Sports & Cardiology

DR. CHARLIEN GABRIELS

27 OCT 2022

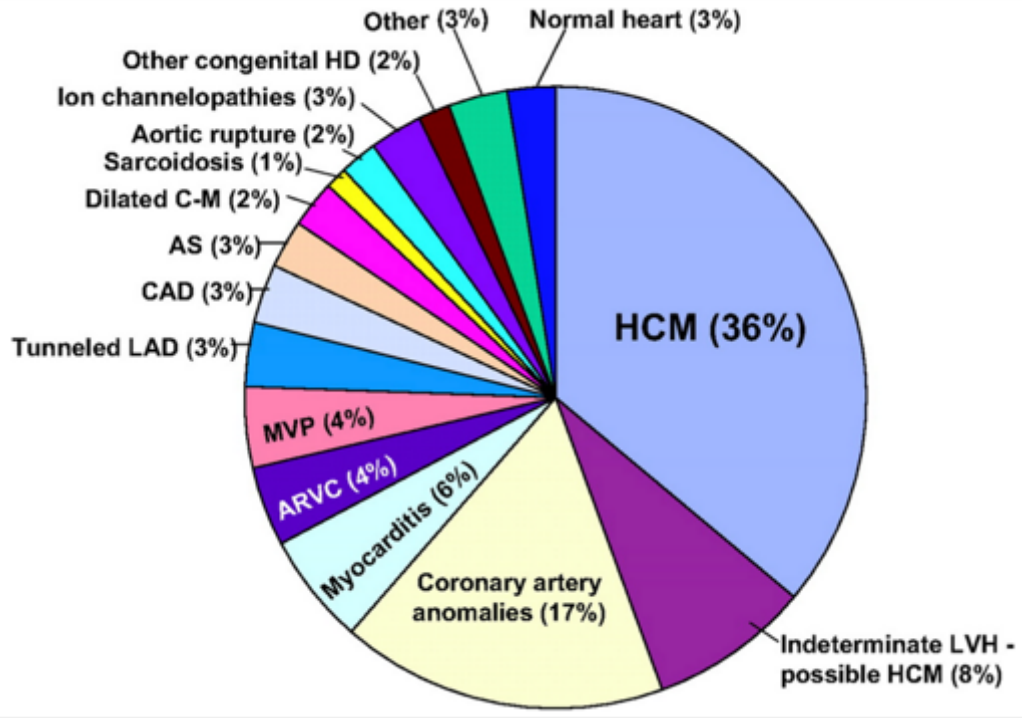
Overview

- Screening of recreative sporters and athletes
  - SKA
- Sports in patients with cardiovascular disease
  - Chronic coronary syndrome
  - Chronic heart failure
  - Arrhythmias
  - Myocarditis
  - Congenital heart disease

1. Screening of recreative sporters and athletes

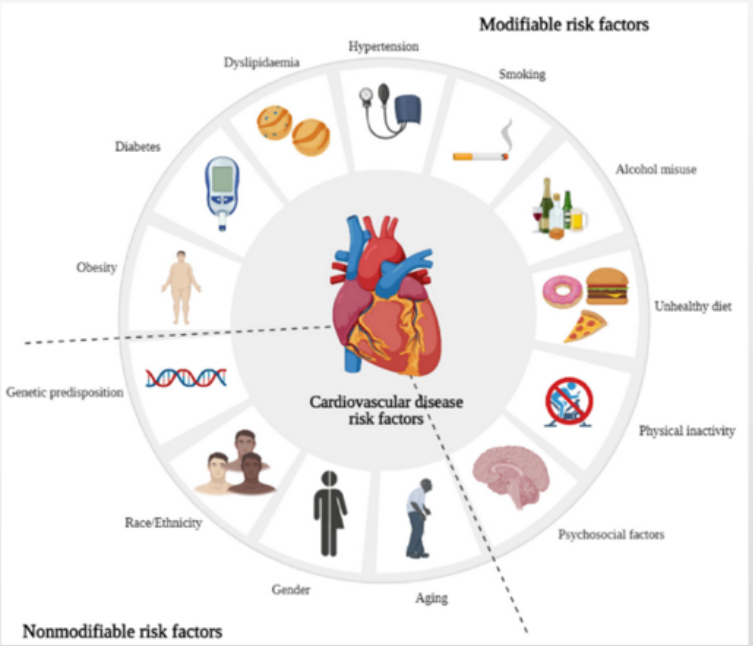
Goal = prevention of sport-related SCD (sudden cardiac death)

- <35y = mostly hereditary



Maron B et al. Circulation 2007; 115: 1643-1655

- >35y = mostly acquired
  - Coronary artery disease = nr 1 (75%)
  - Aortic aneurysm rupture
  - Cardiomyopathy
  - Anomalous CA



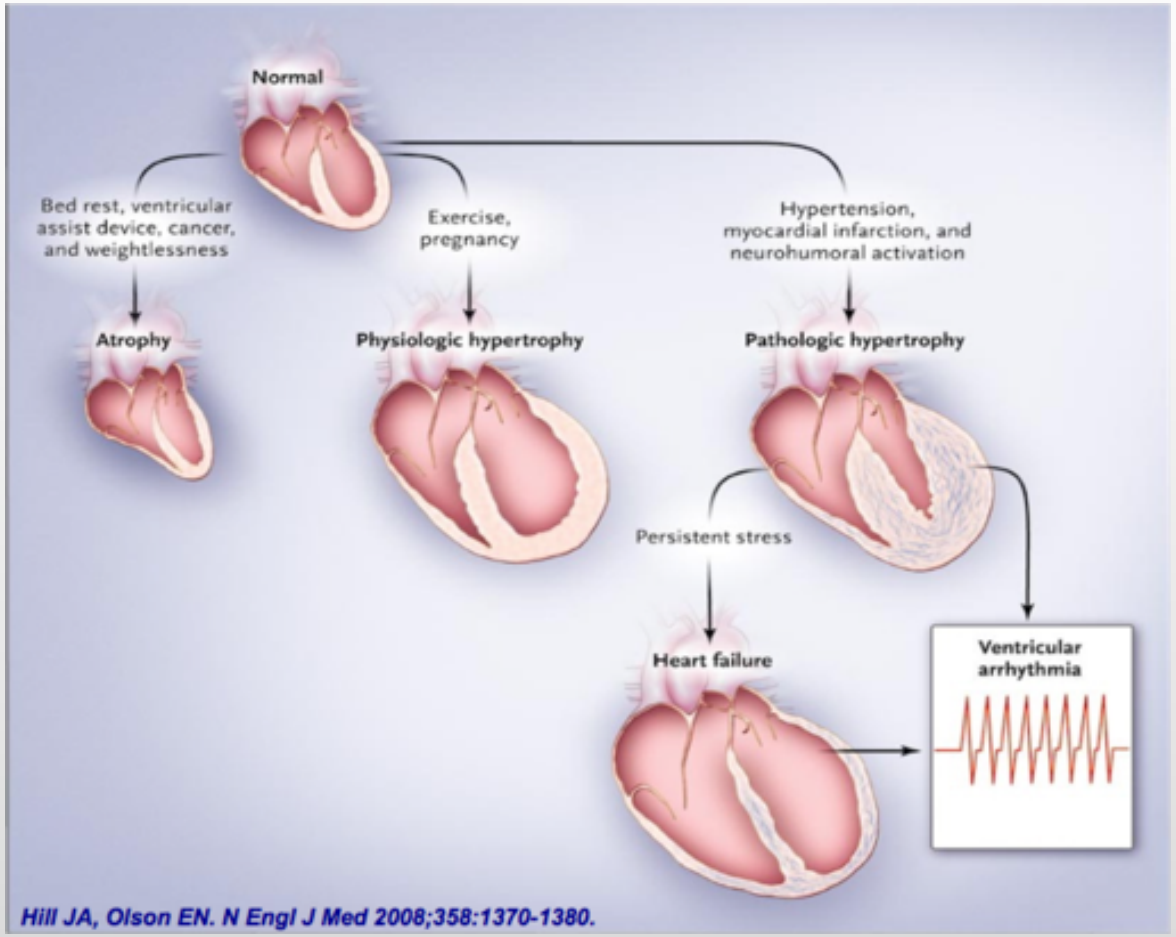
Molecules 2021, 26(12), 5306

1. Screening of recreative sporters and athletes

- Importance of anamnesis and family history, physical examination
- www.sportkeuring.be: is sportmedical examination advisable?
  - For every (recreative) sporter!
- ECG: identifies the majority of hereditary, structural or electrical disorders associated with SCD, except
  - anomalous coronary arteries
  - premature coronary atherosclerosis
  - aortopathies
  - (ARVC)

Physiologic adaptations to sports

- Intensive exercise = minimum of 4h per week (recreational athlete)
- Enlarged cardiac chamber size
- Increased myocardial mass
- Increased vagal tone
  - Lower resting heart rate
  - Neurally mediated conduction fibre slowing



1. Screening of recreative sporters and athletes

ESC European Society of Cardiology

European Heart Journal (2018) **39**, 1466–1480
doi:10.1093/eurheartj/ehw631

CURRENT OPINION
Coronary artery disease

International recommendations for electrocardiographic interpretation in athletes

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Age 12-35 years

1. Screening of recreative sporters and athletes

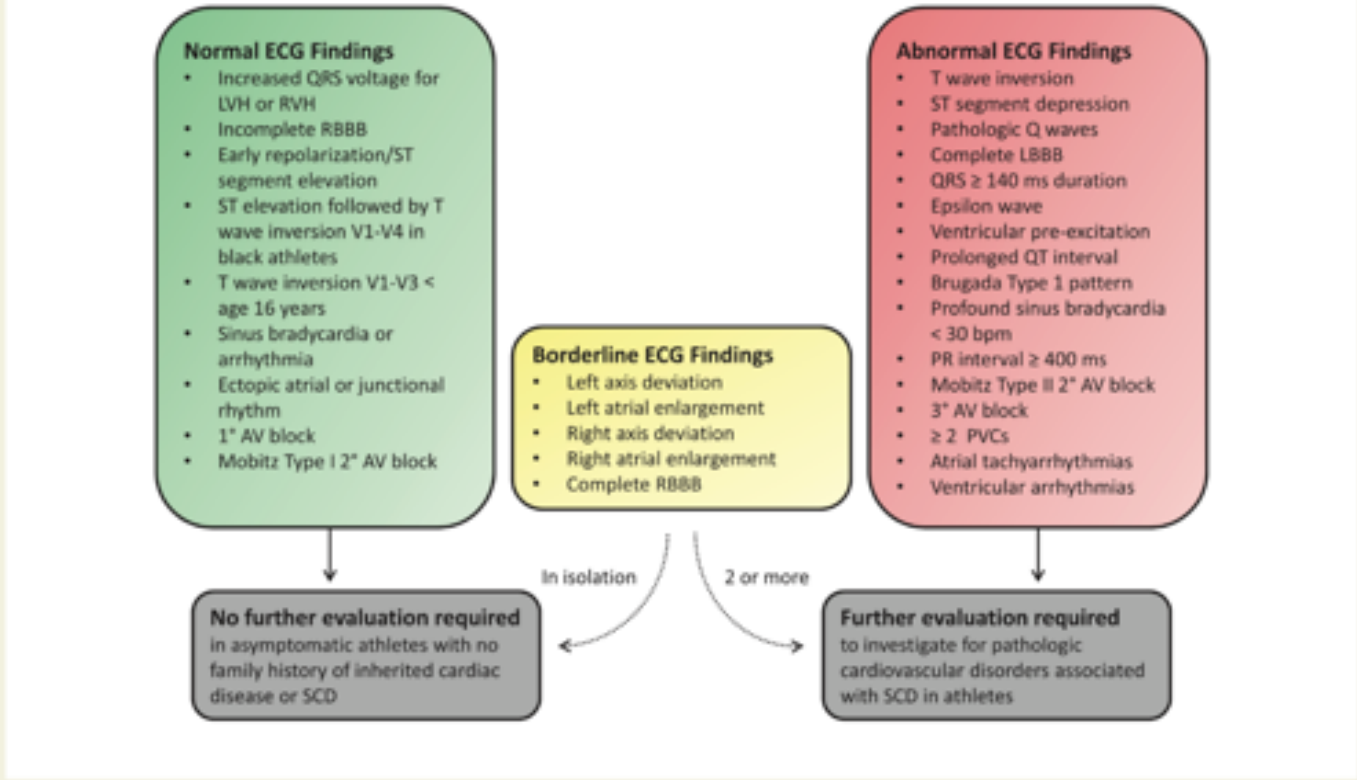


Figure 1 International consensus standards for electrocardiographic interpretation in athletes. AV, atrioventriular block; LBBB, left bundle branch block; LVH, left ventricular hypertrophy; RBBB, right bundle branch block; RVH, right ventricular hypertrophy; PVC, premature ventricular contraction; SCD, sudden cardiac death.

