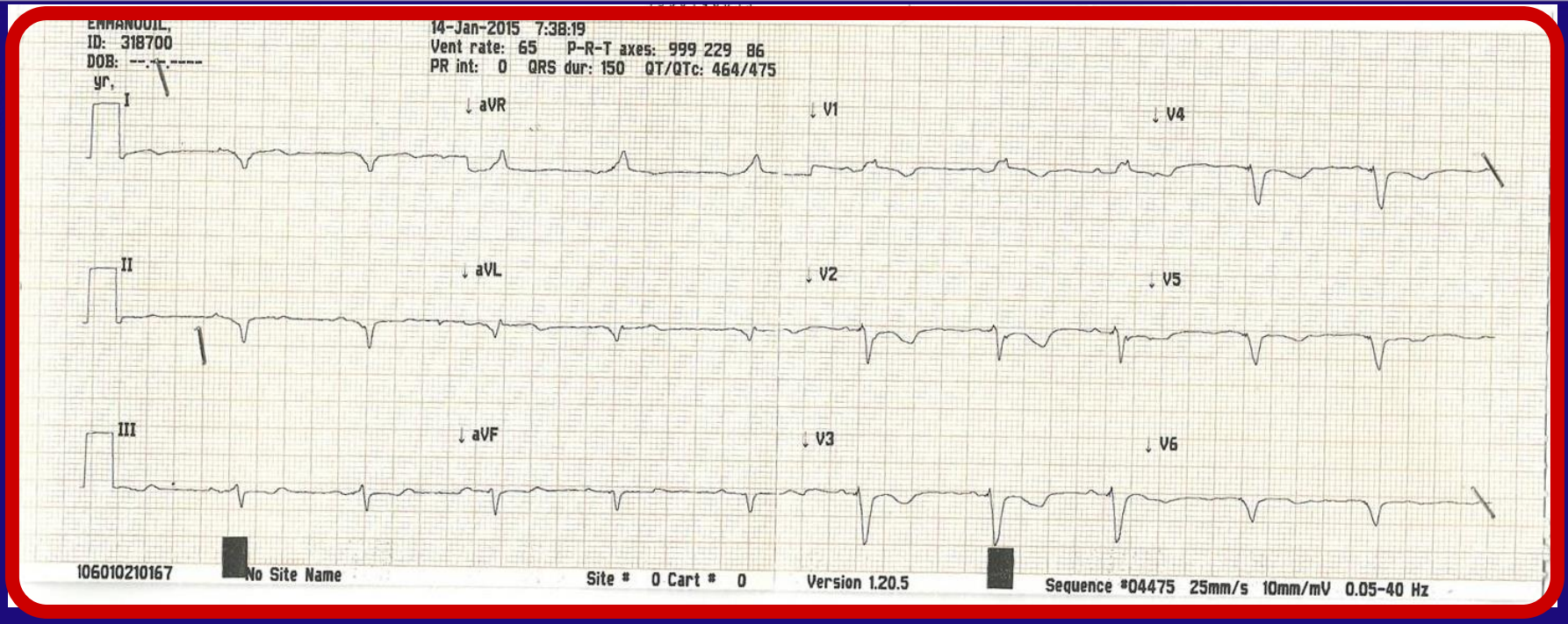
Page 1 of 1

Events	Since 20 Jun 2013	Lifetime
AP	36%	47%
VP	90%	89%
VSt	n/a	0%

Includes time in AMS

Events	Since 20 Jun 2013
AS-VP	45%
AS-VS	1,4%
AP-VP	45%
AP-VS	<1%
PVC	8,4%, 6,0M counts

Excludes time in AMS



[redacted]

Diagnostics Summary Since 3 Aug 2015

AP	54 %
BP	99 %
AMS Episodes	0
Mode Switch	0%
AT/AF Burden	0%

VT/VF Episodes: 0 Since 23 Jul 2015

	VT	VF
Episodes	0	0
ATP Delivered	0	0
Shocks Delivered	0	0

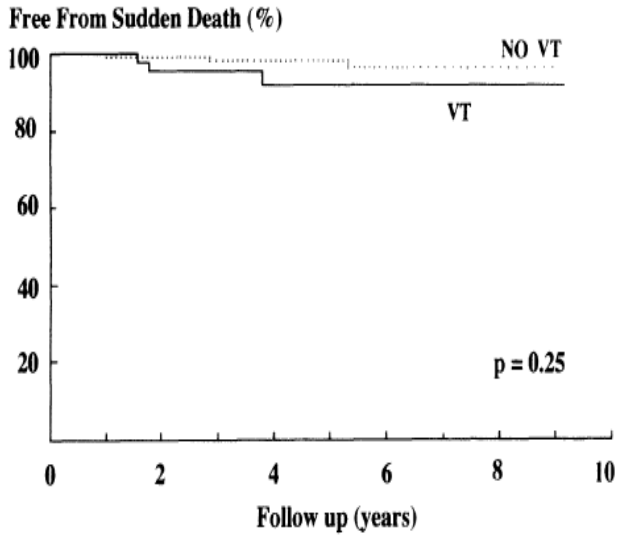
SVT Episodes: 0
Non-sustained Episodes: 0

No Alerts

Hypertrophic Cardiomyopathy and NSVT

Prognosis of Asymptomatic Patients With Hypertrophic Cardiomyopathy and Nonsustained Ventricular Tachycardia

Paolo Spirito, MD; Claudio Rapezzi, MD; Camillo Autore, MD; Paolo Bruzzi, MD, PhD; Pietro Bellone, MD; Paolo Ortolani, MD; Pietro V. Fragola, MD; Franco Chiarella, MD; Massimo Zoni-Berisso, MD; Angelo Branzi, MD; Dario Cannata, MD; Bruno Magnani, MD; Carlo Vecchio, MD



Kaplan-Meier estimate of survival from sudden cardiac death in patients with ventricular tachycardia (VT) and in patients without VT.

TABLE 3. Total Cardiac Mortality and Sudden Cardiac Death in Patients With VT and Patients Without VT

	42 Patients With VT		109 Patients Without VT			
	No. of Events	% Annual Rate	No. of Events	% Annual Rate	P	Relative Risk*
Total cardiac mortality (95% CI)	3	1.4 (0.4-3.5)	5	0.9 (0.4-2.0)	.43	1.4 (0.6-6.1)
Sudden cardiac death (95% CI)	3	1.4 (0.4-3.5)	3	0.6 (0.2-1.5)	.24	2.4 (0.5-11.9)

VT indicates ventricular tachycardia.
*For patients with VT compared with patients without VT.

Spirito et al. Circulation 1994;90:2743-2747

Non-Sustained Ventricular Tachycardia in Hypertrophic Cardiomyopathy: An Independent Marker of Sudden Death Risk in Young Patients

Lorenzo Monserrat, MD,† Perry M. Elliott, MD, MRCP, FACC,* Juan R. Gimeno, MD,* Sanjay Sharma, BSc, MRCP,* Manuel Penas-Lado, MD,† William J. McKenna, MD, FACC, FESC, FRCP*

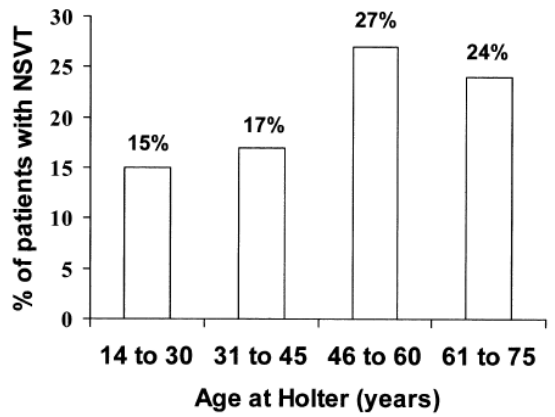
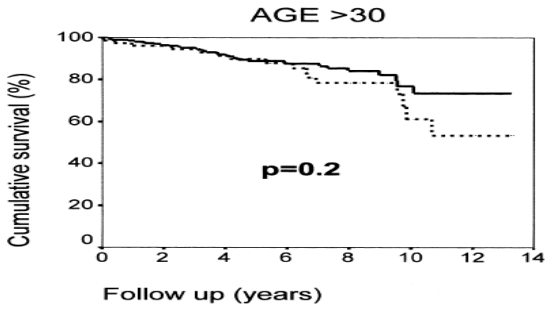


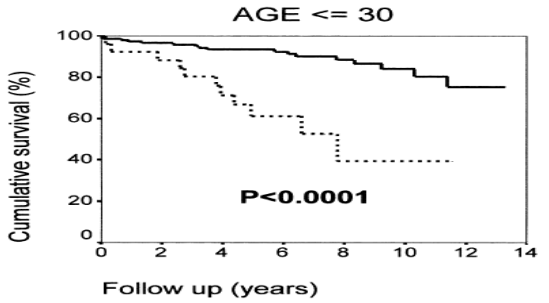
Figure 1. Relation of age to the presence of non-sustained ventricular tachycardia (NSVT) during Holter monitoring. The incidence of NSVT increases with age (p = 0.008).

- NSVT is associated with a substantial increase in sudden death risk in young patients with HCM. A relation between the frequency, duration, and rate of NSVT episodes could not be demonstrated.



Number of patients at risk							
Without NSVT	279	235	184	119	66	23	7
With NSVT	78	68	57	38	28	9	6

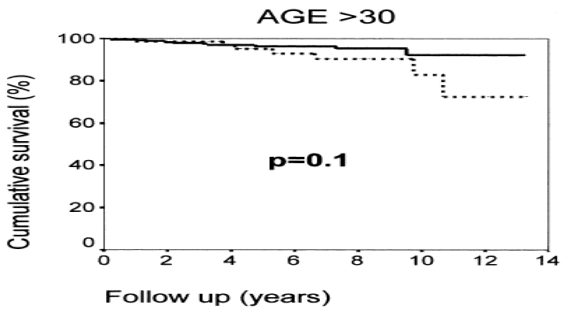
A



Number of patients at risk							
Without NSVT	148	132	107	84	50	25	13
With NSVT	26	22	16	10	3	1	0

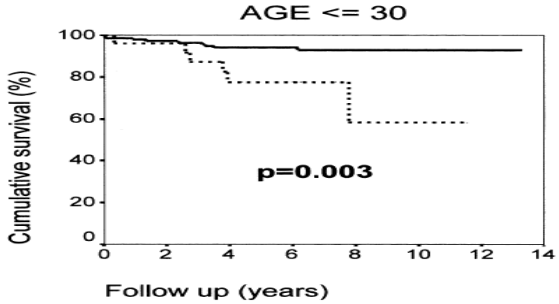
B

Figure 4. Kaplan-Meier survival curves for all-cause mortality, heart transplantation, or appropriate implantable cardioverter defibrillator discharge in patients older **(A)** and younger **(B)** than 30 with and without non-sustained ventricular tachycardia (NSVT). **Dotted lines** = yes; **solid lines** = no.



Number of patients at risk							
Without NSVT	279	235	184	119	66	23	7
With NSVT	78	68	57	38	28	9	6

A



Number of patients at risk							
Without NSVT	148	132	107	84	50	25	13
With NSVT	26	22	16	10	3	1	0

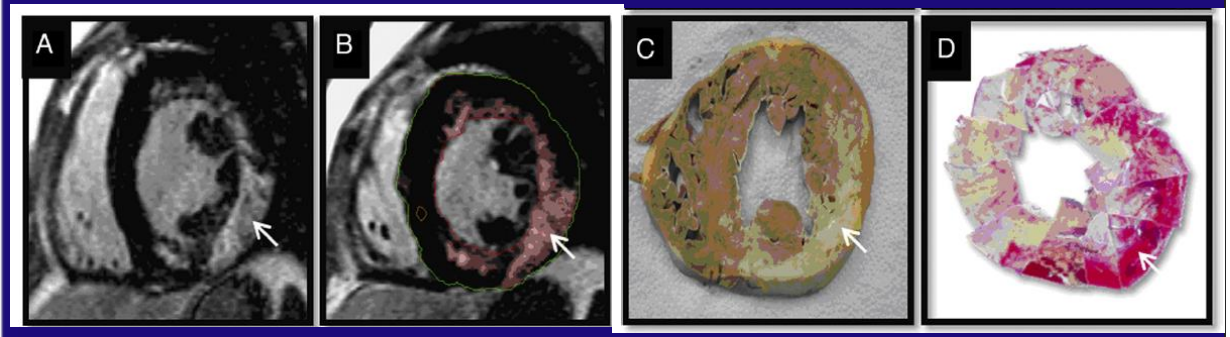
B

Figure 3. Kaplan-Meier survival curves for sudden death in patients older **(A)** and younger **(B)** than 30 with and without non-sustained ventricular tachycardia (NSVT). **Dotted lines** = yes; **solid lines** = no.

