# Prise en charge des Extrasystoles Ventriculaires et des Tachycardies Ventriculaires non soutenues

Centre de Référence des Maladies Cardiaques Héréditaires

Fabrice Extramiana

**Nice le 24 septembre2019**

ASSISTANCE PUBLIQUE HÔPITAUX DE PARIS

université PARIS DIDEROT

Université de Paris

# Déclaration de liens d'intérêts

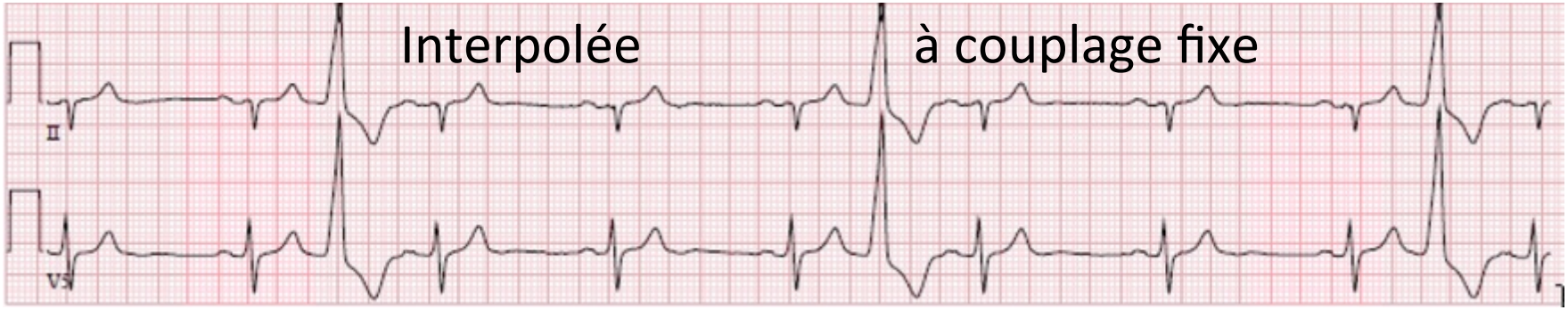
| | |
|---|---|
| • Abbott | honoraria, clinical trials, meeting indemnification |
| • BMS | honoraria |
| • Boehringer | honoraria |
| • Bayer | honoraria, meeting indemnification |
| • Biosense Webster | honoraria, clinical trials, meeting indemnification |
| • Biotronik | clinical trials, meeting indemnification |
| • Chiesi | consulting fees |
| • Meda | honoraria |
| • Medtronic | clinical trials, meeting indemnification |
| • Menarini | consulting fees |
| • Novartis Pharma | honoraria |
| • Pfizer | honoraria |
| • Sanofi | honoraria, consulting fees, clinical trials, meeting indemnification |
| • Servier | honoraria |

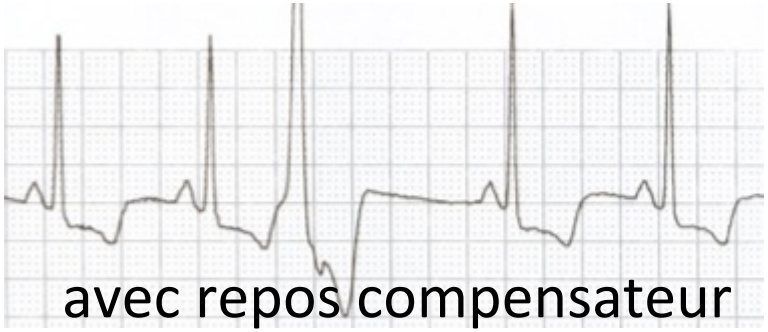
# Prise en charge des Extrasystoles Ventriculaires et des Tachycardies Ventriculaires non soutenues

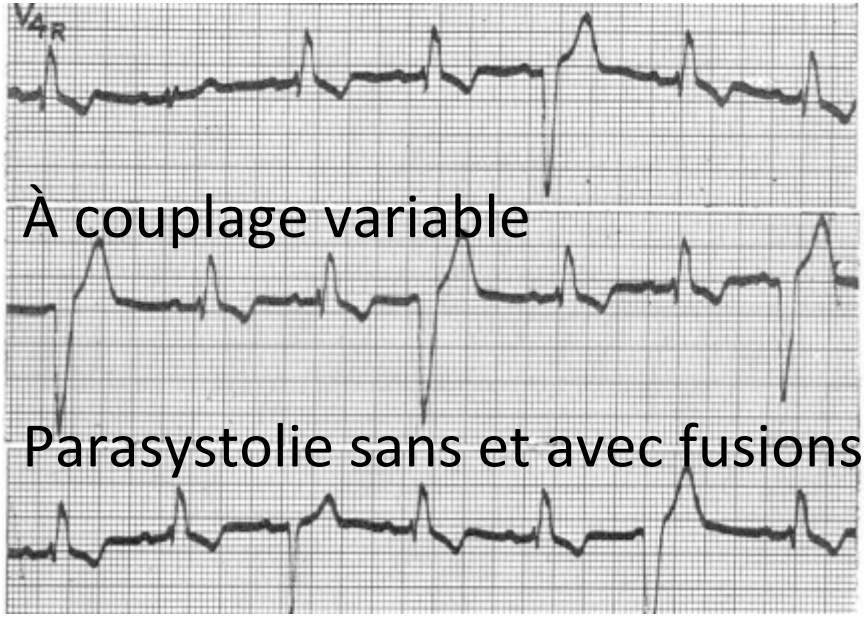
1. ESV
   - Définitions / Epidémiologie
   - ESV sur cœur sain ou marqueur de cardiopathie
   - ESV bénigne / ESV maligne
   - Cardiomyopathie induite par les ESV
2. TVNS
   - Définitions / Epidémiologie
   - TVNS sur cœur sain ou marqueur de cardiopathie

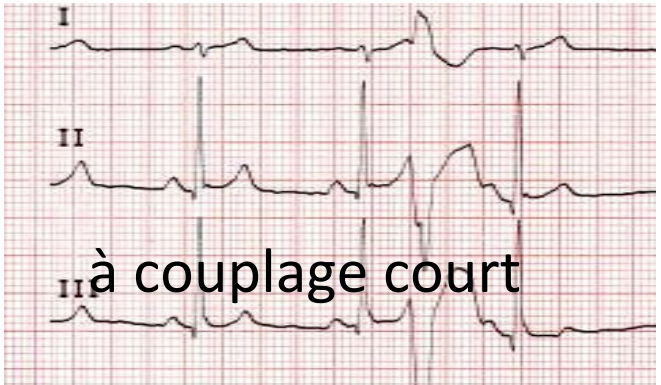
# Extrasystole Ventriculaire :

dépolarisation ventriculaire prématurée
naissant au-delà du faisceau de His



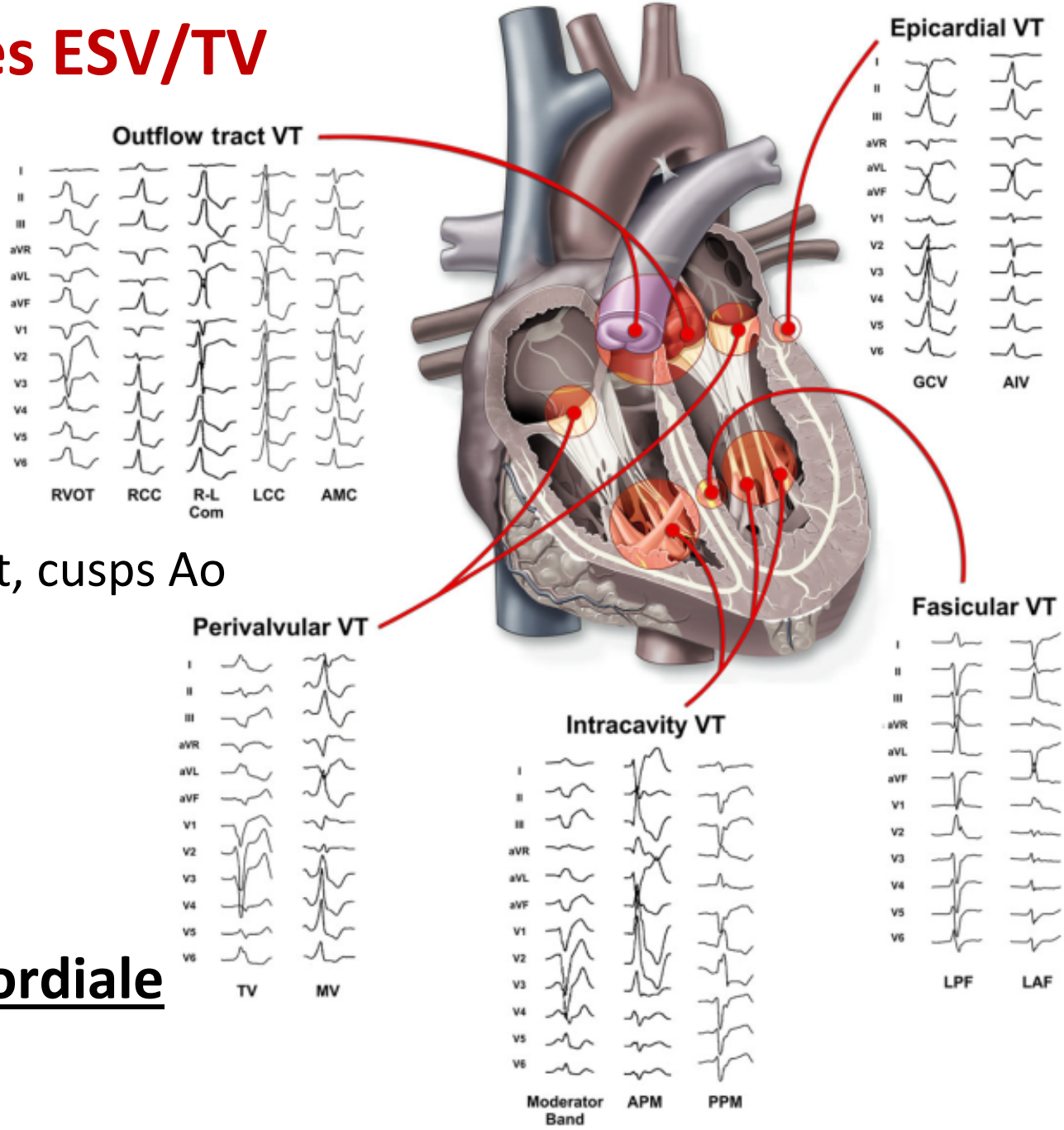




Isolée, bigéminées, trigéminées…

# Morphologie des ESV/TV




## 1. Retard

- **Retard gauche :**

Le + svt dans le VD

Rare: VG septum haut, cusps Ao

- **Retard droit :**

Toujours dans le VG

## 2. Axe QRS

## 3. Transition précordiale

# Electrocardiographic Findings in 122,043 Individuals

Circulation. 1962; 25:947-61

*By* ROLAND G. HISS, Capt. USAF (MC), AND LAWRENCE E. LAMB, M.D.

*Total Number of Persons in Each Age Group*

| Age group | Number of persons |
|---|---|
| 16–19 | 7,072 |
| 20–24 | 37,159 |
| 25–29 | 21,681 |
| 30–34 | 12,966 |
| 35–39 | 22,028 |
| 40–44 | 18,359 |
| 45–49 | 2,044 |
| 50 and over | 734 |
| Total | 122,043 |

US air force subjects
48-sec ECG

**VPB in 952 subjects (0.78%)**
(+55 subjects with V fusions )

7/10 000

*Frequency of Ventricular Premature Contractions in Different Age Groups**

| Age Group | Group I 1 PVC | | Group II 2-4 PVC's | | Group III 5-10 PVC's | | Group IV More than 10 | | Total |
|---|---|---|---|---|---|---|---|---|---|
| 16–19 | (2.1) | 15 | (2.2) | 16 | (0.8) | 6 | (1.1) | 8 | 45 |
| 20–24 | (1.8) | 67 | (2.6) | 99 | (1.1) | 42 | (0.4) | 15 | 223 |
| 25–29 | (1.6) | 36 | (2.5) | 55 | (1.3) | 30 | (0.5) | 12 | 133 |
| 30–34 | (3.8) | 50 | (3.3) | 44 | (1.5) | 20 | (0.9) | 12 | 126 |
| 35–39 | (2.5) | 56 | (2.8) | 62 | (1.4) | 33 | (0.9) | 22 | 173 |
| 40–44 | (3.0) | 56 | (5.1) | 95 | (1.3) | 24 | (0.9) | 18 | 193 |
| 45–49 | (6.8) | 14 | (7.8) | 16 | (2.4) | 5 | (1.9) | 4 | 39 |
| 50–over | (8.1) | 6 | (8.1) | 6 | (10.8) | 8 | (0) | 0 | 20 |
| Total | (2.4) | 300 | (3.2) | 393 | (1.3) | 168 | (0.7) | 91 | 952 |

*Numbers in parentheses are rates/1,000. Numbers not in parentheses are the number of subjects.

# Risk factors for premature ventricular contractions in young and healthy adults

Heart. 2017; 103:702-7

Mirco von Rotz,[1,2] Stefanie Aeschbacher,[1,2] Matthias Bossard,[2,3,4] Tobias Schoen,[2,5] Steffen Blum,[1,2] Susanna Schneider,[2] Joel Estis,[6] John Todd,[6] Martin Risch,[7,8] Lorenz Risch,[7,9,10] David Conen[1,2,3,11]

2048 healthy subjects (Liechtenstein)
25-41 years – 46.5% males
24-hour **Holter monitoring**

**≥ 1 ESV in 69%**
90th percentile : 32 VPBs
95th percentile : 193 VPBs

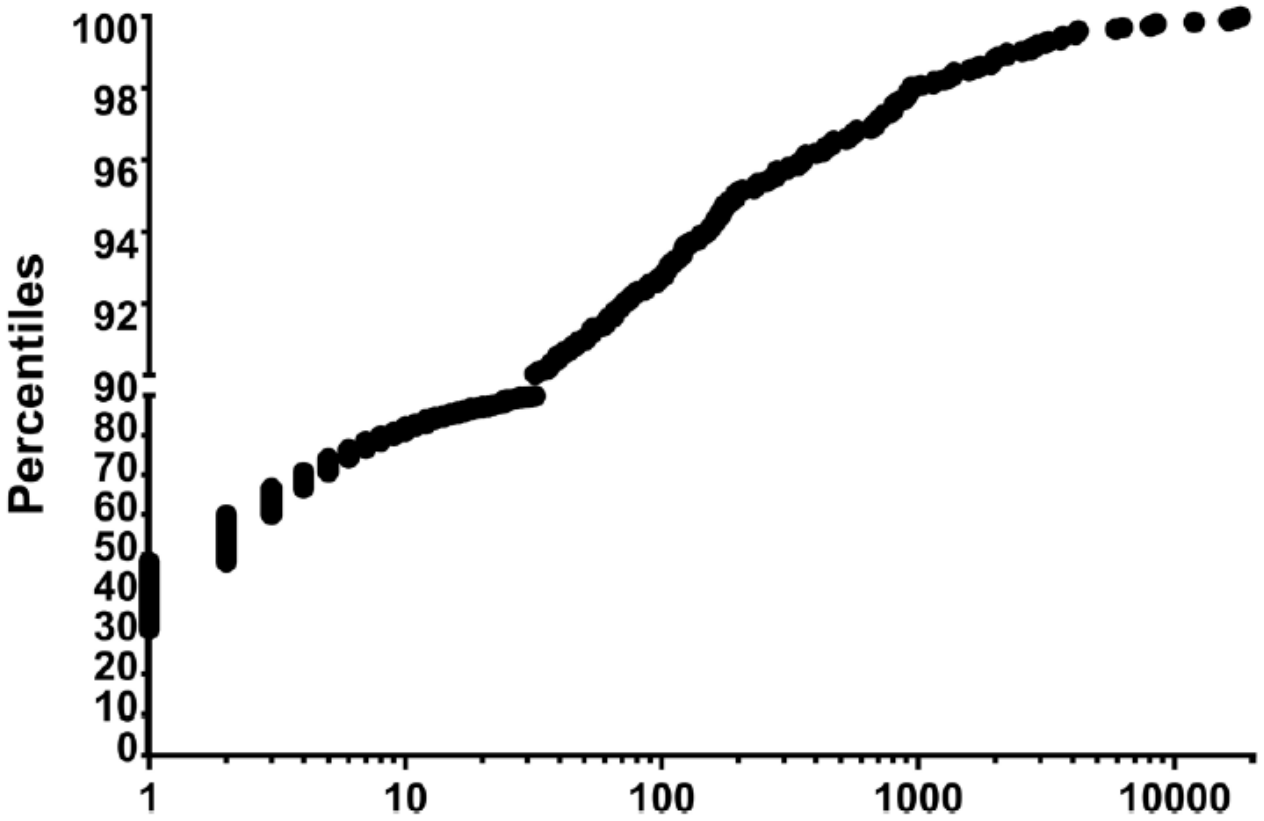


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**Table 2** Associations between risk factors and premature ventricular contractions over the 90th percentile

| Variable | Univariate models OR (95% CI) | p Value | Multivariable model OR (95% CI) | p Value |
|---|---|---|---|---|
| Age (SD) | 1.31 (1.13 to 1.53) | <0.001 | 1.29 (1.10 to 1.52) | 0.003 |
| NT-proBNP (SD) | 1.18 (1.02 to 1.37) | 0.03 | 1.28 (1.07 to 1.54) | 0.008 |
| Height>median | 1.25 (0.94 to 1.67) | 0.13 | 1.52 (1.01 to 2.28) | 0.04 |
| Physical activity quartile 2 | 0.94 (0.68 to 1.30) | 0.71 | 0.69 (0.46 to 1.04) | 0.08 |
| Physical activity quartile 3 | 0.82 (0.58 to 1.17) | 0.28 | 0.63 (0.40 to 0.97) | 0.04 |
| Physical activity quartile 4 | 0.89 (0.64 to 1.24) | 0.47 | 0.67 (0.44 to 1.02) | 0.06 |
| Male sex | 1.04 (0.78 to 1.38) | 0.80 | | |
| SLI (SD) | 1.03 (0.90 to 1.19) | 0.64 | | |
| Fruit/vegetable consumption ≥5 per | | | | |
| NLR (SD) | | | | |
| Sodium (SD) | | | | |
| Low education | | | | |
| Copeptin (SD) | | | | |
| Creatinine (SD) | | | | |
| Haemoglobin (SD) | | | | |
| ASAT (SD) | | | | |
| Resting heart rate (SD) | | | | |
| Waist:hip ratio (SD) | | | | |
| GLP-1 (SD) | | | | |
| Pack-years >15 | | | | |
| Endothelin-1 quartile 2 | | | | |
| Endothelin-1 quartile 3 | | | | |
| Endothelin-1 quartile 4 | 1.11 (0.80 to 1.54) | 0.53 | | |


| | Multivariable model OR (95% CI) | p Value |
|---|---|---|
| Age (SD) | 1.29 (1.10 to 1.52) | 0.003 |
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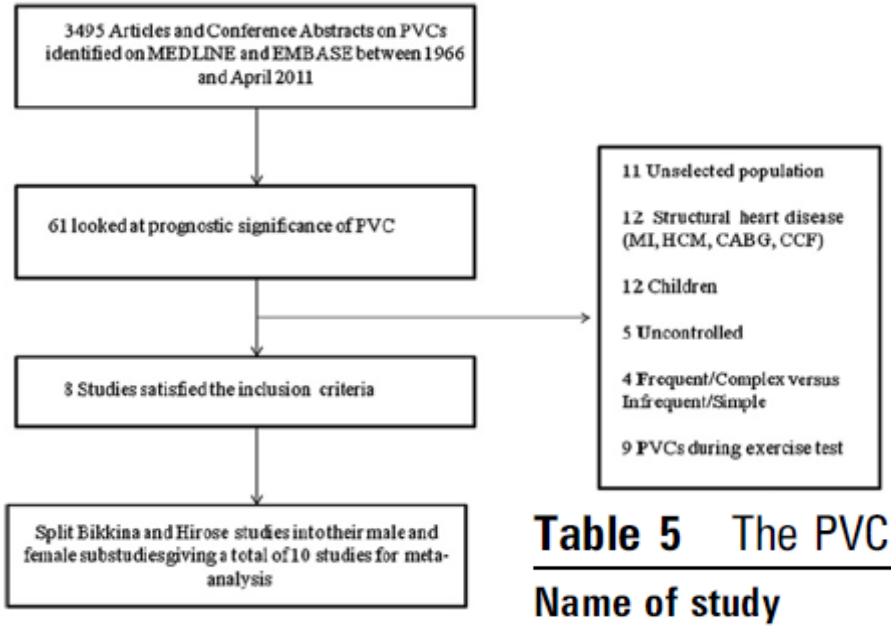
# The prognostic significance of premature ventricular complexes in adults without clinically apparent heart disease: a meta-analysis and systematic review

Heart. 2012; 98:1290-8

Victor Lee,[1] Harry Hemingway,[2] Rami Harb,[1] Tom Crake,[1] Pier Lambiase[1]




**Prognosis**

**Table 5** The PVC frequency of each study population

| Name of study | Adjusted No. of PVCs/day |
|---|---|
| Rodstein *et al*, 1971[6] | 35% >14 400 PVC/day; 65% <14 400 PVC/day |
| Desai *et al*, 1973[7] | 95% <23 040/day |
| Rabkin *et al*, 1981[16] | No information |
| Kennedy *et al*, 1985[12] | Mean 13 584/day; 26% NSVT |
| Abdalla *et al*, 1987[17] | 62% has >1400 PVC/day or complex |
| Bikkina *et al*, 1992[19] | 100% >720 PVC/day or complex |
| Hirose *et al*, 2010[21] | No information |
| Cheriyath *et al*, 2011[22] | No information |

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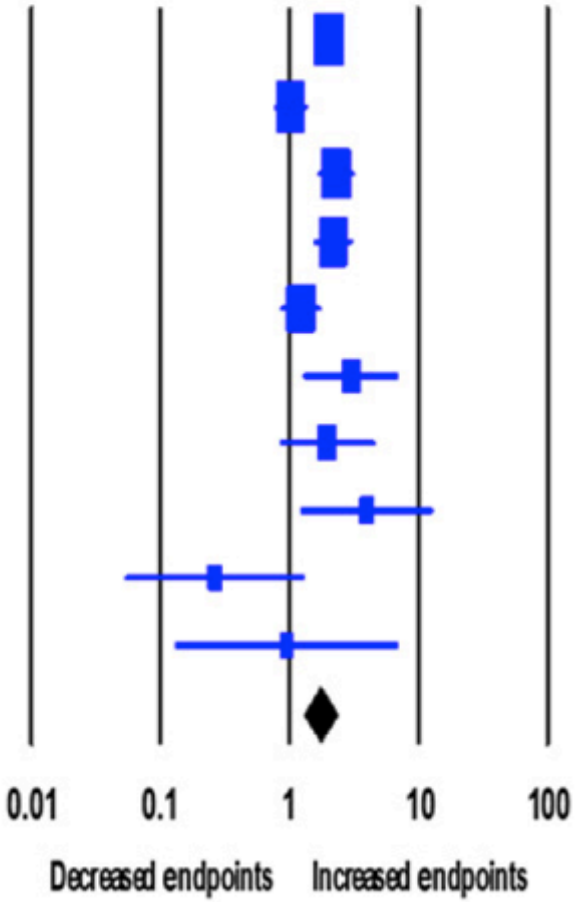
| Study name | Study endpoints | OR | Lower limit | Upper limit | Z-Value | p Value |
|---|---|---|---|---|---|---|
| Ratkin *et al*, 1981[16] | IHD | 2.033 | 1.569 | 2.635 | 5.369 | 0.000 |
| Rodstein *et al*, 1971[6] | All Cause Mortality | 1.025 | 0.754 | 1.393 | 0.157 | 0.875 |
| Bikkina *et al* (m), 1992[19] | All Cause Mortality | 2.300 | 1.652 | 3.203 | 4.929 | 0.000 |
| Cheriyath *et al*, 2011[22] | CV Death | 2.180 | 1.527 | 3.113 | 4.287 | 0.000 |
| Bikkina *et al* (f), 1992[19] | All Cause Mortality | 1.230 | 0.852 | 1.775 | 1.106 | 0.269 |
| Abdalla *et al*, 1987[17] | SCD | 3.000 | 1.266 | 7.109 | 2.496 | 0.013 |
| Desai *et al*, 1973[7] | All Cause Mortality | 1.971 | 0.830 | 4.681 | 1.537 | 0.124 |
| Hirose *et al* (m), 2010[21] | CV Death | 3.980 | 1.214 | 13.046 | 2.280 | 0.023 |
| Kennedy *et al*, 1985[12] | All Cause Mortality | 0.265 | 0.053 | 1.322 | -1.620 | 0.105 |
| Hirose *et al* (f), 2010[21] | CV Death | 0.950 | 0.128 | 7.026 | -0.050 | 0.960 |
| | | 1.721 | 1.281 | 2.313 | 3.605 | 0.000 |



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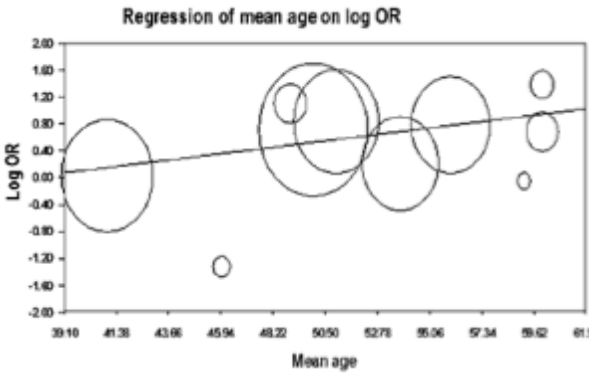
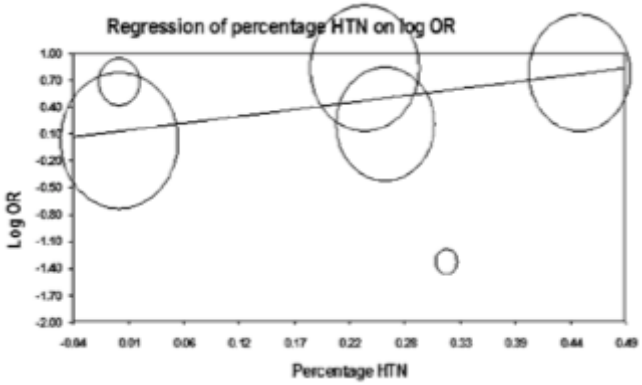
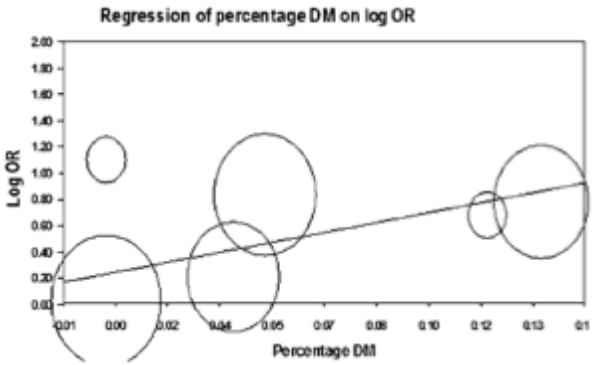
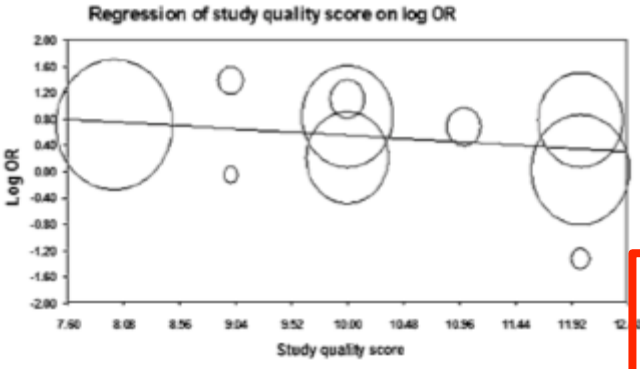


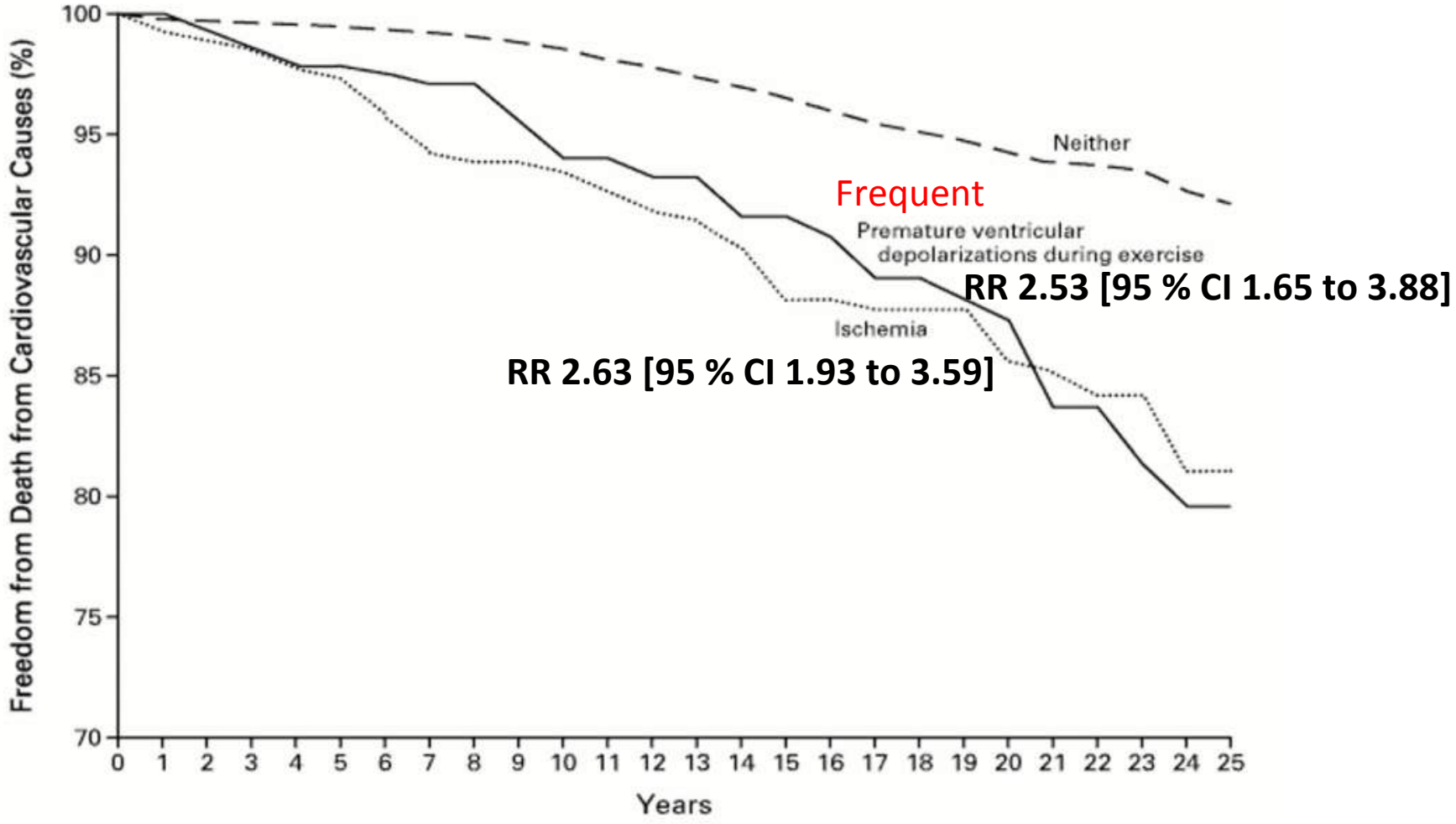

**Conclusions** Most studies on PVC prognosis in 'normal hearts' did not use advanced tests to rule out structural heart disease. Among these patients, PVCs are associated with a worse cardiovascular outcome if patients are older and have higher cardiovascular risk, suggesting that the poor prognosis studies may have inadvertently included patients with occult structural heart disease, the population in which PVCs are known to confer adverse outcomes.

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.