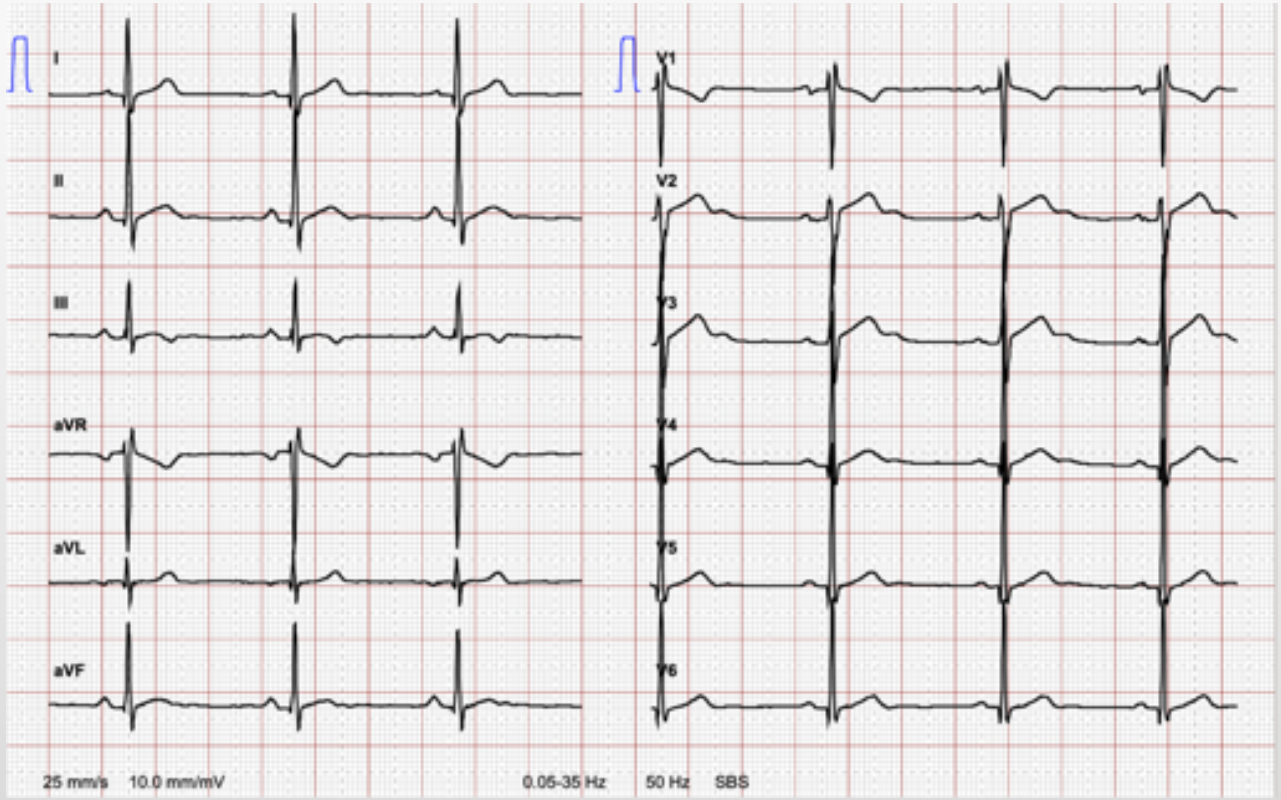
Normal ECG

1. Screening of recreative sporters and athletes

- **Normal ECG findings**
  - Increased QRS voltage for LVH (SV1+RV5 or RV6 > 3.5mV) or RVH (RV1 + SV5 or SV6 > 1.1mV)

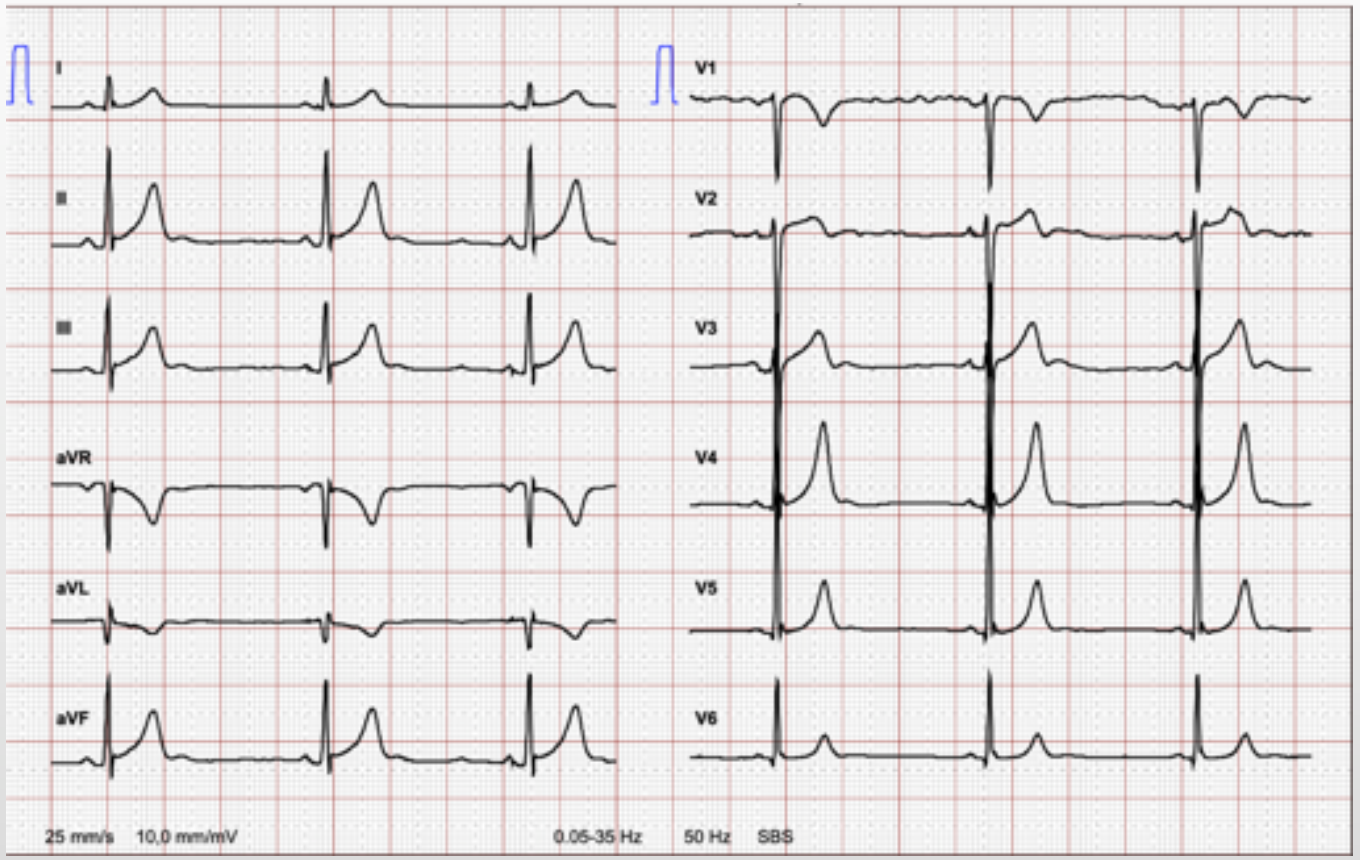
1. Screening of recreative sporters and athletes

- Normal ECG findings
  - Incomplete right bundle branch block
    - rSR’ pattern in V1 and qRS pattern in V6, QRS-duration <120 ms



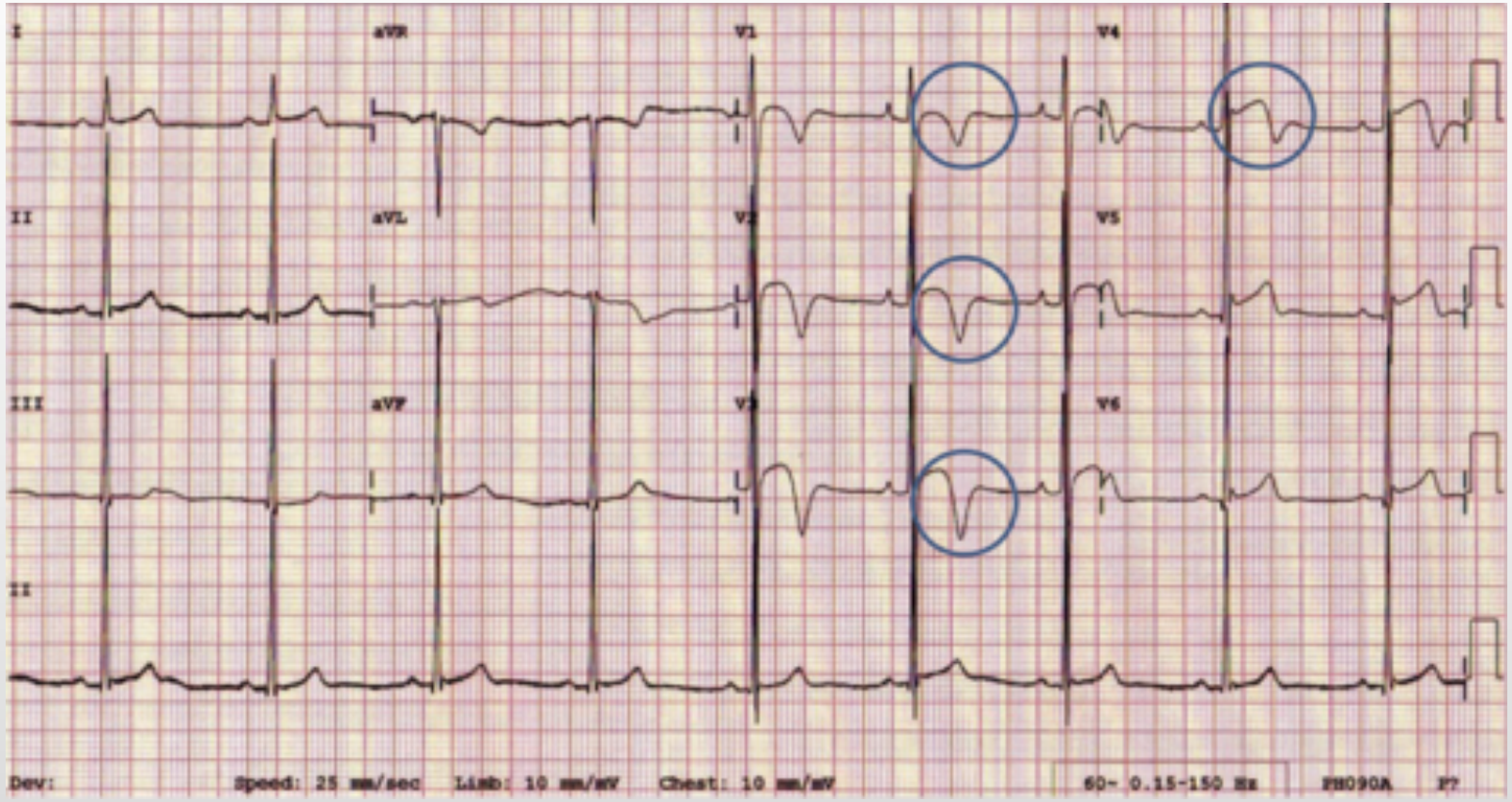
1. Screening of recreative sporters and athletes

