

Arrhythmias in Athletes: When Is It Adaptation, When Is It Disease?

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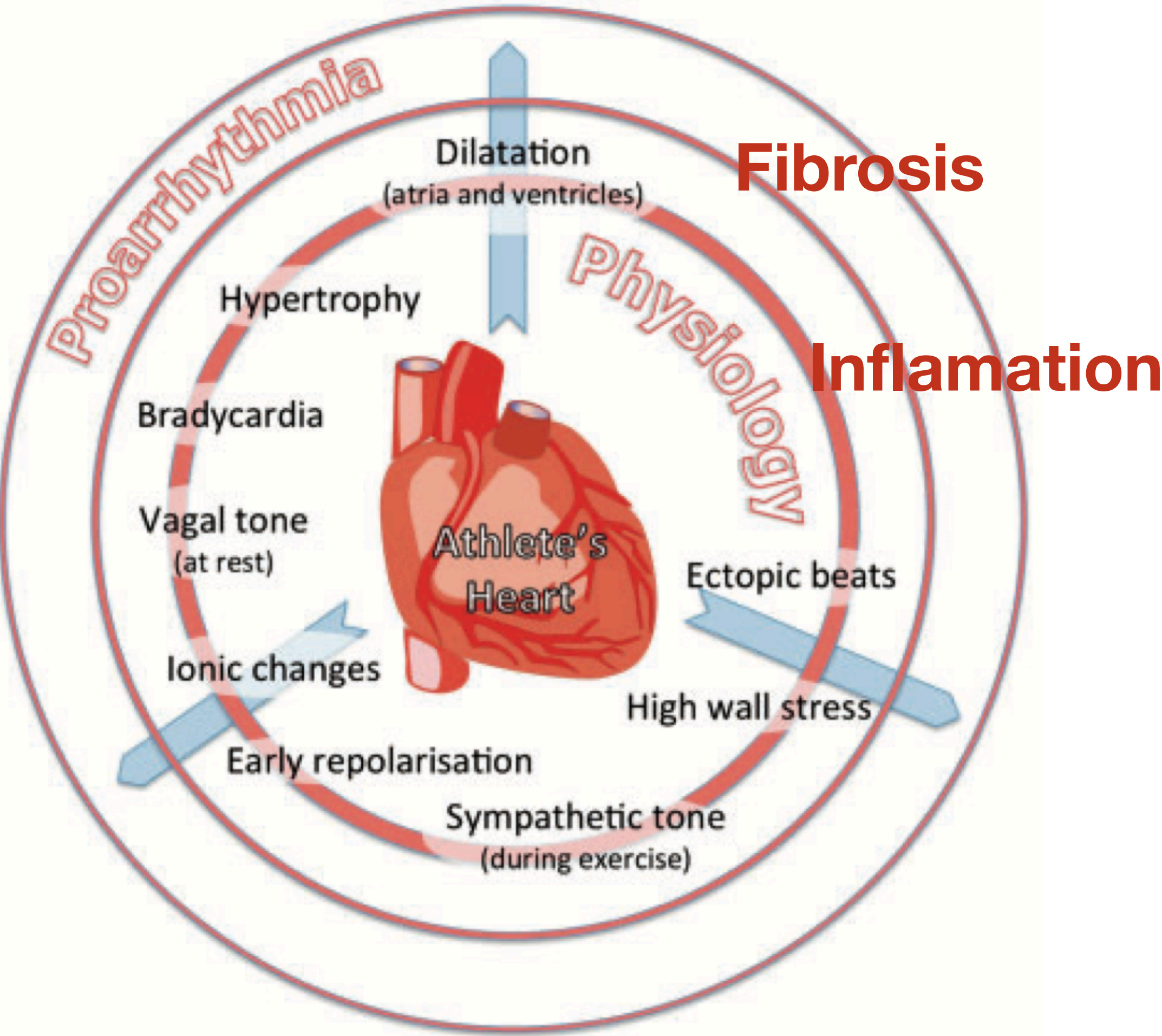
Conflicts of interest:

- I have received honoraria from Boston Scientific, Abbott, Medtronic.
- These relationships had no influence on the content of this presentation.
- AI-assisted tools were used for aesthetics purposes; no AI was used in the creation or development of the content.



Exercise: Friends and Foe

Exercise induced proarrhythmic mechanisms



TRIGGERS (Acute)	POTENTIAL ARRHYTHMIC OUTCOMES	ADDITIONAL RISK WITH UNDERLYING HEART DISEASE
⚡ Sympathetic tone 💧 Dehydration ⚖️ Electrolyte imbalance ⚖️ pH disturbance ☀️ Environment stress 💉 Doping substances ⚔️ Autonomic imbalance	❤️ AF 📶 Supraventricular arrhythmias 📶 PVC 📶 Ventricular arrhythmias 📶 Exercise-induced Arrhythmogenic cardiomyopathy?	📶 STRUCTURAL HEART DISEASE • HCM • Arr.cardiomyopathy • Myocarditis • LV scar... 📶 ELECTRICAL HEART DISEASE • Long QT sdr • CPVT • WPW • Idiopathic VF ⬆️ ↑ RISK OF MALIGNANT ARRHYTHMIAS AND SUDDEN CARDIAC DEATH

How to approach arrhythmias in athletes

 AMBIGUOUS SYMPTOMS	 KEY TESTS	 MANAGEMENT	 UNNECESSARY SPORT RESTRICTION
● Asymptomatic ● Palpitations ● Dizziness ● Chest pain ● Dyspnea ... ● Performance drop!!!	● ECG ● Holter with training session ● Maximal exercise testing ● Wearables... ● Blood test ● Imaging ● EP study ● Genetic test	GOALS: ● Symptoms control ● Prevent disease progression ● Allow safe sport practice Ablation > Medication	Over-restriction: ● Psychological impact ● Reduction of quality of life ● Deconditioning Individualized decisions based on: ● Arrhythmia substrate ● Response to treatment ● Arrhythmia burden ● Shared decision-making



Benign training-related rhythm disorders

- Enhanced vagal tonus
- Related to endurance sports
- Dose-dependent (cumulative training volume)
- Circadian rhythm
- Conduction normalization with light exercise or hyperventilation
- **Proportional, coherent and reversible**

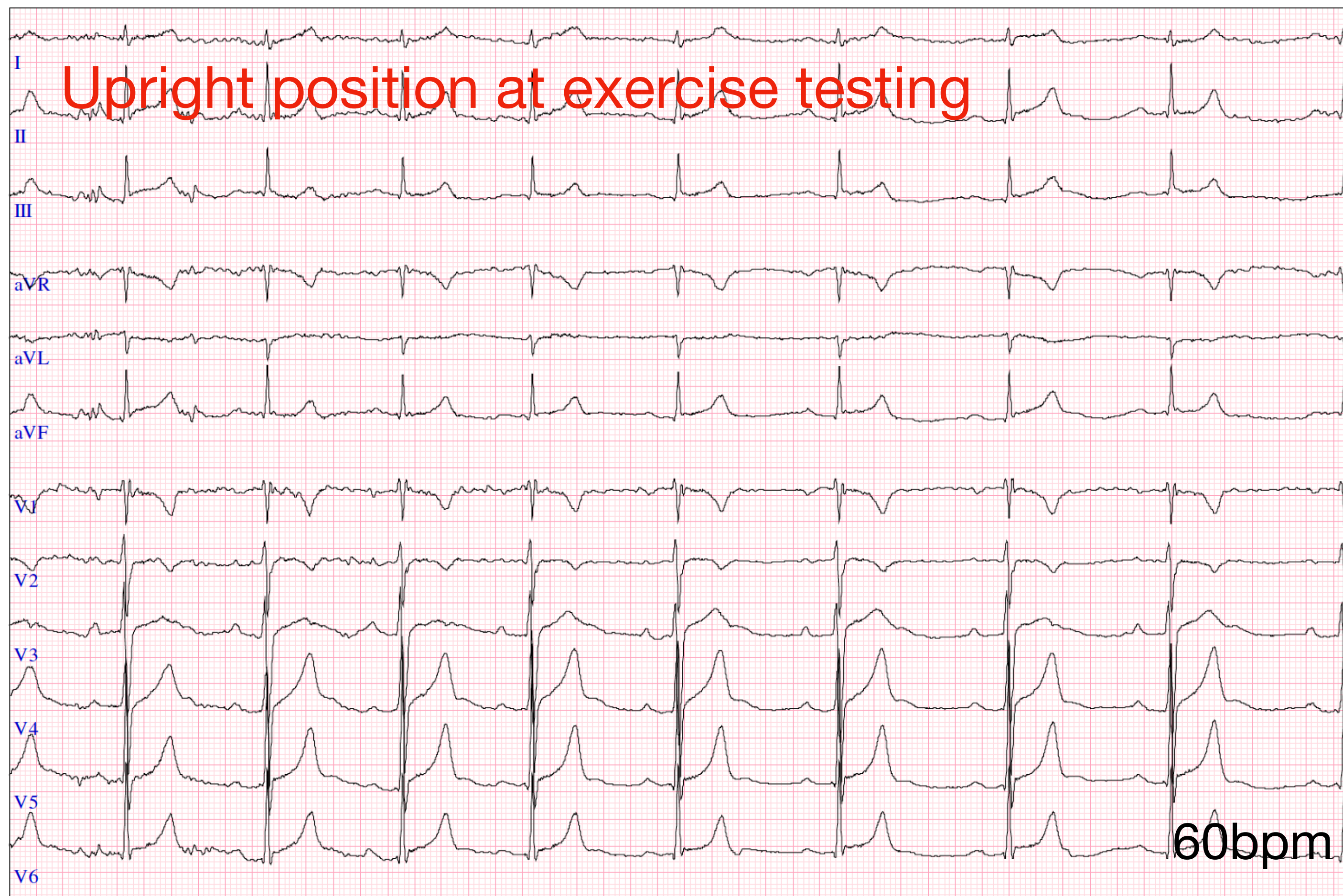
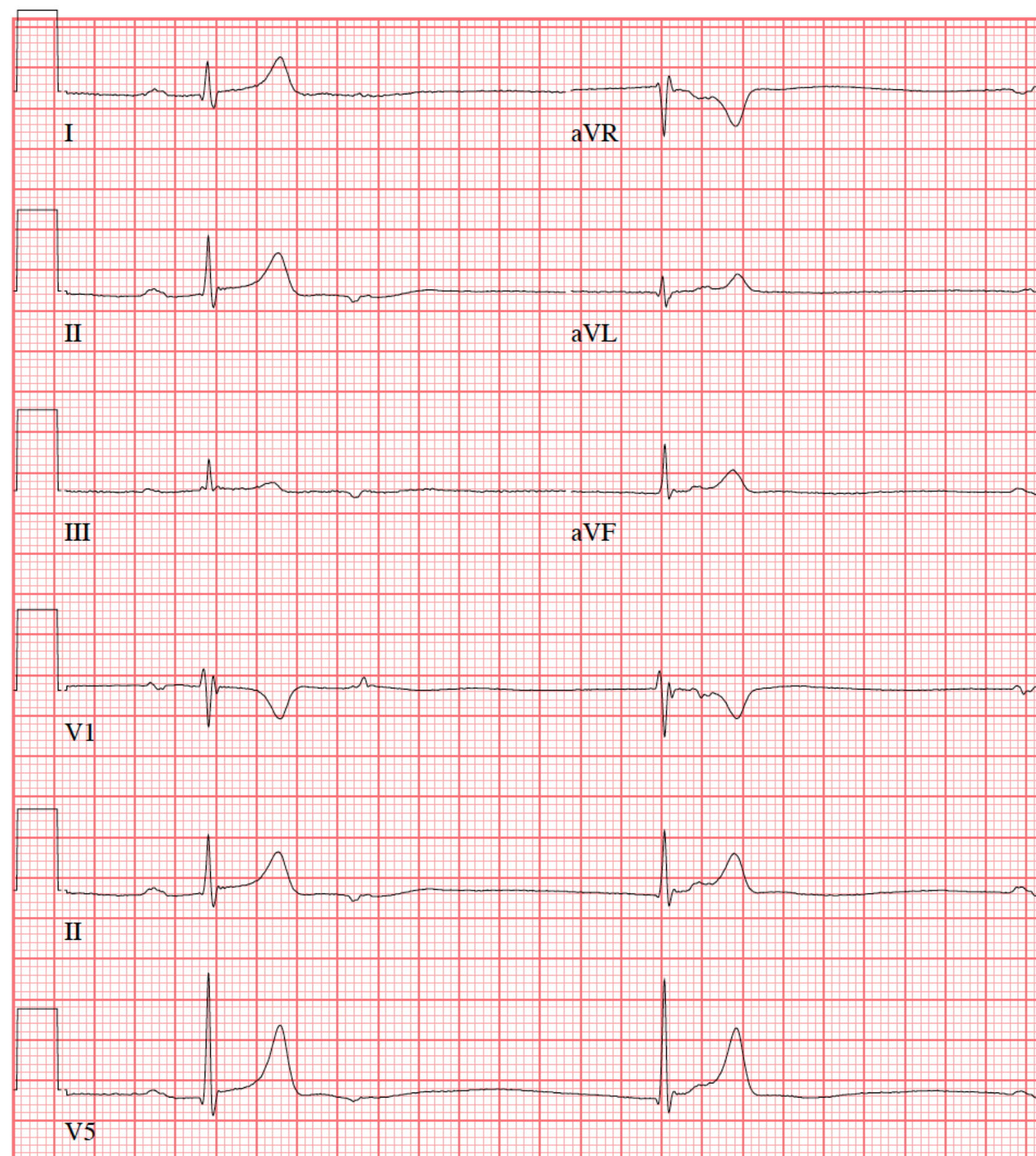
Common benign findings

- Sinus bradycardia
- Sinus pauses <3 seconds
- Respiratory sinus arrhythmia
- Wandering atrial pacemaker
- Low atrial rhythm
- Junctional rhythm
- First-degree AV block
- Mobitz I AV block

SUPRAHISIAN CONDUCTION ALTERATIONS



43 yo master cyclist, asymptomatic



When should bradycardia worry us?