Monserrat et al. JACC 2003;42:873–9

Prognostic Significance of Myocardial Fibrosis in Hypertrophic Cardiomyopathy

Rory O'Hanlon, MD,* Agata Grasso, MD,* Michael Roughton, MSc,¶ James C. Moon, MD,§ Susan Clark, RN,* Ricardo Wage,* Jessica Webb, MD,* Meghana Kulkarni, MD,* Dana Dawson, MD, PhD,* Leena Sulaibeekh, MD,* Badri Chandrasekaran, MD,* Chiara Bucciarelli-Ducci, MD,* Ferdinando Pasquale, MD,§ Martin R. Cowie, MD,† William J. McKenna, MD,‖ Mary N. Sheppard, MD,‡ Perry M. Elliott, MD,‖ Dudley J. Pennell, MD,* Sanjay K. Prasad, MD*



- 217 consecutive HCM patients→ 136 (63%) fibrosis; 81 no-fibrosis (37%)
- Prospective study; FU 3.1+/- 1.7 y
- Primary end point: CV death, unplanned cardiovascular admission & Arrhythmic Events (sustained VT or VF, or appropriate ICD shock)
- NSVT remained an independent predictor of arrhythmic end points, but the extent of fibrosis did not

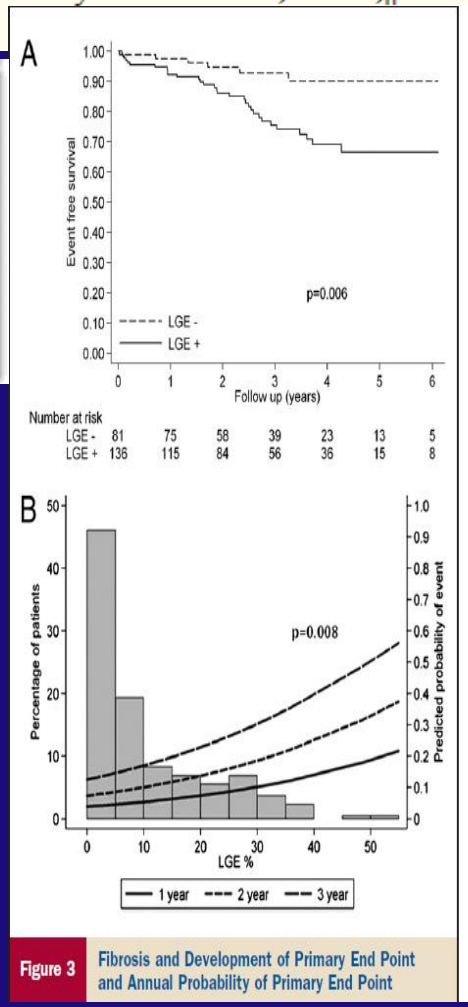


Figure 3 Fibrosis and Development of Primary End Point and Annual Probability of Primary End Point

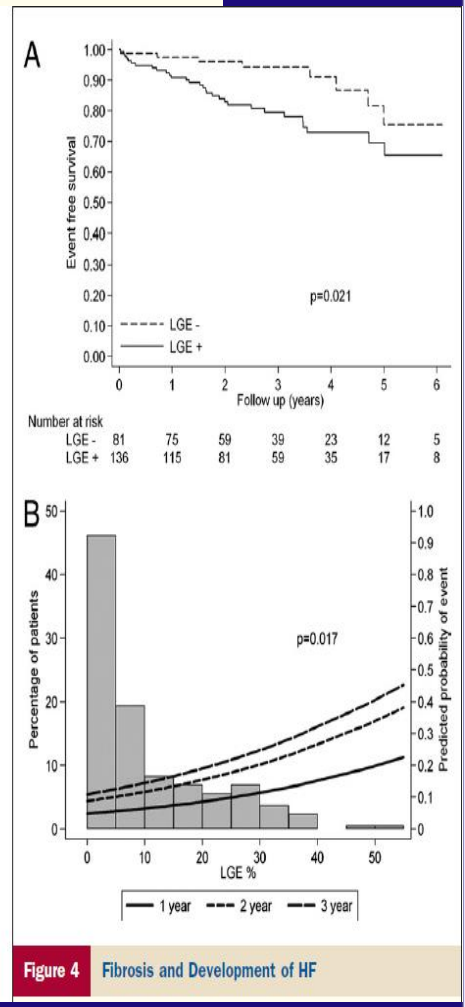


Figure 4 Fibrosis and Development of HF

O'Hanlon et al. JACC 2010;56:867-74

EUROPEAN SOCIETY OF CARDIOLOGY®

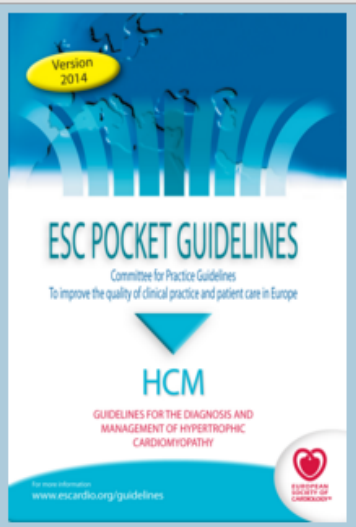
HCM Risk-SCD Calculator

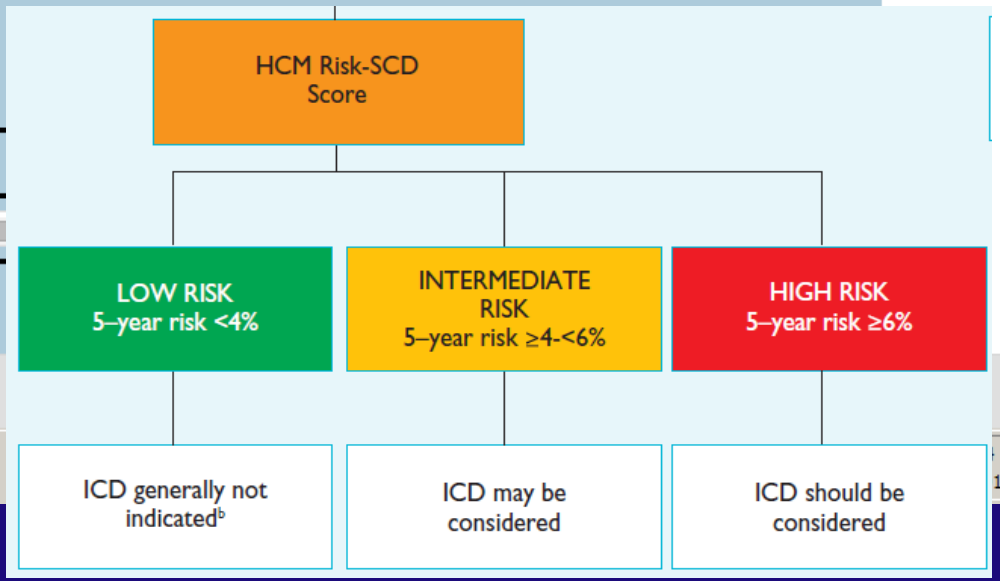
Age	**Years**	*Age at evaluation*
Maximum LV wall thickness	**mm**	*Transthoracic Echocardiographic measurement*
Left atrial size	**mm**	*Left atrial diameter determined by M-Mode or 2D echocardiography in the parasternal long axis plane at time of evaluation*
Max LVOT gradient	**mmHg**	*The maximum LV outflow gradient determined at rest and with Valsalva provocation (irrespective of concurrent medical treatment) using pulsed and continuous wave Doppler from the apical three and five chamber views. Peak outflow tract gradients should be determined using the modified Bernouilli equation: Gradient= $4V^2$, where V is the peak aortic outflow velocity*
Family History of SCD	○ No ○ Yes	*History of sudden cardiac death in 1 or more first degree relatives under 40 years of age or SCD in a first degree relative with confirmed HCM at any age (post or ante-mortem diagnosis).*
Non-sustained VT	○ No ◉ Yes	*3 consecutive ventricular beats at a rate of 120 beats per minute and <30s in duration on Holter monitoring (minimum duration 24 hours) at or prior to evaluation.*
Unexplained syncope	○ No ○ Yes	*History of unexplained syncope at or prior to evaluation.*

Risk of SCD at 5 years (%):

ESC recommendation:

Reset



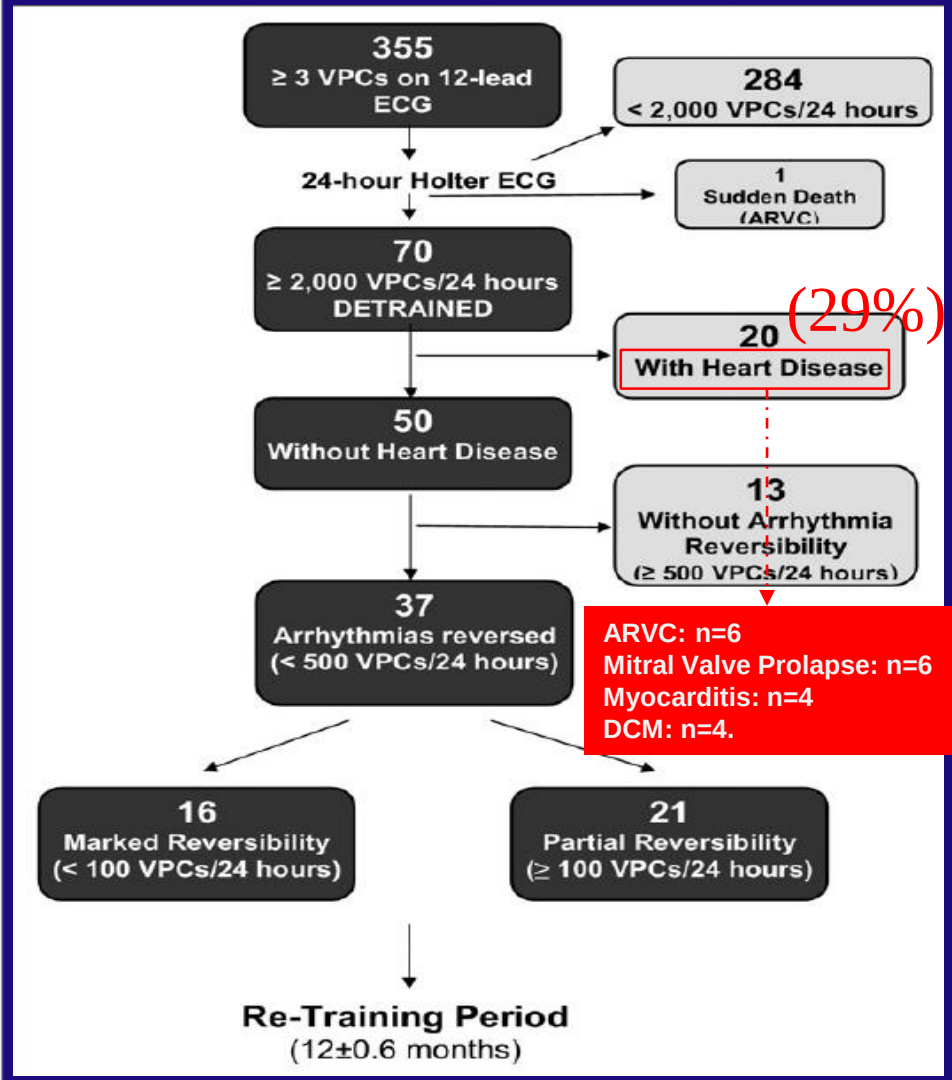


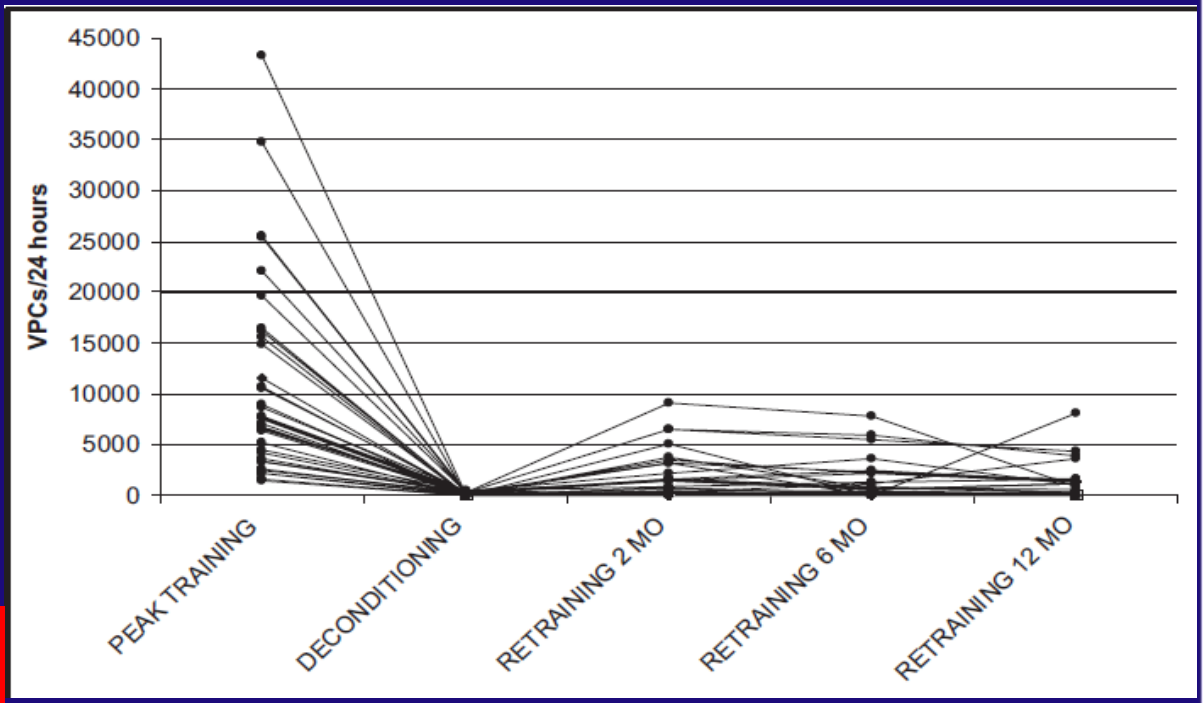
2014 ESC Guidelines on diagnosis and management of HCM Eur Heart J. 2014;35:2733-79

Ventricular Ectopy and NSVT in Athlete's Heart

Patterns of Ventricular Tachyarrhythmias Associated With Training, Deconditioning and Retraining in Elite Athletes Without Cardiovascular Abnormalities