- **Normal ECG findings**
  - Early repolarization



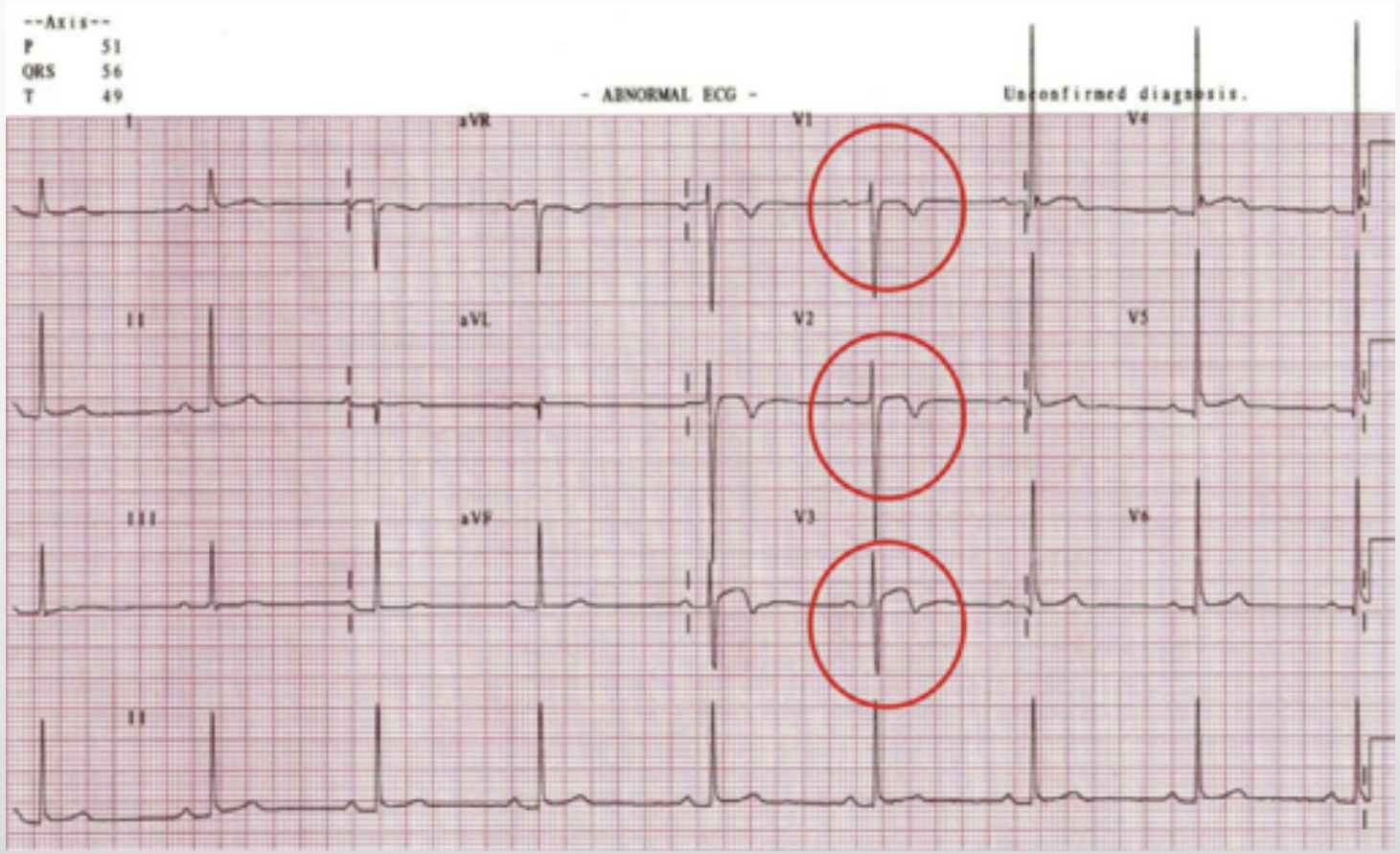
1. Screening of recreative sporters and athletes

- **Normal ECG findings**
  - Black athlete repolarization variant



1. Screening of recreative sporters and athletes

- Normal ECG findings
  - Juvenile ECG pattern (athletes age 12-16y)



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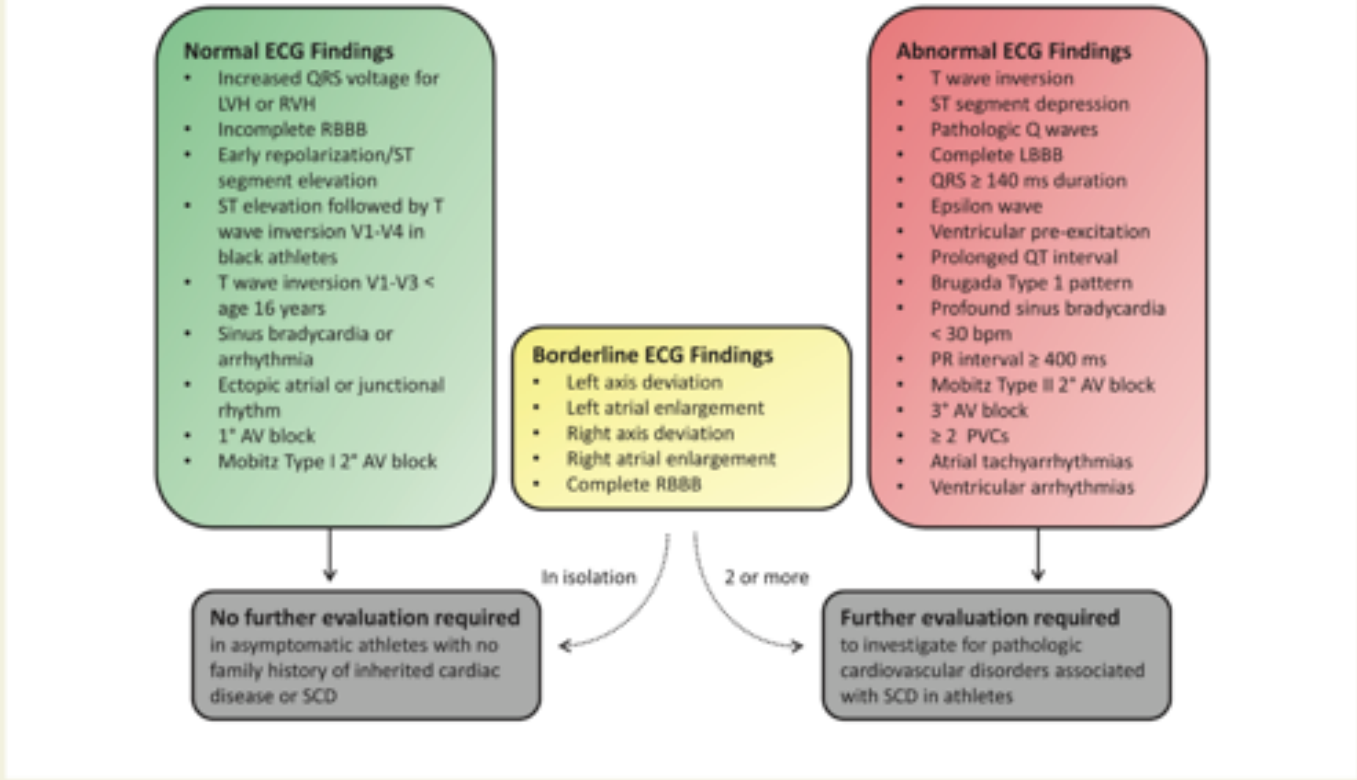
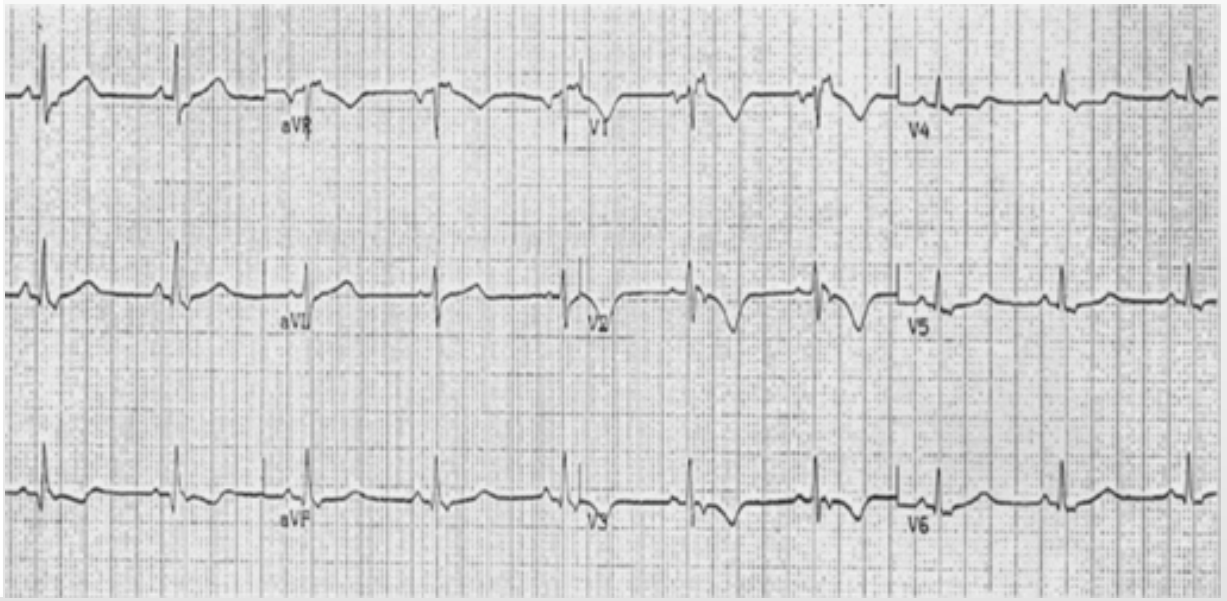


Figure 1 International consensus standards for electrocardiographic interpretation in athletes. AV, atrioventriular block; LBBB, left bundle branch block; LVH, left ventricular hypertrophy; RBBB, right bundle branch block; RVH, right ventricular hypertrophy; PVC, premature ventricular contraction; SCD, sudden cardiac death.

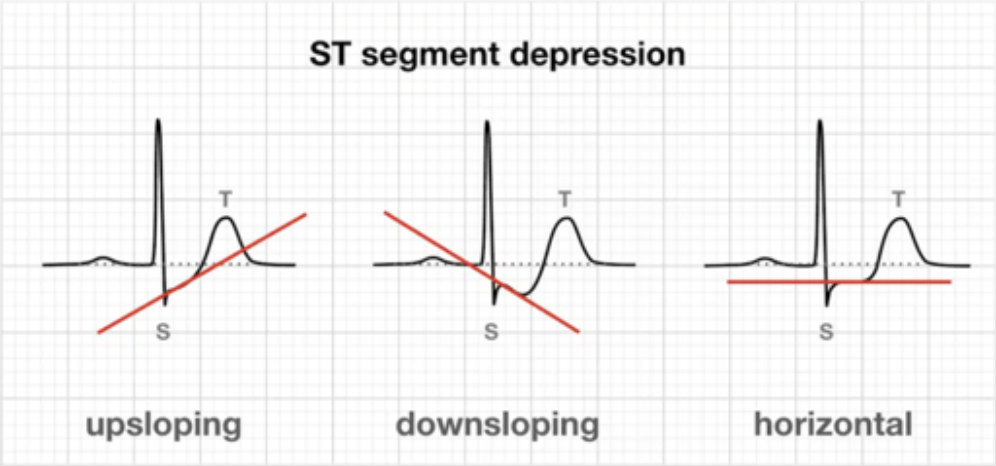
1. Screening of recreative sporters and athletes

- **Abnormal ECG findings**
  - T wave inversion (>1mm in depth in 2 or more leads)
    - Excludes leads aVR, III and V1



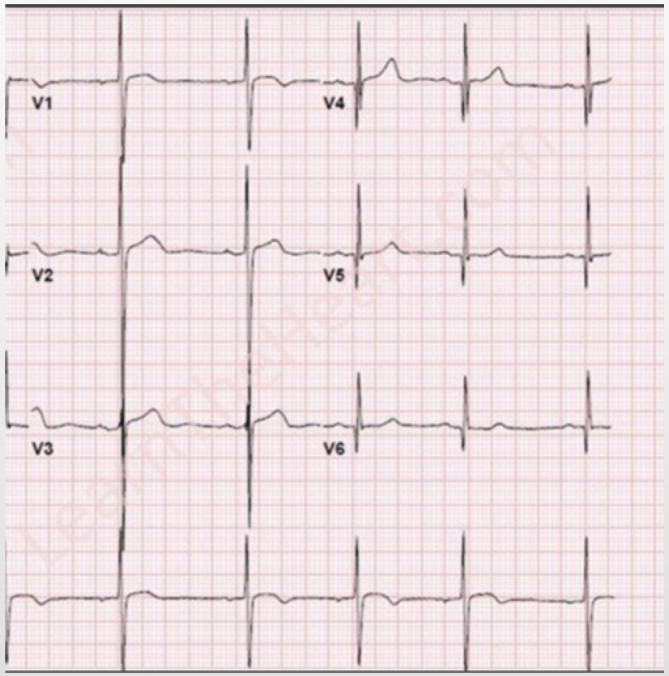
1. Screening of recreative sporters and athletes

- **Abnormal ECG findings**
  - ST segment depression
    - >0.5mm in depth in 2 or more leads



