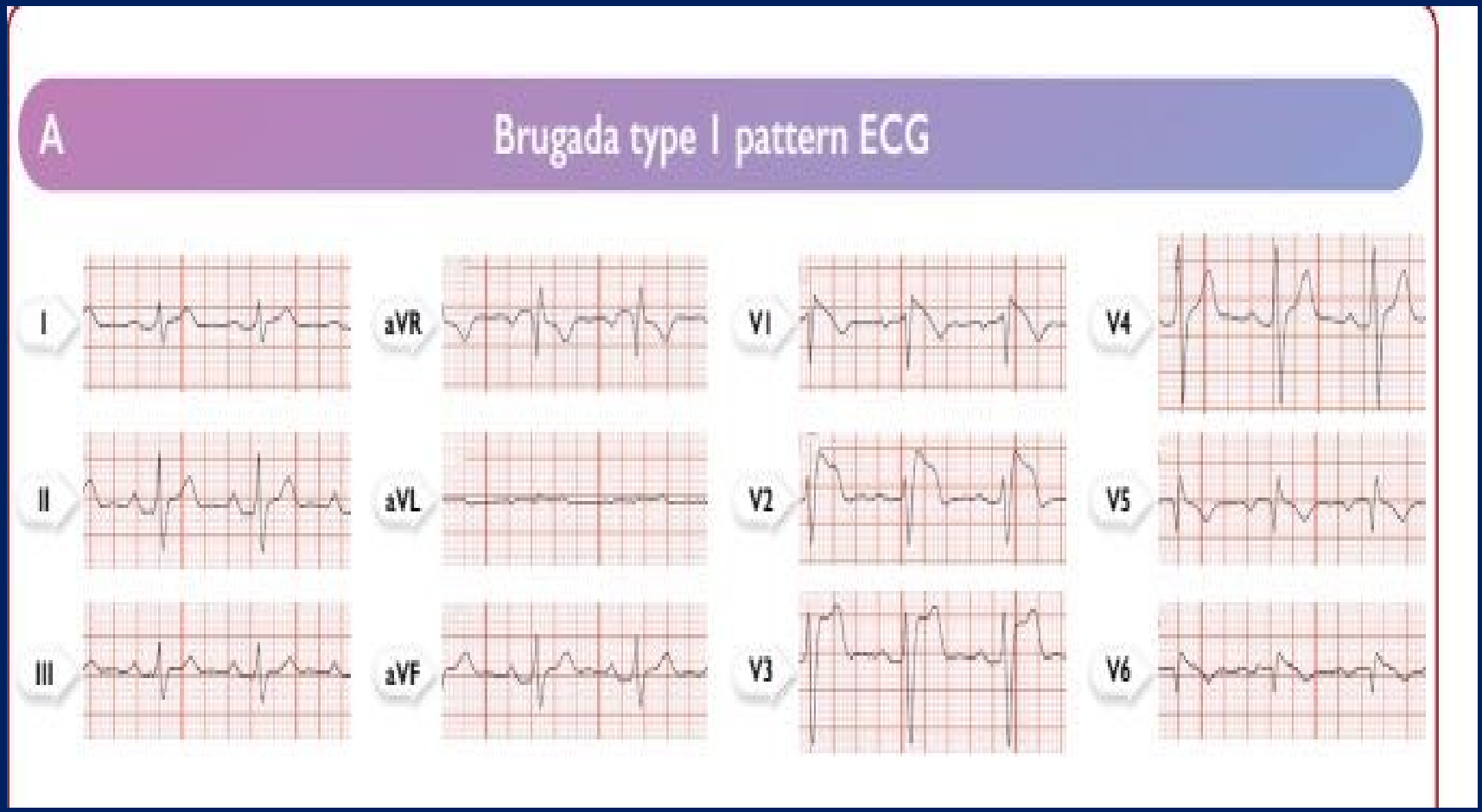
Anomalies de la fin du QRS, du QT et autres

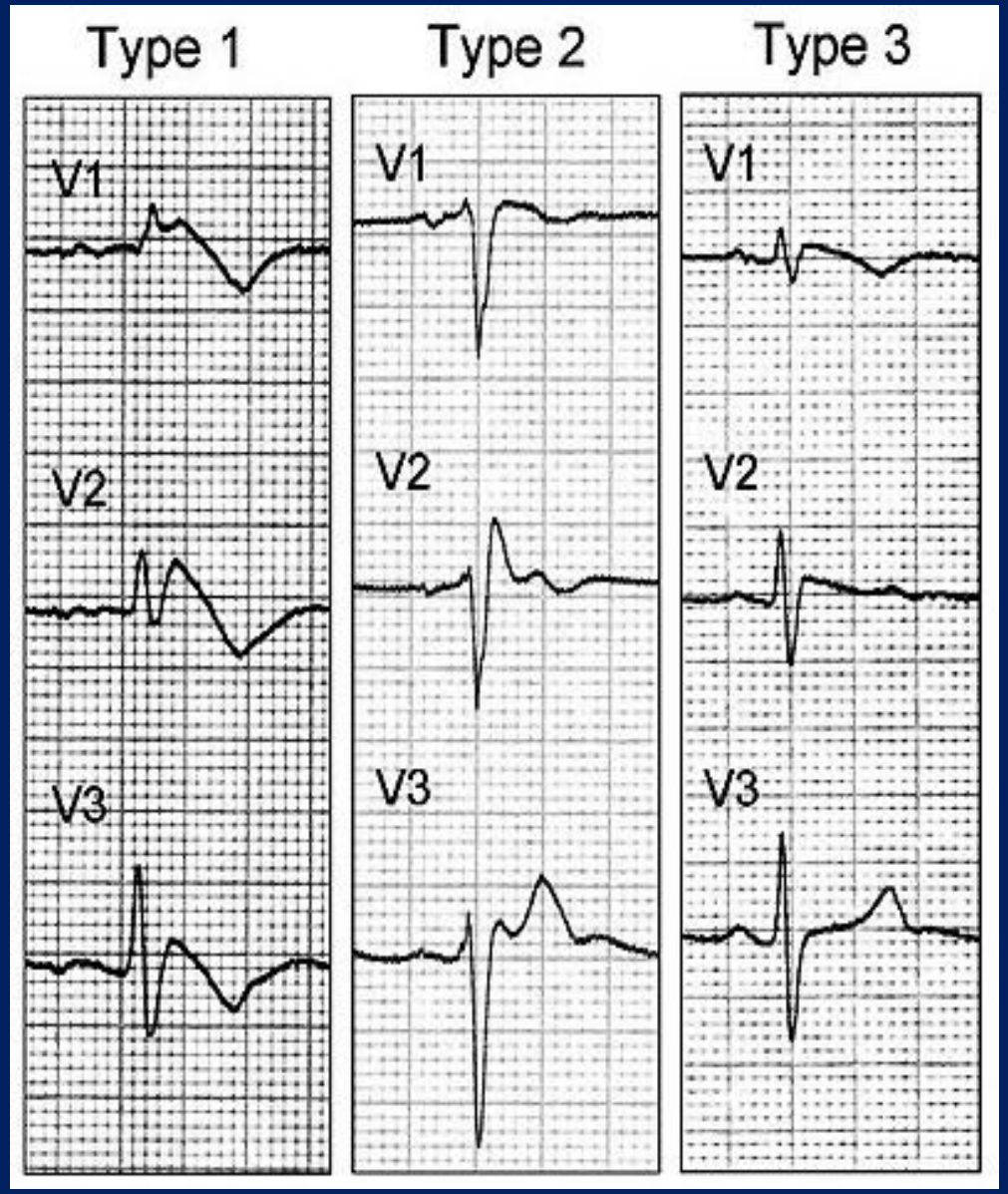
Pr Nicolas Lellouche
Hôpital Henri Mondor, Créteil

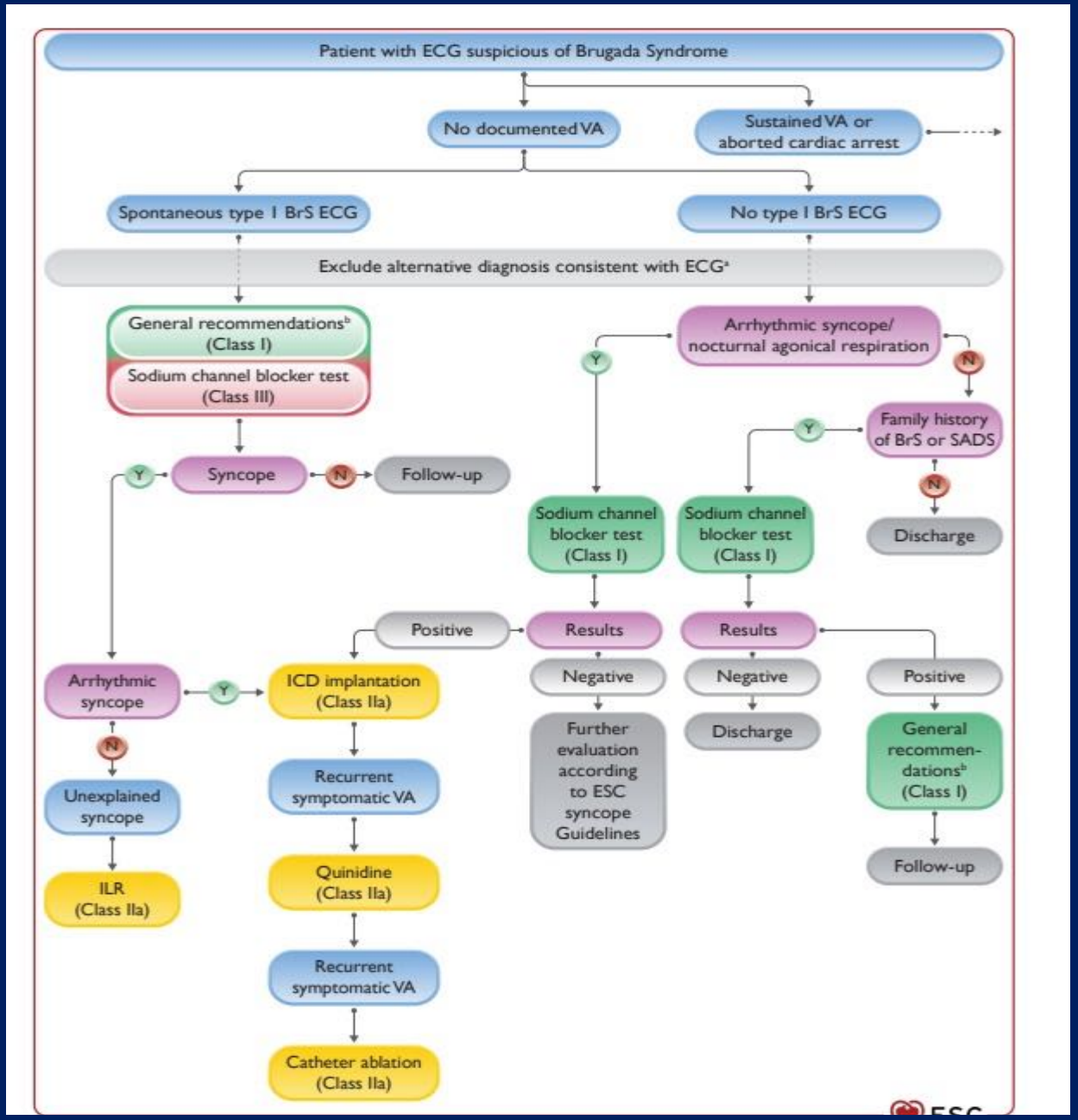
Syndrome de Brugada



7.2.4. Brugada syndrome

The type 1 Brugada ECG pattern is characterized by J point elevation of >2 mV with coved ST elevation and T wave inversion in at least one right precordial ECG lead, V1 or V2, positioned in the second, third or fourth intercostal spaces (*Figure 32*). It may occur either


Type 1
Type 2
Type 3
V1
V2
V3
V1
V2
V3
V1
V2
V3



shocks refractory to drug therapy.[1010–1013]		
PES may be considered in asymptomatic patients with a spontaneous type I BrS ECG.[155]	IIb	B
ICD implantation may be considered in selected asymptomatic BrS patients with inducible VF during PES using up to 2 extra stimuli.[155]	IIb	C

Valeur prédictive globale de la SVP Historique

Patients avec syndrome de Brugada sans ATCD de MS récupérée

TABLE 2. Probability of Sudden Death or Ventricular Fibrillation During Follow-Up Depending on Clinical and Electrophysiological Variables

	Univariate Analysis			Multivariate Analysis		
	Hazard Ratio	95% CI	*P*	Hazard Ratio	95% CI	*P*
Inducible	8.33	2.8–25.0	0.0001	5.88	2.0–16.7	0.0001
Noninducible	1	…	…	1	…	…
Syncope	2.79	1.5–5.1	0.002	2.50	1.2–5.3	0.017
No syncope	1	…	…	1	…	…
Basal ECG	7.69	1.9–33.3	0.0001	2.86	0.7–12.3	0.103
AAD ECG	1	…	…	1	…	…
Male	5.26	1.6–16.6	0.001	…	…	…
Female	1	…	…	…	…	…
Family history	1.29	0.7–2.4	0.406	…	…	…
No family history	1	…	…	…	…	…

Basal ECG indicates spontaneously abnormal ECG; AAD ECG, abnormal ECG only after antiarrhythmic drug administration.

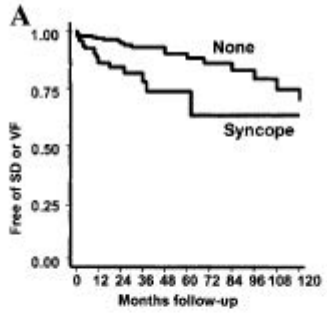


Figure 3. Kaplan-Meier analysis of arrhythmic events (sudden cardiac death [SD] or documented ventricular fibrillation [VF]) during follow-up depending on presence or absence or a history of syncope (A) and on inducibility of sustained ventricular arrhythmias during electrophysiological study (B).

Brugada et al Circ, 2003

Long-Term Prognosis of Patients Diagnosed With Brugada Syndrome

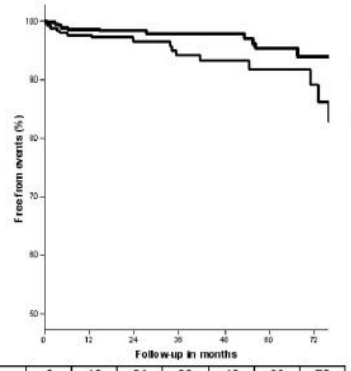
Results From the FINGER Brugada Syndrome Registry

V. Probst, MD, PhD*; C. Veltmann, MD*; L. Eckardt, MD*; P.G. Meregalli, MD*; F. Gaita, MD; H.L. Tan, MD, PhD; D. Babuty, MD, PhD; F. Sacher, MD; C. Giustetto, MD; E. Schulze-Bahr, MD, PhD; M. Borggrefe, MD, PhD; M. Haissaguerre, MD; P. Mabo, MD, PhD; H. Le Marec, MD, PhD; C. Wolpert, MD, PhD; A.A.M. Wilde, MD, PhD

Background—Brugada syndrome is characterized by ST-segment elevation in the right precordial leads and an increased risk of sudden cardiac death (SCD). Fundamental questions remain on the best strategy for assessing the real disease-associated arrhythmic risk, especially in asymptomatic patients. The aim of the present study was to evaluate the prognosis and risk factors of SCD in Brugada syndrome patients in the FINGER (France, Italy, Netherlands, Germany) Brugada syndrome registry.

Methods and Results—Patients were recruited in 11 tertiary centers in 4 European countries. Inclusion criteria consisted of a type 1 ECG present either at baseline or after drug challenge, after exclusion of diseases that mimic Brugada syndrome. The registry included 1029 consecutive individuals (745 men; 72%) with a median age of 45 (35 to 55) years. Diagnosis was based on (1) aborted SCD (6%); (2) syncope, otherwise unexplained (30%); and (3) asymptomatic patients (64%). During a median follow-up of 31.9 (14 to 54.4) months, 51 cardiac events (5%) occurred (44 patients experienced appropriate implantable cardioverter-defibrillator shocks, and 7 died suddenly). The cardiac event rate per year was 7.1% in patients with aborted SCD, 1.9% in patients with syncope, and 0.5% in asymptomatic patients. Symptoms and spontaneous type 1 ECG were predictors of arrhythmic events, whereas gender, familial history of SCD, inducibility of ventricular tachyarrhythmias during electrophysiological study, and the presence of an *SCN5A* mutation were not predictive of arrhythmic events.

Conclusions—In the largest series of Brugada syndrome patients thus far, event rates in asymptomatic patients were low. Inducibility of ventricular tachyarrhythmia and family history of SCD were not predictors of cardiac events. (***Circulation.* 2010;121:635-643.**)



	0	12	24	36	48	60	72
negative	376	301	237	187	136	94	59
positive	262	212	161	113	81	52	34

Figure 5. Kaplan–Meier curves of arrhythmic events during follow-up depending on the results of the EPS. Patients in whom EPS induced ventricular fibrillation (n=262) had a shorter time to the first arrhythmic event than those with a negative EPS (n=376); $P=0.05$.

Limitations

Even if the follow-up of this study is the longest published thus far, because patients are usually diagnosed in the fifth decade of life, this follow-up is still too short to draw final conclusions. Risk stratification in the present study is based

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Heart Rhythm Disorders

Risk Stratification in Brugada Syndrome

Results of the PRELUDE (PRogrammed ELectrical stimUlation preDictive valuE) Registry

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Pavia, Rozzano, Milano, Lido di Camaiore, Bentivoglio, Palermo, Ravenna, Bergamo, Cuneo, and Vicenza, Italy; and New York, New York

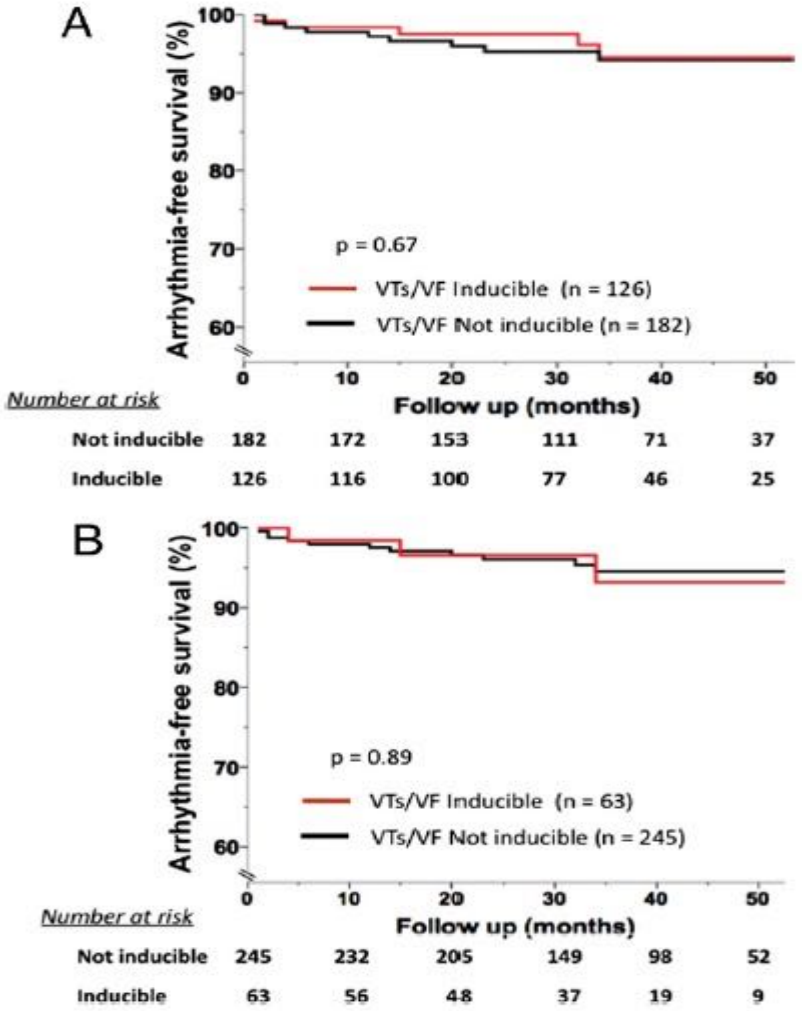


Figure 3 Survival According to VTs/VF Inducibility

Kaplan-Meier survivorship analysis of arrhythmic event-free survival according to the presence/absence of sustained ventricular tachycardia/ventricular fibrillation (VTs/VF) inducibility in the entire PRELUDE cohort **(A)** and in the subgroup of patients inducible with 1 or 2 extrastimuli **(B)**.

Prognostic Value of Programmed Electrical Stimulation in Brugada Syndrome

20 Years Experience

Juan Sieira, MD; Giulio Conte, MD; Giuseppe Ciconte, MD; Carlo de Asmundis, MD; Gian-Battista Chierchia, MD; Giannis Baltogiannis, MD; Giacomo Di Giovanni, MD; Yukio Saitoh, MD; Ghazala Irfan, MD; Ruben Casado-Arroyo; Justo Juliá, MD; Mark La Meir, MD; Francis Wellens, MD; Kristel Wauters, MD; Sophie Van Malderen, MD; Gudrun Pappaert, RN; Pedro Brugada, MD

Background—The prognostic value of electrophysiological investigations in individuals with Brugada syndrome remains controversial. Different groups have published contradictory data. Long-term follow-up is needed to clarify this issue.

Methods and Results—Patients presenting with spontaneous or drug-induced Brugada type I ECG and in whom programmed electric stimulation was performed at our institution were considered eligible for this study. A total of 403 consecutive patients (235 males, 58.2%; mean age, 43.2±16.2 years) were included. Ventricular arrhythmias during programmed electric stimulation were induced in 73 (18.1%) patients. After a mean follow-up time of 74.3±57.3 months (median 57.3), 25 arrhythmic events occurred (16 in the inducible group and 9 in the noninducible). Ventricular arrhythmias inducibility presented a hazard ratio for events of 8.3 (95% confidence interval, 3.6–19.4), $P<0.01$.

Conclusions—Programmed ventricular stimulation of the heart is a good predictor of outcome in individuals with Brugada syndrome. It might be of special value to guide further management when performed in asymptomatic individuals. The overall accuracy of the test makes it a suitable screening tool to reassure noninducible asymptomatic individuals (***Circ Arrhythm Electrophysiol*. 2015;8:777-784. DOI: 10.1161/CIRCEP.114.002647.)**

Key Words: arrhythmias, cardiac ■ Brugada syndrome ■ electrophysiology ■ prognosis

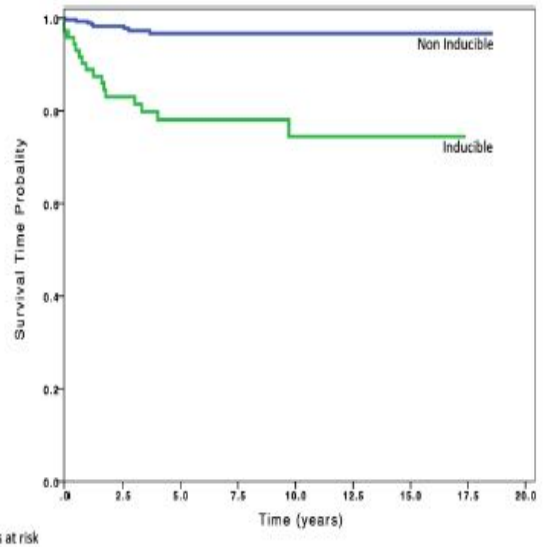


Figure 1. Event-free survival according to Kaplan–Meier method.