Alessandro Biffi, MD[a,*], Barry J. Maron, MD[b], Franco Culasso, MD[c], Luisa Verdile, MD[a], Fredrick Fernando, MD[d], Barbara Di Giacinto, MD[a], Fernando M. Di Paolo, MD[a], Antonio Spataro, MD[a], Pietro Delise, MD[e], and Antonio Pelliccia, MD[a]

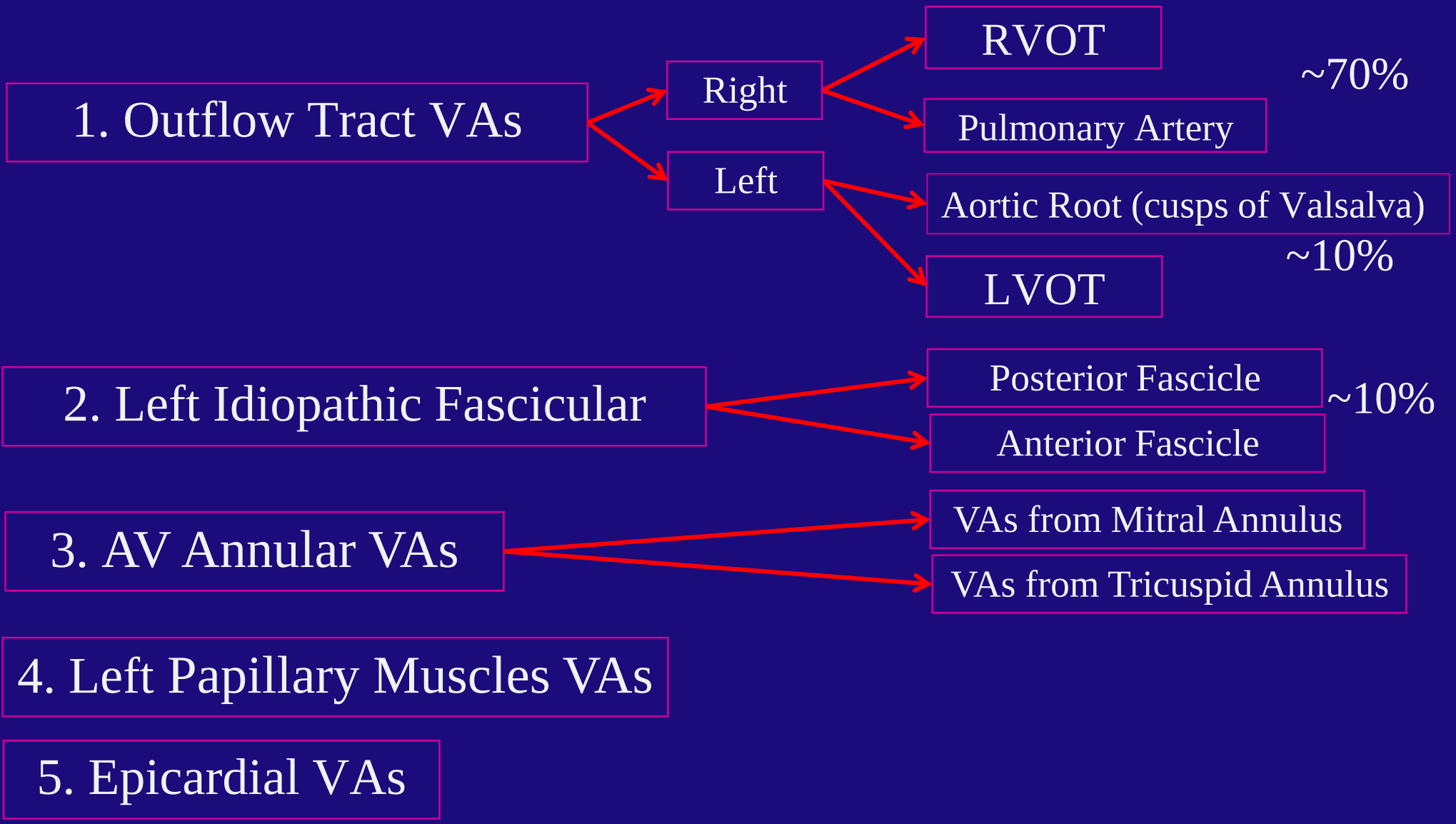




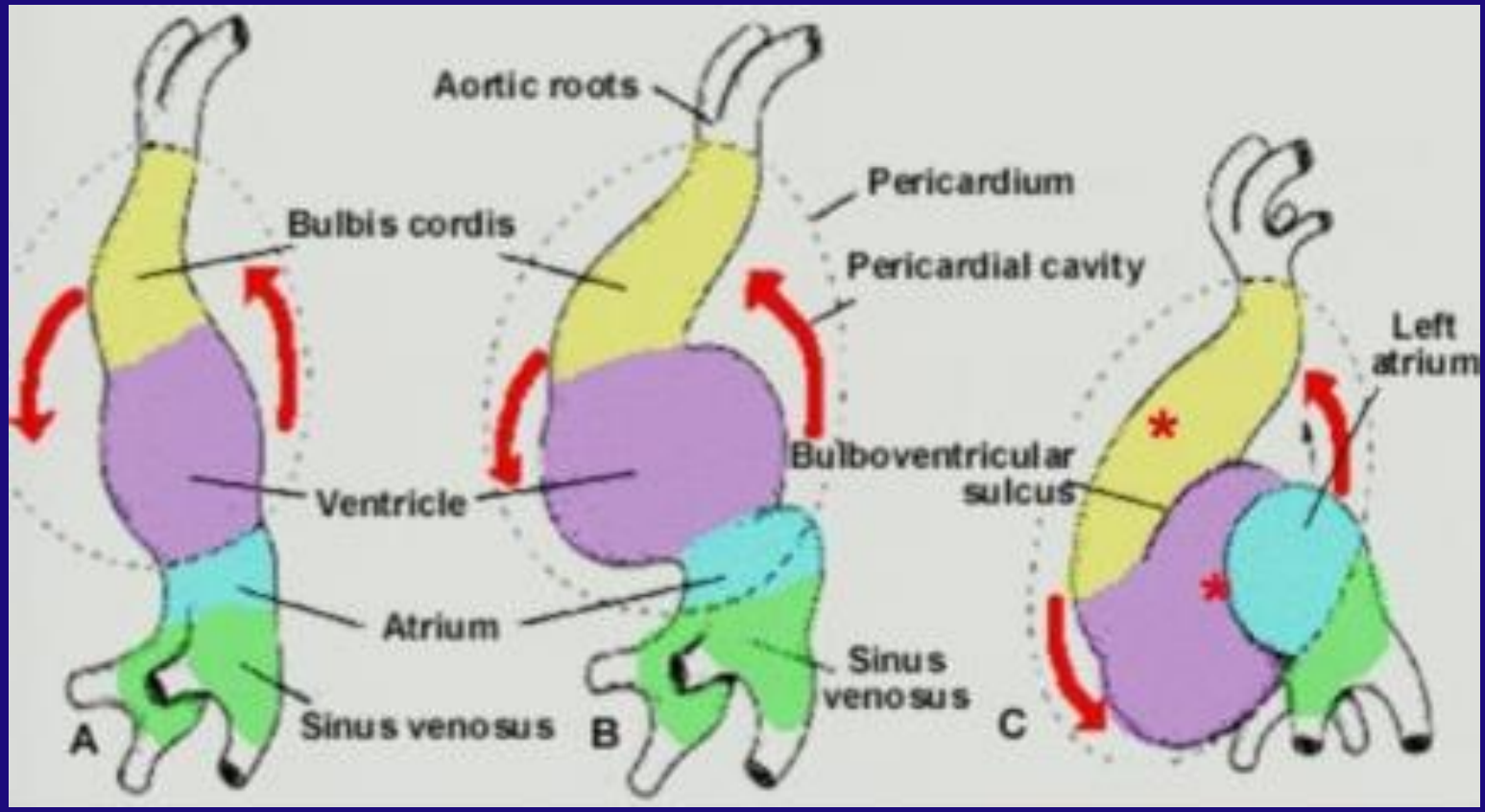
The absence of adverse clinical events with the resumption of training supports the continued eligibility in competitive sports for such athletes and is also consistent with the benign nature of physiologic athlete's heart syndrome

Biffi et al, Am J Cardiol 2011;107:697–703

Idiopathic Ventricular Arrhythmias (VAs)



Outflow Tract Ventricular Arrhythmias: Developmental basis for electrophysiological heterogeneity

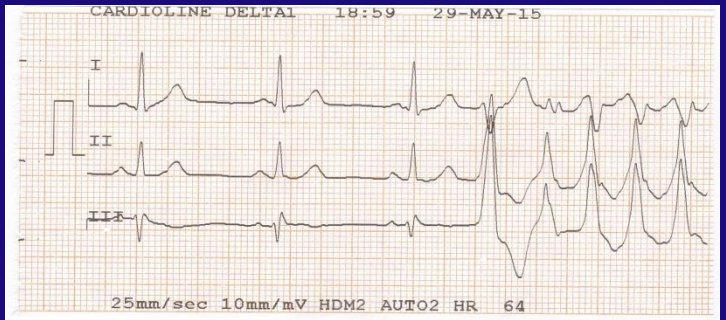


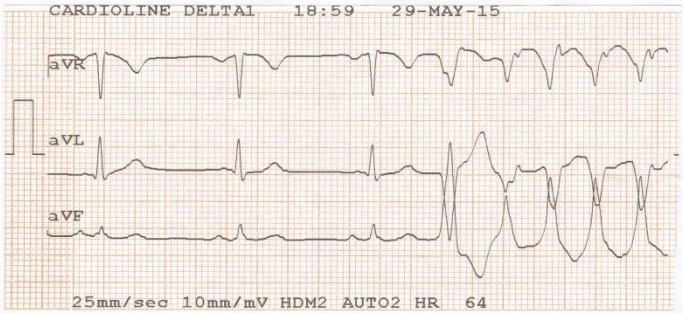
Idiopathic NSVT

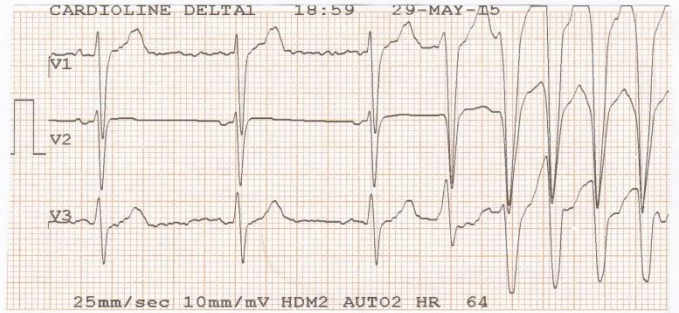
- 47 years-old man
- Palpitations
- No structural Heart Disease

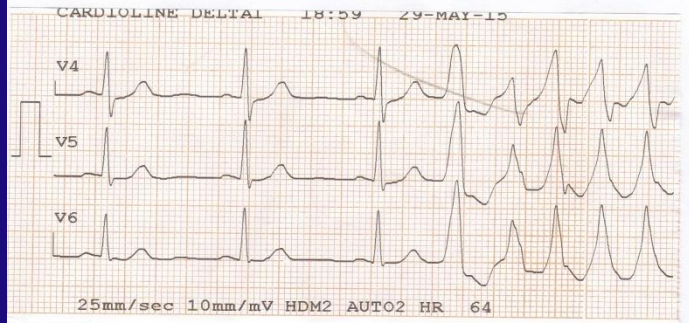
24h Holter:

