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Bradycardia in a young competitive athlete

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Clinical vignette

A 26-year-old female athlete, who competes in orienteering, came in for a routine cardiac screening before participating in the World Championship in 7 weeks. She is currently not experiencing any symptoms and has no family history of heart disease or sudden death. The athlete undergoes 7 h of endurance training and 3 h of strength conditioning every week. She has been a competitive orienteering athlete for 5 years and is studying biology at university. *Figure 1* shows the results of her screening electrocardiogram (ECG). As a result of genetic testing, she was found to be heterozygous for the SCN5A genotype (p.Arg1644His). This mutation is highly predictive of long QT syndrome type 3.

Question 1

Which of the following options best describes the ECG findings:

A. Sinus bradycardia as expected in an elite athlete.
B. Sinus bradycardia with a normal corrected QT (QTc) interval.
C. Sinus bradycardia with a prolonged QTc interval.
D. Sinus bradycardia with incomplete atrioventricular node block.
E. Sinus bradycardia with pathological T-wave abnormalities.

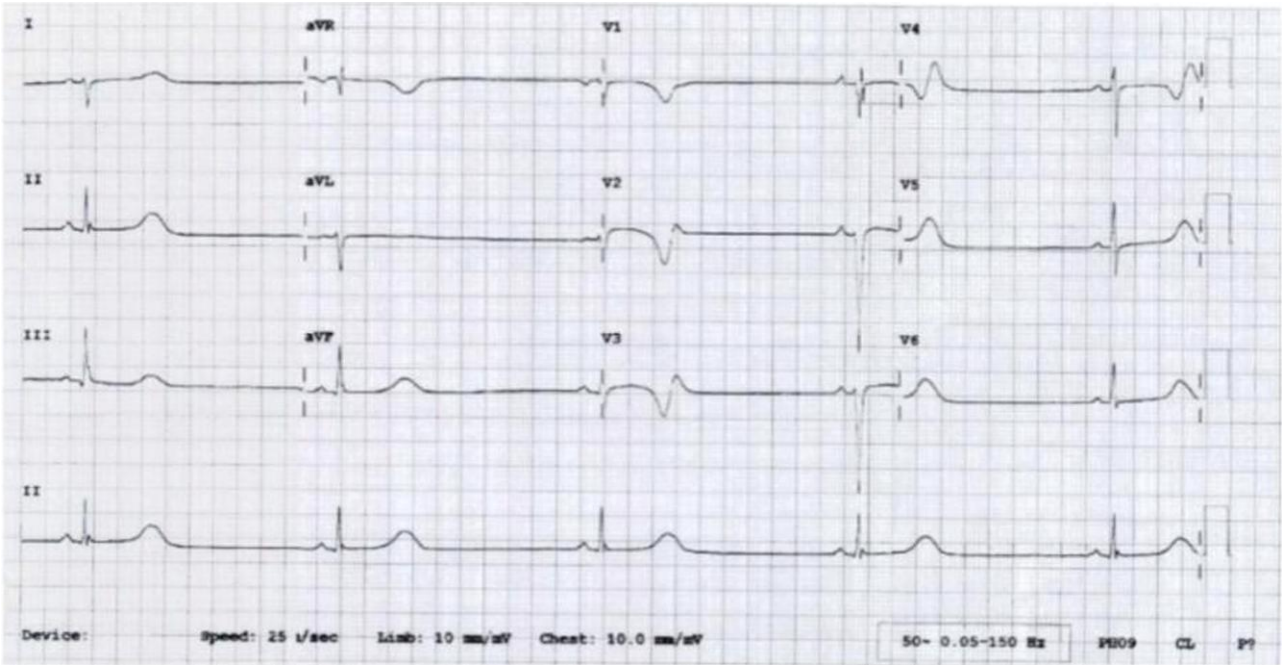

Figure 1 Resting 12-lead ECG.

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Answer: C
Explanation:

Each QRS complex in a sinus rhythm is consistently preceded by a P-wave at regular intervals. To adjust for heart rate, the QT interval is typically corrected to the RR interval, resulting in a QTc interval. The most commonly used formula for this correction is the Bazett's formula, where $QTc = QT/\sqrt{RR}$.[1] This formula is also recommended by the 2020 ESC Guidelines on sports cardiology and exercise.[2] In our case, the QT interval is around 720 ms, leading to a QTc of 492 ms. In women athletes, a QTc ≥ 480 ms is considered prolonged (≥470 ms for men).[2] Additionally, the ECG reveals abnormal biphasic T-waves in leads V1–V4, which is an atypical aspect for an athlete's ECG.[3]

Question 2

After the screening ECG, which investigations should be conducted?

A. Electrophysiological studies to assess for conduction defects.
B. Exercise testing to confirm a prolonged QT interval
C. Genetic testing after patient counselling.
D. Imaging in the form of a cardiac MRI.
E. No further investigations are required.

Answer: B
Explanation:

It is widely known that the Bazett's formula for calculating the QTc can become less reliable at extreme heart rates. Therefore, it is crucial to examine the QT interval in our bradycardic athlete at higher heart rates, which can be done most efficiently through an exercise ECG. Following the 2022 ESC Guidelines on ventricular arrhythmias and prevention of sudden cardiac death, a Schwartz score based on the QTc at the 4th minute post-exercise is used as a criteria to diagnose long QT syndrome (LQTS).[4] Our athlete had a post-exercise QTc of 520 ms at the 4th minute of recovery, giving her a high probability of disease (Schwartz score of 4.5).

Question 3

What is the most appropriate management strategy for this athlete after starting beta-blocker therapy?

A. Genotype specific add on therapy such as mexiletine
B. Uptitrate beta-blocker therapy to maximum dose
C. No treatment is indicated at this stage as the patient is asymptomatic
D. Prophylactic implantable cardiac defibrillator (ICD) insertion
E. Refrain from all competitive sporting activities permanently

Answer: A
Explanation:

LQT3 patients carry a gain-of-function mutation on SCN5A, which encodes fast-inward sodium channels. As such, it has been demonstrated that they benefit from sodium channel blockers like mexiletine to reduce the QT interval and the risk of cardiac arrhythmias, recently benefits have been demonstrated also in LQT2 patients.[1] Beta-blockers may further reduce the resting heart rate in our athlete, negatively affecting the athletic performance. Prophylactic ICD insertion is invasive and not the first-line intervention in asymptomatic patients. According to the 2020 ESC Guidelines on sports cardiology and exercise, women with LQTS and QTc ≥ 480 ms should avoid high-intensity sports, even whilst on beta-blockers.[2]

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Data availability

Anonymized patient data is held by the corresponding author and available upon request.

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