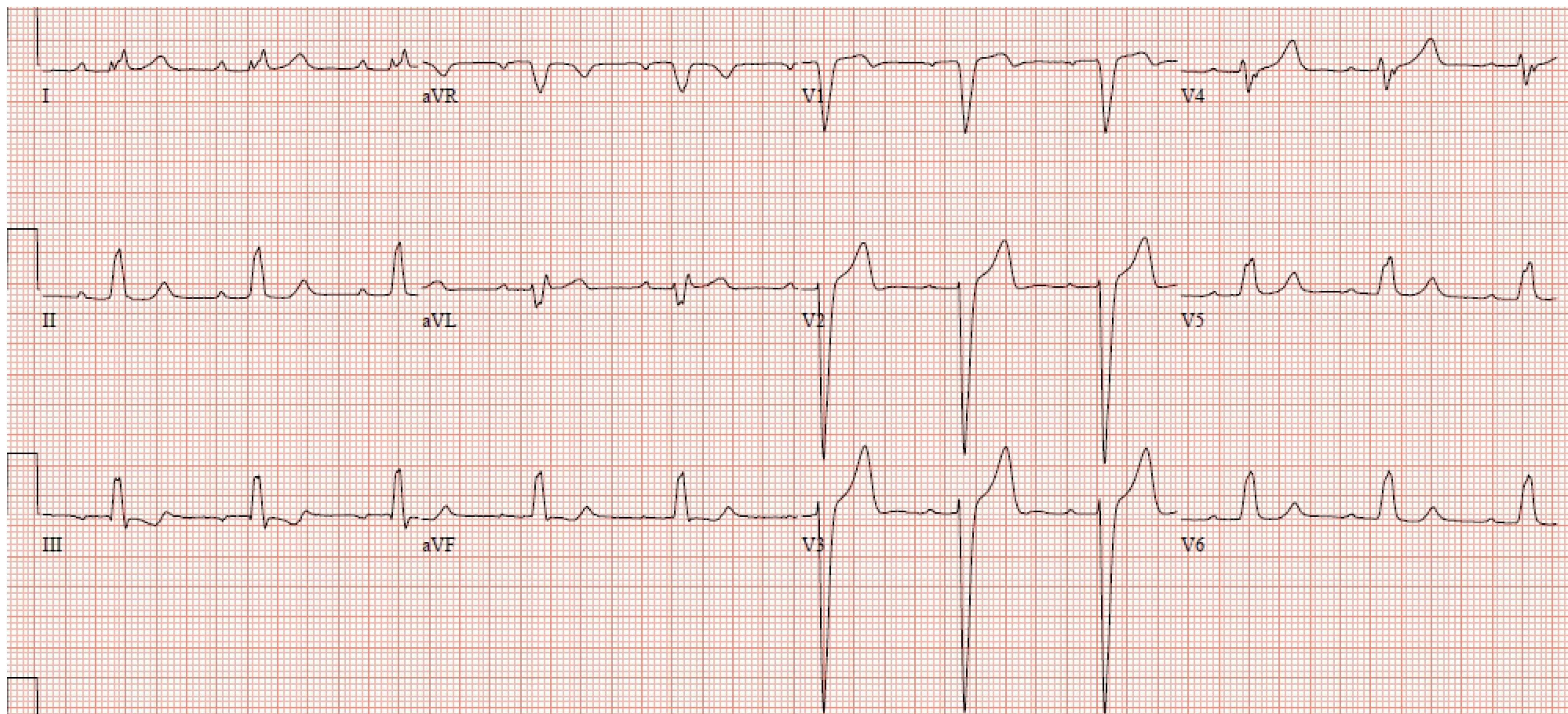
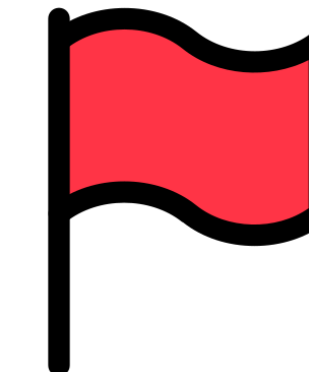


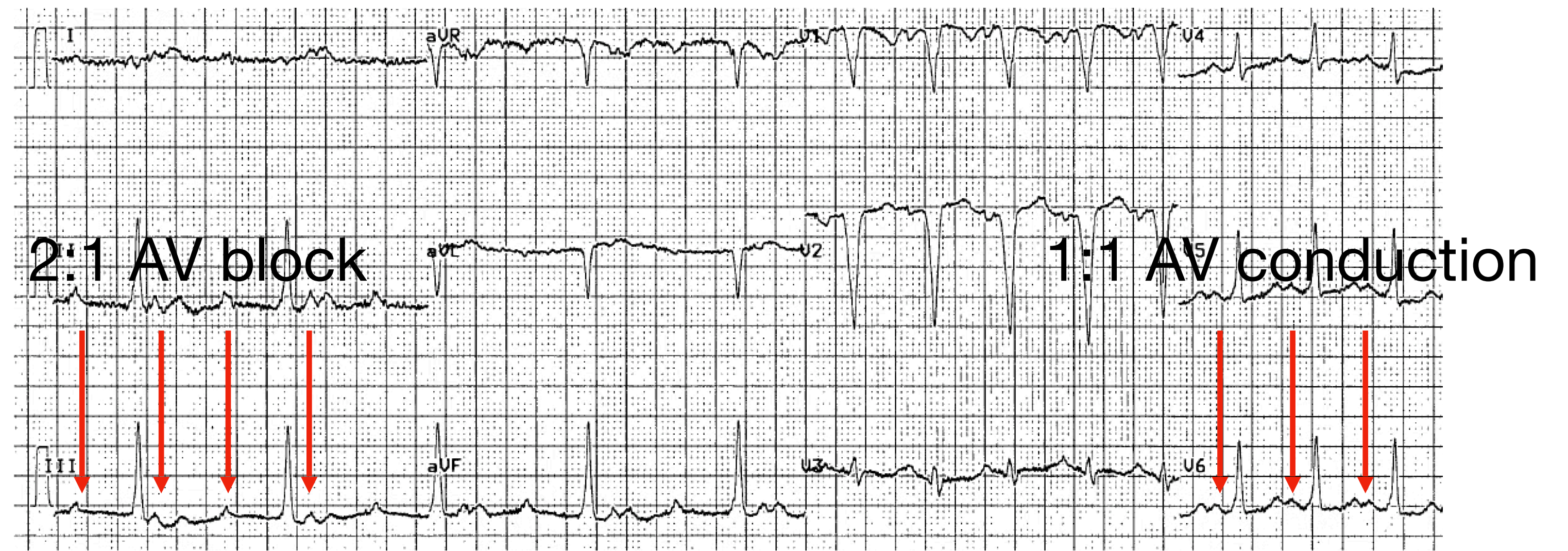
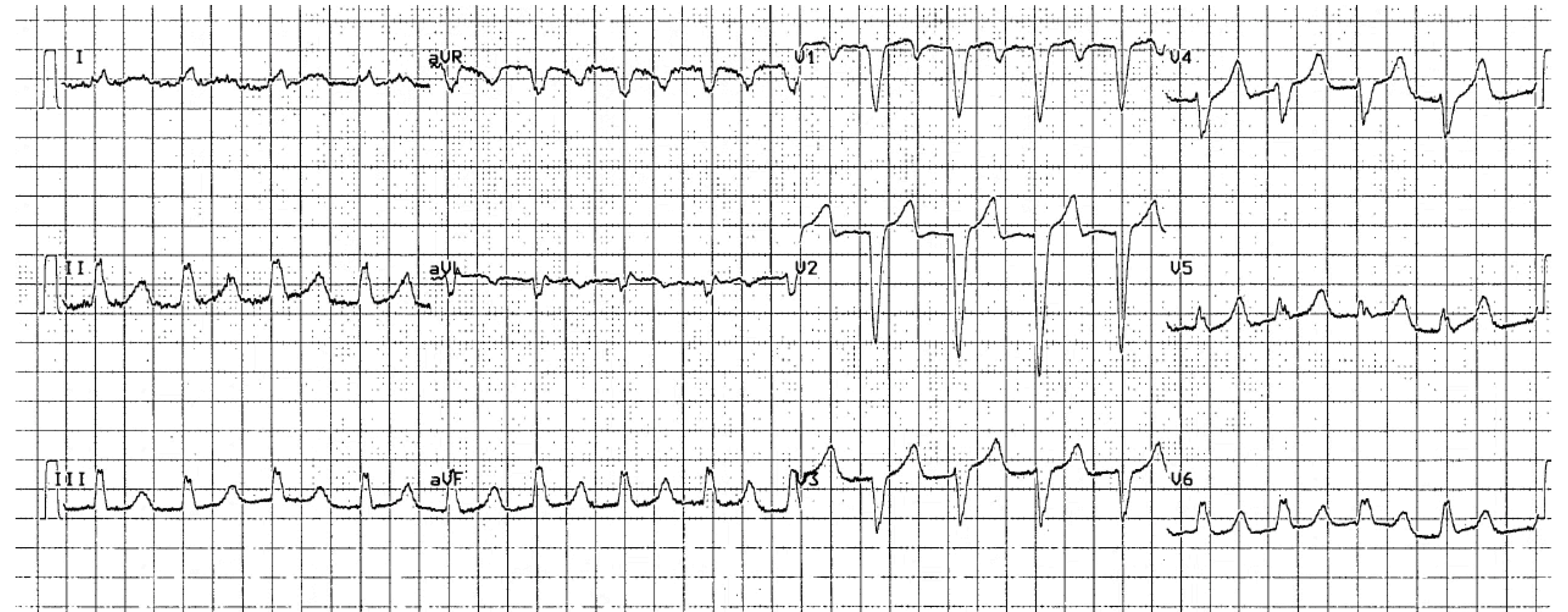
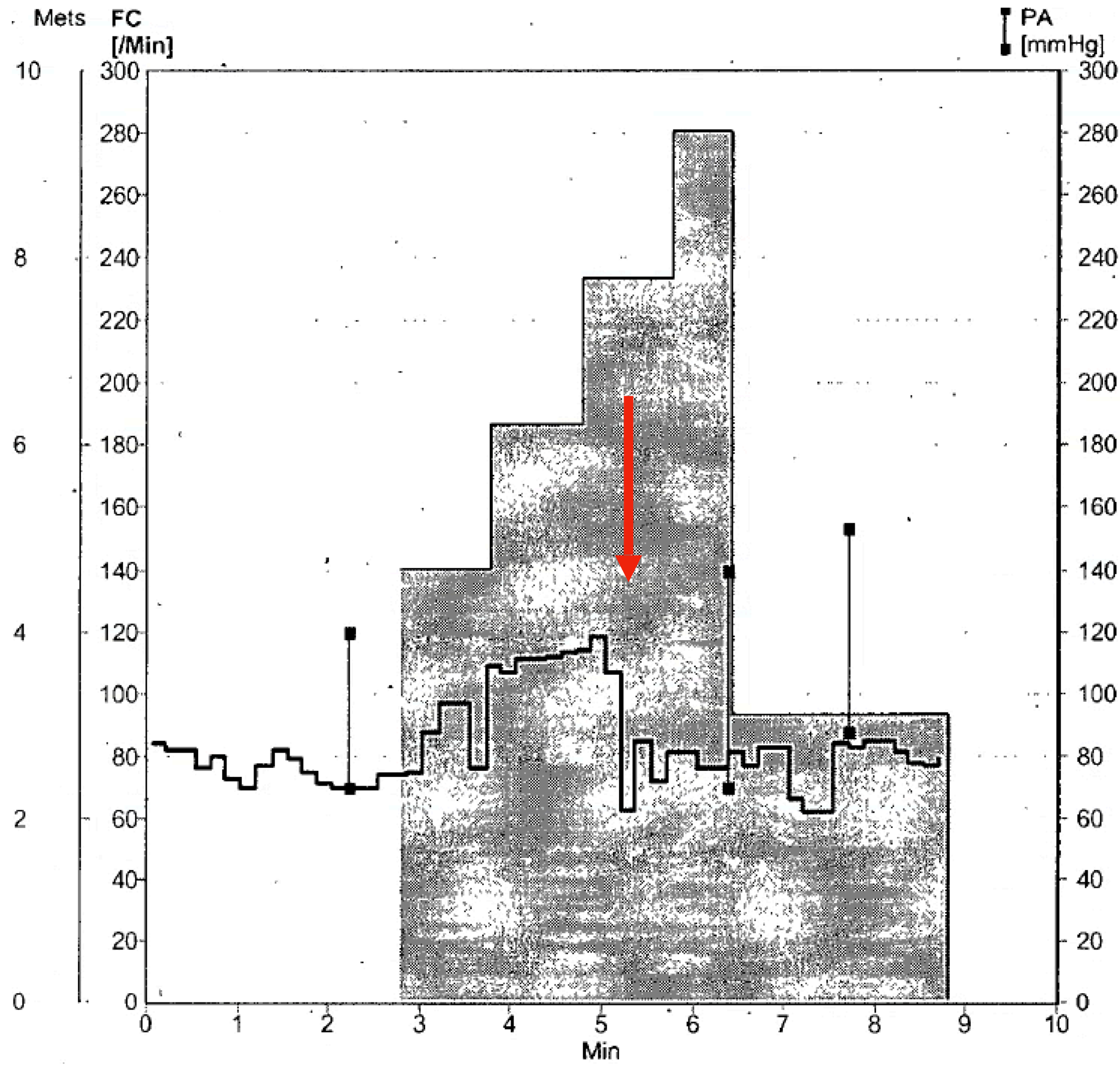
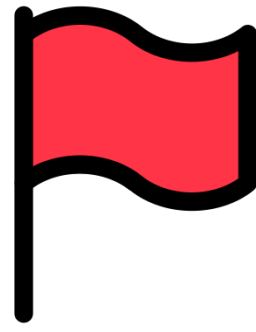
- Sinus bradycardia $< 30\text{bpm}$ during day
- Sinusatrial block/pause $> 3''$
- PR $> 400\text{ms}$ ($> 300\text{ms}$ children)
- Persistent Mobitz I not improved by exercise testing
- Advanced AV block, broad QRS
- Symptoms?
- Doping? Eating disorders? Overtraining? Disease?

