Clinical significance of Early Repolarization (J-wave/QRS slurring) in athletes

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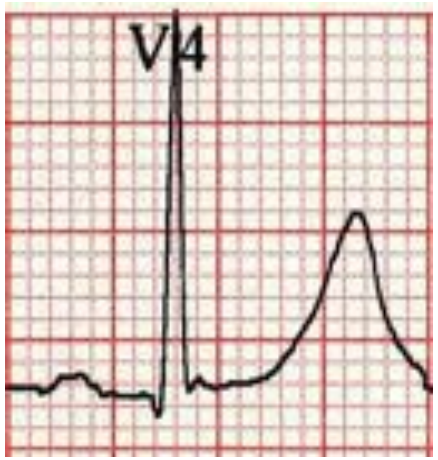
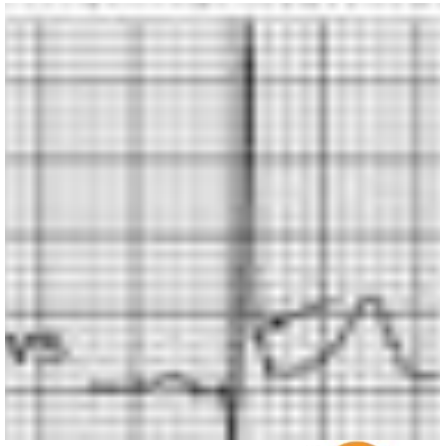
NO CONFLICT OF INTEREST TO DECLARE

Early repolarization and J-wave

- In 1961, Wasserburger et al. described the early repolarization as an elevated takeoff of the ST segment at the J junction, followed by concavity of the ST segment and tall, peaked T wave. This patterns was considered a normal variant.



- In 1999 Gussak and Antzelevitch, and in 2000 Kalla and Takagi defined early repolarization an elevated notch on the downsloping limb of the QRS, followed by upsloping ST segment elevation. They suggested that early repolarization may be malignant.



Contemporary definition of Early Repolarization

- Early Repolarization pattern, is the presence of J-point elevation of ≥0.1 mV, in ≥2 inferior and/or lateral leads on 12-lead ECG;
- Early Repolarization Syndrome is the presence of ER pattern in a patient resuscitated from VF, or in a SD victim with negative autopsy and previous evidence of ER pattern

Clinical significance of Early Repolarization (J-wave/QRS slurring)

Several contemporary observations suggest that early repolarization pattern (J-wave/QRS slurring) may be malignant in humans (i.e., associated with idiopathic ventricular fibrillation).

Gussak I and Antzelevitch C, J Electrocardiology 2000;

Tagaki M et al. J cardiov Electrophysiol 2000;

Haissaguerre et al. NEJM 2008;

Antzelevitch C. Heart Rhythm 2010;

Michel Haussaiguerre

ORIGINAL ARTICLE

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.

NEJM 2008; 358: 2016-23

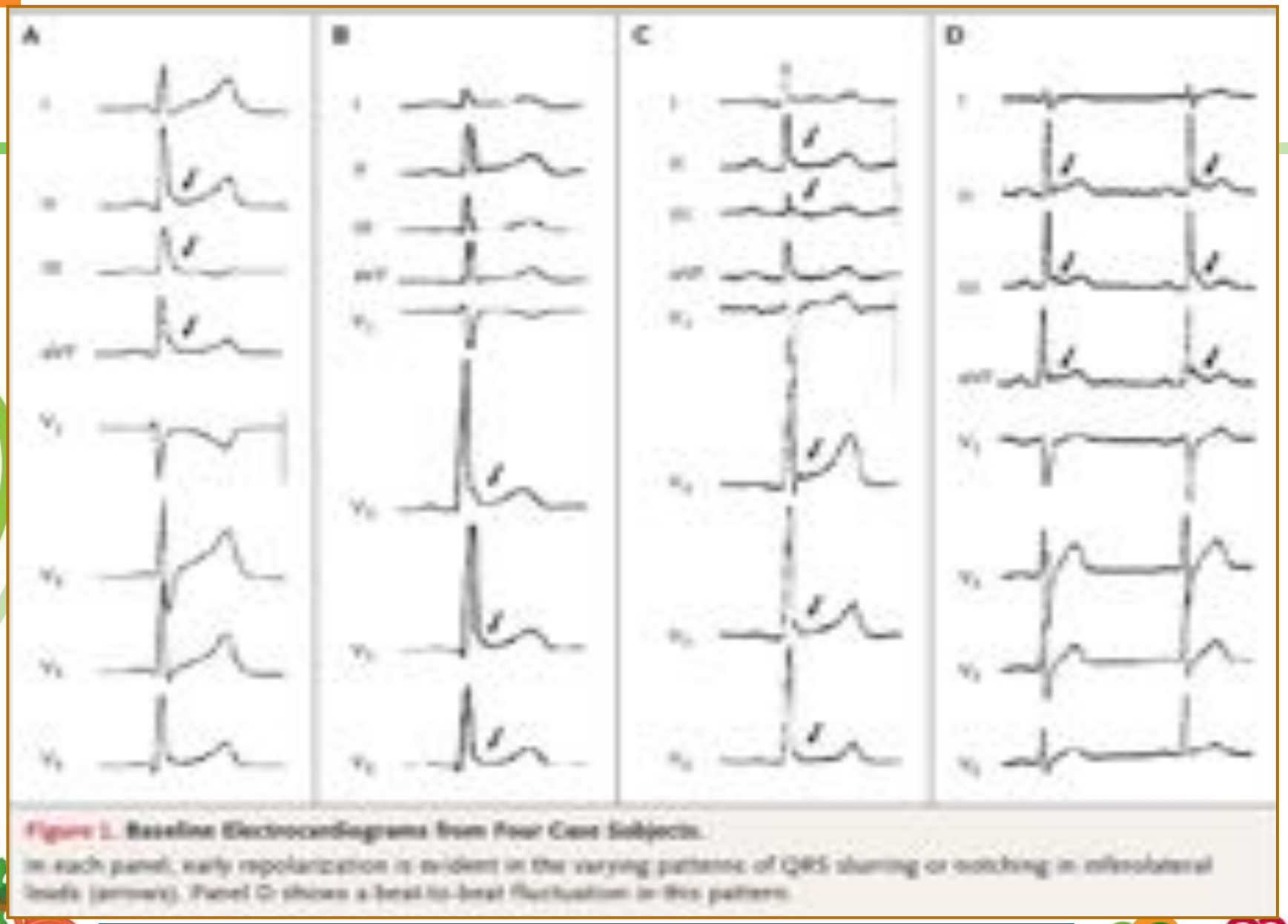
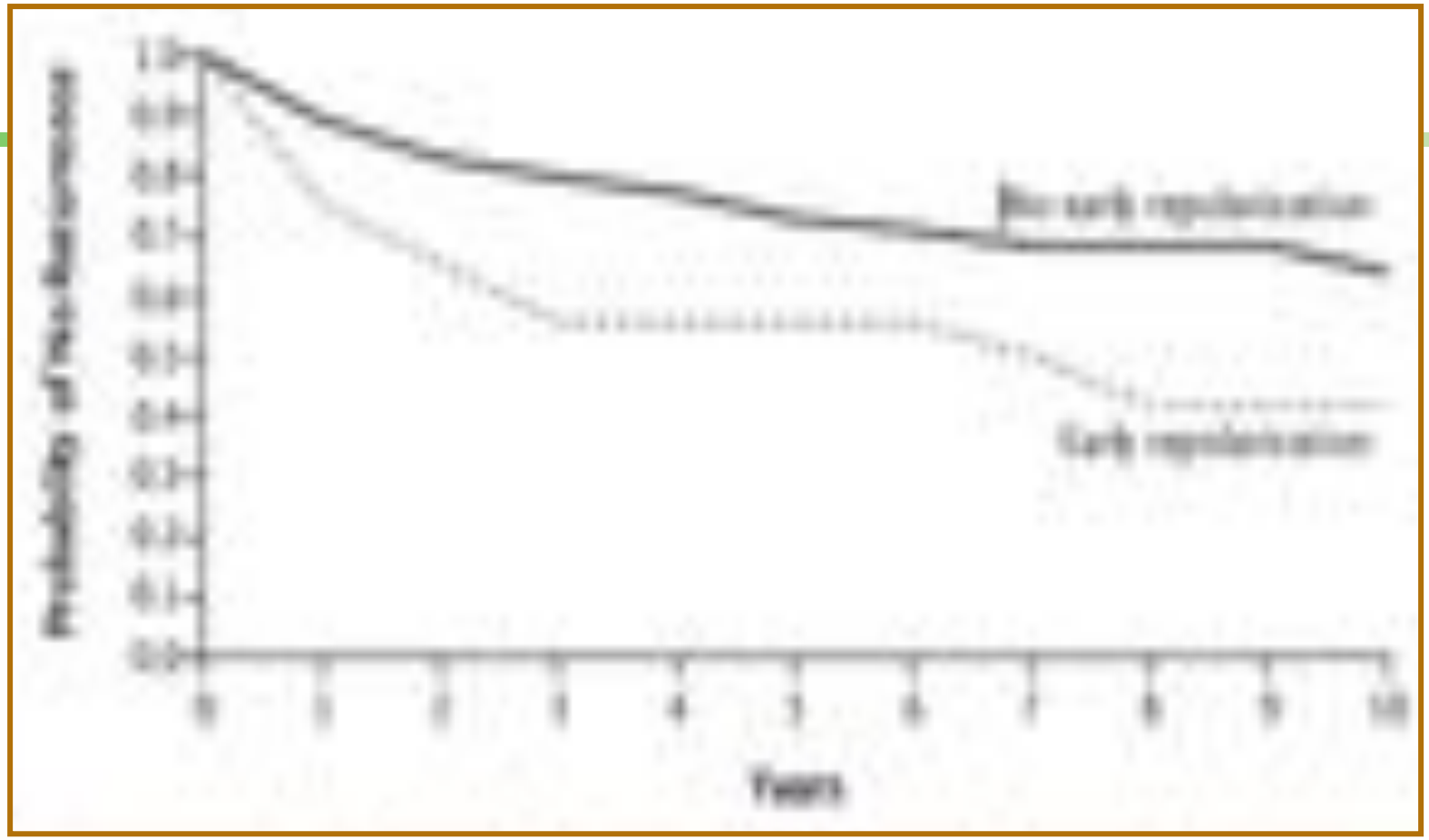