N Engl J Med 2000;343:826-33

5443 (89.2 percent) no PVC – 8.5% infrequent PVC – 2.3% frequent PVC




Tobacco consumption significantly higher in subjects with frequent

# Ventricular Arrhythmias During Clinical Treadmill Testing and Prognosis

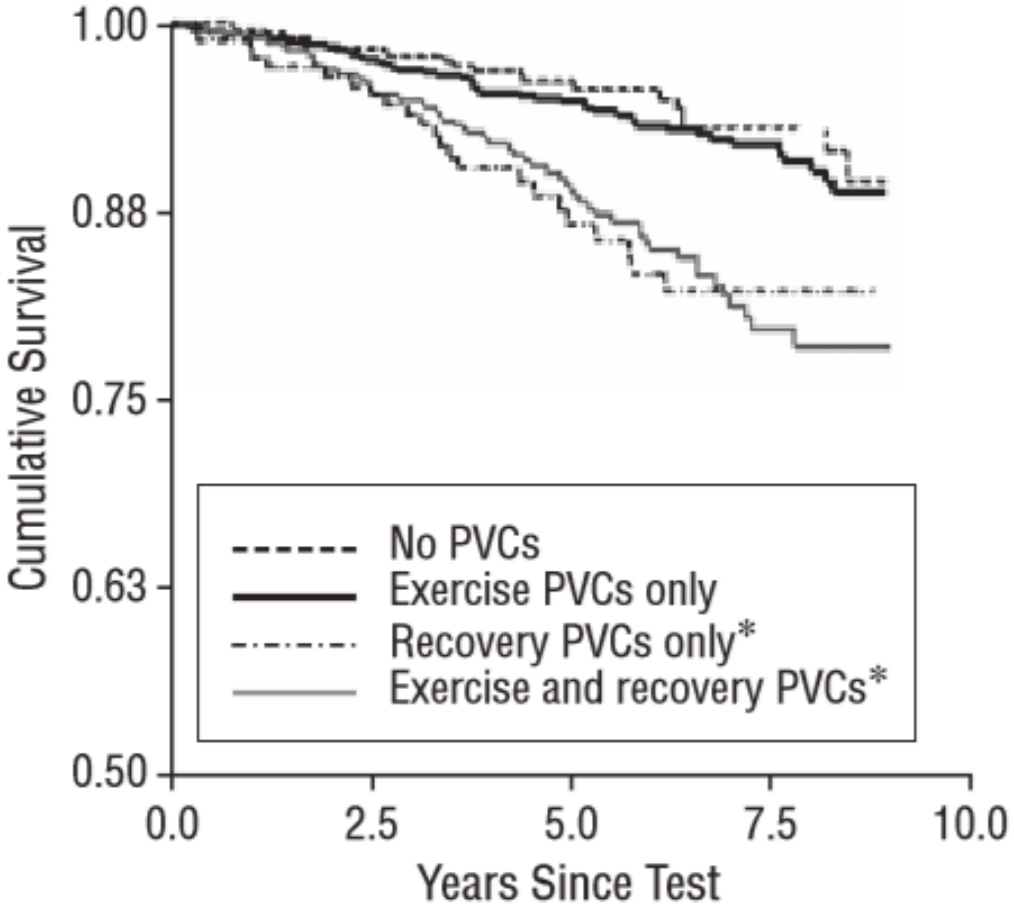
*Frederick E. Dewey, BA; John R. Kapoor, MD, PhD; Ryan S. Williams, MD; Michael J. Lipinski, MD; Euan A. Ashley, MRCP, DPhil; David Hadley, PhD; Jonathan Myers, PhD; Victor F. Froelicher, MD*

Arch Intern Med. 2008;168:225-34

1847 heart failure–free patients
46.0% developed exercise PVCs
33.6% had recovery PVCs

Resting PVCs, age, and systolic BP predictors of both exercise and recovery PVCs

Exercise PVCs related to HR increase with exercise,
Recovery PVCs related to coronary disease



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Arch Intern Med. 2008;168:225-34

**Table 1. Characteristics of Study Population According to Occurrence of PVCs[a]**

| Variable | No PVCs (n=831) | PVCs During Exercise Only (n=396) | PVCs During Recovery Only (n=166) | PVCs During Exercise and Recovery (n=454) |
|---|---|---|---|---|
| Demographics | | | | |
| Age, y[b] | 53 (47-61) | 56 (50-65) | 57 (51-66) | 63 (54-71) |
| Female sex | 48 (5.8) | 12 (3.0) | 7 (4.2) | 21 (4.6) |
| Height, cm[b] | 175 (170-180) | 175 (170-183) | 175 (173-183) | 178 (170-183) |
| BMI | 28 (25-31) | 27 (25-31) | 28 (25-31) | 28 (25-31) |
| Medical history | | | | |
| Previous MI | 101 (12.2) | 46 (11.6) | 25 (15.1) | 62 (13.7) |
| Typical chest pain | 96 (11.6) | 32 (8.1) | 23 (13.9) | 53 (11.7) |
| Atypical chest pain | 226 (27.2) | 114 (28.8) | 44 (26.5) | 108 (23.8) |
| Previous coronary intervention | 96 (11.6) | 44 (11.1) | 25 (15.1) | 65 (14.3) |
| COPD | 32 (3.9) | 14 (3.5) | 5 (3.0) | 23 (5.1) |
| Claudication | 34 (4.1) | 18 (4.6) | 5 (3.0) | 22 (4.8) |
| Smoking history | | | | |
| Ever | 558 (67.1) | 261 (65.9) | 113 (68.1) | 273 (60.1) |
| Currently[b] | 260 (31.3) | 85 (21.5) | 49 (29.5) | 80 (17.6) |
| Diabetes mellitus[c] | 134 (16.4) | 59 (15.2) | 22 (13.3) | 66 (15.1) |

# The relationships among ventricular arrhythmias, left ventricular dysfunction, and mortality in the 2 years after myocardial infarction*

J. Thomas Bigger, Jr., Joseph L. Fleiss, Robert Kleiger, J. Philip Miller, Linda M. Rolnitzky, and The Multicenter Post-Infarction Research Group**

Circulation, 1984; 69:250-8

24-h Holter recordings

| | No. of patients[B] | N=819 Post-MI | Heart 2017 "healthy" |
|---|---|---|---|
| VPD frequency (VPDs/hr) | | | |
| 0 | 112 | 14% | 31% |
| >0–0.9 | 372 | 45% | |
| 1–2.9 | 90 | 11% | |
| 3–9.9 | 83 | 10% | |
| 10–29.9 | 73 | 9% | 10% |
| ≥30 | 89 | 11% | 5% |
| Repetitive VPDs | | | |
| No VPD | 112 | | |
| Single VPD | 476 | | |
| Paired VPDs | 139 | | |
| VPD runs | 92 | 11% | |

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SCD

| | | Hinkle I deaths (n = 54) | | Hinkle II or III deaths (n = 35) | | Total deaths (n = 89) | |
|---|---|---|---|---|---|---|---|
| | No. of patients[B] | Mortality rate | Odds ratio | Mortality rate | Odds ratio | Mortality rate | Odds ratio |
| VPD frequency (VPDs/hr) | | | | | | | |
| 0 | 112 | 3% | — | 4% | — | 6% | — |
| >0–0.9 | 372 | 5% | 1.7 | 3% | 0.7 | 8% | 1.4 |
| 1–2.9 | 90 | 10% | 3.6 | 4% | 1.0 | 14% | 2.6 |
| 3–9.9 | 83 | 12% | 4.4 | 10% | 2.7 | 21% | 4.2 |
| 10–29.9 | 73 | 11% | 4.0 | 6% | 1.5 | 16% | 3.0 |
| ⩾30 | 89 | 14% | 5.3 | 9% | 2.4 | 21% | 4.2 |
| Repetitive VPDs | | | | | | | |
| No VPD | 112 | 3% | — | 4% | — | 6% | — |
| Single VPD | 476 | 6% | 2.1 | 3% | 0.7 | 9% | 1.5 |
| Paired VPDs | 139 | 10% | 3.6 | 8% | 2.1 | 17% | 3.2 |
| VPD runs | 92 | 17% | 6.6 | 10% | 2.7 | 25% | 5.2 |

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J. Thomas Bigger, Jr., Joseph L. Fleiss, Robert Kleiger, J. Philip Miller, Linda M. Rolnitzky, and The Multicenter Post-Infarction Research Group**

Circulation, 1984; 69:250-8

**Relationships between frequency of VPDs, LVEF, and 2 year mortality rates (n = 766[A])**

| | VPDs/hr | | | | | | |
|---|---|---|---|---|---|---|---|
| LVEF | 0 | <1 | 1–2.9 | 3–9.9 | 10–29.9 | ≥30 | Total |
| <30% | 22%[B] | 16% | 29% | 38% | 31% | 42% | 30% |
| | (9) | (39) | (14) | (18) | (13) | (24) | (117) |
| 30–39% | 17% | 9% | 9% | 12% | 12% | 11% | 10% |
| | (6) | (56) | (24) | (18) | (17) | (18) | (139) |
| 40–49% | 0% | 3% | 12% | 16% | 18% | 14% | 7% |
| | (31) | (87) | (17) | (19) | (17) | (21) | (192) |
| ≥50% | 5% | 8% | 7% | 19% | 9% | 0% | 7% |
| | (56) | (167) | (32) | (23) | (23) | (17) | (318) |
| Total | 6% | 8% | 14% | 21% | 16% | 19% | 11% |
| | (102) | (349) | (87) | (78) | (70) | (80) | (766) |

# The relationships among ventricular arrhythmias, left ventricular dysfunction, and mortality in the 2 years after myocardial infarction*

Circulation, 1984; 69:250-8

J. Thomas Bigger, Jr., Joseph L. Fleiss, Robert Kleiger, J. Philip Miller, Linda M. Rolnitzky, and The Multicenter Post-Infarction Research Group**

**Independent contribution of left ventricular dysfunction and ventricular arrhythmias to death after myocardial infarction**

| Factor | Hazard ratio[A] | Chi square | p value |
|---|---|---|---|
| LVEF <30% vs LVEF ≥30% | 3.5 | 30.3 | <.001 |
| ≥3 vs <1 VPD/hr | 2.0 | 6.4 | <.05 |
| ≥3 vs 1–2.9 VPDs/hr | 1.6 | 1.7 | NS |
| 1–2.9 vs <1 VPD/hr | 1.2 | 0.3 | NS |
| VPD runs vs no repetitive VPDs | 1.9 | 4.8 | <.05 |
| Paired VPDs vs no repetitive VPDs | 1.7 | 2.9 | <.10 |
| VPD runs vs paired VPDs | 1.1 | 0.0 | NS |
| Time after infarction | | | |
| First 6 mo vs 6 mo to 3 yr | 3.3 | 29.4 | <.001 |

# Ambulatory Ventricular Arrhythmias in Patients With Heart Failure Do Not Specifically Predict an Increased Risk of Sudden Death

John R. Teerlink, MD; Muhammad Jalaluddin, MS; Susan Anderson, MS; Marrick L. Kukin, MD; Eric J. Eichhorn, MD; Gary Francis, MD; Milton Packer, MD; Barry M. Massie, MD; on Behalf of the PROMISE (Prospective Randomized Milrinone Survival Evaluation) Investigators*

Circulation. 2000; 101:40-46

**TABLE 1. Characteristics of the Patient Population**

| | Placebo (n=525) | Milrinone (n=555) |
|---|---|---|
| Ejection fraction | 0.21±0.07 | 0.21±0.07 |
| PVCs >30/h, % | 58 | 61 |
| Couplets, % | 83 | 86 |

**TABLE 2. Univariate Predictors of Outcome by $\chi^2$ Analysis**

| | Combined Groups | | | |
|---|---|---|---|---|
| Variable | All-Cause Mortality (n=290) | | Sudden Death (n=139) | |
| All patients | 290/1080 (27%) | | 139/1080 (13%) | |
| PVCs >30/h | | | | |
| Yes | 202/647 (31%) | $P<0.001$ | 105/647 (16%) | $P<0.001$ |
| No | 88/433 (20%) | | 34/433 (8%) | |
| Couplets | | | | |
| Yes | 254/915 (28%) | NS ($P=0.14$) | 128/915 (14%) | $P<0.02$ |
| No | 36/165 (22%) | | 11/165 (7%) | |

# Ambulatory Ventricular Arrhythmias in Patients With Heart Failure Do Not Specifically Predict an Increased Risk of Sudden Death

John R. Teerlink, MD; Muhammad Jalaluddin, MS; Susan Anderson, MS; Marrick L. Kukin, MD; Eric J. Eichhorn, MD; Gary Francis, MD; Milton Packer, MD; Barry M. Massie, MD; on Behalf of the PROMISE (Prospective Randomized Milrinone Survival Evaluation) Investigators*

Circulation. 2000; 101:40-46

**TABLE 4. Predictors of Outcome by Backward Elimination Multivariate Analysis**

| | Overall Mortality | | | Sudden Death | | | Non–Sudden Death Mortality | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | Risk Ratio | CI | *P* | Risk Ratio | CI | *P* | Risk Ratio | CI | *P* |
| EF | 1.03 | 1.01–1.04 | 0.004 | 1.05 | 1.02–1.08 | 0.001 | 1.01 | 0.98–1.03 | NS |
| NYHA | 1.49 | 1.16–1.90 | 0.002 | 1.30 | 0.91–1.84 | NS | 1.73 | 1.22–2.45 | 0.002 |
| CAD | 1.44 | 1.13–1.83 | 0.003 | 1.37 | 0.97–1.94 | 0.073 | 1.50 | 1.07–2.10 | 0.020 |
| Age | 1.03 | 1.02–1.04 | 0.001 | 1.02 | 1.00–1.04 | 0.034 | 1.07 | 1.05–1.09 | 0.001 |
| Milrinone | 1.29 | 1.02–1.63 | 0.031 | 1.64 | 1.16–2.32 | 0.005 | 1.06 | 0.77–1.46 | NS |
| Systolic BP | 1.02 | 1.01–1.03 | 0.001 | 1.01 | 0.99–1.02 | NS | 1.03 | 1.02–1.05 | 0.001 |
| NSVT episodes | 1.12 | 1.07–1.17 | 0.001 | 1.16 | 1.09–1.24 | 0.001 | 1.16 | 1.05–1.28 | 0.003 |
| PVCs/h | NS | NS | NS | NS | NS | NS | 0.89 | 0.80–1.00 | 0.029 |
| NSVT | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| NSVT beats | NS | NS | NS | NS | NS | NS | NS | NS | NS |

# Classification des ESV

| Grade | Description |
|---|---|
| 0 | Aucune ESV |
| 1 | ESV isolées et rares (< 30/h) |
| 2 | ESV fréquentes (> 30/h) |
| 3 | ESV polymorphes |
| 4 | ESV répétitives |
| a | Doublets |
| b | Salves |
| 5 | Phénomène R/T |

Plus il y en a,

Plus les morphologies sont différentes,

Plus elles sont répétitives,

Plus la fonction VG est altérée,

**plus le pronostic est péjoratif !**

Lown. Circulation 1971

JAMA 1984

**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019

**Table 5 Factors that may point to worse prognosis in patients with PVCs**

- Underlying structural, ischemic or electrical disease
- More than 2000 PVC/24 h
- Complex PVCs (couplets, triplets, and non-sustained VT)
- Increasing number of morphologies
- Increasing number PVCs with exercise
- Non-outflow tract PVC (usually monomorphic or only slightly divergent morphologies)
- Short coupling interval of the PVCs ('R-on-T')
- PVCs with broader QRS complexes (more frequently related to cardiomyopathy)

# 1er "take-home message"

- Les ESV sont fréquemment observées chez les sujets sains
- La présence d'une cardiomyopathie augmente la fréquence des ESV

→ESV fréquentes = proxy de cardiomyopathie

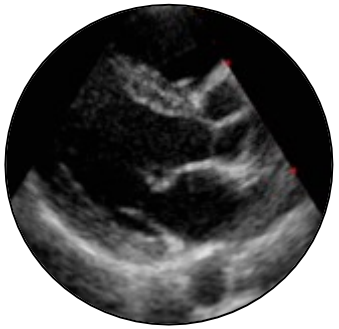
- Le pronostic dépend
  +++ de la cardiomyopathie et
  pas (ou peu) des ESV

→ **Chercher 1 cardiomyopathie en cas d'ESV fréquentes** (>30/h ou ++ >2000/j)

# Workup for PVC on surface ECG (asymptomatic or palpitations)

VPB 12-lead morphology

VPB Burden
Circadian pattern

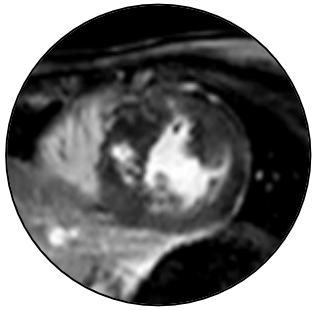


Cardiomyopathy ?

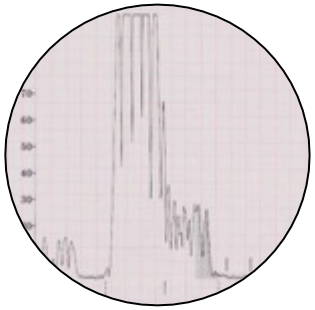
## Additional workup (>2000/24 hours or syncope)

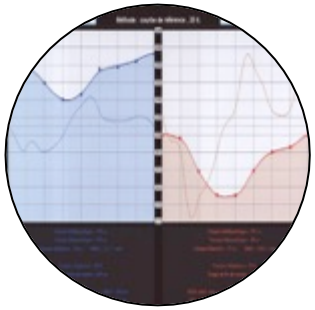
CAD?
CPVT?

CAD?
Abn coron

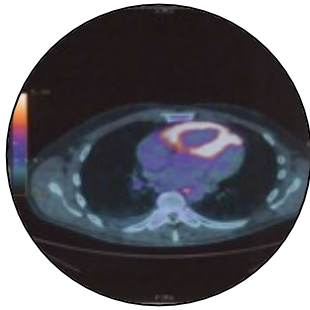


HCM?
ARCV?
Myocarditis





ARVD?



Myocarditis?
Sarcoidosis?
Vascularitis?

# Quand et comment traiter les ESV sur cœur sain ?

- Objectifs du traitement

- Améliorer le pronostic

  → pas d'indication

- Diminuer les symptômes

  → pas d'indication au traitement si asymptomatique

  → symptomatique :

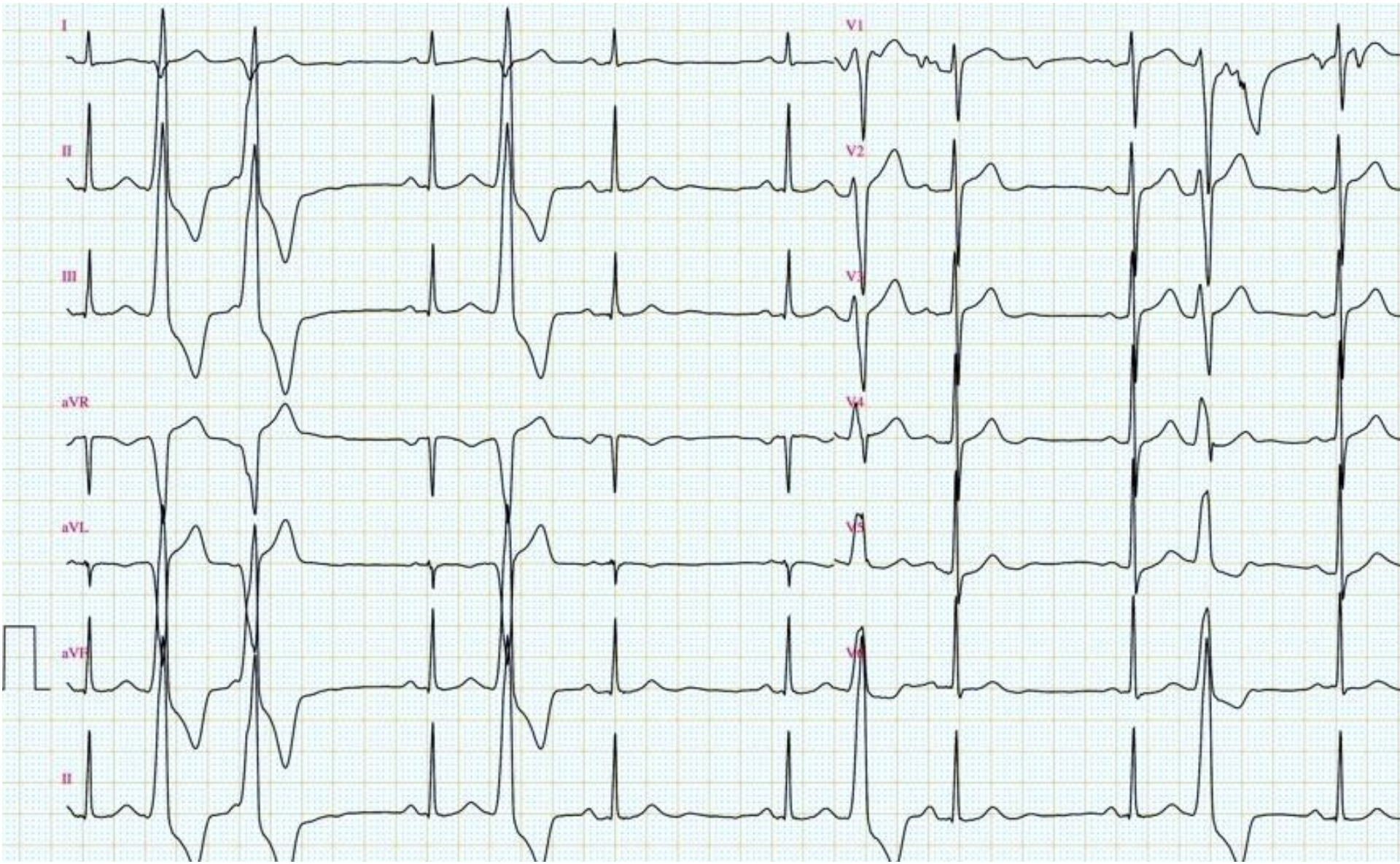
  Gène fonctionnelle, souvent liée à l'anxiété du patient…et du médecin : expliquer, rassurer !

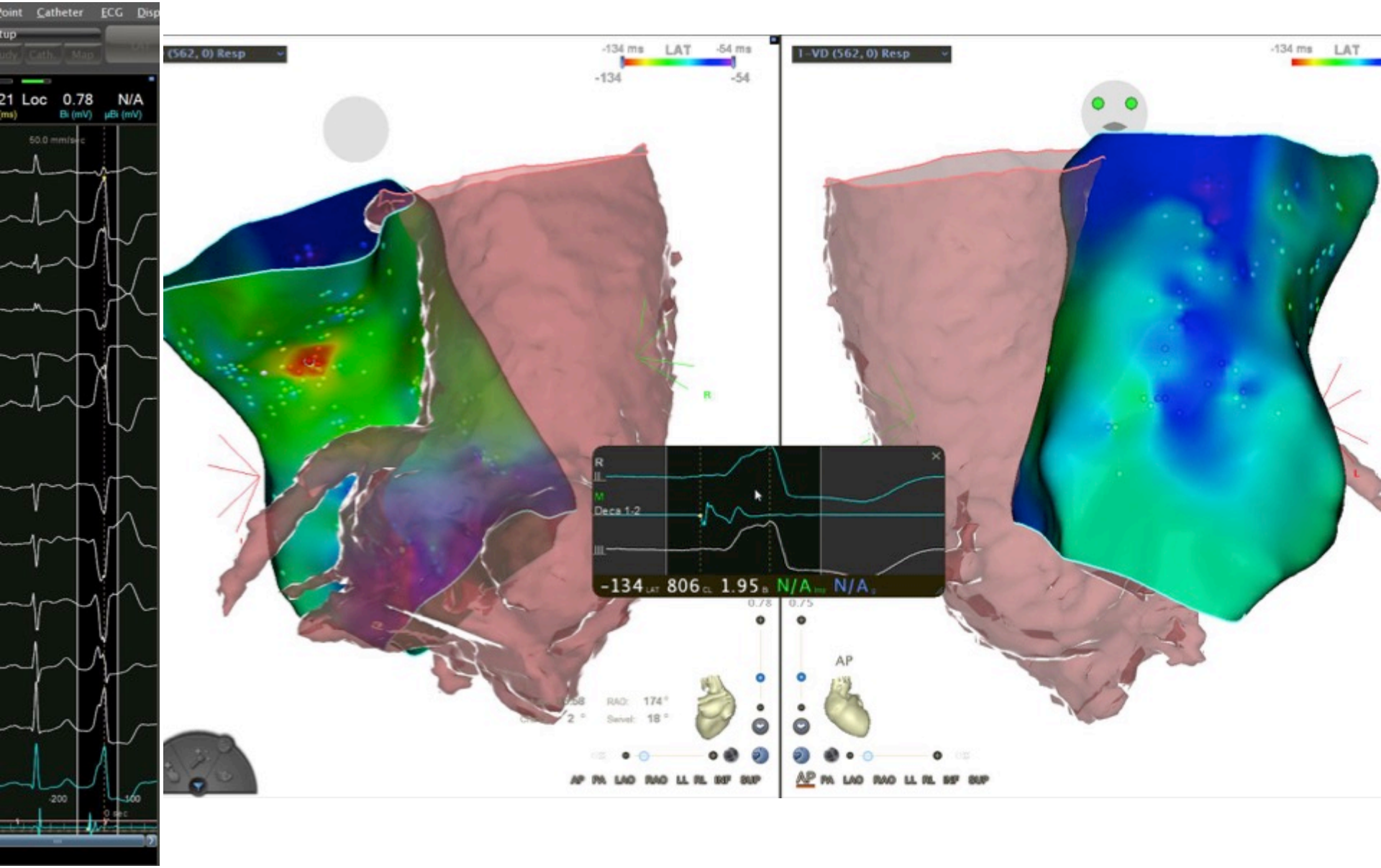
  Supprimer les excitants, proposer sédatifs, anxiolytiques

  AA de classe Ia, Ic, BB-, Ca-, pas d'amiodarone

  Ablation : rarement : symptômes invalidants ou cardiopathie d'allure rythmique

# ESV infundibulaire – de Rosenbaum – « bénigne »




Point Catheter ECG Disp
21 Loc 0.78 N/A
(562, 0) Resp
-134 ms LAT -54 ms
-134 -54
I-VD (562, 0) Resp
-134 ms LAT
R
Deca 1-2
-134 806 1.95 N/A N/A
AP
AP PA LAO RAO LL RL INF SUP

# Differentiating Right- and Left-Sided Outflow Tract Ventricular Arrhythmias

## Classical ECG Signatures and Prediction Algorithms

Robert D. Anderson, MBBS
Saurabh Kumar, BSc(Med)/MBBS, PhD
Ramanathan Parameswaran, MBBS
Geoffrey Wong, MBBS
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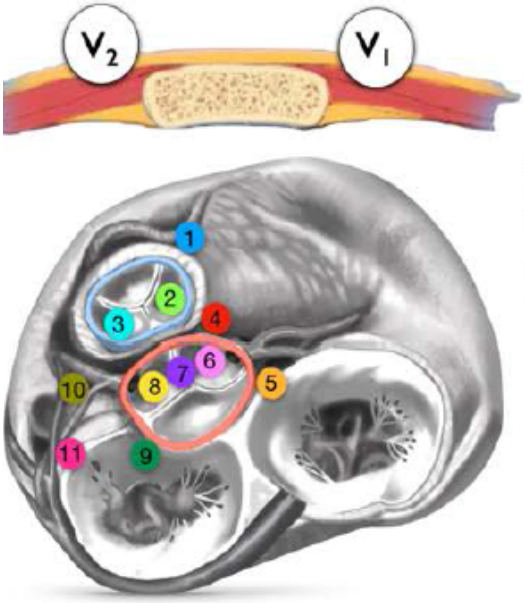


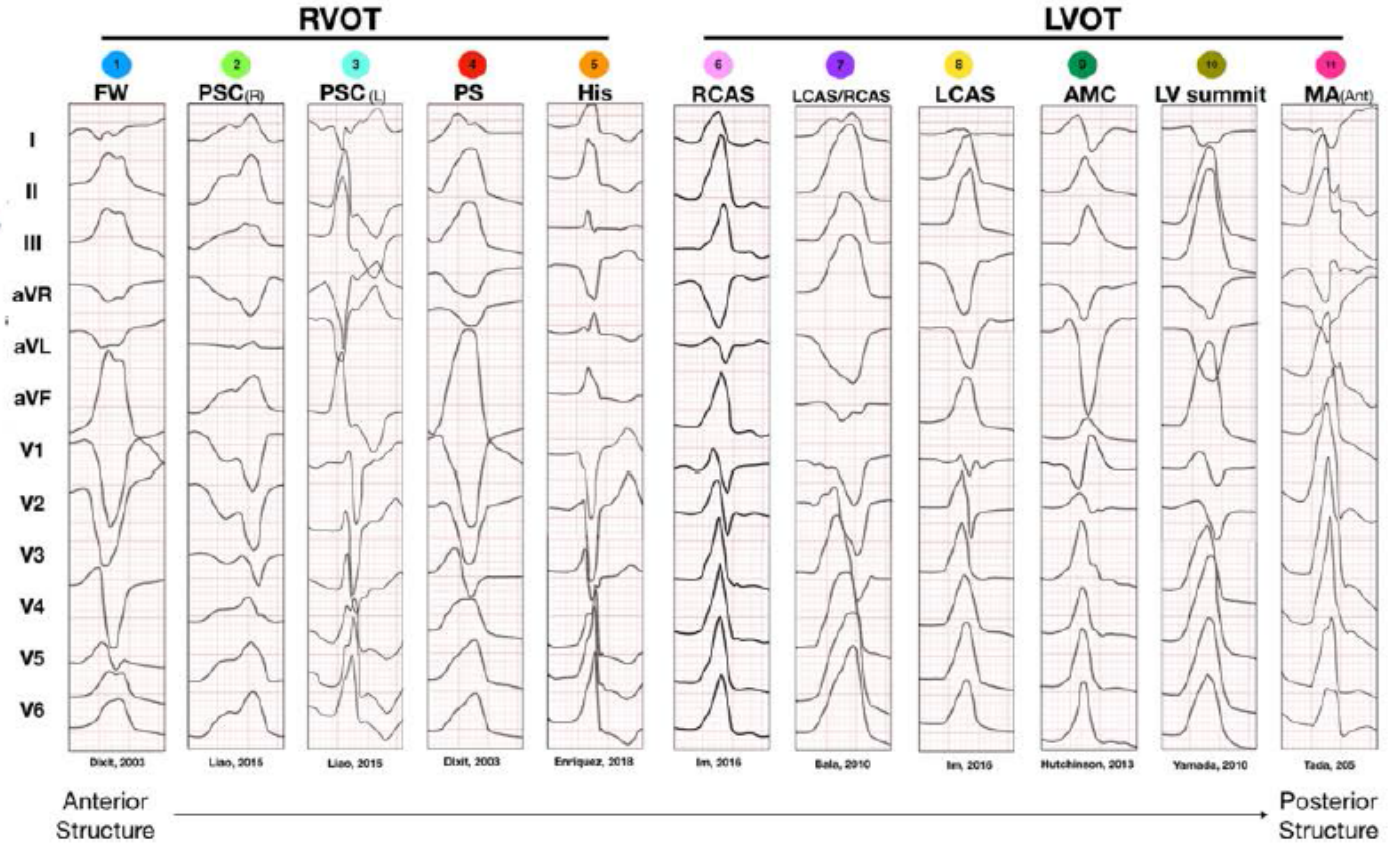


Circ Arrhythm Electrophysiol. 2019;12:e007392

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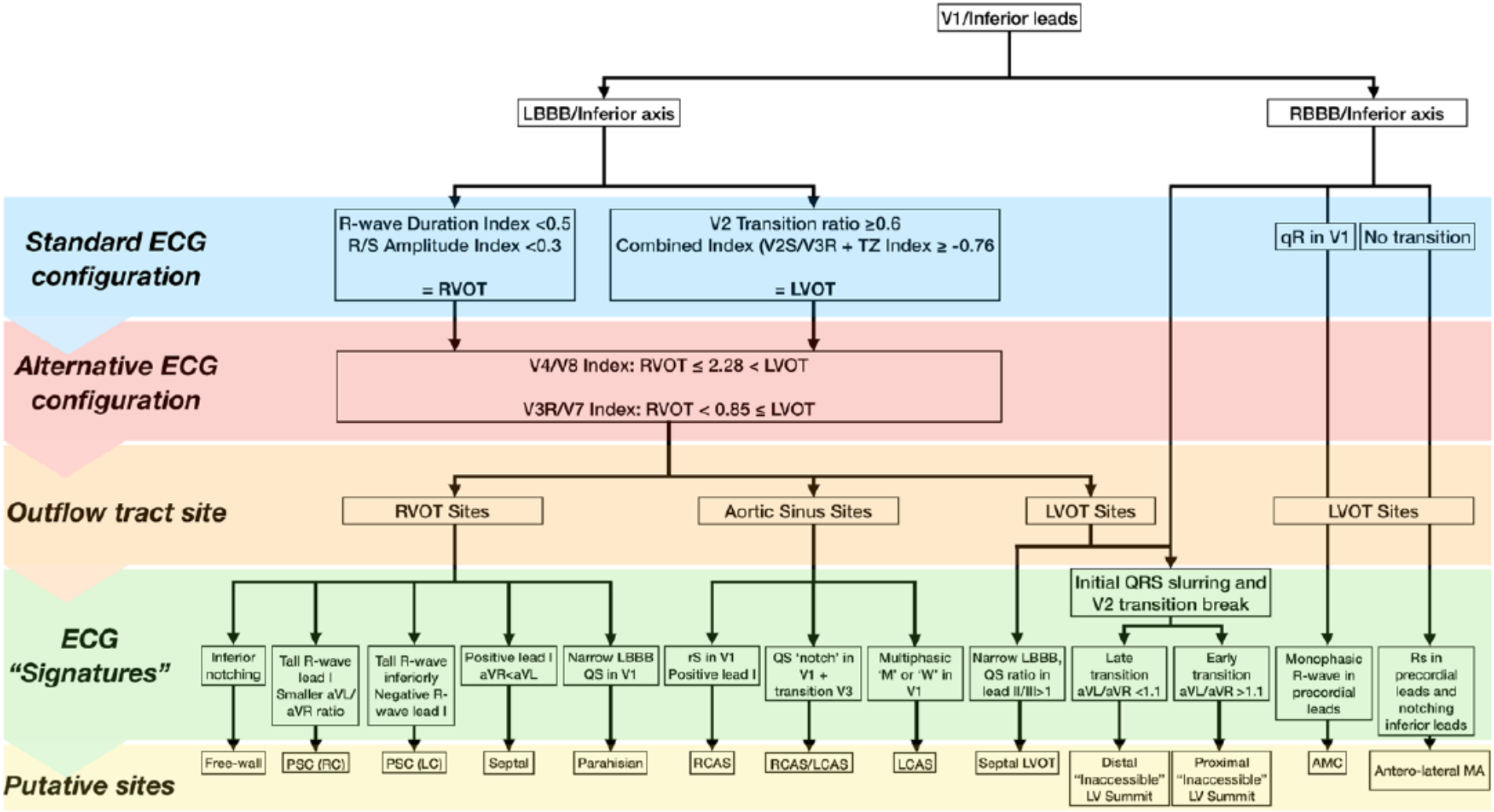