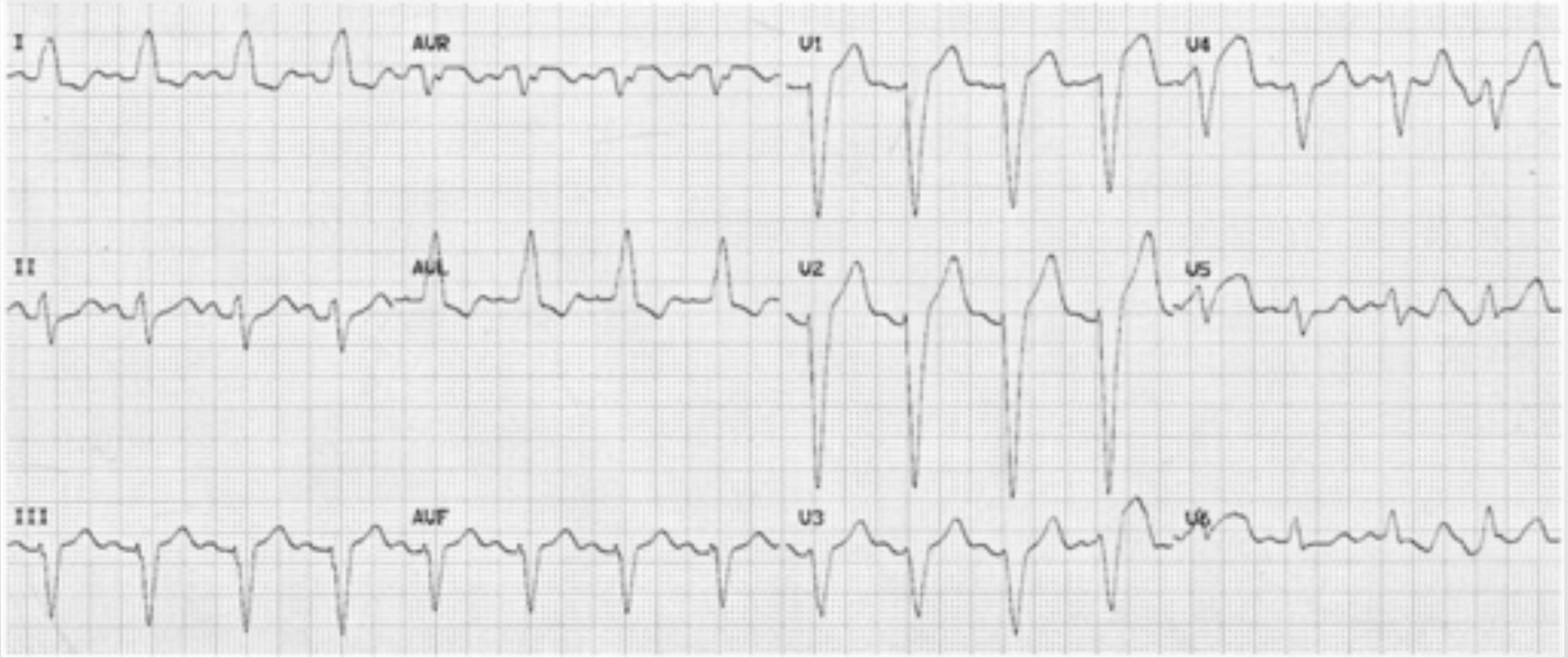
Pathologic Q waves (deep or wide)

Q/R ratio >0.25 or >40ms



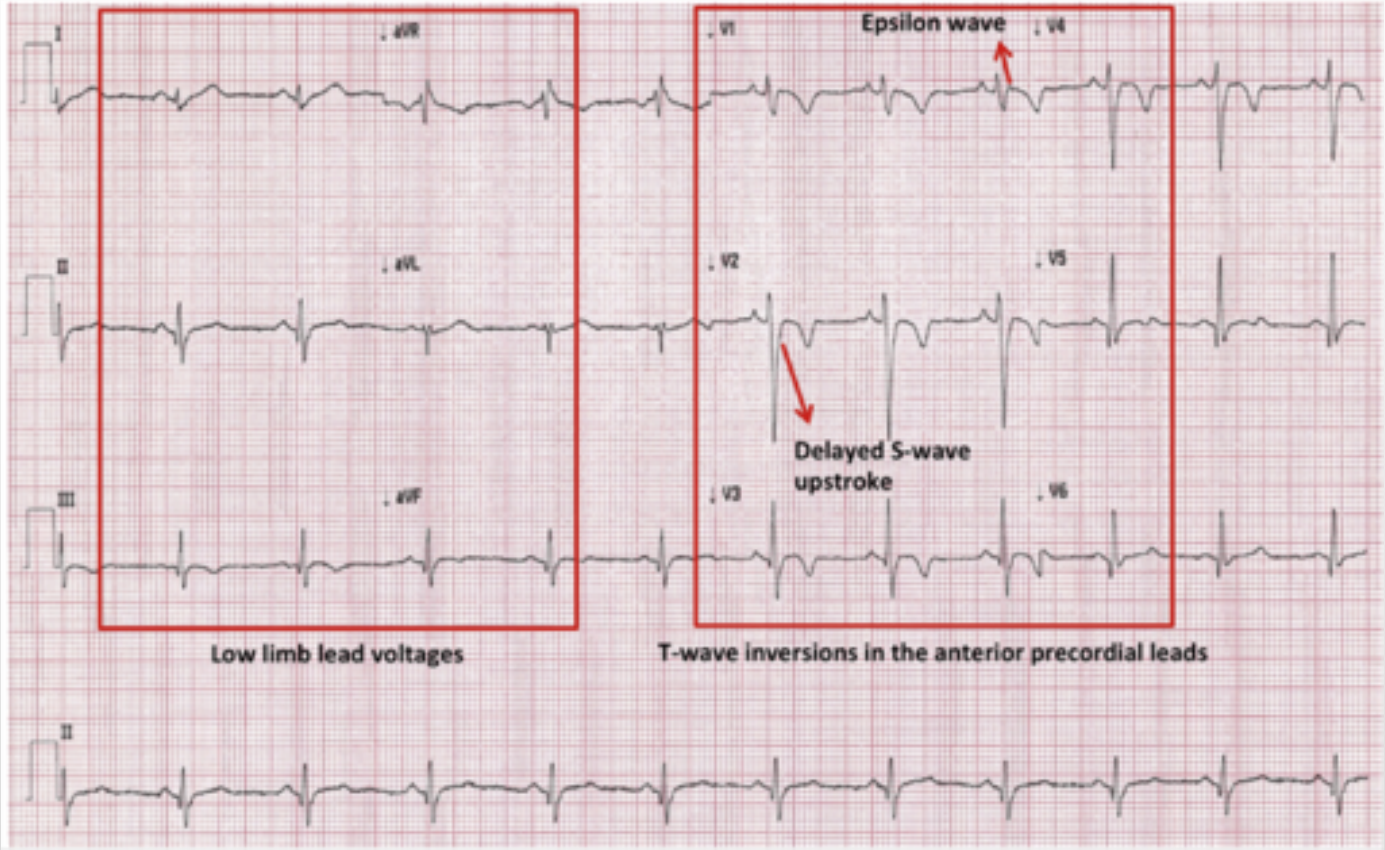
1. Screening of recreative sporters and athletes

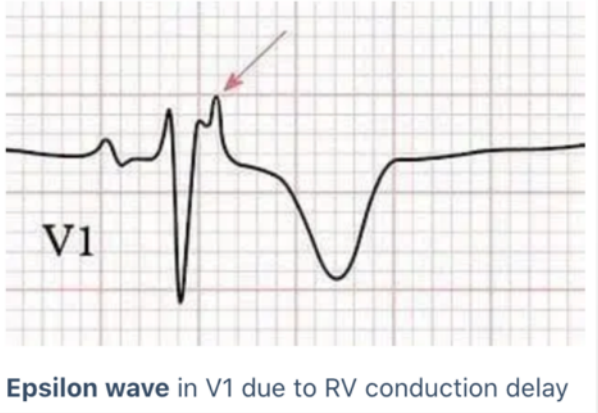
- **Abnormal ECG findings**
  - Complete left bundle branch block
    - QS or rS in V1 and notched R wave in I and V6, QRS duration > 120ms



1. Screening of recreative sporters and athletes

- **Abnormal ECG findings**
  - Epsilon wave (ARVC)