Figure 1. **Baseline Electrocardiograms from Four Case Subjects.**

In each panel, early repolarization is evident in the varying patterns of QRS slurring or notching in mid-to-lateral leads (arrows). Panel D shows a beat-to-beat fluctuation in this pattern.

Haïssaguerre M et al. NEJM 2008; 358: 2016-23



During a 5-year follow-up period, ICD monitoring showed higher incidence of recurrent ventricular fibrillation in subjects with J-wave/QRS slurring.

Haïssaguerre M et al. NEJM 2008; 358: 2016-23

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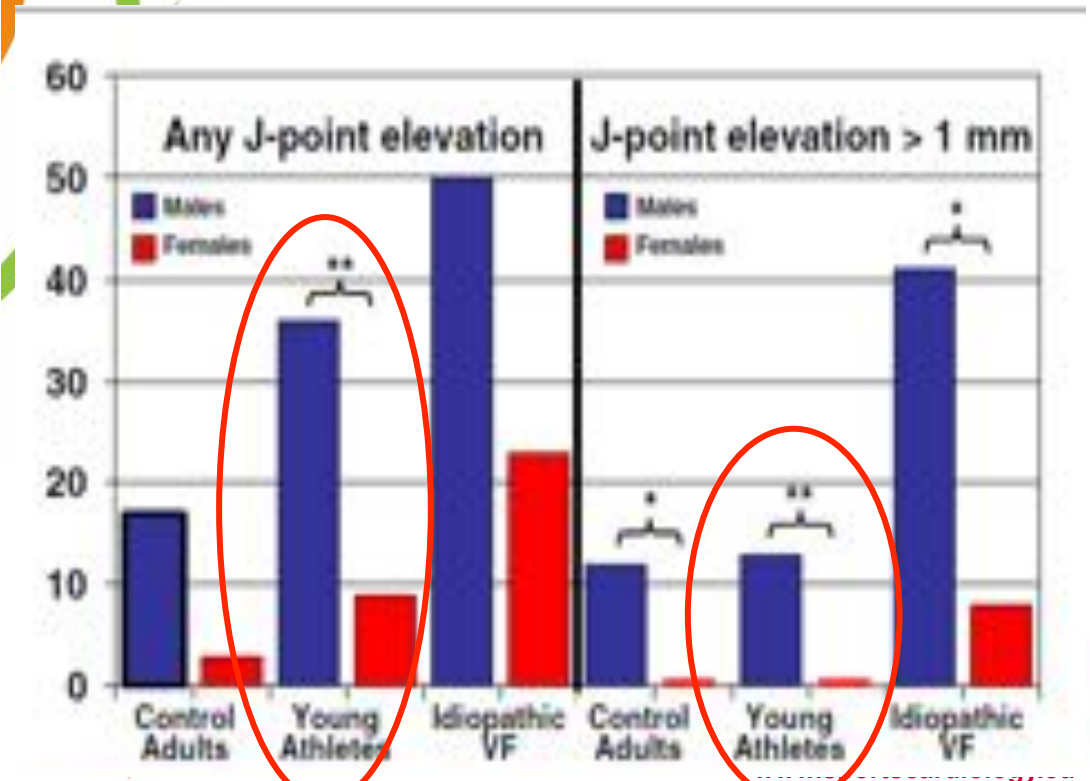
J-Point Elevation in Survivors of Primary Ventricular Fibrillation and Matched Control Subjects

Incidence and Clinical Significance

Raphael Rosso, MD,* Evgeni Kogan, MD,* Bernard Belhassen, MD,* Uri Rozovski, MD,* Melvin M. Scheinman, MD,§ David Zeltser, MD,* Amir Halkin, MD,* Arie Steinvil, MD,* Karin Heller, MD,* Michael Glikson, MD,† Amos Katz, MD,‡ Sami Viskin, MD*