Complete study and follow-up



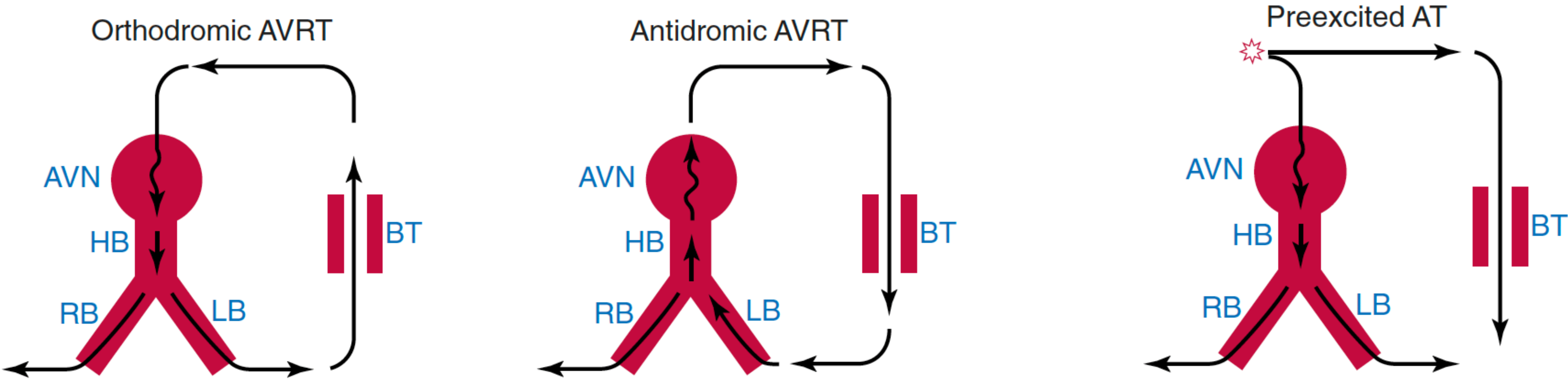
34yo woman, climber
Performance drop





Conduction impairment with exercise

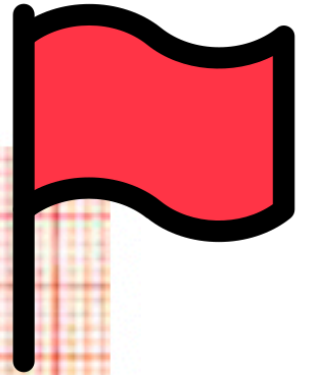
Wolff-Parkinson-White pattern/syndrome



Down through AVN/up through BT	Down through BT/up through AVN or another BT	Risk of ventricular fibrillation 1/1000/y
Narrow QRS (Except aberrant conduction)	Broad QRS	
50 %	10 %	

Wolff-Parkinson-White pattern/syndrome

Who is at high risk of SCD?

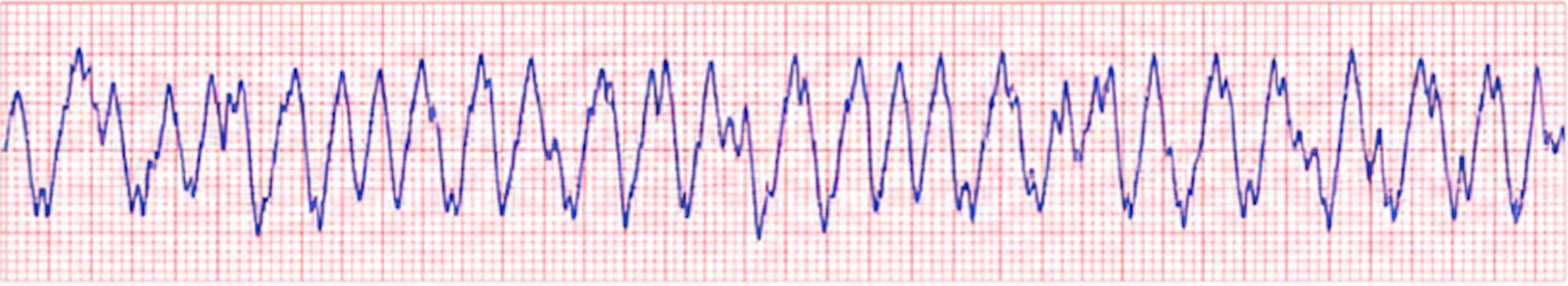
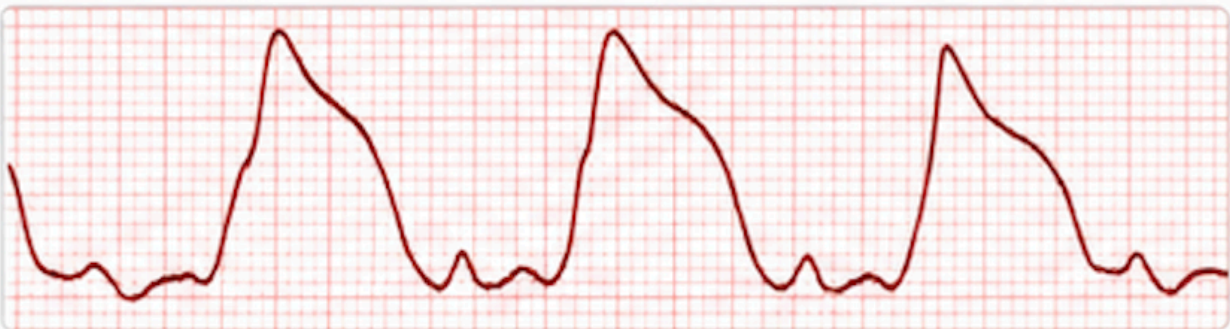
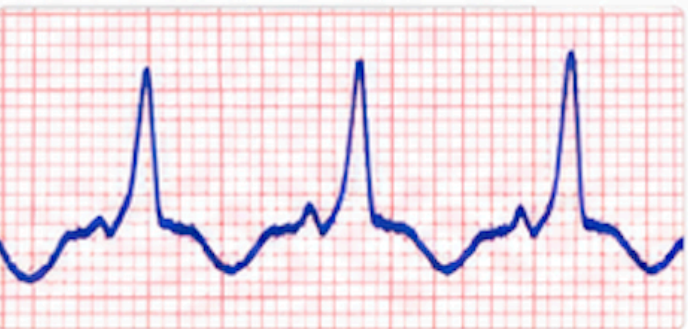
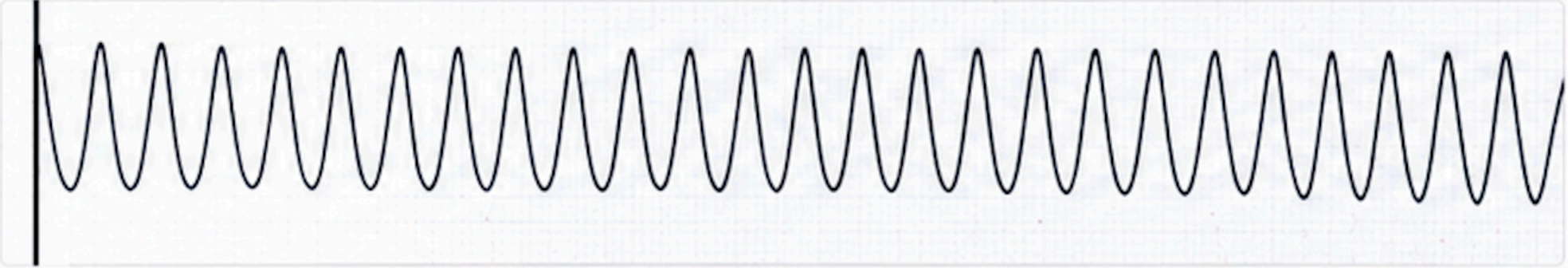


1. Young age: 10-35 years
2. Symptoms (palpitations, syncope)
3. Atrial fibrillation
4. Competitive sport
(50% SCD during exercise or stress)
5. Multiple pathways
6. Associated structural cardiac disease

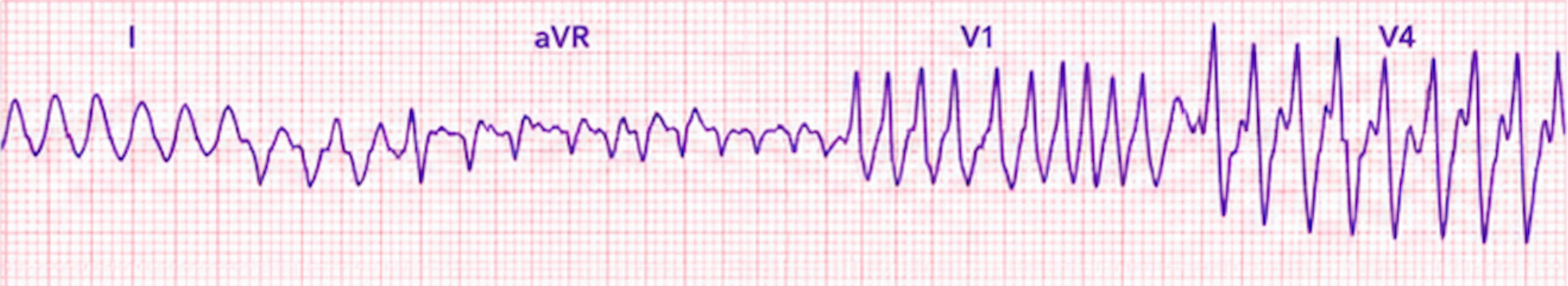
Evaluation with non-invasive studies has limited value