VPP= 22%, VPN = 97% (pas 100%)

Programmed Ventricular Stimulation for Risk Stratification in the Brugada Syndrome

A Pooled Analysis

Circulation. 2016; 133:622-30

Annual Incidence Rates of Cardiac Arrest or Ventricular Tachyarrhythmia

	Spontaneous Type 1 ECG Pattern	Drug-Induced Type 1 ECG Pattern
Syncope at presentation		
Events, n/person-y	34/1056	10/693
Overall	3.22 (2.23–4.50)	1.44 (0.69–2.65)
Induced arrhythmia	5.60 (2.98–9.58)	1.96 (0.40–5.73)
No induced arrhythmia	2.55 (1.58–3.89)	1.29 (0.52–2.67)
Asymptomatic at presentation		
Events, n/person-y	17/1630	4/1506
Overall	1.04 (0.61–1.67)	0.27 (0.07–0.68)
Induced arrhythmia	1.70 (0.73–3.35)	0.45 (0.01–2.49)
No induced arrhythmia	0.78 (0.36–1.47)	0.23 (0.05–0.68)

Table 3. Risk of Sudden Cardiac Arrest or Ventricular Tachyarrhythmia With Different Definitions of Arrhythmia Induction

				Age, Sex, Cohort Adjusted		Age, Sex, Cohort, ECG, and Presenting Symptom Adjusted	
Definition of Induced Arrhythmia	Total, n*	Induced, n (%)	Events Among Induced/Not Induced, n	HR (95% CI) Relative to Those Not Induced	*P* Value	HR (95% CI) Relative to Those Not Induced	*P* Value
Single extrastimulus	1312	22 (2)	3/62	1.99 (0.52–7.68)	0.32	2.39 (0.62–9.21)	0.20
Up to double extrastimuli	1312	253 (19)	25/40	2.87 (1.60–5.12)	<0.001	2.66 (1.44–4.89)	0.002
Up to triple extrastimuli	1247	527 (42)	40/25	2.75 (1.52–4.98)	<0.001	2.66 (1.44–4.92)	0.002

La valeur de la SVP dépend du protocole de SVP utilisé qui est différent suivant les études

TABLE 1 Summary of Electrophysiological Study Protocols and Inducibility Rates by Study Included

Study, Year, Reference	Positive EP Study	Protocol
Sieira, et al 2015 (15)	32/241 (13%)	Single site, 3 cycle lengths, 3 ES (≥200 ms)
Priori 2012, et al (12)	97/243 (40%)	2 sites (RVA, RVOT), 2 cycle lengths, 3 ES (≥200 ms)
Kamakura 2009, et al (11)	61/123 (50%)	2 sites (RVA, RVOT), 2 cycle lengths, 3 ES (does not mention a minimum CL)
Takagi, et al 2007 (16)	50/63 (79%)	Unspecified in the methods
Probst, et al 2010 (14)	137/369 (37%)	2 sites (unspecified), 2 cycle lengths, 3 ES (≥200 ms for a "positive" study)
Priori, et al 2000 (12)	6/19 (32%)	unspecified in the methods but several sites and up to 3 ES (not uniformly specified by the protocol)
Brugada, et al 2003 (10)	91/263 (35%)	Single site (not RVOT), 2 cycle lengths, ≥2 ES (VERP)

EP indicates electrophysiological; ES, extrastimulus; RVA, right ventricular apex; RVOT, right ventricular outflow tract; and VERP, ventricular effective refractory period.

Le but de ces protocoles est plutôt de prédire la survenue future d'arythmie ventriculaire = améliorer la spécificité et donc la VPP

SVP réalisée avec protocole agressif

Table 1. Main Study Results

		Syncope (n=27)			
Patient Presentation	Aborted CA (n=10)	All (n=27)	SUO (n=10)	VVS (n=17)	Asymptomatic (n=59)
Male sex	9 (90%)	25 (93%)	10 (100%)	15 (88%)	51 (86%)
Age, mean±SD, y	21–57 (34±13)	19–80 (42±16)	19–80 (45±22)	23–61 (38±10)	18–79 (40±14)
ECG BrS type 1					
Spontaneous	5 (50%)	7 (26%)	2 (20%)	5 (29%)	21 (36%)
During pharmacological testing	5 (50%)	20 (74%)	8 (80%)	12 (71%)	38 (64%)
Familial history of BrS/SCD	3 (30%)	7 (26%)	3 (30%)	4 (24%)	18 (31%)
Inducible VF at EPS	10 (100%)	20 (74%)	8 (80%)	12 (70.5%)	36 (61%)

Belhassen et al, Circ EP, 2016

Table 3. Clinical Characteristics of Noninducible Patients Presenting Arrhythmic Events During the Follow-Up

Patient	Event	Sex	Age, y*	Proband	Family History of SD	Spontaneous Type I	Symptoms at Presentation	f-QRS
1	ICD shock	Male	52.8	No	No	No	SD	Yes
2	Aborted SD	Male	53.8	Yes	No	No	Asymptomatic	Yes
3	ICD shock	Male	8.3	No	No	No	Syncope	No
4	ICD shock	Male	15.1	No	No	No	SD	No
5	ICD shock	Male	36.7	Yes	No	No	Syncope	Yes
6	ICD shock	Female	43.0	Yes	No	No	Syncope	Yes
7	ICD shock	Male	59.8	No	No	No	Syncope	No
8	ICD shock	Female	60.3	No	No	No	SD	No
9	ICD shock	Male	69.8	No	Yes	No	Asymptomatic	No

f-QRS indicates fragmentation of QRS complex; ICD, implantable cardioverter defibrillator; and SD, sudden death.
*Age indicates age at arrhythmic event.

LA VPN n'est pas de 100%

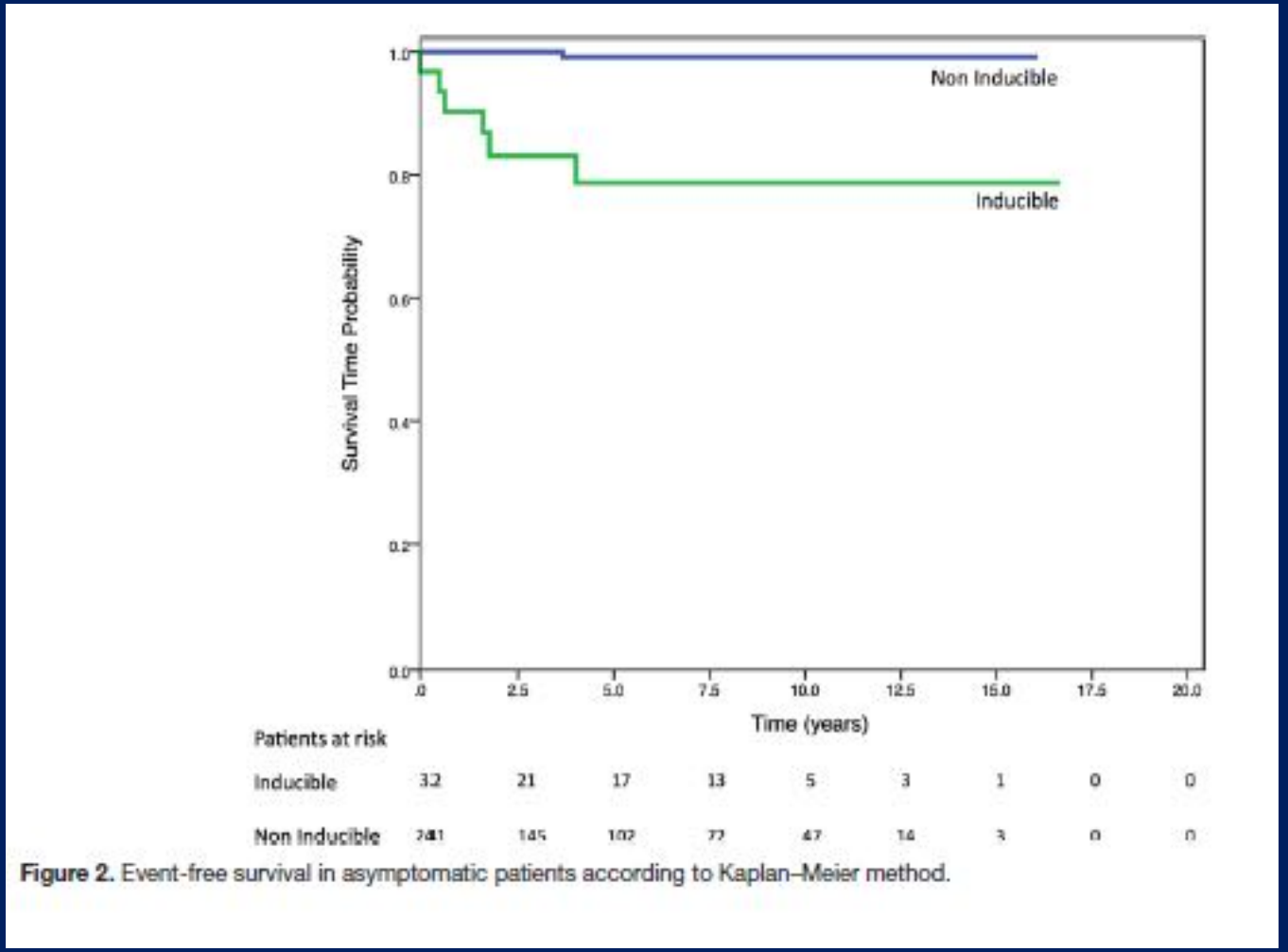
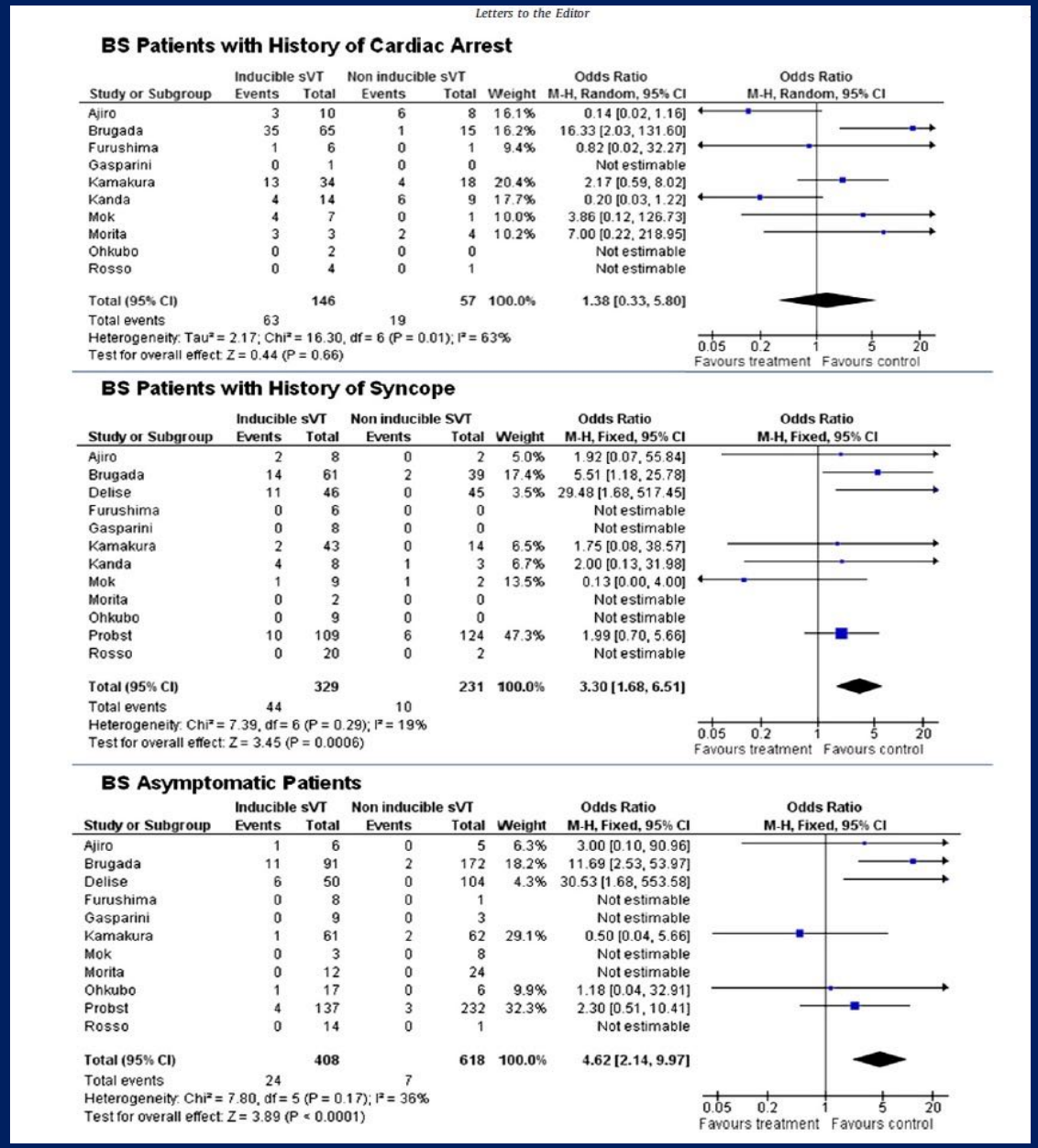


Figure 2. Event-free survival in asymptomatic patients according to Kaplan–Meier method.

Taux d'évènements chez les asymptomatiques avec SVP positive > 1%/an

Sieira et al, Circ, 2015



BS Patients with History of Cardiac Arrest

Study or Subgroup	Inducible sVT Events	Total	Non inducible sVT Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Ajiro	3	10	6	8	16.1%	0.14 [0.02, 1.16]
Brugada	35	65	1	15	16.2%	16.33 [2.03, 131.60]
Furushima	1	6	0	1	9.4%	0.82 [0.02, 32.27]
Gasparini	0	1	0	0		Not estimable
Kamakura	13	34	4	18	20.4%	2.17 [0.59, 8.02]
Kanda	4	14	6	9	17.7%	0.20 [0.03, 1.22]
Mok	4	7	0	1	10.0%	3.86 [0.12, 126.73]
Morita	3	3	2	4	10.2%	7.00 [0.22, 218.95]
Ohkubo	0	2	0	0		Not estimable
Rosso	0	4	0	1		Not estimable
Total (95% CI)		146		57	100.0%	1.38 [0.33, 5.80]
Total events	63		19			

Heterogeneity: Tau² = 2.17; Chi² = 16.30, df = 6 (P = 0.01); I² = 63%
Test for overall effect: Z = 0.44 (P = 0.66)

Odds Ratio M-H, Random, 95% CI
0.05 0.2 1 5 20
Favours treatment Favours control

BS Patients with History of Syncope

Study or Subgroup	Inducible sVT Events	Total	Non inducible SVT Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Ajiro	2	8	0	2	5.0%	1.92 [0.07, 55.84]
Brugada	14	61	2	39	17.4%	5.51 [1.18, 25.78]
Delise	11	46	0	45	3.5%	29.48 [1.68, 517.45]
Furushima	0	6	0	0		Not estimable
Gasparini	0	8	0	0		Not estimable
Kamakura	2	43	0	14	6.5%	1.75 [0.08, 38.57]
Kanda	4	8	1	3	6.7%	2.00 [0.13, 31.98]
Mok	1	9	1	2	13.5%	0.13 [0.00, 4.00]
Morita	0	2	0	0		Not estimable
Ohkubo	0	9	0	0		Not estimable
Probst	10	109	6	124	47.3%	1.99 [0.70, 5.66]
Rosso	0	20	0	2		Not estimable
Total (95% CI)		**329**		**231**	**100.0%**	**3.30 [1.68, 6.51]**
Total events	44		10			

Heterogeneity: Chi² = 7.39, df = 6 (P = 0.29); I² = 19%
Test for overall effect: Z = 3.45 (P = 0.0006)

Odds Ratio M-H, Fixed, 95% CI
0.05 0.2 1 5 20
Favours treatment Favours control

BS Asymptomatic Patients

Study or Subgroup	Inducible sVT Events	Total	Non inducible sVT Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Ajiro	1	6	0	5	6.3%	3.00 [0.10, 90.96]
Brugada	11	91	2	172	18.2%	11.69 [2.53, 53.97]
Delise	6	50	0	104	4.3%	30.53 [1.68, 553.58]
Furushima	0	8	0	1		Not estimable
Gasparini	0	9	0	3		Not estimable
Kamakura	1	61	2	62	29.1%	0.50 [0.04, 5.66]
Mok	0	3	0	8		Not estimable
Morita	0	12	0	24		Not estimable
Ohkubo	1	17	0	6	9.9%	1.18 [0.04, 32.91]
Probst	4	137	3	232	32.3%	2.30 [0.51, 10.41]
Rosso	0	14	0	1		Not estimable
Total (95% CI)		**408**		**618**	**100.0%**	**4.62 [2.14, 9.97]**
Total events	24		7			

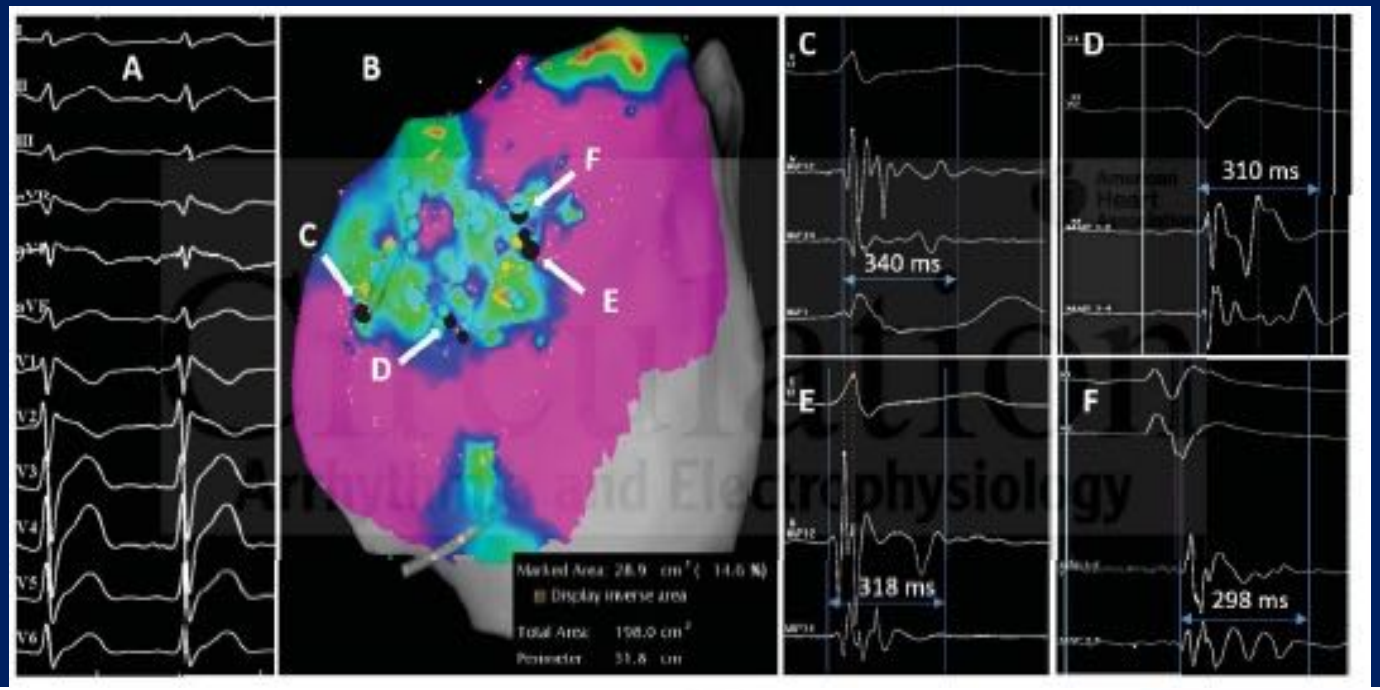
Heterogeneity: Chi² = 7.80, df = 5 (P = 0.17); I² = 36%
Test for overall effect: Z = 3.89 (P < 0.0001)

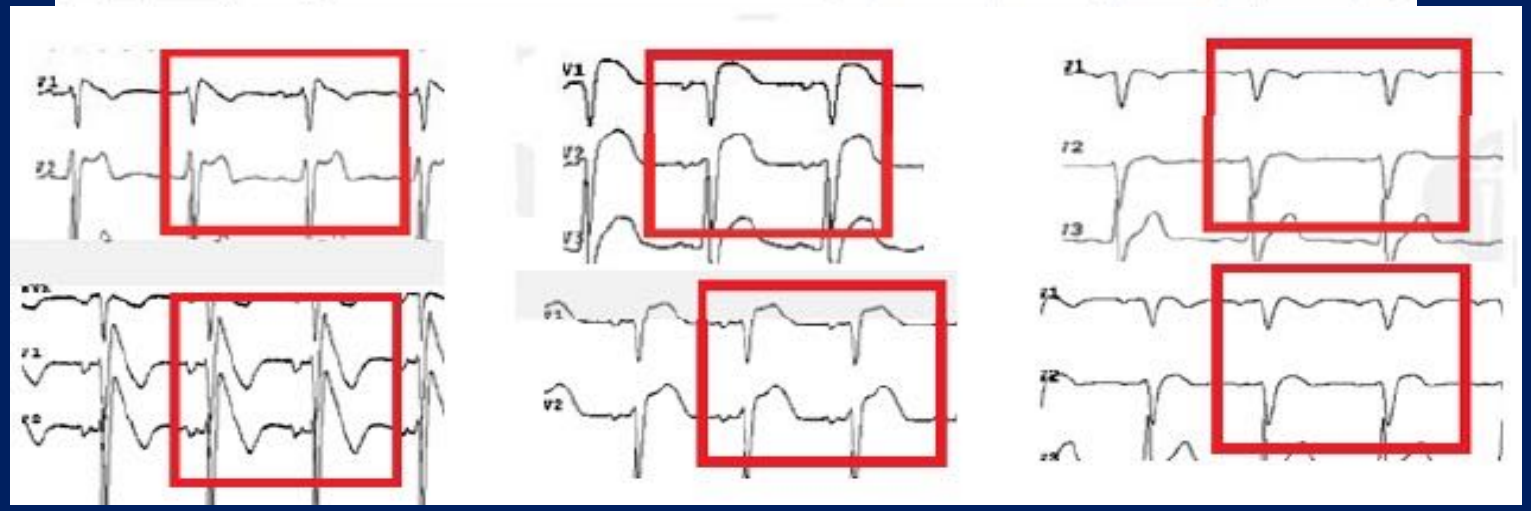
Odds Ratio M-H, Fixed, 95% CI
0.05 0.2 1 5 20
Favours treatment Favours control

contrast, PVS may be useful in asymptomatic patients and in patients with syncope of unknown origin since the inducibility of sustained VT/VF may identify an increased risk of subsequent arrhythmic events. The decision to implant an ICD to asymptomatic patients