Circ Arrhythm Electrophysiol. 2019;12:e007392

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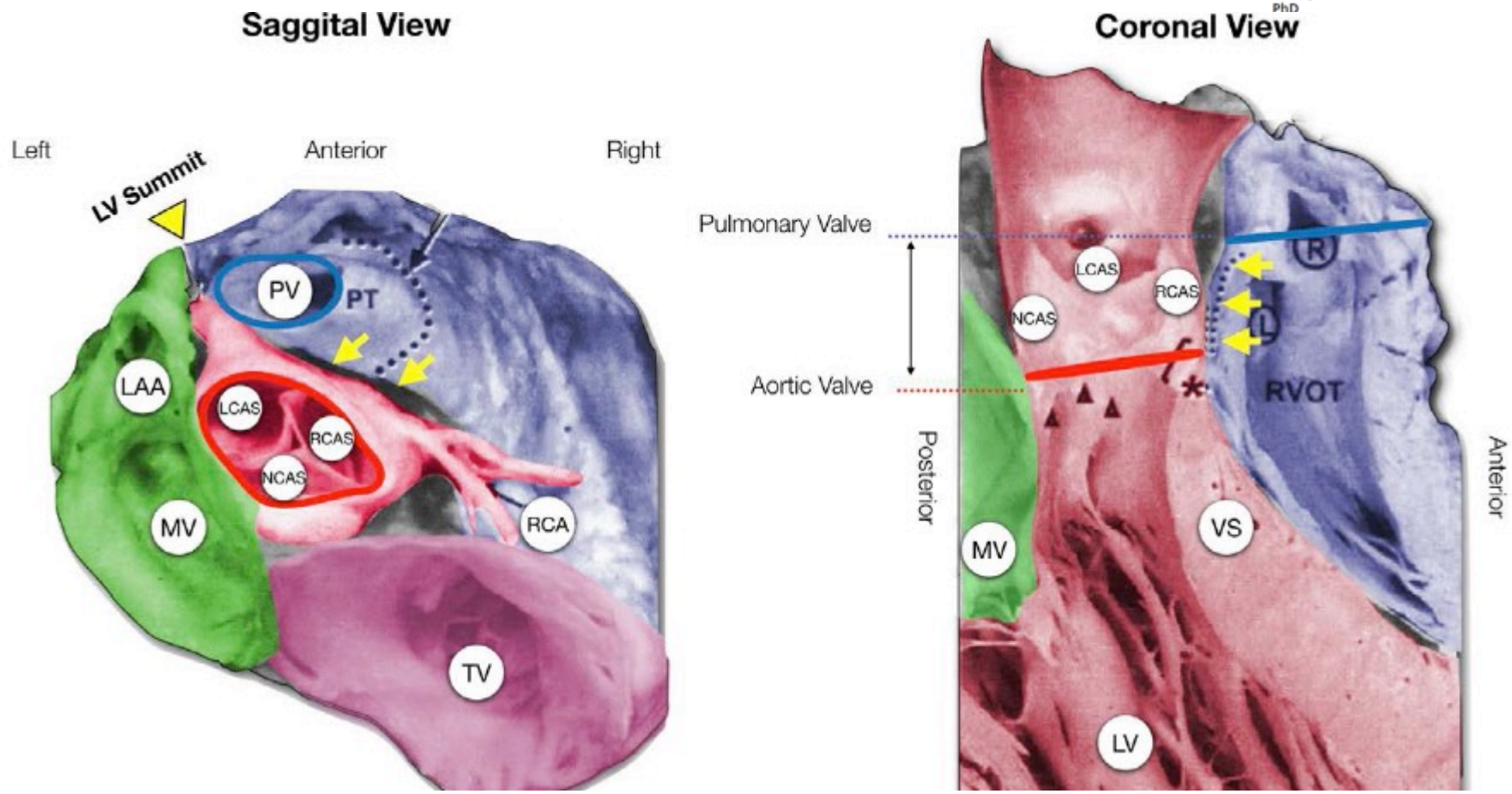
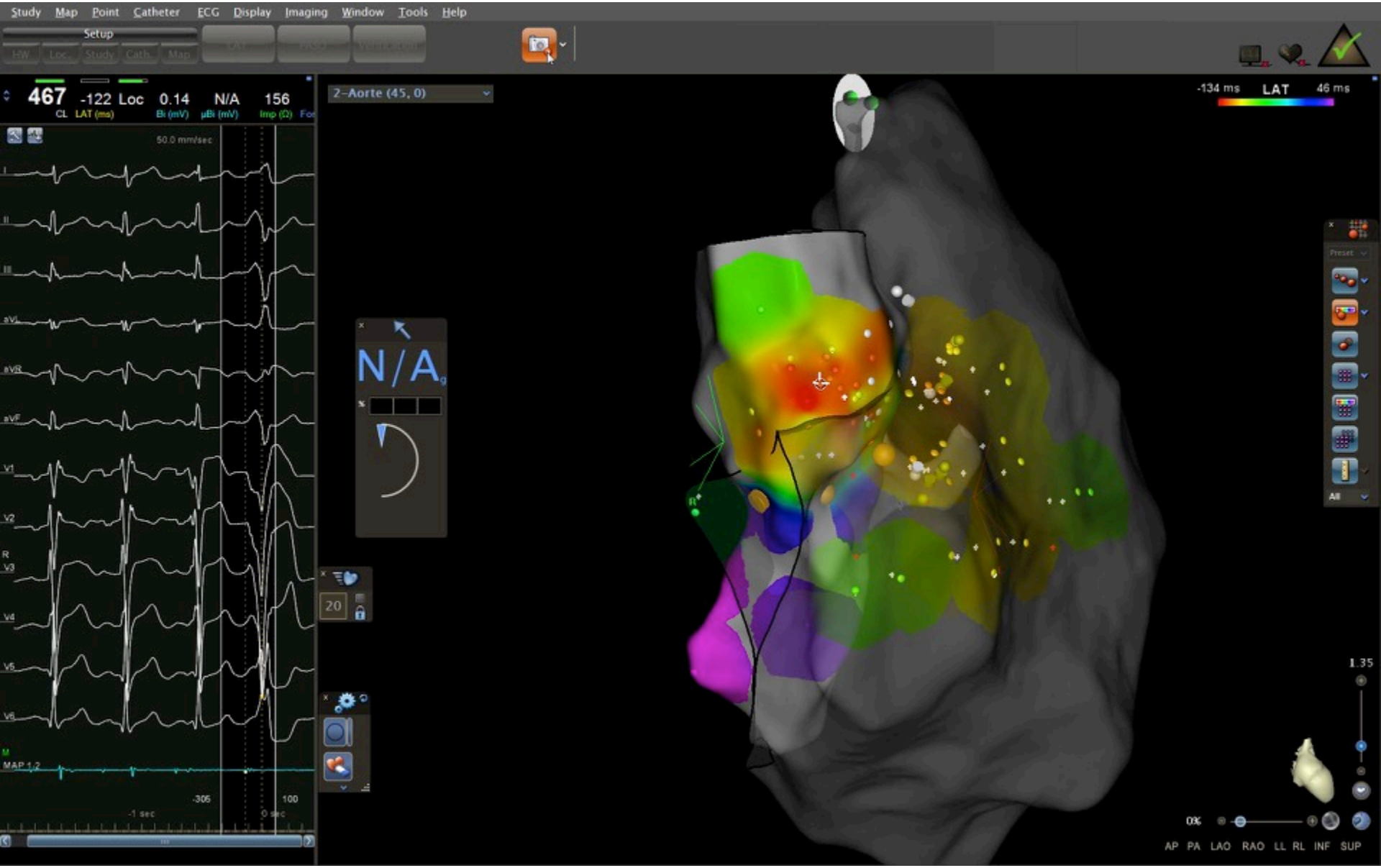
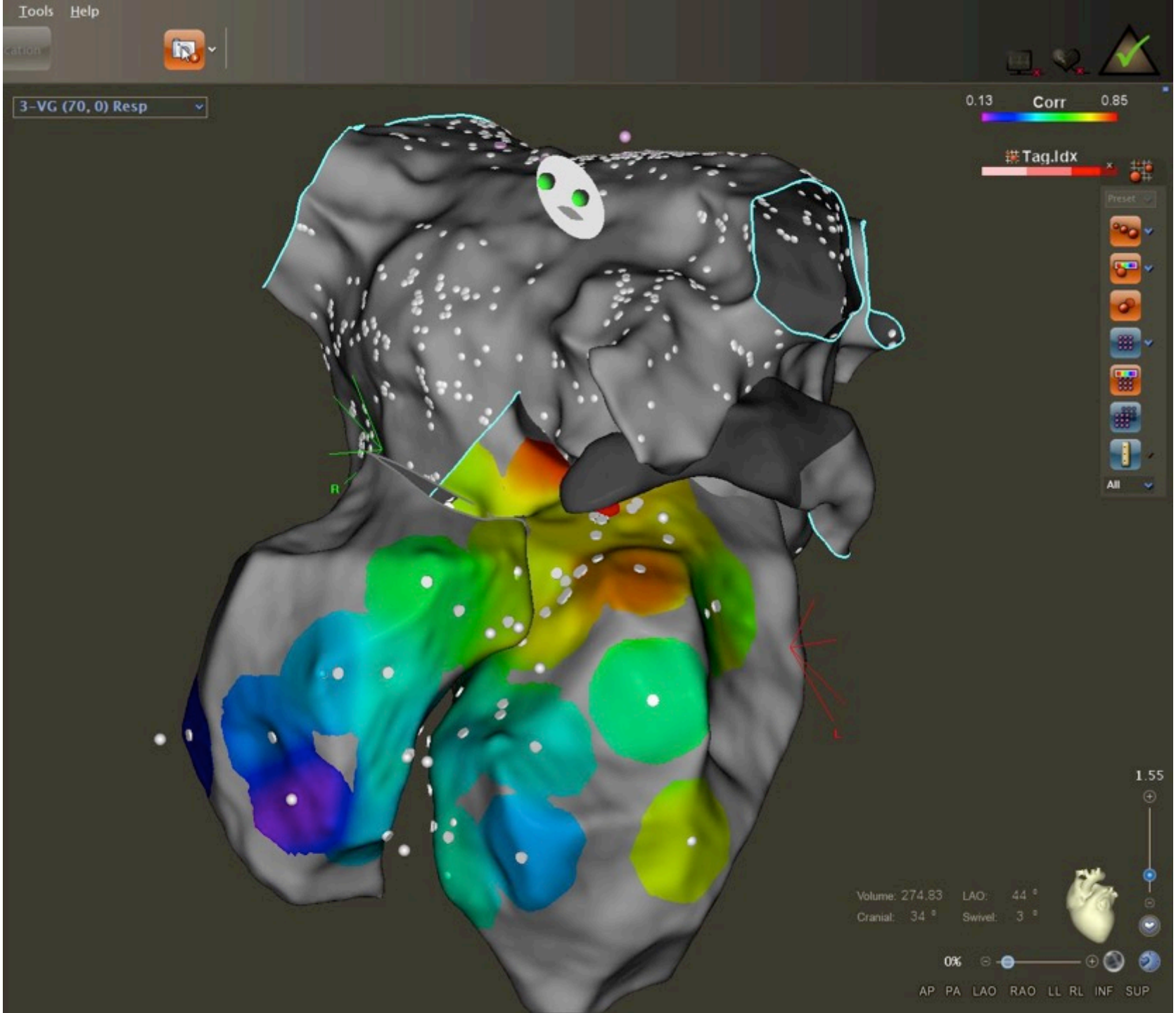
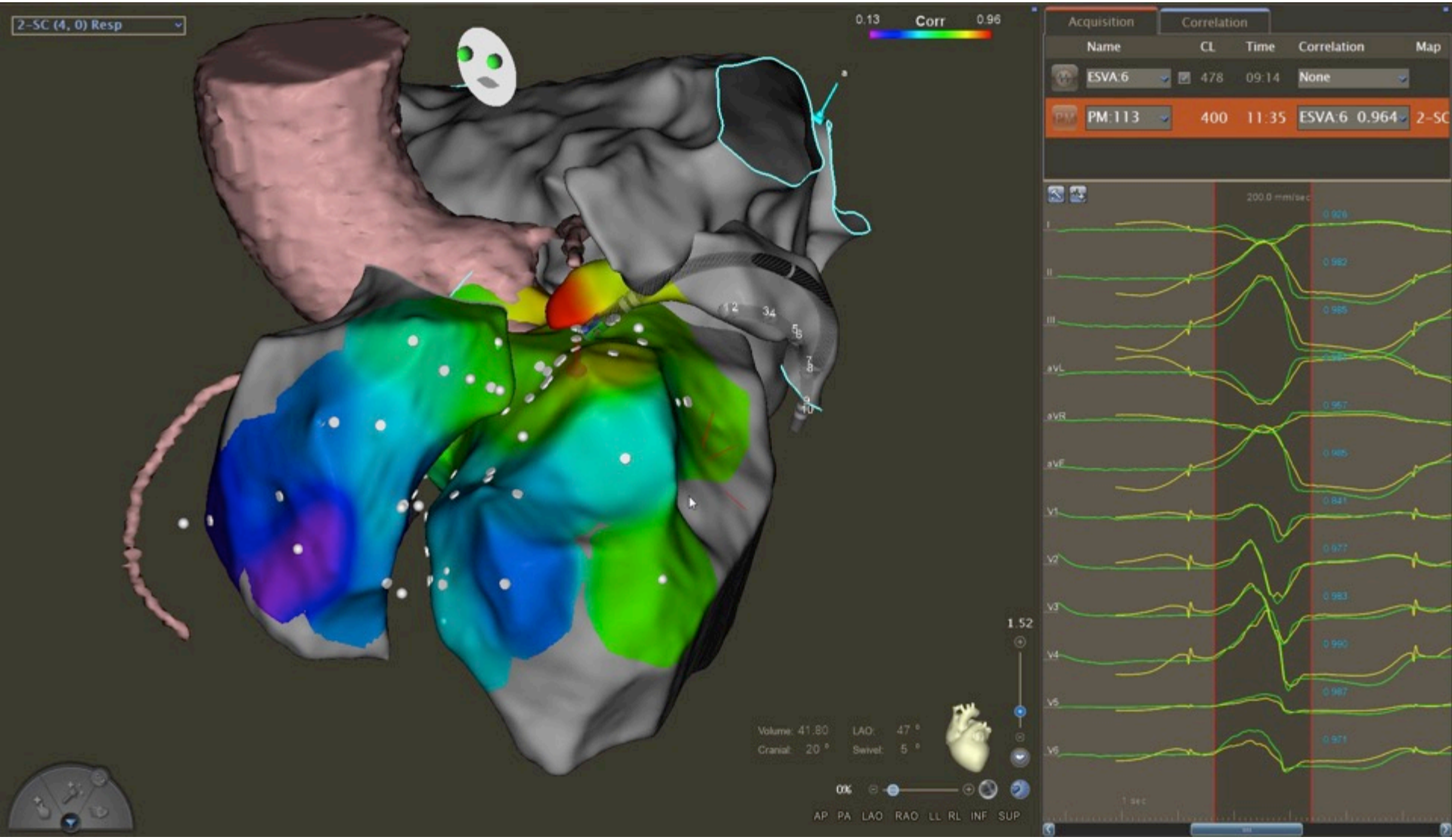



Circ Arrhythm Electrophysiol. 2019;12:e007392


Study Map Point Catheter ECG Display Imaging Window Tools Help
Setup
HW Loc Study Cath Map
467 -122 Loc 0.14 N/A 156
CL LAT (ms) Bi (mV) µBi (mV) Imp (Ω)
50.0 mm/sec
I
II
III
aVL
aVR
aVF
V1
V2
R
V3
V4
V5
V6
M
MAP 1,2
-305
100
-1 sec
0 sec
2-Aorte (45, 0)
-134 ms LAT 46 ms
N/A
20
All
1.35
AP PA LAO RAO LL RL INF SUP


Tools
Help
3-VG (70, 0) Resp
0.13
Corr
0.85
Tag.Idx
Preset
All
R
L
1.55
Volume: 274.83
LAO: 44 °
Cranial: 34 °
Swivel: 3 °
0%
AP PA LAO RAO LL RL INF SUP


2-SC (4, 0) Resp
0.13
Corr
0.96
Acquisition
Correlation
Name
CL
Time
Correlation
Map
ESVA:6
478
09:14
None
PM:113
400
11:35
ESVA:6 0.964
2-SC
1.52
Volume: 41.80
LAO: 47 °
Cranial: 20 °
Swivel: 5 °
0%
AP PA LAO RAO LL RL INF SUP

# Quand et comment traiter les ESV sur cardiopathie ?

- Objectifs du traitement

  - Diminuer les symptômes

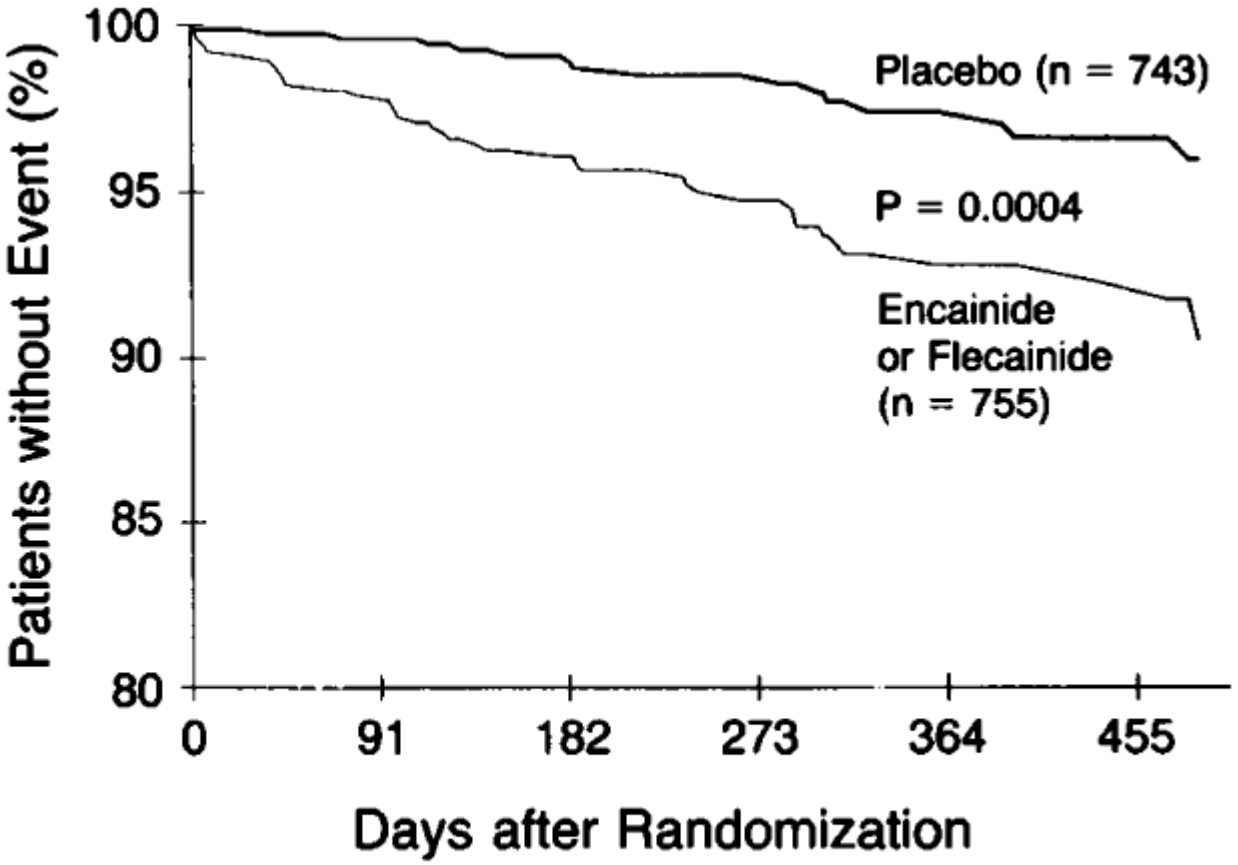
  - Améliorer le pronostic

# 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*

New Engl J Med. 1991;324

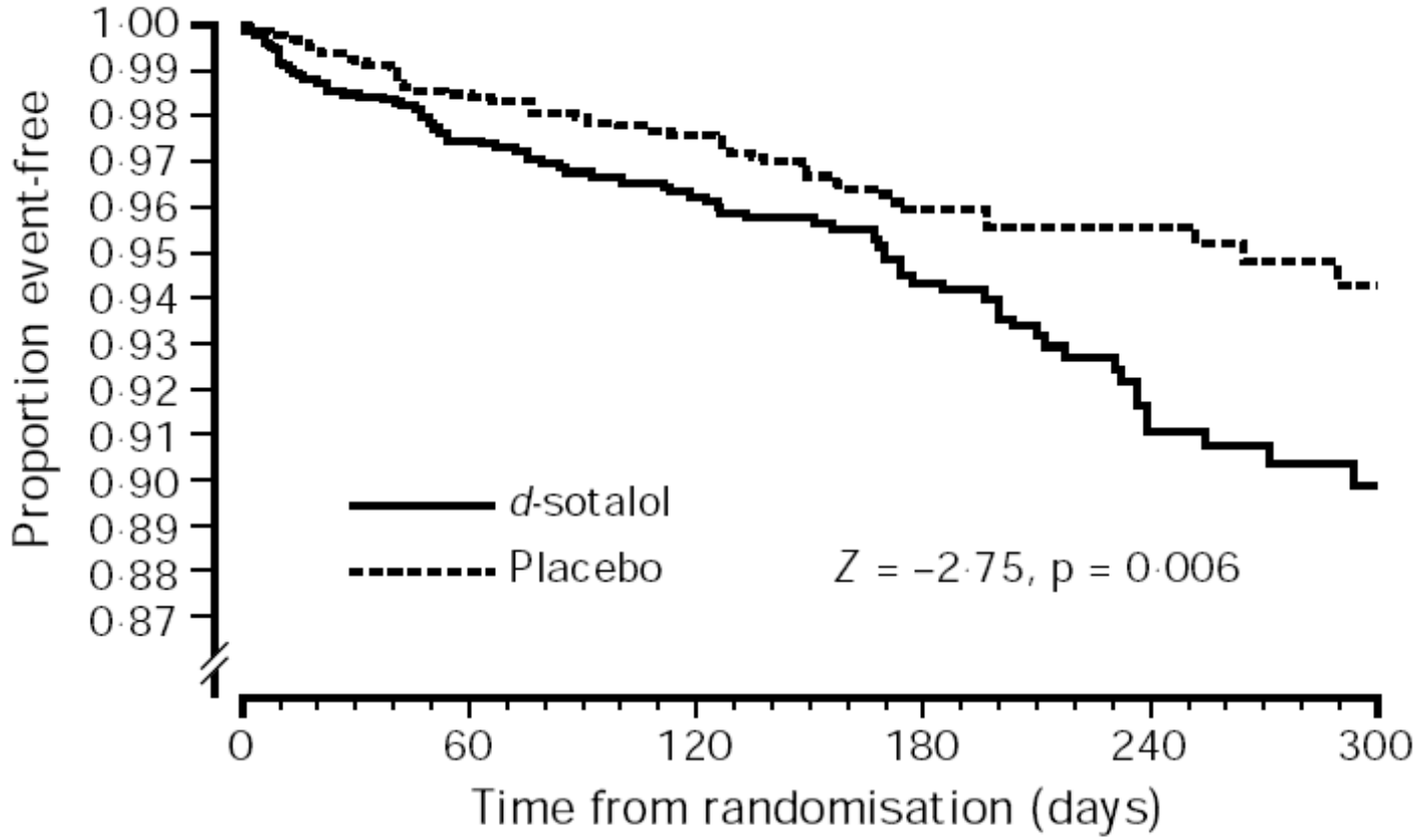



| | | | | | | |
|---|---|---|---|---|---|---|
| Placebo | 743 | 632 | 516 | 412 | 292 | 201 |
| Active drug | 755 | 631 | 507 | 392 | 286 | 198 |

# Effect of *d*-sotalol on mortality in patients with left ventricular dysfunction after recent and remote myocardial infarction

Lancet 1996; 348:7–12

*Albert L Waldo, A John Camm, Hans deRuyter, Peter L Friedman, Daniel J MacNeil, John F Pauls, Bertram Pitt, Craig M Pratt, Peter J Schwartz, Enrico P Veltri, for the SWORD investigators**




| Patients at risk | | | | | |
|---|---|---|---|---|---|
| Placebo | 1572 | 1170 | 874 | 551 | 330 |
| *d*-sotalol | 1549 | 1150 | 844 | 544 | 323 |

# Effect of *d*-sotalol on mortality in patients with left ventricular dysfunction after recent and remote myocardial infarction

Lancet 1996; 348:7–12

*Albert L Waldo, A John Camm, Hans deRuyter, Peter L Friedman, Daniel J MacNeil, John F Pauls, Bertram Pitt, Craig M Pratt, Peter J Schwartz, Enrico P Veltri, for the SWORD investigators**

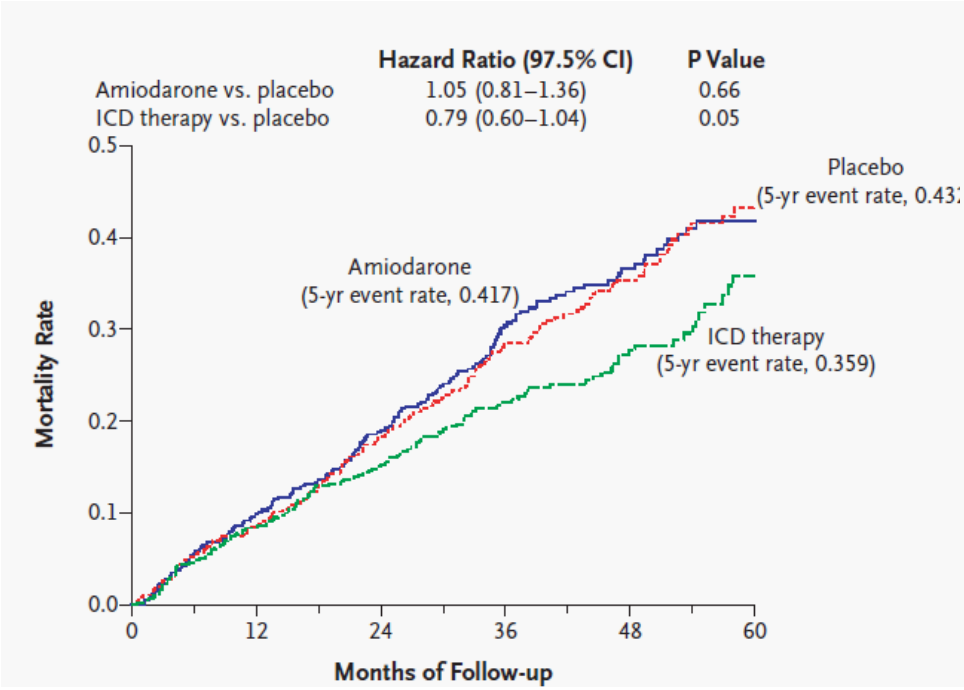
| | Number of deaths | | | |
|---|---|---|---|---|
| | *d*-sotalol (n=1549) | Placebo (n=1572) | Log-rank p* | Relative risk (95% CI) |
| **All causes** | 78 | 48 | 0·006 | 1·65 (1·15–2·36) |
| **Cardiac deaths** | | | | |
| All cardiac | 73 | 45 | 0·008 | 1·65 (1·14–2·39) |
| Arrhythmic (presumed) | 56 | 32 | 0·008 | 1·77 (1·15–2·74) |
| Non-arrhythmic | 17 | 13 | . . | . . |
| Progressive CHF | 10 | 8 | . . | . . |
| Acute MI | 6 | 5 | . . | . . |
| Other | 1 | 0 | . . | . . |
| **Other** | | | | |
| Cerebrovascular | 2 | 2 | . . | . . |
| Non-cardiovascular | 3 | 1 | . . | . . |

# Amiodarone or an Implantable Cardioverter–Defibrillator for Congestive Heart Failure

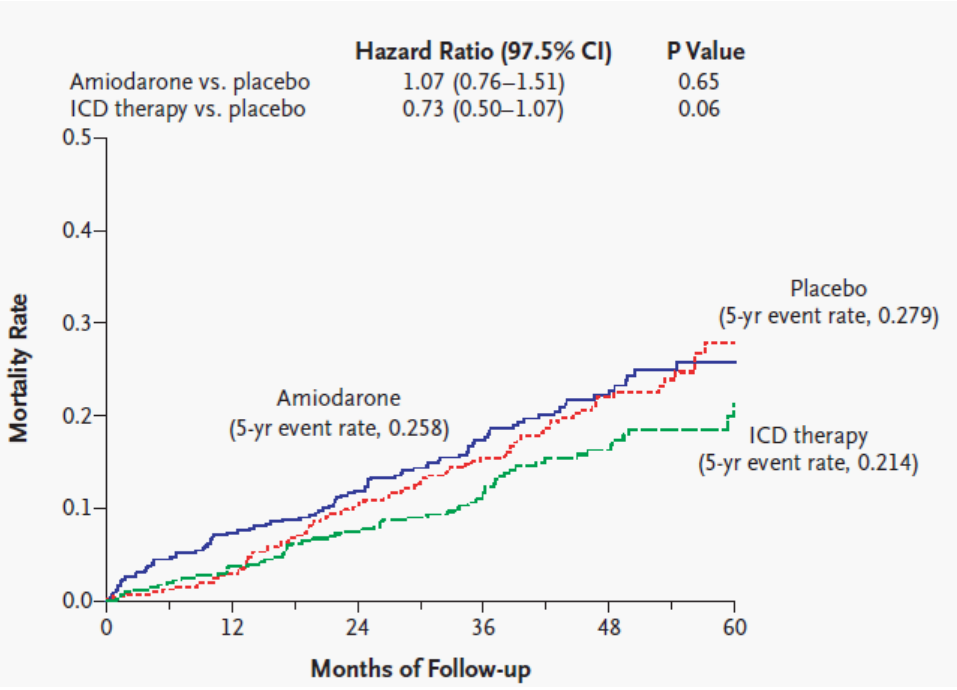
Gust H. Bardy, M.D., Kerry L. Lee, Ph.D., Daniel B. Mark, M.D., Jeanne E. Poole, M.D., Douglas L. Packer, M.D., Robin Boineau, M.D., Michael Domanski, M.D., Charles Troutman, R.N., Jill Anderson, R.N., George Johnson, B.S.E.E., Steven E. McNulty, M.S., Nancy Clapp-Channing, R.N., M.P.H., Linda D. Davidson-Ray, M.A., Elizabeth S. Fraulo, R.N., Daniel P. Fishbein, M.D., Richard M. Luceri, M.D., and John H. Ip, M.D., for the Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT) Investigators*

NEJM. 2005; 352:225-37

## Ischemic CHF




## Non Ischemic CHF



# 2ème "take-home message"

- **ESV du sujet sain**

  - Ne pas traiter les asymptomatiques (sauf exceptions)
  - Eviter un remède pire que le mal

- **ESV sur Cardiopathie**

  - Thérapie optimale
  - Evaluation & prise en charge du risque de mort subite associé à la cardiopathie

  **Traiter le patient si besoin, pas ses ESV**
  (sauf exceptions)

# ESV maligne
## Qu’est que c’est et comment la reconnaître ?

**L’ESV**

**« tueuse »**

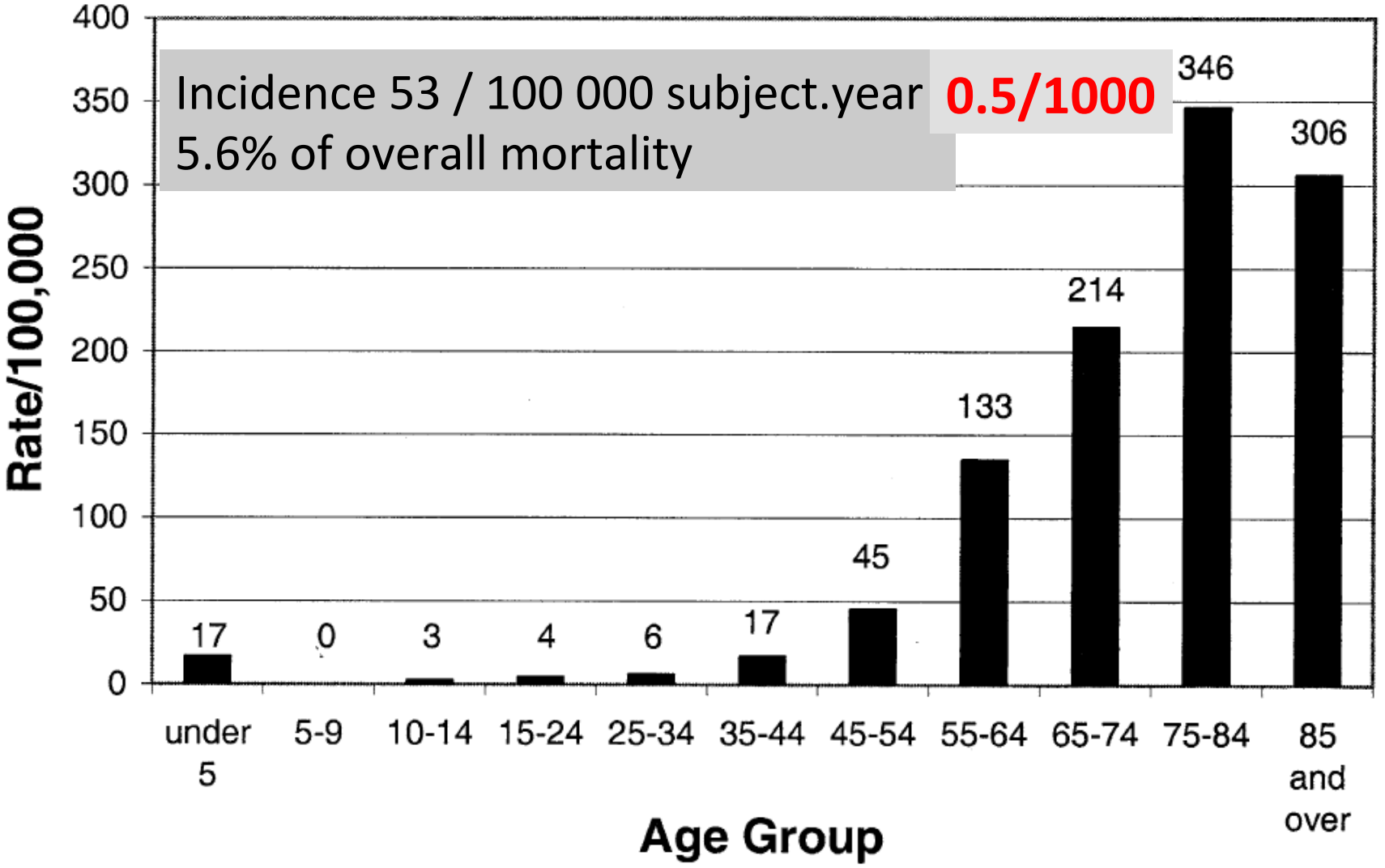
# Current Burden of Sudden Cardiac Death: Multiple Source Surveillance Versus Retrospective Death Certificate-Based Review in a Large U.S. Community

JACC. 2004; 44:1268-75

Sumeet S. Chugh, MD, FACC,* Jonathan Jui, MD,* Karen Gunson, MD,* Eric C. Stecker, MD,* Benjamin T. John, MD,* Barbara Thompson, BSN, JD,* Nasreen Ilias, BS,* Catherine Vickers, RN,* Vivek Dogra, MD,* Mohamud Daya, MD,* Jack Kron, MD, FACC,* Zhi-Jie Zheng, MD, PHD,† George Mensah, MD, FACC,† John McAnulty, MD, FACC*

Incidence 53 / 100 000 subject.year **0.5/1000**

5.6% of overall mortality



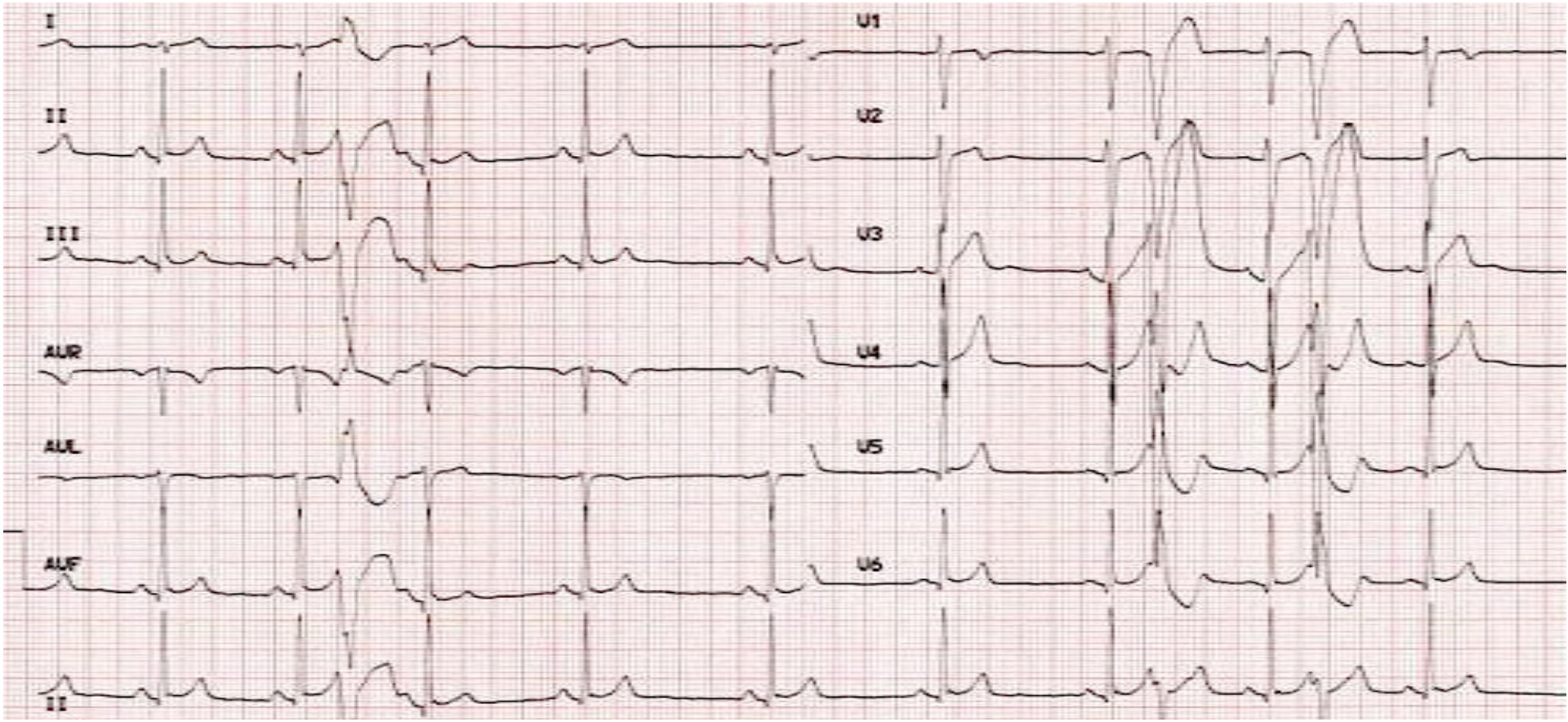
# Qu'est qu'une ESV maligne et comment la reconnaître ?