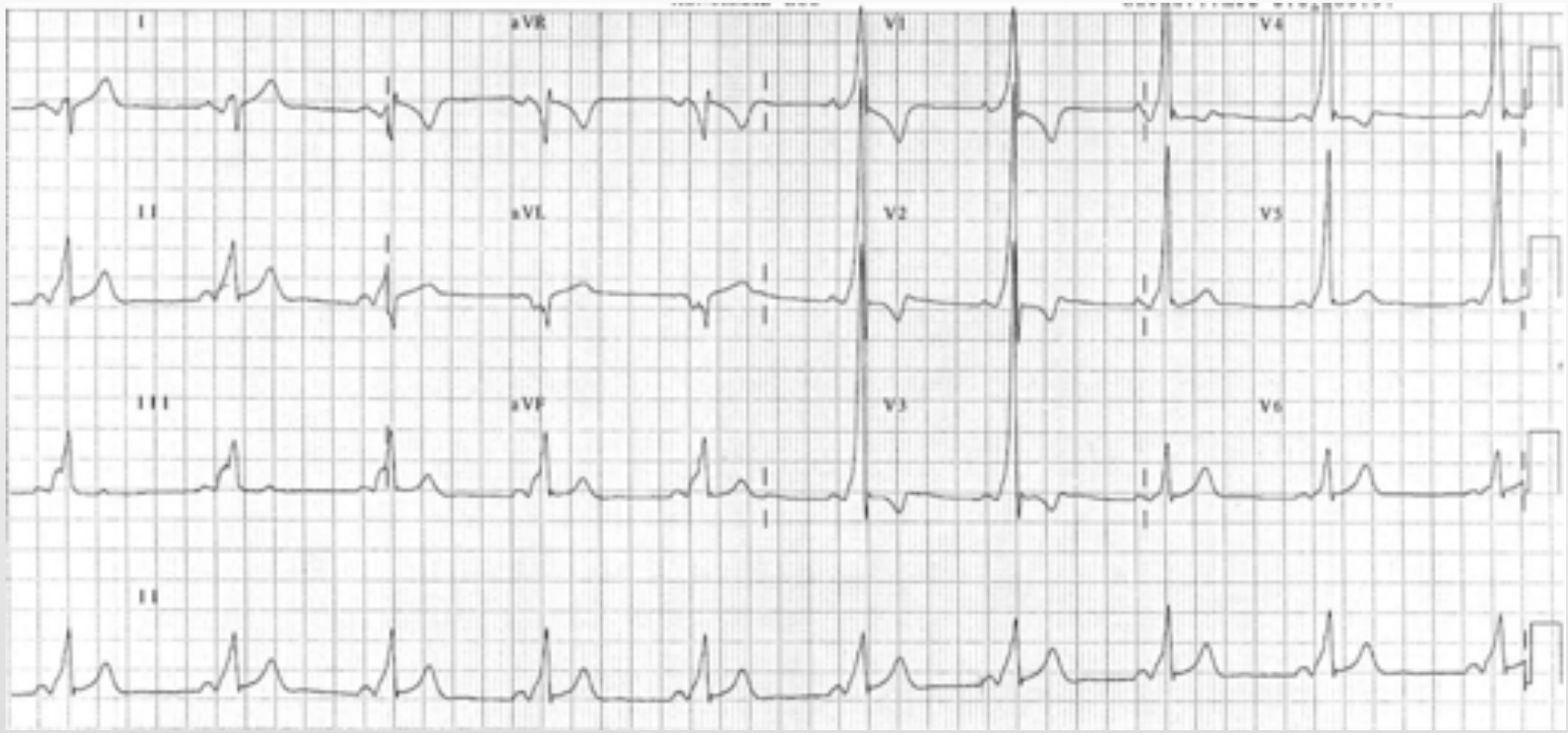




Epsilon wave in V1 due to RV conduction delay

1. Screening of recreative sporters and athletes

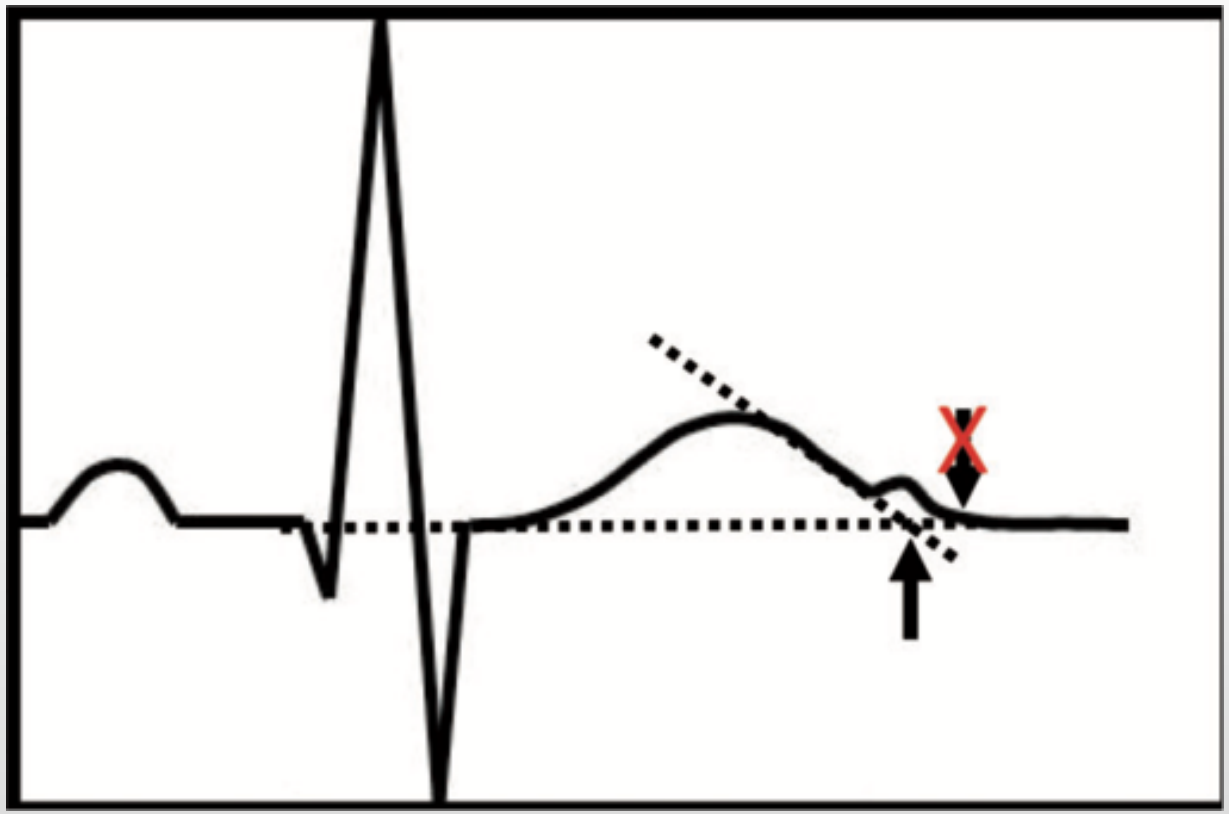
- **Abnormal ECG findings**
  - Ventricular pre-excitation (WPW syndrome): cave SCD (AF -> VF)



1. Screening of recreative sporters and athletes

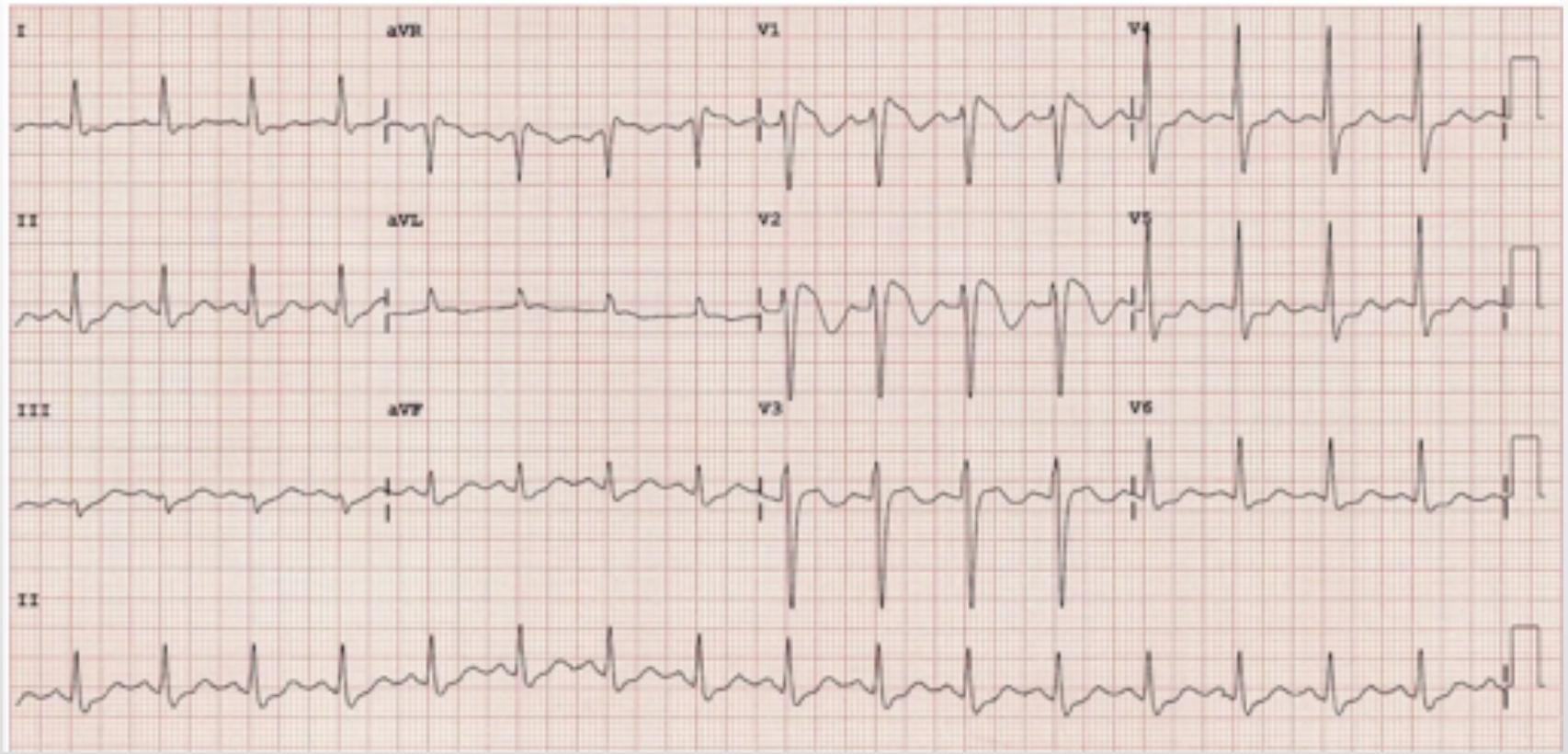
- **Abnormal ECG findings**
  - Prolonged QT interval (LQTS)
    - QTc > 470 ms (male)
    - QTc > 480 ms (female)
    - QTc > 500 ms
      (marked QT prolongation)

QTc measured using Bazett's Formula, HR 60-90 bpm



1. Screening of recreative sporters and athletes

- **Abnormal ECG findings**
  - Brugada Type I pattern (Brugada syndrome)



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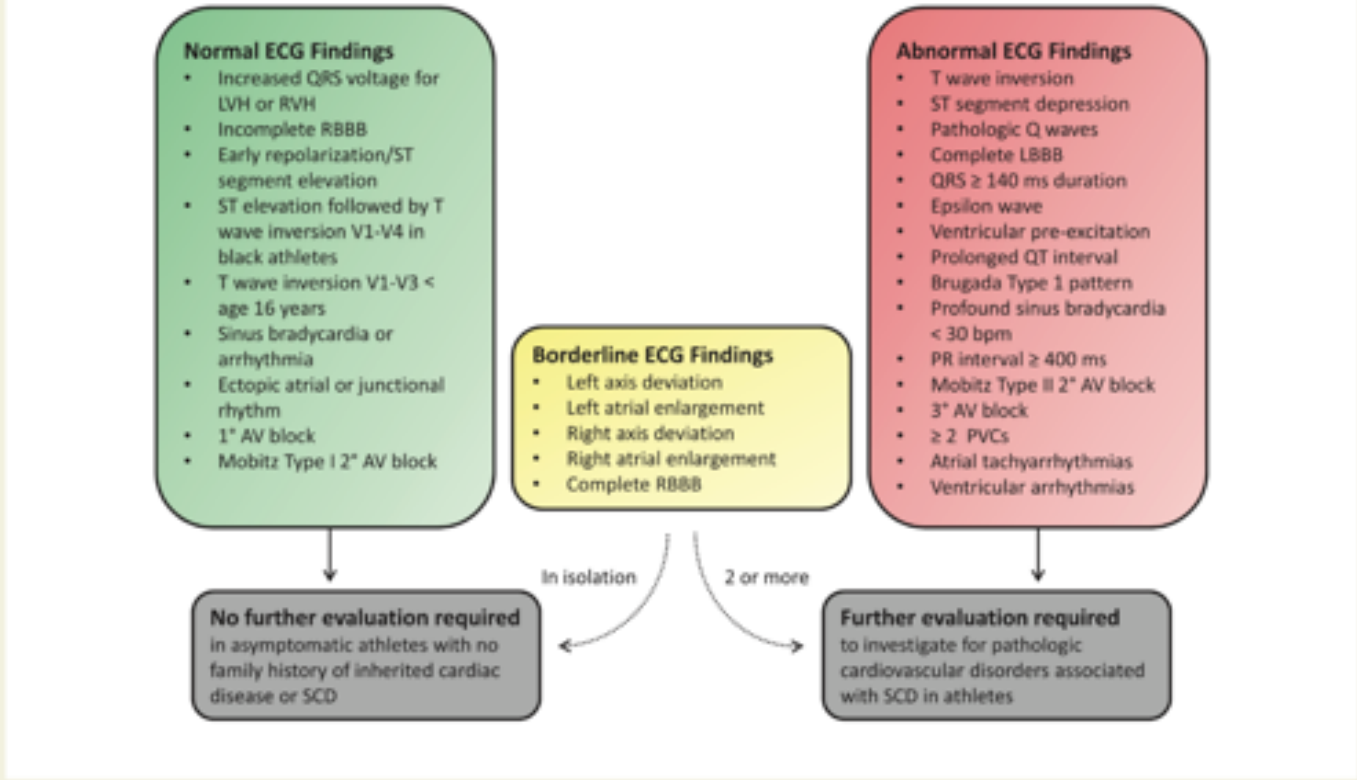

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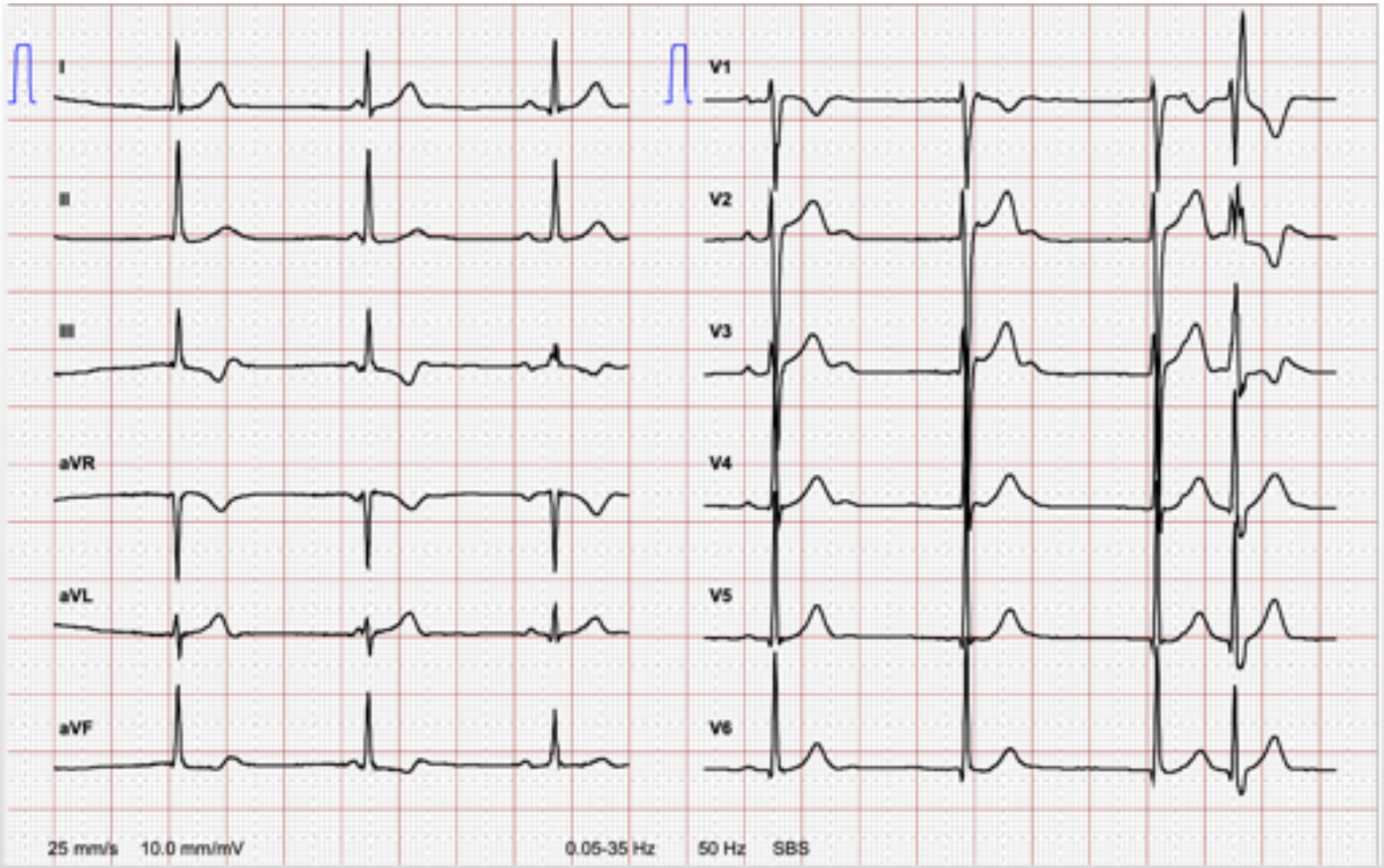
Case 1