Fauchier et al, Int J Card, 2013

ABLATION DE BRUGADA



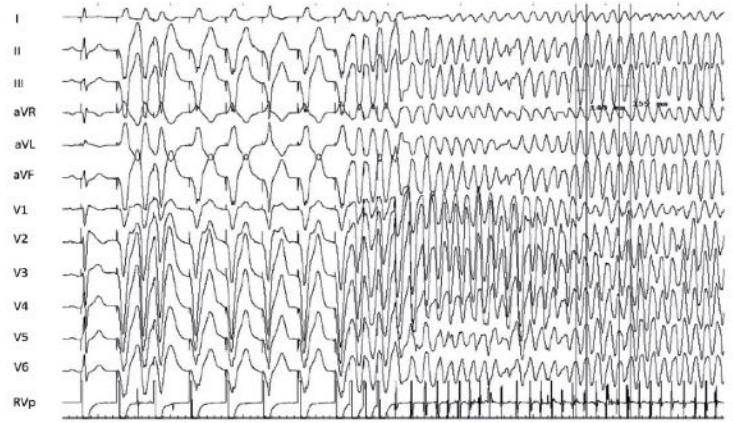


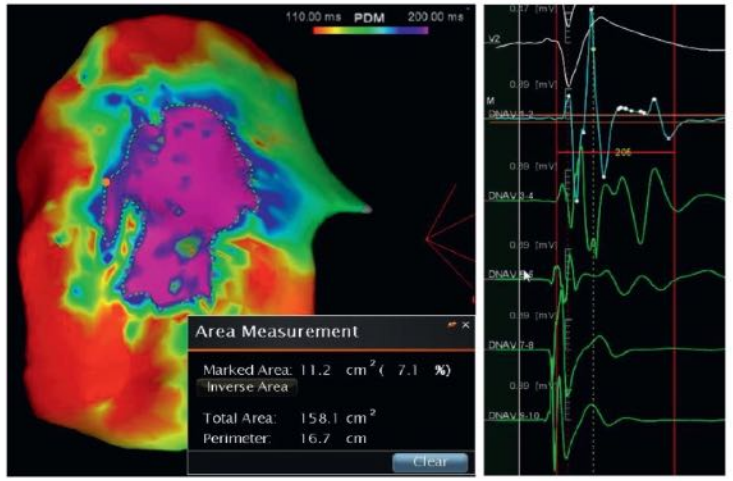
JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 71, NO. 15, 2018

Assessing the Malignant Ventricular Arrhythmic Substrate in Patients With Brugada Syndrome

Carlo Pappone, MD, PhD,[a] Giuseppe Ciconte, MD,[a] Francesco Manguso, MD, PhD,[a] Gabriele Vicedomini, MD,[a] Valerio Mecarocci, MD,[a] Manuel Conti, MD,[a] Luigi Giannelli, MD,[a] Paolo Pozzi, BEng,[a] Valeria Borrelli, PhD,[a] Lorenzo Menicanti, MD,[b] Zarko Calovic, MD,[a] Giuseppe Della Ratta, MD,[a] Josep Brugada, MD, PhD,[c] Vincenzo Santinelli, MD[a]

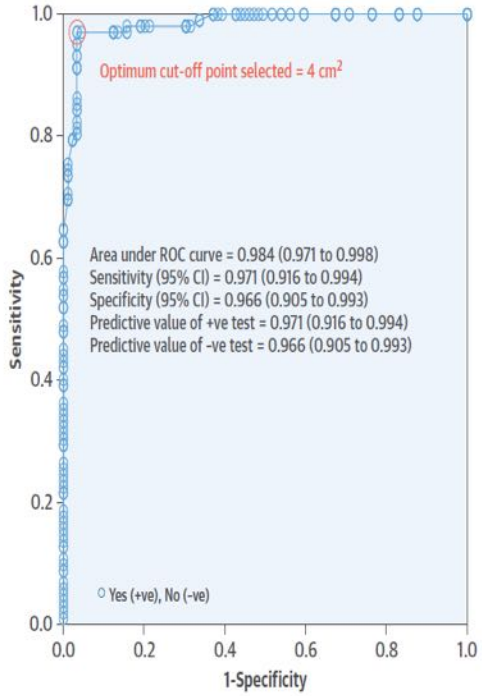
FIGURE 6 After Ajmaline, Sustained Polymorphic VT Degenerating to VF Was Induced Using Triple Extrastimulation in a Patient With BrS-Related Symptoms Who Did Not Have Inducible Arrhythmia at Baseline





Inducibility of ventricular tachycardia (VT) or ventricular fibrillation (VF) was associated with appearance of type 1 Brugada syndrome (BrS) electrocardiogram pattern and an impressive expansion of the substrate size from 0.5 cm^2 at baseline to 11.2 cm^2 after ajmaline. The duration of fragmented potentials also increased from 123 to 205 ms. Abbreviations as in Figure 1.

B Optimal Substrate Cut-off Value Identifying Patients With Inducibility of VA in BrS



Pappone, C. et al. J Am Coll Cardiol. 2018;71(15):1631-46.

NEGATIVATION DE LA SVP CHEZ TOUS LES PATIENTS

A score model to predict risk of events in patients with Brugada Syndrome

Juan Sieira[1]*, Giulio Conte[1], Giuseppe Ciconte[1], Gian-Battista Chierchia[1], Ruben Casado-Arroyo[1], Giannis Baltogiannis[1], Giacomo Di Giovanni[1], Yukio Saitoh[1], Justo Juliá[1], Giacomo Mugnai[1], Mark La Meir[2], Francis Wellens[2], Jens Czapla[2], Gudrun Pappaert[1], Carlo de Asmundis[1†], and Pedro Brugada[1†]

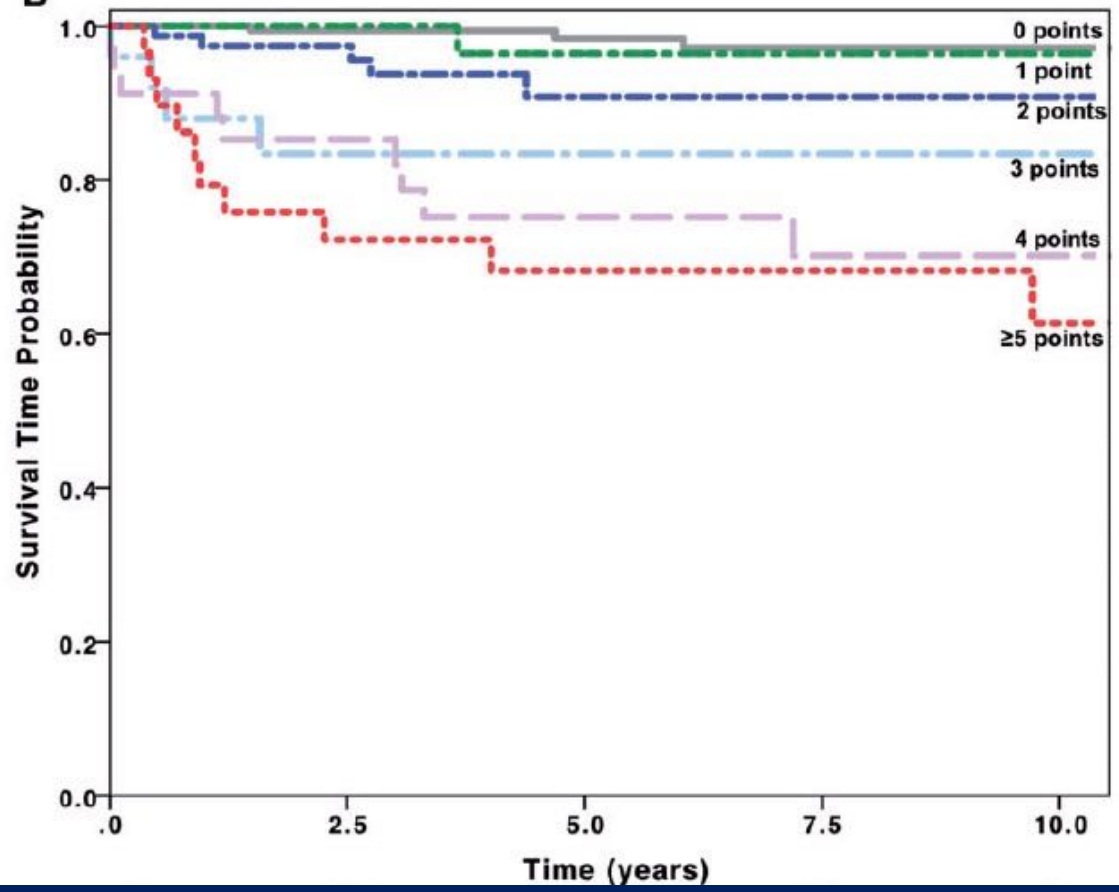
Eur Heart J. 2017;
Doi:10.1093:eurheartj/ehx119

Arrhythmic events refer to SCD and appropriate ICD shocks.

A

Risk factor	Points
Spontaneous type I	1
Early familial SCD	1
Inducible EPS	2
Syncope	2
SND	3
SCD	4

B



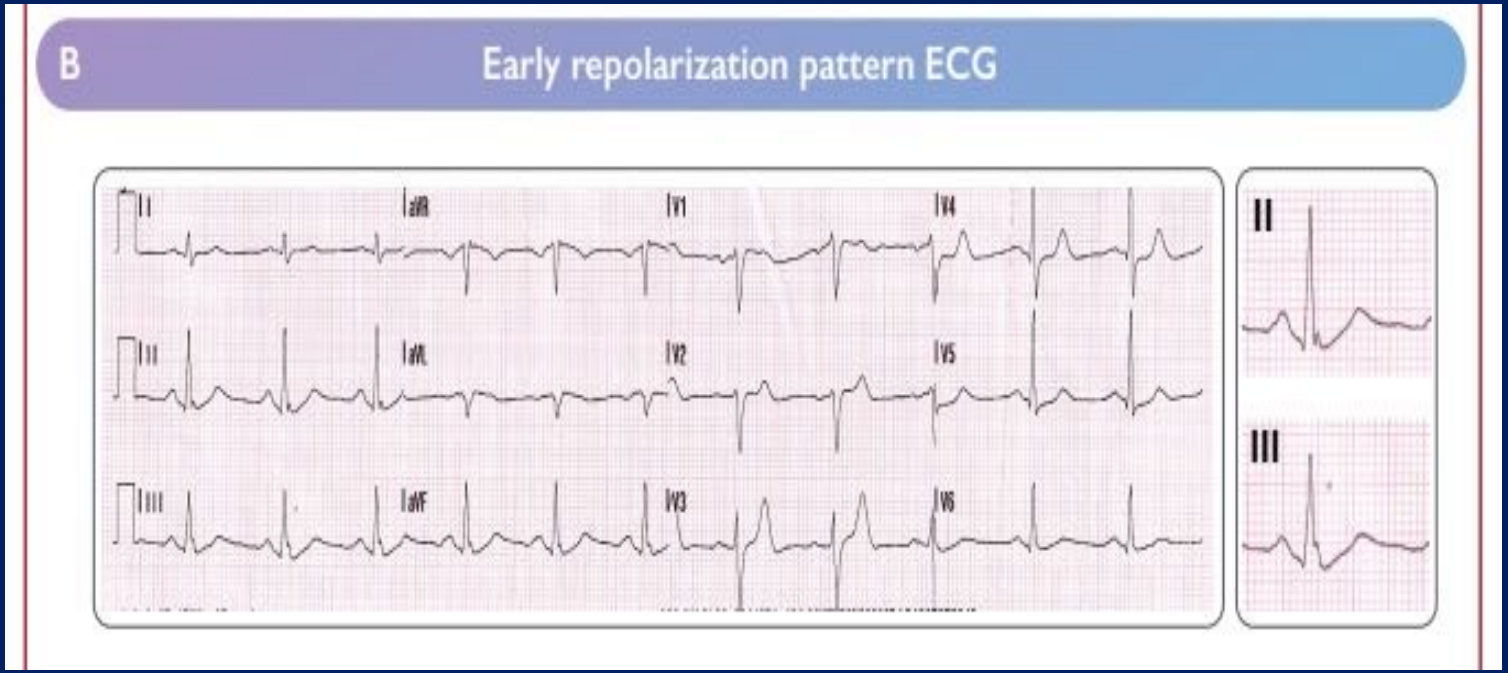
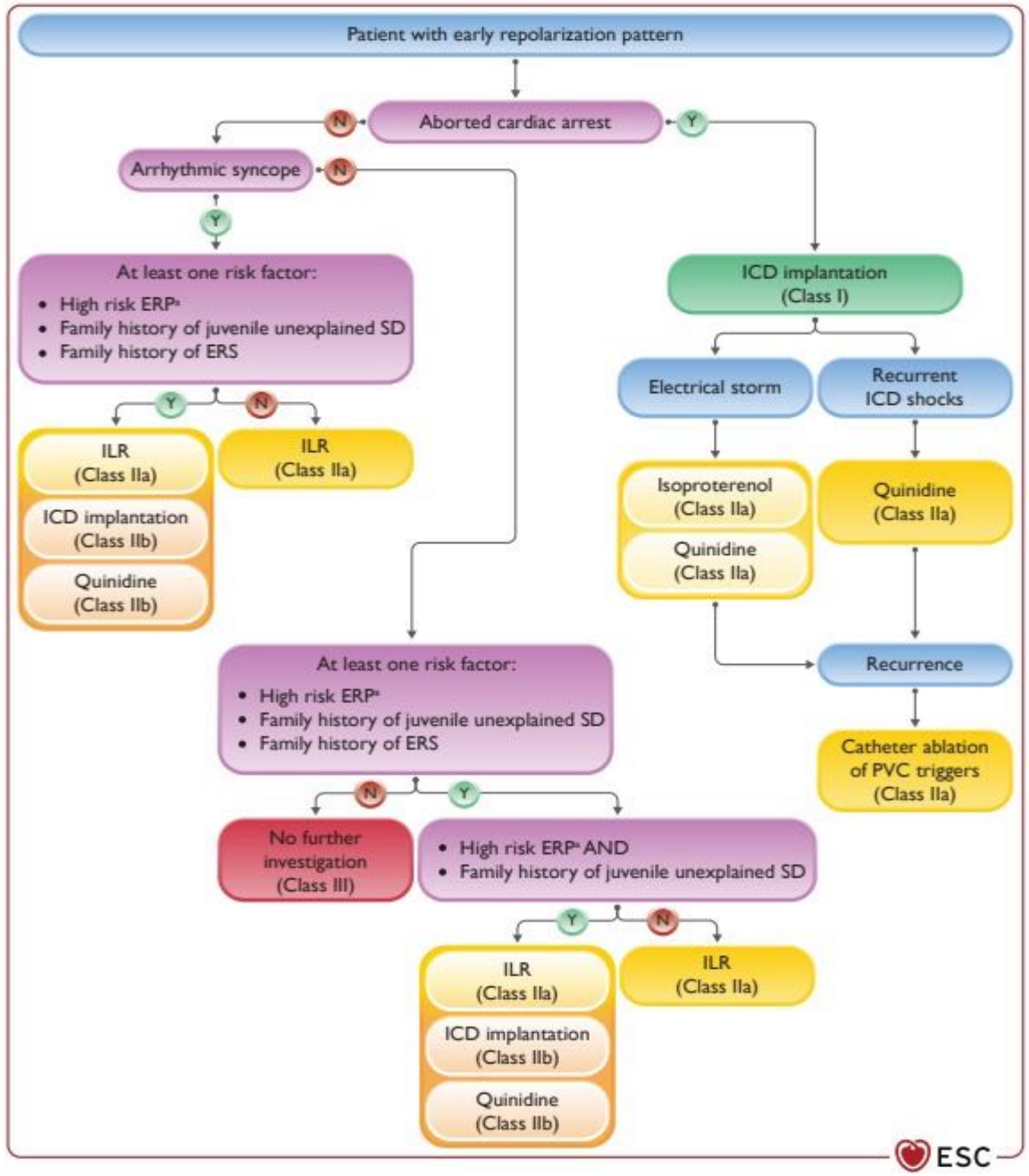


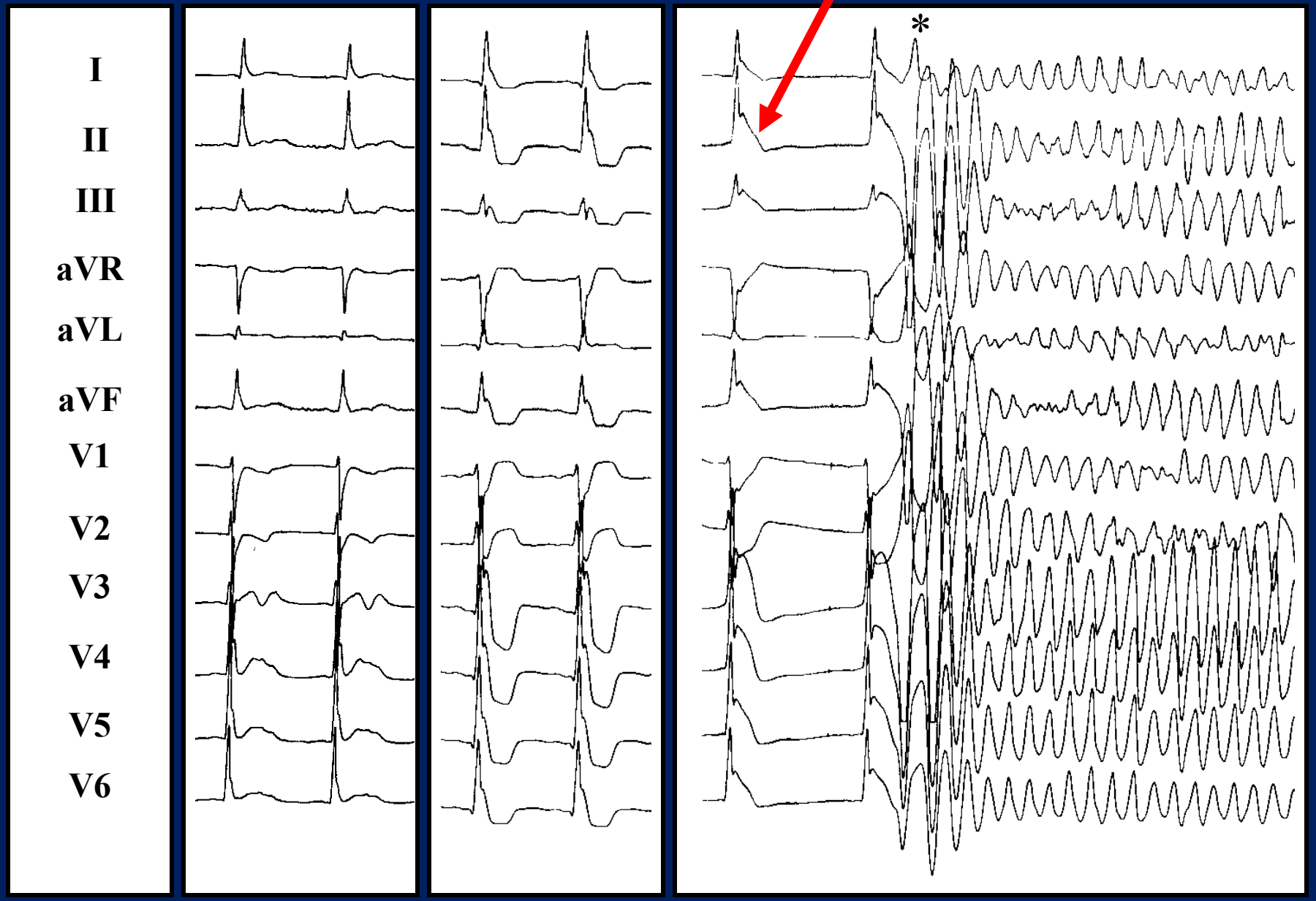
Figure 34 Management of patients with early repolarization pattern/syndrome. ERP, early repolarization pattern; ERS, early repolarization syndrome; ICD, implantable cardioverter defibrillator; ILR, implantable loop recorder; N, No; PVC, premature ventricular complex; SD, sudden death; Y, Yes. [a]ERP high risk features: J waves >2 mm, dynamic changes in ST morphology.

