

1. 2. Defining the optimum upper heart rate limit during exercise a study in pacemaker patients with and without heart failure

There is no noninvasive method to determine the individual optimum of the maximum exercise heart rate.

The knowledge of this value is of particular interest in patients with structural heart disease who are prone to tachycardia intolerance.

In 49 pacemaker patients with chronotropic incompetence, the optimum upper heart rate limit was determined using cardiopulmonary exercise testing (CPx) and exercise Doppler echocardiography.

The optimum upper heart rate limit was given by the highest pacing rate which still produced an increase in oxygen consumption (CPx) or by that pacing rate which was linked to the lowest value for the Doppler – derived Tei index, a marker of myocardial performance.

In patients with normal left ventricular function (ejection fraction $\geq 55\%$) optimum upper heart rate was 86 % of the age – predicted maximum heart rate, in patients with left ventricular dysfunction (ejection fraction $\leq 45\%$) it was 75 % of the age predicted maximum rate ($p < 0.004$).

Optimum upper heart rates as defined by cardiopulmonary exercise testing and exercise Doppler echocardiography were closely correlated ($p < 0.0001$) with a mean deviation of 6 ± 6 beats per minute.

In conclusion, cardiopulmonary exercise testing and exercise Doppler echocardiography are valuable tools to determine the optimum upper heart rate limit in order to avoid excess heart rates in heart failure patients.

The application of these methods is not limited to pacemaker patients but may be helpful in therapeutic interventions with chronotropic drugs (e.g. β – blockers).

The main findings of this study, a reduction in the optimum of the maximum exercise heart rate in patients with left ventricular dysfunction are in close agreement with literature data.