Wolff-Parkinson-White pattern/syndrome

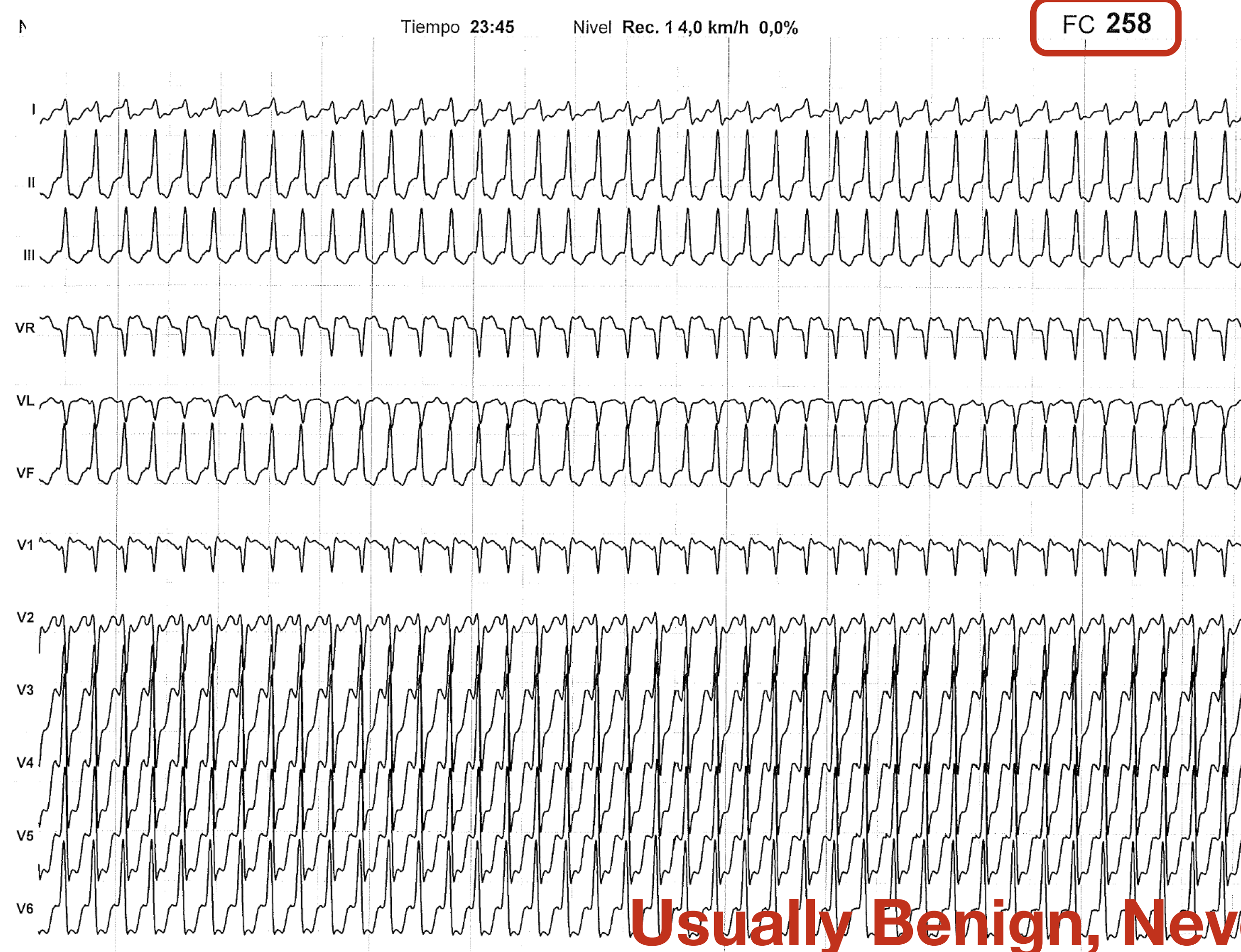
WPW-related SCD in athletes in Sant Pau Hospital

PATIENT / EVENT		ECG / RHYTHM STRIP	ACCESSORY PATHWAY LOCATION
1	20-year-old Sudden cardiac death (SCD) during atrial fibrillation induction. Recovered.		 Right posteroseptal + left lateral accessory pathway
2	14-year-old SCD during a soccer match.	 	 Right posteroseptal accessory pathway
3	33-year-old Ebstein anomaly. Type I atrial flutter (280 bpm). Hemodynamic instability.		 Ebstein anomaly Left lateral + right posteroseptal accessory pathways

→ Electrophysiological study and ablation should be strongly considered in athletes

5	26-year-old SCD during basketball training. Pre-excited atrial fibrillation.		 Left anterolateral accessory pathway
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Supraventricular tachycardias



Mechanisms:

- AVNRT
- AVRT
- Focal atrial tachycardia

AT associate more often structural heart disease

Risk of:

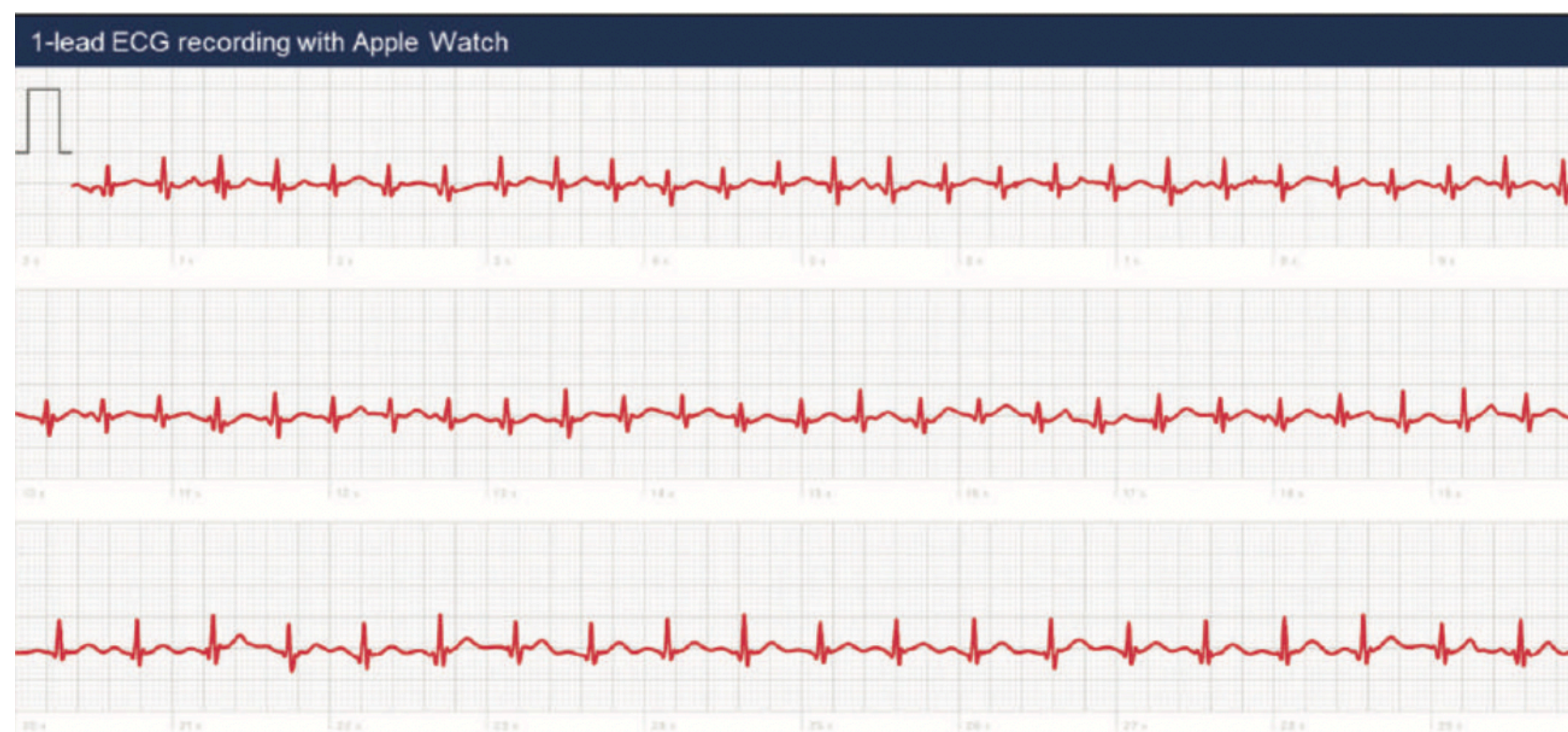
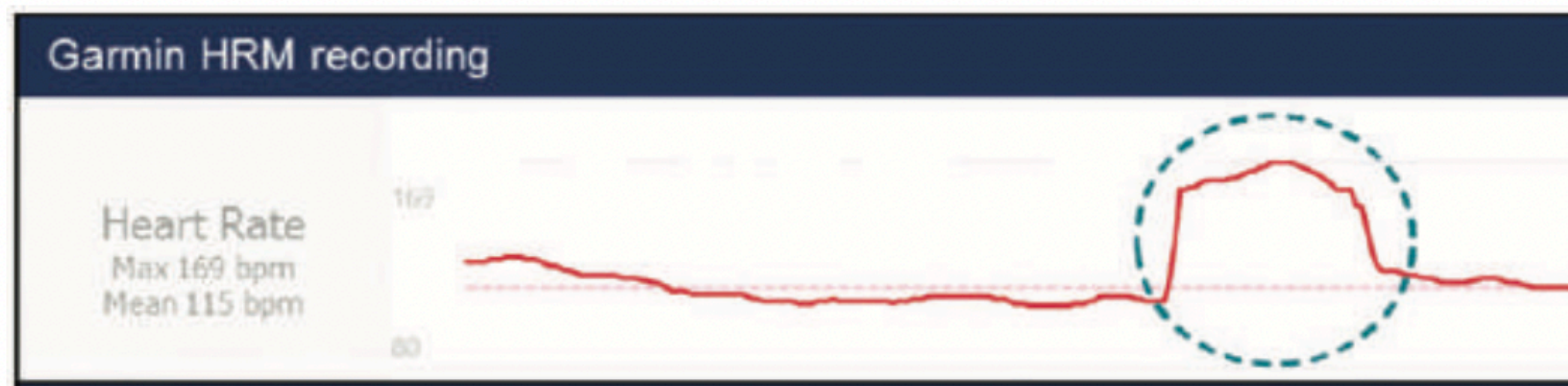
- Accidents
- Severely impair performance

Usually Benign, Never Trivial



Supraventricular tachycardias

No ECG with tachycardia?



- Use information from wearables
- Evaluate clinical plausibility
- Go for an EP study