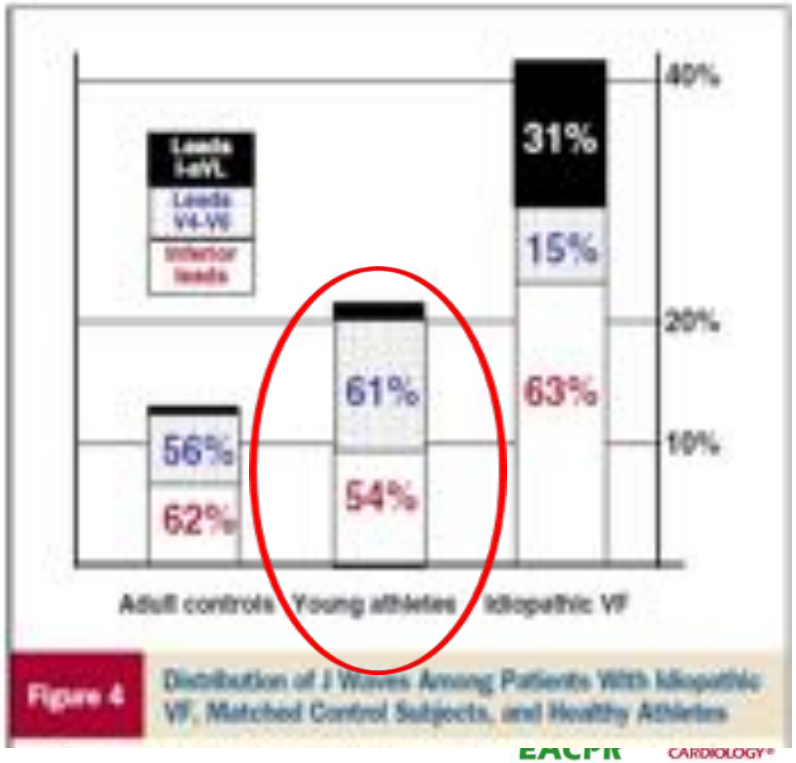


Figure 4 Distribution of J Waves Among Patients With Idiopathic VF, Matched Control Subjects, and Healthy Athletes

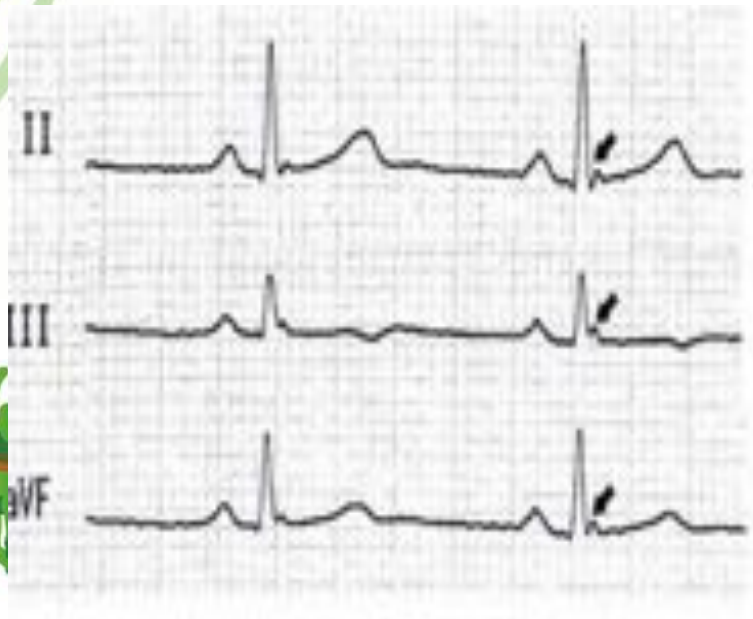
Original Articles

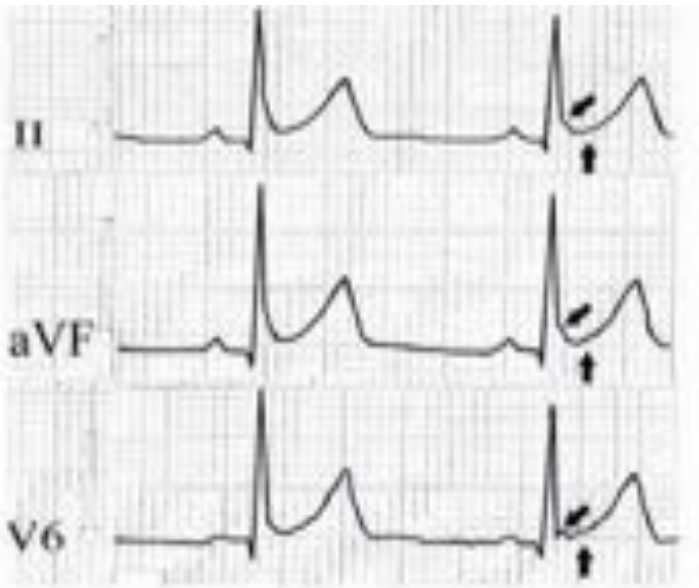
J Wave, QRS Slurring, and ST Elevation in Athletes With Cardiac Arrest in the Absence of Heart Disease

Marker of Risk or Innocent Bystander?

Riccardo Cappato, MD; Francesco Furlanello, MD; Valerio Giovannoni, MD; Tommaso Infusino, MD; Pierpaolo Lupo, MD; Mario Pittalis, MD; Sara Forti, MD; Guido De Ambroggi, MD; Hassan Ali, MD; Elisabetta Bianco, MD; Roberto Riccardoni, MD; Gianfranco Butera, MD; Cristian Ricci, PhD; Marco Ranucci, MD; Antonio Pellicia, MD; Luigi De Ambroggi, MD

J-wave/QRS slurring is more frequent in athletes with cardiac arrest/ sudden death than in control athletes

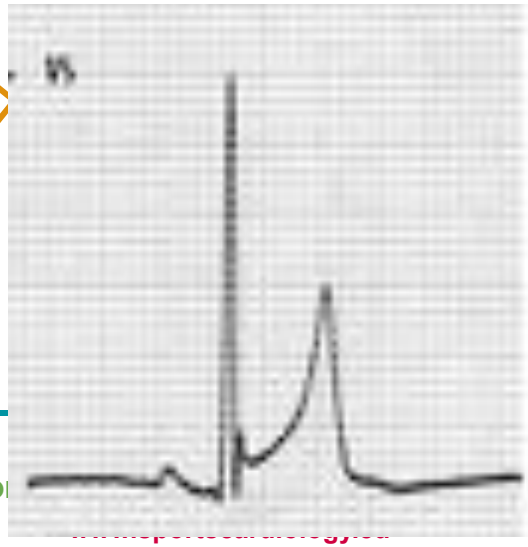




Clinical significance of J-wave/QRS slurring in athletes ?

A silent marker of an electrical cardiac disease

A benign expression of autonomic imbalance



Athlete's Study Population

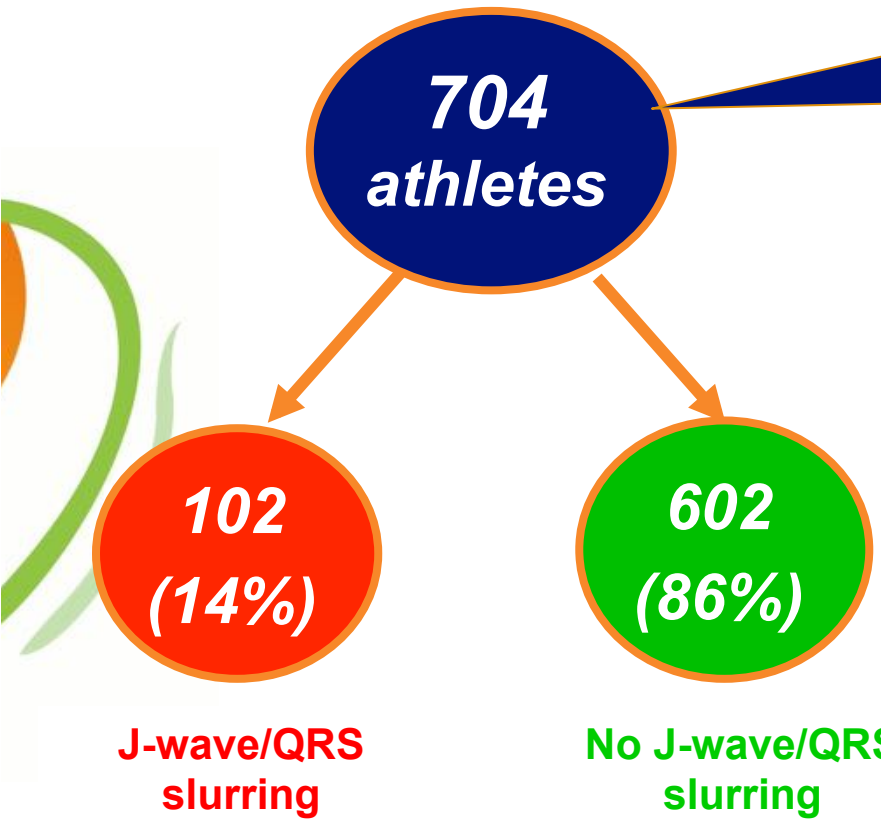
- 704 elite athletes evaluated as potential participants to the Olympics Games and/or World Championships
- 436 males (62%) and 268 females (38%)
- Mean age 25±5 (range 14-45, median 24)
- 30 different sport disciplines participated

