

心拍ゆらぎ非線型解析による スポーツメディカルチェック

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Nonlinear Analysis on Heart Rate Variability for the Sports Medical Check

by

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ABSTRACT

Background : It is known that heart rate shows a complex behavior, attributed to the nonlinear nature of its generating and modulating system. Analyzing the nonlinear properties in the heart rate variability (HRV). may deepen the understanding of the pathophysiological modulation of HRV.

Methods : In 34 patients (mean age 65 ± 9 years, 20 ischemic heart disease, 4 cardiomyopathy, 3 valvular heart disease, 6 chest pain syndrome and one congestive heart failure due to renal dysfunction), a CM5 electrocardiogram was recorded from 5:00 to 6:00 AM by use of the digitalized monitoring system (FS-2100, Fukuda Denshi Co., Tokyo, Japan). With regard to the time series of RR intervals, two non-linear measures, the largest Lyapunov exponent and the correlation dimension were calculated. The following standard HRV index were also measured: 1) mean heart rate, 2) standard deviation of NN intervals (SDNN), 3) the percentage of differences between adjacent NN intervals > 50 msec (%NN50), 4) low frequency (LF, 0.04-0.15 Hz),

5) high frequency (HF, 0.15-0.40 Hz). The hemodynamic indices were compared with those heart rate variability measures.

Results : The largest Lyapunov exponent decreased age-dependently, as well as SDNN or % NN50. The largest Lyapunov exponents were also correlated with SDNN ($r=0.85$, $p<0.01$). The patients were divided into two groups; elevated LVEDP (left ventricular end-diastolic pressure ≥ 14 mmHg, $n=7$). or normal LVEDP (<14 mmHg, $n=24$). Elevated LVEDP group showed lower SDNN and lower Lyapunov exponents, compared with normal LVEDP group. However, correlation dimensions were independent from hemodynamic parameters.

Conclusion : Non-linear analysis can detect the hemodynamic impairment in patients with myocardial dysfunction. Therefore, this will be used for the purpose of sports medical check. (271 ward)

要 旨

【目的】我々は心拍ゆらぎ変動の時系列データについて非線形解析を行い時系列データのフタクトル性の指標：相関次元と，集束性の指標：リアプノフ指数を測定した。さらにこれらの指標と血行動態との相関から非線形心拍変動指標の持つ意義について検討し，スポーツメディカルチェックへの応用可能性を検討した。

【方法】当院にて心臓カテーテル検査にて血行動態の評価を行った34例について，モニター心電図記録をもとにRR時系列データを作成し標準偏差 (SD)，%RR50，高周波成分 (HF)，低周波／高周波 (LF/HF)，相関次元，リアプノフ指数を求め，これらの指標と血行動態諸指標との相関を検討した。

【結果】リアプノフ指数は年齢に依存して減少し，SDと相関を認めた。また左室拡張末期が上昇した群においてSDおよびリアプノフ指数の減少を認めた。

【結語】リアプノフ指数は血行動態を反映する指標となり，スポーツメディカルチェックへの応用が可能であると思われた。