

Abnormal ECG findings in athletes

These ECG findings are unrelated to regular training or expected physiologic adaptation to exercise, may suggest the presence of pathologic cardiovascular disease, and require further diagnostic evaluation.

Abnormal ECG finding	Definition
T wave inversion	> 1 mm in depth in two or more leads V2-V6, II and aVF, or I and aVL (excludes III, aVR, and V1)
ST segment depression	≥ 0.5 mm in depth in two or more leads
Pathologic Q waves	> 3 mm in depth or > 40 ms in duration in two or more leads (except III and aVR)
Complete left bundle branch block	QRS ≥ 120 ms, predominantly negative QRS complex in lead V1 (QS or rS), and upright monophasic R wave in leads I and V6
Intra-ventricular conduction delay	Any QRS duration ≥ 140 ms
Left axis deviation	-30° to -90°
Left atrial enlargement	Prolonged P wave duration of > 120 ms in leads I or II with negative portion of the P wave ≥ 1 mm in depth and ≥ 40 ms in duration in lead V1
Right ventricular hypertrophy pattern	R-V ₁ + S-V ₅ > 10.5 mm <u>and</u> right axis deviation > 120°
Ventricular pre-excitation	PR interval < 120 ms with a delta wave (slurred upstroke in the QRS complex) and wide QRS (> 120 ms)
Long QT interval*	QTc ≥ 470 ms (male) QTc ≥ 480 ms (female) QTc ≥ 500 ms (marked QT prolongation)
Short QT interval*	QTc ≤ 320 ms
Brugada-like ECG pattern	High take-off and downsloping ST segment elevation followed by a negative T wave in ≥ 2 leads in V1-V3
Profound sinus bradycardia	< 30 BPM or sinus pauses ≥ 3 sec
Mobitz type II 2° AV block	Intermittently non-conducted P waves not preceded by PR prolongation and not followed by PR shortening
3° AV block	Complete heart block
Atrial tachyarrhythmias	Supraventricular tachycardia, atrial fibrillation, atrial flutter
Premature ventricular contractions	≥ 2 PVCs per 10 second tracing
Ventricular arrhythmias	Couplets, triplets, and non-sustained ventricular tachycardia

*The QT interval corrected for heart rate is ideally measured with heart rates of 60-90 bpm. Consider repeating the ECG after mild aerobic activity for borderline or abnormal QTc values with a heart rate < 50 bpm.

Normal ECG findings in athletes

These common training-related ECG alterations are physiological adaptations to regular exercise, considered normal variants in athletes, and do not require further evaluation in asymptomatic athletes.

Sinus bradycardia (≥ 30 bpm)
Sinus arrhythmia
Ectopic atrial rhythm
Junctional escape rhythm
1° AV block (PR interval > 200 ms)
Mobitz Type I (Wenckebach) 2° AV block
Incomplete RBBB
Isolated QRS voltage criteria for LVH
<u>Except:</u> QRS voltage criteria for LVH occurring with any non-voltage criteria for LVH such as left atrial enlargement, left axis deviation, ST segment depression, T wave inversion, or pathologic Q waves
Early repolarisation (ST elevation, J point elevation, J waves, or terminal QRS slurring)
Convex ("domed") ST segment elevation combined with T wave inversion in leads V1-V4 in Afro/Caribbean athletes