- **ESV à couplage court**
- ESV sur un substrat arythmogène / canalopathie
  - Syndrome de Brugada
  - Syndrome de repolarisation précoce
  - Syndrome du QT long congénital ou acquis
  - Tachycardies Ventriculaires catécholergiques
  - MEPPC
- ESV sur substrat arythmogène aigu
  - Phase subaiguë de l'infarctus du myocarde
  - Myocardite aigue
  - Takotsubo…

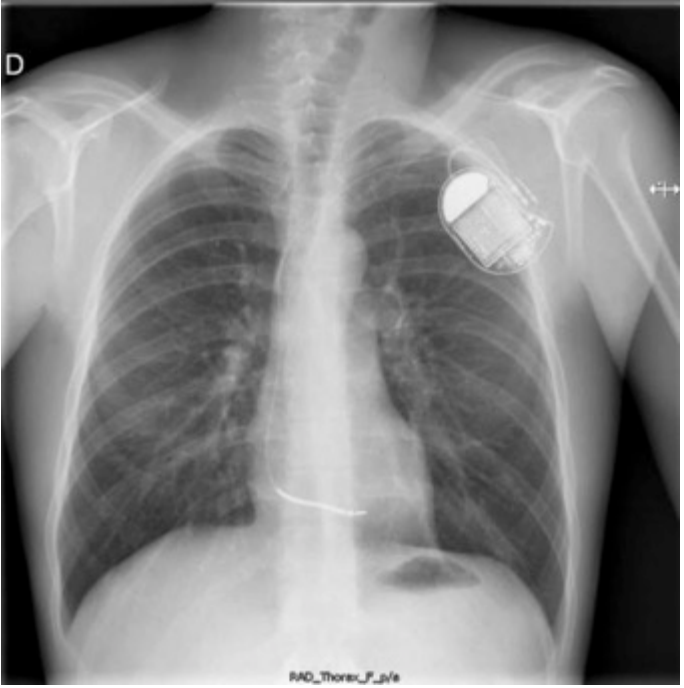
&

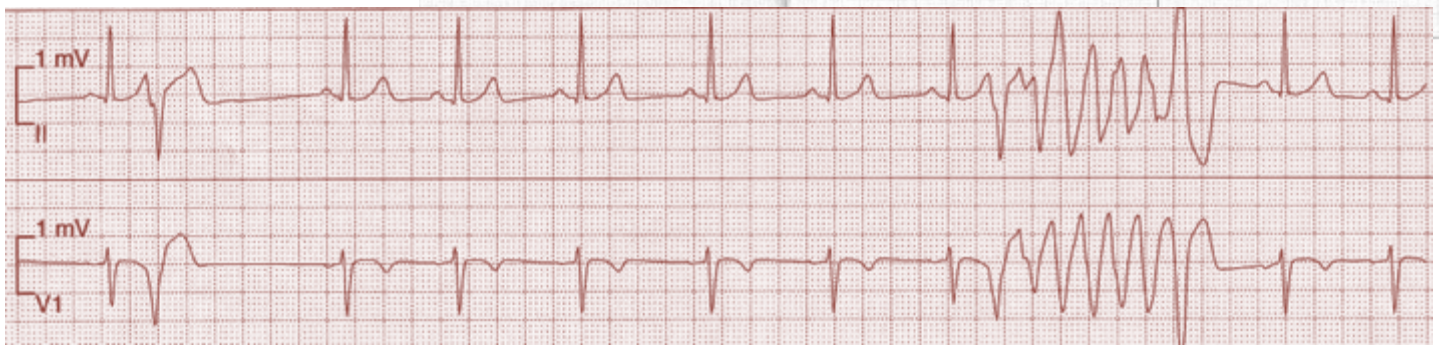
- ESV d'allure banale

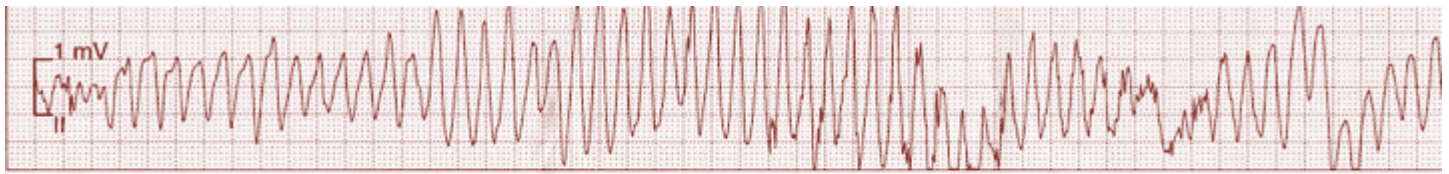
# Homme 25 ans – aucun antécédent - syncope

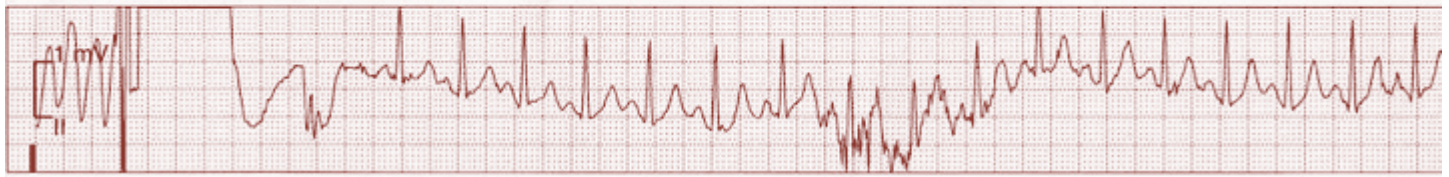



- Echographie cardiaque & IRM cardiaque normales
- Epreuve d'effort : 160 watts
  - pic de VO2 à 32,5 ml/min/kg à 65% de la théorique
  - FC 95 au repos (stress ?) - 160 au pic (82% de la FMT)
  - pas d'ischémie
  - aucune ESA ou ESV


D


1 mV
II
1 mV
V1


1 mV
II


1 mV
II

# Short-Coupled Variant of Torsade de Pointes

## A New Electrocardiographic Entity in the Spectrum of Idiopathic Ventricular Tachyarrhythmias

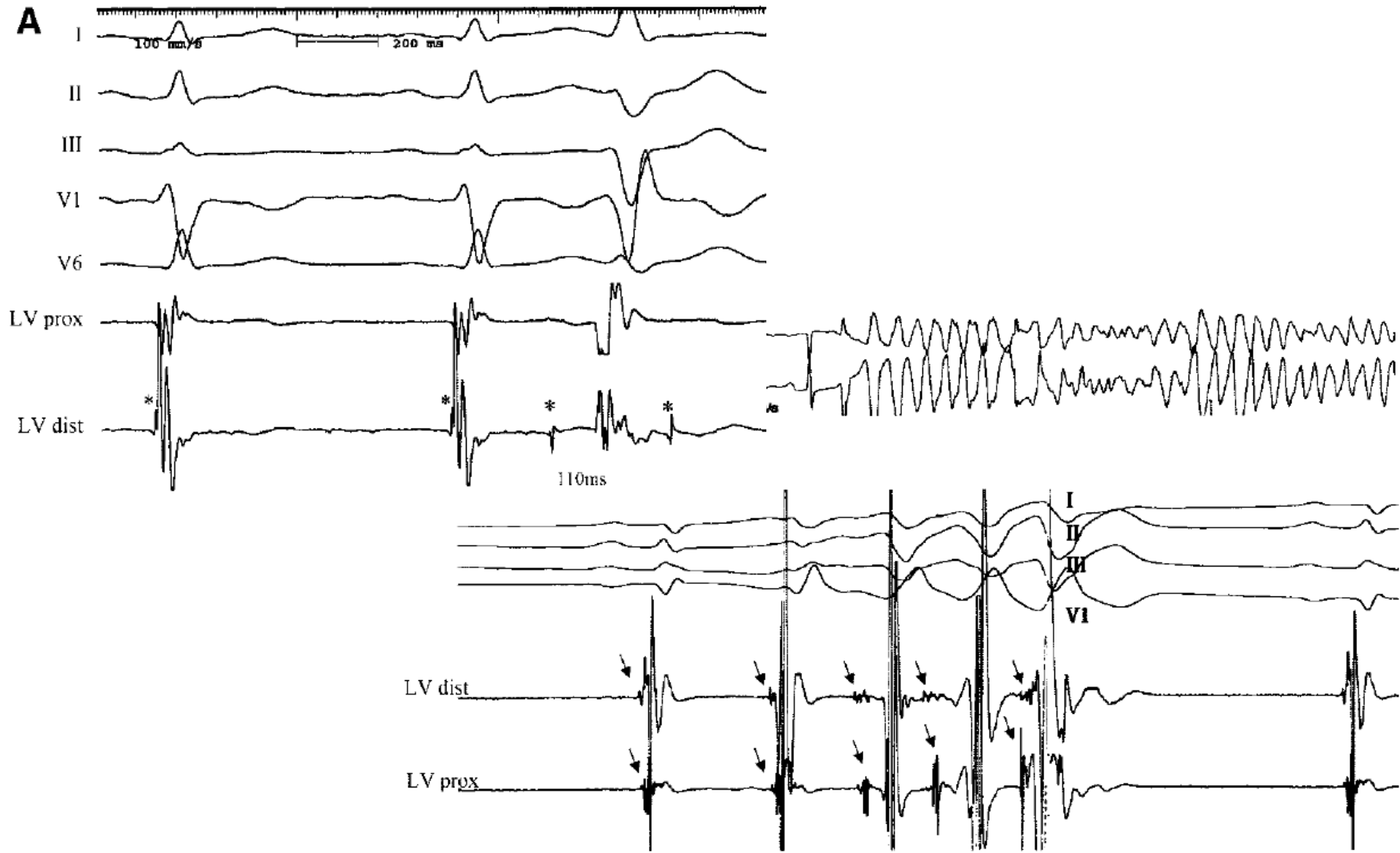
Antoine Leenhardt, MD; Emmanuel Glaser, MD; Miguel Burguera, MD;
Michael Nürnberg, MD; Pierre Maison-Blanche, MD; Philippe Coumel, MD

Circulation. 1994; 89:206-215

# Mapping and Ablation of Idiopathic Ventricular Fibrillation

Michel Haïssaguerre, MD; Morio Shoda, MD; Pierre Jaïs, MD; Akihiko Nogami, MD; Dipen C. Shah, MD; Josef Kautzner, MD; Thomas Arentz, MD; Dietrich Kalushe, MD; Dominique Lamaison, MD; Mike Griffith, MD; Fernando Cruz, MD; Angelo de Paola, MD; Fiorenzo Gaïta, MD; Mélèze Hocini, MD; Stéphane Garrigue, MD; Laurent Macle, MD; Rukshen Weerasooriya, MD; Jacques Clémenty, MD

Circulation. 2002; 106:962-967



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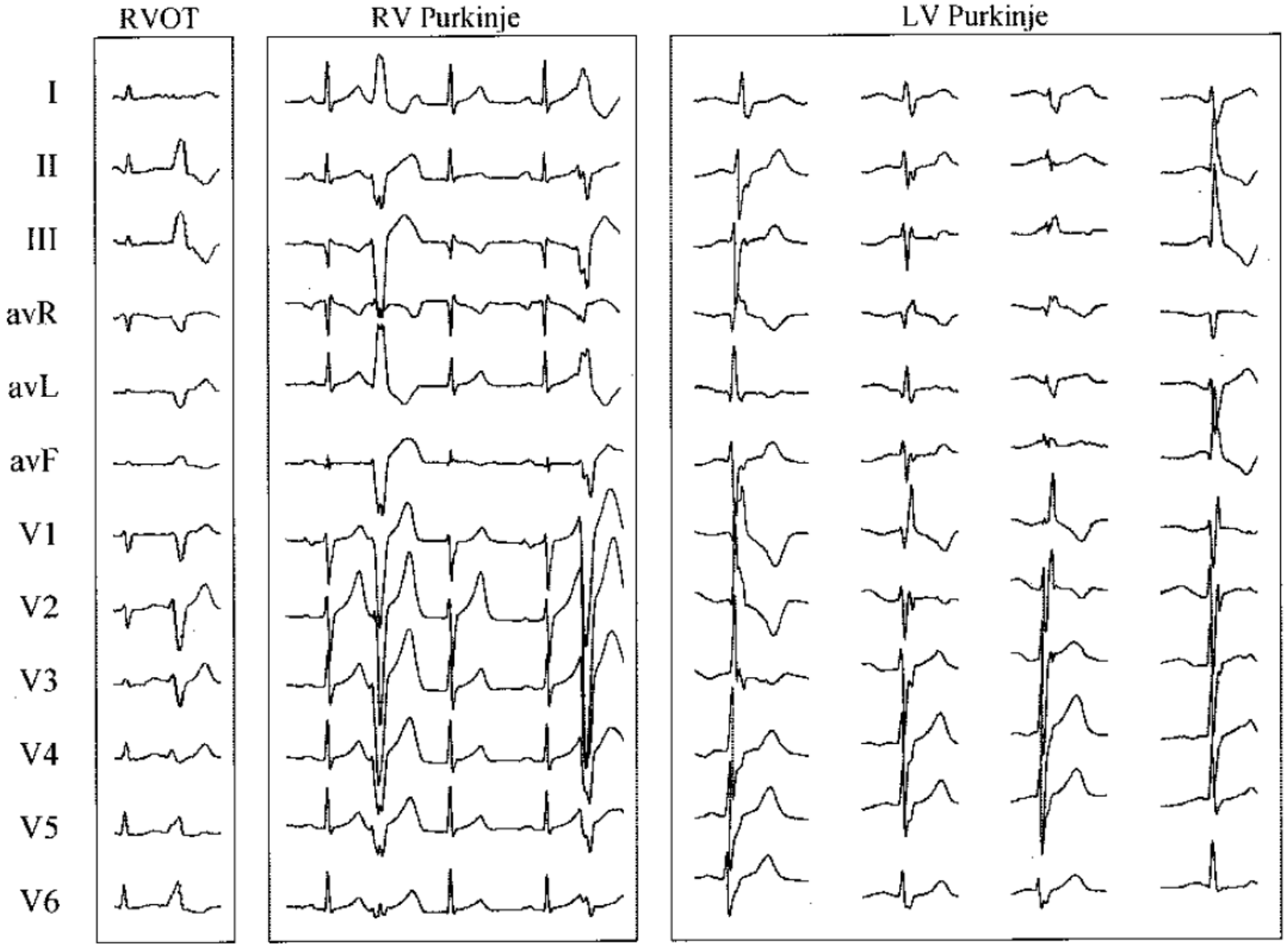

# Qu'est qu'une ESV maligne et comment la reconnaître ?

- ESV à couplage court
- **ESV sur un substrat arythmogène / canalopathie**
  - Syndrome de Brugada
  - Syndrome de repolarisation précoce
  - Syndrome du QT long congénital ou acquis
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- ESV sur substrat arythmogène aigu
  - Phase subaiguë de l'infarctus du myocarde
  - Myocardite aigue
  - Takotsubo…

&

- ESV d'allure banale

# Qu'est qu'une ESV maligne et comment la reconnaître ?

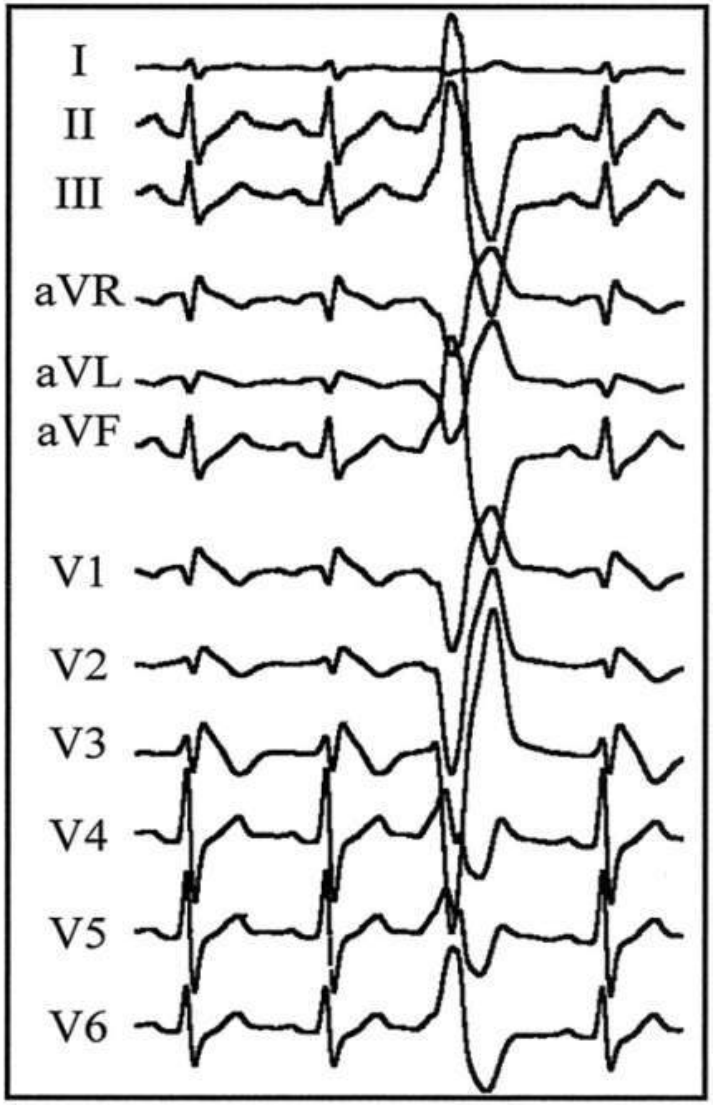
- Une ESV qui pourrait induire une FV

Syndrome de Brugada

**Mapping and Ablation of Ventricular Fibrillation Associated With Long-QT and Brugada Syndromes**

Michel Haïssaguerre, MD; Fabrice Extramiana, MD; Mélèze Hocini, MD; Bruno Cauchemez, MD; Pierre Jaïs, MD; Jose Angel Cabrera, MD; Geronimo Farre, MD; Antoine Leenhardt, MD; Prashanthan Sanders, MBBS; Christophe Scavée, MD; Li-Fern Hsu, MBBS; Rukshen Weerasooriya, MBBS; Dipen C. Shah, MD; Robert Frank, MD; Philippe Maury, MD; Marc Delay, MD; Stéphane Garrigue, MD; Jacques Clémenty, MD

Circulation. 2003;108:925:8



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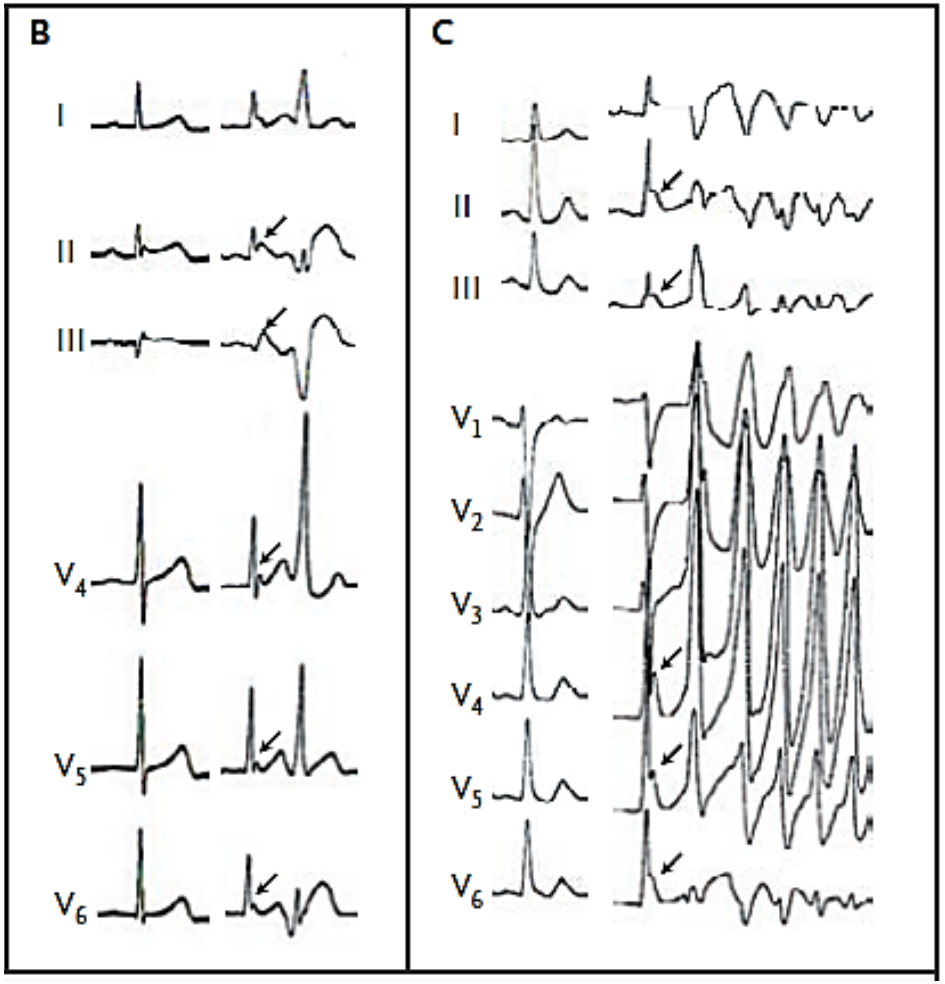
- Une ESV qui pourrait induire une FV

Repolarisation précoce

Sudden Cardiac Arrest Associated with Early Repolarization

Michel Haïssaguerre, M.D., Nicolas Derval, M.D., Frederic Sacher, M.D., Laurence Jesel, M.D., Isabel Deisenhofer, M.D., Luc de Roy, M.D., Jean-Luc Pasquié, M.D., Ph.D., Akihiko Nogami, M.D., Dominique Babuty, M.D., Sinikka Yli-Mayry, M.D., Christian De Chillou, M.D., Patrice Scanu, M.D., Philippe Mabo, M.D., Seiichiro Matsuo, M.D., Vincent Probst, M.D., Ph.D., Solena Le Scouarnec, Ph.D., Pascal Defaye, M.D., Juerg Schlaepfer, M.D., Thomas Rostock, M.D., Dominique Lacroix, M.D., Dominique Lamaison, M.D., Thomas Lavergne, M.D., Yoshifusa Aizawa, M.D., Anders Englund, M.D., Frederic Anselme, M.D., Mark O'Neill, M.D., Meleze Hocini, M.D., Kang Teng Lim, M.B., B.S., Sebastien Knecht, M.D., George D. Veenhuyzen, M.D., Pierre Bordachar, M.D., Michel Chauvin, M.D., Pierre Jais, M.D., Gaelle Coureau, Ph.D., Genevieve Chene, Ph.D., George J. Klein, M.D., and Jacques Clémenty, M.D.

N Engl J Med 2008;358:2016-23



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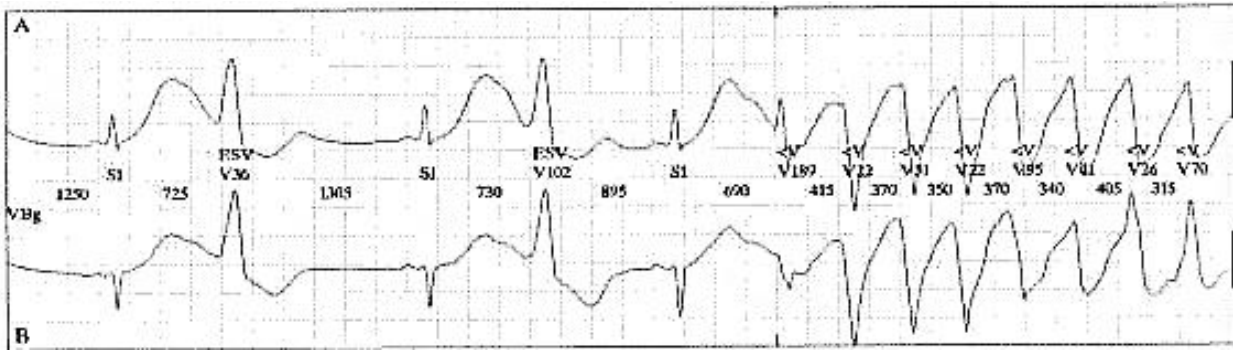
- Une ESV qui pourrait induire une FV

Syndrome du QT long congénital



# Qu'est qu'une ESV maligne et comment la reconnaître ?

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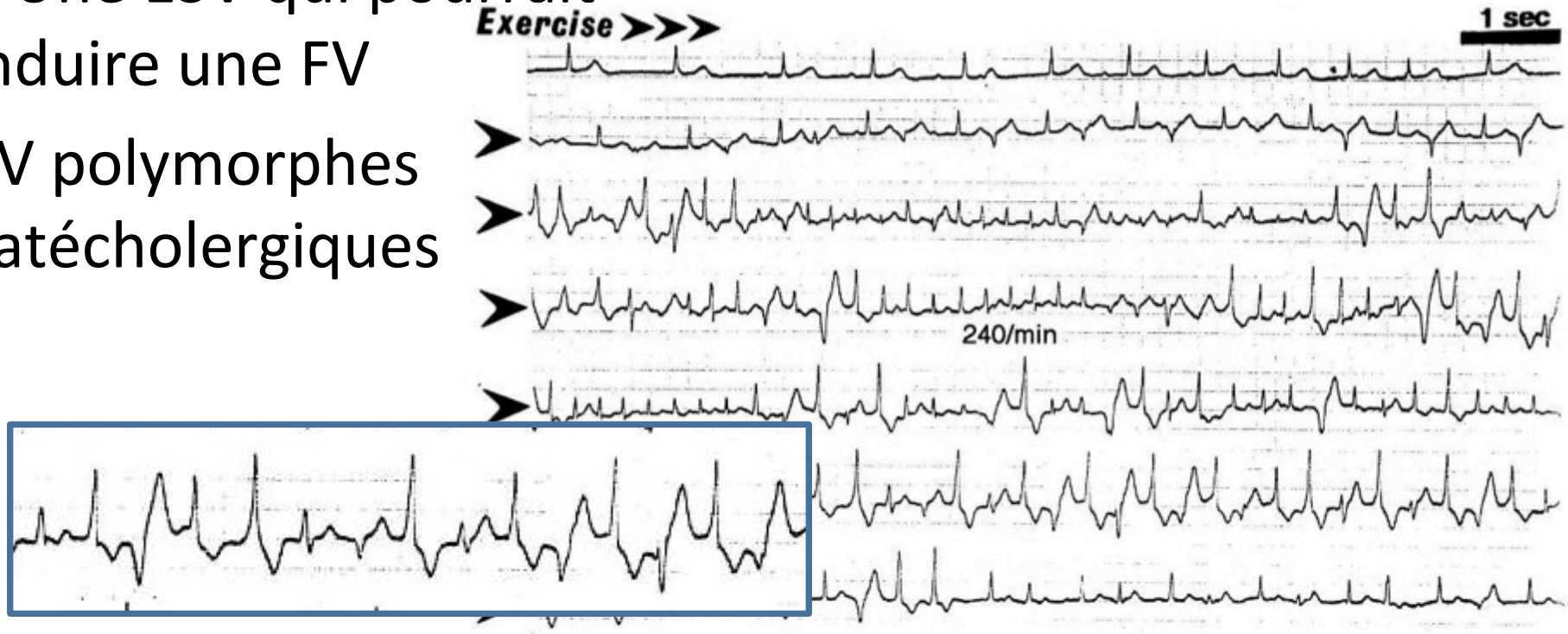
TV polymorphes catécholergiques




**Incidence and Risk Factors of Arrhythmic Events in Catecholaminergic Polymorphic Ventricular Tachycardia**

Meiso Hayashi, MD; Isabelle Denjoy, MD; Fabrice Extramiana, MD, PhD; Alice Maltret, MD; Nathalie Roux Buisson, MD; Jean-Marc Lupoglazoff, MD, PhD; Didier Klug, MD; Miyuki Hayashi, MD; Seiji Takatsuki, MD; Elisabeth Villain, MD; Joël Kamblock, MD; Anne Messali, MD; Pascale Guicheney, PhD; Joël Lunardi, MD, PhD; Antoine Leenhardt, MD

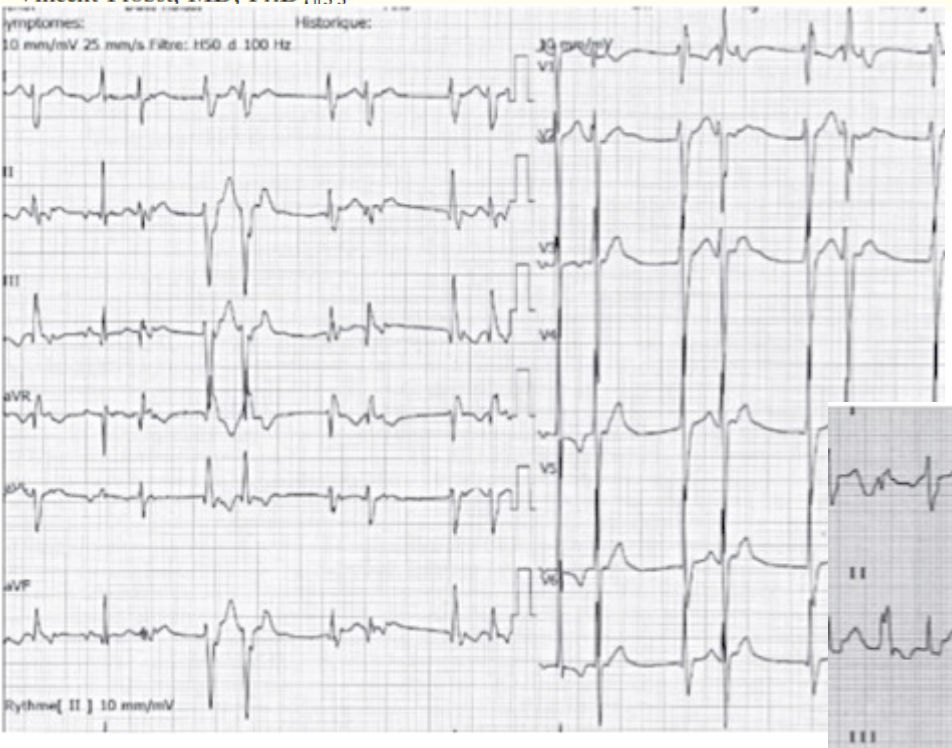
Circulation. 2009;119:2426-34

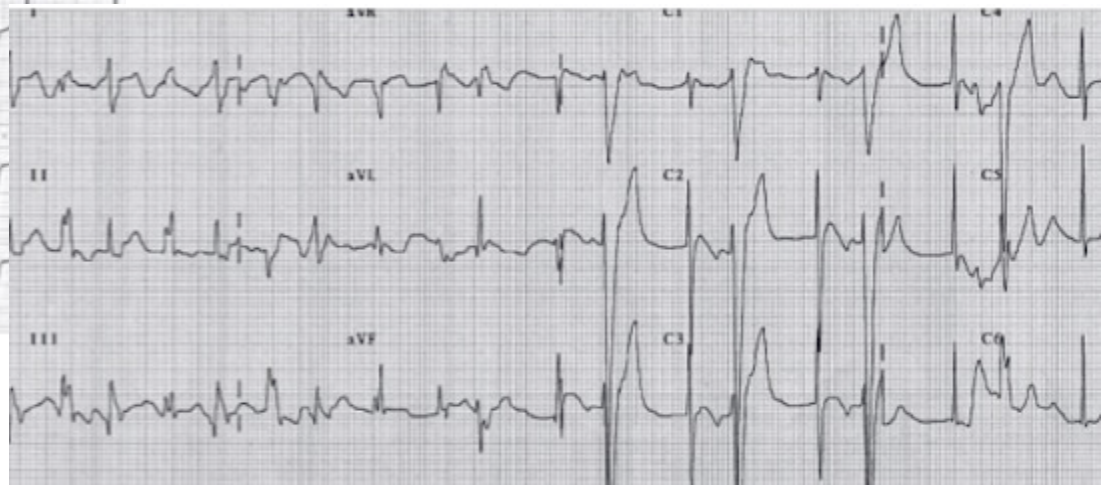
# Multifocal Ectopic Purkinje-Related Premature Contractions

## A New *SCN5A*-Related Cardiac Channelopathy

Gabriel Laurent, MD, PHD,* Samuel Saal, MD,† Mohamed Yassine Amarouch, PHD,‡§‖
Delphine M. Béziau, MSC,‡§‖ Roos F. J. Marsman, MSC,¶ Laurence Faivre, MD, PHD,†
Julien Barc, PHD,‡‖ Christian Dina, PHD,‡‖ Geraldine Bertaux, MD,* Olivier Barthez, MD,*
Christel Thauvin-Robinet, MD, PHD,† Philippe Charron, MD, PHD,# Véronique Fressart, MD, PHD,**
Alice Maltret, MD,†† Elisabeth Villain, MD,†† Estelle Baron, BA,‡‖ Jean Mérot, PHD,‡§‖
Rodolphe Turpault, PHD,‡‡‖ Yves Coudière, PHD,‡‡‖ Flavien Charpentier, PHD,‡§‖§§
Jean-Jacques Schott, PHD,‡‖§§ Gildas Loussouarn, PHD,‡§‖ Arthur A. M. Wilde, MD, PHD,¶
Jean-Eric Wolf, MD, PHD,* Isabelle Baró, PHD,‡§‖ Florence Kyndt, PHARMD, PHD,‡‖‖‖
Vincent Probst, MD, PHD‡‖§§

JACC. 2012;
60:144-56





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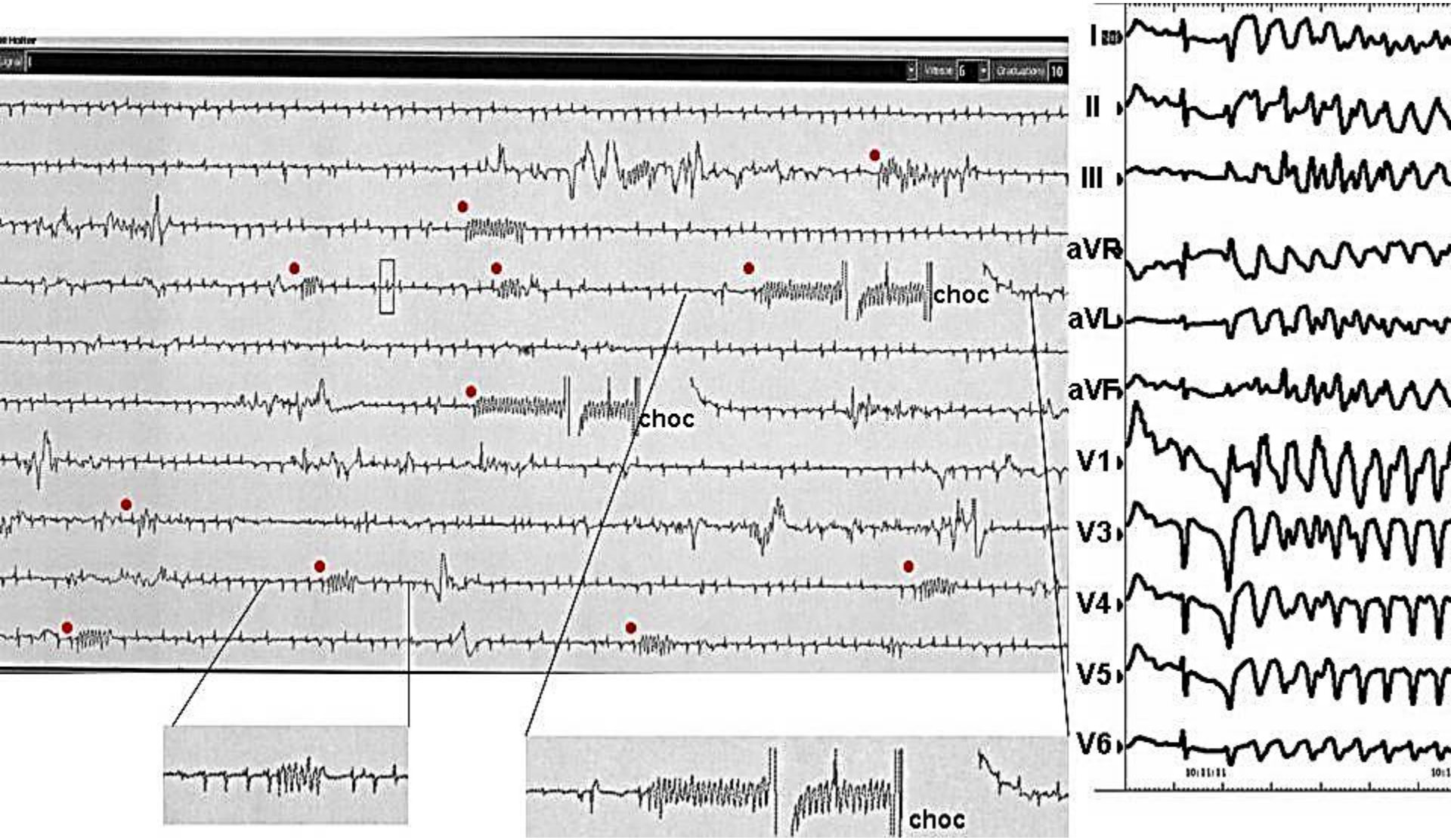
- **ESV sur substrat arythmogène aigu**
  - Phase subaiguë de l'infarctus du myocarde
  - Myocardite aigue
  - Takotsubo…