7.2.5. Early repolarization syndromes

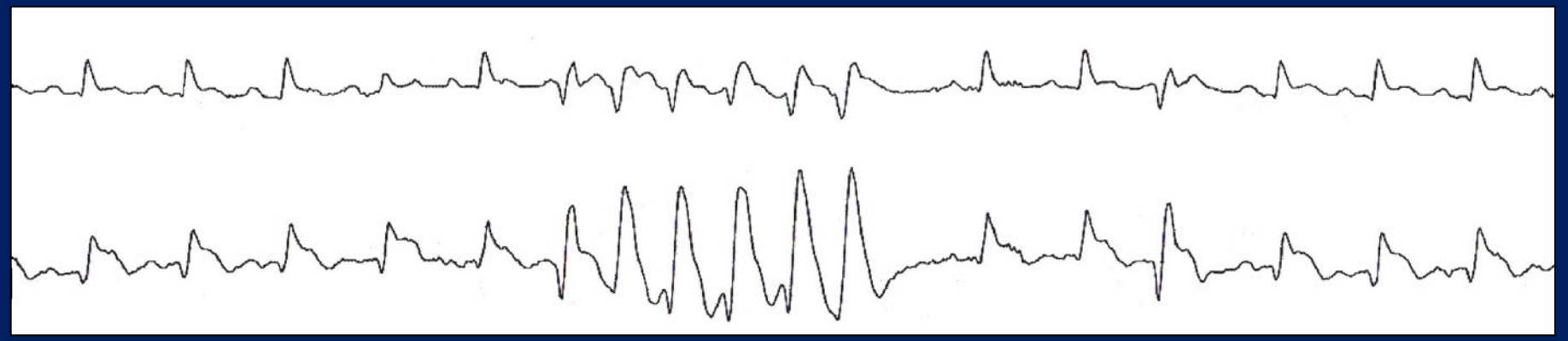
Early repolarization syndrome (ERS) is diagnosed in a patient resuscitated from PVT or VF without any heart disease and the early repolarization pattern (ERP); J-point elevation ≥1 mm in ≥2 adjacent inferior and/or lateral ECG leads (*Figure 32*).[135,231,1017–1019] However, ERP is most often a benign

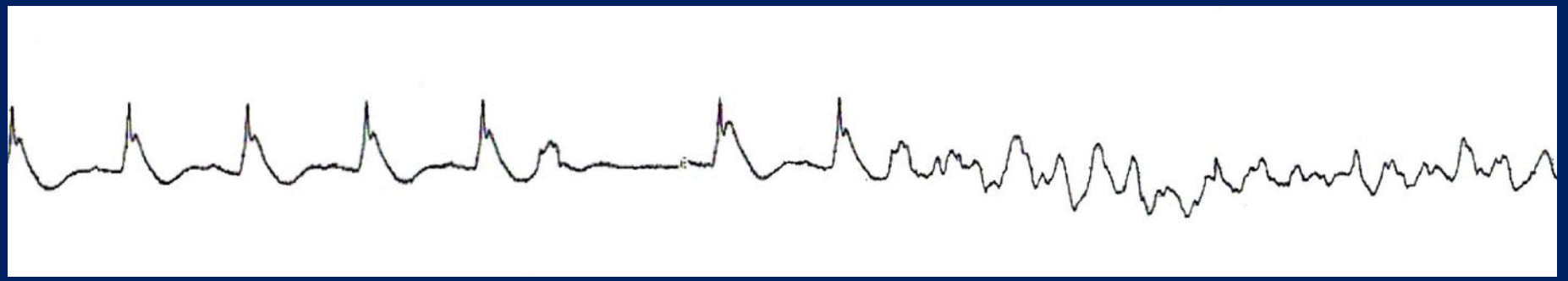

Patient with early repolarization pattern
Aborted cardiac arrest
N
Y
Arrhythmic syncope
N
Y
At least one risk factor:
• High risk ERP*
• Family history of juvenile unexplained SD
• Family history of ERS
Y
N
ILR (Class IIa)
ICD implantation (Class IIb)
Quinidine (Class IIb)
ILR (Class IIa)
ICD implantation (Class I)
Electrical storm
Recurrent ICD shocks
Isoproterenol (Class IIa)
Quinidine (Class IIa)
Quinidine (Class IIa)
Recurrence
Catheter ablation of PVC triggers (Class IIa)
At least one risk factor:
• High risk ERP*
• Family history of juvenile unexplained SD
• Family history of ERS
N
Y
No further investigation (Class III)
• High risk ERP* AND
• Family history of juvenile unexplained SD
Y
N
ILR (Class IIa)
ICD implantation (Class IIb)
Quinidine (Class IIb)
ILR (Class IIa)
ESC

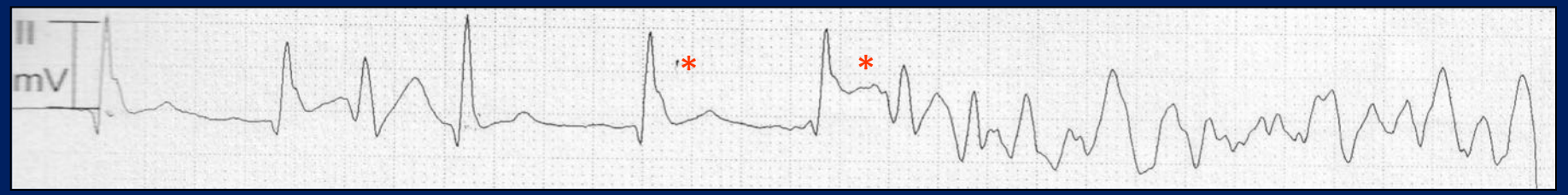
14 year old girl with multiple drug resistant VF

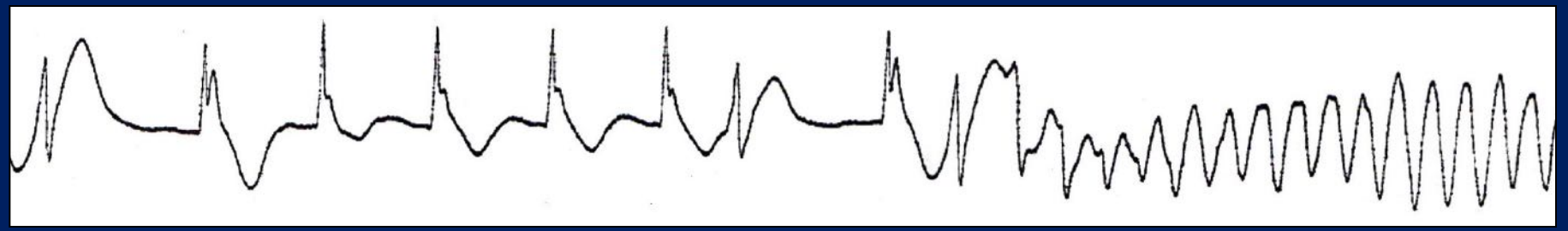


M 52y Familial nocturnal SD ECG minutes after admission 5d later

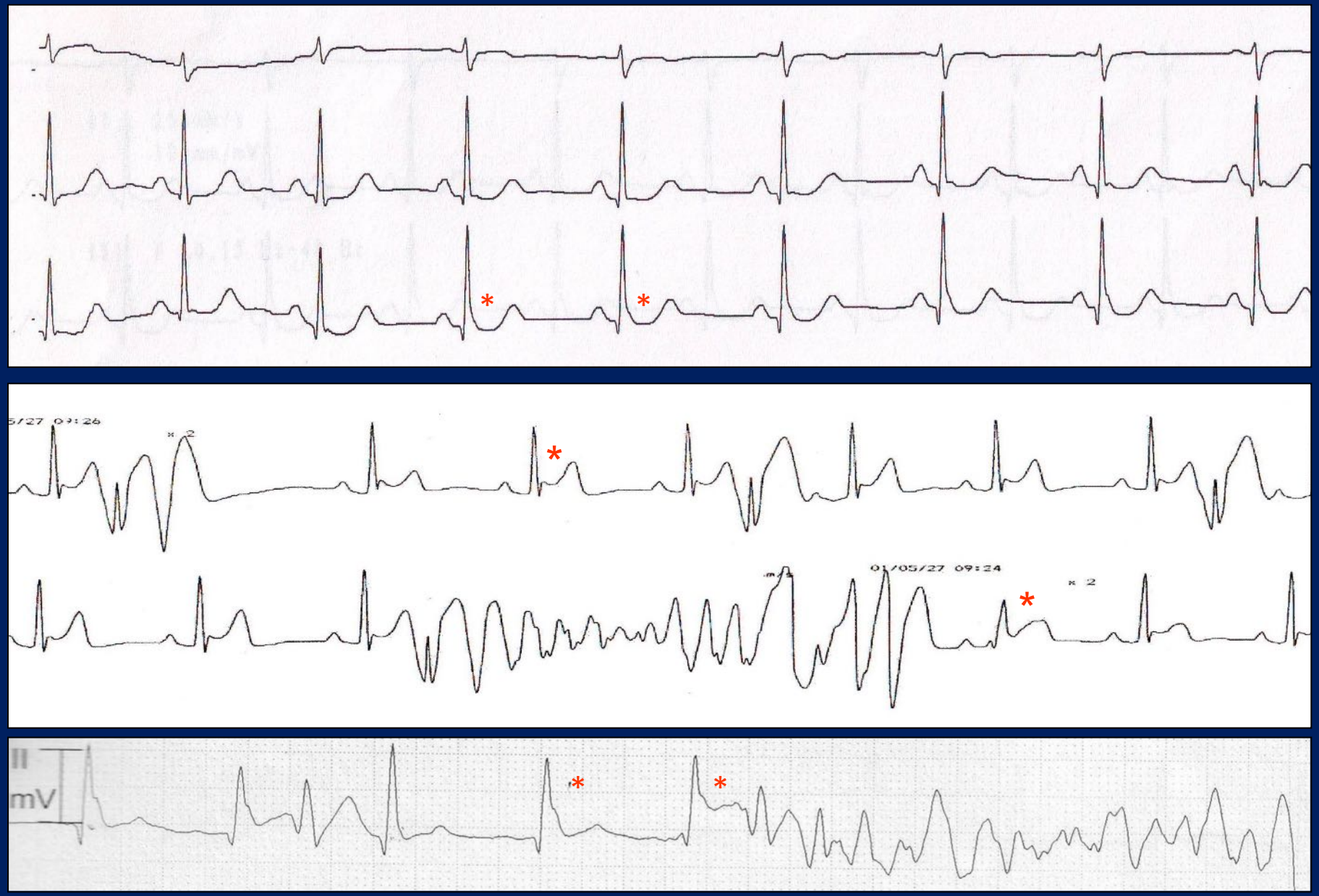


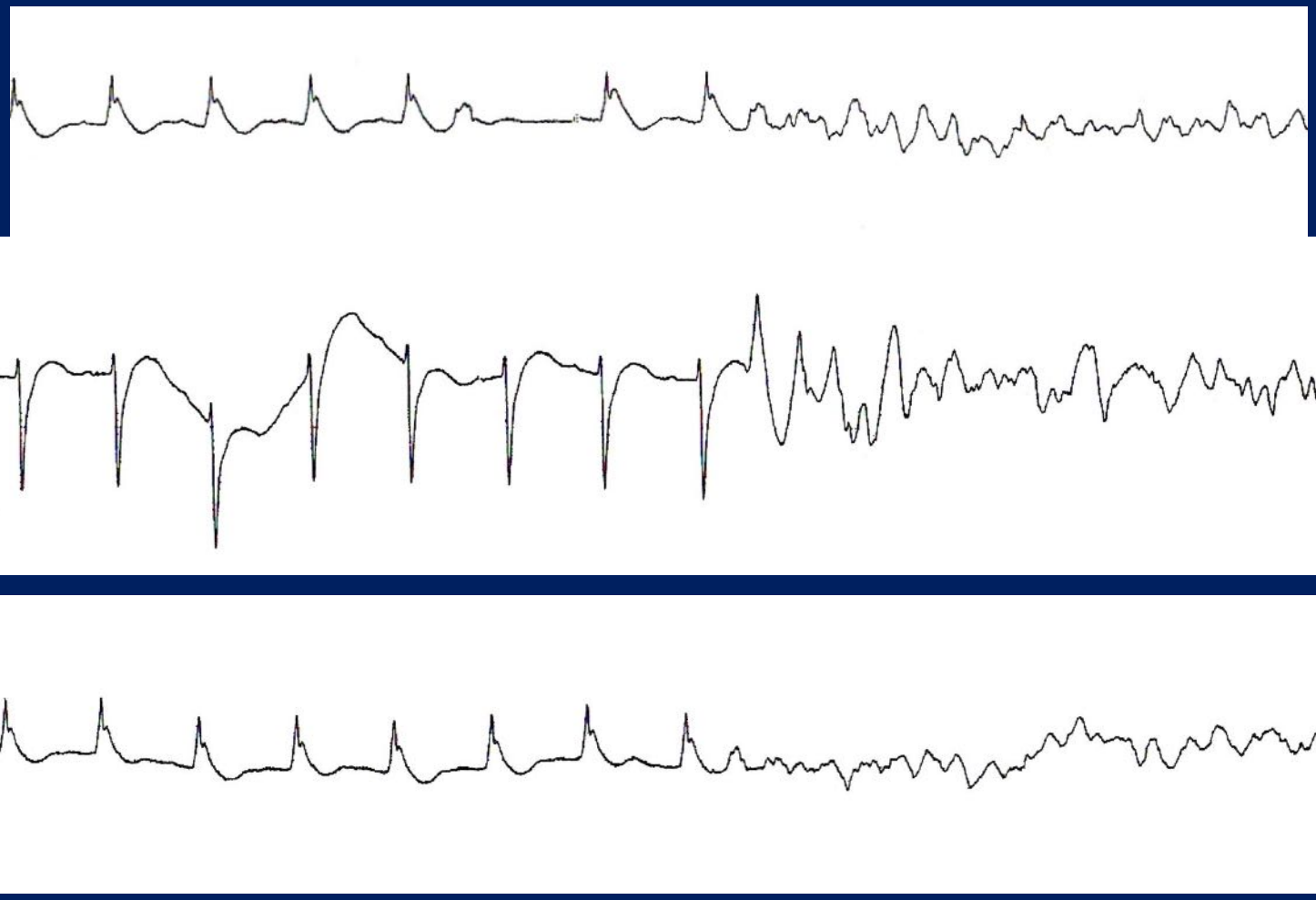



II
mV
*
*

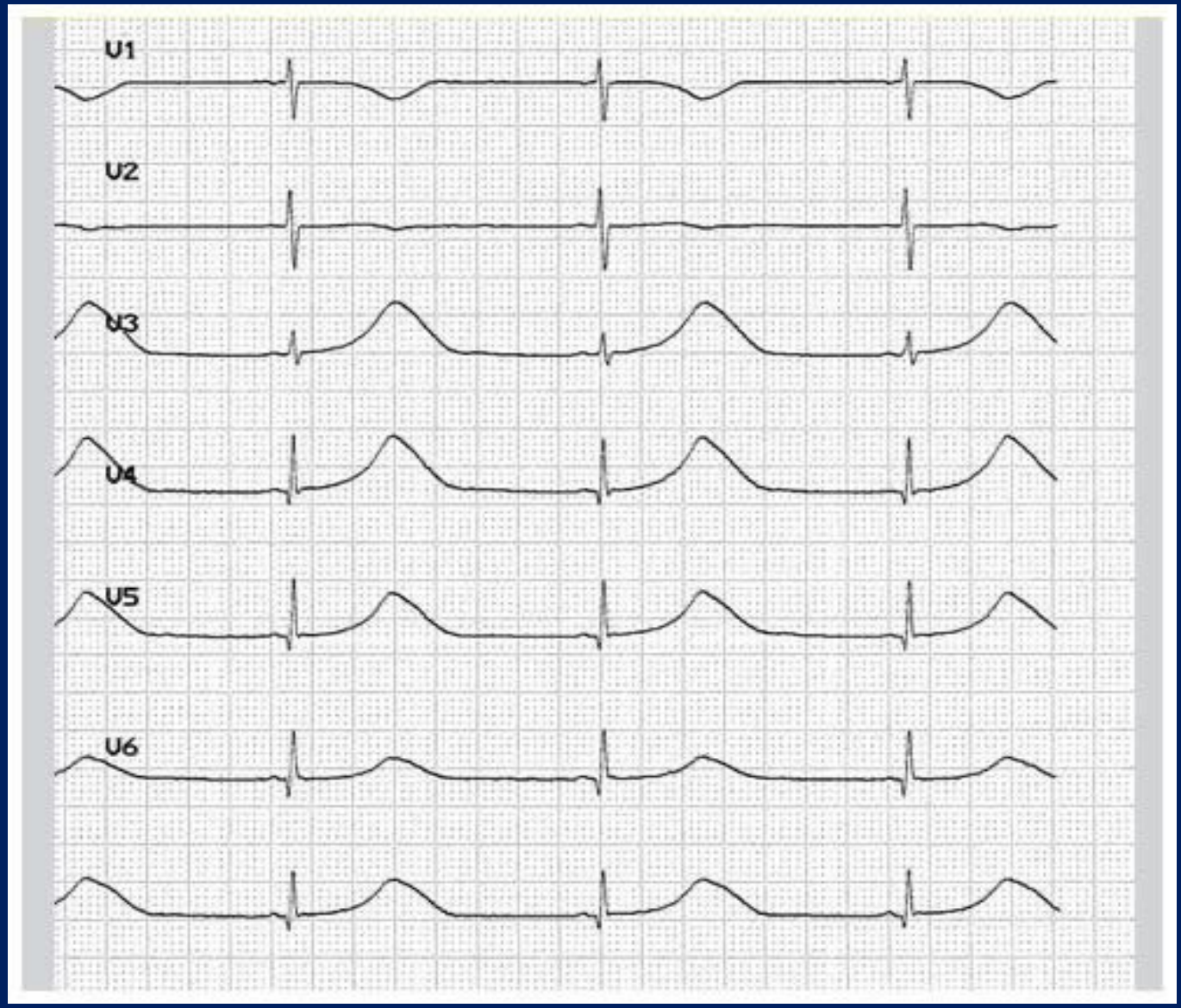


Spontaneous variability of ST changes





QT Long



Mesure de l’intervalle QT: Formule de Bazett

$$QT_c = \frac{QT_m}{\sqrt{RR}}$$

CAUSES OF LONG QT INTERVAL AND TORSADES DE POINTES

- Bradycardia(Bradycardia compounds other factors that cause torsades de pointes)
- Electrolyte disturbance
- Hypokalaemia
- Hypomagnesaemia
- Hypocalcaemia
- Drugs
- Disopyramide (and other class Ia anti-arrhythmic drugs,
- Sotalol, amiodarone (and other class III anti-arrhythmic drugs) Amitriptyline (and other tricyclic antidepressants
- Chlorpromazine (and other phenothiazines
- Erythromycin (and other macrolides) … and many more
- Congenital syndromes
- Romano-Ward syndrome (autosomal dominant)
- Jervell and Lange-Nielson syndrome (autosomal recessive, associated with congenital deafness)

Medications Associated with LQTS

Antibiotics
- Fluoroquinolones
- Macrolides
- Trimethoprim
- Pentamidine
- Azole antifungals

Antipsychotics
- Haloperidol
- Droperidol
- Thioridazine*
- Pimozide

Antiemetics
- Ondansetron
- Granisetron
- Metoclopramide

Antiarrhythmics

Class IA:
Na+ channel blockers
- Quinidine*
- Procainamide
- Disopyramide

Class III:
K+ channel blockers
- Amiodarone*
- Sotalol*
- Dofetilidev
- Ibutilide
- Dronedarone

**Poses the greatest risk of QT prolongation in this category*

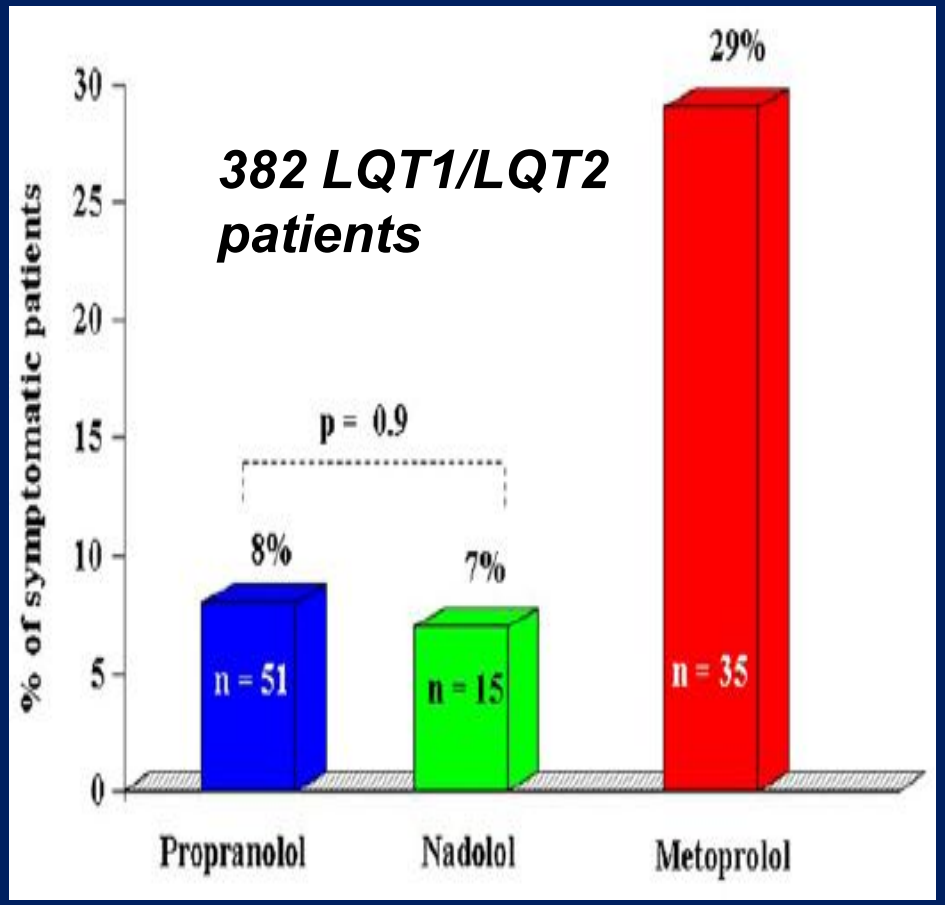
Syndrome du QT long

- Pathologie d'origine génétique (1 / 2 500 naissances)
- Transmission autosomique dominante (95%), pénétrance 70 % (7 à 90%)
- Diagnostic ECG : QTc prolongé
  - ≥ 450 ms chez l'homme
  - ≥ 460 ms chez la femme
- Arythmies caractéristiques : torsades de pointes, TV
- Facteurs favorisants : stimulation adrénergique (effort, émotions), médicaments, QT allongé
- Symptôme initial: syncope mais mort subite possible chez l'enfant ou le jeune adulte

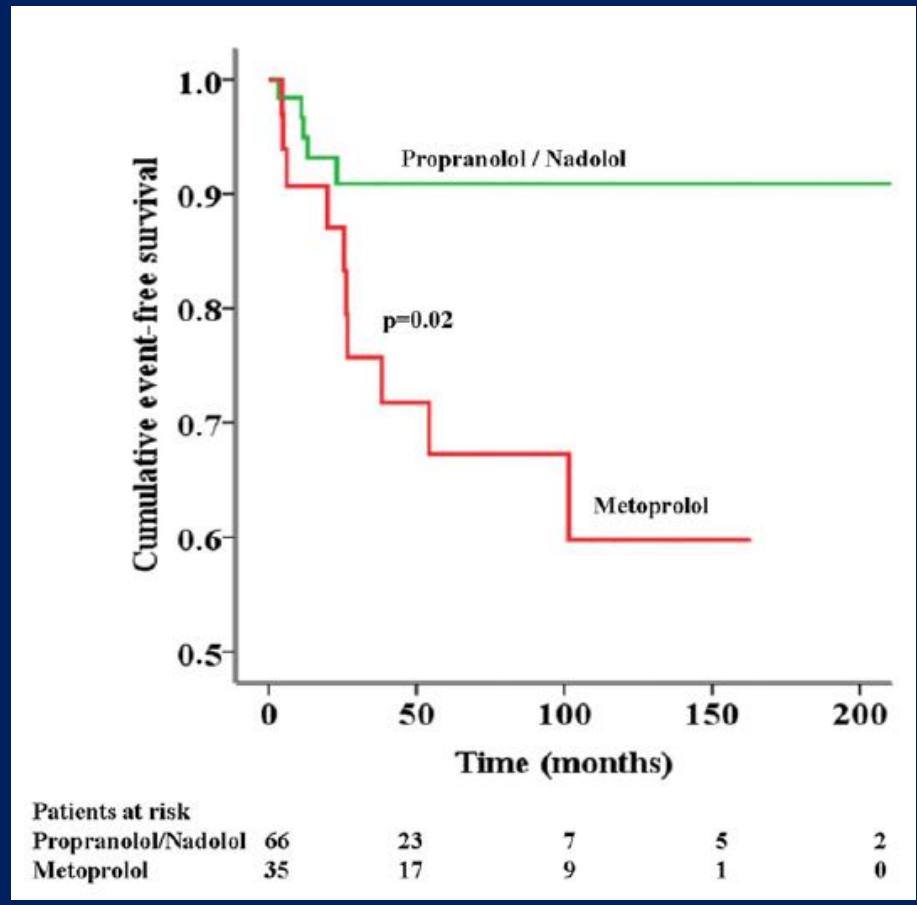
Problèmatiques du syndrome du QT long

- Diagnostic facile si QTc > 500 ms chez un patient ayant été récupéré d'un arrêt cardiaque à la piscine
- Mais incertitude diagnostique fréquente, si repolarisation « limite » (440 < QTc < 500).
- Evaluation pronostique souvent délicate.
- Thérapeutique : béta-bloquant doit être la règle. Suivi, observance, règles de vie et autres traitements.