- Man, 46y
- No history, no cardiac risk factors
- Sports: competitive athlete
  - Long distance running, ultra running, trail running
  - 100 km/week
  - 2500 altimeters/week
  - 10 km/h on average
- Check-up after 4 years: no symptoms or complaints

Case 1


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
25 mm/s
10.0 mm/mV
0.05-35 Hz
50 Hz
SBS

Case 1

- Echo (athlete's heart)
  - Mildly dilated left ventricle, LVEF 53%, normal diastolic function
  - Mildly dilated and hypertrophic right ventricle, normal function
  - Mildly dilated atria
  - Tricuspid valve insufficiency 1-2/4, no pulmonary hypertension
- 24h ambulatory Holter
  - Continuous sinus rhythm (min 35 bpm, av 50 bpm, max 116 bpm)
  - Bradycardia (<45 bpm): 11h/24h
  - 64 SVPB, 1 couplet SVPB, 5 VPB
  - No arrhythmias during running

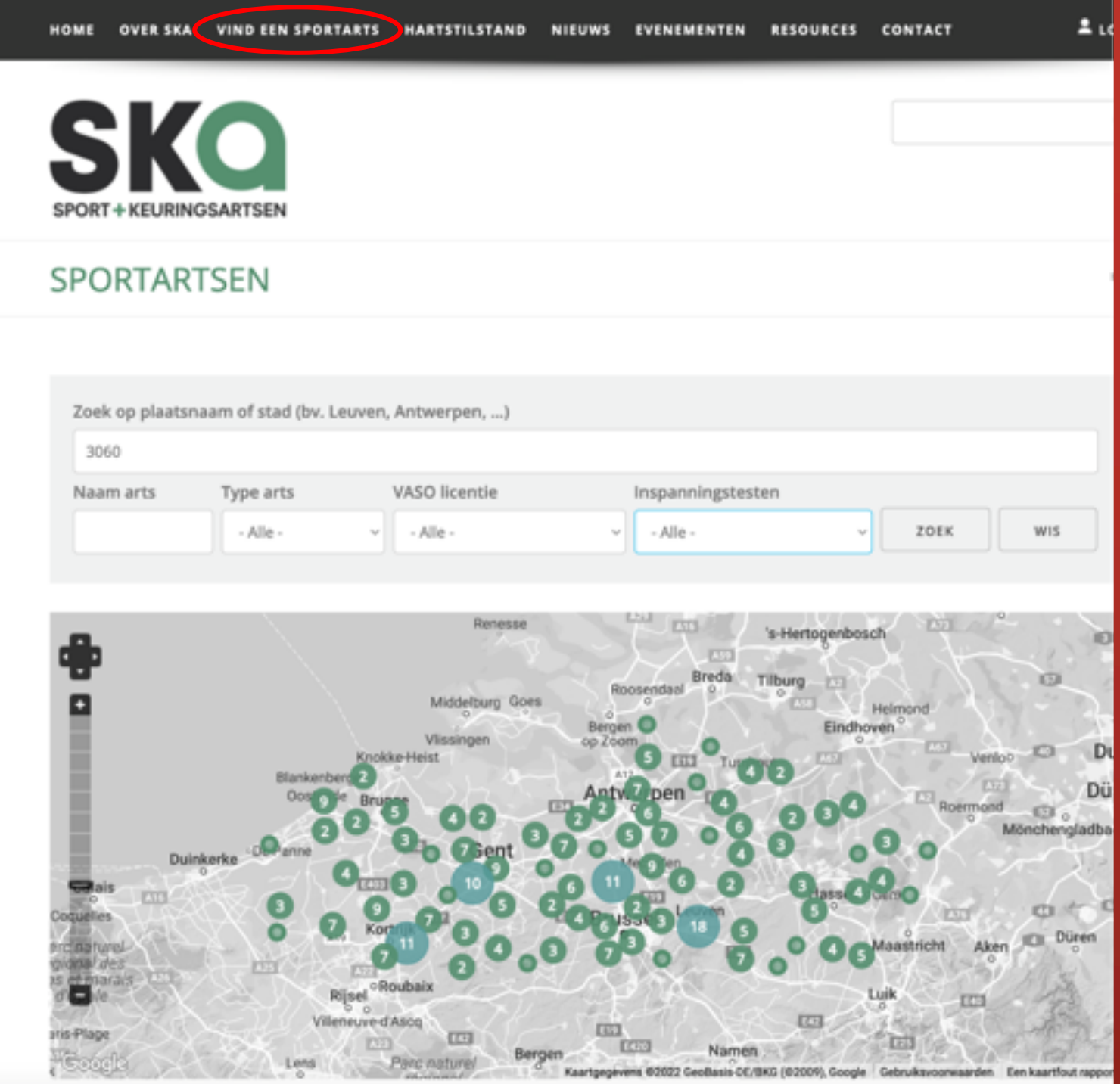
Case 1

Recommendations for exercise in individuals with premature ventricular contractions or non-sustained ventricular tachycardia

Recommendations	Class[a]	Level[b]
In exercising individuals with ≥2 PVCs on a baseline ECG (or ≥1 PVC in the case of high-endurance athletes) thorough evaluation (including a detailed family history) to exclude underlying structural or arrhythmogenic conditions is recommended.[503,522]	I	C
Among individuals with frequent PVCs and non-sustained VT a thorough investigation with Holter monitoring, 12-lead ECG, exercise test, and suitable imaging is recommmended.[503]	I	C
It is recommended that all competitive and leisure-time sports activities are permitted, with periodic re-evaluation in individuals without familial or structural underlying disease.[503]	I	C

SKA (Vereniging voor Sport- en KeuringsArtsen)

Https://www.sportartsen.be



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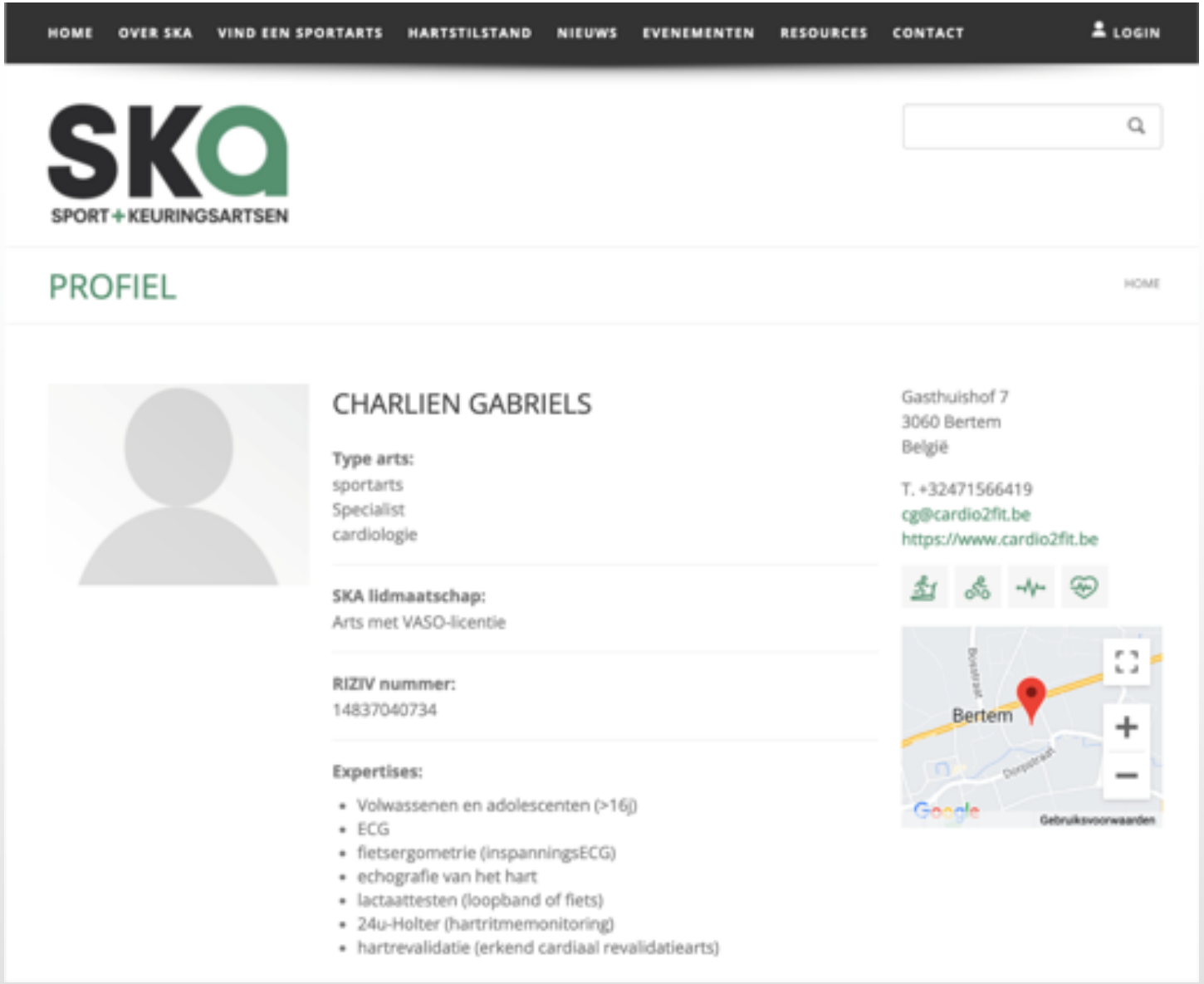

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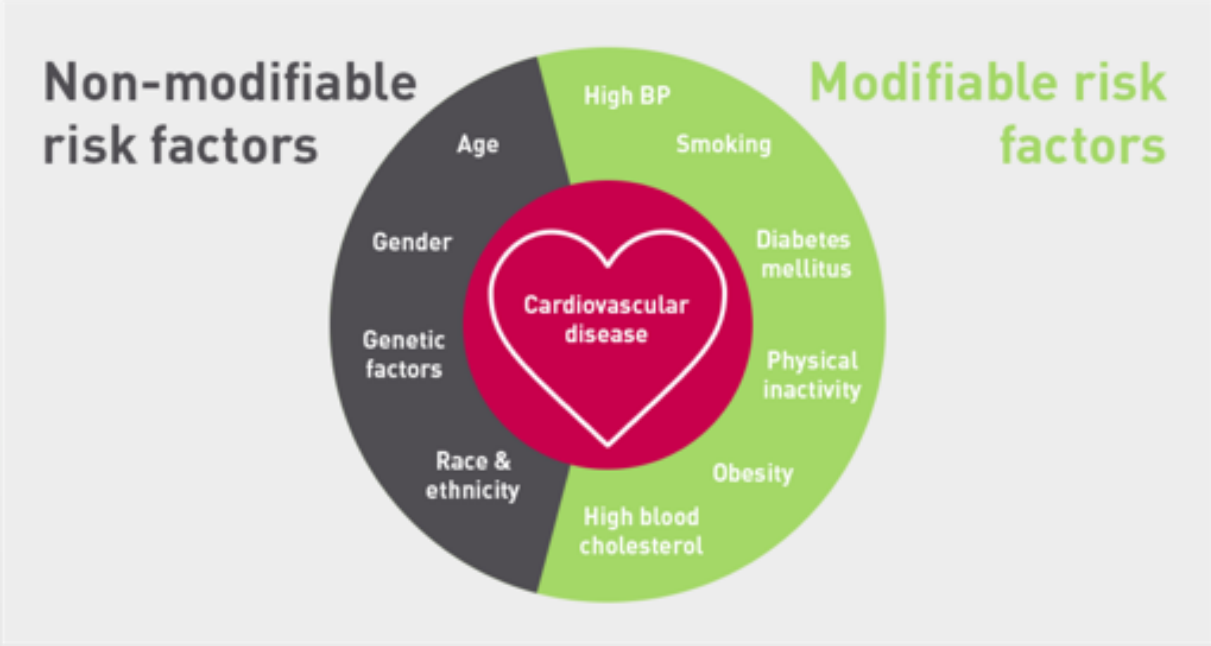
Sports = healthy!!