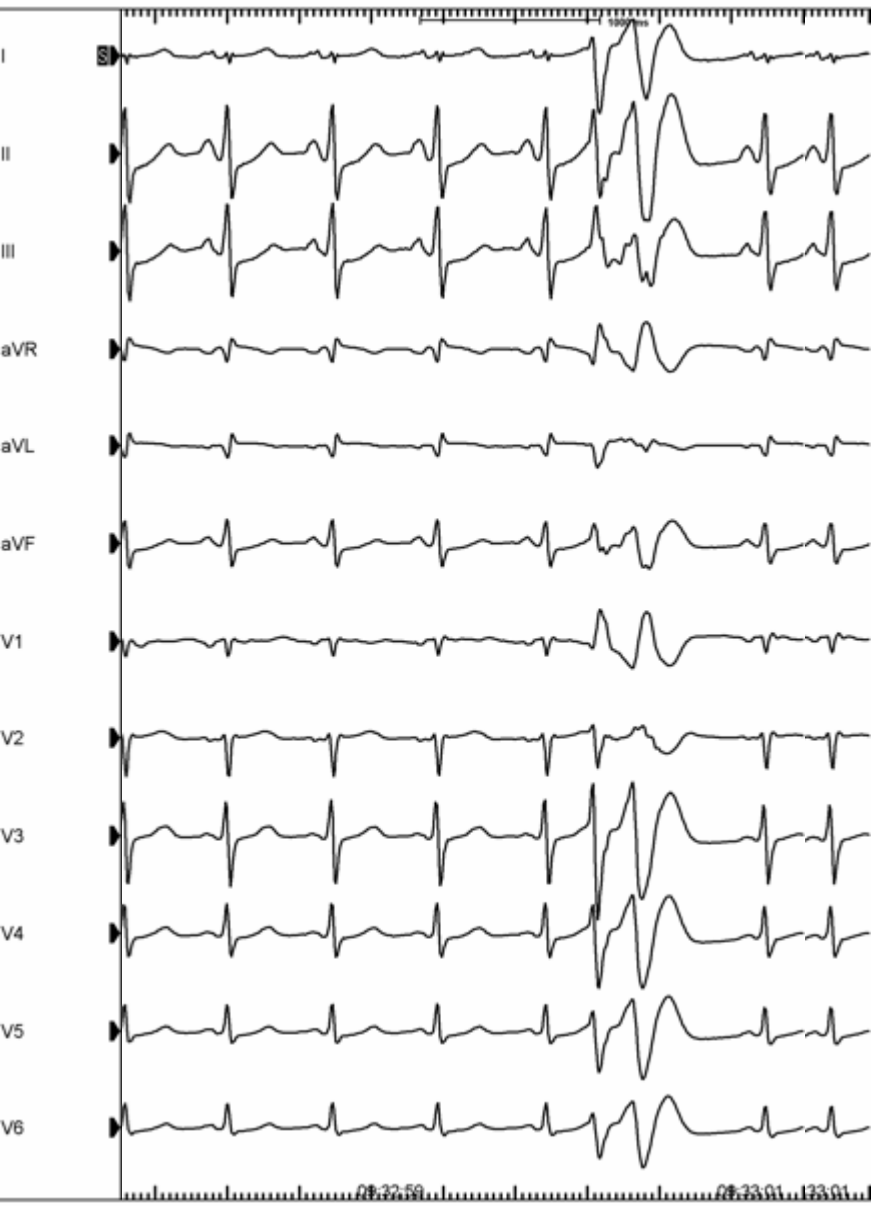
&

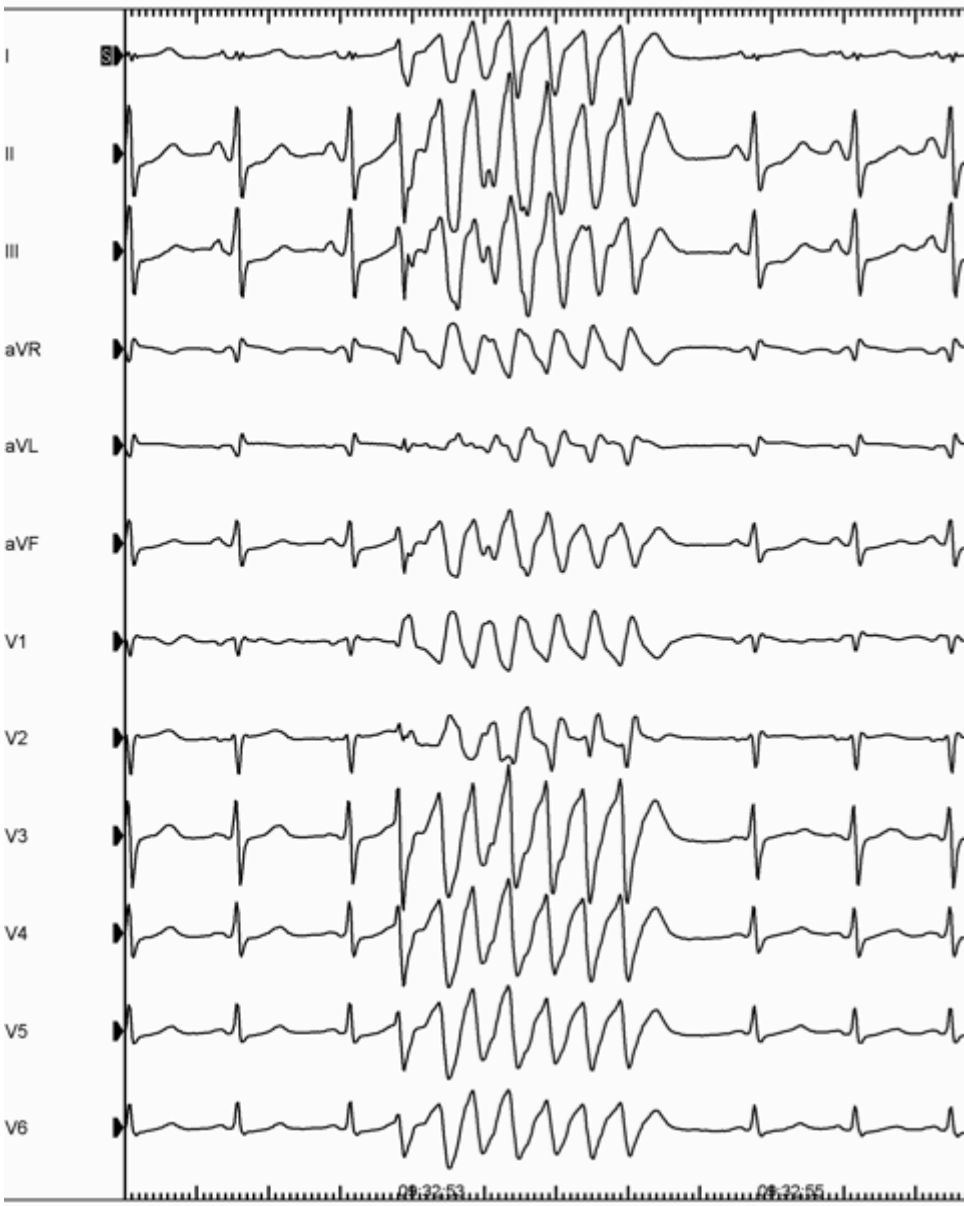
- ESV d'allure banale

# Phase subaiguë de l’infarctus du myocarde



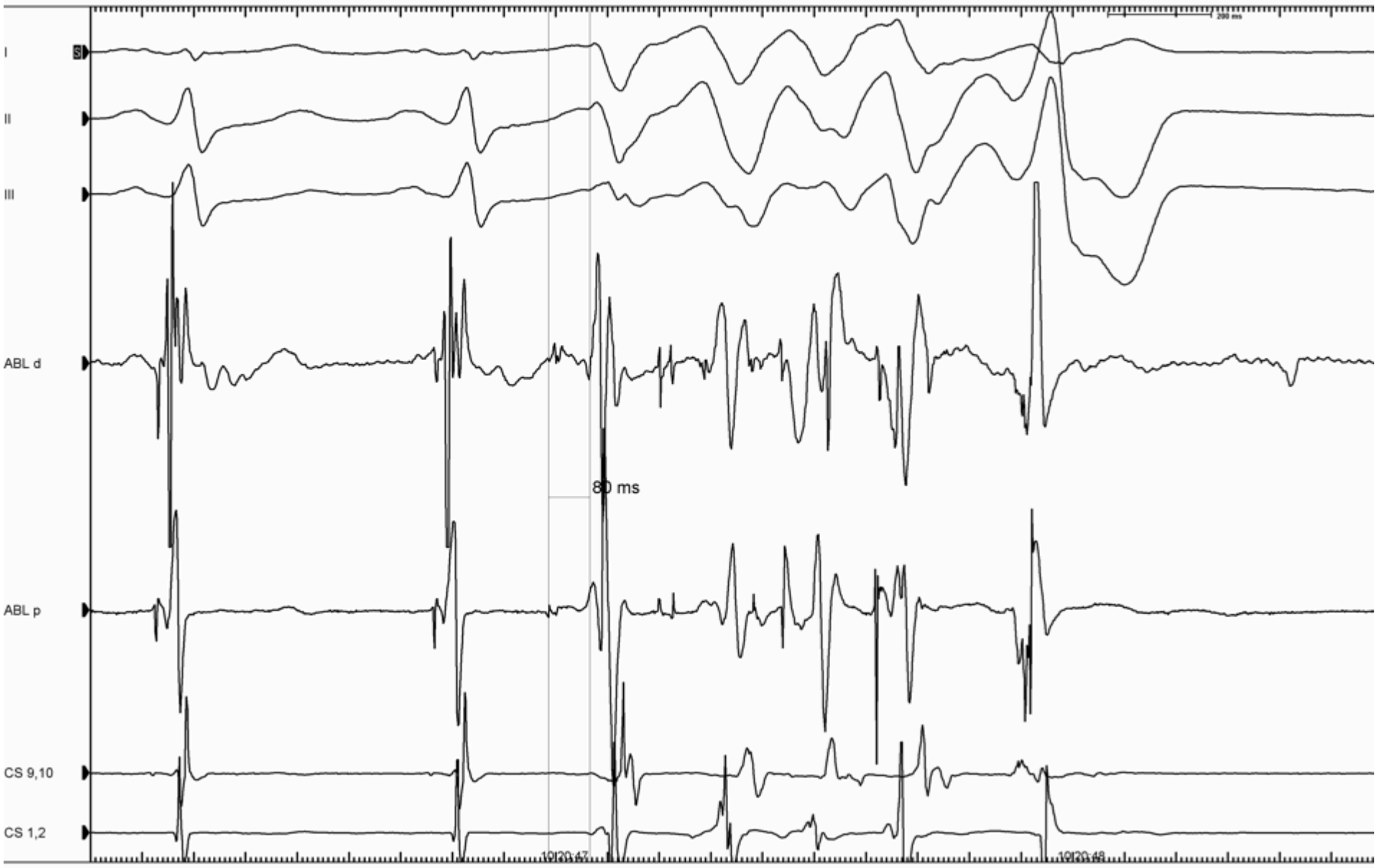
# Myocardite aigue



# Myocardite aigue

# Myocardite aigue



# Comment traiter une ESV maligne?

- Médicaments
  - Isoptine : TdPcc
  - Isuprel : Brugada & ERS
  - Mg2+ : TdP / LQTS
  - Amiodarone/Xylocaine
  - Bêtabloquants

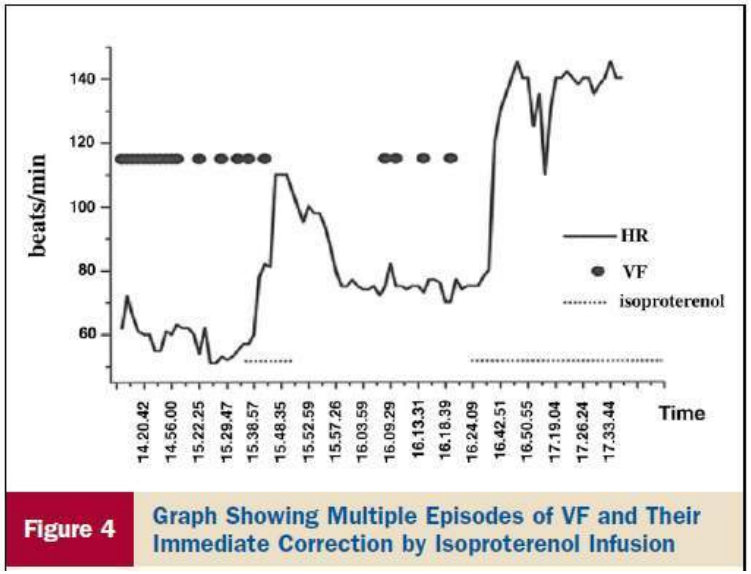
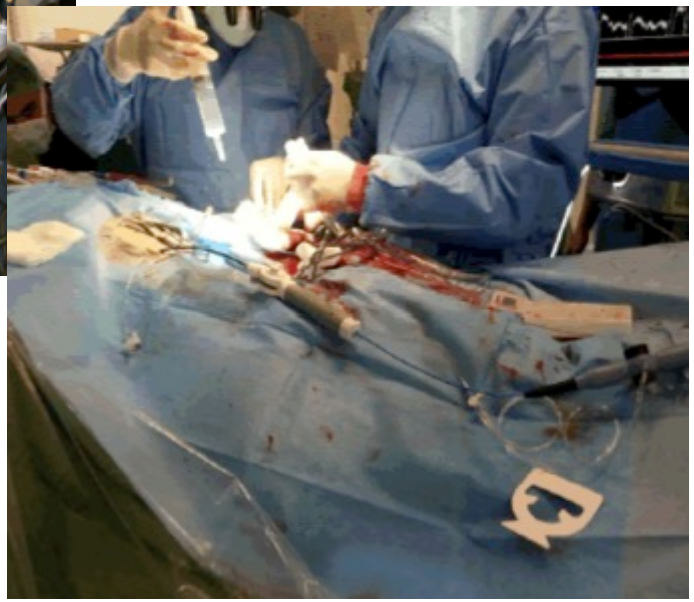



**Figure 4** Graph Showing Multiple Episodes of VF and Their Immediate Correction by Isoproterenol Infusion

JACC. 2009;53:612–9

- Anesthésie Générale
- Sympathectomie
- SEES
  - Overdrive suppression
  - Accélération FC
- Reprogrammation DAI
- Ablation
- ECMO
- HM3 – Tx Cardiaque

# ESV tueuses & orages rythmiques



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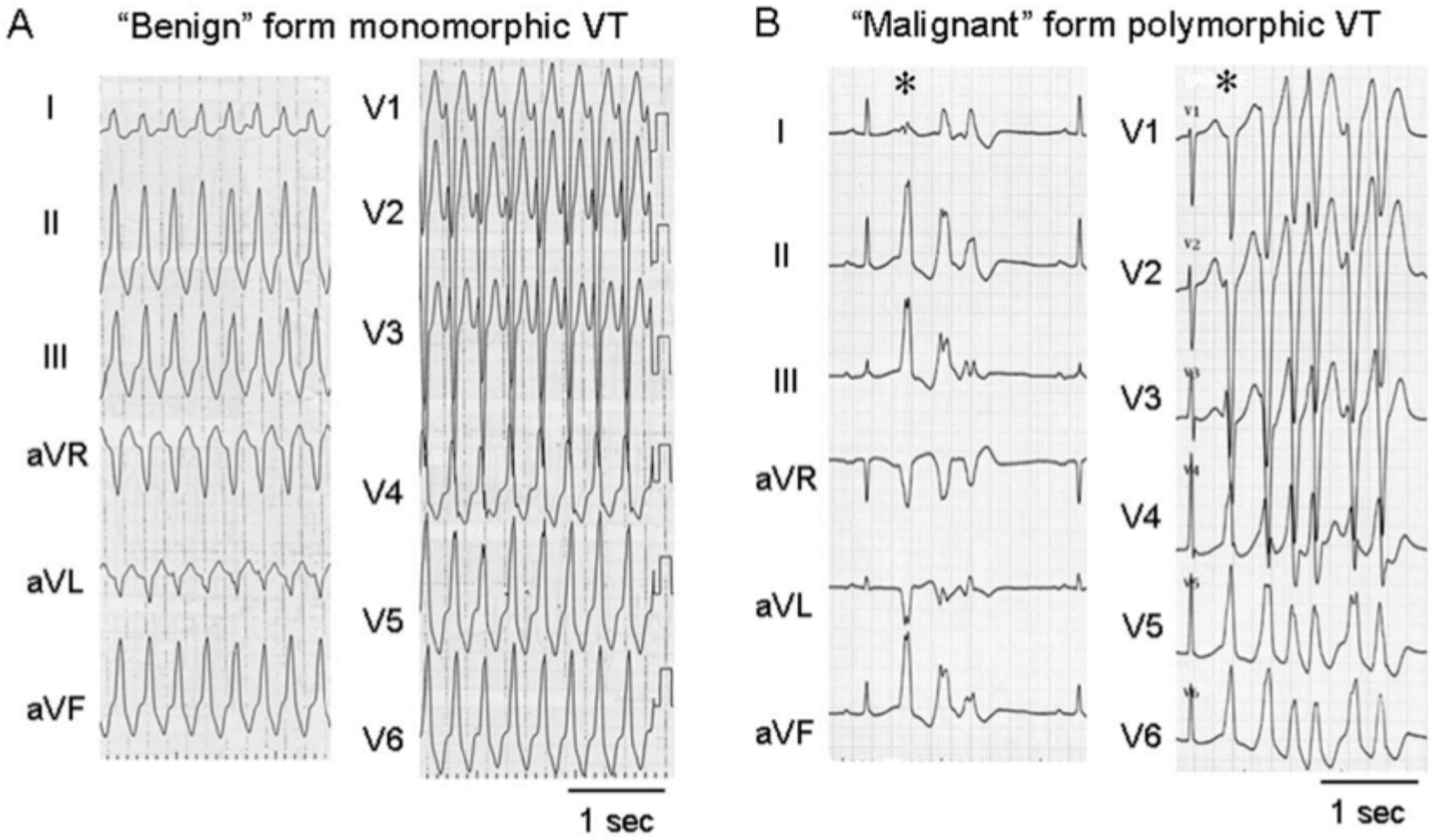
CONTEMPORARY REVIEW

# Arrhythmias originating from the right ventricular outflow tract: How to distinguish "malignant" from "benign"?

Wataru Shimizu, MD, PhD




Heart Rhythm 2009;6:1507–1511

CONTEMPORARY REVIEW

# Arrhythmias originating from the right ventricular outflow tract: How to distinguish "malignant" from "benign"?

Wataru Shimizu, MD, PhD

**Table 1** Comparison of ECG characteristics between malignant RVOT VT, benign RVOT VT, and idiopathic VF

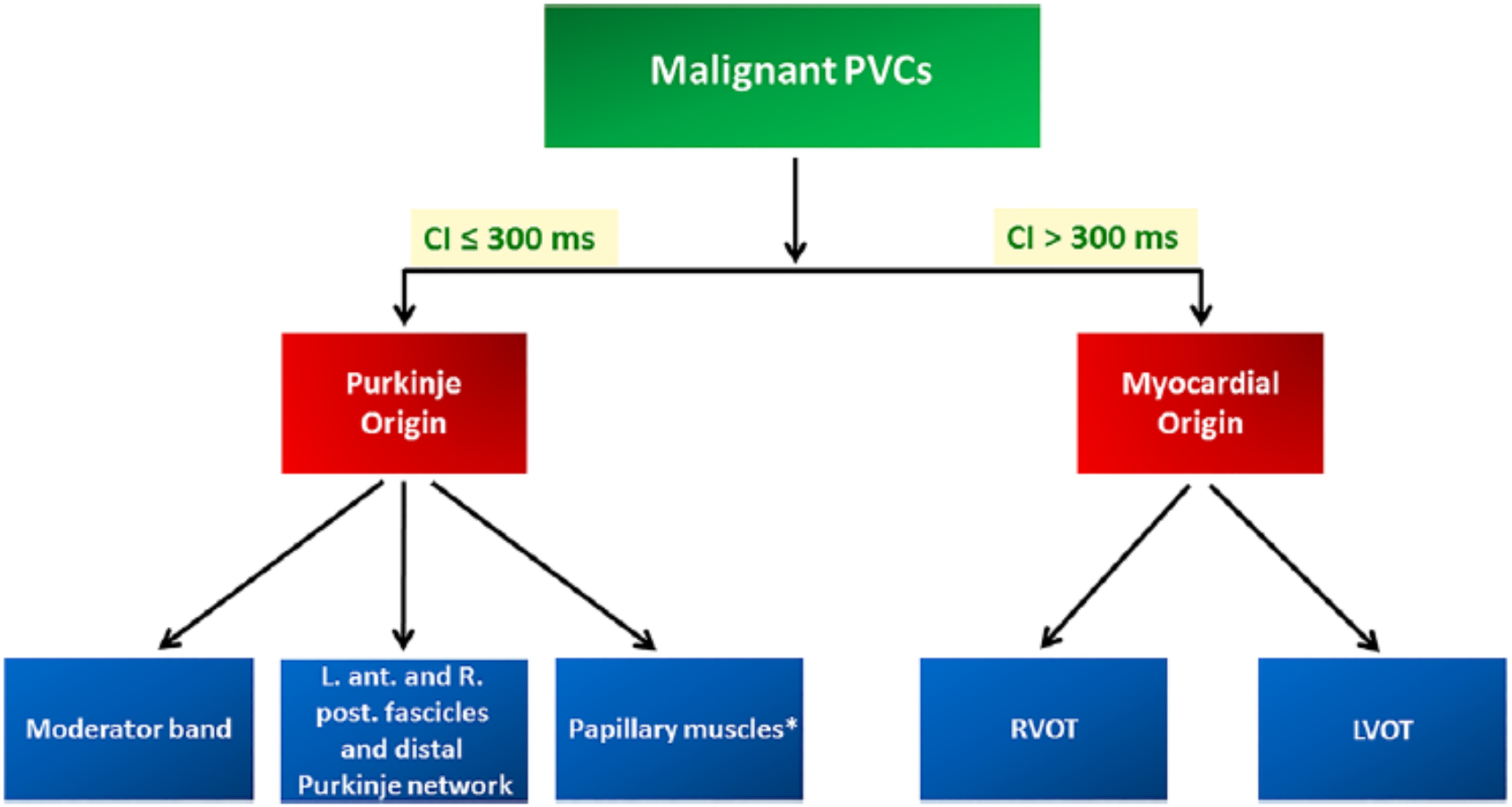
| | Malignant RVOT VT | Benign RVOT VT | Idiopathic VF | *P* |
|---|---|---|---|---|
| CI, ms: | | | | |
| Haissaguerre et al. | 355 ± 30 | — | 280 ± 26 | .01 |
| Viskin et al. | 340 ± 30 | 427 ± 76 | 300 ± 40 | <.001 |
| Noda et al. | 409 ± 62 | 428 ± 65 | — | .27 |
| QRS duration, ms: | | | | |
| Haissaguerre et al. | 145 ± 12 | — | 126 ± 18 | .04 |
| Noda et al. | 148 ± 8 | 142 ± 12 | — | .03 |
| Cycle length of VT, ms: | | | | |
| Noda et al. | 245 ± 28 | 328 ± 65 | — | <.0001 |

Heart Rhythm 2009;6:1507–1511

# Idiopathic malignant premature ventricular contractions

*James E. Ip, MD, and Bruce B. Lerman, MD**

Trends Cardiovasc Med. 2018;28:295-302



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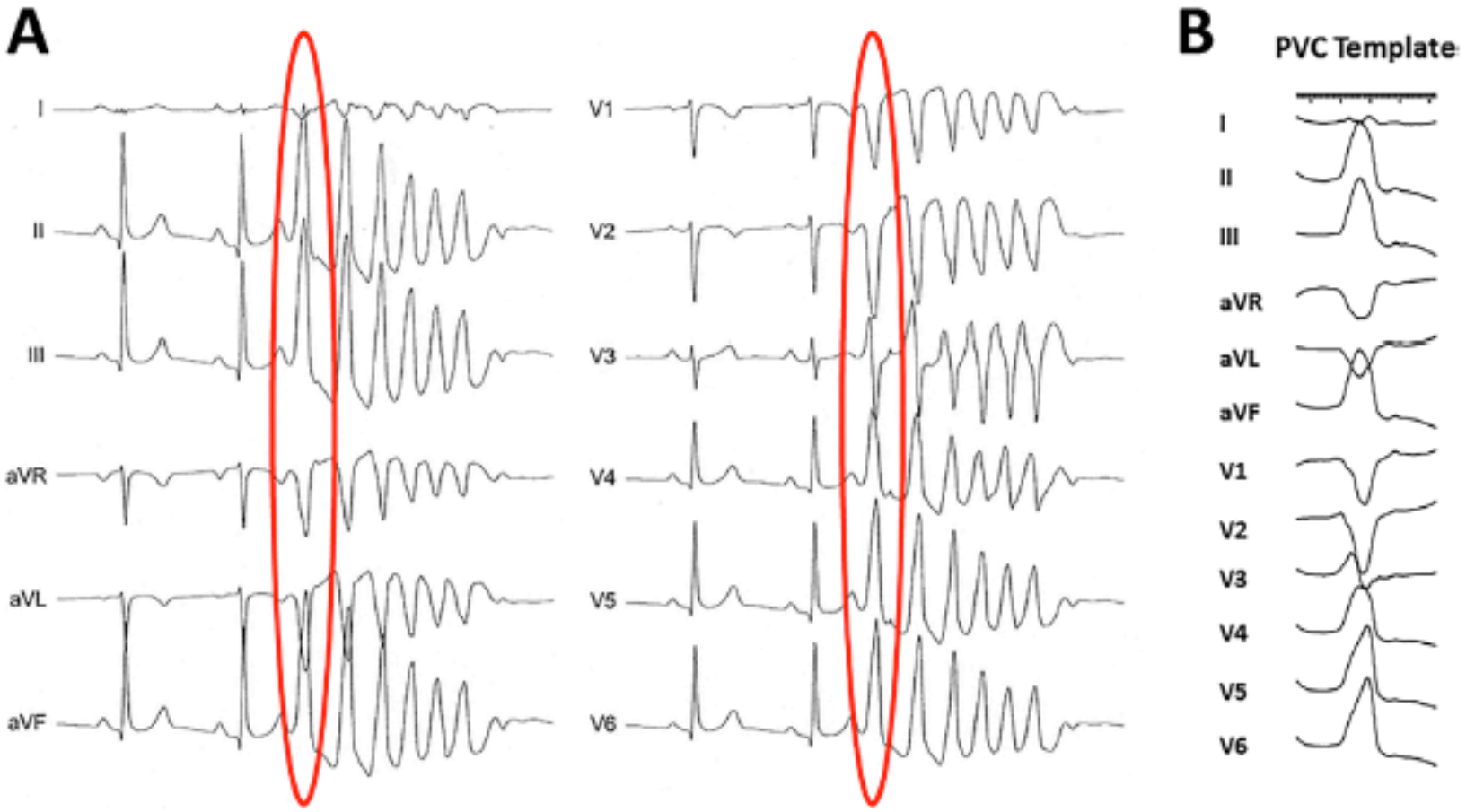


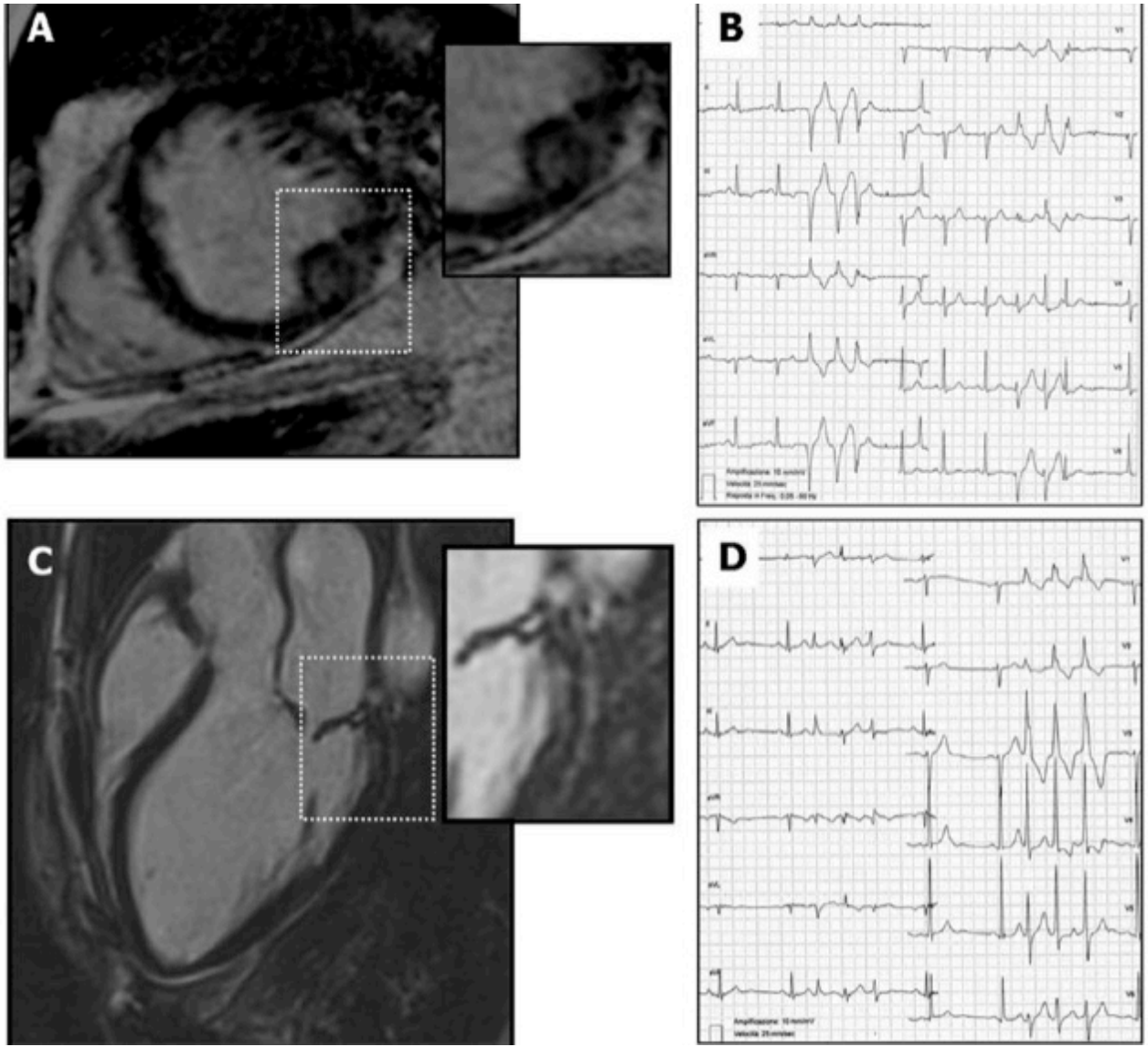

Malignant PVC

Benign PVC

# 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

Circulation. 2015; 132:556-66



## 3ème "take-home message"

- **ESV à couplage court (R sur sommet de T) = ESV tueuse**

  → Hospitalisation / monitoring – avis « expert »

- **ESV sur canalopathies**

  → Avis centre de référence

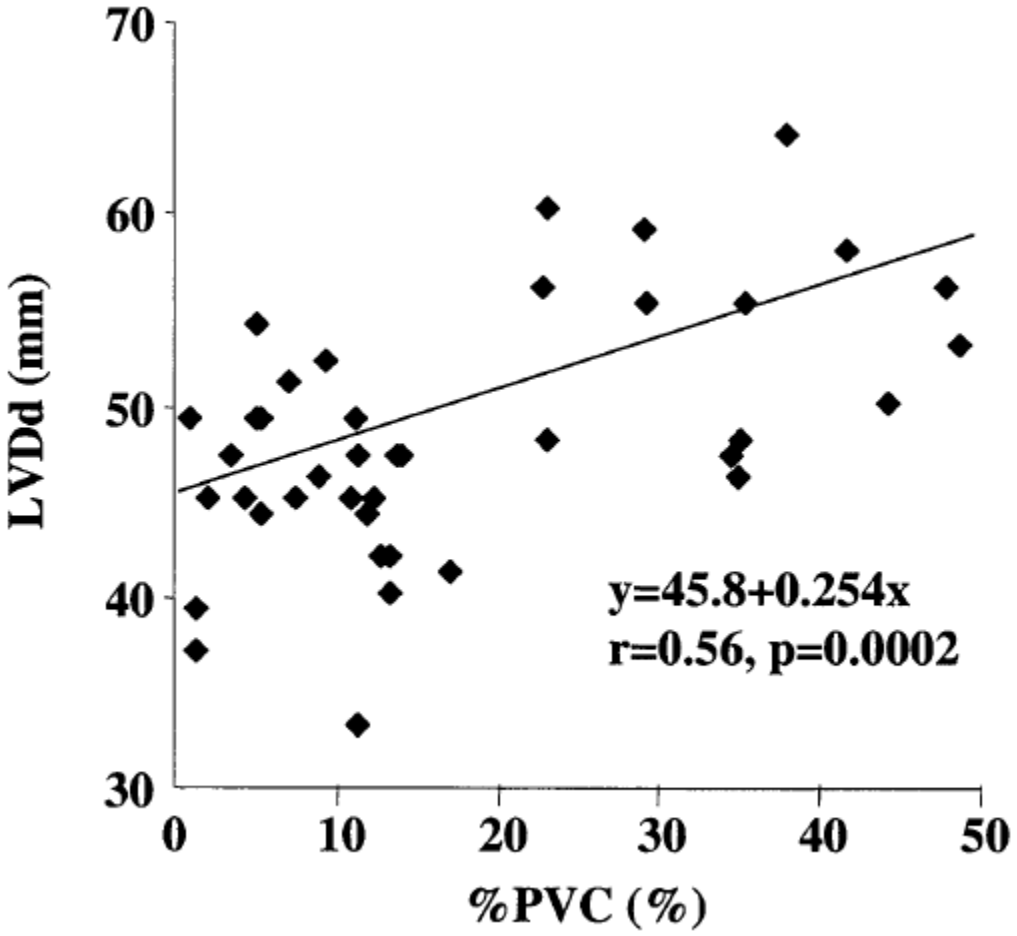
- **ESV initiatrices de FV & d'orage rythmique / substrat aigu**

  → **Hospitalisation immédiate en USIC /réa de centre lourd**

# Radiofrequency Catheter Ablation of Premature Ventricular Complexes From Right Ventricular Outflow Tract Improves Left Ventricular Dilation and Clinical Status in Patients Without Structural Heart Disease

Masao Takemoto, MD, Hitoshi Yoshimura, MD, Yurika Ohba, MD, Yasuharu Matsumoto, MD, Umpei Yamamoto, MD, Masahiro Mohri, MD, Hideo Yamamoto, MD, Hideki Origuchi, MD

JACC. 2005; 45:1259-65



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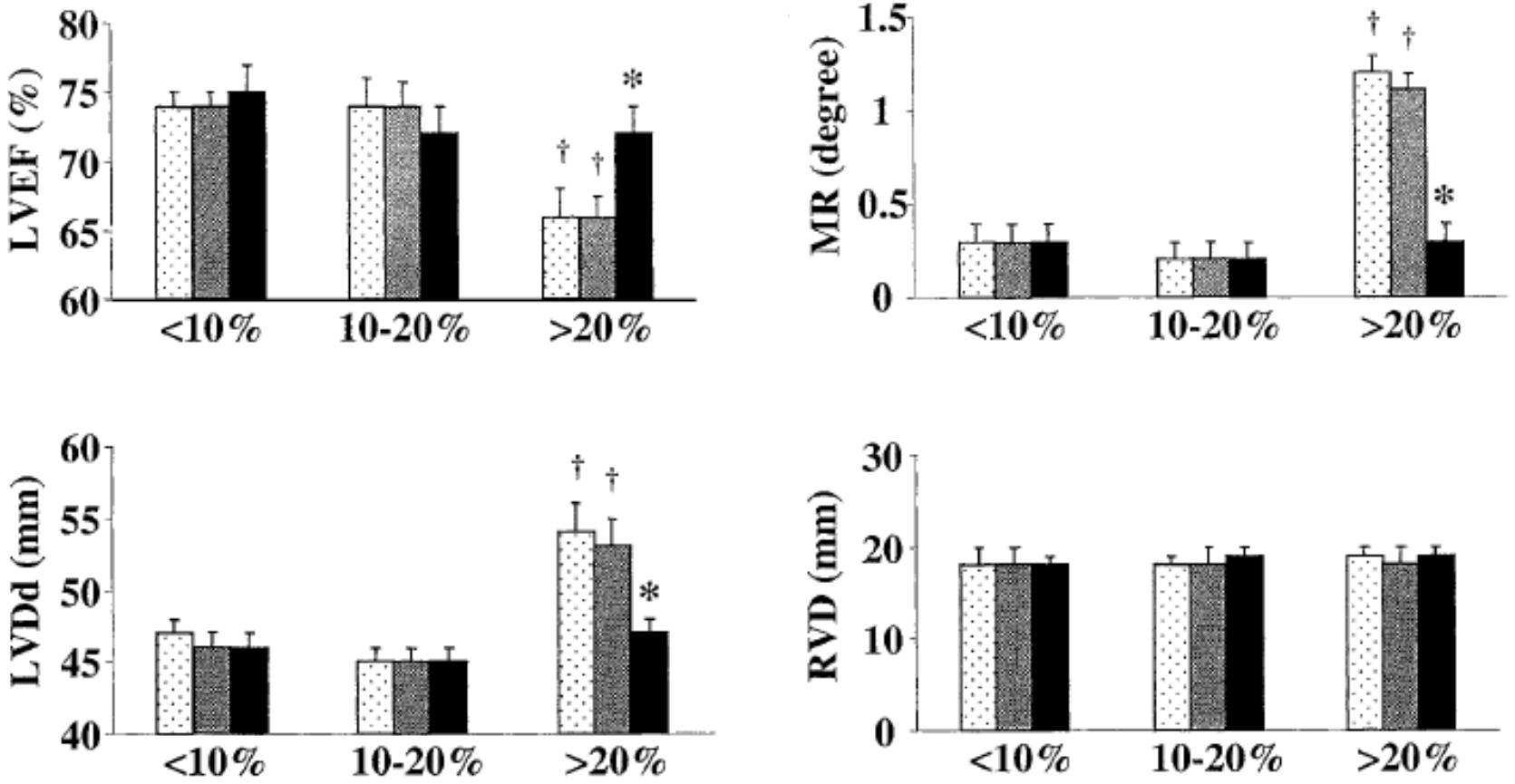


**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019

**Molecular**

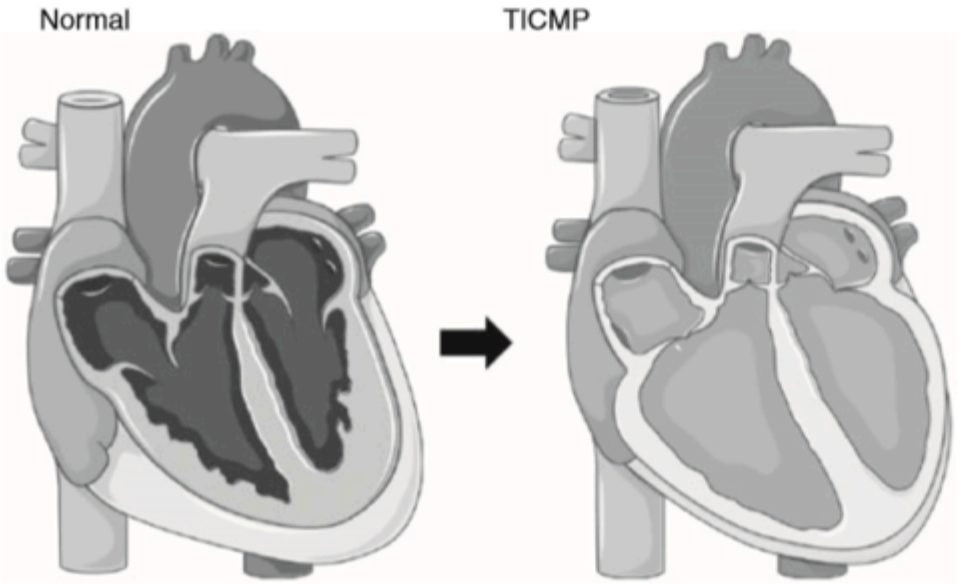
- β-adrenergic receptors: number↓ & sensitivity↓
- Oxidative stress
- Depletion of myocardial phosphates energy stores
- Hypertrophic response during recovery from TICMP

**Hemodynamic**

- Decreased myocardial blood flow
- Decreased filling time
- Cardiac desynchronization at the interventricular level
- Atrial contractile dysfunction/Loss of atrial contraction

**Neurohumoral**

- Renin-angiotensin–aldosterone ↑
- ANP ↑
- Sympatho inhibition ↓ :
  - Irregular RR interval → baroreflex unloading
  - Atrial systole ↓ → Volume sensitive reflexes




**Structural changes**

- Left ventricle:
  - Dilatation
  - Lack of hypertrophy
- Right ventricle:
  - Hypertrophy

**Functional changes**

- Cardiac output & ejection fraction ↓
- Diastolic dysfunction
- Secondary mitral regurgitation

**Figure 4** Possible pathophysiological mechanisms leading to tachycardia-induced cardiomyopathy (TICMP). ANP, atrial natriuretic peptide.