- 8,000 PVCs
- 15 episodes of NSVT
- No response to beta-blocker therapy



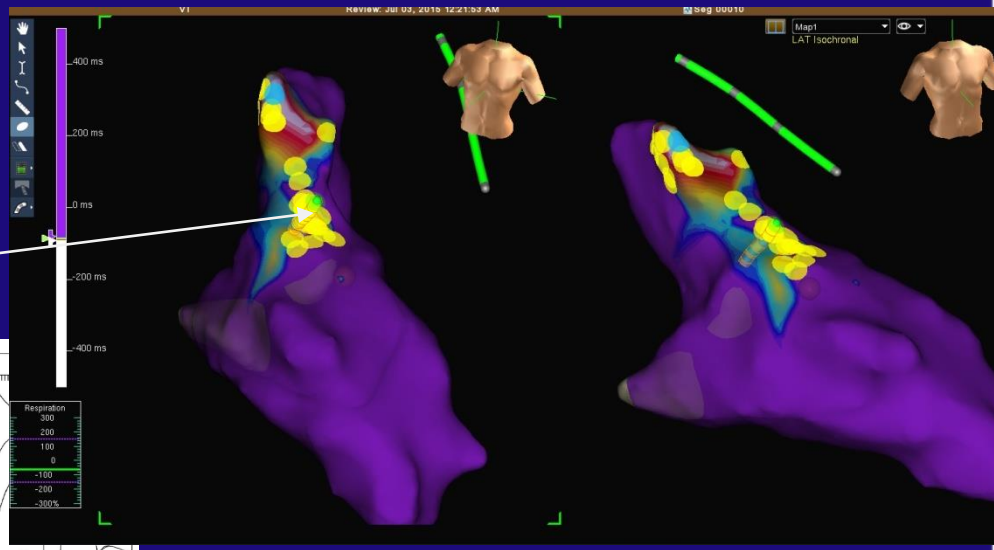


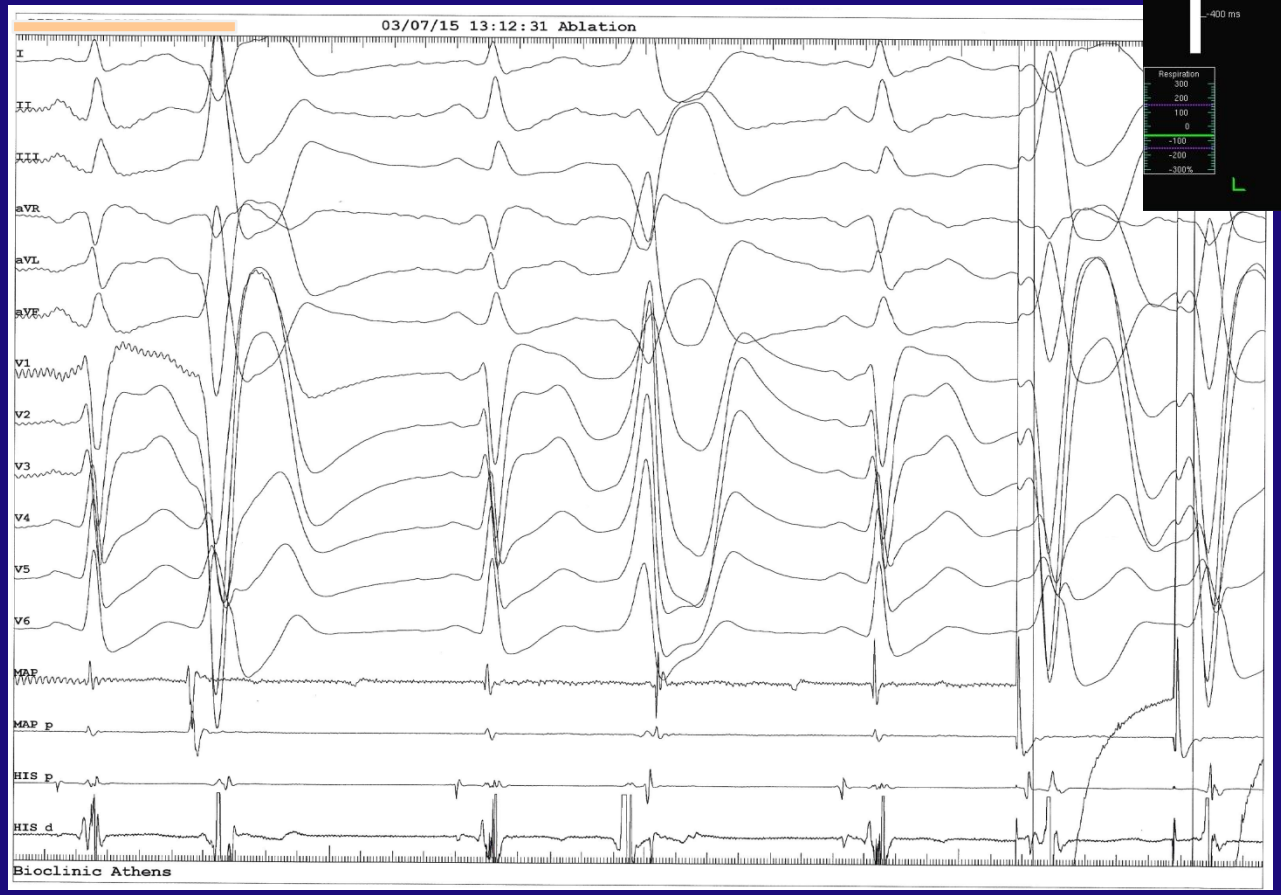




- Catheter Ablation
  - Activation, Pace and 3D Mapping

Low voltage areas





- 24h Holter: Elimination of arrhythmic activity
- Cardiac MRI: (-)
- Recent 24h Holter: 1000 PVCs probably from RVOT; patient asymptomatic

Prevalence and Prognostic Value of Concealed Structural Abnormalities in Patients With Apparently Idiopathic Ventricular Arrhythmias of Left Versus Right Ventricular Origin

A Magnetic Resonance Imaging Study

Gaetano Nucifora, MD; Daniele Muser, MD; Pier Giorgio Masci, MD; Andrea Barison, MD; Luca Rebellato, MD; Gianluca Piccoli, MD; Elisabetta Daleffe, MD; Mauro Toniolo, MD; Davide Zanuttini, MD; Domenico Facchin, MD; Massimo Lombardi, MD; Alessandro Proclemer, MD

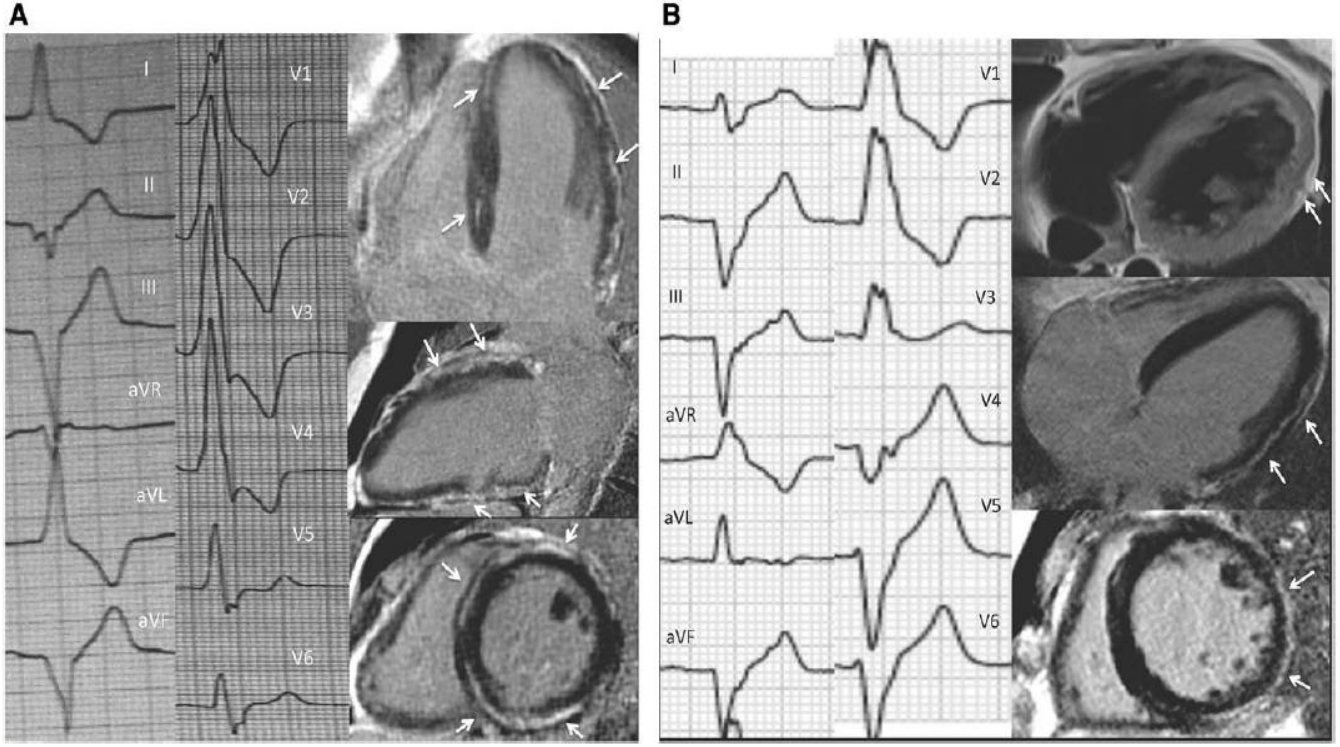


Figure 2. **A**, A 29-year-old asymptomatic football player with family history of sudden cardiac death was diagnosed as having apparently idiopathic frequent premature ventricular beats with right bundle branch block (RBBB) morphology and superior QRS axis (**left**) during screening tests for sport eligibility. Cardiac magnetic resonance late gadolinium enhancement imaging (**right**) demonstrated nonischemic myocardial scar involving the lateral, inferior, and anterior wall of the left ventricle and the interventricular septum. **B**, A 40-year-old military pilot with family history of cardiomyopathy was diagnosed as having apparently idiopathic frequent premature ventricular beats with RBBB morphology and superior QRS axis (**left**) during routine screening tests. Cardiac magnetic resonance T1-weighted imaging demonstrated signal abnormalities suggestive of myocardial fatty replacement of the lateral left ventricular wall (**right upper picture**). Late gadolinium enhancement with nonischemic pattern of the lateral left ventricular wall was also present (**right mid and lower picture**).

Left Right

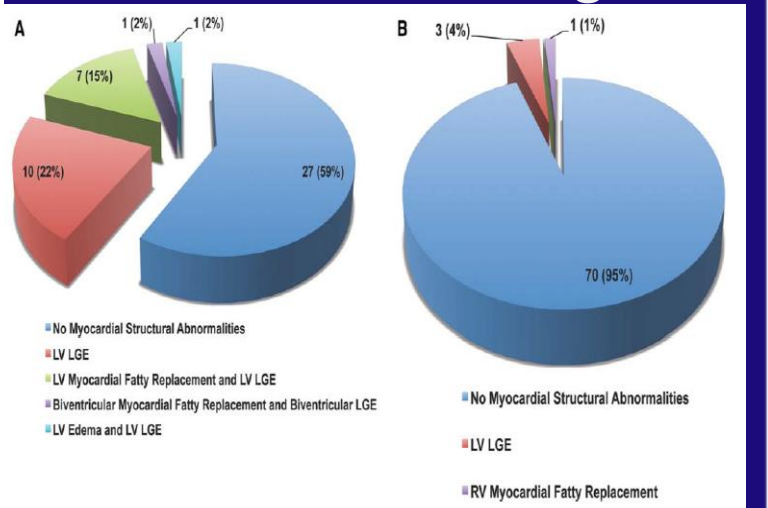
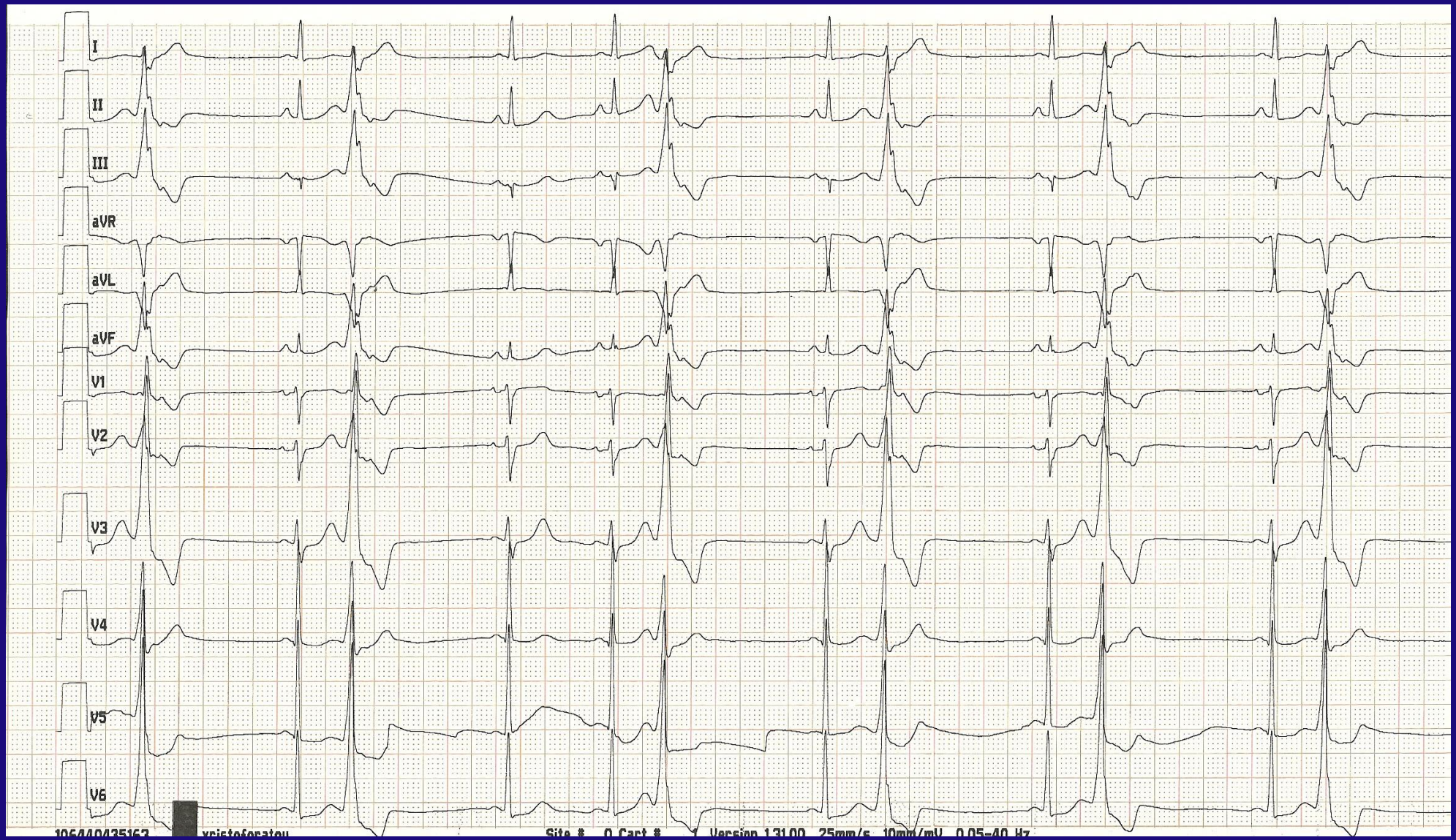


Figure 1. Distribution of myocardial structural abnormalities among patients with apparently idiopathic ventricular arrhythmias of left ventricular origin (**A**) and right ventricular origin (**B**). LGE indicates late gadolinium enhancement; LV, left ventricle; and RV, right ventricle.