Ventricular ectopy

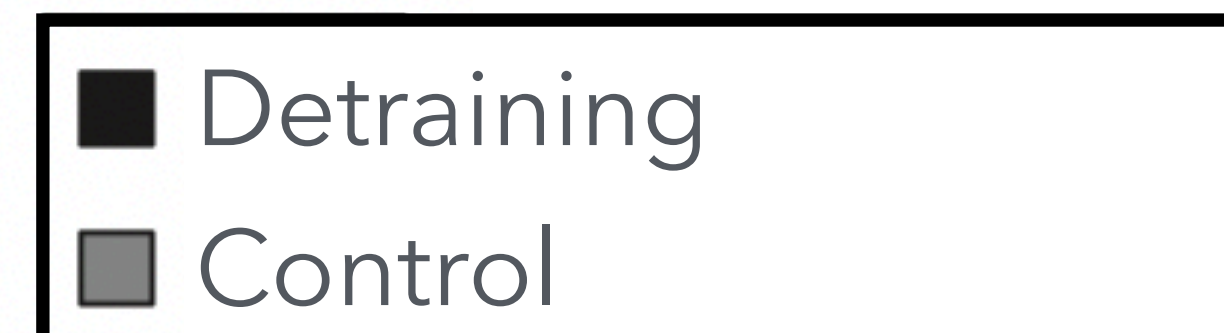
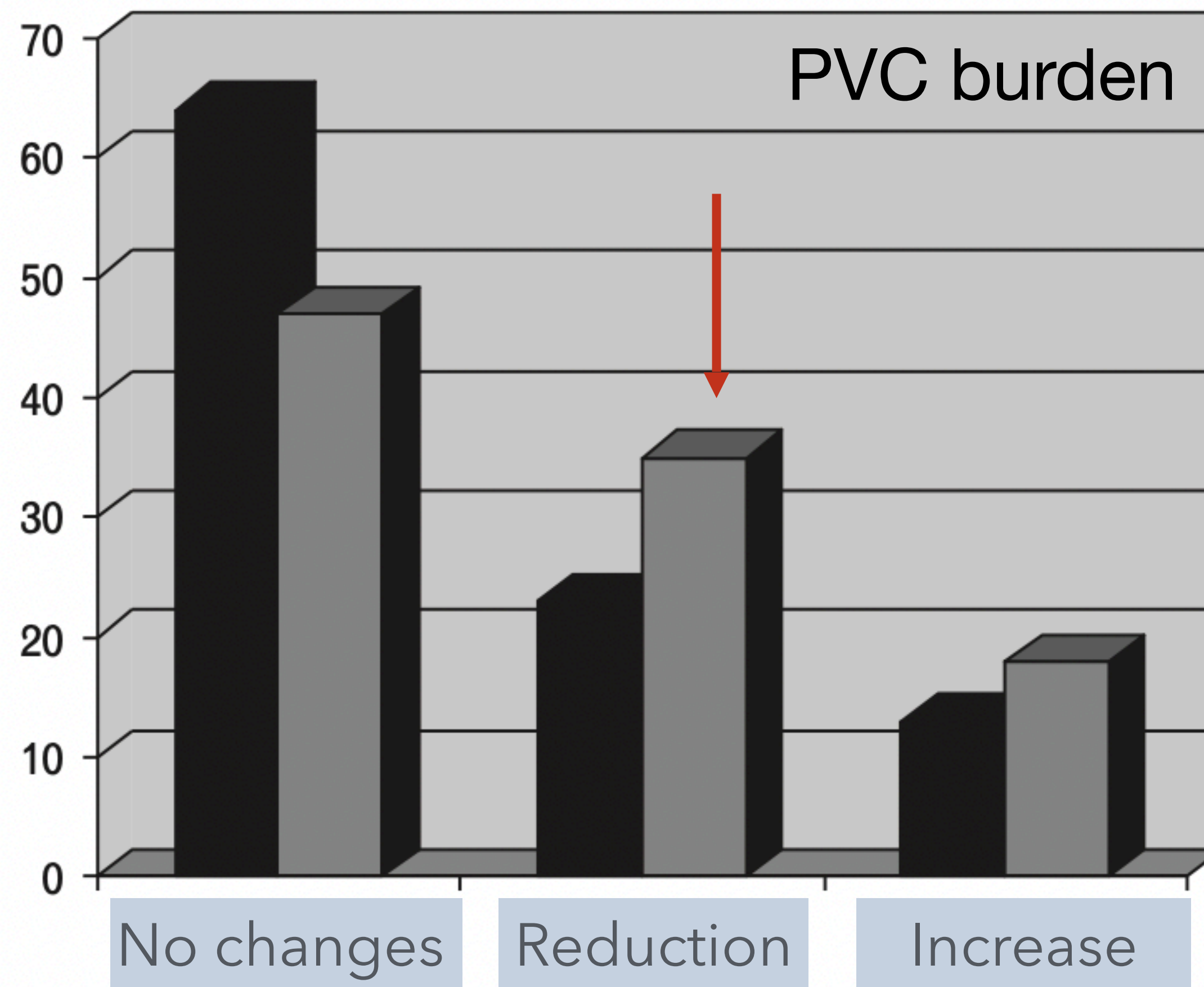
Present in 5% ECG to 40% holter

Idiopathic or benign	Potentially malignant
• Majority • Mechanism: Triggered activity or automatism • Most frequent origin: Outflow tracts or fascicle	• Any heart disease: HCM, AC, myocarditis, anomalous coronary origin, mitral prolapse, channelopathies, idiopathic VF • Exercise-induced right ventricular arrhythmogenic cardiomyopathy (?)[*] • Mechanism: + reentry

Every PVC deserves evaluation by ECG, exercise testing, Holter and echo



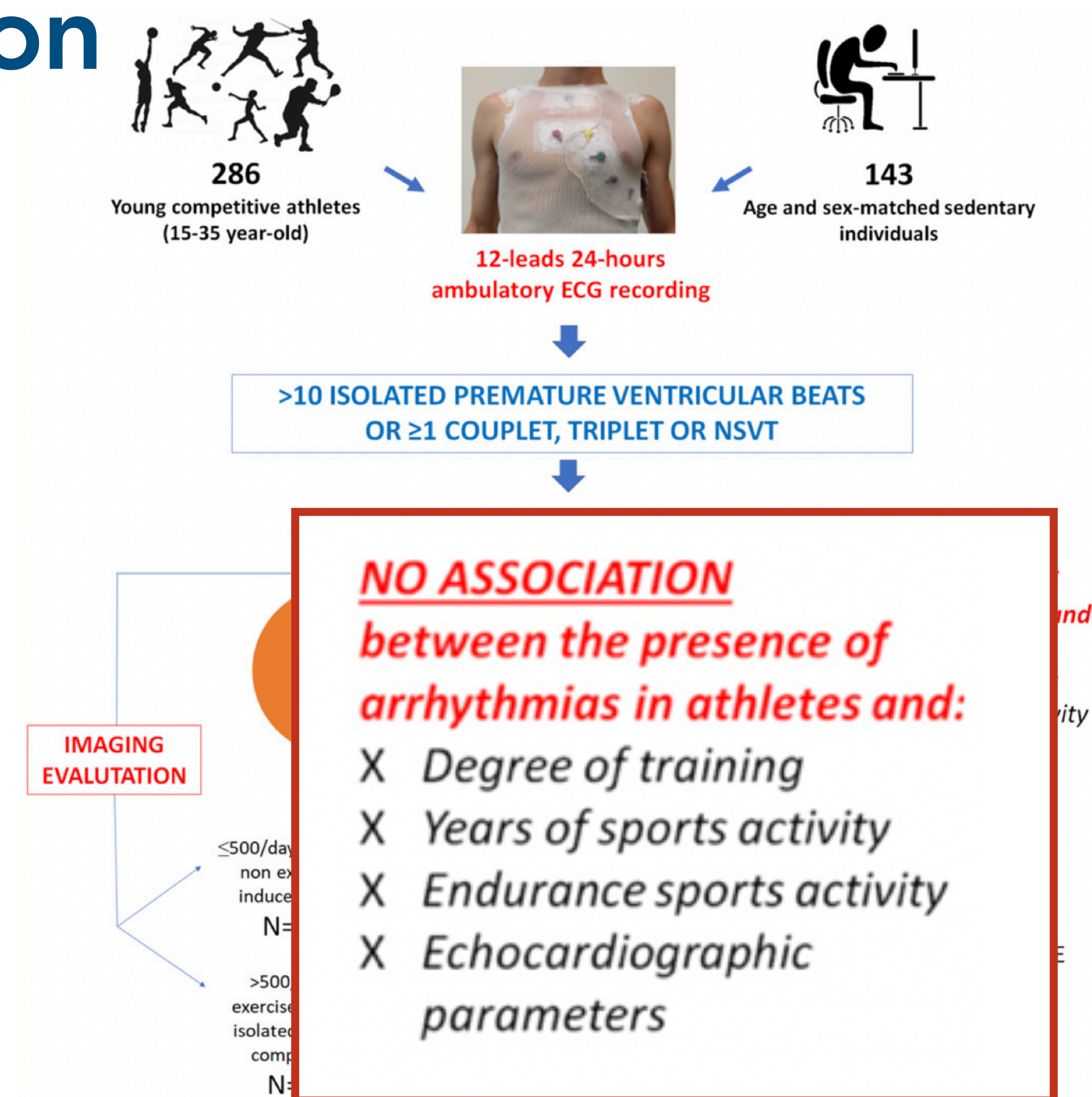
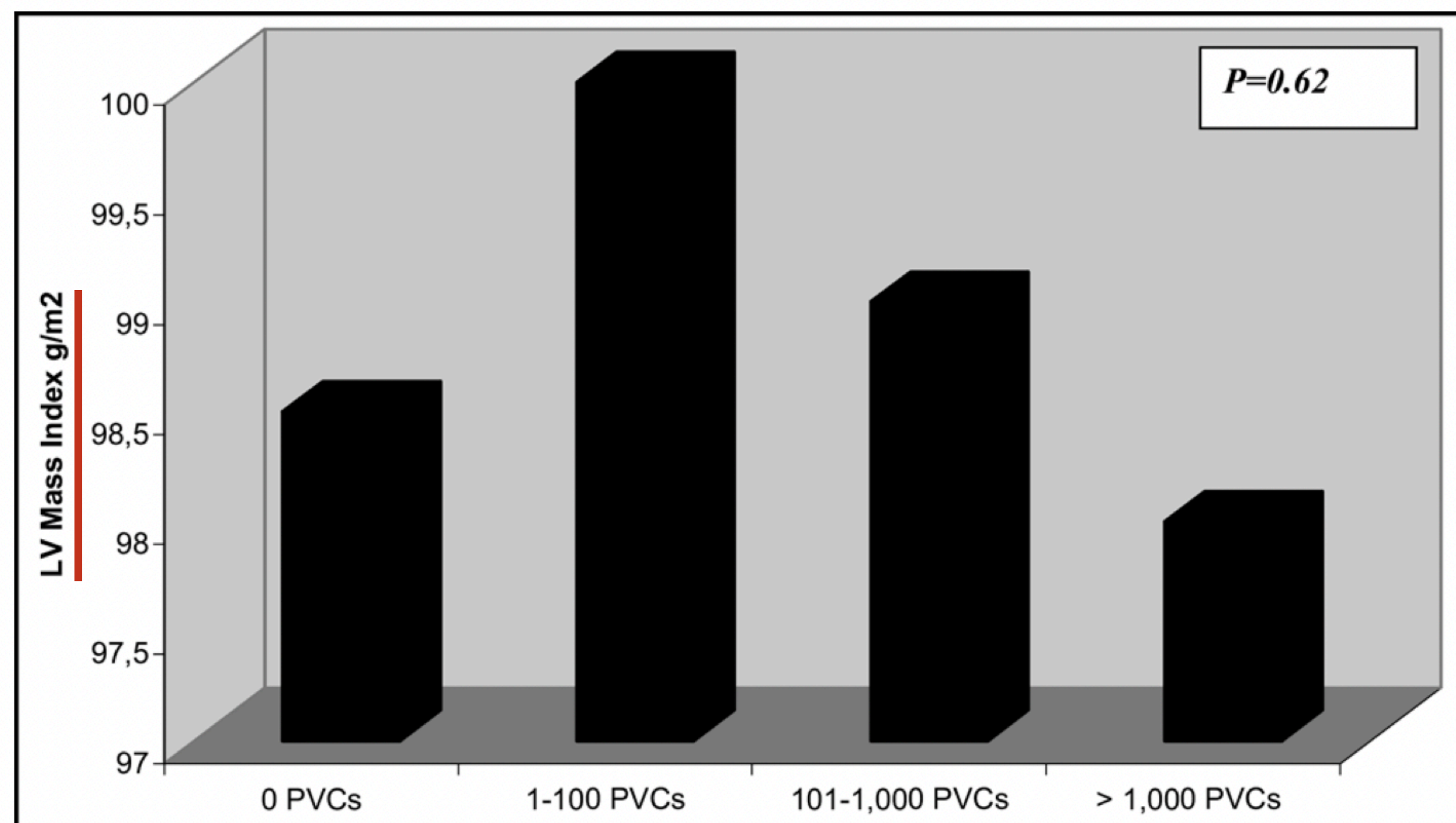
VE is not exercise-adaptation