Sports = healthy

- General recommendations for exercise
  - 150 min/week (30 min/5 days) of moderate-intensity aerobic exercise (endurance training – walking, jogging, cycling, swimming)
  - OR 75 min/week (25 min/3 days) of vigorous-intensity aerobic exercise
  - 3 sessions/week resistance exercise (15 min)
  - Support to increase in exercise volume over time (intensity x duration)

Sports = healthy

- Beneficial effects of regular exercise on all CV risk factors!
  - reduction in intra-abdominal fat mass
  - increments in muscle and bone mass
  - increase in physical fitness, general well-being and self-esteem
  - reduction in blood pressure (SBP 7mmHg, DBP 5mmHg)
  - improvement in glucose tolerance and insulin sensitivity
  - improvement in lipid profile
  - reduction in chronic inflammation



2. Sports in patients with cardiovascular disease

ESC European Society of Cardiology

European Heart Journal (2021) **42**, 17–96
doi:10.1093/eurheartj/ehaa605

ESC GUIDELINES

2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease

The Task Force on sports cardiology and exercise in patients with cardiovascular disease of the European Society of Cardiology (ESC)

Authors/Task Force Members: Antonio Pelliccia* (Chairperson) (Italy), Sanjay Sharma* (Chairperson) (United Kingdom), Sabiha Gati (United Kingdom), Maria Bäck (Sweden), Mats Börjesson (Sweden), Stefano Caselli (Switzerland), Jean-Philippe Collet (France), Domenico Corrado (Italy), Jonathan A. Drezner (United States of America), Martin Halle (Germany), Dominique Hansen (Belgium), Hein Heidbuchel (Belgium), Jonathan Myers (United States of America), Josef Niebauer (Austria), Michael Papadakis (United Kingdom), Massimo Francesco Piepoli (Italy), Eva Prescott (Denmark), Jolien W. Roos-Hesselink (Netherlands), A. Graham Stuart (United Kingdom), Rod S. Taylor (United Kingdom), Paul D. Thompson (United States of America), Monica Tiberi (Italy), Luc Vanhees (Belgium), Matthias Wilhelm (Switzerland)

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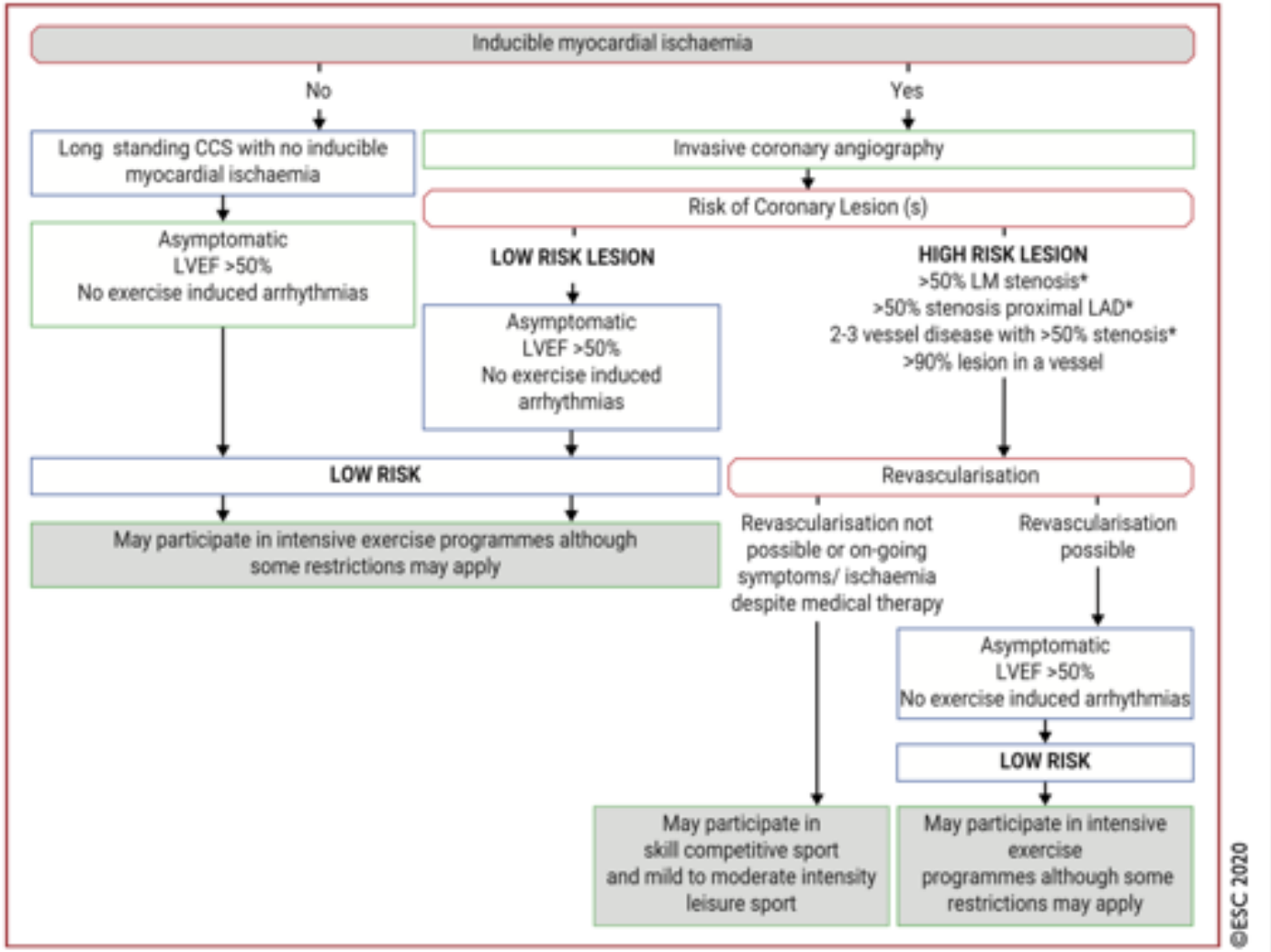
Chronic coronary syndrome



Classification of sports

Figure 2 Sporting discipline in relation to the predominant component (skill, power, mixed, and endurance) and intensity of exercise. Intensity of exercise must be individualized after maximal exercise testing, field testing and/or after muscular strength testing (*Table 2*).

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Chronic heart failure

- Stable patients
- On optimal medical therapy
- Baseline assessment (BNP, TTE and CPET)

Table 12 Optimal exercise training dose for patients with chronic heart failure

	Aerobic exercise	Resistance exercise
Frequency	3–5 days/week, optimally daily	2–3 days/week; balance training daily
Intensity	40–80% of VO_{2peak}	Borg RPE <15 (40–60% of 1RM)
Duration	20–60 min	10–15 repetitions in at least 1 set of 8–10 different upper and lower body exercises
Mode	Continuous or interval	
Progression	A progressively increasing training regimen should be prescribed with regular follow-up controls (at least every 3–6 months) to adjust the duration and the level of the exercise to the reached level of tolerance	A progressively increasing training regimen should be prescribed with regular follow-up controls (at least every 3–6 months) to adjust the duration and the level of the exercise to the reached level of tolerance

1 RM = one repetition maximum; RPE = rating of perceived exertion; VO_{2peak} = peak oxygen consumption.

7	very, very light
8	
9	very light
10	
11	fairly light
12	
13	somewhat hard
14	
15	hard
16	
17	very hard
18	
19	very, very hard
20	

Chronic heart failure

Non-competitive (low-intensity recreational skill-related sports) may be considered (when tolerated) in stable, optimally treated individuals with HFrEF.	IIb	C
High-intensity power and endurance sports are not recommended in patients with HFrEF irrespective of symptoms.	III	C

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Arrhythmias

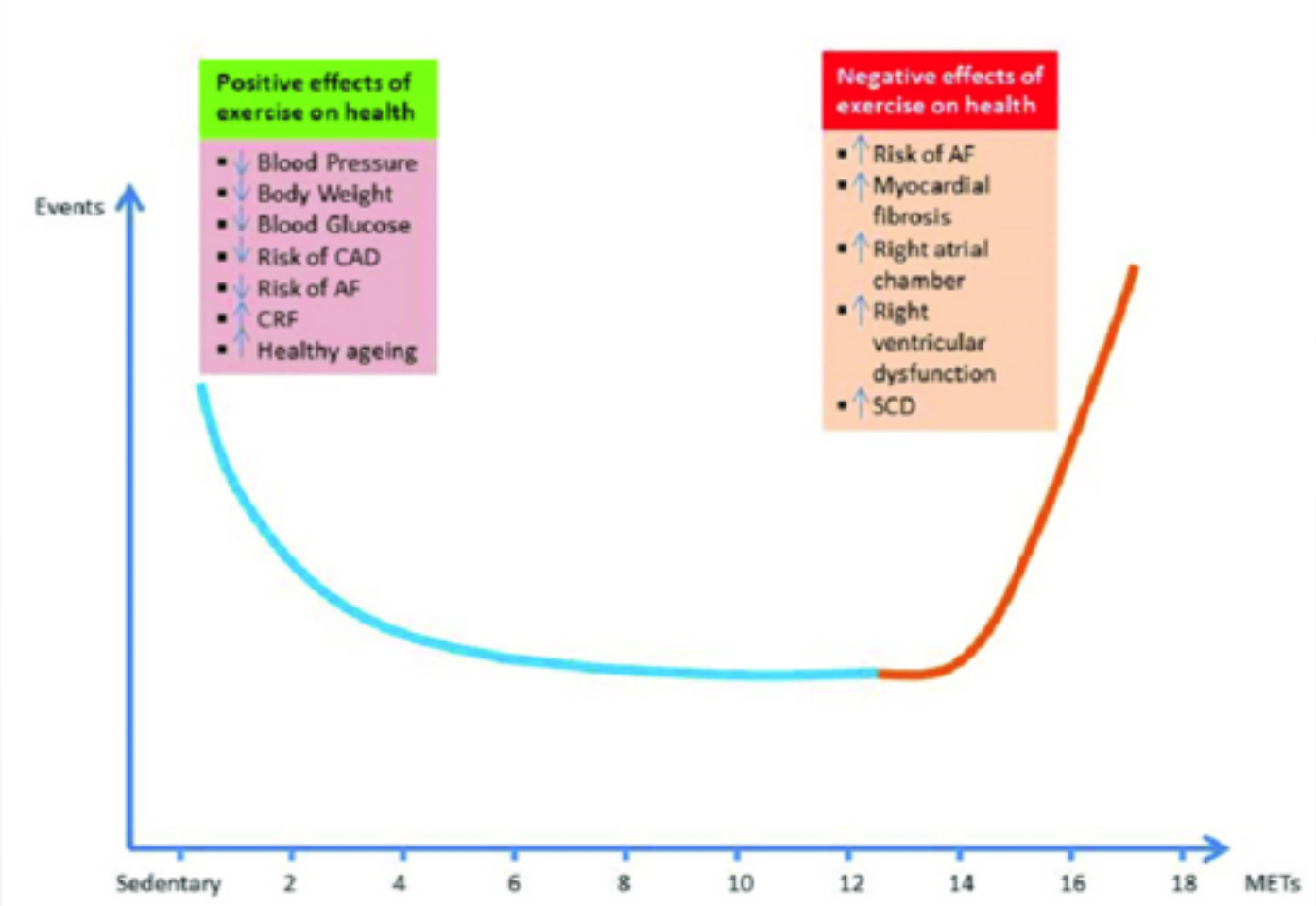
- 3 principle questions for exercise recommendations

1. Increased risk for life-threatening arrythmias?

2. How does one controle symptoms due to arrhythmias during sports?

3. Impact of sports on the natural progression of the arrhythmogenic condition?

Atrial fibrillation: exercise paradox



Atrial fibrillation

- Before advising sports, you should exclude
  - Underlying structural heart disease
  - Pre-excitation
  - Hyperthyroidism
  - Alcohol and drug abuse

Atrial fibrillation

- Symptoms during exercise due to rapid AV nodal conduction
  - Dizziness
  - Fatigue
  - Impaired physical performance
  - Syncope