19% of pts with structural abnormalities (late gadolinium enhancement, fatty replacement)

Nucifora et al. Circ Arrhythm Electrophysiol. 2014;7:456-462

Cardiomyopathy from High Ventricular Ectopy Burden

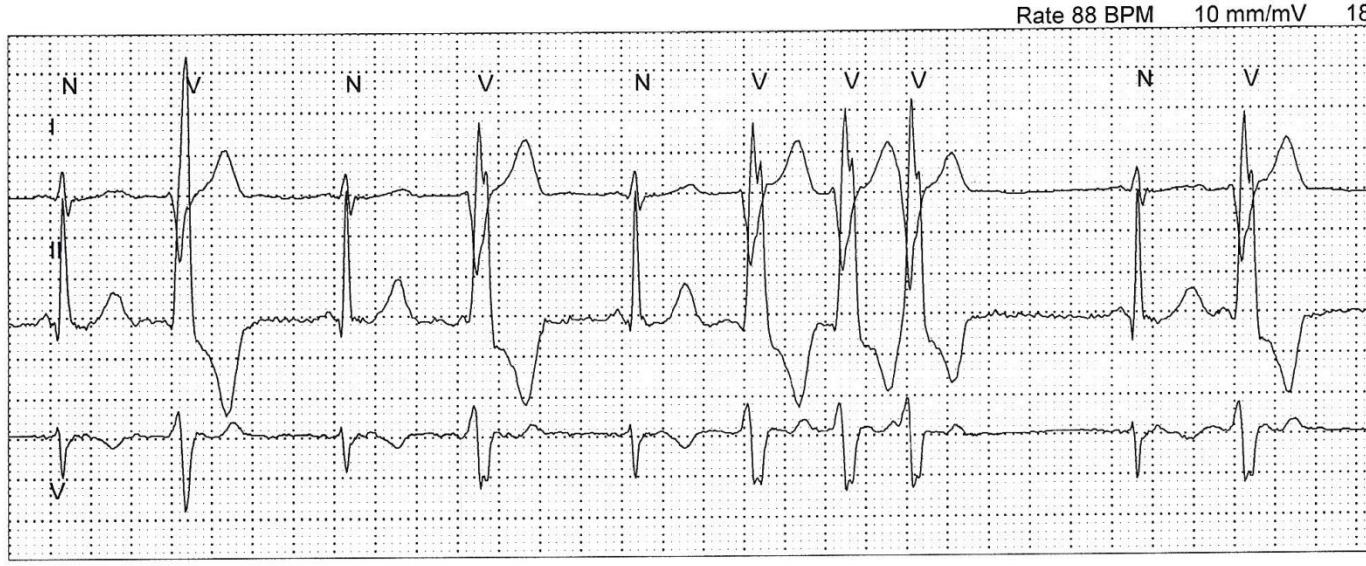


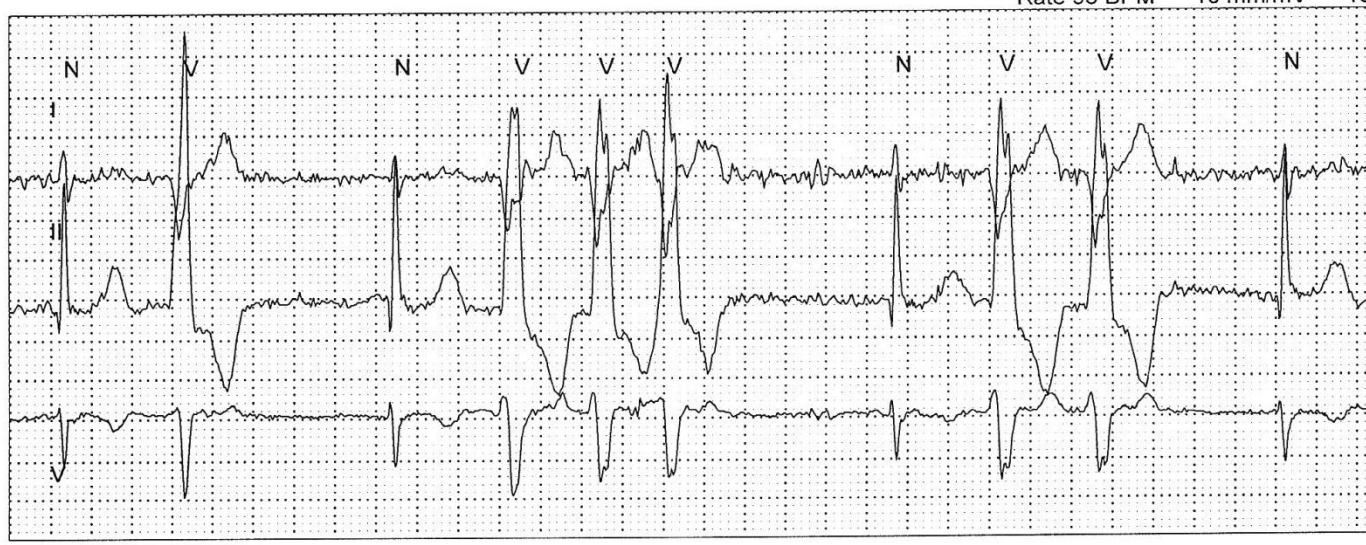
ID: 186564
DOB: --/--/----
yr,

15-Jan-2013 19:20:41

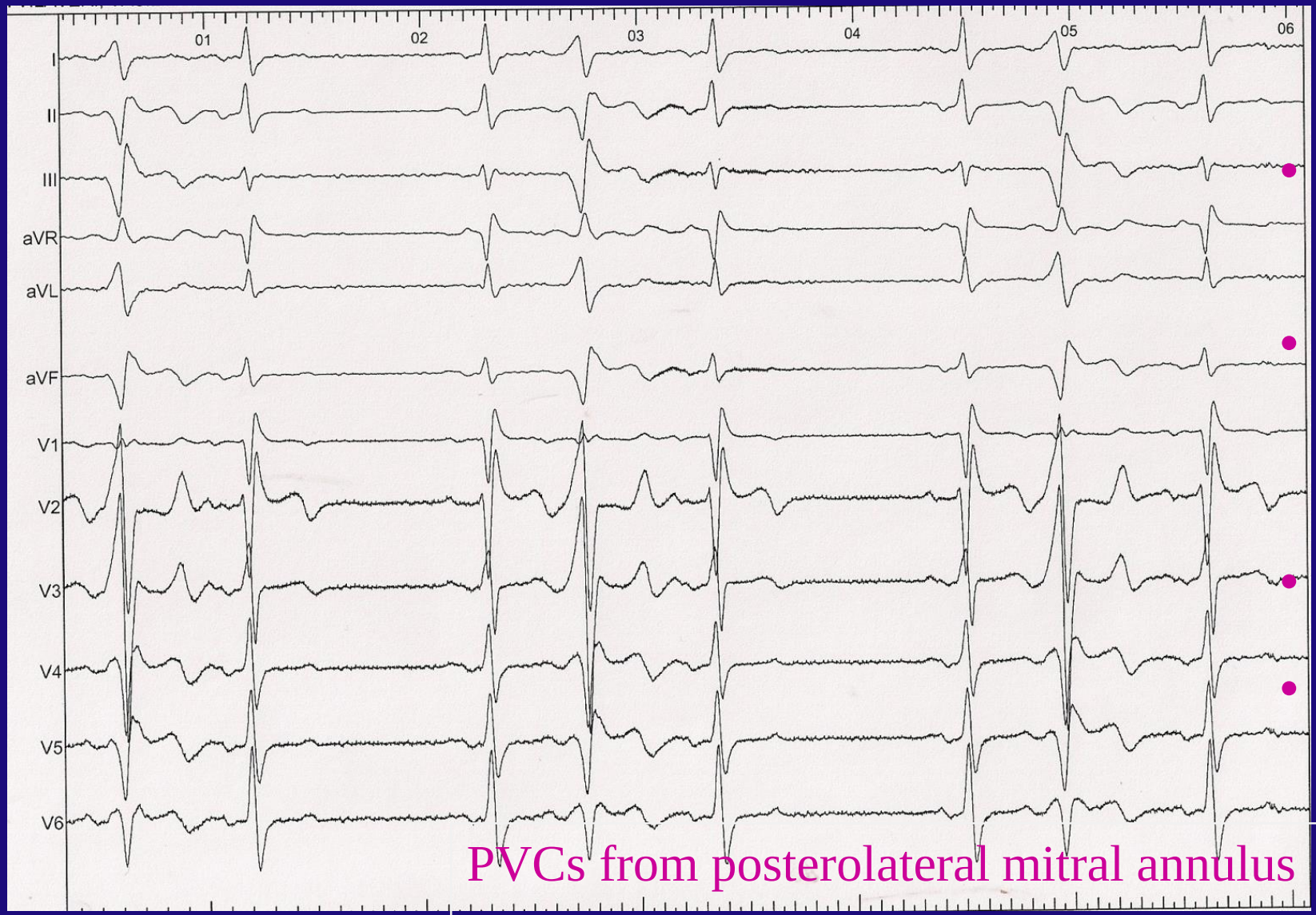
Vent rate	72 BPM
PR int:	108 ms
QRS dur:	89 ms
QT/QTc:	391/416 ms
P-R-T axes:	14 38 78

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





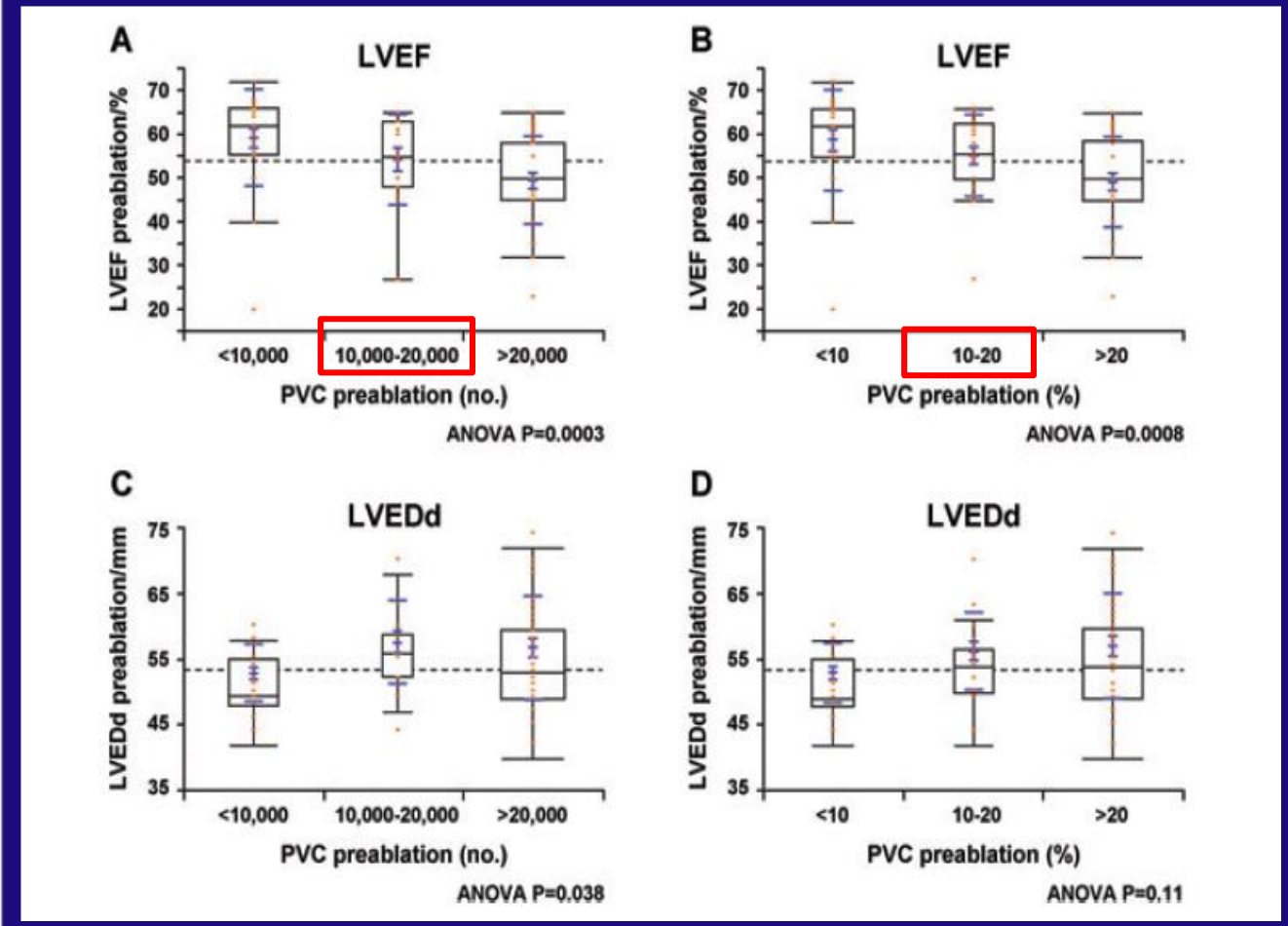
106027086163 No Site Name Site # 0 Cart # 0 Version 1.20.24 Sequence #29950 25mm/s 10mm/mV 0.05-40 Hz