Methods

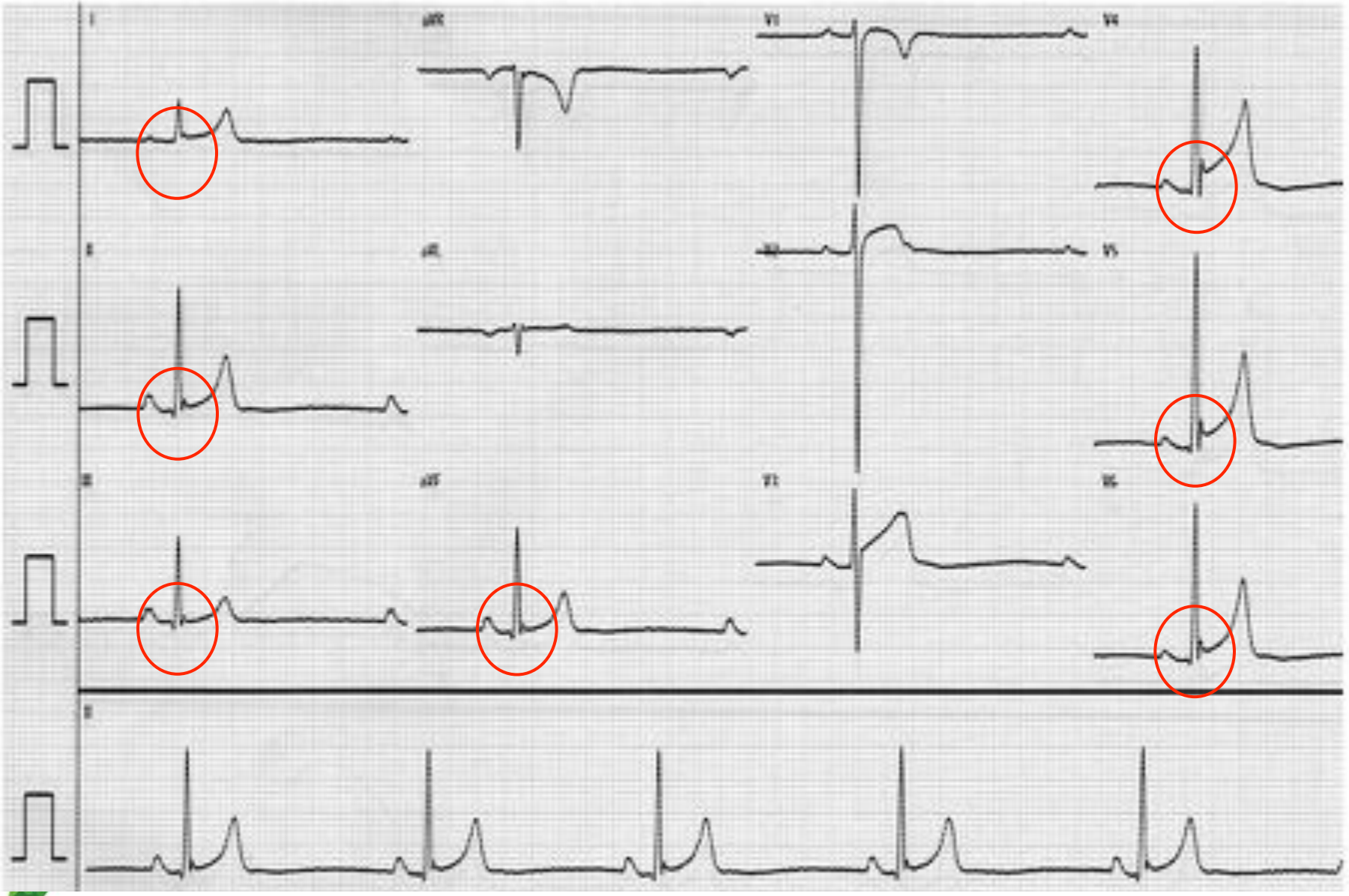
- All athletes routinely performed a 12-lead resting and exercise ECG and Echocardiography.
- Athletes with supraventricular or ventricular arrhythmias on 12-lead ECG, or with history of palpitations, underwent 24-hour ECG Holter monitoring, which included their daily training session.

Results

80% were elite athletes and 26% participated at ≥1 Olympic Games



- *Rowing/Canoeing*
- *Mid-long-distance running*
- *Swimming*
- *Road-cycling*
- *Basketball*
- *Volleyball*



12-lead ECG from a 24-year male, elite swimmer, at 2012 pre-Olympic screening

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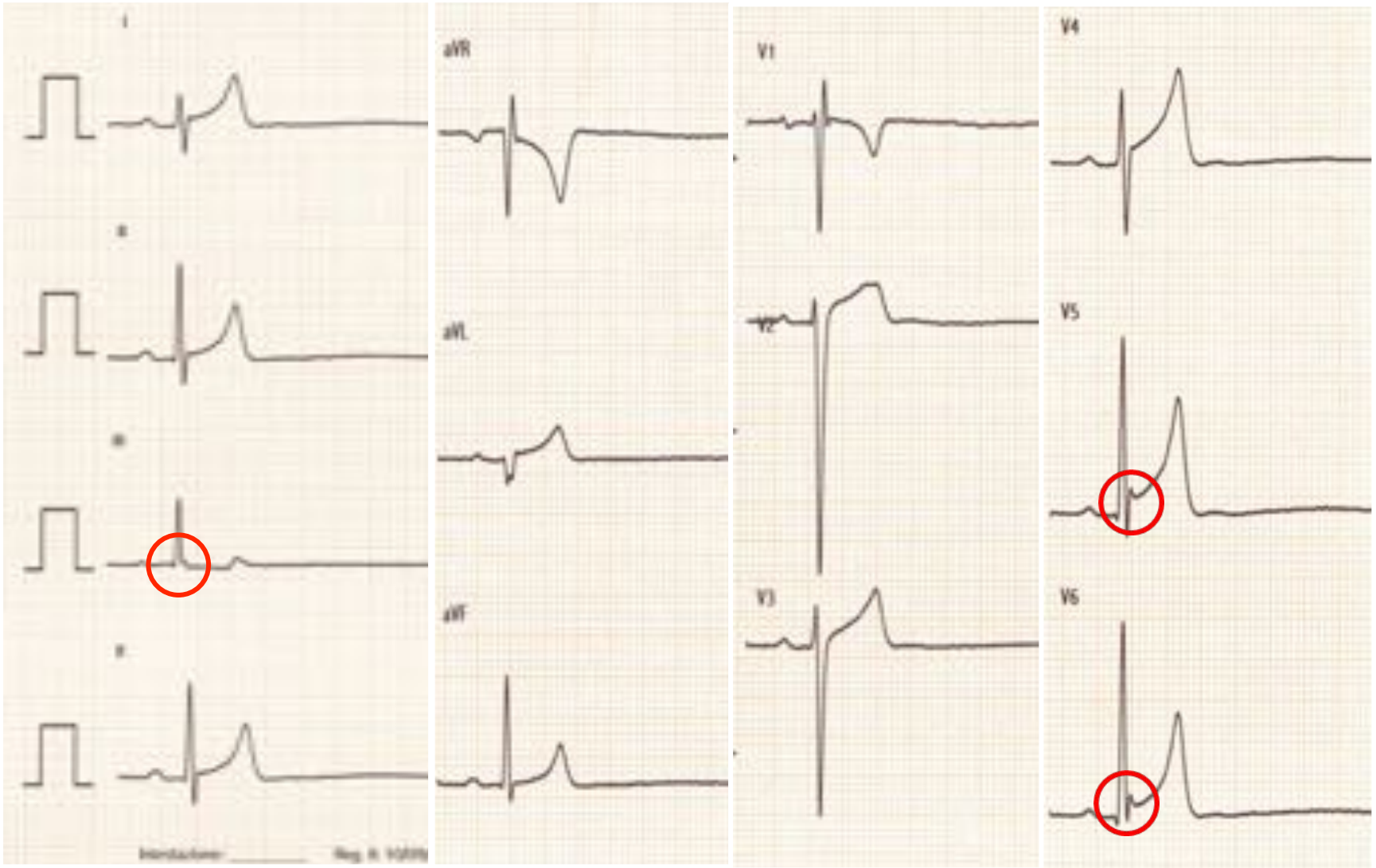