Atrial fibrillation

- Rate control versus rhythm control
  - Rate control
    - Beta-blockers: may not be tolerated (impact on physical performance)
    - Calcium-channel blockers and digitalis: not potent enough when used alone
    - Combination of drugs is needed
  - Rhythm control
    - Class III drugs: insufficient for control (sotalol) or contraindicated in the young (amiodaron)
    - Class I drugs (flecainide, propafenone): NOT used in monotherapy: may induce atrial flutter and 1:1 conduction with hemodynamic compromise -> prophylactic cavo-tricuspid-isthmus ablation should be considered
    - Catheter ablation by PVI if drug therapy fails or is not desired by the athlete

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Myocarditis

- Inflammatory disease of the myocardium
  - Cardiac dysfunction and arrhythmias, 2-20% of SCD in athletes
  - Viral infection most common cause (Enterovirus, Coxsackie B virus)
  - Cocaine, amphetamine
- S/
  - general malaise
  - fatigue
  - exercise intolerance
- D/
  - troponin/CRP
  - ECG (ST and T, LBBB)
  - echo, MRI

Myocarditis

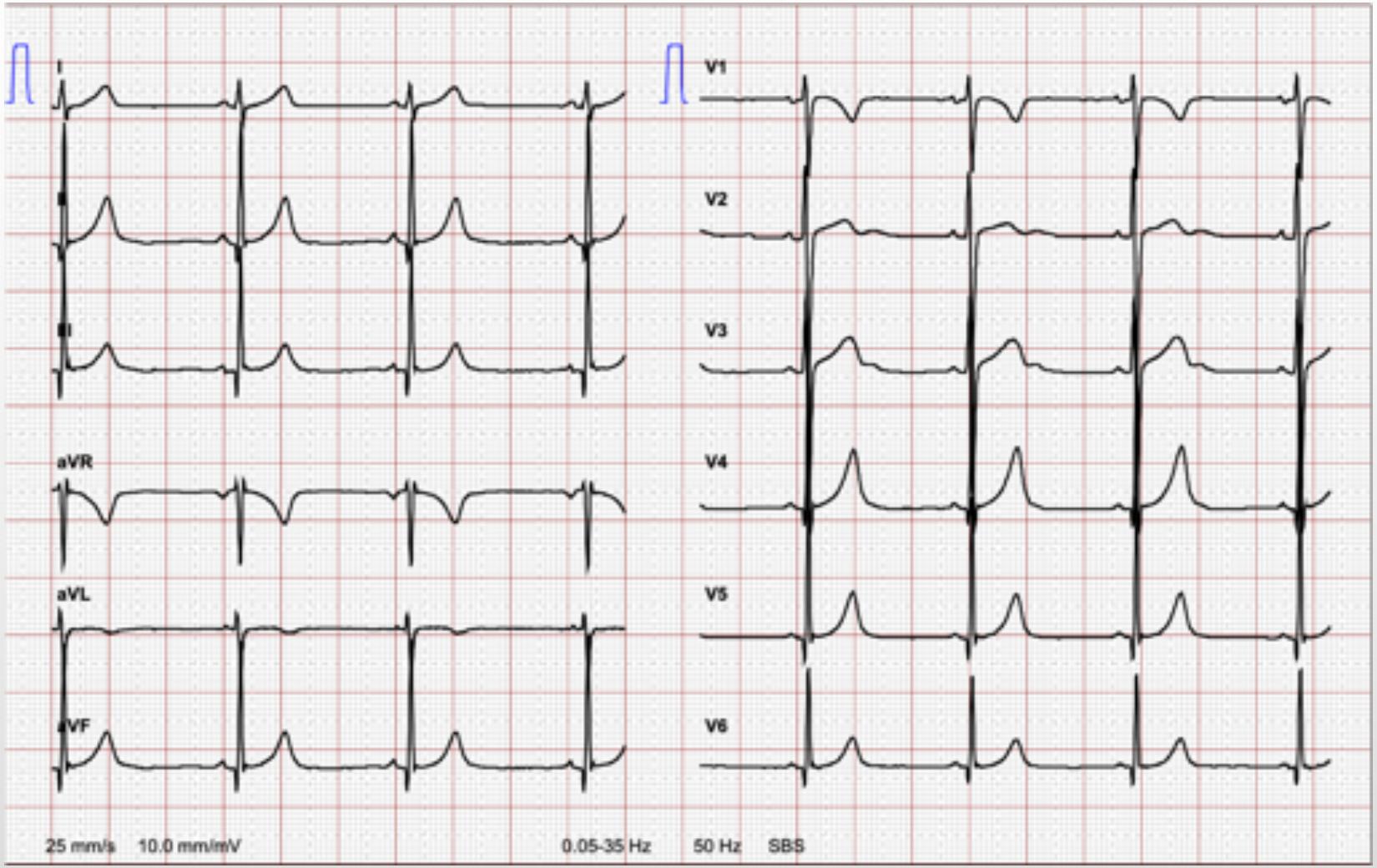
Recommendations for exercise in individuals with myocarditis

Recommendations	Class[a]	Level[b]
Comprehensive evaluation, using imaging studies, exercise stress test and Holter monitoring, is recommended following recovery from acute myocarditis to assess the risk of exercise-related SCD.[455,462,463]	I	B
Return to all forms of exercise including competitive sports should be considered after 3–6 months in asymptomatic individuals, with normal troponin and biomarkers of inflammation, normal LV systolic function on echocardiography and CMR, no evidence of ongoing inflammation or myocardial fibrosis on CMR, good functional capacity, and absence of frequent and/or complex VAs on ambulatory Holter monitoring or exercise testing.[430,434,453,459,460,464]	IIa	C
Among individuals with a probable or definitive diagnosis of recent myocarditis, participation in leisure-time or competitive sports while active inflammation is present is not recommended.[459,460]	III	C
Participation in moderate- to high-intensity exercise for a period of 3–6 months after acute myocarditis is not recommended.[459–461,467]	III	B
Participation in leisure exercise or competitive sports involving high intensity in individuals with residual myocardial scar and persistent LV dysfunction is not recommended.	III	C

Case 2

- Boy, 12y
- Pneumonias and reflux
- No cardiac risk factors or familial cardiac disease or SCD
- Sports
  - Football interprovincial level
- Preventive cardiac check-up
  - Active Covid19 infection 2 weeks before: 4 days fever, sore throat, chest pain upon cough
  - Day 7 jogging with dad (fatigue, dyspnea, chest pain), day 10 football practice (idem)

Case 2


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
25 mm/s
10.0 mm/mV
0.05-35 Hz
50 Hz
SBS

Case 2

- Echo
  - Non-dilated normotrophic left ventricle, low-normal systolic function (LVEF 55%, FS 28%)
  - Hyperreflectivity in lateral free wall of left ventricle?
  - Non-dilated normotrophic right ventricle, normal function
  - Normal atria
  - Normal heart valves
  - No pulmonary hypertension

Case 2

WHAT NOW??

Case 2

BIOCHEMIE			
Ureum	↗ 48.3	mg/dL	10.8-38.4
Creatinine	0.71	mg/dL	0.67-1.18
eGFR (CKD-EPI)	(1)		
CARDIALE MERKERS			
Troponine I (high sensitivity)	7.5	pg/ml	<17.5
CK	↗ 7405	U/L	<172
CK-MB	↗ 13.3	ng/mL	0.6-6.3
BNP	<10	pg/ml	0-99

ENZYMEN			
GOT-AST	↗ 152	U/L	<50
LDH	↗ 486	U/L	<248
IMMUNOLOGIE			
CRP	0.4	mg/L	<5.0

Myocarditis

Recommendations for exercise in individuals with myocarditis

Recommendations	Class[a]	Level[b]
Comprehensive evaluation, using imaging studies, exercise stress test and Holter monitoring, is recommended following recovery from acute myocarditis to assess the risk of exercise-related SCD.[455,462,463]	I	B
Return to all forms of exercise including competitive sports should be considered after 3–6 months in asymptomatic individuals, with normal troponin and biomarkers of inflammation, normal LV systolic function on echocardiography and CMR, no evidence of ongoing inflammation or myocardial fibrosis on CMR, good functional capacity, and absence of frequent and/or complex VAs on ambulatory Holter monitoring or exercise testing.[430,434,453,459,460,464]	IIa	C
Among individuals with a probable or definitive diagnosis of recent myocarditis, participation in leisure-time or competitive sports while active inflammation is present is not recommended.[459,460]	III	C
Participation in moderate- to high-intensity exercise for a period of 3–6 months after acute myocarditis is not recommended.[459–461,467]	III	B
Participation in leisure exercise or competitive sports involving high intensity in individuals with residual myocardial scar and persistent LV dysfunction is not recommended.	III	C

Overview

- Screening of recreative sporters and athletes
  - SKA
- Sports in patients with cardiovascular disease
  - Chronic coronary syndrome
  - Chronic heart failure
  - Arrhythmias
  - Myocarditis
  - Congenital heart disease

Congenital heart disease

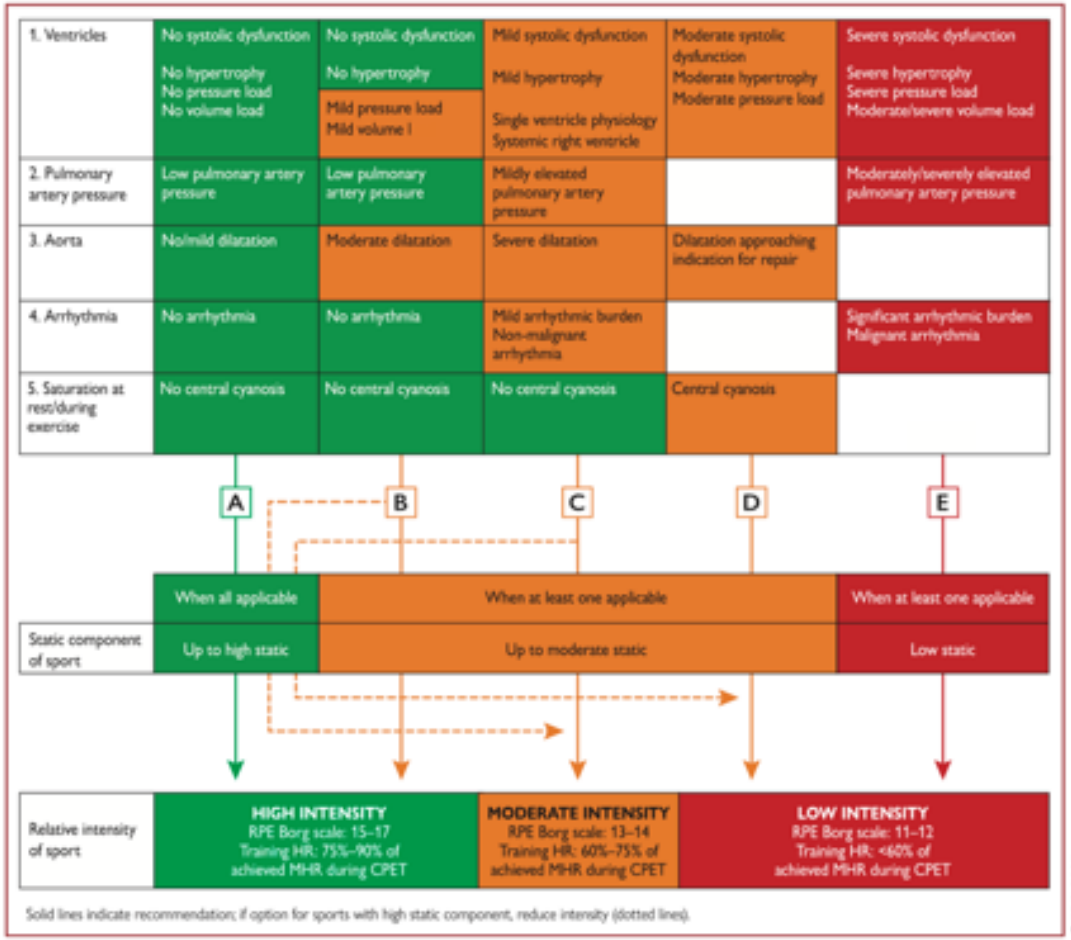


Figure 9 Pre-participation assessment of individuals with congenital heart disease.[598] CPET = cardiopulmonary exercise test; HR = heart rate; MHR = maximum heart rate; RPE = rate of perceived exertion. A–E represent pathways linking static and intensity components for each column. After assessment of CPET and the five variables (*Table 16*), an individual recommendation can be given (solid arrow). If a higher static level sport is chosen, then a lower intensity level is advised (dotted arrow).