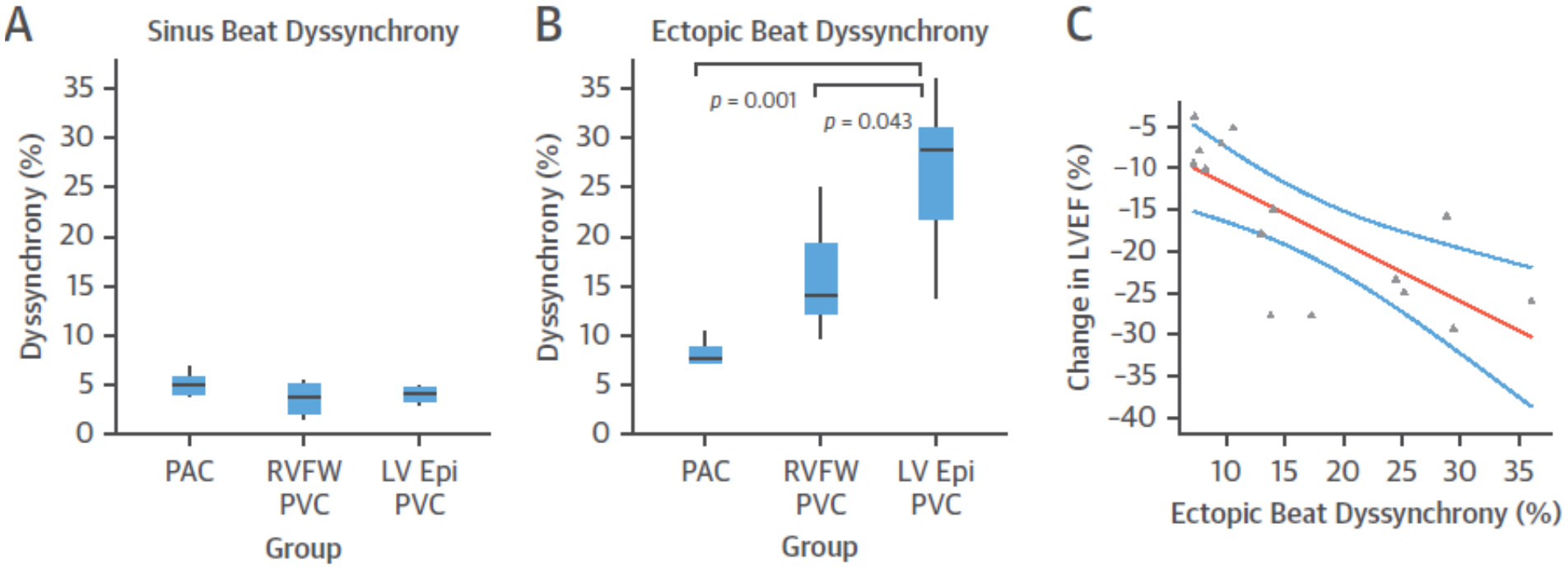
# Left Ventricular Dyssynchrony Predicts the Cardiomyopathy Associated With Premature Ventricular Contractions

JACC. 2018; 72:2870-82

Tomos E. Walters, MD, PhD, Dolkun Rahmutula, MD, PhD, Judit Szilagyi, MD, Christina Alhede, MD, PhD, Richard Sievers, BS, Qizhi Fang, MD, Jeffrey Olgin, MD, Edward P. Gerstenfeld, MS, MD

35 pigs

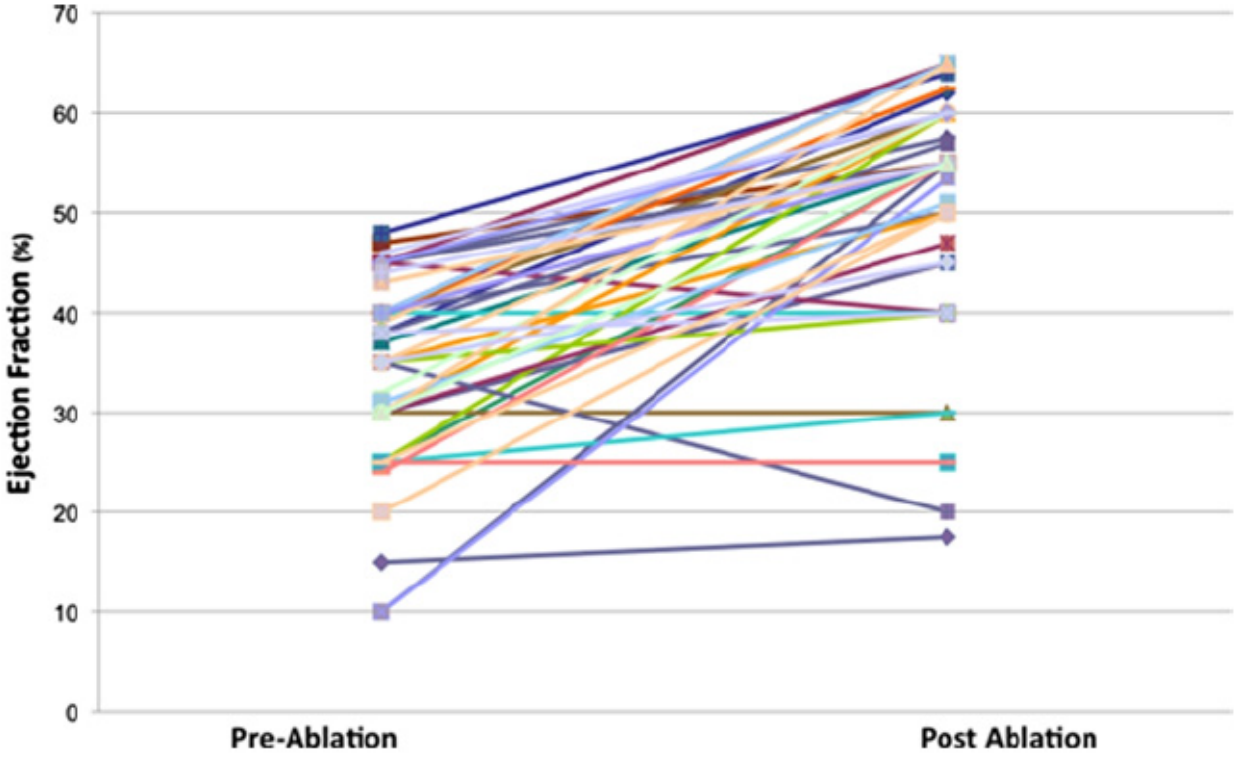
Pacemaker induced bigeminy



# Relationship between burden of premature ventricular complexes and left ventricular function

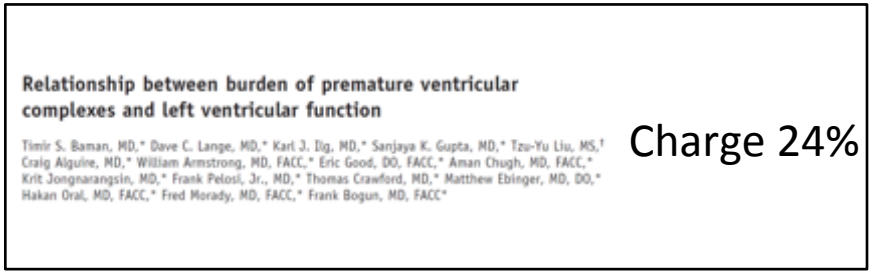
Timir S. Baman MD *, Dave C. Lange MD *, Karl J. Ilg MD *, Sanjaya K. Gupta MD *, Tzu-Yu Liu MS †, Craig Alguire MD *, William Armstrong MD, FACC *, Eric Good DO, FACC *, Aman Chugh MD, FACC *, Krit Jongnarangsin MD *, Frank Pelosi Jr. MD *, Thomas Crawford MD *, Matthew Ebinger MD, DO *, Hakan Oral MD, FACC *, Fred Morady MD, FACC *, Frank Bogun MD, FACC *

Heart Rhythm. 2010;7:865-9.



# Cardiopathie responsable des ESV ou ESV induisant la cardiomyopathie ?

# Charge en ESV



**Relationship between burden of premature ventricular complexes and left ventricular function**

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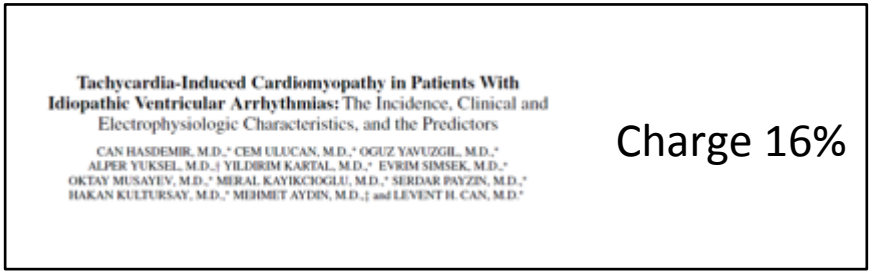
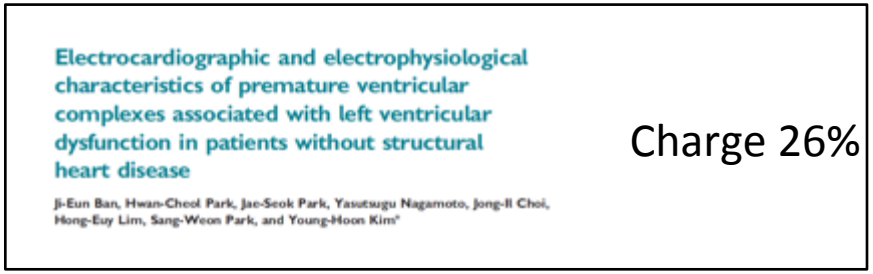
Charge 24%



**Tachycardia-Induced Cardiomyopathy in Patients With Idiopathic Ventricular Arrhythmias:** The Incidence, Clinical and Electrophysiologic Characteristics, and the Predictors

CAN HASDEMIR, M.D.,* CEM ULUCAN, M.D.,* OGUZ YAVUZGIL, M.D.,* ALPER YUKSEL, M.D.,† YILDIRIM KARTAL, M.D.,* EVRIM SIMSEK, M.D.,* OKTAY MUSAYEV, M.D.,* MERAL KAYIKCIOGLU, M.D.,* SERDAR PAYZIN, M.D.,* HAKAN KULTURSAY, M.D.,* MEHMET AYDIN, M.D.,† and LEVENT H. CAN, M.D.*

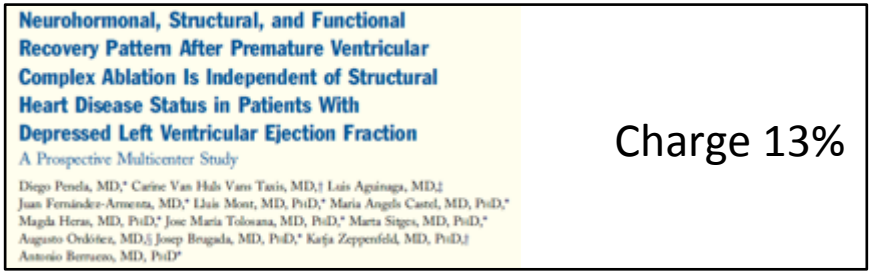
Charge 16%



**Electrocardiographic and electrophysiological characteristics of premature ventricular complexes associated with left ventricular dysfunction in patients without structural heart disease**

Ji-Eun Ban, Hwan-Cheol Park, Jae-Seok Park, Yasutsugu Nagamoto, Jong-Il Choi, Hong-Euy Lim, Sang-Weon Park, and Young-Hoon Kim*

Charge 26%



**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 Hulo Vans Taxis, MD,† Luis Aguinaga, MD,‡ Juan Fernández-Armenta, MD,* Lluis Mont, MD, PhD,* Maria Angels Castel, MD, PhD,* Magda Heras, MD, PhD,* Jose Maria Tolosana, MD, PhD,* Marta Sitges, MD, PhD,* Augusto Ordóñez, MD,§ Josep Brugada, MD, PhD,* Katja Zeppenfeld, MD, PhD,‖ Antonio Berruezo, MD, PhD*

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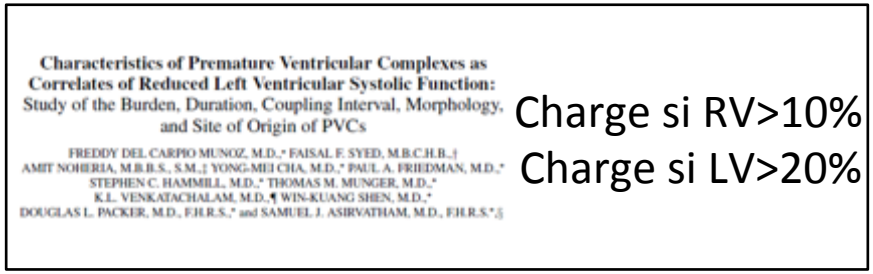

**Characteristics of Premature Ventricular Complexes as Correlates of Reduced Left Ventricular Systolic Function:** Study of the Burden, Duration, Coupling Interval, Morphology, and Site of Origin of PVCs

FREDDY DEL CARPIO MUNOZ, M.D.,* FAISAL F. SYED, M.B.C.H.B.,† AMIT NOHERIA, M.B.B.S., S.M.,‡ YONG-MEI CHA, M.D.,* PAUL A. FRIEDMAN, M.D.,* STEPHEN C. HAMMILL, M.D.,* THOMAS M. MUNGER, M.D.,* K.L. VENKATACHALAM, M.D.,¶ WIN-KUANG SHEN, M.D.,* DOUGLAS L. PACKER, M.D., F.H.R.S.,* and SAMUEL J. ASIRVATHAM, M.D., F.H.R.S.*,‖

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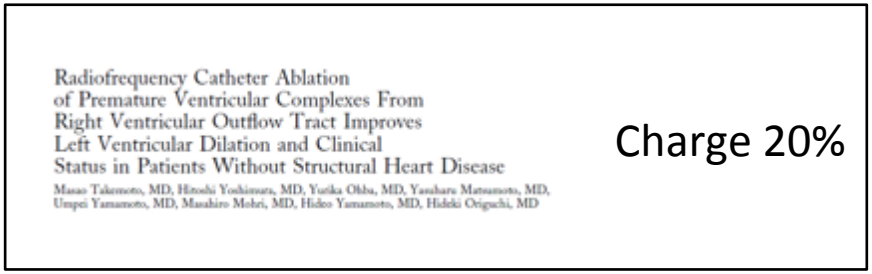

Radiofrequency Catheter Ablation of Premature Ventricular Complexes From Right Ventricular Outflow Tract Improves Left Ventricular Dilation and Clinical Status in Patients Without Structural Heart Disease

Masao Takemoto, MD, Hiroshi Yoshimura, MD, Yuriko Ohba, MD, Yasuharu Matsumoto, MD, Umpei Yamamoto, MD, Masahiro Mohri, MD, Hideo Yamamoto, MD, Hideki Origuchi, MD

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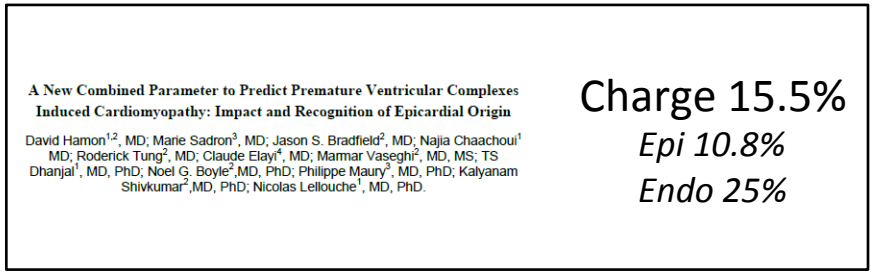


**A New Combined Parameter to Predict Premature Ventricular Complexes Induced Cardiomyopathy: Impact and Recognition of Epicardial Origin**

David Hamon[1,2], MD; Marie Sadron[3], MD; Jason S. Bradfield[2], MD; Najia Chaachoui[1] MD; Roderick Tung[2], MD; Claude Elayi[4], MD; Marmar Vaseghi[2], MD, MS; TS Dhanjal[1], MD, PhD; Noel G. Boyle[2],MD, PhD; Philippe Maury[3], MD, PhD; Kalyanam Shivkumar[2],MD, PhD; Nicolas Lellouche[1], MD, PhD.

Charge 15.5%
*Epi 10.8%*
*Endo 25%*

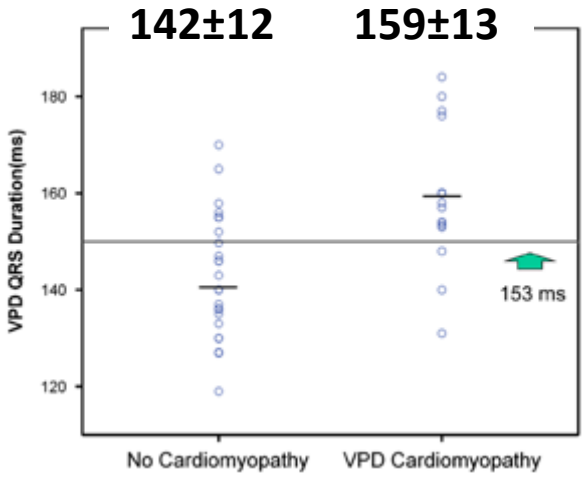
Baman TS et al. Heart Rhythm 2010
Hasdemir C et al. JCE 2011
Penela D et al. JACC 2013

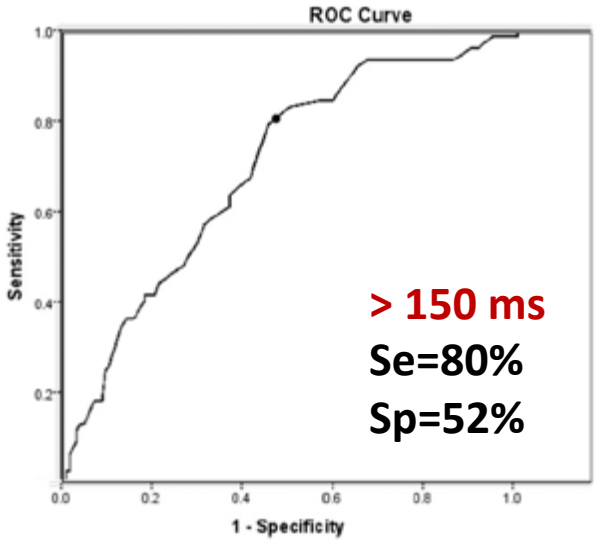
Takemoto M et al. JACC 2005
Del Carpio Munoz F et al. JCE 2011
Ban JE et al. Europace 2013
Hamon D et al. JCE 2016

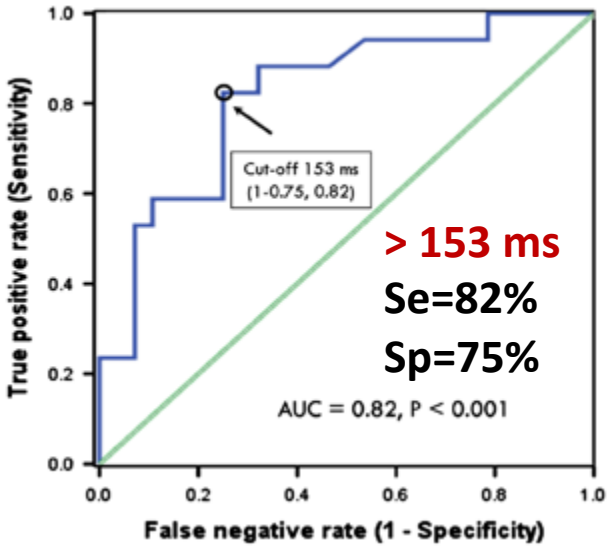
# Largeur des ESV

**Table 3** Multivariate analysis of predictors for reversible PVC-induced cardiomyopathy

| Variables | Odds ratio | 95% CI upper/lower | *P* |
|---|---|---|---|
| PVC burden | 1.04* | 1.01/1.08 | .02 |
| QRS width | 1.03† | 1.0/1.05 | .03 |
| Epicardial origin of PVC | 2.9 | 1.01/7.8 | .04 |
| Symptom duration | 1.005‡ | 1.18/2.33 | .002 |
| Sex: Man | 0.7 | 0.4/1.77 | .5 |




Yokokawa M et al.
Heart Rhythm 2012

Carballeira Pol L et al.
Heart Rhythm 2014

# ESV épicardiques

| Variables | Odds Ratio | IC95% | *P* value |
|---|---|---|---|
| Male | 1.06 | 0.17-6.54 | 0.952 |
| **Structural-Heart-Disease** | **12.30** | **1.63-92.58** | **0.015** |
| Interpolation | 19.72 | 0.28-1363 | 0.168 |
| Coupling | 0.98 | 0.97-1.00 | 0.050 |
| **Epicardial origin** | **68.74** | **3.54-1363** | **0.005** |
| Sinus beat QRS width | 1.04 | 1.00-1.08 | 0.066 |
| **PVC Burden** | **1.25** | **1.10-1.42** | **<0.001** |
| **PVC-QRS width** | **1.07** | **1.01-1.12** | **0.016** |
| Right ventricle origin | 0.22 | 0.04-1.28 | 0.092 |
| **Palpitations** | **0.04** | **0.01-0.55** | **0.011** |

**Table 3** Multivariate analysis of predictors for reversible PVC-induced cardiomyopathy

| Variables | Odds ratio | 95% CI upper/lower | *P* |
|---|---|---|---|
| PVC burden | 1.04* | 1.01/1.08 | .02 |
| QRS width | 1.03† | 1.0/1.05 | .03 |
| Epicardial origin of PVC | 2.9 | 1.01/7.8 | .04 |
| Symptom duration | 1.005‡ | 1.18/2.33 | .002 |
| Sex: Man | 0.7 | 0.4/1.77 | .5 |

Yokokawa M et al. HR 2012
Scanavacca M et al. J of AF 2015
Hamon D et al. JCE 2016

# ESV asymptomatiques

. **70 patients**

. 17 patients avec CpESV

. 53 patients avec VG normal

. **241 patients**

. 76 patients avec CpESV

. 165 patients avec VG normal

Multivariate Regression Analysis of Predictors of LVEF (%) Preablation

| Independent variables | Estimate | Lower 95% confidence limit | Upper 95% confidence limit | P value |
|---|---|---|---|---|
| History of palpitations | −0.090 | −0.146 | −0.035 | 0.001 |
| History of dizziness | −0.020 | −0.056 | 0.015 | 0.260 |
| PVC burden (%) | −0.003 | −0.007 | 0.000 | 0.076 |
| Nonsustained VT | −0.065 | −0.098 | −0.031 | 0.001 |
| PVC duration ≥140 ms | −0.043 | −0.080 | −0.006 | 0.021 |
| Fascicular PVC | 0.068 | 0.004 | 0.131 | 0.038 |
| Multiform PVC | −0.011 | −0.065 | 0.043 | 0.703 |

**Table 2** Predictors of PVC cardiomyopathy based on multiple logistic regression model

| Clinical characteristics | Adjusted odds ratio | 95% confidence interval | *P* value |
|---|---|---|---|
| Asymptomatic status | 13.1 | 4.1–37.8 | <.001 |
| Duration of palpitations (mo) | | | |
| <30 | 1.0 | — | — |
| 30–60 | 4.0 | 1.1–14.4 | .03 |
| >60 | 20.1 | 6.3–64.1 | <.001 |
| PVC burden in asymptomatic patients* | 2.1 | 1.2–3.6 | .007 |

Del Carpio Munozet al. JCE 2011
Yokokawa M et al. HR 2012

**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019

**Table 12 Elements for the diagnosis of TICMP**

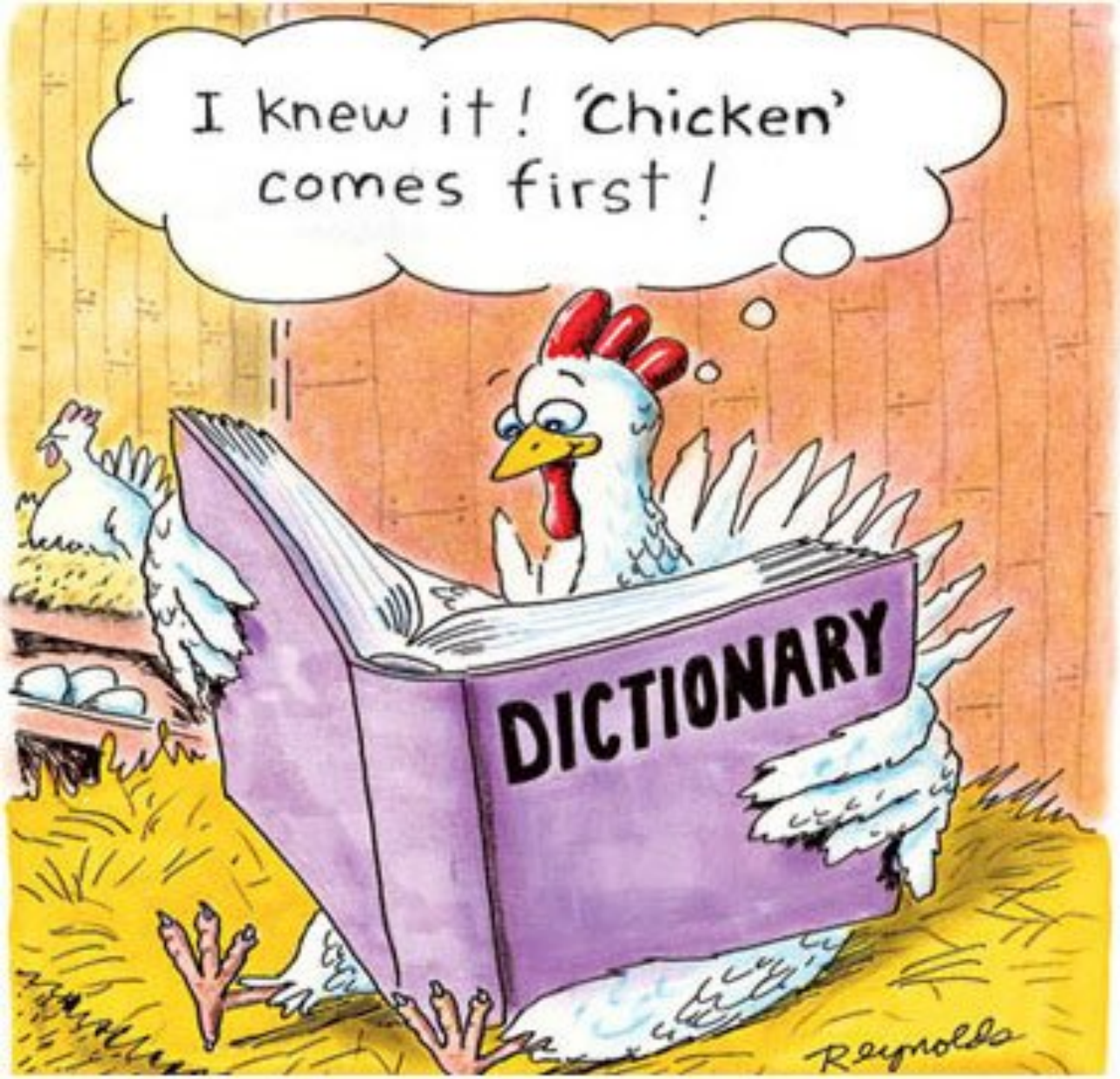
(1) No other cause of cardiomyopathy (myocardial infarction, valve disease, hypertension, alcohol or drug use, stress etc.)
(2) Absence of left ventricular hypertrophy
(3) No major increase in LV dimensions (LV end-diastolic dimension <6.5 cm)
(4) Recovery of LV function after control of tachycardia (by rate control, cardioversion, or radiofrequency ablation) within a time frame of 1–6 months.
(5) Rapid decline in LVEF following recurrence of tachycardia in a patient with recovered LV function after previous control of tachycardia.

**Table 13 Possible predictors or elements associated with development of TICMP**

TICMP induced by premature ventricular contractions (PVC)

- PVC burden (from >10 000/ 24 h to >24% of total beats; threshold may be lower for right as compared to left ventricular PVCs)
- Wider PVCs
- PVCs of epicardial origin
- Presence of interpolated PVCs
- Presence of retrograde P waves
- PVCs that are asymptomatic

Problème de la Cardiomyopathie préexistante aggravée par les ESV (?)


I knew it! 'Chicken' comes first!
DICTIONARY
Reynolds

# 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†‡

JACC. 2012; 60:1531-9

2034 CRT patients

→509 (25%) non responders

→ 65 (13% of 25%) > 10 000 PVC / 24h

**Table 2** Procedural Characteristics

| Intraprocedural Variable | |
|---|---|
| Number of clinical PVC | |
| 1 | 56 (86.2) |
| 2 | 7 (10.8) |
| 3 | 2 (3.1) |
| Type of 3D electroanatomic mapping | |
| Carto | 51 (78.5) |
| NavX | 14 (21.5) |
| Remote magnetic-guided navigation | 18 (27.7) |
| Intracardiac echocardiography | 65 (100) |
| Mean procedure time, min | 157.2 ± 44.8 |
| Procedural complications | 2 (3.0) |
| Tamponade | 1 (1.5) |
| TIA | 1 (1.5) |
| Acute successful PVC ablation | |
| Yes | 69 (90.8) |
| No | 7 (9.2) |

**Table 4** Change in Various Echo Parameters Before and After PVC Ablation

| Change in Echo Parameters | Pre-Ablation | Post-Ablation | Mean Improvement | p Value |
|---|---|---|---|---|
| Δ EF | 26.2 ± 5.5 | 32.7 ± 6.7 | 6.42 ± 5.26 | <0.001 |
| Δ LVEDD | 6.83 ± 0.83 | 6.51 ± 0.91 | −0.32 ± 0.26 | <0.001 |
| Δ LVESD | 5.83 ± 0.55 | 5.62 ± 0.32 | −0.31 ± 0.23 | <0.001 |
| Δ LVESV | 178 ± 72 | 145 ± 23 | −33.17 ± 22.94 | <0.001 |
| Δ LVEDV | 242 ± 85 | 212 ± 63 | −30.65 ± 21.63 | <0.001 |

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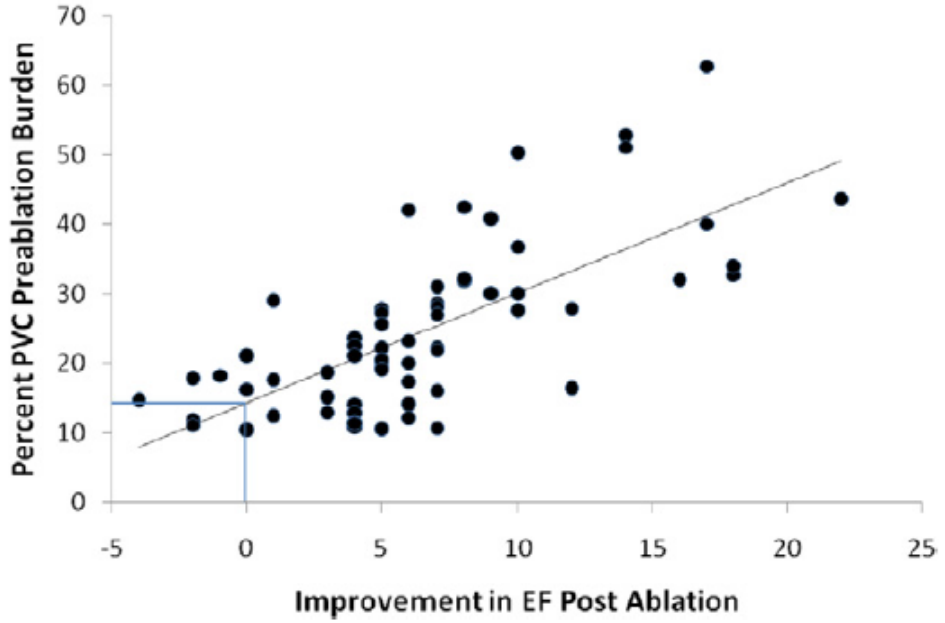
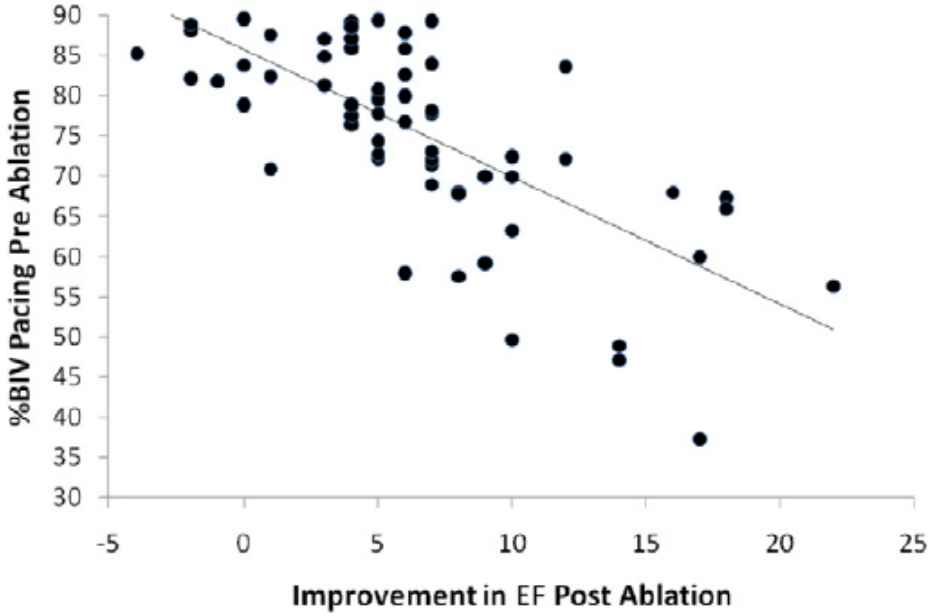
JACC. 2012; 60:1531-9

