

TABLE 2 Evaluation of Electrocardiographic Abnormalities

ECG Abnormality	Potential Cardiac Disease*	Recommended Evaluation†	Considerations
T-wave inversion in the lateral or inferolateral leads	HCM DCM LVNC ARVC (with predominant LV involvement) Myocarditis	Echocardiography CMR Exercise ECG test Minimum 24 h ECG monitor	Lateral or inferolateral T wave inversion is common in primary myocardial disease. CMR should be a routine diagnostic test for this ECG phenotype and is superior to echocardiography for detecting apical HCM, LVH localized to the free lateral wall, ARVC with predominant left ventricular involvement, and myocarditis. If CMR is not available, echocardiography with contrast should be considered as an alternative investigation for apical HCM in patients with deep T wave inversion in leads V ₅ -V ₆ . Consider family evaluation if available and genetic screening. Annual follow-up testing is recommended throughout athletic career in athletes with normal results.
T-wave inversion isolated to the inferior leads	HCM DCM LVNC Myocarditis	Echocardiography	Consider CMR based on echocardiography findings or clinical suspicion.
T-wave inversion in the anterior leads‡	ARVC DCM	Echocardiography CMR Exercise ECG test Minimum 24 h ECG monitor SAECG	The extent of investigations may vary based on clinical suspicion for ARVC and results from initial testing.
ST-segment depression	HCM DCM LVNC ARVC Myocarditis	Echocardiography	Consider CMR and additional testing based on echocardiography findings or clinical suspicion.
Pathologic Q waves	HCM DCM LVNC Myocarditis Prior MI	Echocardiography CAD risk factor assessment Repeat ECG for septal (V ₁ -V ₂) QS pattern; above investigations recommended if septal Q waves are persistent	Consider CMR (with perfusion study if available) based on echocardiography findings or clinical suspicion. In the absence of CMR, consider exercise stress testing, dobutamine stress echocardiogram, or a myocardial perfusion scan for evaluation of coronary artery disease in athletes with suspicion of prior MI or multiple risk factors for CAD.
Complete left bundle branch block	DCM HCM LVNC Sarcoidosis Myocarditis	Echocardiography CMR (with stress perfusion study)§	A comprehensive cardiac evaluation to rule out myocardial disease should be considered.
Profound nonspecific intraventricular conduction delay ≥140 ms	DCM HCM LVNC	Echocardiography	Consider additional testing based on echocardiography findings or clinical suspicion.
Epsilon wave	ARVC	Echocardiography CMR Exercise ECG test Minimum 24 h ECG monitor SAECG	An epsilon wave in leads V ₁ -V ₃ is a highly specific ECG maker and a major diagnostic criterion for ARVC.
Multiple premature ventricular contractions	HCM DCM LVNC ARVC Myocarditis Sarcoidosis	Echocardiography 24 h ECG monitor Exercise ECG test	If >2,000 PVC's or non-sustained ventricular tachycardia are present on initial testing, comprehensive cardiac testing inclusive of CMR is warranted to investigate for myocardial disease. Consider signal averaged ECG (SAECG).
Ventricular pre-excitation	WPW	Exercise ECG test Echocardiography	Abrupt cessation of the delta wave (pre-excitation) on exercise ECG denotes a low risk pathway. EP study for risk assessment should be considered if a low risk accessory pathway cannot be confirmed by non-invasive testing. Consider EP study for moderate to high intensity sports.
Prolonged QTc	LQTS	Repeat resting ECG on separate day Review for QT prolonging medication Acquire ECG of 1st degree relatives if possible	Consider exercise ECG test, laboratory (electrolyte) screening, family screening and genetic testing when clinical suspicion is high. Consider direct referral to a heart rhythm specialist or sports cardiologist for a QTc ≥500 ms.
Brugada Type 1 pattern	Brugada syndrome	Referral to cardiologist or heart rhythm specialist	Consider high precordial lead ECG with leads V ₁ and V ₂ in 2nd intercostal space or sodium channel blockade if Brugada pattern is indeterminate. Consider genetic testing and family screening.
Profound sinus bradycardia <30 beats/min	Myocardial or electrical disease	Repeat ECG after mild aerobic activity	Consider additional testing based on clinical suspicion.
Profound 1° atrioventricular block ≥400 ms	Myocardial or electrical disease	Repeat ECG after mild aerobic activity Exercise ECG test	Consider additional testing based on clinical suspicion.

ECG Abnormality	Potential Cardiac Disease*	Recommended Evaluation†	Considerations
Advanced 2° or 3° atrioventricular block	Myocardial or electrical disease	Echocardiography Minimum 24 h ECG monitor Exercise ECG test	Consider laboratory screening and CMR based on echocardiography findings.
Atrial tachyarrhythmias	Myocardial or electrical disease	Echocardiography Minimum 24 h ECG monitor Exercise ECG test	Consider CMR or EP study based on clinical suspicion.
Ventricular arrhythmias	Myocardial or electrical disease	Echocardiography CMR Minimum 24 h ECG monitor Exercise ECG test	A comprehensive cardiac evaluation to rule out myocardial disease and primary electrical disease should be considered.
Two or more borderline ECG findings	Myocardial disease	Echocardiography	Consider additional testing based on clinical suspicion.

*This list of disorders for each ECG abnormality represents the primary cardiac disorders of concern and is not intended to be exhaustive. †Initial evaluation of ECG abnormalities should be performed under the direction of a cardiologist. Additional testing will be guided by initial findings and clinical suspicion based on the presence of symptoms or a family history of inherited cardiac disease or SCD. ‡Excludes black athlete repolarization variant and juvenile pattern in adolescents < 16 years. §CT coronary angiography if stress perfusion with CMR is unavailable. ||Includes couplets, triplets, accelerated ventricular rhythm, and non-sustained ventricular tachycardia.

ARVC = arrhythmogenic right ventricular cardiomyopathy; CAD = coronary artery disease; CMR = cardiovascular magnetic resonance; DCM = dilated cardiomyopathy; ECG = electrocardiogram; EP = electrophysiological; HCM = hypertrophic cardiomyopathy; LQTS = long QT syndrome; LVNC = left ventricular noncompaction; MI = myocardial infarction; PVC = premature ventricular contraction; SAECG = signal averaged electrocardiogram; WPW = Wolff Parkinson White syndrome.