12-lead ECG from a 28-year male, elite cross-country skier, at 2013 pre-Olympic screening

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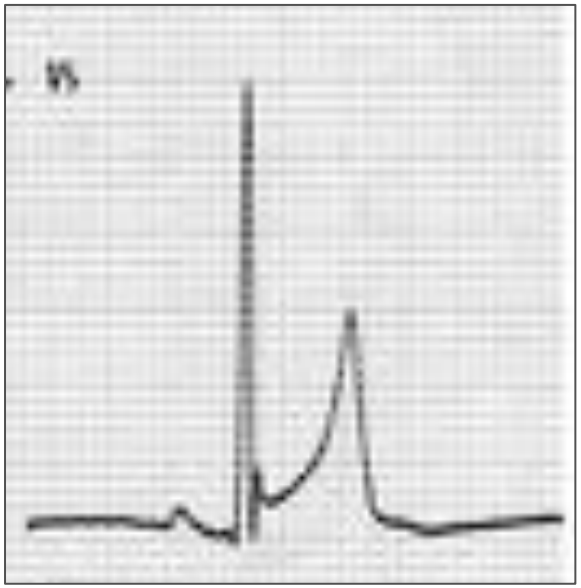
Distribution of J-wave/QRS slurring in 102 athletes



73 (72%)

anterior + lateral + inferior

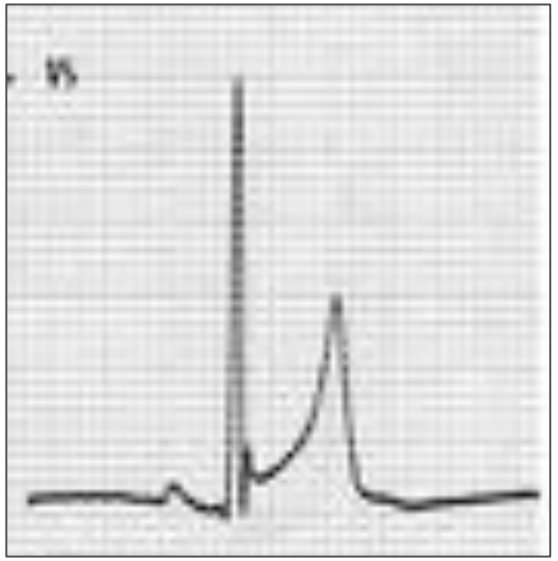
26 (25%)

Lateral

3 (3%)

Inferior

Pattern of ST-segment in 102 athletes with J-wave/QRS slurring



86 (84%)

ascending

18 (16%)

horizontal

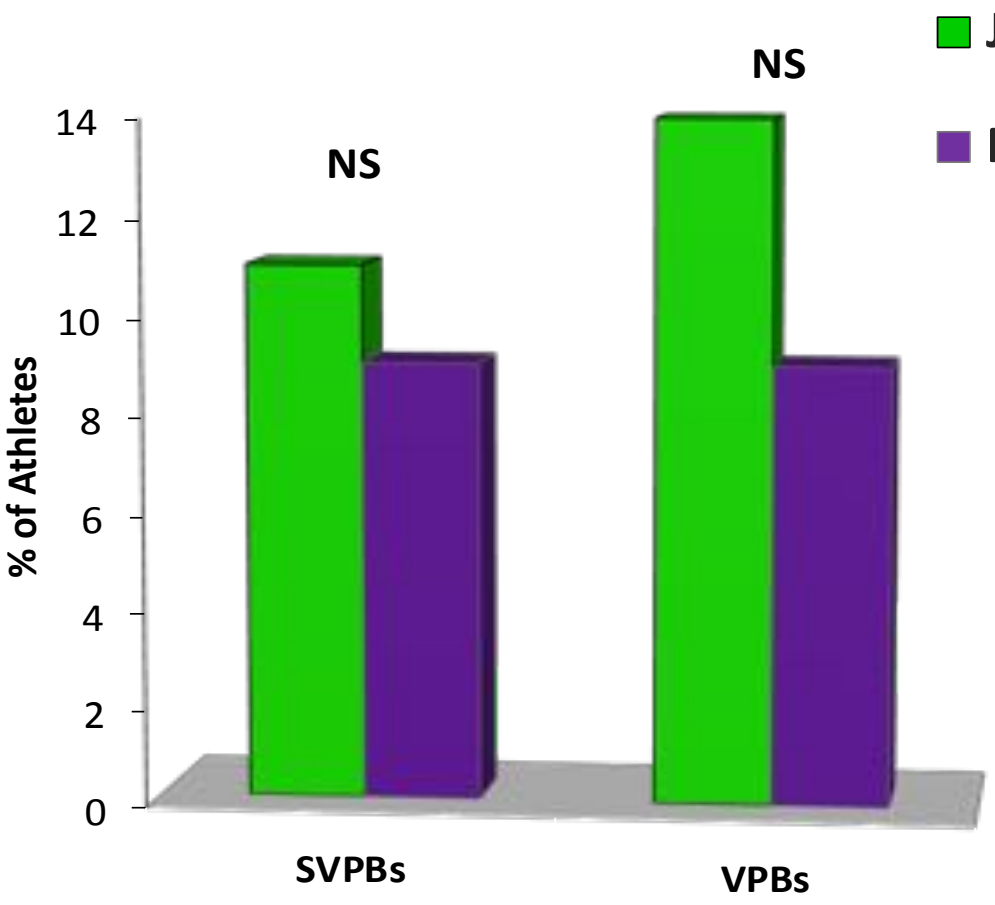
0 (0%)

descending

12-lead ECG characterization

	Athletes J-wave/QRS slurring (n = 102)	Athletes without J-wave/ QRS slurring (n = 602)	p value
Age (yrs)	25.0±4.9	25.2±5.4	ns
Male gender (%)	83 (74%)	380 (59%)	<0.01
BSA (m2)	1.90±0.20	1.92±0.24	ns
BP (mmHg)	116±9/75±7	117±10/75±7	ns
Heart rate (bpm)	54±10	58±11	<0.01
QRS duration (s)	0.093±0.010	0.093±0.012	ns
Sokolow criteria for LVH	78 (76%)	184 (31%)	<0.001
ST-segment elevation (n; %)	86 (84%)	400 (66%)	<0.001
Q-waves (n; %)	30 (27%)	91 (14%)	<0.001
Inverted T-waves (n; %)	6 (5%)	19 (3%)	ns
IRBB (n; %)	28 (25%)	236 (37%)	<0.05
PR interval (s)	0.16±0.03	0.16±0.03	ns
QTc interval (s)	0.40±0.03	0.40±0.02	ns