Not all beta-blockers are equal in the management of LQTS types 1 and 2



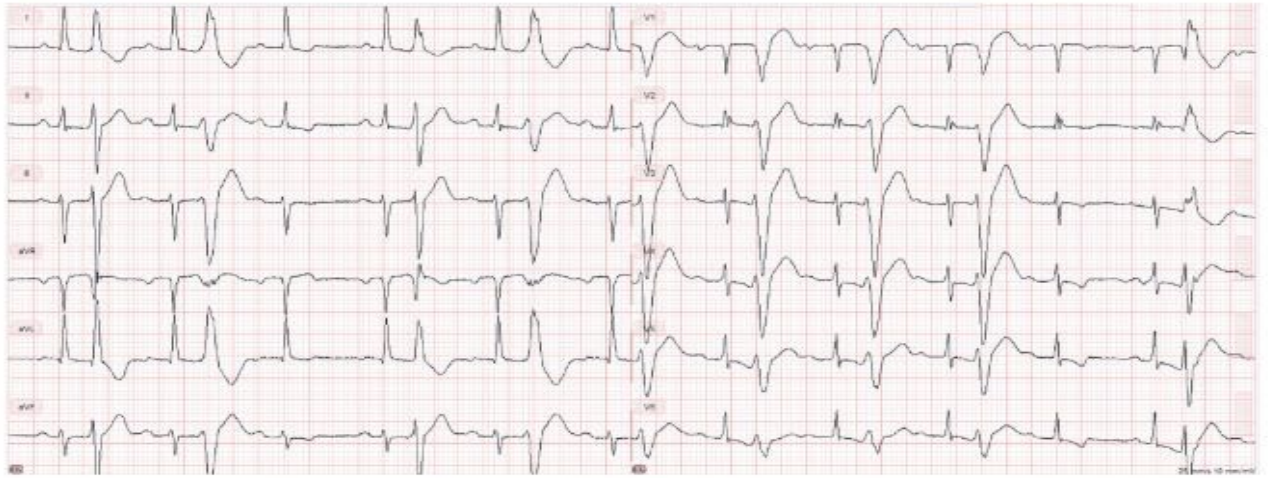
Occurrence of breakthrough cardiac events (syncope, ACA, ICD shock, or SCA while receiving beta-blockers) in symptomatic patients before therapy.



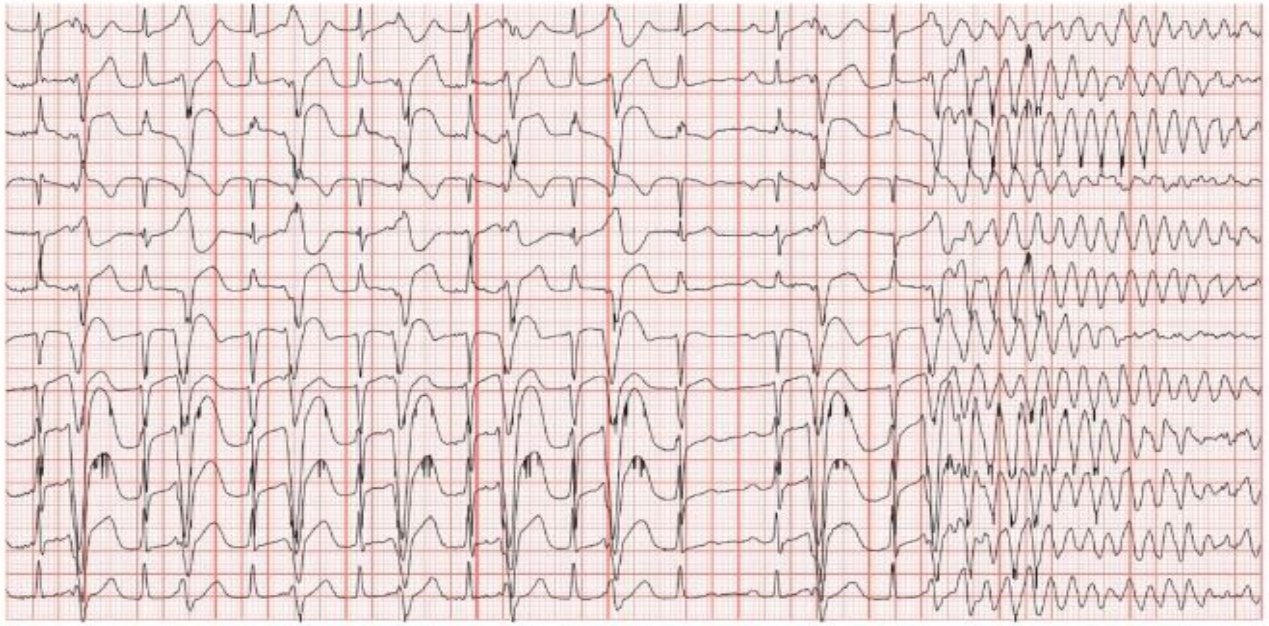
Event-free survival of symptomatic patients initiated on different beta-blockers.

P Chockalingam et al. J Am Coll Cardiol 2012;60:2092–9.

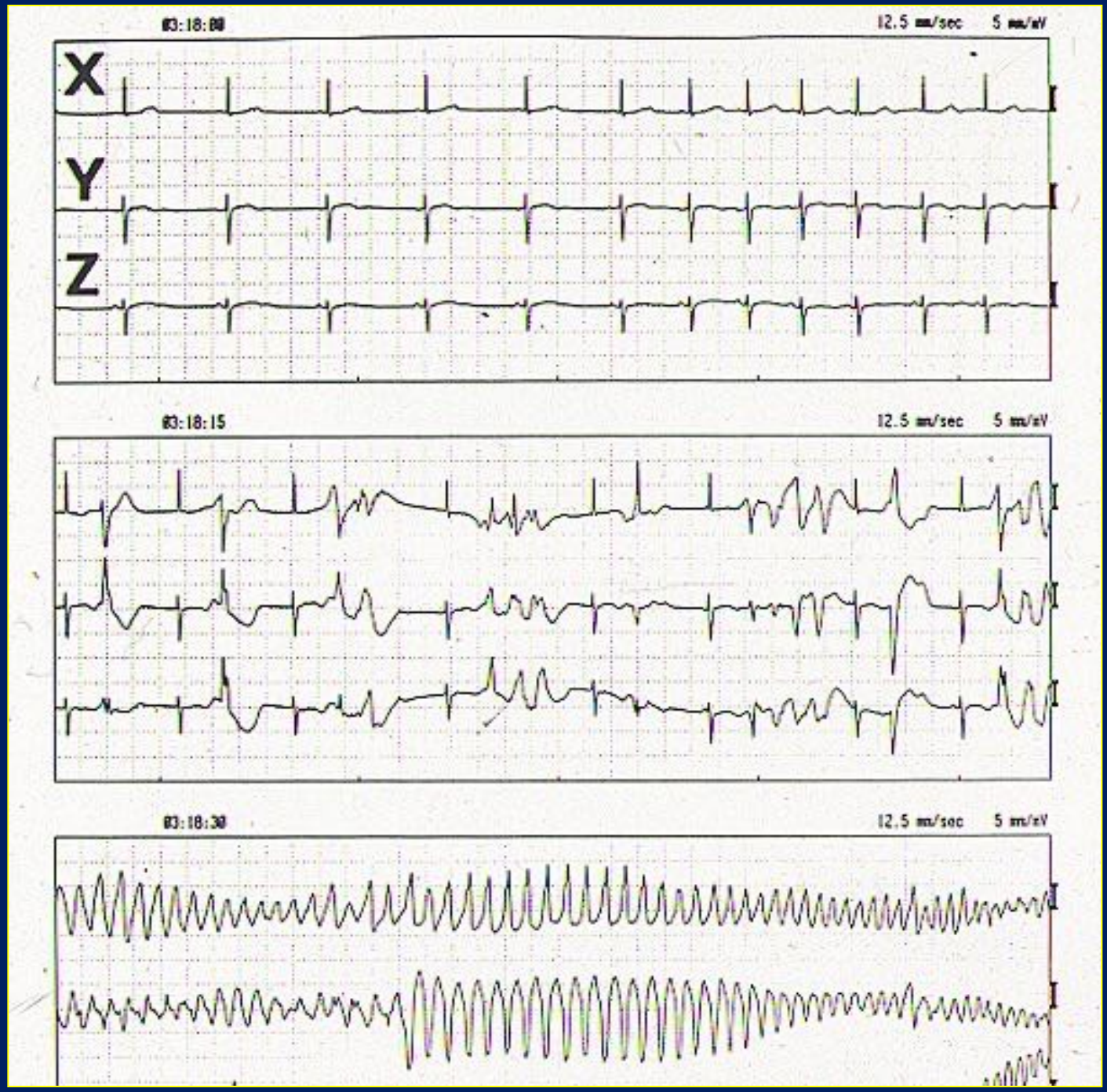
ECG sinus rhythm – short-coupled PVCs



Telemetry tracings – short-coupled PVC inducing VF

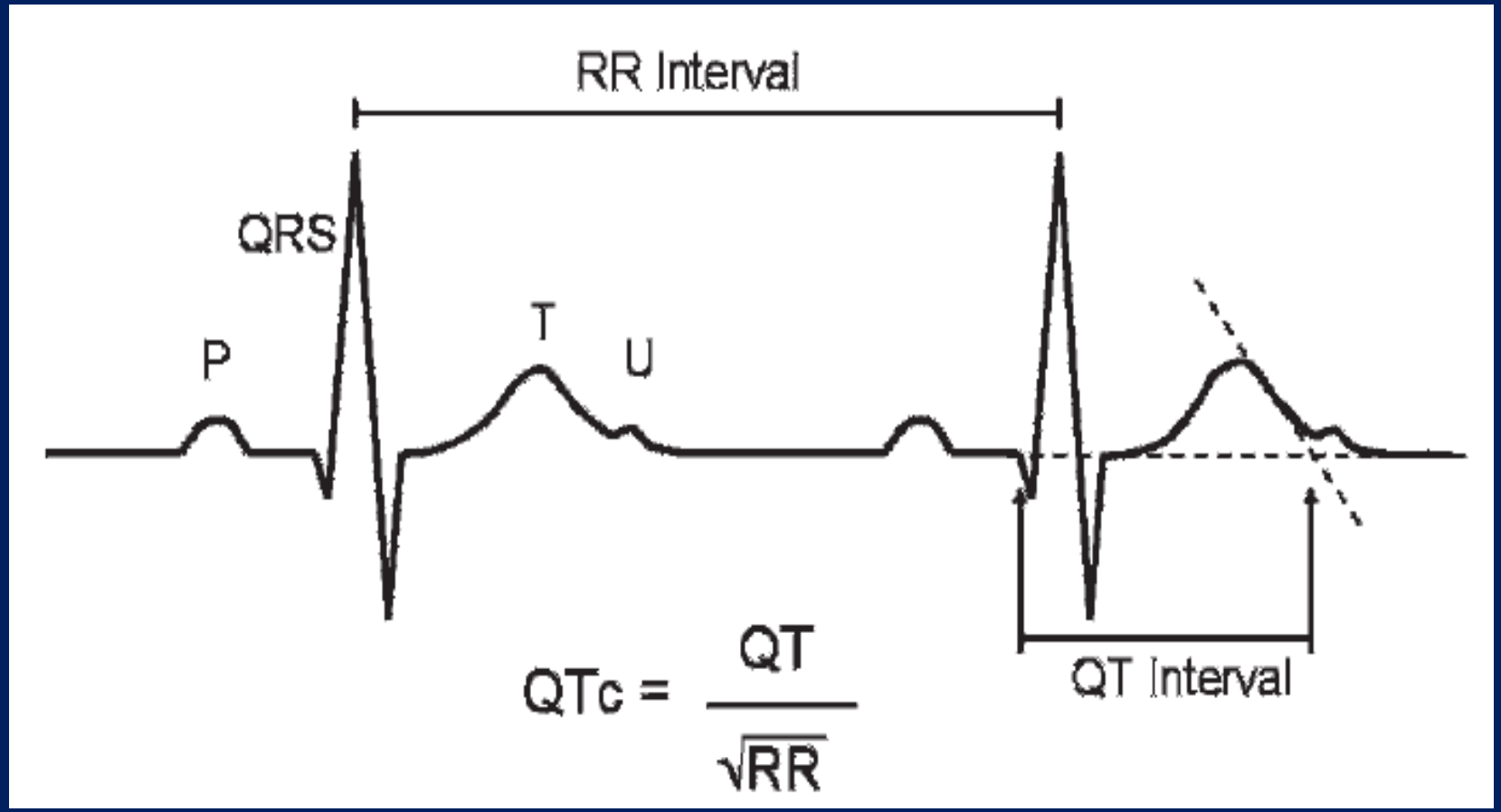


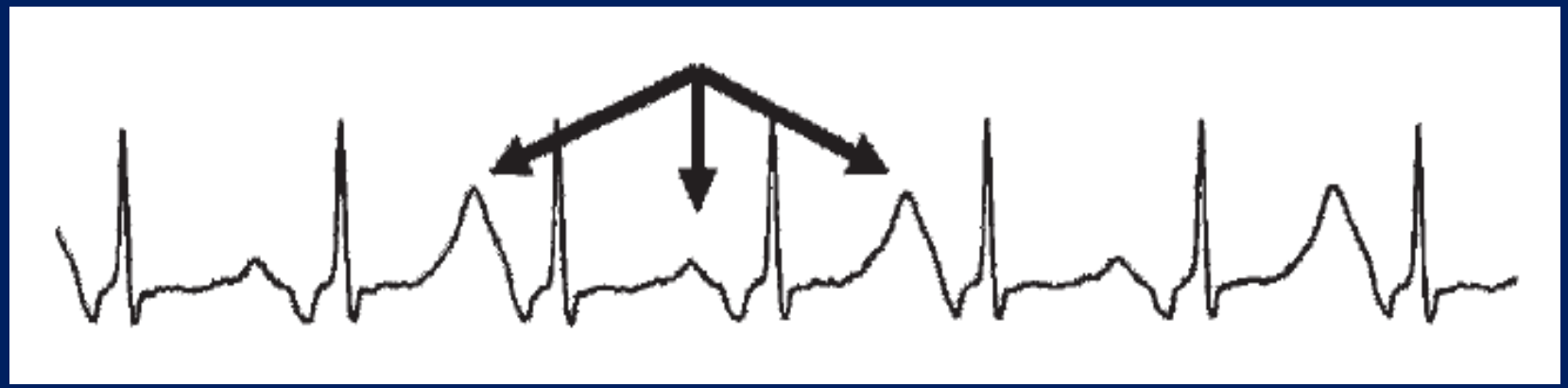
ESC


03:18:00
12.5 mm/sec
5 mm/mV
X
Y
Z
03:18:15
12.5 mm/sec
5 mm/mV
03:18:30
12.5 mm/sec
5 mm/mV

Diagnostic du syndrome du QT Long

- **ECG 12 dérivations** : examen clé mais difficultés de mesure du QTc sources d'erreurs, mauvaise interprétation et mauvaise prise en charge. Un QTc normal est *en principe* le témoin d'un risque très faible d'évènement cardiovasculaire.
- **Holter ECG** : valeur et morphologie du QT.
- **Histoire familiale** : syncope, mort subite, noyade.
- **Test génétique** : mutation pathogène sur l'un des gènes du LQTS. Intérêts diagnostique, pronostique et thérapeutique. L'absence de mutation ne remet pas en cause le diagnostic chez un sujet cliniquement atteint +++





JN Johnson & MJ Ackerman Br J Sports Med 2009;43:657–62.

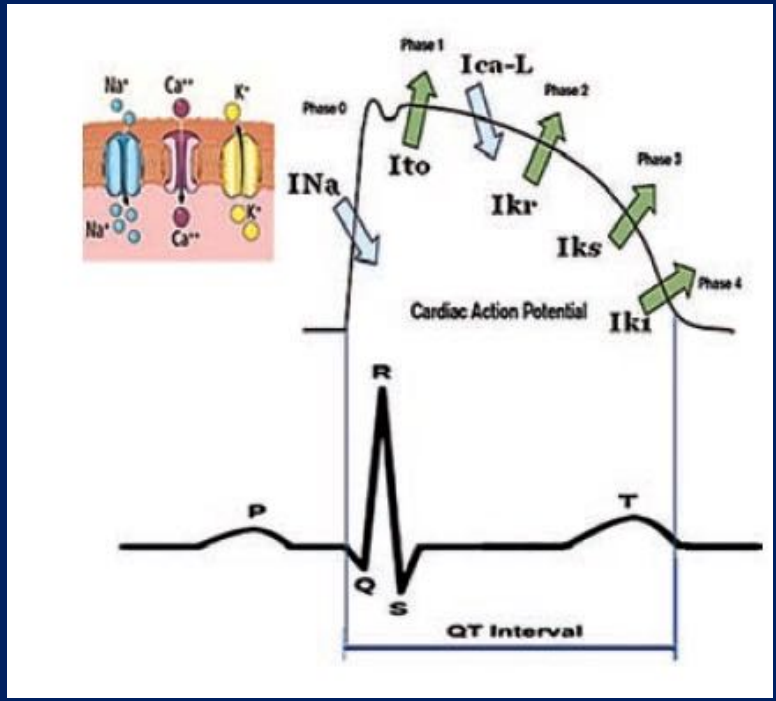
Table 10 Modified long QT syndrome diagnostic score[243]

Findings			Points
ECG	QTc	≥480 ms	3.5
		=460–479 ms	2
		=450–459 ms (in males)	1
		≥480 ms during 4th minute of recovery from exercise stress test	1
	Torsade de pointes		2
	T wave alternans		1
	Notched T wave in 3 leads		1
	Low heart rate for age		0.5
Clinical history	Syncope	With stress	2
		Without stress	1
Family history	Family member(s) with definite LQTS		1
	Unexplained SCD at age <30 years in first-degree family		0.5
Genetic finding	Pathogenic mutation		3.5

ECG, electrocardiogram; LQTS, long QT syndrome; SCD, sudden cardiac death.
Diagnosis of LQTS with a score >3.

Syndrome du QT long : gènes et protéines identifiés

Allongement du PA = allongement du QT
- diminution du courant repolarisant
- augmentation du courant dépolarisant



Cardiogenetics 2011; 1(s1):e2
doi:10.4081/cardiogenetics.2011.s1.e2

LQTS Type	Gene	Protein	Current	Frequency
LQT1	*KCNQ1*	Kv7.1	IKs↓	40%–45%
LQT2	*KCNH2*	KV11.1	IKr↓	30%–35%
LQT3	*SCN5A*	Nav1.5	INa↑	10%
LQT4	*ANK2*	Ankyrin-B	Na+/K+↓	1%
LQT5	*KCNE1*	MinK	IKs↓	1%
LQT6	*KCNE2*	MiRP1	IKr↓	Rare
LQT7	*KCNJ2*	Kir2.1	IK1↓	Rare
LQT8	*CACNA1C*	CaV1.2	ICa-L↑	Rare
LQT9	*CAV3*	Caveolin 3	INa↑	Rare
LQT10	*SCN4B*	SCNβ4 subunit	INa↑	Rare
LQT11	*AKAP9*	Yotiao	IKs↓	Rare
LQT12	*SNTA1*	Syntrophin-α1	INa↓	Rare
LQT13	*KCNJ5*	Kir3.4	IKACH↓	Rare
LQT14	*CALM1*	Calmodulin 1	Calcium signalling	Rare
LQT15	*CALM2*	Calmodulin 2	Calcium signalling	Rare
LQT16	*TRDN*	Triadin	ICa-L↑	Rare
Jervell and Lange-Nielsen syndrome (autosomal recessive)				
JLN1	*KCNQ1*	Kv7.1	IKs↓	Rare
JLN2	*KCNE1*	MinK	IKs↓	Rare

The 3 subtypes of LQTS

1. Autosomal dominant LQTS (Romano–Ward syndrome; prevalence 1 in 2500), includes LQT1–6 and LQT9–13 characterized by an isolated prolongation of the QT interval.

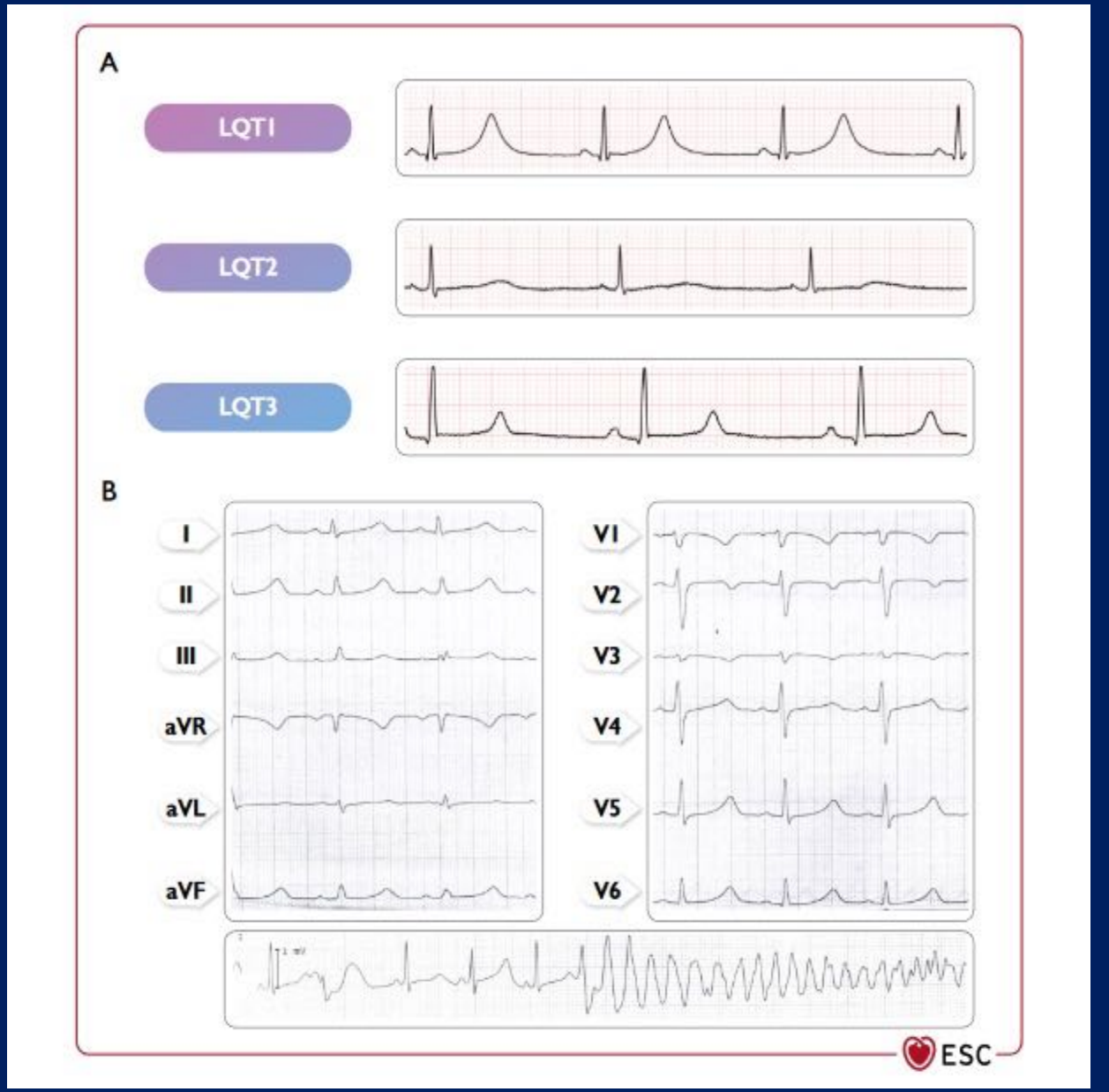
2. Autosomal dominant LQTS with extracardiac manifestation, comprising :

– LQT7 (Andersen–Tawil syndrome): prominent U wave, polymorphic or bidirectional VT, facial dysmorphisms and hyper-/hypokalaemic periodic paralysis

– LQT8 (Timothy syndrome) : syndactyly, cardiac malformations, autism spectrum disorder and dysmorphisms.