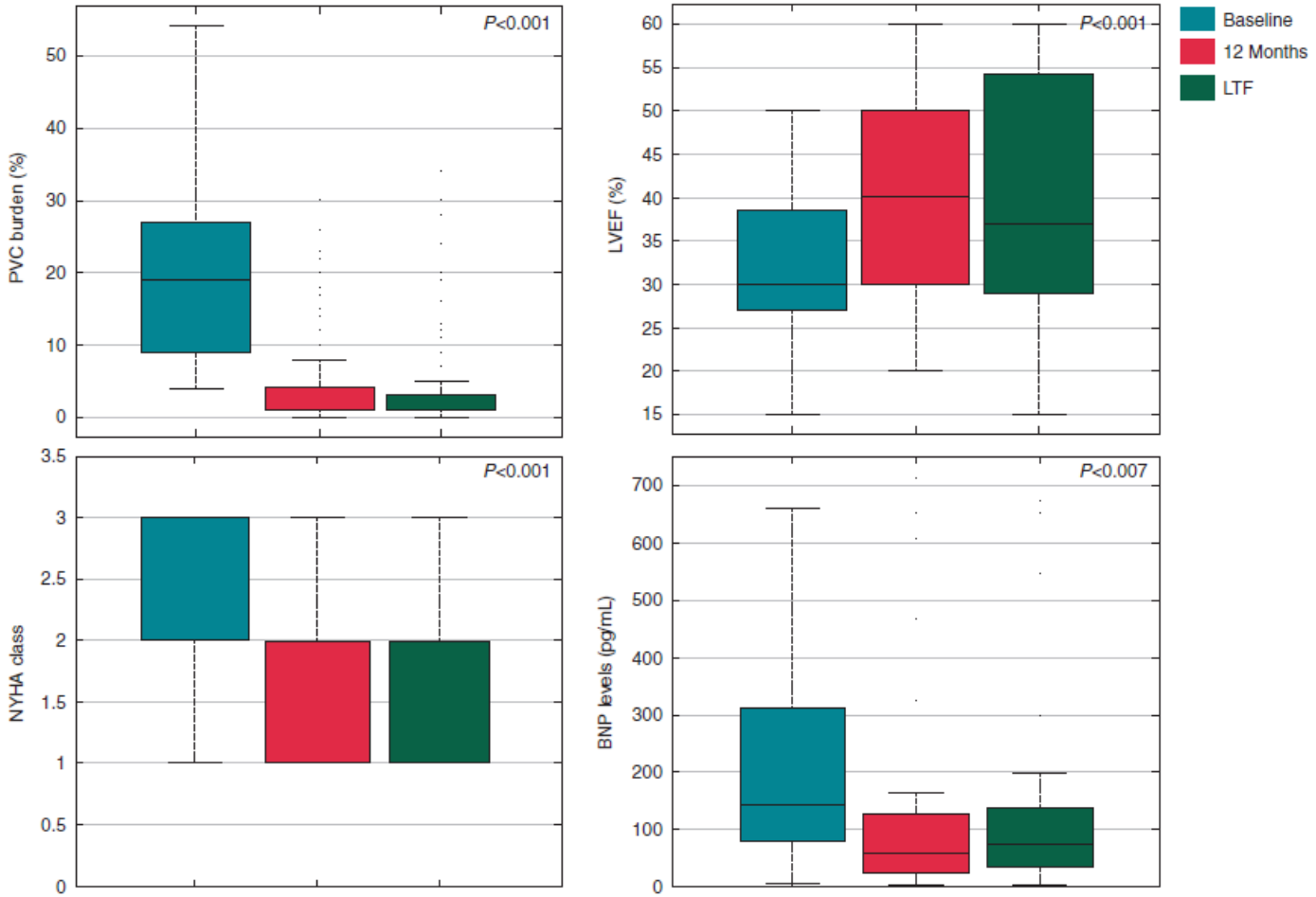


# Mortality and morbidity reduction after frequent premature ventricular complexes ablation in patients with left ventricular systolic dysfunction

Antonio Berruezo[1]*, Diego Penela[2], Beatriz Jáuregui[1], David Soto-Iglesias[1], Luis Aguinaga[3], Augusto Ordóñez[4], Juan Fernández-Armenta[5], Mikel Martínez[6], Luis Tercedor[7], Felipe Bisbal[8,9], Juan Acosta[10], Julio Martí-Almor[11], Marta Aceña[12], Ignasi Anguera[12], Luca Rossi[2], Markus Linhart[6], Roger Borràs[6], Adelina Doltra[6], Paula Sánchez[6], José T. Ortiz-Pérez[6], Rosario J. Perea[6], Susana Prat-González[6], Cheryl Teres[1], and Xavier Bosch[6]

Europace. 2019; 21:1079-87



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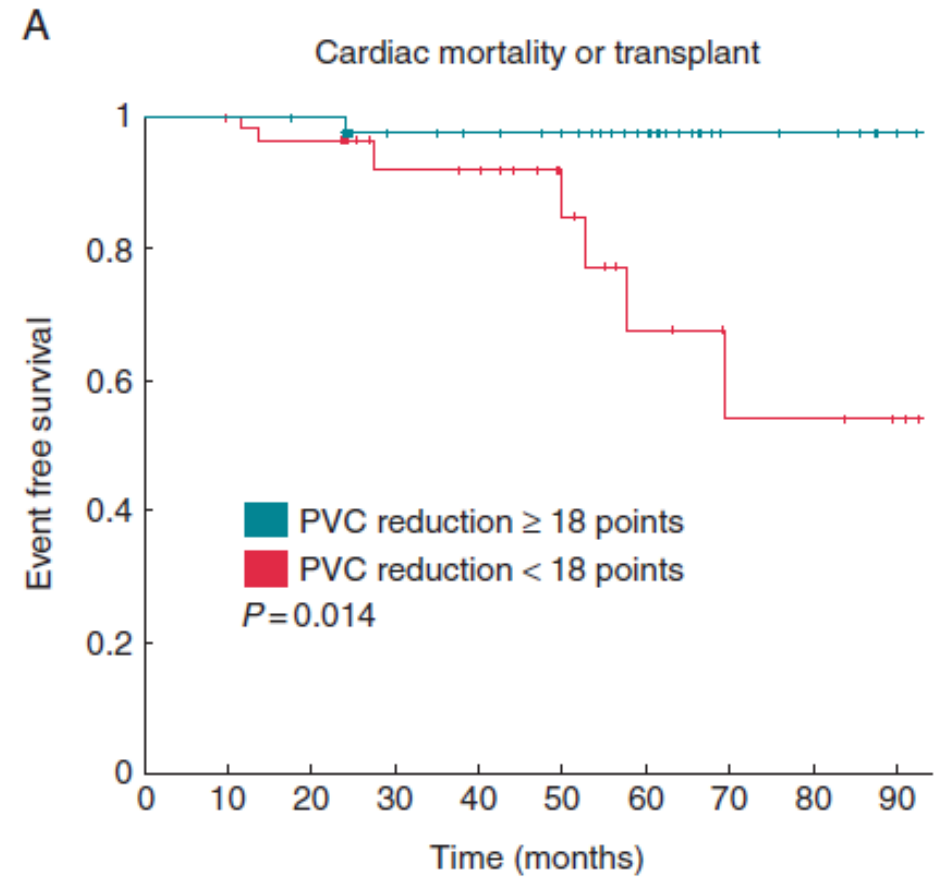
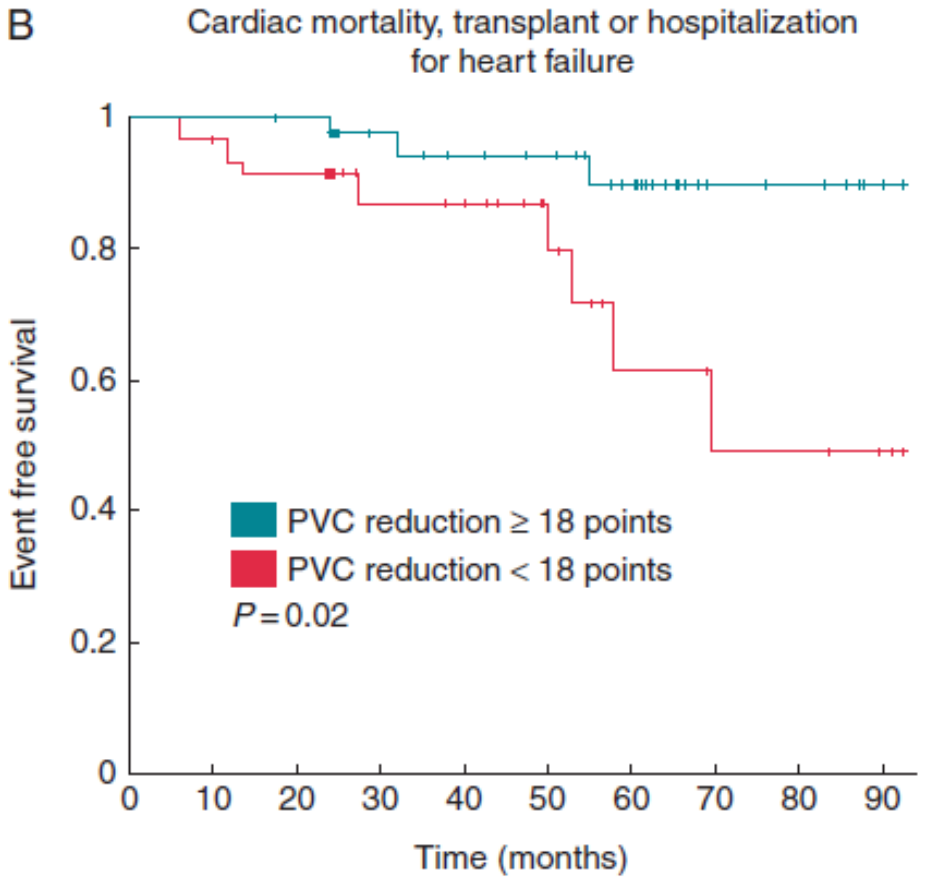
Europace. 2019; 21:1079-87

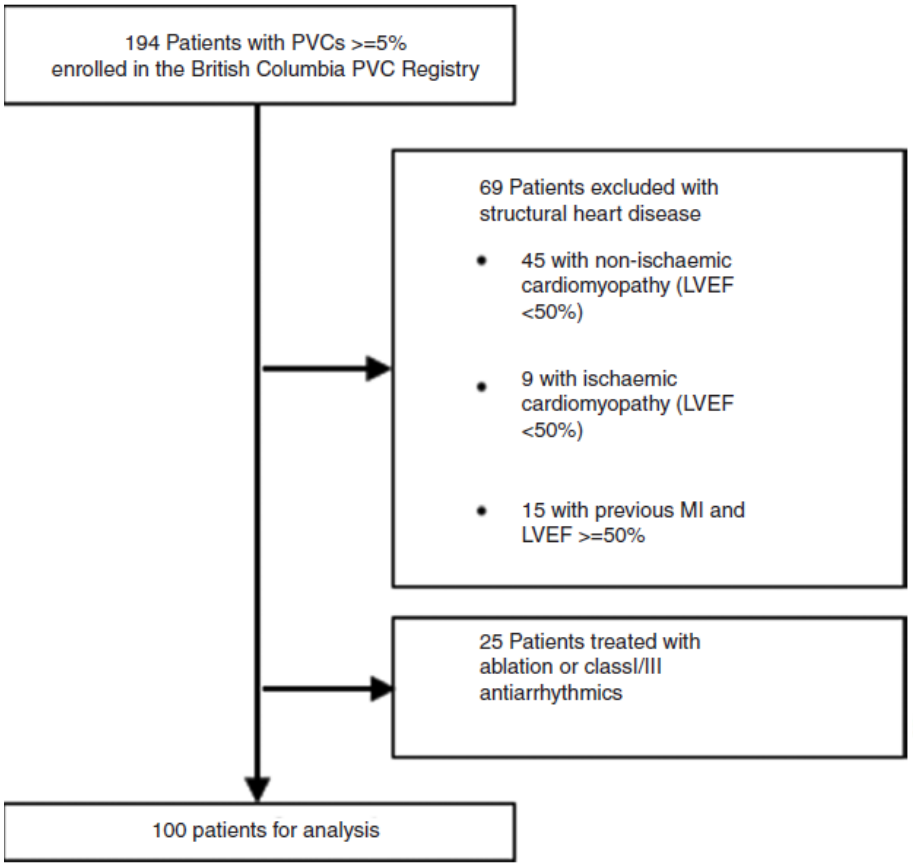


# Outcomes of untreated frequent premature ventricular complexes with normal left ventricular function

Andrea K Y Lee, Jason Andrade, Nathaniel M Hawkins, George Alexander, Matthew T Bennett, Shanta Chakrabarti, Zachary W Laksman, Andrew Krahn, John A Yeung-Lai-Wah, Marc William Deyell

Heart. 2019; 105:1408-13



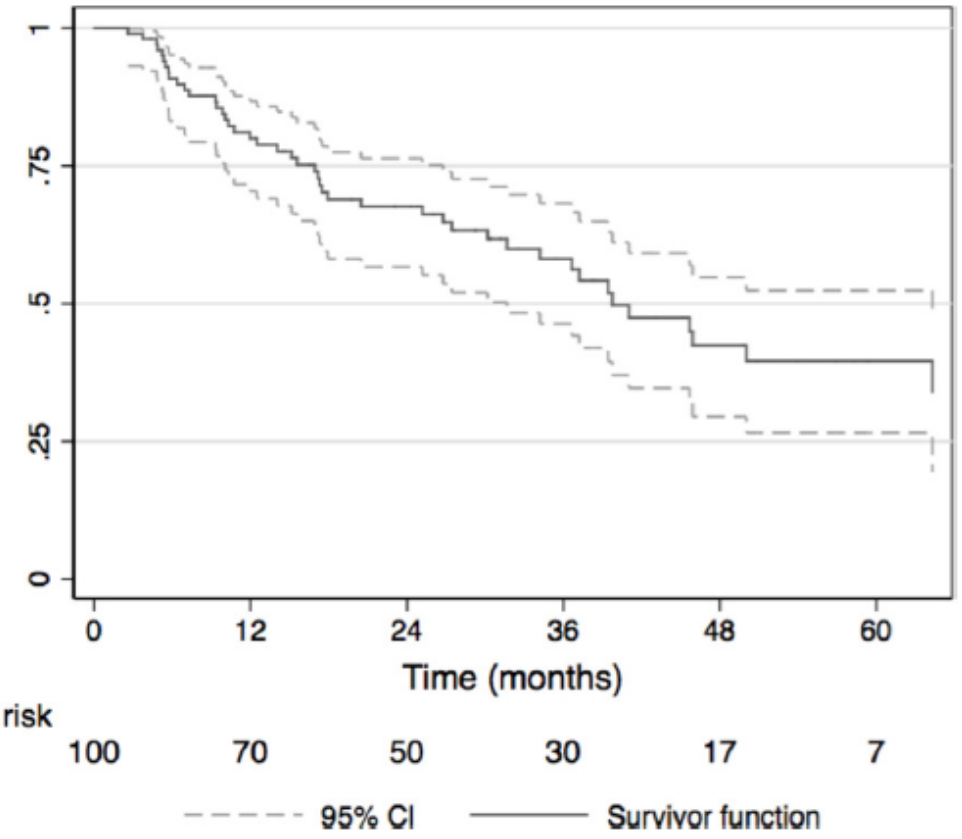




**Figure 2** Time to spontaneous resolution of PVCs to <1% in the overall cohort. The median time to spontaneous reduction was 10.9 months. PVC, premature ventricular complex.

# Outcomes of untreated frequent premature ventricular complexes with normal left ventricular function

Andrea K Y Lee, Jason Andrade, Nathaniel M Hawkins, George Alexander, Matthew T Bennett, Shanta Chakrabarti, Zachary W Laksman, Andrew Krahn, John A Yeung-Lai-Wah, Marc William Deyell

Heart. 2019; 105:1408-13

**Table 2** Characteristics of PVCs

| PVC characteristics | All patients (n=100) | Persistent PVCs (n=56) | Spontaneous PVC reduction (n=44) | Univariate HR* |
|---|---|---|---|---|
| Initial PVC burden (%), median (range) | 18.4 (5.4 to 49.8) | 18.8 (5.4 to 49.8) | 17.6 (5.6 to 44.6) | 1.00 (0.97 to 1.03); p=0.860 |
| Initial PVC burden category, N (%) | | | | |
| 5%–9% | 18 (18.0) | 11 (19.6) | 7 (15.9) | Reference |
| 10%–19% | 40 (40.0) | 21 (37.5) | 19 (43.2) | 0.98 (0.41 to 2.33); p=0.958 |
| ≥20% | 42 (42.0) | 24 (42.9) | 18 (40.9) | 0.97 (0.40 to 2.33); p=0.946 |
| Maximum PVC burden (%), median (range) | 20.3 (5.4 to 49.8) | 23.7 (5.4 to 49.8) | 18.7 (5.6 to 44.6) | 0.97 (0.94 to 1.00); p=0.045 |
| PVC QRS duration (ms), mean (SD) | 139.3 (19.2) | 136.9 (19.4) | 142.8 (18.6) | 1.01 (0.99 to 1.03); p=0.230 |
| PVC QRS location, N (%) | | | | |
| RVOT | 34 (34.0) | 22 (39.3) | 12 (27.3) | Reference |
| Non-RVOT RV | 11 (11.0) | 5 (8.9) | 6 (13.6) | 1.40 (0.52 to 3.74); p=0.505 |
| LVOT and AMC | 34 (34.0) | 20 (35.7) | 14 (31.8) | 1.01 (0.47 to 2.20); p=0.967 |
| Non-LVOT LV | 6 (6.0) | 2 (3.6) | 4 (9.1) | 1.63 (0.52 to 5.08); p=0.402 |
| Multiple morphologies | 6 (6.0) | 5 (8.9) | 1 (2.3) | 0.31 (0.04 to 2.39); p=0.261 |
| Not captured | 9 (9.0) | | | |

LVEF reduction below 50%

N= 4 / 100

All LVEF recovered after treatment

## CONCLUSION

This study demonstrated a high rate of resolution of frequent PVCs among untreated patients with normal LV function and minimal symptoms. It also demonstrated a low rate of subsequent development of LV dysfunction. Given these findings, a conservative approach consisting of observation with serial echocardiographic and ambulatory ECG evaluation is reasonable for patients with minimal or no symptoms, normal LV function a negative initial work-up.

# 4ème "take-home message"

- **Les ESV peuvent être la conséquence de la cardiopathie mais aussi la cause de cardiomyopathie rythmique**

- **Estimation de l'imputabilité :**
  - Charge >20% (peu probable si <10%) - largeur > 150 ms
  - Séquence apparition des ESV et de l'altération FEVG
  - ? Capacité de myocarde pouvant récupérer?

→ **Discuter avec un rythmologue de la probabilité de CMP induite par les ESV et des taux de succès & complications prévisibles en fonction des ESV** (monomorphes, polymorphes, sites…)

# Prise en charge des Extrasystoles Ventriculaires et des Tachycardies Ventriculaires non soutenues

1. ESV
   - Définitions / Epidémiologie
   - ESV sur cœur sain ou marqueur de cardiopathie
   - ESV bénigne / ESV maligne
   - Cardiomyopathie induite par les ESV
2. TVNS
   - Définitions / Epidémiologie
   - TVNS sur cœur sain ou marqueur de cardiopathie

Guidelines

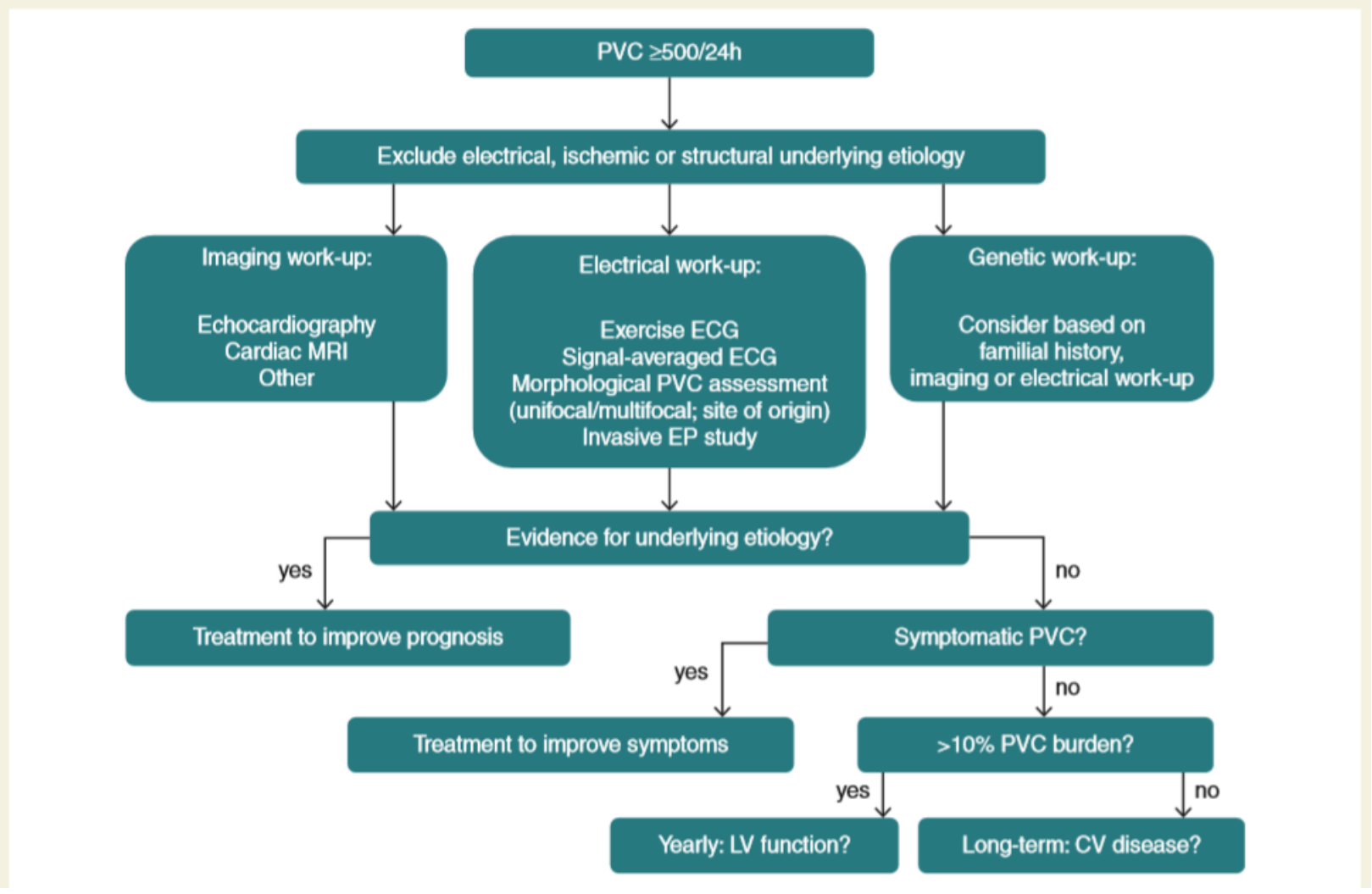
**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019

| Consensus statements | Symbol | References |
|---|---|---|
| Asymptomatic patients with frequent PVCs (>500 per 24 h) should be referred to a specialist for further evaluation to rule out any underlying structural, ischaemic, or electrical heart disease. | | 151,152 |
| Very frequent PVCs (burden > 20%) are a marker of all-cause and cardiovascular mortality and may justify intensified follow-up. | | 154 |
| PVCs should be treated in patients with suspected PVC-mediated cardiomyopathy. | | Expert consensus |
| Treatment of patients with asymptomatic PVCs should focus on the underlying heart disease in order to improve prognosis. | | Expert consensus |

**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019



# 2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

| Recommendations for VA in the Structurally Normal Heart<br>References that support the recommendations are summarized in Online Data Supplement 45. | | |
|---|---|---|
| **COR** | **LOE** | **Recommendation** |
| I | B-R | 1. In patients with symptomatic PVCs in an otherwise normal heart, treatment with a beta blocker or nondihydropyradine calcium channel blocker is useful to reduce recurrent arrhythmias and improve symptoms (1, 2). |
| IIa | B-R | 2. n patients with symptomatic VA in an otherwise normal heart, treatment with an antiarrhythmic medication is reasonable to reduce recurrent symptomatic arrhythmias and improve symptoms if beta blockers and nondihydropyradine calcium channel blockers are ineffective or not tolerated (3, 4). |

| Recommendations for Outflow Tract VA<br>References that support the recommendations are summarized in Online Data Supplement 46. | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| I | B-NR | 1. In patients with symptomatic outflow tract VA in an otherwise normal heart for whom antiarrhythmic medications are ineffective, not tolerated, or not the patient's preference, catheter ablation is useful (1-3). |
| I | B-NR | 2. In patients with symptomatic outflow tract VT in an otherwise normal heart, a beta blocker or a calcium channel blocker is useful (1-3). |

| Recommendation for Papillary Muscle VA (PVCs and VT)<br>References that support the recommendation are summarized in Online Data Supplement 47. | | |
|---|---|---|
| **COR** | **LOE** | **Recommendation** |
| I | B-NR | 1. In patients with symptomatic VA arising from the papillary muscles for whom antiarrhythmic medications are ineffective, not tolerated, or not the patient's preference, catheter ablation is useful (1-5). |

# 2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

| Recommendations for Idiopathic Polymorphic VT/VF<br>References that support the recommendations are summarized in Online Data Supplement 49. | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| I | B-NR | 1. In young patients (<40 years of age) with unexplained SCA, unexplained near drowning, or recurrent exertional syncope, who do not have ischemic or other structural heart disease, further evaluation for genetic arrhythmia syndromes is recommended (1-8). |
| I | B-NR | 2. In patients resuscitated from SCA due to idiopathic polymorphic VT or VF, an ICD is recommended if meaningful survival greater than 1 year is expected (9-13). |
| I | B-NR | 3. For patients with recurrent episodes of idiopathic VF initiated by PVCs with a consistent QRS morphology, catheter ablation is useful (11, 14). |

| Recommendations for PVC-Induced Cardiomyopathy<br>References that support the recommendations are summarized in Online Data Supplement 50. | | |
|---|---|---|
| **COR** | **LOE** | **Recommendations** |
| I | B-NR | 1. For patients who require arrhythmia suppression for symptoms or declining ventricular function suspected to be due to frequent PVCs (generally >15% of beats and predominately of 1 morphology) and for whom antiarrhythmic medications are ineffective, not tolerated, or not the patient's preference, catheter ablation is useful (1, 2). |
| IIa | B-NR | 2. In patients with PVC-induced cardiomyopathy, pharmacological treatment (e.g., beta blocker, amiodarone) is reasonable to reduce recurrent arrhythmias and improve symptoms and LV function (3, 4). |

# Prise en charge des Extrasystoles Ventriculaires et des Tachycardies Ventriculaires non soutenues

1. ESV
   - Définitions / Epidémiologie
   - ESV sur cœur sain ou marqueur de cardiopathie
   - ESV bénigne / ESV maligne
   - Cardiomyopathie induite par les ESV
2. TVNS
   - Définitions / Epidémiologie
   - TVNS sur cœur sain ou marqueur de cardiopathie

# Tachycardie Ventriculaire non soutenue:

≥3 dépolarisations ventriculaires de cycle < 600 ms naissant au-delà du faisceau de His

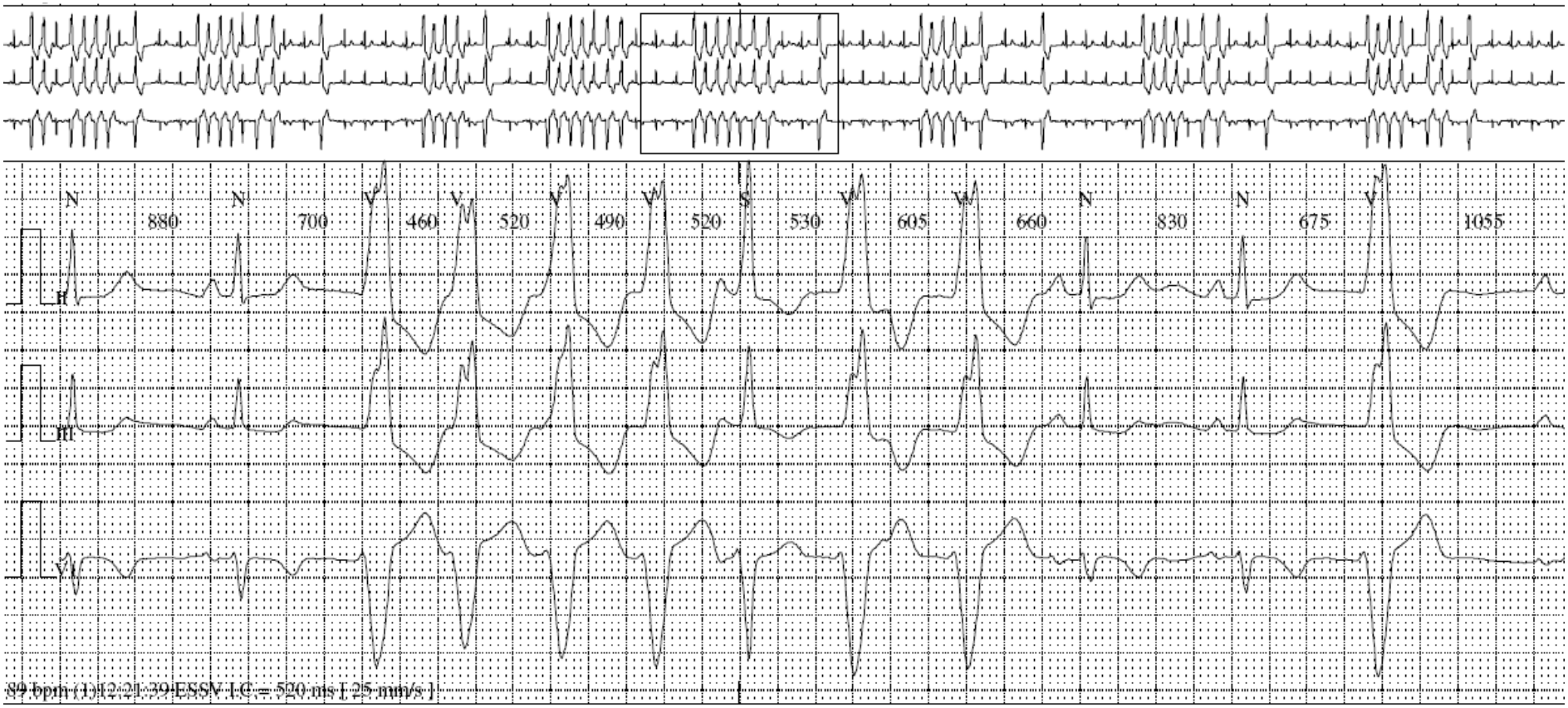
**Table 7** **Definitions of different sub-types of ventricular tachycardia**

| Type of ventricular arrhythmia | Definition |
|---|---|
| Non-sustained VT | Three or more consecutive ventricular beats terminating spontaneously in less than 30 s with a cycle length of <600 ms (>100 b.p.m.) |
| • Non-sustained monomorphic VT | NSVT with a single QRS morphology |
| • Non-sustained polymorphic VT | NSVT with a changing QRS morphology and a cycle length between 600 and 180 ms |
| Monomorphic sustained VT | VT greater than 30 s in duration or terminated by external intervention with a stable QRS morphology |
| Bidirectional VT | VT with a beat to beat alternans in the frontal plane axis often associated with digitalis toxicity or channelopathies such as CPVT or Andersen-Tawil syndrome |
| Torsades de pointes | Polymorphic VT characterized by twisting of the peaks of the QRS complexes around the isoelectric line often associated with long QT.<br>• Typical: initiation following a long/short/long coupling interval<br>• Atypical: short coupled variant initiated by R on T PVCs |
| Accelerated idioventricular rhythm | Ventricular rhythm slower than 100 bpm |

**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019

# Tachycardie Ventriculaire non soutenue




**EVENEMENTS VENTRICULAIRES :**

**EXTRASYSTOLES :**

| | |
|---|---|
| Isolées : 12722 | 11.2 % |
| Doublets : 4083 | 3.6 % |
| Salves : 8031 | 7.0 % |
| Total : 59424 | |

**BI & TRIGEMIN. : 571 & 43**

Durée totale : (1)03:20:32

1/ à (1)15:13:22 : Durée : (1)00:05:14

2/ à (1)14:16:40 : Durée : (1)00:04:46

3/ à (1)15:19:33 : Durée : (1)00:04:05

**TACHYCARDIE : 1230**

Durée totale : (1)05:53:42 (24.6%)

1/ à (1)10:20:32 : 150 bpm (1)00:00:54

2/ à (1)23:10:07 : 111 bpm (1)00:02:31

3/ à (1)08:45:42 : 140 bpm (1)00:00:10

# Electrocardiographic Findings in 122,043 Individuals

Circulation. 1962; 25:947-61

*By* ROLAND G. HISS, Capt. USAF (MC), AND LAWRENCE E. LAMB, M.D.

*Total Number of Persons in Each Age Group*

| Age group | Number of persons |
|---|---|
| 16–19 | 7,072 |
| 20–24 | 37,159 |
| 25–29 | 21,681 |
| 30–34 | 12,966 |
| 35–39 | 22,028 |
| 40–44 | 18,359 |
| 45–49 | 2,044 |
| 50 and over | 734 |
| Total | 122,043 |

US air force subjects
48-sec ECG

**TVNS ~ 5/100 000**

## Ventricular Tachycardia

There were six examples of ventricular tachycardia. This interpretation was made when short bursts of three or more ventricular impulses occurred at a rapid rate. Three cases were studied and found to have heart disease. The other three were unavailable for evaluation.

# Long-Term Clinical Significance of Frequent and Complex Ventricular Tachyarrhythmias in Trained Athletes

JACC. 2002; 40:446-52

Alessandro Biffi, MD,* Antonio Pelliccia, MD,* Luisa Verdile, MD,* Fredrick Fernando, MD,* Antonio Spataro, MD,* Stefano Caselli, MD,* Massimo Santini, MD,† Barry J. Maron, MD, FACC‡

**Patient selection.** The case records of the Institute of Sports Science were reviewed from January 1984 to March 1999, and 355 athletes had been assessed with 24-h ambulatory (Holter) ECG (from a total population of 15,889 athletes), if they met the following criteria: 1) ≥3 PVDs on resting 12-lead ECG (n = 337); and/or 2) history of palpitations (n = 18).