Arrhythmias



Athletes with J wave /QRS slurring

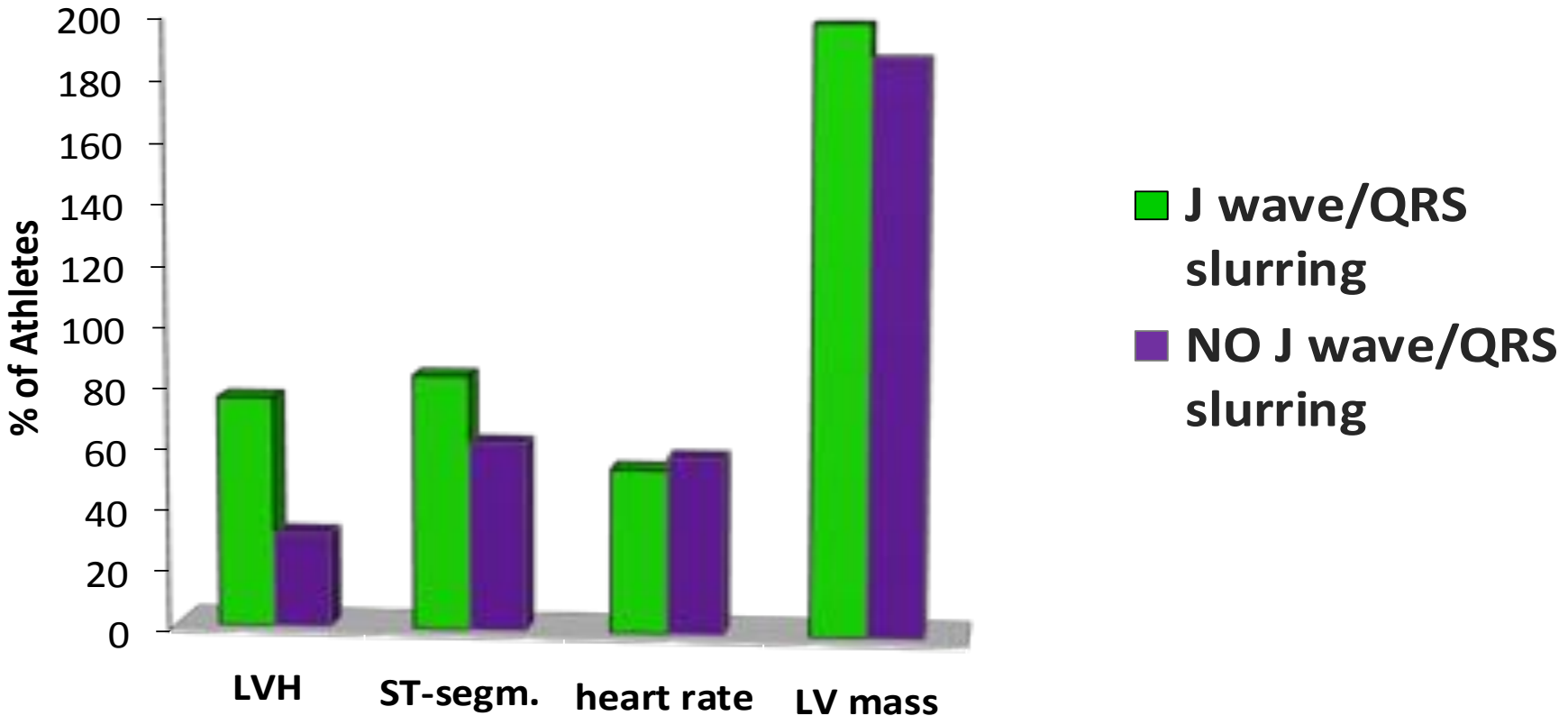
VPBs: n=14;
11 with isolated PVBs
3 with couplets.
None with VT