3. Autosomal recessive LQTS (Jervell and Lange–Nielsen syndrome), which combines an extremely prolonged QT interval with congenital deafness.

S Priori et al. Eur Heart J. 2015; 36: 2793–867.


A
LQT1
LQT2
LQT3
B
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
ESC

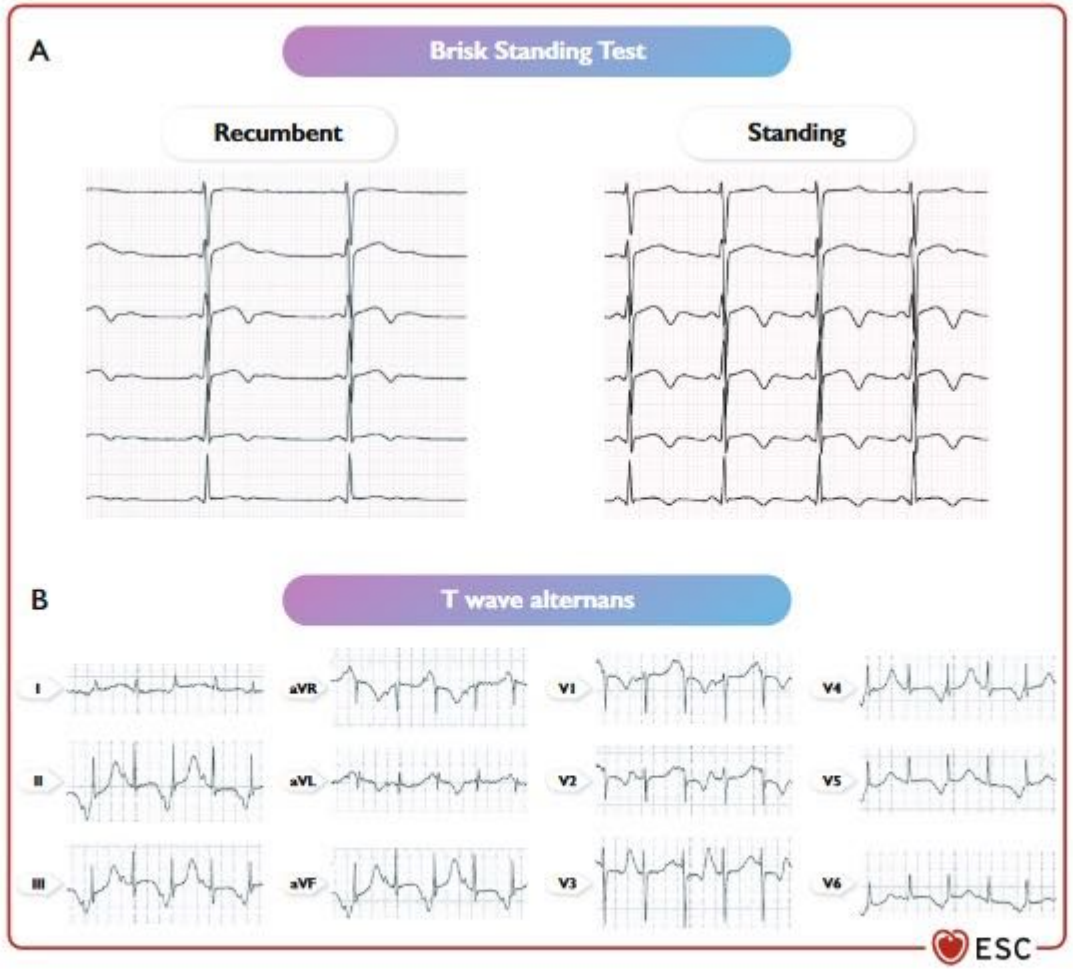
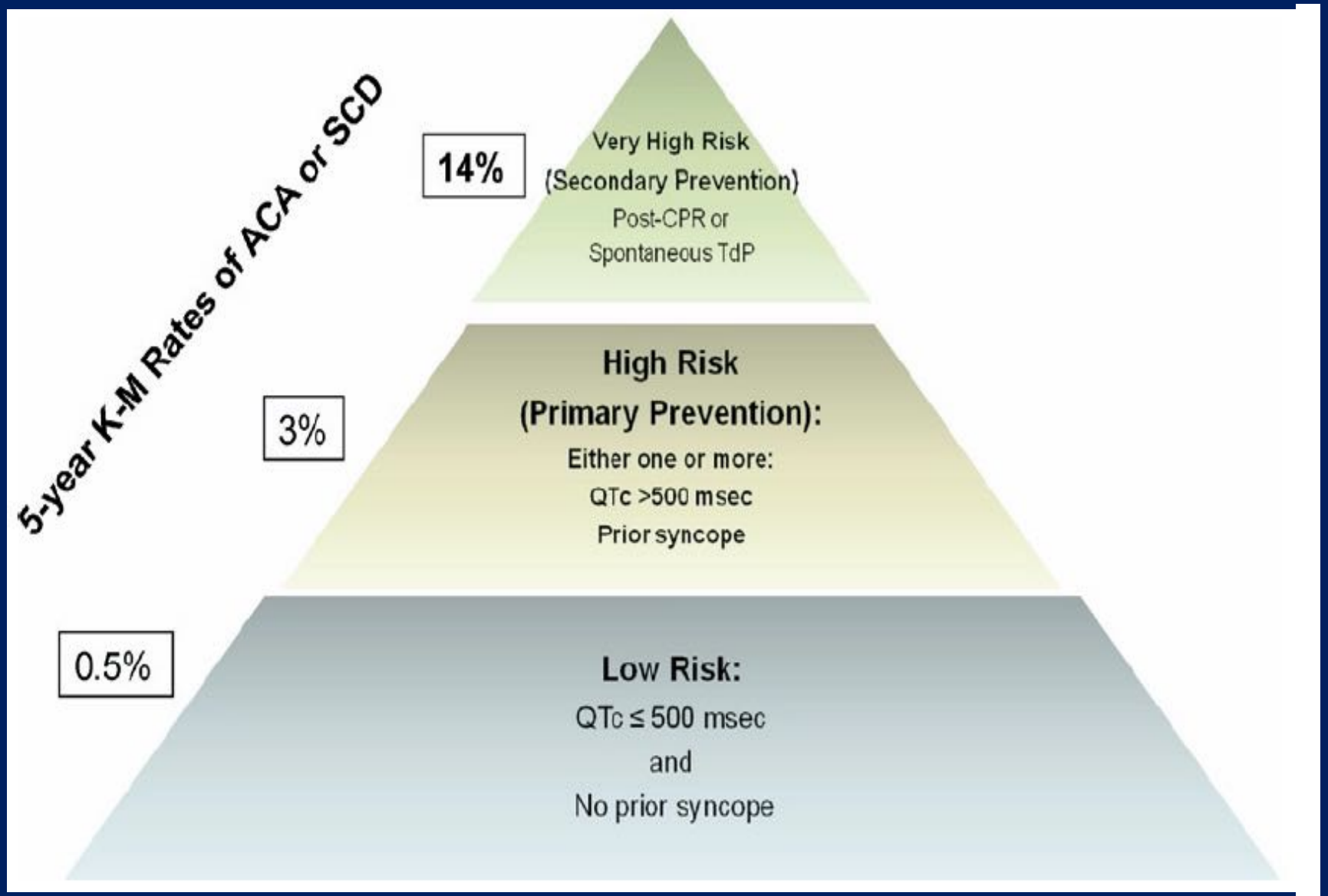


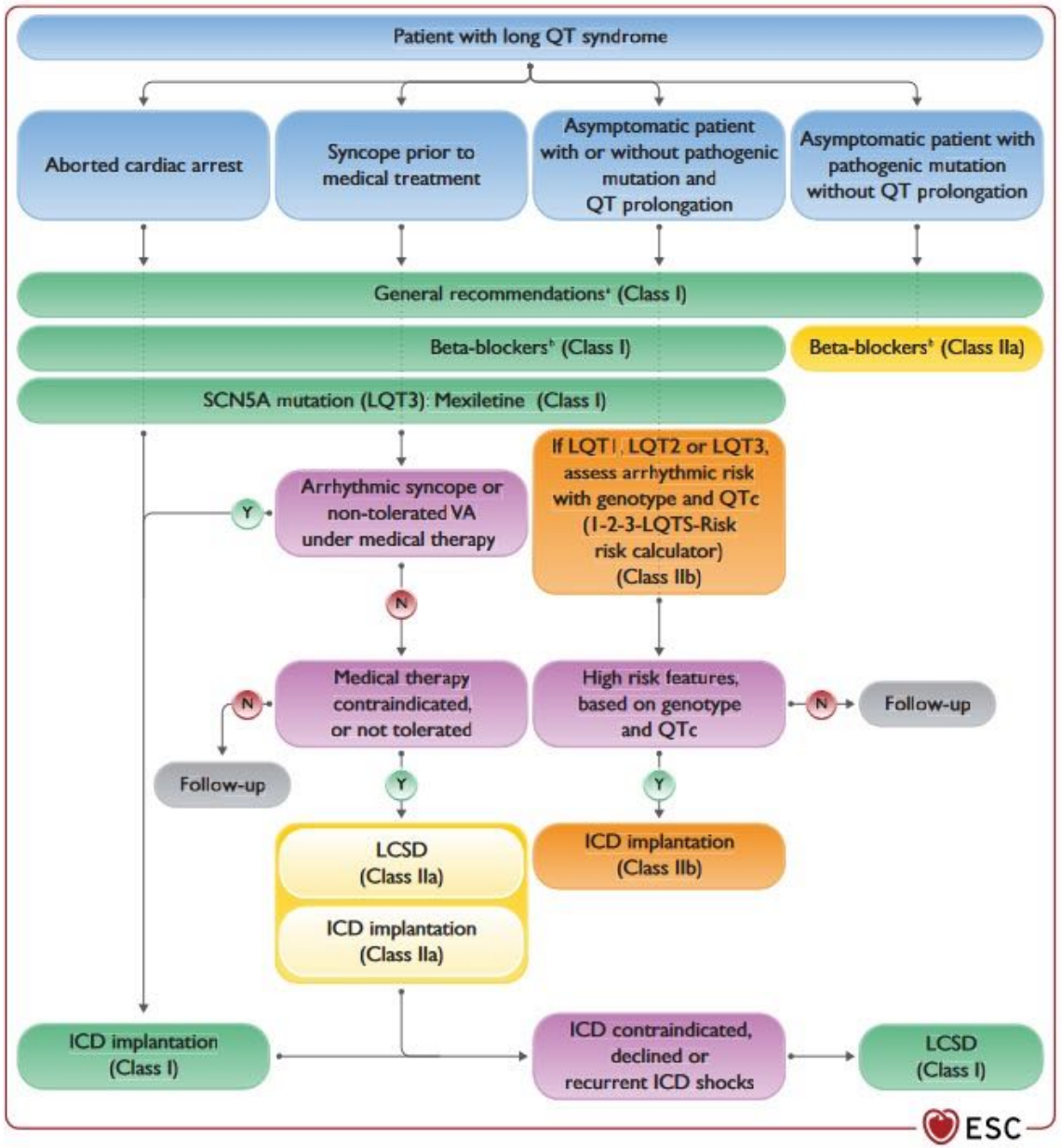
Figure 30 Brisk standing electrocardiogram changes and T wave alternans in Long QT syndrome patients. *(A)* ECG changes during brisk standing test in a male LQTS patient with *KCNH2* (p.S818L) mutation, increased heart rate is associated with less adaptation of QT interval. *(B)* T wave alternans in a male patient with *CACNA1C* (p.G406R) mutation.

MODIFICATION PAR LE SYSTEME NERVEUX AUTONOME++

Risk Stratification in the Long QT Syndrome



I Goldenberg and AJ Moss. J Am Coll Cardiol 2008;51:2291–300.


Patient with long QT syndrome
Aborted cardiac arrest
Syncope prior to medical treatment
Asymptomatic patient with or without pathogenic mutation and QT prolongation
Asymptomatic patient with pathogenic mutation without QT prolongation
General recommendations[a] (Class I)
Beta-blockers[b] (Class I)
Beta-blockers[b] (Class IIa)
SCN5A mutation (LQT3): Mexiletine (Class I)
If LQT1, LQT2 or LQT3, assess arrhythmic risk with genotype and QTc (1-2-3-LQTS-Risk risk calculator) (Class IIb)
Arrhythmic syncope or non-tolerated VA under medical therapy
Y
N
Medical therapy contraindicated, or not tolerated
N
Follow-up
Y
High risk features, based on genotype and QTc
N
Follow-up
Y
LCSD (Class IIa)
ICD implantation (Class IIa)
ICD implantation (Class IIb)
ICD implantation (Class I)
ICD contraindicated, declined or recurrent ICD shocks
LCSD (Class I)
ESC

Conduite à tenir pour la surveillance cardiologique des patients hospitalisés en psychiatrie

V5, 28/05/18

Examens à l'entrée (J0)

ECG

QTc < 450 ms

- Femme ≥ 65 ans
- ou Antécédents de cardiopathie ischémique
- ou Torsadogène[1] déjà prescrit

OUI → **ECG à J0, J3, J7, M1, M6 puis tous les ans**

NON → **ECG à J0**

Dans tous les cas, un **ECG** doit être **surajouté** avant et 3j après :
- Chaque **introduction** ou **augmentation de dose** d'un torsadogène[1] (attention aux inhibiteurs enzymatiques[2]).
- Chaque **initiation d'une association** entre antipsychotiques et/ou antidépresseurs et/ou lithium. **L'association de 2 torsadogènes[1] est contre-indiquée.**

450 ms ≤ QTc < 480 ms → **ECG à J0, J3, J7, M1, M6 puis tous les ans** + **Toute HYPOCALCEMIE doit être corrigée**

Dans tous les cas, un **ECG** doit être **surajouté** avant et 3j après :
- Chaque **introduction** ou **augmentation de dose** d'un torsadogène[1] (attention aux inhibiteurs enzymatiques[2]).
- Chaque **initiation d'une association** entre antipsychotiques et/ou antidépresseurs et/ou lithium. **L'association de 2 torsadogènes[1] est contre-indiquée.**

- **QTc ≥ 480 ms**
- **ou allongement QTc ≥ 10% entre 2 ECG**
- **ou bradycardie sévère (< 45 bpm)**
- **ou Arythmie**

→ **Demander un avis cardiologique en urgence au 13027**/35964 (nuit) (Faxer ECG au 13026) + **Arrêter les torsadogènes[1]** + **Corriger toute hypocalcémie**

Un ECG doit être fait tous les jours jusqu'à normalisation du QTc

Ionogramme

Tension

Bilan thyroïdien

Toute HYPOKALIEMIE doit être CORRIGEE
Attention, risque d'hypokaliémie+++ après lavement, diarrhée ou prise de laxatif stimulant (Xprep®)

Toute PERTURBATION DU BILAN THYROIDIEN et toute HYPERTENSION doivent être explorées

L'ensemble des ECG doivent être **prescrits** sur Actipidos, **analysés** puis **tracés** sur Orbis (dans l'onglet «suivi métabolique») par l'interne.
L'infirmière ou l'externe ayant réalisé l'ECG doit le tracer dans Actipidos (au niveau du plan de soin) et le montrer à l'interne.

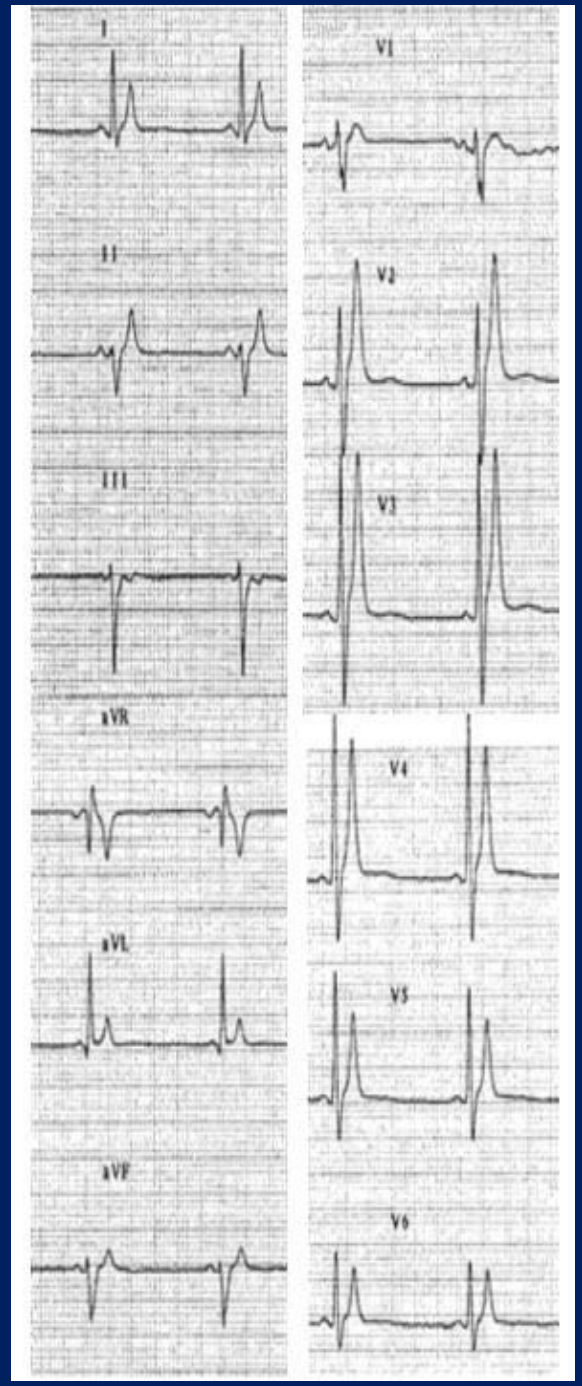
[1] *Les médicaments torsadogènes sont listés dans l'annexe I*
[2] *Les inhibiteurs enzymatiques (comme la paroxétine, la fluoxétine, le fénofibrate, le vérapamil, etc.) peuvent augmenter les concentrations de certains torsadogènes (cf. annexe I)*

Syndrome du QT court

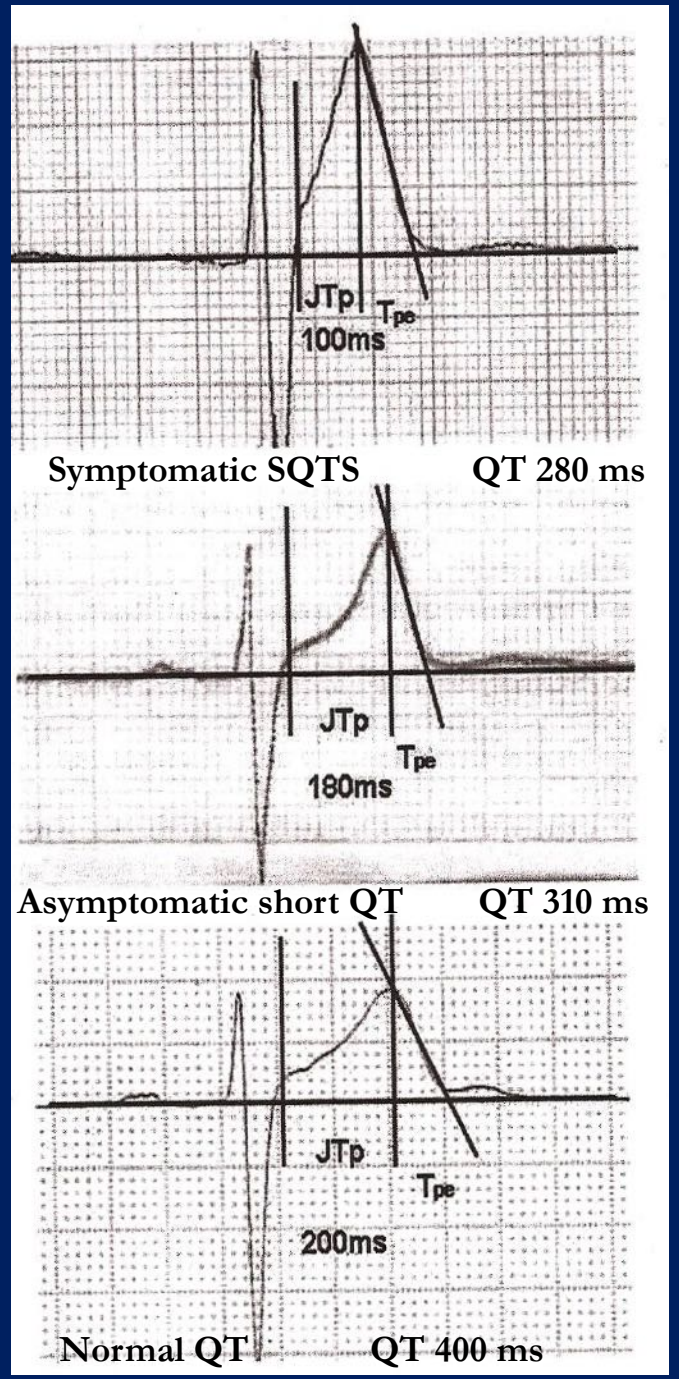
- Première description Gussak 2000
- Malaises, syncopes, palpitations
- Fibrillation atriale
- Mort subite
- Cœur sain

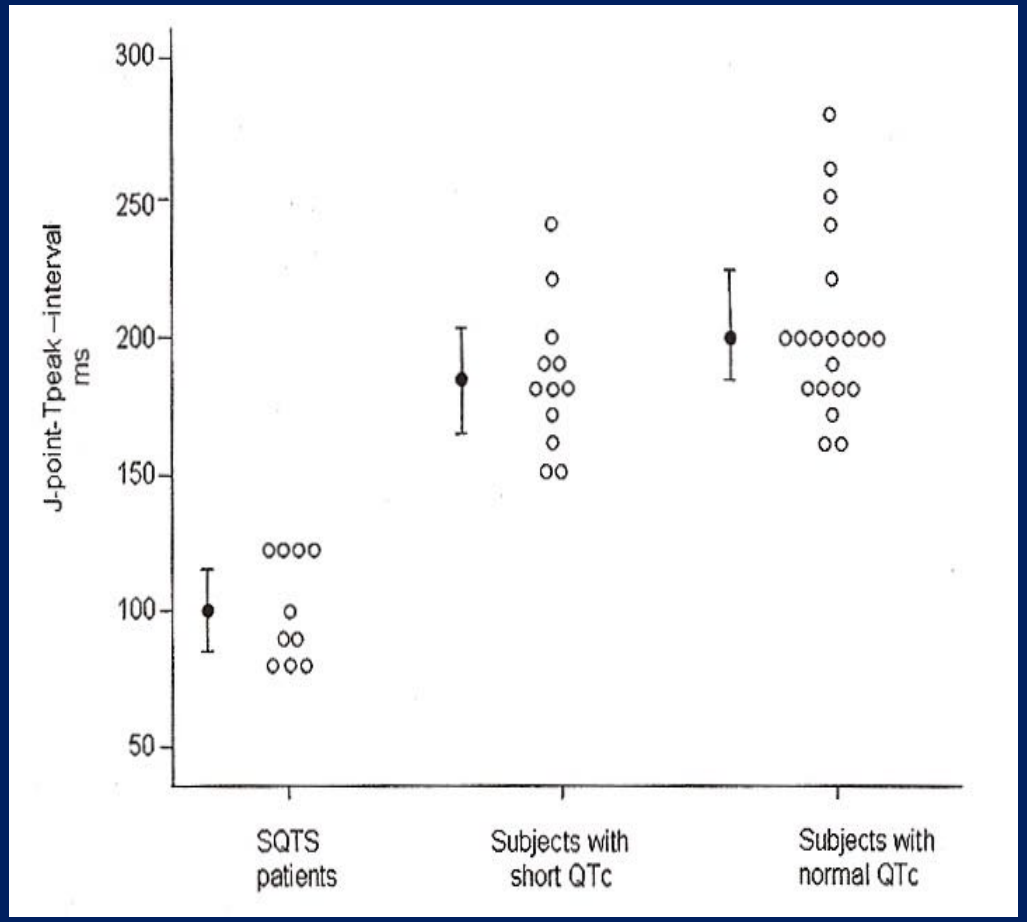
QTc < 330 ou ≤ 340 ms

- Rare. Prévalence : ?