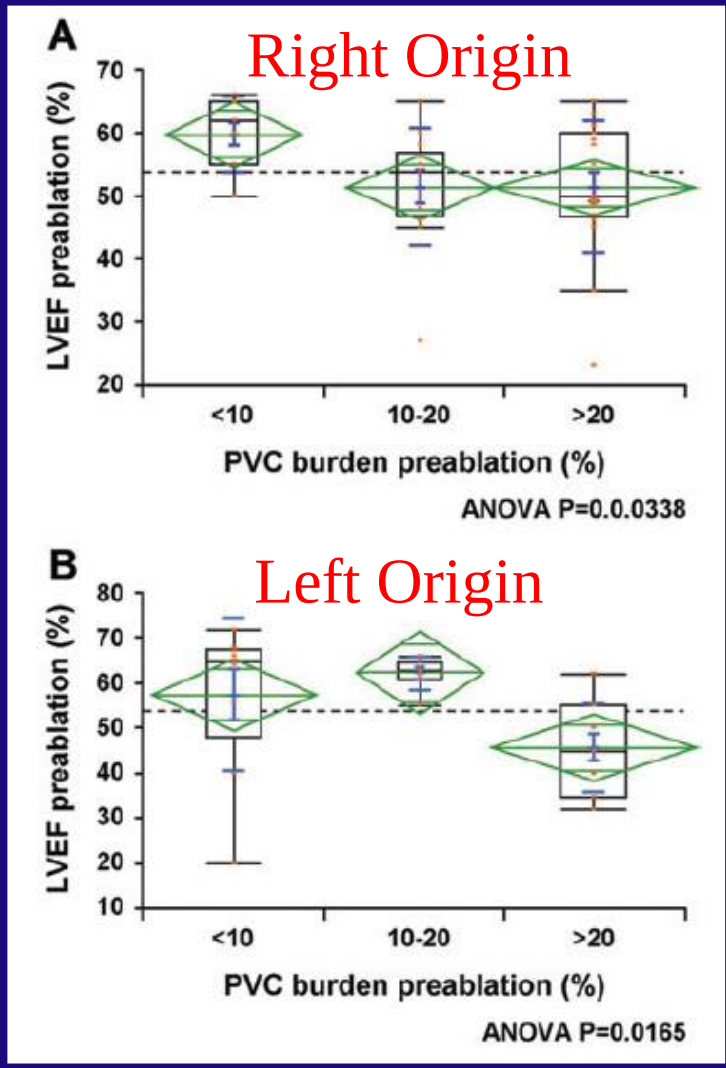


- 55 year old woman
- Palpitations, Shortness of breath
- EF:35%
- Coro:(-)

PVCs from posterolateral mitral annulus

Cardiomyopathy from High Ventricular Ectopy Burden





Munoz et I. J Cardiovasc Electrophysiol 2011;22:791-8

Συμπεράσματα

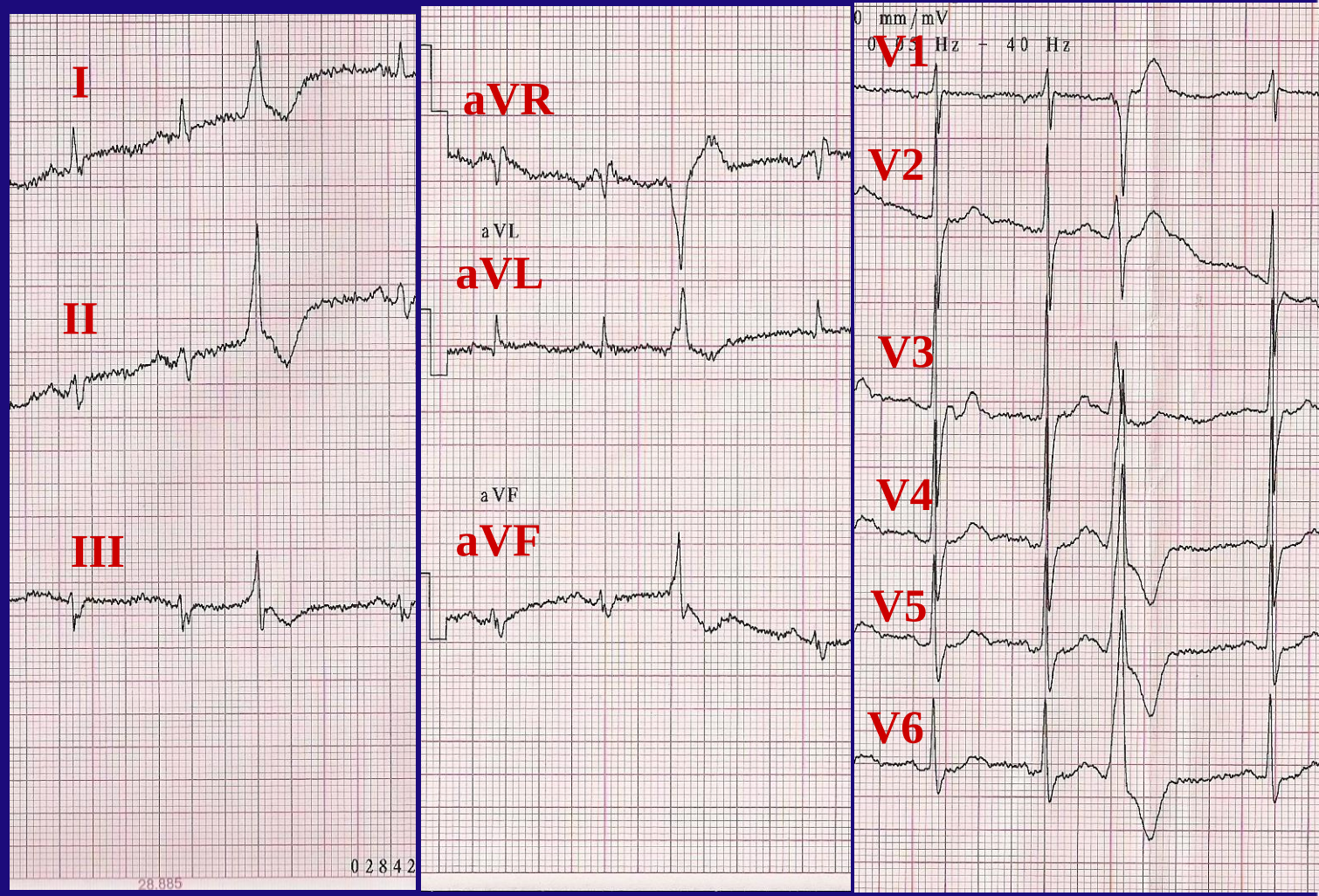
- Η μη εμμένουσα κοιλιακή ταχυκαρδία συναντάται σε ένα μεγάλο εύρος νοσολογικών καταστάσεων
- Η παρουσία της μπορεί να αναδείξει καρδιακό υπόστρωμα και η προγνωστική της σημασία διαφέρει ανάλογα με αυτό
- Η αντιμετώπισή της κυρίως στρέφεται στην αντιμετώπιση του υποκείμενης καταστάσεως
- Η ανάγκη καταστολής της ίδιας της αρρυθμίας υπαγορεύεται από την παρουσία συμπτωμάτων

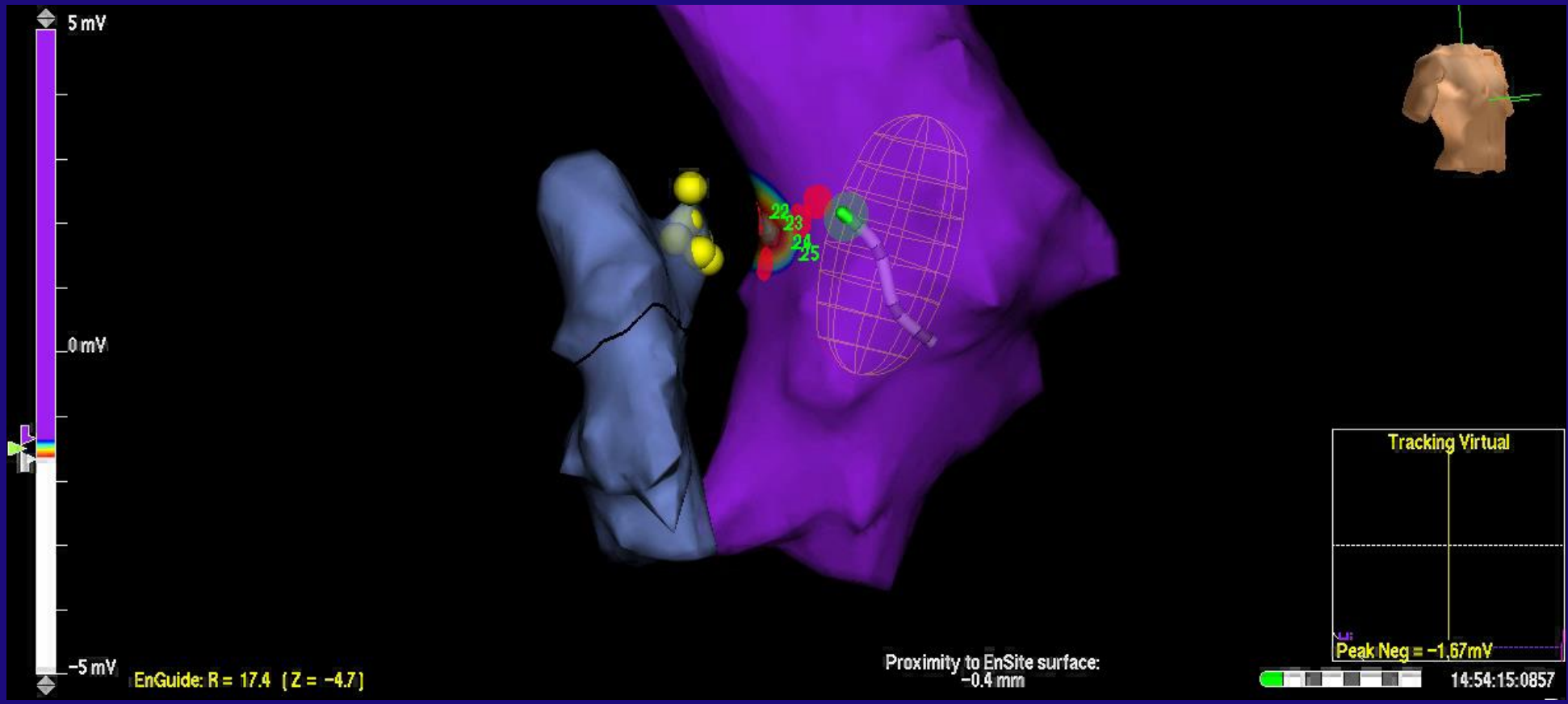
Ευχαριστώ για την προσοχή σας!