SVPBs: n= 11
Only isolated SVPBs

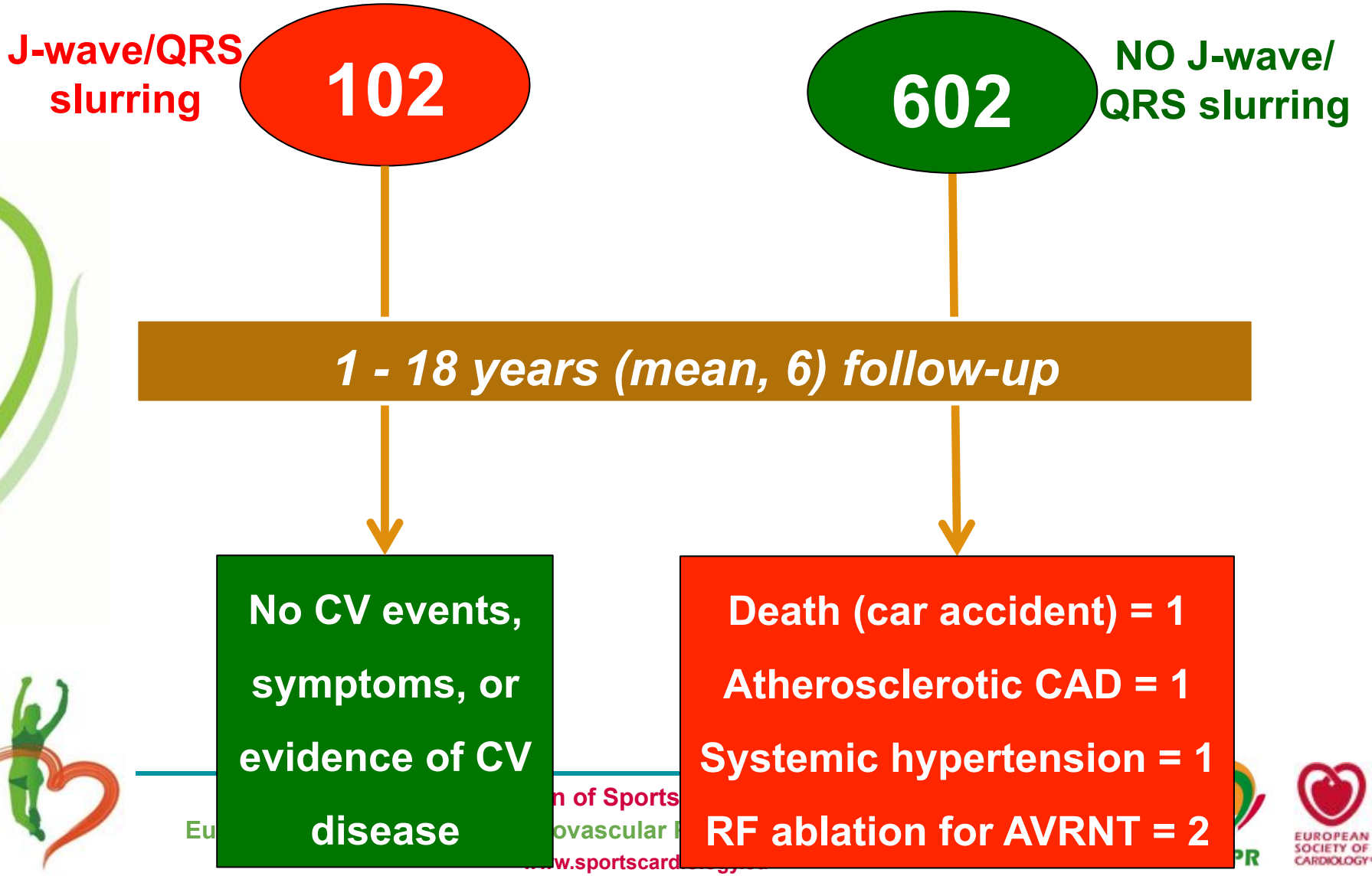
Echocardiographic characterization

	Athletes J-wave/QRS slurring (n = 102)	Athletes without J-wave/QRS slurring (n = 602)	p value
LV cavity dimension (mm)	53.5±3.9	52.7±4.8	<0.05
Max LV Wall thickness (mm)	10.1±1.2	9.8±1.3	<0.01
LV Mass (g)	199±48	188±56	<0.05
Left atrium (mm)	35.4±4.1	34.9±4.3	ns
PW E-wave (mm/s)	88±14	87±16	ns
PW A-wave (mm/s)	46±9	47±10	ns
TDI e-wave (mm/s)	14.1±2.2	13.9±2.3	ns
TDI a-wave (mm/s)	7.0±1.7	7.3±1.8	ns
TDI s-wave (mm/s)	9.2±1.1	9.1±1.3	ns
EF (%)	64±5	64±5	ns

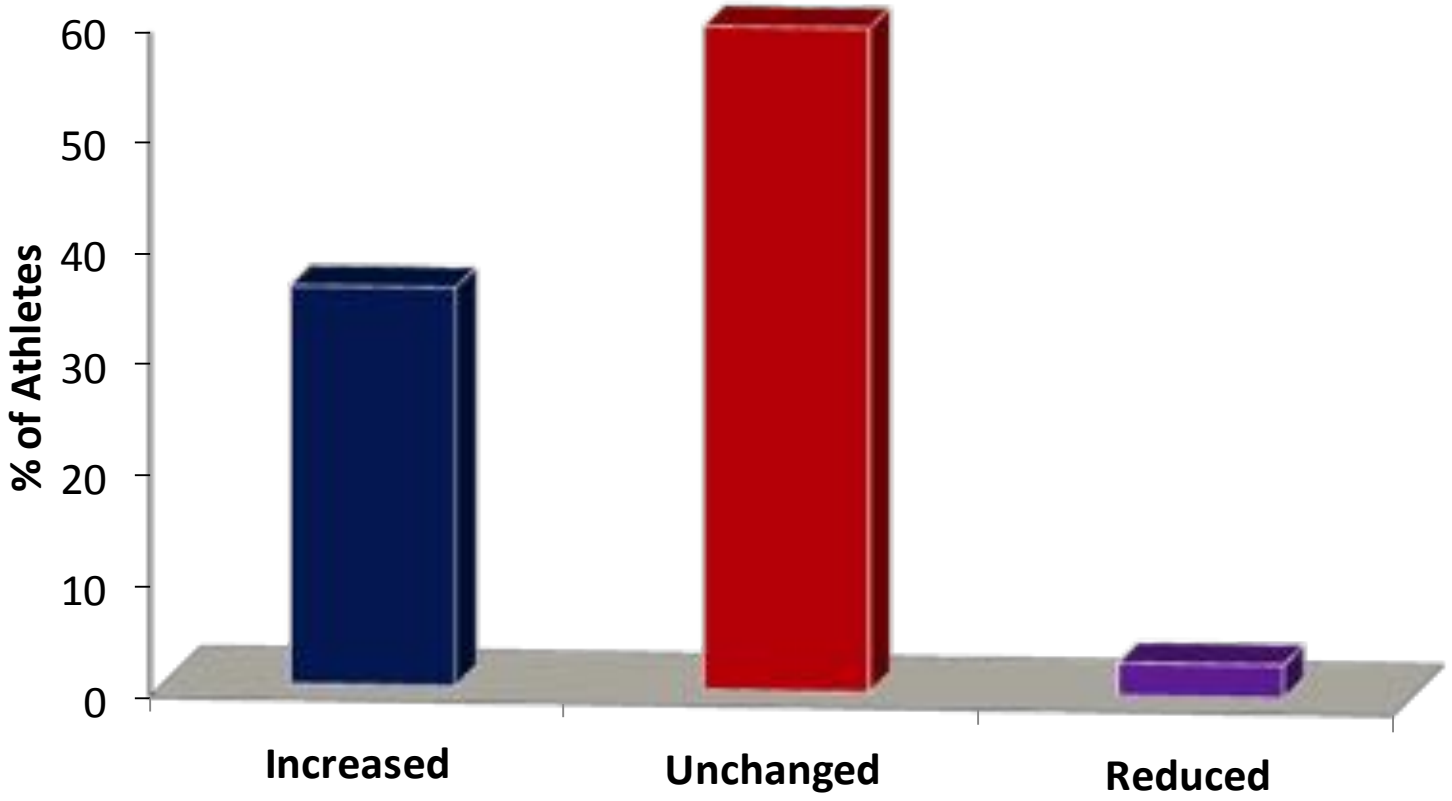
ECG/Echo features



Clinical Outcome



J wave/QRS slurring changing over time



38% of athletes showed increased height/distribution of J-wave/ QRS slurring pattern, associated with reduction of heart rate, in comparison to those without changes.

