

Daily heart rate dynamics reflects global Fontan pathophysiology

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Introduction

A large body of evidence shows that increased resting heart rate (HR) and arrhythmia are associated with poor prognosis in patients with chronic heart failure. Although Fontan pathophysiology shares common pathophysiology of chronic heart failure, precise association of daily HR dynamics with Fontan pathophysiology has not been elucidated.

Methods

We prospectively evaluated daily HR dynamics (bpm) with Holter ECG monitoring in consecutive 223 patients after the Fontan operation (age 17.1 ± 8.3 years). We obtained maximum heart rate (Max), minimum heart rate (Min), mean heart rate (Mean), and total number of premature atrial and ventricular contraction (PAC, PVC, respectively) as their daily HR dynamics. We compared these HR-dynamics with central venous pressure (CVP), cardiac index (CI), arterial oxygen saturation (SaO₂), ejection fraction of the systemic ventricle (EF), and peak oxygen uptake (VO₂) during exercise testing. We excluded Fontan patients with pacemaker implantation and/or those with beta blocker.

Results

Max, Min, Mean was 123 ± 20 , 62 ± 13 , 84 ± 13 , respectively. PAC and PVC was found in 74.9% and 67.3% in all patients. Max, Min, and Mean were inversely correlated with age ($p < 0.001$ for all). Min was lower in male patients ($p=0.0435$) and positively correlated with CI ($p<0.0001$). PAC was more frequent in patients with atrio-pulmonary Fontan connection ($p=0.0015$) and the total number of PAC was inversely correlated with CI ($p<0.0001$). Increased PVC was inversely correlated with EF ($p=0.0587$), arterial oxygen saturation ($p=0.014$), and peak VO₂ ($p<0.0001$). Max and increased number of PVC were independently correlated with lower exercise tolerance ($p<0.05-0.01$).

Conclusions

Daily HR-dynamics, including arrhythmia, based on Holter ECG monitoring reflects global Fontan pathophysiology. Periodic HR-monitoring with Holter monitoring is a useful non-invasive tool to monitor Fontan pathophysiology.