No structural heart disease

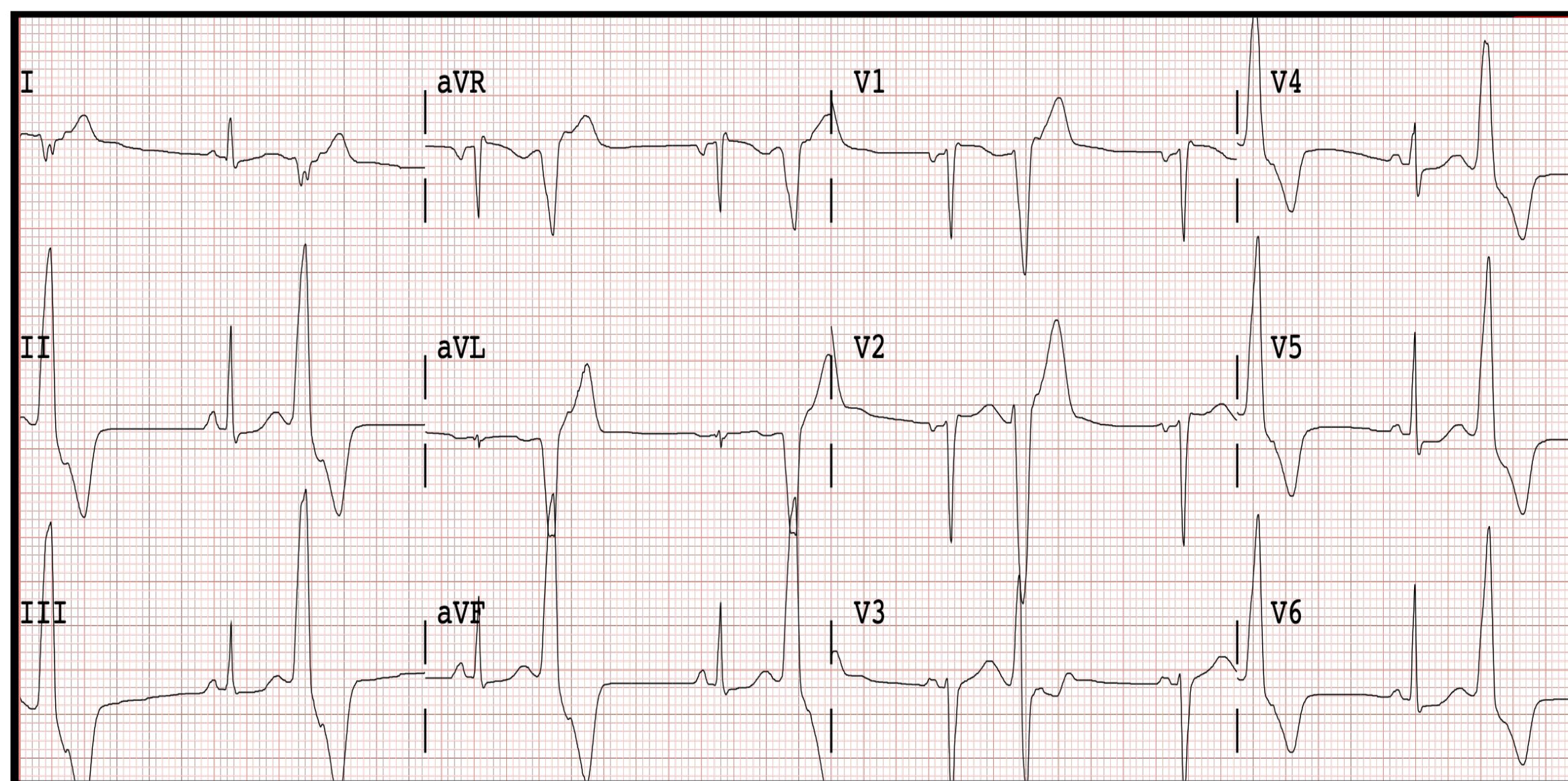


VE is not exercise-adaptation

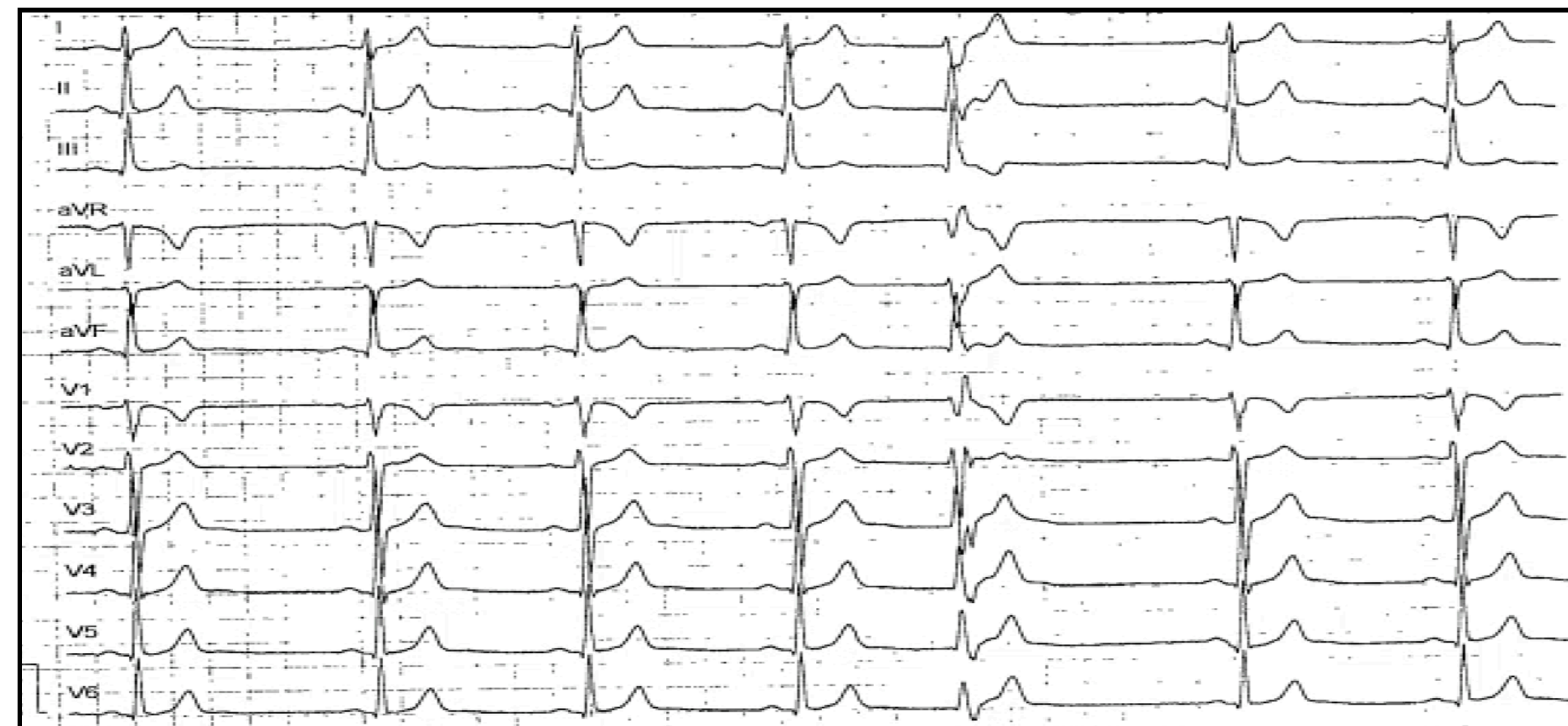


Ventricular ectopy

Idiopathic



Outflow tract

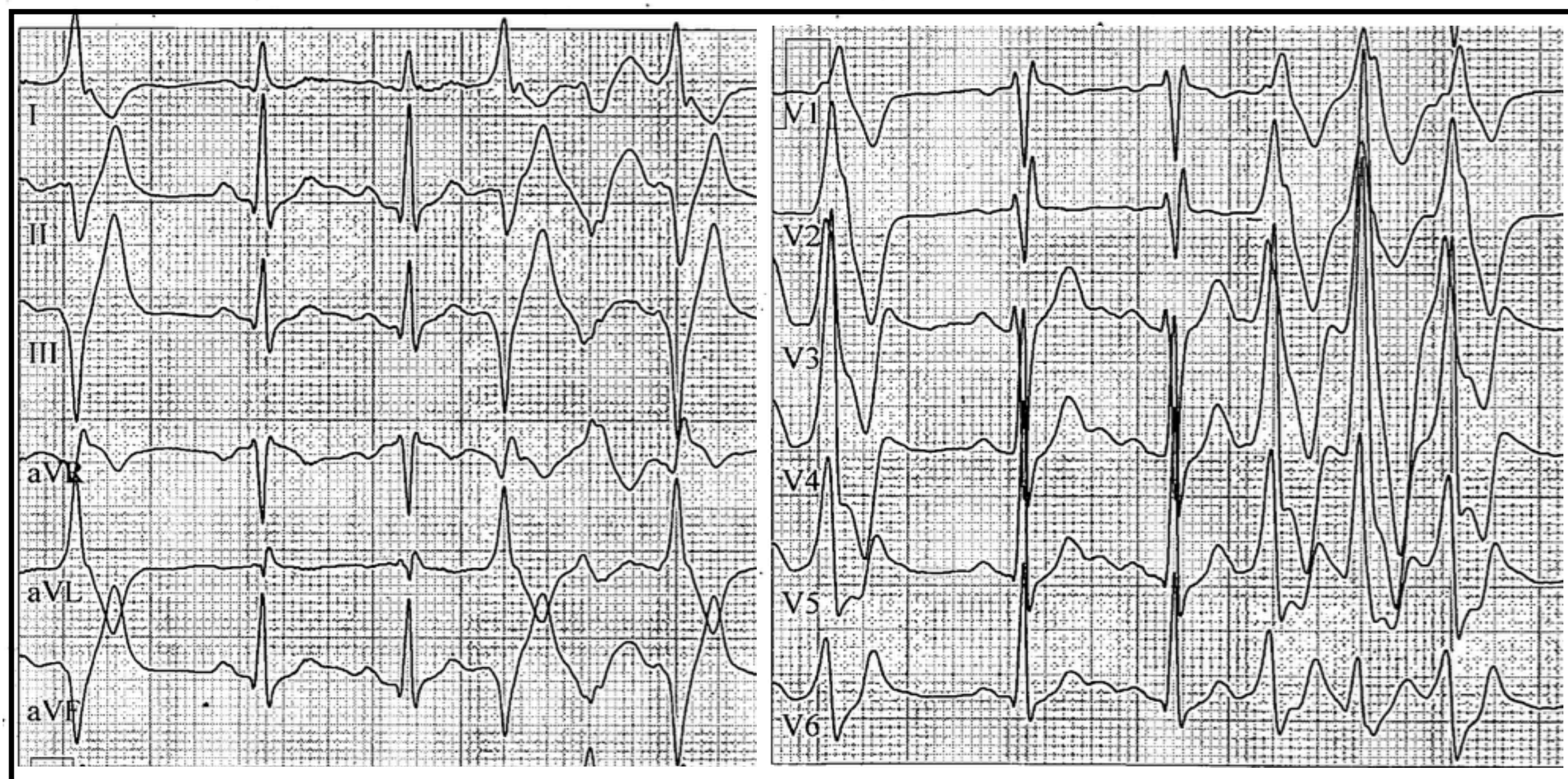


Fascicular

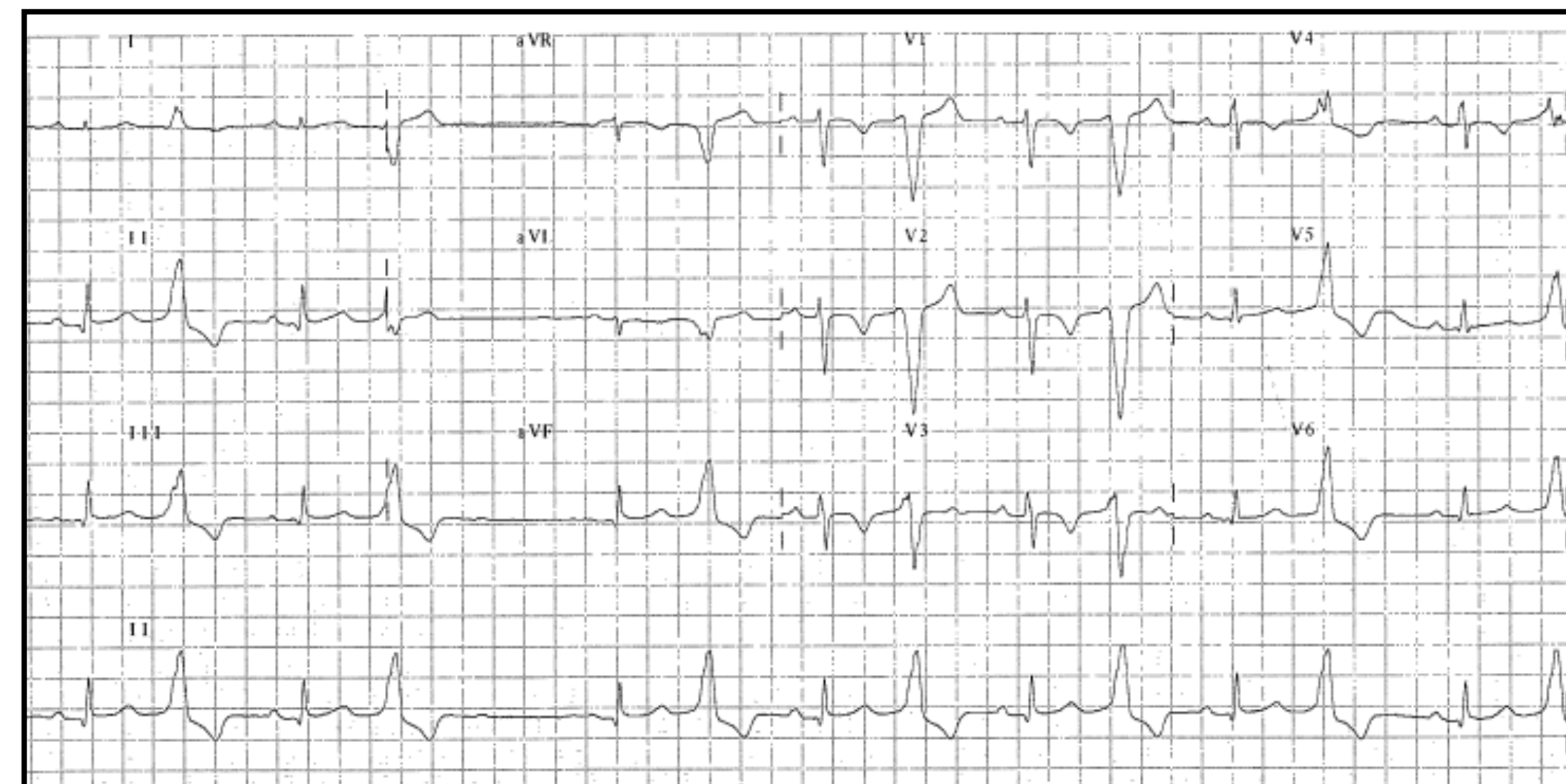


Ventricular ectopy

Atypical/pathological



Non-ischemic LV scar



Arrhythmogenic cardiomyopathy



Ventricular ectopy

	Low risk	High risk
Complexity	Monomorphic, isolated	Polymorphic, x2-3, nsVT, short coupling
Response to exercise	Supression	Increase during or early during recuperation
Baseline ECG	Normal	Abnormal (T-wave inversion (Q-wave)
Family history	Negative	Positive
Symptoms	Asymptomatic	Symptomatic

Include cardiac MR and follow up despite normal echo!!!