Syndrome du QT court





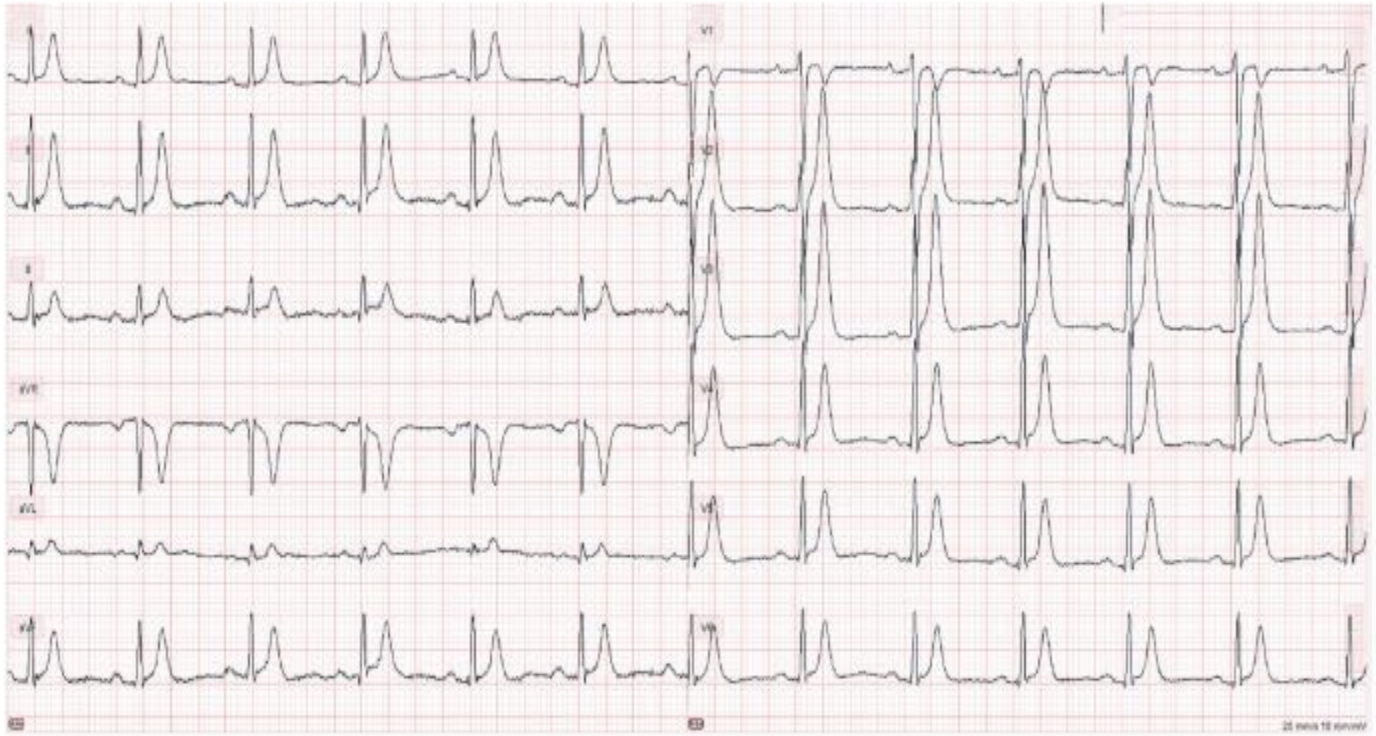
Le diagnostic de SQTS devrait associer QTc < 320 ms et J-apex T < 150 ms (comparaison de 10 SQTS symptomatiques, 12 sujets avec QT court et 20 sujets nx).

O Anttonen et al. Heart Rhythm 2009; 6: 267-71.

Syndrome du QT court

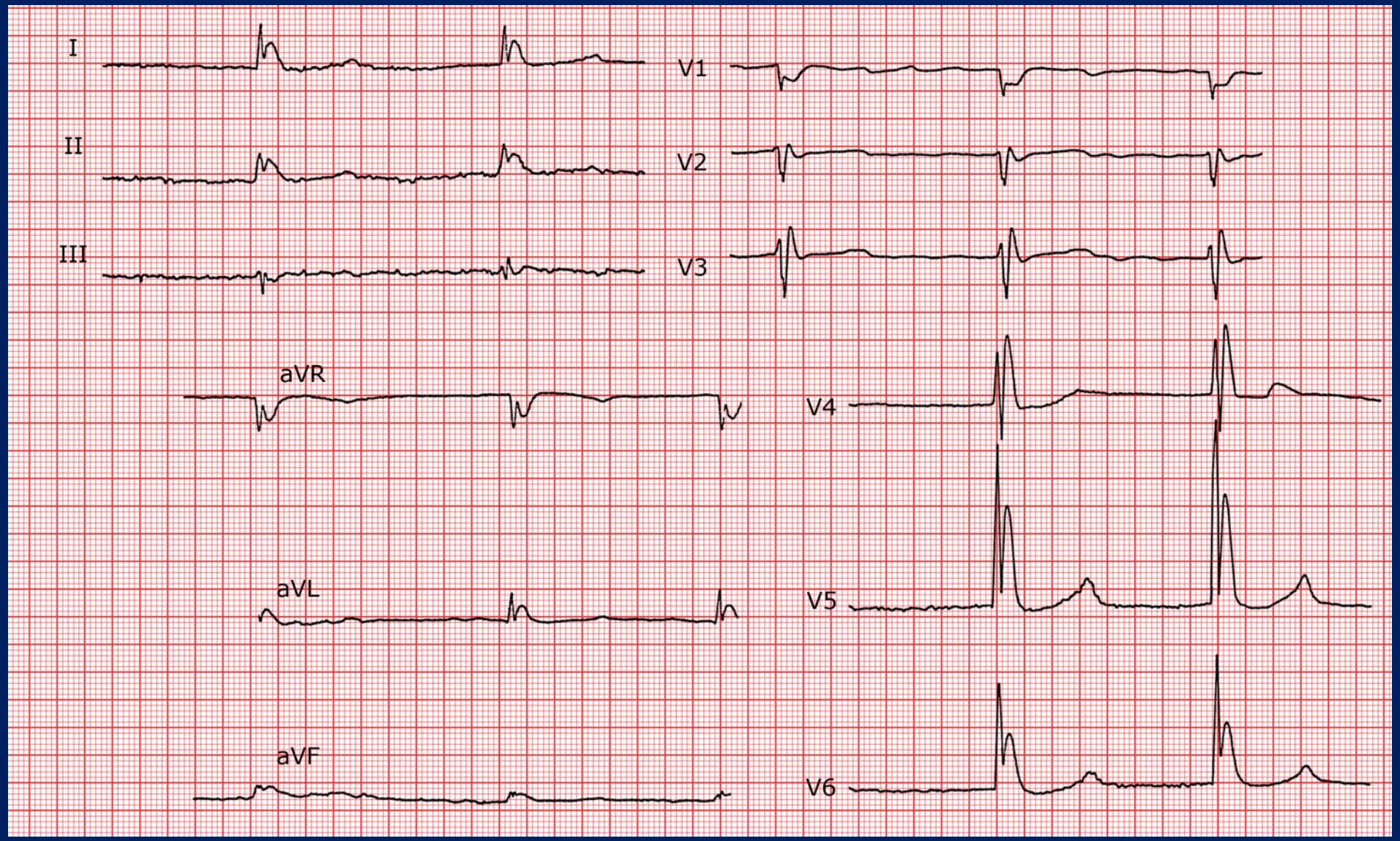
Type	Gène	Courant ionique	Conséquences fonctionnelles	Références
SQTS1	KCNH2	IKr	Gain de fonction	Brugada R Circ. 2004
SQTS2	KCNQ1	IKs	Gain de fonction	Bellocq C Circ. 2004
SQTS3	KCNJ2	IK1	Gain de fonction	Priori S Circ Res 2005

Short QT syndrome

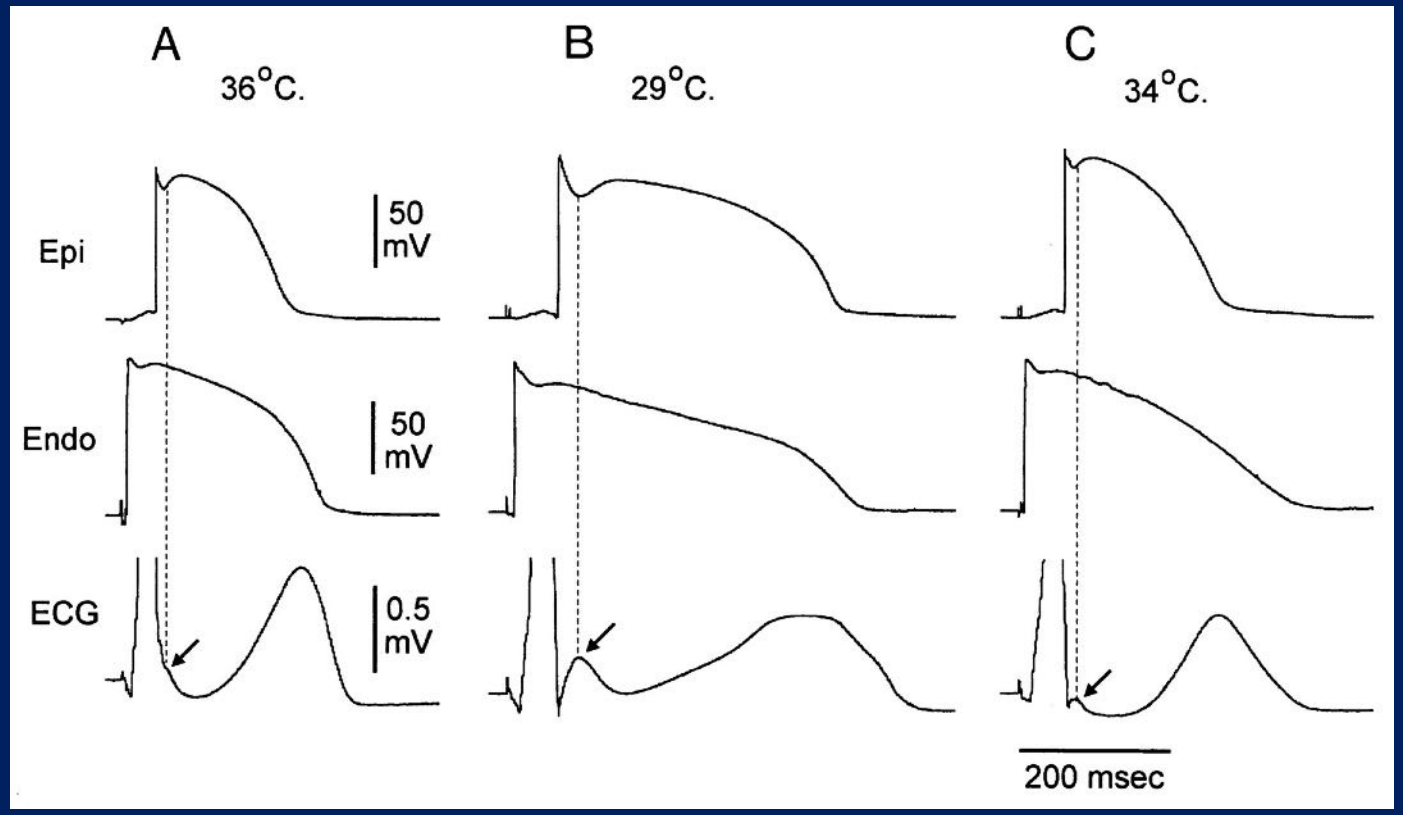


Recommendation Table 46 — Recommendations for the management of patients with short QT syndrome

Recommendations	Class[a]	Level[b]
Diagnosis		
It is recommended that SQTS is diagnosed in the presence of a QTc ≤360 ms and one or more of the following: (a) a pathogenic mutation, (b) a family history of SQTS, (c) survival from a VT/VF episode in the absence of heart disease.[1061,1068]	I	C
Genetic testing is indicated in patients diagnosed with SQTS.[1063]	I	C
SQTS should be considered in the presence of a QTc ≤320 ms.[1064–1067,1073,1074]	IIa	C
SQTS should be considered in the presence of a QTc ≥320 ms and ≤360 ms and arrhythmic syncope.	IIa	C
SQTS may be considered in the presence of a QTc ≥320 ms and ≤360 ms and a family history of SD at age <40 years.	IIb	C
Risk stratification, SCD prevention and treatment of VA		
ICD implantation is recommended in patients with a diagnosis of SQTS who: (a) are survivors of an aborted CA and/or (b) have documented spontaneous sustained VT.[1063]	I	C
ILR should be considered in young SQTS patients.	IIa	C
ICD implantation should be considered in SQTS patients with arrhythmic syncope.	IIa	C
Quinidine may be considered in (a) SQTS patients who qualify for an ICD but present a contraindication to the ICD or refuse it, and (b) asymptomatic SQTS patients and a family history of SCD.[1069–1071]	IIb	C
Isoproterenol may be considered in SQTS patients with an electrical storm.[1075]	IIb	C
PES is not recommended for SCD risk stratification in SQTS patients.	III	C


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

Effect of hypothermia on action potential and ECG morphology



Yan, G.-X. et al. Circulation 1996;93:372-379

Conclusions Our results provide the first direct evidence in support of the hypothesis that heterogeneous distribution of a transient outward current–mediated spike-and-dome morphology of the action potential across the ventricular wall underlies the manifestation of the electrocardiographic J **wave**. The presence of a prominent action potential notch in epicardium but not endocardiu[illegible] a voltage gradient that manifests as a J (**Osborn**) **wave** or elevated J-point in the ECG.