Back-Up Slides

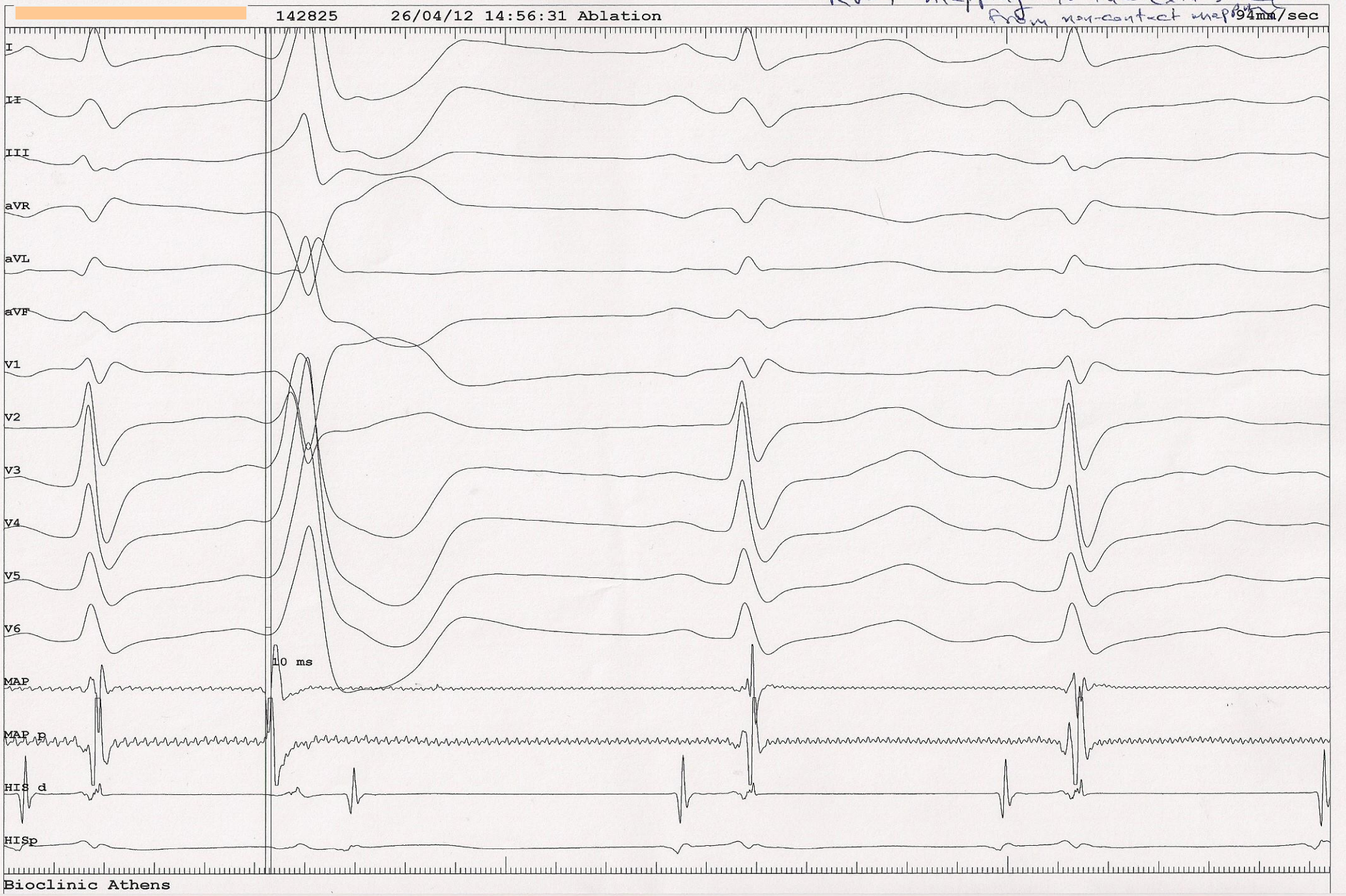
Idiopathic Ventricular Arrhythmias

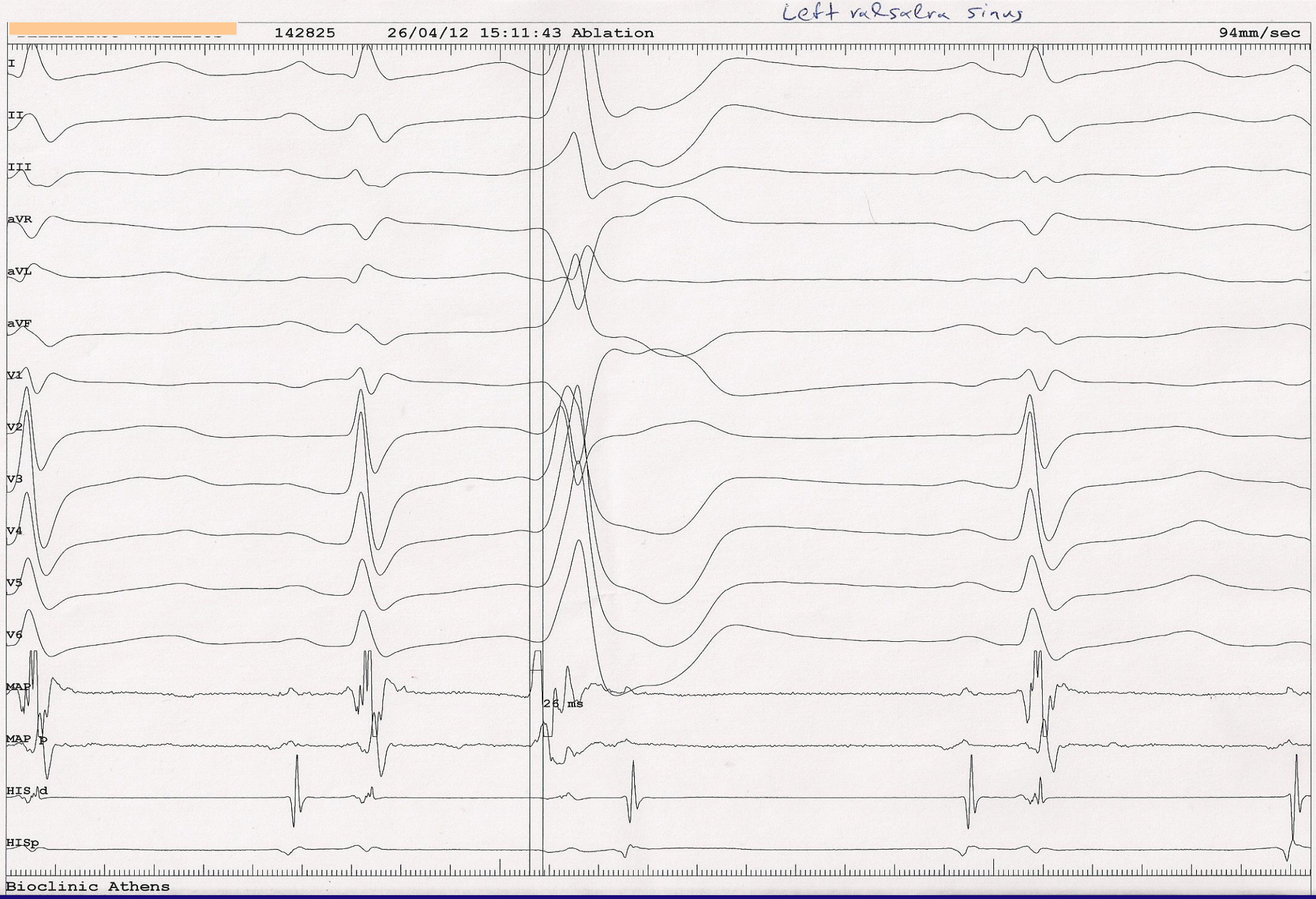
- 61 year-old man
- No structural heart disease
- Coro: (-)
- Symptomatic PVCs, couplets and runs of NSVT (up to 3 beats)
- Medical treatment: ineffective and intolerable




5 mV
0 mV
-5 mV
EnGuide: R = 17.4 (Z = -4.7)
22
23
24
25
Proximity to EnSite surface:
-0.4 mm
Tracking Virtual
Peak Neg = -1.67mV
14:54:15:0857

RVOT mapping to the exit site from non-contact mapping




Left valsalva sinus
142825
26/04/12 15:11:43 Ablation
94mm/sec
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
MAP
MAP p
HIS d
HISp
26 ms
Bioclinic Athens

Long-Term Recording of Cardiac Arrhythmias With an Implantable Cardiac Monitor in Patients With Reduced Ejection Fraction After Acute Myocardial Infarction

The Cardiac Arrhythmias and Risk Stratification After Acute Myocardial Infarction (CARISMA) Study

Poul Erik Bloch Thomsen, MD; Christian Jons, MD; M.J. Pekka Raatikainen, MD; Rikke Moerch Joergensen, MD; Juha Hartikainen, MD; Vesa Virtanen, MD; J. Boland, MD; Olli Anttonen, MD; Uffe Jakob Gang, MD; Nis Hoest, MD; Lucas V.A. Boersma, MD; Eivin S. Platou, MD; Daniel Becker, MSc; Marc D. Messier, PhD; Heikki V. Huikuri, MD; for the Cardiac Arrhythmias and Risk Stratification After Acute Myocardial Infarction (CARISMA) Study Group

297 post-MI patients with LVEF≤40% (mean age 64±11.0 y; LVEF: 31±7%) received an ILR within 11±5 days of the acute MI and were followed up every 3 months for an average of 2 years.

- 13% incidence of NSVT (≥16 beats and <30 sec)
- 3% incidence of sust VT
- 3% incidence of VF

Table 3. Prognostic Significance of Arrhythmias as Recorded by the ICD: Unadjusted HRs

	Cardiac Death			All-Cause Mortality		
Arrhythmia	HR	*P*	95% CI	HR	*P*	95% CI
High degree AV block on ICM	6.64	<0.001	2.72–16.21	5.22	<0.001	2.33–11.71
Sinus bradycardia on ICM	5.06	0.0015	1.86–13.71	3.45	0.011	1.32–9.03
Sinus arrest on ICM	1.54	0.67	0.21–11.49	1.12	0.91	0.15–8.26
Nonsustained VT on ICM	3.13	0.017	1.23–7.99	2.14	0.096	0.87–5.23
New-onset AF on ICM*	1.12	0.83	0.40–3.15	1.29	0.58	0.53–3.14
Sustained VT on ICM	4.27	0.050	1.00–18.22	3.13	0.12	0.75–13.14

Table 4. Prognostic Significance of Arrhythmias as Recorded by the ICD With Adjustment for Prespecified Variables

	Cardiac Death			All-Cause Mortality		
Arrhythmia	HR	*P*	95% CI	HR	*P*	95% CI
High degree AV block on ICM	6.75	<0.001	2.565–17.84	4.97	<0.001	2.09–11.83
Sinus bradycardia on ICM	4.15	0.012	1.37–12.62	2.60	0.07	0.92–7.28
Sinus arrest on ICM	1.33	0.79	0.16–11.08	1.01	1.00	0.13–7.93
Nonsustained VT on ICM	1.98	0.17	0.74–5.24	1.33	0.54	0.53–3.36
New-onset AF on ICM*	1.03	0.96	0.36–2.91	1.10	0.84	0.45–2.67
Sustained VT on ICM	3.61	0.12	0.71–18.26	2.83	0.19	0.60–13.41

Bloch Thomsen et al. Circulation. 2010;121:1258-1264

Sudden Death in Mitral Regurgitation Due to Flail Leaflet

Francesco Grigioni, MD,* Maurice Enriquez-Sarano, MD, FACC,* Lieng H. Ling, MD,* Kent R. Bailey, PHD,† James B. Seward, MD, FACC,* A. Jamil Tajik, MD, FACC,* Robert L. Frye, MD, FACC*

Rochester, Minnesota

OBJECTIVES We sought to assess the incidence and determinants of sudden death (SUD) in mitral regurgitation due to flail leaflet (MR-FL).

BACKGROUND Sudden death is a catastrophic complication of MR-FL. Its incidence and predictability are undefined.

METHODS The occurrence of SUD was analyzed in 348 patients (age 67 ± 12 years) with MR-FL diagnosed echocardiographically from 1980 through 1994.

RESULTS During a mean follow-up of 48 ± 41 months, 99 deaths occurred under medical treatment. Sudden death occurred in 25 patients, three of whom were resuscitated. The sudden death rates at five and 10 years were 8.6 ± 2% and 18.8 ± 4%, respectively, and the linearized rate was 1.8% per year. By multivariate analysis, the independent baseline predictors of SUD were New York Heart Association (NYHA) functional class ($p = 0.006$), ejection fraction ($p = 0.0001$) and atrial fibrillation ($p = 0.059$). The yearly linearized rate of sudden death was 1% in patients in functional class I, 3.1% in class II and 7.8% in classes III and IV. However, of 25 patients who had SUD, at baseline, 10 (40%) were in functional class I, 9 (36%) were in class II and only 6 (24%) in class III or IV. In five patients (20%), no evidence of risk factors developed until SUD. In patients with an ejection fraction ≥60% and sinus rhythm, the linearized rate of SUD was not different in functional classes I and II (0.8% per year). Surgical correction of MR ($n = 186$) was independently associated with a reduced incidence of SUD (adjusted hazard ratio [95% confidence interval] 0.29 [0.11 to 0.72], $p = 0.007$).

CONCLUSIONS Sudden death is relatively common in patients with MR-FL who are conservatively managed. Patients with severe symptoms, atrial fibrillation and reduced systolic function are at higher risk, but notable rates of SUD have been observed without these risk factors. Correction of MR appears to be associated with a reduced incidence of SUD, warranting early consideration of surgical repair. (J Am Coll Cardiol 1999;34:2078–85)

Grigioni et al. JACC 1999;34:2078-85

Mitral valve prolapse and sudden cardiac arrest in the community

Kumar Narayanan, MD,[*] Audrey Uy-Evanado, MD,[*] Carmen Teodorescu, MD, PhD,[*] Kyndaron Reinier, PhD,[*] Gregory A. Nichols, PhD,[†] Karen Gunson, MD,[‡] Jonathan Jui, MD, MPH,[§] Sumeet S. Chugh, MD[*]

BACKGROUND Mitral valve prolapse (MVP) is relatively common in the general population with recently reported prevalence of 1% and familial clustering (Framingham Heart Study). However, its association with ventricular arrhythmias and sudden cardiac arrest (SCA) remains controversial.

OBJECTIVES The purpose of this study was to ascertain the frequency of MVP in SCA cases in the community and characterize the clinical profile of SCA cases with MVP.

METHODS SCA cases were prospectively identified in the population-based Oregon Sudden Unexpected Death Study (population ~1 million). The presence of MVP was identified from echocardiograms recorded prior but unrelated to the SCA event. The detailed clinical profile of SCA cases with MVP was compared with that of SCA cases without MVP to identify potential differences.

RESULTS A total of 729 SCA cases were evaluated over a 12-year period (mean age 69.5 ± 14.8 years; 64.6% men). MVP was seen in 17 cases (2.3%) prearrest (95% confidence interval 1.2%–3.4%). Mitral regurgitation was present in 14 SCA cases with MVP (82.3%) and was moderate or severe in 10 (58.8%). Compared with SCA cases without MVP, SCA cases with MVP were younger (mean age 60.9 ± 16.4 years vs 69.7 ± 14.7 years; $P = .02$), with fewer risk factors (diabetes 5.9% vs 46.4%; $P = .001$; hypertension 41.2% vs 78.9%; $P = .001$) or known coronary disease (29.4% vs 65.6%; $P < .001$).

CONCLUSION MVP was observed in a small proportion (2.3%) of SCA cases in the general population, suggesting a low risk overall. Since SCA cases with MVP were characterized by younger age and relatively low cardiovascular comorbidity, a focus on imaging for valve structure/insufficiency as well as genetics could aid future risk stratification approaches.