**Table 1.** Demographic and Clinical Data in 355 Competitive Athletes With Ventricular Tachyarrhythmias

| | Group A (≥2,000 PVDs and ≥1 NSVT) | Group B* (≥100 to <2,000 PVDs) | Group C* (<100 PVDs) | p Value |
|---|---|---|---|---|
| No. athletes | 71 | 153 | 131 | |
| Age | 24 ± 10 | 24 ± 10 | 25 ± 11 | NS |
| Male:Female | 51:20 | 120:33 | 102:29 | NS |
| Palpitations† | 8 (11%) | 10 (6%) | 0 | 0.0013‖ |
| 12-lead ECG abnormalities‡ | 15 (21%) | 5 (3%) | 2 (1.5%) | < 0.001¶ |
| Echo abnormalities§ | 21 (30%) | 8 (5%) | 0 | < 0.001¶ |

0,4% 1% 0,8% **Total 2,2%**

# Long-Term Clinical Significance of Frequent and Complex Ventricular Tachyarrhythmias in Trained Athletes

Alessandro Biffi, MD,* Antonio Pelliccia, MD,* Luisa Verdile, MD,* Fredrick Fernando, MD,* Antonio Spataro, MD,* Stefano Caselli, MD,* Massimo Santini, MD,† Barry J. Maron, MD, FACC‡

JACC. 2002; 40:446-52

**Table 2.** Prevalence of Structural Cardiovascular Abnormalities in 355 Competitive Athletes With Ventricular Tachyarrhythmias

| | Group A (≥2,000 PVDs and ≥1 NSVT) | Group B* (≥100 to <2,000 PVDs) | Group C* (<100 PVDs) | p Value |
|---|---|---|---|---|
| No. of athletes | 71 | 153 | 131 | |
| ARVC | 7 (10%) | 0 | 0 | < 0.001† |
| MVP | 6 (9%) | 5 (3%) | 0 | 0.0042‡ |
| Myocarditis | 4 (5.5%) | 0 | 0 | 0.0003† |
| DCM | 4 (5.5%) | 0 | 0 | 0.0003† |
| Totals | 21 (30%) | 5 (3%) | 0 | < 0.001† |

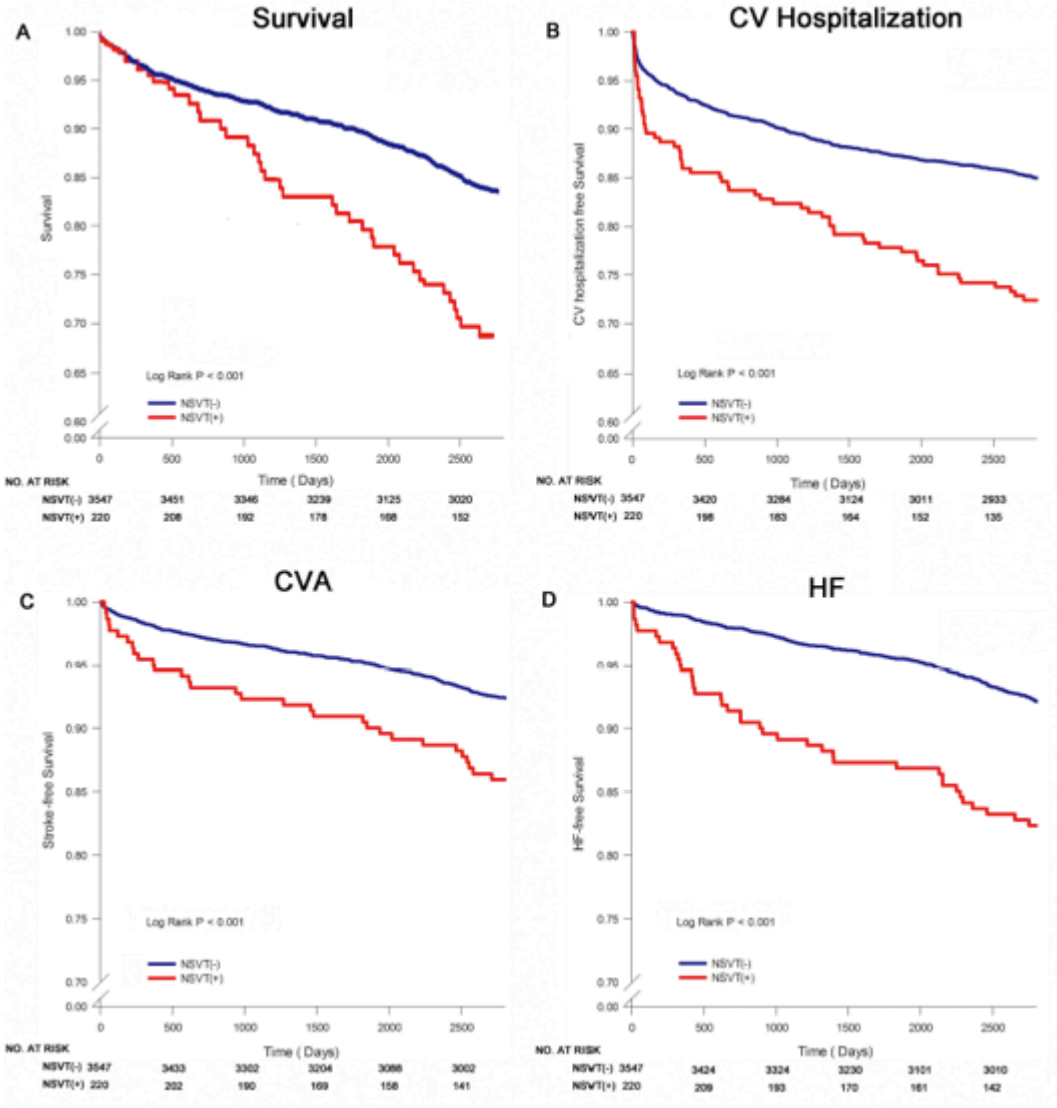
# Long-Term Outcome of Non-Sustained Ventricular Tachycardia in Structurally Normal Hearts

Chin-Yu Lin[1,2], Shih-Lin Chang[1,2], Fa-Po Chung[1,2], Yun-Yu Chen[1,3], Yenn-Jiang Lin[1,2], Li-Wei Lo[1,2], Yu-Feng Hu[1,2], Ta-Chuan Tuan[1,2], Tze-Fan Chao[1,2], Jo-Nan Liao[1,2], Yao-Ting Chang[1,2], Chung-Hsing Lin[1,2], Suresh Allamsetty[1], Rohit Walia[1], Abigail Louise D. Te[1], Shinya Yamada[1], Shuo-Ju Chiang[4], Hsuan-Ming Tsao[2,5]*, Shih-Ann Chen[1,2]

PloS ONE. 2016; 11:e0160181

Database sorted 24-h Holter

NSVT 6%



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PloS ONE. 2016; 11:e0160181

**Table 1. Study Population Characteristics.**

| Characteristics | NSVT (-) | NSVT (+) | P value |
|---|---|---|---|
| | n = 3547 | n = 220 | |
| Age (year) | 58. 50±19.60 | 67.44±15.90 | <0.001 |
| Sex (male) | 1994(56.2) | 164(74.5) | <0.001 |
| Diabetes mellitus | 269(7.6) | 25(11.4) | 0.045 |
| Hypertension | 1083(30.5) | 97(44.1) | <0.001 |
| Hyperlipidemia | 240(6.8) | 14(6.4) | 0.258 |
| Chronic kidney disease | 28(0.8) | 8(3.6) | <0.001 |
| Cirrhosis | 23(0.6) | 0(0.0) | 0.231 |
| Atrial fibrillation | 238(6.7) | 18(8.2) | 0.400 |
| Chronic lung disease | 98(2.8) | 6(2.7) | 0.884 |
| Thyroid dysfunction | 40(1.1) | 2(1.5) | 0.843 |
| Sleep apnea | 2(0.1) | 0(0.0) | 0.725 |
| Anti-arrhythmia | 13(0.4) | 3(1.4) | 0.027 |
| Anti-hypertension* | 583(16.4) | 52(23.6) | 0.063 |
| Statin | 230(6.5) | 13(5.9) | 0.213 |

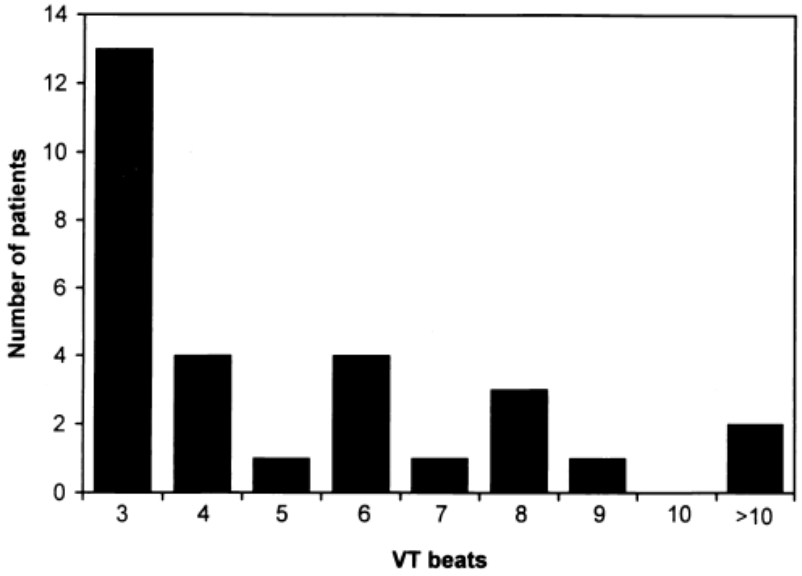
# Prevalence, Characteristics and Prognostic Value During Long-Term Follow-up of Nonsustained Ventricular Tachycardia After Myocardial Infarction in the Thrombolytic Era

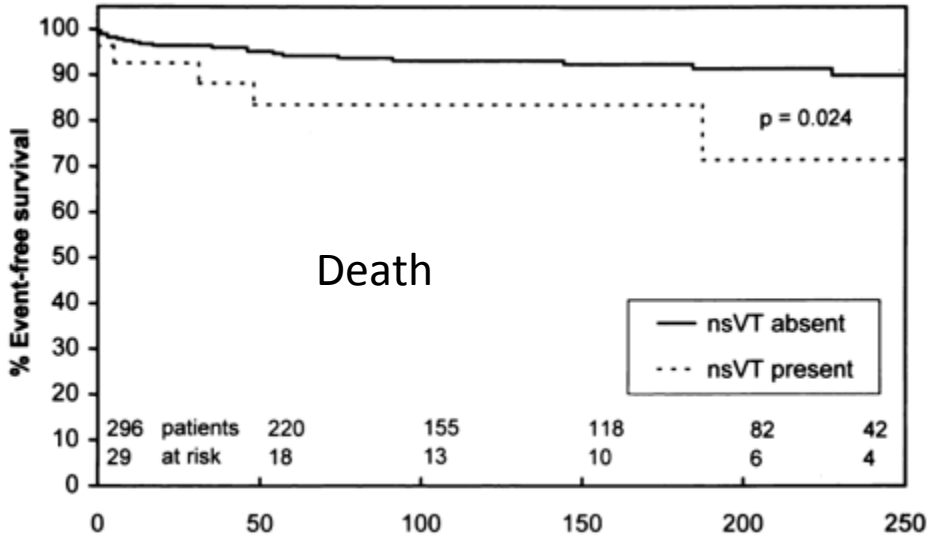
Stefan H. Hohnloser, MD, FACC, Thomas Klingenheben, MD, Markus Zabel, MD, Matthias Schöpperl, MD, Oliver Mauß, MSc

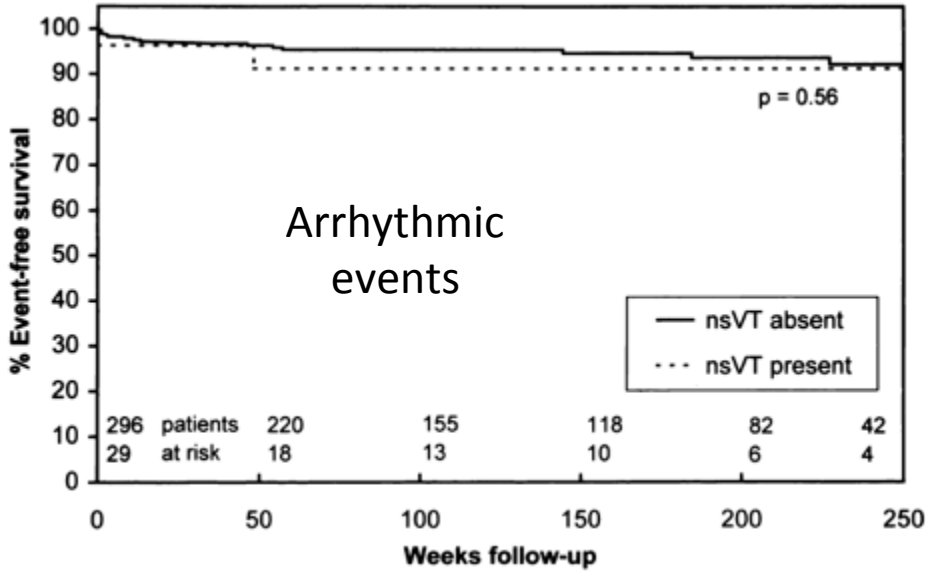
JACC. 1999; 33:1895-902

**Incidence of nonsustained VT after myocardial infarction.** In 29 of 325 patients (9%), Holter monitoring revealed the presence of at least one episode of nonsustained VT. Eight of these patients (28%) had a LVEF of ≤35%. There were no significant differences in clinical characteristics between patients with or without nonsustained VT.

24-H Holter
9% NSVT



# Ambulatory Ventricular Arrhythmias in Patients With Heart Failure Do Not Specifically Predict an Increased Risk of Sudden Death

John R. Teerlink, MD; Muhammad Jalaluddin, MS; Susan Anderson, MS; Marrick L. Kukin, MD; Eric J. Eichhorn, MD; Gary Francis, MD; Milton Packer, MD; Barry M. Massie, MD; on Behalf of the PROMISE (Prospective Randomized Milrinone Survival Evaluation) Investigators*

Circulation. 2000; 101:40-46

**TABLE 1. Characteristics of the Patient Population**

| | Placebo (n=525) | Milrinone (n=555) |
|---|---|---|
| Age, y | 64±11 | 63±11 |
| Males, % | 80 | 76 |
| CAD, % | 54 | 54 |
| NYHA III//IV, % | 57/43 | 58/42 |
| Ejection fraction | 0.21±0.07 | 0.21±0.07 |
| Amiodarone therapy, % | 5 | 5 |
| Other antiarrhythmic, % | 18 | 17 |
| PVCs >30/h, % | 58 | 61 |
| Couplets, % | 83 | 86 |
| NSVT, % | 60 | 63 |
| NSVT >5 episodes, % | 29 | 30 |
| NSVT >10 beats, % | 10 | 9 |

**TABLE 2. Univariate Predictors of Outcome by $\chi^2$ Analysis**

| | Combined Groups | | | |
|---|---|---|---|---|
| Variable | All-Cause Mortality (n=290) | | Sudden Death (n=139) | |
| All patients | 290/1080 (27%) | | 139/1080 (13%) | |
| PVCs >30/h | | | | |
| Yes | 202/647 (31%) | $P<0.001$ | 105/647 (16%) | $P<0.001$ |
| No | 88/433 (20%) | | 34/433 (8%) | |
| Couplets | | | | |
| Yes | 254/915 (28%) | NS ($P=0.14$) | 128/915 (14%) | $P<0.02$ |
| No | 36/165 (22%) | | 11/165 (7%) | |
| NSVT | | | | |
| Yes | 210/663 (32%) | $P<0.001$ | 105/663 (16%) | $P<0.001$ |
| No | 80/417 (19%) | | 34/417 (8%) | |
| NSVT >10 beats | | | | |
| Yes | 42/104 (40%) | $P<0.002$ | 19/104 (18%) | NS ($P=0.09$) |
| No | 248/976 (25%) | | 120/976 (12%) | |
| NSVT >5 episodes | | | | |
| Yes | 115/314 (37%) | $P<0.001$ | 61/314 (19%) | $P<0.001$ |
| No | 176/766 (23%) | | 78/766 (10%) | |
| Age, y | | | | |
| <65 | 107/520 (21%) | $P<0.001$ | 57/463 (12%) | $P<0.05$ |
| ≥65 | 188/568 (33%) | | 83/485 (17%) | |

# Ambulatory Ventricular Arrhythmias in Patients With Heart Failure Do Not Specifically Predict an Increased Risk of Sudden Death

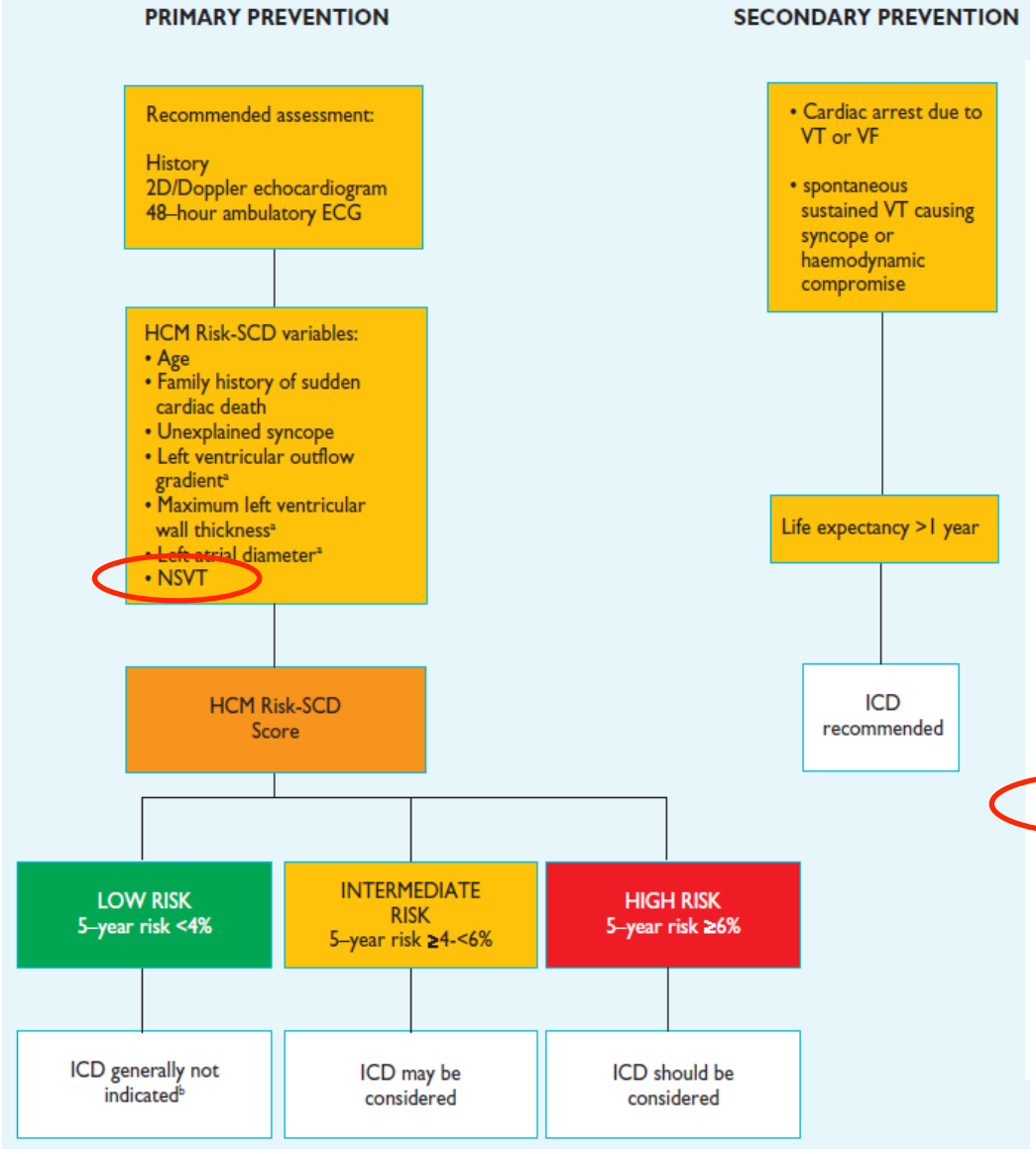
John R. Teerlink, MD; Muhammad Jalaluddin, MS; Susan Anderson, MS; Marrick L. Kukin, MD; Eric J. Eichhorn, MD; Gary Francis, MD; Milton Packer, MD; Barry M. Massie, MD; on Behalf of the PROMISE (Prospective Randomized Milrinone Survival Evaluation) Investigators*

Circulation. 2000; 101:40-46

**TABLE 4. Predictors of Outcome by Backward Elimination Multivariate Analysis**

| | Overall Mortality | | | Sudden Death | | | Non–Sudden Death Mortality | | |
|---|---|---|---|---|---|---|---|---|---|
| Variable | Risk Ratio | CI | *P* | Risk Ratio | CI | *P* | Risk Ratio | CI | *P* |
| EF | 1.03 | 1.01–1.04 | 0.004 | 1.05 | 1.02–1.08 | 0.001 | 1.01 | 0.98–1.03 | NS |
| NYHA | 1.49 | 1.16–1.90 | 0.002 | 1.30 | 0.91–1.84 | NS | 1.73 | 1.22–2.45 | 0.002 |
| CAD | 1.44 | 1.13–1.83 | 0.003 | 1.37 | 0.97–1.94 | 0.073 | 1.50 | 1.07–2.10 | 0.020 |
| Age | 1.03 | 1.02–1.04 | 0.001 | 1.02 | 1.00–1.04 | 0.034 | 1.07 | 1.05–1.09 | 0.001 |
| Milrinone | 1.29 | 1.02–1.63 | 0.031 | 1.64 | 1.16–2.32 | 0.005 | 1.06 | 0.77–1.46 | NS |
| Systolic BP | 1.02 | 1.01–1.03 | 0.001 | 1.01 | 0.99–1.02 | NS | 1.03 | 1.02–1.05 | 0.001 |
| NSVT episodes | 1.12 | 1.07–1.17 | 0.001 | 1.16 | 1.09–1.24 | 0.001 | 1.16 | 1.05–1.28 | 0.003 |
| PVCs/h | NS | NS | NS | NS | NS | NS | 0.89 | 0.80–1.00 | 0.029 |
| NSVT | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| NSVT beats | NS | NS | NS | NS | NS | NS | NS | NS | NS |

# 2014 ESC Guidelines on diagnosis and management of hypertrophic cardiomyopathy




## HCM Risk-SCD

Assess risk of sudden cardiac death and need for ICD in hypertrophic cardiomyopathy

**Age?**

Should not be used if age <16 or >80

Unanswered — Years

**Maximum LV Wall Thickness?**

Transthoracic echocardiographic measurement

Unanswered — mm

**Left Atrial Size?**

Left atrial diameter as determined by M-mode or 2D echocardiography in the parasternal long axis plane at the time of evaluation

Unanswered — mm

**LVOT Gradient?**

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 gradient should be determined using the modified Bernoulli equation, Gradient = 4V², where V is the peak aortic outflow velocity

Unanswered — mmHg

Obtain this answer using a linked calculator

**Family History of Sudden Cardiac Death?**

History of sudden cardiac death in ≥1 first degree relatives under 40 years of age or SCD in a first degree relative with confirm HCM at any age (post or ante-mortem diagnosis)

Yes
No

**Non-sustained VT?**

3 consecutive ventricular beats at a rate of ≥120 beats per min and <30s in duration on Holter monitoring (minimum duration 24 hours) at or prior to evaluation.

Yes
No

**Unexplained Syncope?**

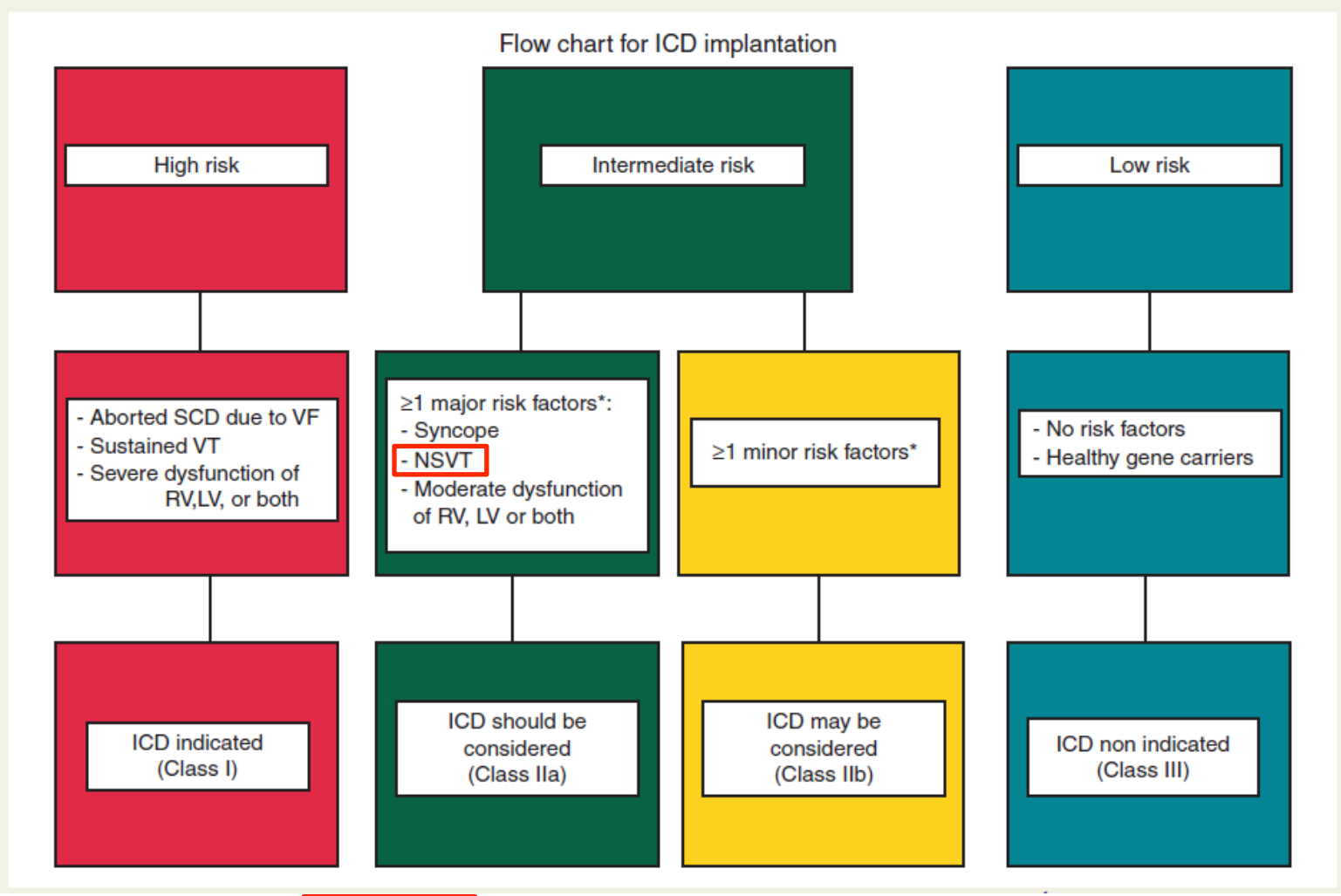
History of unexplained syncope at or prior to evaluation.

Yes
No

# Diagnostic and therapeutic strategies for arrhythmogenic right ventricular dysplasia/cardiomyopathy patient

Europace.
2019;21:9-21

Weijia Wang, Cynthia A. James, and Hugh Calkins*




Minor risk factors: PVC>1000, T-wave inversion > 3 leads, male sex, younger age at presentation, proband statud, +/- PVS inducibility

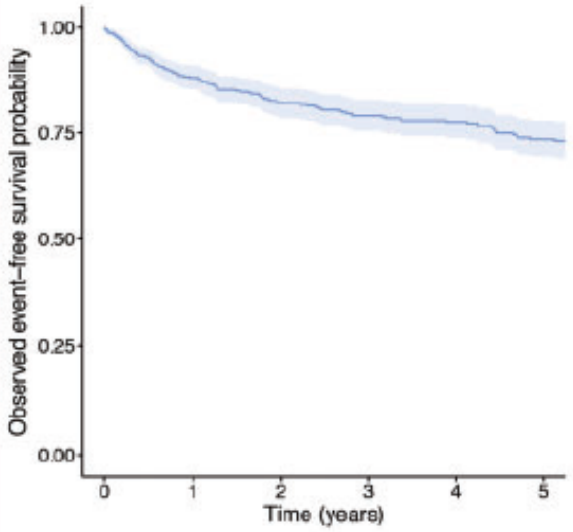
# A new prediction model for ventricular arrhythmias in arrhythmogenic right ventricular cardiomyopathy

Eur Heart J. 2019; 40:1850-8

Julia Cadrin-Tourigny[1,2†], Laurens P. Bosman[3,4†], Anna Nozza[5], Weijia Wang[1], Rafik Tadros[2], Aditya Bhonsale[1], Mimount Bourfiss[4], Annik Fortier[5], Øyvind H. Lie[6,7], Ardan M. Saguner[8], Anneli Svensson[9], Antoine Andorin[2], Crystal Tichnell[1], Brittney Murray[1], Katja Zeppenfeld[10], Maarten P. van den Berg[11], Folkert W. Asselbergs[3,4,12], Arthur A.M. Wilde[13], Andrew D. Krahn[14], Mario Talajic[2], Lena Rivard[2], Stephen Chelko[1], Stefan L. Zimmerman[15], Ihab R. Kamel[15], Jane E. Crosson[1], Daniel P. Judge[1], Sing-Chien Yap[16], Jeroen F. van der Heijden[4], Harikrishna Tandri[1], Jan D.H. Jongbloed[17], Marie-Claude Guertin[5], J. Peter van Tintelen[3,18], Pyotr G. Platonov[19], Firat Duru[8], Kristina H. Haugaa[6,7], Paul Khairy[2], Richard N.W. Hauer[3,4], Hugh Calkins[1], Anneline S.J.M. te Riele[3,4‡], and Cynthia A. James[1*‡]

## Prediction of sustained ventricular arrhythmia in ARVC

**5-year event-free survival (n = 528)**
Overall

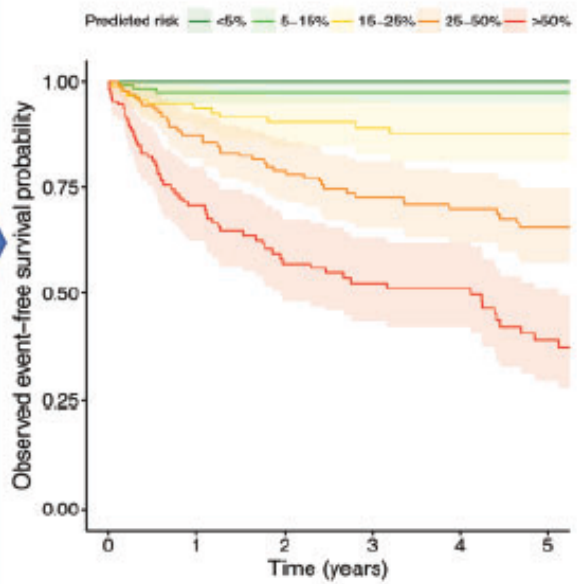



**Model for 5-year risk prediction**

| | | |
|---|---|---|
| Sex | x | 0.49 |
| Age | x | -0.022 |
| Recent syncope | x | 0.66 |
| Non-sustained VT | x | 0.81 |
| Ln(24h PVC count) | x | 0.17 |
| Leads with T-wave inv. | x | 0.11 |
| RVEF | x | -0.025 |

$$1 - 0.802^{\exp(\ \ )} = 5 \text{ year risk}$$

**5-year event-free survival (n = 528)**
Per predicted risk group



# Prise en charge des Extrasystoles Ventriculaires et des Tachycardies Ventriculaires non soutenues

1. ESV
   - Définitions / Epidémiologie
   - ESV sur cœur sain ou marqueur de cardiopathie
   - ESV bénigne / ESV maligne
   - Cardiomyopathie induite par les ESV
2. TVNS
   - Définition / Epidémiologie
   - TVNS sur cœur sain ou marqueur de cardiopathie

Guidelines

# Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)

2019

**Table 8** Evaluation of patients with asymptomatic sustained or non-sustained VT

| | |
|---|---|
| **First line evaluation** | |
| History | Prior cardiovascular disease, hypertension, syncope or near-syncope, relation of VT to exercise. |
| Family history | SCD, inherited arrhythmia syndromes, coronary artery disease, cardiomyopathy |
| Medications | QT prolonging drugs, sodium channel blockers, drug interactions |
| Physical examination | Sign of structural heart disease or heart failure |
| Twelve-lead ECG | Q-waves, ischaemic changes, prolonged or fractionated QRS, QT prolongation or shortening, J point elevation and coved-type ST elevation V1–V3, early repolarization, epsilon waves, or T-wave inversion anteriorly, laterally or inferiorly |
| Prolonged rhythm monitoring (Holter-ECG) | Day/night/effort appearance. Frequency and duration of episodes |
| Echocardiography | Signs of structural heart disease |
| Laboratory | Serum electrolytes, renal function, thyroid function and BNP |
| Stress test | Suspicion of coronary artery disease, exercise-related symptoms, borderline QT interval. VT provocation by exertion |
| **Second line evaluation** | |
| Non-invasive evaluation of coronary artery | Low suspicion of coronary artery disease |
| Coronary arteriography | High suspicion of coronary artery disease |
| Cardiac MRI | Suspicion of structural heart disease such as ARVC, HCM, cardiac sarcoidosis, congenital abnormalities |
| Electrophysiological study | In case of NSVT, coronary artery disease and moderate LV dysfunction (EF<40%), syncope |
| Pharmacological testing | To unmask suspected Brugada syndrome |
| • Ajmaline test | |
| • Flecainide test | |
| Genetic testing | In case of inherited arrhythmic disorders or in the setting of familial screening when a mutation is identified in the family. |

**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019

| Consensus statements | Symbol | References |
|---|---|---|
| Patients with asymptomatic NSVT should be referred for careful evaluation to detect any underlying structural, ischaemic, or electrical heart disease. | | Expert consensus |
| After ruling out acute coronary artery stenosis, an ICD is indicated for sustained VT without a reversible cause in those with LVEF < 35%. | | Expert consensus |
| NSVT in an asymptomatic patient with a LVEF ≥ 40% does not usually require specific antiarrhythmic therapy, but optimization of the treatment of the underlying heart disease. | | 202 |

**Management of asymptomatic arrhythmias: a European Heart Rhythm Association (EHRA) consensus document, endorsed by the Heart Failure Association (HFA), Heart Rhythm Society (HRS), Asia Pacific Heart Rhythm Society (APHRS), Cardiac Arrhythmia Society of Southern Africa (CASSA), and Latin America Heart Rhythm Society (LAHRS)**

2019

**Table 10** **A brief summary of treatment of patients with asymptomatic ventricular arrhythmias in the setting of channelopathies**

| Asymptomatic ventricular arrhythmia | Treatment options |
|---|---|
| Monomorphic sustained or non-sustained VT | If evaluation for structural heart disease with echo, cardiac MRI is normal, no therapy. Need follow-up and monitoring of LV function |
| Polymorphic VT | • Culprit PVC ablation<br>• Discuss ICD and/or quinidine |
| MEPPC | Discuss quinidine |
| Andersen–Tawil | Beta-blockers ± flecainide or calcium channel blocker |
| CPVT on beta-blockers | • Ascertain the intake of beta-blocker<br>• Add flecainide and/or left cardiac sympathetic denervation<br>• Discuss ICD as last option |
| Long QT syndrome | • Correction of hypokalaemia if present<br>• Careful consideration of QT prolonging drug withdrawal. Consider genetic testing and beta-blockers if no reversible cause found |
| Brugada syndrome and early repolarization syndrome | • Quinidine<br>• Discuss ICD with expert in Brugada syndrome |

# 5ème "take-home message"

- **Les TVNS sont exceptionnelles sur cœur sain mais très fréquentes en cas d'altération de la FEVG**

→ **Toujours chercher 1 cardiomyopathie en cas de TVNS**

- **Le risque de mort subite des CMI et CMNI dépend de la FEVG & parfois du résultat de la SVP**

→ **DAI si FEVG ≤35% ou si TVMS déclenchable**

- **La présence de TVNS est associé à un sur risque de mort subite dans la DVDA, dans la CMH**

→ **Rechercher les TVNS dans ces cardiopathies**

# “take-home messages”

→ Chercher 1 cardiomyopathie en cas d’ESV fréquentes (>30/h ou ++ >2000/j)

→ Traiter le patient si symptomatique, pas ses ESV

→ Référer les ESV à couplage court ou sur canalopathies à un centre spécialisé

→ Hospitalisation immédiate en USIC /réa de centre lourd en cas d’ESV initiatrices responsables d’orage rythmique

→ Discuter avec un rythmologue de la probabilité de CMP induite par les ESV et des taux de succès & complications prévisibles en fonction des ESV

→ Toujours chercher 1 cardiomyopathie en cas de TVNS

# Apple Watch catches premature ventricular contraction, impressing doctor; deaf customer praises vibrating alarm clock and more

Michael Potuck - Mar. 8th 2019 9:47 am PT @michaelpotuck

25 mm/s, 10 mm/mV, Lead I, 513Hz, iOS 12.1.4, watchOS 5.1.3, Watch4,4 — The waveform is similar to a Lead I ECG. For more information, see Instructions for Use.

https://9to5mac.com/2019/03/08/apple-watch-stories-benefits/

# 1er “take-home message”

- Les ESV sont fréquemment observées chez les sujets sains
- La présence d’une cardiomyopathie augmente la fréquence des ESV

→ESV fréquentes = proxy de cardiomyopathie

- Le pronostic dépend
  +++ de la cardiomyopathie et
  pas (ou peu) des ESV

→ **Chercher 1 cardiomyopathie en cas d’ESV fréquentes** (>30/h ou ++ >2000/j)

# 2ème "take-home message"

- **ESV du sujet sain**

  - Ne pas traiter les asymptomatiques (sauf exceptions)
  - Eviter un remède pire que le mal

- **ESV sur Cardiopathie**

  - Thérapie optimale
  - Evaluation & prise en charge du risque de mort subite associé à la cardiopathie

  **Traiter le patient si besoin, pas ses ESV**
  (sauf exceptions)

## 3ème "take-home message"

- **ESV à couplage court (R sur sommet de T) = ESV tueuse**

  → Hospitalisation / monitoring – avis « expert »

- **ESV sur canalopathies**

  → Avis centre de référence

- **ESV initiatrices de FV & d'orage rythmique / substrat aigu**

  → **Hospitalisation immédiate en USIC /réa de centre lourd**

# 4ème "take-home message"

- **Les ESV peuvent être la conséquence de la cardiopathie mais aussi la cause de cardiomyopathie rythmique**

- **Estimation de l'imputabilité :**
  - Charge >20% (peu probable si <10%) - largeur > 150 ms
  - Séquence apparition des ESV et de l'altération FEVG
  - ? Capacité de myocarde pouvant récupérer?

→ **Discuter avec un rythmologue de la probabilité de CMP induite par les ESV et des taux de succès & complications prévisibles en fonction des ESV** (monomorphes, polymorphes, sites)

# 5ème "take-home message"

- **Les TVNS sont exceptionnelles sur cœur sain mais très fréquentes en cas d'altération de la FEVG**

→ **Toujours chercher 1 cardiomyopathie en cas de TVNS**

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→ **Rechercher les TVNS dans ces cardiopathies**