Anterior T-Wave Inversion Does Not Convey Short-Term Sudden Death Risk

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Inverted is the new normal. Anterior T wave inversion does not convey short-term sudden death risk in young white adults.

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Ventricular fibrillation leading to sudden arrhythmic death, one of the major causes of death in young adults (together with road accidents, suicide, and violence), is a devastating event for affected families. (1) The first symptomatic manifestation is often lethal, despite better dissemination of first responder support for witnessed sudden arrhythmic death events, automated defibrillators, and faster “chains of survival” supporting acute care. Hence, early detection of individuals at risk is needed to prevent sudden arrhythmic death in younger adults. Unfortunately, it is a bit like looking for a golden needle in the haystack (Figure 1).

Inherited cardiac conditions such as arrhythmogenic right ventricular cardiomyopathy (ARVC), hypertrophic cardiomyopathy, or long QT syndrome, are among the more common causes of sudden death in young adults. The ECG is often sufficient to detect long QT syndrome, and has a reasonable sensitivity to detect hypertrophic cardiomyopathy. ECG screening has been successfully applied to detect long QT syndrome and Brugada ECG patterns in population-based studies (2,3) including the very young. (4-6) Many soccer, basketball, baseball, and cricket clubs routinely require an ECG and other cardiac tests before they sign contracts with professional players. Several international organisations, including the International Olympic Committee and other expert groups have proposed ECG screening in young adults and athletes (7-9), but it is unclear whether all athletes should undergo ECG screening. (10,11)

Screening tests require a high specificity to minimize anxiety and resource-use for further work-up in carriers of a given marker. In this issue of JACC, Dr. Malhotra and colleagues report a systematic analysis of over 16000 ECGs of Caucasian young adults including almost 3000 athletes (12). They found that T wave inversions in leads V1 and V2 are a normal variant, present in 1.4% of men and 4.3% of women studied. T wave inversions beyond V2 (i.e. in V1-V3 or in more than three chest leads) was rare (0.2%) in males and uncommon (1.2%) in females (2.1% in female athletes). None of the probands studied fulfilled the diagnostic criteria ARVC. (13) Furthermore, none of the probands with T wave inversion in the anterior chest leads suffered from an adverse event during a follow-up time of almost two years. This can clearly help clinicians who are faced with young adults showing anterior T wave inversion. The data also provide robust information on the spectrum of anterior T wave morphologies in young Caucasian adults, and support an updated definition of the normal range in Europe, as already suggested by the “Seattle criteria” (14).

The ECG integrates electrical differences throughout the chest, reflecting the main electrical gradients in the heart. Hence, it is less sensitive to changes in the right ventricle than in the larger left ventricle. Because ARVC affects the right ventricle earlier and more severely than the left ventricle, it can be more challenging to detect signs of ARVC in the ECG, compared to predominantly left ventricular diseases. Based on the position of the heart in the chest and

the type of recording of the chest (Wilson) ECG leads, the anterior chest leads of the ECG (V1-V3) are most likely to reveal right ventricular abnormalities. Indeed, anterior T wave inversion is found in many ARVC patients. (14,15) The report by Dr. Malhotra and colleagues clearly underpins that anterior T wave inversion in the anterior chest leads was not associated with a high risk of adverse events within a few years (12). It is conceivable that ARVC develops over a longer follow-up period in some of the probands. The data also suggest that the post-pubertal female anatomy of the chest is more conducive to T wave inversion in the anterior chest leads than male anatomies.

Detection of arrhythmogenic right ventricular cardiomyopathy appears of special relevance in athletes as endurance training accelerates the progression of disease. (16-18) Should we thus combine abnormal T wave patterns with other ECG markers for ARVC, e.g. further T wave abnormalities (19), S waves (13,20), or late potentials in the signal averaged ECG (13,21,22)? Should we alternatively stop using the ECG to screen for ARVC in young adults? The report by Dr Malhotra provides robust information on the relevance of T wave inversion in the short term in young adults. It is sufficient to reassure affected individuals that there is no imminent danger. Further work is needed to develop better tools to screen for rare but potentially life threatening diseases like ARVC.

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