KEYWORDS Mitral valve prolapse; Sudden cardiac arrest; Risk

ABBREVIATIONS **LV** = left ventricular; **LVEF** = left ventricular ejection fraction; **MR** = mitral regurgitation; **MVP** = mitral valve prolapse; **Oregon-SUDS** = Oregon Sudden Unexpected Death Study; **SCA** = sudden cardiac arrest; **VT** = ventricular tachycardia

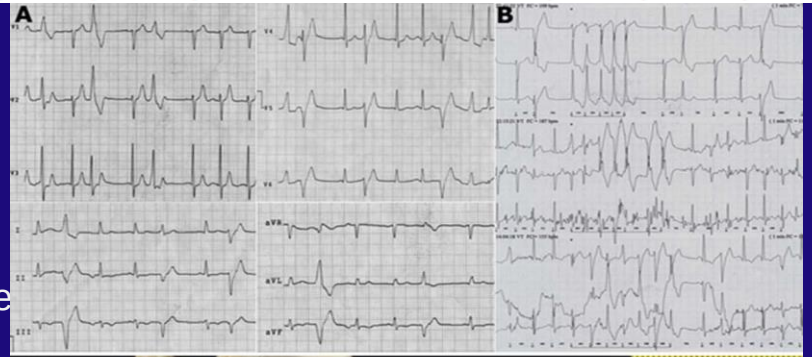
(Heart Rhythm 2015;0:0–6)

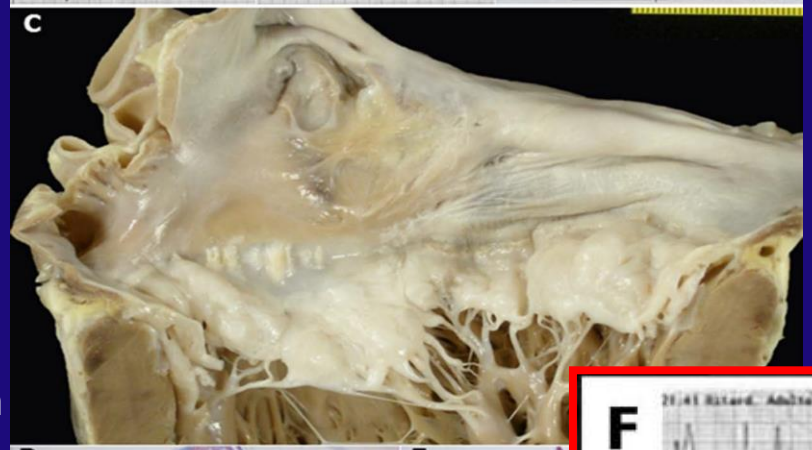
Narayanan et al. Heart Rhythm 2015; Sep 28 [Epub ahead of print]

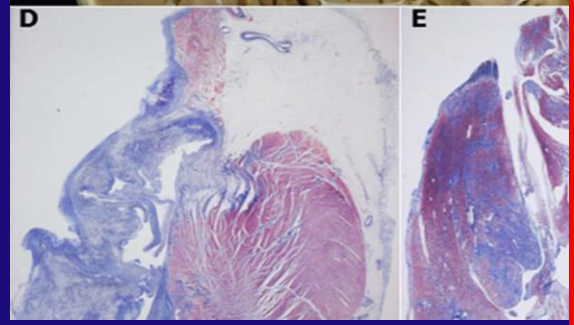
Arrhythmic Mitral Valve Prolapse and Sudden Cardiac Death

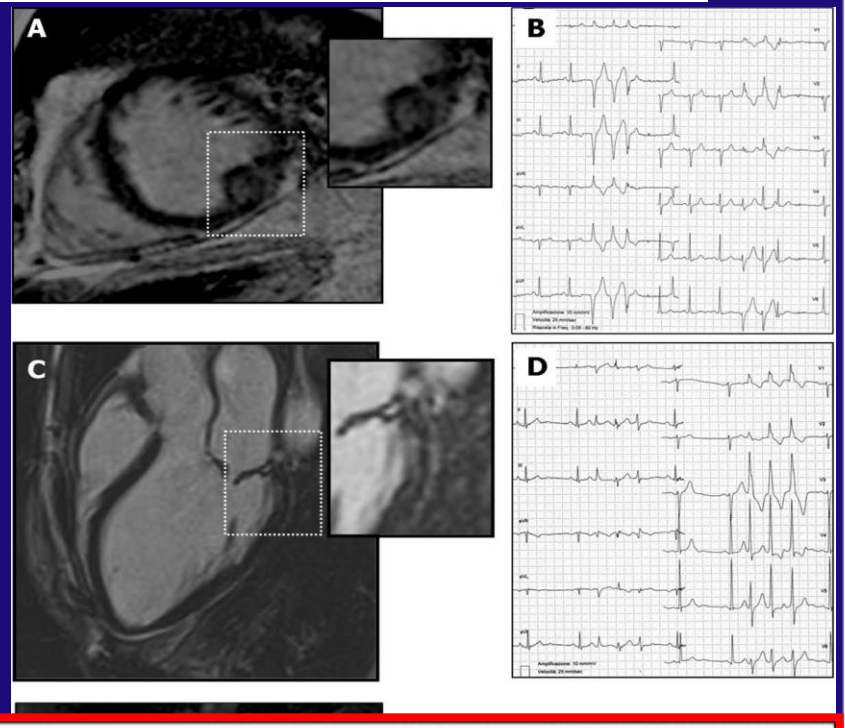
Cristina Basso, MD, PhD*; Martina Perazzolo Marra, MD, PhD*; Stefania Rizzo, MD, PhD; Manuel De Lazzari, MD; Benedetta Giorgi, MD; Alberto Cipriani, MD; Anna Chiara Frigo, MSc; Ilaria Rigato, MD, PhD; Federico Migliore, MD, PhD; Kalliopi Pilichou, PhD; Emanuele Bertaglia, MD; Luisa Cacciavillani, MD, PhD; Barbara Bauce, MD, PhD; Domenico Corrado, MD, PhD; Gaetano Thiene, MD; Sabino Iliceto, MD

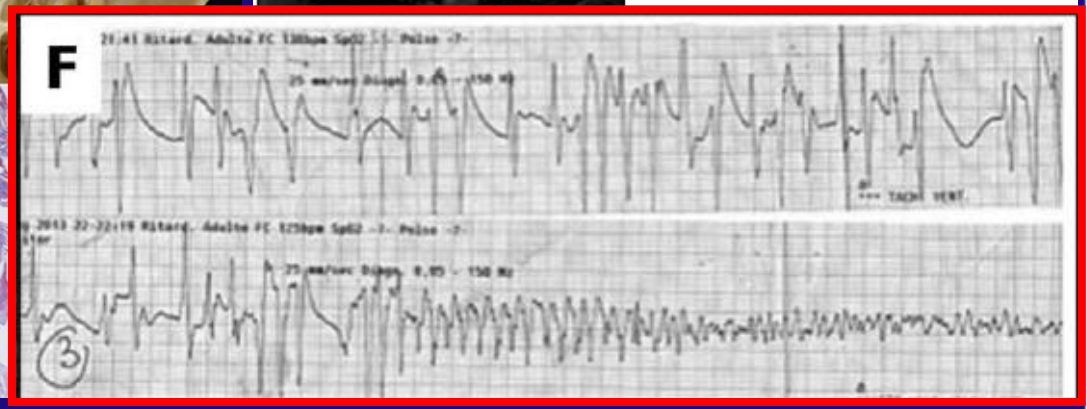
- 650 young adults (≤40 y) with SCD - Cardiac pathology registry
- 43 cases with MVP (26 females; age range, 19–40 y; median, 32 y) as the only cause of SCD were identified (7% of all SCD, 13% of women).
- Among 12 cases with available ECG, 10 (83%) had inverted T waves on inferior leads, and all had RBBB ventricular arrhythmias. A bileaflet involvement was found in 70%. Left ventricular fibrosis was detected at histology at the level of papillary muscles in all patients, and inferobasal wall in 88%.











Basso et al. Circulation 2015;132:556-66

Prediction of sudden cardiac death after acute myocardial infarction: role of Holter monitoring in the modern treatment era

Timo H. Mäkikallio[1*†], Petra Barthel[2†], Raphael Schneider[2], Axel Bauer[2], Jari M. Tapanainen[1], Mikko P. Tulppo[1], Georg Schmidt[2], and Heikki V. Huikuri[1]

2130 AMI patients
33,7 months mean FU
Analysis of various risk parameters from Holter monitoring

	EF ≤ 35% (n = 226)				EF > 35% (n = 1904)			
	SCD (n = 17)		Non-SCD (n = 26)		SCD (n = 35)		Non-SCD (n = 35)	
	HR (95% CI)	*P*-value	HR (95% CI)	*P*-value	HR (95% CI)	*P*-value	HR (95% CI)	*P*-value
Multivariable analysis[a]								
NsVT	2.1 (0.7–6.7)	0.2010	3.1 (1.3–6.3)	0.0085	3.5 (1.5–8.2)	0.0021	1.3 (0.4–4.3)	0.4505
VPCs > 10/h	1.9 (0.7–5.4)	0.3322	2.2 (0.9–5.2)	0.0746	1.2 (0.5–3.1)	0.7345	2.8 (1.2–6.2)	0.0088
SDNN < 70 ms	1.3 (0.5–3.4)	0.6148	2.3 (0.9–5.8)	0.0689	1.5 (0.7–3.4)	0.3074	0.8 (0.3–2.0)	0.5124
SDNN (continuous)	1.00 (0.98–1.02)	0.7733	0.98 (0.96–1.00)	0.0235	0.99 (0.97–1.00)	0.0292	0.99 (0.98–1.00)	0.2541
ln VLF < 5.3	0.8 (0.2–3.9)	0.7996	2.6 (0.9–5.6)	0.0588	2.7 (1.0–7.1)	0.0505	1.5 (0.5–5.1)	0.5044
ln VLF (continuous)	1.26 (0.75–2.11)	0.3726	0.65 (0.42–1.00)	0.0477	0.62 (0.46–0.82)	0.0008	0.74 (0.51–1.07)	0.1128
ln LF < 3.85	0.7 (0.2–3.4)	0.6979	3.7 (1.5–9.2)	0.0046	2.6 (0.9–7.9)	0.0826	2.1 (0.7–6.3)	0.1932
ln LF (continuous)	1.24 (0.79–1.95)	0.3450	0.59 (0.38–0.90)	0.0146	0.63 (0.50–0.81)	0.0002	0.76 (0.56–1.02)	0.0707
TS (≤2.5 ms/RRI)	1.0 (0.4–2.1)	0.9310	3.0 (1.1–8.3)	0.0350	4.7 (2.3–9.8)	0.0001	2.4 (1.1–5.3)	0.0340
TS (continuous)	1.04 (0.89–1.21)	0.6418	0.81 (0.63–1.04)	0.1011	0.77 (0.67–0.88)	0.0001	0.89 (0.79–1.00)	0.0507
DFA (α_1 < 0.75)	1.0 (0.4–2.7)	0.5123	2.3 (0.9–6.1)	0.0811	2.7 (1.3–5.7)	0.0088	2.8 (1.2–5.9)	0.0084
DFA (continuous)	1.53 (0.13–17.4)	0.7317	0.14 (0.02–0.84)	0.0316	0.26 (0.06–1.10)	0.0673	0.20 (0.05–0.84)	0.0283
QRS ≥ 120 ms	0.9 (0.3–3.1)	0.9843	2.6 (1.2–5.9)	0.0201	3.2 (1.4–7.3)	0.0039	2.8 (1.2–6.6)	0.0173
QRS (continuous)	1.00 (0.98–1.02)	1.0000	1.01 (1.00–1.02)	0.0838	1.00 (1.00–1.00)	0.4845	1.00 (1.00–1.00)	0.4063

Makikallio et al. European Heart Journal 2005;26:762-769

Αρρυθμιογένεση στην στεφανιαία νόσο

- Ενεργοποίηση του I_{KATP} ►αύξηση εξωκυττάριου K+
- Υπερφότηση σε Na ► υπερφόρτηση σε Ca

- Αποσύζευξη των μυοκαρδιακών κυττάρων με μείωση των χασματικών συνάψεων

- Δημιουργία νησίδων νέκρωσης – ίνωσης που ευνοούν την βραδεία αγωγή

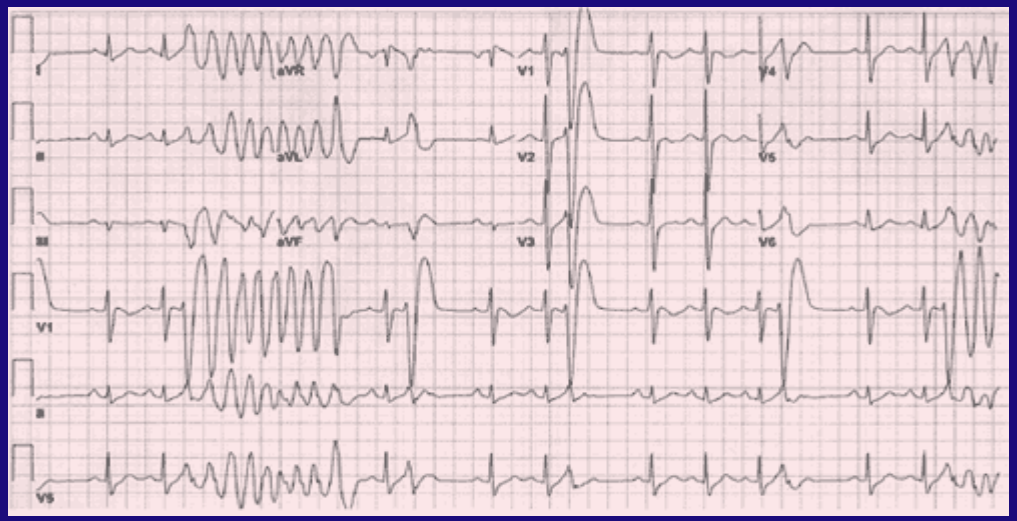
Οξεία Ισχαιμία

Δυναμικά εξελισσόμενο υπόστρωμα

Σταθερότερο υπόστρωμα

Polymorphic VT - VF

Ασταθείς ταχυκαρδίες - Διισωζόμενο δυνητικά μυοκάρδιο



Monomorphic VT

Σταθερές ταχυκαρδίες - Μόνιμη μυοκαρδιακή βλάβη