Channelopathies

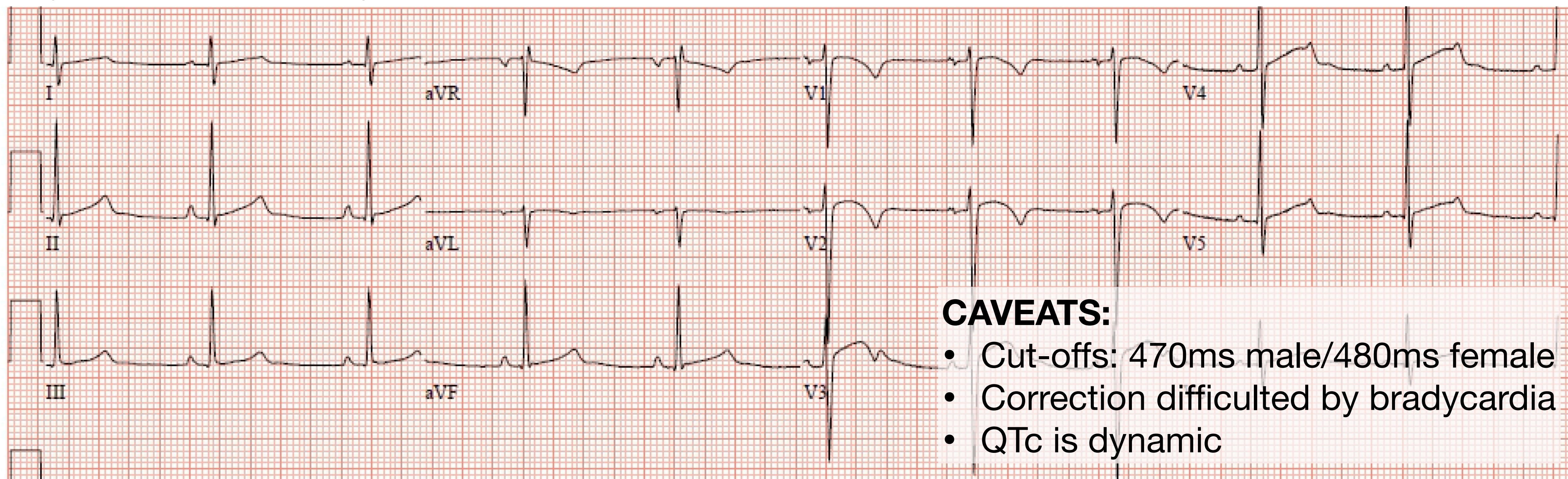
- Suspect by typical ECG pattern (LQTS, Brugada)
- Normal imaging test
- Family history
- Positive genetic testing
- Syncope or SCD

ECG alterations are dynamic... Repeat it



Channelopathies

21yo male, enduro, asymptomatic

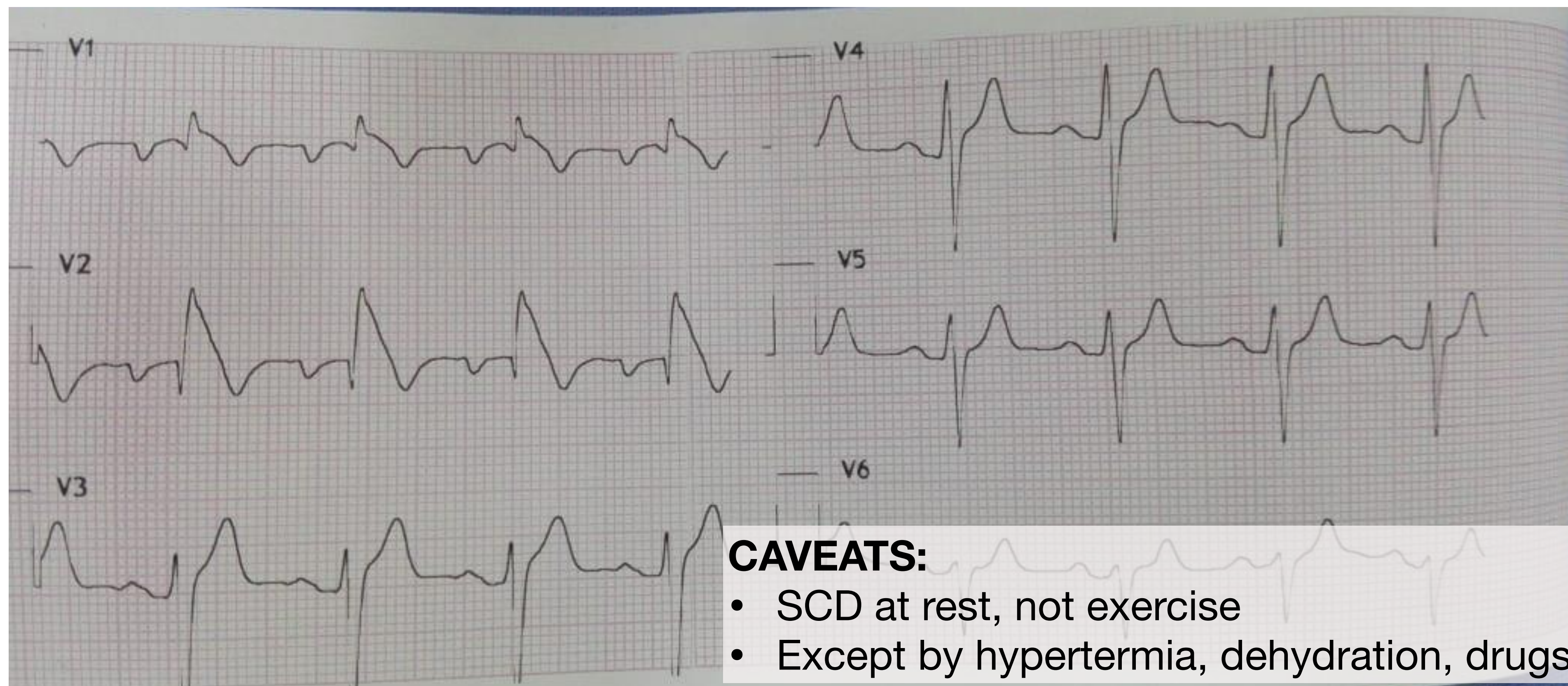


Long QT syndrome



Channelopathies

31yo woman, hypertermia after marathon Des Sables



Brugada pattern/syndrome



Channelopathies

40yo male, long-distance runner, screening



CAVEATS:

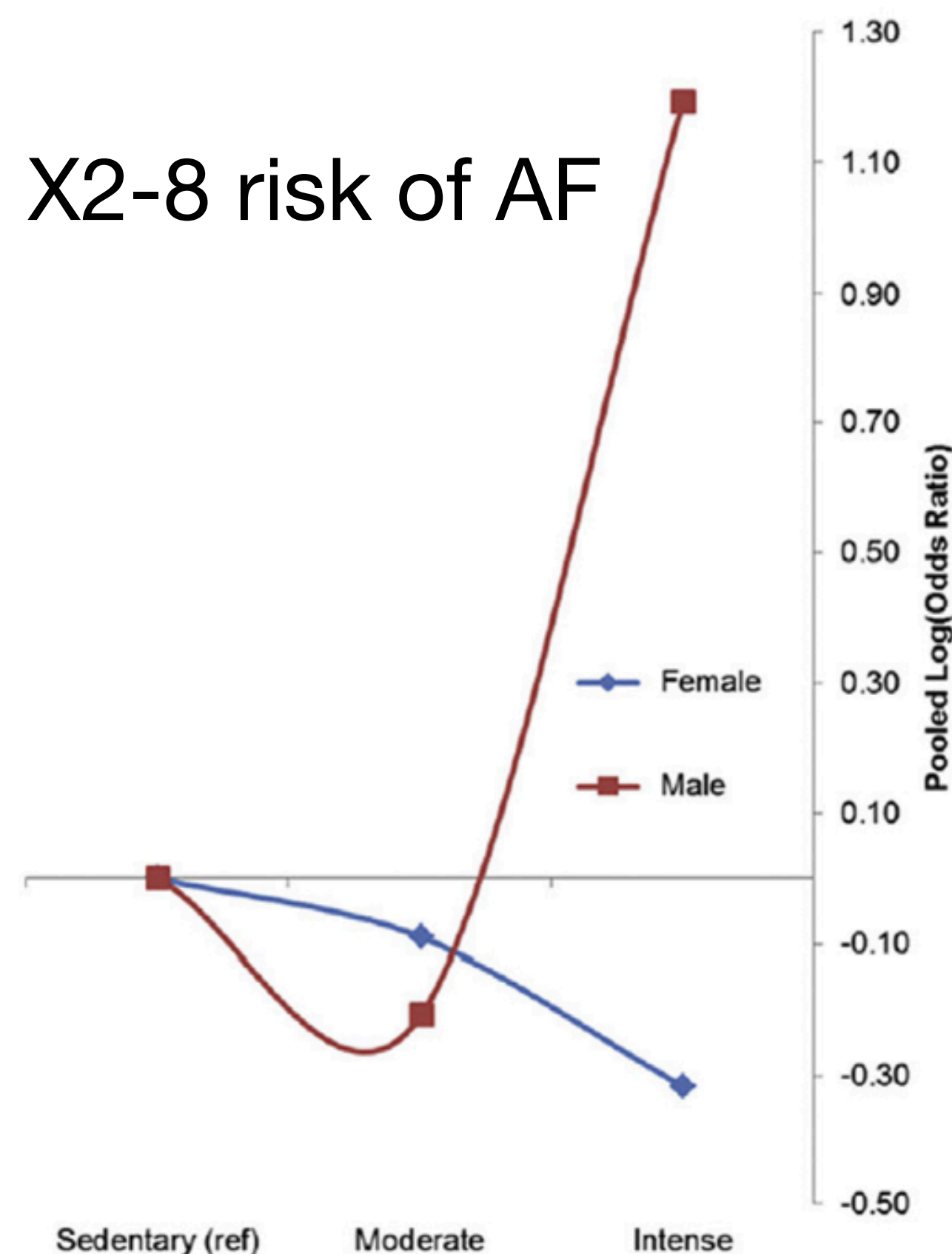
- Normal ECG at rest
- Exercise-induced arrhythmias