Circulation

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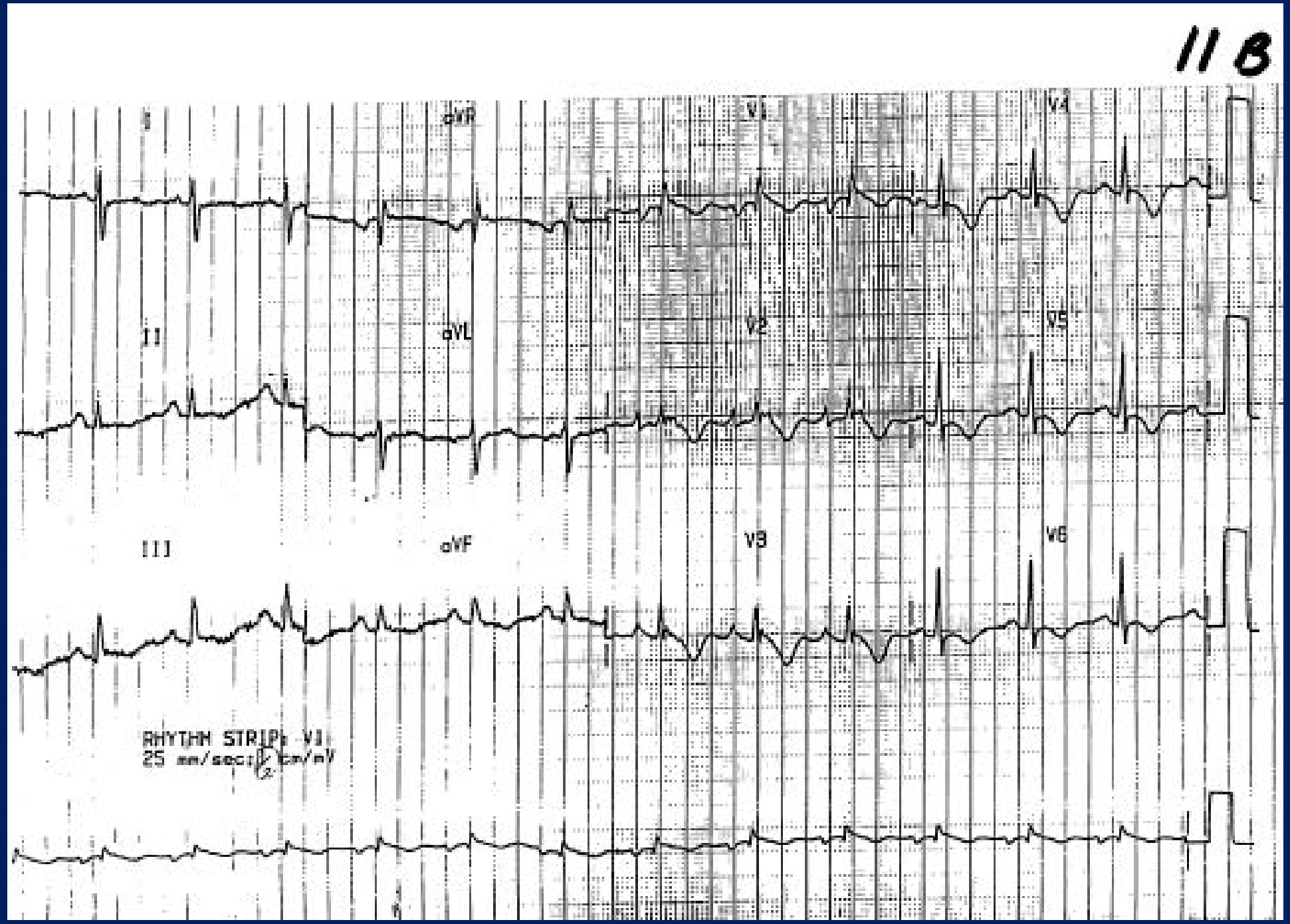
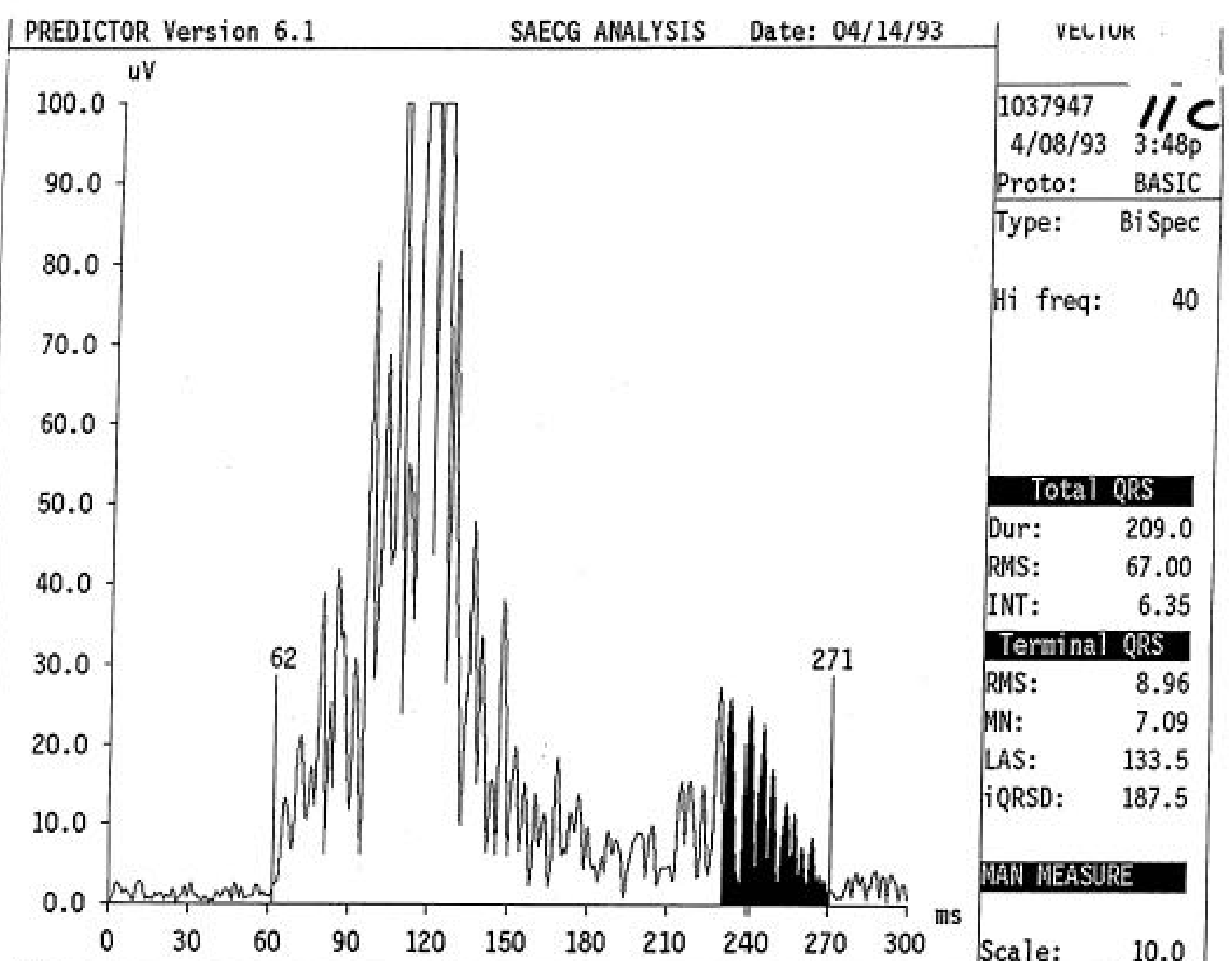
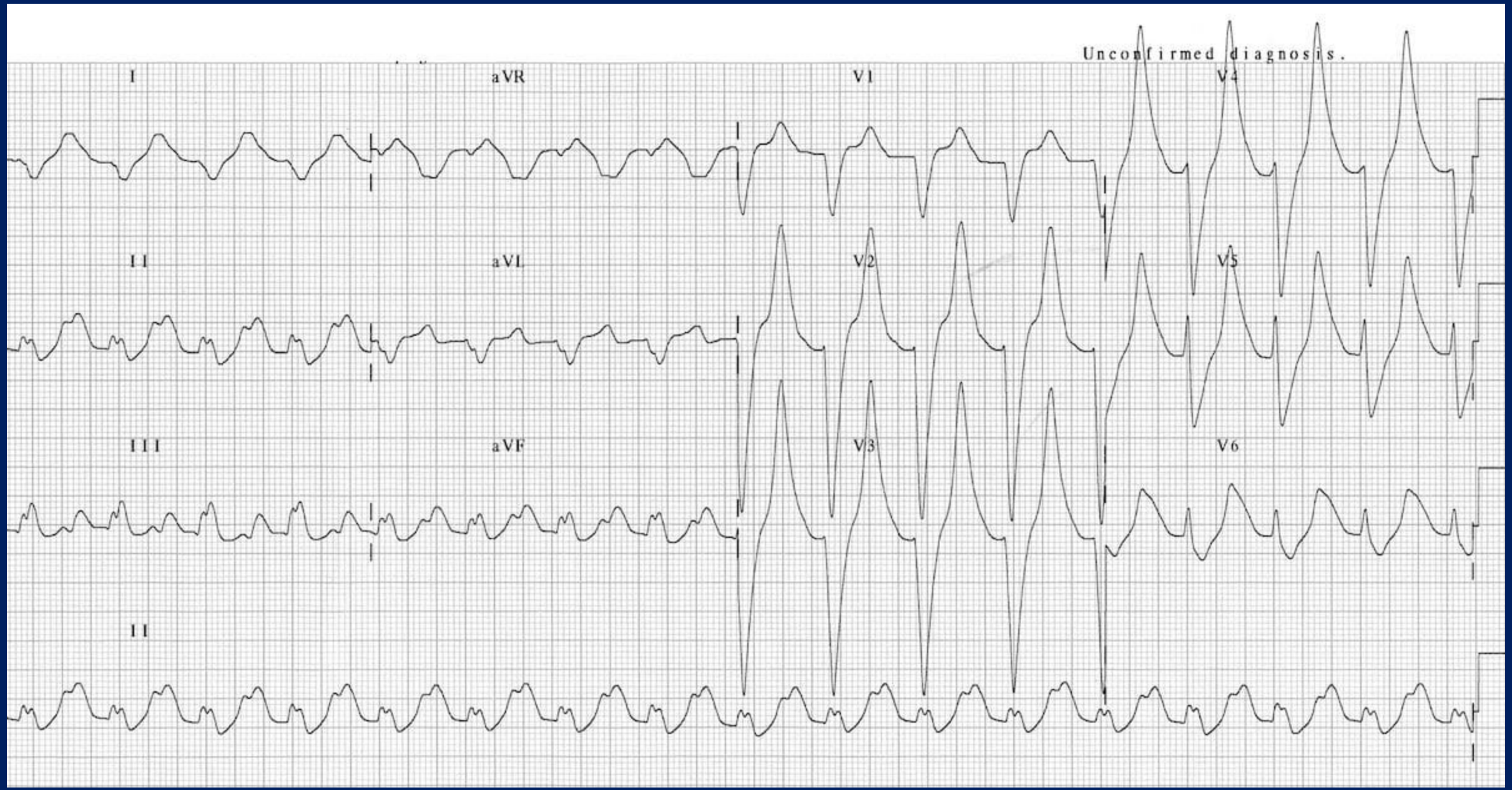
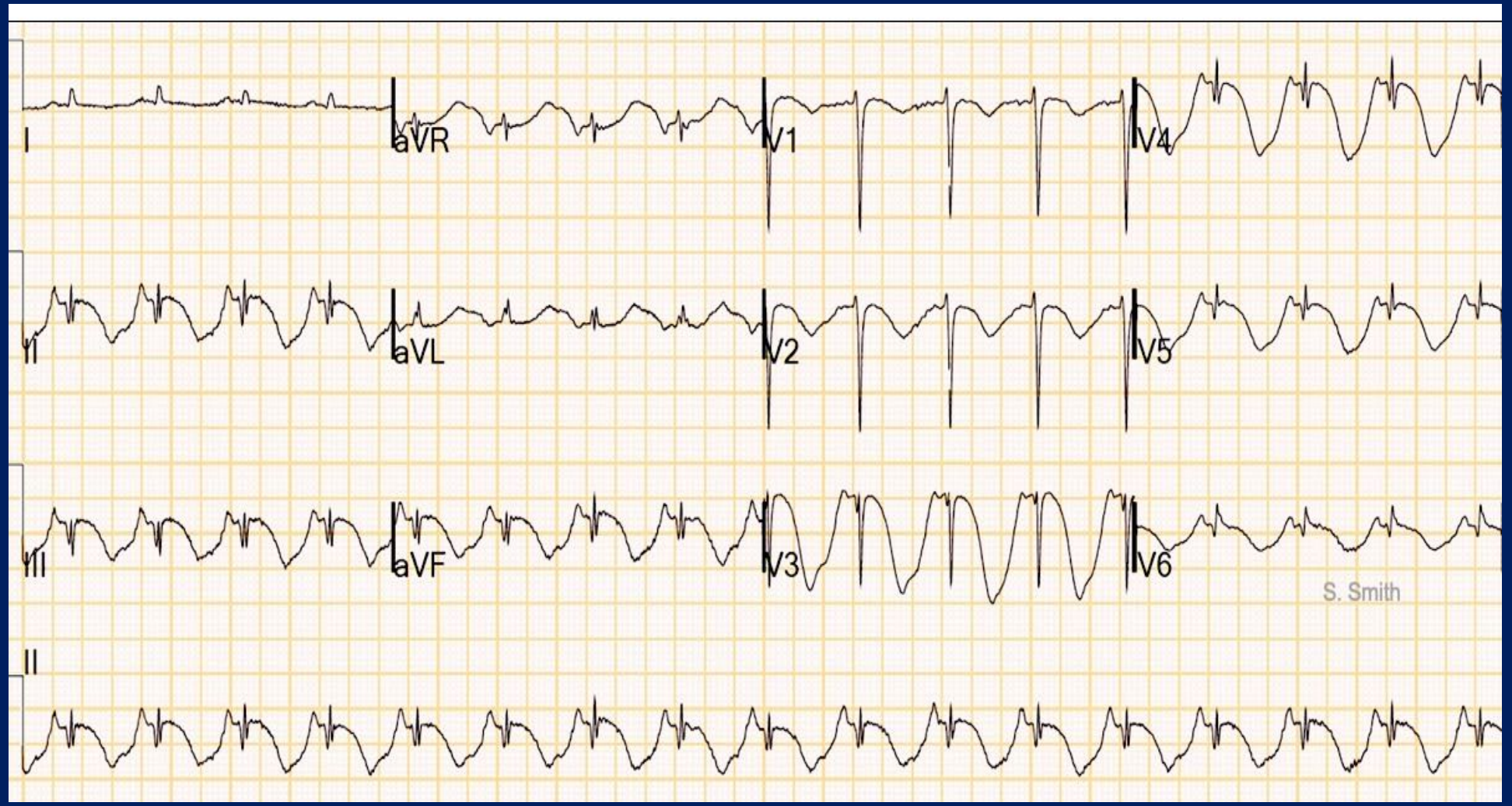
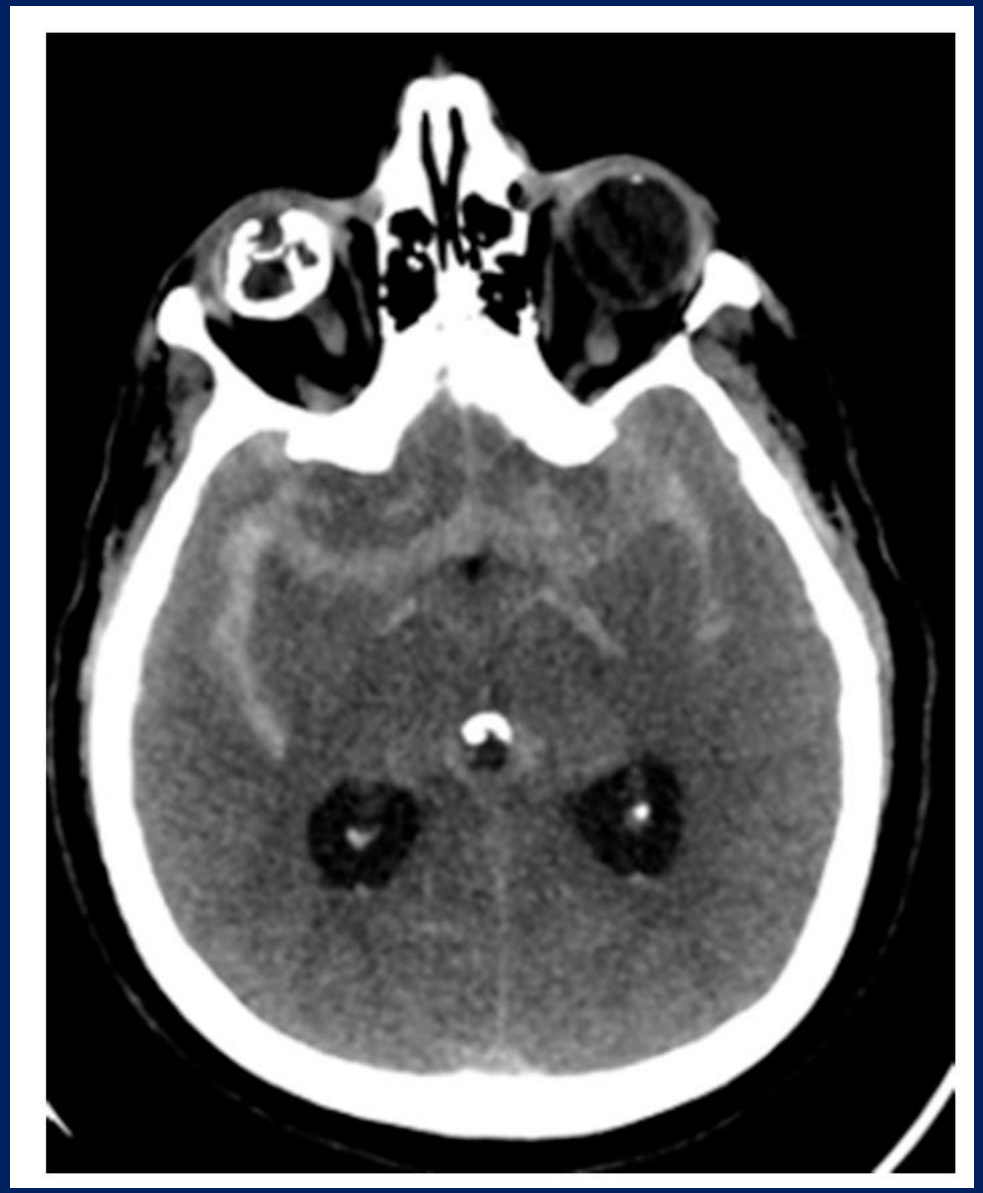
11 B


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: V1
25 mm/sec; cm/mV


PREDICTOR Version 6.1
SAECG ANALYSIS Date: 04/14/93
VECTOR
uV
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
62
271
0
30
60
90
120
150
180
210
240
270
300
ms
1037947
4/08/93 3:48p
Proto: BASIC
Type: BiSpec
Hi freq: 40
Total QRS
Dur: 209.0
RMS: 67.00
INT: 6.35
Terminal QRS
RMS: 8.96
MN: 7.09
LAS: 133.5
iQRSD: 187.5
MAN MEASURE
Scale: 10.0

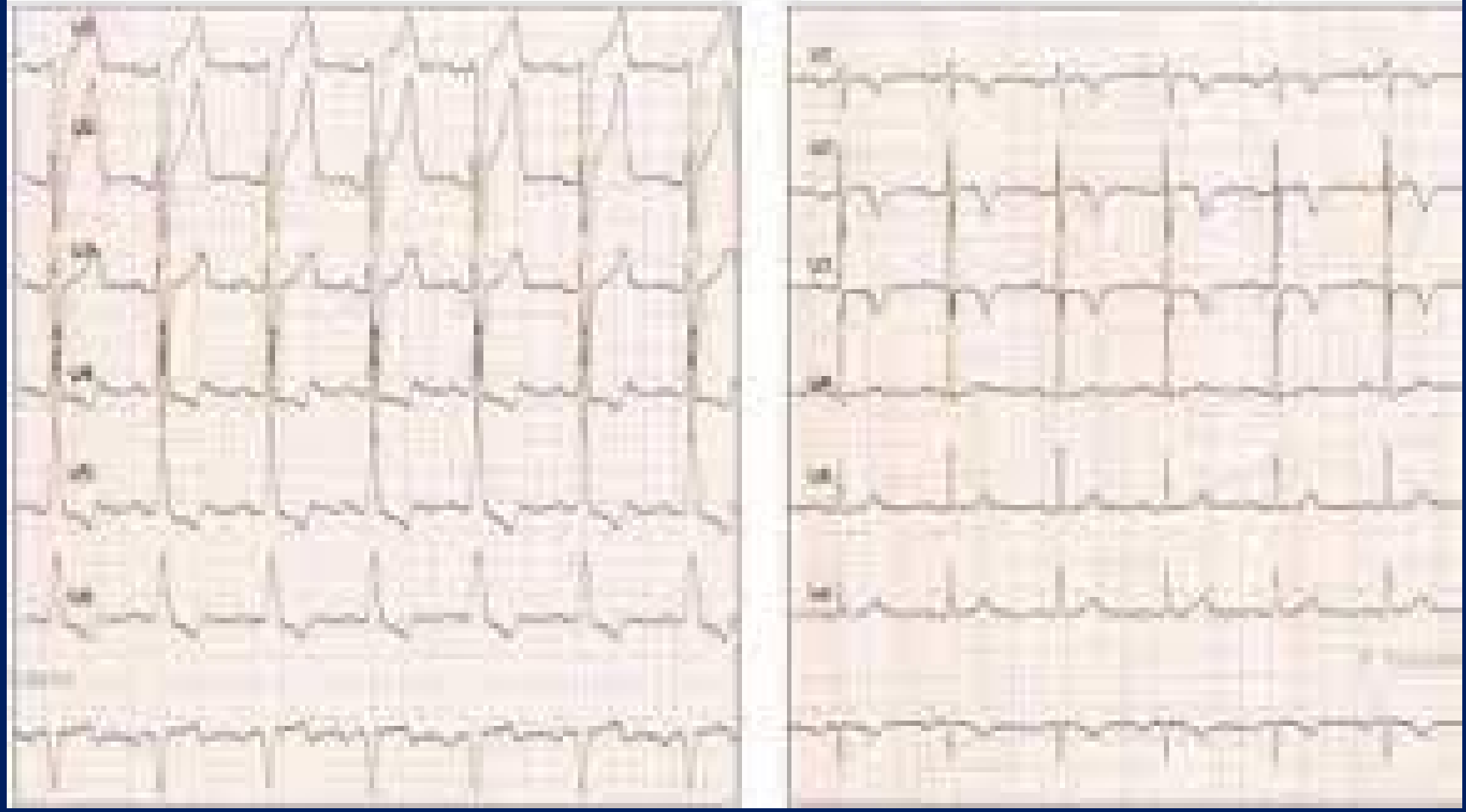

Unconfirmed diagnosis.
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

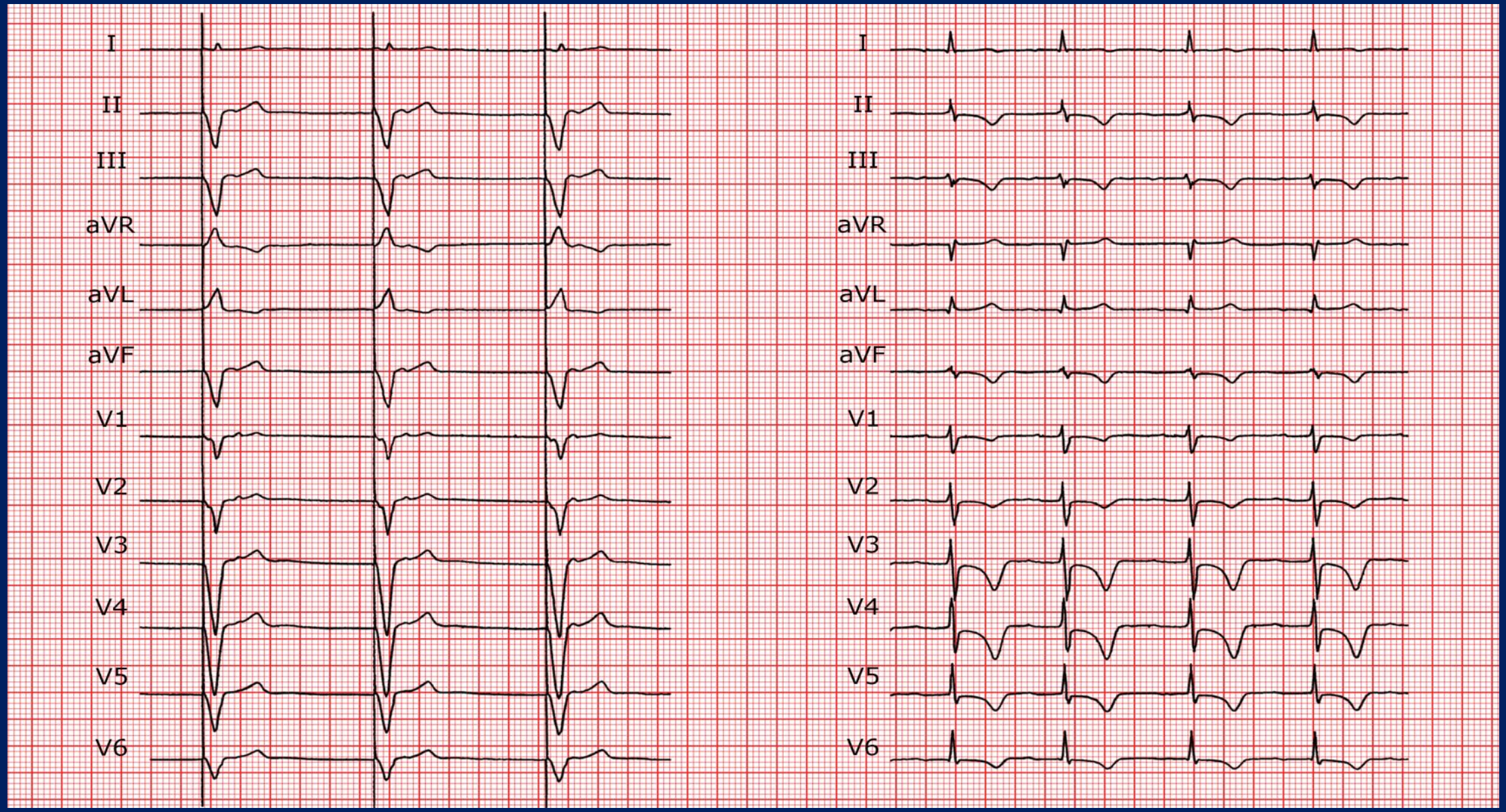

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
S. Smith
II



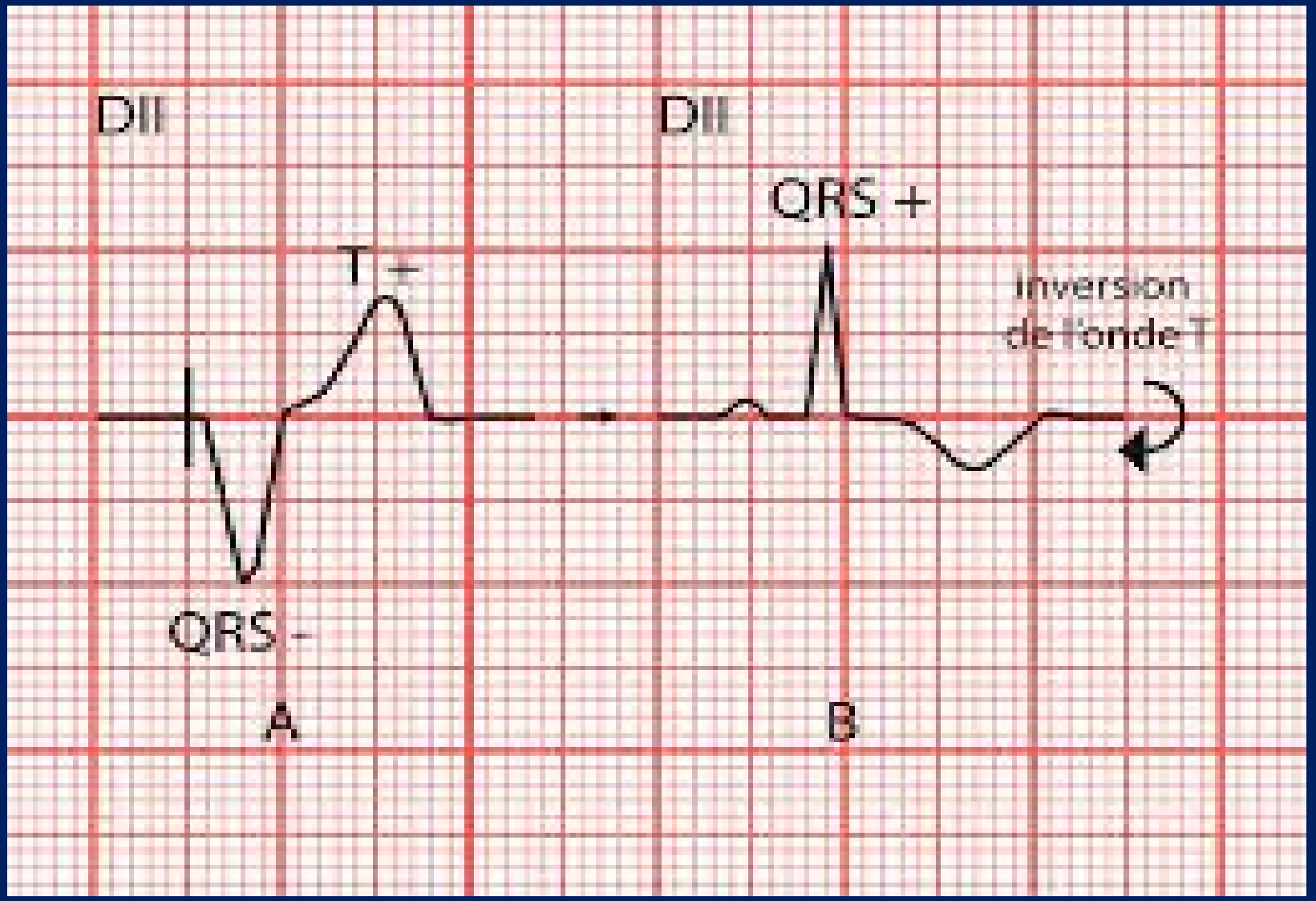
A : BBG

B : QRS fins 12 heures plus tard





Autres TV, WPW


DII
DII
QRS +
T −
Inversion
de l'onde T
QRS -
A
B

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