

Frequency and gender differences of minor ECG changes and their relation to cardiac structural remodelling in athletes

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Regular exercise training results in a complex structural and electrical remodelling of the cardiac chambers, also referred as the athlete's heart (AH). Several minor ECG changes, such as incomplete right bundle branch block (iRBBB) or QRS voltage criteria of left ventricular hypertrophy (LVH) are more frequent in this population. However, the correlation of these ECG changes with structural remodelling is not well characterized and gender differences may be also present.

Our aim was to determine the relationship between AH-related ECG changes and structural remodelling assessed by three-dimensional echocardiography (3D) and to identify gender-specific ECG patterns which may refer to structural alterations.

Young competitive athletes of mixed exercise training (n=183; 18±4 years; m/f: 131/52) were enrolled in our current study. 12-lead ECG was performed to identify iRBBB and LVH by the Sokolow-Lyon or Cornell criteria. One patient with left anterior hemiblock, an uncommon ECG sign in athletes were excluded. Beyond conventional echocardiographic examination, 3D datasets focused on the left (LV) or the right ventricle (RV) were acquired to reconstruct 3D surface models using dedicated software. We have measured LV and RV end-diastolic volume indices (EDVi), stroke volume indices (SVi) and LV mass index (LVMi). Measurements were normalised to body surface area.

The presence of iRBBB was more common in males compared to females (45% vs. 27%). In males, there was no difference in terms of echocardiographic parameters between the iRBBB and non-iRBBB group. In females, however, the iRBBB group had significantly higher ventricular volumes (LVEDVi: 88±10 vs. 81±8 mL/m², p<0.05; LVSVi: 52±8 vs. 46±6 mL/m², p<0.01; RVEDVi: 94±14 vs. 81±10 mL/m², p=0.001; RVSVi: 53±8 vs. 45±5 mL/m², p<0.001). ECG criteria of LVH were only present in males (13%). However, the presence of ECG criteria of LVH was not accompanied by a higher LVMi or other structural alterations determined by 3D echocardiography in this subgroup (LVMi: 89±14 vs. 88±13 g/m²).

In conclusion, AH is frequently associated with minor ECG abnormalities, and there are considerable gender differences in their relation to cardiac remodelling. Females with iRBBB have presented higher LV and RV end-diastolic and stroke volumes. Nevertheless, ECG criteria of LVH are not sensitive to detect higher LVMi. These findings may contribute to a better understanding of electrical and structural remodelling present in AH and to determine the value of ECG parameters in routine sports cardiology screening.