Catecholaminergic Polymorphic Ventricular Tachycardia

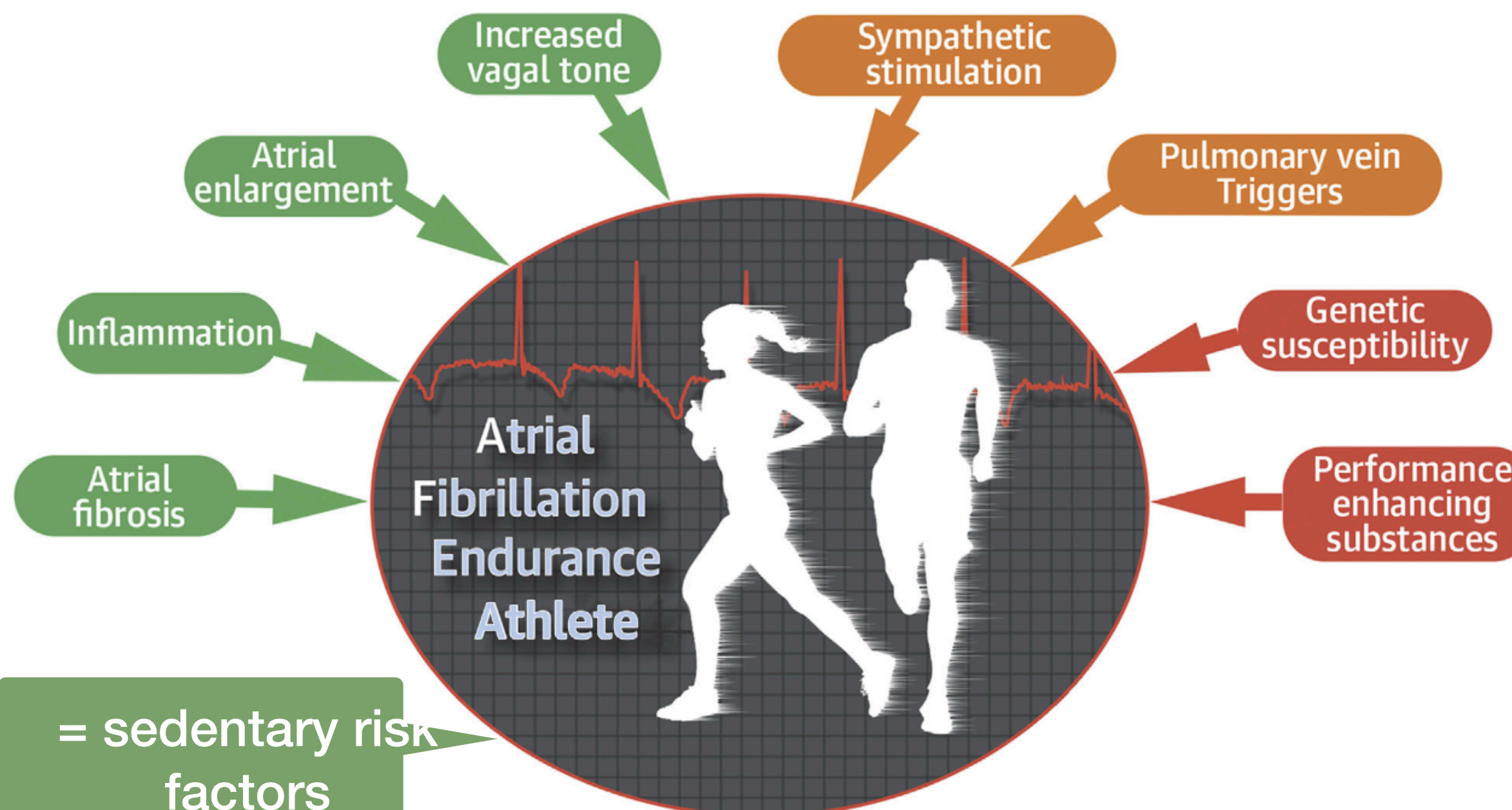


Atrial fibrillation

FIGURE 1 Association Between Level of Physical Activity and Risk of AF in Men and Women



CENTRAL ILLUSTRATION Proposed Pathophysiologic Mechanisms of AF in the Endurance Athlete



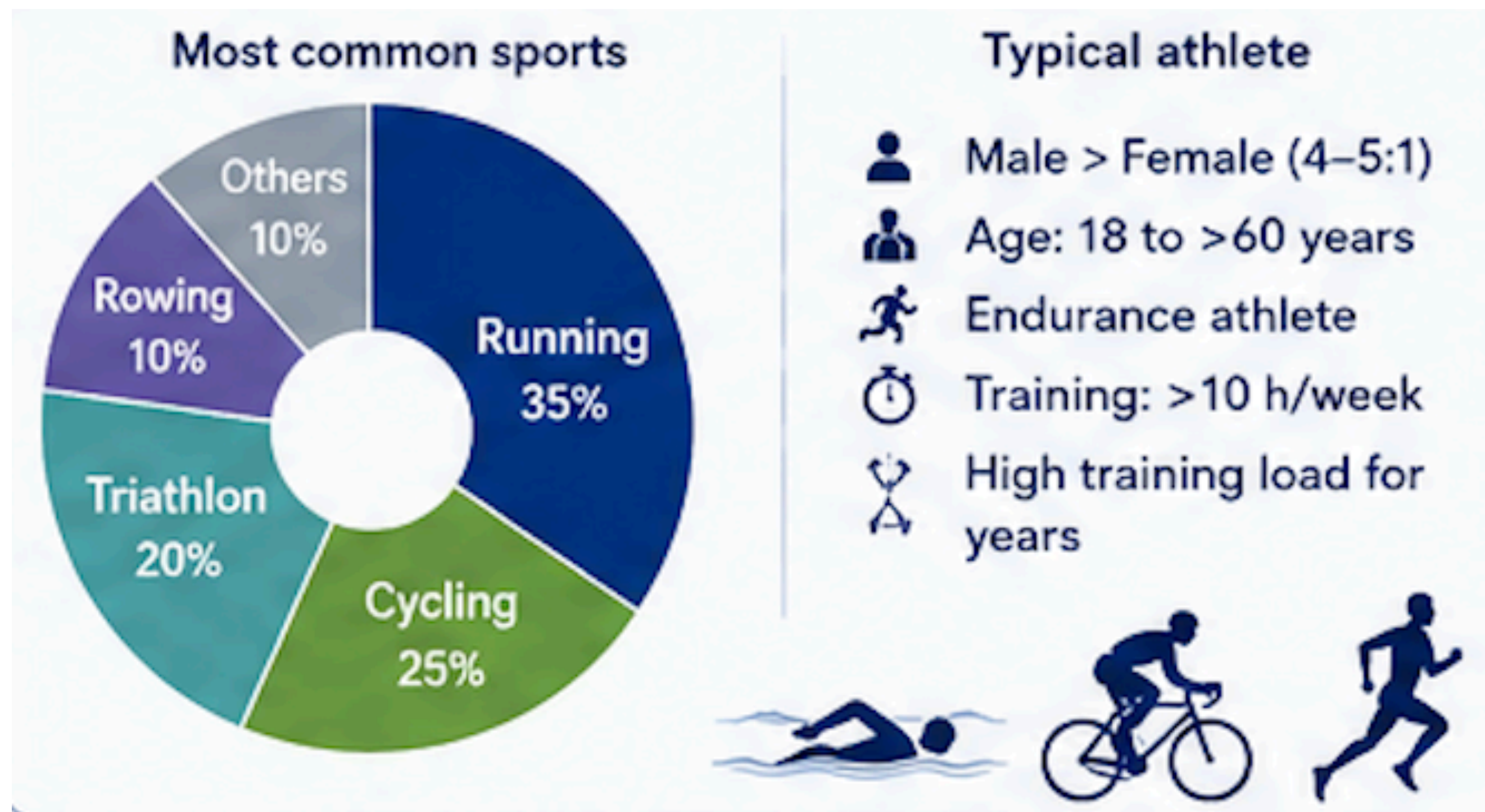
Supporting Evidence

High (Proven) Intermediate (Possible) Low (Speculative)

Estes III, N.A.M. et al. J Am Coll Cardiol EP. 2017;3(9):921-8.

Multiple factors contributing to atrial fibrillation (AF) with intense endurance exercise are shown with color coding according to the strength of the supporting evidence.
PV = pulmonary vein.

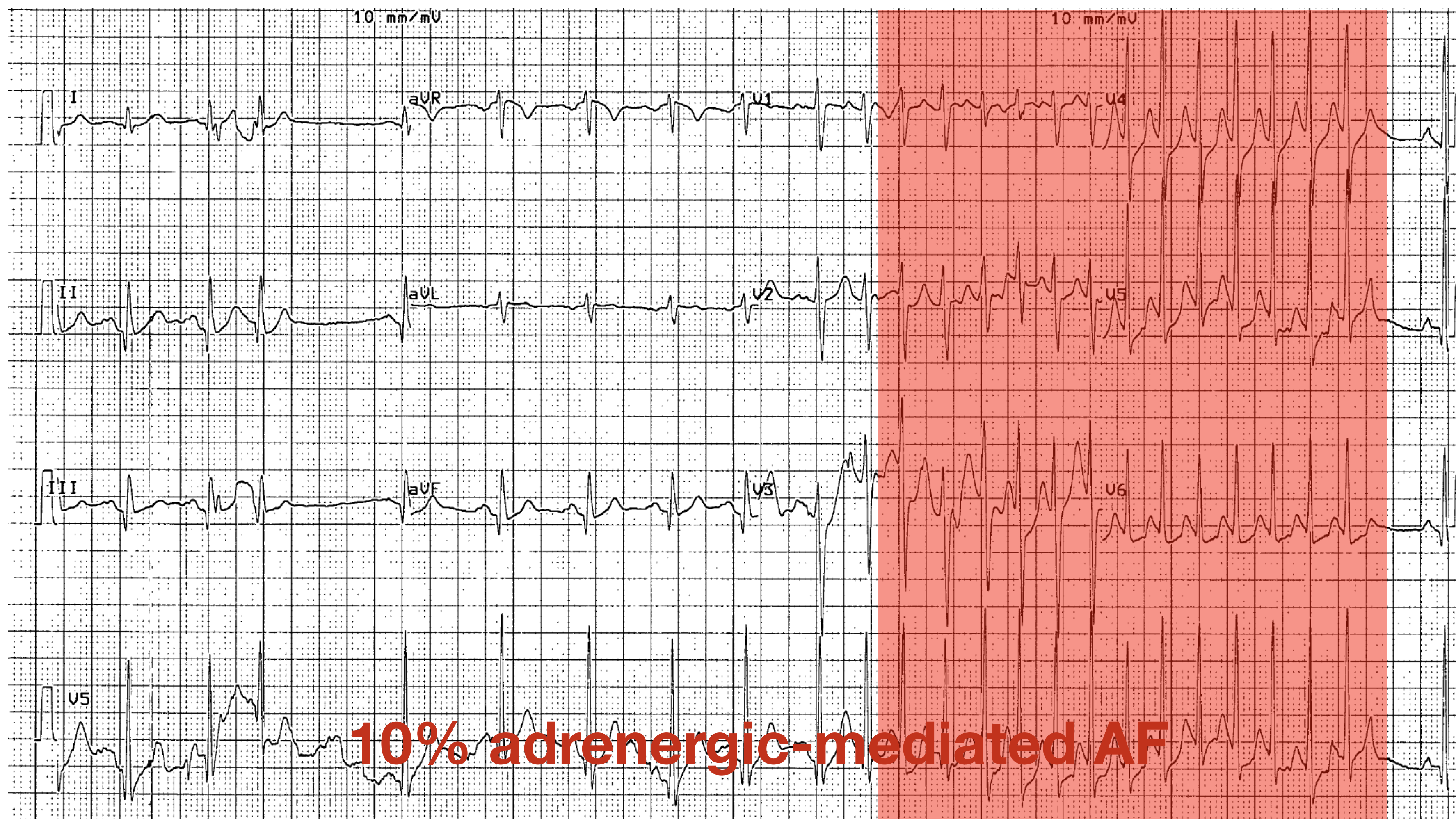
Atrial fibrillation



PAFIYAMA (Paroxysmal AF in Young and Adult Master Athletes)



45yo male, master swimmer



Atrial fibrillation

Study:

- Structural/Electrical heart disease
- If young, search for a primary arrhythmia
- Doping?
- Thyroid disorders

Arrhythmia management:

- Detraining (?)
- Control of modifiable risk factors, reduce stimulants
- Caution with IC Anti-arrhythmic drugs
- Ablation
- Don't restrict if not exercise-related

Anticoagulation:

- According to CHADS-VASc
- Caution with collision sports



Conclusions

- Bradycardia that improves with exercise is usually physiological
- WPW in athletes deserves invasive study and ablation
- Single PVCs also require complete evaluation
- AF is increasingly common in endurance athletes
- The goal is not restriction
- **The goal is safe participation through accurate diagnosis, risk stratification, and individualized management**



Thanks for your attention

Participate in the ACTIVE-ICD registry:

- ✓ Safety in sports for ICD carriers
- ✓ Limited European data
- ✓ Lack of pediatric data
- ✓ Absence of extravascular ICDs



SCAN ME