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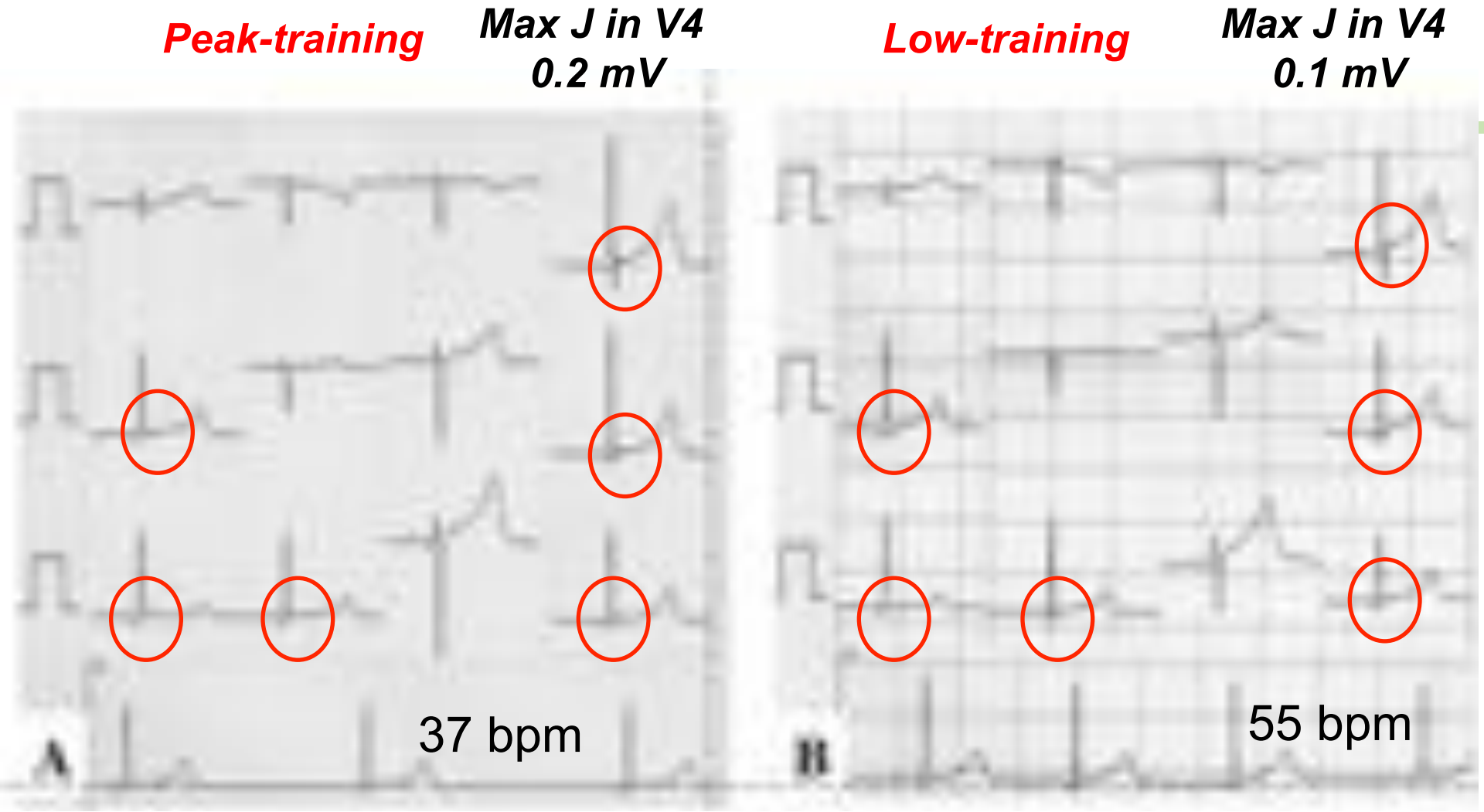


27-year old female middle-distance runner at the time of the peak training (**Panel A**) and after detraining (**Panel B**).

Low training (68 bpm)

Peak-training (58 bpm)

12-lead ECG in a 20-year old male rower at (C) low-level training and (D) at peak-training

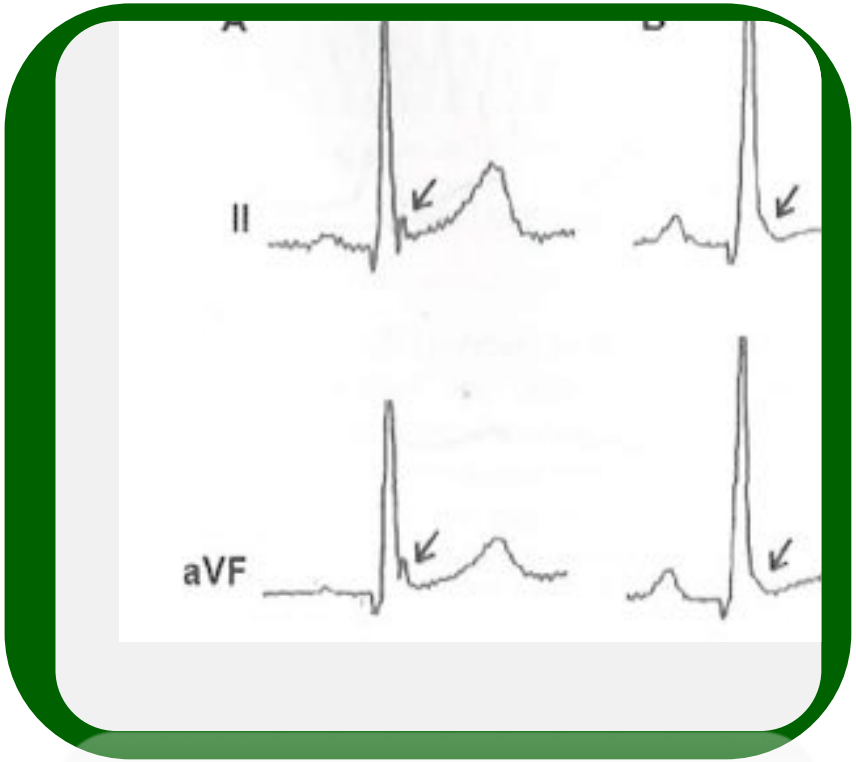
Clinical implications

Characteristics of benign *vs.* malignant early repolarization

Characteristics of benign ER

(Pelliccia and Quattrini, Heart Rhythm 2015)

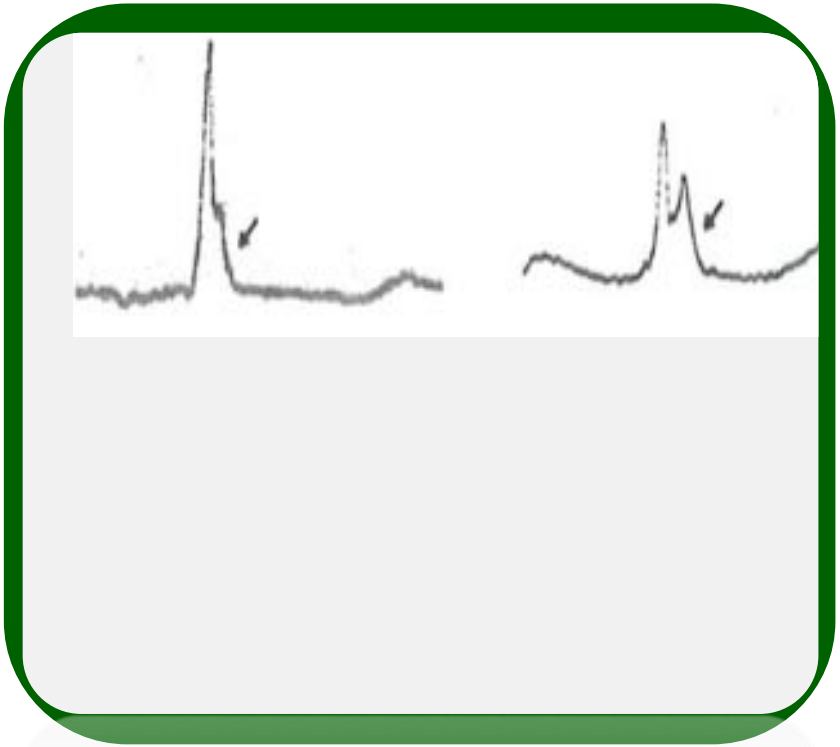
- Distribution in anterior and lateral leads
- Low amplitude of J-wave (≤0.2 mV)
- ST-segment morphology (ascending with positive, peaked T-wave), increased R/S-wave voltages
- Modest dynamic changes over time
- No symptoms, no family Hx of SD



Characteristics of malignant ER

(Tikkanen JT and Huikuri VH J Electrocardiol 2015)

- Distribution in inferior and lateral leads
- Amplitude of J-wave (>0.2 mV)
- Dynamic, marked changes (increased amplitude precedes VF)
- ST-segment morphology (horizontal or descending)
- Associated short-coupled PVBs
- Unexplained syncope
- Family Hx of sudden death



In conclusion,

- ER pattern in trained athletes has specific characteristics (amplitude, distribution, dynamicity, ST-segment).
- ER pattern is not associated with incidence of threatening arrhythmias or adverse clinical events over a medium follow-up period.
- Therefore, no additional testing are required in case of isolated J-wave/ST elevation in a trained athlete.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