

## **Screening of Elite High School Athletes with Electrocardiogram Compared with Adolescents with Hypertrophic Cardiomyopathy**

Alex J. Thompson, MD, Bryan C. Cannon, MD, Justin M. Horner, MD, Michael J. Ackerman, MD, PhD, Benjamin W. Eidem, MD, Jonathan N. Johnson, MD

**Background :** In trained athletes, ECG are common and can result in further and often unnecessary testing. Criteria have been developed to better identify electrocardiograms (ECGs) that require further investigation. The European Society of Cardiology (ESC) Criteria and the more recent Seattle Criteria are two such guidelines.

**Methods :** We prospectively performed standard 15-lead ECGs and echocardiograms in 147 elite high school athletes (mean age  $16.0 \pm 1.3$  years). Athlete ECGs were compared in a blinded fashion to baseline ECGs of 148 age-matched adolescents diagnosed previously with non-syndromic HCM (age  $16.1 \pm 1.8$  years). In addition to standard ECG hypertrophy criteria, both the European Society of Cardiology (ESC) Criteria and the recently released Seattle Criteria were used to electrocardiographically phenotype the subjects in both cohorts for “abnormal” ECG findings.

**Results :** All athletes participating in this study had normal echocardiograms. Overall, 126/148 (85%) adolescents with HCM satisfied standard ECG criteria for left ventricular hypertrophy (LVH), right ventricular hypertrophy (RVH), or biventricular hypertrophy (BVH), compared to 77/147 (52%) elite athletes ( $p < 0.0001$ ). Of the 22 HCM patients not meeting ECG criteria for hypertrophy, 17 had other ECG anomalies including Q-wave, T-wave, and ST-segment abnormalities or left or right axis deviation. Less than 4% (5/148) of HCM patients had “normal” ECGs. Overall, 111/148 (75%) adolescents with HCM had Q-wave, T-wave, and/or ST-segment abnormalities compared to only 7/147 (5%) athletes ( $p < 0.0001$ ). There were 124/148 (84%) HCM patients who had  $\geq 1$  abnormal ECG finding(s) according to the Seattle Criteria, compared to 8/147 (5%) of athletes ( $p < 0.0001$ ). Similarly, 132/148 (89%) of HCM patients met group 2 ESC Criteria (high-risk), compared to 40/147 (27%) of athletes ( $p < 0.0001$ ).

**Conclusion :** Among elite high school athletes with echocardiographically confirmed normal hearts, nearly 80% of male athletes and 15% of female athletes satisfied standard voltage criteria for ventricular hypertrophy. The criteria from the ESC had a higher incidence of false positive results than the Seattle Criteria for ECG interpretation of athletes, with roughly 1 out of 4 elite athletes being flagged with an ECG finding that would necessitate further evaluation. Q wave, T wave and ST segment abnormalities as well as combined voltages in V3 and V4 were helpful in distinguishing hypertrophic cardiomyopathy.